ENGINE OVERHAUL

1995-96 ENGINES Mazda - 2.5L V6

ENGINE IDENTIFICATION

Engine code identifies basic engine type. Engine is also identified by engine number. Engine code and number are stamped on front of cylinder block. See **Fig. 1**. The 2.5L V6 engine is identified as code KL.

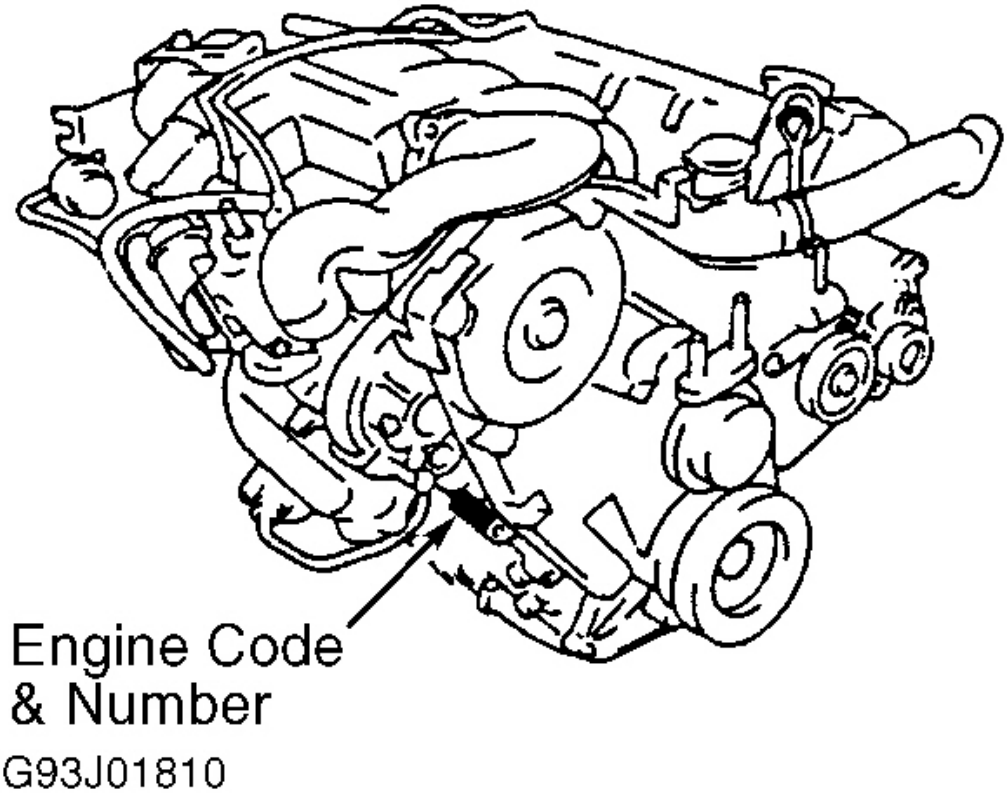


Fig. 1: Locating Engine Code & Number
Courtesy of MAZDA MOTORS CORP.

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

NOTE: Valve clearance is not adjustable. Some Hydraulic Lash Adjuster (HLA) noise

may occur during engine start-up. Noise should disappear after engine reaches normal operating temperature. If noise persists, run engine at 2000-3000 RPM and noise should stop within 20 minutes. If noise persists, change engine oil. If oil change does not reduce noise, replace HLA. Replace HLA, if HLA to camshaft clearance exceeds .006" (.15 mm).

NOTE: Before installing valve cover, apply sealant to cylinder head at designated areas. See Fig. 9. Tighten valve cover bolts to specification in sequence. See Fig. 10.

REMOVAL & INSTALLATION

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

1. Start engine. Remove fuel pump relay from fuse block on left side of engine compartment, in front of strut tower. Allow engine to idle until it stalls. Turn ignition off. Install fuel pump relay.
2. Before disconnecting any fuel line connections, cover connection with shop towel to absorb any residual gasoline that may remain in fuel line. Carefully loosen fuel line connection, allowing residual gasoline to be released.

COOLING SYSTEM BLEEDING

1. Fill radiator and coolant reservoir. Start engine and allow to idle until engine is at normal operating temperature. Accelerate engine to 2200-2800 RPM for 5 minutes. Shut engine off and allow engine to cool.
2. Repeat step 1). Remove filler cap. Verify coolant level is near filler neck. If coolant level is not near filler neck, repeat steps 1) and 2). Fill coolant reservoir to the FULL level.

ENGINE

NOTE: Remove engine and transaxle as an assembly.

Removal

1. Release fuel pressure. See **FUEL PRESSURE RELEASE** under REMOVAL & INSTALLATION. Disconnect negative battery cable. Drain cooling system, engine oil and transaxle fluid. Reference mark hood hinges and remove hood. Raise and support vehicle. Remove front wheels.
2. Remove lower engine covers. Remove MAF sensor connector and IAT sensor connector. Remove air intake duct and air cleaner assembly. Remove battery and battery tray. Disconnect necessary control cables, electrical connections, coolant hoses, vacuum hoses, fuel lines and filter. Remove upper radiator hose transaxle cooler lines, if equipped. Disconnect electrical connector from electric cooling fan.

Remove radiator with electric cooling fan.

CAUTION: To disconnect heater hoses, press tabs inward on retainer on end of heater hose, then separate heater hoses at heater hose joint. DO NOT lose "O" rings and spacers located on heater hose joint.

3. Remove A/C compressor and power steering pump with hoses attached, and secure components aside. See **Fig. 2**. Disconnect A/C harness connector. Disconnect heater hoses at bulkhead connectors.
4. On M/T, remove clutch release cylinder with hose attached, and secure cylinder aside. Disconnect shift control rod and extension bar at transaxle. On A/T, disconnect shift control cable at transaxle.
5. On all models, disconnect electrical connections at transaxle. Remove transverse crossmember. Remove No. 5 engine mount rubber and No. 2 engine mount nuts. See **Fig. 3**. Support engine with hoist. Remove engine mount crossmember. Remove exhaust pipe. Remove stabilizer bar links.

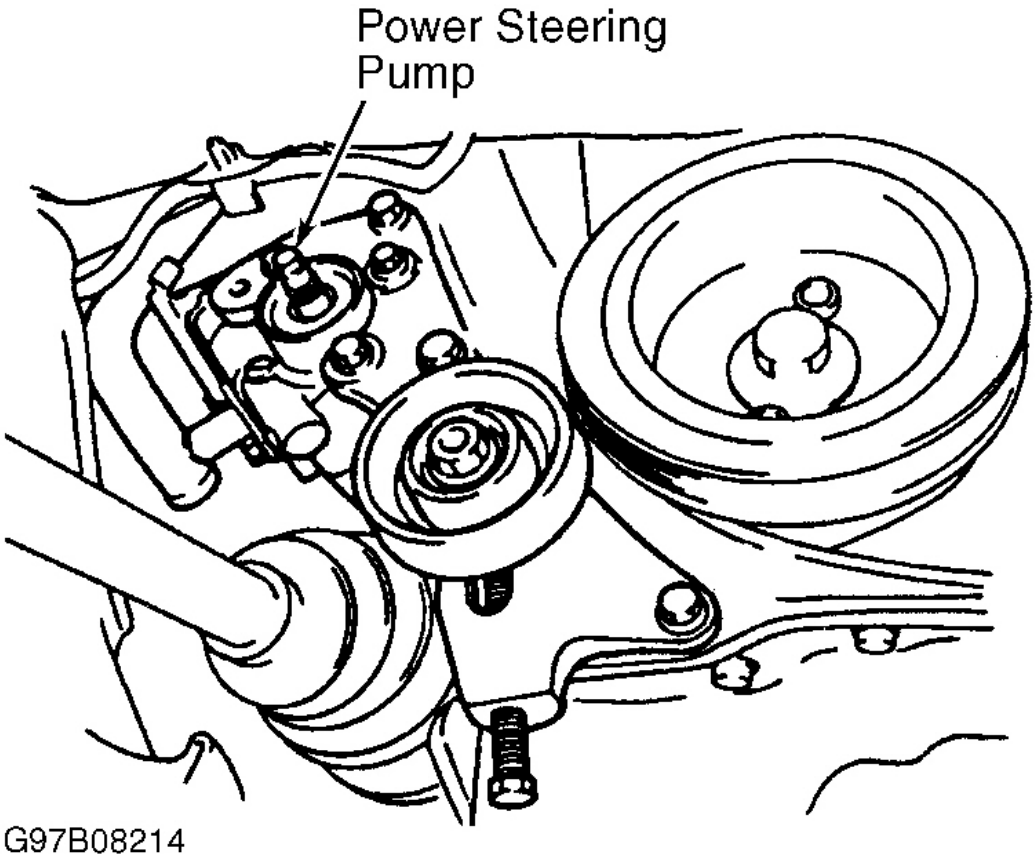


Fig. 2: Removing Power Steering Pump
Courtesy of MAZDA MOTORS CORP.

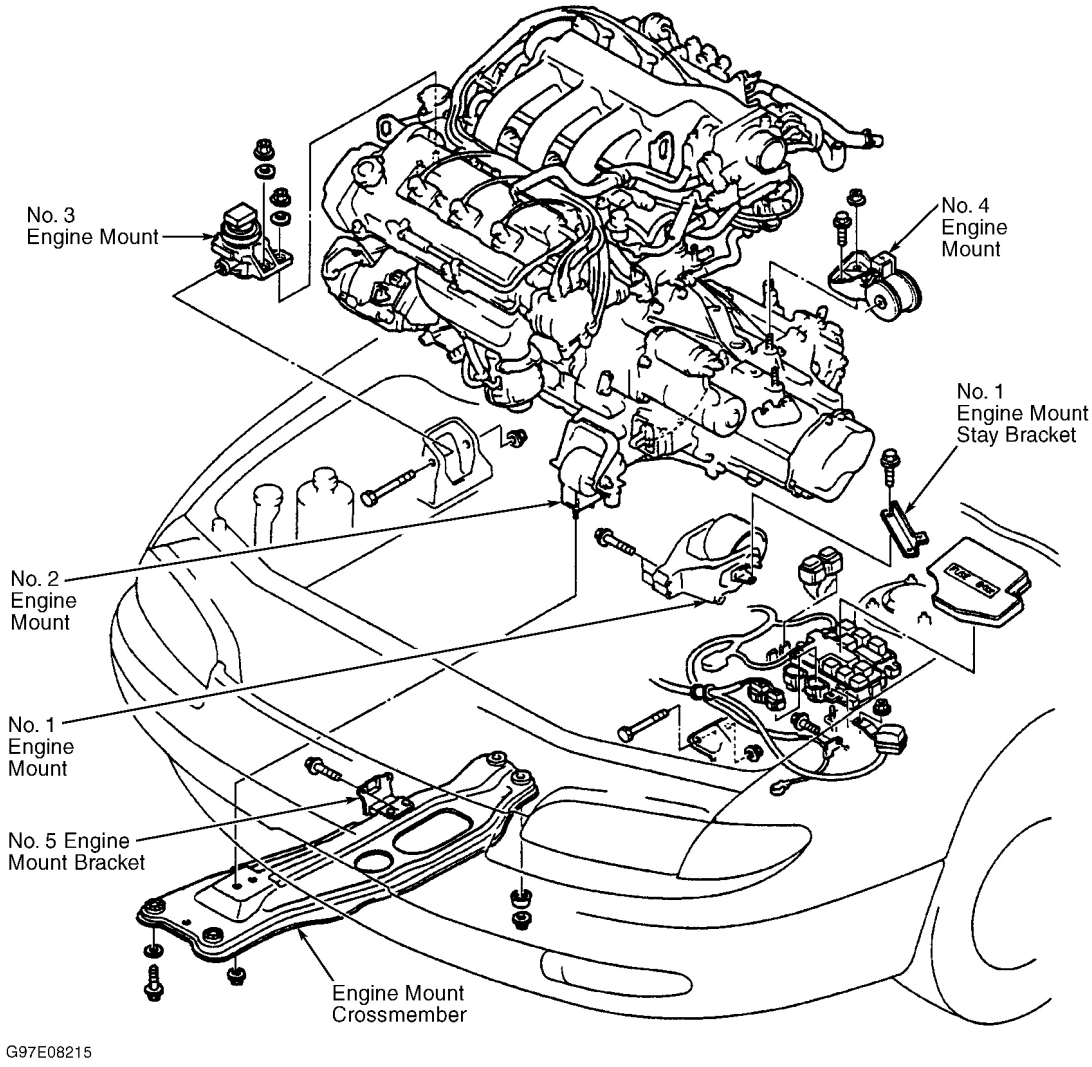


Fig. 3: Identifying Engine Mounts
Courtesy of MAZDA MOTORS CORP.

6. Separate tie rod ends from steering knuckles. Remove ball joint pinch bolts. Remove axle shaft support bearing bracket-to-cylinder block retaining bolts. Pry lower control arm downward and separate ball joint from steering knuckle.
7. Using bar inserted between axle shaft and transaxle, pry axle shafts from transaxle. DO NOT damage oil seal when removing axle shaft. Remove intermediate (joint) shaft.
8. Remove No. 1 engine mount bracket. See **Fig. 3**. Remove No. 3 engine mount rubber. On A/T models, remove No. 1 engine mount bolts. On M/T models, remove No. 1 engine mount. On all models, remove No. 4 engine mount rubber and bracket. Lift engine and transaxle from vehicle.

Installation

1. Ensure No. 2 engine mount and bracket are installed on transaxle hand tight. Install engine mount

crossmember. Tighten retaining nuts and bolts to specification. See **TORQUE SPECIFICATIONS**. Install engine and transaxle.

2. Install engine mount-to-engine mount crossmember retaining nut, and tighten to specification. Install No. 1 engine mount mounting bolts. Install No. 3 engine mount rubber. See **Fig. 3**. Install No. 4 engine mount bracket and rubber. Tighten bolts and retaining nuts to specification. See **TORQUE SPECIFICATIONS**.
3. Remove chain hoist from engine. Tighten No. 2 engine mount bolt. Tighten bracket retaining bolts and nuts to specification. Install No. 5 engine mount rubber and tighten to specification. See **Fig. 3**. Install No. 1 engine mount stay bracket. Install NEW retaining ring on end of axle shaft. Coat axle shaft splines and sliding surfaces with grease. Install axle shafts in transaxle with opening of retaining ring facing upward.
4. Pull outward on axle shafts to ensure retaining ring is seated in transaxle. Install and tighten axle support bearing bracket evenly to specification.
5. To install remaining components, reverse removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS**. Fill engine with oil. Fill automatic transaxle with Dexron II ATF or manual transaxle with SAE 75W-90 gear oil with API rating of GL-4 or GL-5.
6. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** under REMOVAL & INSTALLATION. Ensure accelerator cable has .06-.16" (1.5-4.0 mm) deflection at throttle body when installed. If deflection is not as specified, rotate nut on end of cable at throttle body until specified deflection is obtained.

INTAKE MANIFOLD

Removal

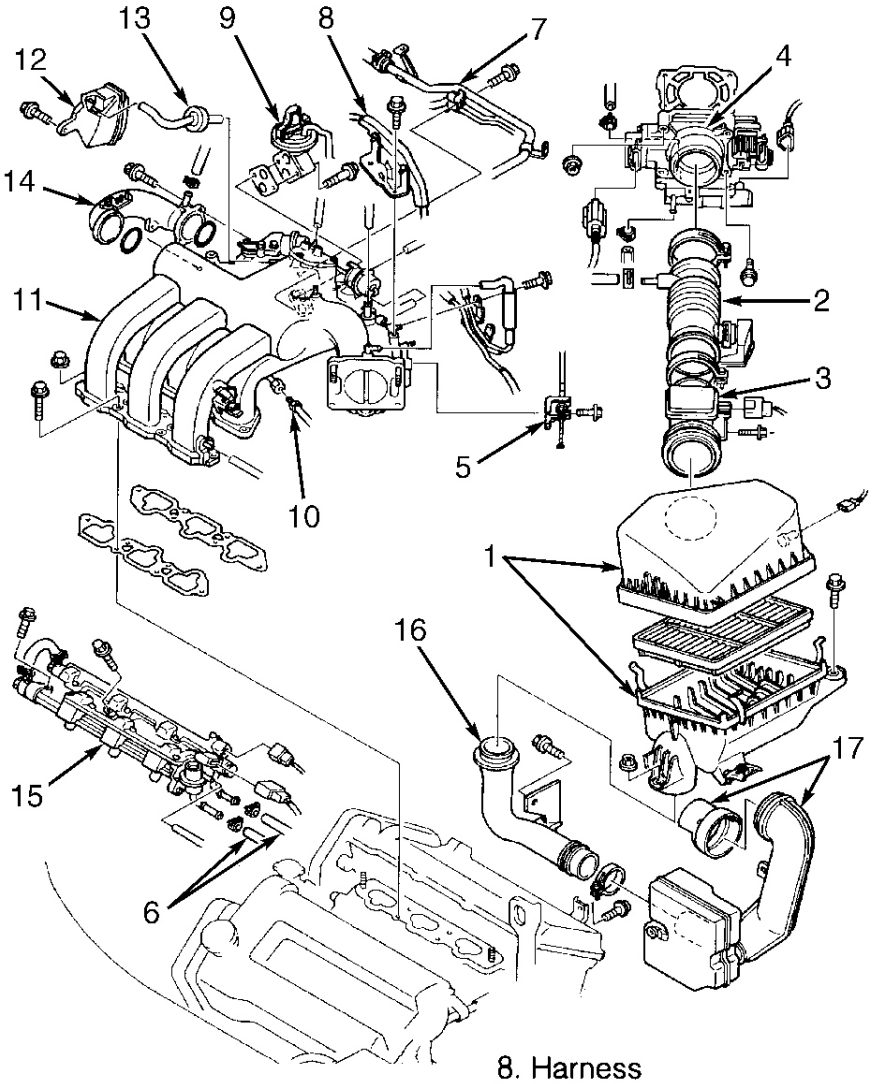
1. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Drain cooling system. Disconnect negative battery cable. Remove air intake duct, airflow sensor and air cleaner assembly. Disconnect necessary control cables, electrical connections, coolant hoses, vacuum hoses and fuel lines.
2. Loosen intake manifold retaining bolts and nuts evenly using several steps. Remove intake manifold assembly and gaskets. See **Fig. 4**.
3. If removing fuel injectors, retaining bolts, fuel injector retainer, insulators, fuel injectors, fuel rail and pressure regulator, and fuel rail insulators (if necessary). See **Fig. 4**. Fuel rail insulators are located between fuel rail and intake manifold.

CAUTION: Ensure notch on side of fuel injector engages with notch in fuel rail.

Installation

1. To install fuel injectors, install NEW "O" rings on fuel injector. Coat "O" rings with engine oil. Using twisting motion, install fuel injector in fuel rail so notch on side of fuel injector engages notch in fuel rail.
2. Install NEW insulators and "O" rings on fuel rail. Install and tighten retaining bolts to specification. See **TORQUE SPECIFICATIONS**. To install remaining components, reverse removal procedure. Install all intake manifold retaining bolts and nuts before tightening to specification. Tighten all fasteners evenly to specification.

3. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** under REMOVAL & INSTALLATION. Ensure accelerator cable has .06-.16" (1.5-4.0 mm) deflection at throttle body when installed. If deflection is not as specified, rotate nut on end of cable at throttle body until specified deflection is obtained.



1. Air Cleaner Assembly
2. Air Intake Hose
3. MAF Sensor
4. Throttle Body Assembly
5. Throttle Cable
6. Fuel Hoses
7. Water Pipes
8. Harness
9. EGR Valve
10. EGR Pipe
11. Intake Manifold
12. Vacuum Chamber
13. Check Valve
14. Air Intake Pipe
15. Fuel Distributor Assembly
16. Air Duct
17. Fresh Air Duct

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Fig. 4: Exploded View Of Intake Manifold & Related Components (Typical)
Courtesy of MAZDA MOTORS CORP.

EXHAUST MANIFOLD

Removal & Installation

1. Disconnect exhaust pipe from exhaust manifold. Remove exhaust manifold heat insulator. Remove retaining bolts, nuts, exhaust manifold and gasket.
2. To install, reverse removal procedure using NEW exhaust manifold gasket. Tighten bolts and nuts to specification. See **TORQUE SPECIFICATIONS**.

CYLINDER HEAD

Removal

1. Release fuel pressure. See **FUEL PRESSURE RELEASE**. Drain cooling system. Disconnect negative battery cable. Remove spark plug wires. Remove timing belt. See **TIMING BELT**. Remove retaining bolt and distributor (if necessary). Remove intake manifold. See **INTAKE MANIFOLD**.
2. Remove upper radiator hose and water outlet. Install engine support. Remove through bolt from No. 3 engine mount and remove bracket from front of engine. See **Fig. 5**. Remove retaining bolts and seal plate from front of cylinder head. Remove front exhaust pipe.
3. Remove generator bracket. Remove retaining bolts, valve cover and gasket. Remove camshaft pulleys while holding camshafts with wrench on cast hexagonal area of camshaft. Remove camshafts. See **CAMSHAFT**.

CAUTION: Cylinder head bolts must be loosened in proper sequence to prevent cylinder head warpage. See Fig. 6.

4. Temporarily install No. 3 engine mount to support engine. Remove engine support. Loosen cylinder head bolts in sequence using several steps. See **Fig. 6**. Remove cylinder head bolts and washers, cylinder head and gasket.

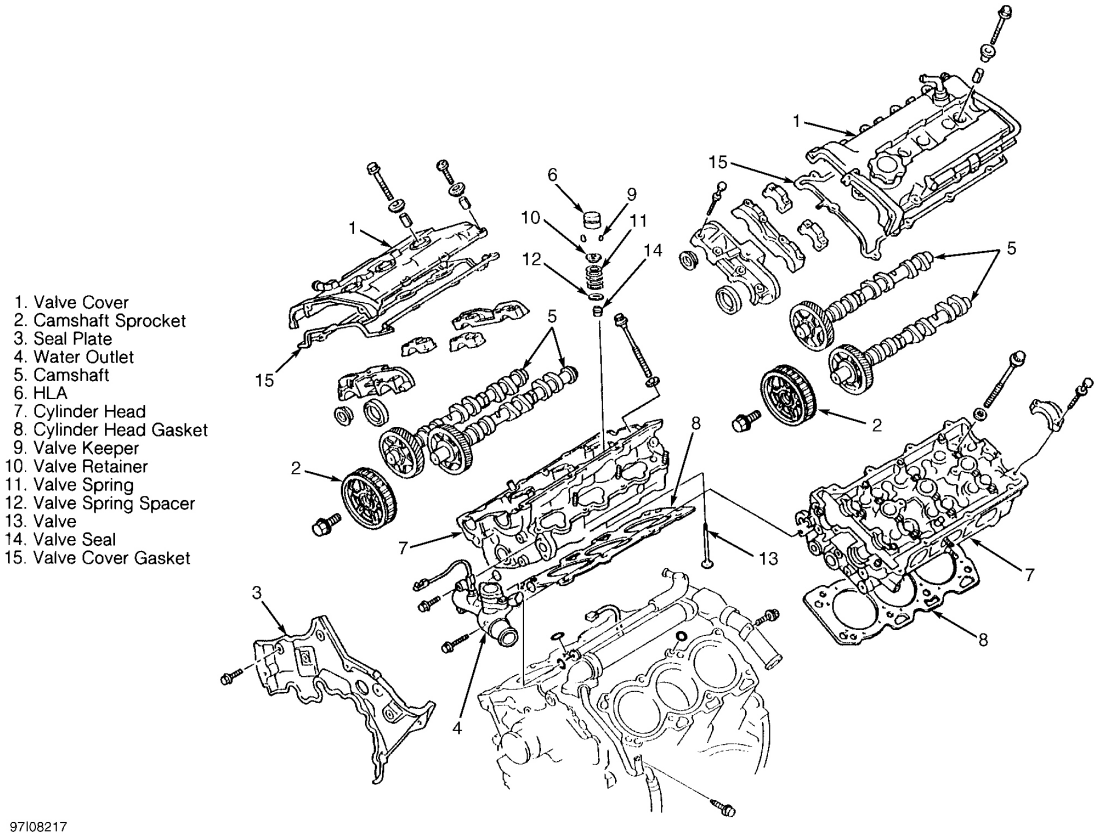


Fig. 5: Exploded View Of Cylinder Head & Components
Courtesy of MAZDA MOTORS CORP.

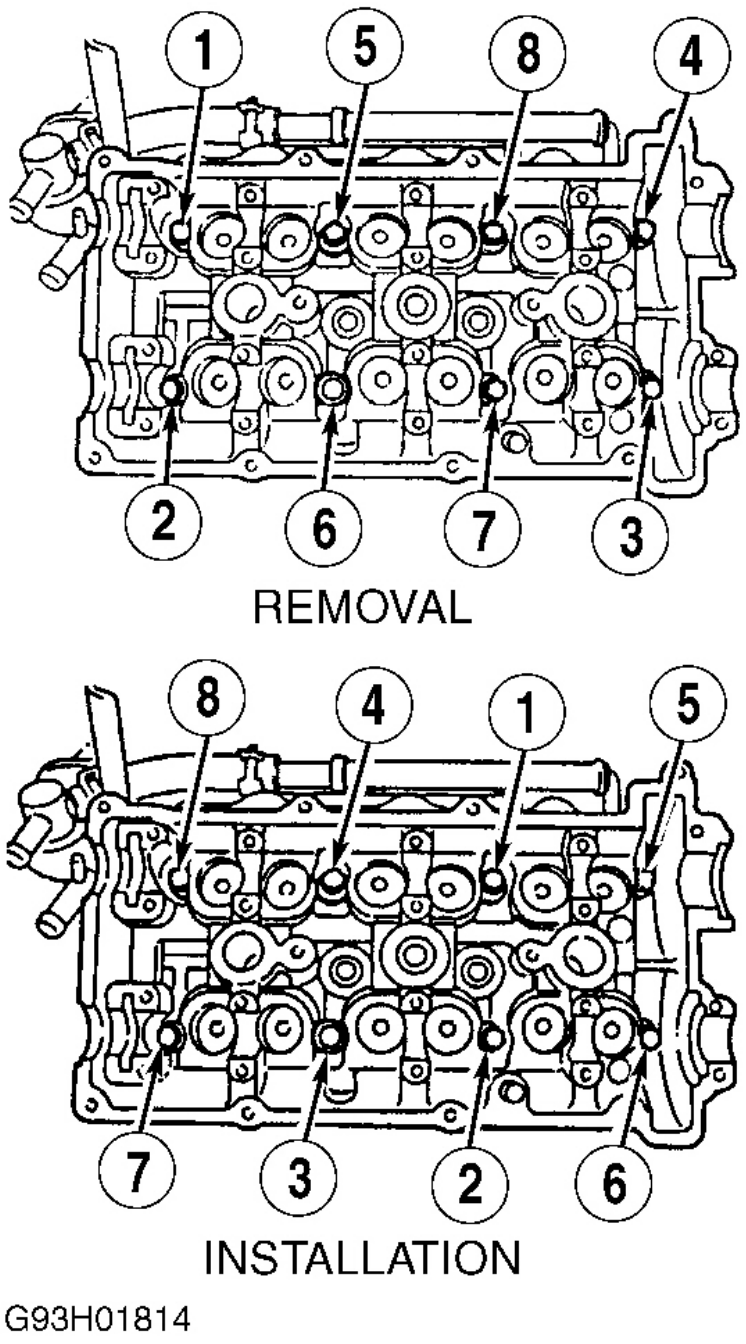


Fig. 6: Cylinder Head Bolt Removal & Installation Sequence
Courtesy of MAZDA MOTORS CORP.

Inspection

1. Inspect cylinder head for cracks or warpage at cylinder block and manifold areas. Resurface or replace cylinder head if warpage exceeds specification. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS. Measure cylinder head bolt length. See **Fig. 7**. Replace cylinder head bolts if length is not 5.17-5.19" (131.2-131.8 mm).
2. Ensure cylinder head bolt holes are completely clean. Inspect cylinder block deck surface for warpage. Replace cylinder block if warpage exceeds specification. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS. Inspect camshaft and components. See **CAMSHAFT**.

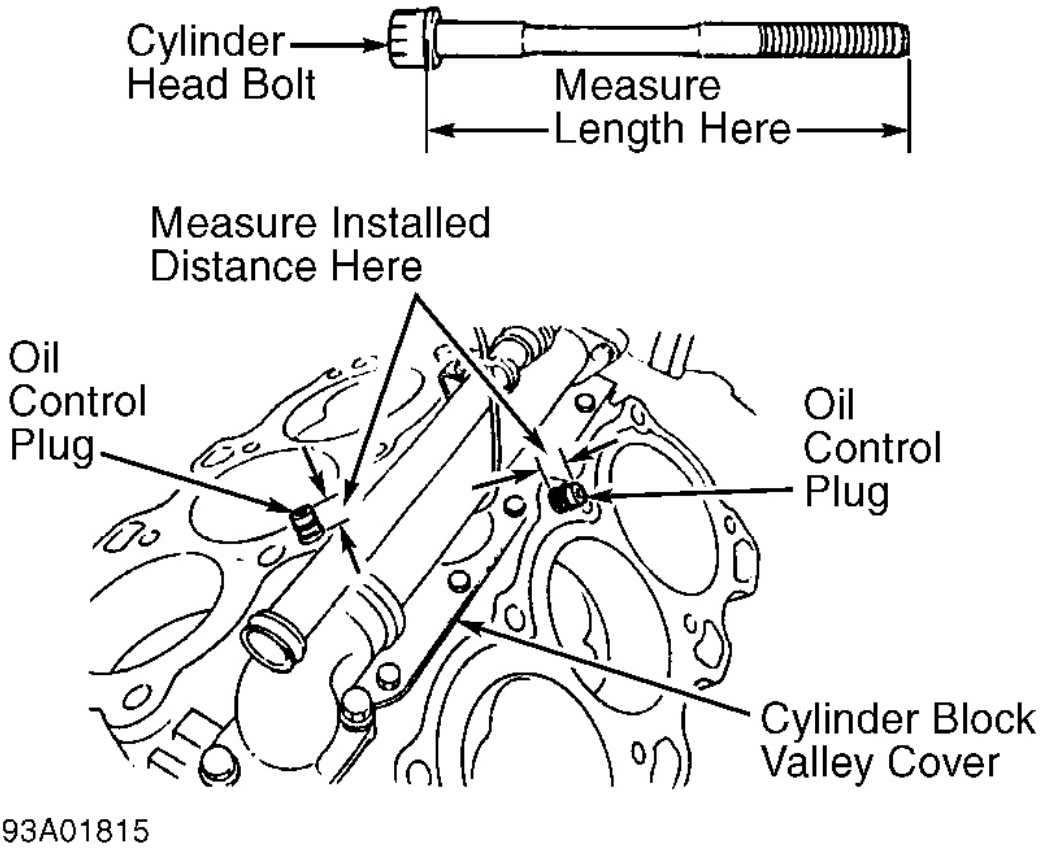


Fig. 7: Measuring Cylinder Head Bolt Length & Identifying Oil Control Plug
Courtesy of MAZDA MOTORS CORP.

Installation

1. Install NEW "O" ring on oil control plugs. Coat "O" rings with engine oil. Install cylinder head gasket on cylinder block, paying attention to identification marks on head gaskets. See **Fig. 8**.
2. Install cylinder head. Apply engine oil on cylinder head bolt threads and cylinder head bolt-to-cylinder head contact surfaces. Install cylinder head bolts and tighten to specification in sequence. See **Fig. 6**. See **TORQUE SPECIFICATIONS**.

3. After tightening head bolts to torque specification, put a paint mark on each head bolt. Using paint mark as a reference, further tighten head bolts 85-95 degrees in sequence, then tighten an additional 85-95 degrees. See Fig. 6.
4. Install engine support. Remove No. 3 engine mount bracket. Install camshafts using proper installation procedure. See **CAMSHAFT**. To install remaining components, reverse removal procedure.

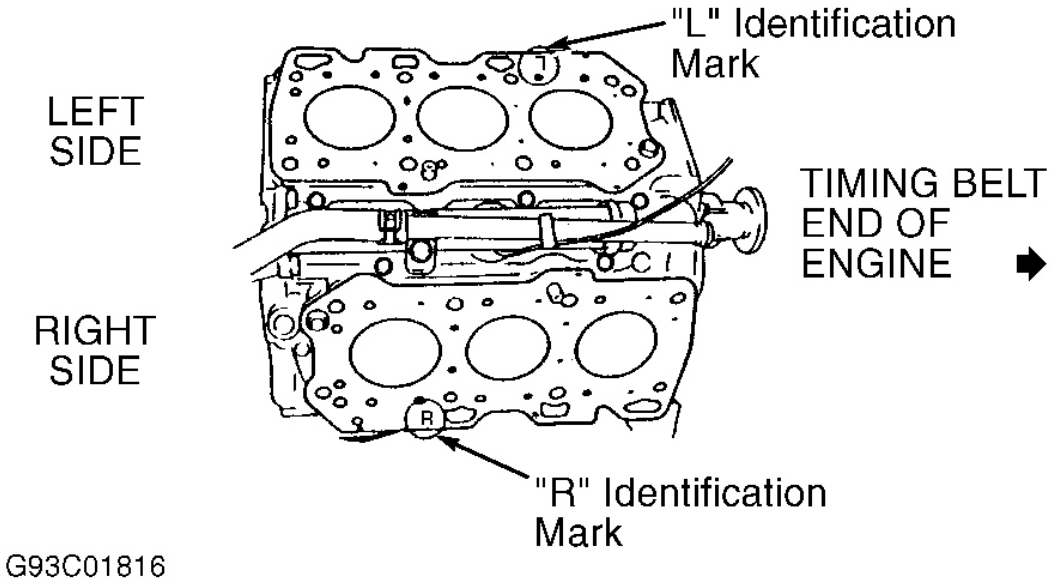


Fig. 8: Installing Cylinder Head Gaskets
Courtesy of MAZDA MOTORS CORP.

5. Before installing valve cover and gasket, apply sealant at specified areas on cylinder head. See **Fig. 9**. Apply sealant to valve cover, and install NEW gasket into valve cover. Install valve cover and gasket.
6. Install and tighten valve cover bolts to specification in sequence using several steps. See **Fig. 10**. See **TORQUE SPECIFICATIONS**. Coat distributor "O" ring and drive blade on distributor with engine oil. When installing distributor, rotate crankshaft so No. 1 cylinder is at TDC of compression stroke.
7. Ensure timing mark on crankshaft pulley aligns with TDC mark on timing belt cover. Align distributor drive blade with groove on distributor body.
8. Install distributor and hold-down bolt. Install remaining components. Tighten all fasteners to specification. See **TORQUE SPECIFICATIONS**. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** under REMOVAL & INSTALLATION. Adjust ignition timing.

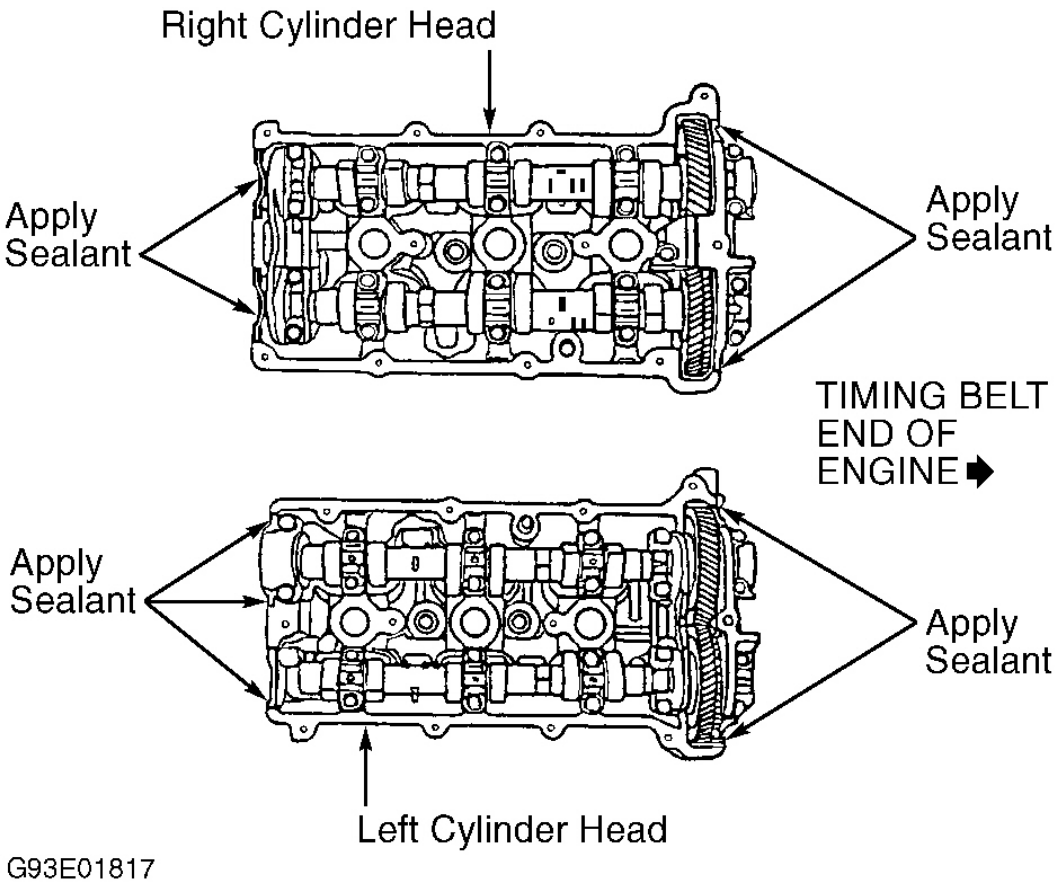


Fig. 9: Applying Sealant To Cylinder Head Valve Cover
Courtesy of MAZDA MOTORS CORP.

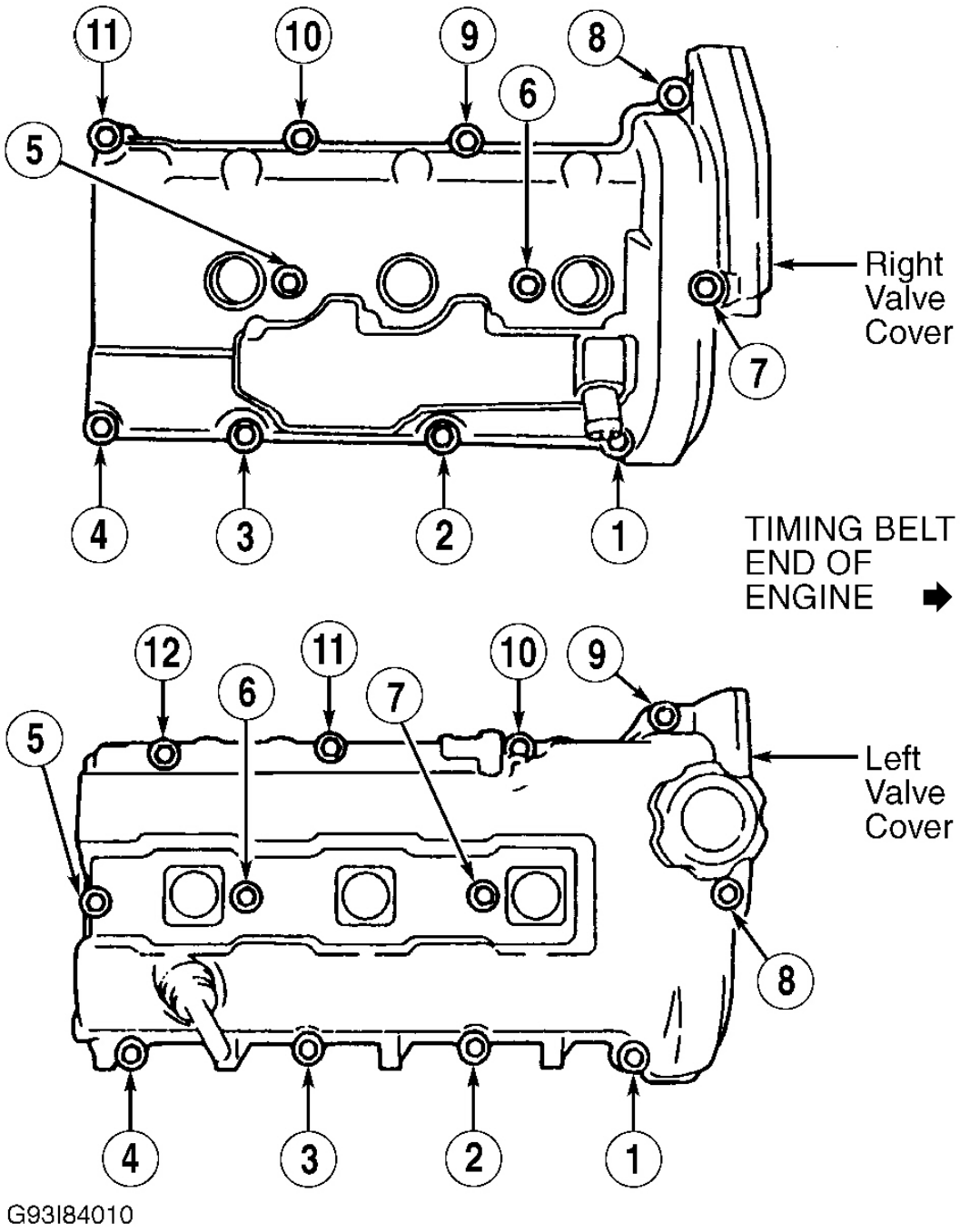


Fig. 10: Valve Cover Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT FRONT OIL SEAL

Removal & Installation

1. Disconnect negative battery cable. Remove timing belt and crankshaft sprocket. See **TIMING BELT** under REMOVAL & INSTALLATION. Using a knife, cut seal lip from the seal. Pry seal from oil pump body. DO NOT damage sealing surfaces.
2. To install, apply engine oil to lip of seal. Install seal on crankshaft. Using hammer and pipe of suitable diameter, tap seal into oil pump body until seal surface is even with oil pump body. To install remaining components, reverse removal procedure.

TIMING BELT

Removal

1. Disconnect negative battery cable. Remove lower engine covers. Remove accessory drive belts. Remove water pump pulley. Remove idler pulley bracket. See **Fig. 11**.
2. Remove retaining bolts and power steering reservoir with hoses attached, and secure aside. Remove retaining nut and power steering pump pulley. Remove retaining bolts and power steering pump with hoses attached, and secure aside. Remove crankshaft pulley retaining bolt. Using puller, remove crankshaft pulley.

CAUTION: DO NOT damage crankshaft position sensor rotor on rear of crankshaft pulley during crankshaft pulley removal.

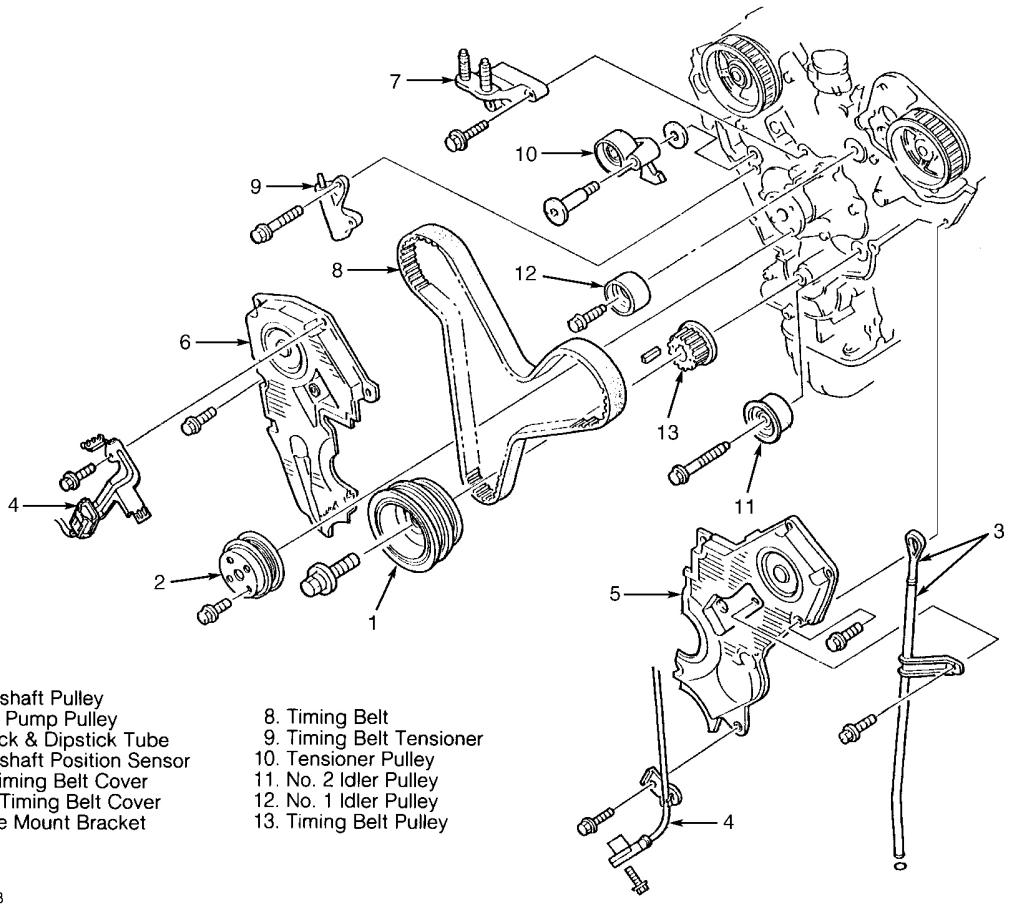


Fig. 11: Exploded View Of Timing Belt & Components
Courtesy of MAZDA MOTORS CORP.

3. Unplug crankshaft position sensor and unclip wires from oil dipstick tube. Remove oil dipstick and oil dipstick tube. Remove crankshaft position sensor and harness bracket. Remove engine wiring harness, located along top of timing belt cover.
4. Support engine using hoist. Remove through-bolt, retaining nuts and No. 3 engine mount sub-bracket. See **Fig. 11**. Remove retaining bolts and timing belt covers.
5. Install crankshaft pulley retaining bolt in crankshaft. Rotate crankshaft so No. 1 cylinder is at TDC on compression stroke. Ensure groove on crankshaft sprocket aligns with indicator on oil pump body. See **Fig. 12**.
6. If reusing timing belt, place reference mark on timing belt to indicate direction of rotation. Hold timing belt tensioner and remove lower retaining bolt first, then remove upper bolt. Remove timing belt tensioner.
7. Remove No. 2 timing belt pulley and timing belt. Remove No. 1 idler pulley and tensioner pulley (if necessary). If removing camshaft sprocket, hold camshaft with wrench on hexagonal area at center of camshaft. Remove retaining bolt and camshaft sprocket.
8. If removing crankshaft sprocket, use puller to remove crankshaft sprocket from crankshaft. Remove key from crankshaft (if necessary).

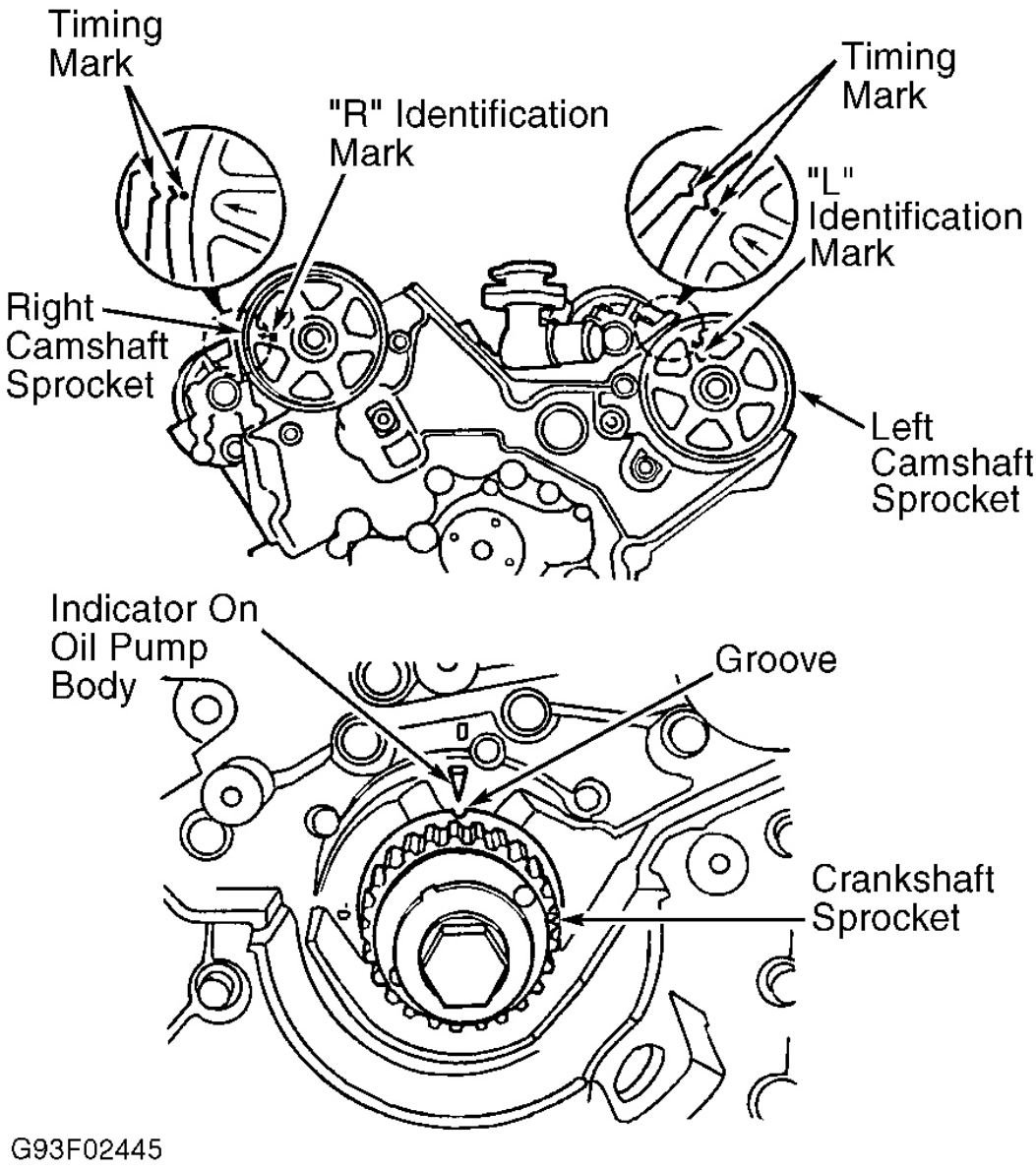


Fig. 12: Aligning Timing Marks & Identifying Camshaft Sprocket Identification Marks
Courtesy of MAZDA MOTORS CORP.

Inspection

1. Inspect timing belt for damaged teeth, cracking and oil contamination. Ensure idler pulleys No. 1 and 2 and tensioner pulley rotate freely. Replace damaged components.
2. Inspect timing belt tensioner for signs of oil leakage. Replace timing belt tensioner if oil leakage exists. Measure timing belt tensioner rod protrusion from end of rod to edge of the housing. See **Fig. 13**. Replace timing belt tensioner if distance is not within specification. See **TENSIONER SPECIFICATION**.

TENSIONER SPECIFICATION

Application	Free Length
626	.551-.630" (14.00-16.00 mm)

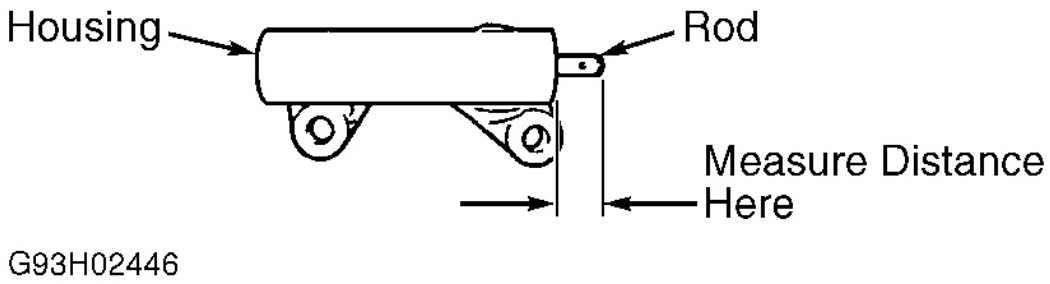


Fig. 13: Measuring Timing Belt Tensioner Rod Protrusion
Courtesy of MAZDA MOTORS CORP.

Installation

1. If crankshaft sprocket was removed, align crankshaft sprocket with key in crankshaft. Install crankshaft sprocket on crankshaft with flange toward cylinder block. See **Fig. 12**.
2. If camshaft sprocket was removed, align dowel pin in camshaft with hole in camshaft sprocket. Install camshaft sprocket. Coat retaining bolt threads with oil. Install bolt and tighten to specification. See **TORQUE SPECIFICATIONS**.

CAUTION: Ensure camshaft sprocket is installed with identification mark facing outward. Right camshaft sprocket has an "R" identification mark and left camshaft sprocket has an "L" identification mark. See Fig. 12.

3. Place timing belt tensioner in a press, using a flat washer to prevent damage to timing belt tensioner. See **Fig. 14**. Compress tensioner rod until holes in rod and housing are aligned and install .063" (1.60 mm) diameter pin through holes in housing and rod to hold rod in retracted position. See **Fig. 14**.

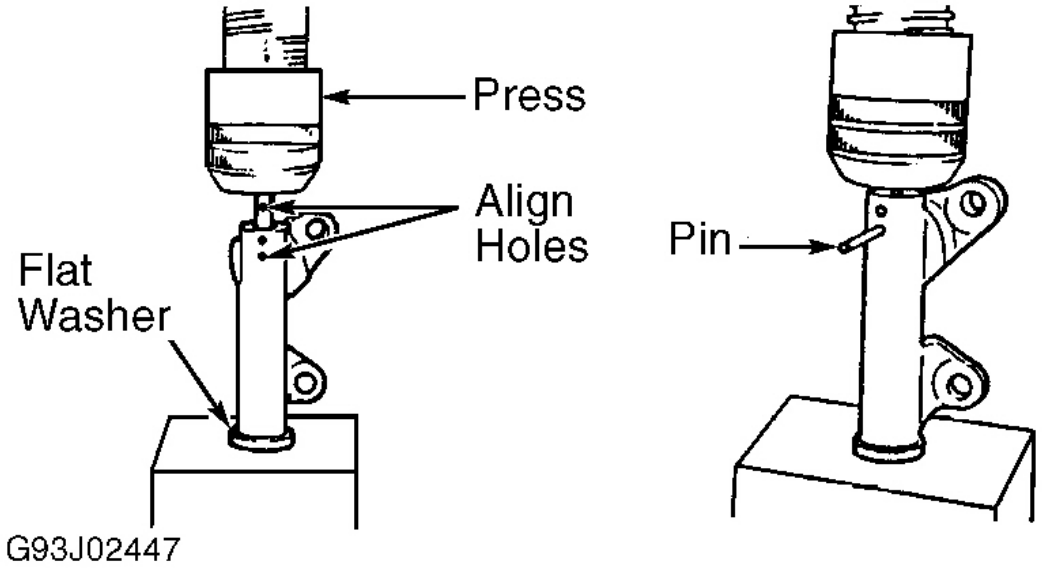


Fig. 14: Retracting Timing Belt Tensioner Rod
Courtesy of MAZDA MOTORS CORP.

4. Install timing belt tensioner on cylinder block with upper retaining bolt only. DO NOT fully tighten upper bolt. Install No. 2 idler pulley and tighten to specification. See **TORQUE SPECIFICATIONS**.

CAUTION: If reusing timing belt, ensure timing belt is installed in original direction of rotation.

5. Ensure all timing marks align. See **Fig. 12**. Install timing belt on sprockets and ensure all slack is on tensioner side. Install in sequence. See **Fig. 15**. Ensure timing belt fully engages all sprockets.
6. Ensure tension exists between crankshaft pulley and each camshaft pulley. All timing belt slack should be between camshaft pulleys. Install No. 1 idler pulley and tighten bolts to specification.
7. Push outward at bottom of timing belt tensioner and install lower retaining bolt in timing belt tensioner. Tighten both timing belt tensioner retaining bolts to specification. See **TORQUE SPECIFICATIONS**.
8. Remove pin from timing belt tensioner, allowing tension to be applied on timing belt. Rotate crankshaft 2 full revolutions clockwise from TDC to TDC. Ensure timing marks on camshaft sprockets and crankshaft sprocket are properly aligned. See **Fig. 12**. If timing marks are not aligned, remove and repeat entire timing belt installation procedure.
9. Timing belt deflection must be checked. Apply 22 lbs. (10 kg) of force at designated area on timing belt and check timing belt deflection. See **Fig. 16**. Timing belt deflection should be .24-.31" (6.0-8.0 mm). If timing belt deflection is not within specification, replace timing belt tensioner.
10. Install timing belt covers using NEW gaskets. Tighten retaining bolts to specification. See **TORQUE SPECIFICATIONS**. Install dipstick tube with NEW "O" ring. To install remaining components, reverse

removal procedure. Tighten fasteners to specification. See **TORQUE SPECIFICATIONS**.

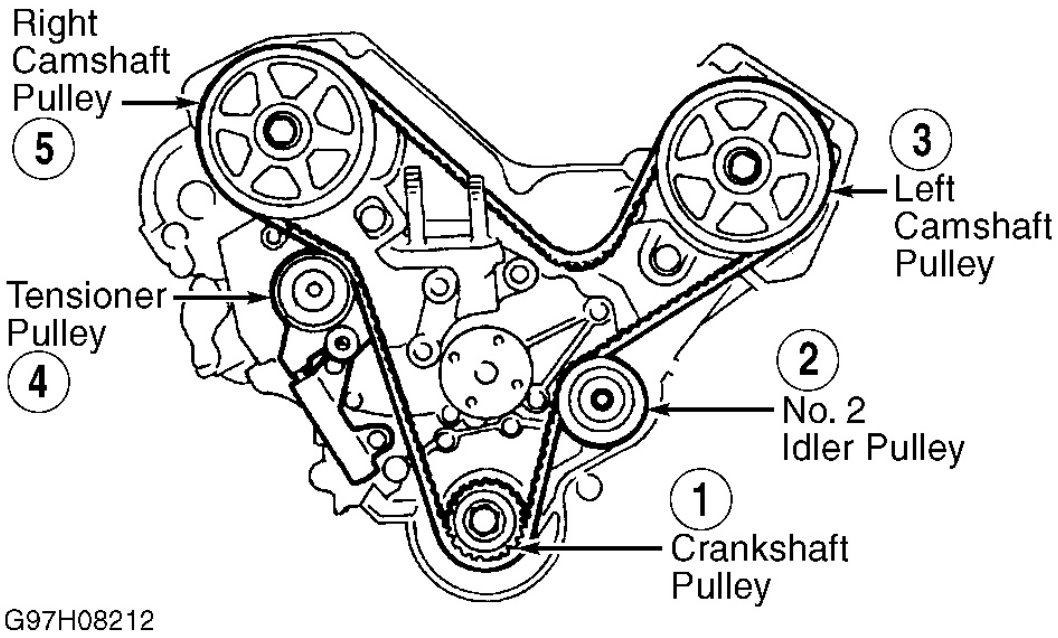


Fig. 15: Installing Timing Belt
Courtesy of MAZDA MOTORS CORP.

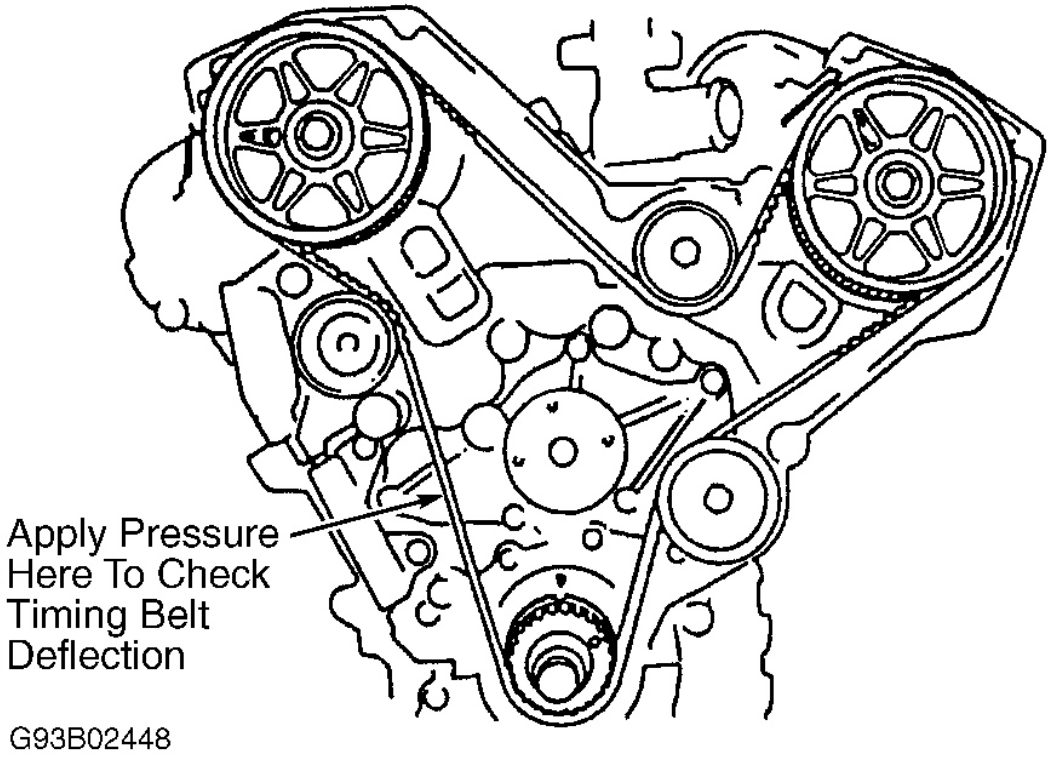


Fig. 16: Measuring Timing Belt Deflection
Courtesy of MAZDA MOTORS CORP.

HYDRAULIC LASH ADJUSTER

Removal

1. Remove intake manifold. See **INTAKE MANIFOLD** under REMOVAL & INSTALLATION. Remove retaining bolts, valve cover and gasket. Remove camshafts. See **CAMSHAFT** under REMOVAL & INSTALLATION.
2. Note location of Hydraulic Lash Adjusters (HLA) for reassembly reference. Remove hydraulic lash adjusters from cylinder head.

NOTE: Store hydraulic lash adjusters in upright position submerged in clean engine oil.

Inspection

1. Inspect components for damage. Measure HLA diameter and bore diameter, and determine oil clearance. Ensure oil clearance is within specification. Replace components if oil clearance is not within specification. See **HYDRAULIC LASH ADJUSTERS** under ENGINE SPECIFICATIONS.

2. Hold HLA upright and attempt to compress adjuster using hand pressure only. If plunger moves, replace HLA.

CAUTION: HLAs must be installed in original position or rapid camshaft wear will occur. Install NEW HLA if original position cannot be identified.

Installation

Coat HLA and cylinder head surface with engine oil. Install HLA in original location. To install remaining components, reverse removal procedure.

CAMSHAFT

Removal

1. Remove intake manifold. See **INTAKE MANIFOLD**. Remove spark plug wires and distributor assembly. Remove seal plate. See **Fig. 5**. Remove front exhaust pipe. Remove generator bracket. Remove retaining bolts, valve cover and gasket. Remove timing belt and camshaft sprocket. See **TIMING BELT**.
2. Note location of camshaft bearing caps for reassembly reference. Camshaft bearing caps on right cylinder head are numbered for location with No. 1 at timing belt end of engine. Camshaft bearing caps on left cylinder head contain letters for location with "A" at timing belt end of engine. See **Fig. 17**.
3. Loosen front camshaft bearing cap bolts in sequence using several steps. See **Fig. 17**. Remove front camshaft bearing caps. Loosen remaining camshaft bearing cap bolts in sequence using several steps. Remove all camshaft bearing caps except thrust bearing cap. Thrust bearing cap is removed last.

CAUTION: Remove thrust bearing cap last to prevent damage to thrust caps. See Fig. 17.

4. Remove camshaft, oil seal and blind cap. See **Fig. 5**. Note location of hydraulic lash adjuster for reassembly reference. Remove hydraulic lash adjuster (if necessary).

NOTE: Store hydraulic lash adjusters in upright position submerged in clean engine oil.

5. Inspect friction gear on front of camshaft for damage (if equipped). If removing friction gear, install camshaft in soft-faced vise on hexagonal area of camshaft. Remove nut and friction gear.

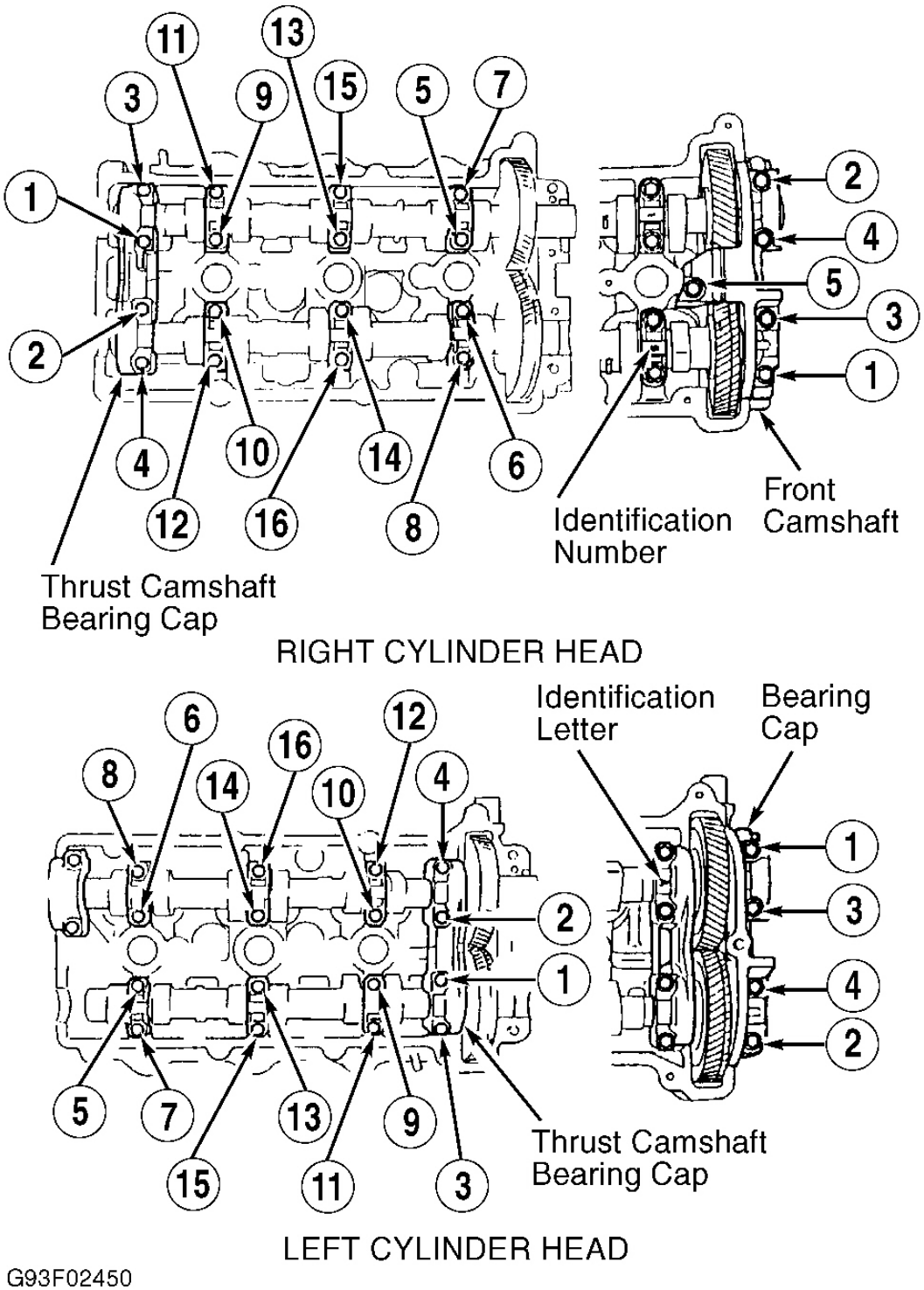


Fig. 17: Identifying Thrust Caps & Camshaft Bearing Cap Bolt Removal Sequence
Courtesy of MAZDA MOTORS CORP.

Inspection

Inspect components for damage. Check camshaft journal diameter, lobe height and runout. Replace camshaft if any measurement is not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.

Installation

1. Apply oil to camshaft journals. When installing friction gear on camshaft, ensure reference mark on friction gear is aligned with reference mark on camshaft gear. Install retaining nut, and tighten to specification. See **TORQUE SPECIFICATIONS**.
2. Coat hydraulic lash adjuster, camshaft journals and camshaft journals cylinder head surfaces with engine oil. Install HLAs in original location (if removed). Install camshafts in cylinder head with timing marks aligned. See **Fig. 18**. Ensure camshaft bearing cap surfaces are clean on cylinder head. Install thrust bearing caps (with bolts) by hand, gradually in several steps. Apply sealant at designated areas on cylinder head. See **Fig. 19**.

CAUTION: DO NOT allow sealant to contact camshaft.

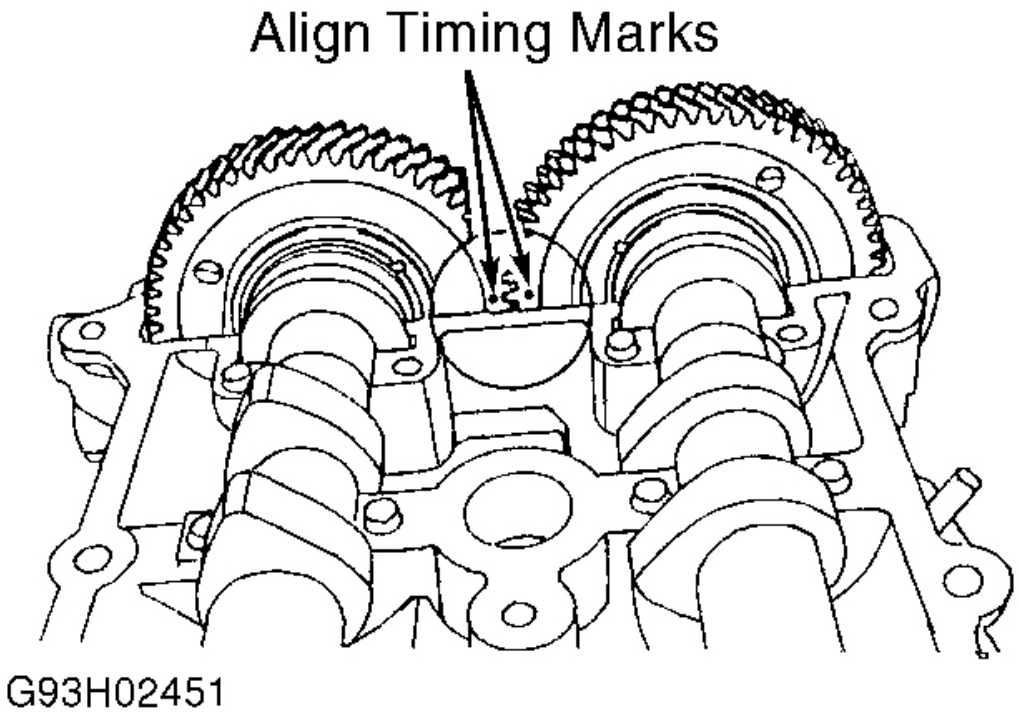


Fig. 18: Installing Camshafts

Courtesy of MAZDA MOTORS CORP.

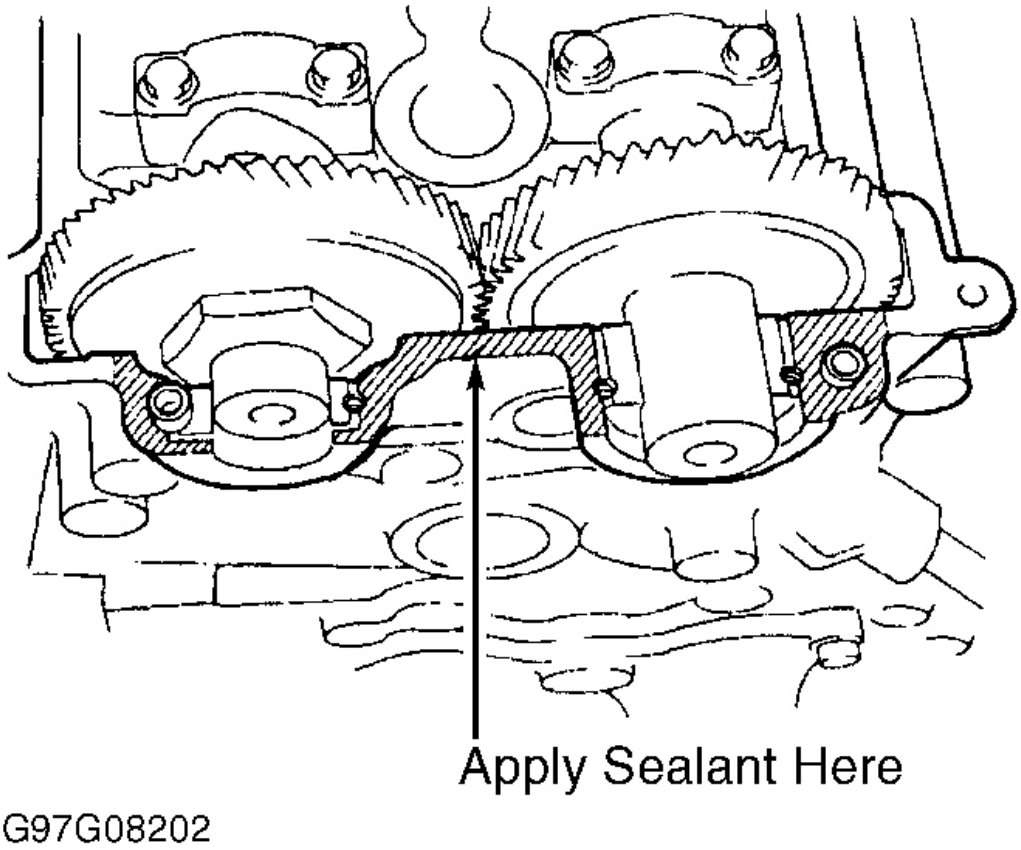
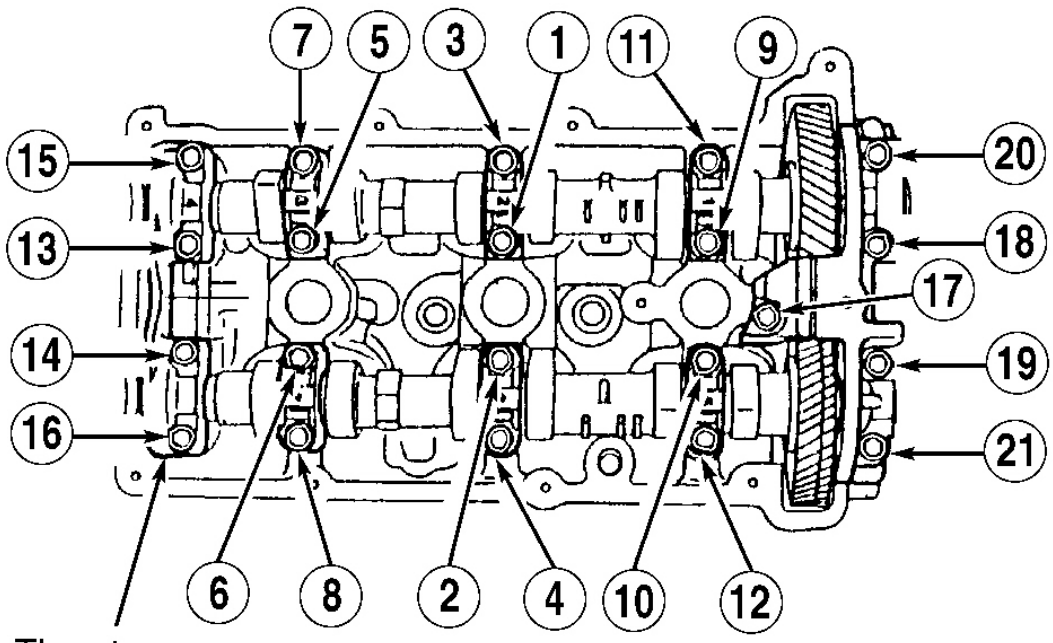


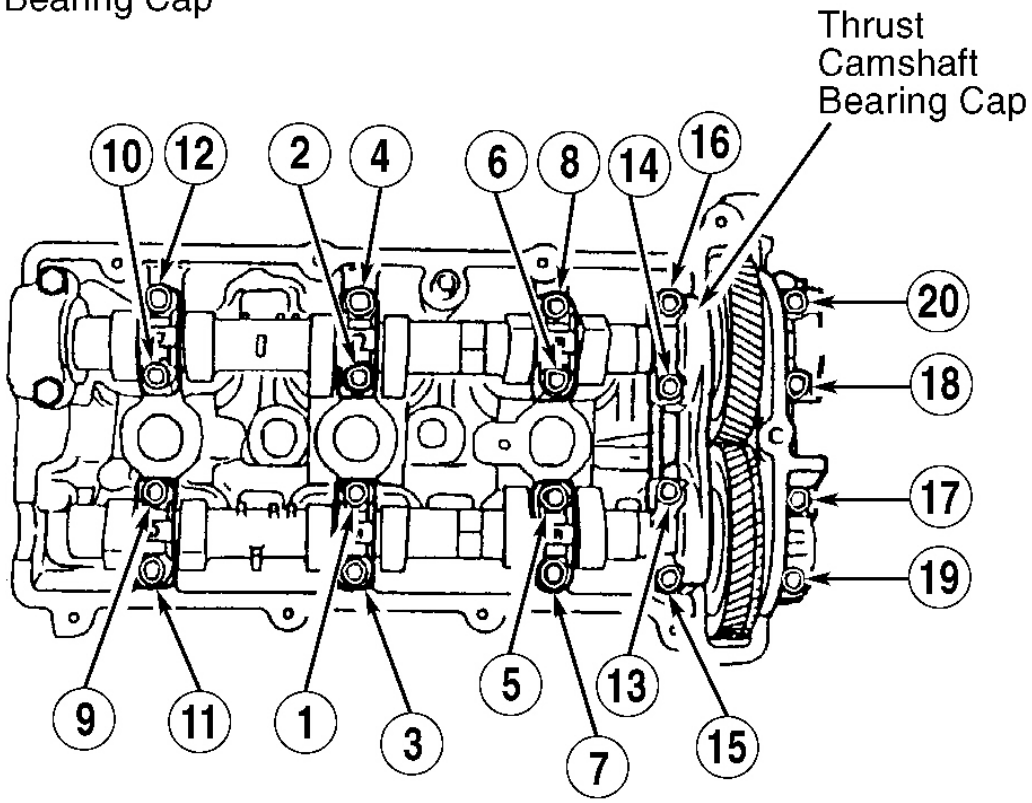
Fig. 19: Identifying Camshaft Bearing Sealant Application Areas
Courtesy of MAZDA MOTORS CORP.

NOTE: Camshaft bearing caps on right cylinder head are identified by numbers, with No. 1 at timing belt end of engine. Camshaft bearing caps on left cylinder head are identified by letters, with "A" at timing belt end of engine.

3. Install remaining camshaft bearing caps (with bolts) loosely. Tighten camshaft bearing cap bolts to specification in sequence using several steps. See **Fig. 20**. See **TORQUE SPECIFICATIONS**. DO NOT allow camshafts to bind.



RIGHT CYLINDER HEAD



LEFT CYLINDER HEAD

G93J02452

Fig. 20: Camshaft Bearing Cap Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

4. Lubricate NEW camshaft oil seal and push in by hand. Using hammer and suitable diameter pipe, tap camshaft oil seal into cylinder head. Apply sealant on NEW blind cap. Using soft-faced hammer, tap blind cap into cylinder head.
5. Install coolant outlet. Tighten retaining bolts to specification. See **TORQUE SPECIFICATIONS**. Install seal plate. Tighten retaining bolts to specification. See **TORQUE SPECIFICATIONS**.
6. Hold camshaft from turning by using a wrench on camshaft hex. Install left and right camshaft pulleys as identified by "L" and "R" stamped on them. Tighten camshaft pulley bolts to specification. See **TORQUE SPECIFICATIONS**.
7. Before installing valve cover and gasket, apply sealant at specified areas on cylinder head. See **Fig. 9**. Apply sealant on valve cover, and install NEW gasket in valve cover. Install valve cover and gasket.
8. Install and tighten valve cover bolts to specification in sequence using several steps. See **Fig. 10**. See **TORQUE SPECIFICATIONS**. Rotate crankshaft so No. 1 cylinder is at TDC on compression stroke. Ensure timing mark on crankshaft pulley aligns with TDC mark on timing belt cover. Coat distributor "O" ring and drive blade on distributor with engine oil. Align groove on distributor body drive blade.
9. Install distributor and hold-down bolt. To install remaining components, reverse removal procedure. Tighten all fasteners to specification. See **TORQUE SPECIFICATIONS**. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** under REMOVAL & INSTALLATION.

CRANKSHAFT REAR OIL SEAL

Removal & Installation

1. Disconnect negative battery cable. Remove transmission/transaxle and flywheel/flexplate. For automatic transmission removal procedure, see TRANSMISSION REMOVAL & INSTALLATION - A/T article in AUTOMATIC TRANS SERVICE section or TRANSMISSION REMOVAL & INSTALLATION - M/T article in MANUAL TRANS SERVICE section. Pry out oil seal.
2. To install, apply light coat of oil to seal lip and push seal over crankshaft. Tap seal into rear cover until it is flush with edge of rear cover. DO NOT bottom seal in cover.
3. Completely remove used sealant from flywheel/flexplate bolts. Apply lock-type sealant to bolts, and install flywheel/flexplate to crankshaft. Tighten flywheel/flexplate bolts to 45-49 ft. lbs. (61-67 N.m) in a crisscross pattern. Install clutch assembly (if equipped) and tighten cover bolts to 13-19 ft. lbs. (18-26 N.m) in a crisscross pattern. Install transmission.

THERMOSTAT

Removal & Installation

NOTE: Numbers in parenthesis refer to numbers in illustration.

1. Disconnect the negative battery cable. Remove ignition coil. Drain the engine coolant. Remove water inlet pipe (1). See **Fig. 21**. Remove thermostat housing (3). Remove thermostat (4).
2. To install, reverse removal procedure. Verify that the jiggle pin is aligned with the projection on the

thermostat gasket as shown. See **Fig. 22**. Install the thermostat into the thermostat case, aligning the projection on the gasket to the thermostat case as shown. See **Fig. 23**.

3. Tighten thermostat housing bolts to specification. See **Fig. 21**. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING**.

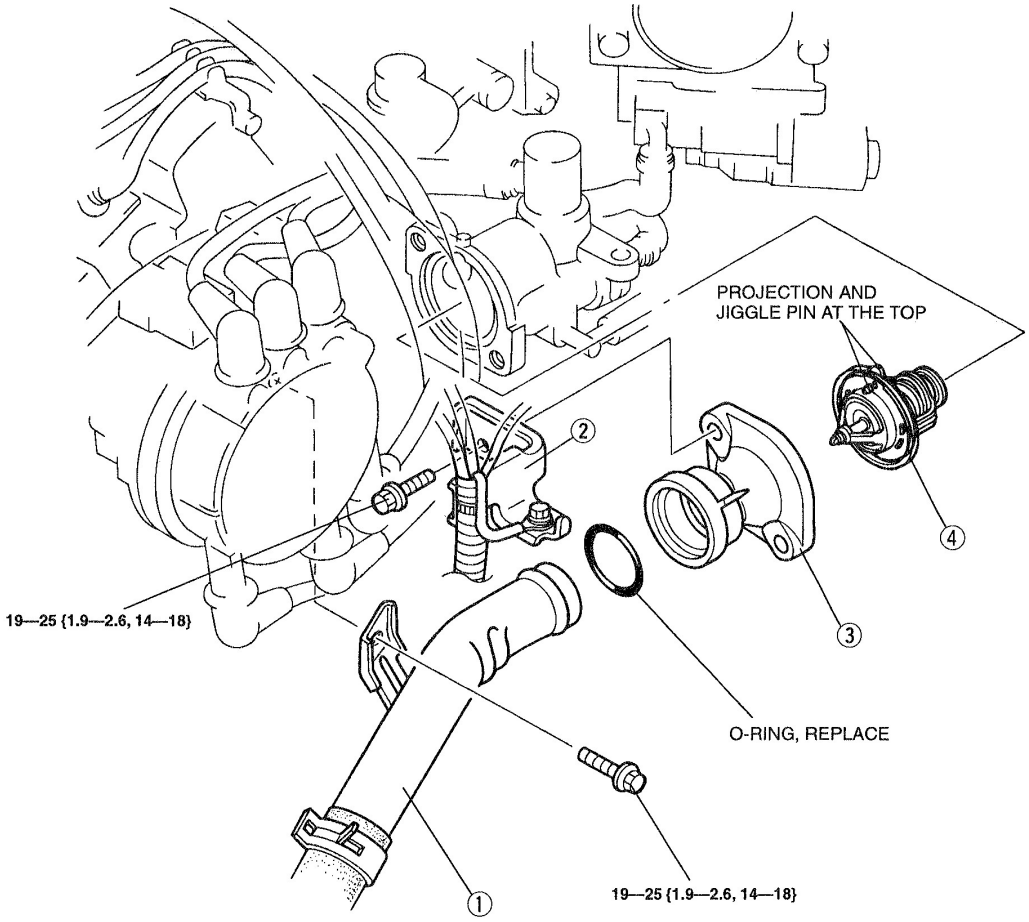


Fig. 21: Exploded View Of Thermostat Assembly With Torque Specifications
Courtesy of MAZDA MOTORS CORP.

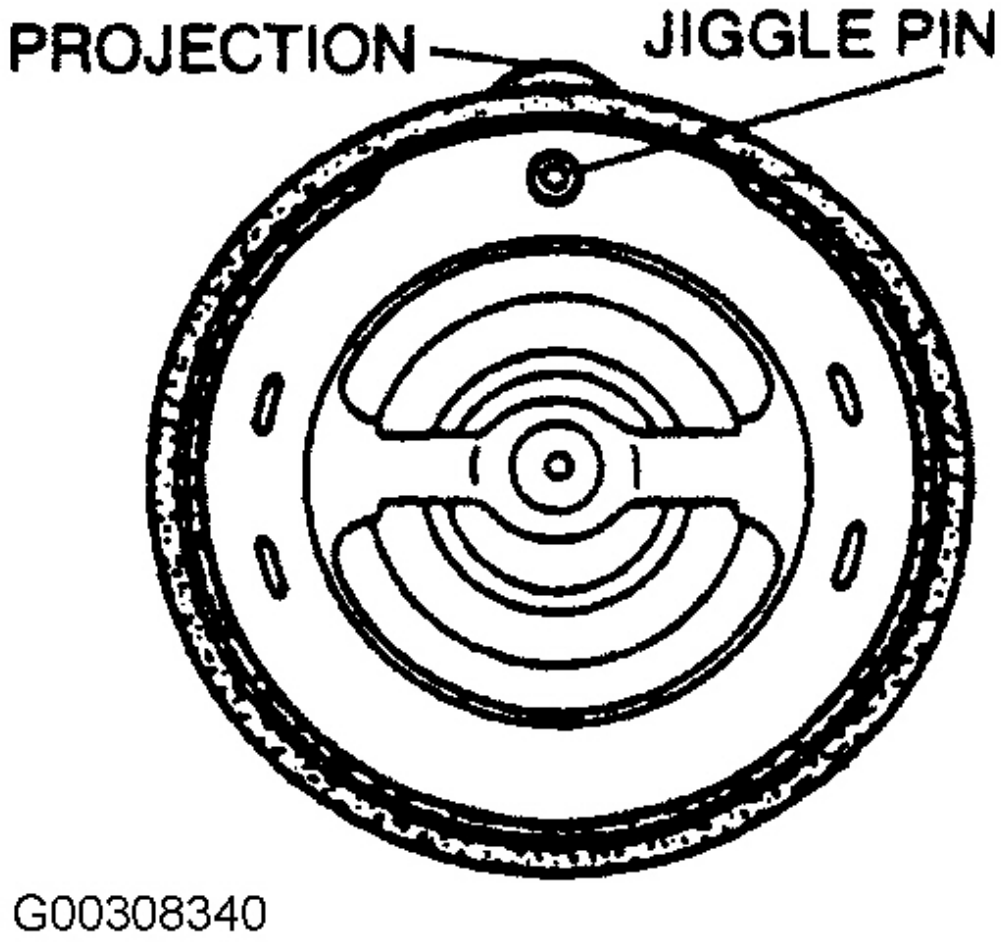


Fig. 22: Verifying Thermostat Jiggle Pin Is Aligned
Courtesy of MAZDA MOTORS CORP.

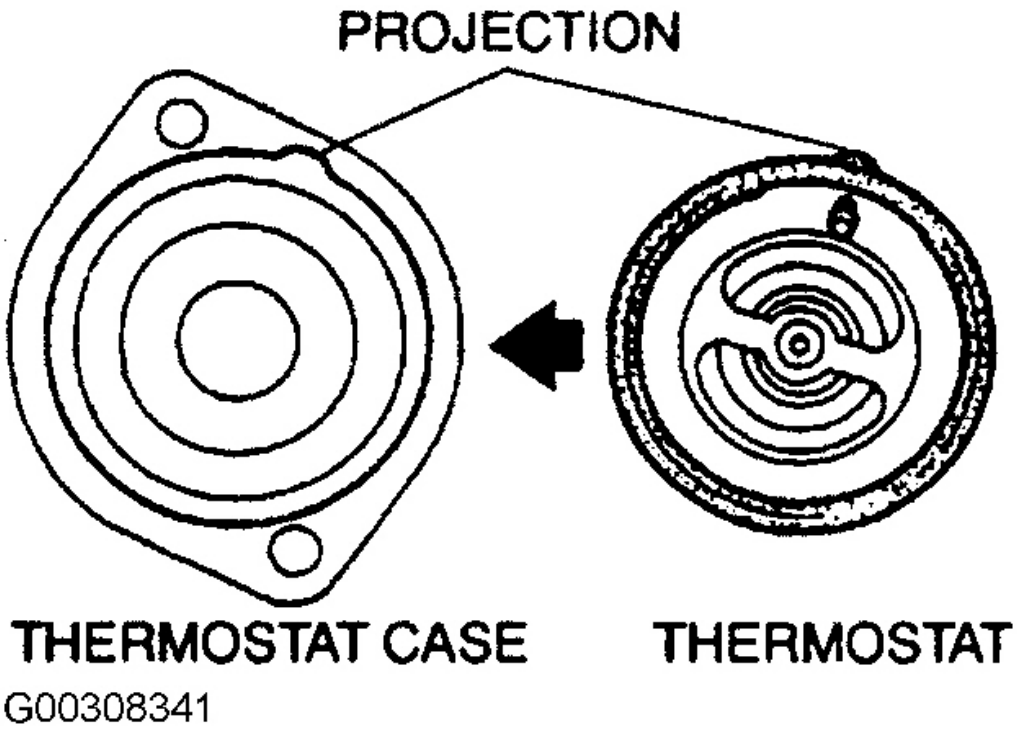


Fig. 23: Installing Thermostat
Courtesy of MAZDA MOTORS CORP.

WATER PUMP

Removal

Disconnect negative battery cable. Drain cooling system. Remove timing belt. See **TIMING BELT**. Remove idler pulleys for timing belt (if necessary). Remove engine mount bracket located above water pump on cylinder block. Remove retaining bolts, water pump and "O" ring seal.

Installation

To install, reverse removal procedure. Tighten bolts to specification. See **TORQUE SPECIFICATIONS**. Fill and bleed cooling system. See **COOLING SYSTEM BLEEDING** under REMOVAL & INSTALLATION.

OIL PAN

Removal

1. Disconnect negative battery cable. Raise and support vehicle. Drain engine oil. Remove lower engine

covers. Remove front crossmember. Remove exhaust pipe.

2. Remove oil pan retaining bolts. Install a bolt into nut welded on oil pan flange at rear corner of oil pan. Slightly tighten bolt to separate oil pan from cylinder block. Using screwdriver or seal cutter, remove oil pan from block. Remove retaining bolts, pick-up tube and gasket (if necessary).

Installation

1. Install gasket and pick-up tube (if removed). Tighten retaining bolts to specification. See **TORQUE SPECIFICATIONS**. 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.

CAUTION: Before installing oil pan bolts, ensure oil pan bolts and cylinder block bolt holes are free of sealant. Cylinder block may be crack if bolts are not cleaned before installation.

2. Install oil pan. Install bolts, and tighten to specification. See **TORQUE SPECIFICATIONS**. To install remaining components, reverse removal procedure. Fill crankcase with oil.

OVERHAUL

CYLINDER HEAD

Cylinder Head

1. Inspect cylinder head warpage at cylinder block and manifold areas in 6 directions. Resurface or replace cylinder head if warpage exceeds specification. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS.

CAUTION: Ensure cylinder head height is within specification after resurfacing cylinder head. See CYLINDER HEAD under ENGINE SPECIFICATIONS.

2. Ensure valve stem installed height is within specification. See VALVES in **CYLINDER HEAD**. Ensure cylinder head-to-valve lash adjuster oil clearance is within specification. See **HYDRAULIC LASH ADJUSTERS** under ENGINE SPECIFICATIONS.

Camshaft

1. Visually inspect camshaft gears. If helical gear is defective, replace camshaft. If friction gear is defective, replace friction gear. Ensure matching marks are aligned. Tighten lock nut to specification. See **TORQUE SPECIFICATIONS**.
2. Inspect remaining components for damage. Measure camshaft journal diameter, lobe height and runout. Replace camshaft if not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.
3. With HLAs removed from cylinder head, install one camshaft in cylinder head without camshaft bearing caps. Check camshaft end play. Install Plastigage on camshaft journals and install bearing caps and tighten to specification. See **TORQUE SPECIFICATIONS**.

4. Remove bearing caps and measure bearing oil clearance. Repeat procedure on remaining camshaft. Replace camshaft and/or cylinder head if end play or oil clearance is not within specification. See **CAMSHAFT** under ENGINE SPECIFICATIONS.

Valve Springs

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

Valve Stem Oil Seals

1. Lubricate valve stem oil seal with engine oil. Assemble Valve Stem Oil Seal Installer Set (49-L012-001, 49-L012-005 and 49-L012-002).
2. Adjust valve stem oil seal installer depth to .641" (16.28 mm) for intake valve stem oil seal or .543" (13.80 mm) for exhaust valve stem oil seal. See **Fig. 24**.

NOTE: Intake and exhaust valve seals are different. Exhaust valve seal has 2 ridges on top and intake valve seal has one or none. Ensure proper valve stem oil seal is used.

3. Insert valve stem oil seal into installer. Press valve stem oil seal onto valve guide until fully seated. Remove valve stem oil seal installer.

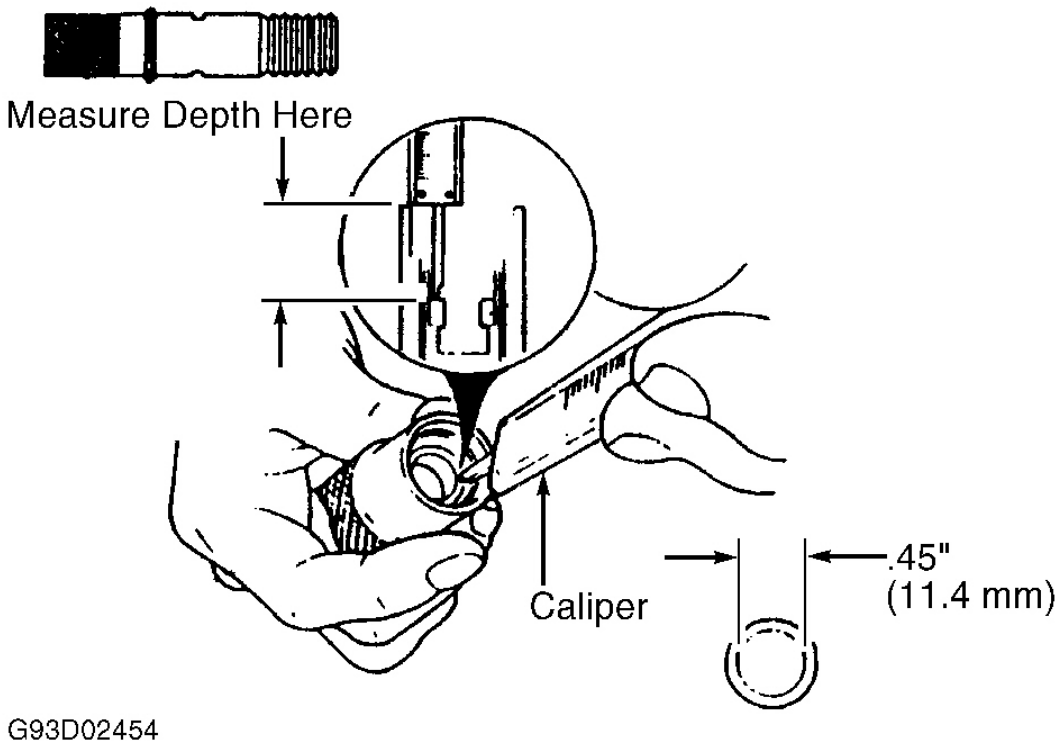


Fig. 24: Adjusting Valve Stem Oil Seal Installer
Courtesy of MAZDA MOTORS CORP.

Valve Guides

1. Ensure valve guide inside diameter and installed height are within specification. Measure inside diameter at top, center and bottom in 2 positions. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS. Replace valve guide if inside diameter exceeds specification or valve guide installed height is not within specification.

NOTE: Measure valve guide installed height from top of valve guide to cylinder head surface.

2. To replace valve guide, using hammer and Valve Guide Remover (49-B012-005), drive valve guide toward camshaft side of cylinder head. To install, assemble Valve Guide Installer components (49-L012-004), (49-L012-003) and (49-L012-002).
3. Adjust valve guide installer so depth is set at specified distance for proper valve guide application. See **Fig. 25**. Adjust depth to .579-.602" (14.70-15.30 mm) for intake valve guide, or .480-.504" (12.20-12.80 mm) for exhaust valve guides.

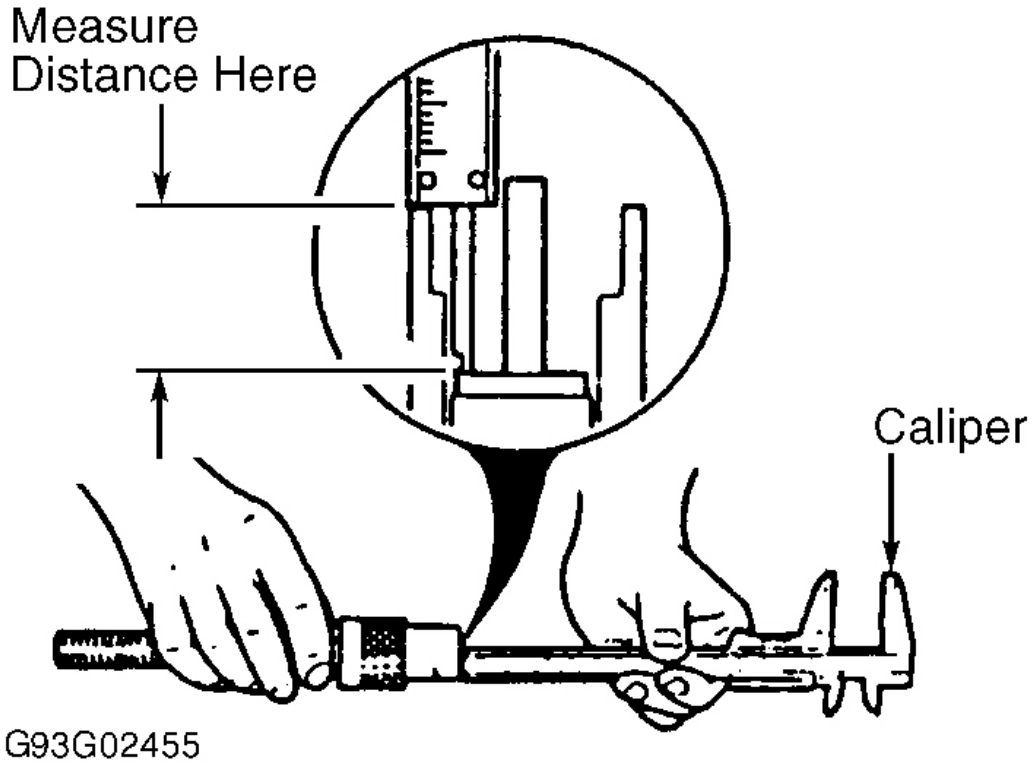


Fig. 25: Adjusting Valve Guide Installer
Courtesy of MAZDA MOTORS CORP.

4. Using hammer and valve guide installer, drive valve guide in from camshaft side of cylinder head until valve guide installer contacts cylinder head.
5. Ensure valve guide installed height is within specification. See **CYLINDER HEAD** under ENGINE SPECIFICATIONS. If valve guide installed height is not within specification, readjust depth on valve guide installer and adjust valve guide installed height.

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 at time of publication.

Valve Seat Correction Angles

Use 75-degree stone to lower valve seat contact area. Use 45-degree stone to raise valve seat contact area.

Valves

1. Ensure valve length, stem diameter, head diameter and valve margin are within specification. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
2. To check valve installed height, ensure valve is within minimum refinish length. See **VALVES & VALVE SPRINGS** under ENGINE SPECIFICATIONS.
3. Install valve in cylinder head. Using caliper, measure valve protrusion from top of valve stem to spring seat on cylinder head. See **Fig. 26**. If valve stem protrusion is 1.634-1.654" (41.50-42.00 mm), valve and cylinder head can be used without installing washer on valve spring seat.
4. If valve stem protrusion is 1.658-1.692" (42.10-43.00 mm), install washer on valve spring seat so distance is 1.634" (41.50 mm). If valve stem protrusion exceeds 1.697" (43.10 mm) replace cylinder head.

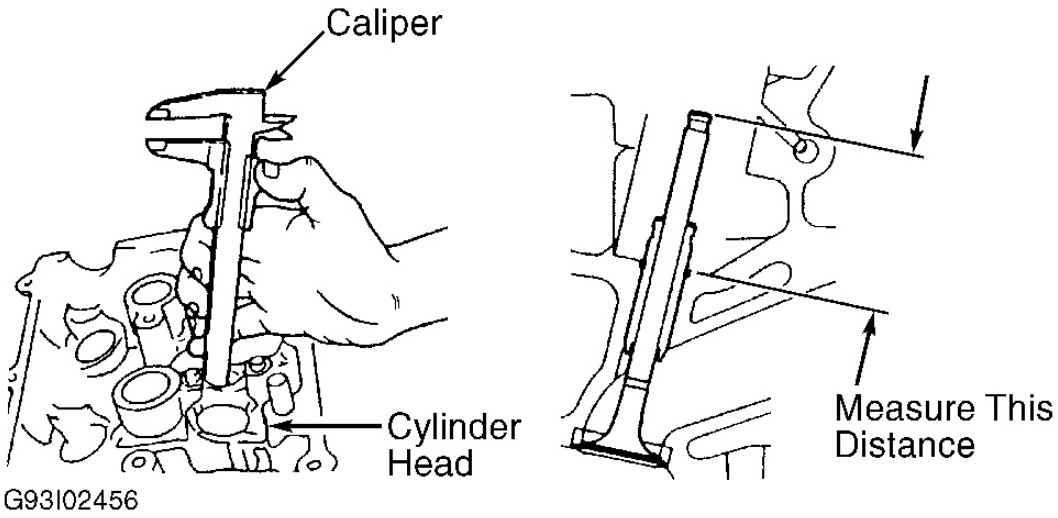


Fig. 26: Measuring Valve Installed Height
Courtesy of MAZDA MOTORS CORP.

HYDRAULIC LASH ADJUSTER

Hydraulic Lash Adjuster (HLA)

1. Store HLAs in upright position, submerged in clean engine oil. Inspect friction surface of HLA for wear and replace as necessary.
2. To check HLA function, hold HLA in hand. Attempt to compress HLA plunger using finger. If plunger compresses, replace HLA.
3. Ensure HLA-to-cylinder head oil clearance is within specification. Measure HLA outside diameter of both sections in crisscross pattern. Measure HLA bore in cylinder head at top and bottom in crisscross pattern. See **HYDRAULIC LASH ADJUSTERS** under ENGINE SPECIFICATIONS. Ensure HLA is installed in original location.

CYLINDER BLOCK ASSEMBLY

Piston & Rod Assembly

1. Ensure piston, connecting rod and connecting rod cap are match-marked for reassembly reference. Hold piston/rod assembly with connecting rod positioned horizontally. Pull connecting rod upward. Release connecting rod and ensure connecting rod drops freely. Replace piston or piston pin if connecting rod fails to drop freely.
2. To remove piston from connecting rod, properly support piston in hydraulic press. Press piston pin from connecting rod. Replace piston pin or connecting rod if pressure required to remove piston pin is less than 880 lbs. (400 kg).
3. Ensure piston pin diameter and pin-to-piston fit are within specification. See **PISTONS, PINS & RINGS** under ENGINE SPECIFICATIONS.
4. Ensure connecting rod bend, center-to-center length, crankpin bore and piston pin bore diameter are within specification. See **CONNECTING RODS** under ENGINE SPECIFICATIONS.
5. To assemble piston on connecting rod, ensure front mark on piston ("L" or "R") and connecting rod are facing upward. See **Fig. 27**. Ensure piston is properly supported in hydraulic press. Press in piston pin. Ensure connecting rod pivots freely.

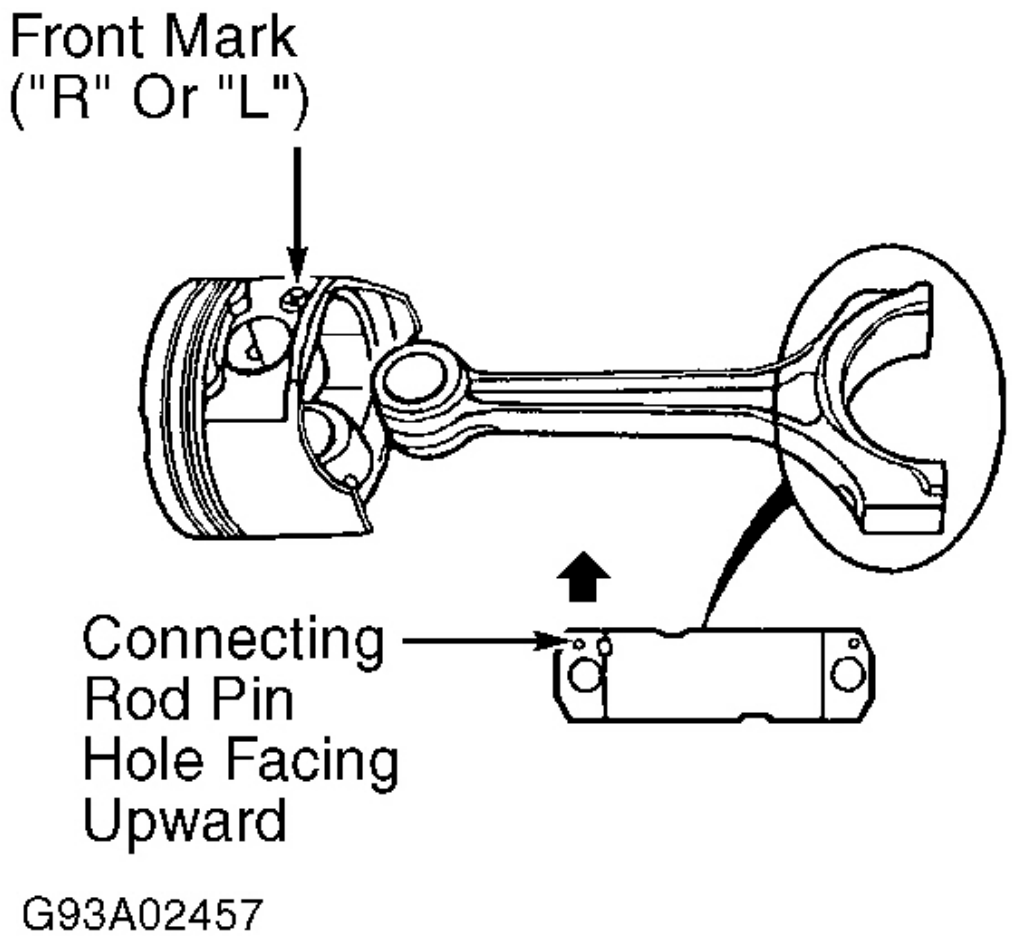


Fig. 27: Assembling Piston & Connecting Rod
Courtesy of MAZDA MOTORS CORP.

Fitting Pistons

1. Measure piston skirt at 90 degree angle to piston pin .650" (16.5 mm) below lowest piston ring groove. Measure cylinder bore diameter just below top of bore, at middle of cylinder bore and just above bottom of cylinder bore and record measurements.
2. If cylinder taper and out-of-round are NOT within specification, bore cylinder to next oversize. If cylinder taper and out of round are within specification, subtract piston diameter measurement from cylinder bore measurement to determine piston-to-cylinder clearance. See **PISTONS, PINS & RINGS** under ENGINE SPECIFICATIONS. If piston-to-cylinder clearance is excessive, replace piston or bore cylinder to next oversize. Piston Rings Ensure piston ring end gap and side clearance are within specification. See **PISTONS, PINS & RINGS** under ENGINE SPECIFICATIONS. Position piston ring gaps in proper

areas, with identification mark "R" on ring toward top of piston. See **Fig. 28**.

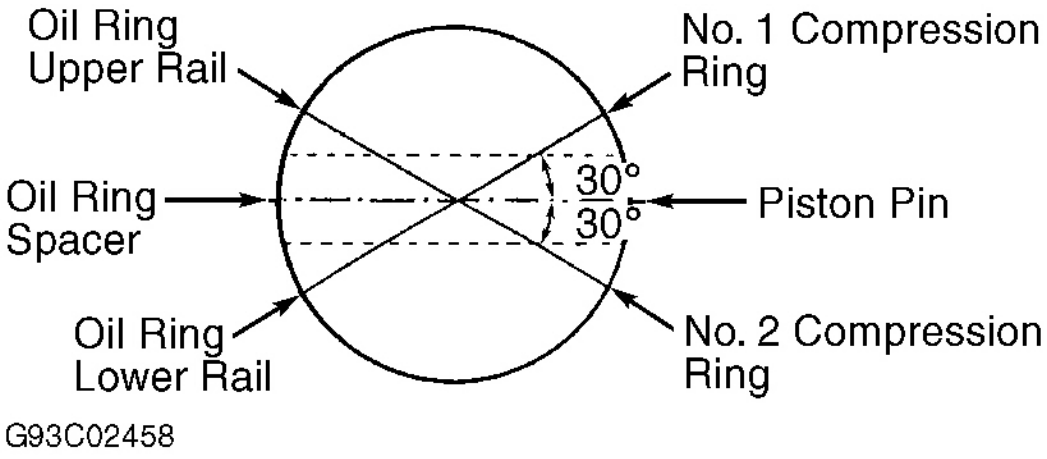


Fig. 28: Positioning Piston Rings
Courtesy of MAZDA MOTORS CORP.

Rod Bearings

1. Ensure connecting rod and connecting rod cap are marked with matching cylinder number for reassembly reference. Piston must be installed so front mark ("R" or "L") is toward timing belt end of engine. See **Fig. 27**.
2. Measure connecting rod cap bolt length. Measurement is taken from contact surface of bolt head to tip of bolt shank. Replace bolt if measurement exceeds 1.889" (48.00 mm). Coat connecting rod bolt threads with engine oil before tightening to specification. Ensure bearing oil clearance and connecting rod side play are within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** under ENGINE SPECIFICATIONS.

Crankshaft & Main Bearings

1. Before removing crankshaft, measure and record crankshaft end play. Note that cylinder block contains a lower cylinder block section. See **Fig. 29**. Loosen lower cylinder block bolts in sequence using several steps. See **Fig. 30**.

CAUTION: Do not pry on cylinder block except where indicated. See Fig. 31. Note location and length of lower cylinder block bolts for reassembly reference. Bolts must be installed in proper location. See Fig. 33.

2. Remove lower cylinder block retaining bolts. To loosen lower cylinder block, tap on lower cylinder block while prying with a screwdriver at rear of cylinder block. See **Fig. 31**. Separate lower cylinder block from cylinder block.

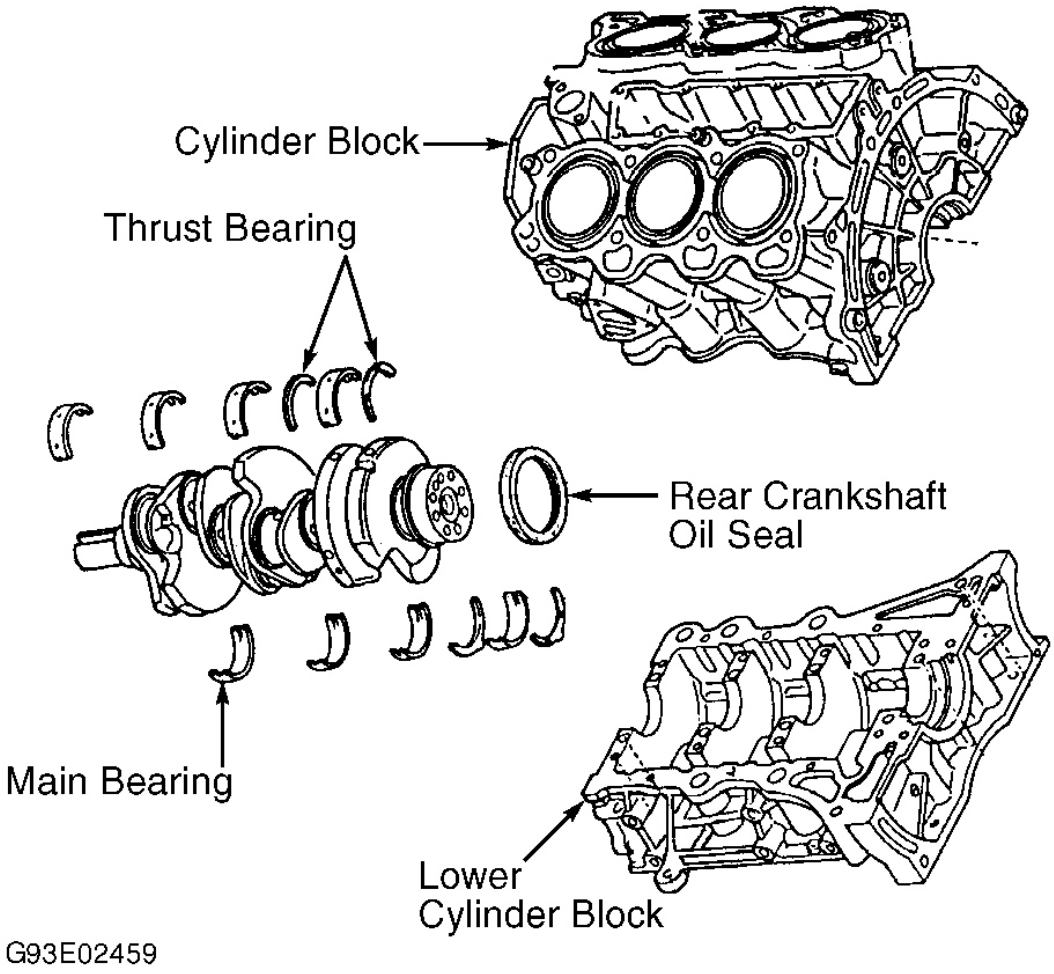


Fig. 29: Exploded View Of Cylinder Block, Crankshaft & Main Bearings
Courtesy of MAZDA MOTORS CORP.

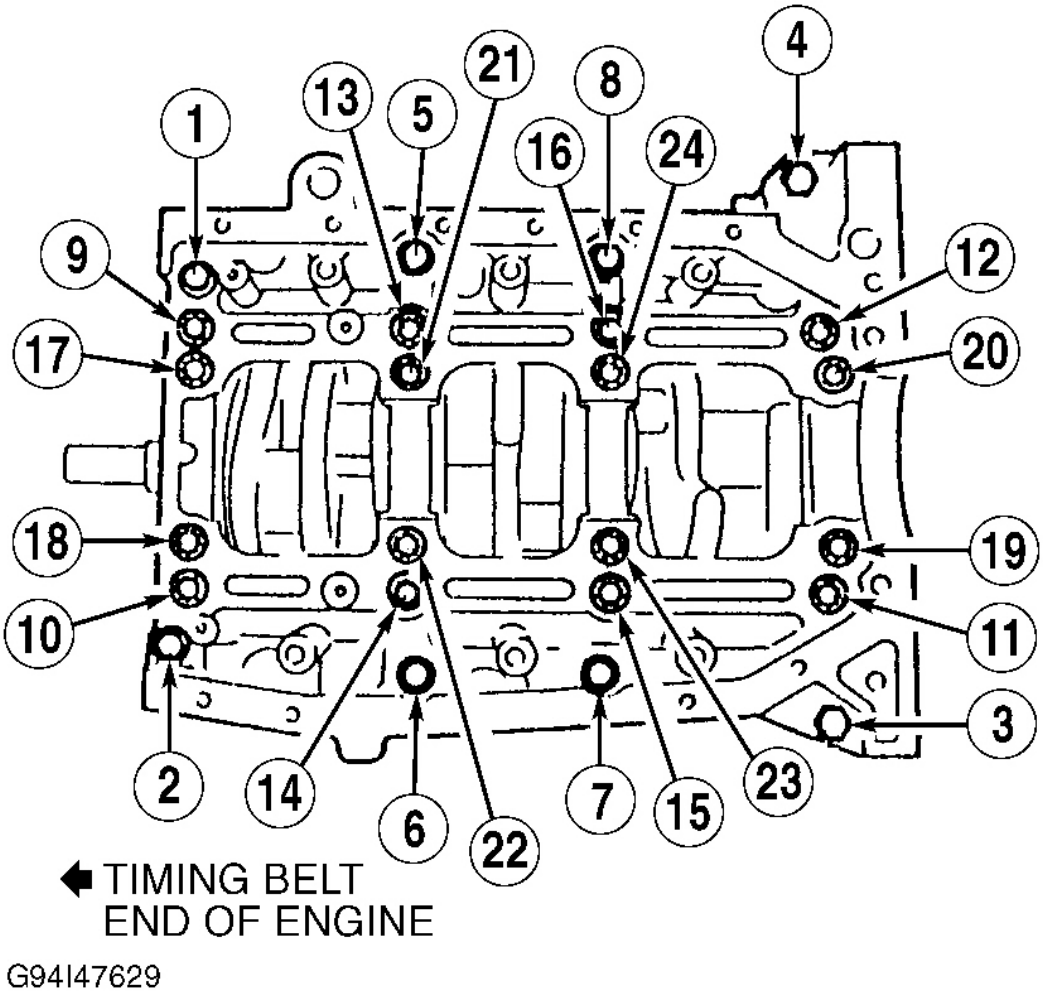


Fig. 30: Loosening Lower Cylinder Block Bolts
Courtesy of MAZDA MOTORS CORP.

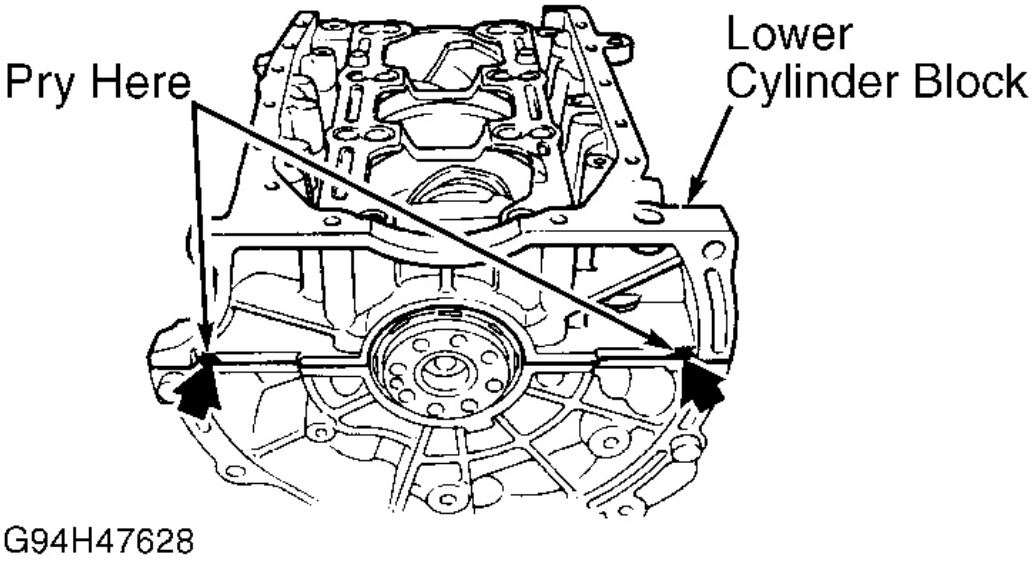


Fig. 31: Identifying Lower Cylinder Block Prying Areas
Courtesy of MAZDA MOTORS CORP.

3. Measure lower cylinder block bolt length of retaining bolts "A", "B" and "C". See **Fig. 32**. Replace bolts if not within specification. See **LOWER CYLINDER BLOCK BOLT LENGTH SPECIFICATIONS**.

NOTE: Lower cylinder block bolts "A" have a No. 4 stamped on top of bolt head and bolts "B" are stamped with an "I". Bolts "C" are the shortest bolts. Bolts "D" are outer bolts. See Fig. 33.

LOWER CYLINDER BLOCK BOLT LENGTH SPECIFICATIONS

Application	In. (mm)
Bolt "A" & "B"	
Standard	5.34-5.37 (135.7-136.3)
Maximum	5.45 (138.5)
Bolt "C"	
Standard	4.71-4.74 (119.7-120.3)
Maximum	4.76 (121.0)

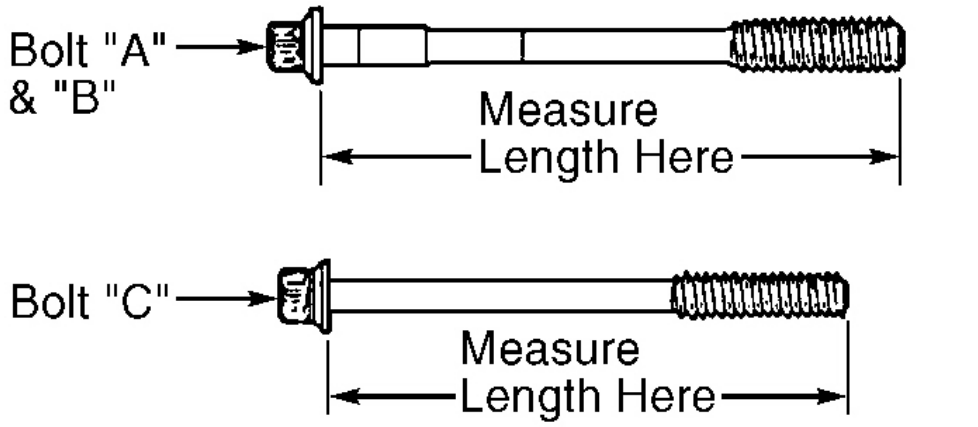


Fig. 32: Measuring Lower Cylinder Block Bolts
Courtesy of MAZDA MOTORS CORP.

4. Ensure crankshaft journal diameter, taper and out-of-round are with within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** under ENGINE SPECIFICATIONS.

CAUTION: DO NOT remove fillet roll on crankshaft journals when grinding journals for undersize bearings.

5. Crankshaft journals can be ground for .010" (.25 mm) undersize bearings if diameter is not within specification. Grind crankshaft rod journals to 2.0745-2.0749" (52.690-52.705 mm). Grind main bearing journals to 2.4287-2.4293" (61.688-61.705 mm) for undersize bearings.
6. To check oil clearance, install upper main and thrust bearings in cylinder block. Rear (No. 4) main bearing is wider than all other main bearings. Install lower main and thrust bearings, and lower cylinder block.
7. Coat lower cylinder block bolt threads and bolt-to-lower cylinder block surface with engine oil. Install bolts "A", "B" and "C" in proper location on cylinder block. See **Fig. 33**.

NOTE: Manufacturer does not require lower cylinder block bolts "D" to be installed when checking oil clearance.

8. Tighten bolts to specification in sequence using several steps. Perform STEPS 1 and 2 of illustration. See **Fig. 33**. Measure inside diameter of main bearings on front and rear main bearings. Subtract crankshaft main journal diameter from main bearing inside diameter to determine oil clearance.
9. Ensure crankshaft main bearing oil clearance is within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** under ENGINE SPECIFICATIONS.
10. Crankshaft main journals can be ground for .010" (.25 mm) undersize bearings if oil clearance is not within specification. Grind main bearing journals to 2.4287-2.4293" (61.688-61.705 mm) for undersize bearings.

CAUTION: DO NOT remove fillet roll on crankshaft journals when grinding journals for undersize bearings.

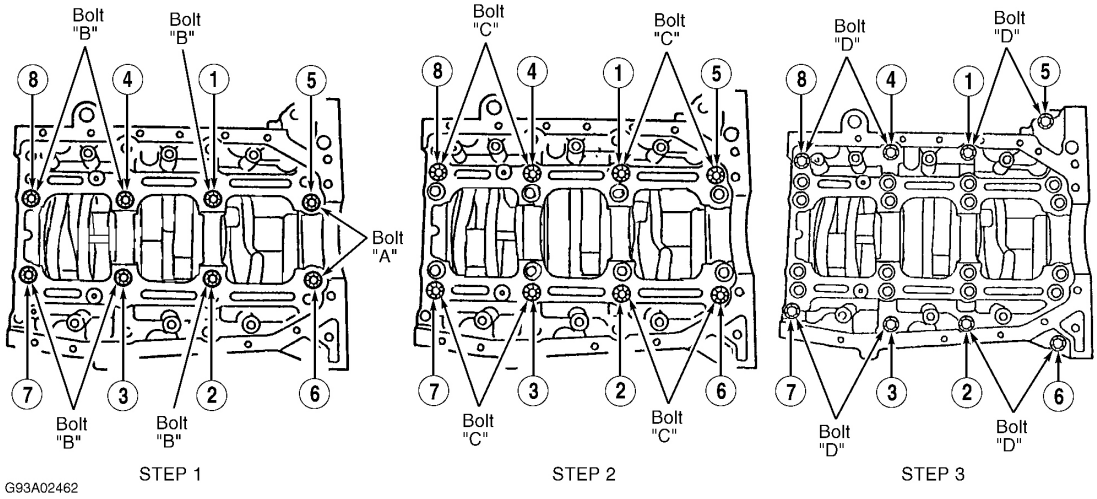


Fig. 33: Identifying Lower Cylinder Block Bolt Location & Installation Sequence
Courtesy of MAZDA MOTORS CORP.

11. When performing final installation of crankshaft, ensure oil jet is installed in cylinder block. See **OIL JET** under ENGINE OILING. Install main and thrust bearings in cylinder block and in lower cylinder block. Rear (No. 4) main bearing is wider than all other main bearings.

CAUTION: Ensure thrust bearing is installed on rear (No. 4) main bearing with oil groove facing inward.

12. Coat all bearings and crankshaft journals with engine oil. Install crankshaft. Ensure lower cylinder block and cylinder block sealing surfaces are clean. Apply sealant on cylinder block in specified areas. See **Fig. 34**. DO NOT allow sealant to enter bolt holes.
13. Install lower cylinder block. Coat lower cylinder block bolt threads with engine oil. Install bolts in proper location on cylinder block. Tighten bolts to specification in sequence using several steps. See **Fig. 33**.
14. Ensure crankshaft end play is within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** under ENGINE SPECIFICATIONS. Replace thrust bearing if end play is not within

specification. Apply oil to rear main seal lip and install rear main seal. Push seal in by hand and seat flush in block using appropriate driver.

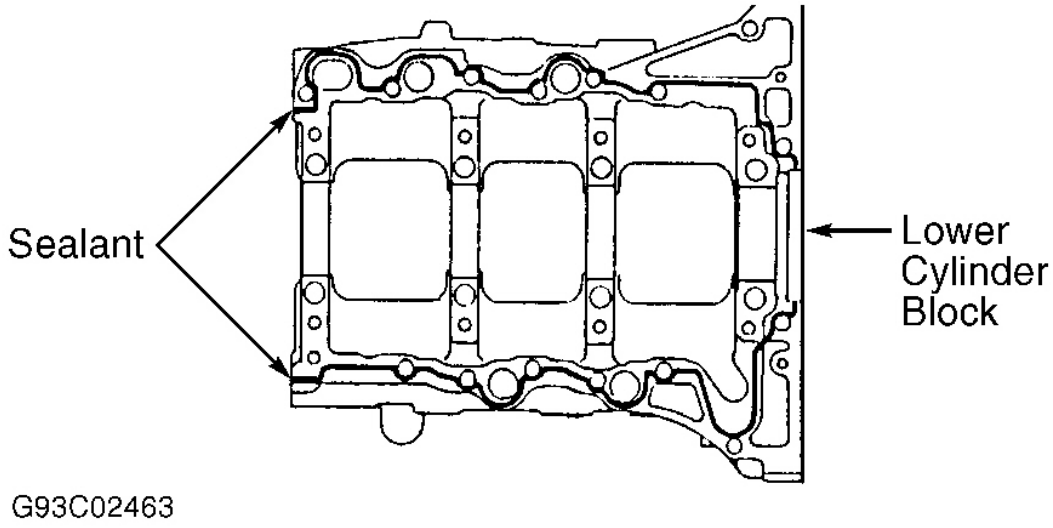


Fig. 34: Applying Sealant On Lower Cylinder Block
Courtesy of MAZDA MOTORS CORP.

Thrust Bearing

1. Install thrust bearing on rear (No. 4) main bearing with grooves facing toward crankshaft (away from cylinder block). Replace thrust bearing if crankshaft end play is not within specification. See **CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS** under ENGINE SPECIFICATIONS.
2. Standard thrust bearing width is .0788-.0807" (2.000-2.050 mm). Oversize thrust bearings are available in 2 different sizes. See OVERSIZE THRUST BEARING SPECIFICATIONS table.

OVERSIZE THRUST BEARING SPECIFICATIONS

Oversize Specification In. (mm)	Bearing Thickness In. (mm)
.010 (.25)	.0837-.0856 (2.125-2.175)
.020 (.50)	.0886-.0906 (2.250-2.300)

Cylinder Block

1. Inspect cylinder block deck surface warpage. Replace cylinder block if deck warpage exceeds specification. See **CYLINDER BLOCK** under ENGINE SPECIFICATIONS.
2. Measure cylinder bore diameter just below top of bore, at middle of cylinder bore and just above bottom of cylinder bore. Ensure cylinder bore diameter, taper and out-of-round are within specification. If cylinder bore diameter, taper or out-of-round exceeds specification, bore cylinder to nearest oversize. Cylinder block can be bored for .010" (.25 mm) or .020" (.50 mm) oversize pistons.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

The crankshaft driven oil pump provides pressurized lubrication for engine lubrication. See **Fig. 35**.

Crankcase Capacity

Crankcase capacity is 5.2 qts. (4.9L) after engine overhaul. Oil capacity with oil filter is 4.2 qts. (4.0L).

Oil Pressure

Inspect oil pressure at gallery above oil filter. With engine at normal operating temperature, oil pressure should be 48-71 psi (3.4-5.0 kg/cm^2) at 3000 RPM.

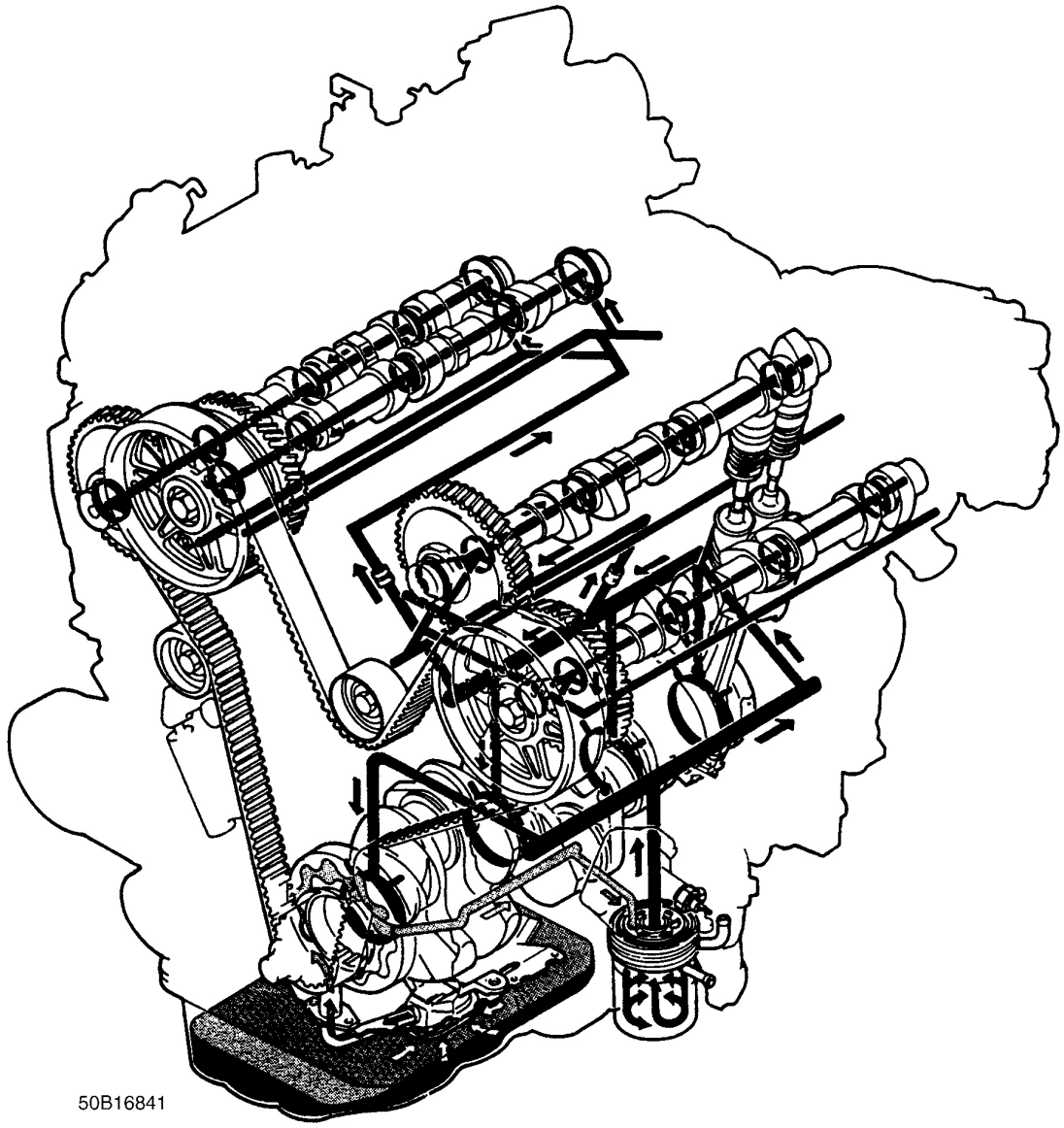


Fig. 35: Engine Oil Circuit
Courtesy of MAZDA MOTORS CORP.

OIL PUMP

Removal & Disassembly

Remove oil pan. See **OIL PAN** under REMOVAL & INSTALLATION. Remove oil pump pick-up tube and baffle plate. Remove retaining bolts, noting bolt length for reassembly reference. Remove oil pump and "O" ring. Remove oil pump body cover and oil pump components. See **Fig. 36**.

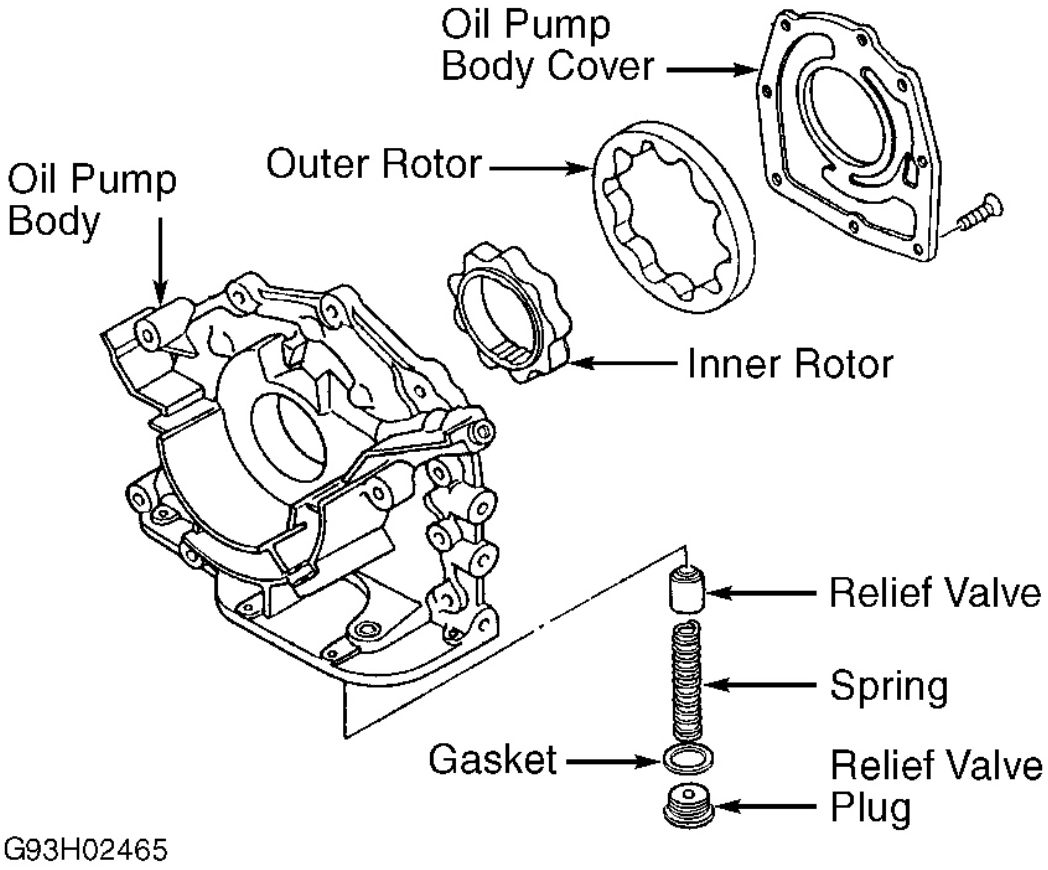


Fig. 36: Exploded View Of Oil Pump
Courtesy of MAZDA MOTORS CORP.

Inspection

1. Inspect components for damage. Ensure relief valve slides freely in bore. Install inner and outer rotors in oil pump body. Using feeler gauge, measure clearance between outer rotor and oil pump body. See **OIL PUMP SPECIFICATIONS**.
2. Measure rotor tip clearance between tips of both rotors. Place straightedge across oil pump body, above both rotors. Measure rotor end clearance between straightedge and rotor surface. Replace rotor assembly or oil pump body if any measurement exceeds specification.
3. Measure free length of spring for relief valve. Replace spring if free length is not 1.842" (46.79 mm).

OIL PUMP SPECIFICATIONS

Application	In. (mm)
Outer Rotor-To-Body Clearance	.0087 (.220) Maximum
Rotor End Clearance	.0051 (.130) Maximum

Rotor Tip Clearance	.0079 (.200) Maximum

Reassembly & Installation

1. To reassemble, coat rotors with engine oil. Install rotors in oil pump body. Ensure reference marks (dots) on rotors face outside of oil pump body (toward oil pump cover) and are aligned at top of oil pump body.
2. Install oil pump body cover, and tighten bolts to specification. See **TORQUE SPECIFICATIONS**. Install relief valve, spring, NEW gasket and relief valve plug. Tighten relief valve plug to specification.
3. Install crankshaft front seal (if removed) until seal surface is even with oil pump body. Coat seal lip with grease. To install, apply sealant on rear of oil pump. Coat NEW "O" ring with oil and install on rear of oil pump. Install oil pump. Ensure splined teeth on rotor of oil pump engages with splines on crankshaft.
4. Install proper length bolts in designated locations. Tighten retaining bolts to specification. Install baffle plate and retaining bolts. Tighten bolts to specification. Install gasket and pick-up tube. Tighten pick-up tube-to-oil pump bolts to specification, then pick-up tube support bracket bolts. To install remaining components, reverse removal procedure.

CAUTION: Before installing oil pan bolts, ensure oil pan bolts and cylinder block bolt holes are free of sealant. Cylinder block may be cracked if bolts are installed without cleaning out old sealant.

OIL COOLER

Removal & Installation

1. Disconnect negative battery cable. Drain cooling system. Disconnect coolant hoses from oil cooler. Remove oil filter and remove retaining nut from filter adapter. Remove oil cooler and "O" ring from oil filter bracket.
2. To install, reverse removal procedure using NEW "O" ring coated with engine oil. Tighten retaining nut to specification. See **TORQUE SPECIFICATIONS**. Fill and bleed cooling system. For procedures see COOLING SYSTEM BLEEDING under REMOVAL & INSTALLATION.

OIL JET

Removal & Installation

1. With crankshaft and main bearings removed, remove oil jet from cylinder block main bearing bore. See **Fig. 37**.
2. Ensure threads on oil jet and cylinder block are clean. Apply thread sealant on oil jet threads. Install oil jet and tighten to specification. See **TORQUE SPECIFICATIONS**.

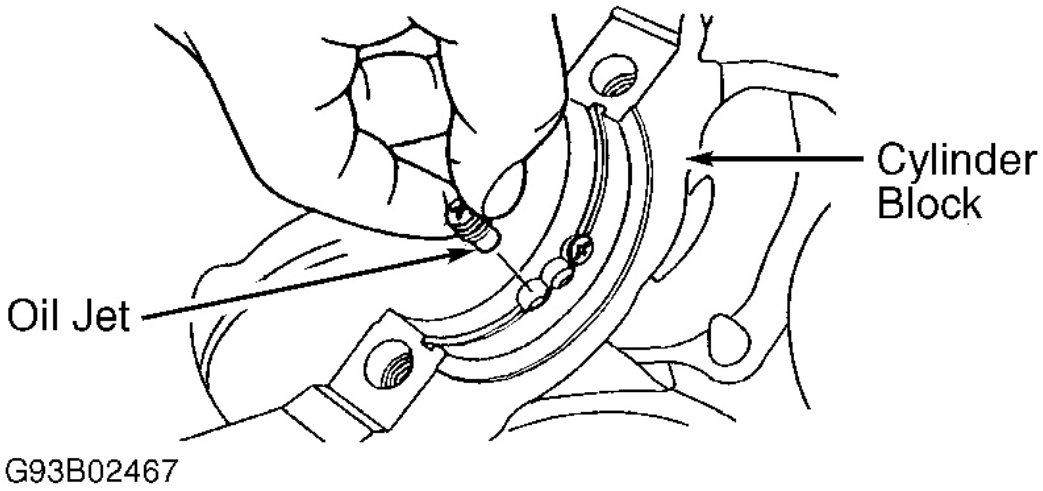


Fig. 37: Identifying Oil Jet
Courtesy of MAZDA MOTORS CORP.

ENGINE SPECIFICATIONS

GENERAL ENGINE SPECIFICATIONS

GENERAL ENGINE SPECIFICATIONS

Application	Specification
Displacement	153 Cu. In. (2.5L)
Bore	3.33" (84.5 mm)
Stroke	2.92" (74.2 mm)
Compression Ratio	9.2:1
Fuel System	MFI
Horsepower @ RPM	164 @ 5600
Torque Ft. Lbs. @ RPM	160 @ 4800

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS SPECIFICATIONS

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft	
End Play	
Standard	.0031-.0111 (.080-.282)
Maximum	.0125 (.320)
Maximum Runout	.0006 (.015)

Main Bearings	
Journal Diameter	2.4385-2.4392 (61.938-61.955)
Journal Out-Of-Round	.002 (.05)
Journal Taper	.002 (.05)
Oil Clearance	
Standard	.0015-.0022 (.037-.056)
Maximum	.0025 (.064)
Connecting Rod Bearings	
Journal Diameter	2.0843-2.0848 (52.940-52.955)
Journal Out-Of-Round	.002 (.05)
Journal Taper	.002 (.05)
Oil Clearance	
Standard	.0009-.0017 (.023-.043)
Maximum	.0032 (.080)

CONNECTING RODS SPECIFICATIONS

CONNECTING RODS

Application	**In. (mm)**
Pin Bore Diameter	.7852-.7858 (19.943-19.961)
Crankpin Bore Diameter	2.2047-2.2053 (56.000-56.015)
Center-To-Center Length	5.426-5.429 (137.80-137.90)
Maximum Bend	.002 Per 1.969 (.05 Per 50.01)
Side Play	
Standard	.0070-.0130 (.178-.330)
Maximum	.016 (.40)

PISTONS, PINS & RINGS SPECIFICATIONS

PISTONS, PINS & RINGS

Application	**In. (mm)**
Pistons	
Clearance	
Standard	.0011-.0022 (.028-.056)
Maximum	.005 (.13)
Diameter	3.3243-3.3252 (84.437-84.461)
Pin Bore Diameter	.7869-.7874 (19.988-20.000)
Pins	
Diameter	.7863-.7866 (19.974-19.980)
Piston Fit	.0003-.0010 (.008-.025)
Rod Fit (Interference Fit)	.0005-.0015 (.013-.038)
Rings	

No. 1	
End Gap (1)	.006-.012 (.15-.30)
Side Clearance (2)	.0008-.0026 (.020-.065)
No. 2	
End Gap (1)	.010-.016 (.25-.40)
Side Clearance (2)	.0012-.0026 (.030-.065)
No. 3 (Oil)	
End Gap (1)	.008-.028 (.20-.70)
Side Clearance (2)	.0010-.0020 (.025-.052)
(1) Maximum end gap is .040" (1.0 mm).	
(2) Maximum side clearance is .006" (.15 mm).	

CYLINDER BLOCK SPECIFICATIONS

CYLINDER BLOCK

Application	In. (mm)
Cylinder Bore	
Standard Diameter	3.3268-3.3276 (84.500-84.522)
Maximum Taper	.0009 (.022)
Maximum Out-Of-Round	.0008 (.020)
Maximum Deck Warpage	.006 (.15)

VALVES & VALVE SPRINGS SPECIFICATIONS

VALVES & VALVE SPRINGS

Application	Specification
Intake Valves	
Face Angle	45°
Head Diameter	1.253-1.265" (31.85-32.15 mm)
Minimum Margin	.035" (.90 mm)
Valve Length	
Standard	3.6970" (93.91 mm)
Minimum	3.6775" (93.41 mm)
Stem Diameter	
Standard	.2350-.2356" (5.970-5.985 mm)
Minimum	.2331" (5.920 mm)
Exhaust Valves	
Face Angle	45°

Head Diameter	1.080-1.092" (27.45-27.75 mm)
Minimum Margin	.039" (1.00 mm)
Valve Length	
Standard	3.7400" (94.99 mm)
Minimum	3.7200" (94.49 mm)
Stem Diameter	
Standard	.2348-.2354" (5.965-5.980 mm)
Minimum	.2329" (5.915 mm)
Valve Springs	
Free Length	1.847" (46.92 mm)
Out-Of-Square	.064" (1.63 mm)
	Lbs. @ In. (kg @ mm)
Pressure	
Intake & Exhaust Valve	52-59 @ 1.524 (23-27 @ 38.70)

CYLINDER HEAD SPECIFICATIONS

CYLINDER HEAD

Application	**Specification**
Cylinder Head Height	5.252-5.260" (133.40-133.60 mm)
Maximum Warpage (1)	
Cylinder Block Surface	.004" (.10 mm)
Manifold Surface	.004" (.10 mm)
Valve Installed Height	
Standard	1.634-1.653" (41.5-42.0 mm)
Serviceable	1.658-1.693" (42.1-43.0 mm)
Valve Seats	
Intake Valve	
Seat Angle	45°
Seat Width	.031-.055" (.79-1.40 mm)
Exhaust Valve	
Seat Angle	45°
Seat Width	.031-.055" (.79-1.40 mm)
Valve Guides	
Intake Valve	
Valve Guide I.D.	.2366-.2374" (6.01-6.03 mm)
Valve Guide Installed Height	.579-.602" (14.7-15.3 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0010-.0024" (.025-.060 mm)
Maximum	.008" (.20 mm)

Exhaust Valve	
Valve Guide I.D.	.2366-.2374" (6.01-6.03 mm)
Valve Guide Installed Height	.480-.504" (12.2-12.8 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0012-.0026" (.030-.065 mm)
Maximum	.008" (.20 mm)
(1) DO NOT remove more than .006" (.15 mm) material from original surface of cylinder head.	

CAMSHAFT SPECIFICATIONS

CAMSHAFT

Application	**In. (mm)**
End Play	
Standard	.0020-.0039 (.050-.099)
Maximum	.0055 (.140)
Journal Runout	.0008 (.020)
Journal Diameter (1) (2)	
No. 1 Journal	
Left Exhaust Camshaft	
Standard	1.1801-1.1809 (29.975-29.995)
Minimum	1.1781 (29.925)
Left Intake Camshaft	
Standard	1.0213-1.0220 (25.940-25.960)
Minimum	1.0193 (25.890)
Right Exhaust Camshaft	
Standard	1.0213-1.0220 (25.904-25.960)
Minimum	1.0193 (25.890)
Right Intake Camshaft	
Standard	1.1801-1.1809 (29.975-29.995)
Minimum	1.1781 (29.925)
No. 2, 3 & 4 Journals	
Standard	1.1021-1.0209 (25.910-25.930)
Minimum	1.0181 (25.860)
No. 5 Journal	
Standard	1.0213-1.0220 (25.940-25.960)
Minimum	1.0193 (25.890)

Oil Clearance (2)	
No. 1 & 5 Journals	
Standard	.0016-.0032 (.040-.081)
Maximum	.0047 (.120)
No. 2, 3 & 4 Journals	
Standard	.0028-.0044 (.070-.111)
Maximum	.0059 (.150)
Lobe Height	
Exhaust	
Standard	1.7145 (43.549)
Minimum	1.7067 (43.349)
Intake	
Standard	1.7145 (43.549)
Minimum	1.7067 (43.349)

(1) Left and right as viewed from rear of engine.

(2) The No. 1 journal is timing belt end and No. 5 journal is flywheel end.

HYDRAULIC LASH ADJUSTERS SPECIFICATIONS

HYDRAULIC LASH ADJUSTERS

Application	In. (mm)
Oil Clearance	
Standard	.0010-.0026 (.025-.066)
Maximum	.0071 (.180)

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor Bracket Bolt	28-38 (38-52)
Axle Shaft Bracket-To-Cylinder Block Bolt	32-46 (43-62)
Baffle Plate Bolt	14-18 (19-25)
Camshaft Sprocket Bolt	90-103 (122-140)
Clutch Release Cylinder Bolt (M/T)	12-17 (16-23)
Connecting Rod Bolt	
Step 1	16-20 (22-27)
Step 2	Additional 83-97 Degrees
Coolant Outlet Bolt	14-18 (19-25)
Crankshaft Pulley Bolt	116-122 (157-166)
Cylinder Head Bolt (1)	

Step 1	17-19 (23-26)
Step 2	Additional 85-95 Degrees
Step 3	Additional 85-95 Degrees
Engine Mount Bracket Above Water Pump-To-Cylinder Block Bolt	32-45 (43-61)
Engine Mount Crossmember Retaining Bolt/Nut	50-69 (68-93)
Engine Mount-To-Engine Mount Crossmember Nut	55-77 (75-104)
Engine Mount-To-Transaxle Case Nut	27-38 (37-52)
Engine-To-Transaxle Case Bolt	66-86 (90-116)
Exhaust Manifold Bolt/Nut	12-16 (16-22)
Flywheel/Flexplate Bolt	45-49 (61-67)
Friction Gear Nut	51-57 (69-78)
Front Exhaust Pipe-To-Exhaust Manifold Nut	28-38 (38-52)
Front Suspension Crossmember Bolt	69-97 (94-131)
Fuel Rail Bolt	14-18 (19-25)
Intake Manifold Bolt/Nut	14-18 (19-25)
Knock Sensor	15-25 (20-34)
Lower Control Arm Ball Joint To-Steering Knuckle Through-Bolt	32-43 (43-58)
Lower Cylinder Block Bolt (2)	
Bolt "A"	
Step 1	17-19 (23-26)
Step 2	Additional 75-85 Degrees
Bolt "B"	
Step 1	17-19 (23-26)
Step 2	Additional 65-75 Degrees
Bolt "C"	
Step 1	13-15 (18-20)
Step 2	Additional 55-65 Degrees
Bolt "D"	14-18 (19-25)
No. 1 Idler Pulley Bolt	28-38 (38-51)
No. 2 Idler Pulley Bolt	28-38 (38-51)
Oil Cooler-To-Oil Filter Adapter Nut	19-25 (25-34)
Oil Pan Bolt	
Long Bolt	14-18 (19-25)
Short Bolt	(3)
Oil Pump Bolt	14-18 (19-25)
Power Steering Pump Bracket Bolt	(4)
Power Steering Pump Pulley Nut	37-43 (52-58)
Relief Valve Plug	42-50 (57-68)

Right (Timing Belt Side) Engine Mount	
Nut	55-75 (74-102)
Through-Bolt	63-86 (86-116)
Shift Rod-To-Transaxle Bolt (M/T)	12-17 (16-23)
Spark Plug	11-16 (15-22)
Stabilizer Bar Link Nut	32-45 (43-61)
Stabilizer Rod-To-Transaxle Bolt (M/T)	23-34 (31-46)
Starter-To-Transaxle Case Bolt	24-34 (32-46)
Tensioner Pulley Bolt	28-32 (38-44)
Throttle Body Bolt/Nut	14-18 (19-25)
Tie Rod End Nut	32-41 (43-55)
Timing Belt Tensioner Bolt	14-18 (19-25)
Transaxle Mount & Bracket Bolt/Nut	50-68 (67-92)
Water Pump Bolt	14-18 (19-25)
Wheel Lug Nut	65-87 (88-118)
	INCH Lbs. (N.m)
Air Pipe-To-Intake Manifold Bolt	71-97 (8-11)
Camshaft Bearing Cap Bolt (5)	97-124 (11-14)
Crankshaft Position Sensor Bracket Bolt	71-97 (8-11)
Cylinder Block Valley Cover Bolt	71-97 (8-11)
Fuel Injector Retainer Bolt	18-35 (2-4)
Oil Jet	27-45 (3-5)
Oil Pump Body Cover Bolt	54-80 (6-9)
Pick-Up Tube Bolt	71-97 (8-11)
Pressure Regulator Bolt	62-89 (7-10)
Seal Plate Bolt	71-97 (8-11)
Timing Belt Cover Bolt	71-97 (8-11)
Valve Cover Bolt (6)	45-80 (5-9)
Water Pump Pulley Bolt	71-97 (8-11)

(1) Tighten bolts to specification in sequence. See **Fig. 6**.

(2) Identify bolts and tighten bolts to specification in proper sequence. See **Fig. 33**.

(3) Tighten bolts to 71-97 INCH lbs. (8-11 N.m).

(4) Tighten 2 upper bolts on front of bracket to 23-34 ft. lbs. (31-46 N.m). Tighten lower bolt on front of bracket to 14-19 ft. lbs. (19-26 N.m). Tighten bolt on rear of bracket-to-cylinder block to 24-33 ft. lbs. (32-45 N.m)

(5) Tighten bolts to specification in sequence. See **Fig. 20**.

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

