

1991 Mazda MX-5 Miata

MAZDA ENGINES 1.6L 4-Cylinder - VIN (1)

MAZDA ENGINES

1.6L 4-Cylinder - VIN (1)

ENGINE IDENTIFICATION

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

Engine may be identified by Vehicle Identification Number (VIN). VIN is stamped on a metal pad located near lower left corner of windshield. The eighth character identifies the engine model. Engine can also be identified by engine number. On Miata, engine number is stamped on flange, at upper right rear of cylinder block deck as viewed from flywheel.

ENGINE IDENTIFICATION CODES

Application	Engine Code	VIN Code
1.6L 4-Cylinder DOHC	B6	1

ADJUSTMENTS

VALVE CLEARANCE ADJUSTMENT

NOTE: Valve clearance is not adjustable. Some valve noise may occur during engine start-up. Noise should disappear after engine reaches normal operating temperature. If noise persists, check oil pressure, oil level and engine condition.

TROUBLE SHOOTING

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

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

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Disconnect circuit opening relay, located behind lower dash, left of steering column. Start engine and allow to idle until it stalls. Turn ignition off. Disconnect negative battery cable, and reconnect circuit opening relay. When disconnecting fuel hoses, cover connection with shop rag to catch fuel spray.

ENGINE

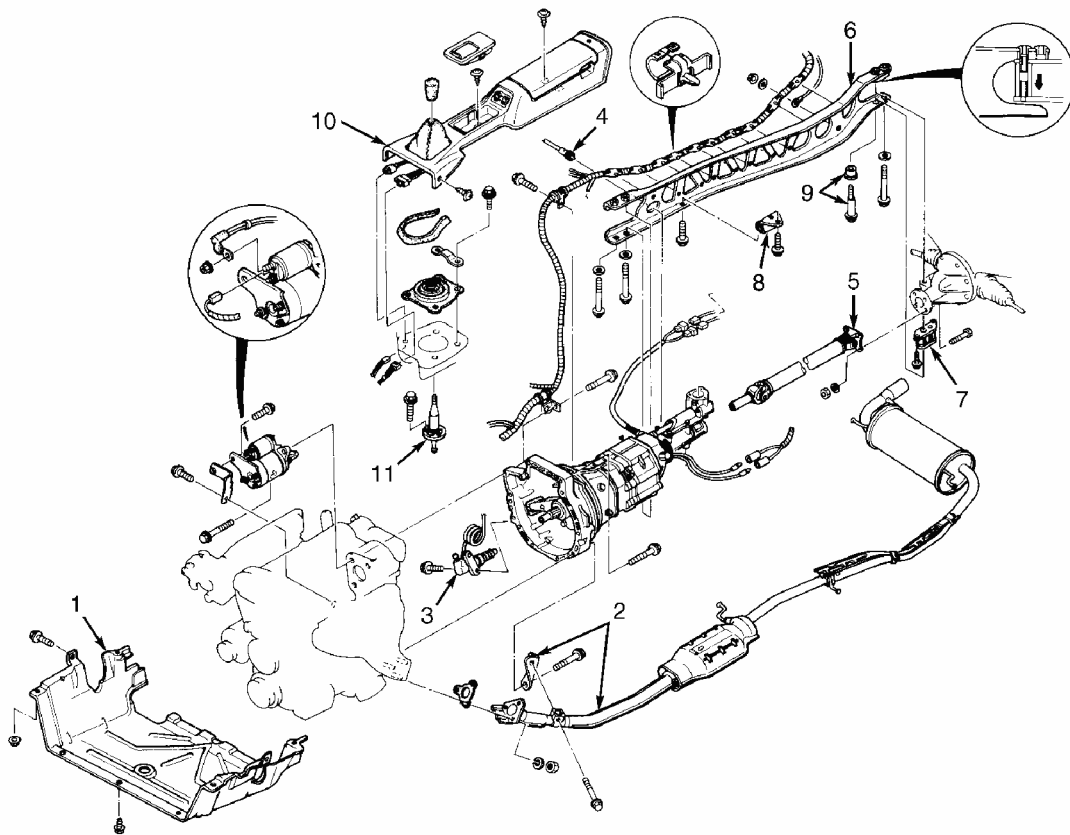
NOTE: On Miata audio anti-theft system, radio will not operate if power is cut to radio. obtain code number from customer to reactivate radio. To reactivate radio after reconnecting power supply, turn ignition switch to ACC position. press and hold FF and REW buttons until code is displayed. Again press and hold FF and REW buttons until bars (--- -) are displayed. Use preset button No. 1 to enter first number. Use preset buttons No. 2 to enter second number, 3 for third number, ect. Press FF and REW buttons for about 2 seconds until a beep is heard. After 5 seconds, flashing "code" will go away and radio will operate.

Removal

1. Relieve fuel pressure. See FUEL PRESSURE RELEASE under REMOVAL & INSTALLATION. Disconnect negative battery cable from trunk-mounted battery. Reference mark hood and remove. Raise vehicle, and remove engine undercover. See **Fig. 1**. Drain engine oil, transmission oil and cooling system.
2. Disconnect exhaust manifold downpipe and exhaust bracket bolts. On A/T models, disconnect shift rod linkage at transmission. On M/T models, remove clutch release cylinder from clutch housing, DO NOT disconnect fluid line.

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- | | | |
|-------------------------------|-------------------------------------|-------------------------|
| 1. Undercover | 5. Drive Shaft | 9. Reamer Bolt & Spacer |
| 2. Exhaust Downpipe & Bracket | 6. Power Plant Frame (PPF) | 10. Console |
| 3. Clutch Release Cylinder | 7. PPF/Differential Mounting Spacer | 11. Shift Lever |
| 4. Speedometer Cable | 8. Transmission-To-PPF Bracket | |

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Fig. 1: Removing & Installing Drive Train Components
Courtesy of MAZDA MOTORS CORP.

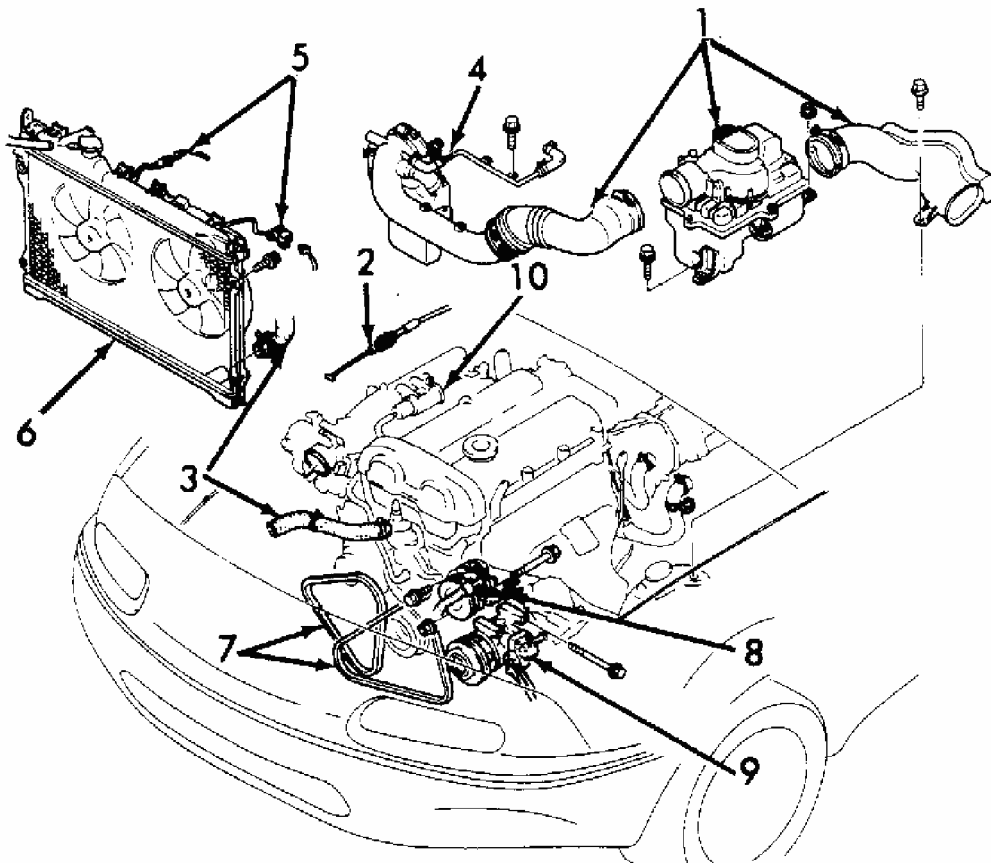
3. On all models, note location and remove transmission wiring harness connectors and speedometer cable. Match mark rear drive shaft flanges, and remove drive shaft.
4. Push up on transmission, and remove Power Plant Frame (PPF) angle bracket from lower rear of transmission extension housing. Remove 4 PPF long mounting bolts from transmission and differential, noting location of large shank reamer bolt at differential. Remove PPF/differential mounting spacer bolts, and pry out spacer at differential. See **Fig. 3**. Remove engine mount nuts.
5. Lower vehicle. On M/T models, remove shift knob, center console, boot and transmission shift lever. See **Fig. 1**. On all models, remove air cleaner assembly and throttle body intake duct assembly. See **Fig. 2**. Remove throttle cable.
6. Remove all cooling system hoses and A/T oil cooler lines at radiator (if equipped).

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Remove radiator and cooling fans as an assembly. Remove all drive belts. DO NOT disconnect power steering hoses or A/C compressor hoses. Remove power steering pump and A/C compressor from engine, and secure units away from engine.

7. Note locations of and disconnect all necessary electrical connectors, ground wires, vacuum hoses, fuel hoses, coolant hoses and control cables for engine removal. Plug all fuel hoses to prevent leakage. Remove engine and transmission as an assembly. Remove starter after engine is removed from vehicle.



- | | |
|--|-----------------------------------|
| 1. Air Cleaner Assembly | 6. Radiator /Cooling Fan Assembly |
| 2. Throttle Cable | 7. Drive Belts |
| 3. Radiator Hoses | 8. P/S Pump |
| 4. Throttle Body Intake Ducting Assembly | 9. A/C Compressor |
| 5. Cooling Fan Connectors | 10. Air Valve |

Fig. 2: Removing Engine Components
Courtesy of MAZDA MOTORS CORP.

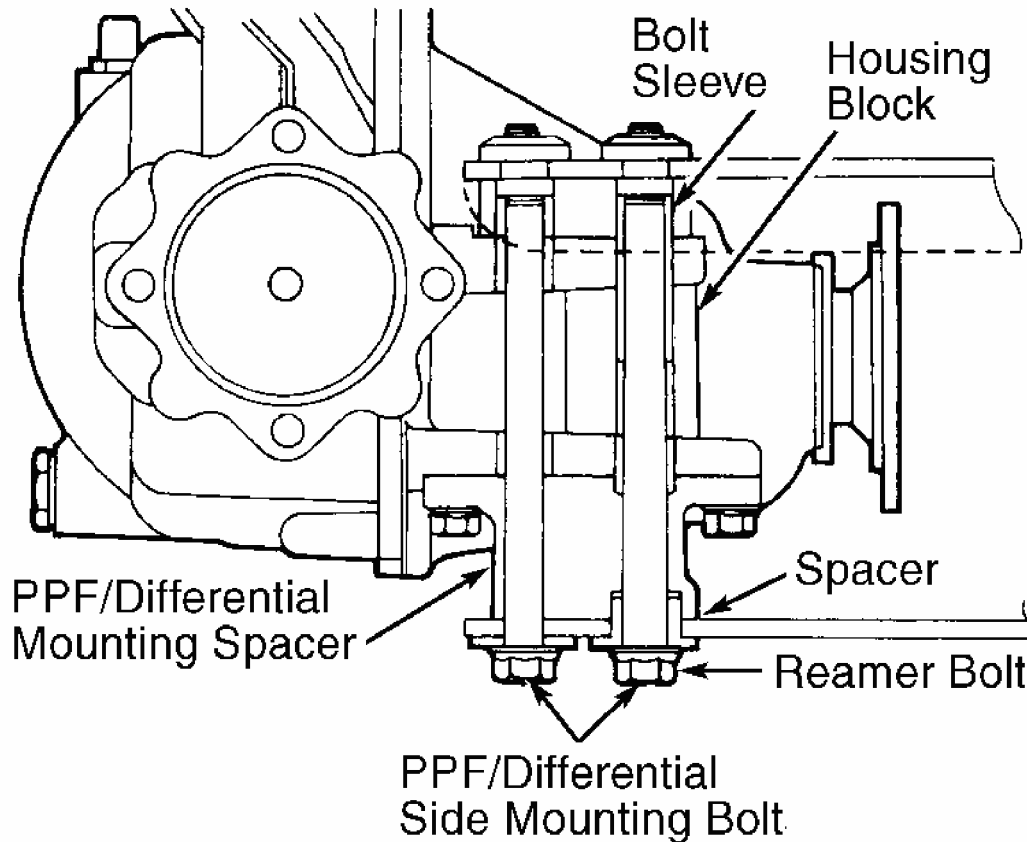
NOTE: Proper installation of PPF is critical for aligning drive shaft, and eliminating harmonic vibrations.

Installation

1. To install, reverse removal procedure. After installing engine mount nuts, mount PPF to transmission, and tighten long bolts by hand. Ensure bolt sleeve and PPF/differential mounting spacer are installed to differential housing block.
2. Tighten PPF/differential mounting spacer bolts to 27-38 ft. lbs.(37-52 N.m). See **Fig. 3** . Install PPF to differential. Hand-tighten longbolts. Ensure PPF-to-differential large shank reamer bolt and spacer are properly installed.

NOTE: Reamer bolt is the front long bolt attaching PPF to differential. This bolt aligns PPF with drive train.

3. When PPF is properly aligned between transmission and differential, tighten all long mounting bolts to specification. Install rear transmission-to-PPF bracket, and tighten to specification. See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure. Before installing M/T shift lever, add gear oil to transmission through shifter hole. Fill all fluids to correct levels.



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Fig. 3: Locating PPF-To-Differential Reamer Bolt, Sleeve & Spacer
 Courtesy of MAZDA MOTORS CORP.

INTAKE MANIFOLD

Removal

1. Relieve fuel pressure. See FUEL PRESSURE RELEASE. Disconnect negative battery cable. Drain cooling system. Remove air cleaner assembly and ducting. See **Fig. 2**. Mark and disconnect coolant hoses, vacuum hoses and electrical connectors from intake manifolds.
2. Disconnect throttle cable. Remove fuel lines from fuel rail and pressure regulator. Remove throttle body intake duct housing and throttle body. Remove air valve.
3. On all models, remove intake manifold support bracket from underneath manifold. Disconnect injector harness connectors, and remove injectors/fuel rail assembly. Remove

intake manifold and gasket.

Installation

1. Ensure all gasket surfaces are clean and flat. Install NEW gasket and intake manifold to cylinder head. Tighten manifold bolts/nuts evenly to specification, starting from center bolt and alternating outward. See TORQUE SPECIFICATIONS. Install support bracket underneath intake manifold.
2. Install gasket and upper intake manifold (if equipped). Tighten bolts/nuts evenly to specification, alternating from top to bottom. See TORQUE SPECIFICATIONS.
3. To complete installation, reverse removal procedure. Ensure Throttle cable has .04-.12" (1-3 mm) free play. Ensure injectors twist freely and are not cocked in insulator "O" rings. Refill engine with coolant.

EXHAUST MANIFOLD**Removal & Installation**

1. Disconnect oxygen sensor. Remove heat shields. Disconnect downpipe from exhaust manifold. Remove exhaust manifold.
2. To install, reverse removal procedure. Ensure all mating surfaces are clean and flat. Install NEW gasket to cylinder head. Tighten manifold bolts evenly to specification, starting from center bolt and alternating outward. See TORQUE SPECIFICATIONS.

CYLINDER HEAD**Removal**

1. Drain engine coolant. Release fuel pressure. See FUEL PRESSURE RELEASE under REMOVAL & INSTALLATION. Remove exhaust and intake manifolds.
2. Note locations and disconnect all necessary electrical connectors, ground wires, vacuum hoses, fuel hoses, coolant hoses and control cables for cylinder head removal. Plug all fuel hoses to avoid leakage.
3. Remove spark plug wires from spark plugs. Remove all drive belts. Remove water pump pulley. Remove timing belt. See TIMING BELT. Remove camshaft/rocker cover.
4. Remove front exhaust pipe. Remove intake manifold support bracket. Loosen all cylinder head bolts evenly in sequence, in 2-3 steps. See **Fig. 2** . Remove bolts and cylinder head assembly.

Inspection

Carefully clean carbon and gasket material from all mating surfaces. Clean threads of cylinder

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head bolts; use tap to clean threads in engine block. Check cylinder head for warpage. Resurface or replace head if it is not within specification. Check valve train components. Replace or resurface components if they are not within specification. See CYLINDER HEAD and VALVES & VALVE SPRINGS tables under ENGINE SPECIFICATIONS at end of article.

Installation

Install cylinder head gasket, cylinder head assembly and bolts. Tighten cylinder head bolts in 2 steps and in sequence to specification. See **Fig. 2** . See TORQUE SPECIFICATIONS. To complete installation, reverse removal procedure.

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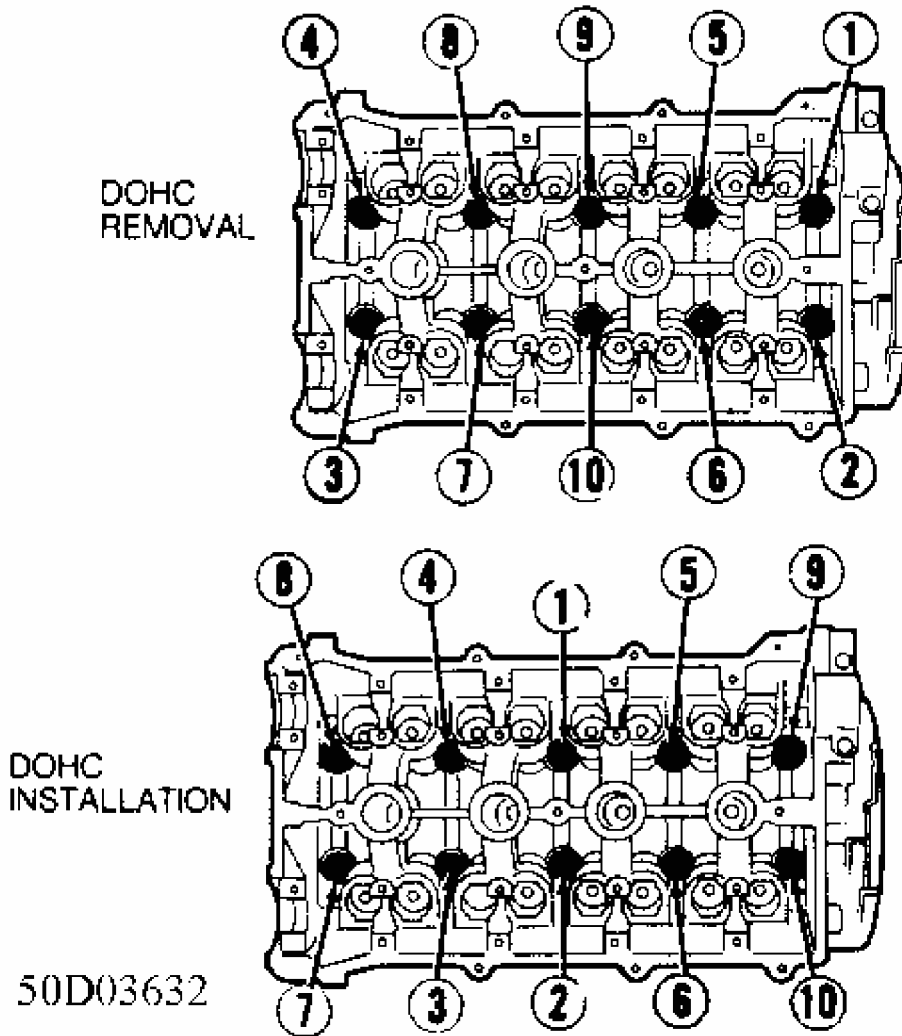


Fig. 4: Cylinder Head Bolt Removal & Installation Sequence
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT FRONT SEAL

Removal

Disconnect negative battery cable. Remove drive belts and crankshaft pulley. Remove water pump pulley, timing belt covers and timing belt. See TIMING BELT under REMOVAL &

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INSTALLATION. Use Crankshaft Lock Tools (49-S120-710 and 49-B011-102) to lock crankshaft sprocket into position. Remove crankshaft sprocket bolt. Remove crankshaft sprocket using steering wheel puller. Pry out seal.

Installation

1. Apply light oil coat to seal lip, and push seal over crankshaft. Tap seal into oil pump body until it is flush with edge of pump body. **DO NOT** bottom seal in pump body. Align keyway slots, and install crankshaft sprocket by tapping lightly using brass hammer. **DO NOT** deform sprocket end with hammer, or pulley misalignment may result.
2. Install Woodruff key with tapered side toward oil pump body. Install crankshaft sprocket lock bolt. Using Crankshaft Lock Tools (49-S120-710 and 49-B011-102), lock crankshaft sprocket into position. Tighten lock bolt to specification. See **TORQUE SPECIFICATIONS**.
3. Install timing belt. See **TIMING BELT** under **REMOVAL & INSTALLATION**. Install timing belt covers, pulleys and drive belts. Reconnect negative battery cable, and ensure timing is correct.

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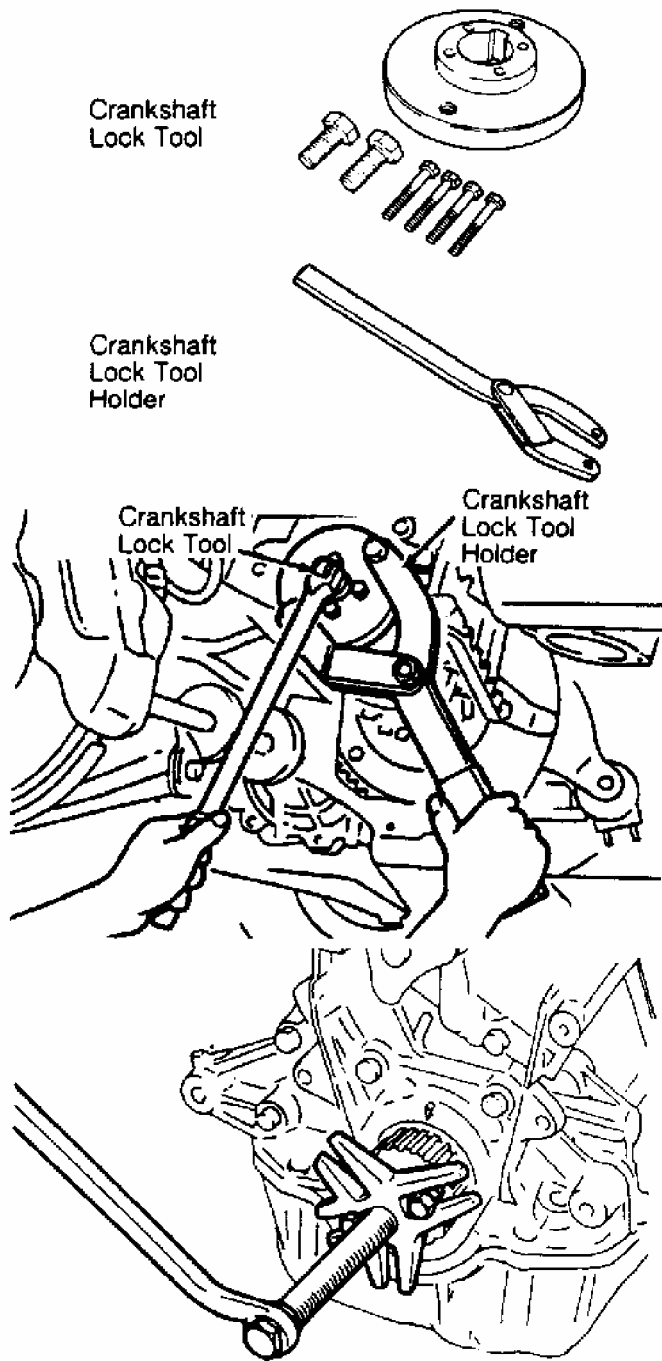


Fig. 5: Removing Crankshaft Sprocket
Courtesy of MAZDA MOTORS CORP.

TIMING BELT

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NOTE: Manufacturer's recommended timing belt replacement interval is 60,000 miles (96,000 km).

Removal

1. Disconnect negative battery cable. On Miata, drain cooling system, and remove radiator hose and by-pass hoses from thermostat housing. Remove air cleaner intake duct assembly from throttle body to air cleaner filter housing.
2. On all models, remove drive belt(s) and water pump pulley. Align crankshaft pulley timing mark with cylinder No. 1 at TDC of compression stroke. Remove crankshaft pulley bolts, and remove pulley only.
3. Remove timing belt cover(s). If timing belt is to be reused, mark timing belt rotation direction. Align timing marks on camshaft sprocket(s). See **Fig. 6** and **Fig. 7**. Loosen timing belt tensioner lock bolt. Temporarily secure tensioner away from belt with spring fully expanded. Remove timing belt.

Inspection

Check timing belt for cracks, peeling, abrasion or other damage. Check tensioner bearing for looseness or roughness of rotation. Inspect tensioner spring for stretching. Replace parts as necessary.

Installation

1. Position notch on crankshaft sprocket to 12 o'clock position (aligned with mark on oil pump). Align timing marks on camshaft sprocket(s). See **Fig. 6** and **Fig. 7**. Ensure crankshaft timing mark is at TDC. Install belt around crankshaft sprocket. Keeping belt pulled tight on right side (facing engine), route belt around camshaft sprocket(s).
2. Loosen timing belt tensioner lock bolt, and allow spring to apply tension on belt. Snug tensioner lock bolt. Rotate crankshaft 2 complete turns in direction of normal engine rotation. Ensure timing marks align. If timing marks are not aligned, remove belt, realign all timing marks, and repeat installation procedure.
3. Ensure timing marks align and crankshaft is at TDC. Rotate crankshaft 1 5/6 revolutions and check timing belt deflection.
4. On all engines, check timing belt deflection with 22 lbs. (10 kg) of pressure applied to belt. See **Fig. 5**. Ensure timing belt deflection is within specification. See TIMING BELT DEFLECTION table.

TIMING BELT DEFLECTION

Application	(1) Deflection In. (mm)

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DOHC

.35-.45 (9.0-11.5)

(1) Deflection measurement is with 22 lbs. (10 kg) of pressure applied to timing belt. See **Fig. 5**.

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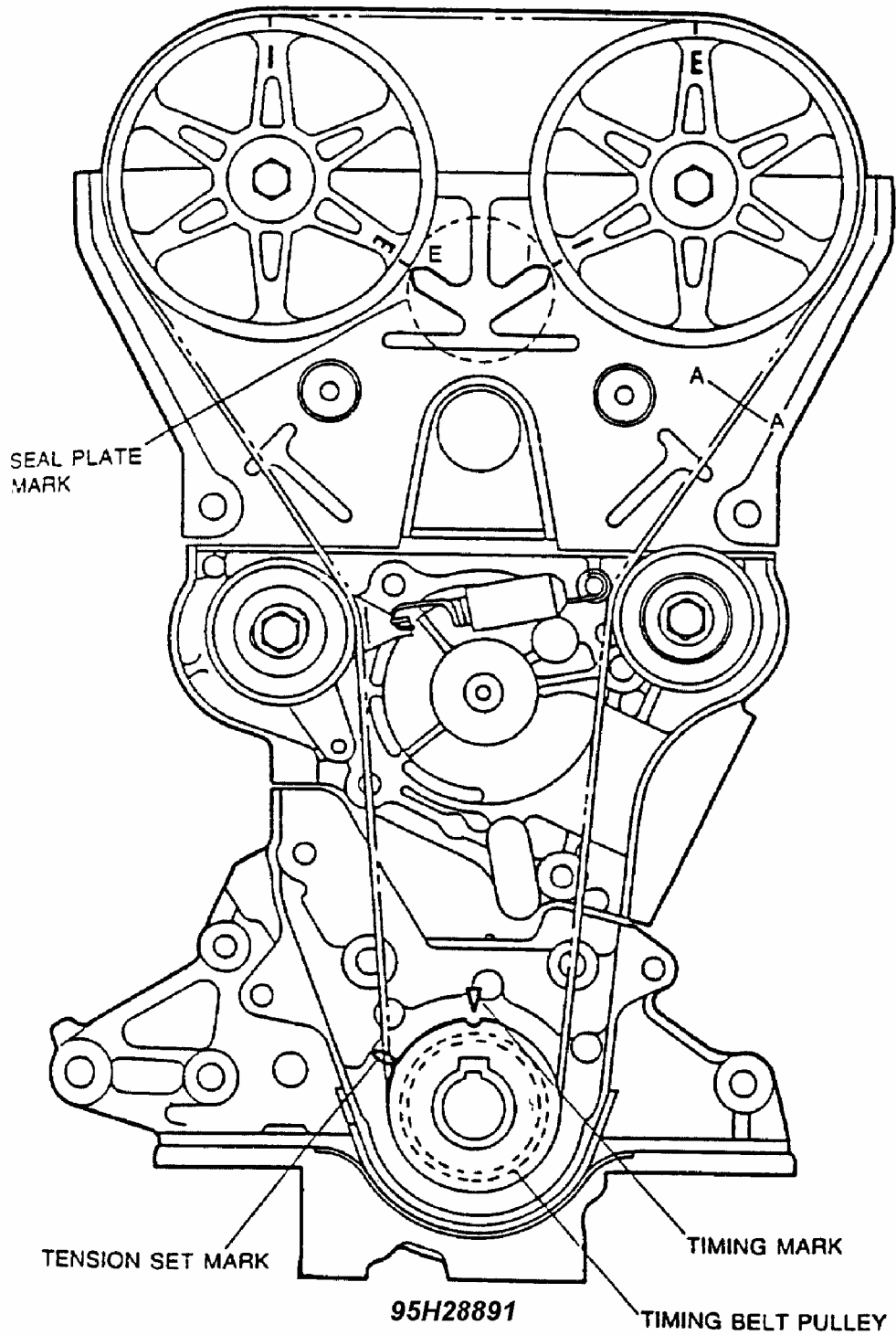


Fig. 6: Aligning Camshaft Timing Marks
Courtesy of MAZDA MOTORS CORP.

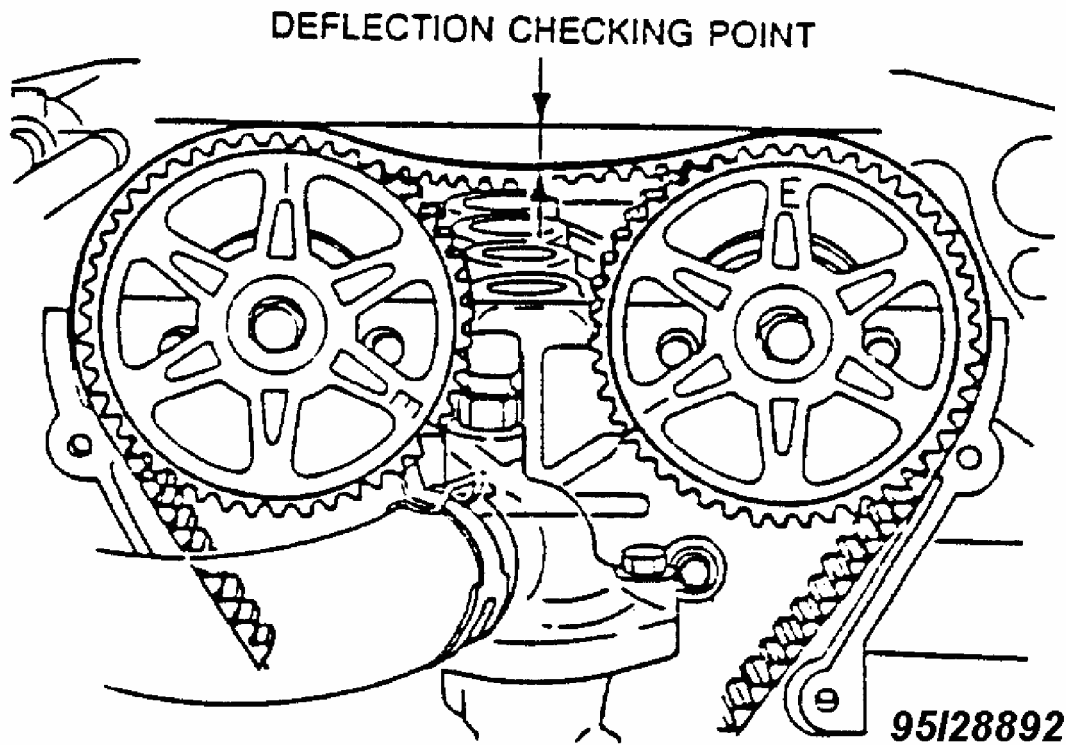


Fig. 7: Measuring Timing Belt Deflection
Courtesy of MAZDA MOTORS CORP.

HYDRAULIC LASH ADJUSTER (HLA)

Removal

Disconnect negative battery cable. Remove camshaft. See CAMSHAFT. Mark location of each HLA for reassembly reference. Remove HLA from cylinder head.

Inspection

Place HLA in palm of hand. Attempt to compress HLA plunger with thumb. If plunger compresses, replace HLA.

Installation

Insert HLA in original location. To complete installation, reverse removal procedure. Tighten camshaft caps evenly in sequence to specification. See TORQUE SPECIFICATIONS.

CAMSHAFT

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NOTE: On Miata, intake camshaft has slot for crank angle sensor drive. Match mark camshafts and sprockets for installation reference.

Removal

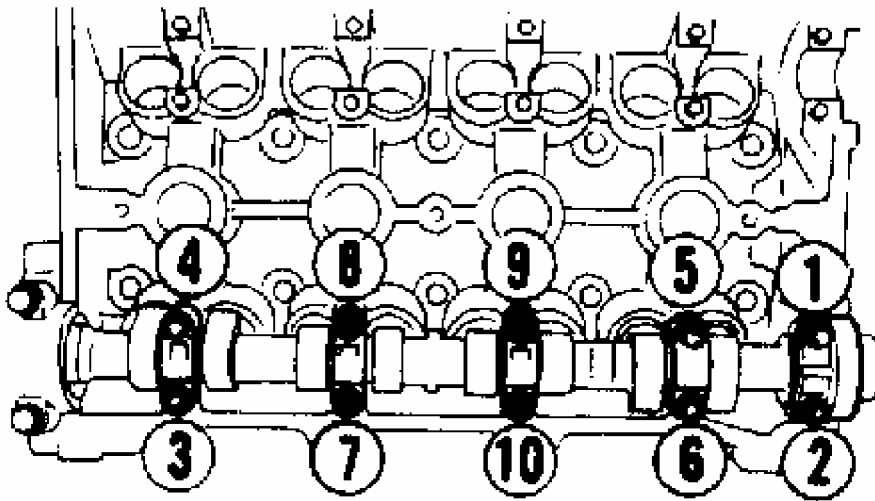
Remove cylinder head cover. Remove timing belt. See TIMING BELT under REMOVAL & INSTALLATION. Reference mark camshafts, caps and sprockets, and remove sprockets. Loosen camshaft cap bolts evenly in 2-3 steps in sequence. Remove camshafts.

Inspection

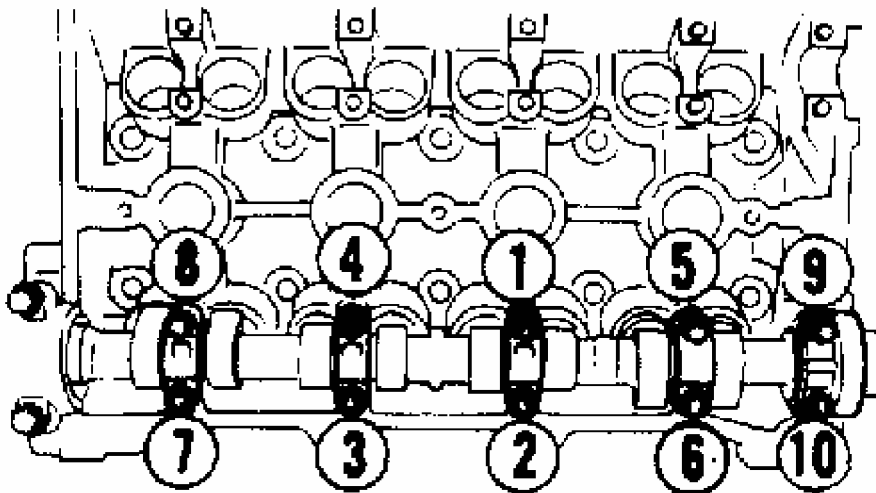
Check camshaft end play. Check camshaft journal diameters and bearing clearances. Check camshaft lobes for wear. See CAMSHAFT table under ENGINE SPECIFICATIONS at end of article. If any measurement is not within specification, replace camshaft and/or cylinder head.

Installation

To install, reverse removal procedure. On both camshafts, apply small amount of silicone sealant to contact area of cylinder head/camshaft seal cover cap. Tighten camshaft caps evenly in sequence to specification. See TORQUE SPECIFICATIONS.



REMOVAL



INSTALLATION

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Fig. 8: Camshaft Cap Bolt Removal & Installation Sequence

Courtesy of MAZDA MOTORS CORP.

REAR CRANKSHAFT OIL SEAL

Removal & Installation

1. Disconnect negative battery cable. Remove transmission/transaxle and flywheel. Pry out 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 bolts. Apply lock-type sealant to bolts, and install flywheel to crankshaft. Tighten bolts to 71-76 ft. lbs. (96-103 N.m) in a star-pattern sequence. Install clutch assembly (if equipped) and tighten cover bolts to 13-20 ft. lbs. (18-26 N.m) in a star-pattern sequence. Install transmission. See ENGINE under REMOVAL & INSTALLATION.

WATER PUMP

Removal & Installation

1. Drain engine coolant. Disconnect battery cable. Position No. 1 cylinder at TDC of compression stroke.
2. On Miata, remove air cleaner intake duct between throttle body and air cleaner/filter assembly. On all models, remove power steering pump with hoses attached, and secure pump away from engine. Remove upper radiator hose and by-pass hoses from thermostat housing.
3. Remove drive belts and water pump pulley. Remove timing belt, tensioner and idler. See TIMING BELT. Unbolt water inlet pipe from water pump. Water pump inlet pipe has lower radiator hose and by-pass pipe attached to it. Remove water pump. To install, reverse removal procedure. Tighten bolt to specification. See TORQUE SPECIFICATIONS.

NOTE: For further information on cooling systems, see **ENGINE COOLING FANS** article in **ENGINE COOLING**.

OIL PAN

NOTE: On Miata, engine must be supported in order to remove oil pan.

Removal & Installation

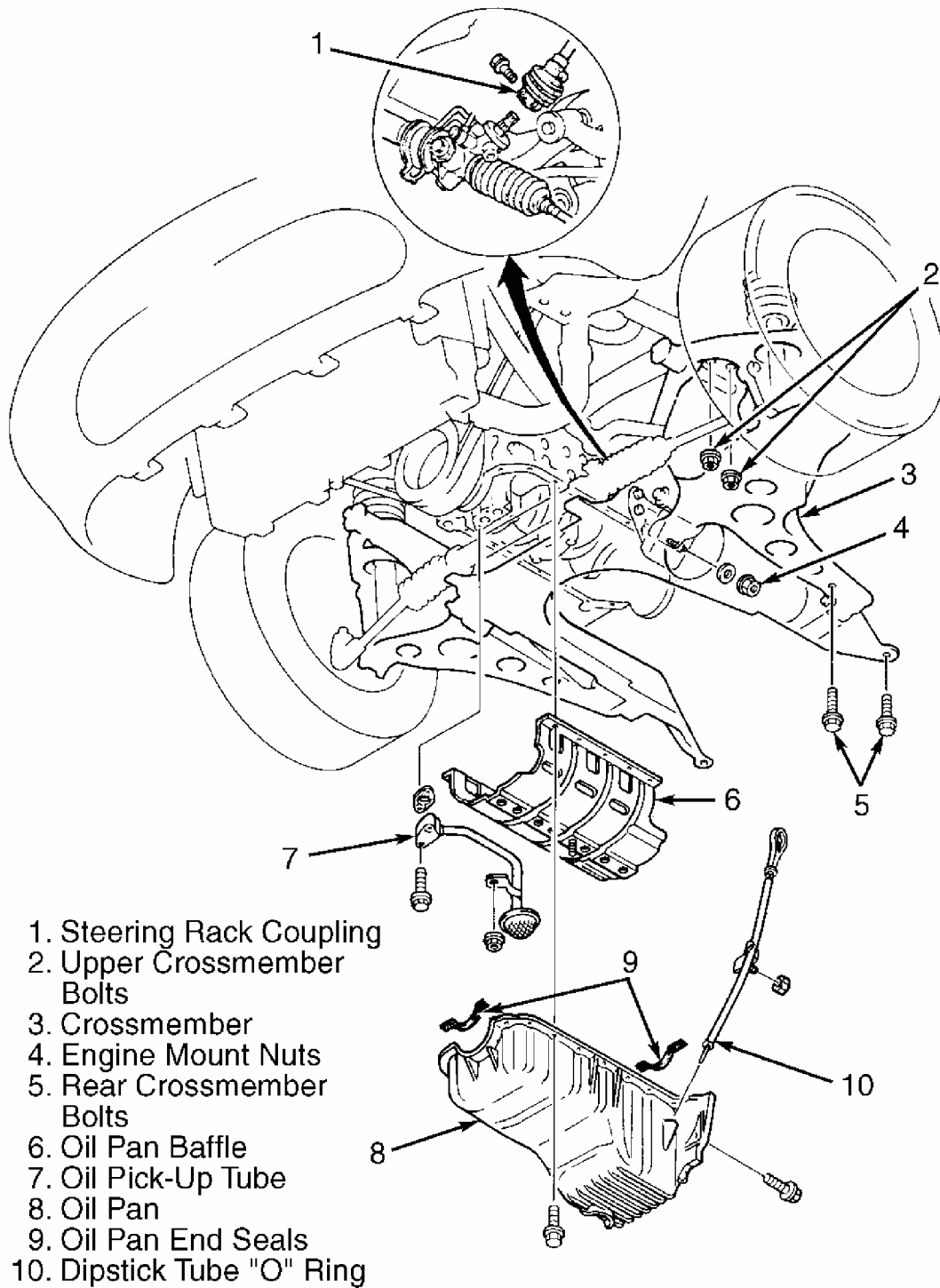
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1. Disconnect negative battery cable. Remove dipstick, tube and "O" ring. Raise vehicle on hoist. Remove engine undercover. Drain engine oil. Disconnect steering column shaft at steering rack coupling. Remove engine mount nuts. See **Fig. 9** . Lift and support engine using jack.
2. Support crossmember using transmission jack, and remove crossmember bolts and upper "A" frame nuts. Slowly and carefully lower crossmember until clearance between oil pan and steering rack is about 4 inches. Remove oil pan bolts from engine block and transmission.
3. DO NOT damage sealant contact surfaces. Remove oil pan by prying between oil pan and transmission support. Remove oil pan baffle by prying it from engine. See **Fig. 9** . DO NOT deform oil pan baffle. Replace oil pan baffle if deformed. Clean sealant from oil pan, bolts, engine block and both sides of oil pan baffle.
4. To install, apply oil resistant sealant to engine block and oil pan. Install oil pan baffle and oil pan. To complete installation, reverse removal procedure. Tighten bolts to specification. See TORQUE SPECIFICATIONS. Fill engine with oil to specification. See ENGINE LUBRICATION SYSTEM under ENGINE OILING.

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Fig. 9: Removing Crossmember & Oil Pan

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Courtesy of MAZDA MOTORS CORP.

OVERHAUL

CYLINDER HEAD

Cylinder Head

Clean carbon and gasket material from all mating surfaces. Using a tap, clean cylinder head threads. Check cylinder head for warpage, and resurface or replace if warpage exceeds specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS.

Valve Springs

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

Valve Stem Oil Seals

Use Installer Set (49-L012-0A0) to install valve seals. See **Fig. 10** . Adjust installer dimension "L" to seal depth of .720-.728" (18.3-18.5 mm). Using hand pressure ONLY, install seal until it contacts cylinder head. Lightly oil valve seal lip.

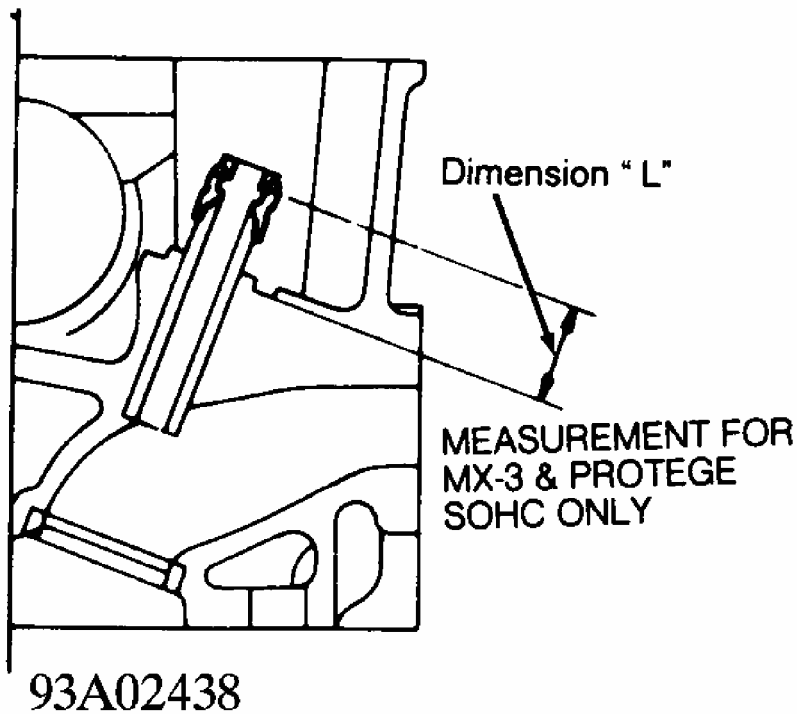
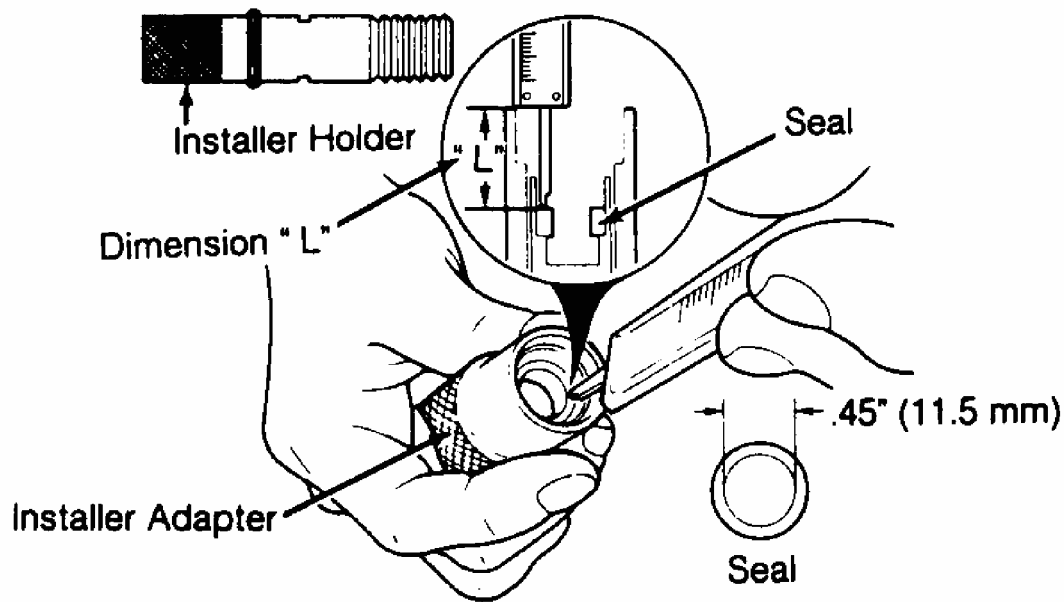


Fig. 10: Installing Valve Guide Seals
Courtesy of MAZDA MOTORS CORP.

NOTE: On Miata, use only new exhaust valve guides to replace intake or exhaust valve guides.

Valve Guides

1. Check valve stem-to-valve guide oil clearance. Ensure valve guide inside diameter is within specification. See CYLINDER HEAD under ENGINE SPECIFICATIONS.
2. Completely disassemble cylinder head. Gradually heat cylinder head in water to 194°F (94°C). Using Valve Guide Remover (49-B002-005), drive valve guide out from camshaft side of cylinder head. Repeat procedure if required, keeping cylinder head hot so aluminum head will not warp.
3. If required, install new circlip on guide. Using proper components of Valve Guide Installer (49-L012-0A0), adjust installer guide depth (dimension "L") to specification using depth micrometer or caliper. See **Fig. 11** .
4. Insert guide into pre-adjusted installer, and drive guide into cylinder head from camshaft side until guide circlip and/or installer contact cylinder head. Measure dimension "L" (guide installed height). See **Fig. 11** or **Fig. 12** . If installed height is not within specification, adjust or replace valve guide or cylinder head as necessary. See VALVE GUIDE INSTALLED HEIGHTS table.

VALVE GUIDE INSTALLED HEIGHTS

Application	In. (mm)
1.6L DOHC	.661-.685 (16.79-17.40)

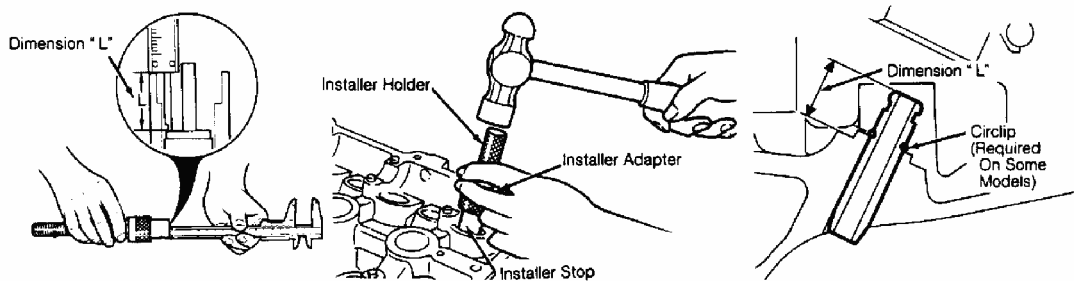


Fig. 11: Adjusting Valve Guide Installer & Installing Guide
 Courtesy of MAZDA MOTORS CORP.

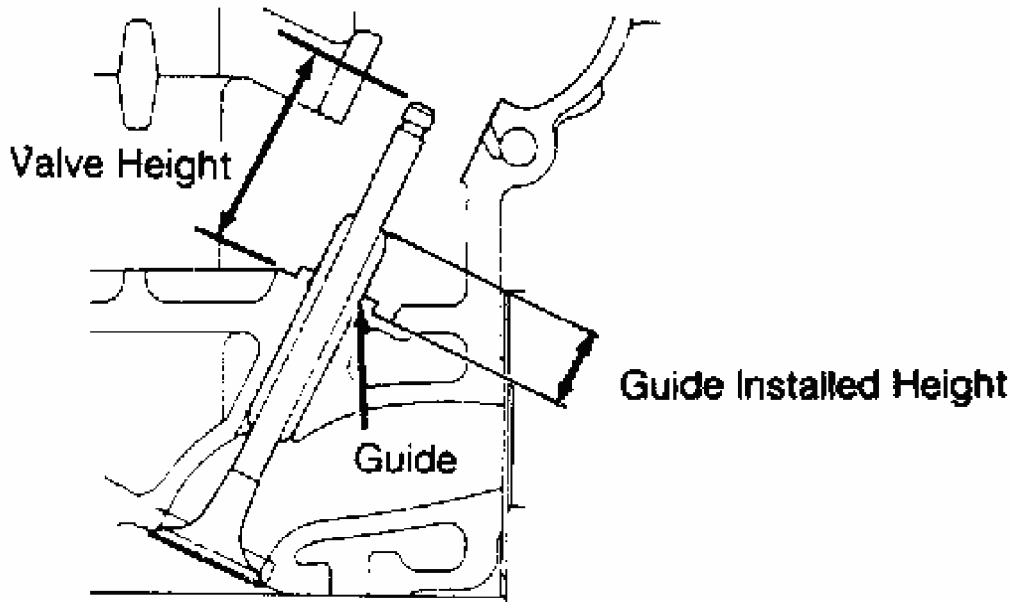


Fig. 12: Measuring Installed Valve & Guide Height
 Courtesy of MAZDA MOTORS CORP.

Valve Seat

1. Service valve guide before valve seat. Valve seat replacement information is not available from manufacturer. Inspect valve seat for roughness and damage. Check valve seat angle and seat width.
2. Measure seat contact width on valve, and note that seat contact position should be in center of valve face. Service seat if angle and width are not within specification. See CYLINDER HEAD table under ENGINE SPECIFICATIONS at end of article. Measure valve installed height after servicing valve seat. See **Fig. 12** . See VALVE INSTALLED HEIGHTS table.
3. If valve installed height is within serviceable range, install adjusting shim on spring seat. If installed height exceeds serviceable range, replace cylinder head.

VALVE INSTALLED HEIGHTS

Application	In. (mm)
Normal	1.713-1.732 (43.51-43.99)

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Service Limit

1.733-1.772 (44.02-45.00)

Valves

Check valve face angle, head diameter, margin thickness and stem diameter. Service or replace valves if measurements are not within specifications. See VALVES & VALVE SPRINGS table under ENGINE SPECIFICATIONS.

Valve Seat Correction Angles

Measure seat contact width on valve. See VALVE SEAT. Ensure valve/seat contact position is at center of valve face. If width and position are not within specifications, cut seats as follows:

- Miata - If seat contact position is too high, correct it using 75-degree cutter stone. Finish angle using 45-degree cutter until contact width is corrected. If seat contact position is too low, correct it using 35-degree cutter for intake seat and/or 15-degree cutter for exhaust seat. Finish angle using 45-degree cutter until contact width is corrected. Seat valve to valve seat using lapping compound.

VALVE TRAIN

NOTE: Valve clearance is not adjustable. Some valve noise may occur during engine start-up. Noise should disappear after engine reaches normal operating temperature. If noise persists, check oil pressure, oil level and engine condition.

Hydraulic Lash Adjusters

1. Remove camshaft cover. Check movement of each Hydraulic Lash Adjuster (HLA) by pushing downward using hand pressure only. If HLA moves down, replace HLA. To remove HLA, remove camshafts. See CAMSHAFT under REMOVAL & INSTALLATION. Mark location of HLA before removing it from bore. Lift HLA from cylinder head.
2. Inspect HLA friction surfaces for wear and damage. Replace HLA if required. Hold HLA between fingers and press plunger together. If plunger moves, replace HLA. Coat HLA with engine oil, and install it in original location. Ensure HLA moves smoothly in bore by using small magnet attached to HLA.

CYLINDER BLOCK ASSEMBLY

NOTE: During disassembly, match mark components for reassembly reference.

Piston & Connecting Rod Assembly

1. Before removing rod cap from crankshaft, measure and record rod side play. See CONNECTING RODS table under ENGINE SPECIFICATIONS at end of article. Before removing rod from crankshaft, record rod oil clearance. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.
2. Remove rod cap from crankshaft. Install short pieces of rubber hose over rod bolts. Push piston and rod assembly out of block.
3. To install, ensure parts are matched to cylinder. Ensure piston, rod, rings and bearings are properly fitted and in related positions. See **Fig. 13** . Install piston and rod assembly into block.

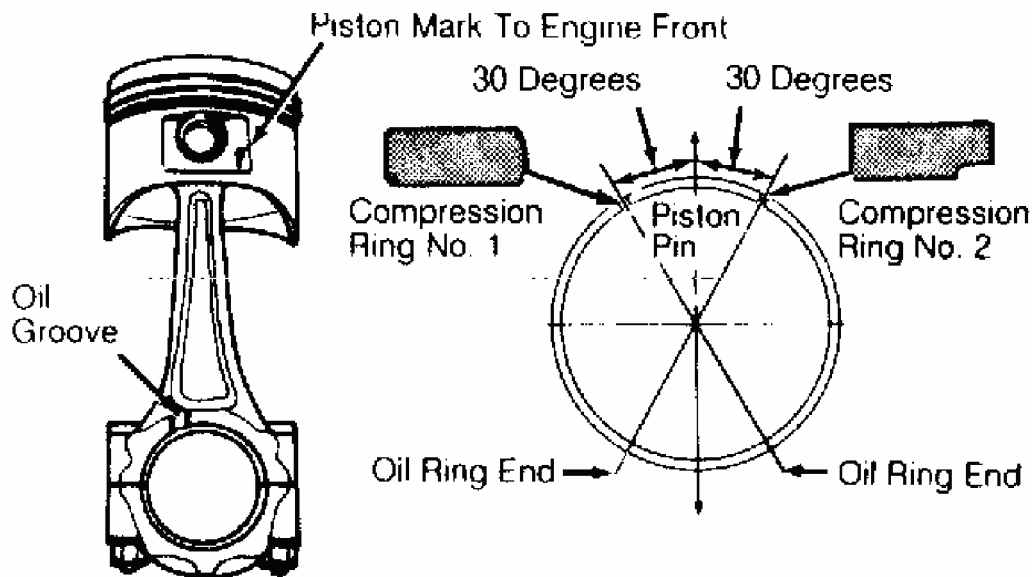


Fig. 13: Assembling Piston, Rod & Rings
 Courtesy of MAZDA MOTORS CORP.

Piston Pin Replacement

Match mark piston-to-pin and rod-to-piston positions for proper reassembly. Remove piston pin retaining clip. Drive piston pin out of piston and rod assembly. Install one piston pin retaining clip into groove in piston. Ensure piston is positioned properly on connecting rod. See **Fig. 13** . Tap piston pin into piston and through rod. Install second retaining clip. Piston should pivot freely.

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Fitting Pistons

1. Ensure pistons are not scored or damaged. Measure piston diameter on piston skirt at 11/16" below oil ring land. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS at end of article.
2. Check piston-to-cylinder wall clearance in 3 different vertical places of piston travel. If clearance is not within specification, rebore cylinders to fit oversize pistons. Using NEW piston ring, measure piston ring side clearance around entire piston circumference. If clearance is not within specification, replace piston. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS.

NOTE: Pistons and rings are available in .010" (.25 mm) and .020" (.50 mm) oversize.

Piston Rings

Insert NEW piston ring into cylinder, and measure ring end gap. Grind ring ends or replace piston ring if ring end gap is not within specification. See PISTONS, PINS & RINGS table under ENGINE SPECIFICATIONS.

Crankshaft & Main Bearings

1. Check crankshaft connecting rod journals for wear, out-of-round, taper and undersize. Machine or replace crankshaft and/or bearings as necessary. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS.
2. Before removing main cap, measure and record crankshaft end play by prying crankshaft forward then rearward. Using Plastigage method, measure and record main bearing oil clearance. Remove crankshaft. Measure and record each main journal diameter in 2 places. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table.
3. Main bearing caps are marked and must be installed in original position. Tighten bearing caps evenly to specification. See TORQUE SPECIFICATIONS.

Thrust Bearing

Install thrust bearing before installing crankshaft. Check crankshaft end play with crankshaft bearings and caps installed, but without connecting rods attached to crankshaft. DO NOT turn crankshaft until bearings are lubricated. Replace thrust bearing if end play is not within specification. See CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS table under ENGINE SPECIFICATIONS. Oversize thrust bearings are available.

Cylinder Block

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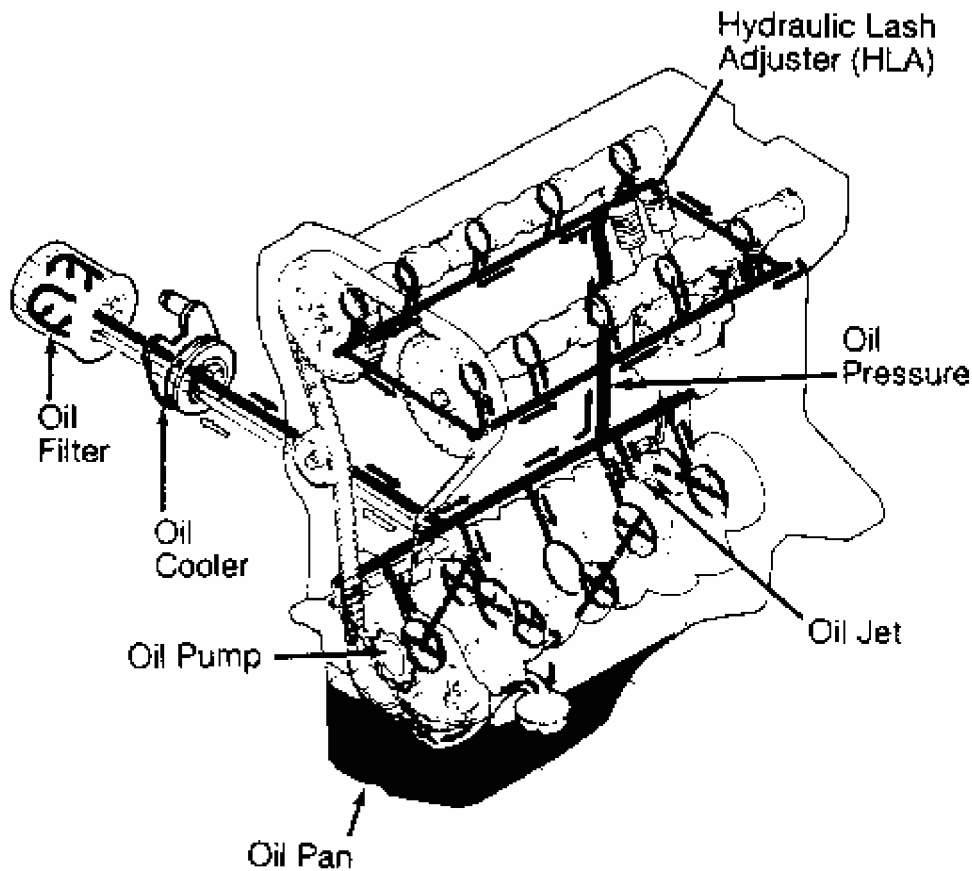
MAZDA ENGINES 1.6L 4-Cylinder - VIN (1)

Check cylinder bore out-of-round, taper, ridge and piston-to-cylinder bore clearance. Check head gasket surface for warpage. If warpage is not within specification, machine or replace cylinder block as necessary. See CYLINDER BLOCK table under ENGINE SPECIFICATIONS. Remove, clean and install oil jets for piston oil spraying.

ENGINE OILING

ENGINE LUBRICATION SYSTEM

NOTE: For cross-sectional view of engine oil circuit, See Fig. 14.



50C03636

DOHC

Fig. 14: Cross-Sectional View Of Engine Oil Circuit
Courtesy of MAZDA MOTORS CORP.

Crankcase Capacity

See **ENGINE OIL CRANKCASE CAPACITY** table.

Oil Pressure

With engine at operating temperature, oil pressure should be 28-43 psi (2.0-3.0 kg/cm²) at

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1000 RPM, and 43-57 psi (3.0-4.0 kg/cm²) at 3000 RPM.

Oil Pressure Relief Valve

Pressure relief valve opening pressure is 50-64 psi (3.5-4.5 kg/cm²). Pressure relief valve is located in oil pump body and is not adjustable.

ENGINE OIL CRANKCASE CAPACITY

Application	W/O Filter - Qts. (L)	W/Filter - Qts. (L)
Miata	3.6 (3.4)	3.8 (3.6)

OIL PUMP

Removal & Installation

1. Disconnect negative battery cable. Remove dipstick, tube and "O" ring. Drain engine oil and coolant. Remove drive belts, crankshaft and water pump pulleys. Remove alternator, A/C compressor and mounting bracket. Without disconnecting A/C hoses, secure A/C compressor away from engine. Remove timing belt and related components. See TIMING BELT under REMOVAL & INSTALLATION.
2. Using Crankshaft Lock Tools (49-S120-710 and 49-B011-102), lock crankshaft sprocket into position, and remove crankshaft sprocket bolt. See **Fig. 5**. Remove crankshaft sprocket using steering wheel puller. Leave crankshaft Woodruff key in place.
3. Remove oil pan and oil pump pick-up tube. See OIL PAN under REMOVAL & INSTALLATION. Remove oil pump housing assembly. See **Fig. 15**. Carefully clean all gaskets and sealant from mating surfaces without damaging sealing/mating surfaces. Remove all sealant from components and bolts. Check oil pump clearances. Repair or replace pump if necessary. See **OIL PUMP SPECIFICATIONS** table.
4. To install, reverse removal procedure. Tighten all bolts to specifications. See TORQUE SPECIFICATIONS.

OIL PUMP SPECIFICATIONS

Application	Maximum Clearance - In. (mm)
Inner Gear Tip-To-Outer Gear Clearance	.0079 (.201)
Outer Gear-To-Pump Body Clearance	.0087 (.221)
Gear End Play-To-Pump Body Clearance	.0055 (.140)
Pressure Spring Length	1.791 (45.49)

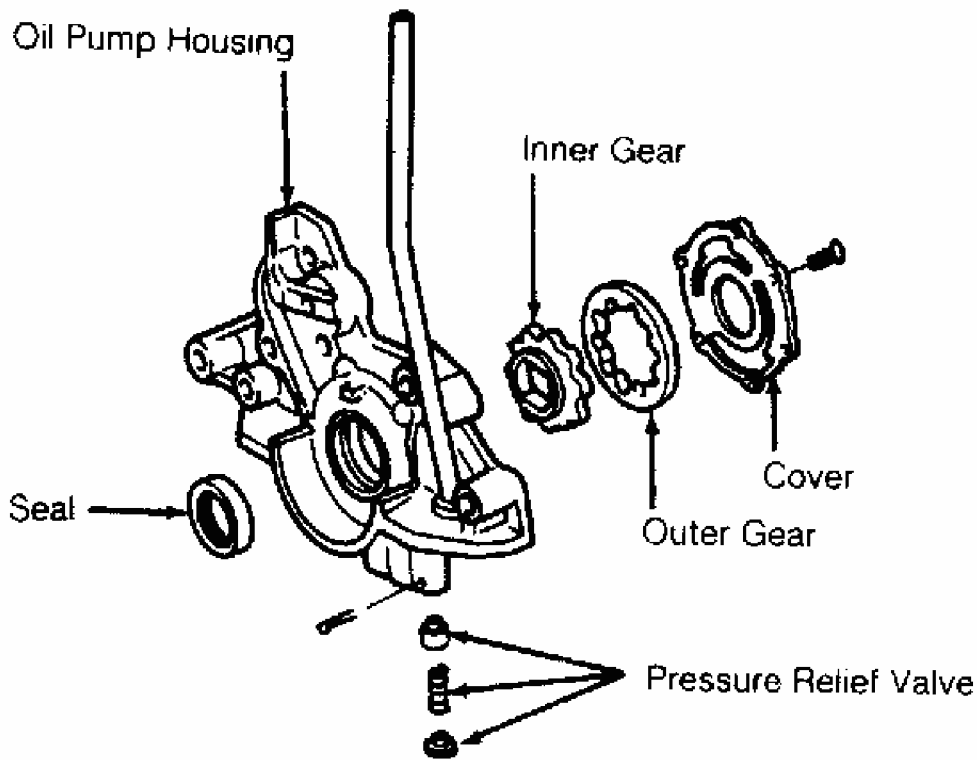


Fig. 15: Exploded View Of Oil Pump
 Courtesy of MAZDA MOTORS CORP.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
A/C Compressor-To-Bracket Bolt	11-16 (15-22)
Alternator Top Bolt	27-38 (37-52)
Axle Shaft Nut	174-235 (235-319)
Camshaft Sprocket Bolt	36-45 (49-61)
Connecting Rod Cap Nut	(1) 37-40 (50-54)
Crankshaft Pulley Attaching Bolts	9-13 (12-18)
Crankshaft/Timing Belt Sprocket Bolt	116-123 (157-167)

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Crossmember-To-Frame Bolt	47-66 (63-89)
Cylinder Head Bolt ⁽²⁾	
Step 1	35-40 (47-54)
Step 2 (Final)	56-60 (76-81)
Distributor Bolt	14-19 (19-26)
Drive Shaft Bolts	20-22 (27-30)
Engine Mount-To-Frame Nut	42-57 (57-77)
Exhaust Header Pipe-To-Exhaust Manifold Nut	23-34 (31-46)
Exhaust Manifold-To-Head Bolt	⁽¹⁾ 28-34 (38-46)
Flywheel Bolt	71-76 (96-103)
Fuel Rail Bolt	14-19 (19-26)
Intake Manifold Support Bracket	14-19 (19-26)
Intake Manifold Bolt/Nut	⁽¹⁾ 14-19 (19-26)
Main Bearing Cap Bolt	
Step 1	⁽¹⁾ 22-27 (30-37)
Step 2 (Final)	⁽¹⁾ 40-43 (54-58)
Main Bearing Support Plate-To-Motor Mount Nut	42-58 (57-79)
Motor Mount-To-Engine Bolt	27-40 (37-54)
Oil Pan Support-To-Transaxle	38-51 (52-69)
Oil Pump-To-Block Bolt	14-19 (19-26)
PPF/Differential Spacer Mounting Bolt ⁽²⁾	27-38 (37-52)
PPF-To-Differential Long Mounting Bolt ⁽²⁾	77-91 (104-123)
PPF-To-Transmission Side Mounting Bolt ⁽²⁾	77-91 (104-123)
PPF/Transmission Rear Bracket Mounting Bolt	27-40 (37-54)
Spark Plug	11-17 (15-23)
Timing Belt Tensioner Bolt	27-38 (37-52)
Water Pump Bolt	14-19 (19-26)
	INCH Lbs. (N.m)
Camshaft Cap Bolt (DOHC)	⁽³⁾ 100-125 (11.3-14.1)
Camshaft/Rocker Cover Bolt DOHC (Top)	43-78 (5-9)
Crankshaft Pulley Bolts	109-152 (12-17)
Oil Jet	104-156 (12-18)

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MAZDA ENGINES 1.6L 4-Cylinder - VIN (1)

Oil Pan Bolt	69-95 (8-11)
Oil Strainer Bolt	69-95 (8-11)
Water Pump Pulley Bolt	69-95 (8-11)

(1) Tighten evenly to specification in alternating sequence.

(2) Tighten in sequence. See **Fig. 4**.

(3) Tighten in sequence. See **Fig. 8**.

ENGINE SPECIFICATIONS**GENERAL SPECIFICATIONS**

Application	Specification
Displacement	97.4 Cu. In. (1.6L)
Bore	3.07" (78.0 mm)
Stroke	3.29" (83.6 mm)
Compression Ratio DOHC	
A/T	9.0:1
M/T	9.4:1
Fuel System	PFI
Horsepower @ RPM	
A/T	105 @ 6000
M/T	116 @ 6500
Torque Ft. Lbs. @ RPM	
A/T	100 @ 4000
M/T	10 @ 5500

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft	
End Play	
Standard	.0031-.0111 (.079-.282)
Maximum Wear Limit	.012 (.30)
Maximum Runout	.0016 (.040)
Main Journals	
Diameter	1.9660-1.9668 (49.938-49.956)

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MAZDA ENGINES 1.6L 4-Cylinder - VIN (1)

Out-Of-Round & Taper	.002 (.05)
Oil Clearance	
Standard	.0007-.0014 (.018-.036)
Maximum Wear Limit	.0039 (.100)
Crankpin Journal Diameter	
Standard	1.7693-1.7699 (44.940-44.956)
Minimum	1.7680 (44.908)
Out-Of-Round & Taper	.002 (.05)
Oil Clearance	
Standard	.0011-.0027 (.028-.068)
Maximum Wear Limit	.0039 (.100)

CONNECTING RODS

Application	In. (mm)
Bore Diameter	
Crankpin Bore	1.8898-1.8904 (48.000-48.016)
Pin Bore	.7875-.7880 (20.003-20.014)
Center-To-Center Length	5.230-5.234 (132.85-132.95)
Maximum Bend	.003 (.08)
Side Play	
Standard	.0043-.0103 (.110-.262)
Wear Limit	.012 (.30)

PISTONS, PINS & RINGS

Application	In. (mm)
Pistons	
Clearance	
Standard	.0015-.0020 (.039-.052)
Maximum	.006 (.15)
Diameter 1.6L (Standard)	3.0690-3.0698 (77.954-77.974)
Pins	
Diameter (DOHC)	.7869-.7871 (19.987-19.993)

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MAZDA ENGINES 1.6L 4-Cylinder - VIN (1)

Piston Fit (DOHC)		-.0002-.0005 (-.005-.013)	
Rings 1.6L (DOHC)			
No. 1			
End Gap			
Standard		.006- .012 (.15- .30)	
Wear Limit		.039 (1.0)	
No. 2			
End Gap			
Standard		.012- .018 (.30- .45)	
Wear Limit	.039 (1.0)		
Side Clearance			
Standard		.0012- .0026 (.030- .065)	
Wear Limit		.006 (.15)	

CYLINDER BLOCK

Application	In. (mm)
Cylinder Bore	
Standard Diameter	3.0711-3.0714 (78.006-78.013)
Maximum Taper & Out-Of-Round	.0007 (.019)
Deck Height	
Standard	8.720 (221.5)
Minimum	8.712 (221.3)
Maximum Deck Warpage	.006 (.15)

CYLINDER HEAD

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MAZDA ENGINES 1.6L 4-Cylinder - VIN (1)

Application	In. (mm)
Cylinder Head Height	5.268-5.276 (133.81-134.01)
Maximum Warp	.006 (.15)
Valve Seats	
Seat Angle	45°
Seat Width	.031-.055 (.79-1.40)
Valve Guides	
Valve Guide I.D.	.2366-.2374 (6.009-6.029)
Valve Guide Installed Height ⁽¹⁾	.661-.685 (16.79-17.40)
Valve Stem-To-Guide Oil Clearance	
Intake	.0010-.0024 (.025-.060)
Exhaust	.0012-.0026 (.030-.065)
Maximum Wear Limit	.008 (.20)
Cylinder Head-To-HLA Clearance DOHC	.0010-.0071 (.025-.180)
(1) Valve guide installed height is measured from top of installed guide to spring seat. See Fig. 14 and Fig. 15 .	

VALVES & VALVE SPRINGS

Application	Specification
Valves	
Face Angle	45°
Head Diameter	
Intake	1.22" (31.0 mm)
Exhaust	1.032" (26.2 mm)
Installed Height ⁽¹⁾	1.713-1.772" (43.51-45.00 mm)
Minimum Margin	
Intake	.035" (0.9 mm)
Exhaust	.039" (1.0 mm)
Minimum Refinish Length	
Intake	4.1256" (104.79 mm)
Exhaust	4.1295" (104.89 mm)
Stem Diameter	
Intake	.2350-.2356 (5.970-5.985)
Exhaust	.2348-.2354 (5.965-5.980)
Valve Springs	

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MAZDA ENGINES 1.6L 4-Cylinder - VIN (1)

Free Length	
Standard	
Intake	1.894 (48.10)
Exhaust	1.902 (48.30)
Minimum Limit	
Intake ⁽²⁾	1.575 (40.00)
Exhaust ⁽³⁾	1.575 (40.00)
Maximum Out-Of-Square	.0661 (1.680)
<p>(1) Valve height is measured from top of installed valve to spring seat. See VALVE INSTALLED HEIGHTS table under VALVE SEAT under CYLINDER HEAD under OVERHAUL. See Fig. 10 .</p> <p>(2) Measure with 52 lbs. (23.6 kg) of pressure applied to spring.</p> <p>(3) Measure with 42 lbs. (19.1 kg) of pressure applied to spring.</p>	

CAMSHAFT

Application	In. (mm)
End Play	.0028-.0074 (.071-.188)
Journal Diameter	1.0213-1.0222 (25.940-25.965)
Maximum Journal Out-Of-Round	.002 (.05)
Maximum Journal Runout	.0012 (.030)
Journal Oil Clearance	.0014-.0032 (.035-.081)
Lobe Height	
A/T	
Intake	1.5662-1.5741 (39.784-39.984)
Exhaust	1.6018-1.6097 (40.688-40.888)
M/T	1.6019-1.6098 (40.689-40.889)