1.5L 4-CYL

1997-98 ENGINES Toyota 1.5L 4-Cylinder

ENGINE IDENTIFICATION

Engine serial number is stamped on left rear corner of cylinder block. See **Fig. 1** .

ENGINE IDENTIFICATION CODE

Engine	Code
1.5L 4-Cylinder	5E-FE

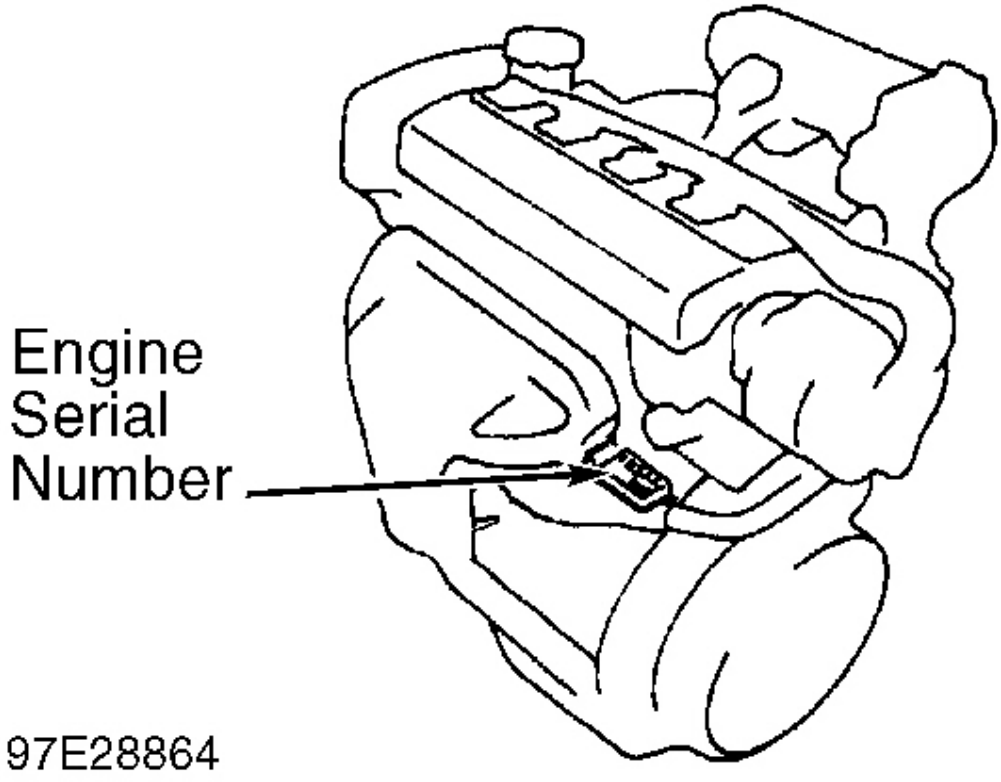


Fig. 1: Locating Engine Serial Number
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

NOTE: Adjust valve clearance with engine cold.

1. Disconnect PCV hose and necessary electrical connections to access valve cover. Disconnect spark plug wires from spark plugs. Remove bolts and ignition coils with spark plug wires.
2. Remove oil filler cap, valve cover nuts, seal washers, valve cover and gasket. Rotate crankshaft clockwise (viewed from timing belt end of engine) so cylinder No. 1 is at TDC on compression stroke and timing mark (groove) on crankshaft pulley aligns with "0" mark on timing belt cover. Cylinder No. 1 is front cylinder at timing belt end of engine.
3. Ensure valve lifters on cylinder No. 1 are loose and valve lifters on cylinder No. 4 are tight. If conditions are not as described, rotate crankshaft clockwise one complete revolution (360 degrees).
4. Using feeler gauge, measure valve clearance between valve lifter and camshaft on intake valves of cylinders No. 1 and 2, and exhaust valves of cylinders No. 1 and 3. Record valve clearance. Rotate crankshaft clockwise one complete revolution (360 degrees) with timing mark (groove) on crankshaft pulley aligned with "0" mark on timing belt cover.
5. Measure and record valve clearance on intake valves of cylinders No. 3 and 4, and exhaust valves of cylinders No. 2 and 4. Ensure valve clearance is within specification. See **VALVE CLEARANCE SPECIFICATIONS** .

VALVE CLEARANCE SPECIFICATIONS (1)

Application	In. (mm)
Intake Valve	.006-.010 (.15-.25)
Exhaust Valve	.012-.016 (.31-.41)
(1) Adjust valve clearance with engine cold.	

6. If valve clearance requires adjustment, rotate crankshaft to position camshaft so lobe on valve to be adjusted is facing upward, away from valve lifter. Position notch area on valve lifter toward inside (spark plug side) of cylinder head. DO NOT align notch area with camshaft. Valve Clearance Adjuster (SST 09248-55040) is used to remove adjusting shim.
7. Using SST "A" of valve clearance adjuster, push downward on valve lifter. Place SST "B" between camshaft and valve lifter with the side marked with "9" at specified location. See **Fig. 2** . Remove SST "A".

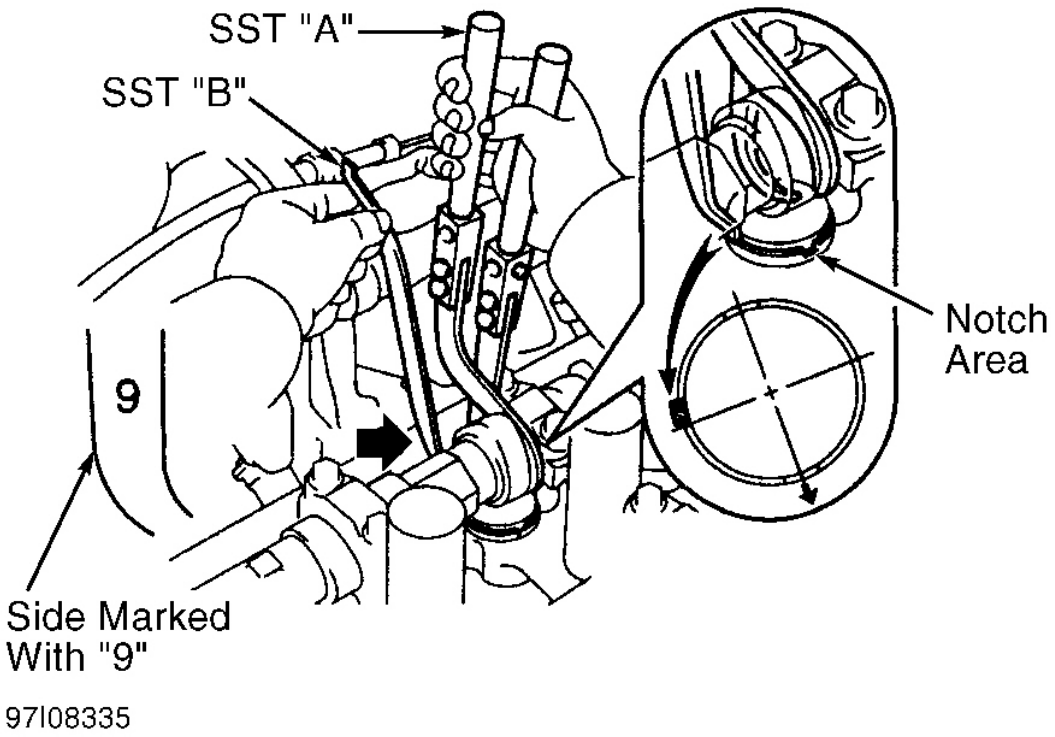


Fig. 2: Adjusting Valve Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. Using small screwdriver and magnet, remove adjusting shim. Measure and record thickness of adjusting shim removed. Using measured clearance and adjusting shim thickness, select proper replacement adjusting shim. See **Fig. 4** and **Fig. 5** . Install replacement adjusting shim. Recheck valve clearance.
9. If spark plug tube gasket in valve cover requires replacement, pry spark plug tube gasket from top of valve cover. DO NOT scratch valve cover sealing surface.
10. Using Handle (SST 09252-10010) and Gasket/Seal Installer (SST 09556-10010), install NEW spark plug tube gasket until it is even with upper edge of valve cover surface. Coat spark plug tube gasket sealing area with grease.
11. Apply sealant at indicated valve cover sealing areas on cylinder head. See **Fig. 3** . Using NEW gasket, install valve cover and sealing washers. Install and tighten valve cover nuts to specification. See **TORQUE SPECIFICATIONS** .
12. To install remaining components, reverse removal procedure. Tighten ignition coil bolts to specification. See **TORQUE SPECIFICATIONS** .

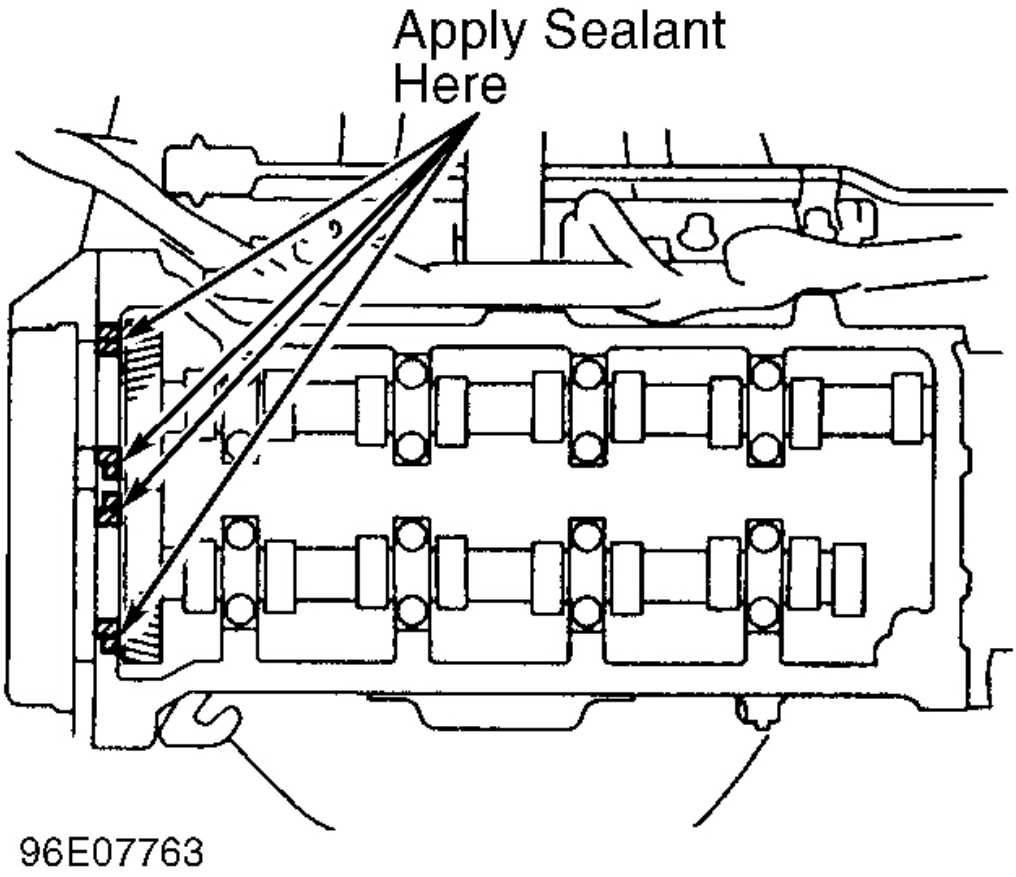


Fig. 3: Locating Cylinder Head Sealant Application Areas
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

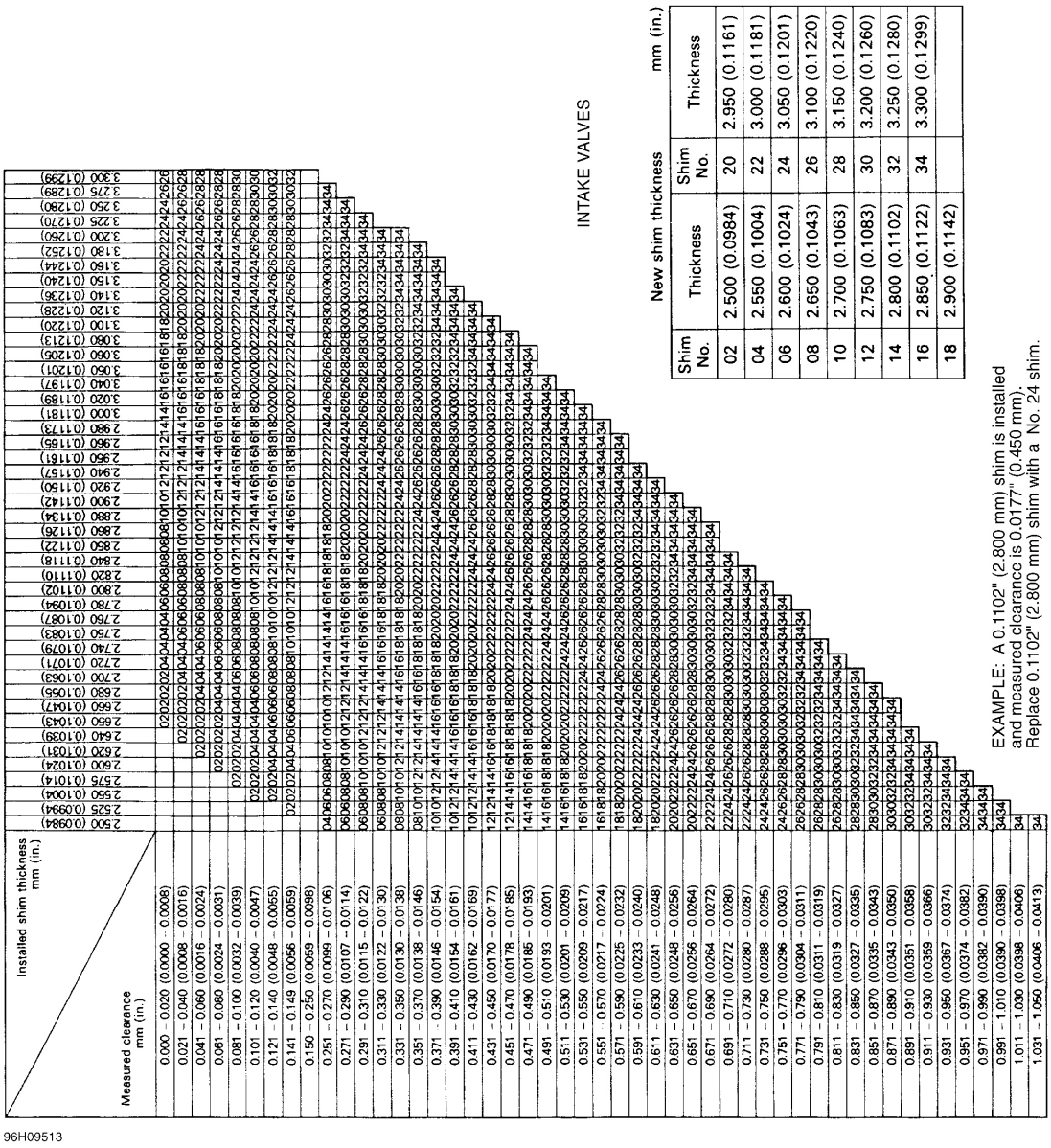


Fig. 4: Intake Valve Adjusting Shim Selection Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

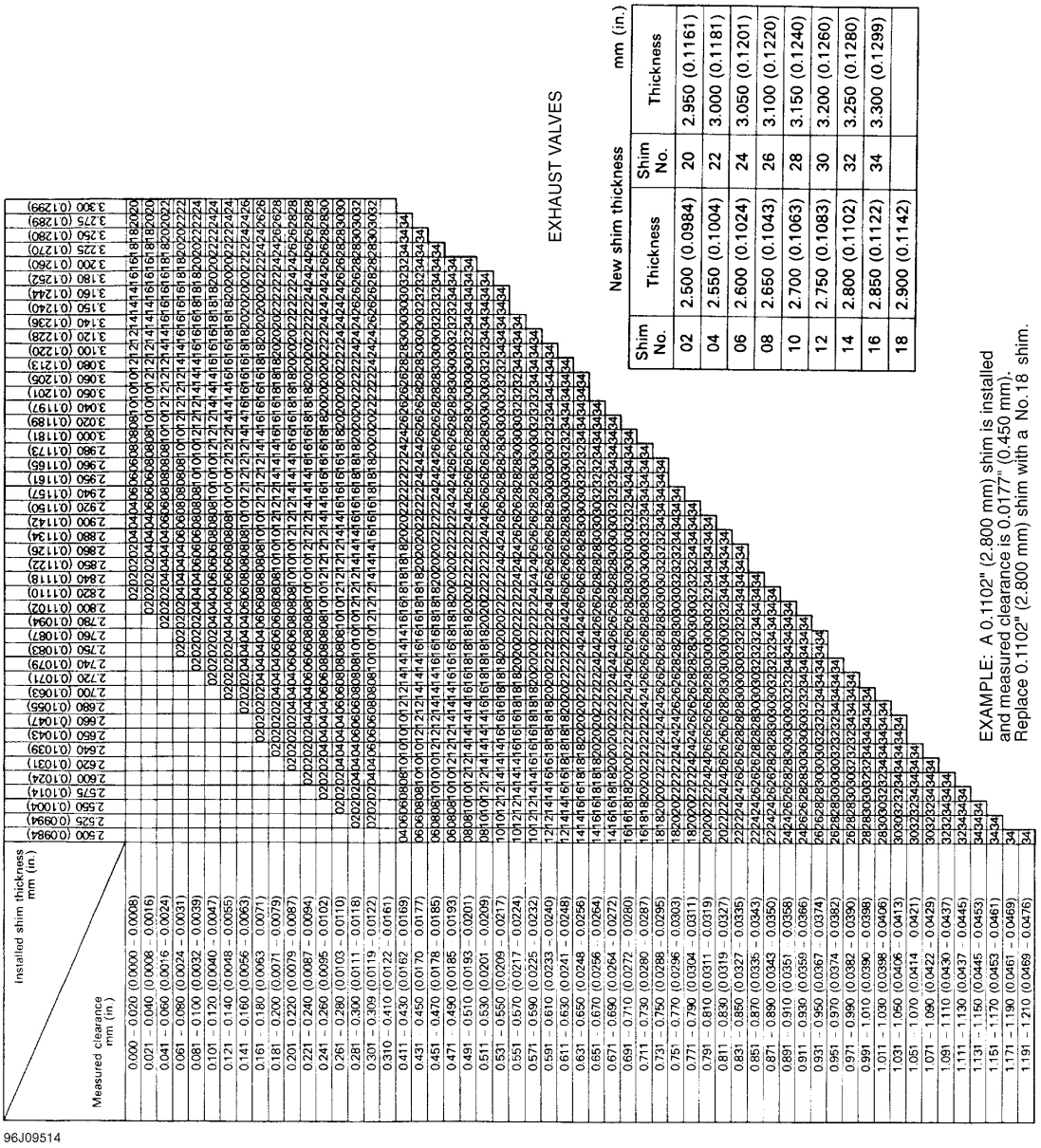


Fig. 5: Exhaust Valve Adjusting Shim Selection Chart
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL & INSTALLATION

WARNING: Ensure negative battery cable is disconnected at least 90 seconds before working on vehicle to prevent air bag deployment.

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.

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

FUEL PRESSURE RELEASE

NOTE: Manufacturer recommends disconnecting electrical connector at electric fuel pump and operating engine until engine stalls before loosening fuel line connection.

1. Remove rear seat cushion and floor panel cover for access to electrical connector for electric fuel pump. Electric fuel pump is located in fuel tank. Disconnect electrical connector for electric fuel pump.
2. Start engine and allow engine to idle until engine stalls. Turn ignition off. Reconnect electrical connector for electric fuel pump. Reinstall floor panel cover and rear seat cushion.
3. Disconnect negative battery cable. Place approved gasoline container under fuel line. Cover fuel line connection with shop towel.
4. Slowly loosen fuel line connection to release fuel pressure. Once fuel pressure is released, fuel system components may be serviced.

ENGINE

NOTE: Remove engine and transaxle as an assembly.

Removal

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** under REMOVAL & INSTALLATION. Ensure negative battery cable is disconnected. Drain cooling system and engine oil. Remove hood and battery. Remove air cleaner assembly with air intake hose.
2. Disconnect necessary coolant hoses and remove radiator. Disconnect control cables at throttle body. Disconnect necessary electrical connectors, coolant hoses, fuel lines and vacuum hoses for engine removal. Remove charcoal canister.
3. Raise and support vehicle. Remove lower engine covers. Disconnect necessary electrical connectors, control cables and speedometer cable from transaxle.
4. On A/T models, disconnect oil cooler lines at transaxle. On M/T models, remove clutch release cylinder with hose attached and secure aside. On all models, remove power steering pump (if equipped) and A/C compressor (if equipped) with hoses attached, and secure aside.
5. Remove exhaust pipe-to-cylinder block support bracket bolts (if equipped). Remove bolts and separate exhaust pipe from exhaust manifold.
6. Remove front wheels. Drain transaxle fluid. Remove bolts and Anti-Lock Brake System (ABS) speed sensor from top of steering knuckle (if equipped).
7. Remove cotter pin and retainer from end of axle shaft. Apply brakes and remove axle shaft nut. Remove nut and separate tie rod from steering knuckle.

8. Remove ball joint-to-lower control arm bolts/nuts. Separate lower control arm from ball joint. Using soft-faced hammer, tap axle shaft from hub assembly. Push hub assembly outward. Separate axle shaft from hub assembly.
9. Pry left shaft from transaxle or use hammer and brass drift to tap right axle shaft from transaxle. See **Fig. 6** . Support engine with hoist.
10. Remove rear (firewall side) engine mount through-bolt. Remove through-bolt and right (timing belt side) engine mount. Remove left (transaxle side) engine mount insulator and bracket. Lift engine and transaxle from vehicle.

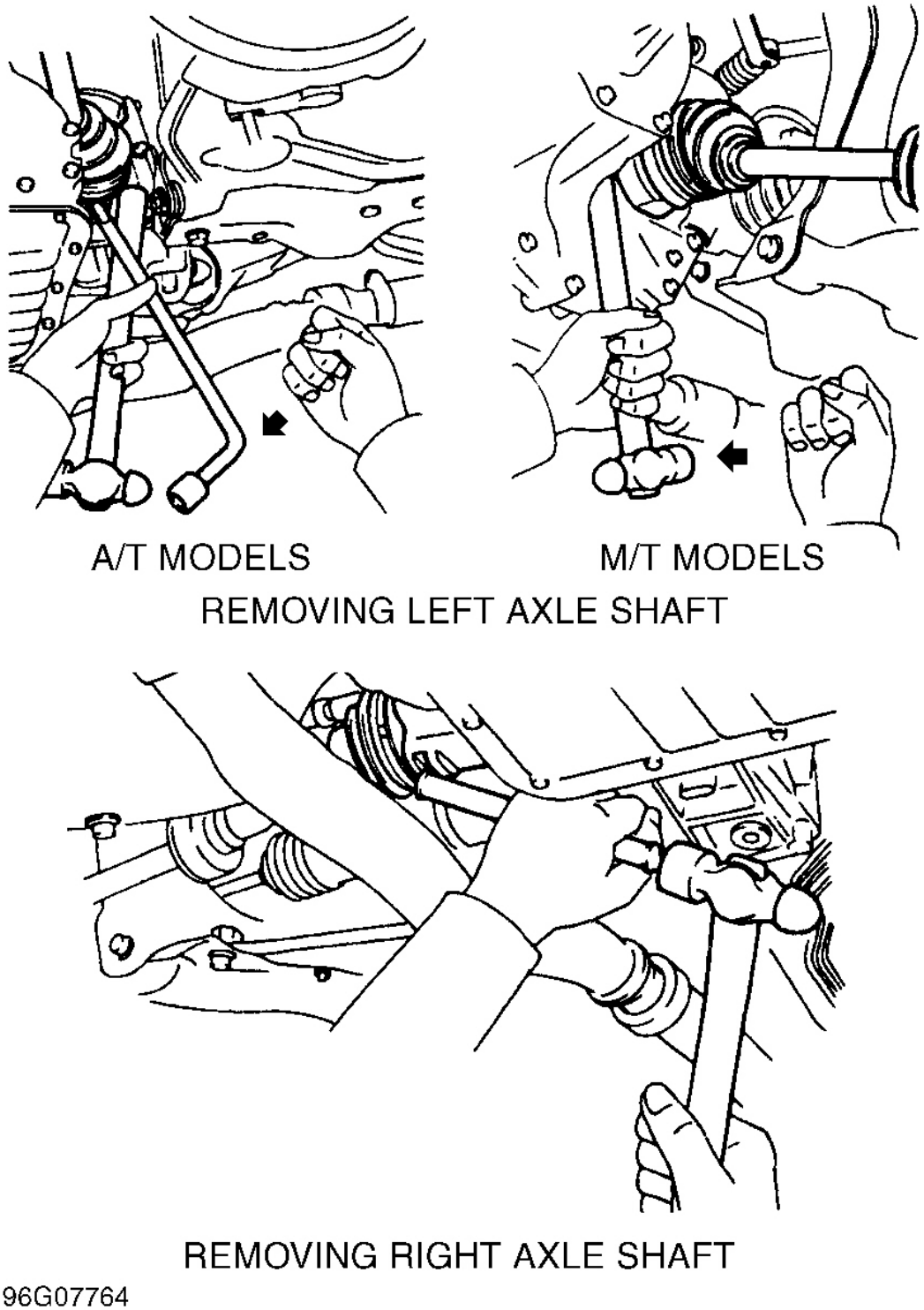


Fig. 6: Removing Axle Shafts

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Installation

1. On A/T models, if installing torque converter bolts, install the Gray colored bolt first. Tighten torque converter bolts to specification. See **TORQUE SPECIFICATIONS** .
2. On all models, install engine and transaxle. Install right (timing belt side) engine mount and through-bolt. DO NOT tighten bolts/nuts at this time.

NOTE: Ensure ground strap is connected to left (transaxle side) engine mount bracket.

3. Install left (transaxle side) bracket and engine mount insulator. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** . Install rear (firewall side) engine mount through-bolt. Tighten bolt to specification. See **TORQUE SPECIFICATIONS** .
4. With all other engine mount bolts tightened to specification, tighten right (timing belt side) engine mount bolts/nuts and through-bolt to specification. See **TORQUE SPECIFICATIONS** .
5. Install NEW snap ring on end of axle shaft. Install axle shaft in transaxle. Ensure axle shaft moves in and out and cannot be pulled from transaxle.
6. To install remaining components, reverse removal procedure. Tighten bolts/nuts to specification. See **TORQUE SPECIFICATIONS** . Fill cooling system. Adjust control cables. Fill transaxle with Dexron-III ATF on A/T models or SAE 75W-90 GL-5 gear oil on M/T models.

CYLINDER HEAD & MANIFOLDS

Removal

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** under REMOVAL & INSTALLATION. Ensure negative battery cable is disconnected. Drain cooling system. Disconnect control cables, vacuum hoses, coolant hoses and electrical connectors at throttle body.
2. Remove air cleaner assembly with air intake hose. Disconnect necessary electrical connectors, coolant hoses, fuel lines and vacuum hoses for cylinder head removal. Disconnect PCV hose.
3. Remove power steering pump (if equipped) with hoses attached, and secure aside. Remove power steering pump mounting bracket. On models equipped with A/C without power steering, remove A/C idler pulley (if equipped).
4. Disconnect spark plug wires from spark plugs. Remove bolts and ignition coils with spark plug wires. Remove retaining bolt and camshaft position sensor with "O" ring from cylinder head. Camshaft position sensor is located on flywheel/drive plate end of cylinder head, just below the valve cover. See **Fig. 7** .
5. Remove bolts/nuts and coolant housing from rear of cylinder head. See **Fig. 7** . Raise and support vehicle. Remove passenger's side lower engine cover.

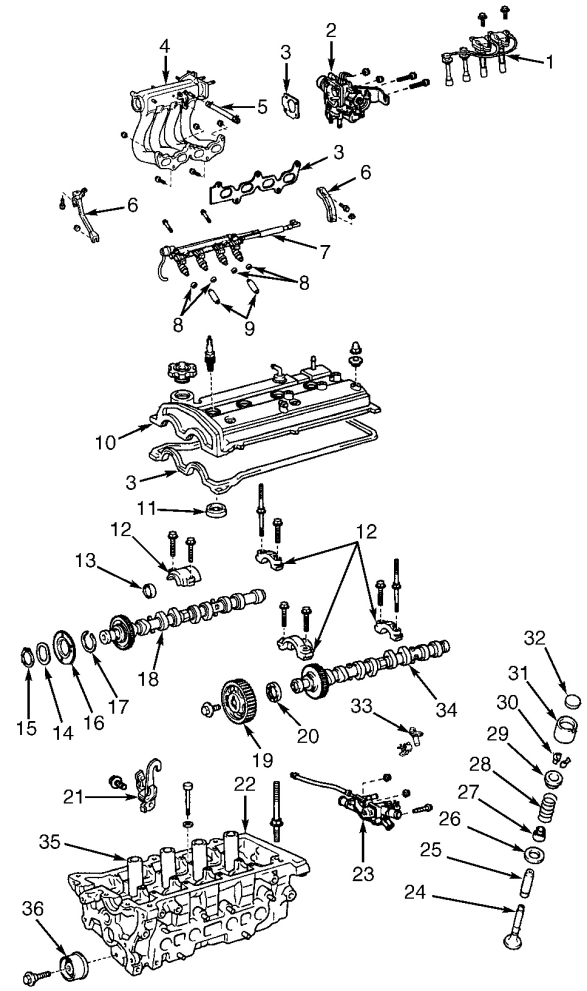


Fig. 7: Exploded View Of Cylinder Head & Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Remove bolts and separate exhaust pipe from exhaust manifold. Remove bolts/nuts, exhaust manifold heat insulator, exhaust manifold and gasket. Remove bolts/nuts, throttle body and gasket from intake

manifold. Remove bolt/nuts and intake manifold braces.

CAUTION: DO NOT allow fuel injectors to fall from delivery pipe when removing delivery pipe.

NOTE: Spacers are installed between delivery pipe and cylinder head. Note direction of spacer installation for installation reference. Note location of electrical connectors on fuel injectors for installation reference.

7. Disconnect fuel line from end of delivery pipe. Disconnect electrical connectors from fuel injectors. Remove delivery pipe-to-cylinder head bolts. Remove delivery pipe with fuel injectors, 2 spacers and 4 insulators from cylinder head. See **Fig. 7** .
8. Remove bolts/nuts, intake manifold and gasket. Remove nuts, seal washers, valve cover and gasket. Remove charcoal canister for access to timing belt covers. Remove bolts, No. 2 timing belt cover and gasket. See **Fig. 12** .
9. Remove generator drive belt. Remove No. 3 timing belt cover from No. 1 timing belt cover. See **Fig. 12** .
10. Rotate crankshaft clockwise (viewed from timing belt end of engine) so cylinder No. 1 is at TDC on compression stroke and timing mark (groove) on crankshaft pulley aligns with "0" mark on timing belt cover. Cylinder No. 1 is front cylinder at timing belt end of engine.
11. With cylinder No. 1 at TDC on compression stroke, ensure timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap. See **Fig. 8** . Timing mark on camshaft sprocket is indicated by 5E stamped near hole in camshaft sprocket. If timing mark is not aligned, rotate crankshaft clockwise one complete revolution (360 degrees).

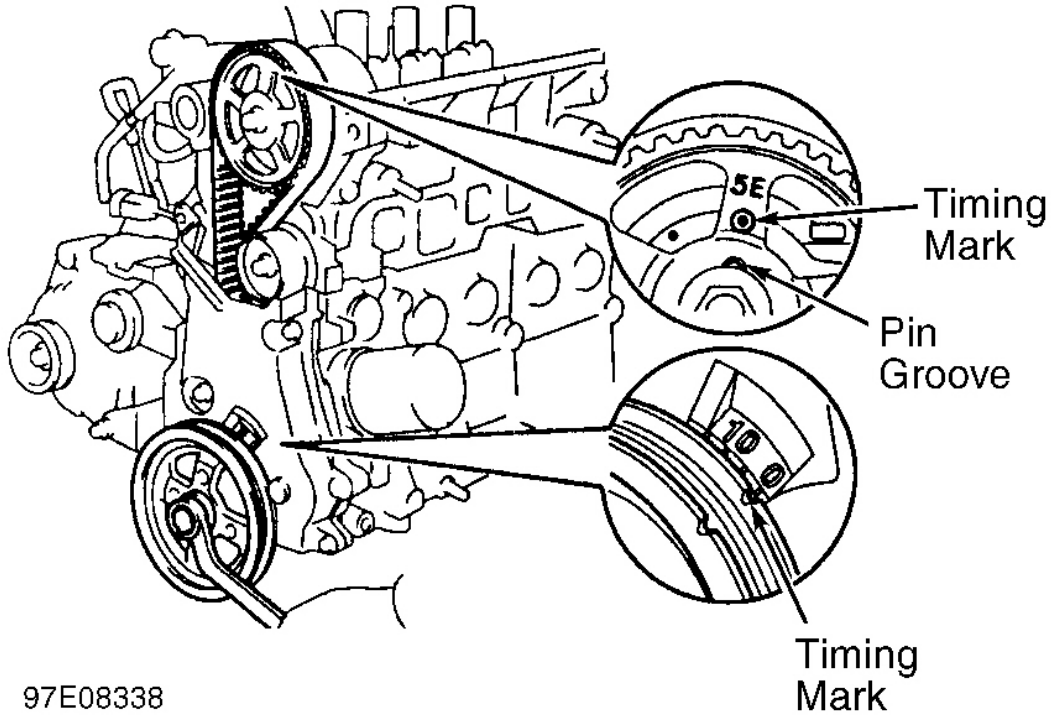


Fig. 8: Checking Timing Mark Alignment
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CAUTION: Manufacturer lists cylinder head servicing procedure with timing belt removed only from camshaft sprocket. DO NOT allow timing belt to disengage from crankshaft sprocket during cylinder servicing.

12. Place tape around end of pry bar and place pry bar between No. 2 idler pulley and No. 1 idler pulley with shop towel placed over No. 2 idler pulley. See **Fig. 9** . Loosen No. 1 idler pulley bolt. Move No. 1 idler pulley away from timing belt as far as possible and tighten bolt. Remove timing belt from camshaft sprocket.
13. Remove bolt and No. 2 idler pulley from front of cylinder head. Remove camshafts. See CAMSHAFT under **REMOVAL & INSTALLATION** .

CAUTION: Cylinder head bolts must be loosened in proper sequence to prevent cylinder head warpage.

14. Loosen cylinder head bolts in sequence using several steps. See **Fig. 10** . Remove cylinder head bolts, cylinder head and cylinder head gasket.

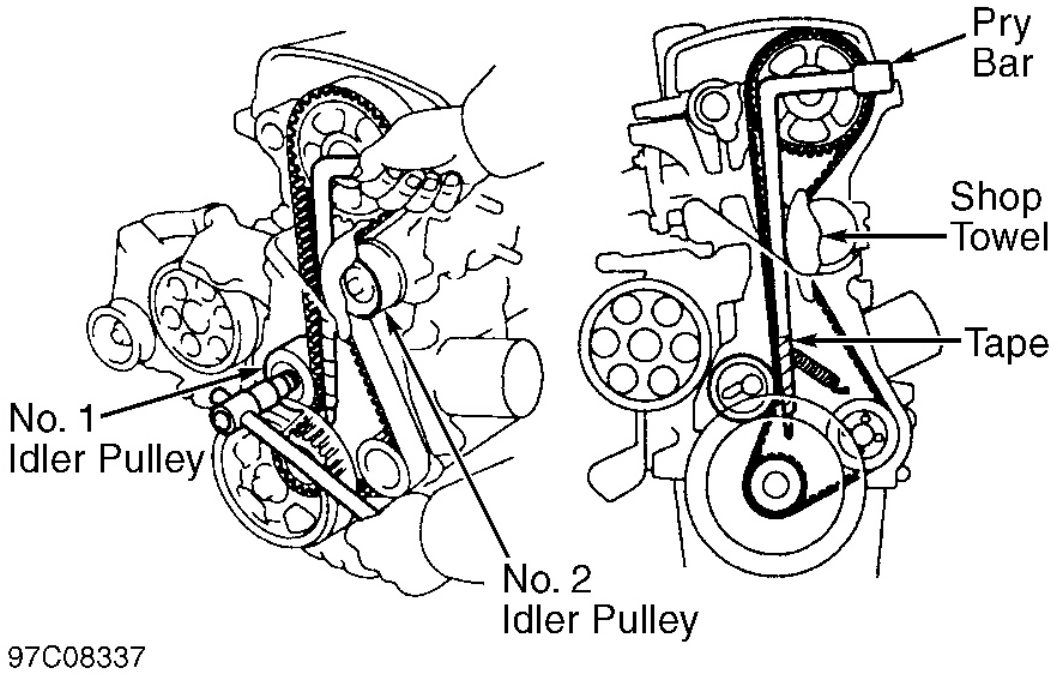


Fig. 9: Loosening Tension On Timing Belt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

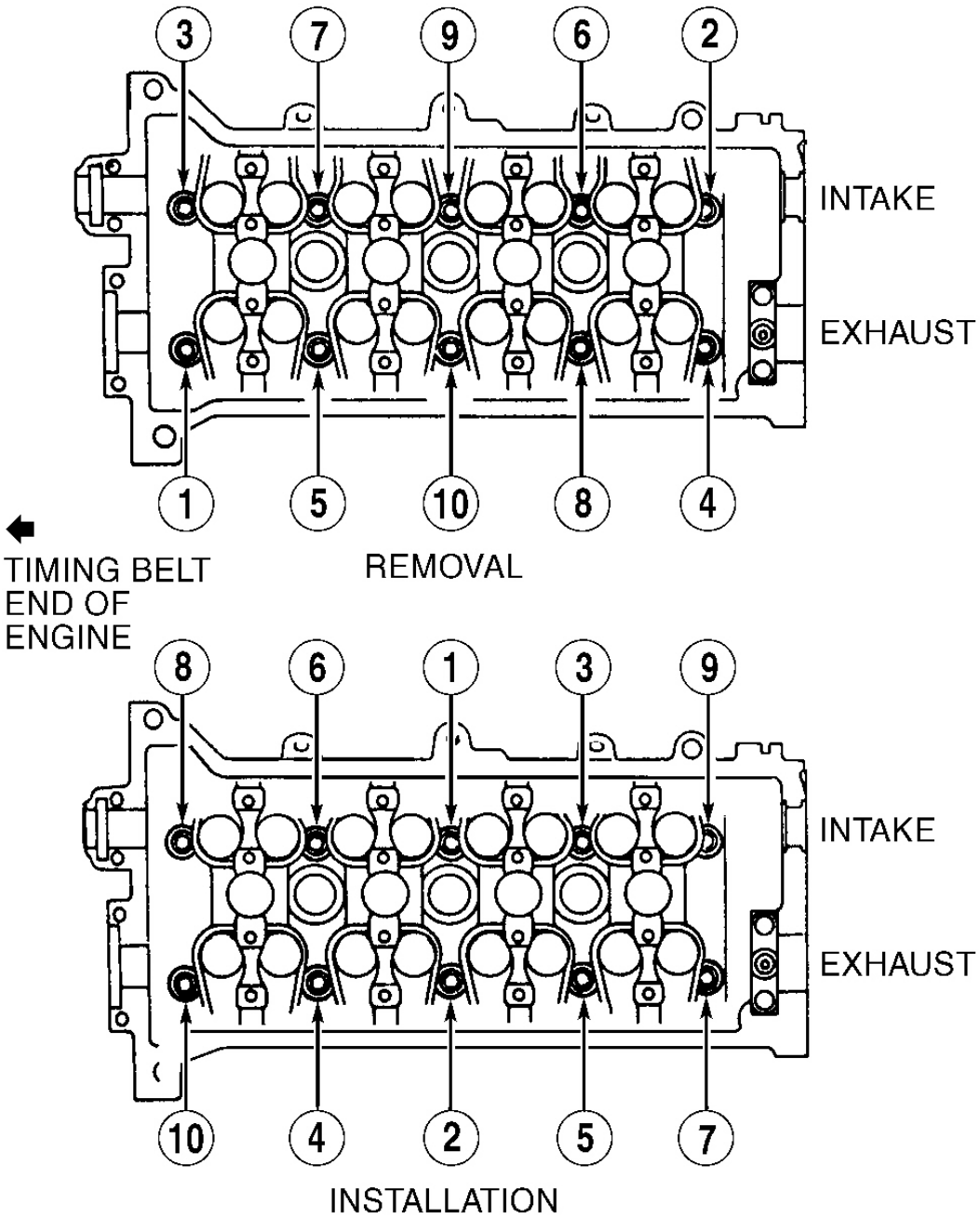


Fig. 10: Cylinder Head Bolt Removal & Installation Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Inspection

1. Inspect cylinder head warpage at cylinder block and manifold areas. Replace cylinder head if warpage exceeds specification. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS.
2. Inspect intake manifold and exhaust manifold-to-cylinder head surfaces for warpage. Replace manifold if warpage exceeds specification. See **MANIFOLD WARPAGE SPECIFICATIONS** .

MANIFOLD WARPAGE SPECIFICATIONS

Application	In. (mm)
Exhaust Manifold	.0200 (.500)
Intake Manifold	.0039 (.100)

3. Inspect cylinder block deck surface for warpage. Replace cylinder block if deck surface warpage exceeds specification. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS.
4. Inspect camshaft and components. See CAMSHAFT under **REMOVAL & INSTALLATION** . Measure valve lifter diameter and bore diameter. Ensure oil clearance is within specification. Replace components if oil clearance is not within specification. See **VALVE LIFTERS** under ENGINE SPECIFICATIONS.

Installation

1. Install NEW cylinder head gasket on cylinder block. Ensure all holes in cylinder head gasket align with holes in cylinder block. Install cylinder head.
2. Apply engine oil on threads and cylinder head bolt-to-cylinder head contact surfaces on cylinder head bolts. Install and tighten cylinder head bolts to specification in sequence. See **Fig. 10** . See **TORQUE SPECIFICATIONS** .
3. Install camshafts using proper procedure. See CAMSHAFT under **REMOVAL & INSTALLATION** . Install No. 2 idler pulley on front of cylinder head. Tighten bolt to specification. See **TORQUE SPECIFICATIONS** . Ensure No. 2 idler pulley is clean.

CAUTION: Crankshaft must always be rotated clockwise. DO NOT rotate crankshaft counterclockwise.

4. Rotate crankshaft clockwise (viewed from timing belt end of engine) so cylinder No. 1 is at TDC on compression stroke and timing mark (groove) on crankshaft pulley aligns with "0" mark on timing belt cover.
5. Rotate exhaust camshaft until timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap. See **Fig. 8** . Exhaust camshaft may be rotated by using wrench on hexagonal area at the center of the camshaft.
6. Starting from the right side of camshaft sprocket, install timing belt counterclockwise on camshaft sprocket. Loosen No. 1 idler pulley bolt, allowing tension spring to move No. 1 idler pulley against timing belt.
7. Rotate crankshaft clockwise (viewed from timing belt end of engine) 2 full revolutions from TDC to TDC. With timing mark (groove) on crankshaft pulley aligned with "0" mark on timing belt cover, ensure timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap. See **Fig. 8** . If timing mark is not aligned, remove timing belt from camshaft sprocket and reinstall.

8. Tighten No. 1 idler pulley bolt to specification. See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure using NEW gaskets and "O" rings.
9. If camshaft or cylinder head components are serviced, adjust valve clearance. See **VALVE CLEARANCE ADJUSTMENT** under ADJUSTMENTS.
10. If spark plug tube gasket in valve cover requires replacement, pry spark plug tube gasket from top of valve cover. DO NOT scratch valve cover sealing surface.
11. Using Handle (SST 09252-10010) and Gasket/Seal Installer (SST 09556-10010), install NEW spark plug tube gasket until it is even with upper edge of valve cover surface. Coat spark plug tube gasket sealing area with grease.
12. Before installing valve cover and gasket, apply sealant at indicated valve cover sealing areas on cylinder head. See **Fig. 3** . Using NEW gasket, install valve cover and sealing washers. Install and tighten nuts to specification. See **TORQUE SPECIFICATIONS** .
13. If fuel injectors were removed from delivery pipe, install NEW grommets on fuel injectors. Coat NEW "O" rings with gasoline and install on fuel injectors. Use twisting motion and install fuel injectors on delivery pipe.
14. When installing delivery pipe with fuel injectors, ensure the 4 insulators are installed and the 2 spacers are installed between delivery pipe and cylinder head in original direction.
15. Ensure all fuel injectors rotate smoothly after delivery pipe is installed on cylinder head with delivery pipe-to-cylinder head bolts loosely installed. If fuel injector does not rotate smoothly, check for improperly installed "O" ring. Ensure electrical connector on fuel injector is facing upward, toward valve cover before tightening delivery pipe-to-cylinder head bolts to specification.
16. When installing throttle body, ensure NEW throttle body gasket is installed with protrusion in proper location. See **Fig. 11** .
17. When installing exhaust manifold-to-cylinder block support brace bolt/nut, tighten bolt at exhaust manifold to specification before tightening nuts at cylinder block to specification.
18. Before installing coolant housing, apply sealant in groove on rear of coolant housing. DO NOT apply excessive sealant on rear of coolant housing, as sealant may enter passages on cylinder head.
19. Install remaining components. Tighten bolts/nuts to specification. See **TORQUE SPECIFICATIONS** . Fill cooling system and adjust control cables.

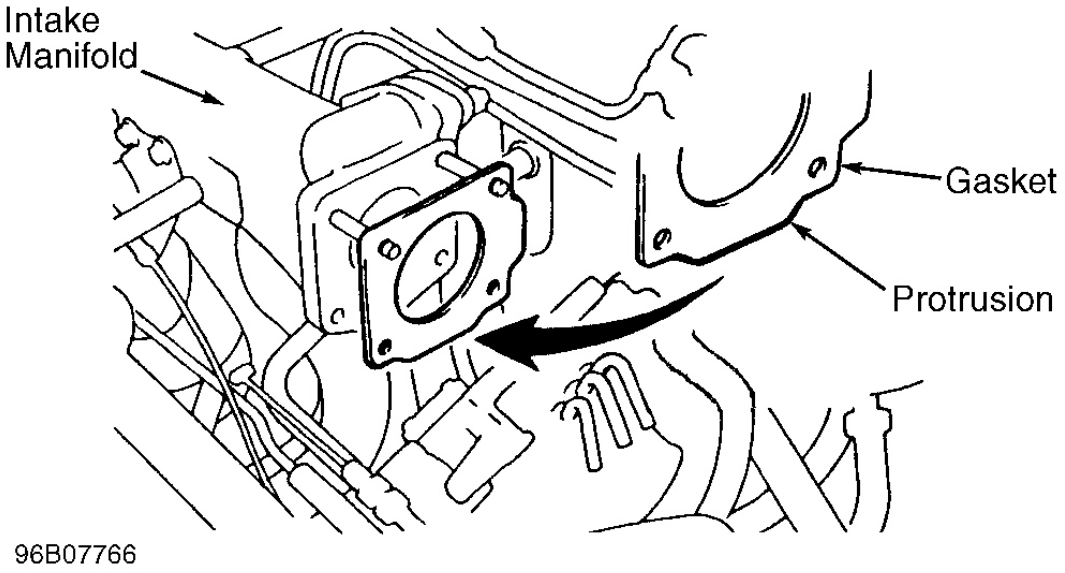


Fig. 11: Installing Throttle Body Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CRANKSHAFT FRONT SEAL

Removal & Installation (Oil Pump Installed)

1. Remove timing belt and crankshaft sprocket. See **TIMING BELT** under REMOVAL & INSTALLATION. Using a knife, cut seal lip from seal. Pry seal from oil pump body. DO NOT damage sealing surfaces.
2. To install, apply grease to lip of seal. Using hammer and Seal Installer (SST 09309-37010), install seal until seal surface is even with oil pump body. To install remaining components, reverse removal procedure.

Removal & Installation (Oil Pump Removed)

Pry seal from oil pump body. Using hammer and Seal Installer (SST 09309-37010), install seal until seal surface is even with oil pump body. Apply grease to seal lip of seal.

TIMING BELT

Removal

1. Disconnect negative battery cable. Raise and support vehicle. Remove passenger's side lower engine cover. Remove accessory drive belts.
2. Remove charcoal canister for access to timing belt covers. Slightly raise engine to remove weight from right (timing belt side) engine mount. Remove through-bolt and right (timing belt side) engine mount.

3. Remove bolts, No. 2 timing belt cover and gasket. See **Fig. 12** .

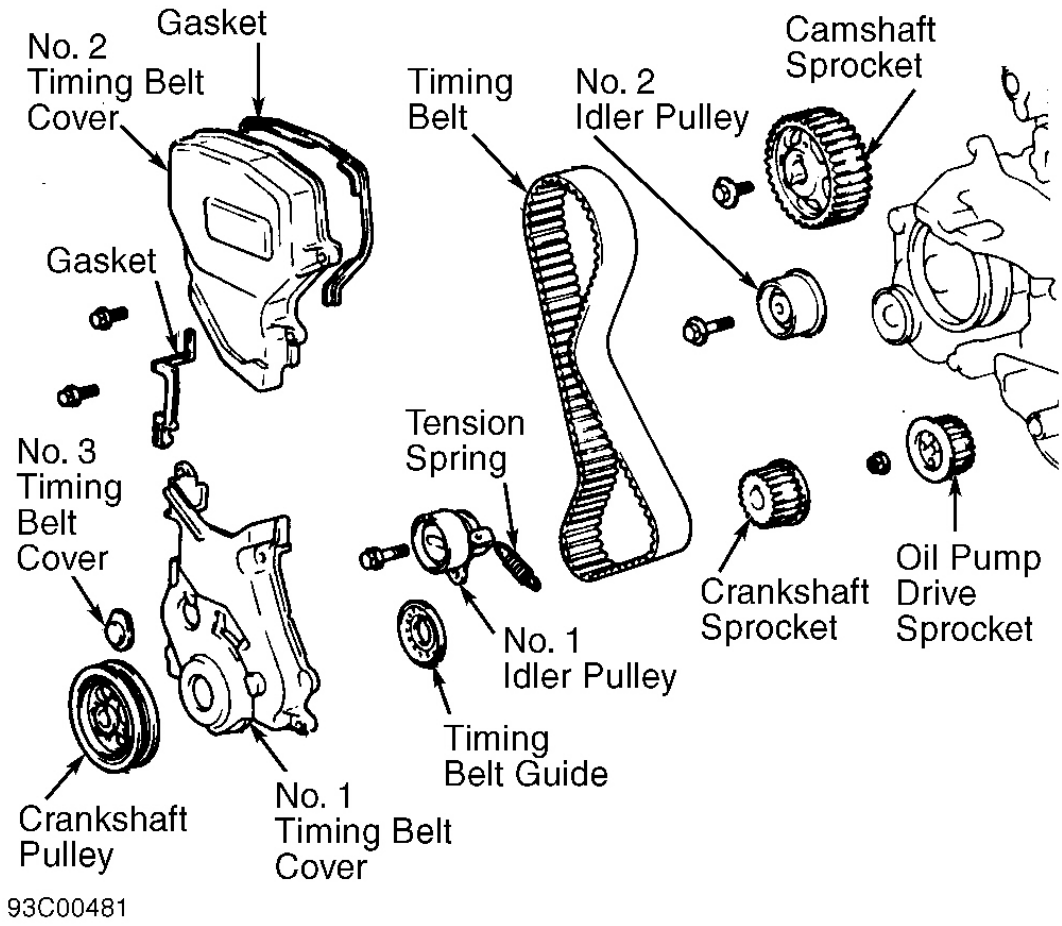


Fig. 12: Exploded View Of Timing Belt & Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. Rotate crankshaft clockwise (viewed from timing belt end of engine) so cylinder No. 1 is at TDC on compression stroke and timing mark (groove) on crankshaft pulley aligns with "0" mark on timing belt cover. Cylinder No. 1 is front cylinder at timing belt end of engine.
5. With cylinder No. 1 at TDC on compression stroke, ensure timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap. See **Fig. 8** . Timing mark on camshaft sprocket is indicated by 5E stamped near hole in camshaft sprocket. If timing mark is not aligned, rotate crankshaft clockwise one complete revolution (360 degrees).
6. Remove bolts and accessory drive belt pulley from front of crankshaft pulley. Using Pulley Holder (SST 09213-14010) and Handle (SST 09330-00021), hold crankshaft pulley and remove crankshaft pulley bolt.
7. Using puller, remove crankshaft pulley. Remove No. 3 timing belt cover, and then No. 1 timing belt cover and gasket. See **Fig. 12** . Note direction of timing belt guide installation for installation reference. See **Fig. 12** . Remove timing belt guide.

CAUTION: If reusing timing belt, place arrow on timing belt to indicate direction of timing belt rotation and place reference marks on timing belt at camshaft and crankshaft sprockets for reassembly reference. See Fig. 13 .

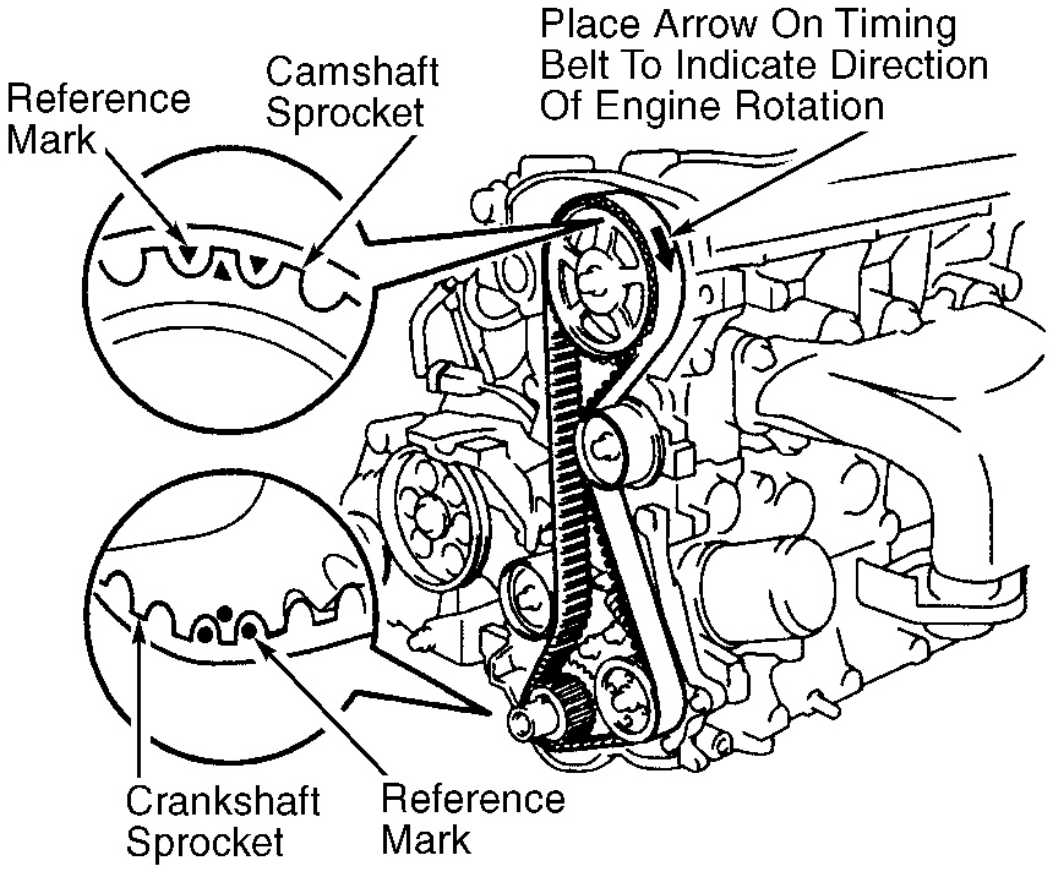


Fig. 13: Placing Arrow & Reference Marks On Timing Belt & Sprockets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. Remove tension spring from No. 1 idler pulley. See **Fig. 12** . Loosen No. 1 idler pulley bolt. Move No. 1 idler away from timing belt as far as possible and tighten bolt. Remove timing belt.
9. Remove No. 1 and 2 idler pulleys (if necessary). If removing camshaft sprocket, use spanner wrench on front of camshaft sprocket to hold camshaft while removing camshaft sprocket bolt. Remove camshaft sprocket.
10. If removing crankshaft sprocket, use soft-faced hammer to lightly tap crankshaft sprocket from crankshaft. DO NOT pry on outer edges of crankshaft sprocket for crankshaft sprocket removal.

Inspection

1. Inspect timing belt for damaged teeth, cracking and oil contamination. DO NOT bend timing belt inside out while inspecting timing belt. If excessive wear or damage exists on face of timing belt, check for nicks on idler pulley. If excessive wear or damage exists only on one side of timing belt, check timing belt guide and alignment of all sprockets. If excessive wear exists on teeth of timing belt, check timing belt covers for damage and foreign material on sprockets. Replace timing belt if damaged.
2. Ensure No. 1 and 2 idler pulleys rotate freely and no signs of oil leakage exists. Replace idler pulley if pulley does not rotate smoothly or signs of oil leakage exists. Inspect all sprockets for damage. Replace sprockets if damaged.
3. Measure free length of tension spring. Replace tension spring if free length is not 1.512" (38.40 mm). Measure tension required to extend tension spring to 1.866" (47.40 mm). Replace tension spring if tension is not 7.3 lbs. (3.3 kg).

Installation

1. If installing crankshaft sprocket, align crankshaft sprocket with key in crankshaft. Install crankshaft sprocket with flange toward cylinder block.
2. If installing No. 2 idler pulley, install idler pulley. Tighten bolt to specification. See **TORQUE SPECIFICATIONS** . Ensure No. 2 idler pulley rotates freely.
3. If installing camshaft sprocket, align pin groove just below the timing mark on camshaft sprocket with pin in camshaft. See **Fig. 14** .
4. Install camshaft sprocket on camshaft so 5E stamped near hole in camshaft sprocket is facing outward, away from cylinder head. See **Fig. 14** . Install and tighten camshaft sprocket bolt to specification while holding camshaft with spanner wrench. See **TORQUE SPECIFICATIONS** .

CAUTION: Pivot hole at bottom of No. 1 idler pulley mounting flange must engage with pin on front of cylinder block when installing No. 1 idler pulley.

5. Install tension spring and No. 1 idler pulley with bolt loosely installed. DO NOT tighten bolt at this time. Ensure pivot hole at bottom of No. 1 idler pulley mounting flange engages with pin on front of cylinder block.
6. Move No. 1 idler pulley away from timing belt area as far as possible. Temporarily tighten No. 1 idler pulley bolt. Ensure No. 1 idler pulley moves freely.
7. Ensure all sprockets and idler pulleys are clean. Using spanner wrench, rotate camshaft sprocket and align timing mark on camshaft sprocket with timing mark on camshaft bearing cap. See **Fig. 14** .
8. Temporarily install crankshaft pulley bolt in end of crankshaft. Rotate crankshaft clockwise so timing mark on crankshaft sprocket aligns with timing mark on oil pump body. See **Fig. 15** .

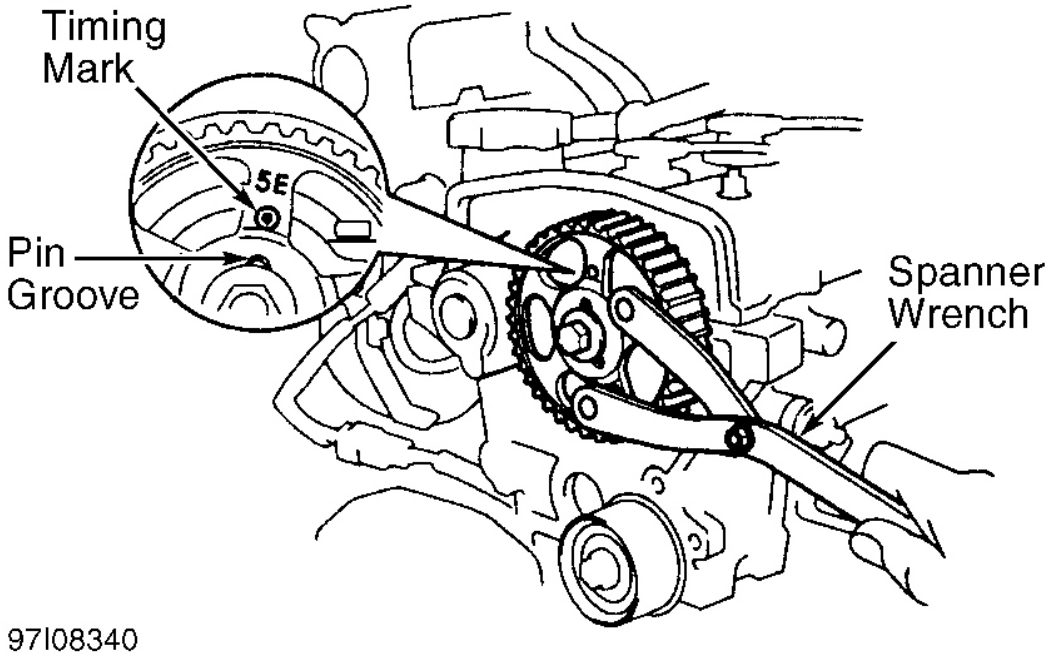


Fig. 14: Locating Pin Groove & Aligning Camshaft Sprocket Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

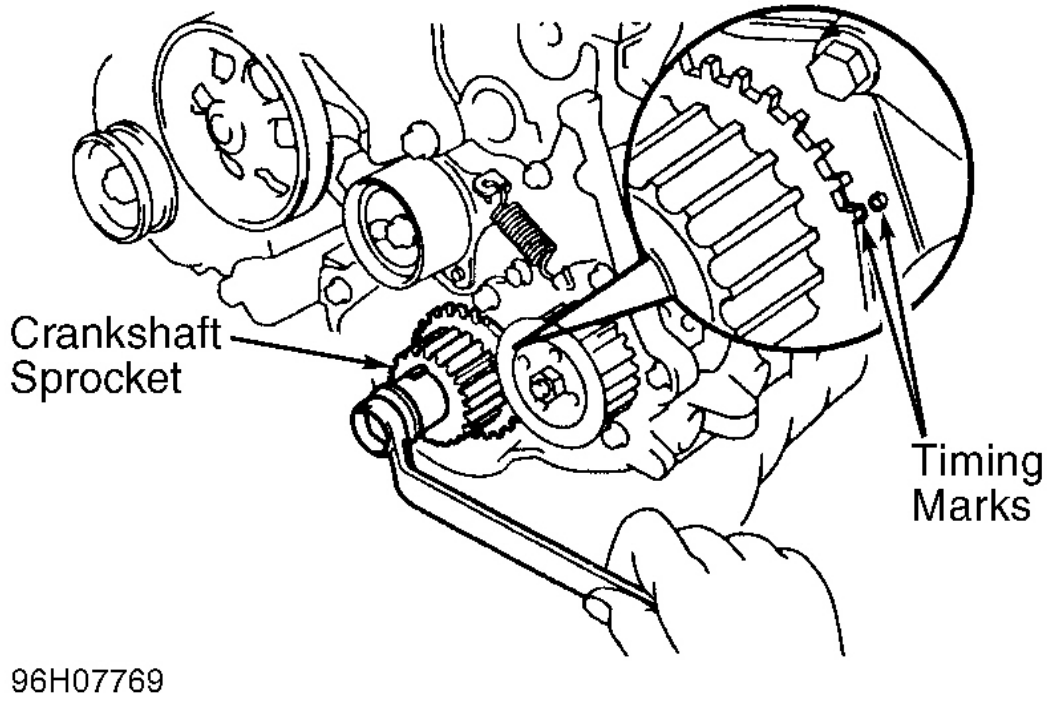


Fig. 15: Aligning Crankshaft Sprocket Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

CAUTION: If reusing timing belt, ensure reference marks on timing belt align with those placed on all sprockets and timing belt is installed so arrow on timing belt indicates original direction of timing belt rotation. See Fig. 13 .

9. Install timing belt on all sprockets. Ensure tension exists on timing belt between crankshaft sprocket and camshaft sprocket.

CAUTION: Crankshaft must always be rotated clockwise. DO NOT rotate crankshaft counterclockwise.

10. Loosen No. 1 idler pulley bolt, allowing tension spring to move No. 1 idler pulley against timing belt. Rotate crankshaft clockwise 2 full revolutions from TDC to TDC.
11. Ensure timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap when timing mark on crankshaft sprocket aligns with timing mark on oil pump body. See **Fig. 8** and **Fig. 15** . If timing marks are not aligned, remove and reinstall timing belt.
12. If all timing marks are aligned, tighten No. 1 idler pulley bolt to specification. See **TORQUE SPECIFICATIONS** . Remove crankshaft pulley bolt. Install timing belt guide with cupped side away

from crankshaft sprocket and flat side toward timing belt.

13. Install gasket and No. 1 timing belt cover. Install No. 3 timing belt cover. Align crankshaft pulley key groove with key in crankshaft. Install crankshaft pulley. Install and tighten crankshaft pulley bolt to specification while holding crankshaft pulley with pulley holder and handle. See **TORQUE SPECIFICATIONS** .
14. Install accessory drive belt pulley on front of crankshaft pulley. Tighten bolts to specification. See **TORQUE SPECIFICATIONS** .
15. Install gasket and No. 2 timing belt cover. To install remaining components, reverse removal procedure. To ensure proper engine mount alignment, install all right (timing belt side) engine mount bolts/nuts before tightening to specification. See **TORQUE SPECIFICATIONS** .

VALVE LIFTER

Removal

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

Inspection

Inspect components for damage. Measure valve lifter diameter and lifter bore diameter. Ensure oil clearance is within specification. Replace components if not within specification. See **VALVE LIFTERS** under ENGINE SPECIFICATIONS.

Installation

To install, reverse removal procedure. Ensure components are installed in original location and valve lifter rotates smoothly in cylinder head. If camshaft, adjusting shims or valve lifters are replaced, check valve clearance. See **VALVE CLEARANCE ADJUSTMENT** under ADJUSTMENTS.

CAMSHAFT

Removal

1. Disconnect PCV hose and necessary electrical connections to access valve cover. Disconnect spark plug wires from spark plugs. Remove bolts and ignition coils with spark plug wires.
2. Remove retaining bolt and camshaft position sensor with "O" ring from cylinder head. Camshaft position sensor is located on flywheel/drive plate end of cylinder head, just below valve cover. See **Fig. 7** .
3. Remove oil filler cap, valve cover nuts, seal washers, valve cover and gasket. Remove necessary components for access to No. 2 timing belt cover. See **Fig. 12** . Remove bolts, No. 2 timing belt cover and gasket. Remove No. 3 timing belt cover from No. 1 timing belt cover. See **Fig. 12** .
4. Rotate crankshaft clockwise (viewed from timing belt end of engine) so cylinder No. 1 is at TDC on compression stroke and timing mark (groove) on crankshaft pulley aligns with "0" mark on timing belt cover. Cylinder No. 1 is front cylinder at timing belt end of engine.
5. With cylinder No. 1 at TDC on compression stroke, ensure timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap. See **Fig. 8** . Timing mark on camshaft sprocket is indicated by 5E

stamped near hole in camshaft sprocket. If timing mark is not aligned, rotate crankshaft clockwise one complete revolution (360 degrees).

CAUTION: Manufacturer lists camshaft servicing procedure with timing belt removed only from camshaft sprocket. DO NOT allow timing belt to disengage from crankshaft sprocket during camshaft servicing.

6. Place tape around end of pry bar and place pry bar between No. 2 idler pulley and No. 1 idler pulley with shop towel placed over No. 2 idler pulley. See **Fig. 9** . Loosen No. 1 idler pulley bolt. Move No. 1 idler away from timing belt as far as possible and tighten bolt. Remove timing belt from camshaft sprocket.
7. Hold exhaust camshaft with wrench on hexagonal area of camshaft and remove camshaft sprocket bolt. Remove camshaft sprocket from exhaust camshaft.

CAUTION: Camshafts must be properly positioned to lift camshaft straight from cylinder head to prevent damage to cylinder head and camshaft. DO NOT pry or force camshafts from cylinder head, or component damage will result.

8. Rotate intake camshaft so service bolt hole is positioned upward. See **Fig. 16** . This aids in lifting exhaust camshaft evenly from cylinder head. Remove bolts and No. 1 (front) camshaft bearing cap from intake and exhaust camshafts.
9. Remove oil seal and housing plug from front of cylinder head. See **Fig. 7** . Using a 6 x 1 x 18-mm service bolt, secure sub-gear on intake camshaft to main gear. See **Fig. 17** .

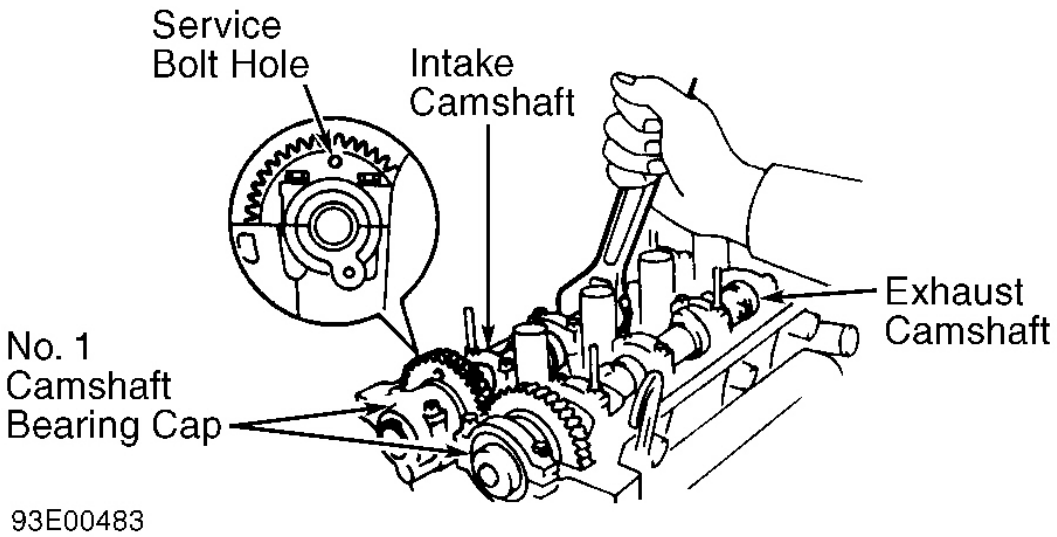


Fig. 16: Positioning Intake Camshaft Service Bolt Hole
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

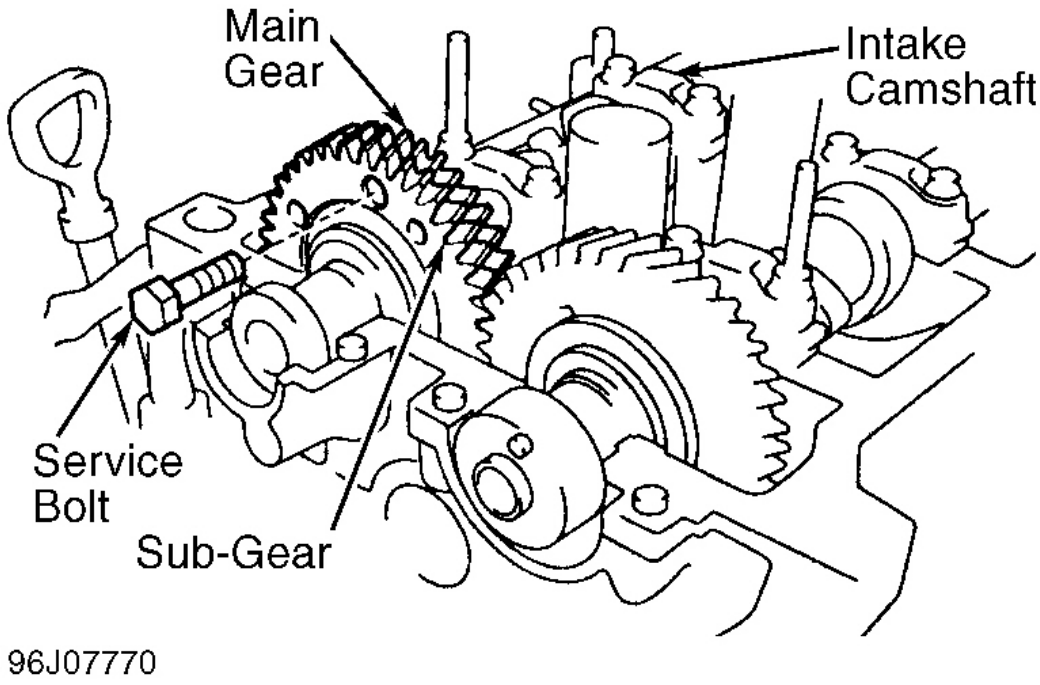


Fig. 17: Securing Sub-Gear On Intake Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

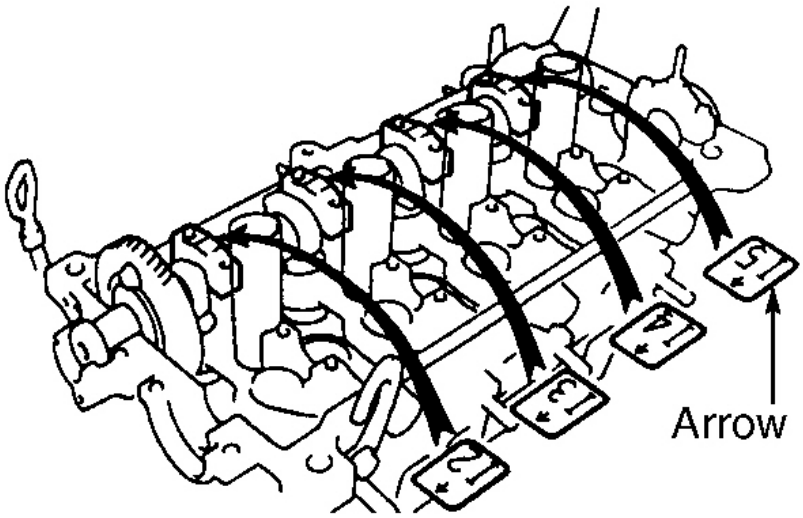
NOTE: Note location of camshaft bearing caps. Camshaft bearing caps are numbered on top of camshaft bearing cap. Camshaft bearing caps are also stamped with either an "I" for intake camshaft or an "E" for exhaust camshaft. See Fig. 18 . Arrow on top of camshaft bearing cap must point toward timing belt end of engine.

CAUTION: Ensure camshaft is lifted upward evenly from cylinder head when loosening camshaft bearing cap bolts.

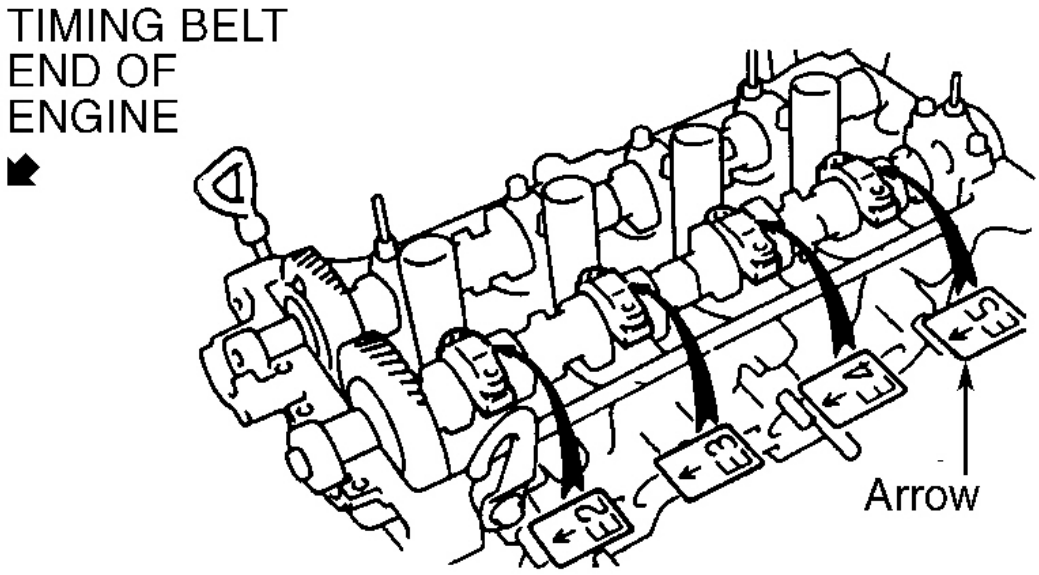
10. Ensure sub-gear is secured to main gear on intake camshaft with service bolt. Loosen and remove exhaust camshaft bearing cap bolts in sequence using several steps. See **Fig. 19** .
11. Remove exhaust camshaft bearing caps. If exhaust camshaft is not lifted upward evenly after removing all bolts and camshaft bearing caps bolts, reinstall only No. 3 camshaft bearing cap on exhaust camshaft and slightly tighten bolts. Alternately loosen bolts on No. 3 camshaft bearing cap while pulling upward on the gear on the exhaust camshaft. Remove exhaust camshaft from cylinder head.
12. Loosen and remove intake camshaft bearing cap bolts in sequence using several steps. See **Fig. 19** . Remove intake camshaft bearing caps. If intake camshaft is not lifted upward evenly after removing all bolts and camshaft bearing caps, reinstall only No. 3 camshaft bearing cap on intake camshaft and slightly tighten bolts. Alternately loosen bolts on No. 3 camshaft bearing cap while pulling upward on the gear on

the intake camshaft. Remove intake camshaft from cylinder head.

13. If removing sub-gear from intake camshaft, place hexagonal area of intake camshaft in soft-jawed vise. Using spanner wrench, rotate sub-gear clockwise and remove service bolt. See **Fig. 20** .
14. Remove snap ring, wave washer, sub-gear and gear spring from intake camshaft. See **Fig. 7** .



INTAKE CAMSHAFT BEARING CAPS



EXHAUST CAMSHAFT BEARING CAPS

93F00484

Fig. 18: Identifying Camshaft Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

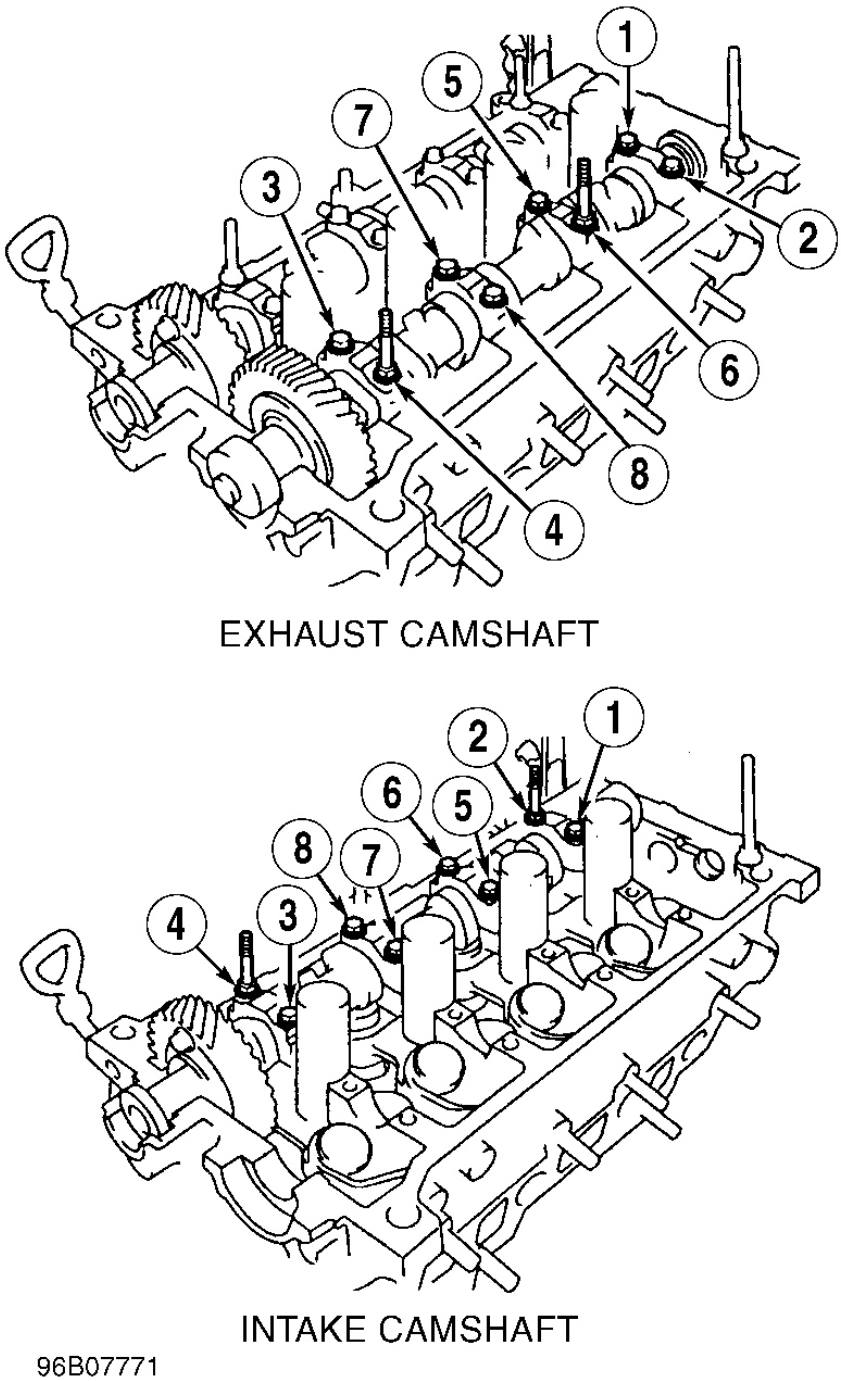


Fig. 19: Camshaft Bearing Cap Bolt Removal Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

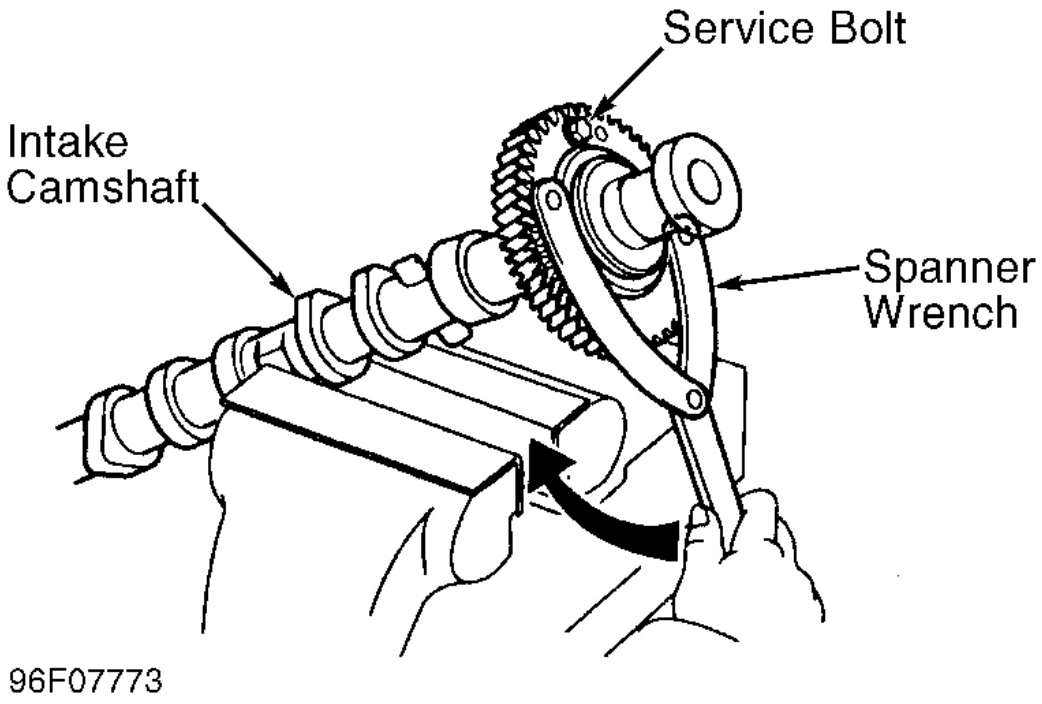
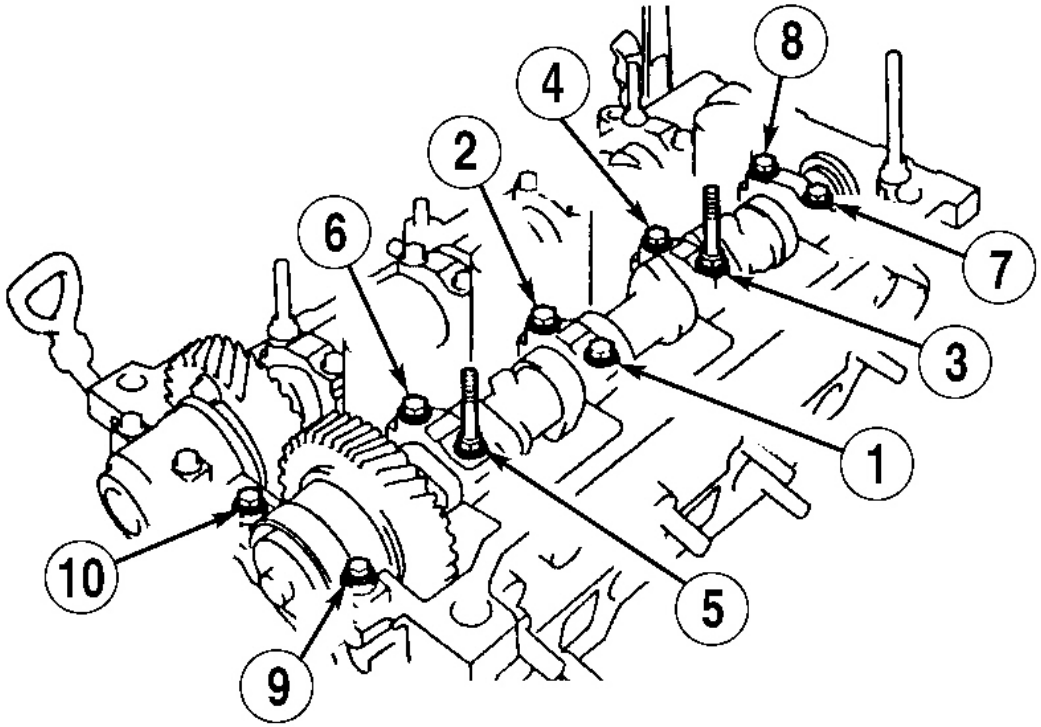


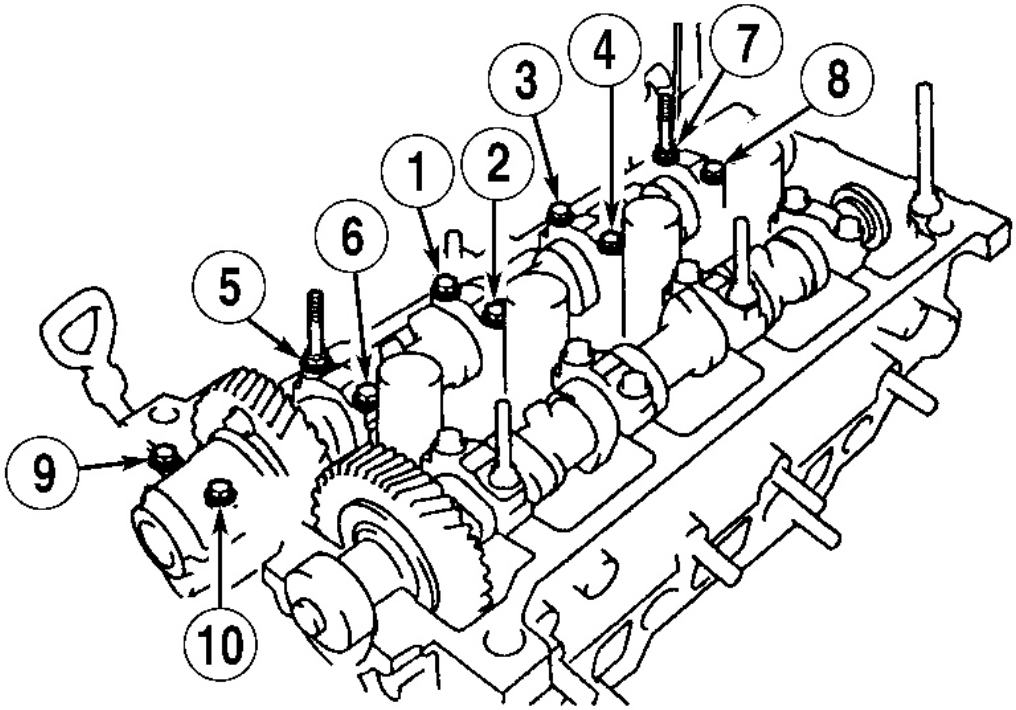
Fig. 20: Disassembling Intake Camshaft Gears
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Inspection

1. Inspect components for damage. Check camshaft journal diameter, lobe height and journal runout. Replace camshaft if not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
2. Install camshaft in cylinder head. Using Plastigage, check camshaft oil clearance with camshaft bearing cap bolts tightened to specification in sequence. See **Fig. 21** . See **TORQUE SPECIFICATIONS** .
3. Replace camshaft and/or cylinder head if oil clearance is not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
4. Check camshaft end play with camshaft bearing cap bolts tightened to specification in sequence. See **Fig. 21** . See **TORQUE SPECIFICATIONS** . Replace camshaft and/or cylinder head if camshaft end play is not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
5. Install both camshafts in cylinder head without sub-gear installed on intake camshaft. Install and tighten camshaft bearing cap bolts to specification in sequence. See **Fig. 21** . See **TORQUE SPECIFICATIONS** .
6. Using dial indicator, check gear backlash between gears on camshafts. Replace camshafts if gear backlash exceeds specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
7. Using caliper, measure width between ends of gear spring for sub-gear on intake camshaft. Replace gear spring if distance is not .886-.902" (22.50-22.90 mm).



EXHAUST CAMSHAFT



INTAKE CAMSHAFT

G96C07776

Fig. 21: Camshaft Bearing Cap Bolt Installation Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Installation

1. To reassemble intake camshaft, place hexagonal area of intake camshaft in soft-faced vise. Install gear spring, sub-gear, wave washer and snap ring on intake camshaft. Ensure pins on sub-gear and main gear align with ends of the gear spring.
2. Using spanner wrench, rotate sub-gear clockwise to align bolt holes in sub-gear and main gear on intake camshaft. Install service bolt to secure sub-gear to main gear.
3. Apply engine oil to thrust surfaces of camshafts. Install intake camshaft in cylinder head with lobes on cylinders No. 3 and 4 as shown, and service bolt at 12 o'clock position. See **Fig. 22** .
4. Install No. 2 through 5 intake camshaft bearing caps with arrows pointing toward timing belt end of engine. See **Fig. 18** .
5. Install and slightly tighten intake camshaft bearing cap bolts in sequence in several steps until all camshaft bearing caps are snug against the cylinder head. See **Fig. 21** .

CAUTION: When installing camshafts, use specified timing marks on rear of camshaft gears. DO NOT use assembly reference marks on camshaft gears. See Fig. 23 .

6. Install exhaust camshaft so timing mark aligns with timing mark on intake camshaft. See **Fig. 23** . DO NOT use assembly reference marks on camshaft gears. If necessary, rotate exhaust camshaft slightly during installation.

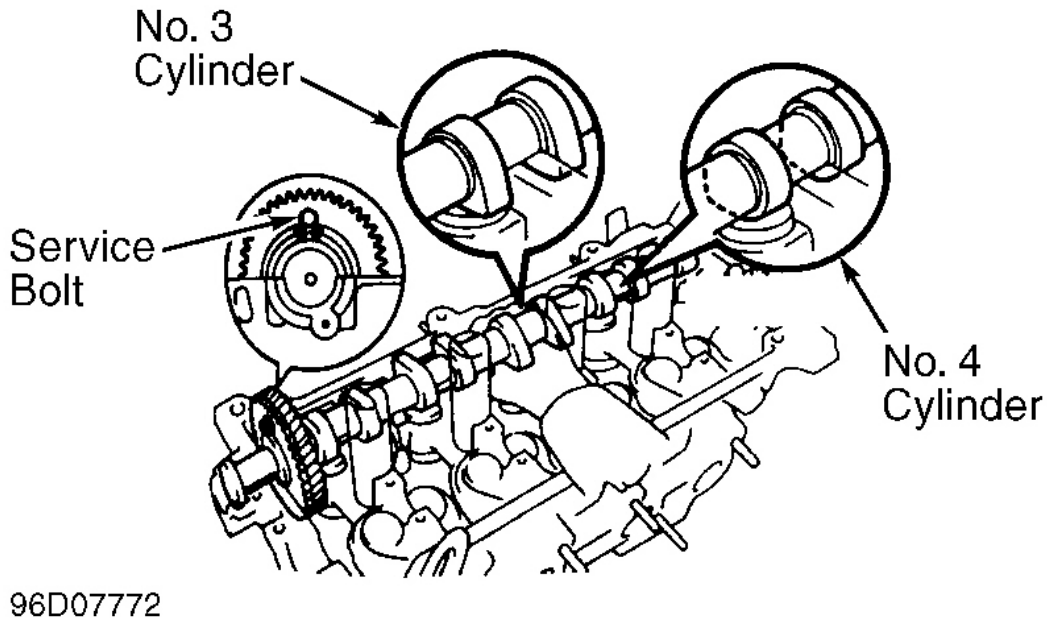


Fig. 22: Installing Intake Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

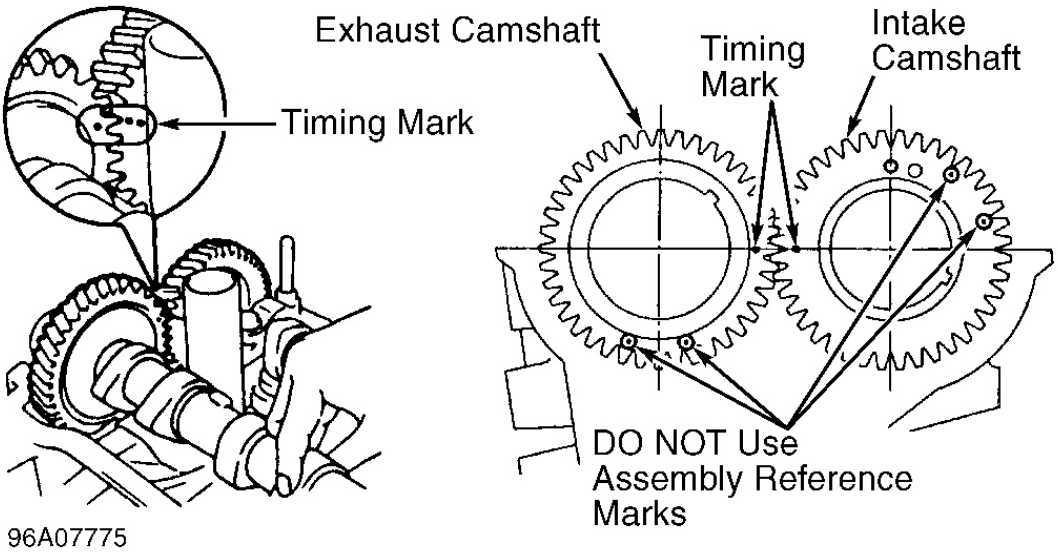


Fig. 23: Aligning Camshaft Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. Install No. 2 through 5 exhaust camshaft bearing caps on exhaust camshaft with arrows pointing toward timing belt end of engine. See **Fig. 18** .
8. Install and slightly tighten exhaust camshaft bearing cap bolts in sequence using several steps until all camshaft bearing caps are snug against cylinder head. See **Fig. 21** .
9. Remove service bolt from intake camshaft. Apply sealant on No. 1 (front) intake camshaft bearing cap-to-cylinder head surface and install on cylinder head. Ensure no clearance exists between No. 1 (front) camshaft bearing cap and cylinder head surface.
10. Install and slightly tighten No. 1 (front) intake camshaft bearing cap bolts. Install housing plug. Tighten all intake camshaft bearing cap bolts to specification in sequence using several steps. See **Fig. 21** . See **TORQUE SPECIFICATIONS** .
11. Coat seal lip of NEW oil seal for exhaust camshaft with grease. Install oil seal on front of exhaust camshaft until backside of oil seal contacts cylinder head.
12. Apply sealant on No. 1 (front) exhaust camshaft bearing cap-to-cylinder head surface and install on cylinder head. Ensure no clearance exists between No. 1 (front) camshaft bearing cap and cylinder head surface.
13. Install and slightly tighten No. 1 (front) exhaust camshaft bearing cap bolts. Tighten all exhaust camshaft bearing cap bolts to specification in sequence using several steps. See **Fig. 21** . See **TORQUE SPECIFICATIONS** .
14. Ensure service bolt is removed from sub-gear on intake camshaft. Rotate camshaft one full revolution and ensure timing marks are still aligned. See **Fig. 23** .
15. Align pin groove just below timing mark on camshaft sprocket with pin in camshaft. See **Fig. 14** .
16. Install camshaft sprocket on camshaft so 5E stamped near hole in camshaft sprocket is facing outward, away from cylinder head. See **Fig. 14** . Install and tighten camshaft sprocket bolt to specification while holding camshaft hexagonal area of camshaft. See **TORQUE SPECIFICATIONS** .

CAUTION: Crankshaft must always be rotated clockwise. DO NOT rotate crankshaft counterclockwise.

17. Rotate crankshaft clockwise (viewed from timing belt end of engine) so cylinder No. 1 is at TDC on compression stroke and timing mark (groove) on crankshaft pulley aligns with "0" mark on timing belt cover.
18. Rotate exhaust camshaft until timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap. See **Fig. 14** . Exhaust camshaft may be rotated by using wrench on hexagonal area at center of camshaft.
19. Starting from right side of camshaft sprocket, install timing belt counterclockwise on camshaft sprocket. Loosen No. 1 idler pulley bolt, allowing tension spring to move No. 1 idler pulley against timing belt.
20. Rotate crankshaft clockwise (viewed from front of engine) 2 full revolutions from TDC to TDC. With timing mark (groove) on crankshaft pulley aligned with "0" mark on timing belt cover, ensure timing mark on camshaft sprocket aligns with timing mark on camshaft bearing cap. See **Fig. 8** . If timing mark is not aligned, remove timing belt from camshaft sprocket and reinstall.
21. Tighten No. 1 idler pulley bolt to specification. See **TORQUE SPECIFICATIONS** . Check and adjust valve clearance. See **VALVE CLEARANCE ADJUSTMENT** under ADJUSTMENTS. To install remaining components, reverse removal procedure using NEW gaskets and "O" ring.

22. Apply sealant at indicated valve cover sealing areas on cylinder head. See **Fig. 3** . Using NEW gasket, install valve cover and sealing washers. Install and tighten valve cover nuts to specification. See **TORQUE SPECIFICATIONS** .

CRANKSHAFT REAR OIL SEAL

Removal

Remove transaxle and flywheel/drive plate. For manual transaxle, see **CLUTCH** article. For automatic transaxle, see **TRANSMISSION REMOVAL & INSTALLATION - A/T** article in AUTOMATIC TRANSMISSION SERVICING. Using a knife, cut off oil seal lip. Pry oil seal from rear oil seal retainer on cylinder block. DO NOT damage sealing surfaces.

Installation

1. Ensure all sealing surfaces are clean. Apply grease to lip of oil seal. Using Oil Seal Installer (SST 09223-15030), install oil seal in rear oil seal retainer until oil seal is even with surface of rear oil seal retainer.
2. Apply Loctite to flywheel/drive plate bolts. Install and tighten flywheel/drive plate bolts to specification in a crisscross pattern. See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure.

WATER PUMP

Removal

1. Drain cooling system. Remove drive belt and generator. Remove bolts/nuts and intake manifold brace located on lower side of intake manifold.
2. Disconnect coolant hoses from coolant inlet pipe at rear of water pump. Remove bolt, coolant inlet pipe and "O" ring from rear of water pump.
3. Remove oil dipstick, generator adjusting bar, dipstick tube and "O" ring. Remove bolts/nuts and water pump from side of cylinder block.

Installation

1. Ensure sealing surfaces are clean. Apply bead of sealant in groove on water pump-to-cylinder block surface on side of water pump. Install water pump. Install and tighten bolts/nuts to specification. See **TORQUE SPECIFICATIONS** .

CAUTION: Install coolant inlet pipe evenly in water pump. DO NOT install coolant inlet pipe at an angle or use twisting motion during installation, as "O" ring will be damaged.

2. To install remaining components, reverse removal procedure. Use NEW "O" rings and coat all "O" rings with soapy water solution before installing. Tighten all bolts/nuts to specification. See **TORQUE SPECIFICATIONS** . Fill cooling system.

OIL PAN

Removal

1. Raise and support vehicle. Drain engine oil. Remove bolts and separate exhaust pipe with gasket from exhaust manifold.
2. If necessary to access oil pan bolts, remove A/C compressor (if equipped) with hoses attached, and secure aside. Remove bolts and A/C compressor mounting bracket. Remove oil dipstick. Remove bolts and oil pan.

Installation

1. To install, ensure sealing surfaces are clean. Apply bead of sealant on inside of bolt holes and at center of oil pan sealing surface, between bolt holes.
2. Install oil pan. Install and tighten bolts to specification. See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure using NEW gaskets. Tighten bolts/nuts to specification. See **TORQUE SPECIFICATIONS** . Fill crankcase with oil.

OVERHAUL

CYLINDER HEAD

Cylinder Head

1. Inspect cylinder head warpage at cylinder block and manifold surfaces. Replace cylinder head if warpage exceeds specification. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS.
2. Install camshaft in cylinder head. Using Plastigage, check camshaft oil clearance with camshaft bearing caps installed, and bolts tightened to specification in sequence. See **Fig. 21** . See **TORQUE SPECIFICATIONS** .
3. Replace camshaft and/or cylinder head if oil clearance is not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
4. Check camshaft end play with camshaft bearing cap bolts tightened to specification in sequence. See **Fig. 21** . See **TORQUE SPECIFICATIONS** . Replace camshaft and/or cylinder head if camshaft end play is not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
5. Install both camshafts in cylinder head without sub-gear installed on intake camshaft. Install and tighten camshaft bearing cap bolts to specification in sequence. See **Fig. 21** . See **TORQUE SPECIFICATIONS** .
6. Using dial indicator, check gear backlash between gears on camshafts. Replace camshafts if gear backlash exceeds specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
7. Ensure valve lifter diameter, bore diameter and oil clearance are within specification. See **VALVE LIFTERS** under ENGINE SPECIFICATIONS. Replace components if not as specified.
8. If installing spark plug tubes in NEW cylinder head, apply Three Bond Sealant (08833-00070) on spark plug tube surface of cylinder head.
9. Using press, install spark plug tube in cylinder head until spark plug tube protrusion is 1.870-1.909" (47.50-48.50 mm). See **Fig. 24** .

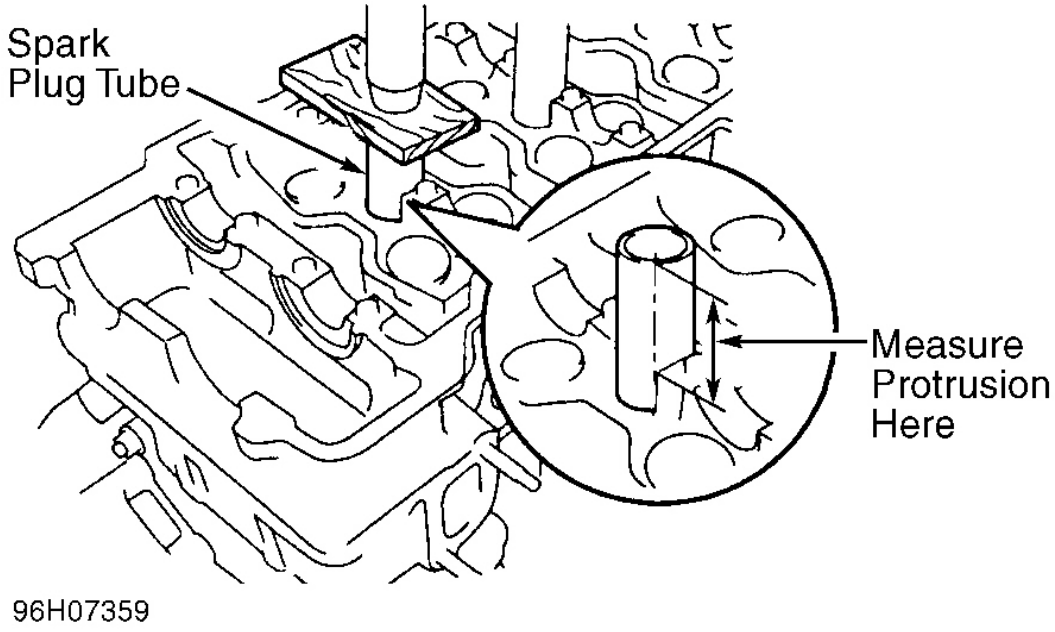


Fig. 24: Measuring Spark Plug Tube Protrusion
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Valve Springs

Ensure valve spring free length, pressure and out-of-square are within specification. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.

CAUTION: Valve stem oil seals are painted a different color on top of oil seal for specified valve application. Intake valve stem oil seal is Silver and exhaust valve stem oil seal is Black. Ensure valve stem oil seals are installed in proper location.

Valve Stem Oil Seals

Intake valve stem oil seal is Silver and exhaust valve stem oil seal is Black. Lubricate valve stem oil seal with engine oil. Install valve stem oil seal using the appropriate diameter socket.

Valve Guides

1. Ensure valve guide inside diameter is within specification. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS. Replace valve guide if inside diameter exceeds specification.
2. To replace valve guide, use Valve Guide Remover/Installer (SST 09201-10000). Using hammer and valve guide remover/installer, drive valve guide from camshaft side of cylinder head.
3. Measure cylinder head valve guide bore inside diameter. If bore inside diameter is .4331-.4341" (11.000-

11.027 mm), use standard valve guide. If bore inside diameter is .4350-.4361" (11.050-11.077 mm), use oversize valve guide.

4. If bore inside diameter exceeds .4341" (11.027 mm), machine valve guide bore to .4350-.4361" (11.050-11.077 mm) for oversize valve guide. If bore inside diameter exceeds .4361" (11.077 mm), replace cylinder head.

CAUTION: Exhaust valve guide is 1.594" (40.50 mm) long and intake valve guide is 1.516" (38.50 mm) long. Ensure proper length valve guides are installed.

5. To install valve guide, use hammer and valve guide remover/installer. Drive valve guide in from camshaft side of cylinder head until valve guide installed height is .500-.516" (12.70-13.10 mm). See **Fig. 25** .
6. Using .236" (6.00 mm) reamer, ream valve guide to obtain specified valve stem-to-guide oil clearance. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS.

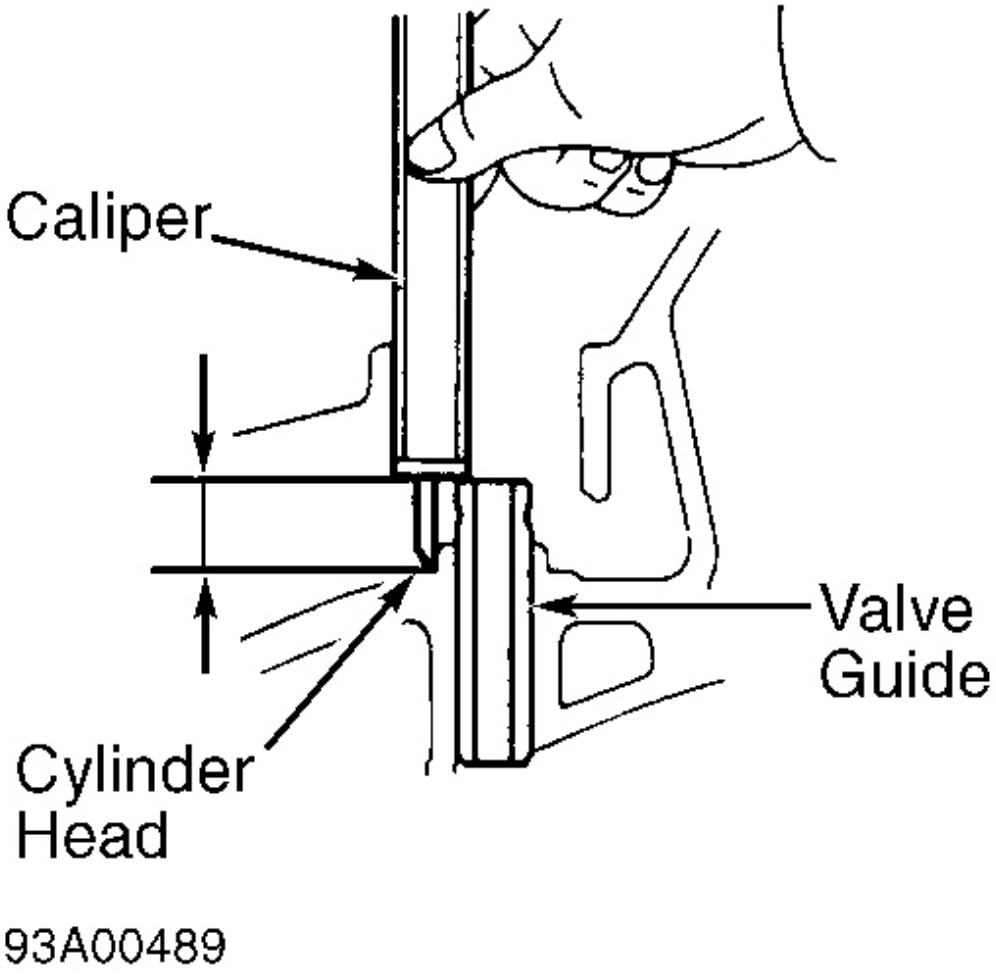


Fig. 25: Measuring Valve Guide Installed Height
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Valve Seat

Ensure valve seat angle and seat width are within specification. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS. Valve seat replacement information is not available.

Valves

Ensure minimum refinish length, stem diameter and valve margin are within specification. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.

Valve Seat Correction Angles

Use 30-degree and 45-degree stones to lower valve seat contact area. Use 75-degree and 45-degree stones to raise exhaust valve seat contact area. Use 75-degree, 60-degree and 45-degree stones to raise intake valve seat contact area.

VALVE TRAIN

Valve Lifters

Ensure valve lifter diameter, lifter bore diameter and oil clearance are within specification. See **VALVE LIFTERS** under ENGINE SPECIFICATIONS.

CYLINDER BLOCK ASSEMBLY

Piston & Rod Assembly

1. Ensure connecting rod and connecting rod cap are marked with matching cylinder number for installation reference. Piston and connecting rod must be installed in cylinder block with front mark facing timing belt end of engine. See **Fig. 26** .
2. Before disassembling piston and connecting rod, try to move piston back and forth on piston pin. Replace piston and piston pin as an assembly if any movement is felt. When removing piston from connecting rod, press piston pin from piston.
3. Different size pistons are used. Piston diameter is determined by size mark ("1", "2" or "3") stamped on top of piston. See **Fig. 27** .
4. Measure piston skirt diameter at .91" (23.0 mm) from top of piston at 90-degree angle to piston pin. Ensure piston diameter is within specification. See **PISTONS, PINS & RINGS** and **CYLINDER BLOCK** under ENGINE SPECIFICATIONS.
5. Ensure connecting rod bend, twist and crankpin bore diameter are within specification. See **CONNECTING RODS** under ENGINE SPECIFICATIONS.

NOTE: Crankpin bore diameter is determined by size mark stamped on connecting rod cap. See Fig. 30 .

6. To reassemble, install piston on connecting rod so front mark on top of piston aligns with front mark on connecting rod. See **Fig. 26** . Coat piston pin and piston pin holes in piston with engine oil . Press piston pin into piston.

CAUTION: With connecting rod centered in piston, ensure same distance exists between each end of piston pin and the piston. If distance varies, relocate piston pin until the distance is equal.

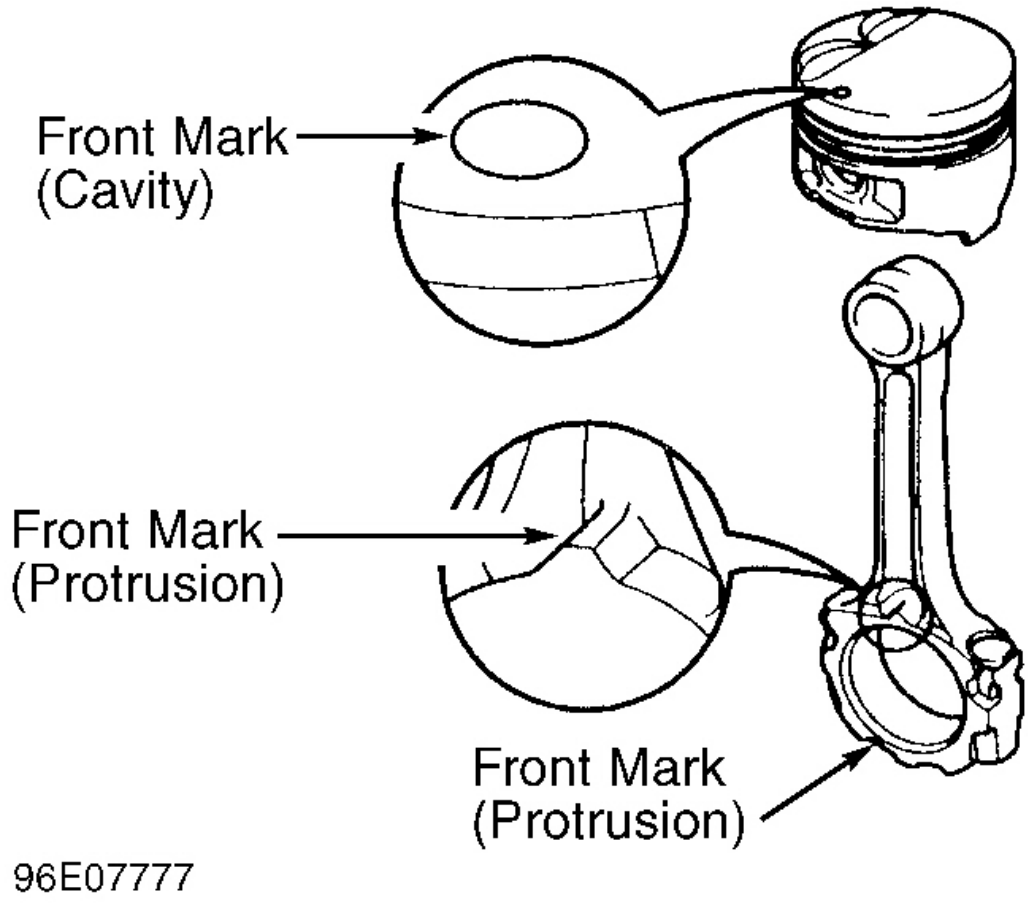


Fig. 26: Locating Connecting Rod & Piston Front Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Fitting Pistons

1. Different piston and cylinder bore sizes are used. Piston diameter is determined by size mark ("1", "2" or "3") stamped on top of piston. See **Fig. 27** .
2. Cylinder bore diameter is determined by cylinder bore size mark ("1", "2" or "3") stamped on cylinder block deck surface. See **Fig. 28** .
3. To determine piston-to-cylinder clearance, measure piston diameter and cylinder bore diameter. Measure piston skirt diameter at .91" (23.0 mm) from top of piston at 90-degree angle to piston pin.
4. Measure cylinder bore diameter at 2 different places, 90 degrees apart at .39" (10.0 mm) from top and bottom of cylinder bore and at center of cylinder bore. Ensure piston diameter and cylinder bore diameter are within specification. See **PISTONS, PINS & RINGS** and **CYLINDER BLOCK** under ENGINE SPECIFICATIONS.

CAUTION: If replacing piston, ensure replacement piston contains same size mark as cylinder bore size mark on cylinder block.

5. Calculate piston-to-cylinder clearance. Replace piston or cylinder block if clearance is not within specification. See **PISTONS, PINS & RINGS** .

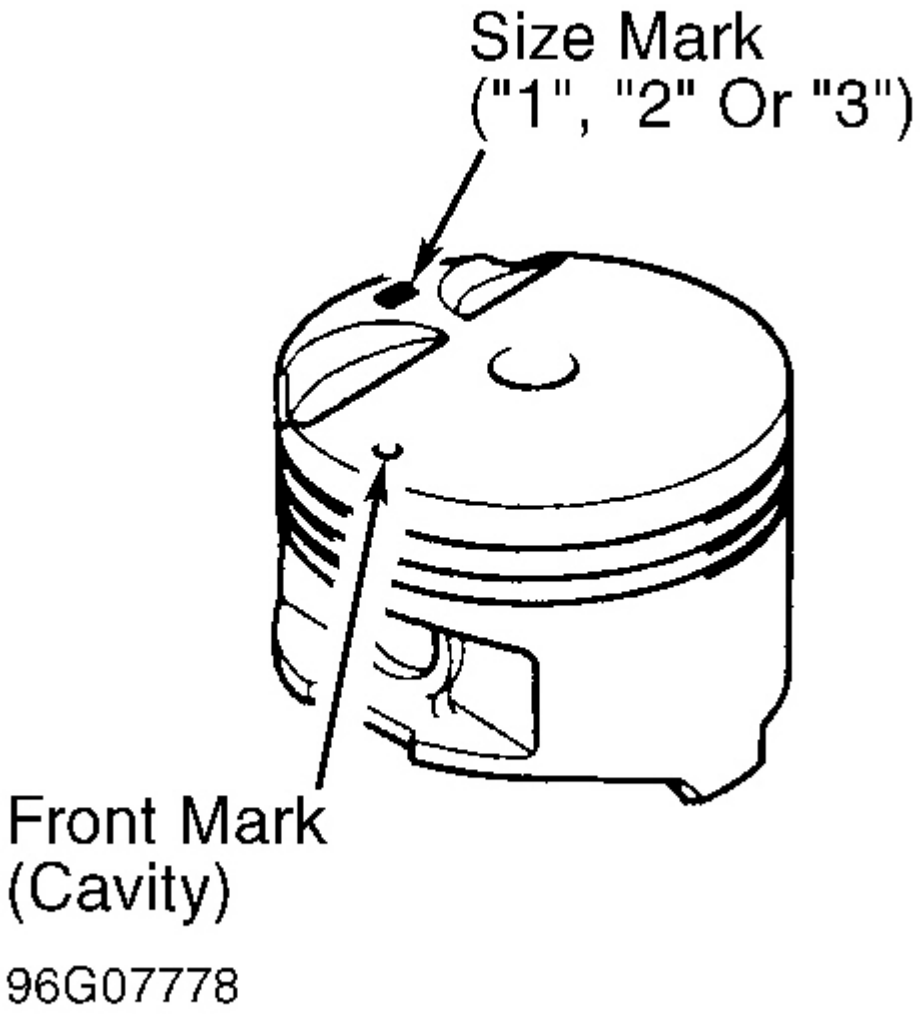


Fig. 27: Locating Piston Size Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

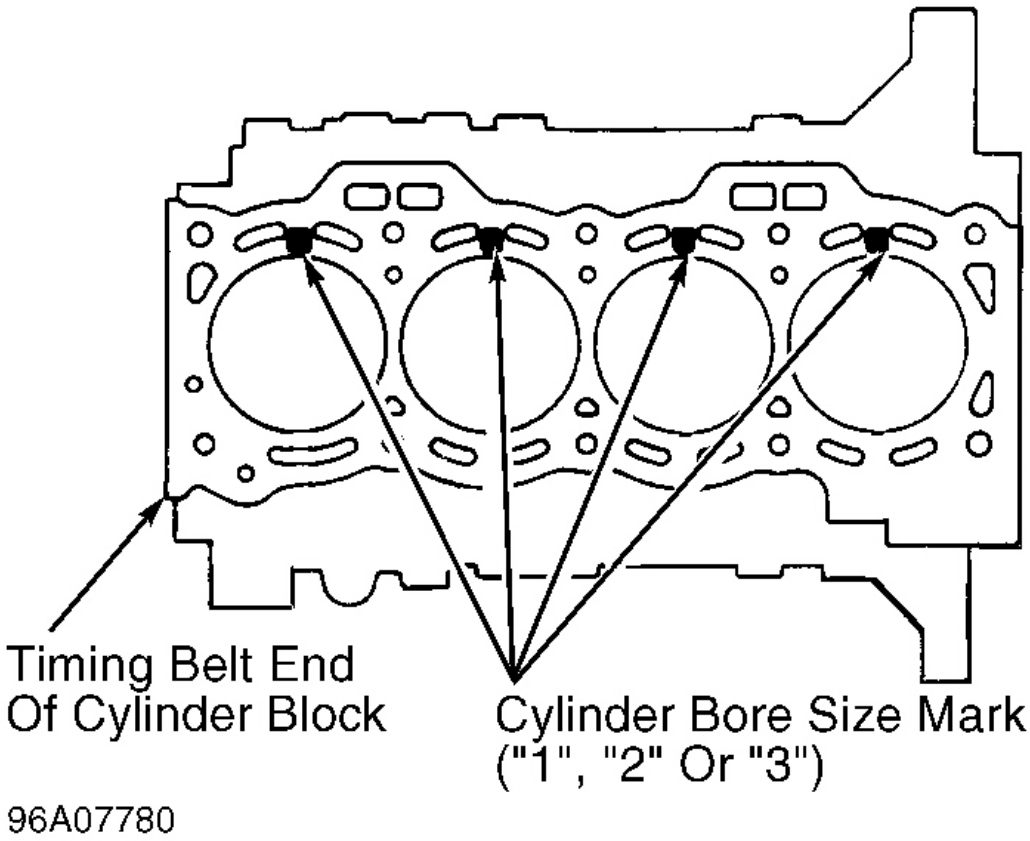


Fig. 28: Locating Cylinder Bore Size Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Piston Rings

Ensure piston ring end gap and side clearance are within specification. See **PISTONS, PINS & RINGS** under ENGINE SPECIFICATIONS. Position piston rings with ring end gaps in proper areas and identification mark on piston ring toward top of piston. See **Fig. 29** .

NOTE: No. 1 compression ring contains a "1R" identification mark. No. 2 compression ring contains a "2R" identification mark. Ensure compression rings are installed in correct location.

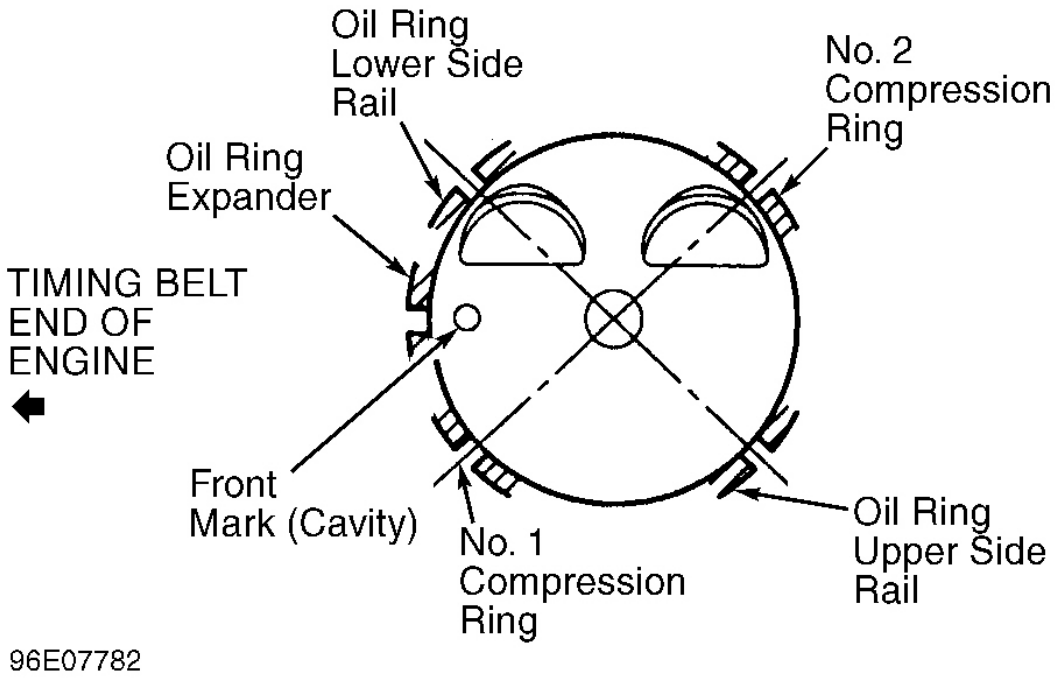


Fig. 29: Positioning Piston Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Rod Bearings

1. Ensure connecting rod and connecting rod cap are marked with matching cylinder number for installation reference. Piston, connecting rod and connecting rod cap must be installed so front mark is toward timing belt end of engine. See **Fig. 26** .
2. Connecting rod cap and rod bearing are stamped with size mark ("1", "2" or "3"). See **Fig. 30** . Ensure size marks on connecting rod cap and rod bearing are same.

NOTE: If replacing rod bearing, ensure size mark on replacement rod bearing is same as size mark on original rod bearing.

3. Rod bearing thickness is determined by size mark. See **ROD BEARING SPECIFICATIONS** . Install connecting rod and connecting rod cap with front mark (protrusion) toward timing belt end of engine. See **Fig. 26** .
4. Coat threads of connecting rod bolt and connecting rod nut-to-connecting rod cap surface with engine oil before tightening nuts to specification. See **TORQUE SPECIFICATIONS** .
5. Ensure bearing oil clearance and connecting rod side play are within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** and **CONNECTING RODS** under ENGINE SPECIFICATIONS.

ROD BEARING SPECIFICATIONS

Rod Bearing Size Mark	Thickness - In. (mm)
"1"	.0585-.0587 (1.487-1.491)
"2"	.0587-.0589 (1.491-1.495)
"3"	.0589-.0590 (1.495-1.499)

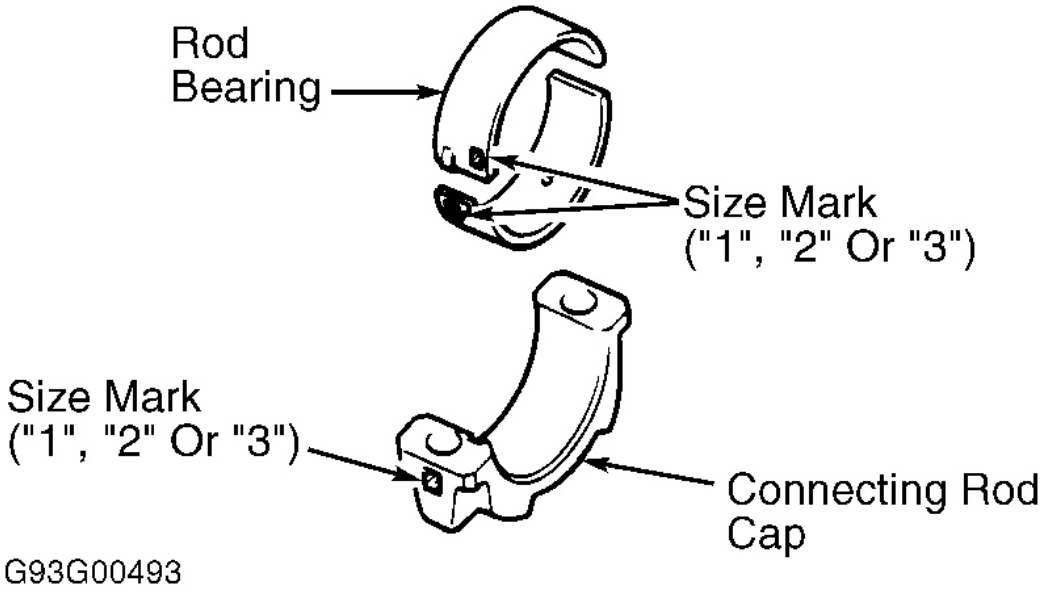


Fig. 30: Locating Connecting Rod & Rod Bearing Size Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Crankshaft & Main Bearings

1. Main bearing caps contain a location number and a front mark. See **Fig. 31** . No. 1 main bearing cap is located at timing belt end of engine and No. 5 is at flywheel/drive plate end of engine.
2. Remove main bearing cap bolts in sequence. See **Fig. 32** . Remove main bearing caps, crankshaft, thrust bearings and main bearings.
3. Cylinder block main bearing bore inside diameter is identified by size mark ("1", "2" or "3") stamped on cylinder block. See **Fig. 33** . Front size mark indicates No. 1 main bearing bore and rear size mark indicates No. 5 main bearing bore.
4. Crankshaft main bearing journal diameter is identified by size mark ("0", "1" or "2") on crankshaft counterweight. See **Fig. 33** . Front size mark indicates No. 1 main bearing journal and rear size mark indicates No. 5 main bearing journal.
5. Ensure journal diameter, taper and out-of-round are within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** under ENGINE SPECIFICATIONS.
6. Main bearing size mark ("1", "2", "3", "4" or "5") is located on side of main bearing. See **Fig. 33** . If

replacing main bearing, ensure size mark on replacement main bearing is same as size mark on original main bearing.

7. If main bearing size mark cannot be obtained, add size marks on cylinder block and crankshaft together to determine size mark of main bearing to be used. For example, if size mark on cylinder block is "2" and size mark on crankshaft is "1", use main bearing with size mark "3".
8. Main bearing thickness is determined by size mark. See **MAIN BEARING SPECIFICATIONS** . Install main bearings, thrust bearings, crankshaft and main bearing caps. Ensure main bearing caps are properly installed in numerical sequence with No. 1 at timing belt end of engine and No. 5 at flywheel/drive plate end of engine. Ensure front mark on each main bearing cap is pointing toward timing belt end of engine. See **Fig. 31** .
9. Coat threads and bolt-to-main bearing cap surfaces with engine oil. Install and tighten main bearing cap bolts to specification in sequence using several steps. See **Fig. 32** . See **TORQUE SPECIFICATIONS** .
10. Ensure crankshaft main bearing oil clearance and crankshaft end play are within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** . Replace thrust bearings if crankshaft end play is not within specification.

MAIN BEARING SPECIFICATIONS

Main Bearing Size Mark	Thickness: In. (mm)
"1"	.07862-.07874 (1.9970-2.0000)
"2"	.07877-.07885 (2.0010-2.0030)
"3"	.07889-.07897 (2.0040-2.0060)
"4"	.07901-.07909 (2.0070-2.0090)
"5"	.07913-.07921 (2.0100-2.0120)

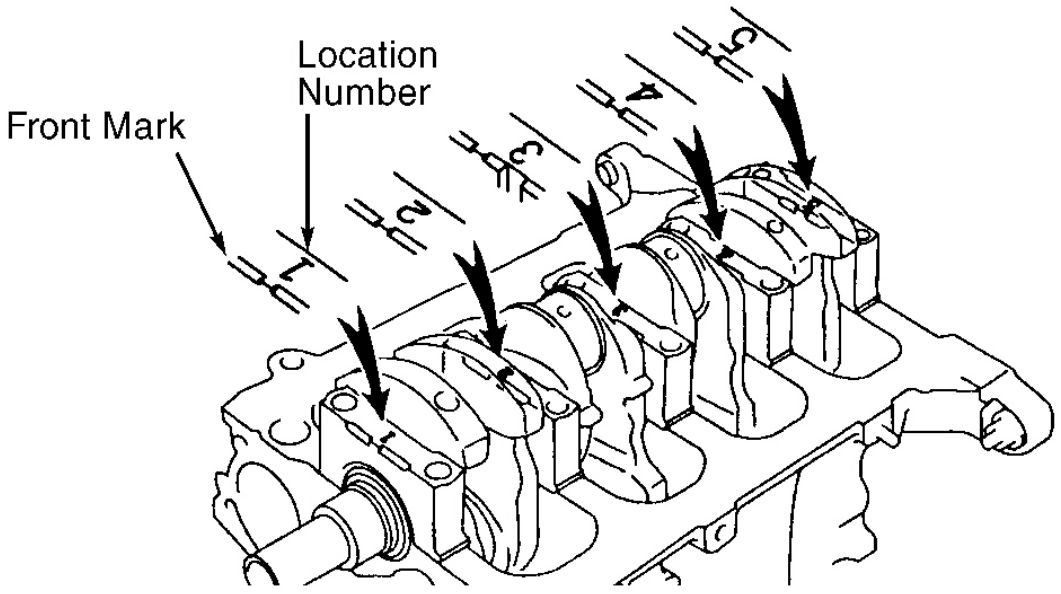


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Fig. 31: Locating Main Bearing Cap Location Number & Front Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

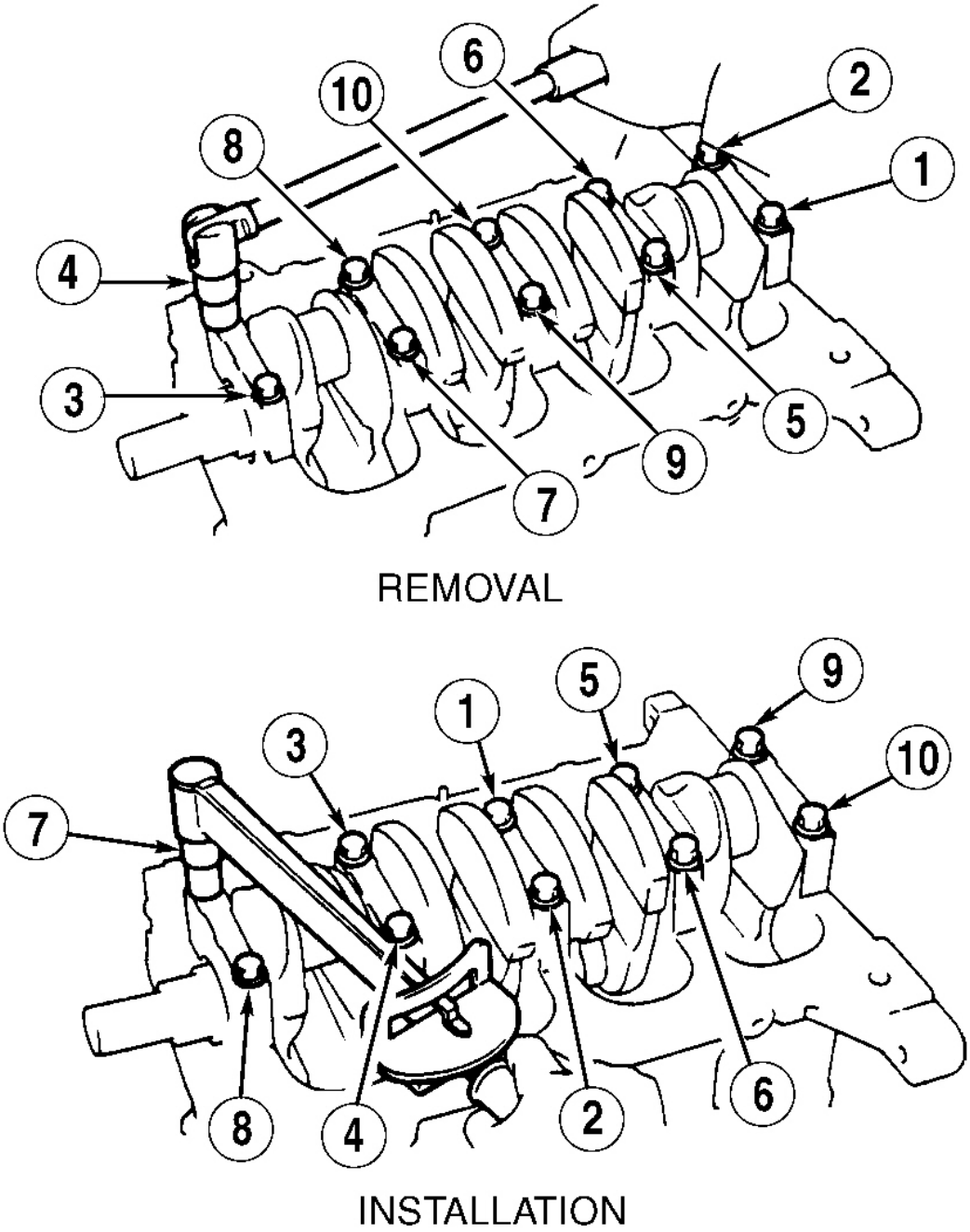

Fig. 32: Main Bearing Cap Bolt Removal & Installation Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

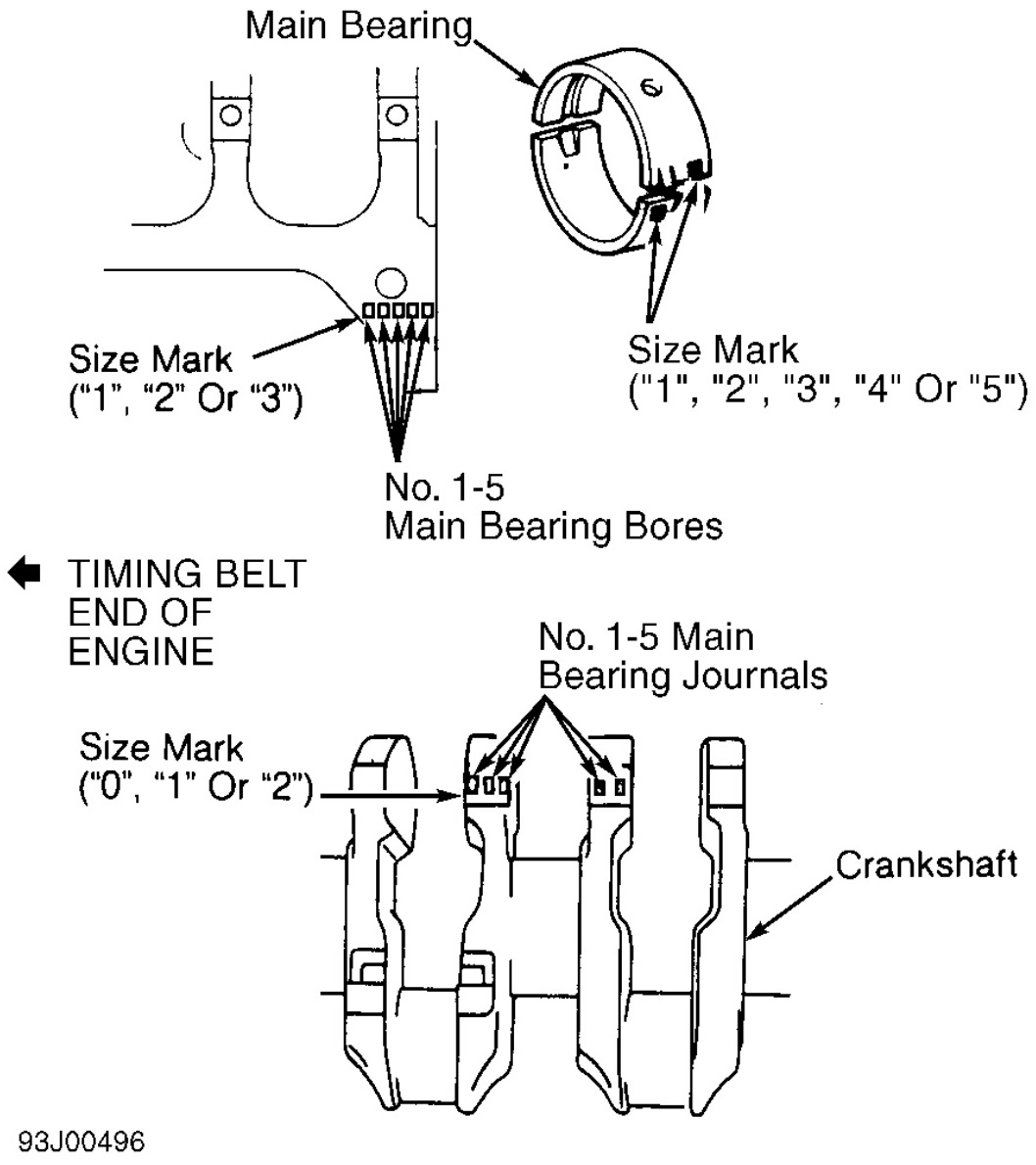

Fig. 33: Locating Cylinder Block, Crankshaft & Main Bearing Size Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Thrust Bearing

Install thrust bearings on No. 3 main bearing with grooves toward crankshaft, away from cylinder block and main bearing cap. Replace thrust bearing if crankshaft end play is not within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** under ENGINE SPECIFICATIONS.

Cylinder Block

1. Inspect cylinder block deck surface warpage. Replace cylinder block if deck surface warpage exceeds specification. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS.
2. Different cylinder bore sizes are used. Cylinder bore diameter is determined by cylinder bore size mark ("1", "2" or "3") stamped on cylinder block deck surface. See **Fig. 28** .
3. Measure cylinder bore diameter at 2 different places, 90 degrees apart at .39" (10.0 mm) from top and bottom of cylinder bore and at center of cylinder bore. Ensure cylinder bore diameter is within specification. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS. Replace cylinder block if cylinder bore exceeds specification.
4. Install main bearing caps in numerical sequence with No. 1 at timing belt end of and No. 5 at flywheel/drive plate end of engine. Ensure front mark on each main bearing cap points toward timing belt end of engine. See **Fig. 31** .
5. Install and tighten main bearing cap bolts to specification in sequence using several steps. See **Fig. 32** . See **TORQUE SPECIFICATIONS** . Ensure main bearing bore inside diameter is within specification. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS.

NOTE: Main bearing bore inside diameter is identified by size mark ("1", "2" or "3") stamped on cylinder block. See Fig. 33 .

ENGINE OILING

ENGINE LUBRICATION SYSTEM

Crankshaft-driven oil pump provides pressurized engine lubrication. See **Fig. 34** .

Crankcase Capacity

Crankcase capacity with oil filter is 3.0 qts. (2.8L).

Oil Pressure

With engine at normal operating temperature, oil pressure should be at least 4.3 psi (0.3 kg/cm^2) at idle and 36-71 psi (2.5-5.0 kg/cm^2) at 3000 RPM.

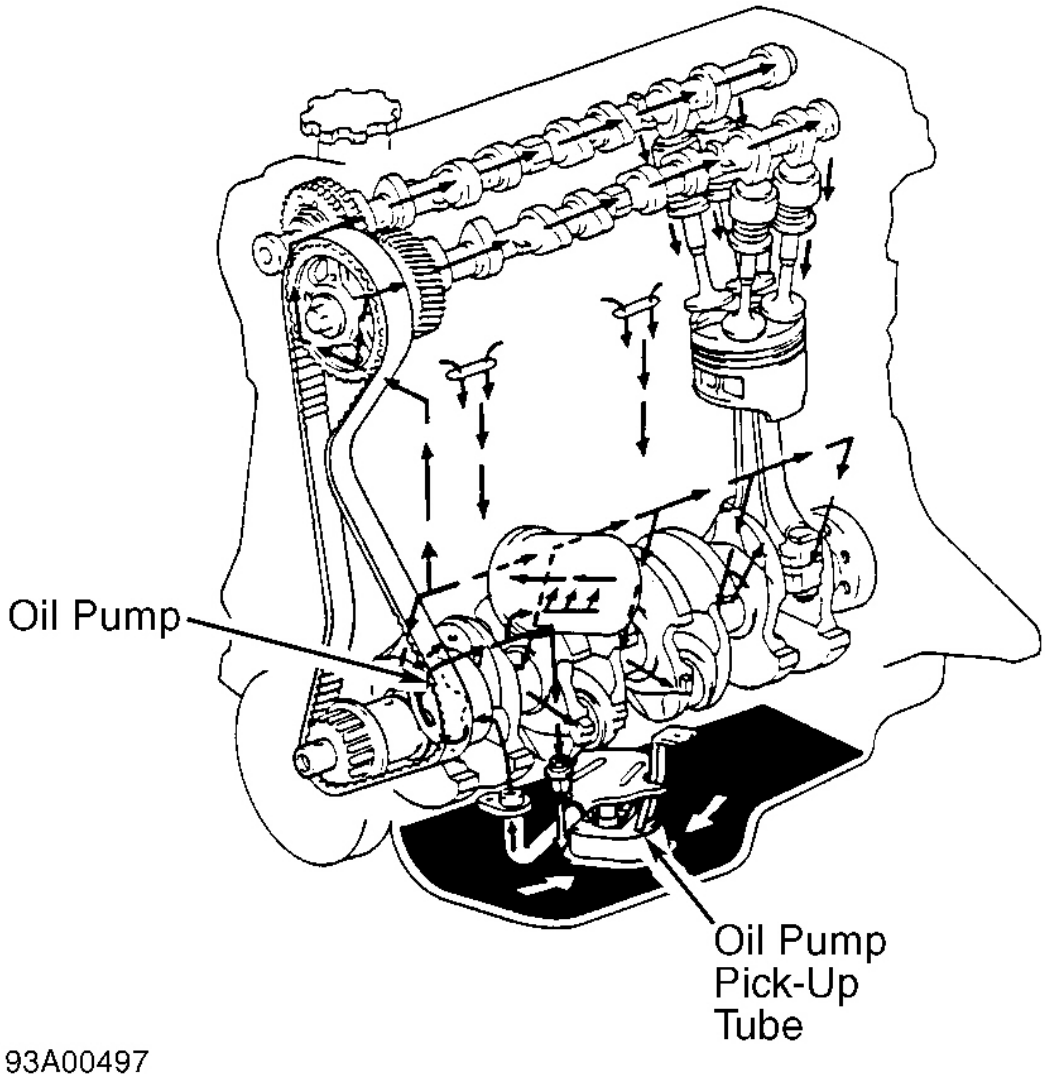

Fig. 34: Cross-Sectional View Of Engine Oiling System
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

OIL PUMP

Removal & Disassembly

1. Remove timing belt and crankshaft sprocket. See **TIMING BELT** under REMOVAL & INSTALLATION. Remove oil pan. See **OIL PAN** under REMOVAL & INSTALLATION.
2. Remove bolts, oil pump pick-up tube and "O" ring. Unscrew pressure regulator valve from oil pan flange area on cylinder block. See **Fig. 35** . Remove bolts, tension spring bracket, oil pump and "O" ring from cylinder block. See **Fig. 36** .

3. Place oil pump drive sprocket in soft-jawed vise. Remove nut and oil pump drive sprocket from drive rotor. Remove oil pump components. Remove oil seal and crankshaft front seal from oil pump body (if necessary). Remove snap ring, retainer, spring and piston from pressure regulator valve.

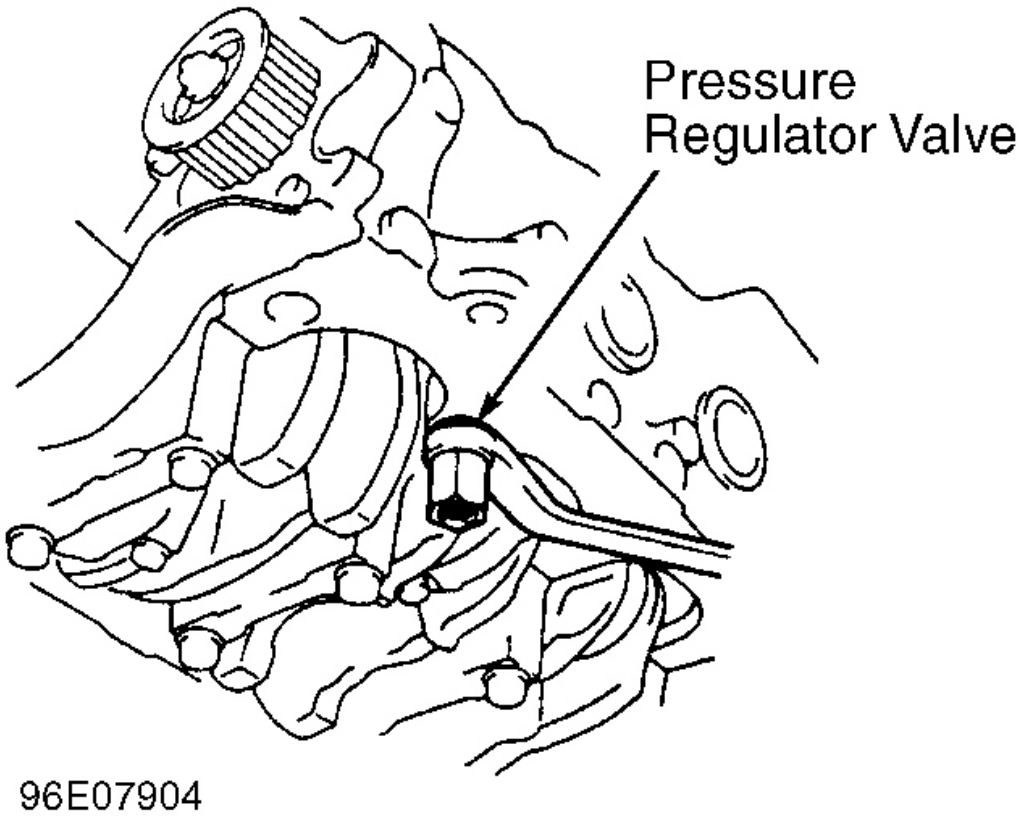

Fig. 35: Locating Pressure Regulator Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

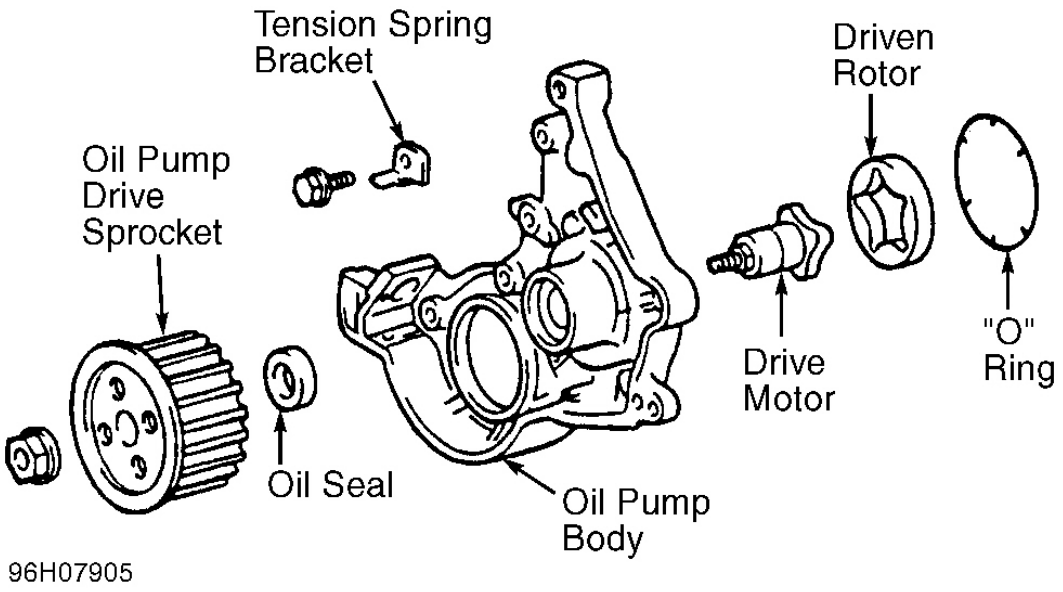

Fig. 36: Exploded View Of Oil Pump
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Inspection

1. Inspect components for damage. Coat piston with engine oil and ensure piston slides freely in pressure regulator valve. Replace pressure regulator valve if piston fails to slide freely.
2. Install drive and driven rotors in oil pump body. Using feeler gauge, measure driven rotor-to-oil pump body clearance between outer edge of driven rotor and oil pump body. Replace rotor assembly and/or oil pump body if clearance exceeds specification. See **OIL PUMP SPECIFICATIONS** .
3. Using feeler gauge, measure rotor tip clearance between outside edge of tip on drive rotor and inside edge of tip on driven rotor. See **Fig. 37** . Replace rotor assembly if rotor tip clearance exceeds specification. See **OIL PUMP SPECIFICATIONS** .
4. With both rotors installed in oil pump body, place straightedge across rotors. Using feeler gauge, measure rotor end clearance (protrusion) above oil pump housing. See **Fig. 38** . Replace rotor assembly and/or oil pump body if rotor end clearance (protrusion) is less than the minimum wear limit. See **OIL PUMP SPECIFICATIONS** .

OIL PUMP SPECIFICATIONS

Application	In. (mm)
Driven Rotor-To-Oil Pump Body Clearance	
Standard	.0039-.0063 (.100-.160)
Wear Limit	.0079 (.200)
Rotor End Clearance	
Standard	.1145-.1169 (2.910-2.970)

Minimum Wear Limit	.1142 (2.900)
Rotor Tip Clearance	
Standard	.0012-.0055 (.030-.140)
Wear Limit	.0079 (.200)

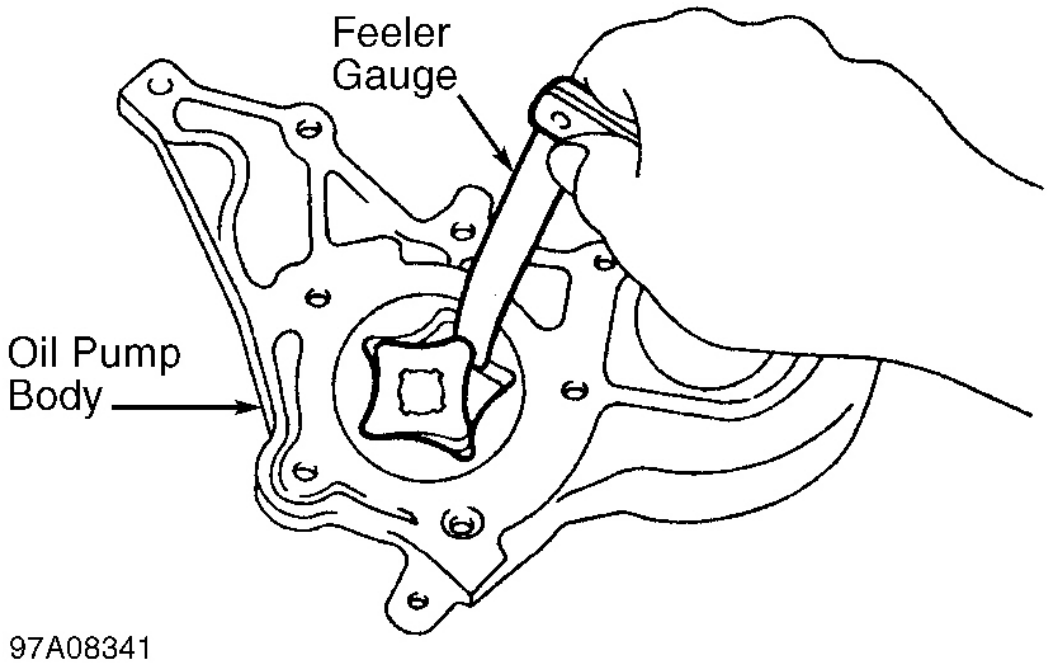

Fig. 37: Measuring Rotor Tip Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

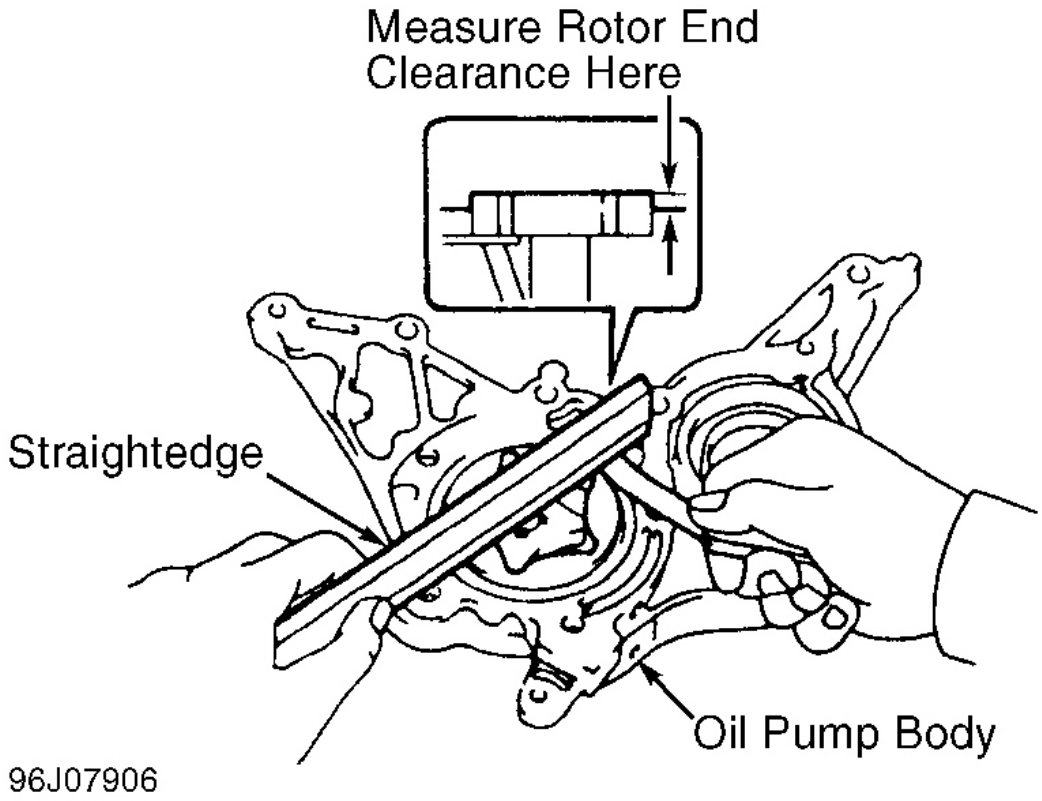

Fig. 38: Measuring Rotor End Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Reassembly & Installation

1. To reassemble, reverse disassembly procedure. Using Seal Installer (SST 09309-37010), install NEW crankshaft front seal (if removed) until seal surface is even with oil pump body. Coat seal lip with grease.
2. Install NEW oil seal (if removed) in oil pump body, using appropriate size socket, until seal surface is even with oil pump body. Coat seal lip with grease.
3. When install rotors, ensure reference marks on rotors face toward outside of oil pump body (away from cylinder block surface). See **Fig. 39** . Tighten oil pump drive sprocket nut to specification. See **TORQUE SPECIFICATIONS** .
4. To install, apply sealant on rear of oil pump. Install NEW "O" ring in groove on oil pump body. Install oil pump on cylinder block. Install and tighten oil pump bolts and pressure regulator valve to specification. See **TORQUE SPECIFICATIONS** . To install remaining components, reverse removal procedure.

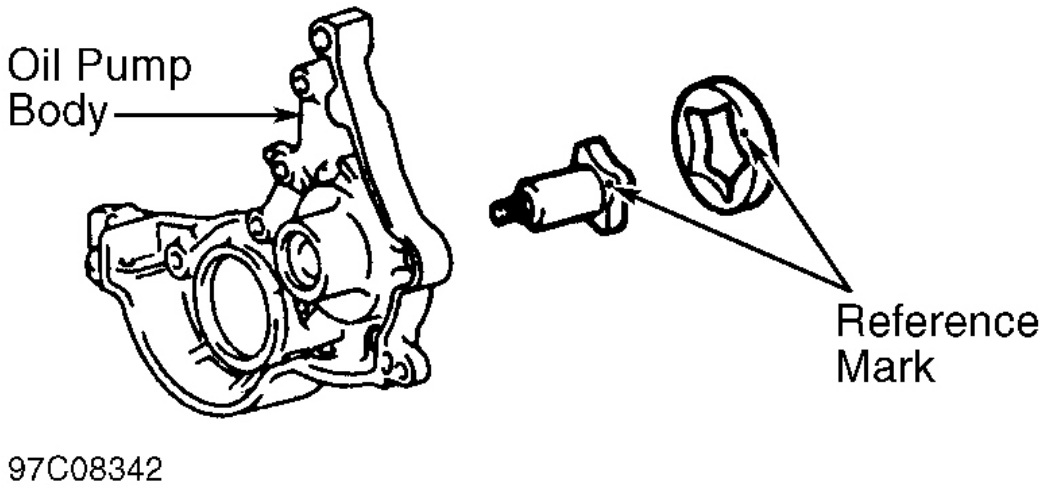

Fig. 39: Installing Rotors In Oil Pump Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

GENERAL SPECIFICATIONS

Application	Specification
Displacement	92 Cu. In. (1.5L)
Bore	2.91" (74.0 mm)
Stroke	3.43" (87.0 mm)
Compression Ratio	9.4:1
Fuel System	SFI
Horsepower @ RPM	93 @ 5400
Torque Ft. Lbs. @ RPM	100 @ 4400

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft	
End Play	
Standard	.0008-.0079 (.020-.200)
Wear Limit	.0118 (.300)
Runout	.0024 (.060)

Main Bearings	
Journal Diameter (1)	
Size Mark "0"	1.9683-1.9685 (49.995-50.000)
Size Mark "1"	1.9681-1.9683 (49.990-49.995)
Size Mark "2"	1.9679-1.9681 (49.985-49.990)
Journal Out-Of-Round	.0028 (.070)
Journal Taper	.0031 (.080)
Oil Clearance	
Standard Crankshaft	
Standard	.0006-.0014 (.016-.035)
Wear Limit	.0031 (.080)
.010" (.25 mm) Undersize Crankshaft	
Standard	.0006-.0022 (.016-.055)
Wear Limit	.0031 (.080)
Connecting Rod Bearings	
Journal Diameter	1.6923-1.6929 (42.985-43.000)
Journal Out-Of-Round	.0028 (.070)
Journal Taper	.0031 (.080)
Oil Clearance	
Standard Crankshaft	
Standard	.0006-.0019 (.016-.048)
Wear Limit	.0031 (.080)
.010" (.25 mm) Undersize Crankshaft	
Standard	.0006-.0023 (.016-.058)
Wear Limit	.0031 (.080)
(1) Main bearing journal diameter is identified by size mark on the crankshaft. See **Fig. 33** .	

CONNECTING RODS

CONNECTING RODS

Application	**In. (mm)**
Bore Diameter	
Crankpin Bore (1)	
Size Mark "1"	1.8110-1.8113 (46.000-46.007)
Size Mark "2"	1.8113-1.8116 (46.007-46.014)
Size Mark "3"	1.8116-1.8118 (46.014-46.021)
Maximum Bend	.0012 Per 3.94 (.030 Per 100.0)
Maximum Twist	.0020 Per 3.94 (.050 Per 100.0)

Side Play	
Standard	.0059-.0138 (.150-.350)
Wear Limit	.0177 (.450)
(1) Crankpin bore diameter is identified by size mark on connecting rod cap. See **Fig. 30** .	

PISTONS, PINS & RINGS

PISTONS, PINS & RINGS

Application	In. (mm)
Pistons	
Clearance	
Standard	.0035-.0043 (.090-.110)
Wear Limit	.0051 (.130)
Diameter (1)	
Size Mark "1"	2.9094-2.9098 (73.900-73.910)
Size Mark "2"	2.9098-2.9102 (73.910-73.920)
Size Mark "3"	2.9102-2.9106 (73.920-73.930)
Rings	
No. 1	
End Gap	
Standard	.0102-.0189 (.260-.480)
Wear Limit	.0421 (1.070)
Side Clearance	.0016-.0031 (.040-.080)
No. 2	
End Gap	
Standard	.0142-.0224 (.360-.570)
Wear Limit	.0402 (1.020)
Side Clearance	.0012-.0028 (.030-.070)
No. 3 (Oil)	
End Gap	
Standard	.0051-.0197 (.130-.500)
Wear Limit	.0433 (1.100)
(1) Piston diameter is identified by size mark on top of piston. See **Fig. 27** .	

CYLINDER BLOCK

CYLINDER BLOCK

Application	In. (mm)
Cylinder Bore	
Standard Diameter (1)	

Size Mark "1"	2.9134-2.9138 (74.000-74.010)
Size Mark "2"	2.9138-2.9142 (74.010-74.020)
Size Mark "3"	2.9142-2.9146 (74.020-74.030)
Main Bearing Bore Inside Diameter (2)	
Size Mark "1"	2.1267-2.1269 (54.018-54.024)
Size Mark "2"	2.1270-2.1272 (54.025-54.030)
Size Mark "3"	2.1272-2.1274 (54.030-54.036)
Maximum Deck Warpage	.002 (.05)

(1) Cylinder bore diameter is identified by cylinder bore size mark on cylinder block deck surface. See **Fig. 28** . Maximum cylinder bore diameter is 2.9224" (74.230 mm).

(2) Main bearing bore inside diameter is identified by size mark on cylinder block. See **Fig. 33** .

VALVES & VALVE SPRINGS

VALVES & VALVE SPRINGS

Application	Specification
Intake Valves	
Face Angle	44.5°
Minimum Margin	.020" (.50 mm)
Minimum Refinish Length	3.6594" (92.950 mm)
Stem Diameter	.2350-.2356" (5.970-5.985 mm)
Exhaust Valves	
Face Angle	44.5°
Minimum Margin	.020" (.50 mm)
Minimum Refinish Length	3.6768" (93.390 mm)
Stem Diameter	.2348-.2354" (5.965-5.980 mm)
Valve Springs	
Free Length	2.1094" (53.580 mm)
Out-Of-Square	.079" (2.00 mm)
Pressure Valve Closed	33-37 Lbs. @ 1.252 In. (15-17 kg @ 31.80 mm)

CYLINDER HEAD

CYLINDER HEAD

Application	Specification
Maximum Warpage	

Cylinder Block Surface	.002" (.05 mm)
Manifold Surface	.002" (.05 mm)
Valve Seats	
Intake Valve	
Seat Angle	45°
Seat Width	.039-.055" (1.00-1.40 mm)
Exhaust Valve	
Seat Angle	45°
Seat Width	.039-.055" (1.00-1.40 mm)
Valve Guides	
Intake Valve	
Valve Guide Cylinder Head Bore I.D.	
Standard Valve Guide	.4331-.4341" (11.000-11.027 mm)
Oversize Valve Guide	.4350-.4361" (11.050-11.077 mm)
Valve Guide I.D.	.2366-.2374" (6.010-6.030 mm)
Valve Guide Installed Height	.500-.516" (12.70-13.10 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0010-.0024" (.025-.060 mm)
Wear Limit	.0031" (.080 mm)
Exhaust Valve	
Valve Guide Cylinder Head Bore I.D.	
Standard Valve Guide	.4331-.4341" (11.000-11.027 mm)
Oversize Valve Guide	.4350-.4361" (11.050-11.077 mm)
Valve Guide I.D.	.2366-.2374" (6.010-6.030 mm)
Valve Guide Installed Height	.500-.516" (12.70-13.10 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0012-.0026" (.030-.065 mm)
Wear Limit	.0039" (.100 mm)

CAMSHAFT

CAMSHAFT

Application	**In. (mm)**
End Play	
Standard	.0018-.0039 (.045-.100)
Wear Limit	.0047 (.120)
Journal Diameter	
Exhaust Camshaft	

No. 1 Journal	.9822-.9829 (24.949-24.965)
All Others	.9035-.9041 (22.949-22.965)
Intake Camshaft	
All Journals	.9035-.9041 (22.949-22.965)
Journal Runout	.0016 (.040)
Lobe Height	
Intake	
Standard	1.6344-1.6383 (41.514-41.614)
Wear Limit	1.6279 (41.350)
Exhaust	
Standard	1.6146-1.6185 (41.011-41.111)
Wear Limit	1.6083 (40.850)
Oil Clearance	
Standard	.0014-.0028 (.035-.072)
Wear Limit	.0039 (.100)
Gear Backlash	
Standard	.0008-.0079 (.020-.200)
Wear Limit	.0118 (.300)

VALVE LIFTERS

VALVE LIFTERS

Application	In. (mm)
Bore Diameter	1.1024-1.1032 (28.000-28.021)
Lifter Diameter	1.1014-1.1018 (27.975-27.985)
Oil Clearance	
Standard	.0006-.0018 (.015-.046)
Wear Limit	.0039 (.100)

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Accessory Drive Belt Pulley Bolt	14 (19)
A/C Compressor Bolt	18 (24)
A/C Compressor Mounting Bracket Bolt	20 (27)
A/C Idler Pulley Bolt	
12-mm Bolt Head	20 (27)
14-mm Bolt Head	27 (37)
Axle Shaft Nut	159 (216)

Ball Joint-To-Lower Control Arm Bolt/Nut	59 (80)
Camshaft Sprocket Bolt	37 (51)
Connecting Rod Nut	29 (39)
Coolant Housing Bolt/Nut	13 (18)
Crankshaft Pulley Bolt	114 (155)
Cylinder Head Bolt (1)	
Step 1	33 (45)
Step 2	Additional 90 Degrees
Delivery Pipe-To-Cylinder Head Bolt	14 (19)
Exhaust Manifold Nut	35 (47)
Exhaust Manifold-To-Cylinder Block Support Brace Bolt/Nut	29 (39)
Exhaust Pipe-To-Exhaust Manifold Bolt	46 (62)
Exhaust Pipe-To-Tailpipe Clamp Bolt	14 (19)
Flywheel/Drive Plate Bolt	66 (90)
Fuel Line-To-Delivery Pipe Union Bolt	22 (30)
Fuel Line-To-Fuel Filter Union Bolt	22 (30)
Intake Manifold Bolt/Nut	14 (19)
Intake Manifold Brace Bolt/Nut	15 (20)
Knock Sensor	33 (45)
Left (Transaxle Side) Engine Mount Bracket-To-Insulator Bolt	35 (47)
Left (Transaxle Side) Engine Mount Bracket-To-Transaxle Bolt	47 (64)
Main Bearing Cap Bolt (2)	42 (57)
No. 1 Idler Pulley Bolt	13 (18)
No. 2 Idler Pulley Bolt	20 (27)
Oil Pan Drain Plug	18 (24)
Oil Pump Drive Sprocket Nut	27 (37)
Oxygen Sensor-To-Exhaust Pipe	33 (45)
Power Steering Pump Adjusting Bracket Bolt	15 (20)
Power Steering Pump Mounting Bracket-To-Cylinder Head Bolt	32 (43)
Pressure Regulator Valve	22 (30)
Rear (Firewall Side) Engine Mount Through-Bolt	47 (64)
Right (Timing Belt Side) Engine Mount Bracket-To-Cylinder Block Bolt/Nut	43 (58)
Right (Timing Belt Side) Engine Mount Through-Bolt	54 (73)
Right (Timing Belt Side) Engine Mount-To-Bracket On Cylinder Block Bolt/Nut	47 (64)
Spark Plug	13 (18)
Throttle Body Bolt/Nut	14 (19)
Tie Rod Nut	36 (49)
Torque Converter Bolt	20 (27)
Water Pump Bolt/Nut	13 (18)
Wheel Lug Nut	76 (103)

	INCH Lbs. (N.m)
ABS Speed Sensor Bolt	71 (8.0)
Camshaft Bearing Cap Bolt (3)	115 (13.0)
Camshaft Position Sensor Retaining Bolt	71 (8.0)
Clutch Release Cylinder Bolt	106 (12.0)
Coolant Inlet Pipe-To-Water Pump Bolt	66 (7.5)
Ignition Coil Bolt	75 (8.5)
Oil Pan Bolt	115 (13.0)
Oil Pump Bolt	66 (7.5)
Oil Pump Pick-Up Tube Bolt	89 (10.1)
Rear Oil Seal Retainer-To-Cylinder Block Bolt	66 (7.5)
Rear Plate-To-Cylinder Block Bolt	89 (10.1)
Valve Cover Nut	62 (7.0)

(1) Tighten bolts to specification in sequence. See **Fig. 10** .

(2) Tighten bolts to specification in sequence. See **Fig. 32** .

(3) Tighten bolts to specification in sequence. See **Fig. 21** .

