ENGINE

CONTENTS

GENERAL SPECIFICATIONS

General	
No. and arrangement of cylinders	4, in-line, vertical
Combustion chamber type	Semi-spherical
Valve arrangement	Overhead valve type
Camshaft arrangement	Overhead camshaft type
Total displacement cm³ (in.³)	2,555 (155.9)
Bore × Stroke mm (in.)	91.1 × 98 (3.59 × 3.86)
Compression ratio	7.0
Compression pressure kPa (psi)/rpm	980 (140)/250
Valve timing	
Inlet valve opened/closed	25°BTDC/59°ABDC
Exhaust valve opened/closed	64°BBDC/20°ATDC
Firing order	1−3−4−2
Valve clearance at hot engine mm (in.)	0.25 (.010) ..... Jet
	0 (Self-adjusting type) ..... Inlet and exhaust
Timing chain	
Type	Double roller
No. of links	102
Pitch mm (in.)	9.525 (.375)
Timing chain "B" for silent shaft drive	
Type	Single roller
No. of links	90
Pitch mm (in.)	8.0 (.315)
Crankshaft sprocket	
Material	Ferrous sintered alloy
No. of teeth	19
Crankshaft sprocket "B"	
Material	Cast iron
No. of teeth	34
Camshaft sprocket	
Material	Cast iron
No. of teeth	38
Silent shaft and oil pump sprocket	
Material	Steel
No. of teeth	17
Rocker arm	
Material	Aluminum die casting, Slipper made from special sintered alloy
I.D. mm (in.)	18.9 (.744)
Oil clearance mm (in.)	0.01−0.04 (.0004−.0016)
Identification mark	1−3

*1 Engine without an intercooler
*2 Engine with an intercooler

Camshaft	
Driven by	Chain
Material	Cast iron, Cam surface chilled
Cam height mm (in.)	42.4 (1.669)
Valve lift mm (in.)	10.5 (.413)
Journal diameter mm (in.)	34 (1.339)
Oil clearance mm (in.)	0.05 – 0.09 (.002 – .004)
Identification mark	A (on camshaft rear end)
Cylinder head	
Material	Aluminum alloy
Cylinder head (Overall height) mm (in.)	90 ± 0.1 (3.543 ± .004)
Flatness of gasket surface mm (in.)	Less than 0.05 (.002)
Valve guide hole diameter mm (in.)	
0.05 (.002) O.S.	13.050 – 13.068 (.5138 – .5145)
0.25 (.010) O.S.	13.250 – 13.268 (.5217 – .5224)
0.50 (.020) O.S.	13.500 – 13.518 (.5315 – .5322)
Inlet valve seat ring hole diameter mm (in.)	
0.3 (.012) O.S.	47.300 – 47.325 (1.8622 – 1.8632)
0.6 (.024) O.S.	47.600 – 47.625 (1.8740 – 1.8750)
Exhaust valve seat ring hole diameter mm (in.)	
0.3 (.012) O.S.	40.300 – 40.325 (1.5866 – 1.5876)
0.6 (.024) O.S.	40.600 – 40.625 (1.5984 – 1.5994)
Valve guide installing height mm (in.)	14 (.551)
Jet valve	
Material	Special heat resistace steel
Stem diameter mm (in.)	4.3 (.169)
Valve diameter mm (in.)	7 (.276)
Length mm (in.)	92.5 (3.64)
Jet body	
Material	FCD
I.D. mm (in.)	4.3 (.169)
Inlet valve	
Material	Special heat resisting steel
Treatment	Sur-sulf
Valve diameter mm (in.)	46 (1.811)
Stem diameter mm (in.)	8.0 (.3150)
Clearance (stem-to-guide) mm (in.)	0.03 – 0.06 (.0012 – .0024)
Margin mm (in.)	1.2 (.047)
Identification mark	N

*1 Engine without an intercooler
*2 Engine with an intercooler

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Exhaust valve	
Material	Special heat resisting steel, Valve face padded with stellite
Treatment	Tufftriding *1 Chrome flash plating to stem *2
Valve diameter mm (in.)	38 (1.496)
Stem diameter mm (in.)	8.0 (.3150)
Clearance (stem-to-guide) mm (in.)	0.05—0.09 (.0020—.0035)
Margin mm (in.)	2.0 (.079)
Identification mark	N *1 G5T *2
Valve spring	
Free height mm (in.)	49.8 (1.961)
Load N (lbs.)/mm (in.)	322 (72)/40.4 (1.591)
Square	Less than 2°
Identification color	White
Right silent shaft	
Driven by	Chain
Material	Steel
Rear journal diameter mm (in.)	43 (1.693)
Oil clearance mm (in.)	0.06—0.10 (.0024—.0039)
Left silent shaft	
Driven by	Chain
Material	Steel
Front journal diameter mm (in.)	23 (.906)
Rear journal diameter mm (in.)	43 (1.693)
Oil clearance mm (in.)	
Front	0.02—0.06 (.0008—.0024)
Rear	0.06—0.10 (.0024—.0039)
Piston	
Material	Special aluminum alloy
Type	Autothermic
Diameter (standard) mm (in.)	91.1 (3.587)
Clearance (piston-to-cylinder) mm (in.)	0.02—0.04 (.0008—.0016)
Pistons for service mm (in.)	0.25 (.010), 0.50 (.020), 0.75 (.030), 1.00 (.040), oversize
Identification mark	54T
Piston ring	
No. of rings per piston	3
Compression	2
Oil	1
Compression ring type	
No. 1	Barrel type, special cast iron, chrome face
No. 2	Taper type, special cast iron, chrome face
Oil ring	3-piece steel rail chrome face

*1 Engine without an intercooler
*2 Engine with an intercooler

Ring gap mm (in.)	
No. 1	0.3 – 0.5 (.012 – .020)
No. 2	0.25 – 0.4 (.010 – .016)
Oil	0.3 – 0.8 (.012 – .031)
Ring side clearance mm (in.)	
No. 1	0.05 – 0.09 (.002 – .004)
No. 2	0.02 – 0.06 (.001 – .002)
Rings for service mm (in.)	0.25 (.010), 0.50 (.020), 0.75 (.030), 1.00 (.040), oversize
Connecting rod	
Length (center to center) mm (in.)	166 (6.535)
Piston pin bore diameter mm (in.)	21.974 – 21.985 (.8651 – .8655)
Side clearance (big end) mm (in.)	0.1 – 0.25 (.004 – .010)
Crankshaft	
Material	Steel
Main bearing journal diameter mm (in.)	60 (2.362)
Connecting rod journal diameter mm (in.)	53 (2.087)
Maximum allowable out-of-round and/or taper of journal mm (in.)	0.01 (.0004)
Oil clearance mm (in.)	
Main bearing journal	0.02 – 0.05 (.0008 – .0020)
Connecting rod journal	0.02 – 0.06 (.0008 – .0024)
Thrust taken by	No. 3 main bearing
End play mm (in.)	0.05 – 0.18 (.0020 – .0071)
Cylinder block	
Material	Cast iron
Water jacket	Siamese type
Cylinder block (Ovarall height) mm (in.)	316 (12.44)
Cylinder bore mm (in.)	91.1 (3.587)
Out-of-round and taper mm (in.)	Less than 0.02 (.0008)
Maximum allowable oversize (cylinder bore) mm (in.)	1.00 (.039)
Oil pump	
Type	Gear
Driven by	Chain
Oil pressure at idle kPa (psi)	78 (11) *3
Relief valve opening pressure kPa (psi)	392 (57)
Oil filter	
Type	Cartridge, Full flow
Size (Diameter × Length) mm (in.)	90 × 100 (3.54 × 3.94)

*1 Engine without an intercooler
*2 Engine with an intercooler
*3 Conditions : Oil temperature is 75 to 90°C (167 to 194°F) at idling

SERVICE SPECIFICATIONS

Standard value	
Valve clearance – Hot engine mm (in.)	
Intake and exhaust valve	0 (Self-adjusting type)
Jet valve	0.25 (.010)
Piston pin press in load N (lbs.)	7,355–17,162 (1,653–3,858)
Flywheel runout mm (in.)	0.1 (.004) max.
Oil pressure gauge unit	
Current value mA	
at 0 kPa (0 psi)	0
at 392 kPa (57 psi)	84
at 785 kPa (114 psi)	110

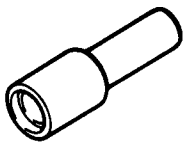
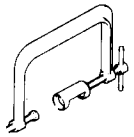
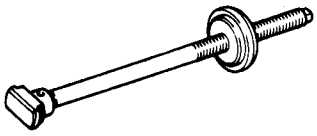
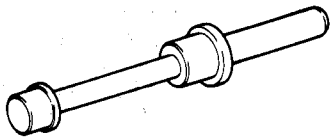
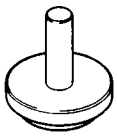
TORQUE SPECIFICATIONS

	Nm (ft.lbs.)
Engine mounting front insulator to engine	13–20 (9.4–14)
Engine mounting front insulator to cross member	30–40 (22–29)
Engine mounting rear insulator to engine support bracket	13–20 (9.4–14)
Engine mounting rear insulator to engine	20–24 (14–17)
Engine support bracket to body	10 (7.2)
Cylinder head bolts – Cold engine	
No. 1 to No. 10	89–98 (65–72)
No. 11	15–21 (11–15)
Cylinder head bolts – Hot engine	
No. 1 to No. 10	98–107 (73–79)
No. 11	15–21 (11–15)
Camshaft bearing cap bolts	19–20 (14–15)
Camshaft sprocket bolt	49–58 (37–43)
Rocker cover bolts	5–6.8 (4–5)
Heater joint	20–39 (15–28)
Intake and exhaust manifold nuts or bolts	15–19 (11–14)
Rocker arm adjusting nuts	12–17 (9–13)
Main bearing cap bolts	74–83 (55–61)
Connecting rod cap nuts	45–47 (33–34)
Crankshaft pulley bolts	108–127 (80–94)
Oil pump sprocket bolt	30–39 (22–28)
Silent shaft sprocket bolt	59–68 (44–50)
Silent shaft chamber cover bolts	4–5 (3–4)
Flywheel bolts	128–137 (94–101)
Drive plate bolts	128–137 (94–101)
Engine support bracket bolts	49–55 (37–43)
Chain guide "B" bolt (Upper)	8–9 (6–7)
Chain guide "B" bolt (Lower)	15–21 (11–15)
Chain guide access hole cover bolts	10–11.5 (7.5–8.5)
Oil pump cover bolt	10–11 (7–8)

Oil pump assembly mounting bolt	8–9 (6–7)
Oil pressure switch or gauge unit	15–21 (11–15)
Oil pan bolt	6–7 (4.5–5.5)
Oil pan drain plug	35–44 (26–32)
Oil filter	11–12 (8–9)
Oil filter stud	50–58 (37–43)
Oil relief valve plug	40–49 (29–36)
Water temperature gauge unit	30–39 (22–28)

LUBRICANT

	Specified lubricants	Quantity
Engine oil (including of oil filter)	API classification SF or SF/CC	4.8 liters (5.1 U.S. qts., 4.2 Imp. qts.)

Tool (Number and name)	Use	Tool (Number and name)	Use
MD998005 Valve stem seal installer 	Installation of valve stem seal Use with valve spring seat	MD998303 Valve spring compressor 	Removal and installation of valve spring
MD998251 Silent shaft bearing puller 	Removal of silent shaft bearing	MD998250 Silent shaft bearing installer 	Installation of silent shaft bearing
MD998376 Crankshaft rear oil seal installer 	Installation of crank-shaft rear oil seal	MD998442 Air-bleed wire 	Bleeding of air inside the adjuster on vehicle
MD998443 Auto-lash adjuster holder 	Supporting of the auto-lash adjuster to prevent it from falling when rocker shaft assembly is removed of installed		

Symptom	Probable cause	Remedy
NOISY ENGINE		
Knocking of crankshaft and bearing	Loose main bearing	Replace
	Seized bearing	Replace
	Bent crankshaft	Replace
	Excessive crankshaft end play	Replace main bearing
Piston and connecting rod knocking	Loose bearing	Replace
	Seized bearing	Replace
	Loose piston pin	Replace piston and pin or connecting rod
	Loose piston in cylinder	Recondition cylinder
	Broken piston ring	Repair or replace
	Improper connecting rod alignment	Realign
Camshaft knocking	Loose bearing	Replace
	Excessive end play	Replace
	Broken cam gear	Replace
Timing chain noise	Improper chain tension	Adjust or replace
	Worn and/or damaged chain	Replace
	Worn sprocket	Replace
	Worn and/or broken tension adjusting mechanism	Replace
	Excessive camshaft and bearing clearance	Replace
Camshaft and valve mechanism knocking	Improper valve clearance	Adjust
	Worn adjusting screw	Replace
	Worn rocker face	Replace
	Loose valve stem in guide	Replace guide
	Weakened valve spring	Replace
	Seized valve	Repair or replace
Water pump knocking	Improper shaft end play	Replace water pump assembly
	Broken impeller	Replace water pump assembly

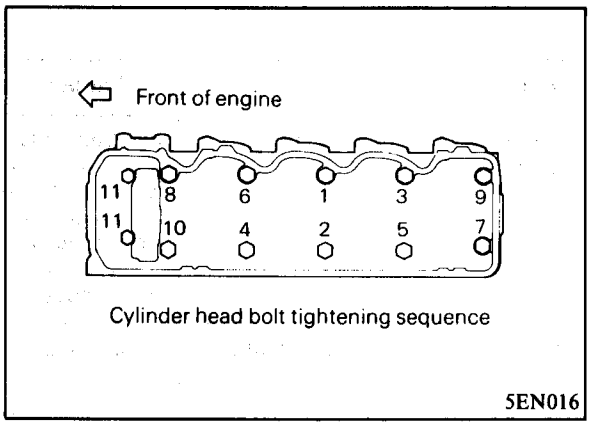
Symptom	Probable cause	Remedy
OTHER MECHANICAL TROUBLE		
Stuck valve in guide	Improper valve clearance	Adjust
	Insufficient clearance between valve stem and guide	Clean stem or ream the guide
	Weakened or broken valve spring	Replace
	Damage to valve stem	Replace
Valve stuck on seat	Improper valve clearance	Adjust
	Weakened valve spring	Replace
	Thin valve head edge	Replace valve
	Narrow valve seat	Reface
	Overheating	Repair or replace
	Excessive engine speed	Drive at proper speed
	Stuck valve guide	Repair or replace
Excessively worn cylinder and piston	Shortage of engine oil	Add or replace oil Check oil level on daily basis
	Dirty engine oil	Clean crankcase, replace oil and replace oil filter element
	Poor oil quality	Use proper oil
	Overheating	Repair or replace
	Wrong assembly of piston with connecting rod	Repair or replace
	Improper piston ring clearance	Replace
	Dirty air cleaner	Clean air cleaner and replace filter
	Too rich mixture	Adjust or replace carburetor
	Stuck choke valve	Clean or replace carburetor choke chamber
	Over choking	Repair or replace choke assembly
Damaged connecting rod	Shortage of engine oil	Add or replace oil Check oil level on daily basis
	Low oil pressure	Correct
	Poor engine oil quality	Use proper oil
	Rough crankshaft surface	Grind or replace
	Clogged oil passage	Clean

Symptom	Probable cause	Remedy
Damaged connecting rod (continued)	Bearing worn or eccentric	Replace
	Bearing improperly assembled	Repair or replace
	Loose bearing	Replace
	Incorrect connecting rod alignment	Repair or replace
Damaged crankshaft bearing	Shortage of engine oil	Add or replace Check oil level on daily basis
	Low oil pressure	Adjust or repair
	Poor quality engine oil	Use proper oil
	Worn or out-of-round crankshaft journal	Repair or replace
	Clogged oil passage in crankshaft	Clean
	Bearing worn or eccentric	Replace bearings and check engine oil lubrication system
	Bearing improperly assembled	Repair or replace
	Non-concentric crankshaft or bearing	Replace
Excessive vibration	Loose engine mounts	Tighten or replace
	Silent shaft bearings damaged	Replace
	Silent shaft out-of-time	Retime

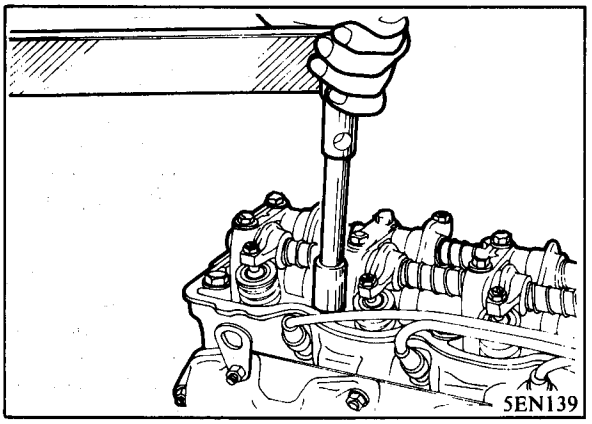
RETORQUING OF CYLINDER HEAD BOLTS

1. When cylinder head bolts are retorqued, first slightly loosen and then tighten to specified torque.
2. Be sure to follow the specified torquing sequence. (5EN016)
3. After cylinder head bolts have been tightened to specified torque, run engine until normal operating temperature is reached, allow it to cool down, and then retorque bolts to specification for best results.

Tightening torque
Cylinder head bolts (No. 1 to 10)
Cold engine ..... 89–98 Nm (65–72 ft.lbs.)
Hot engine ..... 98–107 Nm (73–79 ft.lbs.)
Cylinder head bolts (No. 11) .....
15–21 Nm (11–15 ft.lbs.)



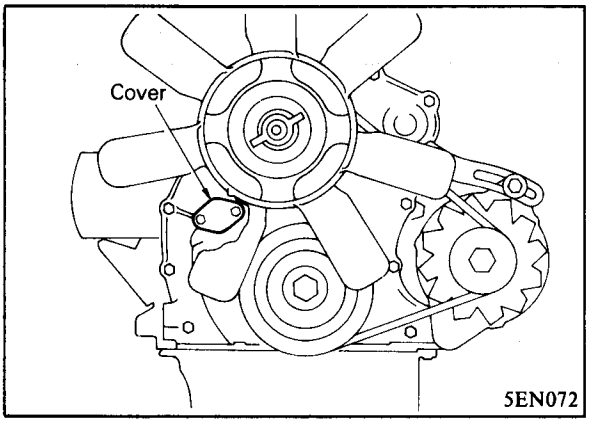
Cylinder head bolt tightening sequence
5EN016


5EN139

SILENT SHAFT DRIVE CHAIN TENSION ADJUSTMENT PROCEDURE

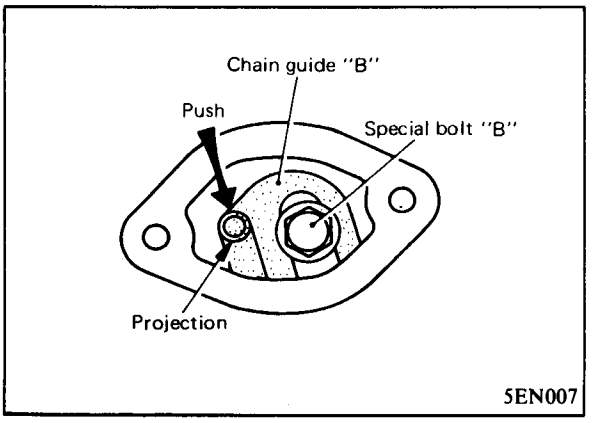
Tension of silent shaft drive chain is adjustable without removing timing chain cover as follows:

1. Remove cover from access hole provided at center of chain case (under water pump).



5EN072

2. Loosen special bolt "B".
3. Push projection on chain guide "B" positively with finger tip in direction of arrow. Do not push projection with a screwdriver or other tool. Improperly tensioned chain will produce noise. (5EN007)
4. Tighten special bolt "B".
5. Install cover. Do not reuse damaged gasket.

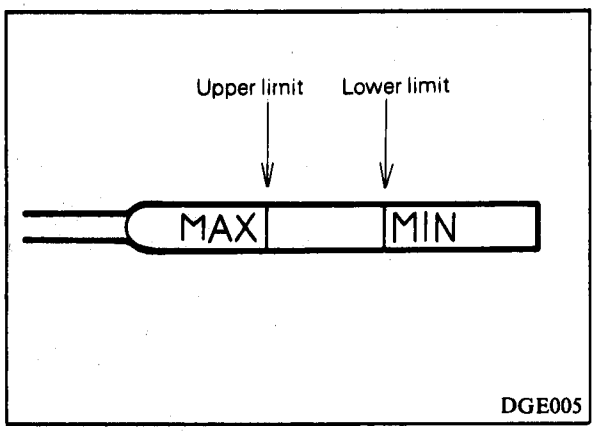


5EN007

ENGINE OIL LEVEL GAUGE

The oil level gauge is located on the right side of the engine.
Maintain engine oil level within the marking lines on the oil level gauge. (DGE005)
The oil level in the oil pan may read at the "MAX" mark line (upper limit) after the engine has been standing for several hours. When the engine is started the oil level drops somewhat due to filling of oil passage, etc.
When the oil level is at or below the "MIN" mark line (lower limit) on the level gauge, add 1 liter (1 U.S. qts., 0.9 Imp. qts.). The oil should never be allowed to remain below the lower limit.

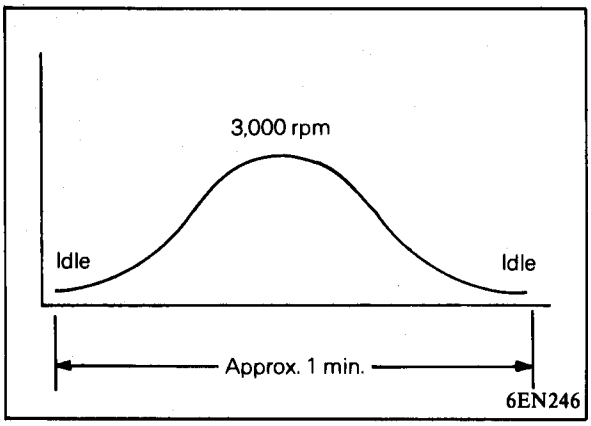
Caution
Do not overfill crankcase. This will cause oil aeration and loss of oil pressure.



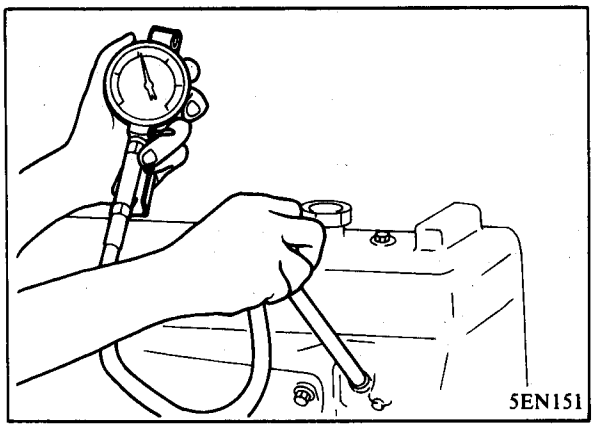
BLEEDING AUTO-LASH ADJUSTER

Caution
Since the auto-lash adjuster is a precision part, use care to prevent entry of foreign substances such as dust.
Do not attempt disassembly of the auto-lash adjuster.
Use clean gas oil for cleaning the auto-lash adjuster.

If there is air in the auto-lash adjuster when the engine is assembled, abnormal noise may occur. If so, race the engine (for about one minute at a time) by slowly increase engine speed from idle speed to 3,000 rpm. This should bleed out the air and eliminate the noise.



COMPRESSION PRESSURE CHECK



1. Warm up engine.
2. Remove all spark plugs.
3. Disconnect distributor harness.
4. Attach a compression gauge adapter and compression gauge.
5. Depress accelerator pedal to fully open throttle.
6. Crank engine and read gauge indication.

Compression pressure	980 kPa (142 psi)/250 rpm
Minimum pressure	834 kPa (121 psi)/250 rpm
Difference between each cylinder	Less than 98 kPa (14 psi)

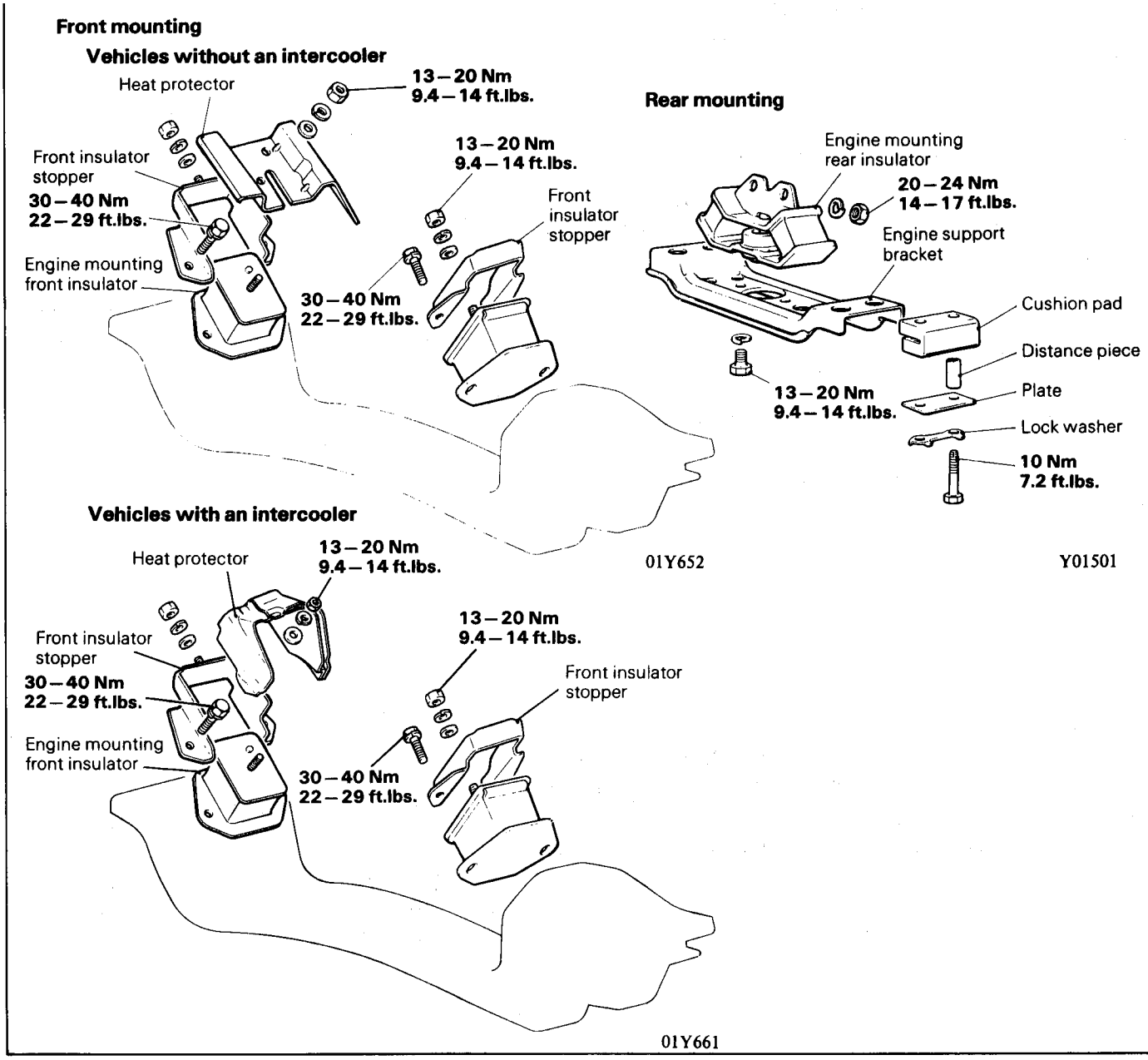
7. If cylinder compression in one or more cylinders is low, pour a small amount of engine oil into cylinders through the spark plug holes and retest compression.
   - If adding oil helps the compression pressure, chances are that piston rings are worn or damaged.
   - If pressure stays low, valve may be sticking or seating improperly.
   - If cylinder compression in any two adjacent cylinders is low, and if adding oil does not help the compression, there is leakage past the gasket surface.

OIL PRESSURE CHECK

1. Remove oil pressure gauge unit from cylinder block.
2. Connect an oil pressure gauge (available on market) to oil pressure switch mounting hole.
3. Start and operate the engine for warm-up.
4. Read oil pressure gauge indication while engine is running at idle. [Oil temperature is 75 to 90°C (167 to 194°F)]

Oil pressure at idle	78 kPa (11 psi) or more

COMPONENTS



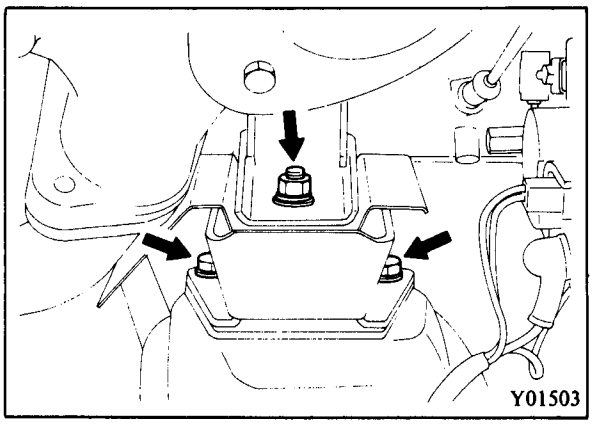
REMOVAL

Front Mounting

1. Remove the engine mounting nuts and bolts from the front insulators. (Y01503)
2. Attach a chain to the engine hangers.
3. Using an engine hoist, raise the engine and remove the insulators.

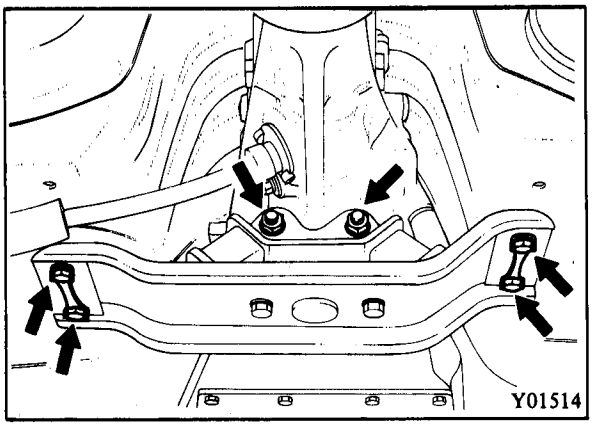
Caution

Avoid applying a strain on the radiator and fuel hoses and cables by raising the engine too high.



Rear Mounting

1. Support the transmission with a jack.
2. Remove the support bracket and insulator assembly. (Y01514)



INSPECTION

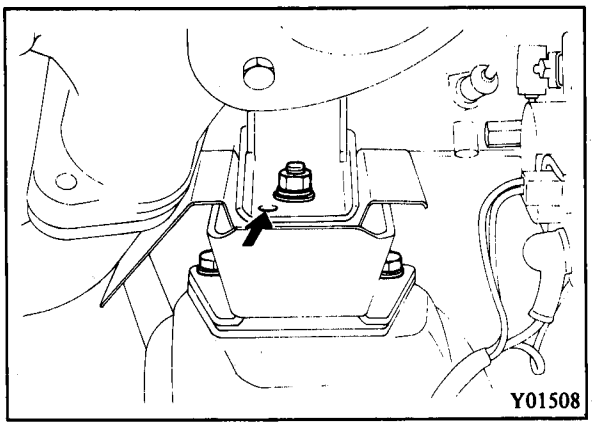
1. Check the insulators for cracks, separation and deformation.
2. Check the cushion pad for cracks and deterioration.
3. Check the engine support bracket for deformation and corrosion.

INSTALLATION

Front Insulator

Make sure that the locating boss and hole are in alignment.

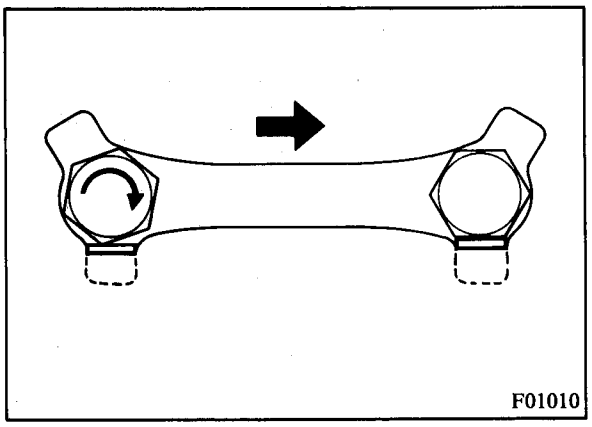
Caution
Do not distort rubber portions, and never stain rubber portions with fuel or oil.



Rear Insulator

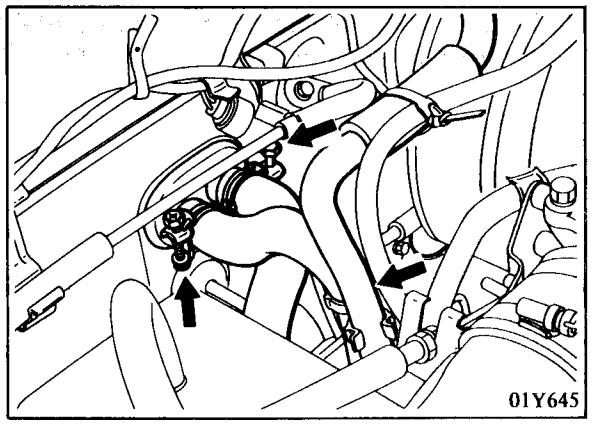
Install the rear insulator and bend the lock washer tabs to keep the engine support bracket mounting bolts from turning.

Caution
Do not distort rubber portions, and never stain rubber portions with fuel or oil.

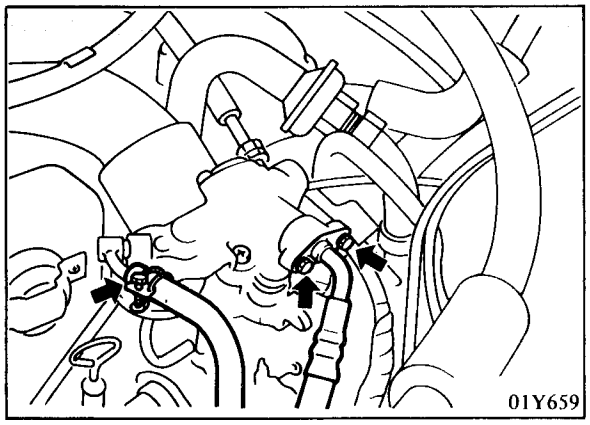


REMOVAL

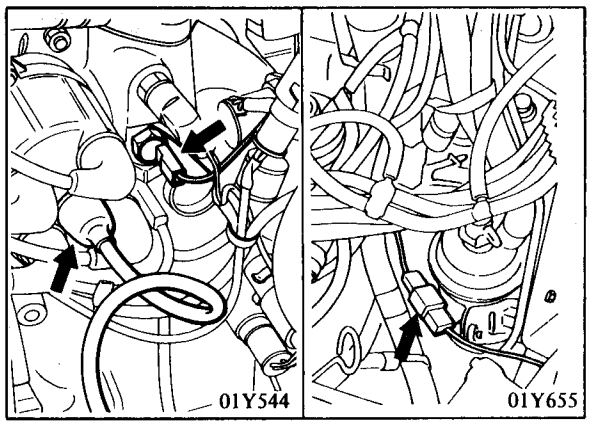
1. Drain the engine coolant.
2. Disconnect the accelerator cable. (Refer to GROUP 14.)
3. Disconnect the heater hoses. (01Y645)
4. Disconnect the brake booster vacuum hose.



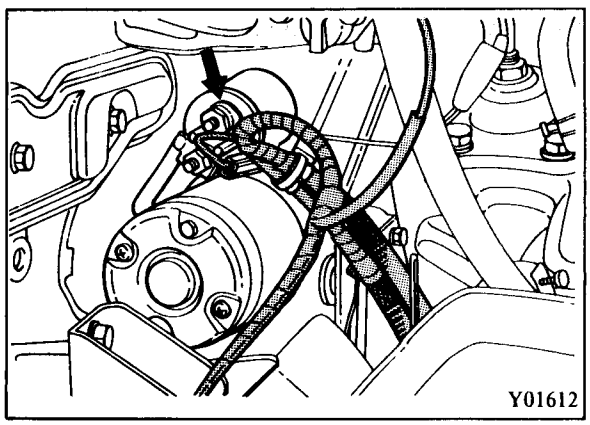
5. Disconnect the fuel hoses.



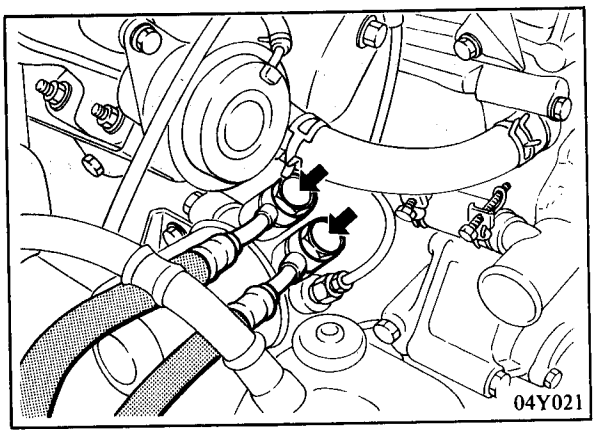
6. Disconnect the high tension cable. (01Y544)
7. Disconnect the intake manifold ground cable connector. (01Y655)



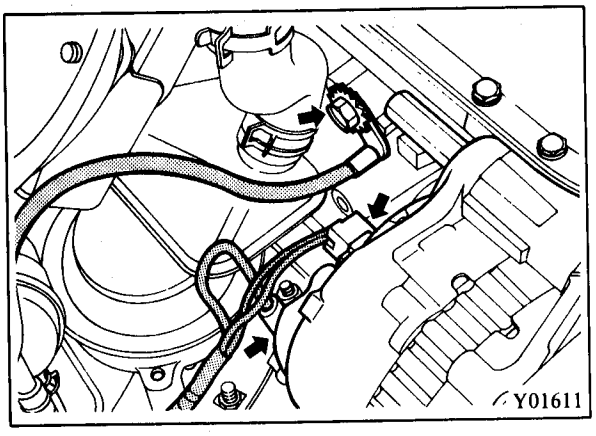
8. Disconnect the starter motor wiring harness.
9. Remove the power steering pump. (Refer to GROUP 19.)



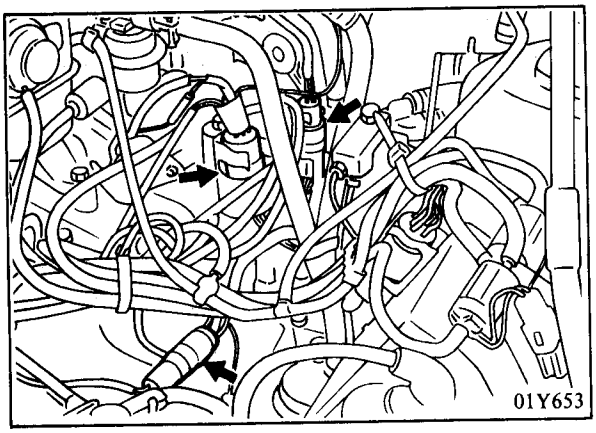
10. Disconnect the engine oil cooler hoses. (04Y021)
11. Remove the radiator assembly. (Refer to GROUP 7.)



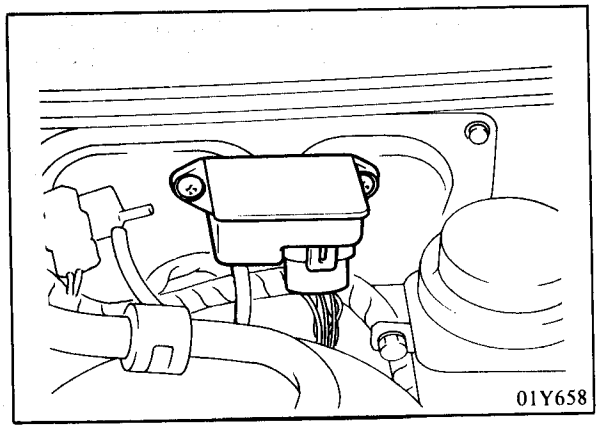
12. Disconnect the alternator wiring harness and engine ground cable.



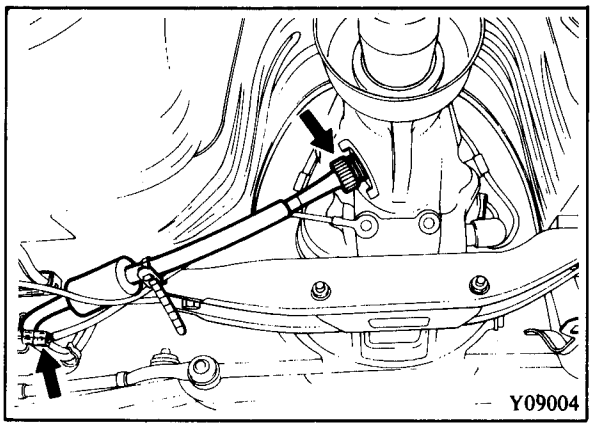
13. Disconnect the ECI unit wiring harnesses.



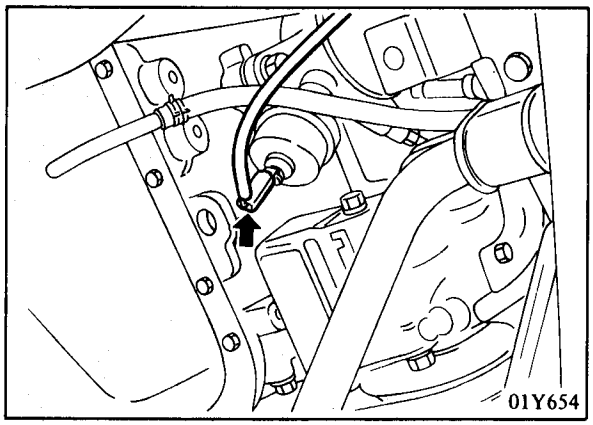
14. Disconnect the boost sensor hose.



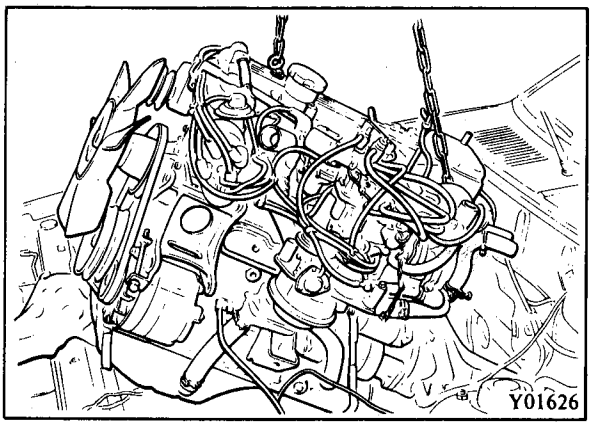
15. Remove the rear catalytic converter. (Refer to GROUP 11.)
16. Disconnect the speedometer cable. (Y09004)
17. Drain the air conditioner refrigerant slowly.
18. On vehicles equipped with an automatic transmission, disconnect the automatic transmission oil cooler hoses.
19. Disconnect the back-up light switch harness.
20. Remove the propeller shaft. (Refer to GROUP 16.)



21. Disconnect the wiring harnesses for the oil pressure gauge unit. (01Y654)
22. Remove the clutch release cylinder. (Refer to GROUP 6.)
23. Remove the engine mounting bolts. (Refer to P. 9-15.)
24. Remove the gearshift lever assembly. (Refer to GROUP 21.)



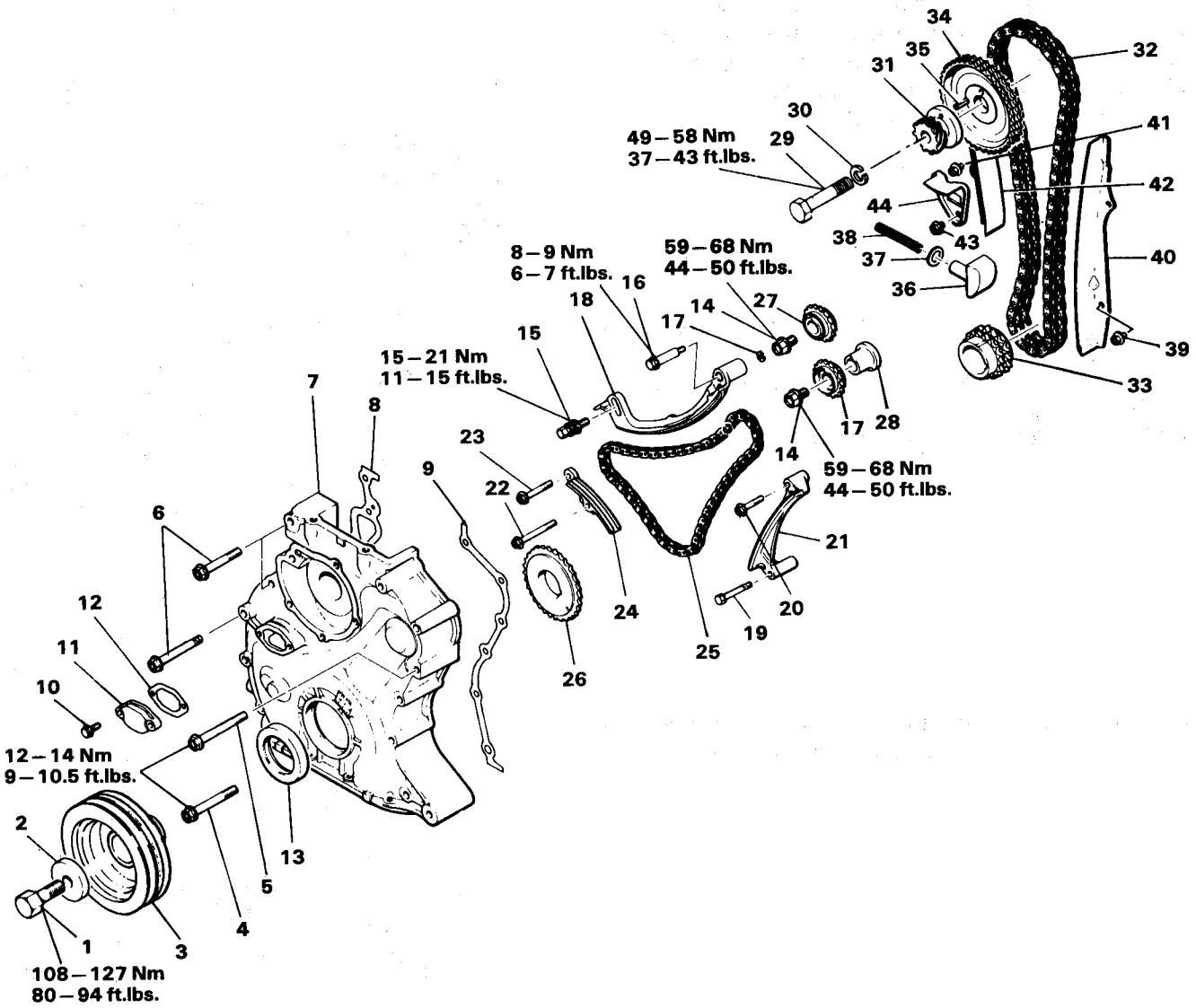
25. Using an engine hoist, raise and remove the engine and transmission assembly from the engine compartment.



INSTALLATION

1. Supply coolant to the cooling system. (Refer to GROUP 7.)
2. Supply transmission fluid. (Refer to GROUP 21.)
3. Refill the air conditioner refrigerant. (Refer to Group 24.)
4. Adjust the clutch control system. (Refer to GROUP 6.)
5. Adjust the accelerator cable. (Refer to GROUP 14.)
6. Adjust the hood alignment. (Refer to GROUP 23.)

COMPONENTS



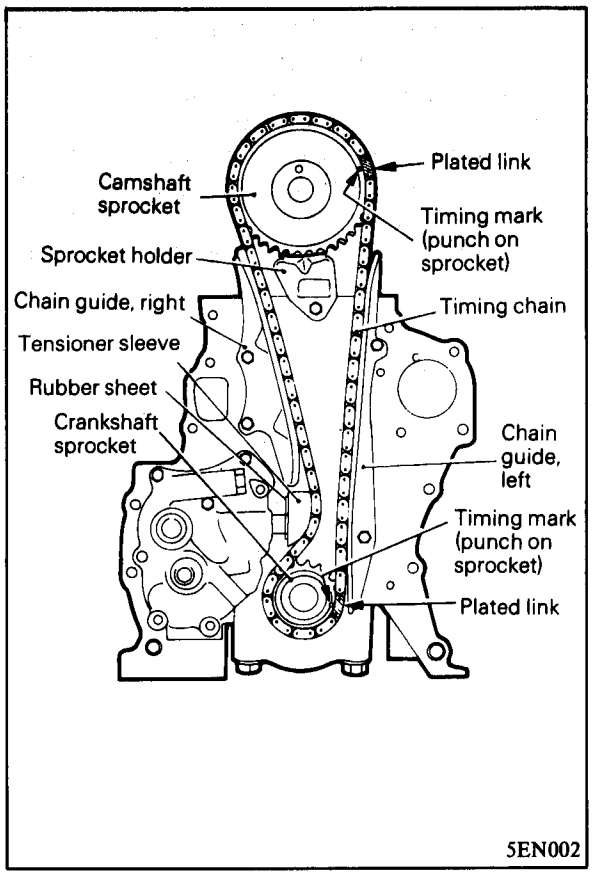
1. Crankshaft pulley bolt
2. Special washer
3. Damper pulley
4. Flange bolt (8)
5. Flange bolt
6. Flange bolt (2)
7. Timing chain case
8. Chain case gasket (R)
9. Chain case gasket (L)
10. Flange bolt (2)
11. Cover
12. Gasket
13. Oil seal
14. Flange bolt (2)
15. Special bolt "B"
16. Special bolt "A"
17. Spring washer
18. Chain guide "B"
19. Flange bolt
20. Flange bolt
21. Chain guide "A"
22. Flange bolt
23. Flange bolt
24. Chain guide "C"
25. Chain "B"
26. Crankshaft sprocket "B"
27. Sprocket "B" (2)
28. Spacer
29. Bolt w/washer
30. Plain washer
31. Distributor gear
32. Timing chain
33. Crankshaft sprocket
34. Camshaft sprocket
35. Spring pin
36. Tensioner
37. Rubber washer
38. Spring
39. Flange bolt
40. Tension side chain guide
41. Flange bolt (2)
42. Loose side chain guide
43. Flange bolt (2)
44. Sprocket holder

NOTE
Numbers show order of disassembly.
For reassembly, reverse order of disassembly.

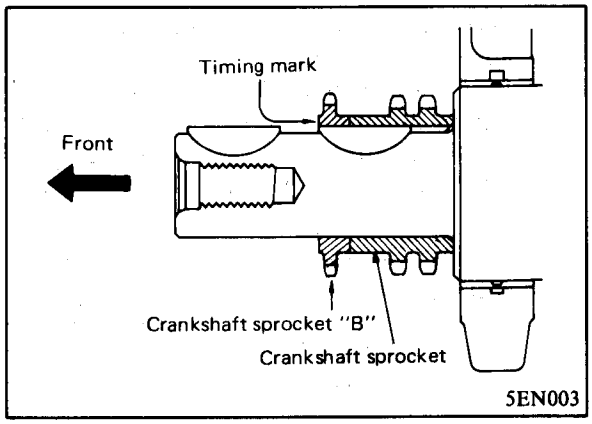
5EN152

TIMING CHAIN INSTALLATION PROCEDURE

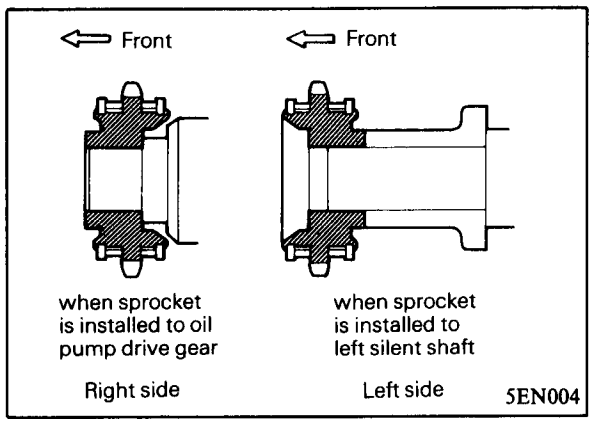
1. Install sprocket holder and chain guides.
2. Turn crankshaft until piston of No.1 cylinder is at top dead center.
3. Install tensioner spring, sleeve and rubber sheet to oil pump.
4. Line up plated links of timing chain and timing marks on sprockets as chain and sprockets are assembled.
5. While sliding crankshaft sprocket onto crankshaft, install chain and sprocket. Place camshaft sprocket on sprocket holder.



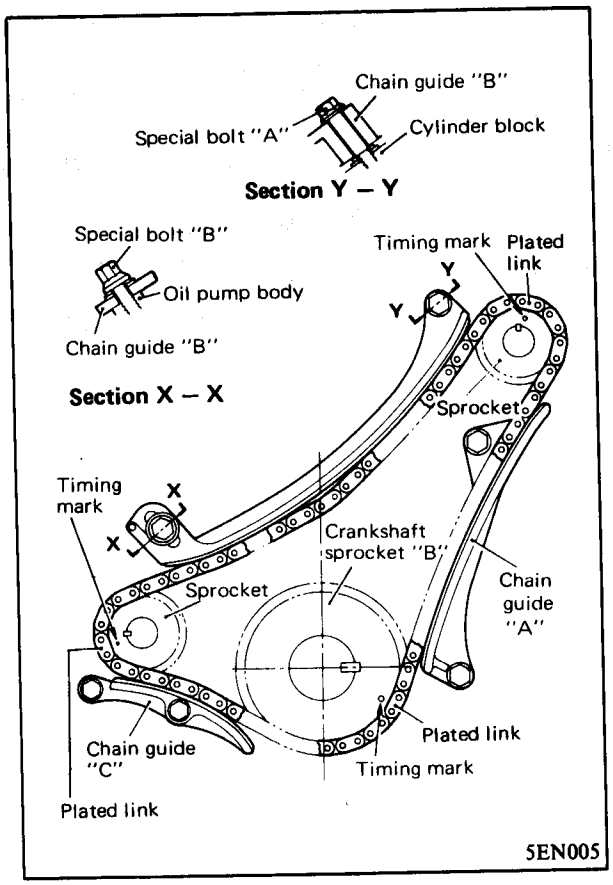
6. Install crankshaft sprocket "B" (for driving silent shafts) on crankshaft.



7. Assemble silent shaft sprockets to chain "B". Make sure that timing marks are in alignment with plated links.
   Use care not to confuse right and left sprockets, as they are installed in opposite directions.

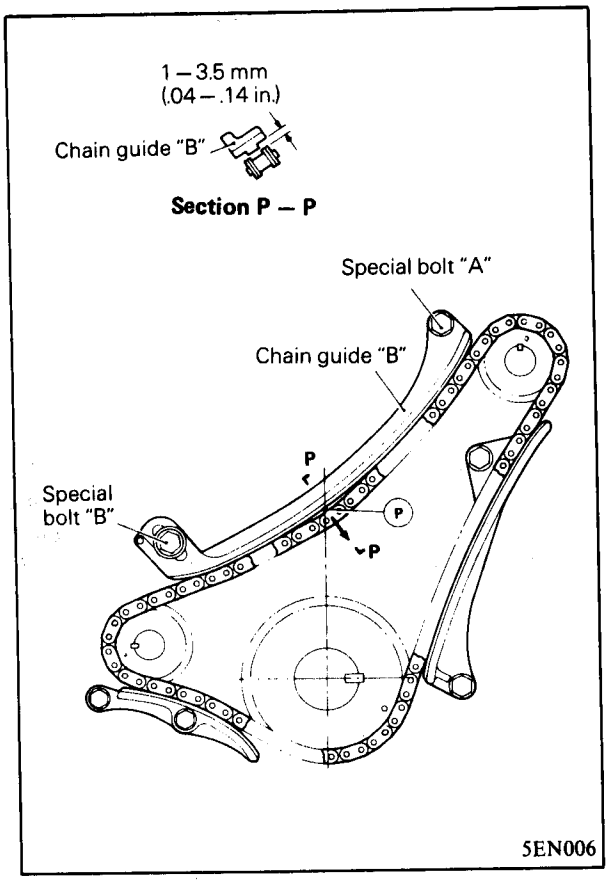


8. Holding assembled sprockets and chain "B", align timing mark on crankshaft sprocket "B" with that on chain "B", and install sprockets to oil pump drive gear and left silent shaft. Partially tighten bolt.
9. Temporarily install chain guides "A", "B" and "C".
10. Tighten silent shaft sprocket bolts to specified torque.
11. Tighten chain guide "A" mounting bolts firmly.
12. Tighten chain guide "C" mounting bolts firmly.



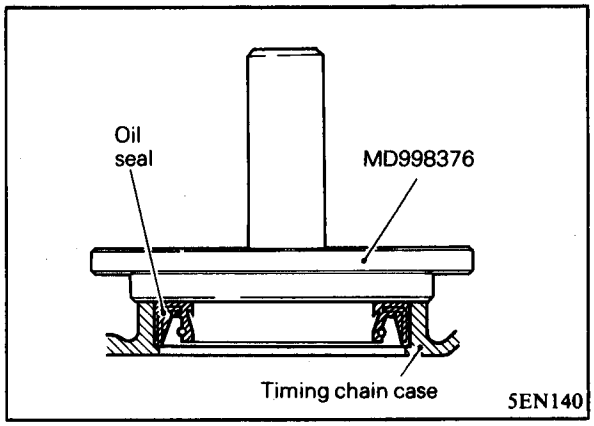
13. Rotate both silent shaft sprockets slightly to position chain slack at point P.
14. Adjust position of chain guide "B" so that when chain is pulled in direction of arrow with finger tips, clearance between chain guide "B" and links of chain "B" will be 1 to 3.5 mm (.04 to .14 in.) and tighten special bolts "A" and "B".

Tightening torque	
Special bolt "A"	8—9 Nm (6—7 ft.lbs.)
Special bolt "B"	15—21 Nm (11—15 ft.lbs.)

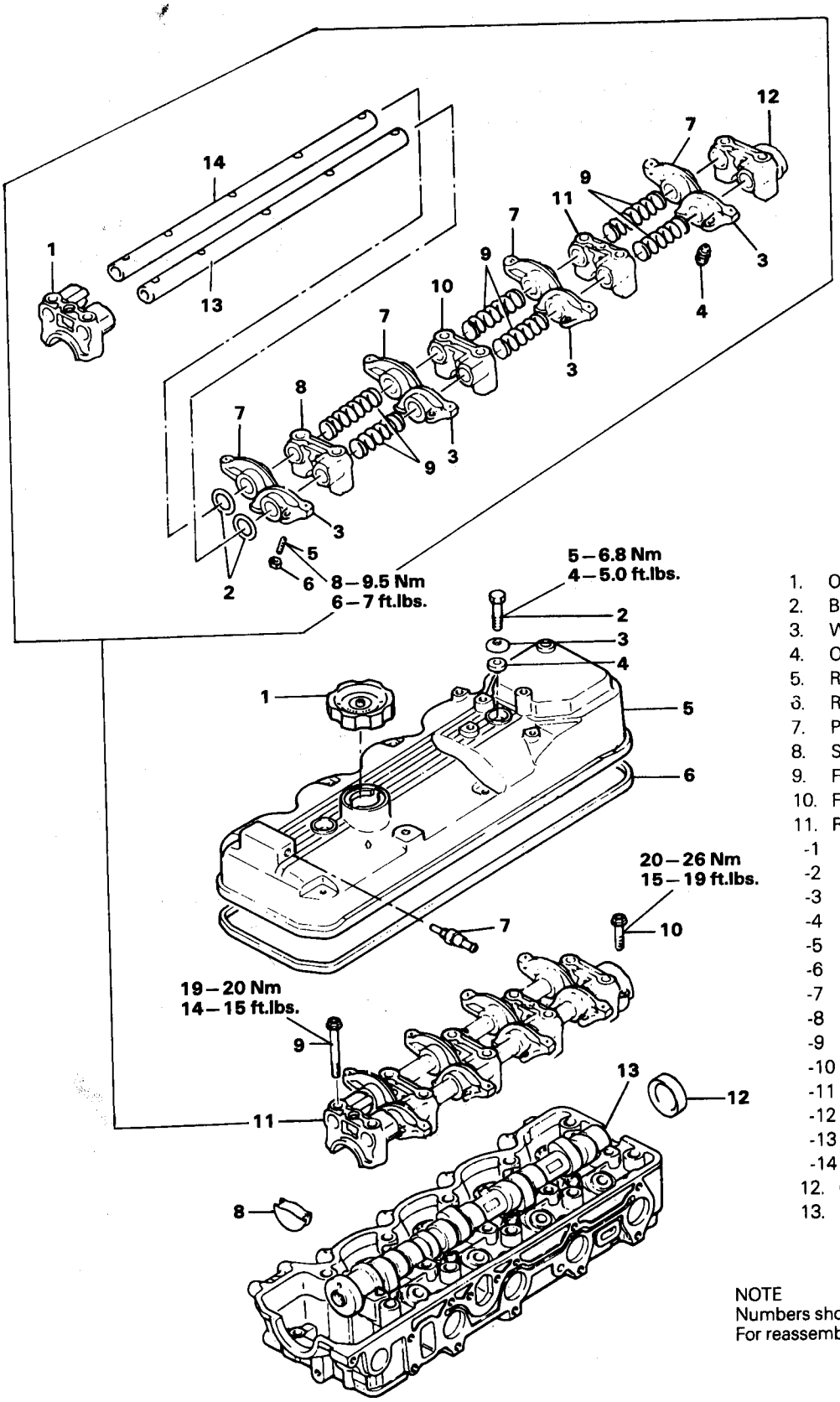


TIMING CHAIN CASE

1. Pry out oil seal taking care not to nick or damage sealing surfaces of timing chain case.
2. Install the new oil seal using Tool MD998376.
3. Clean the gasket surfaces of chain case and cylinder block.
4. Install the chain case gaskets and chain case to the cylinder block.
5. Lightly coat the O.D. of crank pulley boss and insert the pulley to the crankshaft.
   Then tighten the pulley bolt to 108–127 Nm (80–94 ft.lbs.).



COMPONENTS



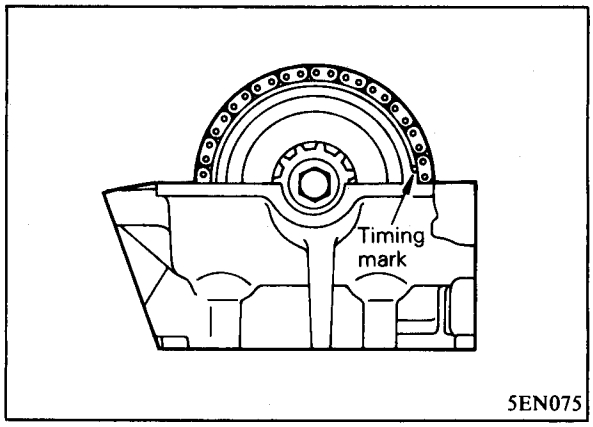
1. Oil filler cap
2. Bolt – 8x40 (2)
3. Washer (2)
4. Oil seal (2)
5. Rocker cover
6. Rocker cover gasket
7. PCV valve
8. Semi-circular packing
9. Flange bolt (10)
10. Flange bolt – 8x25 (2)
11. Rocker arm and shaft assembly
    - -1 Bearing cap, front
    - -2 Wave washer (2)
    - -3 Rocker arm "A" (4)
    - -4 Auto-lash adjuster (8)
    - -5 Adjusting screw (4)
    - -6 Nut (4)
    - -7 Rocker arm "C" (4)
    - -8 Bearing cap, No. 2
    - -9 Rocker arm spring (6)
    - -10 Bearing cap, No. 3
    - -11 Bearing cap, No. 4
    - -12 Bearing cap, rear
    - -13 Rocker arm shaft, left
    - -14 Rocker arm shaft, right
12. Circular packing
13. Camshaft

NOTE
Numbers show order of disassembly.
For reassembly, reverse order of disassembly

5EN153

REMOVAL

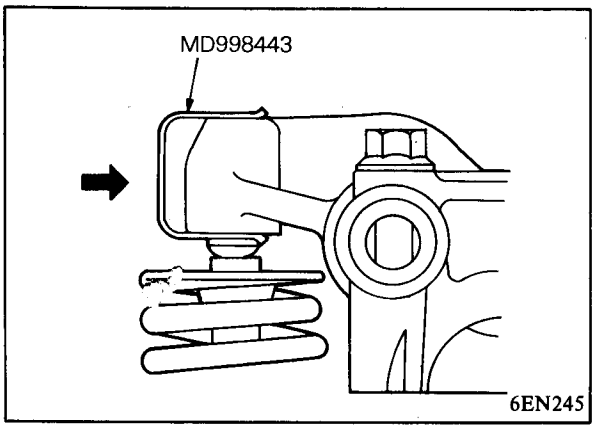
1. Remove the rocker cover and gasket.
2. Loosen the camshaft sprocket bolt until it can be turned with fingers.
3. Turn the crankshaft until No. 1 cylinder is at top dead center of compression stroke.
   Illustration shows position of camshaft sprocket timing mark when piston in No. 1 cylinder is placed at top dead center of compression stroke.
4. Remove the camshaft sprocket bolt with fingers.
5. Remove the camshaft sprocket with timing chain from the camshaft and place the sprocket onto the sprocket holder.



6. Install a special tool, the Auto-lash Adjuster Holder (MD998443), to make sure that the auto-lash adjuster is not allowed to fall.
7. Remove the camshaft bearing cap bolts.
8. Remove the rocker arms and shafts as an assembly.

Caution
Put the rocker arms and auto-lash adjusters in order in cylinder No. separated places with clear distinction between the intake and exhaust ones to prevent confusion.

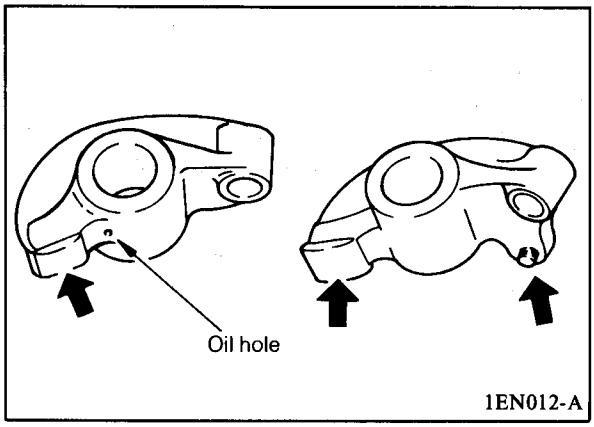
9. Remove the camshaft from the cylinder head.



INSPECTION

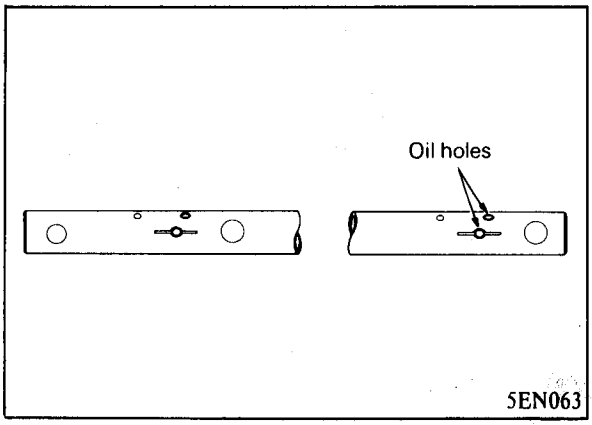
Rocker Arms

1. Check rocker arms for wear or damage. Replace if necessary.
2. Check to ensure that oil holes are clear.



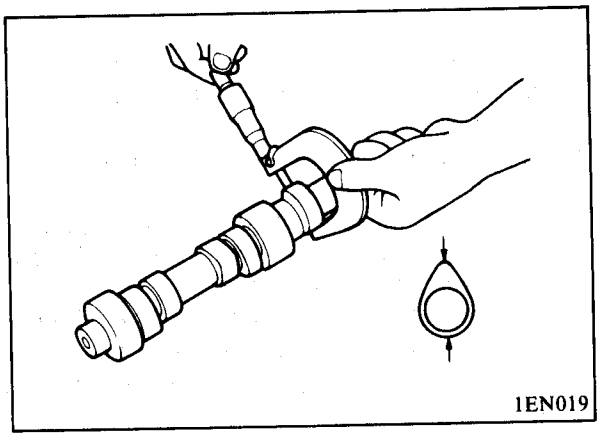
Rocker Arm Shafts

1. Check rocker arm mounting portions of rocker arm shaft for wear or damage. Replace as necessary.
2. Check to ensure that oil holes are clear.



Camshaft

1. Check five journals of camshaft for wear or damage. Replace as necessary. If journals damaged, also inspect camshaft bearing for wear or damage. If camshaft bearing is badly worn, replace cylinder head.
2. Check fuel pump drive cam and distributor drive gear teeth for wear or damage. Replace if necessary.
3. Check the cam lobe for wear, burr or damage. Lobe wear should not exceed 0.5 mm (.020 in.).

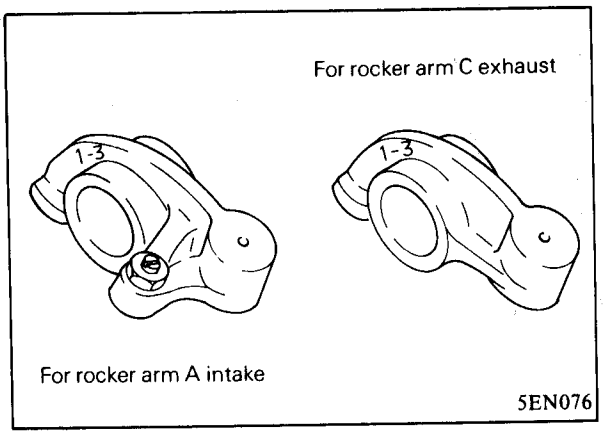

1EN019

Rocker Cover Gasket

1. Check the perimeter of rocker cover gasket where it contacts the cylinder head for damage.
2. If it is not damaged, the rocker cover gasket do not need to be replaced.

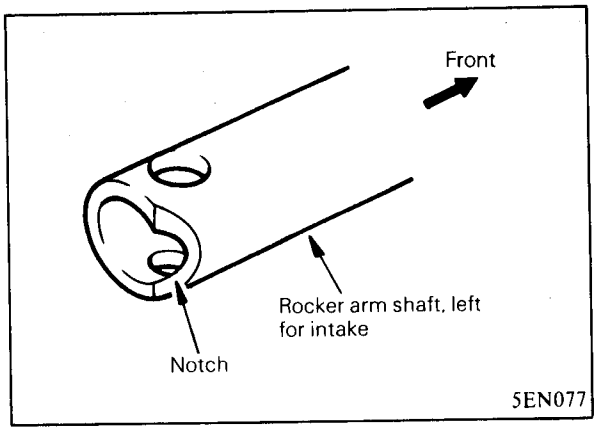
INSTALLATION

There are two kinds of rocker arms: rocker arm "A" and rocker arm "C".
Rocker arm "A" drives intake valves and jet valves.
Rocker arm "C" drives exhaust valves.



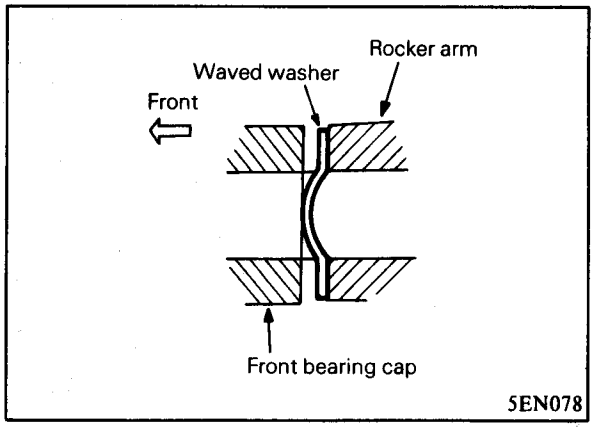
5EN076

1. Insert the left and right rocker shafts into the front bearing cap. The rear end of left (intake) rocker arm shaft has a notch as shown in 5EN077.
2. Align the mating mark of the rocker arm shaft front end to the mating mark of the front bearing cap. Then insert the bolts to hold shafts in bearing cap.

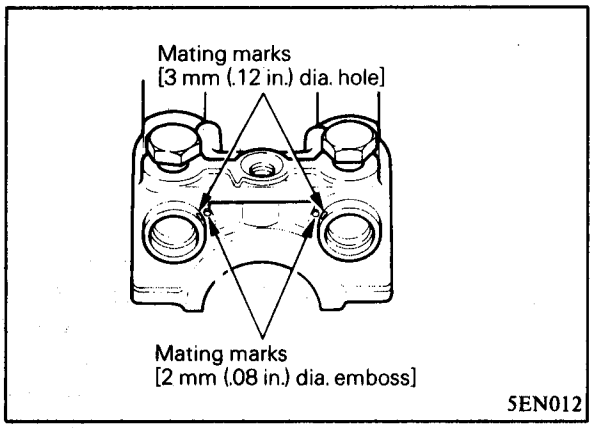


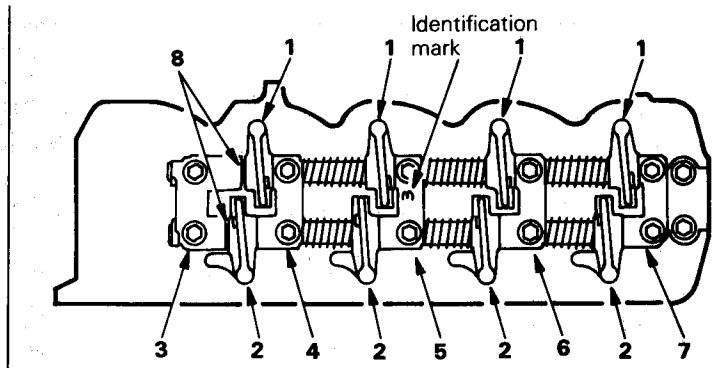
5EN077

3. Install the waved washer in the direction shown in the illustration.



4. Assemble the rocker arm shaft so that the alignment mark at the front end matches the alignment mark of the front bearing cap. (5EN012)
5. Install the rocker arms, shafts, caps, etc., as shown in illustration before installation to the cylinder head. Insert the bolts to hold parts in position. (5EN079)

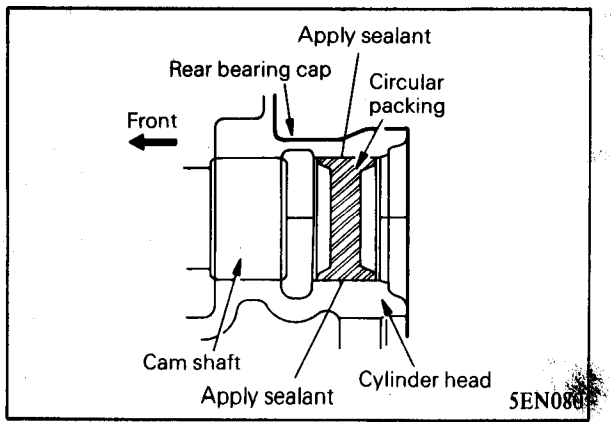




1. Rocker arm "C"
2. Rocker arm "A"
3. Front bearing cap
4. No. 2 bearing cap
5. No. 3 bearing cap
   (Inscribed mark 3 on top surface)
6. No. 4 bearing cap
   (Rocker screw hole on top surface)
7. Rear bearing cap
8. Waved washer

5EN079

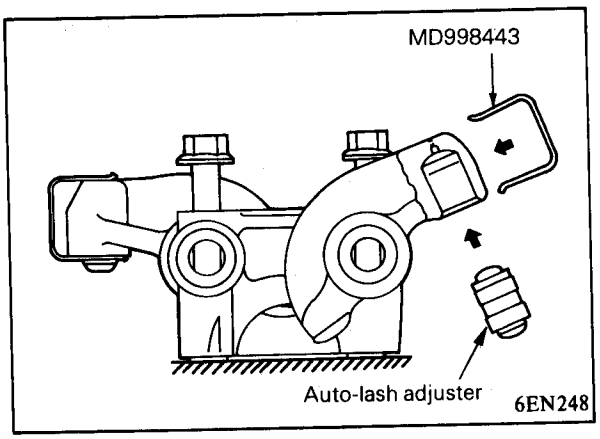
6. Apply engine oil to the journals of camshaft and install it to cylinder head.
7. Coat the sealant to the O.D. of circular packing and install the circular packing to cylinder head as shown in 5EN080.
8. Install the rocker arms, shafts and bearing caps assembly to the cylinder head, and tighten the bearing cap bolts to specified torque.



9. Make sure that the rocker arm and rocker shaft are thoroughly cleaned to remove "dust", etc. before reassembly. The holes and grooves in particular should be carefully cleaned.
10. Insert the auto-lash adjuster from under the rocker arm as shown in the illustration and set a special tool, the Holder (MD998443), to prevent the adjuster from falling down. To make sure that the diesel fuel in the adjuster is not spilt, avoid tilting the adjuster more than necessary. If the diesel fuel was spilt, bleed by the procedures of shown in Item "BLEEDING AUTO-LASH ADJUSTER".

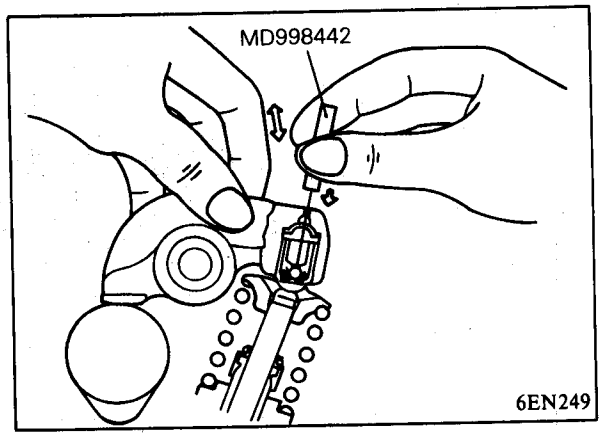
    CHECKING ADJUSTMENT MARGIN – Simplified checking method

    (a) Place the slipper portion of the rocker arm on the base circle of the cam.



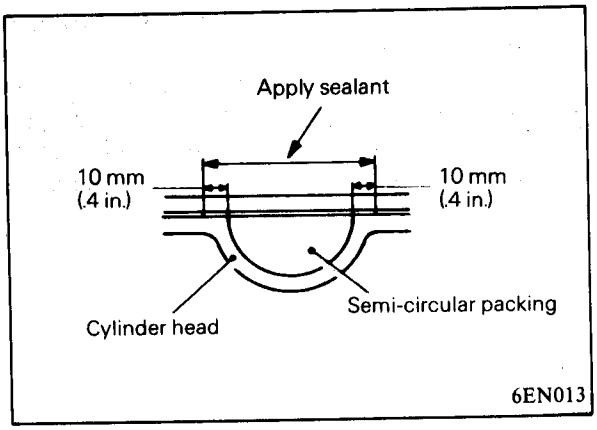
    (b) While holding down the steel ball through use of a special tool, the Air Bleed Wire (MD998442), move the rocker arm up and down to check for "looseness". If there is no "looseness", remove the auto-lash adjuster and check to see if the plunger operates correctly. (The full stroke of the plunger is approx. 2.2 mm.)

Caution
When the Air Bleed Wire (MD998442) is used to bleed air, do not force the Air Bleed Wire more than necessary. The spring load of the steel ball is so small that excessive forcing of the Air Bleed Wire may cause damage to the auto-lash adjuster.



11. Adjust the jet valve clearance. See "Lubrication and Maintenance", Group 0, for detailed procedure.
12. Install the semi-circular packing to the front of cylinder head and apply sealant to top of semi-circular packing.

Recommended adhesive .....
3M Super Weatherstrip Adhesive 8001
or equivalent

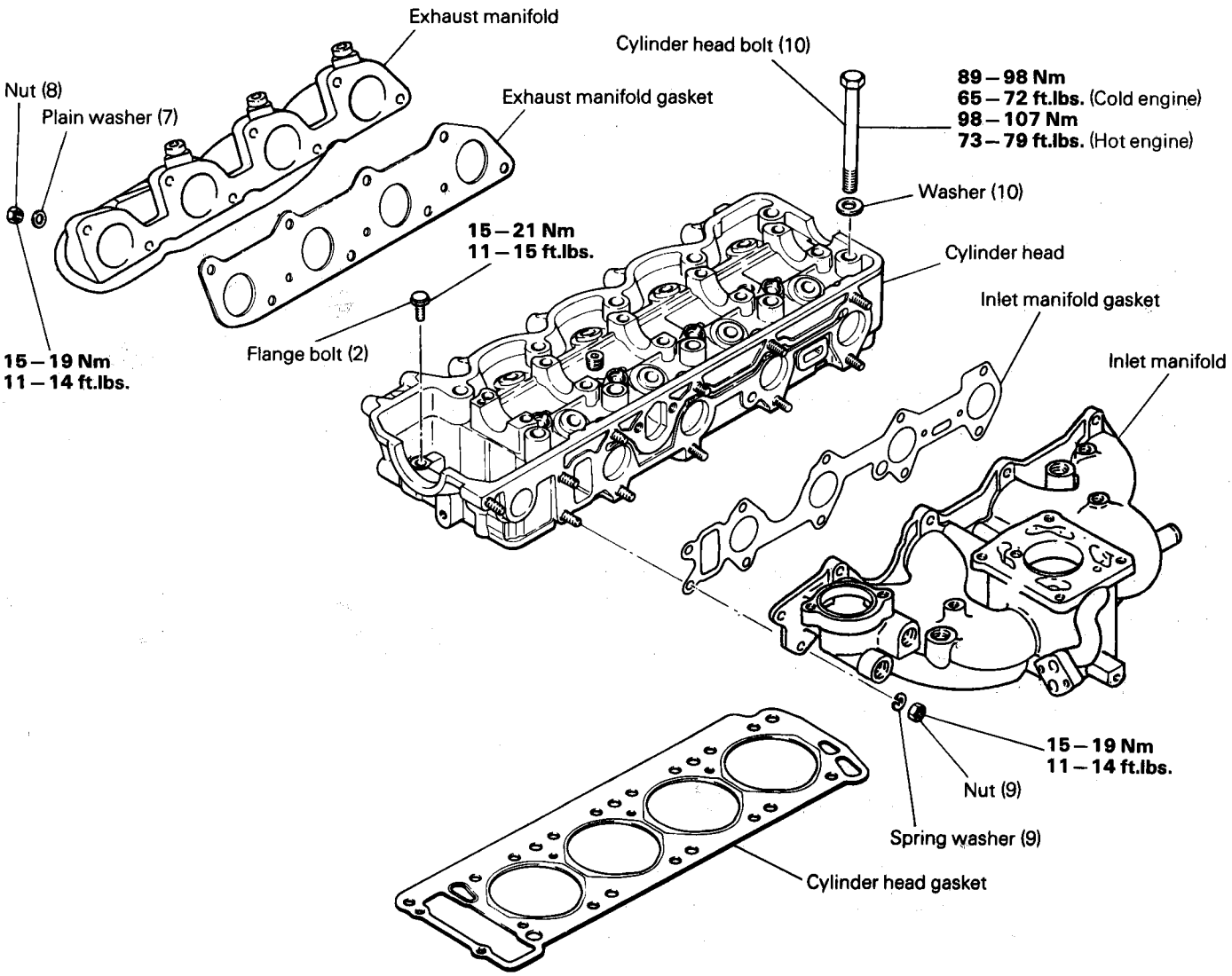


13. Install the rocker cover gasket and rocker cover.

Caution
Make sure that rocker cover bolts are tightened to specified torque.
If they are overtorqued, a deformed rocker cover or oil leakage could result.

Tightening torque
Rocker cover bolts ..... 5 – 6.8 Nm (4 – 5.0 ft.lbs.)

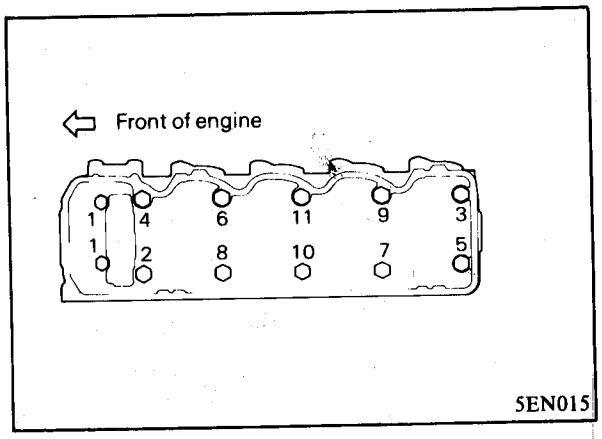
COMPONENTS



5EN141

REMOVAL

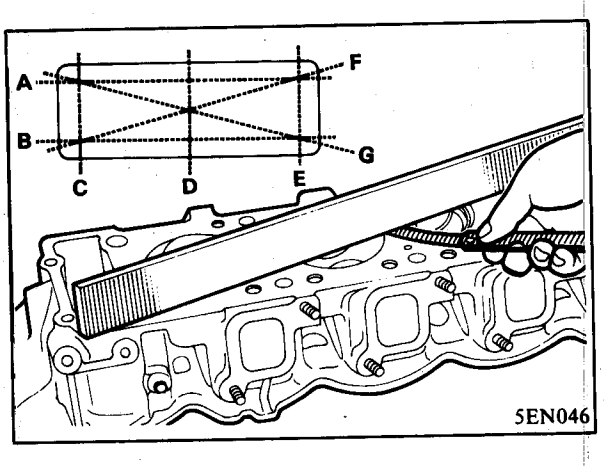
1. Remove cylinder head bolts in sequence shown in illustration.
2. Remove the cylinder head.
3. Remove the cylinder head gasket.



INSPECTION

Cylinder Head

1. Remove scale, sealing compound and carbon deposits completely. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.
2. Check the jet air passage and EGR gas passage for clogging.
3. Visually check the cylinder head for cracks, damage and water leakage.
4. Check cylinder head gasket surface for flatness with a straight edge as shown in illustration. (5EN046)
5. If flatness exceeds service limit in any direction, either replace cylinder head or lightly machine the cylinder head gasket surface.



Cylinder head flatness:

Standard dimension	Less than 0.05 mm (.002 in.)
Service limit	0.2 mm (.008 in.)
Grinding limit	0.2 mm (.008 in.)
Overall height of cylinder head (standard value for new part)	90.0 ± 0.1 mm (3.543 ± .004 in.)

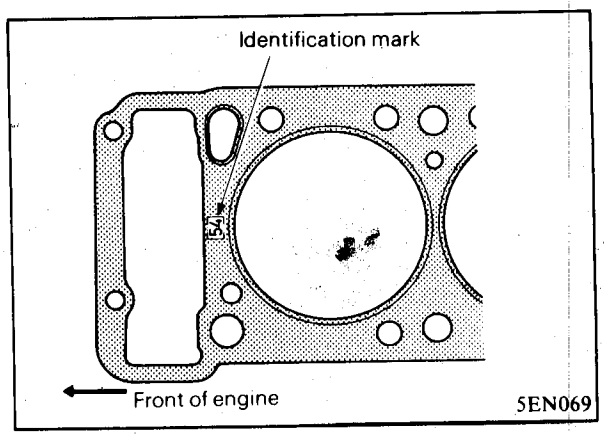
Caution
It is recommended to grind less than 0.2 mm (.008 in.) as combined with the mating cylinder block.

Intake and Exhaust Manifolds

1. Visually check the manifolds for cracks or damage.
2. Check the jet air passage, EGR gas passage and water passage of intake manifold for clogging clean if necessary.

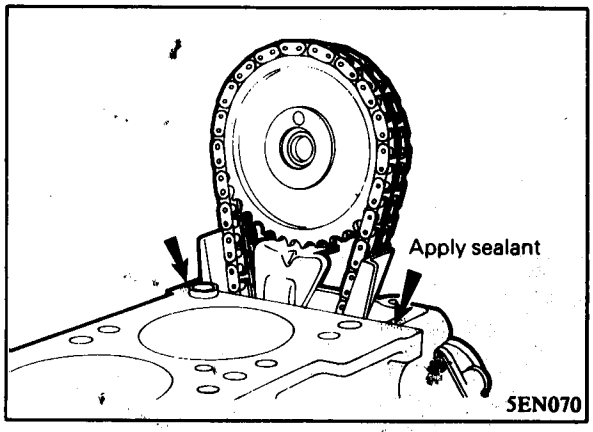
INSTALLATION

1. Clean gasket surfaces of cylinder head and cylinder block.

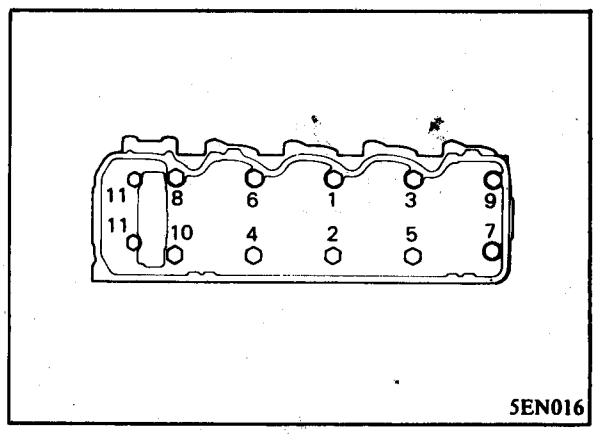


2. Apply sealant to top surface of each butt joint between cylinder block and chain case.
3. Install the cylinder head gasket on the cylinder block. (5EN069)

Caution
Do not apply sealant to cylinder head gasket.

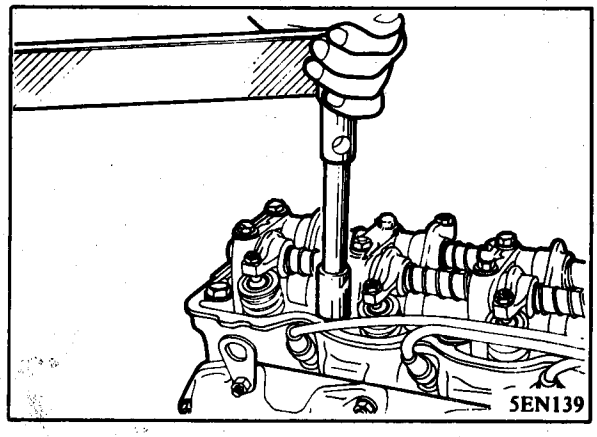


4. Install cylinder head assembly.
5. Install cylinder head bolts. Starting at top center, tighten all cylinder head bolts to 1/2 of specified torque in sequence shown in illustration. (5EN016)

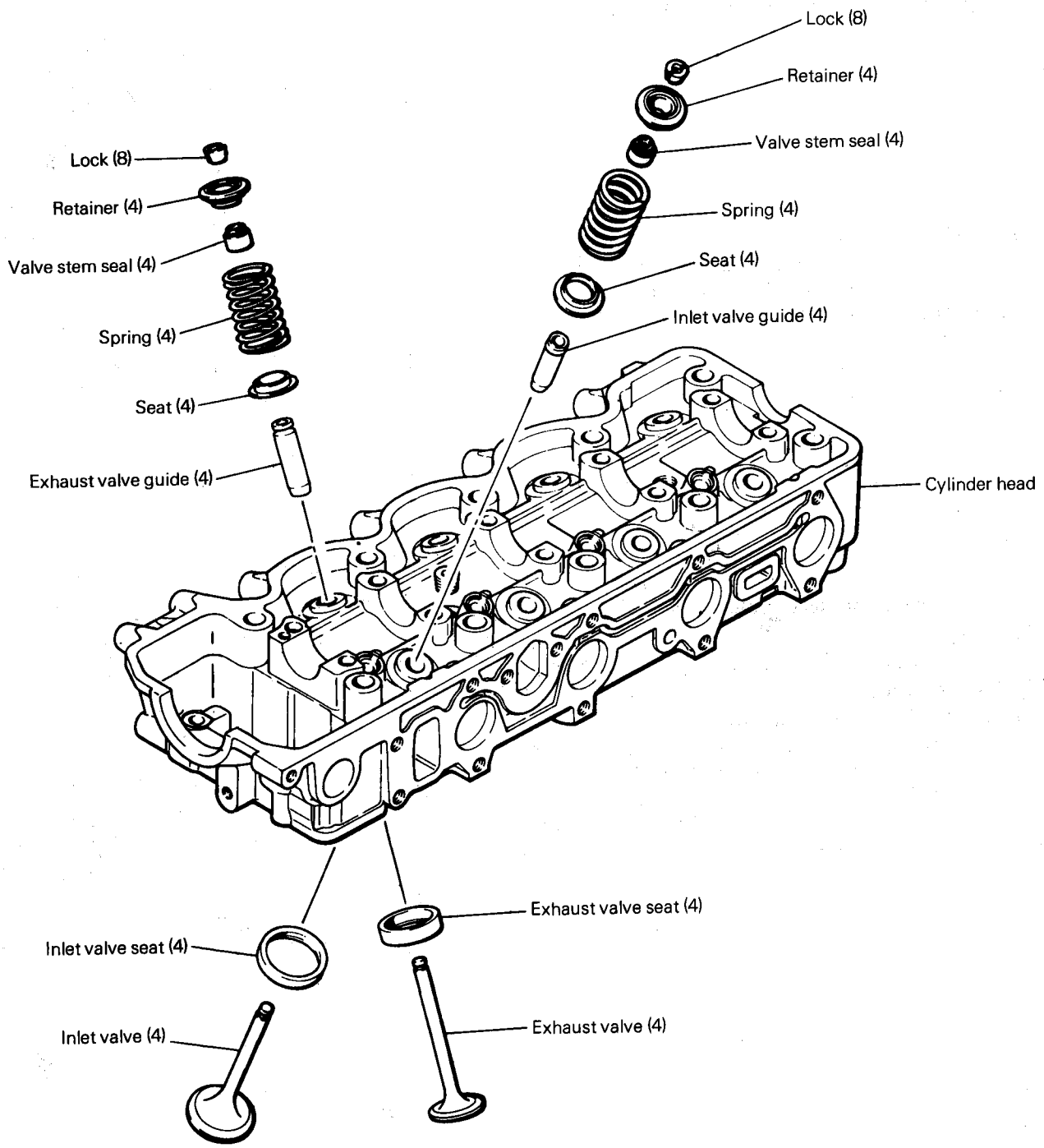


6. Torque all cylinder head bolts to specification in same sequence.

Tightening torque
Cylinder head bolt (No. 1 to 10)
Cold engine ..... 89–98 Nm (65–72 ft.lbs.)
Hot engine ..... 98–107 Nm (73–79 ft.lbs.)
Cylinder head bolt (No. 11) .....
15–21 Nm (11–15 ft.lbs.)



COMPONENTS

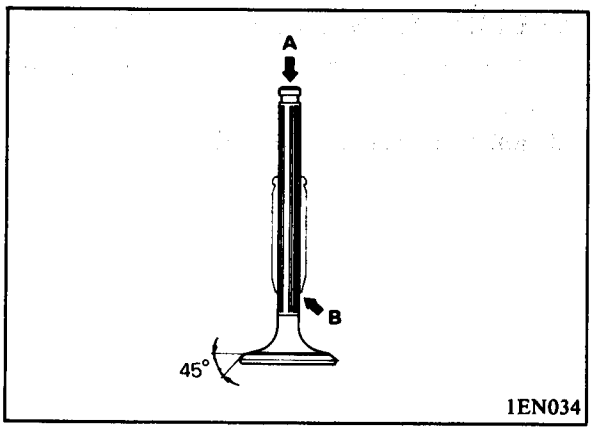


5EN017

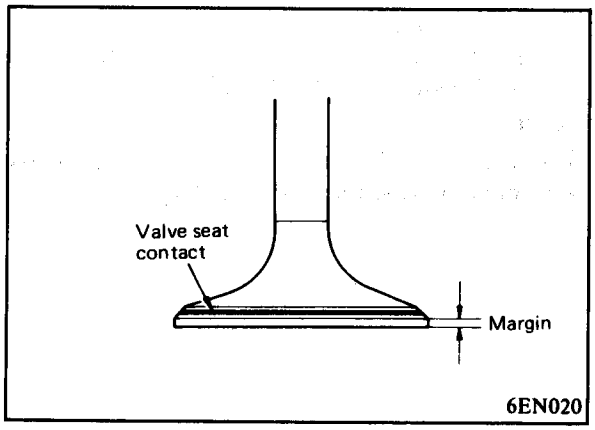
INSPECTION

Valves

1. Check each valve for wear, damage and deformation of head and stem at "B". Repair or correct excessively worn, damaged or deformed valves.
   If stem tip "A" has been pitted, correct by grinding. This correction must be limited to a minimum. Also reface valves with a valve grinder.
2. Check valve stem-to-guide clearance. Replace valve and/or valve guide if necessary.

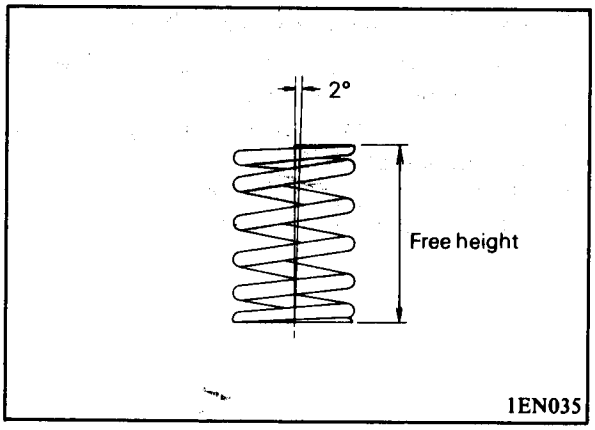


3. Replace valve if margin of face has decreased to less than 0.5 mm (.02 in.). (6EN020)
4. Valve seat contact should be made at center of valve face. Using marking compound, evidence of even contact with valve seat should be found all around valve face.
   If inadequate contact with valve seat is evident, correct valve seat and reface valve face.



Valve Springs

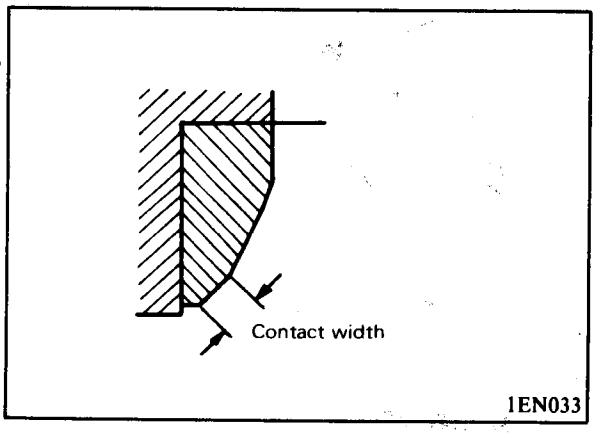
1. Check free height of each valve spring and replace if necessary.
2. Using a square, test squareness of each valve spring. If spring is excessively out of square, replace it.



Valve Seats

1. Check valve seat for evidence of overheating and improper contact with valve face. Correct or replace seat if necessary.
2. Valve seat contact width should be of specified value.

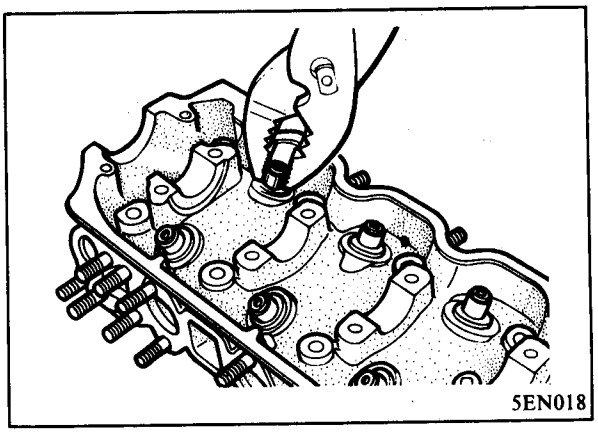
Contact width	
Intake	0.9–1.3 mm (.035–.051 in.)
Exhaust	1.2–1.6 mm (.047–.063 in.)



VALVE STEM SEAL REPLACEMENT

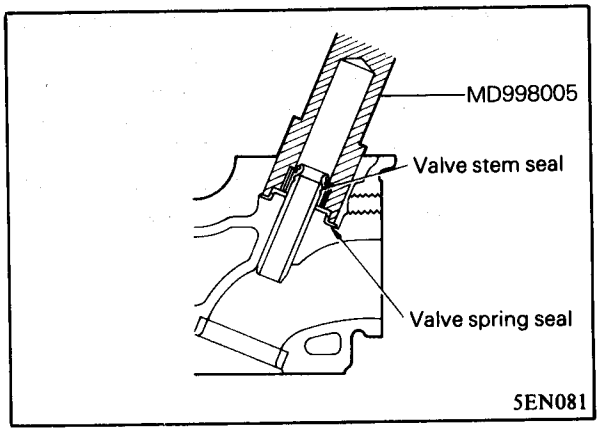
1. Remove valve stem seal with pliers and discard.

Caution
Do not reuse valve stem seal.



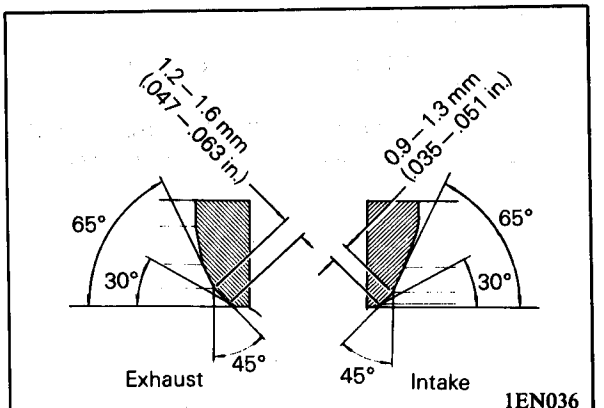
2. Install spring seats.
3. Lightly tap seal into place with Special Tool, Valve Stem Seal Installer (MD998005).

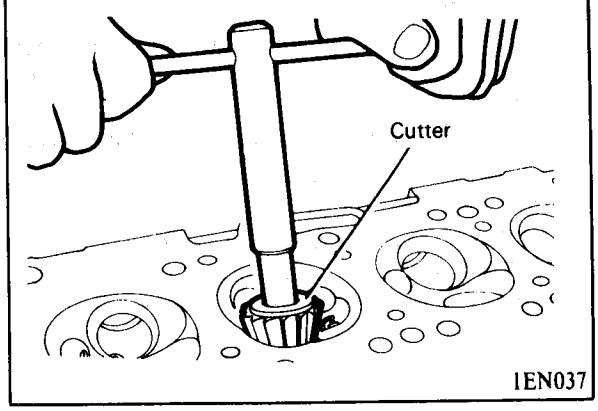
NOTE
Incorrect installation of seal will adversely affect lip and eccentricity, resulting in oil leakage past valve guides.



VALVE SEAT RECONDITIONING

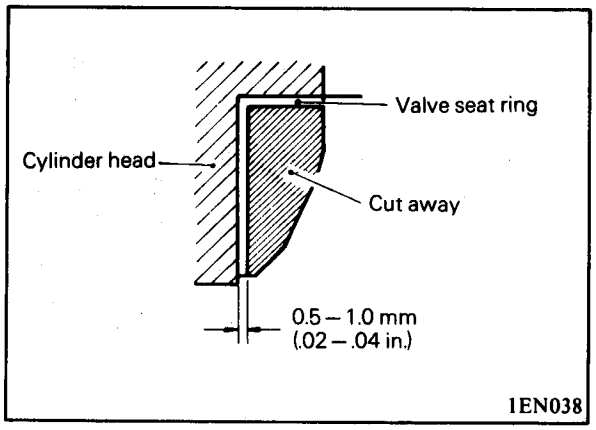
1. When correcting, check valve guide for wear. Replace worn guide, and then correct seat.
2. To correct valve seat, use Special Tools, Valve Seat Cutter and Pilot.
3. After correction, valve and valve seat should be lapped with a lapping compound.





VALVE SEAT INSERT REPLACEMENT PROCEDURE

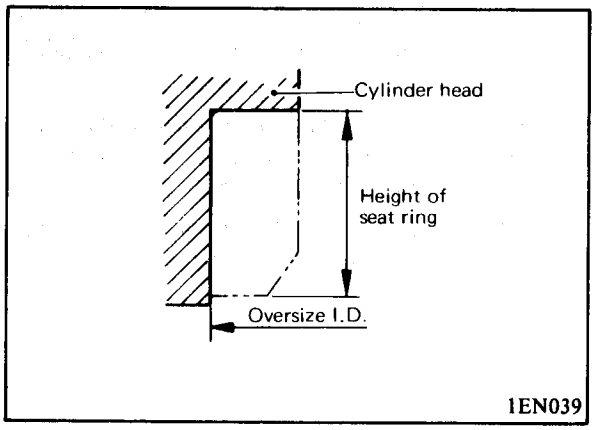
1. When seat insert is to be removed, cut away excess metal from inside of insert with cutter before removal.



2. Grind valve insert bore in cylinder head to outside diameter and height of oversize seat insert. (1EN039)
3. Before insert is installed, heat cylinder head proper to approx. 250°C (480°F).

Caution
If seat insert is installed at room temperature, cylinder head will be ground and seat ring will not tightly fit.

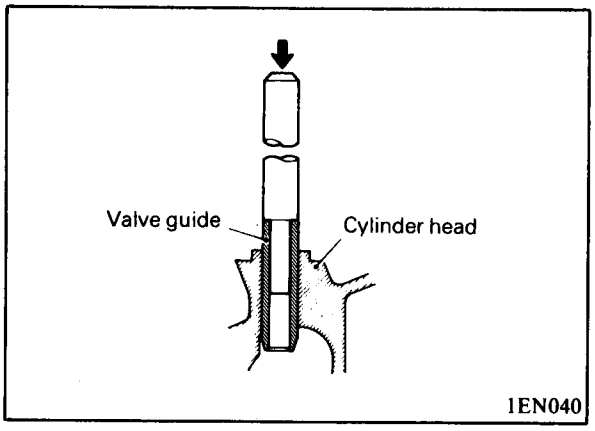
4. Press-fit insert quickly in hole provided in cylinder head.
5. After installation, recondition valve seat with seat cutter. See "Valve Seat Reconditioning".



VALVE GUIDE REPLACEMENT PROCEDURE

Using special tool, Valve Guide Installer, replace valve guide as follows.

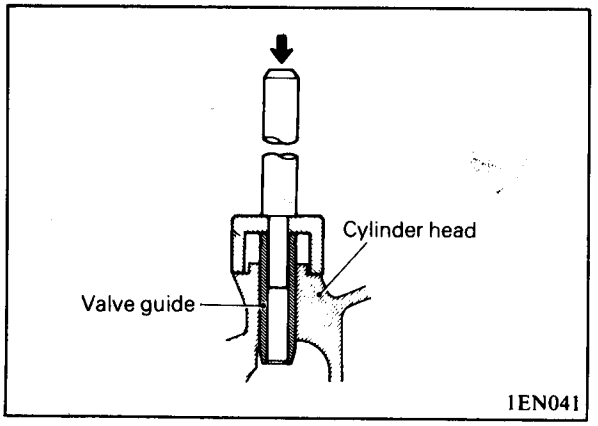
1. With the push rod of special tool, press valve guide out of position toward cylinder head lower surface. (1EN040)
2. Machine valve guide inserting hole in cylinder head to outside diameter of oversize valve guide.



3. With special tool, press-fit valve guide. Use of the special tool makes it possible to press-fit valve guide to a predetermined height. Valve guide should be installed from top of cylinder head. (1EN041)

Caution
If valve guide of standard size has been removed, do not press-fit valve guide of standard size again.
Valve guide may be installed at room temperature.

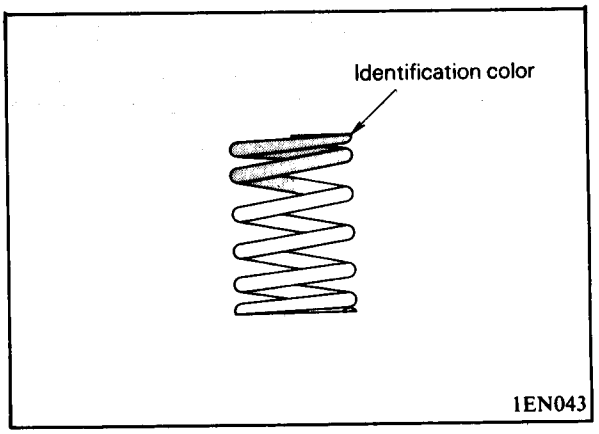
4. After valve guides have been installed, insert new valves and check them for free movement.
5. When valve guides have been replaced, check for valve contact and correct valve seats as necessary.



REASSEMBLY

1. Apply engine oil to stem of each valve. Insert valve into guide. After insertion, check to see if valve moves smoothly.
2. Install spring seat, valve spring and spring retainer. Valve springs should be installed with identification color side toward valve spring retainer. (1EN043)

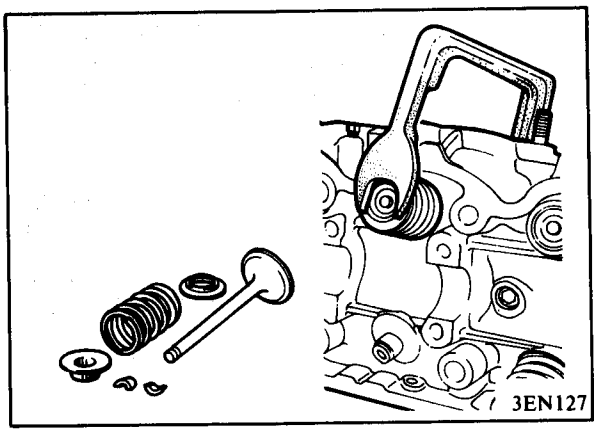
Identification color	White

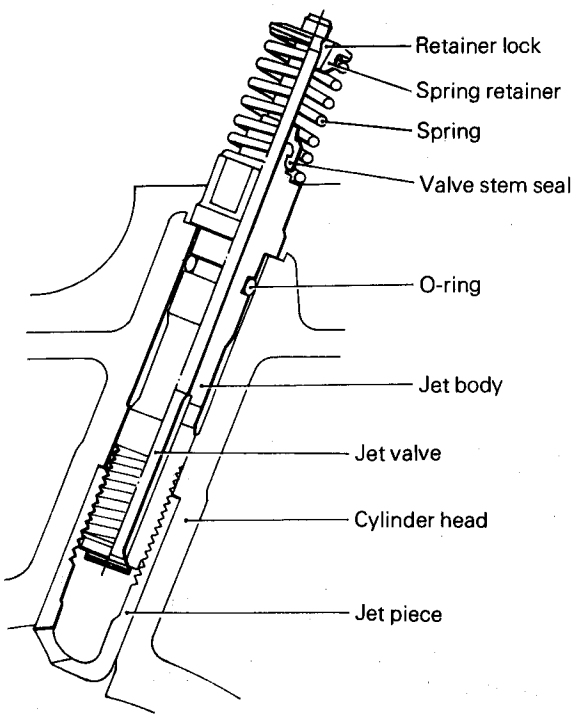


3. Use Valve Spring Compressor or suitable tool, to compress spring and install retainer lock. (3EN127)

Caution
When spring is compressed with Valve Spring Compressor or suitable tool, check to see that the bottom of retainer does not contact the valve stem seals.

4. After installation of valves, make certain that retainer locks are positively installed.



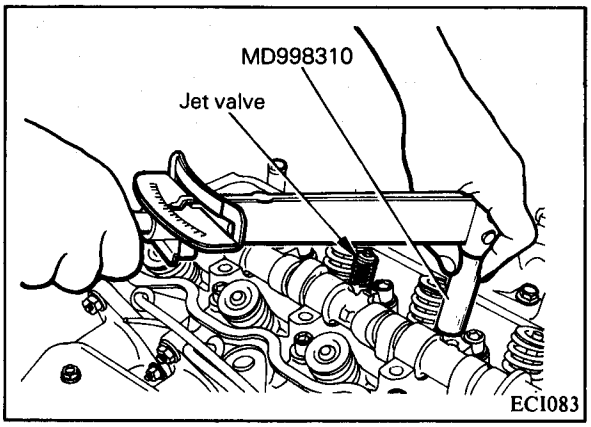


ECI084

REMOVAL

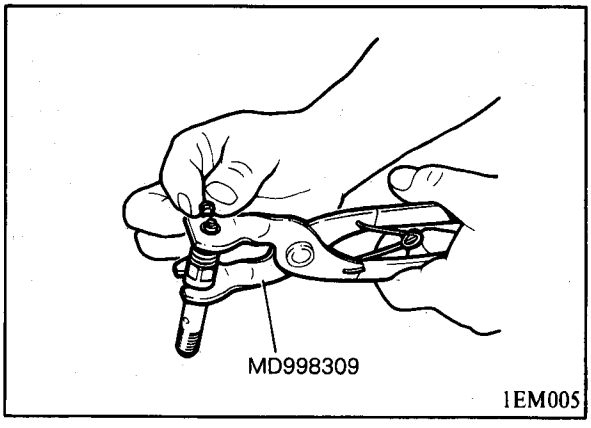
1. Remove the jet valve assembly, using Special Tool, Jet Valve Socket Wrench (MD998310).

Caution
When the jet valve socket wrench is used, make certain that the wrench is not tilted with respect to the center of the jet valve. If the tool is tilted, the valve stem might be bent by the force exerted on the valve spring retainer, resulting in defective jet valve operation.



ECI083

2. Remove the jet valve spring retainer lock, using Special Tool, Jet Valve Spring Pliers (MD998309), and remove the valve spring retainer and valve spring.
3. Remove the jet valve from the jet body.



1EM005

INSPECTION

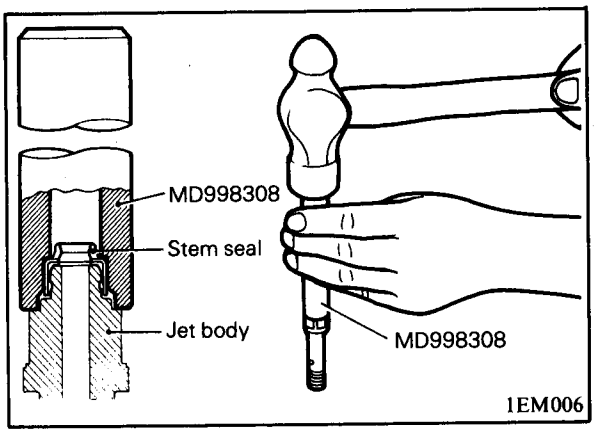
1. Check to ensure that the jet valve slides smoothly in the jet body. Do not disturb the combination of the jet valve and jet body. Replace the jet valve and jet body as an assembly.
2. Check the face of the jet valve and the jet body seat for seizure and damage. If defective, replace the jet valve and jet body as an assembly.
3. Check the jet valve spring for deterioration, cracks or damage, and replace if defective.

INSTALLATION

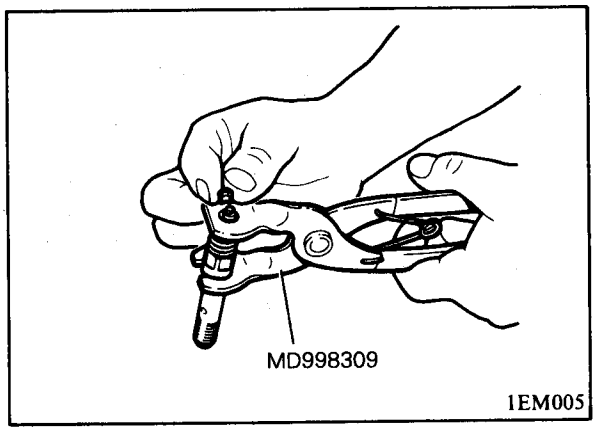
1. Install the jet valve stem seal, using Special Tool, Jet Valve Stem Seal Installer (MD998308).

Caution
Do not reuse old valve stem seal.

2. Apply engine oil to the stem of the jet valve and insert the jet valve into jet body. When the valve is inserted, use care to prevent damage to the new valve stem seal lips. After installation, check to ensure that the valve slides smoothly.

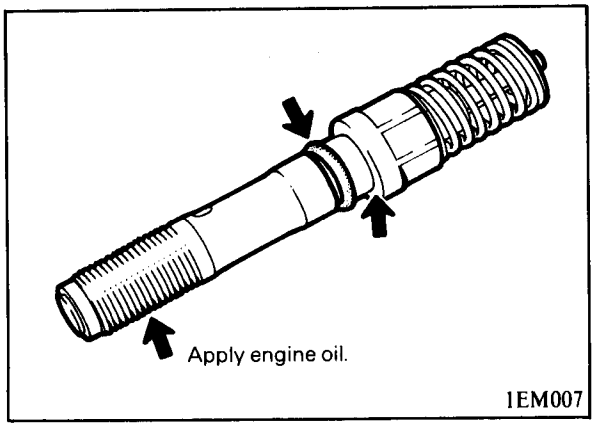


3. Mount the jet valve spring and jet valve spring retainer. While compressing the spring with Special Tool, Jet Valve Spring Pliers (MD998309), install the retainer lock. When the spring is compressed with the pliers, use care to prevent damage to the valve stem by the bottom of the spring retainer.

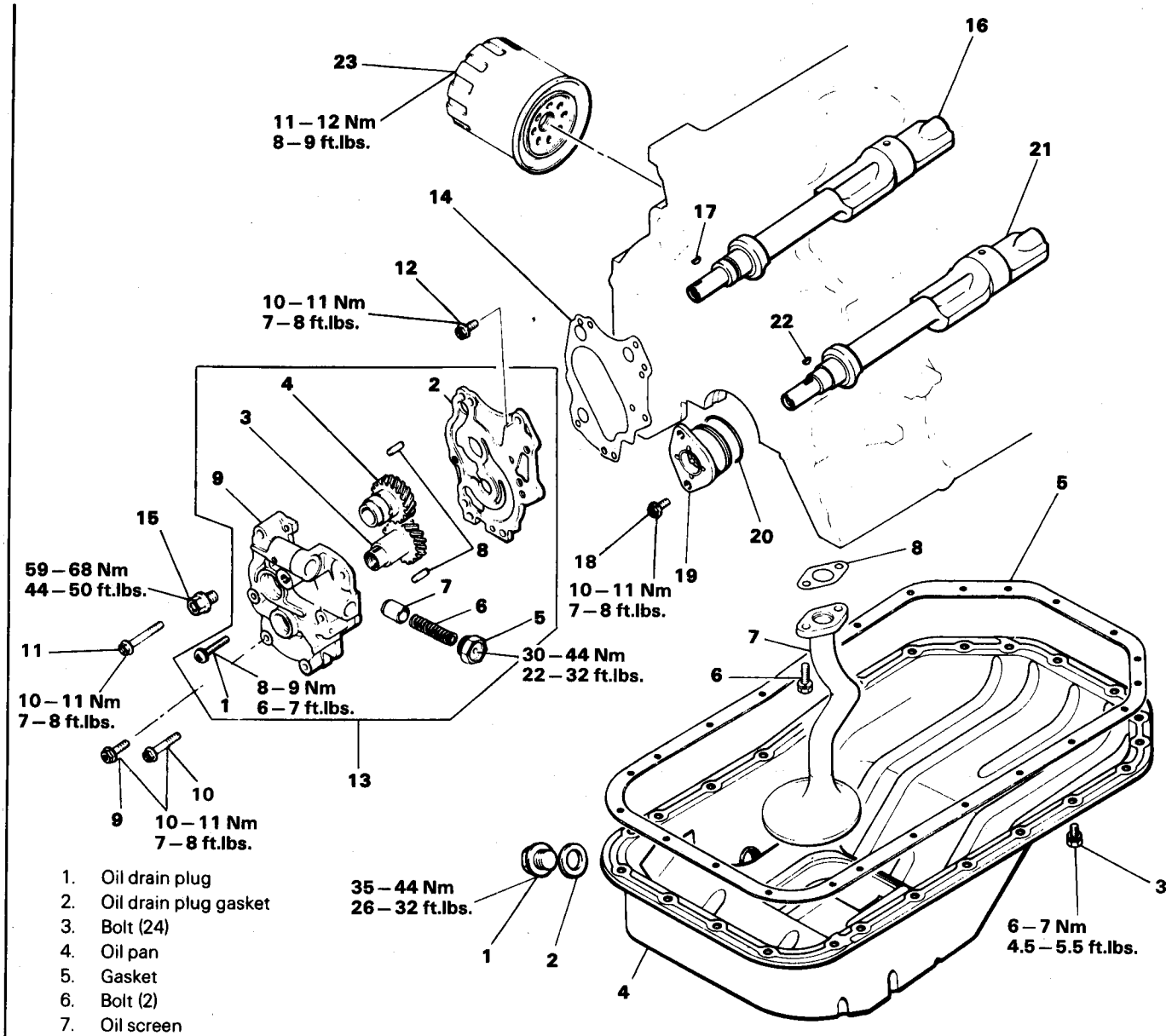


4. Install a new O-ring in the groove around the jet body and apply engine oil to the O-ring. Apply engine oil to the jet body threaded area and seat surface. (1EM007)
5. Screw the jet valve assembly into the cylinder head by hand, and tighten to the specified torque, using Special Tool, Jet Valve Socket Wrench (MD998310). Hold the jet valve socket wrench firmly to make sure that it is not tilted with respect to the center of the jet valve. (ECI083)

Tightening torque
Jet valve assembly .... 18 – 21 Nm (13 – 15 ft.lbs.)



COMPONENTS



1. Oil drain plug
2. Oil drain plug gasket
3. Bolt (24)
4. Oil pan
5. Gasket
6. Bolt (2)
7. Oil screen
8. Oil screen gasket
9. Flange bolt – 6x22
10. Flange bolt – 6x38
11. Flange bolt – 6x45
12. Flange bolt – 6x16
13. Oil pump assembly
    - -1 Screw
    - -2 Oil pump cover
    - -3 Oil pump drive gear
    - -4 Oil pump driven gear
    - -5 Plug
    - -6 Relief spring
    - -7 Relief valve
    - -8 Pin (2)
    - -9 Oil pump body
14. Oil pump gasket
15. Flange bolt
16. Silent shaft, right
17. Woodruff key
18. Flange bolt (2)
19. Thrust plate
20. O-ring
21. Silent shaft, left
22. Woodruff key
23. Oil filter

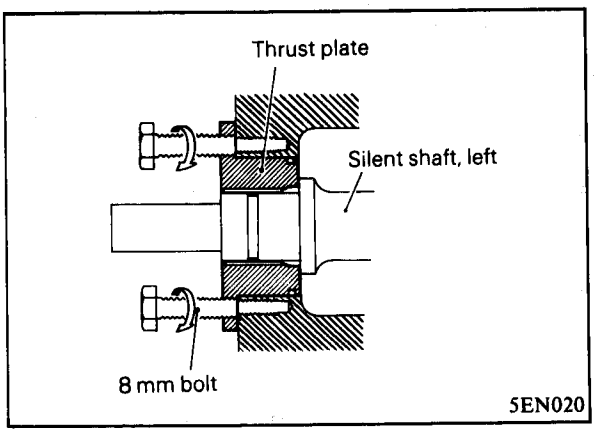
NOTE
Numbers show order of disassembly.
For reassembly, reverse order of disassembly.

5EN019

REMOVAL

When removing the oil pump and the silent shafts, pay special attention to the following item.

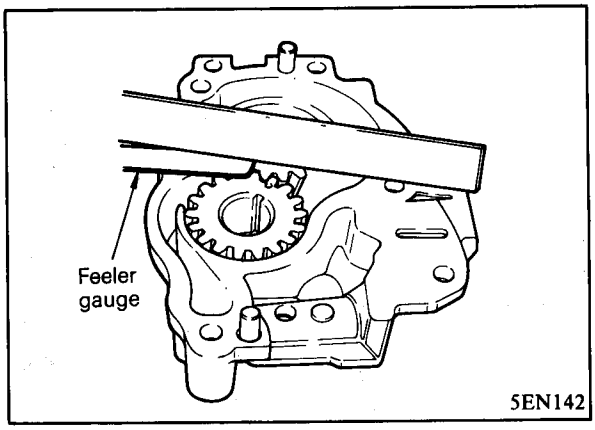
1. When thrust plate is to be removed, install 8 mm dia. bolts into threaded holes of flange and turn bolts in to remove the thrust plate.



INSPECTION

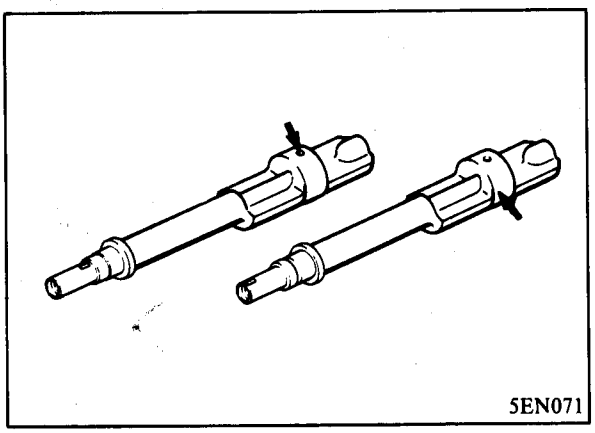
Oil Pump

1. Check gear contacting surfaces of cover for step wear.
2. Check the end play of drive and driven gears. If end play is excessive, replace case and cover assembly and/or gears.



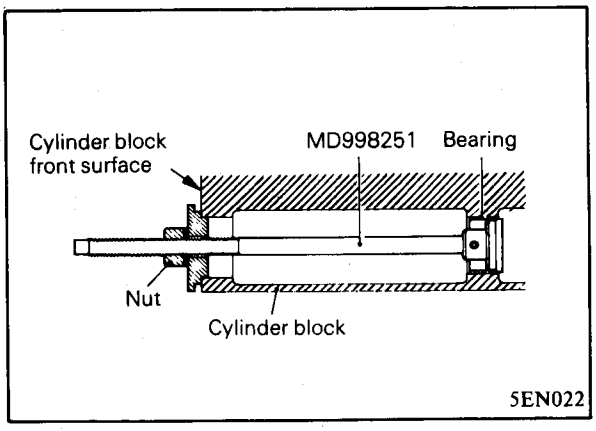
Silent Shafts

1. Check journals for wear, damage and seizure. If excessive damage or seizure is evident, check bearing as well. If necessary, replace silent shaft or bearing or both.
2. Check oil hole (passage) for clogging. Clean or repair as necessary.

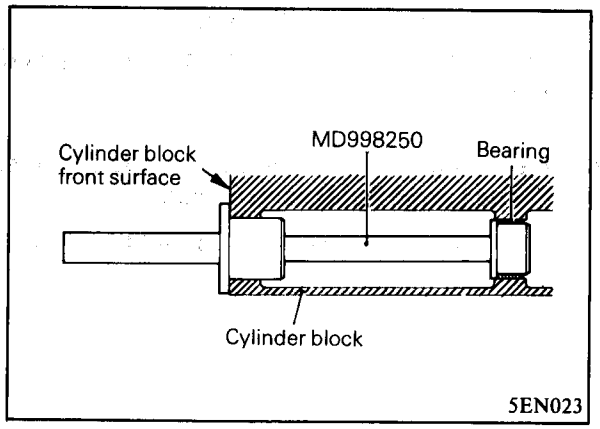


SILENT SHAFT BEARING REPLACEMENT PROCEDURE

1. Using Special Tool (MD998251), remove silent shaft rear bearing.



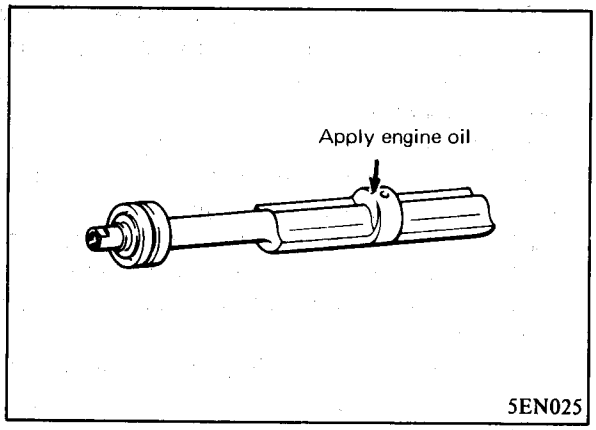
2. Apply engine oil to O.D. of bearing, using special tool (MD998250), install silent shaft bearing to cylinder block.



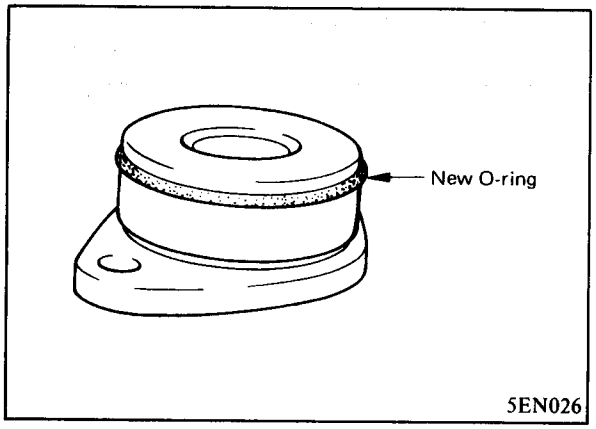
INSTALLATION

Left Silent Shaft

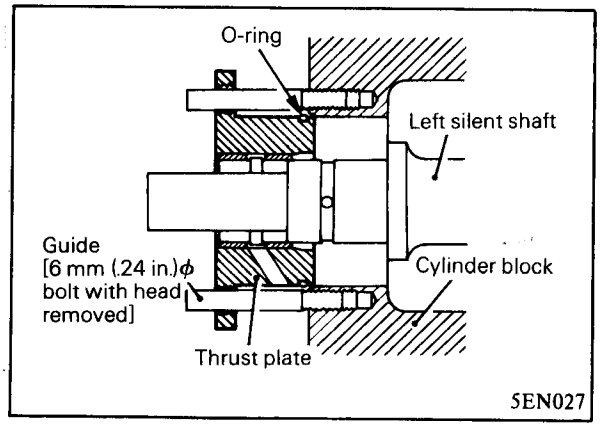
1. Apply engine oil to journal of left silent shaft. (5EN025)
2. Insert left silent shaft into cylinder block. Insert silent shaft carefully to prevent damage to the bearing.



3. Install new O-ring in groove of thrust plate. (5EN026)
4. Apply engine oil around O-ring.



5. Install two guides in threaded holes for mounting thrust plate. Guides should be fabricated by cutting off hexagon heads of bolts 6 mm (.24 in.) in diameter and 50 mm (2 in.) long. (5EN027)
6. Install thrust plate into cylinder block along guides. Without use of guide, threaded holes will be hard to align.

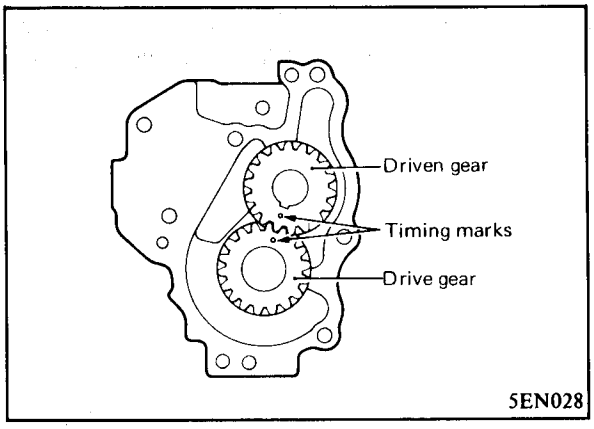


Right Silent Shaft and Oil Pump

1. Install oil pump gears to oil pump body and align timing marks. (5EN028)

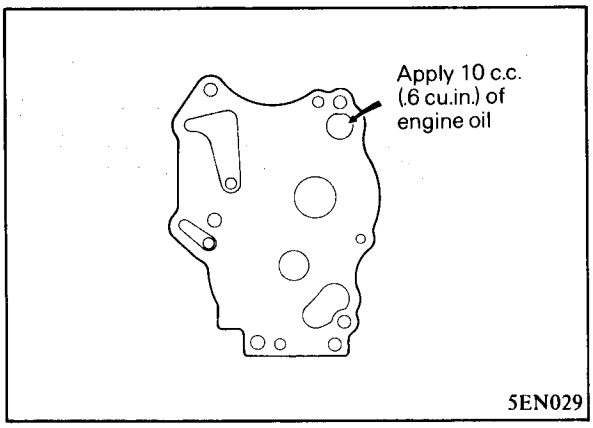
Caution
If timing marks are out of alignment, phase of silent shaft will change and vibration will result.

2. Install oil pump cover to body and tighten screws.

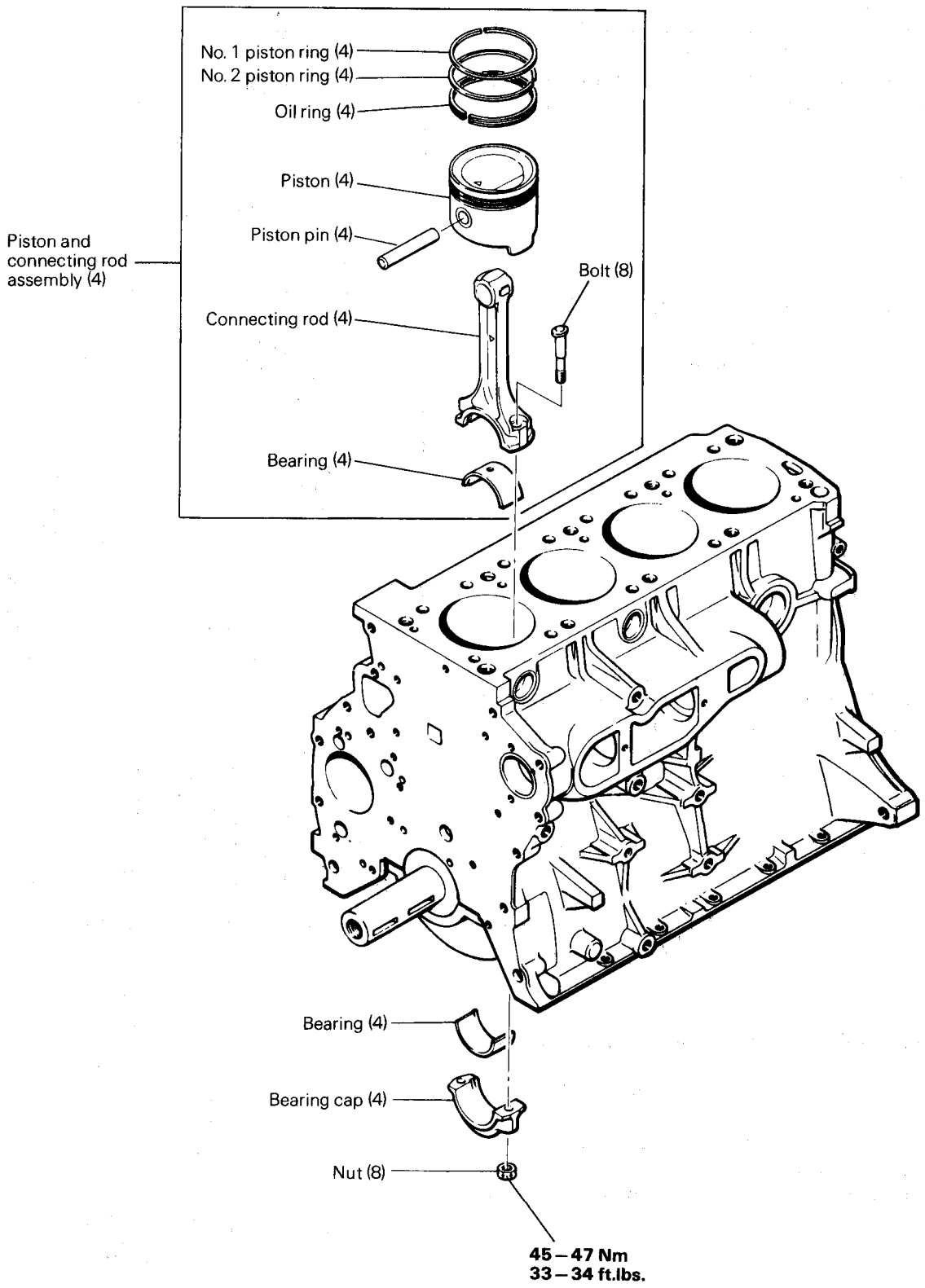


3. After pump cover has been installed, place pump assembly in same position as is installed on engine and put approx. 10 c.c. (.6 cu.in.) of clean engine oil in delivery port. (5EN029)
4. Insert right silent shaft to oil pump driven gear.
5. Install driven gear and silent shaft tightening bolt and then tighten to specified torque.
6. Apply engine oil to journal of right silent shaft.
7. Install silent shaft and oil pump as an assembly to cylinder block. When shaft is inserted, use care to prevent damage to rear bearing.
8. Tighten oil pump mounting bolts to specified torque.

Tightening torque
Oil pump mounting bolt ..... 10—11 Nm (7—8 ft.lbs.)



COMPONENTS

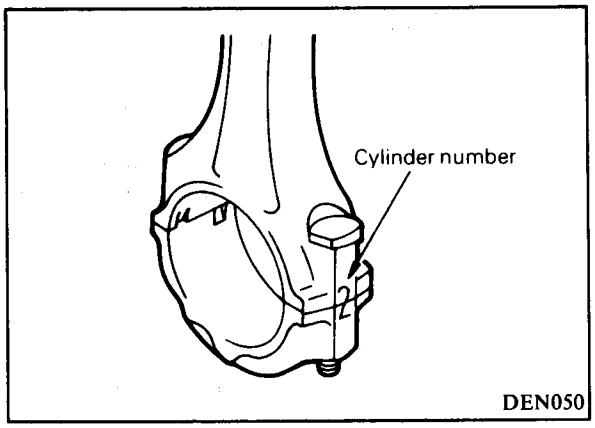


5EN030

REMOVAL

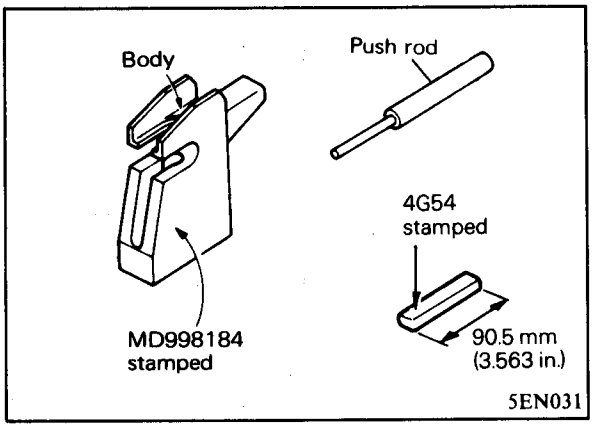
When removing the piston and connecting rod, pay special attention to the following items.

1. Before connecting rod cap is removed, mark the connecting rod and cap for proper reassembly.
2. Keep bearings in order for corresponding connecting rods (according to cylinder numbers) for proper reassembly.

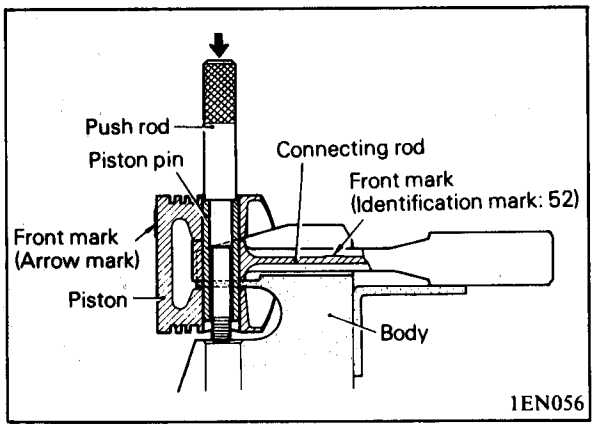


PISTON PIN REMOVAL AND INSTALLATION PROCEDURES

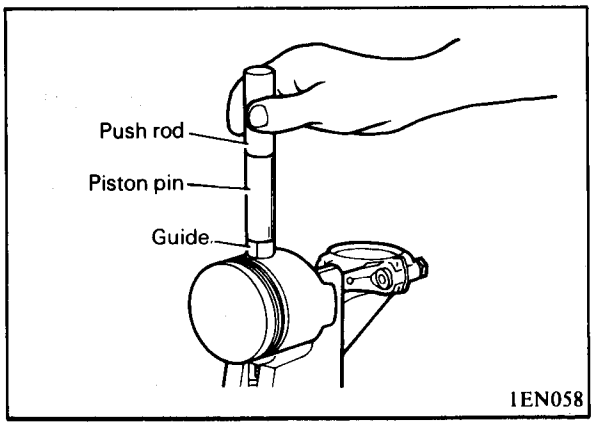
1. Remove and install piston and connecting rod using special tools.



2. Set piston and connecting rod assembly in tool body in such a way that front marks (arrow mark of piston and identification mark of connecting rod) are upward.
3. Place connecting rod securely on tool body.
4. Insert push rod in piston pin and remove piston pin with press.

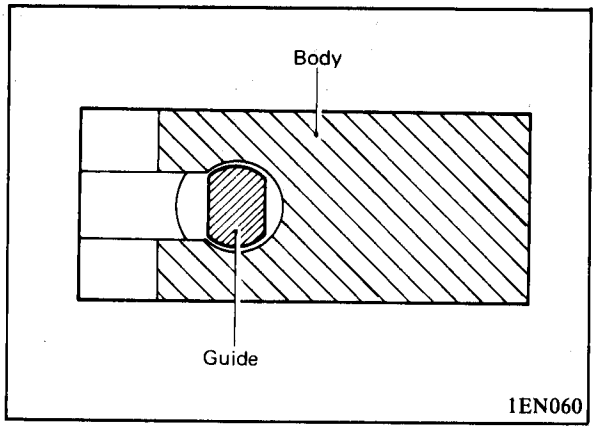


5. Set piston pin positively between push rod and guide of special tool.
   Be sure to use the guide which is stamped "MD998183" and "4G54".
6. Apply engine oil to outer surface of piston pin and small end bore of connecting rod.
7. Set connecting rod and piston with front marks facing up.

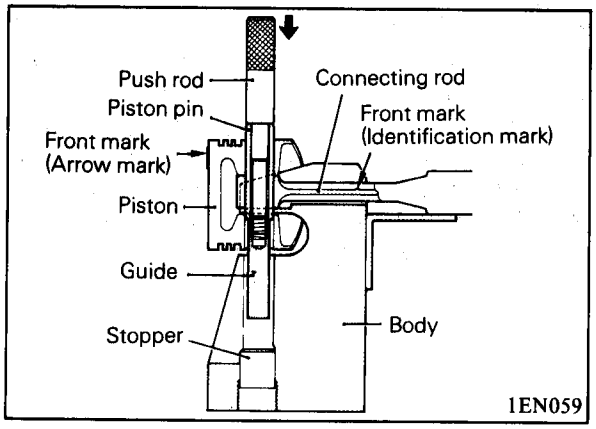


8. Insert assembled push rod, piston pin and guide, into piston pin hole and connecting rod small end hole.
9. Set guide in such a manner that two parallel surfaces will be directed as shown in illustration.
10. Press piston pin into piston pin hole with specified load applied through push rod to pin end by a press. If required installation load is out of specification, replace piston pin and/or connecting rod.

Piston pin press-in load .....
7,355 – 17,162 N (1,653 – 3,858 lbs.)

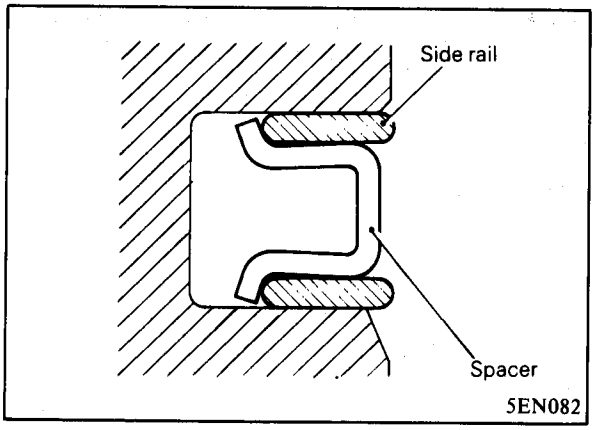


11. Turn push rod 1/4 turn to dismount piston and connecting rod assembly.
12. After pressing in piston pin, make sure that connecting rod slides lightly and moves freely.



PISTON RING INSTALLATION PROCEDURE

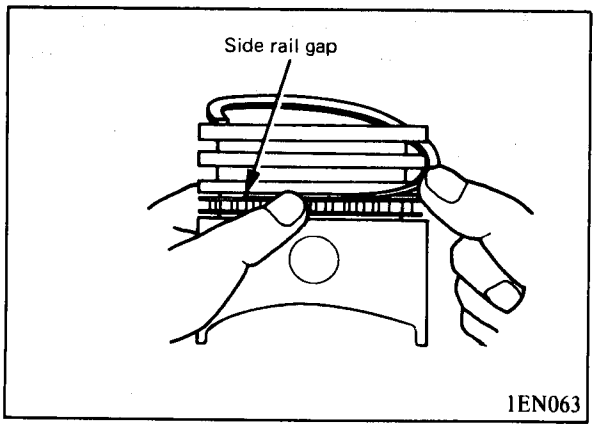
1. Install spacer.



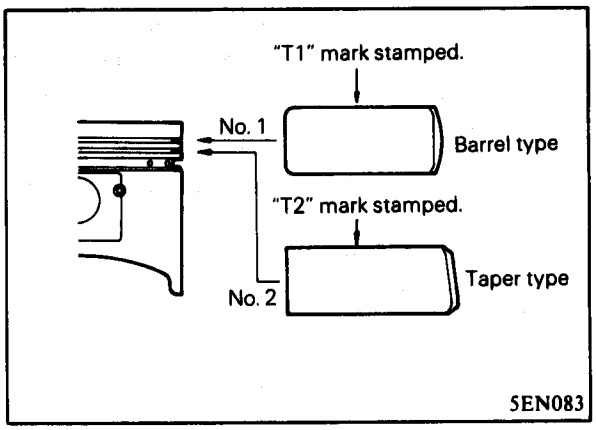
2. Install lower side rail. To install side rail, first put one end of side rail between piston ring groove and spacer, hold it down firmly, and then press down the portion which is to be inserted into groove with a finger as illustrated.

Caution
Do not use piston ring expander when installing side rail.

3. Install upper side rail by same procedures as Step 2.



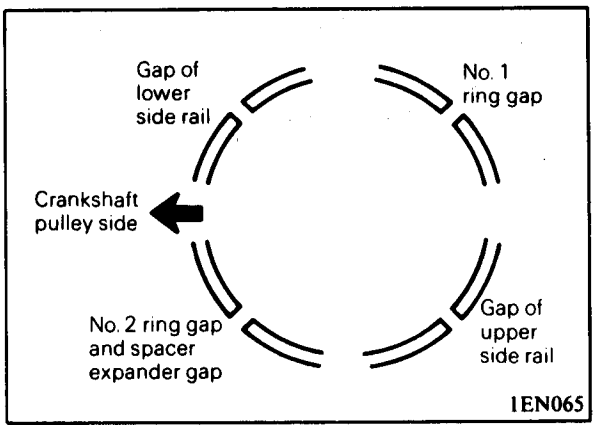
4. Using piston ring expander, install No. 2 piston ring.
5. Install No. 1 piston ring.
6. Apply engine oil around piston and piston rings.



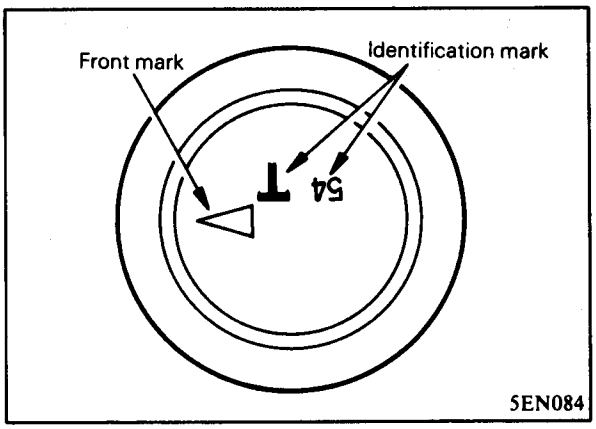
INSTALLATION

When piston and connecting rod assembly is inserted into cylinder, pay attention to following items.

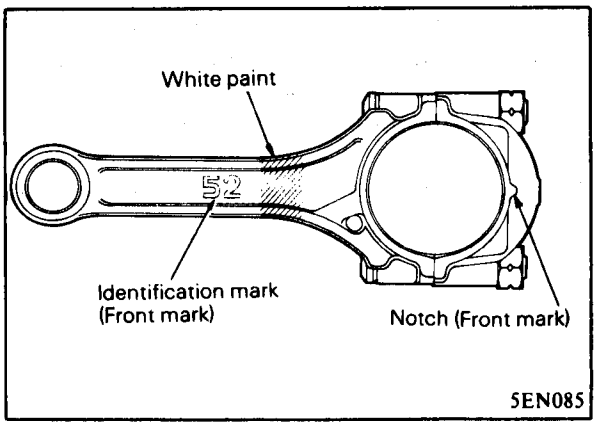
1. Position each piston ring gap as far apart from neighboring gaps as possible. Make sure that gaps are not positioned over thrust surfaces or pin bosses. (1EN065)
2. Hold piston rings firmly in a piston ring compressor as they are inserted into cylinder.



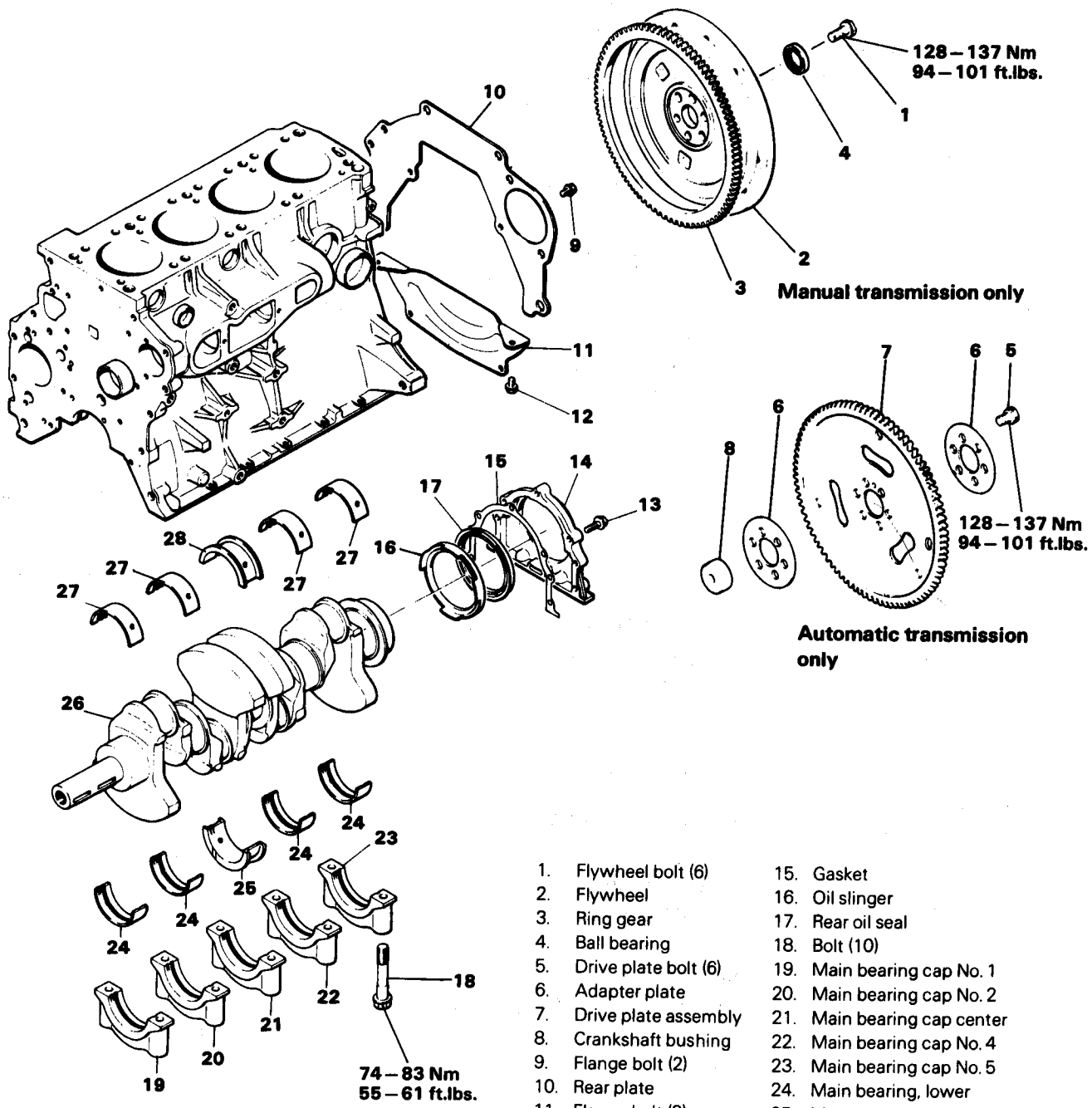
3. Make sure that front mark of piston and front mark (identification mark) of connecting rod are directed toward front of engine.



4. When new connecting rod is installed, make sure that identification mark and notch are on same side.



COMPONENTS



1. Flywheel bolt (6)
2. Flywheel
3. Ring gear
4. Ball bearing
5. Drive plate bolt (6)
6. Adapter plate
7. Drive plate assembly
8. Crankshaft bushing
9. Flange bolt (2)
10. Rear plate
11. Flange bolt (2)
12. Bell housing cover
13. Flange bolt (5)
14. Oil seal case
15. Gasket
16. Oil slinger
17. Rear oil seal
18. Bolt (10)
19. Main bearing cap No. 1
20. Main bearing cap No. 2
21. Main bearing cap center
22. Main bearing cap No. 4
23. Main bearing cap No. 5
24. Main bearing, lower
25. Main bearing, center
26. Crankshaft
27. Main bearing, upper
28. Main bearing, center

NOTE
Numbers show order of disassembly.
For reassembly, reverse order of disassembly.

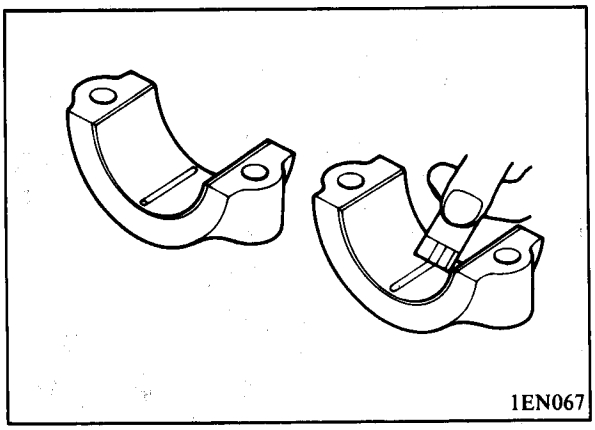
6EN079

INSPECTION

Crankshaft

1. Check the crankshaft journals and pins for wear, scuffs or scores.
2. Check the oil passage for clogging, clean or repair as necessary.
3. Check the main bearing clearance as follows:
   (1) Remove oil and dirt from bearings and journals.
   (2) Cut plastigage to same length as width of bearing and place it in parallel with journal, off oil holes.
   (3) Install crankshaft, bearings and caps and tighten them to specified torque. During this operation, do NOT turn crankshaft.
   (4) Remove caps. Measure width of plastigage at the widest part with the scale printed on plastigage envelope. (1EN067)

Bearing clearance .. 0.02—0.05 mm (.0008—.0010 in.)


1EN067

Flywheel and Ring Gear for Manual Transmission

1. Friction face of flywheel should also be free from excessive discoloration, burned areas, small cracks, deep grooves, or ridges.
2. Check the flywheel runout.

Flywheel runout
Service limit ..... Less than 0.13 mm (.005 in.)

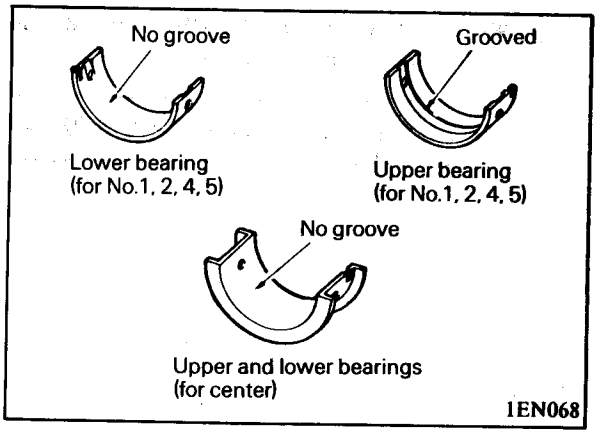
3. Check the ring gear teeth for damage. Replace as necessary. If ring gear damaged, also inspect starter motor pinion for damage.

Drive Plate for Automatic Transmission

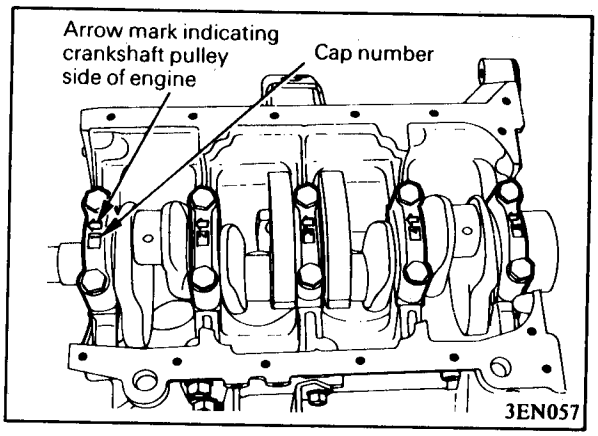
1. Check the drive plate for distortion or cracks. Replace as necessary.

INSTALLATION

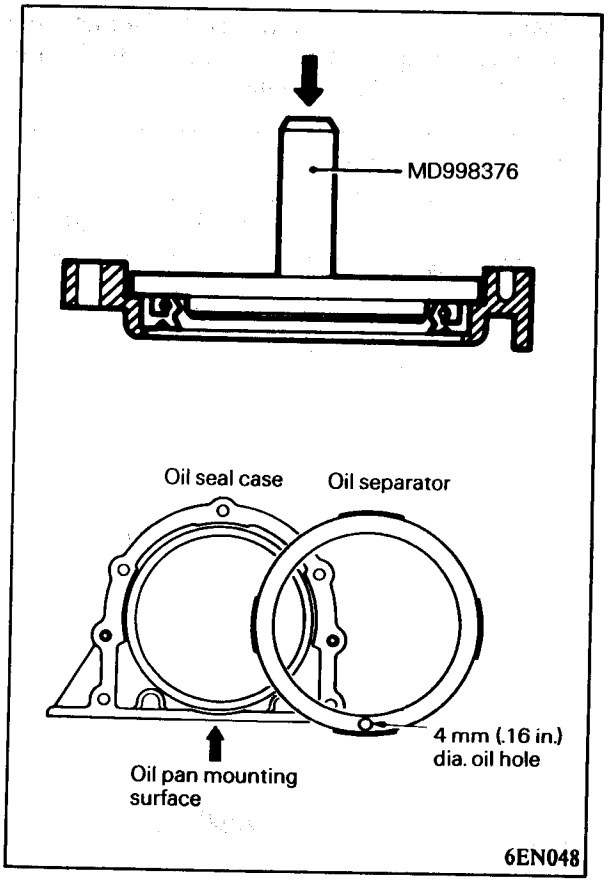
1. Install grooved main bearing (upper bearing) except center bearing on cylinder block side. An upper bearing for center is grooveless. Then apply engine oil to bearings.
2. Install crankshaft. Apply engine oil to journal and pin.
3. Install bearings without grooves (lower bearing) on main bearing cap side.



4. Caps should be installed with arrow mark directed toward front of engine. Cap number must be correct. (3EN057)
5. Tighten cap bolts to specified torque in sequence of center, No. 2, No. 4, front and rear caps. Cap bolts should be tightened evenly in 2 to 3 stages before they are tightened to 49–53 Nm (37–39 ft.lbs.).
6. Make certain that crankshaft turns freely and has proper end play.

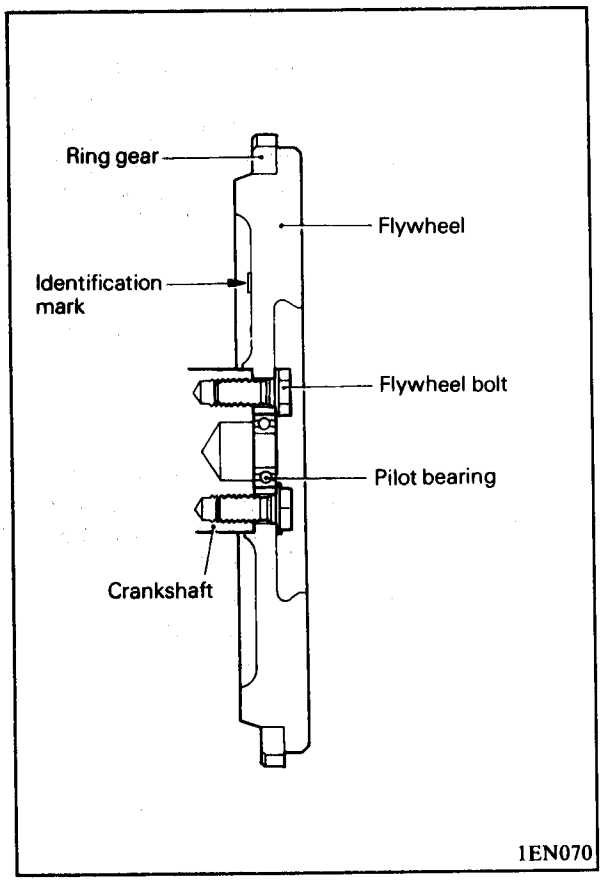


7. Using special tool, install crankshaft rear oil seal into oil seal case.
8. With 4 mm (.16 in.) diameter oil hole in the lowermost position (oil pan mounting surface side), push oil separator into case.
9. Install the new oil seal case gasket and oil seal case assembly.
10. Install the rear plate to the cylinder block.



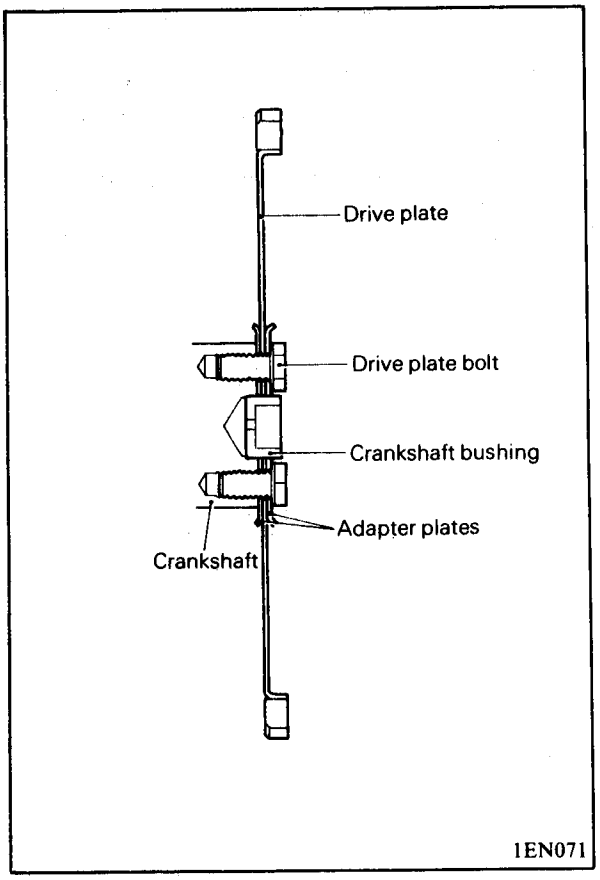
11. Install flywheel, for vehicle with manual transmision, and tighten bolts to specified torque.

Flywheel bolts	128—137 Nm (94—101 ft.lbs.)

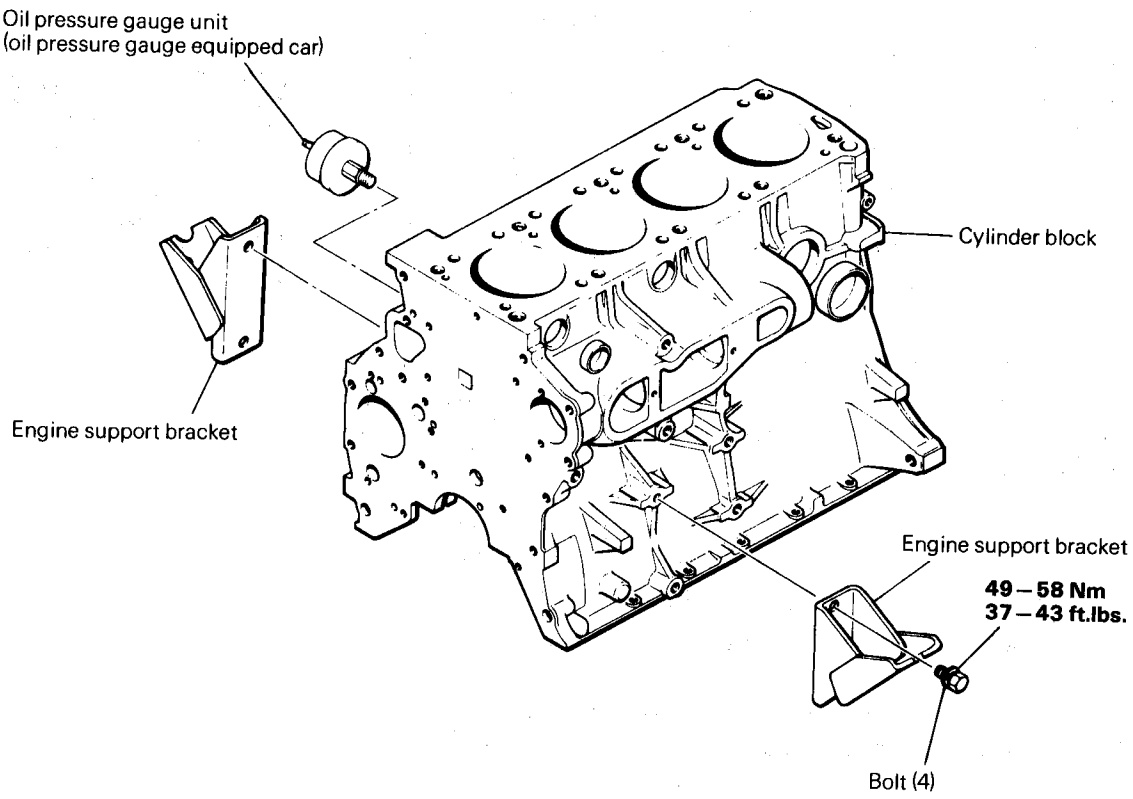


12. Install adapter plates and drive plate and tighten bolts to specified torque. (1EN071) Use bolt 17 mm (.669 in.) in length to install drive plate.

Tightening torque	
Drive plate bolts	128—137 Nm (94—101 ft.lbs.)



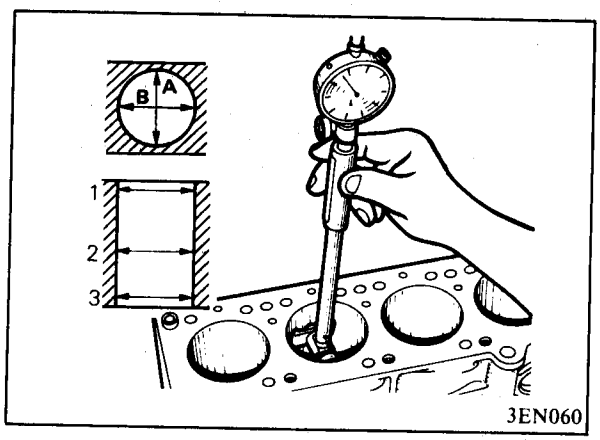
COMPONENTS



5EN034

INSPECTION

1. Measure cylinder bore with a cylinder gauge at three levels in directions of A and B.
   - Level 1: Top piston ring position with piston at TDC
   - Level 2: Center of cylinder
   - Level 3: Bottom of cylinder
2. If cylinder bores show more than specified out-of-round or taper, or if cylinder walls are badly scuffed or scored, cylinder block should be rebored and honed, and new oversize piston and rings fitted.

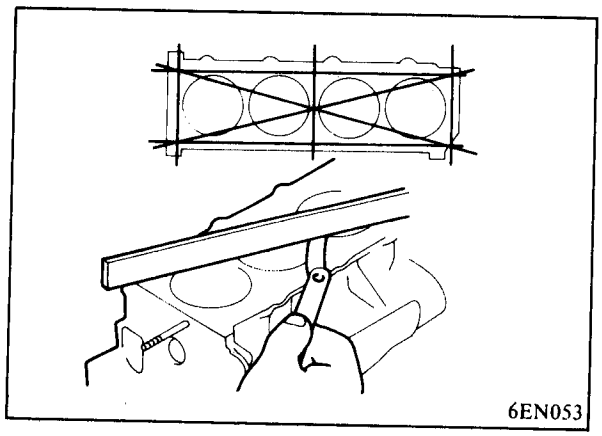


3EN060

3. Check for damage and cracks.
4. Check top surface for distortion. If excessive distortion is evident, grind to minimum limit or replace.

Service limit	0.1 mm (.004 in.)
Grinding limit	0.2 mm (.008 in.)
Overall height of cylinder block (standard value for new part)	316 mm (12.44 in.)

Caution
It is recommended to grind less than 0.2 mm (.008 in.) as combined with the mating cylinder head.



6EN053

BORING CYLINDER

1. Oversize pistons to be used should be determined on the basis of the largest bore cylinder.

Size mark	
0.25 mm (.01 in.) O.S.	0.25
0.50 mm (.02 in.) O.S.	0.50
0.75 mm (.03 in.) O.S.	0.75
1.00 mm (.04 in.) O.S.	1.00

NOTE
Size mark is stamped on top of piston.

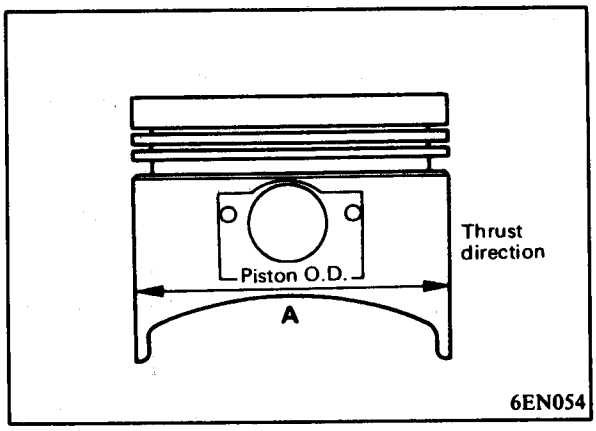
2. Measure outside diameter of piston to be used. Measure it at position "A" in thrust direction as shown. (6EN054)
3. Based on measured piston O.D., calculate the boring finish dimension.

   Boring finish dimension = Piston O.D. + 0.01 to 0.03 mm (.0004 to .0012 in.) (clearance between piston O.D. and cylinder) – 0.02 mm (.0008 in.) (honing margin)
4. Bore all cylinders to calculated boring finish dimension.

Caution
To prevent distortion that may result from temperature rise during honing, bore cylinders, working from No. 2 to No. 4 to No. 1 to No. 3.

5. Hone to final finish dimension [piston O.D. + 0.01 to 0.03 mm (.0004 to .0012 in.)].
6. Check clearance between piston and cylinder.

NOTE
When boring cylinders, finish all of four cylinders to same oversize. Do not bore only one cylinder to an oversize.

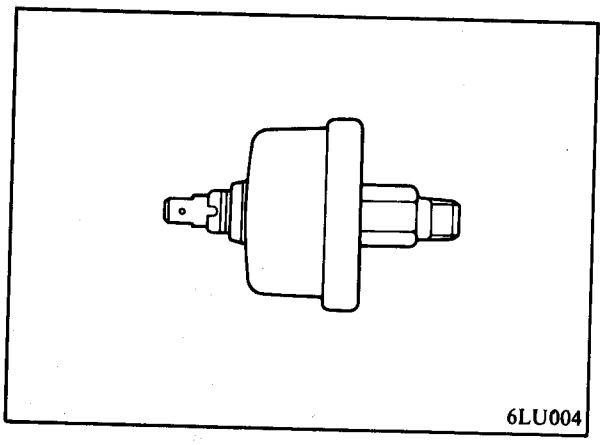


INSPECTION

Oil Pressure Gauge Unit

1. Since bimetal type has construction characteristics which vary its resistance as it repeats ON-OFF states, it cannot be checked by measuring its resistance.
2. It can be checked by use of an AC type ammeter measuring changes in current.

Oil pressure gauge unit current	
at 0 kPa (0 psi)	0 mA
at 392 kPa (57 psi)	84 mA
at 785 kPa (114 psi)	110 mA

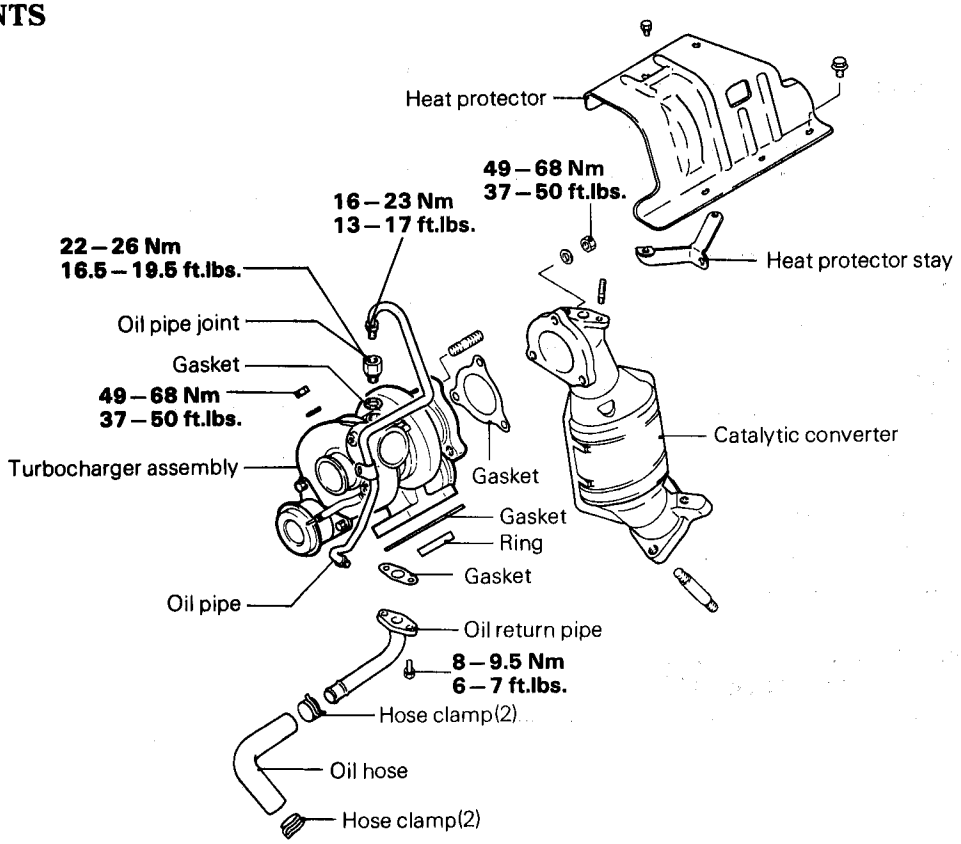


INSTALLATION

1. Apply sealant to threaded portion.
2. Tighten gauge to specified torque.

Tightening torque	
Oil pressure gauge unit	15—21 Nm (11—15 ft.lbs.)

COMPONENTS



EC1227

INSPECTION

Check the following items. If defective, replace turbocharger assembly. If related parts are defective, repair or replace.

Abnormal Condition or Vibration

1. Probable causes are defective bearings and interference of rotating parts with surrounding objects. Neglect of engine oil replacement, sustained operation with foreign matter in oil pipe, a clogged or broken oil filter, or repeated abrupt starts and stops could cause bearing failure.
2. If there is nothing wrong with the lubricating system, an incorrectly balanced rotating section or bent shaft may be suspected. This is due to excessive wear of bearings or entry of foreign substances that have caused damage to turbine wheel or compressor wheel.
3. If any of above items is evident, the turbocharger assembly must be replaced. Before a new turbocharger assembly is installed, carefully check for foreign substances or pieces of broken turbine wheel or compressor wheel which might be left in intake and exhaust systems.

Low Output

If low output has occurred while turbocharger appears to be good, check the following items.

1. Check the exhaust system for gas leaks.
2. Check for a deformed or clogged exhaust pipe, muffler, etc. which might be causing increased exhaust resistance.
3. Check for air leaks from compressor discharge side.
4. Check the air cleaner element for contamination and clogging and clean or replace element as necessary.
5. If turbine wheel or compressor wheel does not rotate smoothly and lightly when turned by hand, replace turbocharger assembly.
6. Check the waste gate valve or relief valve which might be left opened.

White Exhaust Color

Leakage of engine oil from the turbocharger into the exhaust pipe or intake pipe will result in white exhaust color. In such a case, check the following items.

1. Clogged, crushed or deformed oil return pipe.
2. If there is nothing wrong with the oil return pipe, leakage is probably due to wear of piston ring (seal ring) in turbocharger.

Sustained operation with faulty bearings will result in failure of oil seal which could cause leakage of engine oil into exhaust and intake pipes.

REMOVAL

Caution

Before exhaust system is removed, check to ensure that it has cooled down.

1. Remove the heat protector.
2. Remove the oxygen sensor from the catalytic converter.
3. Remove the catalytic converter to turbocharger tightening nuts.
4. Disconnect the oil hose from the oil return pipe and timing chain case. (ECI228)
5. Remove the oil pipe from the turbocharger and oil filter bracket.
6. Remove the air intake pipe connecting bolt.
7. Remove the turbocharger mounting nuts and remove the turbocharger assembly from the exhaust manifold.

INSPECTION

Turbocharger

1. Check the turbocharger case for cracks or damage. Replace as necessary.
2. Check the turbine and compressor wheels for damage.
3. Make sure turbine and compressor wheels turn smoothly.

Waste Gate Actuator

1. Apply pressure into the waste gate actuator through the nipple.
2. Make sure the actuator and the waste gate valve linkage operate properly.

INSTALLATION

Perform installation in reverse procedure of removal, paying special attention to the following items:

1. Torque all parts to specifications shown in the component illustration.
2. Before oil pipe flare nut (at top of the turbocharger) is installed, pour clean engine oil into the turbocharger.
3. Make sure that the oil and air hoses, etc. are properly installed and securely clamped.
4. Do not reuse a heat-damaged, corroded or deformed exhaust manifold gasket or turbocharger gasket (made of stainless steel).