B2200 4-CYLINDER DIESEL

ENGINE CODING

ENGINE IDENTIFICATION

Engine identification code is 8th character of the Vehicle Identification Number (VIN). The VIN is stamped on a metal tab located on top of instrument panel near lower left of windshield. Engine serial number is stamped on a machined pad, and is located at front of the cylinder block, just above injection pump.

ENGINE IDENTIFICATION CODE

Engine	Code
B2200 Diesel (1816 cc)	S2

ENGINE, MANIFOLDS & CYLINDER HEAD

ENGINE

1) Remove hood after marking hinge location. Drain cooling system and crankcase. Remove battery and air cleaner. Disconnect accelerator cable at injection pump.

2) Disconnect fuel lines. Disconnect oil cooler lines at crankcase. Remove radiator hoses and radiator. Disconnect engine vacuum hoses.

3) Disconnect wires from temperature sending unit, oil pressure switch, alternator, back-up light switch and starter. Disconnect exhaust pipe from manifold.

4) Remove cover plate from clutch housing and clutch slave cylinder. Support transmission with a jack and remove nuts and bolts attaching transmission to engine. Remove starter. Remove clutch slave cylinder.

5) Remove engine mount attaching nuts and bolts. Install a lifting sling to engine lifting brackets. Attach an engine hoist and raise slightly. Pull engine forward until clear of transmission. Lift engine from vehicle.

Installation

To install reverse removal procedure, and check all fluid levels before starting engine.

MANIFOLDS & CYLINDER HEAD

Removal

1) Remove engine lifting brackets from cylinder head. Disconnect exhaust pipe, then remove exhaust manifold. Drain cooling system. Remove coolant hoses at engine. Remove thermostat housing retaining bolts, and remove housing.

2) Remove vacuum sensing tube. Loosen drive belt, then remove water pump fan and pulley. Remove 5 water pump retaing bolts and water pump. Remove alternator and bracket retaining bolts, and remove as an assembly.

3) Label and disconnect all necessary wiring and cables from cylinder head and manifolds. Disconnect and remove injection nozzle. Remove intake manifold retaining bolts and remove manifold.

4) Remove rocker arm cover. Gradually loosen cylinder head bolts in reverse order of tightening sequence, then remove bolts. Remove rocker arm assembly, and push rods. Lift off cylinder head.

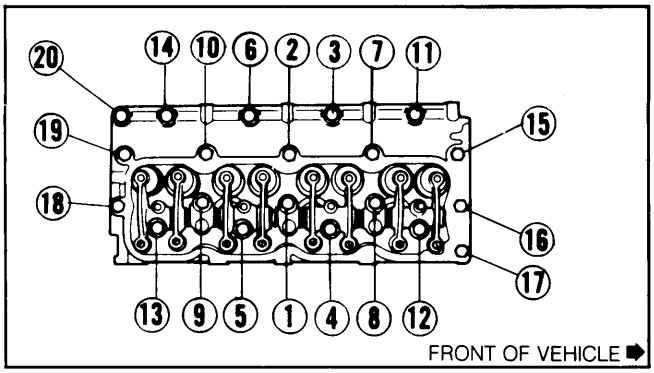
Installation

1) Clean all gasket mating surfaces. Install new head gasket, and install cylinder head. Install rocker arm assembly, and head bolts.

2) Tighten cylinder head bolts in sequence. *See Fig. 1.* Install and tighten remaining components in reverse order of removal. Adjust valves.

3) Tighten cylinder head bolts in sequence. *See Fig. 1.* Install and tighten remaining components in reverse order of removal. Adjust valves.

Fig. 1: Cylinder Head Tightening Sequence



Loosen bolts in reverse order of tightening sequence.

VALVES

VALVE ARRANGEMENT

I-E-I-E-I-E-I-E (Front-to-rear).

ROCKER ARM SHAFT ASSEMBLY

Removal

Remove rocker arm cover. Starting with the ends and working inward, remove rocker arm shaft attaching bolts. Remove rocker arm shaft assembly.

Installation

Tighten attaching bolts evenly in sequence, starting with inner bolts and working outward in a circular pattern.

VALVE SPRINGS

Removal & Installation

To remove and install valve springs, use procedures outlined in Valve Stem Oil Seal removal and installation.

Inspection

1) Measure inner and outer valve spring free length. Outer valve spring free length is 1.717" (43.6 mm). Inner valve spring free length is 1.654" (42.0 mm). If not within specifications, replace springs. Always replace inner and outer valve springs as a set.

2) Measure valve spring squareness. Place the valve spring on a surface plate and measure the squareness with a square. Measure the squareness at the upper part of valve spring.

3) Outer valve spring squareness limit is .054" (1.37 mm). Inner valve spring squareness limit is .049" (1.25 mm). If not within specifications, replace springs. Always replace inner and outer valve springs as a set.

VALVE STEM OIL SEALS

Removal

1) Remove rocker arm cover, and remove rocker arm shaft assembly. Position piston of cylinder concerned to TDC.

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2) Using spring compressor tool, compress spring and remove valve locks (taper sleeves). Release pressure and remove spring retainer and springs. Remove valve stem oil seal.

Installation

When installing new stem seals, apply grease to stem of valve. Reverse removal procedure, to complete installation.

VALVE GUIDE SERVICING

Inspection

1) Using dial indicator, check valve stem-to-guide clearance. Position dial indicator point about .40" (10 mm) above end of guide.

2) Rock valve stem back and forth and measure movement. If clearance exceeds .0050" (.127 mm) replace valve and valve guide.

Removal

Using a valve guide installer tool (49 0636 165A), drive out old valve guide toward combustion chamber side of cylinder head.

Installation

1) Coat outer surface of guide with engine oil. Working from top side of head, drive guide into head with valve guide installer tool (49 0636 165A).

2) Guide should project from cylinder head .650" (16.5 mm). Always replace valve guide and valve as a set.

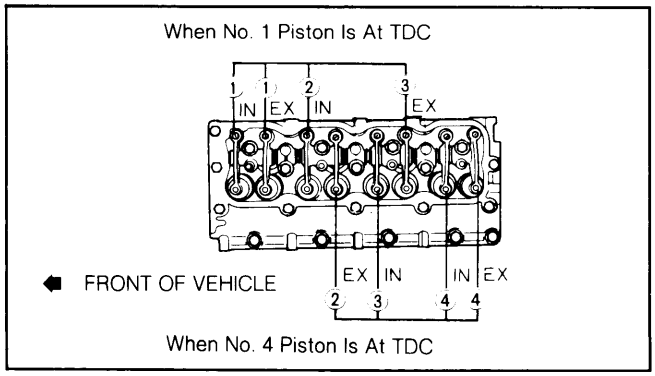
VALVE CLEARANCE ADJUSTMENT

1) Ensure rocker arm shaft is properly tightened. Hot valve clearance is .012" (.30 mm) for intake and exhaust valves. *See Fig. 2.*

2) Turn crankshaft to position No. 1 piston to TDC compression stroke. Adjust intake valve clearance on No. 1 and No. 2 cylinder, and exhaust valve clearance on No. 1 and No. 3 cylinder.

3) Turn crankshaft 1 revolution to place No. 4 piston to TDC compression stroke and adjust intake valve clearance on No. 3 and No. 4 cylinder, and exhaust valve clearance on No. 2 and No. 4 cylinder.

Fig. 2: Valve Adjustment Sequence



CAMSHAFT

ENGINE FRONT COVER

Removal

1) Drain cooling system. Remove battery. Disconnect radiator hoses at engine. Remove radiator. Remove alternator belt.

2) Remove crankshaft pulley retaining bolt, and remove pulley. Remove front cover retaining bolts and remove front cover.

Installation

To install, reverse removal procedure.

CRANKSHAFT FRONT OIL SEAL

Removal

Remove front engine cover. Using a screwdriver, carefully pry oil seal out of front cover.

Installation

Coat seal lip with engine oil. Using seal driver, install seal. Install remaining components in reverse order of removal.

TIMING GEAR

Removal

Remove front engine cover. Remove gear retaining nut. Using a gear puller, remove gear(s).

Installation

To install reverse removal procedure, and ensure timing gears are in proper alignment. *See Fig. 3.*

VALVE TIMING

To check for correct valve timing, refer to procedures explained in Timing Gear removal and installation.

CAMSHAFT

Removal

1) Remove engine from vehicle. Remove engine front cover. Remove rocker arm shaft assembly and push rods. Remove camshaft gear.

2) Remove camshaft thrust plate retaining bolts, and carefully slide out camshaft.

Installation

To install, reverse removal procedure, and ensure valve timing is correct. *See Fig. 3.*

CAMSHAFT END THRUST

1) Remove engine front cover. Attach a dial indicator to cylinder block with indicator point on camshaft gear center bolt. Push camshaft rearward and zero dial indicator.

2) Use a screwdriver to pry camshaft forward and record end thrust. Maximum end thrust is .0118" (.3 mm). If not within specifications, replace thrust plate.

INJECTION PUMP TIMING

1) Checked that notched lines on injection pump flange and injection pump front bracket are aligned. With No. 1 cylinder at TDC on compression stroke, check timing mark alignment of timing gears. *See Fig. 3.*

2) Disconnect injection pipe from pump and remove hydraulic head plug. Rotate the crankshaft pulley until the 2°ATDC mark on the pulley is aligned with the pointer. Install a dial indicator so that the pointer touches the plunger end of the pump, and dial gauge indicates approximetly .08" (2.0 mm).

3) Turn the crankshaft counter-clockwise (in reverse order of engine rotation)until the timing mark on the crankshaft pulley moves from the original position (2°ATDC) to the counter-clockwise side by 30-50°. *See Fig. 4.*

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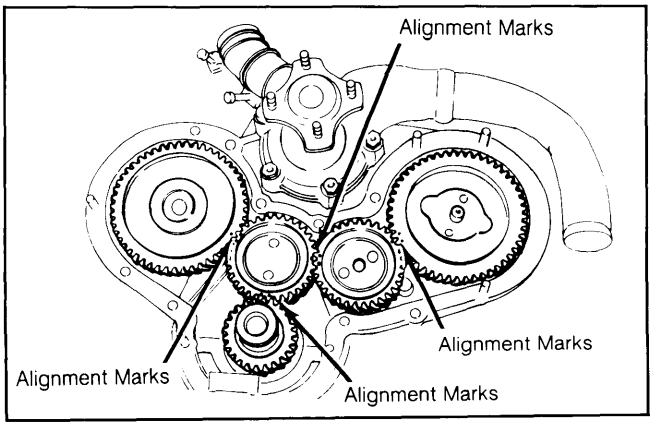
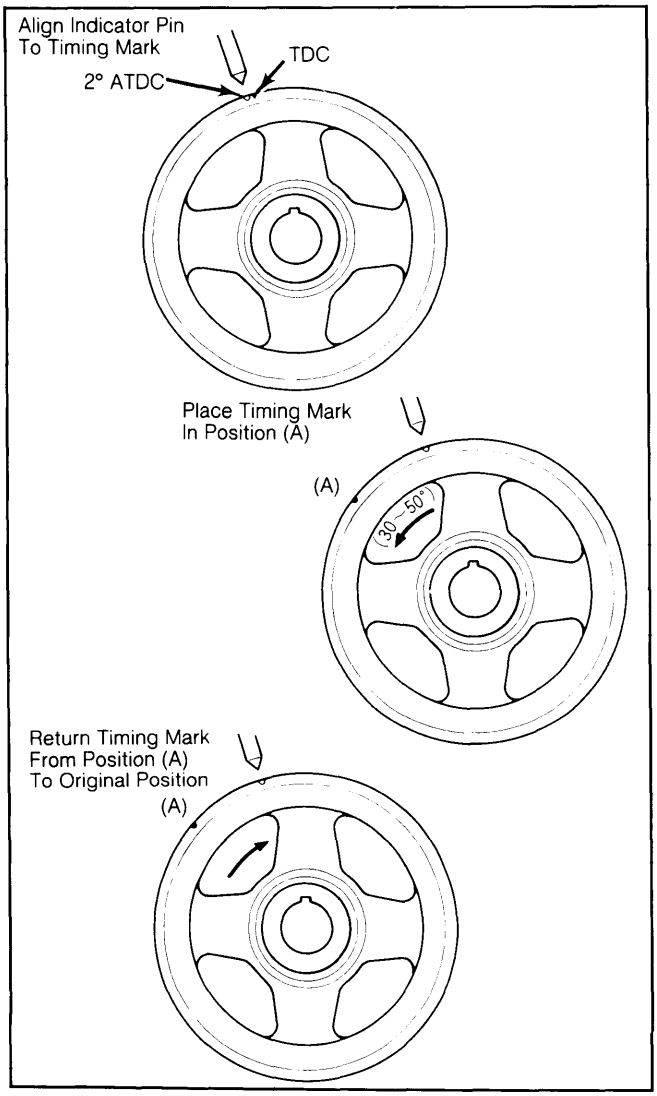
Fig. 3: Injection Pump Alignment Marks



Ensure marks are in correct alignment.

4) Ensure that the dial indicator pointer has stoped moving. Zero dial indicator. Turn crankshaft pulley slightly in both directions and check that gauge indication is stable.

Fig. 4: Injection Pump Adjustment



Ensure pump flange nuts are loose, when adjusting pump.

5) Turn crankshaft in normal direction of rotation until timing mark is aligned with timing pointer. Dial indicator should read .04" (1.0 mm).

6) If indicator reading is not within specifications, loosen the injection pump flange retaining nuts, and rotate housing until correct specifications are obtained. Tighten nuts and recheck reading.

PISTONS, PINS & RINGS

OIL PAN

Raise vehicle, and remove engine under cover. Drain engine oil. Remove the oil pan nuts and bolts, and remove oil pan.

PISTON AND ROD ASSEMBLY

Removal

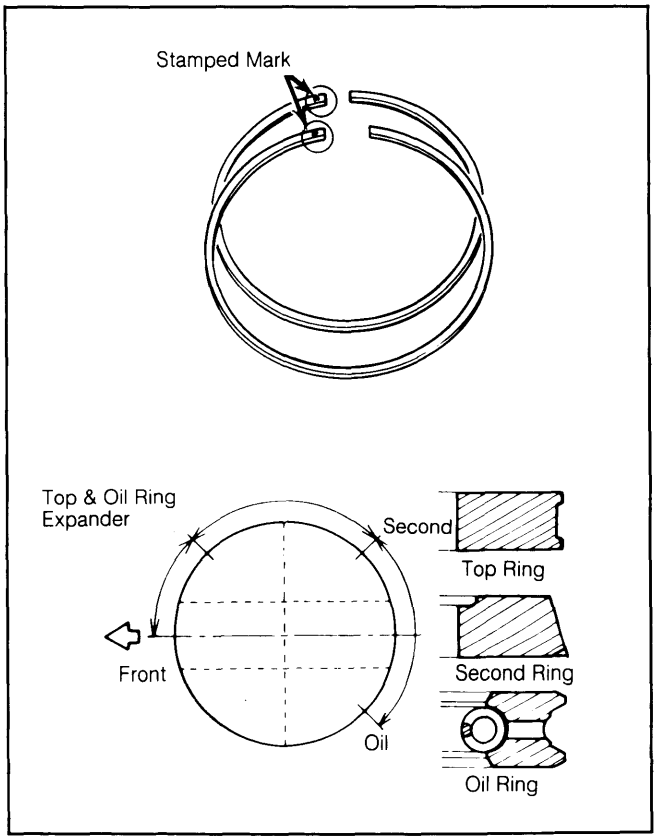
1) Remove cylinder head. Remove oil pan. Remove oil pump set screw at side of cylinder block. Remove oil pipe attaching bolts, then remove oil pump with oil pipe attached.

2) Remove carbon deposits from upper edge of cylinder wall. Remove rod cap. Push piston/rod assembly out top of cylinder block. Install rod cap on its respective piston/rod assembly.

Installation

1) Lightly oil rings, piston and cylinder wall. Ensure ring gaps are properly spaced. *See Fig. 5.* Make sure bearing halves are properly seated in connecting rod and cap.

Fig. 5: Piston Ring Gap Locations



The ring gap should not be directed toward the thrust side or counter thrust side.

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2) Install a ring compressor and compress rings. Install piston in cylinder. Ensure piston/connecting rod assembly is installed in proper direction. *See Fig. 6.* Install and tighten rod cap. Reverse removal procedure to complete installation.

FITTING PISTONS

Measure the clearance between the piston and cylinder liner. If the clearance exceeds .0021-.0031" (.054-.080 mm), measure the piston diameter in the thrust direction, .6299" (16 mm) above the bottom of piston. Piston diameter should be 3.4985-3.4994" (88.867-88.893 mm). If not within specifications, replace the piston.

CYLINDER LINERS

Inspection

1) Measure the inner diameter of cylinder liners and determan the extent of wear. Measure the cylinder liner diameter at 3 positions, top, middle and bottom.

2) Standard diameter is 3.5001-3.5020" (88.90-88.95 mm), maximum wear limit (beyond standard diameter) is .0079" (.20 mm). If not within specifications, replace liner.

Removal

Press out old liner, using cylinder liner replacement tool (49 0636 015). Check cylinder block bore for any scratches. If any scratches are found, remove with a oil soaked fine emery cloth.

Installation

1) Apply engine oil on the cylinder block bore and a new liner outer surface and set the liner on the cylinder block.

2) Press fit the liner with the cylinder liner replacer, taking special care not to distort it.

NOTE: When inserting the liner into the cylinder block, press fit liner within the limits of 2,200-6,600 lbs. (10,000-30,000 N) If the pressing force exceeds the limits, find the trouble and repair it.

3) After the liner has been installed, make sure that the cylinder bore and the protrusion height are within the specified values. Protrusion height above cylinder block is .026-.031" (.659-.790 mm).

FITTING RINGS

1) Position rings into cylinder bore at a point where bore diameter is smallest. Ring must be square in bore. Measure ring end gap with a feeler gauge. Maximum allowable end gap is .0059" (1.5 mm).

2) Using a feeler gauge, check ring side clearance. Maximum allowable side clearance is .012" (.3 mm). Ensure rings turn freely in their ring grooves.

3) When installing rings on piston, ensure gaps are correct. *See Fig. 5.* The stamped mark on piston rings must be upward.

PISTON PIN REPLACEMENT

Removal

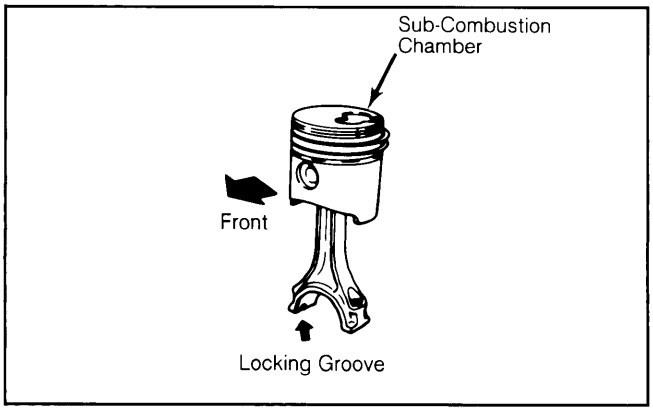
To remove pin, use snap ring pliers and remove snap rings from piston. Press piston pin out. Piston pin bushings in rod's small end are replaceable.

Installation

1) Assemble rod to piston so that sub-combustion chamber side of piston head is oposite locking groove on connecting rod. *See Fig. 6.*

2) Coat pin with oil and install in piston and rod. Install snap rings to secure pin in place.

Fig. 6: Positioning Rod to Piston



Note position of identification markings when installing rod to piston.

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

MAIN BEARINGS

1) Mark all bearing caps for proper identification. Check bearing clearances 1 at a time. With all bearing caps tighted, check clearances using Plastigage method.

2) If clearances are excessive, machine the crankshaft and use under size main bearings.

3) To check crankshaft for straightness, place "V" blocks under crankshaft at No. 1 and No. 5 journals. Position dial indicator point on No. 3 journal.

4) Slowly turn crankshaft at least 1 full revolution, while recording runout. If runout exceeds .0019" (.050 mm), replace crankshaft and bearings.

5) Ensure each main bearing cap is set with the arrow mark on the top pointing towards the front of engine. Assemble the collared thrust washers on both ends of the center bearing cap with the oil groove set outward.

CONNECTING ROD BEARINGS

1) After ensuring rod caps are marked for cylinder identification, remove rod caps. Use Plastigage method to check for proper bearing clearance.

2) If not within limits, machine crankshaft and install undersize bearings.

CRANKSHAFT END THRUST

Using a dial indicator, measure crankshaft end thrust by moving the crankshaft in a axial direction. If clearance is greater than .0157" (.40 mm), replace thrust washer located at center bearing with a .007" (.178 mm) oversize washer.

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REAR MAIN BEARING OIL SEAL

Removal

Remove transmission, and flywheel assembly. Remove 8 bolts attaching rear oil seal housing to cylinder block, and remove housing. Using a screwdriver carefully pry seal out of housing.

Installation

Coat seal lip with engine oil. Using seal installer tool, install new seal. Reverse removal procedures to install remaining components.

ENGINE OILING

CRANKCASE CAPACITY

Capacity is 7.9 qts. (7.5L).

NORMAL OIL PRESSURE

Normal oil pressure is 57 psi (4.1 kg/cm²), at 3600 RPM.

ENGINE OILING SYSTEM

A rotor-type oil pump. Oil drawn from crankcase passes through a strainer, then to oil pump. Oil is delivered to full flow oil filter, oil cooler, and main oil gallery. By-pass valves are incorporated into oil filter and oil cooler.

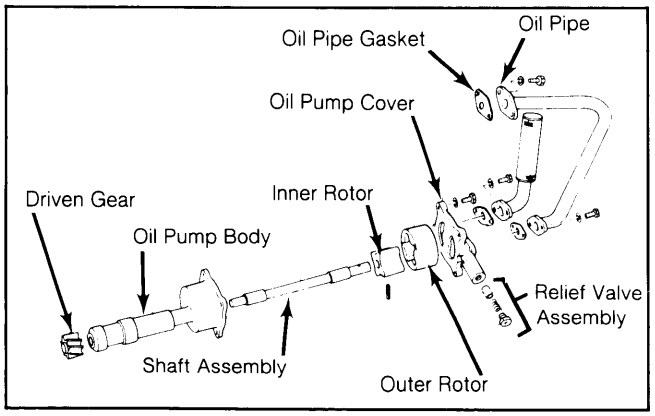
Main oil gallery supplies oil to lubricate crankshaft, main and connecting rod bearings. Oil gallery feeds oil camshaft. From camshaft, oil is routed to feed rocker arm shaft assembly and upper valve train components.

OIL PUMP

Removal

Remove oil pan. Remove oil pump set screw, located at side of cylinder block. Remove oil pipe attaching bolts, and remove oil pump.

Fig. 7: Oil Pump Assembly



Thoroughly clean all parts prior to measuring clearances.

Inspection

1) Disassemble oil pump and clean all parts thoroughly. Inspect for signs of unusual wear or damage.

2) With rotors installed in pump, place a straightedge over pump housing. Use a feeler gauge to measure clearance between rotors and straightedge. If clearance over rotors is excessive, replace rotor set.

3) Using a feeler gauge, measure clearance between inner and outer rotors. If clearance is beyond limits, replace rotor set.

4) Using feeler gauge, measure clearance between outer rotor and pump housing. If clearance is excessive, replace entire pump assembly.

5) Check clearance between rotor shaft and pump body. If beyond limits, replace entire pump assembly.

Inspection

1) Using a feeler gauge, check clearance between pump body inner wall and tip of each gear. If clearance is beyond limits, replace entire gear set.

2) With gears installed, lay a straightedge over pump housing. Use a feeler gauge to measure clearance between gears and straightedge. If gear-to-cover clearance is excessive, replace entire pump assembly.

Installation

To install, reverse removal procedures.

OIL PUMP SPECIFICATIONS

Application	[1] Clearance In. (mm)
Clearance Over Rotors	.006 (.15)
Inner-to-Outer Rotor Clearance	.012 (.30)
Outer Rotor-to-Pump Housing	.012 (.30)
Rotor Shaft-to-Pump Housing	.0039 (.1)

[1] — Clearances given are wear limits.

ENGINE COOLING

THERMOSTAT

Thermostat opens at approximately 180°F (82°C), and is fully open at approximately 203°F (95°C).

COOLING SYSTEM CAPACITY

Cooling system capacity is 11.1 qts. (10.5L).

RADIATOR CAP

Radiator cap pressure relief valve opens at 13 psi (.914 kg/cm²).

WATER PUMP

Removal

Drain cooling system. Remove fan, fan shroud and upper radiator hose. Remove drive belt and fan pulley. Remove water pump retaining bolts (5) and remove pump.

Installation

Clean gasket mating surfaces. Using new gasket, install water pump in reverse order of removal.

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Cylinder Head	80-85 (110-117)
Camshaft Gear	45-51 (62-70)
Connecting Rod	50-54 (69-75)
Crankshaft Pulley	145-181 (200-250)
Engine Rear Plate	23-34 (33-48)
Flywheel	95-137 (131-190)
Main Bearing Caps	80-85 (110-117)
Manifolds (Intake & Exhaust)	11-17 (16-24)
Injection Pump Timing Gear	29-51 (40-70)
Rocker Arm Shaft Assembly	80-85 (110-117)
Idle Gear	16-23 (23-32)

Mazda Engines

B2200 4-CYLINDER DIESEL (Cont.)

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Year	DISPLACEMENT Cu. In.	DISPLACEMENT cc	Fuel System	HP@RPM	Torque Ft. Lbs.@RPM	Compr. Ratio	BORE In.	BORE mm	STROKE In.	STROKE mm
1982	134.8	2209	Fuel Inj.	.....	.....	.....	3.50	88.9	3.50	89.0

VALVES

Engine Size & Valve	Head Diam. In. (mm)	Face Angle	Seat Angle	Seat Width In. (mm)	Stem Diameter In. (mm)	Stem Clearance In. (mm)	Valve Lift In. (mm)
2209 cc							
Intake	1.591-1.599 (40.4-40.6)	45°	45°	.079 (2.0)	.3150-.3197 (7.880-8.050)	.0015-.0055 (.051-.14)	.....
Exhaust	1.412-1.422 (35.987-36.013)	30°	30°	.079 (2.0)	.3150-.3197 (7.867-8.088)	.0015-.0055 (.051-.14)	.....

CRANKSHAFT MAIN & CONNECTING ROD BEARINGS

Engine	MAIN BEARINGS Journal Diam. In. (mm)	MAIN BEARINGS Clearance In. (mm)	MAIN BEARINGS Thrust Bearing	MAIN BEARINGS Crankshaft End Play In. (mm)	CONNECTING ROD BEARINGS Journal Diam. In. (mm)	CONNECTING ROD BEARINGS Clearance In. (mm)	CONNECTING ROD BEARINGS Side Play In. (mm)
2209 cc	2.5588-2.5591 (64.987-65.00)	.0016-.0047 (.040-.12)	No. 3	.0055-.0157 (.140-.40)	2.0861-2.0871 (52.987-52.00)	.0014-.0039 (.036-.1)	.0094-.0157 (.239-.40)

PISTONS, PINS, RINGS

Engine	PISTONS Clearance In. (mm)	PINS Piston Fit In. (mm)	PINS Rod Fit In. (mm)	RINGS Ring No.	RINGS End Gap In. (mm)	RINGS Side Clearance In. (mm)
2209 cc	.0021-.0031 (.054-.080)	.0006 (.016)	.0006-.0016 (.014-.041)	No. 1	.0157-.0217 (.40-.55)	.0020-.0035 (.050-.090)
				No. 2	.0118-.0157 (.30-.40)	.0016-.0031 (.04-.08)
				Oil	.0138-.0217 (.35-.55)	.0012-.0028 (.30-.012)

VALVE SPRINGS

Engine	Free Length In. (mm)	PRESSURE Lbs. @ In. (Kg @ mm) Valve Closed	PRESSURE Lbs. @ In. (Kg @ mm) Valve Open
2209 cc			
Inner	1.736 (44.1)	.....	.....
Outer	1.807 (45.9)	.....	.....

CAMSHAFT

Engine	Journal Diam. In. (mm)	Clearance In. (mm)	Lobe Lift In. (mm)
2209 cc			
No. 1	2.0473 (52.00)	.0024-.0047 (.060-.120)	.....
No. 2	2.0374 (51.75)	.0024-.0047 (.060-.120)	.....
No. 3	2.0177 (51.25)	.0024-.0047 (.060-.120)	.....

VALVE TIMING

Engine	INTAKE Open (BTDC)	INTAKE Close (ABDC)	EXHAUST Open (BBDC)	EXHAUST Close (ATDC)
2209 cc	[1]	[1]	[1]	[1]

[1] — Information not available from manufacturer.