

ENGINE OVERHAUL <2.0L (420A)>

CONTENTS

11309000159

CAMSHAFT AND CAM FOLLOWER	28	INTAKE MANIFOLD.....	25
COOLING SYSTEM COMPONENTS	21	OIL PAN AND OIL PUMP	39
CRANKSHAFT	55	OIL PUMP	42
CYLINDER HEAD AND VALVE	32	PISTON, CONNECTING ROD AND CYLINDER BLOCK	45
EXHAUST MANIFOLD	27	SPECIAL TOOLS	9
FUEL AND EMISSION CONTROL PARTS	23	SPECIFICATIONS	3
GENERAL INFORMATION	2	Sealants	7
General Specifications	2	Service Specifications..	3
GENERATOR	11	Torque Specifications	6
IGNITION SYSTEM	12	TIMING BELT.....	16

GENERAL INFORMATION

11300010106

GENERAL SPECIFICATIONS

Descriptions		Specifications	
Type		In-line OHV, DOHC	
Number of cylinders		4	
Cylinder bore mm (in.)		87.5 (3.445)	
Piston stroke mm (in.)		83.0 (3.267)	
Compression ratio		9.6	
Valve timing [Measured at 0.5 mm (.02 in.) lift]	Intake valve	Opens (BTDC)	1.3°
		Closes (ABDC)	39.7°
	Exhaust valve	Opens (BBDC)	36°
		Closes (ATDC)	1.1°
Lubrication system		Pressure feed, full-flow filtration,	
Water pump type		Centrifugal impeller type	
EGR type		Single type	
Injector type and number		Electromagnetic, 4	

SPECIFICATIONS

11300030119

SERVICE SPECIFICATIONS

Items		Standard value	Limit
Ignition coil system			
Spark plug cable resistance Ω		3000– 12000	–
Ignition coil resistance Ω	Primary	0.51–0.61	
	Secondary	11500–13500	–
Camshaft and cam follower			
Cam wear amount mm (in.)		0.0254 (.001)	0.254 (.01)
Camshaft bearing bore diameter mm (in.)		26.020–26.041 (1.024–1.025)	–
Camshaft diameter bearing clearance mm (in.)		0.069–0.071 (.0027–.0028)	–
Camshaft end play mm (in.)		0.15 (.006)	–
Camshaft bearing journal diameter mm (in.)		25.951–25.970 (1.0217–1.0224)	–
Camshaft lift mm (in.)	Intake	8.22 (.324)	
	Exhaust	7.00 (.276)	–
Hydraulic lash adjuster mm (in.)	Body diameter	22.949–22.962 (.9035–.9040)	–
	Plunger travel minimum (dry)	4.24 (.167)	
Cylinder head and valve			
Flatness of gasket surface mm (in.)		–	0.1 (.004)
Valve seat angle		44.5°–45°	–
Valve seat runout (max) mm (in.)		0.050 (.002)	–
Valve seat width (Finish) mm (in.)		0.9–1.3 (.035–.051)	–
Valve seat guide bore diameter mm (in.)		11.00–11.02 (.4330–.4338)	–
Intake valve seat diameter mm (in.)		34.50 (1.358)	–
Exhaust valve diameter mm (in.)		29.50 (1.161)	–
Valve face angle		45°–45.5°	–
Valve head diameter mm (in.)	Intake	34.67–34.93 (1.364–1.375)	–
	Exhaust	30.37–30.63 (1.195–1.205)	–

Items		Standard value	Limit
Valve margin mm (in.)	Intake	1.285-1.615 (.050-.063)	-
	Exhaust	0.985-1.315 (.038-.051)	-
Valve length (Overall) mm (in.)	Intake	111.49-111.99 (4.389-4.409)	-
	Exhaust	109.59-110.09 (4.314-4.334)	-
Valve stem tip height mm (in.)	Intake	48.04 (1.891)	-
	Exhaust	47.99 (1.889)	-
Valve stem diameter mm (in.)	Intake	5.934-5.952 (.233-.234)	-
	Exhaust	5.906-5.924 (.233-.233)	-
Valve stem to guide clearance mm (in.)	Intake	0.048-0.066 (.0019-.0026)	0.076 (.003)
	Exhaust	0.074-0.094 (.0029-.0037)	0.101 (.004)
Valve guide inner diameter mm (in.)		5.975-6.000 (.2352-.2362)	-
Valve spring free length mm (in.)		46 (1.811)	-
Valve spring tension (valve closed) N/mm (lbs./in.)		246-270/38.0 (55-60/1.496)	-
Valve spring tension (valve open) N/mm (lbs./in.)		549-611/29.3 (123-137/1.153)	-
Valve spring number of coils mm (in.)		7.35	-
Valve spring wire diameter mm (in.)		3.76 (.148)	-
Valve installed spring height mm (in.)		38.00 (1.496)	-
Oil pump			
Oil pump clearance over rotors mm (in.)			0.102 (.004)
Oil pump cover out of flat mm (in.)			0.076 (.003)
Oil pump inner rotor thickness mm (in.)			7.64 (.301)
Oil pump outer rotor clearance mm (in.)			0.39 (.015)
Oil pump outer rotor diameter mm (in.)			79.95 (3.148)
Oil pump outer rotor thickness mm (in.)			7.64 (.301)
Oil pump tip clearance between rotors mm (in.)		-	0.02 (.0008)
Oil pressure at curb idle speed kPa (psi)		25 (4)	

Items		Standard value	Limit
Piston, connecting rod and cylinder block			
Piston standard piston size mm (in.)		87.463-87.481 (3.4434-3.4441)	-
Piston to bore clearance mm (in.)		0.012-0.044 (.0005-.0017)	-
From bottom of skirt mm (in.)		0.012-0.044 (.0005-.0017)	-
Land clearance (Diametrical) mm (in.)		0.740-0.803 (.029-.032)	-
Piston length mm (in.)		63.82 (2.513)	-
Piston ring groove depth mm (in.)	Top upper compression ring	3.983-4.132 (.157-.163)	-
	Intermediate compression ring	4.456-4.605 (.175-.181)	-
	Oil control (Steel ring) ring	3.841-4.075 (.151-.160)	-
Piston pin clearance in piston mm (in.)		0.008-0.020 (.0003-.0008)	-
Piston pin in rod (interference) mm (in.)		0.018-0.043 (.0007-.0017)	-
Piston pin diameter mm (in.)		20.998-21.003 (.8267-.8269)	-
Piston pin length mm (in.)		74.75-75.25 (2.943-2.963)	-
Piston ring gap mm (in.)	Top upper compression ring	0.23-0.52 (.009-.020)	0.8 (.031)
	Intermediate compression ring	0.49-0.78 (.019-.031)	1.0 (.039)
	Oil control (Steel ring) ring	0.23-0.66 (.009-.026)	1.0 (.039)
Piston ring side clearance mm (in.)	Top upper and intermediate compression ring	0.025-0.065 (.0010-.0026)	0.10 (.004)
	Oil control (Pack) ring	0.004-0.178 (.0002-.0070)	-
Piston ring width mm (in.)	Top upper and intermediate compression ring	1.17- 1.19 (.046-.047)	-
	Oil control (Pack) ring	2.854-3.008 (.1124-.1184)	-
Cylinder block cylinder bore diameter mm (in.)		87.5 (3.445)	-
Cylinder block cylinder bore out-of-round mm (in.)		-	0.051 (.002)
Cylinder block cylinder bore taper mm (in.)		-	0.051 (.002)

11D-6**ENGINE OVERHAUL <2.0L (420A)> – Specifications**

Items	Standard value	Limit
Connecting rod bearing oil clearance mm (in.)	0.026–0.059 (.0010–.0023)	0.075 (.015)
Connecting rod piston pin bore diameter mm (in.)	20.96–20.98 (.8252–.8260)	–
Connecting rod large end bore diameter mm (in.)	50.991–51.005 (2.0075–2.0081)	–
Connecting rod side clearance mm (in.)	0.13–0.38 (.0051–.0150)	0.37 (.015)
Main bearing journal diameter mm (in.)	51.9924–52.0076 (2.0469–2.0475)	–
Main bearing journal out-of-round mm (in.)	–	0.0035 (.0001)
Main bearing journal taper mm (in.)	–	0.0038 (.0001)
Crankshaft		
Crankshaft connecting rod journal diameter mm (in.)	47.9924–48.0076 (1.8894–1.8900)	–
Crankshaft out-of-round mm (in.)		0.0035 (.0001)
Crankshaft taper mm (in.)		0.0038 (.0001)
Crankshaft main bearing diameter clearance mm (in.)	0.022–0.062 (.0008–.0024)	–
Crankshaft end play mm (in.)	0.09–0.24 (.0035–.0094)	–

TORQUE SPECIFICATIONS

Items	Nm	ft.lbs.
Generator		
Pivot	54	39
Lock nut	61	44
Ignition system		
Spark plug	28	20
Camshaft position sensor	3	2.2
Timing belt		
Crankshaft damper bolt	62	45
Engine mount bracket	41	30
Timing belt inspection cover	12	8.7
Tensioner pulley	28	20
Timing belt tensioner	31	22
Tensioner arm bracket	31	22
Camshaft sprocket	101	73
Rear timing belt cover	9.6	6.9
Cooling system components		
Water pump	12	9
Thermostat housing	22	16

TSB Revision

ENGINE OVERHAUL <2.0L (420A)> – Specifications

11D-7

Items	Nm	ft.lbs.
Engine coolant temperature sensor	7	5
Fuel and emission control parts		
EGR tube	11	8
EGR valve	22	16
Intake manifold		
Intake manifold air temperature sensor	7	5
Manifold absolute pressure sensor	2	1.4
Intake manifold	23	17
Exhaust manifold		
Exhaust manifold	23	17
Camshaft and cam follower		
Cylinder head cover	12	9
Bearing head cover	No. 2, 3, 4, 5	12
	No. 1, 6	28
Cylinder head and valve		
Cylinder head bolt	Long bolt	87 + 1/4 turn
	Short bolt	48 + 1/4 turn
Oil pan and oil pump		
Oil filter	21	15
Adapter	55	40
Oil pan	12	9
Oil pick-up tube	28	20
Oil pump	23	17
Oil pump		
Relief valve retaining cap	54	39
Oil pump cover	12	9
Piston, connecting rod and cylinder block		
Connecting rod cap bolt	27 + 1/4 turn	20 + 1/4 turn
Knock sensor	10	7

SEALANTS

11300050207

	Specified sealant
Engine coolant temperature sensor	Loctite 24200 or equivalent
Thermo switch	Loctite 24200 or equivalent
Camshaft bearing cap No.1, No.6	Loctite 51817 or equivalent
Oil pump	Loctite 51817 or equivalent
Bed plate to oil pan gasket	Loctite 18718 or equivalent
Oil pressure switch	Loctite 24200 or equivalent
Bed plate to cylinder block	Loctite 19614 or equivalent

TSB Revision

FORM-IN-PLACE GASKETS

11301810019

There are numerous places where form-in-place gaskets are used on the engine. Care must be **taken** when applying form-in-place gaskets to assure obtaining the desired results. **Bead** size, continuity, and location are of great importance. Too thin a bead can result in leakage **while** too much can result in spill-over which can break off and obstruct fluid feed lines. A continuous bead of the proper width **is** essential to obtain a leak-free joint.

GASKET DISASSEMBLY

Parts assembled with form-in-place gaskets may be disassembled without unusual effort. **In some instances**, it may be necessary to lightly tap the part with a mallet or other suitable tool to break the seal between the mating surfaces. A flat gasket scraper may also be lightly tapped into the joint but care **must** be taken not to damage the mating surfaces.

SURFACE PREPARATION

Scrape clean or wire brush all gasket surfaces removing all loose material. Inspect **stamped parts to** assure gasket rails are flat. Flatten rails with a hammer on a flat plate if **required**. **Gasket surfaces** must be free of oil and dirt. Make sure old gasket material is removed from blind **attaching holes**.

FORM-IN-PLACE GASKET APPLICATION

Assembling parts using a form-in-place gasket requires care but it's easier than using precut gaskets. Gasket material should be applied sparingly 1 mm (.040 inch.) diameter or less **of sealant** to one **gasket** surface. Be certain the material surrounds each mounting hole. Excess material can easily be **wiped** off. Components should be torqued in place within 15 minutes. The use of a locating dowel is recommended during assembly, to prevent smearing the material off location.

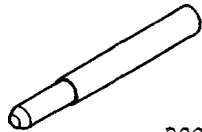
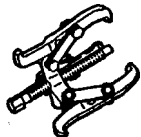
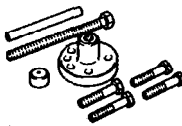
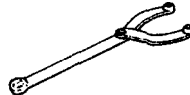
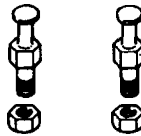


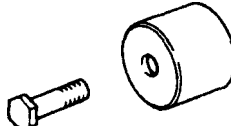
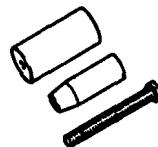
Loctite 18718 gasket material or equivalent should be applied in a continuous bead **approximately** 3 mm (.120 inch.) in diameter. All mounting holes must be circled. For corner sealing, a 3.17 or 6.35 mm (1/8 or 1/4 inch.) drop is placed in the center of the gasket contact area. Uncured **sealant** may be removed with a shop towels. Components should be torqued in place while the sealant **is still** wet to the touch (within 10 minutes). The usage of a locating dowel is recommended during assembly to prevent smearing of material off location.

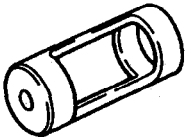
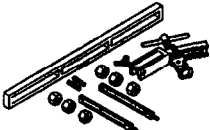
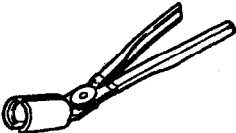



MOPAR TORQUE CURE GASKET MAKER

Mopar torque cure gasket maker is a unique anaerobic type gasket material to be used **ONLY** **between** the **bedplate** and engine block. The material cures in the absence of air when **torqued between** two metallic surfaces. It will not cure if left in the uncovered tube. This anaerobic material **is** specially made to seal the area between the **bedplate** and cylinder block without disturbing the bearing **clearance** or alignment of these components.

SPECIAL TOOLS

11300060217

Tool	Tool number and name	Supersession	Application
 8995057	MB995057 Removal crankshaft damper/sprocket	6827-A	Removal of crankshaft damper and crankshaft sprocket .
	MB995055 Removal puller damper	1026	Removal of crankshaft damper .
	MB995035 Installer crankshaft damper/sprocket	C-4685-C	Installation of crankshaft damper and crankshaft sprocket .
	MB990767 End yoke holder	MB990767-01	Holding camshaft sprocket when loosening or torquing bolt .
	MD99871 9 Pin (2)		
	MB995026 Installer crankshaft sprocket	6792	Installation of crankshaft sprocket.
	MB995027 Installer crankshaft sprocket	6793	
	MD99871 3 Installer camshaft oil seal		Installation of crankshaft seal.
	MB995022 Installer crankshaft seal	6780- 1	

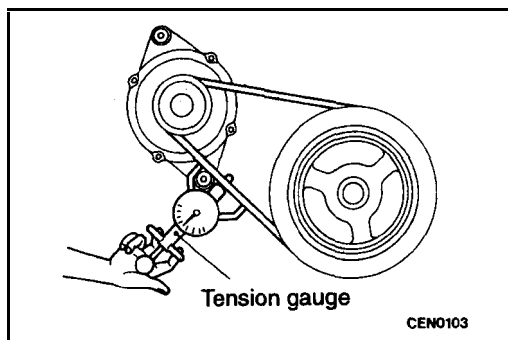
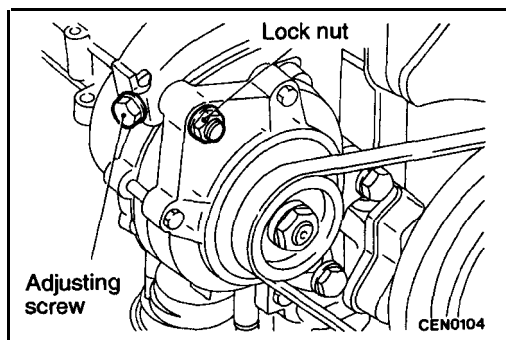
Tool	Tool number and name	Supersession	Application
	MB995021 Compressor valve spring adapter	6779	Compression of valve spring.
	MD998772 Compressor valve spring	MD998772-A	
	MB995037 Remover/ installer valve stem seal	C-4745	Removal of valve stem seal.
	MB995020 Remover crankshaft seal	6771	Removal of crankshaft seal.
 <p>8995059</p>	MB995059	6926-1	Installation of crankshaft oil seal
 <p>8995060</p>	MB995060	6926-2	

GENERATOR

11301820012

REMOVAL

- (1) Remove drive belt.
- (2) Remove generator.
- (3) Remove generator **brace**.
- (4) Remove bracket.

**INSTALLATION**

11301830015

- (1) Install bracket.
- (2) Install generator brace.
- (3) Install generator.
- (4) Install drive belt.
- (5) Loosen the generator pivot nut.
- (6) Loosen the lock nut.

- (7) Turn the adjusting screw to adjust the belt tension to the standard value.

NOTE

When installing a new belt, apply 310 N (70 lbs.) of tension for 5 minutes or more, and then apply the final tension.

Standard value:

Used belt 400–490 N (90–110 lbs.)

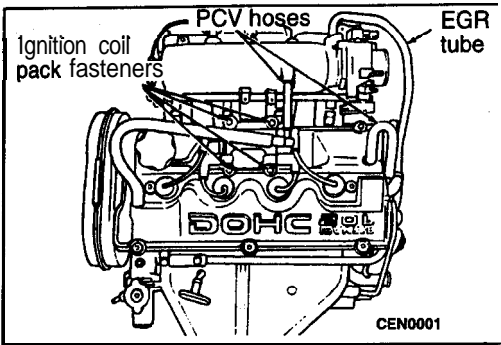
New belt 490–712 N (110–160 lbs.)

- (8) Tighten the generator pivot nut.

Tightening torque: 54 Nm (39 ft.lbs.)

- (9) Tighten the lock nut.

Tightening torque: 61 Nm (44 ft.lbs.)



IGNITION SYSTEM

11301840018

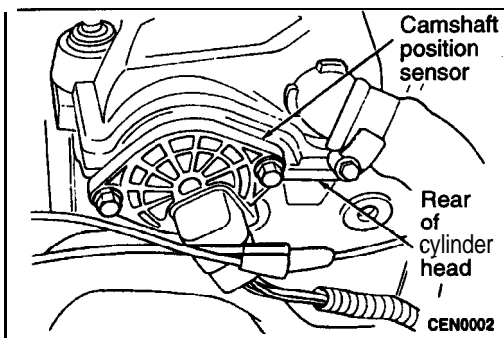
REMOVAL

The electronic ignition coil pack attaches to the cylinder head cover.

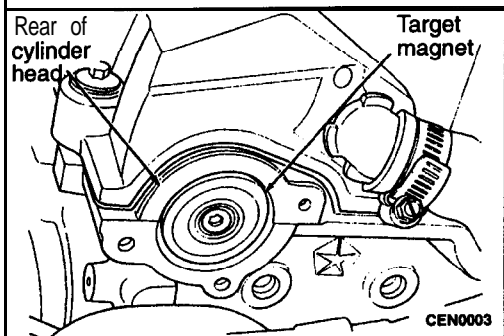
- (1) Disconnect electrical connector from coil pack.
- (2) Remove coil pack mounting nuts.
- (3) Remove coil.

- (4) Remove spark plug cables.

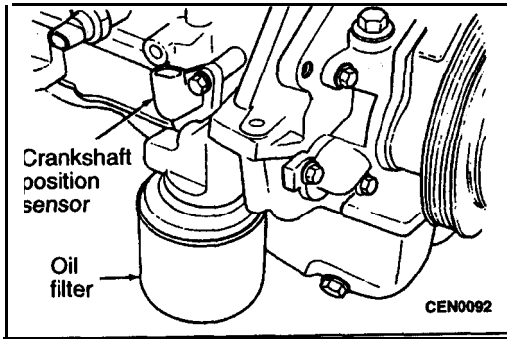
- (5) Remove the spark plug using a **quality** socket with a rubber or foam insert.
- (6) Inspect the spark plug condition.. Refer to Spark Plug Condition in this section.



- (7) Remove camshaft position sensor mounting screws on the rear of the cylinder head. Remove sensor.



- (8) Loosen screw attaching target magnet to rear of camshaft.

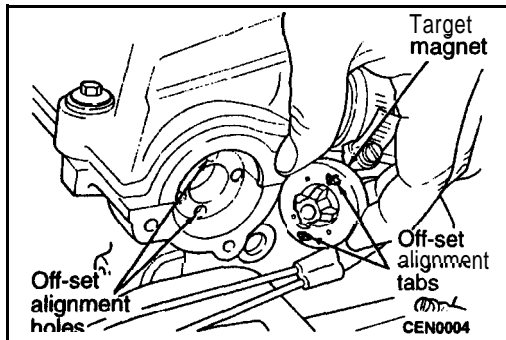


- (9) Remove crankshaft position sensor mounting screw. Remove sensor

INSTALLATION

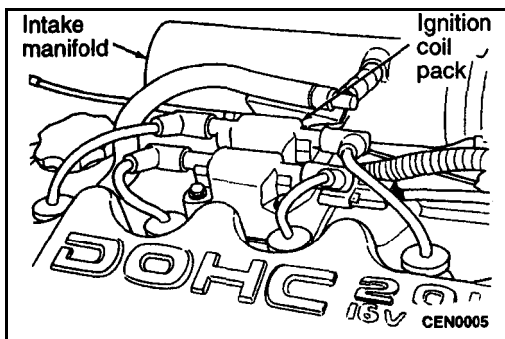
11301850011

- (1) Install crankshaft position sensor.



- (2) The target magnet has locating dowels that fit into off-set machined locating holes in end of the camshaft. install target magnet in end of camshaft. Tighten mounting screw to 3 Nm (2.2 **ft.lbs.**) torque.
- (3) Install camshaft position sensor. Tighten sensor mounting screws to 9 Nm (6.5 **ft.lbs.**) torque.

- (4) To avoid cross threading, **start** the spark plug into the cylinder head by hand.
- (5) Tighten spark plugs to 28 Nm (20 **ft.lbs.**) torque.
- (6) Install spark plug insulators over spark plugs. Ensure the top of the spark plug insulator seals the upper end of the spark plug tube.



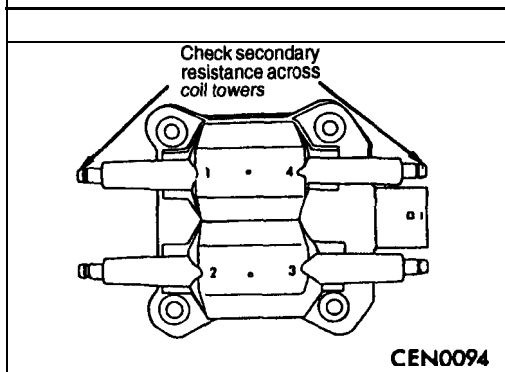
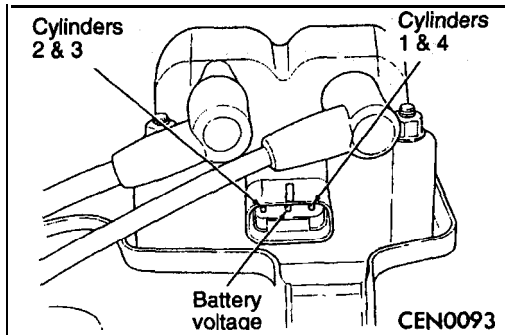
- (7) Install ignition coil pack.
Connect spark plug cables to coil pack.
The coil pack towers are numbered with the cylinder identification.

INSPECTION

11300170019

SPARK PLUG CABLE

- (1) **Resistance** must be between 3,000 to 12,000 ohms per foot of cable. Replace any cable not within tolerance.



IGNITION COIL

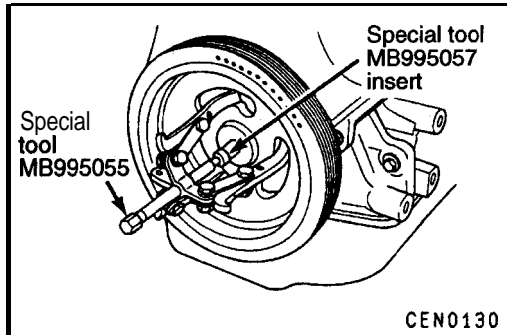
- (1) Measure the primary **resistance** of each coil. At the coil, connect an ohmmeter between the **B + pin** and the pin corresponding to the **cylinders in question**. Resistance on the primary side of **each coil should be 0.51 – 0.61** ohm. Replace the coil if resistance is **not within tolerance**.
- (2) Remove ignition cables from **the secondary** towers of the coil. Measure the **secondary resistance of** the coil between the towers of each individual coil. **Secondary resistance should be 11,500–13,500** ohms. **Replace** the coil if resistance is not within tolerance.

TIMING BELT

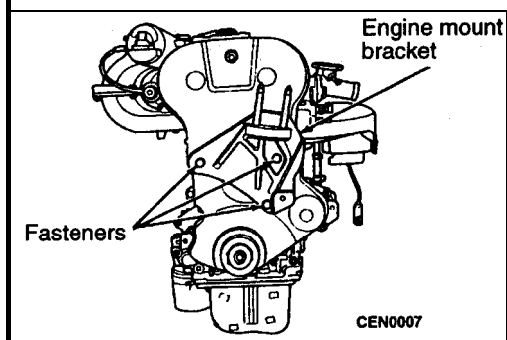
REMOVAL

Caution

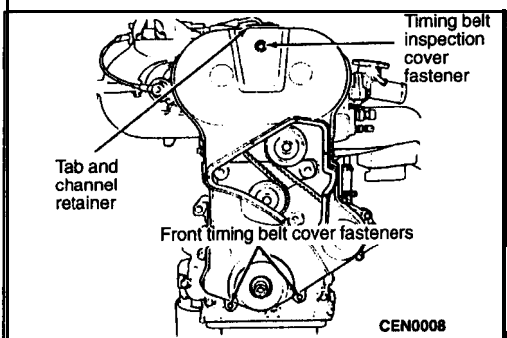
Camshaft or crankshaft should not be rotate after timing belt is removed. Damage to valve components may occur. Always align timing marks before removing timing belt.



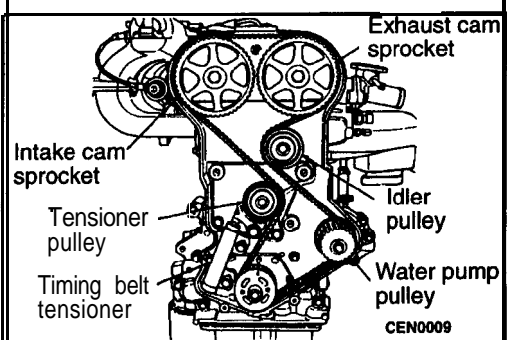
- (1) Remove crankshaft damper bolt. Remove damper using Special Tool **MB995055** and insert **MB995057** or equivalent.



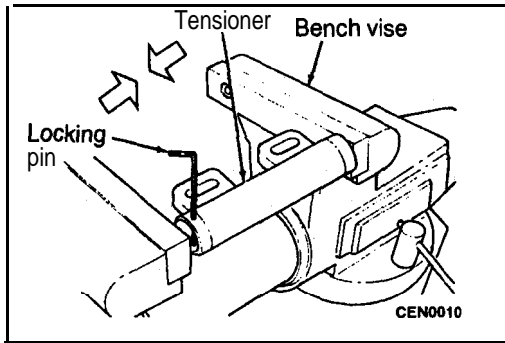
- (2) Remove engine mount bracket.



- (3) Remove front half of timing belt cover.



- (4) Align timing marks. Loosen timing belt tensioner screws and remove timing belt.
- (5) Remove tensioner pulley
- (6) Remove timing belt tensioner.
- (7) Remove tensioner arm bracket.
- (8) Remove idler pulley.

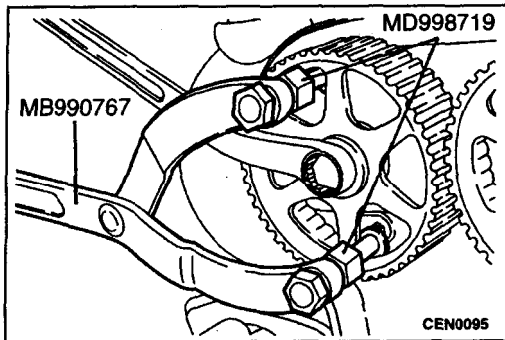


- (9) When tensioner is removed from **the engine**, it is necessary to compress the plunger into the tensioner **body**.
- (10) **Place** the tensioner into a vise **and** slowly compress the plunger.

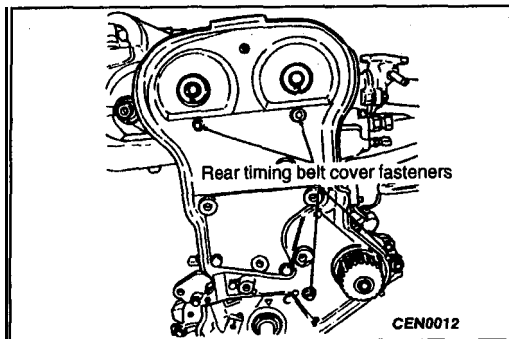
Caution

Index the tensioner in the vise the same way it is installed on the engine. This is to ensure proper pin orientation when tensioner is installed on the engine.

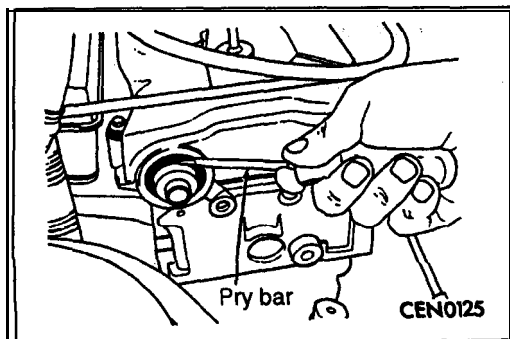
- (11) When plunger is compressed into the tensioner body install a pin through the body and plunger to **retain** plunger in place until tensioner is installed.



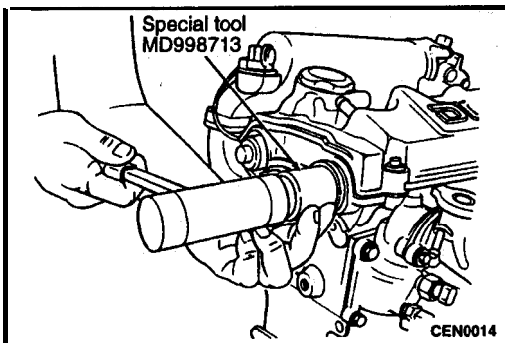
- (12) **Hold** camshaft sprocket with Special Tools **MB990767** and **MD998719** while removing bolt.
- (13) Remove support bracket.



- (14) **Remove** rear timing belt cover fasteners.
Remove cover.



- (15) **Remove** camshaft seal.



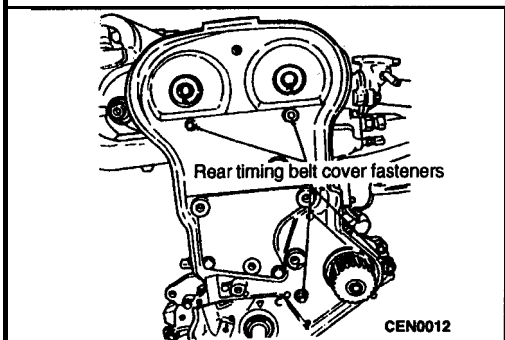
INSTALLATION

11301870017

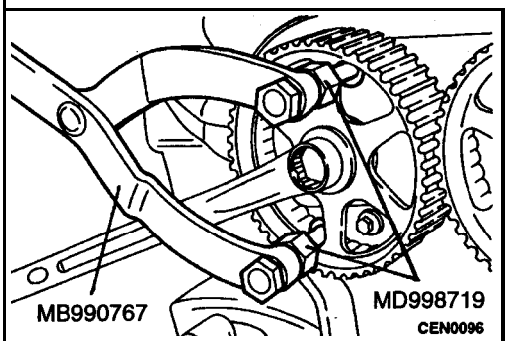
- (1) Install camshaft seal into cylinder head using **Special Tool MD998713** until flush with the head.

NOTE

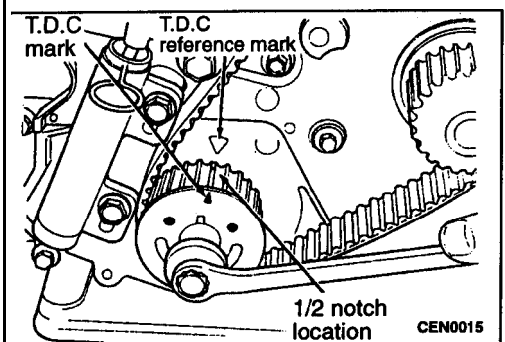
Shaft seal lip surface must be free of varnish, **dirt** or nicks. Polish with 400 grit paper if necessary.



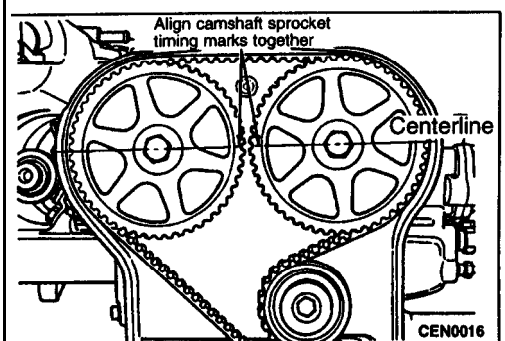
- (2) Install rear timing belt cover.
Tighten fasteners to 9.6 Nm (6.9 ft.lbs.).
- (3) Install support bracket.



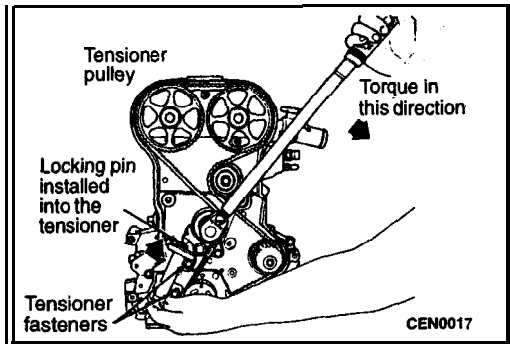
- (4) Install camshaft sprockets and tighten attaching **bolts** to, 101 Nm (73 ft.lbs.).
- (5) Install idler pulley.
- (6) Install tensioner arm bracket.
- (7) Install timing belt tensioner.
- (8) Install tensioner pulley.



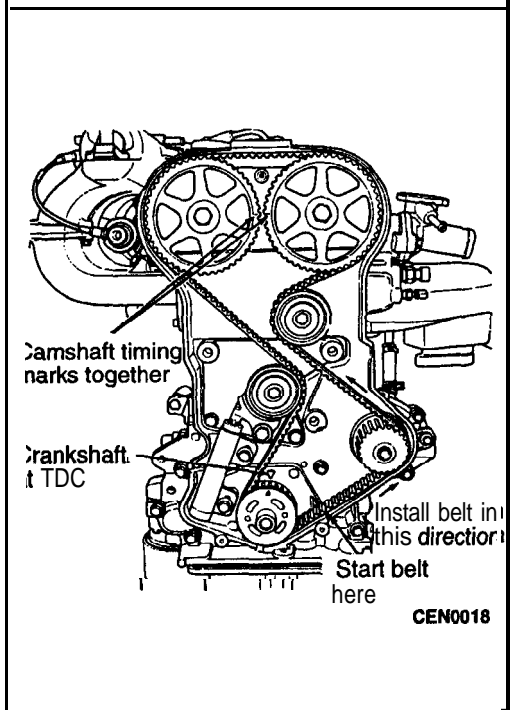
- (9) Set crankshaft sprocket to TDC by aligning the sprocket with the arrow on the oil pump housing



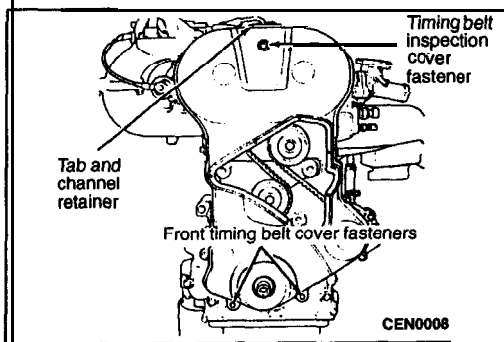
- (IO) Set camshafts timing marks together by aligning **notches** on sprockets.
- (II) Move crankshaft to 1/2 notch before **TDC**.



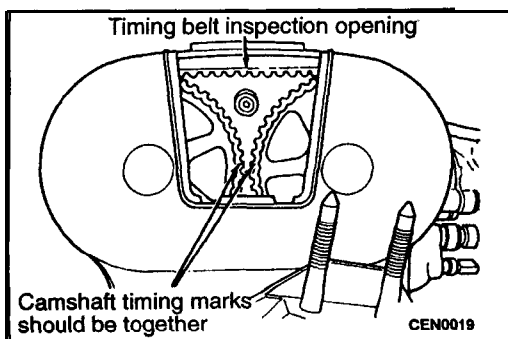
- (12) Install timing belt. Starting at the crankshaft, go around the water pump sprocket, idler pulley, **camshaft sprockets** and then around the tensioner pulley.
- (13) Move crankshaft sprocket to **TDC to take** up belt slack. Install tensioner to block but do not tighten fasteners.
- (14) Using a torque wrench on the tensioner pulley, apply 28 Nm (20 ft.lbs.) of torque to tensioner.



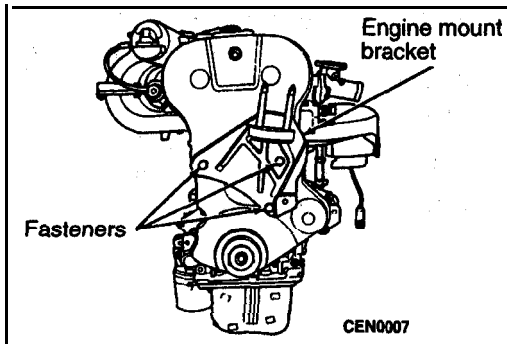
- (15) With torque being applied to the tensioner pulley move the tensioner up against the tensioner pulley **bracket and** tighten fasteners to 31 Nm (22 ft.lbs.).
- (16) Pull tensioner plunger pin, Pretension is correct when pin can be removed and installed.
- (17) Rotate crankshaft 2 revolutions and check the alignment of the timing marks.



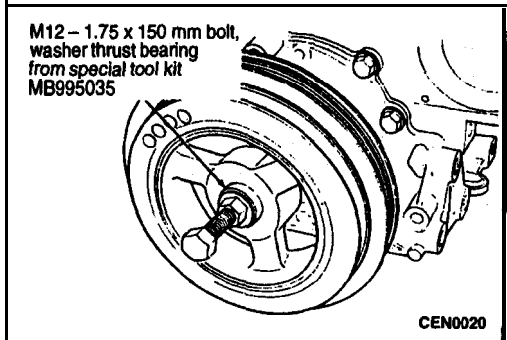
- (18) Install front timing belt cover.



- (19) Valve Timing Check; (timing belt cover installed), remove the inspection cover on timing belt cover. With number one cylinder at TDC, the timing marks on the camshaft sprocket should be aligned together. If marks are not aligned correctly, perform procedure again.



- (20) Install engine mount bracket.
Tighten bolts to 41 Nm (30 ft.lbs.).



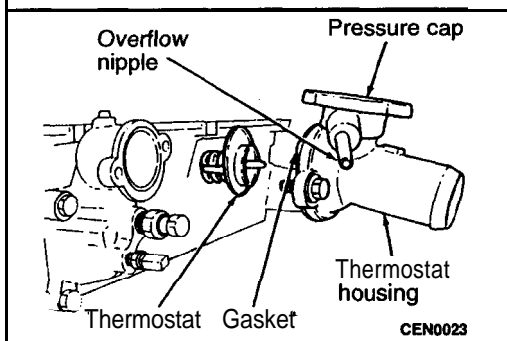
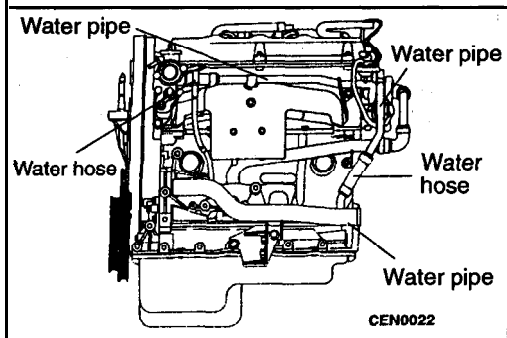
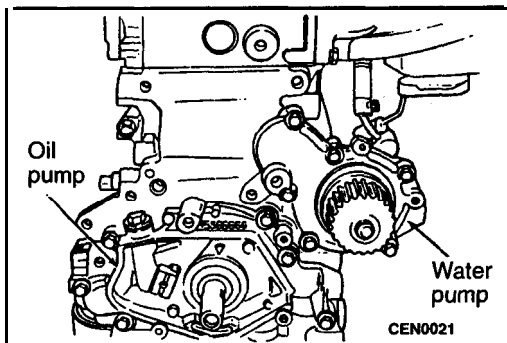
- (21) Install crankshaft damper using MB995035.
Using Special Tools MB990767 and MD998719 to hold damper, tighten crankshaft bolt to 62 Nm (45 ft.lbs.).

COOLING SYSTEM COMPONENTS

11301680010

REMOVAL

(1) Remove water pump attaching screws to engine.



(2) Remove oil level gauge.
(3) Remove exhaust manifold cover.
(4) Remove water hose.
(5) Remove water pipe.
(6) Remove O-ring.

(7) Remove thermostat housing bolts and housing.
(8) Remove thermostat, discard gasket and clean both gasket sealing surfaces.

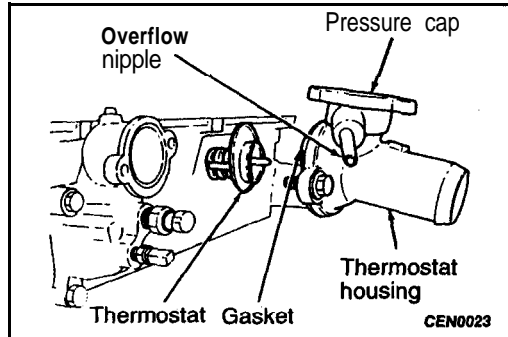
(9) Remove engine coolant temperature sensor.
(10) Remove thermo switch.

11 D-22 ENGINE OVERHAUL <2.0L (420A)> – Cooling System Components

INSTALLATION

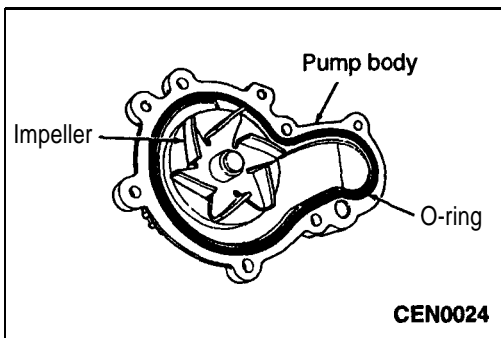
11301900013

- (1) Install **thermo** switch.
- (2) Install engine coolant **temperature sensor**. Lighten sensor to 7 Nm (5 **ft.lbs.**) torque.



- (3) Place a new gasket (dipped in clean water) on water box surface, center thermostat in water **box** on gasket. Place housing over gasket and thermostat; making sure thermostat is in the thermostat housing. Bolt housing to water box. Tighten bolts to 22 Nm (**16 ft.lbs.**).

- (4) Install O-ring.
- (5) Install water pipe.
- (6) Install water hose.
- (7) Install exhaust manifold cover:
- (8) Install oil level gauge.



- (9) Install new O-ring gasket in water pump body O-ring groove.

Caution

Make sure O-ring is properly seated in water pump groove before tightening screws. An improperly located O-ring may cause damage to the O-ring and cause a coolant leak.

- (10) Assemble pump body to block and tighten screws to 12 Nm (9 **ft.lbs.**)
- (II) Rotate pump by hand to check for freedom of movement.

INSPECTION

11301890013

Replace water pump body assembly if it has any of these defects:

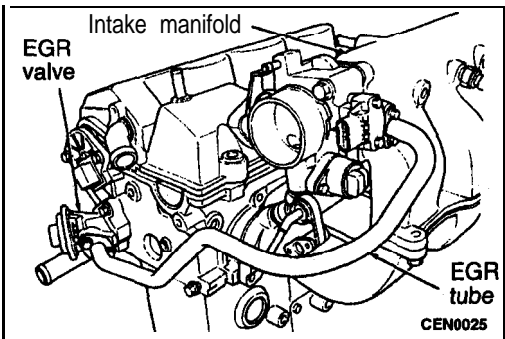
- (1) Cracks or damage on the body.
- (2) Coolant leaks from the shaft seal, evident by coolant traces on the pump body.
- (3) Loose or rough turning bearing.
- (4) Impeller rubs either the pump body or the engine block.
- (5) Impeller loose or damaged.
- (6) Sprocket or sprocket flange loose or damaged.

FUEL AND EMISSION CONTROL PARTS

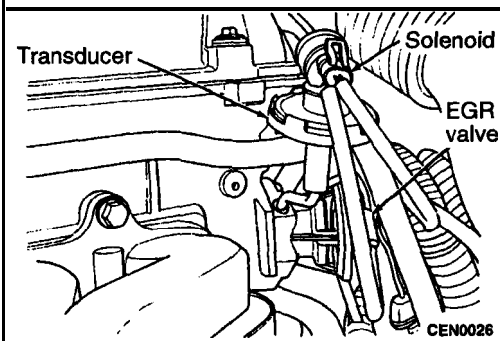
11301910016

REMOVAL

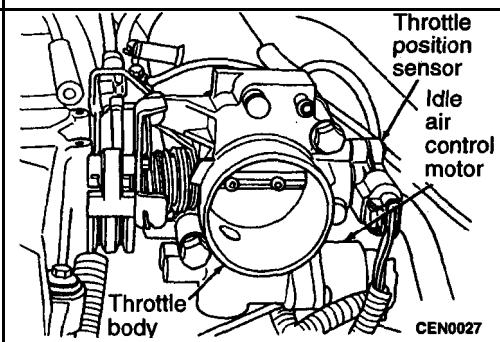
(1) Remove screws attaching EGR tube to intake manifold.



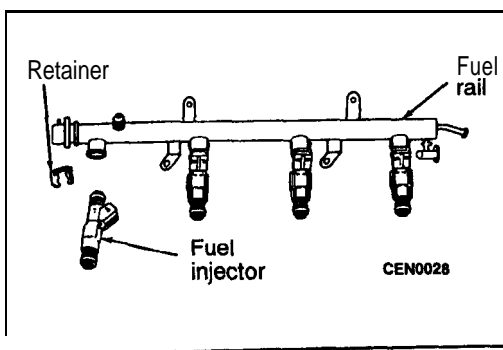
(2) Remove EGR valve mounting screws. Remove EGR valve and transducer.



- (3) Disconnect purge hose from throttle body.
 (4) Remove throttle body mounting bolts. Remove throttle body.
 (5) Remove gaskets. Clean gasket **mating surfaces**.
 (6) Release fuel system pressure. Refer to Fuel **System** Pressure Release procedure in this section..



(7) Remove fuel rail mounting screws. Access screws through the space between the intake manifold plenum runners.

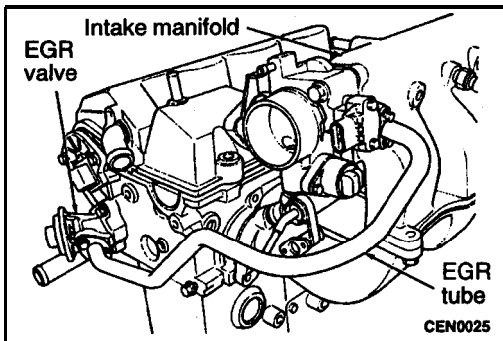


- (8) Lift rail off of intake manifold. Cover the fuel injector openings in the intake manifold.
 (9) Remove fuel injector retainer.
 (10) **Pull** injector out of fuel rail. Replace fuel injector O-rings.

INSTALLATION

11301920019

- (1) Apply a light coating of clean engine oil to the upper O-ring.
- (2) Install injector in cup on fuel rail.
- (3) Install retaining clip.
- (4) Apply a light coating of clean engine oil to the O-ring on the nozzle end of each injector.
- (5) Insert fuel injector nozzle into openings in intake manifold. Seat the injectors in place. Tighten fuel rail mounting screws.
- (6) Connect fuel supply tube to fuel rail.
- (7) Install throttle body and new gasket on intake manifold. Tighten mounting bolts.



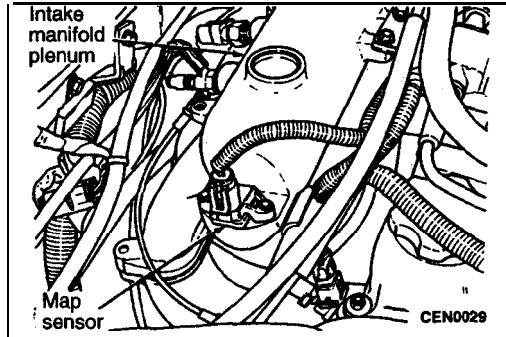
- (8) Connect purge hose nipple on throttle body.
- (9) Loosely install EGR valve with a new gasket. Install new gasket between EGR tube and EGR valve.
- (10) Finger tighten EGR tube fasteners.
- (11) Tighten EGR valve mounting screws to 22 Nm (16 ft.lbs.) torque.
- (12) Tighten EGR tube fasteners to 11 Nm (8 ft.lbs.) torque.
- (13) Connect vacuum supply tube to solenoid.;

INTAKE MANIFOLD

11301930012

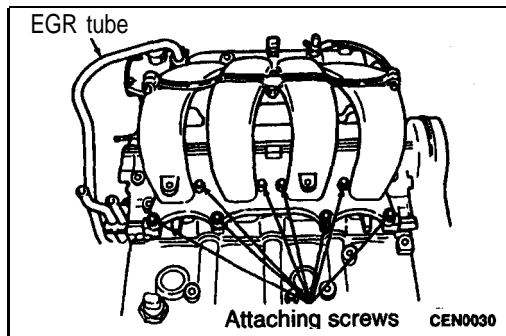
REMOVAL

(1) Remove intake air temperature sensor.



(2) Remove manifold absolute pressure (MAP) sensor mounting screws.

(3) Remove manifold absolute pressure (MAP) sensor.

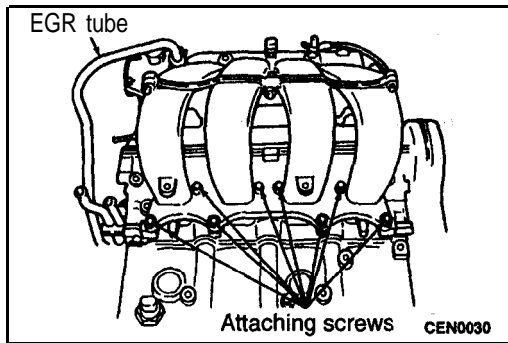


(4) Remove intake manifold stay.

(5) Remove EGR tube fasteners from the **intake manifold** and valve. Remove tube from engine.

(6) Remove vacuum hose and electrical connection from intake manifold.

(7) Remove attaching **screws from** engine and remove intake manifold from engine.

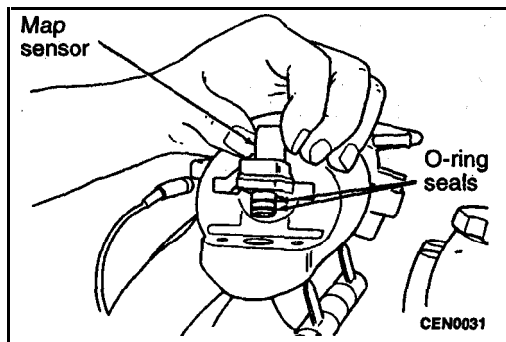


INSTALLATION

11661966616

- (1) Install new manifold gasket. **DO NOT APPLY SEALER.**
- (2) Set manifold in place. Tighten retaining fasteners, starting at center and progressing outward in both directions to 23 Nm (17 **ft.lbs.**). Repeat this procedure until all fasteners are at specified torque.

- (3) Install vacuum hose and electrical connection from **intake** manifold.
- (4) Install new EGR tube gaskets at **the intake manifold and valve.**
- (5) Install EGR tube and tighten fasteners to 8 Nm (6 **ft.lbs.**).
- (6) Install intake manifold stay.



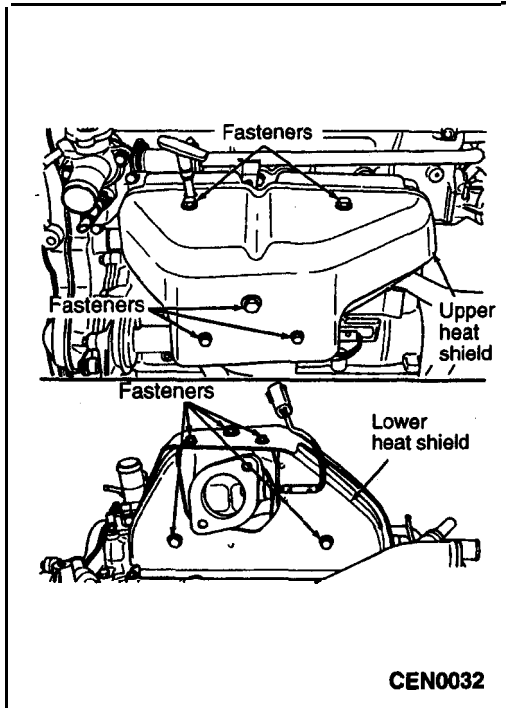
- (7) Insert sensor into **intake** manifold **while** making **sure not** to damage O-ring seals.
- (8) Tighten mounting screws to 2 Nm (1.4 **ft.lbs.**) torque.

- (9) Install manifold air temperature sensor. Tighten sensor to 7 Nm (5 **ft.lbs.**) torque.

CLEANING AND INSPECTION

.11301940015

- (1) Discard gasket and clean gasket surfaces of manifold.
- (2) Test manifold gasket surfaces for flatness with straight edge. Surface must be flat within 0.15 mm per 300 mm of manifold length.
- (3) Inspect manifold for cracks or distortion. Replace manifold if necessary.

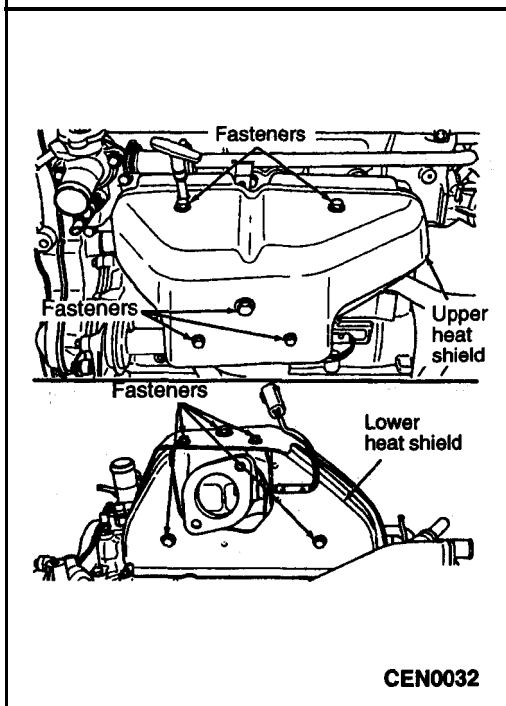


EXHAUST MANIFOLD

11301980011

REMOVAL

- (1) Remove oil level gauge.
- (2) Remove exhaust manifold heat shield.
- (3) Remove 8 exhaust manifold retaining **fasteners** and remove exhaust manifold.



INSTALLATION

11301980017

- (1) Install new manifold gasket. **DO NOT APPLY SEALER.**
- (2) Set exhaust manifold in **place**. Tighten **retaining** nuts and bolt, starting at center and **progressing outward** in both directions to **23 Nm (17 ft.lbs.) torque**. **Repeat this procedure** until all fasteners are **at specified torque**.
- (3) Install exhaust manifold heat shield.
- (4) Install oil level gauge.

CLEANING AND INSPECTION

11301970014

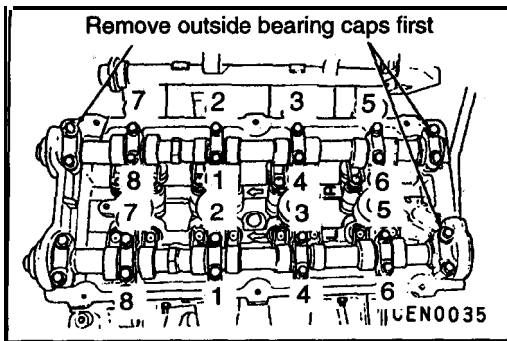
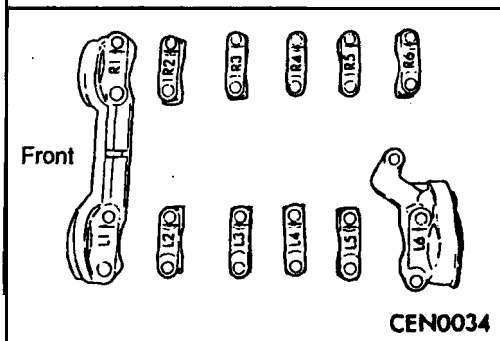
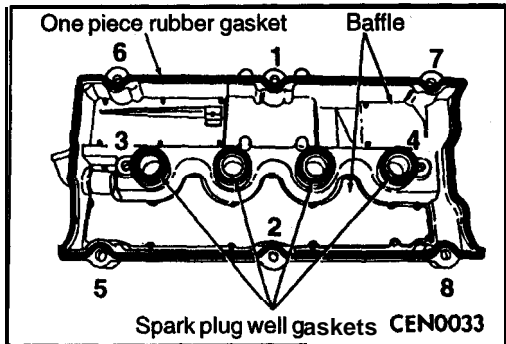
- (1) Discard gasket and clean all gasket surfaces of manifolds and cylinder head.
- (2) Test manifold gasket surfaces for flatness with straight edge. Surface must be flat within 0.15 mm per 300 mm (.006 in. per foot) of manifold length.
- (3) Inspect manifolds for cracks or distortion. Replace manifold if necessary.

CAMSHAFT AND CAM FOLLOWER

11301990010

REMOVAL

- (1) Remove the cylinder head cover fasteners.
- (2) Remove cylinder head cover from cylinder head.



- (3) Bearing caps are identified for **location**. Remove the outside bearing caps first.

- (4) Loosen the camshaft bearing cap attaching fasteners in sequence shown in one camshaft at a time.

Caution

Camshafts are not interchangeable. The exhaust cam number 6 bearing journal **is wider**.

- (5) Identify the **camshafts** before removing **from the head**. The cams are not **interchangeable**.
- (6) Remove cam follower assemblies **from** cylinder head. Keep the cam followers in the order they have been removed from the head for **reassembly**.
- (7) Mark hydraulic lash adjusters for reassembly in their **original** positions. Lash adjusters are serviced as an assembly.

CLEANING

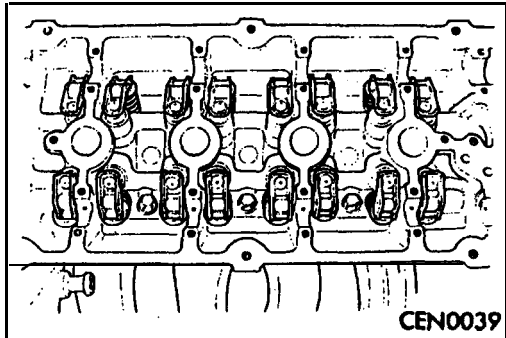
11302000019

Before installation, clean cylinder head and cover mating surfaces. Make certain the rails are flat.

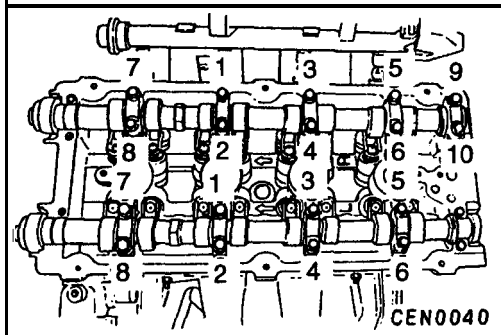
INSTALLATION

11302020015

- (1) Install hydraulic lash adjuster **assembly** making **sure** that adjusters are at least **partially full of oil**. This is **indicated** by little or no plunger travel **when** the lash adjuster is depressed.



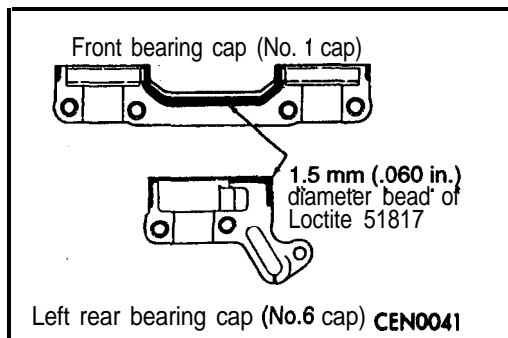
- (2) Lubricate with clean oil and install cam follower assemblies in their original position on the hydraulic adjuster and valve stem.



Caution

Piston should NOT be at top dead center when installing the camshaft.

- (3) Lubricate bearing journals and cams with clean oil and install the camshafts. Install right and left camshaft bearing caps No. 2 thru No. 5 and right **No.6**. Tighten **M6** fasteners to 12 Nm (9 ft.lbs.) in sequence shown in the figure.



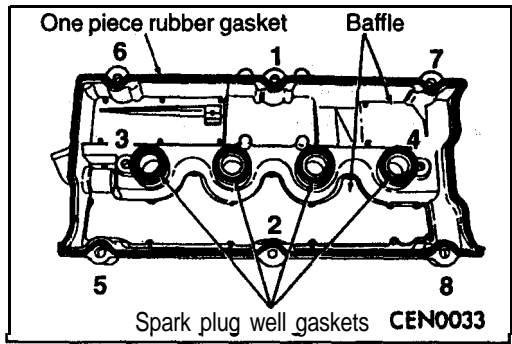
- (4) Apply Loctite 51817 to No. 1 and No. 6 bearing caps. Install bearing caps and tighten **M8** fasteners to 28 Nm (21 ft.lbs.).
- (5) Bearing end caps must be installed before seals can be installed.
- (6) Install timing belt, sprockets and timing covers. Refer to "Timing belt".

Caution

Do not allow oil or solvents to contact the timing belt as they can deteriorate the rubber and cause tooth skipping.

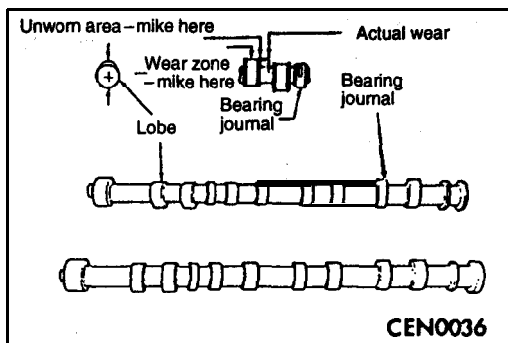
- (7) Install new cylinder head cover gaskets.
- (8) Apply Loctite 18718 at the camshaft cap corners and at the top edge of the 1/2 round seal.

11 D-30 ENGINE OVERHAUL <2.0L (420A)> – Camshaft and Cam Follower



(9) Install **cylinder** head cover assembly to head and tighten fasteners in sequence shown in the figure. Using the 3 step torque method:

- Step 1 Tighten all fasteners to 4.5 Nm (3.3 ft.lbs.)
- Step 2 Tighten all fasteners to 9.0 Nm (6.5 ft.lbs.)
- Step 3 Tighten all fasteners to 12 Nm (9 ft.lbs.)



INSPECTION

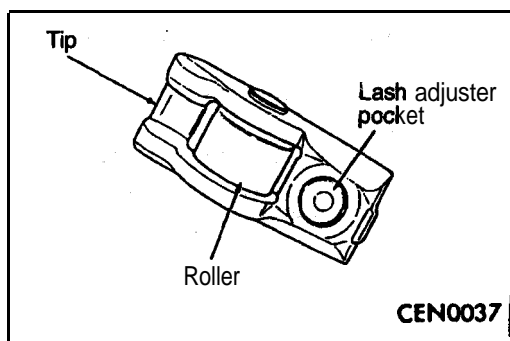
CAMSHAFT

- (1) Inspect camshaft bearing journals for damage and binding. If journals are binding, also check the cylinder head bearing surface for damage, and check the camshaft bearing oil feed holes in the cylinder head for clogging.
- (2) Check the cam surface for abnormal wear and damage. Replace if defective. Also measure the cam height and replace if out of limit.

Standard value: 0.0254 mm (.001 in.)

Limit: 0.254 mm (.01 in.)

To measure cam lobe wear, measure lobe diameter in two places at the largest diameter (over the nose). Take first reading with micrometer in unworn area at the edge of the lobe. Take second reading in the worn area where cam follower contacts the lobe. Subtract second reading from the first. The difference is the cam lobe wear.

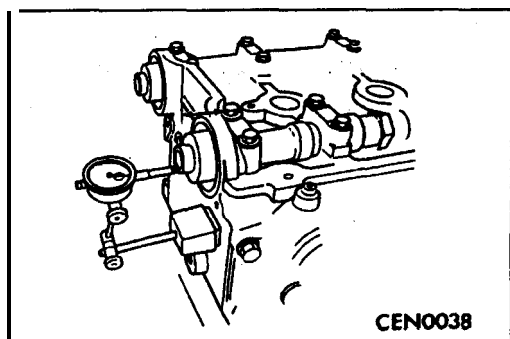


CAM FOLLOWER

- (1) Inspect the cam follower assembly for wear or damage. Replace as necessary.

CAMSHAFT END PLAY

- (1) Oil camshaft journals and install camshaft without cam follower assemblies. Install rear cam caps and tighten screws to specified torque.
- (2) Using a suitable tool, move camshaft as far rearward as it will go.



- (3) Zero dial indicator.
- (4) Move camshaft as far forward as it will go.

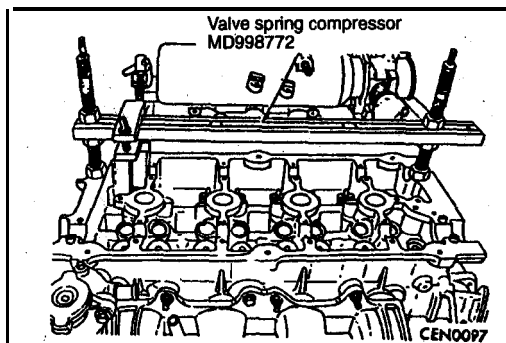
End play standard value: 0.15 mm (.006 in.)

CYLINDER HEAD AND VALVE

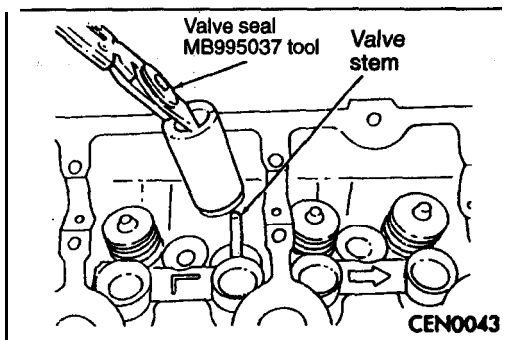
V11302030018

REMOVAL

- (1) Remove cylinder head bolts.



- (2) With cylinder head removed, compress valve springs using Special Tool MD998772 or equivalent.



- (3) Remove valve retaining locks, valve spring retainers and valve spring.
- (4) Remove valve stem seal/valve spring seat by using Special Tool MB995037 or equivalent.
- (5) Before removing valves, remove any burrs from valve stem lock grooves to prevent damage to the valve guides. Identify valves to insure installation in original location.

CLEANING

11302040011

CYLINDER HEAD

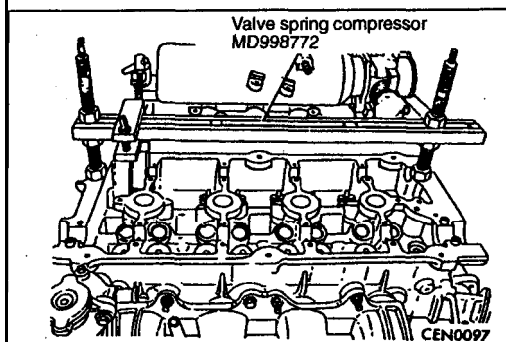
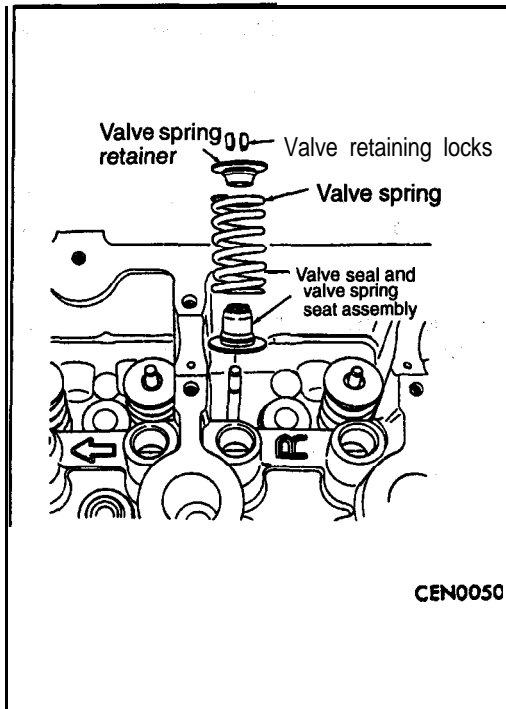
Caution

Be careful not to gouge or scratch the aluminum head sealing surface.

- (1) Remove all gasket material from cylinder head and block.

VALVE ASSEMBLY

- (1) Clean all valve guides, valves and valve spring assemblies thoroughly with suitable cleaning solution before reassembling.



INSTALLATION

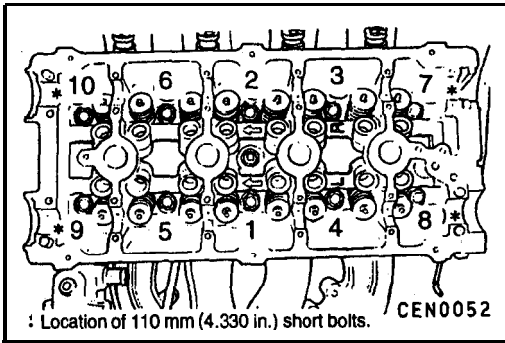
11302050014

- (1) Coat valve stems with clean engine oil and **insert them** in cylinder head:
- (2) If valves or seats have been reground,! **check** valve tip height (A).
Make sure of measurements from cylinder head **surface** to the top of valve stem.
- (3) Install valve seal/spring seat assembly over valve guides on all valve stems. Ensure **that the garter spring is** intact around the top of the rubber seal. Install valve springs, valve retainers.

- (4) Compress valve springs with a valve spring compressor. Install locks and release tool.

- (5) Before installing the bolts, the threads should be oiled with clean engine oil.

11 D-34 ENGINE OVERHAUL <2.0L (420A)> – Cylinder Head and Valve



- (6) Tighten the cylinder head bolts in the sequence shown in the figure.
Using the 4 step torque turn method, tighten according to the following values:

Step 1

Tighten center fasteners 1 thru 6 to 33 Nm (24 ft.lbs.), then outer fasteners 7 thru 10 to 26 Nm (20 ft.lbs.)

Step 2

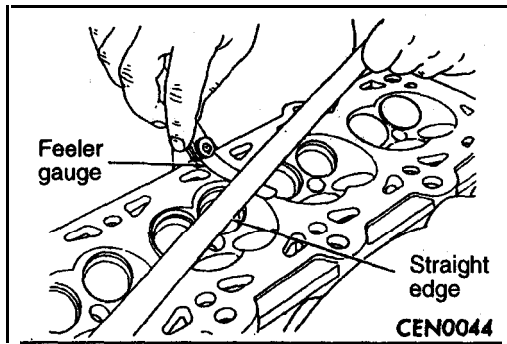
Tighten center fasteners 1 thru 6 to 67. Nm (46 ft.lbs.), then outer fasteners 7 thru 10 to 28 Nm (20 ft.lbs.).

Step 3

Tighten center fasteners 1 thru 6 to 67 Nm (46 ft.lbs.), then outer fasteners 7 thru 10 to 28 Nm (20 ft.lbs.).

Step 4

Turn all fasteners 1 thru 10 1/4 turn (90 degrees).
Do not use a torque wrench for this step.



INSPECTION

CYLINDER HEAD

- (1) Check the cylinder head gasket surface for flatness by using a straightedge and feeler gauge.

Limit: 0.1 mm (.004 in.)

VALVE

- (1) Clean valves thoroughly and discard burned, warped and cracked valves.
- (2) Measure valve stems for wear.
- (3) If valve stems are worn more than 0.05 mm (.002 in.), replace valve.

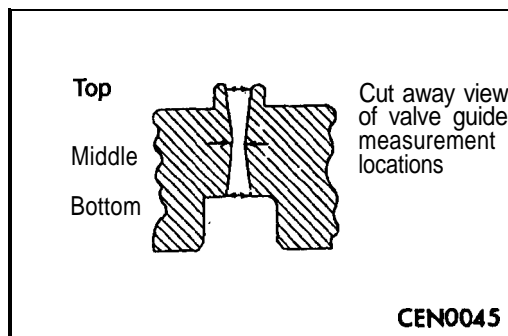
Standard value:

Intake 5.934–5.952 mm (.233 –.234 in.)

Exhaust 5.906–5.924 mm (.233–.233 in.)

VALVE GUIDES

- (1) Remove carbon and varnish deposits from inside of valve guides with a reliable guide cleaner.



- (2) Using a small hole gauge and a **micrometer**, measure valve guides in 3 places top, middle and bottom. Replace guides if they are not within specification.

Standard value:

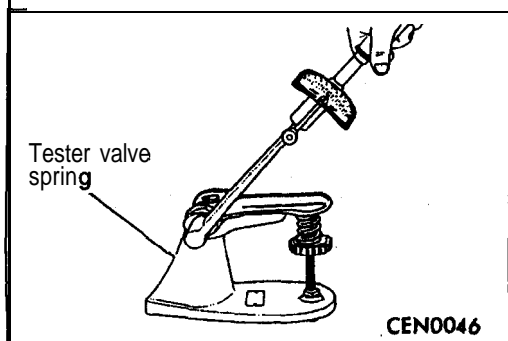
Intake 0.048–0.066 mm (.0019 –.0026 in.)

Exhaust 0.074–0.094 mm (.0029–.0037 in.)

Limit:

Intake 0.076 mm (.003 in.)

Exhaust 0.101 mm (.004 in.)



TESTING VALVE SPRINGS

- (1) Whenever valves have been removed for inspection, reconditioning or replacement, valve springs should be tested. As an example, the compression length of the spring to be tested is 33.34 mm (1.313 in.). Turn table of Tool until surface is in line with the 33.34 mm (1.313 in.) mark on the threaded stud and the zero mark on the front. Place spring over stud on the table and lift compressing lever to set tone device. Pull on torque wrench until ping is heard. Take reading on torque

11 D-36 ENGINE OVERHAUL <2.0L (420A)> – Cylinder Head and Valve

wrench at this instant. Multiply this reading by **two**. This will give the spring load at test length. Fractional measurements are indicated on the table for finer adjustments. Refer to specifications to obtain specified **height** and allowable tensions. Discard the springs that **do not meet specifications**.

Standard value:

Free length 46 mm (1.811 in.)

Spring tension

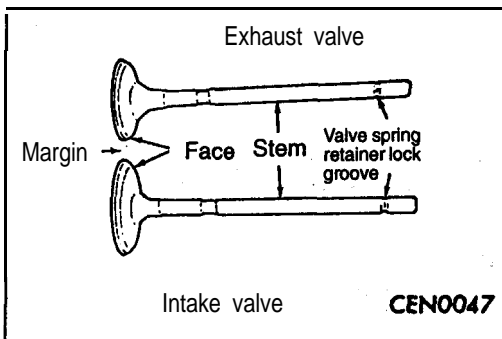
Valve closed 246–270 N/38.0 min
(50–60 lbs./1.496 in.)

Valve open 459–611 N/29.3 mm
(123–137 lbs./1.153 in.)

- (2) inspect each valve spring for squareness with a steel square and surface plate, test springs from both ends. If the spring is more than 1.5 mm (.06 in.) out of square, install a new spring.

REFACING VALVES AND VALVE SEATS

- (1) The intake and exhaust valve seats and valve face have a 45 degree angle.



- (2) Inspect the remaining margin after the **valves** are refaced. Exhaust valves with less than 0.95 mm (.0037 in.) margin and intake valves with less than 1.05 mm (.0413 in.) **margin** should be discarded and replaced.

Standard value:

Face Angle

Intake and Exhaust 45–45.5°

Head Diameter

Intake 34.67–34.93 mm (1.364–1.375 in.)

Exhaust 30.37–30.63 mm (1.195–1.205 in.)

Length (Overall)

Intake 111.49-111.99 mm (4.389-4.499 in.)
 Exhaust 109.59–110.09 mm (4.314–4.334 in.)

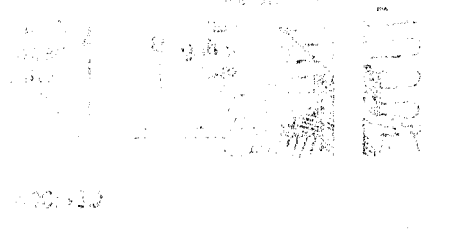
Stem Diameter

Intake 5.934-5.952 mm (.233–.234 in.)
 Exhaust 5.906–5.924 mm (.233–.233 in.)

Valve Margin

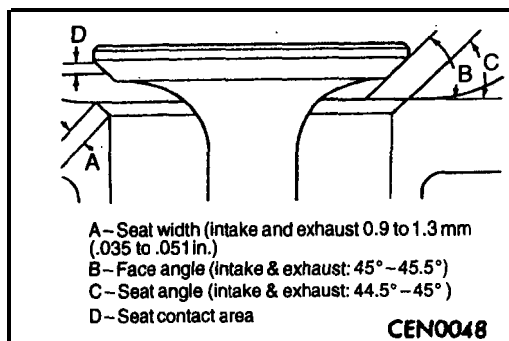
Intake 1.285-1.615 mm (.050–.063 in.)
 Exhaust 0.985–1.315 mm (.038–.051 in.)

- (3) When refacing valve seats, it is important that the correct size valve guide pilot be used for reseating stones. A true and complete surface must be obtained.



- (4) Measure the concentricity of valve seat using a valve seat dial indicator. Circular runout should not exceed.

Limit:
0.05 mm (.002 in.) Indicator reading.



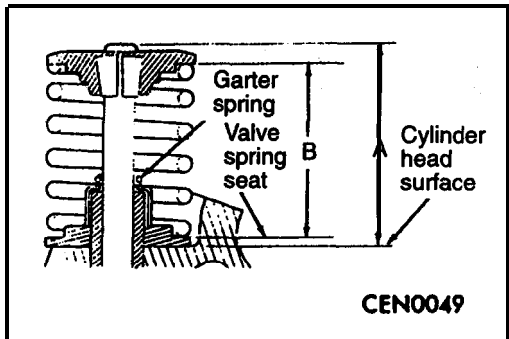
- (5) Inspect the valve seat with Prussian blue to determine where the valve contacts the seat. To do this, coat valve face LIGHTLY with Prussian blue then set valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of valve face, contact is satisfactory. If the blue is transferred to top edge of the valve face, lower valve seat with a 15 degree stone. If the blue is transferred to the bottom edge of valve face raise valve seat with a 65 degree stone.

Intake valve seat diameter
34.50 mm (1.358 in.)

Exhaust valve seat diameter
29.50 mm (1.161 in.)

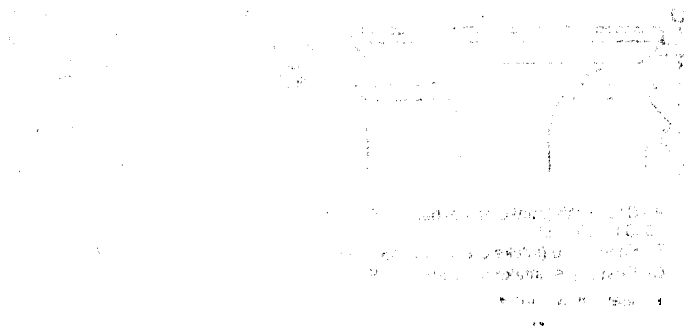
Valve seats which are worn or burned can be reworked if correct angle and seat width are maintained. Otherwise, cylinder head must be replaced.

- (6) When seat is properly positioned, the width of intake and exhaust seats should be 0.9 to 1.3 mm (.035 to .051 in.).



- (7) Check valve tip to spring seat dimensions A after grinding the valve seats or faces. Grind valve tip until **dimension A** is equal to 47.99 mm (1.889 in.) for exhaust valve and 48.04 mm (1.891 in.) for intake valve over spring seat when installed in the head. The valve tip chamfer may need to be reground to prevent seal damage when the valve is installed.

- (8) **Check** the valve spring installed height **B** after refacing the valve and seat. Make sure measurements are taken from top of spring seat to the bottom surface of spring retainer. If **height** is greater than 38.00 mm (1.496 in.), install a 0.762 mm (.030 in.) spacer in head counterbore under the valve spring seat to bring spring height back within specification.



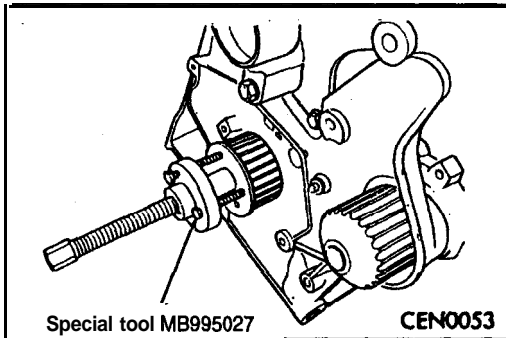
OIL PAN AND OIL PUMP

11302060017

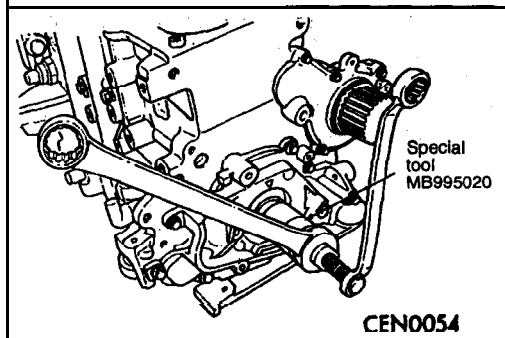
REMOVAL

- (1) Remove flywheel or drive plate:
- (2) Remove rear plate.
- (3) Remove oil filter.
- (4) Remove adapter.

- (5) Drain engine oil and remove oil pan.
- (6) Clean oil pan and all gasket surfaces.
- (7) Remove oil pick-up tube.

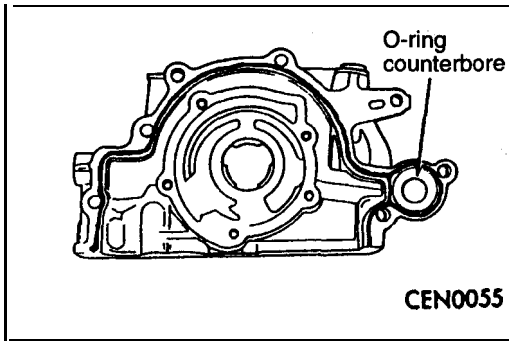


- (8) Remove crankshaft sprocket using **Special Tool, MB995027.**

Caution**Do not nick shaft seal surface or seal bore.**

- (9) Use Tool **MB995020** to remove front, **crankshaft oil seal.** **Be careful not damage the seal surface of cover.**

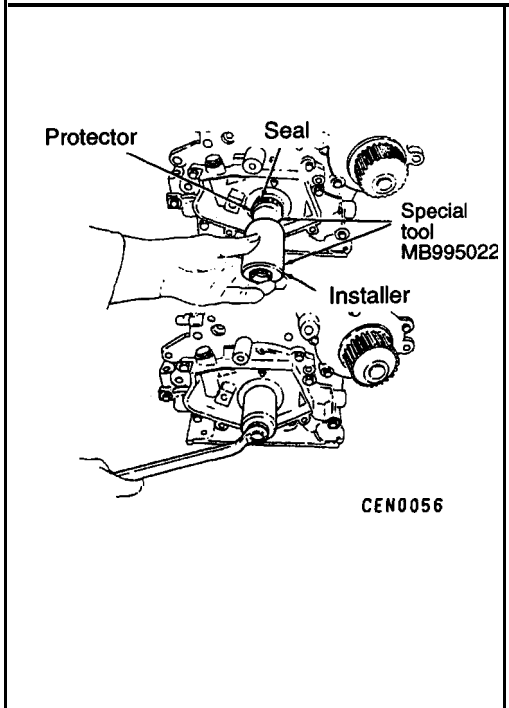
- (10) Remove oil pump.



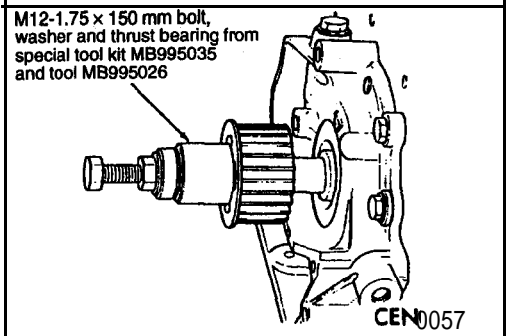
INSTALLATION

11302070010

- (1) Apply Loctite 51817 to oil pump as shown in the figure. Install oil-ring into the counter bore on the oil pump body discharge passage.
- (2) **Install** oil pump slowly onto crankshaft until seated to engine 'block. Tighten fasteners to 23 Nm (17 ft.lbs.).

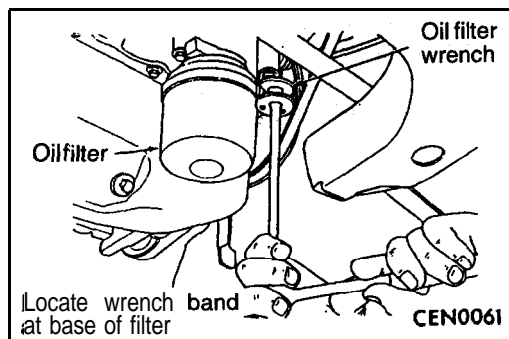
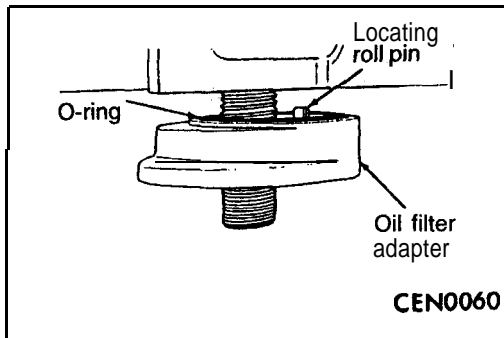
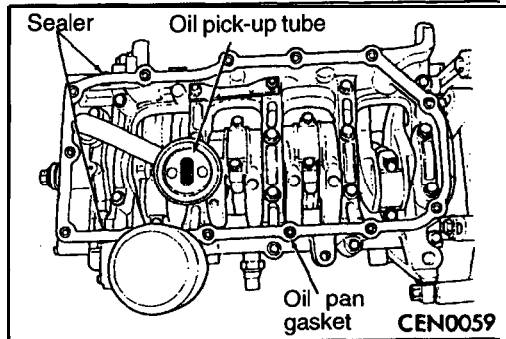
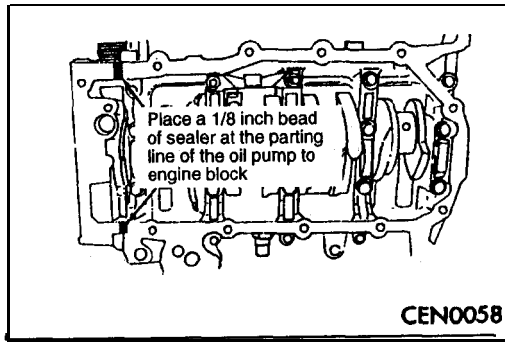


- (3) Install new seal by using Tool **MB995022**.



- (4) Place seal into opening with seal spring toward the inside of engine. Install seal until flush with cover.
- (5) Install crankshaft sprocket using **M12-1.75 x 150 mm** bolt, washer and thrust bearing, from Special Tool Kit **MB995035** and Tool **MB995026**.

- (6) Install oil pick-up tube.



(7) Apply Loctite 18716 or equivalent at the oil pump to engine bed plate parting line.

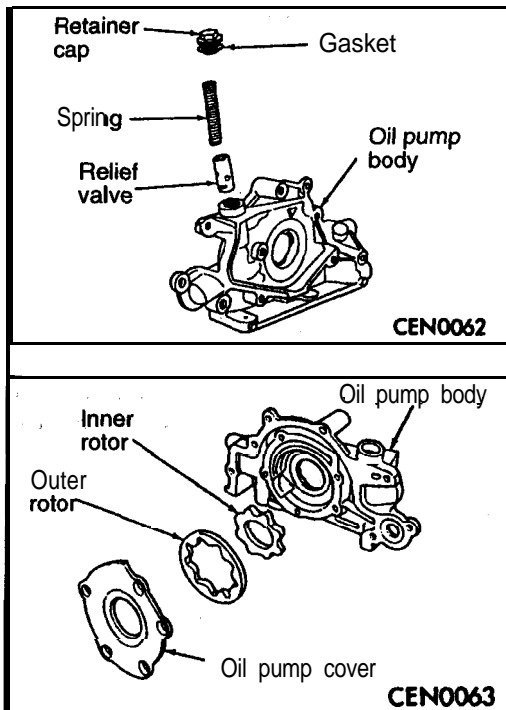
- (8) Install the oil pan gasket to the bed plate. Use Mopar Silicone Rubber Adhesive Sealant or equivalent to hold in place.
- (9) Install oil pan and tighten the screws to 12 Nm (9 ft.lbs.).

(10) Ensure O-ring is in the groove on adapter. Align roll pin into engine block and tighten assembly to 55 Nm (40 ft.lbs.).

Caution

When servicing the oil filter avoid deforming the filter can by installing the remove/install tool band strap against the can-to-base lockseam. The lockseam joining the can to the base is reinforced by the base plate.

- (11) Lubricate new filter gasket and install it on filter.
- (12) Check filter mounting surface. The surface must be smooth, flat and free of debris or old pieces of rubber.
- (13) Screw filter on until gasket contacts base. Tighten to 3/4 turn or Torque to 21 Nm (15 ft.lbs.).
- (14) Install rear plate.
- (15) Install flywheel or drive plate.



OIL PUMP

11302080013

DISASSEMBLY

- (1) To remove the relief valve, proceed as follows:
 (a) Remove the threaded plug and gasket from the oil pump.

Caution

Install oil pump pressure relief valve as shown in the figure, or serious damage may occur.

- (b) Remove spring and relief valve.
 (2) Remove oil pump cover screws, and lift off cover.
 (3) Remove pump rotors.

REASSEMBLY

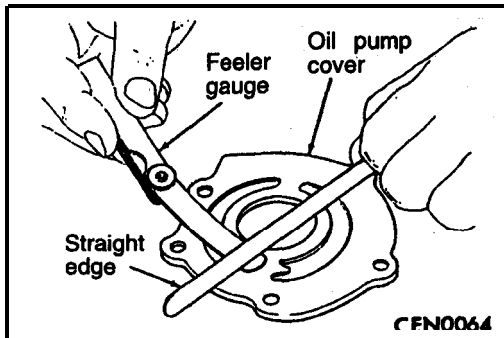
11302090016

- (1) Assemble pump, using new parts as required.
 Install the inner rotor with chamfer. **facing the cast, iron** oil pump cover.
- (2) Tighten cover screws to 12 Nm (9 **ft.lbs.**).
- (3) Install relief valve, spring, gasket **and** cap. Tighten cap to 54 Nm (39 **ft.lbs.**)
- (4) Prime oil pump before installation **by** filling **rotor** cavity with engine oil.

INSPECTION

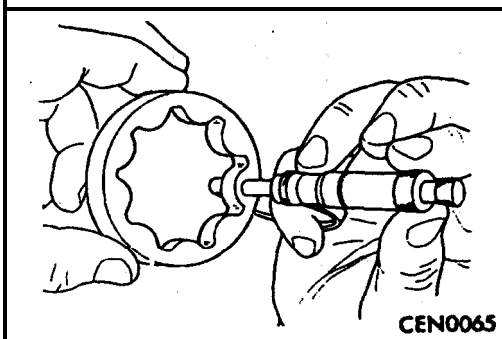
11302230012

- (1) Wash all parts in a suitable solvent and **inspect carefully** for damage or wear.
- (2) Mating surface of the oil pump should be smooth. Replace pump cover if scratched or **grooved**.

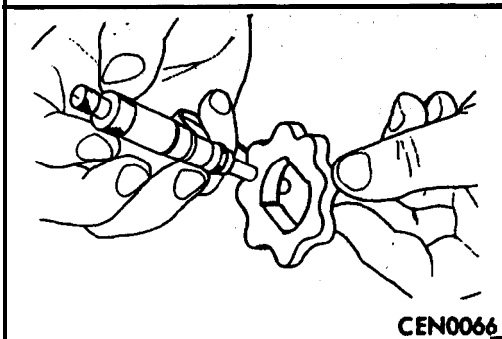


- (3) Lay a straightedge across the pump cover surface. If a feeler gauge of 0.076 mm (.003 in.) or more can be inserted between cover and straightedge, cover should be replaced.

Limit: 0.076 mm (.003 in.)

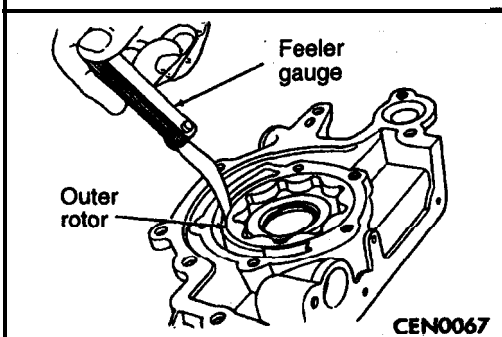


- (4) Measure thickness and diameter of outer rotor. If outer rotor thickness measures 7.64 mm (.301 in.) or less, or if the diameter is 79.95 mm (3.148 in.) or less, replace outer rotor.



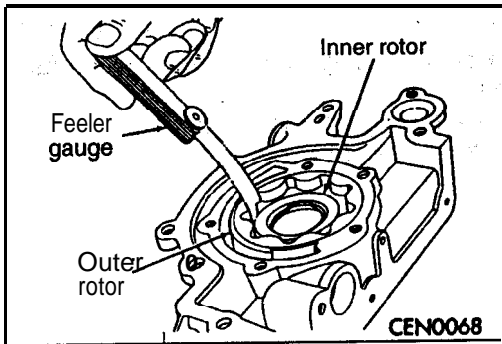
- (5) If inner rotor measures limit or less, replace inner rotor.

Limit: 7.64 mm (.301 in.)



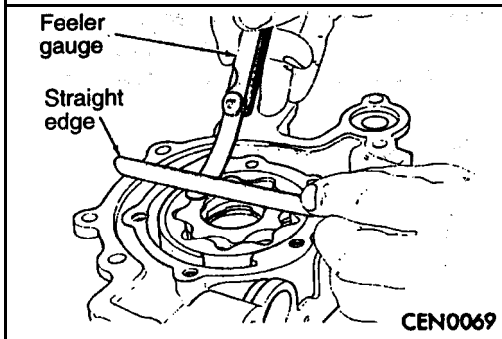
- (6) Slide outer rotor into pump housing, press to one side with fingers and measure clearance between rotor and housing. If measurement exceeds the limit, replace housing only if outer rotor is in specification.

Limit: 0.39 mm (.015 in.)



- (7) Install inner rotor into pump housing. If clearance between inner and outer rotors exceeds the limit, replace both rotors.

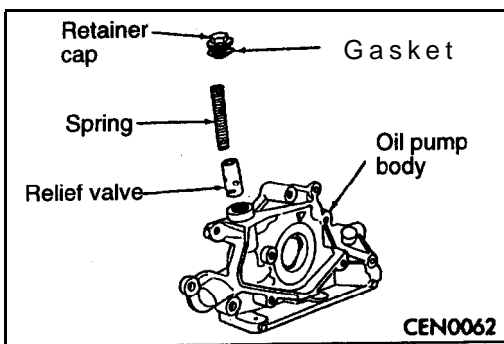
Limit: **0.203 mm (.008 in.)**



- (8) Place a straightedge across the face of the pump housing, between bolt holes. If a feeler gauge of **0.102 mm (.004 in.)** or more can be inserted between rotors and the straightedge, replace pump assembly.

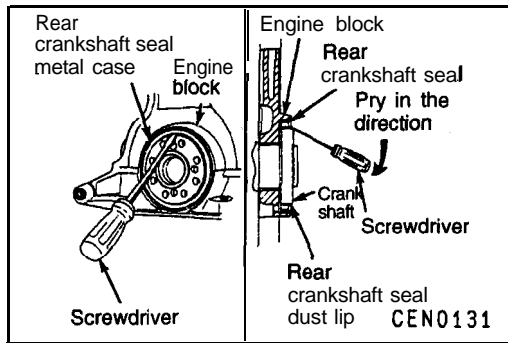
Limit: **0.102 mm (.004 in.)**

- (9) Inspect oil pressure relief valve plunger for scoring and free operation in its bore. Small marks may be removed, with **400-grit** wet or dry sandpaper.



- (10) The relief valve spring has a free length of approximately **60.7 mm (2.39 in.)**. It should test between **80 - and 84 N** when compressed to **40.5 mm (1.60 in.)**. **Replace spring** that fails to meet specifications.

- (11) If oil pressure is **low** and pump is within **specifications**, inspect for worn engine bearings, or other **reasons** for oil pressure loss.



PISTON, CONNECTING ROD AND CYLINDER BLOCK

11302110026

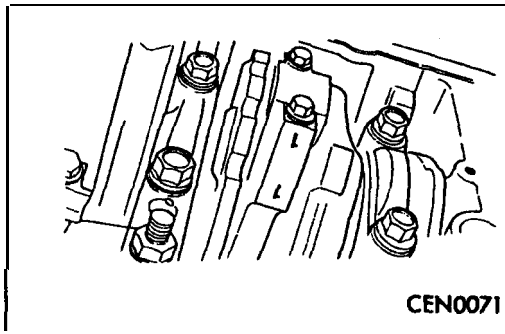
REMOVAL

- (1) insert a 3/16 flat bladed 'screwdriver between the dust lip and the metal case of the crankshaft seal. Angle the screwdriver through the dust lip against metal case of the seal. Pry out seal.

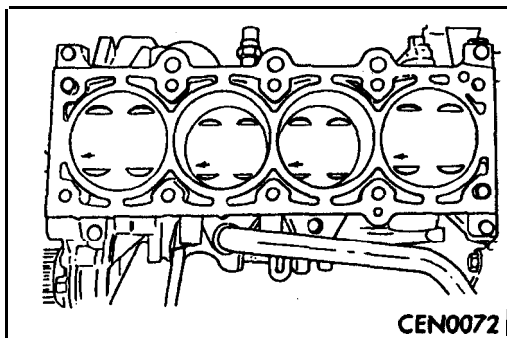
Caution

Do not permit the screwdriver blade to contact crankshaft seal surface. Contact of the screwdriver blade against crankshaft edge (chamfer) is permitted.

- (2) Remove top ridge of cylinder bores with a reliable ridge reamer before removing pistons from cylinder block. Be sure to keep tops of pistons covered during this operation. Mark piston with matching cylinder number.

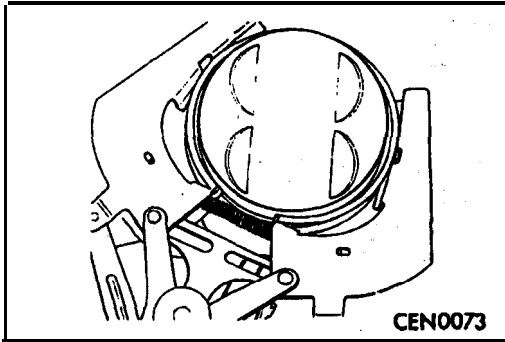


- (3) Ensure connecting rods and connecting rod caps match and proper set for the cylinder number. Identify them if necessary.



- (4) Pistons and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in cylinder bore.

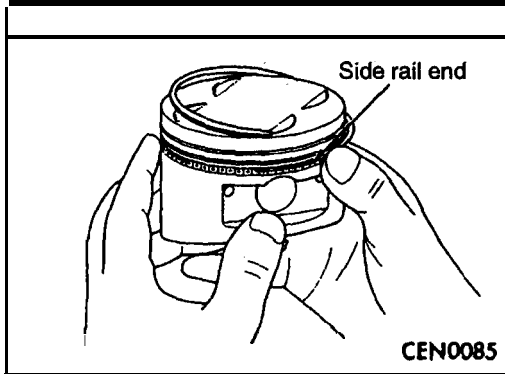
- (5) Remove connecting rod cap bolts. Push each piston and rod assembly out of cylinder bore. Be careful not to nick crankshaft journals.
- (6) After removal, install bearing cap in the connecting orientation on the mating connecting rod.

**DISASSEMBLY**

11302120012

- (1) Separate piston from **connecting** rod by removing piston pin.
- (2) **Using** a suitable ring expander,, remove **upper** and intermediate piston rings.

- (3) Remove the upper oil ring side rail, lower oil ring side rail and then oil ring expander from piston.
- (4) **Clean** ring grooves of any carbon deposits.



REASSEMBLY

11302140018

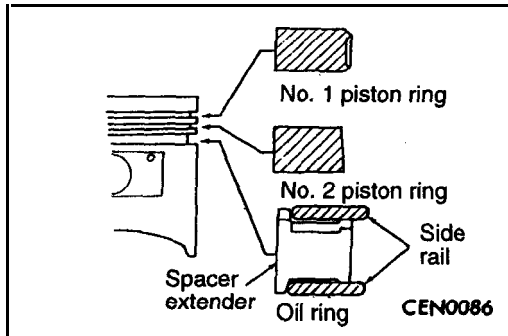
- (1) Install rings with manufacturer's I.D. mark facing up, toward the top of the piston.

Caution

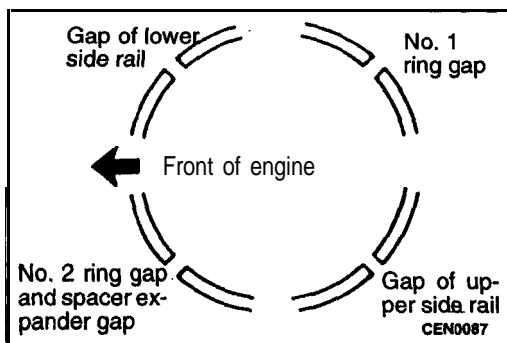
Install piston rings in the following order:

- (a) Oil ring expander.
 - (b) Upper oil ring side rail.
 - (c) Lower oil ring side rail.
 - (d) No. 2 intermediate piston ring.
 - (e) No. 1 upper piston ring.
- (2) Install the side rail by placing one end between the piston ring groove and the expander. Hold end firmly and press down the portion to be installed until side rail is in position. Do not use a piston ring expander.

- (3) Install upper side rail first and then the lower side rail.



- (4) Install No. 2 piston ring and then No. 1 piston ring.



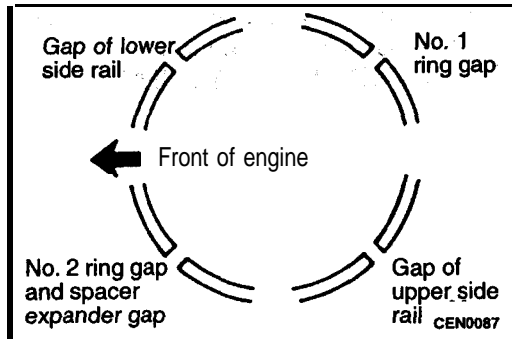
- (5) Position piston ring end gaps as shown in the figure.

- (6) Position oil ring expander gap at least 45 degrees from the side rail gaps but not on the piston pin center or on the thrust direction. Staggering ring gap is important for oil control.

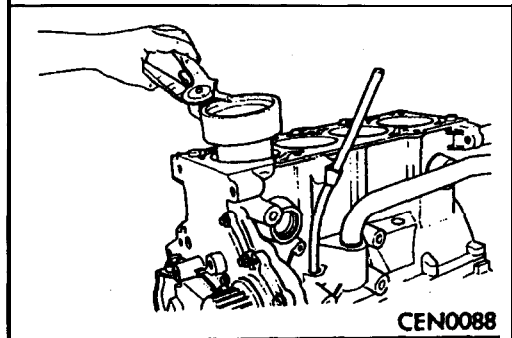
INSTALLATION

11302150028

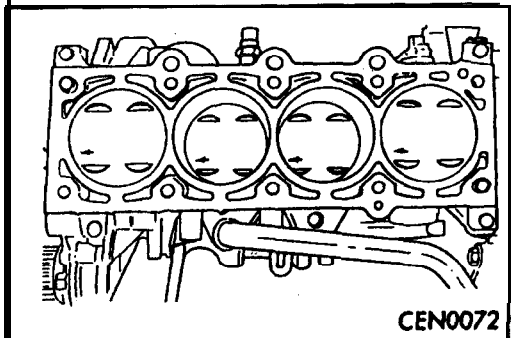
- (1) Before installing pistons and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.



- (2) Before installing the ring compressor, make sure the oil ring expander ends are butted and the rail gaps located as shown in the figure.



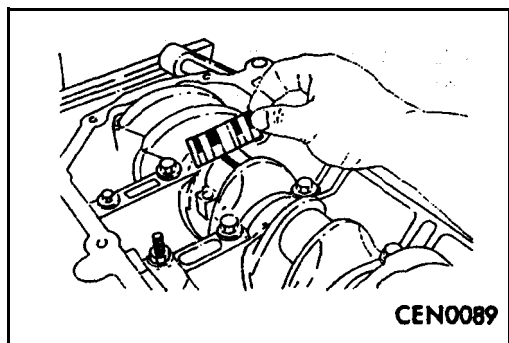
- (3) Immerse the piston head and rings in clean engine oil, slide the ring compressor, over the piston. Be sure that position of rings does not change during this operation.



- (4) The arrow should face toward the front of the engine. Install the pistons.

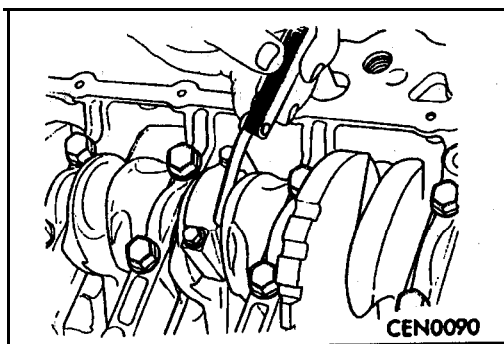
- (5) Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston assembly into cylinder bore and guide rod over the crankshaft journal.

- (6) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.



- (7) Install connecting rod bearings selected based **on the** obtained connecting rod bearing **clearance**.
(Refer to CONNECTING ROD BEARING CLEARANCE.)

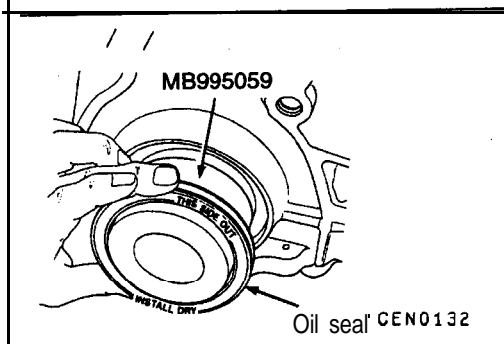
- (8) Install each bolt finger tight then alternately torque each nut to assemble the cap properly.
- (9) Tighten the bolts to 27.0 Nm PLUS 1/4 turn (20 ft.lbs. PLUS 1/4 turn). Do not use a torque wrench for last step.



- (10) Using a feeler gauge, check connecting rod' side clearance.

Standard value: 0.13–0.38 mm (.005–.015 in.)

Limit 0.37 mm (.015 in.)



Caution

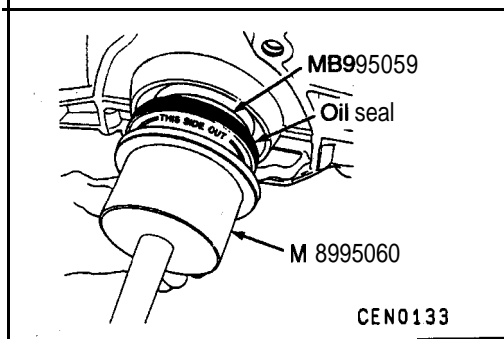
If burr or scratch is present on the **crankshaft edge** (chamfer), cleanup with 400 grit sand paper to prevent seal damage during **installation of new seal.**

NOTE

When installing seal, no lube on seal is **needed.**

- (11) Place Special Tool MB995059 on crankshaft. This is a pilot tool with a magnetic base.

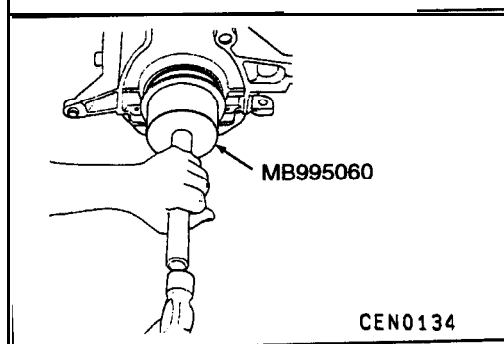
- (12) Position seal over pilot tool. Make sure you can read the words THIS SIDE OUT on seal. Pilot tool should remain on crankshaft during **installation** of seal.



- (13) Drive the seal into the block using Special Tool MB995060 and handle C-4171 until the tool bottoms out against the block.

Caution

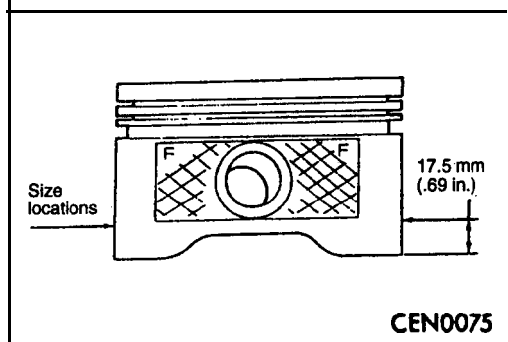
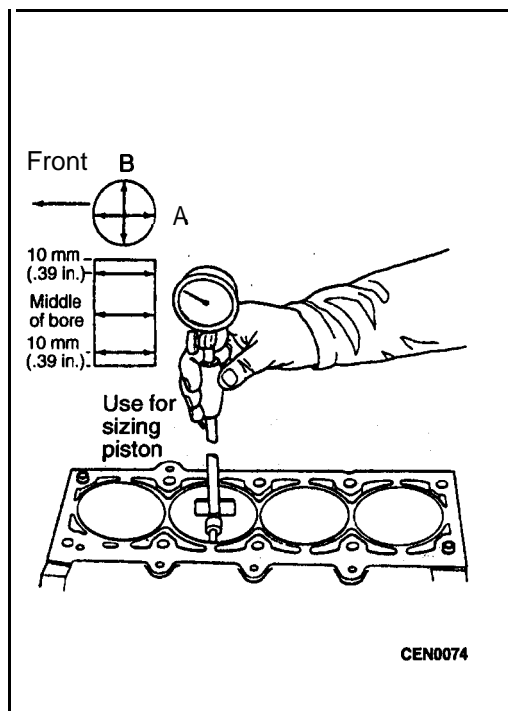
If the seal is driven into the **block** past flush, **this** may cause an oil leak.



INSPECTION

CYLINDER BLOCK

- (1) Clean cylinder block thoroughly and check all core hole plugs for evidence of leaking.
- (2) Examine block and cylinder bores for cracks or fractures.



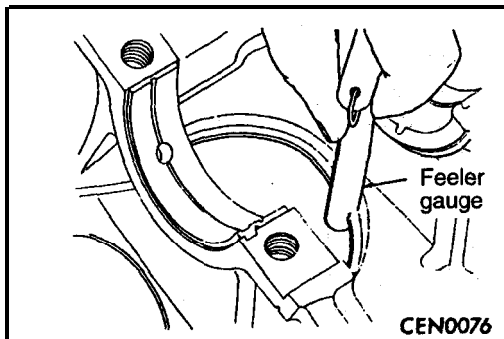
CYLINDER BORE

- (1) The cylinder walls should be checked for out-of-round and taper with Tool C-119 or equivalent. The cylinder bore out-of-round is 0.051 mm (.002 in.) maximum, and cylinder bore taper is 0.051 mm (.002 in.) maximum. If the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new pistons and rings fitted. Whatever type of boring equipment is used, boring and honing should be closely coordinated with the fitting of pistons and rings so that specified clearances may be maintained.
- (2) Measure the cylinder bore at three levels in directions A and B. Top measurement should be 10 mm (.39 in.) down and bottom measurement should be 10 mm (.39 in.) up from bottom of bore.

Standard value: 87.5 mm (3.445 in.)

PISTONS

- (1) Piston and cylinder wall must be clean and dry. Piston diameter should be measured 90 degrees to piston pin at size location shown in the figure. Cylinder bores should be measured halfway down the cylinder bore and transverse to the engine crankshaft center line. Correct piston to bore clearance must be established in order to assure quiet and economical operation.
- Standard value: 0.012–0.044 mm (.0005–.0017 in.)**
- (2) Pistons and cylinder bores should be measured at normal room temperature, 21 °C. (70°F).



PISTON RING

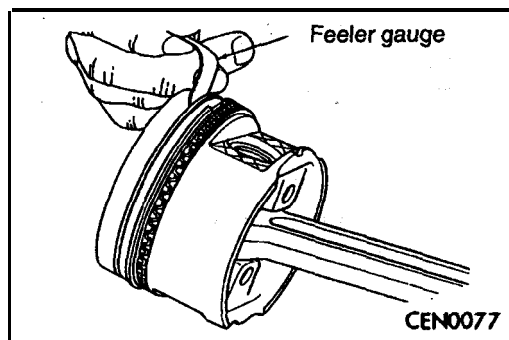
- (1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (.47 in.) from bottom of cylinder bore. Check gap with feeler gauge.

Standard value:

Upper ring 0.23–0.52 mm (.009–.020 in.)
Intermediate ring 0.49–0.78 mm (.019–.031 in.)
Oil control ring 0.23–0.66 mm (.009–.026 in.)

Limit:

Upper ring 0.8 mm (.031 in.)
Intermediate ring 1.0 mm (.039 in.)
Oil control ring 1.0 mm (.039 in.)



- (2) Check piston ring to groove side clearance.

Standard value: 0.025–0.065 mm (.0010–.0026 in.)

Limit: 0.10 mm (.004 in.)

CRANKSHAFT MAIN BEARINGS

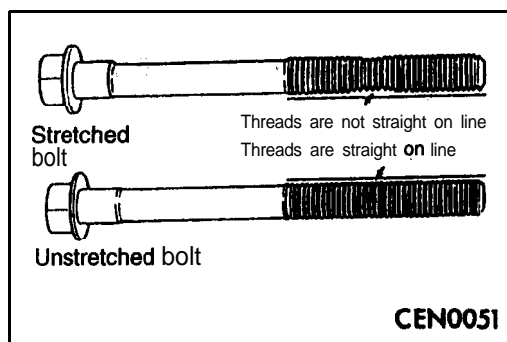
The crankshaft is supported in five main bearings. All upper bearing shells in the crankcase have oil grooves. All lower bearing shells installed in the (bedplate) main bearing caps are plain. Crankshaft end play is controlled by a flanged bearing on the number three main bearing journal.

CONNECTING ROD BEARING CLEARANCE

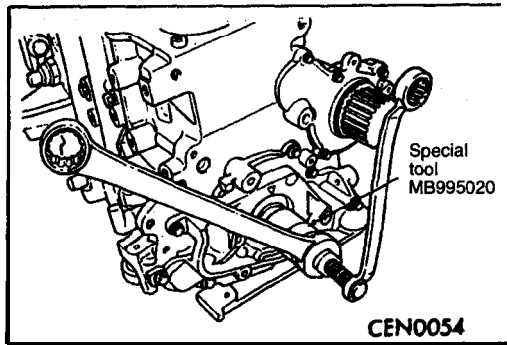
- (1) Place a piece of Plastigage across the **entire** width of the bearing shell in the bearing cap **approximately** 6.35 mm off center and away from the oil hole. **In addition**, suspect areas can be checked, by placing **Plastigage** in the suspect area.
- (2) Before assembling the rod cap with **Plastigage** in place; the crankshaft must be rotated **until** the connecting rod being checked starts moving toward the top of the engine. Only then should the cap be **assembled** and torqued to the specification.
Do not rotate the crankshaft while assembling the cap or the Plastigage may be smeared, giving inaccurate results.
- (3) Remove the bearing cap and compare the width of the flattened Plastigage with the metric scale provided on the package.

Standard value: 0.026–0.059 mm (.001–.0023 in.)

Limit: 0.075 mm (.003 in.)

**CONNECTING ROD BEARING CAP BOLT**

- (1) Since the connecting rod bearing cap bolts are torqued using a new procedure, they should **be** examined **BEFORE** reuse. If the threads are necked down, **replace** the bolts.
- (2) Necking can be checked by holding a scale or straight edge against the threads. If all the threads **do not** contact, the scale, the bolt should be replaced.



CRANKSHAFT

11302170017

REMOVAL

Procedures after removing crankshaft sprocket, oil pan, pistons and connecting rods.

- (1) Using Tool **MB995022**, remove front crankshaft oil seal. Be careful not to damage the seal surface of cover.
- (2) Pry out rear seal with screwdriver. Be careful not to nick or damage crankshaft flange seal surface or retainer bore.
- (3) Remove main bearing cap **bedplate**.
- (4) Remove bearing lower.
- (5) Remove crankshaft.
- (6) Remove bearing upper.
- (7) Remove knock sensor.
- (8) Remove oil pressure switch.
- (9) Remove oil level gauge (dipstick).

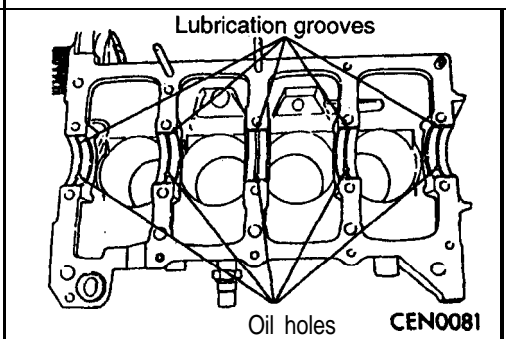
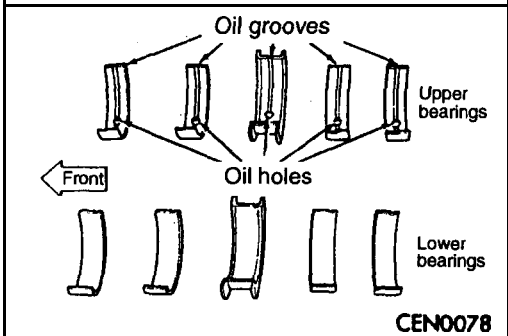
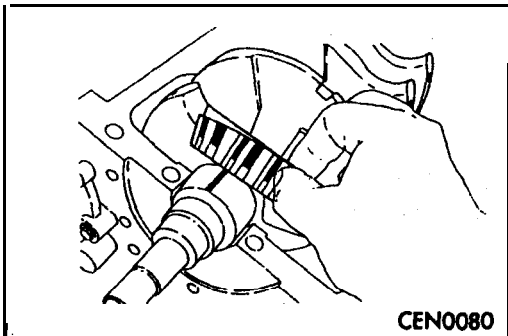
INSTALLATION

11302190020

- (1) Install oil level gauge (dipstick).
- (2) Install oil pressure switch.

- (3) Install knock sensor. Tighten knock sensor to 10 Nm (7 ft.lbs.) torque. Over or under tightening effects knock sensor performance, possibly causing improper spark control.

- (4) Select proper thickness main bearing shells by referring to CRANKSHAFT BEARING CLEARANCE.



NOTE

Upper and lower No. 3 bearing halves are flanged to carry the crankshaft thrust loads and are NOT interchangeable with any other bearing halves in the engine. Bearing shells are available in standard and the following undersized:

0.016 mm, 0.032 mm, 0.250 mm.

Never install an undersize bearing that will reduce clearance below specifications.

- (5) Install the main bearing shells with the lubrication groove in the cylinder block.

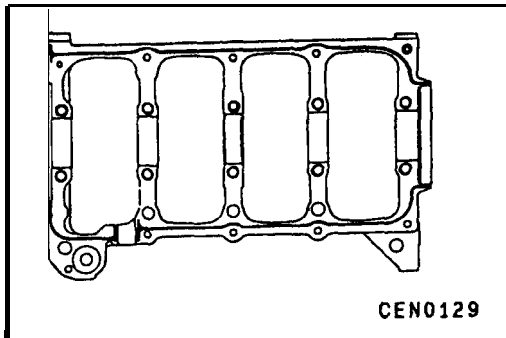
NOTE

All upper bearing shells in the crankcase have oil grooves. All lower bearing shells installed in the (bedplate) main bearing caps are plain. Crankshaft end play is controlled by a flanged bearing on the number three main bearing journal.

- (6) Make certain oil holes in block line up with oil hole in bearings and bearing tabs seat in the **block** tab slots.
- (7) Oil the bearings and, journals and install crankshaft.

Caution

Do not get oil on bedplate mating surface.
If may effect the sealer ability to seal the bedplate to cylinder block.

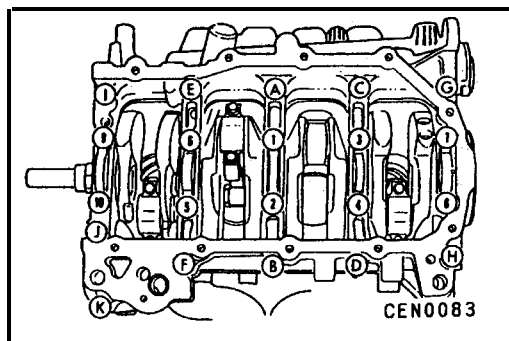


- (8) Apply 1.5 to 2.0 mm (.059 to .078 in.) bead of Loctite 19614 to cylinder block as shown in the figure.
- (9) Install main bearing cap **bedplate** together with lower bearing shells.

Caution

Use only the specified anaerobic sealer "on the bedplate or damage may occur to the engine."

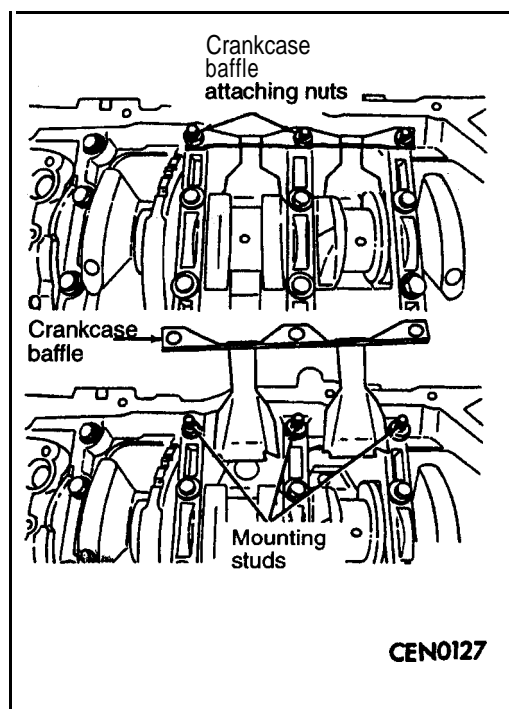
(10) Before installing the bolts, the threads should be oiled with engine oil.

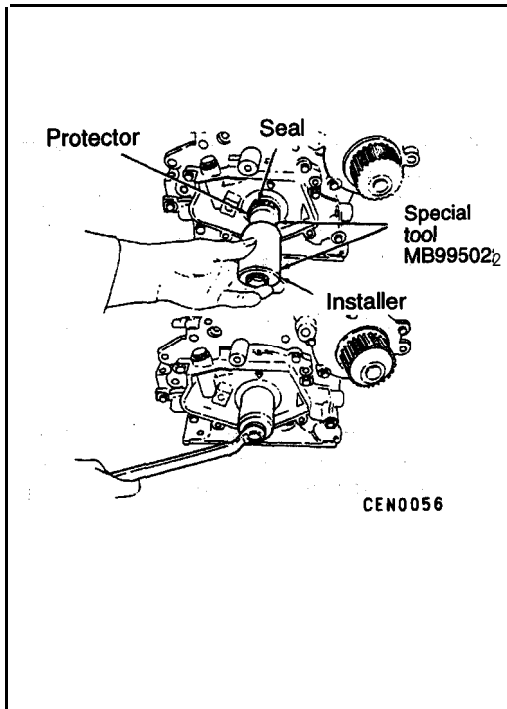


(11) Install main bearing bedplate to engine block bolts (1 thru 10) finger tight, then torque main bearing bolts to 75 Nm (55 ft.lbs.) in sequence shown in the figure.

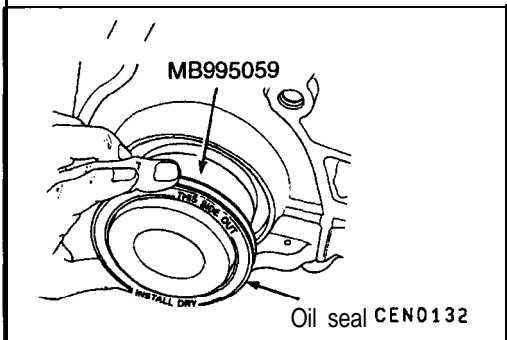
(12) Install main bearing bedplate to engine block bolts (A thru K) finger tight, then torque each bolt to 28 Nm (20 ft.lbs.) in sequence shown in the figure.

(13) Install crankcase baffle into the opening in the block. Attach baffle to main bearing cap fasteners.





(14) Place new front seal into opening with seal spring towards the inside of engine. Install seal by using Tool MB995022 until flush with oil pump cover.



Caution

if burr or scratch is present on the crankshaft edge (chamfer), cleanup with 400 grit sand paper to prevent seal damage during installation of new seal.

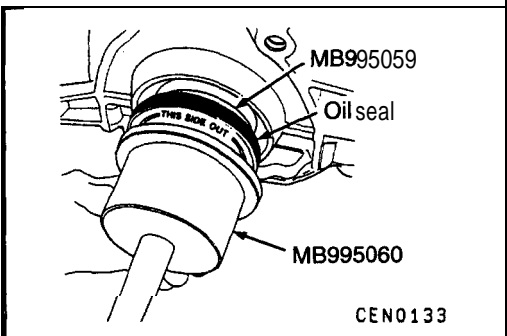
NOTE

When installing seal, no lube on seal is needed.

(15) Place Special Tool MB995059 on crankshaft. This is a pilot tool with a magnetic base.

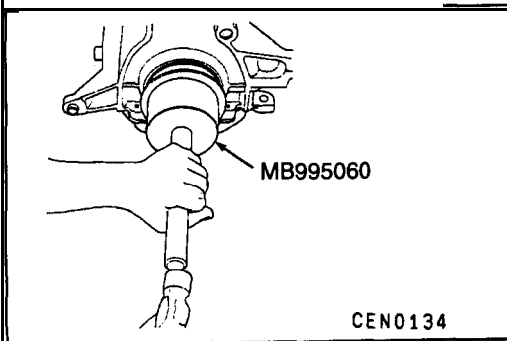
(16) Position seal over pilot tool. Make sure you can read the words THIS SIDE OUT on seal. Pilot tool should remain on crankshaft during installation of seal.

(17) Drive the seal into the block using Special Tool MB995060 and handle C-4171 until the tool bottoms out against the block.



Caution

If the seal is driven into the block past flush, this may cause an oil leak.



INSPECTION

11302180010

CRANKSHAFT MAIN JOURNALS

- (1) The crankshaft journals should be checked for excessive wear, taper and scoring. Limits of taper or **out-of-round** on any crankshaft journals should be held to **0.025 mm (.001 in.)**. Journal grinding should not exceed **0.305 mm (.012 in.)** under the standard **journal diameter**. Do NOT grind thrust faces of **Number 3 main journal**. Do NOT nick crank pin or journal fillets. After grinding, remove rough edges from crankshaft oil holes and clean out all passages.

Caution

With the nodular cast iron **crankshafts used it is important** that the final paper or **cloth polish after any journal regrind** be in the same direction as normal rotation in the engine.

CRANKSHAFT BEARING CLEARANCE

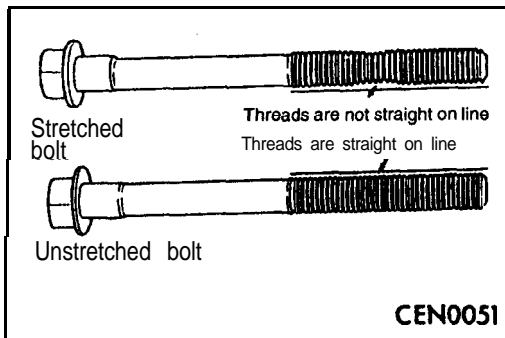
- (1) The total clearance of the main bearings can only be determined by removing the weight of the crankshaft. This is accomplished by having the engine turned upside down on the engine stand. This will remove all the crankshaft weight off the bearing surface.
- (2) Place a piece of Plastigage across the entire width of the bearing shell in the bedplate approximately 6.35 mm (.25 in.) off center and away from the oil holes. In addition, suspect areas can be checked by placing the Plastigage in the suspect area.
Torque the bedplate bolts of the bearing being checked to the proper specifications.

Caution

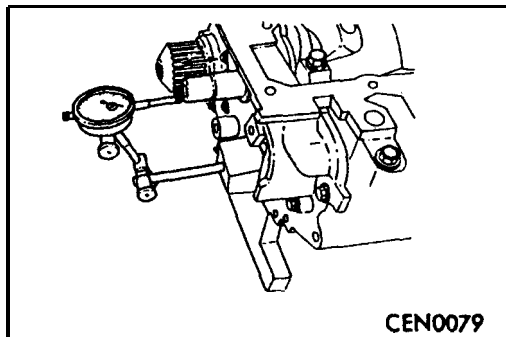
Do not rotate crankshaft, or the Plastigage may be smeared.

- (3) Remove the bedplate and compare the width of the flattened Plastigage with the metric scale provided on the package.

Standard value: 0.022–0.062 mm (.0009–.0024 in.)

**MAIN BEARING BOLTS**

- (1) Since the main bearing bolts are torqued using a new procedure, they should be examined BEFORE reuse. If the threads are necked down, replace the bolts.
- (2) Necking can be checked by holding a scale or straight edge against the threads. If all the threads do not contact the scale, the bolt should be replaced.

**CHECKING CRANKSHAFT END PLAY**

- (1) Mount a dial indicator to front of engine, locating probe on nose of crankshaft.
- (2) Move crankshaft all the way to the rear of its travel using a lever inserted between a main bearing cap and a crankshaft cheek, using care not to damage any bearing surface. Do not loosen main bearing cap.
- (3) Zero the dial indicator.
- (4) Move crankshaft all the way to the front and read the dial indicator.

Standard value: 0.09–0.24 mm (.0035–.0094 in.)

Limit: 0.37 mm (.015 in.)

- (5) Replace No. 3 main bearing if limit is exceeded and re-measure.
- (6) Replace crankshaft if limit is still exceeded.

OPTIONAL CRANKSHAFT END PLAY CHECK

- (1) Move crankshaft all the way to the rear of its travel using a lever inserted between a main bearing cap and a crankshaft cheek, using care not to damage any bearing surface. Do not loosen main bearing cap.
- (2) Use a feeler gauge between number three thrust bearing and machined crankshaft surface to determine end play.