
ENGINE

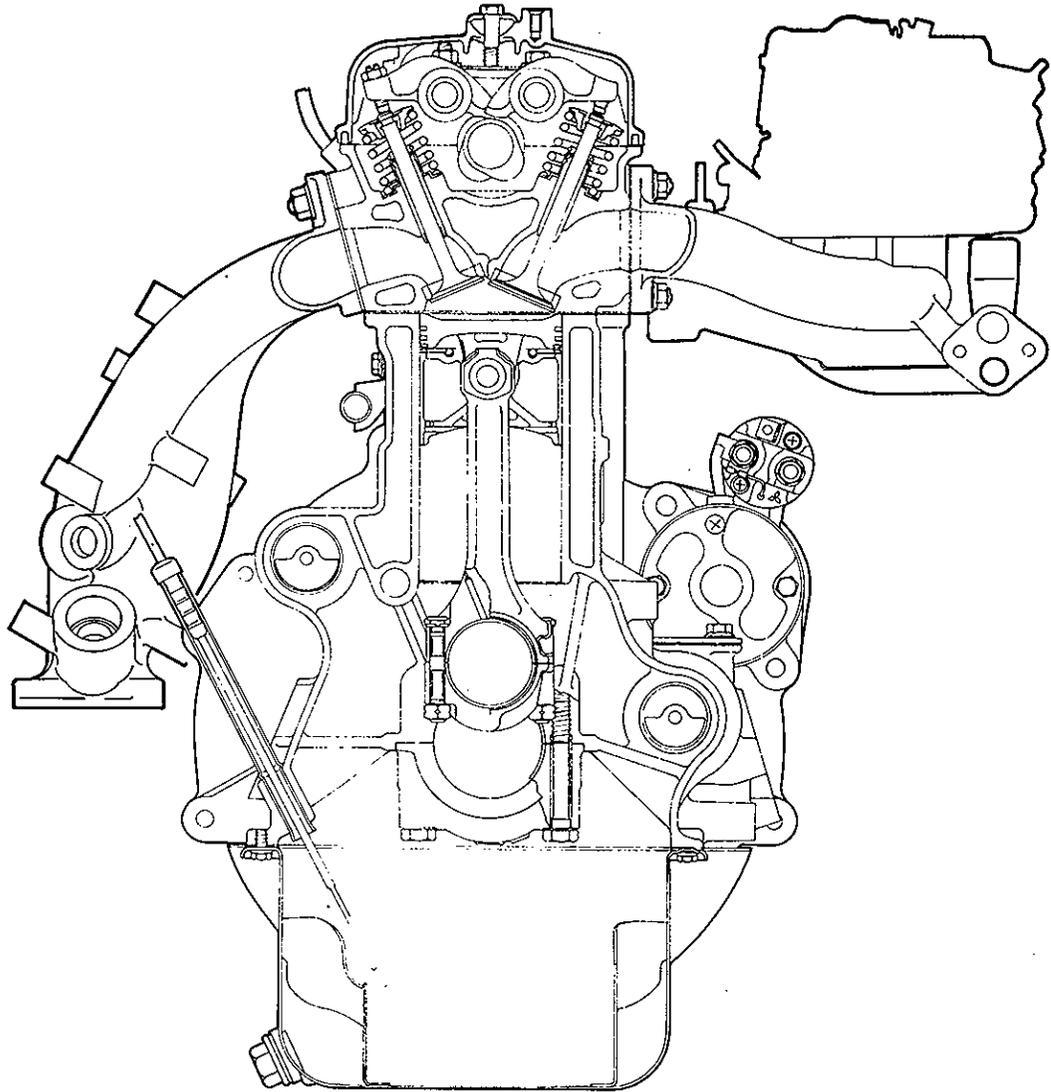
4G3 SERIES

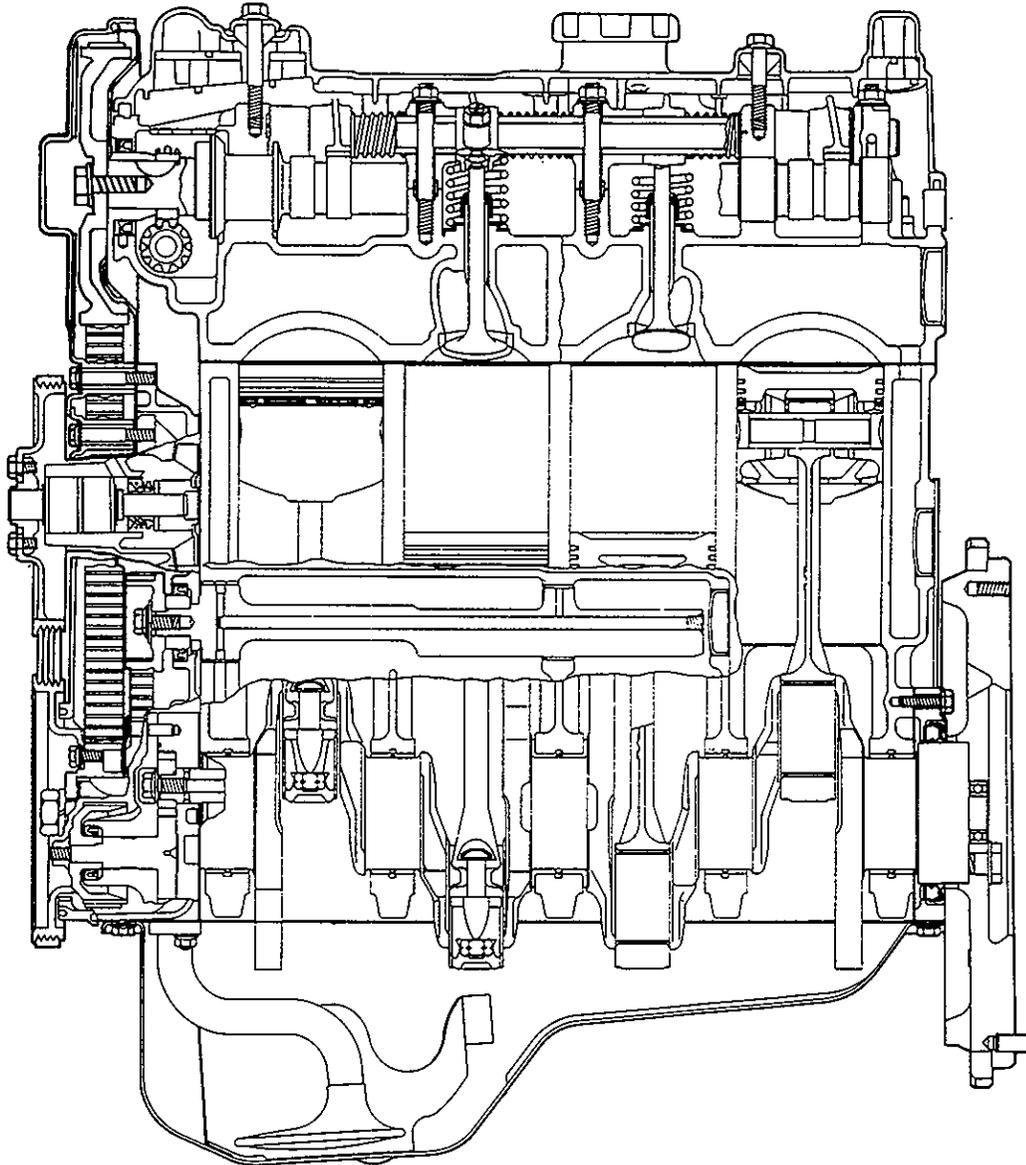
CONTENTS

GENERAL INFORMATION	11A- 0- 3
1. SPECIFICATIONS	11A- 1- 1
GENERAL SPECIFICATIONS	11A- 1- 1
SERVICE SPECIFICATIONS	11A- 1- 2
TORQUE SPECIFICATIONS	11A- 1- 6
SEALANT	11A- 1- 7
2. SPECIAL TOOLS	11A- 2- 1
3. DRIVE BELT AND TIMING BELT	11A- 3- 1
4. INTAKE MANIFOLD	11A- 4- 1
5. EXHAUST MANIFOLD AND WATER PUMP	11A- 5- 1
6. ROCKER ARMS AND CAMSHAFT	11A- 6- 1
7. ROCKER ARMS AND ROCKER SHAFTS	11A- 7- 1
8. CYLINDER HEAD AND VALVES	11A- 8- 1
9. FRONT CASE, OIL PUMP AND OIL PAN	11A- 9- 1
10. PISTON AND CONNECTING ROD	11A-10- 1
11. CRANKSHAFT, FLYWHEEL AND DRIVE PLATE	11A-11- 1
12. CYLINDER BLOCK	11A-12- 1

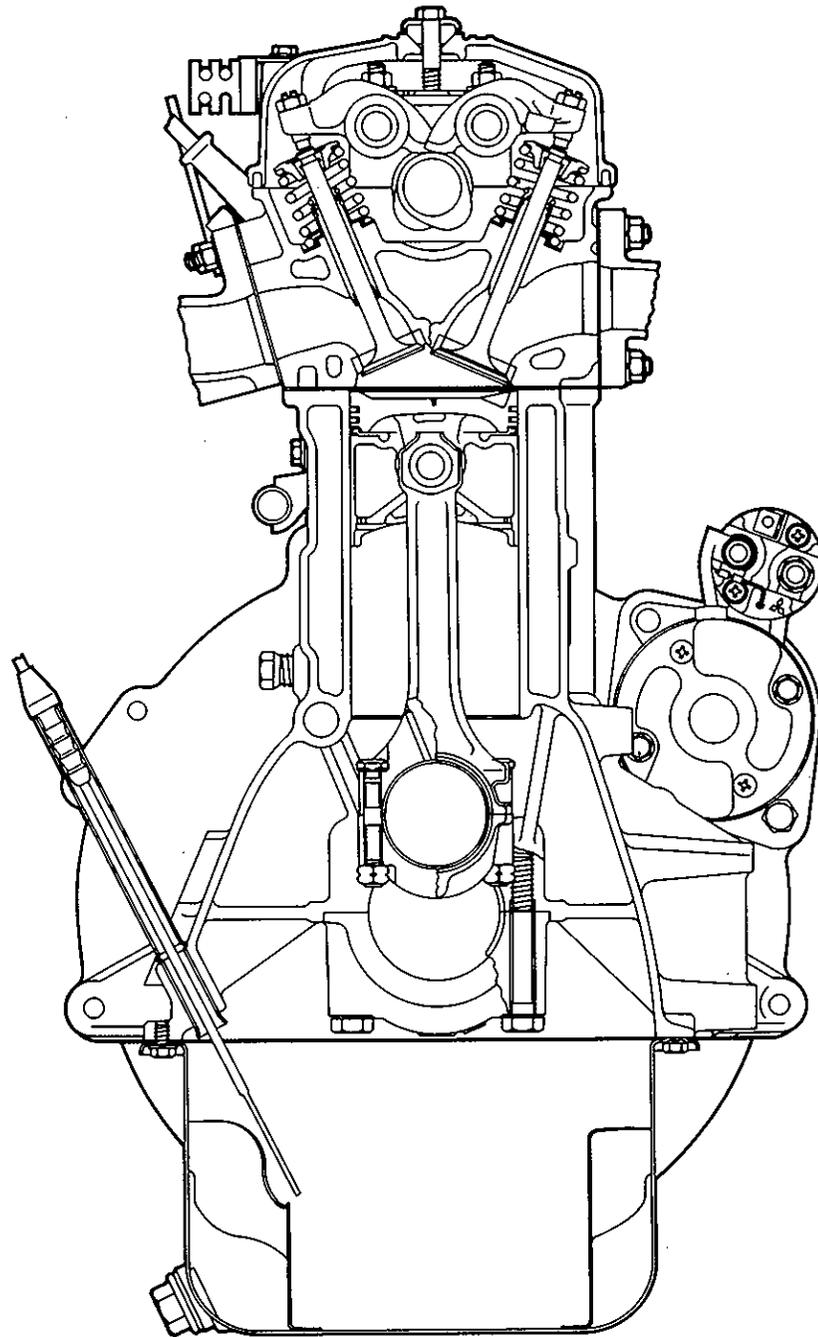
GENERAL INFORMATION

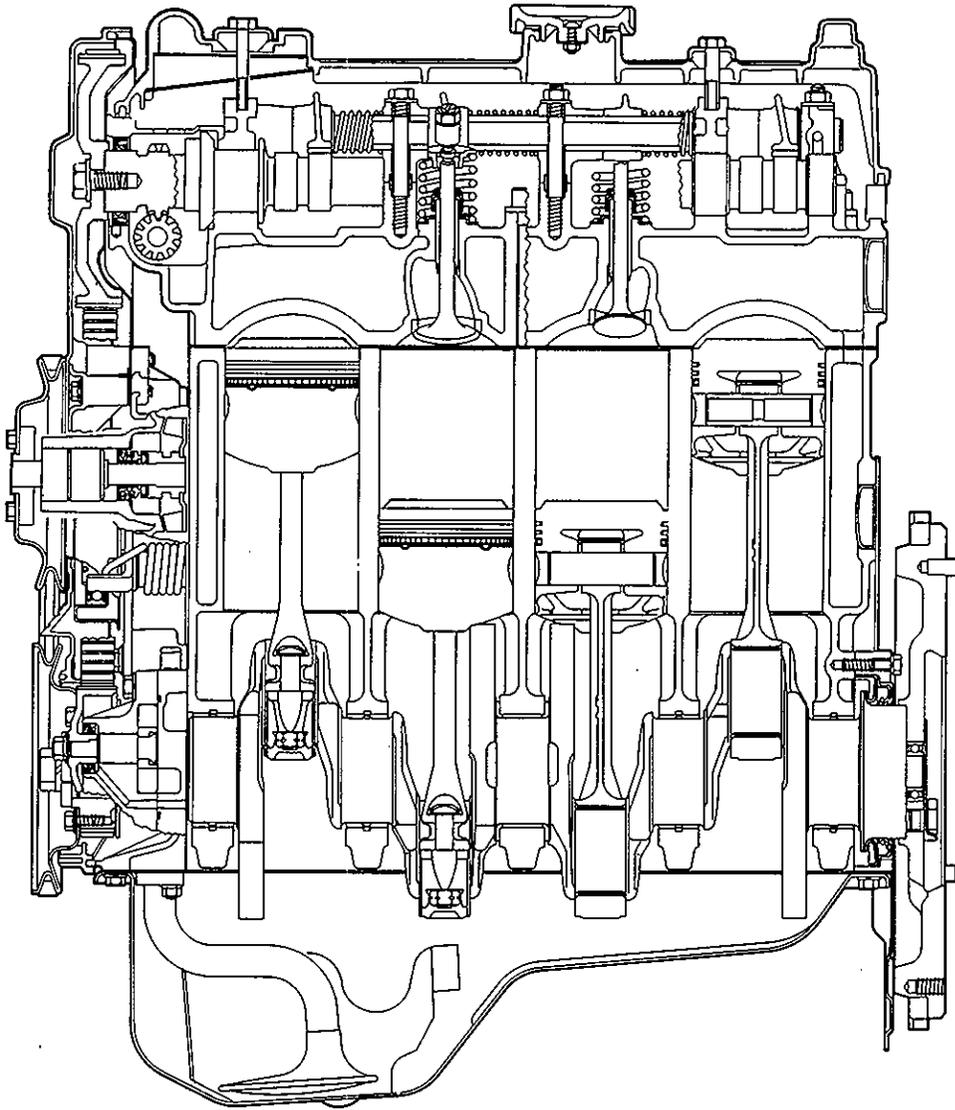
ENGINE SECTIONAL VIEW – ENGINES WITH SILENT SHAFTS





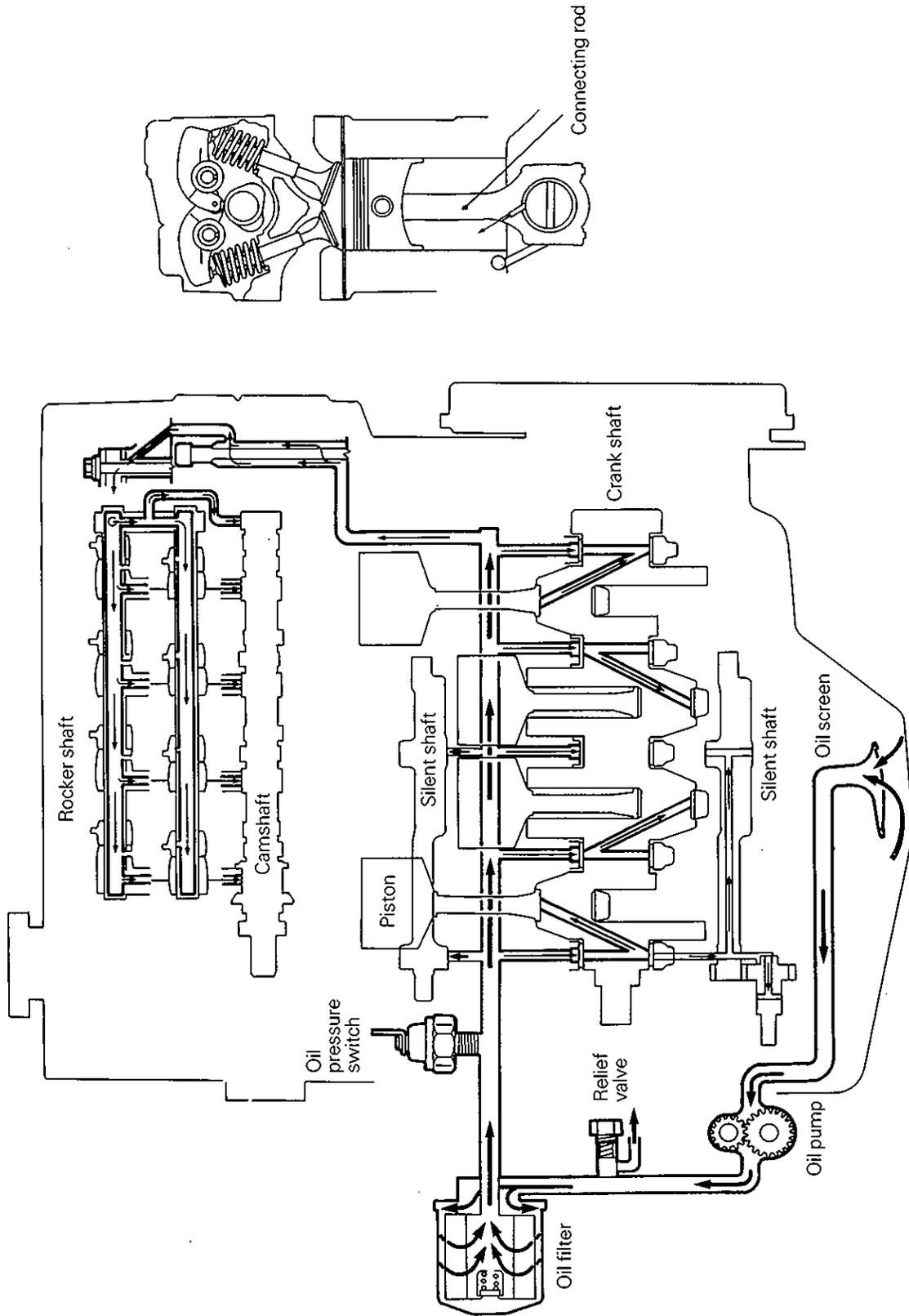
ENGINE SECTIONAL VIEW – ENGINES WITHOUT SILENT SHAFTS



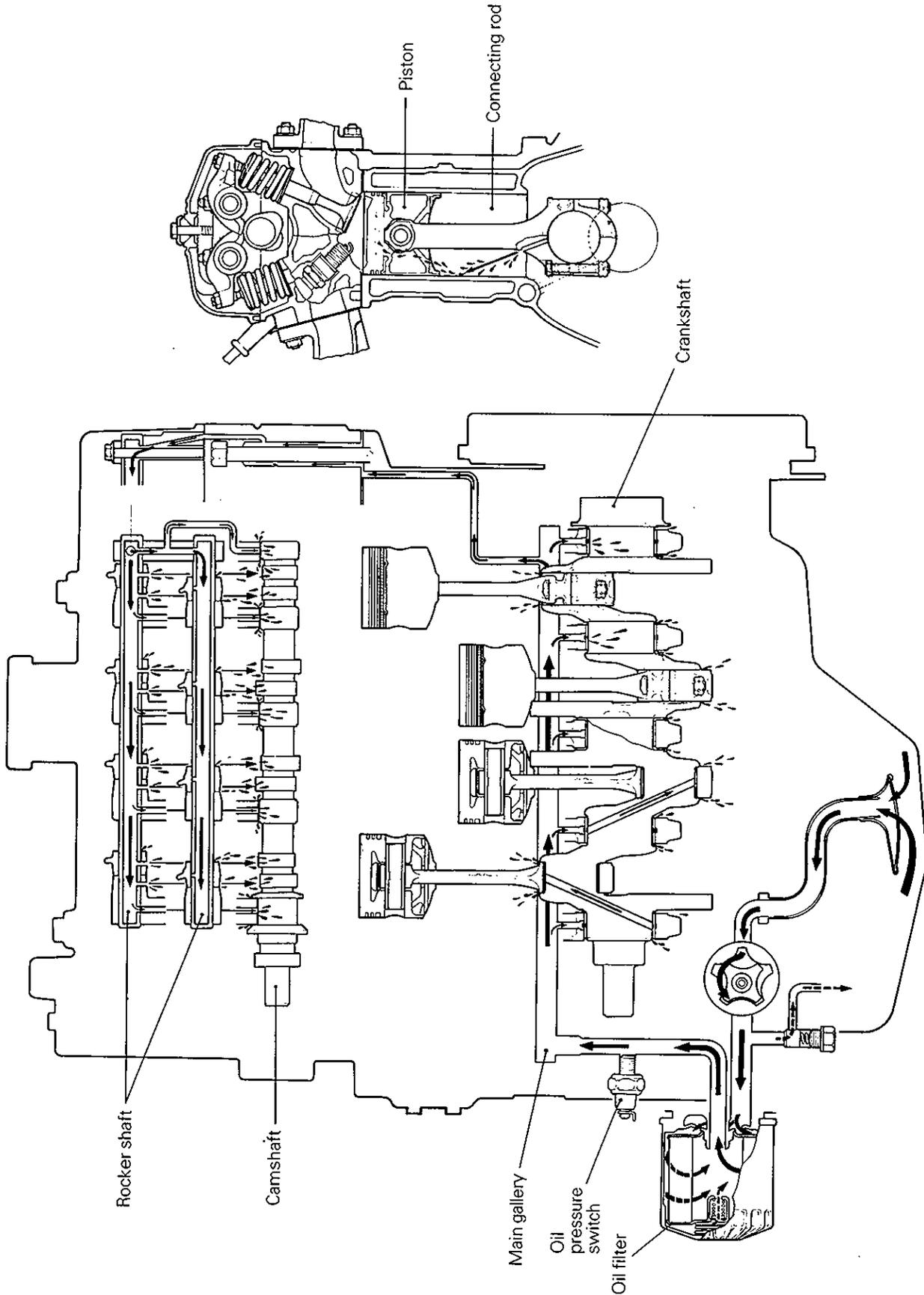


24

LUBRICATION SYSTEM – ENGINES WITH SILENT SHAFTS



LUBRICATION SYSTEM – ENGINES WITHOUT SILENT SHAFTS



1. SPECIFICATIONS**GENERAL SPECIFICATIONS**

Description	Specifications
Type	In-line OHV, SOHC
Number of cylinders	4
Combustion chamber	Compact type
Total displacement	
4G33	1,439 cc (87.81 cu.in.)
4G32	1,597 cc (97.45 cu.in.)
4G37	1,755 cc (107.10 cu.in.)
Cylinder bore	
4G33	73 mm (2.87 in.)
4G32	76.9 mm (3.03 in.)
4G37	80.6 mm (3.17 in.)
Piston stroke	86 mm (3.39 in.)
Compression ratio	
4G33	9.0
4G32	8.5
4G37	9.5
Valve timing: Camshaft identification mark "1"	
Intake valve	
Opens	20°
Closes	48°
Exhaust valve	
Opens	51°
Closes	17°
Valve timing: Camshaft identification mark "6"	
Intake valve	
Opens	24°
Closes	64°
Exhaust valve	
Opens	67°
Closes	21°
Lubrication system	Pressure feed, full-flow filtration
Oil pump type	
Engines with silent shafts	Involute gear type
Engines without silent shafts	Trochoid type
Cooling system	Water-cooled forced circulation
Water pump type	Centrifugal impeller type

SERVICE SPECIFICATIONS

mm (in.)

	Standard	Limit
Cylinder head		
Flatness of gasket surface	0.05 (0.0020)	0.2 (0.008)
Grinding limit		*0.2 (0.008)
*Includes / Combined with cylinder block grinding.		
Flatness of manifold mounting surface	0.15 (0.0059)	0.3 (0.012)
Overall height	88.4 – 88.6 (3.480 – 3.488)	
Oversize rework dimensions of valve guide hole (both intake and exhaust)		
0.05	13.05 – 13.07 (0.5138 – 0.5146)	
0.25	13.25 – 12.27 (0.5217 – 0.5224)	
0.50	13.50 – 13.52 (0.5315 – 0.5323)	
Oversize rework dimensions of intake valve seat ring hole		
0.30	4G33, 4G32: 39.30 – 39.33 (1.5472 – 1.5484) 4G37: 43.30 – 43.33 (1.7047 – 1.7059)	
0.60	4G33, 4G32: 39.60 – 39.63 (1.5591 – 1.5602) 4G37: 43.60 – 43.63 (1.7165 – 1.7177)	
Oversize rework dimensions of exhaust valve seat ring hole		
0.30	4G33, 4G32: 34.30 – 34.33 (1.3504 – 1.3516) 4G37: 37.30 – 37.33 (1.4685 – 1.4697)	
0.60	4G33, 4G32: 34.60 – 34.63 (1.3622 – 1.3634) 4G37: 37.60 – 37.63 (1.4803 – 1.4815)	
Camshaft		
Cam height – Identification mark: 1		
Intake	36.36 (1.4315)	35.86 (1.4118)
Exhaust	36.41 (1.4335)	35.91 (1.4138)
Cam height – Identification mark: 6		
Intake	36.52 (1.4378)	36.02 (1.4181)
Exhaust	36.57 (1.4398)	36.07 (1.4201)
NOTE: The camshaft identification mark is stamped on the rear end of the camshaft.		
Fuel pump driving cam diameter	40 (1.57)	39.5 (1.555)
Journal diameter	33.94 – 33.95 (1.3362 – 1.3366)	
Oil clearance	0.05 – 0.09 (0.0020 – 0.0035)	
Rocker arm		
I.D.	18.91 – 18.93 (0.7444 – 0.7453)	
Rocker arm-to-shaft clearance	0.01 – 0.04 (0.0004 – 0.0016)	0.1 (0.004)
Rocker shaft		
O.D.	18.89 – 18.90 (0.7437 – 0.7440)	
Overall length		
Intake	365.5 (14.035)	
Exhaust	350.0 (13.780)	

mm (in.)

	Standard	Limit
Valve		
Overall length		
Intake	4G33, 4G32: 103.4 (4.071) 4G37: 98.2 (3.866)	4G33, 4G32: 102.9 (4.051) 4G37: 97.7 (3.846)
Exhaust	4G33, 4G32: 100.0 (3.937) 4G37: 95.5 (3.760)	4G33, 4G32: 99.5 (3.917) 4G37: 95.0 (3.740)
Stem diameter		
Intake	7.96 – 7.98 (0.313 – 0.314)	
Exhaust	7.93 – 7.95 (0.312 – 0.313)	
Face angle	45° – 45°30'	
Thickness of valve head (margin)		
Intake	4G33, 4G32: 1.5 (0.059) 4G37: 1.2 (0.047)	1.0 (0.039) 0.7 (0.028)
Exhaust	1.5 (0.059)	1.0 (0.039)
Stem-to-guide clearance		
Intake	0.02 – 0.06 (0.0008 – 0.0024)	0.10 (0.0039)
Exhaust	0.05 – 0.09 (0.0020 – 0.0035)	0.15 (0.0059)
Valve stem projection	39.4 (1.551)	39.9 (1.571)
Valve spring – Identification color: red or green		
Free height	45.9 (1.807)	44.9 (1.768)
Load/installed height N (kg,lbs.)/mm (in.)	280 (28, 62)/37.3 (1.469)	
Out-of-squareness	Max. 2°	4°
Valve spring – Identification color: blue		
Free height	49.2 (1.937)	48.2 (1.898)
Load/installed height N (kg,lbs.)/mm (in.)	310 (31, 68)/37.3 (1.469)	
Out-of-squareness	Max. 2°	4°
Valve guide		
Overall length		
Intake	44 (1.73)	
Exhaust	48 (1.89)	
I.D.	8.00 – 8.02 (0.3150 – 0.3157)	
O.D.	13.06 – 13.07 (0.5142 – 0.5146)	
Service size	0.05 (0.002), 0.25 (0.01), 0.50 (0.02) oversize	
Press-in temperature	Room temperature	
Valve seat		
Seat angle	45°	
Valve contact width	0.9 – 1.3 (0.035 – 0.051)	
Sinkage		0.2 (0.008)
Service size	0.3 (0.012), 0.6 (0.024) oversize	

	Standard	Limit
Silent shaft		
Journal diameter		
Right (front)	38.96 – 38.98 (1.5339 – 1.5346)	
(rear)	35.95 – 35.97 (1.4154 – 1.4161)	
Left (front)	18.47 – 18.48 (0.7272 – 0.7276)	
(rear)	35.95 – 35.97 (1.4154 – 1.4161)	
Oil clearance		
Right (front)	0.02 – 0.06 (0.0008 – 0.0024)	
(rear)	0.05 – 0.09 (0.0020 – 0.0035)	
Left (front)	0.02 – 0.05 (0.0008 – 0.0020)	
(rear)	0.05 – 0.09 (0.0020 – 0.0035)	
Piston		
O.D.	4G33: 72.97 – 73.00 (2.8728 – 2.8740)	
	4G32: 76.86 – 76.89 (3.0260 – 3.0272)	
	4G37: 80.57 – 80.60 (3.1720 – 3.1732)	
Piston-to-cylinder clearance	0.01 – 0.03 (0.0004 – 0.0012)	
Ring groove width		
No. 1 ring	1.52 – 1.54 (0.0598 – 0.0606)	
No. 2 ring	1.51 – 1.53 (0.0594 – 0.0602)	
Oil ring	4.02 – 4.05 (0.1583 – 0.1594)	
Service size	0.50 (0.02), 1.00 (0.04) oversize	
Piston ring		
End gap		
No. 1 ring	4G33: 0.25 – 0.45 (0.0098 – 0.0177)	0.8 (0.031)
	4G32: 0.25 – 0.40 (0.0098 – 0.0157)	0.8 (0.031)
	4G37: 0.30 – 0.45 (0.0118 – 0.0177)	0.8 (0.031)
No. 2 ring	4G33: 0.25 – 0.45 (0.0098 – 0.0177)	0.8 (0.031)
	4G32: 0.20 – 0.35 (0.0079 – 0.0138)	0.8 (0.031)
	4G37: 0.20 – 0.55 (0.0079 – 0.0217)	0.8 (0.031)
Oil ring	0.20 – 0.70 (0.0079 – 0.0276)	1.0 (0.039)
Ring-to-ring groove clearance		
No. 1 ring	0.03 – 0.09 (0.0012 – 0.0035)	
No. 2 ring	0.02 – 0.06 (0.0008 – 0.0024)	
Service size	0.50 (0.02), 1.00 (0.04) oversize	
Piston pin		
O.D.	19.00 – 19.01 (0.7480 – 0.7484)	
Press-in load N (kg, lbs.)	5,000 – 15,000 (500 – 1,500, 1,102 – 3,307)	
Press-in temperature	Room temperature	
Connecting rod		
Big end center-to small end center length ...	153.6 – 153.7 (6.047 – 6.051)	
Bend	0.05 (0.0020)	
Twist	0.1 (0.004)	
Big end side clearance	0.10 – 0.25 (0.0039 – 0.0098)	0.4 (0.016)

	Standard	Limit
Crankshaft		
End play	0.05 – 0.18 (0.0020 – 0.0071)	0.25 (0.0098)
Journal O.D.	57 (2.24)	
Pin O.D.	45 (1.77)	
Out-of-roundness and taper of journal and pin	Within 0.01 (0.0004)	
Concentricity of journal	Within 0.02 (0.0008)	
Oil clearance of journal	0.02 – 0.05 (0.0008 – 0.0020)	0.10 (0.0039)
Oil clearance of pin	0.02 – 0.05 (0.0008 – 0.0020)	0.10 (0.0039)
Journal under size		
0.25 U.S.	56.74 – 56.75 (2.2339 – 2.2342)	
0.50 U.S.	56.49 – 56.50 (2.2240 – 2.2244)	
0.75 U.S.	56.24 – 56.25 (2.2142 – 2.2146)	
Pin under size		
0.25 U.S.	44.74 – 44.75 (1.7614 – 1.7618)	
0.50 U.S.	44.49 – 44.50 (1.7516 – 1.7520)	
0.75 U.S.	44.24 – 44.25 (1.7417 – 1.7421)	
Cylinder block		
I.D.	4G33: 73.00 – 73.03 (2.8740 – 2.8752) 4G32: 76.90 – 76.93 (3.0276 – 3.0287) 4G37: 80.60 – 80.63 (3.1732 – 3.1744)	
Flatness of gasket surface	0.05 (0.020)	0.1 (0.0039)
Grinding limit		*0.2 (0.008)
*Includes / Combined with cylinder head grinding.		
Overall height	285.1 – 285.3 (11.224 – 11.232)	
Flywheel		
Runout		0.13 (0.0051)
Valve clearance (on cold engine)		
Intake	0.07 (0.0028)	
Exhaust	0.17 (0.0067)	
Oil pump (Involute gear type)		
Tip clearance		
Drive gear	0.15 – 0.25 (0.0059 – 0.0098)	0.35 (0.0138)
Driven gear	0.10 – 0.20 (0.0039 – 0.0079)	0.30 (0.0118)
Side clearance		
Drive gear	0.08 – 0.14 (0.0031 – 0.0055)	0.18 (0.0071)
Driven gear	0.06 – 0.12 (0.0024 – 0.0047)	0.15 (0.0059)
Oil pump (Trochoid type)		
Tip clearance	0.04 – 0.12 (0.0016 – 0.0047)	0.18 (0.0071)
Side clearance	0.06 – 0.12 (0.0024 – 0.0047)	0.15 (0.0059)
Body clearance	0.10 – 0.16 (0.0039 – 0.0063)	0.20 (0.0079)
Drive belt deflection		
V-type belt		
New belt	7 – 10 (0.28 – 0.39)	
V-ribbed type belt		
New belt	6.5 – 8 (0.26 – 0.31)	
Old belt	8 – 11 (0.31 – 0.43)	

TORQUE SPECIFICATIONS

	Nm	Torque kgm	ft.lbs.
Drive belt and timing belt			
Cooling fan bolt	9	0.9	7
Water pump pulley bolt	9	0.9	7
Crankshaft pulley bolt	17	1.7	12
Crankshaft bolt	95	9.5	69
Timing belt tensioner bolt and nut	26	2.6	19
Camshaft sprocket bolt	90	9.0	65
Oil pump sprocket nut	37	3.7	27
Silent shaft sprocket bolt	37	3.7	27
Tensioner "B" bolt	19	1.9	14
Intake manifold			
Coolant temperature gauge unit	11	1.1	8
Coolant temperature sensor	30	3.0	22
Water outlet fitting bolt	19	1.9	14
Air intake plenum stay bolt	18	1.8	13
Air intake plenum bolt and nut	18	1.8	13
Thermostat housing bolt and nut	18	1.8	13
Intake manifold stay bolt			
Multi-point fuel injection engine	22	2.2	16
Carburetor engine	26	2.6	19
Intake manifold bolt and nut	18	1.8	13
Exhaust manifold and water pump			
Oil level gauge guide bolt	14	1.4	10
Exhaust manifold cover "A" and "B" bolt	30	3.0	22
Exhaust manifold cover "A" and "B" mounting bolt	9	0.9	7
Exhaust manifold cover "B" bolt	24	2.4	17
Exhaust manifold nut	18	1.8	13
Water inlet pipe bolt	14	1.4	10
Water pump bolt	14	1.4	10
Alternator brace installed portion	24	2.4	17
Rocker arms and camshaft			
Rocker cover bolt	6	0.6	4.3
Camshaft bearing cap bolt (M8)	20	2.0	15
Camshaft bearing cap bolt (M6)	11	1.1	8
Rocker arms and rocker shafts			
Rocker arm lock nut	15	1.5	11
Cylinder head and valves			
Cylinder head bolt	73	7.3	53

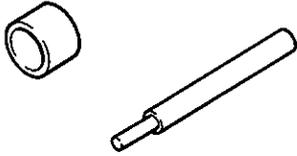
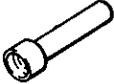
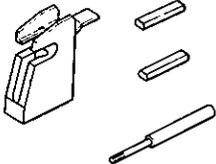
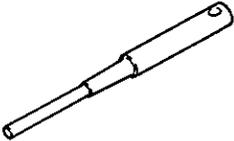
	Nm	Torque kgm	ft.lbs.
Front case, oil pump and oil pan			
Oil pressure switch	10	1.0	7
Oil filter bracket	14	1.4	10
Oil pan drain plug	40	4.0	29
Oil level sensor	9	0.9	7
Oil pan bolt	7	0.7	5
Oil pan nut	6	0.6	5
Oil screen nut	22	2.2	16
Oil pump cover bolt	17	1.7	12
Oil pump driven gear bolt	37	3.7	27
Oil relief valve plug	45	4.5	33
Front case bolt	17	1.7	12
Piston and connecting rod			
Connecting rod cap nut	34	3.4	25
Crankshaft, flywheel and drive plate			
Flywheel and drive plate bolt	135	13.5	98
Oil seal case bolt	11	1.1	8
Bearing cap bolt	53	5.3	38
Cylinder block			
Engine support bracket, right	65	6.5	47
Engine support bracket, left			
Front wheel drive vehicles	36	3.6	26
Rear wheel drive vehicles	65	6.5	47
Roll stopper bracket, front	65	6.5	47
Roll stopper bracket, rear	65	6.5	47
Exhaust pipe support bracket	36	3.6	26

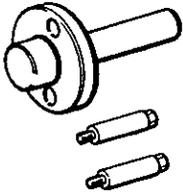
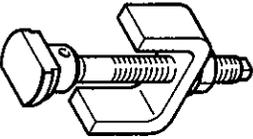
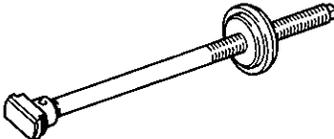
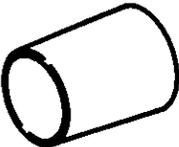
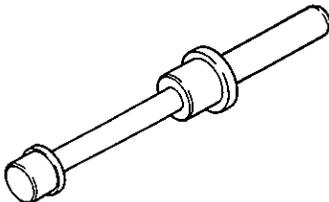
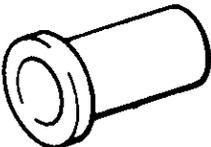
SEALANT

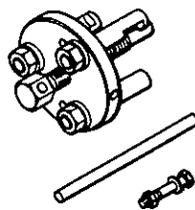
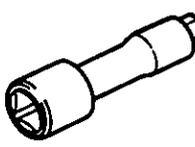
	Specified sealant	Quantity
Engine coolant temperature sensor	3M Nut Locking Part No. 4171 or equivalent	As required
Engine coolant temperature gauge unit	3M ATD Part No. 8660 or equivalent	As required
Semi-circular packing.....	3M ATD Part No. 8660 or equivalent	As required
Oil pan	MITSUBISHI GENUINE Part MD997110 or equivalent	As required
Oil pressure switch	3M ATD Part No. 8660 or Three Bond Part No. 1141E	As required

NOTES

2. SPECIAL TOOLS

Tool	Number	Name	Use
	MD998002	Valve guide installer	Removal and installation of valve guide
	MD998005	Valve stem seal installer	Installation of valve stem seal
	MD998011	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal
	MD998128	Piston pin setting tool	Removal and installation of piston pin
	MD998148	Valve seat cutter pilot	Correction of valve seat
	MD998158 (intake) MD998157 (exhaust)	Valve seat cutter 45°	Correction of valve seat
	MD998165	Valve seat cutter 65°	Correction of valve seat

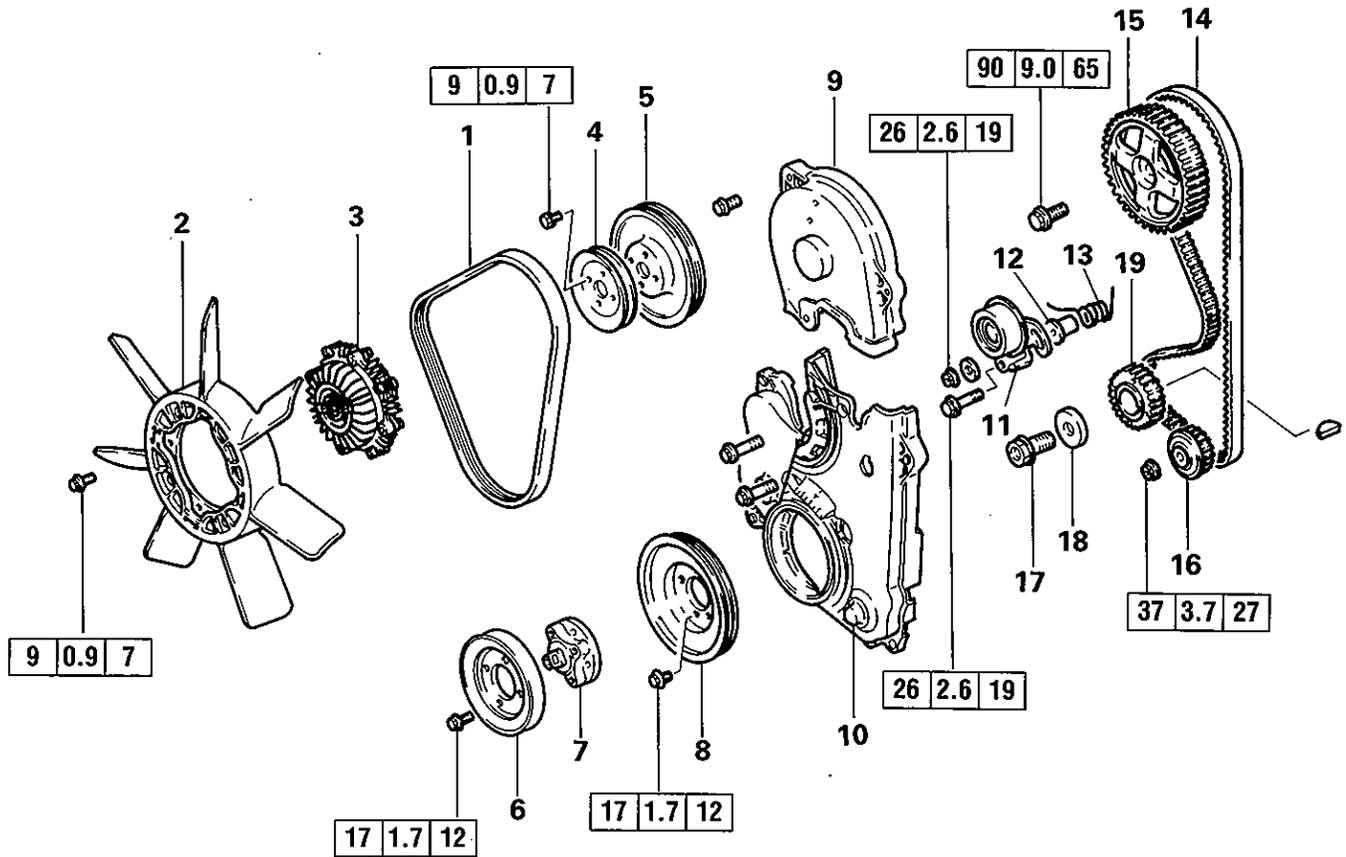
Tool	Number	Name	Use
	MD998173 (intake) MD998172 (exhaust)	Valve seat cutter 30°	Correction of valve seat
	MD998280	Silent shaft bearing installer	Installation of silent shaft front bearing
	MD998282	Silent shaft bearing puller	Removal of silent shaft front bearing
	MD998283	Silent shaft bearing puller	Removal of silent shaft rear bearing
	MD998285	Crankshaft front oil seal guide	Guide for installation of crankshaft front oil seal
	MD998286	Silent shaft bearing installer	Installation of silent shaft rear bearing
	MD998304	Crankshaft front oil seal installer	Installation of crankshaft front oil seal

Tool	Number	Name	Use
	MD998311	Crankshaft sprocket puller	Removal of crankshaft sprocket
	MD998360	Cylinder head bolt wrench	Removal and installation of cylinder head bolt
	MD998364	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998727	Oil pan remover	Removal of oil pan

NOTES

3. DRIVE BELT AND TIMING BELT

REMOVAL AND INSTALLATION



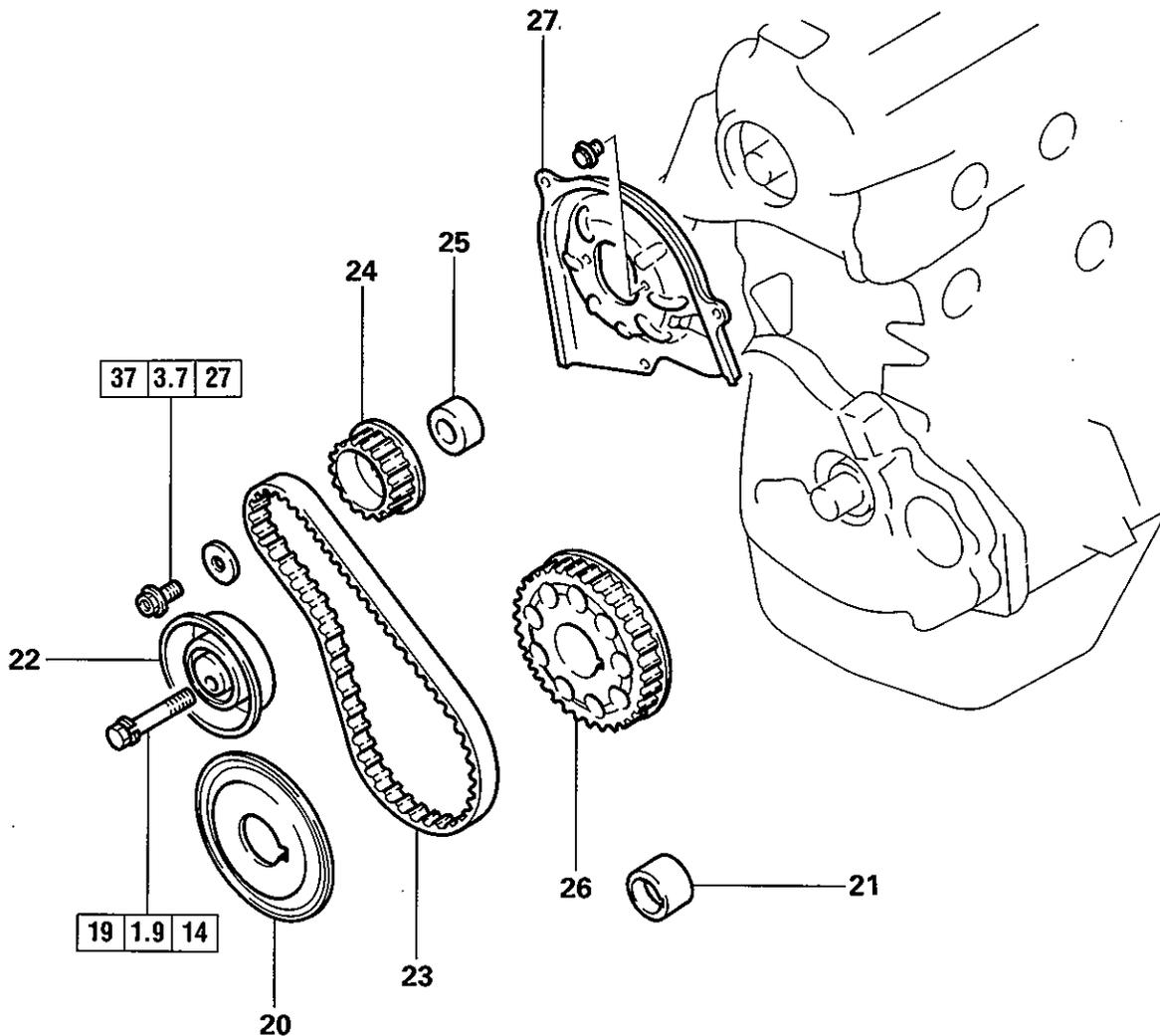
Removal steps

1. Drive belt
2. Cooling fan*
3. Fan clutch*
4. Power steering pump drive pulley**
5. Water pump pulley
6. Damper pulley
7. Adapter
8. Crankshaft pulley
9. Timing belt front upper cover
10. Timing belt front lower cover
11. Tensioner
12. Tensioner spacer
13. Tensioner spring
- ◇A◇ 14. Timing belt
- ◇B◇ 15. Camshaft sprocket
16. Oil pump sprocket

17. Crankshaft sprocket bolt
18. Special washer
- ◇C◇ 19. Crankshaft sprocket
20. Flange
21. Spacer**
- ◇D◇ 22. Tensioner "B"***
- ◇D◇ 23. Timing belt "B"***
24. Silent shaft sprocket***
25. Spacer***
- ◇E◇ 26. Crankshaft sprocket "B"***
27. Timing belt under upper cover

NOTE

- *: Engines for rear wheel drive vehicles
- ** : Engines without silent shafts
- ***: Engines with silent shafts

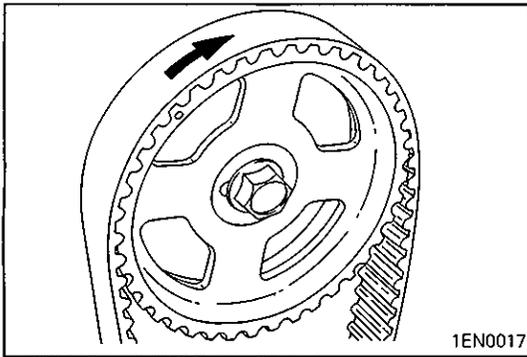


Installation steps

- 27. Timing belt under upper cover
- 26. Crankshaft sprocket "B"***
- ▶A▶ 25. Spacer***
- 24. Silent shaft sprocket***
- 22. Tensioner "B"***
- ▶B▶ 23. Timing belt "B"***
- 21. Spacer**
- ▶C▶ 20. Flange
- 19. Crankshaft sprocket
- 18. Special washer
- 17. Crankshaft sprocket bolt
- ▶D▶ 16. Oil pump sprocket
- 15. Camshaft sprocket
- 13. Tensioner spring
- 12. Tensioner spacer
- ▶E▶ 11. Tensioner
- ▶F▶ 14. Timing belt
- 10. Timing belt front lower cover
- 9. Timing belt front upper cover
- 8. Crankshaft pulley
- 7. Adapter
- 6. Damper pulley
- 5. Water pump pulley
- 4. Power steering pump drive pulley
- 3. Fan clutch*
- 2. Cooling fan*
- ▶G▶ 1. Drive belt

NOTE

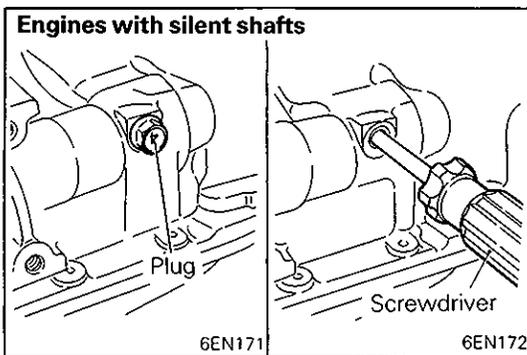
- *: Engines for rear wheel drive vehicles
- ** : Engines without silent shafts
- ***: Engines with silent shafts

**SERVICE POINTS OF REMOVAL****◁A▷ REMOVAL OF TIMING BELT**

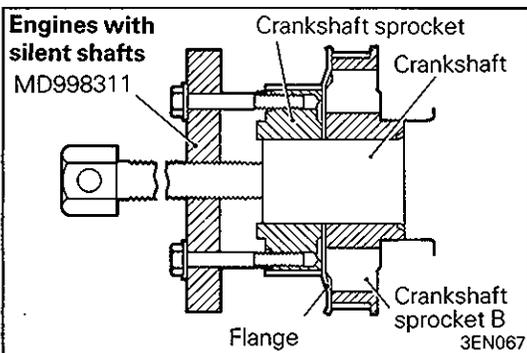
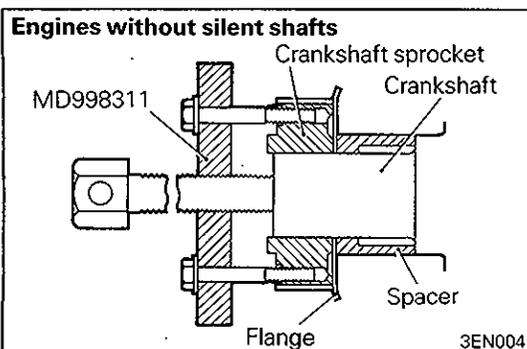
- (1) Make a mark on the back of the timing belt indicating the direction of rotation so it may be reassembled in the same direction if it is to be reused.

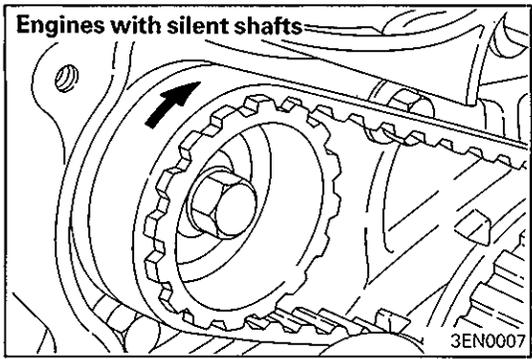
NOTE

- (1) Water or oil on the belt shorten its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. These parts should not be washed. Replace parts if seriously contaminated.
- (2) If there is oil or water on each part check front case oil seals, camshaft oil seal and water pump for leaks.

**◁B▷ REMOVAL OF OIL PUMP SPROCKET (ENGINES WITH SILENT SHAFTS)**

- (1) Remove the plug on the left side of cylinder block.
- (2) Insert a Phillips screwdriver [shank diameter 8 mm (0.31 in.)] to block the left silent shaft.
- (3) Remove the nuts.
- (4) Remove the oil pump sprocket.

**◁C▷ REMOVAL OF CRANKSHAFT SPROCKET**

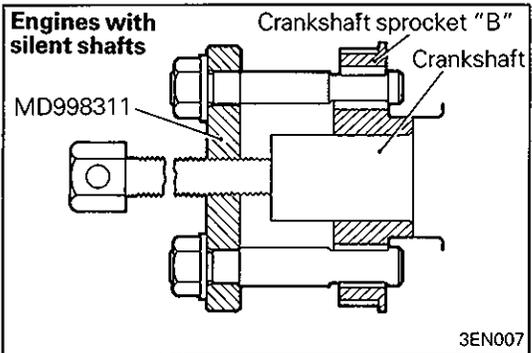


◀▶ **REMOVAL OF TIMING BELT "B" (ENGINES WITH SILENT SHAFTS)**

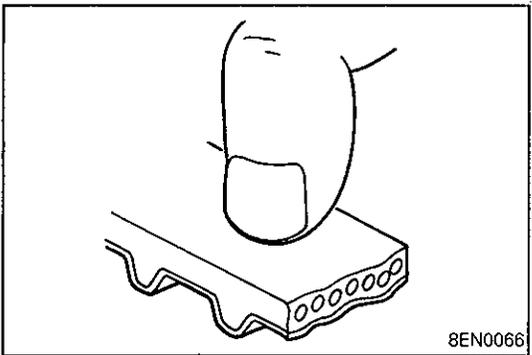
- (1) Make a mark on the back of the timing belt indicating the direction of rotation so it may be reassembled in the same direction if it is to be reused.

NOTE

- (1) Water or oil on the belt shorten its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. These parts should not be washed. Replace parts if seriously contaminated.
- (2) If there is oil or water on each part check front case oil seals, camshaft oil seal and water pump for leaks.



◀▶ **REMOVAL OF CRANKSHAFT SPROCKET "B"**

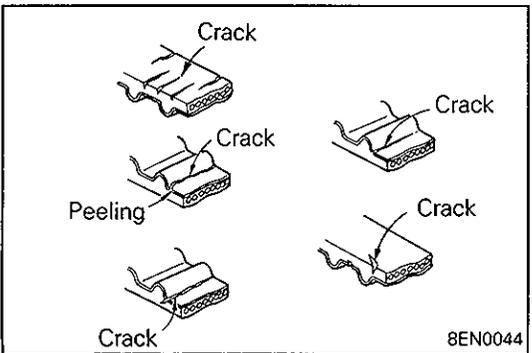


INSPECTION

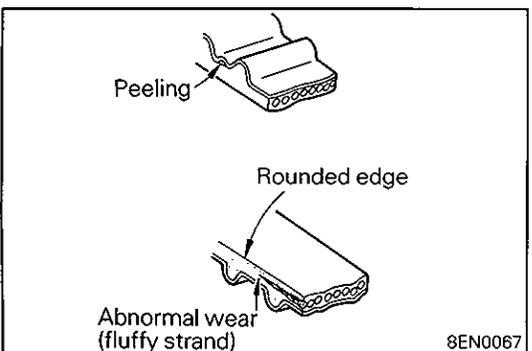
TIMING BELT

The timing belts must be checked closely. Should the following defects be evident, replace the belt with a new one.

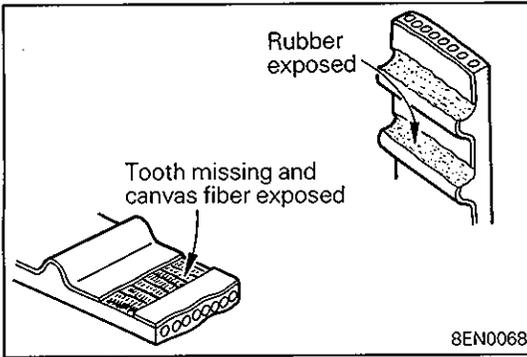
- (1) Hardened back rubber
Glossy, non-elastic and so hard that no mark is produced even when scratched by fingernail.



- (2) Cracked back rubber
- (3) Cracked or peeling canvas
- (4) Cracked rib root
- (5) Cracked belt sides



- (6) Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife.



(7) Abnormal wear in teeth

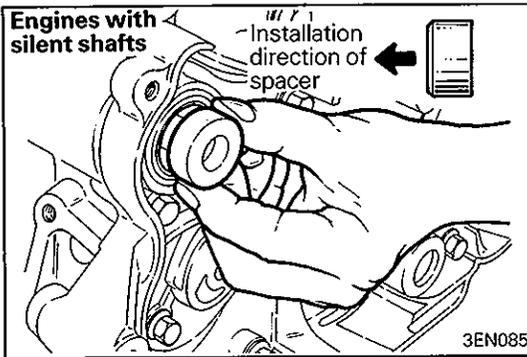
Initial stage:

Canvas on load side tooth flank worn (Fluffy canvas fibers, rubber gone and color changed to white, and unclear canvas texture)

Final stage:

Canvas on load side tooth flank worn down and rubber exposed (tooth width reduced)

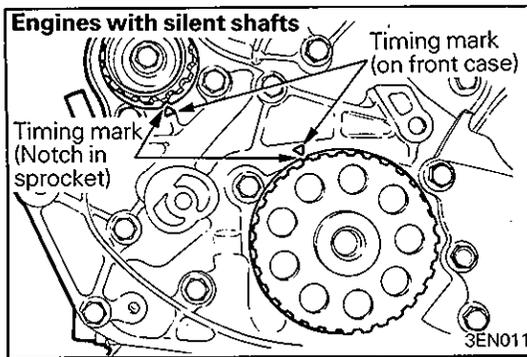
(8) Missing tooth



SERVICE POINTS OF INSTALLATION

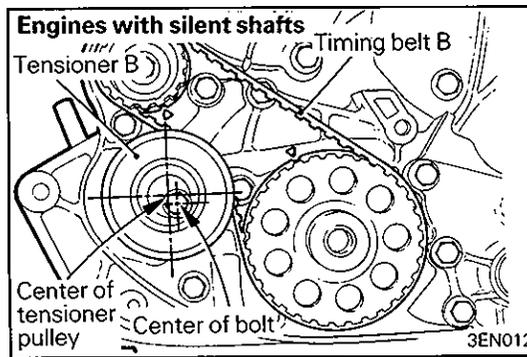
▶A◀ INSTALLATION OF SPACER (ENGINES WITH SILENT SHAFTS)

- (1) Install the spacer with the chamfered end toward the oil seal.

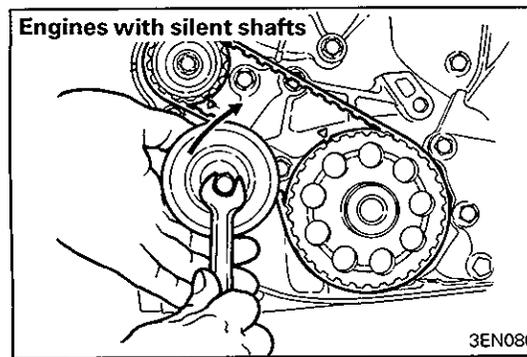


▶B◀ INSTALLATION OF TIMING BELT "B" (ENGINES WITH SILENT SHAFTS)

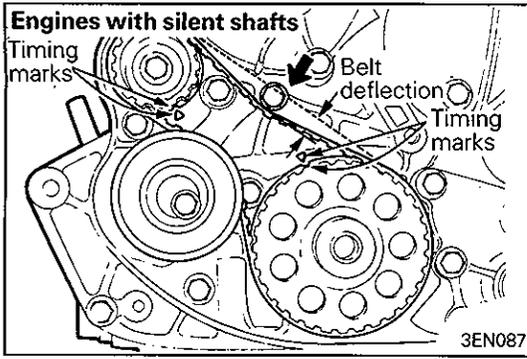
- (1) Align timing marks on the crankshaft sprocket "B" and silent shaft sprocket with the marks on the front case respectively.



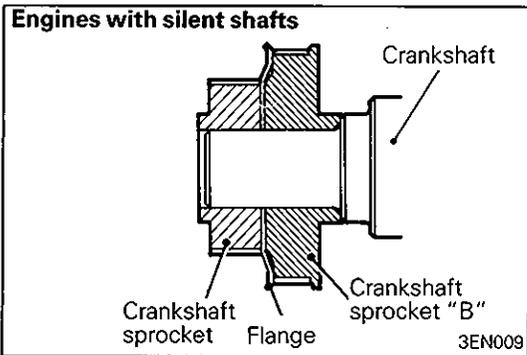
- (2) Install the timing belt "B" on the crankshaft sprocket "B" and silent shaft sprocket. There should be no slack on the tension side.
- (3) Make sure that the relationship between the tensioner pulley center and the bolt center is as shown in the illustration.



- (4) Move the tensioner "B" in the direction of arrow while lifting with a finger to give a sufficient tension to the tension side of timing belt. In this condition, tighten bolt to secure tensioner "B". When bolt is tightened, use care to prevent shaft from turning together. If shaft is turned together, belt will be overtensioned.

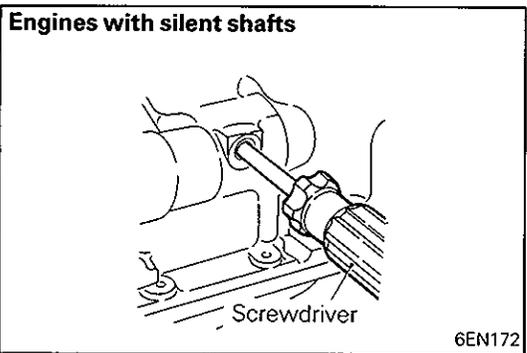
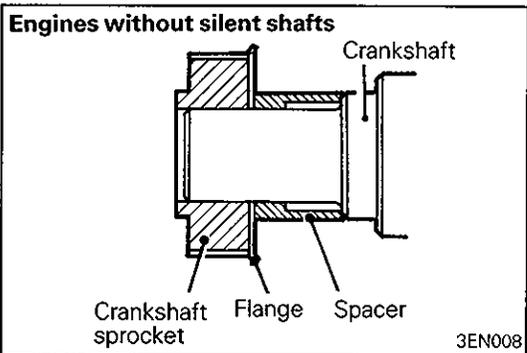


- (5) Check to ensure that timing marks on sprockets and front case are in alignment.
- (6) Press with index finger the center of span on tension side of timing belt "B". The bolt must deflect 5 to 7 mm (0.20 to 0.28 in.).



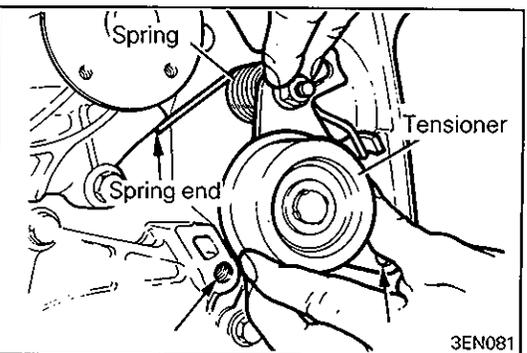
⇨⇩ INSTALLATION OF FLANGE

- (1) Pay special attention to direction of flange. If it is installed in wrong direction, a broken timing belt could result.



⇨⇩ INSTALLATION OF OIL PUMP SPROCKET (ENGINES WITH SILENT SHAFTS)

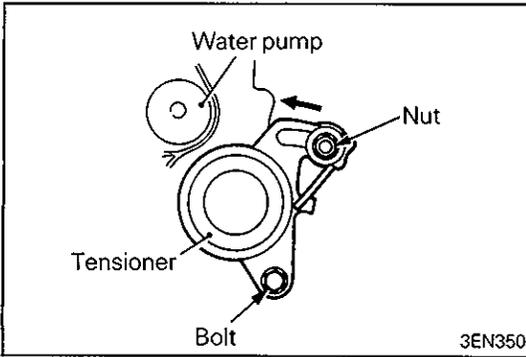
- (1) Insert a Phillips screwdriver [shank diameter 8 mm (0.31 in.) shaft] through the plug hole on the left side of cylinder block to block the left silent shaft.
- (2) Install the oil pump sprocket.
- (3) Tighten the nuts to the specified torque.



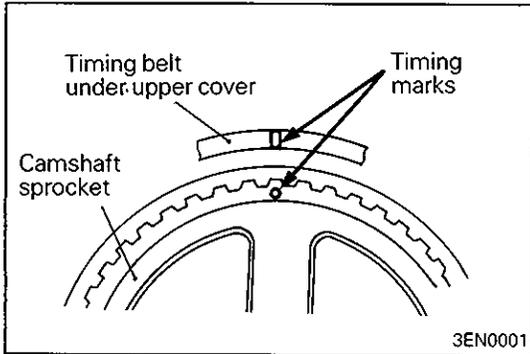
⇨⇩ INSTALLATION OF TENSIONER

- (1) Hook the tensioner spring ends to the water pump body projection and tensioner bracket.

104

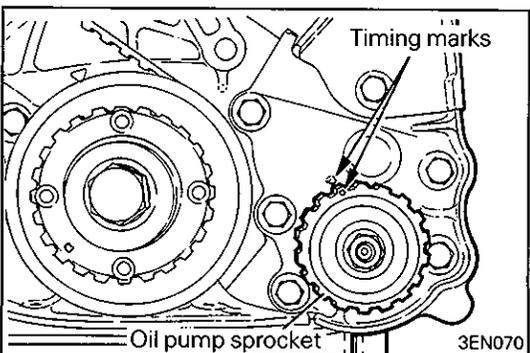
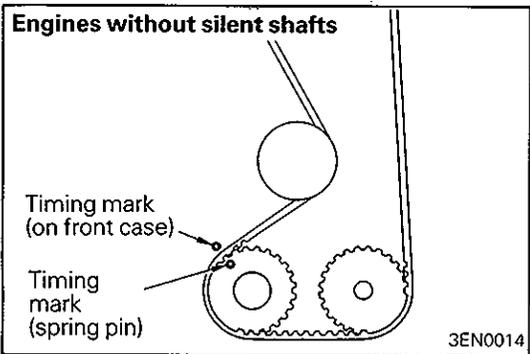
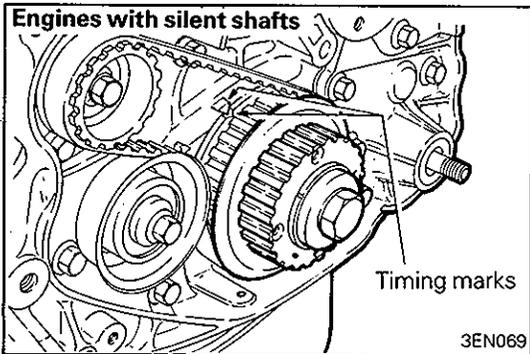


- (2) Move tensioner fully toward water pump and tighten the nut and bolt.

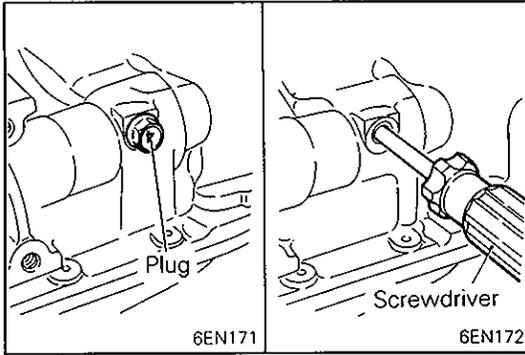


INSTALLATION OF TIMING BELT

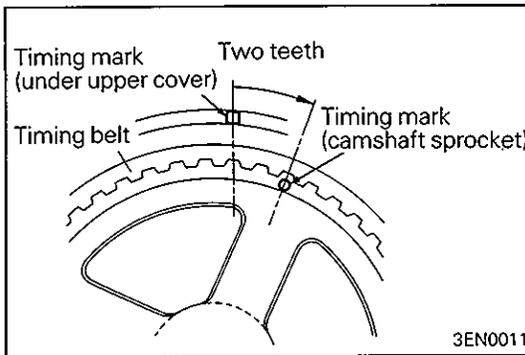
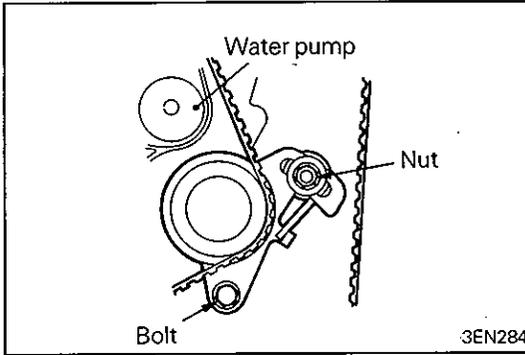
- (1) Align timing marks on camshaft sprocket and crankshaft sprocket with their timing marks.



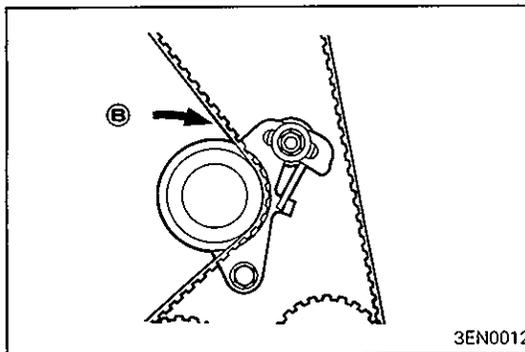
- (2) Align the timing mark on oil pump sprocket with its mating mark. (Engines with silent shafts)



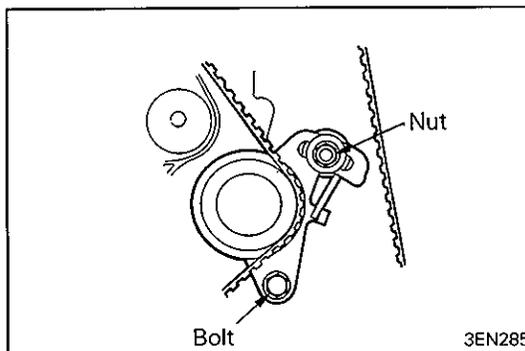
- (3) Remove the plug on cylinder block and insert a Phillips screwdriver [shank diameter 8 mm (0.31 in.)] through the hole. If it can be inserted as deep as 60 mm (2.4 in.) or more, the timing marks are correctly aligned. If the inserted depth is only 20 to 25 mm (0.8 to 1.0 in.), turn the oil pump sprocket one turn and realign timing marks. Then check to ensure that the screwdriver can be inserted 60 mm (2.4 in.) or more. Keep the screwdriver inserted until installation of timing belt is finished. (Engines with silent shafts)
- (4) Install the timing belt on the crankshaft sprocket, oil pump sprocket and camshaft sprocket in that order. There should be no slack on the tension side.
- (5) Loosen the tensioner mounting bolt and nut.



- (6) Turn the crankshaft clockwise by two teeth of camshaft sprocket (or crankshaft sprocket).



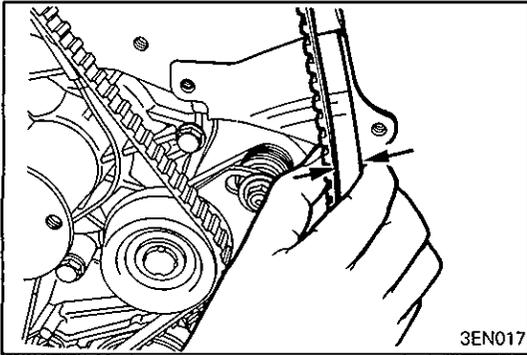
- (7) Apply force to the tensioner in the direction shown by arrow B to make the belt engage completely with each sprocket.



- (8) Tighten the tensioner attaching nut, then tighten the tensioner attaching bolt.

Caution

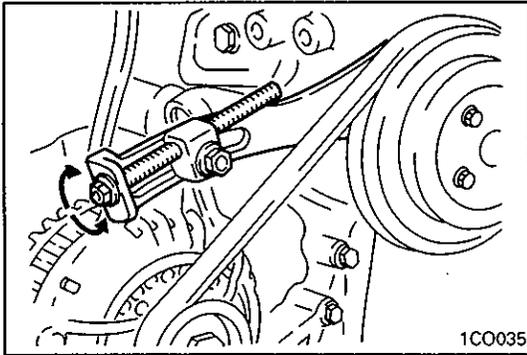
- If the bolt is tightened first, tensioner turns as the bolt is tightened, resulting in an excessive belt tension.



- (9) Hold the center of the tension side span of the timing belt (between the camshaft and oil pump sprockets) between your thumb and index finger as shown. Then, make sure that the clearance between the belt back surface and cover is standard value.

Standard value:

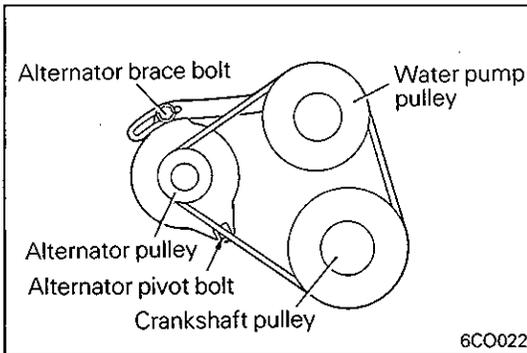
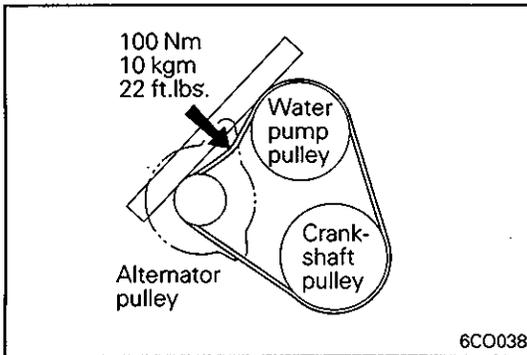
- Engines with silent shafts: 12 mm (0.47 in.)**
- Engines without silent shafts: 6 mm (0.24 in.)**



ADJUSTMENT OF DRIVE BELT TENSION
ADJUSTER TYPE

- (1) Adjust belt deflection to standard value. Turn adjusting bolt clockwise to increase the belt tension and turn adjusting bolt counterclockwise to decrease the belt tension.

Standard value: 7 – 10 (0.28 – 0.39 in.)



BRACE BOLT TYPE

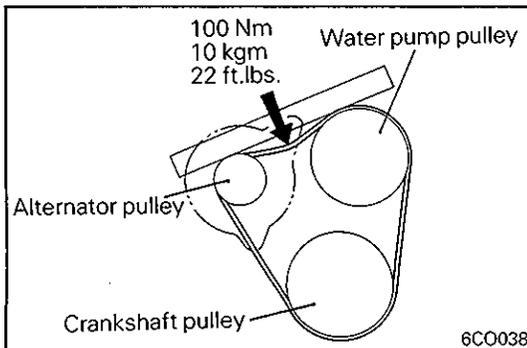
- (1) Move the alternator to give greater tension to the belt so that the specified deflection is obtained.

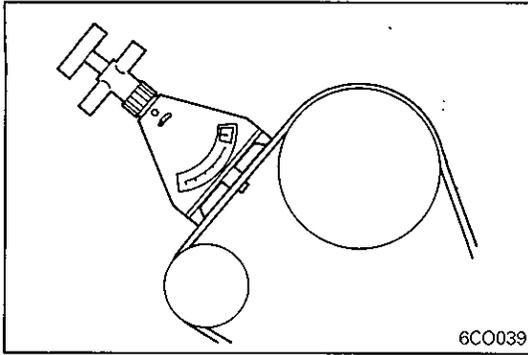
Standard value for V-type belt:

7 – 10 mm (0.28 – 0.39 in.)

Standard value for V-ribbed type belt:

6.5 – 8 mm (0.26 – 0.31 in.) **New belt**
8 – 11 mm (0.31 – 0.43 in.) **Used belt**





Or using tension gauge, move alternator to adjust tension to standard value. (V-ribbed type belt only)

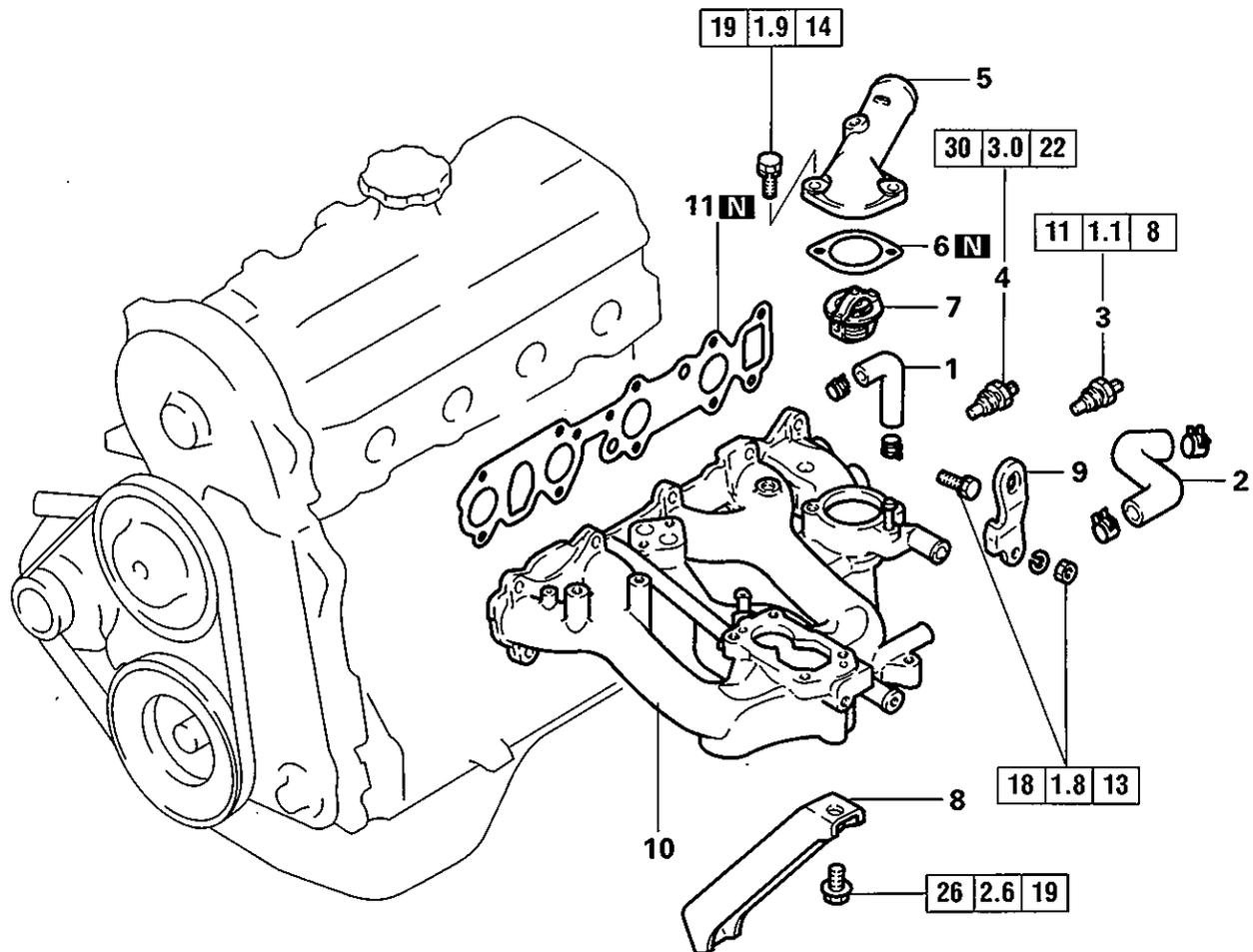
Standard value:

500 – 700 N (50 – 70 kg, 110 – 154 lbs.)	....	New belt
400 N (40 kg, 88 lbs.)	.....	Used belt

- (2) Tighten alternator brace bolt.
- (3) Tighten nut for alternator pivot bolt.

4. INTAKE MANIFOLD**REMOVAL AND INSTALLATION**

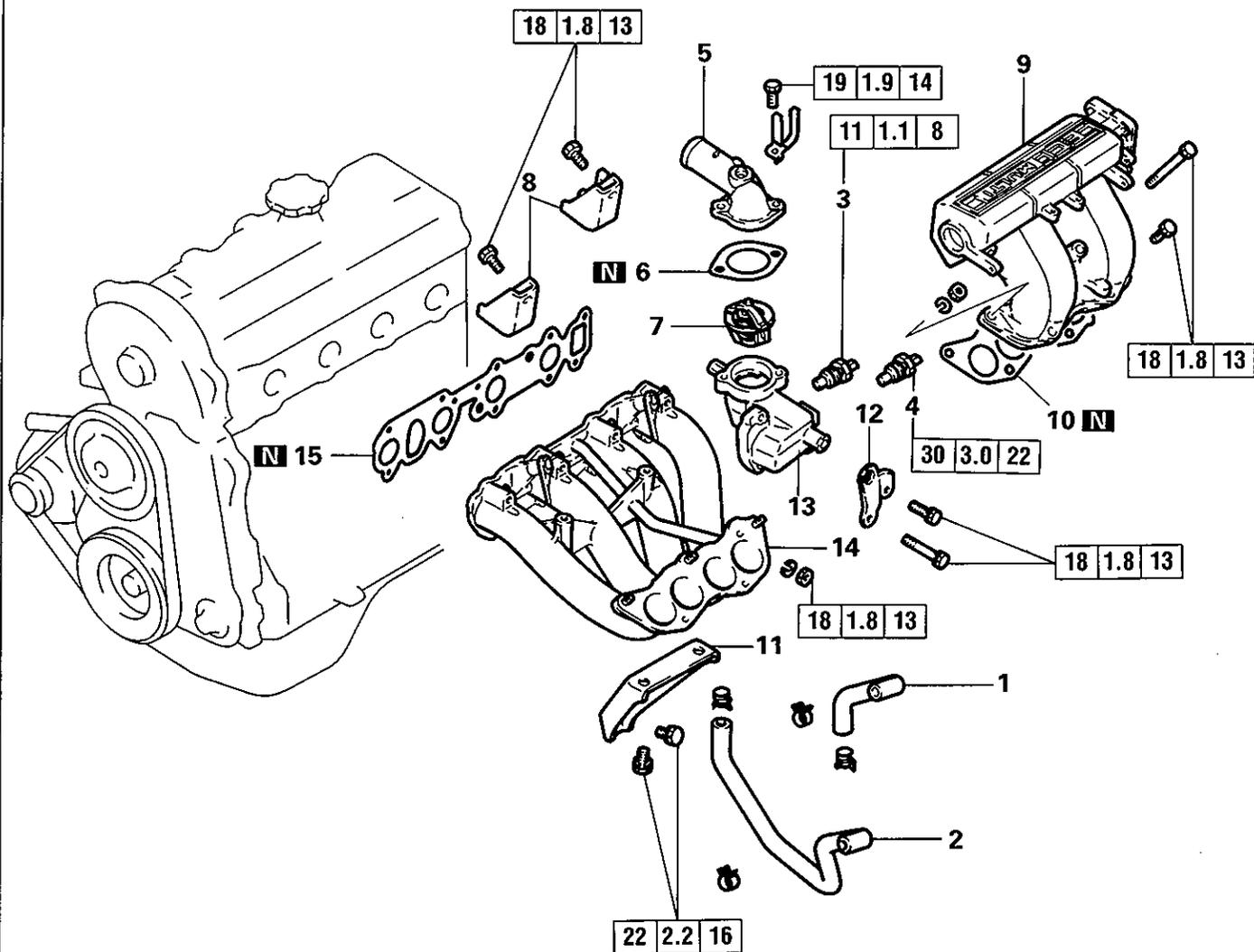
<FRONT WHEEL DRIVE VEHICLES – CARBURETOR TYPE>

**Removal steps**

1. Water hose
2. Water by-pass hose
- ▶C▶ 3. Water temperature gauge unit
- ▶B▶ 4. Water temperature sensor
- ▶A▶ 5. Water outlet fitting
- ▶A▶ 6. Water outlet fitting gasket
7. Thermostat
8. Intake manifold stay
9. Engine hanger
10. Intake manifold
11. Intake manifold gasket

REMOVAL AND INSTALLATION

<FRONT WHEEL DRIVE VEHICLES – MULTI POINT FUEL INJECTION TYPE>

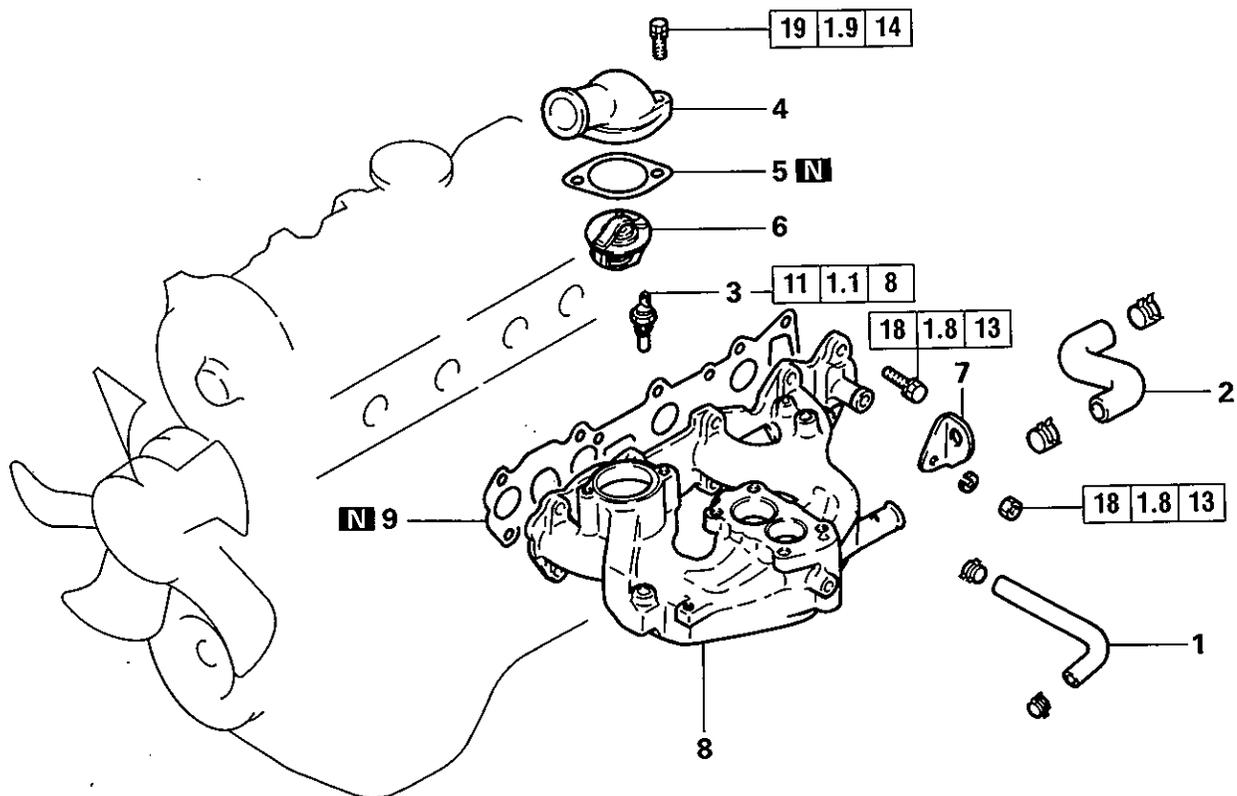


Removal steps

1. Water hose "A"
2. Water hose "B"
- ▶C▶ 3. Water temperature gauge unit
- ▶B▶ 4. Water temperature sensor
5. Water outlet fitting
- ▶A▶ 6. Water outlet fitting gasket
7. Thermostat
8. Air intake plenum stay
9. Air intake plenum
10. Air intake plenum gasket
11. Intake manifold stay
12. Engine hanger
13. Thermostat housing
14. Intake manifold
15. Intake manifold gasket

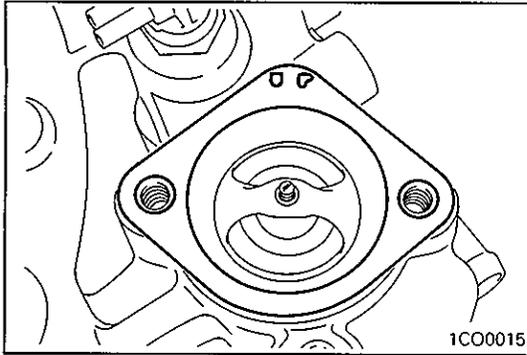
REMOVAL AND INSTALLATION

<REAR WHEEL DRIVE VEHICLES>



Removal steps

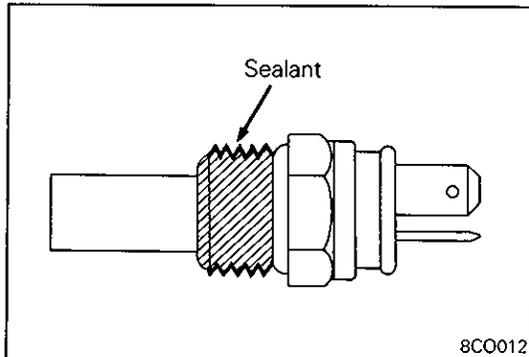
1. Water hose
2. Water by-pass hose
- ◆C◆ 3. Water temperature gauge unit
- ◆A◆ 4. Water outlet fitting
- ◆A◆ 5. Water outlet fitting gasket
6. Thermostat
7. Engine hanger
8. Intake manifold
9. Intake manifold gasket



SERVICE POINTS OF INSTALLATION

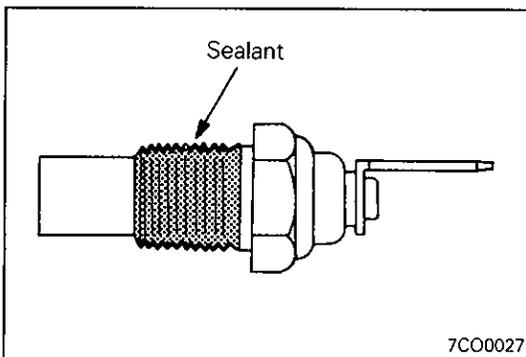
▶A◀ INSTALLATION OF WATER OUTLET FITTING GASKET FOR RUBBER COATED METAL GASKET ONLY

- (1) Install the water outlet fitting gasket with its "UP" mark facing up (toward the water outlet fitting side).



▶B◀ APPLICATION OF SEALANT TO WATER TEMPERATURE SENSOR

Specified sealant:
3M Nut Locking Part No. 4171 or equivalent

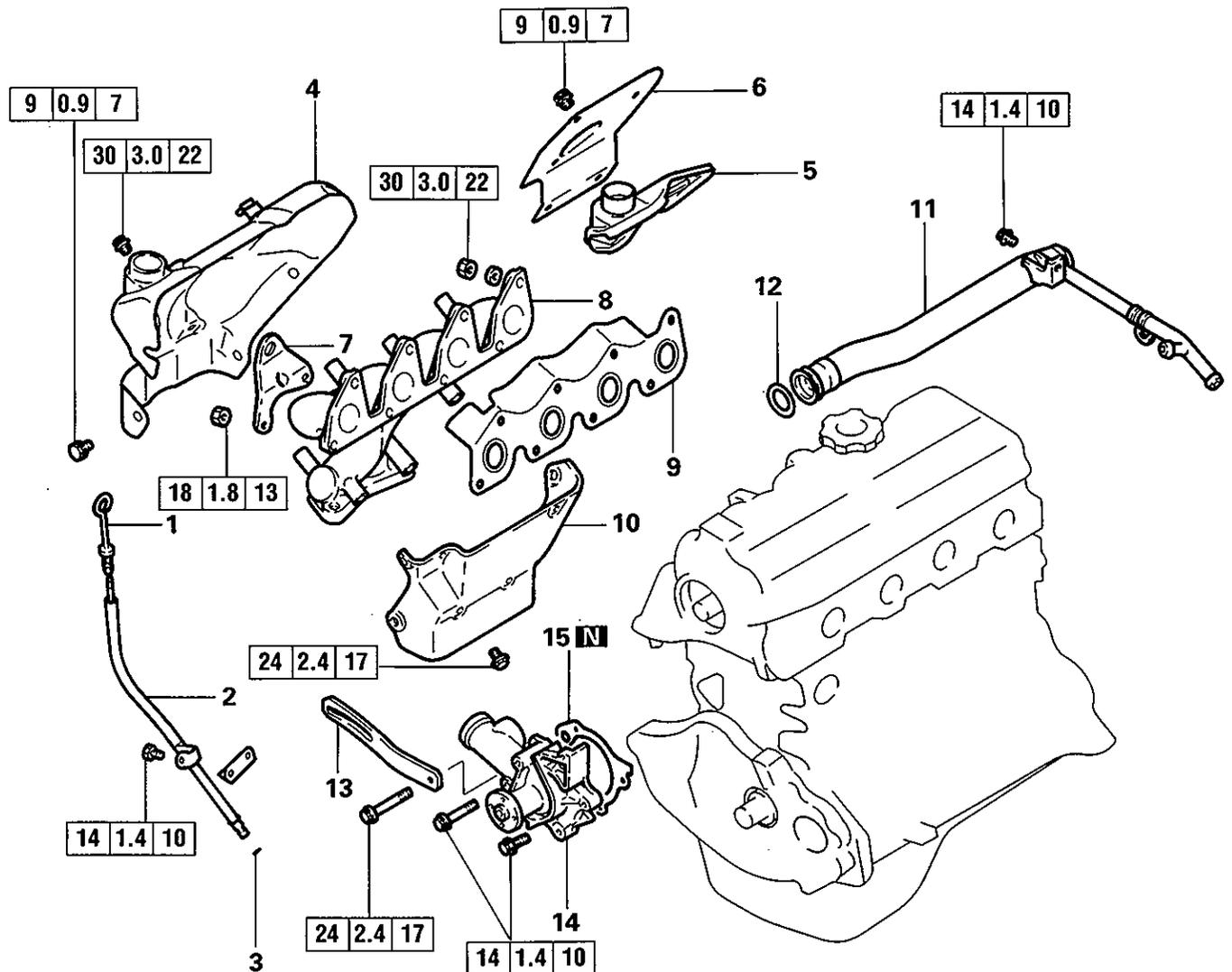


▶C◀ APPLICATION OF SEALANT TO WATER TEMPERATURE GAUGE UNIT

Specified sealant:
3M ATD Part No. 8660 or equivalent

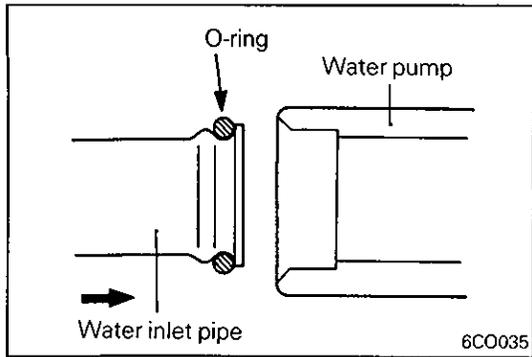
5. EXHAUST MANIFOLD AND WATER PUMP

REMOVAL AND INSTALLATION



Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Exhaust manifold cover "A" (4G37)
5. Heat cowl
6. Heat protector (FWD) } (4G32)
7. Engine hanger
8. Exhaust manifold
9. Exhaust manifold gasket
10. Exhaust manifold cover "B"
- ▶▶ 11. Water inlet pipe
- ▶▶ 12. O-ring
13. Alternator brace
14. Water pump
15. Water pump gasket



SERVICE POINTS OF INSTALLATION

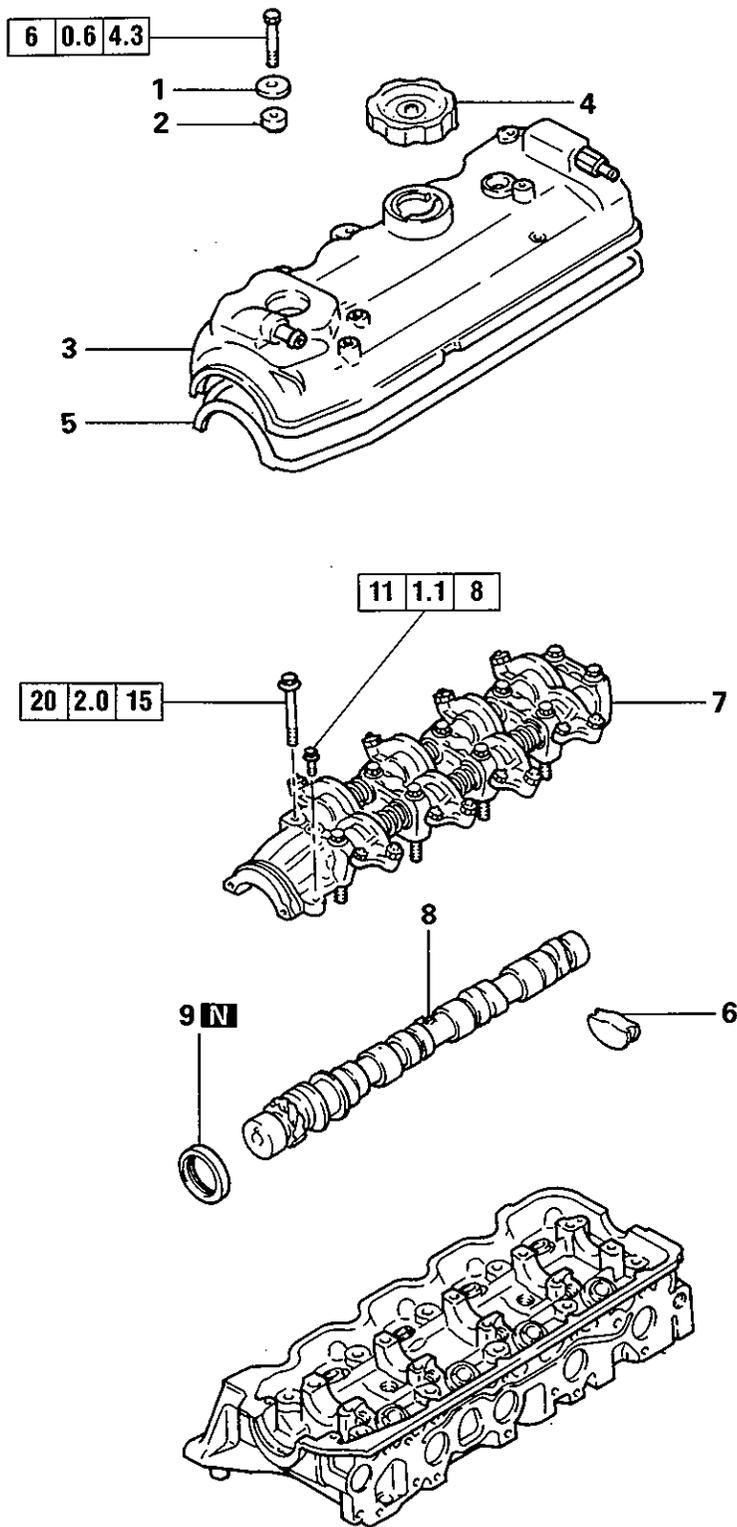
▶▶ INSTALLATION OF WATER PIPE / O-RING

- (1) Apply water to O-ring for easier insertion into the water pump body.

Caution

- Never apply engine oil or other lubricant to the O-ring.

6. ROCKER ARMS AND CAMSHAFT REMOVAL AND INSTALLATION

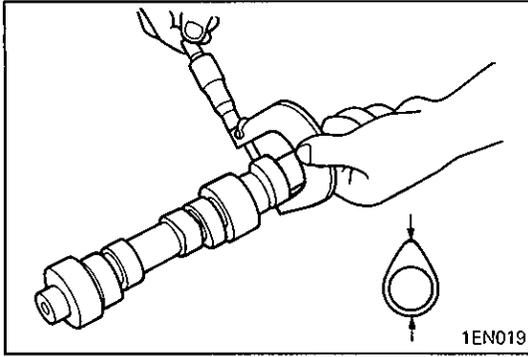


Removal steps

1. Washer
2. Oil seal
3. Rocker cover
4. Oil filler cap
5. Gasket
6. Semi-circular packing
7. Rocker arms and shafts assembly
8. Camshaft
9. Camshaft oil seal

Installation steps

8. Camshaft
7. Rocker arms and shafts assembly
9. Camshaft oil seal
- ▶A▶
▶C▶
▶B▶ Valve clearance adjustment
6. Semi-circular packing
5. Gasket
4. Oil filler cap
3. Rocker cover
2. Oil seal
1. Washer



INSPECTION

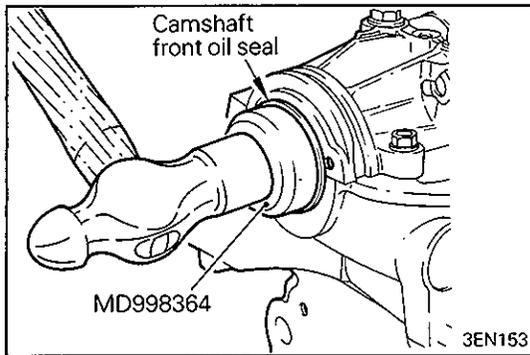
- (1) Check camshaft journals and cam lobes for excessive wear or damage. Replace if defects are evident.
- (2) Measure also the cam height and, if the limit is exceeded, replace.

Unit: mm (in.)

Identification mark	Standard value	Limit
1 : Intake	36.36 (1.4315)	35.86 (1.4118)
Exhaust	36.41 (1.4335)	35.91 (1.4138)
6 : Intake	36.52 (1.4378)	36.02 (1.4181)
Exhaust	36.57 (1.4398)	36.07 (1.4201)

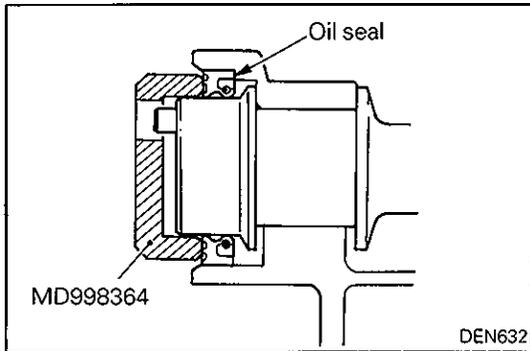
NOTE:

The camshaft identification mark is stamped on the opposite end of the camshaft sprocket side.



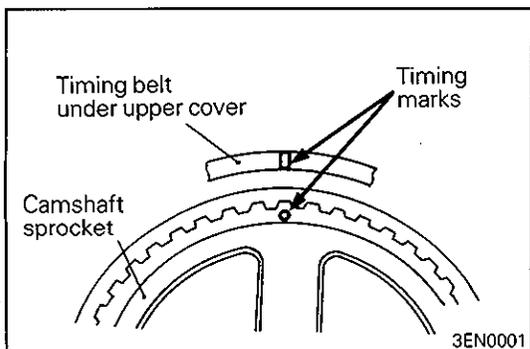
SERVICE POINTS OF INSTALLATION

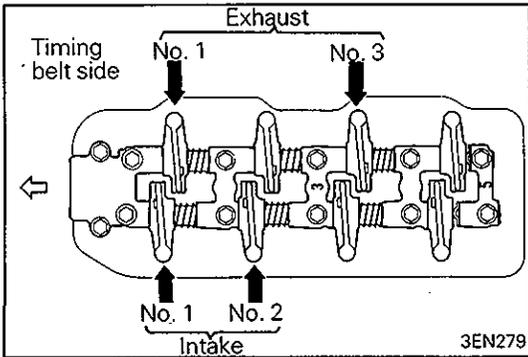
◆A◆ INSTALLATION OF CAMSHAFT OIL SEAL



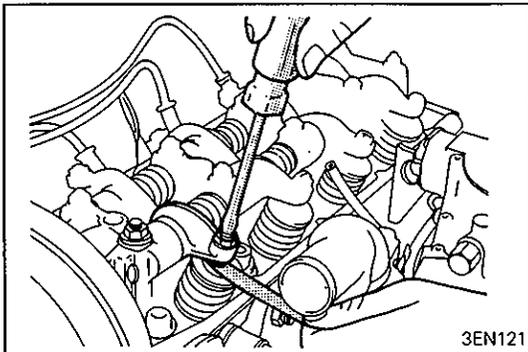
◆B◆ VALVE CLEARANCE ADJUSTMENT

- (1) Turn the crankshaft clockwise and align the timing mark on camshaft sprocket with that on timing belt under upper cover.





(2) Adjust the valve clearance at points shown in the illustration.

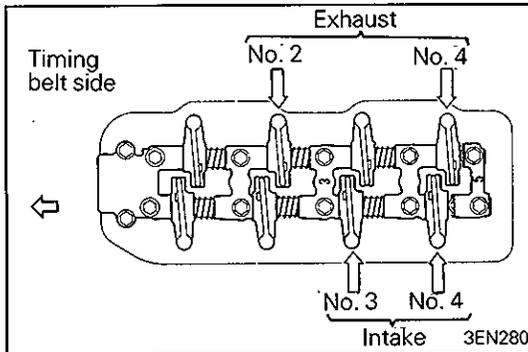


- (3) Loosen the adjusting screw lock nut.
- (4) Using a thickness gauge, adjust the valve clearance by turning the adjusting screw.

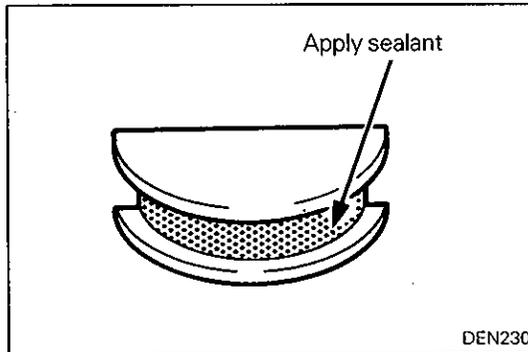
Standard value: on cold engine

0.07 mm (0.0028 in.)	.....	Intake
0.17 mm (0.0067 in.)	.....	Exhaust

(5) While holding the adjusting screw with a screwdriver, tighten the lock nut.



- (6) Rotate clockwise the crankshaft one complete turn (360°).
- (7) Adjust the valve clearance at points shown in the illustration.
- (8) Repeat steps (3) to (5) to adjust the valve clearance of remaining valves.

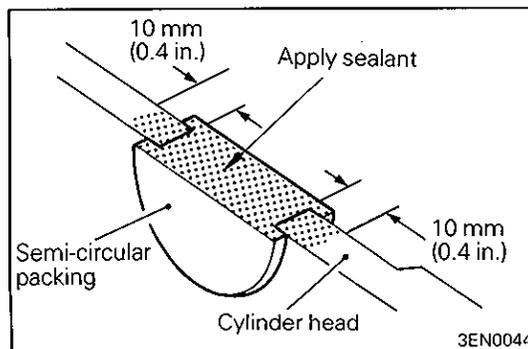


◆C◆ INSTALLATION OF SEMI-CIRCULAR PACKING

(1) Apply specified sealant to portions indicated in illustration.

Specified sealant:

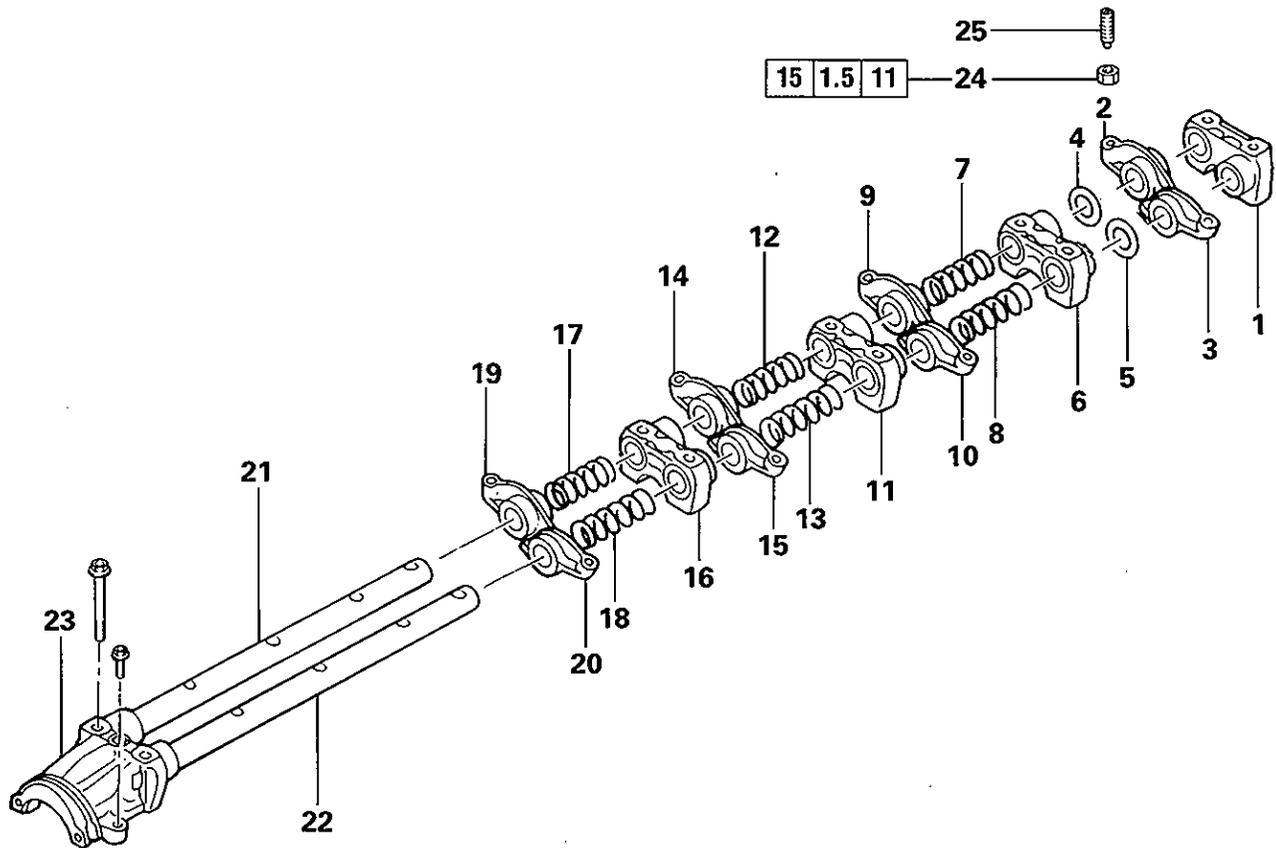
3M ATD Part No. 8660 or equivalent



NOTES

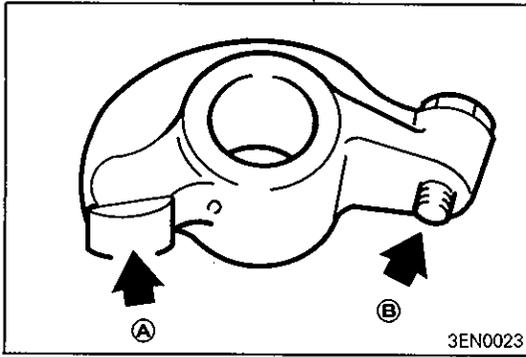
7. ROCKER ARMS AND ROCKER SHAFTS

REMOVAL AND INSTALLATION

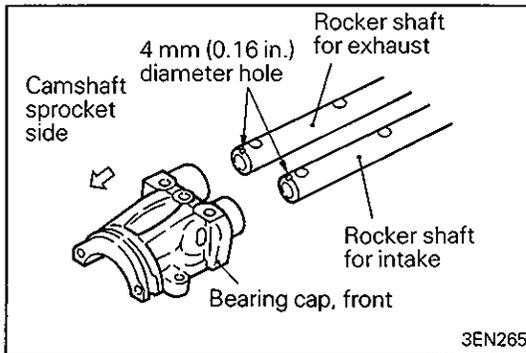


Removal steps

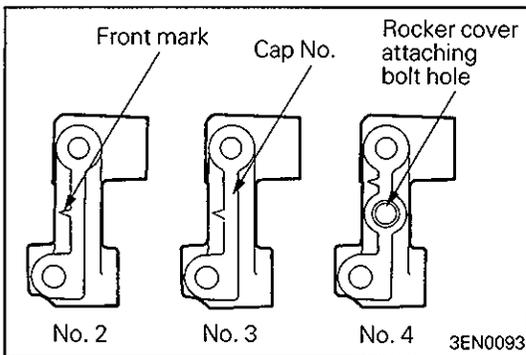
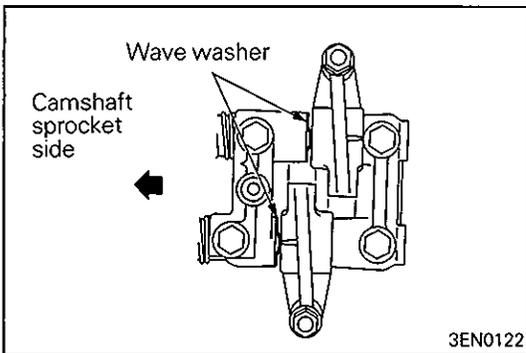
1. Bearing cap, rear
2. Rocker arm
3. Rocker arm
- ↔C↔ 4. Wave washer
- ↔C↔ 5. Wave washer
- ↔B↔ 6. Bearing cap, No. 4
7. Rocker shaft spring, right
8. Rocker shaft spring, left
9. Rocker arm
10. Rocker arm
- ↔B↔ 11. Bearing cap, No. 3
12. Rocker shaft spring, right
13. Rocker shaft spring, left
14. Rocker arm
15. Rocker arm
- ↔B↔ 16. Bearing cap, No.2
17. Rocker shaft spring, right
18. Rocker shaft spring, left
19. Rocker arm
20. Rocker arm
- ↔A↔ 21. Rocker shaft, right
- ↔A↔ 22. Rocker shaft, left
23. Bearing cap, front
24. Nut
25. Adjusting screw

**INSPECTION****ROCKER ARM**

- (1) Check the surface **(A)** that contacts the cam lobe and replace if there is any dent, damage or seizure.
- (2) Check the adjusting screw end **(B)** and replace if it is worn flat.
- (3) Check the bore and replace if there is any damage or seizure.

**SERVICE POINTS OF INSTALLATION****▶A◀ INSTALLATION OF ROCKER SHAFTS**

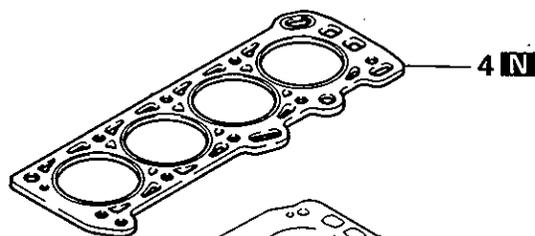
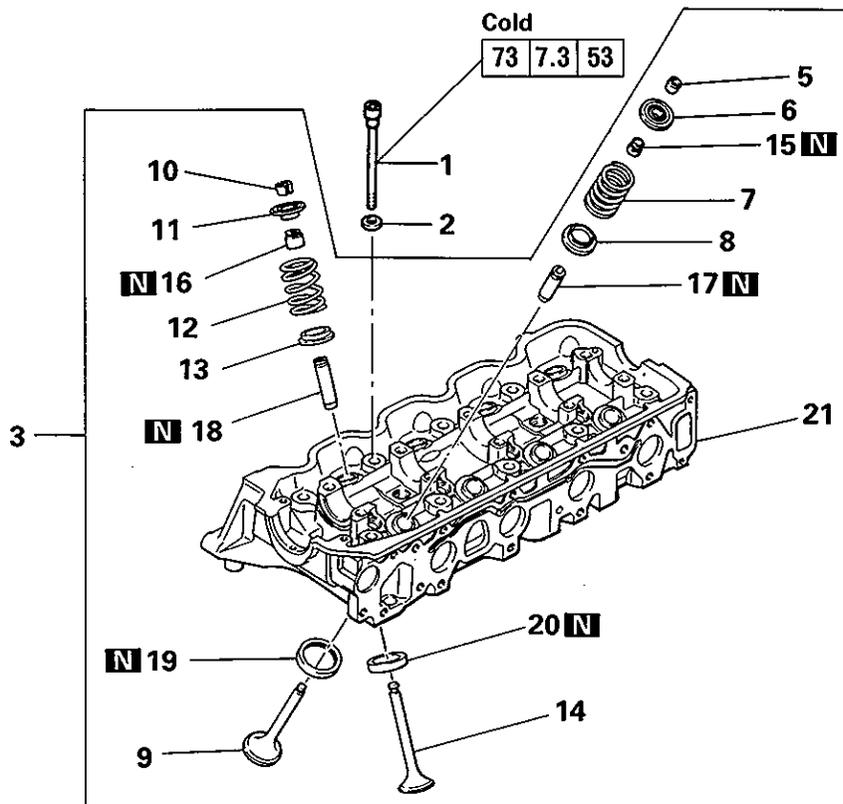
- (1) Install the rocker shafts with notches up and toward the front bearing cap.
- (2) The overall length of the left (intake) rocker shaft is 356.5 mm (14.04 in.); that of right (exhaust) rocker shaft is 350 mm (13.78 in.).

**▶B◀ IDENTIFICATION OF CAMSHAFT BEARING CAPS****▶C◀ INSTALLATION OF WAVE WASHER**

- (1) Install the wave washers in correct direction as shown.

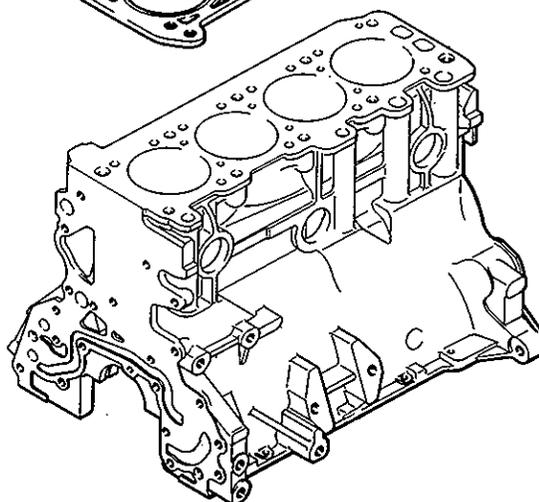
8. CYLINDER HEAD AND VALVES

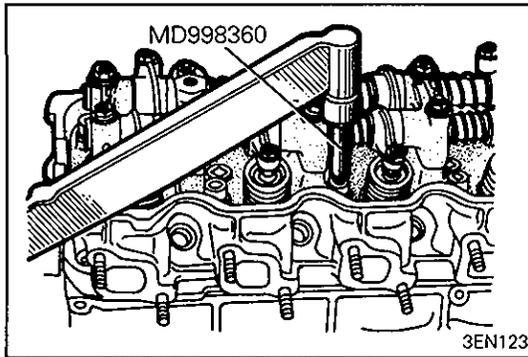
REMOVAL AND INSTALLATION



Removal steps

- ◊A◊ ◊D◊ 1. Cylinder head bolt
- 2. Washer
- 3. Cylinder head assembly
- ◊C◊ 4. Cylinder head gasket
- 5. Retainer lock
- 6. Valve spring retainer
- ◊B◊ 7. Valve spring
- 8. Valve spring seat
- 9. Intake valve
- 10. Retainer lock
- 11. Valve spring retainer
- ◊B◊ 12. Valve spring
- 13. Valve spring seat
- 14. Exhaust valve
- ◊B◊ ◊A◊ 15. Valve stem seal
- ◊B◊ ◊A◊ 16. Valve stem seal
- 17. Intake valve guide
- 18. Exhaust valve guide
- 19. Intake valve seat
- 20. Exhaust valve seat
- 21. Cylinder head

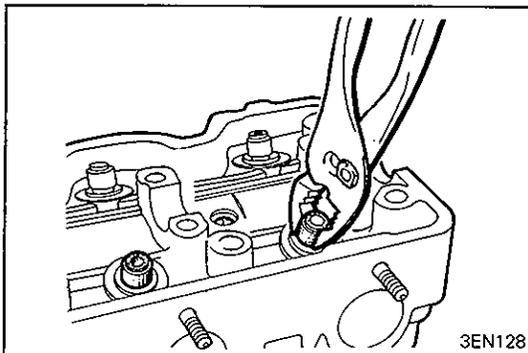


**SERVICE POINTS OF REMOVAL****PRECAUTION FOR REMOVED PARTS**

- (1) Keep removed parts in order, according to the cylinder number and intake/exhaust.

◁A▷ REMOVAL OF CYLINDER HEAD BOLT

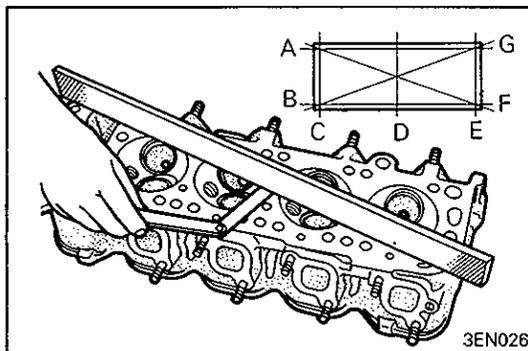
- (1) Using the special tool, loosen the cylinder head bolts. Loosen evenly, little by little.

**◁B▷ REMOVAL OF VALVE STEM SEAL**

- (1) Do not reuse valve stem seal.

INSPECTION**CYLINDER HEAD**

- (1) Check the cylinder head, before cleaning, for water leaks, gas leaks, damage, and cracks.
 (2) Remove oil, scale, sealing compound, and carbon deposits completely. After cleaning oil passages, apply compressed air to ensure that the passages are not clogged.



- (3) Check the cylinder head gasket surface for flatness by using a straightedge in the direction of A through G shown in illustration.

Standard value: 0.05 mm (0.0020 in.)

Limit: 0.2 mm (0.008 in.)

- (4) If the service limit is exceeded, correct to meet specification.

Grinding limit: 0.2 mm (0.008 in.)*

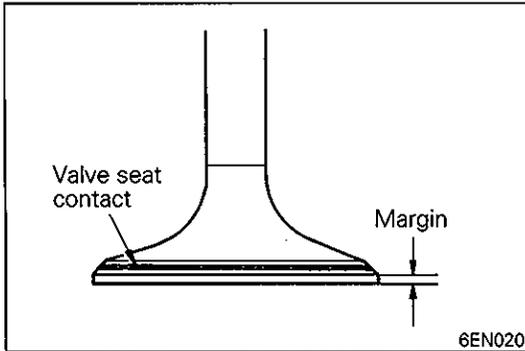
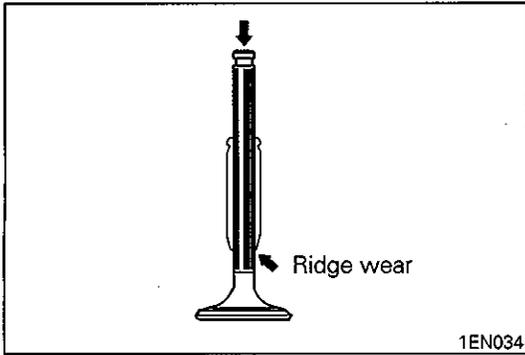
* Maximum of 0.2 mm (0.008 in.) for grinding is permitted.

Caution

- This is a combined total dimension of stock removal from cylinder head (if any) and block top surface.

Cylinder head height (Specification when new):

88.4 – 88.6 mm (3.480 – 3.488 in.)



VALVE

(1) If the valve stem is worn (ridge wear) or otherwise damaged, replace. Also replace the valve if the stem end (that contacts to the rocker arm adjust screw) has a dent.

(2) Check the valve face for correct contact. If incorrect, reface using valve refacer. Valve seat contact should be maintained uniform at the center of valve face.

(3) If the margin is smaller than the service limit, replace the valve.

Standard value:

1.5 mm (0.059 in.)	.....	Intake: 4G33, 4G32
1.2 mm (0.047 in.)	.....	Intake: 4G37
1.5 mm (0.059 in.)	.....	Exhaust

Limit:

1.0 mm (0.039 in.)	.....	Intake: 4G33, 4G32
0.7 mm (0.028 in.)	.....	Intake: 4G37
1.0 mm (0.039 in.)	.....	Exhaust

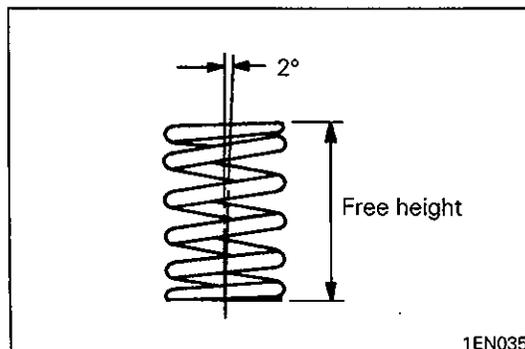
(4) Measure the overall length of the valve. If the measurement exceeds the specified limit, replace the valve.

Standard value:

103.4 mm (4.071 in.)	.....	Intake: 4G33, 4G32
98.2 mm (3.866 in.)	.....	Intake: 4G37
100.0 mm (3.937 in.)	.....	Exhaust: 4G33, 4G32
95.5 mm (3.760 in.)	.....	Exhaust: 4G37

Limit:

102.9 mm (4.051 in.)	.....	Intake: 4G33, 4G32
97.7 mm (3.846 in.)	.....	Intake: 4G37
99.5 mm (3.917 in.)	.....	Exhaust: 4G33, 4G32
95.0 mm (3.740 in.)	.....	Exhaust: 4G37



VALVE SPRING

(1) Measure the free height of the spring and, if it is smaller than the limit, replace.

Standard value:

45.9 mm (1.807 in.)	.....	Red or green
49.2 mm (1.937 in.)	.....	Blue

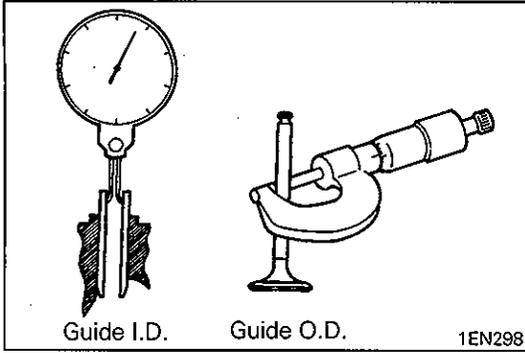
Limit:

44.9 mm (1.768 in.)	.....	Red or green
48.2 mm (1.898 in.)	.....	Blue

(2) Measure the squareness of the spring and, if the limit is exceeded, replace.

Standard value: 2° or less

Limit: 4°



VALVE GUIDE

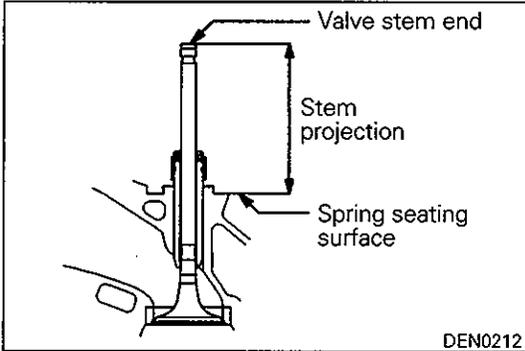
- (1) Measure the clearance between the valve guide and valve stem. If the limit is exceeded, replace the valve guide or valve, or both.

Standard value:

0.02 – 0.06 mm (0.0008 – 0.0024 in.) Intake
 0.05 – 0.09 mm (0.0020 – 0.0035 in.) Exhaust

Limit:

0.10 mm (0.0039 in.) Intake
 0.15 mm (0.0059 in.) Exhaust

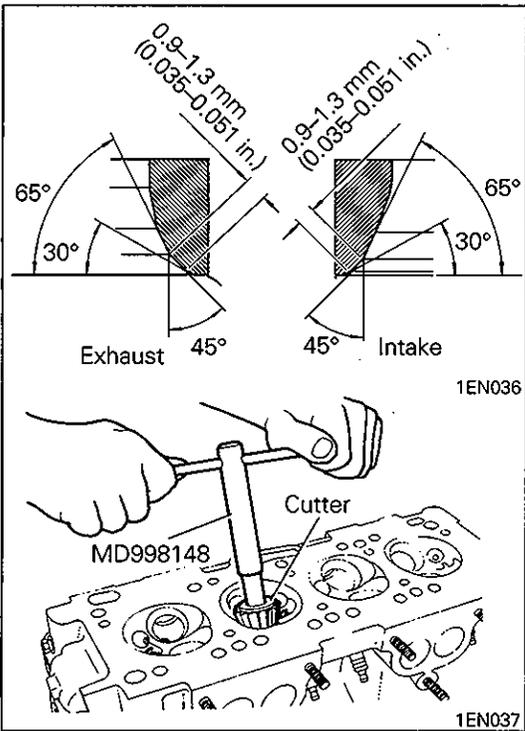


VALVE SEAT

- (1) Assemble the valve, then measure the valve stem projection between the end of the valve stem and the spring seating surface. If the measurement exceeds the specified limit, replace the valve seat.

Standard value: 39.4 mm (1.551 in.)

Limit: 39.9 mm (1.571 in.)

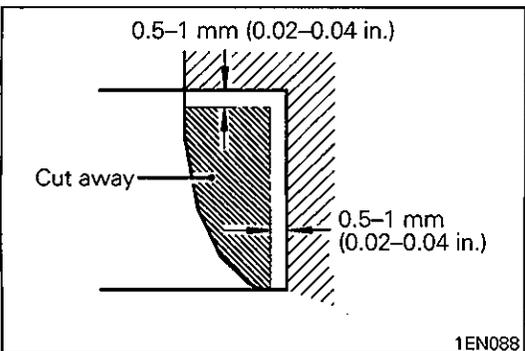


VALVE SEAT RECONDITIONING PROCEDURE

- (1) Before correcting the valve seat, check for clearance between the valve guide and valve and, if necessary, replace the valve guide.
- (2) Using the special tool or seat grinder, correct to obtain the specified seat width and angle.

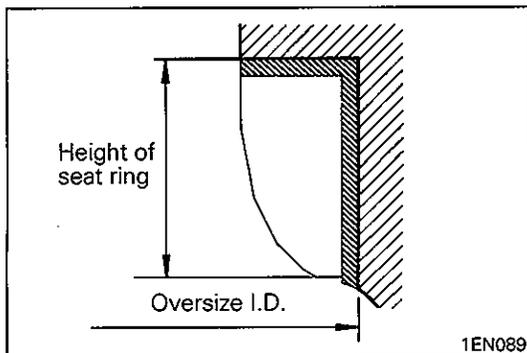
Cutter angle	Tool number	
	Intake	Exhaust
45°	MD998158	MD998157
65°	MD998165	MD998165
30°	MD998173	MD998172

- (3) After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection (refer to VALVE SEAT in INSPECTION).



VALVE SEAT REPLACEMENT PROCEDURE

- (1) Cut the valve seat to be replaced from the inside to thin the wall thickness. Then, remove the valve seat.



- (2) Rebore the valve seat hole in cylinder head to a selected oversize valve seat diameter.

Intake valve seat hole diameter:

4G33, 4G32

0.30 O.S. ... 39.30 – 39.33 mm (1.5472 – 1.5484 in.)

0.60 O.S. ... 39.60 – 39.63 mm (1.5591 – 1.5602 in.)

4G37

0.30 O.S. ... 43.30 – 43.33 mm (1.7047 – 1.7059 in.)

0.60 O.S. ... 43.60 – 43.63 mm (1.7165 – 1.7177 in.)

Exhaust valve seat hole diameter:

4G33, 4G32

0.30 O.S. ... 34.30 – 34.33 mm (1.3504 – 1.3516 in.)

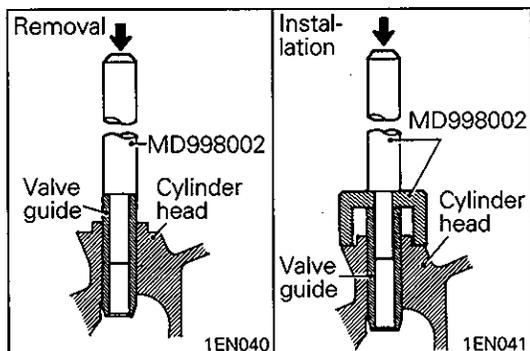
0.60 O.S. ... 34.60 – 34.63 mm (1.3622 – 1.3634 in.)

4G37

0.30 O.S. ... 37.30 – 37.33 mm (1.4685 – 1.4697 in.)

0.60 O.S. ... 37.60 – 37.63 mm (1.4803 – 1.4815 in.)

- (3) Before fitting the valve seat, either heat the cylinder head up to approximately 250°C (482°F) or cool the valve seat in liquid nitrogen, to prevent the cylinder head bore from galling.
- (4) Using valve seat cutter, correct the valve seat to the specified width and angle. See "VALVE SEAT RECONDITIONING PROCEDURE."



VALVE GUIDE REPLACEMENT PROCEDURE

- (1) Using the special tool and a press, remove the valve guide toward cylinder head gasket surface.
- (2) Rebore valve guide hole to the new oversize valve guide outside diameter.

Valve guide hole diameter:

0.05 O.S. ... 13.05 – 13.07 mm (0.5138 – 0.5146 in.)

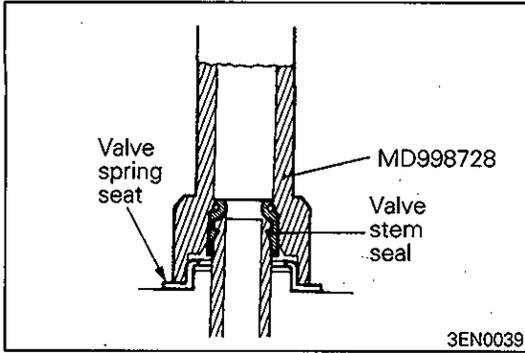
0.25 O.S. ... 13.25 – 13.27 mm (0.5217 – 0.5224 in.)

0.50 O.S. ... 13.50 – 13.52 mm (0.5315 – 0.5323 in.)

NOTE

Do not install a valve guide of the same size again.

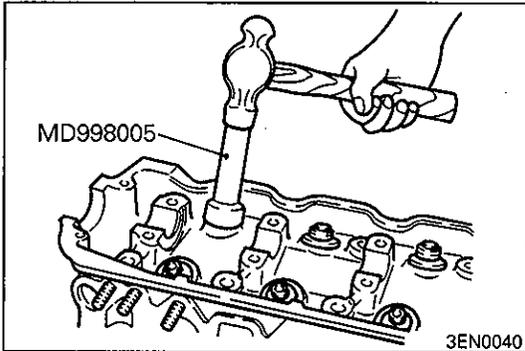
- (3) Using the special tool, press-fit the valve guide, working from the cylinder head top surface.
- (4) After installing valve guides, insert new valves in them to check for sliding condition.
- (5) When valve guides have been replaced check for valve contact and correct valve seats as necessary.



SERVICE POINTS OF INSTALLATION

▶A◀ INSTALLATION OF VALVE STEM SEAL

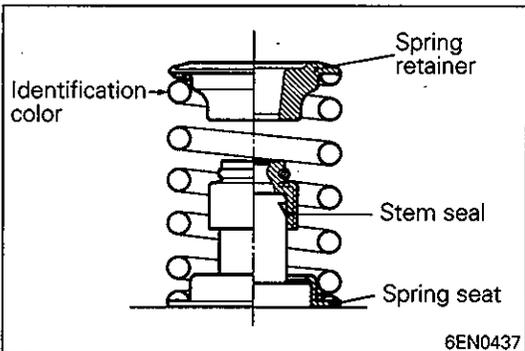
(1) Install the valve spring seat.



(2) Using the special tool, install a new stem seal to the valve guide.

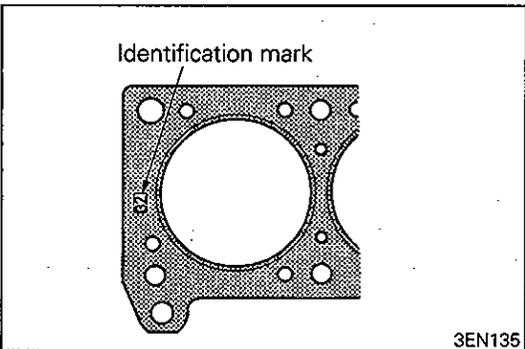
Caution

- Do not reuse the valve stem seal.



▶B◀ INSTALLATION OF VALVE SPRING

(1) Direct the valve spring end with identification color end toward the spring retainer.

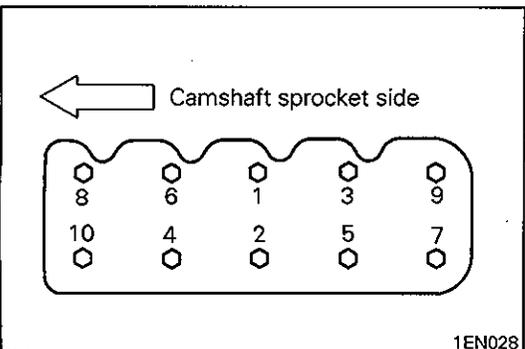


▶C◀ IDENTIFICATION OF CYLINDER HEAD GASKET

Identification mark: 33	.....	4G33
32	.....	4G32
37	.....	4G37

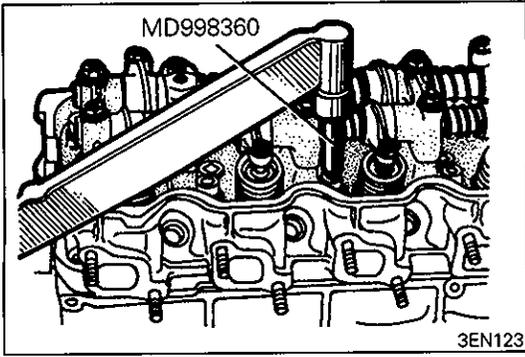
Caution

- Do not apply sealant to cylinder head gasket.



▶D◀ INSTALLATION OF CYLINDER HEAD BOLT

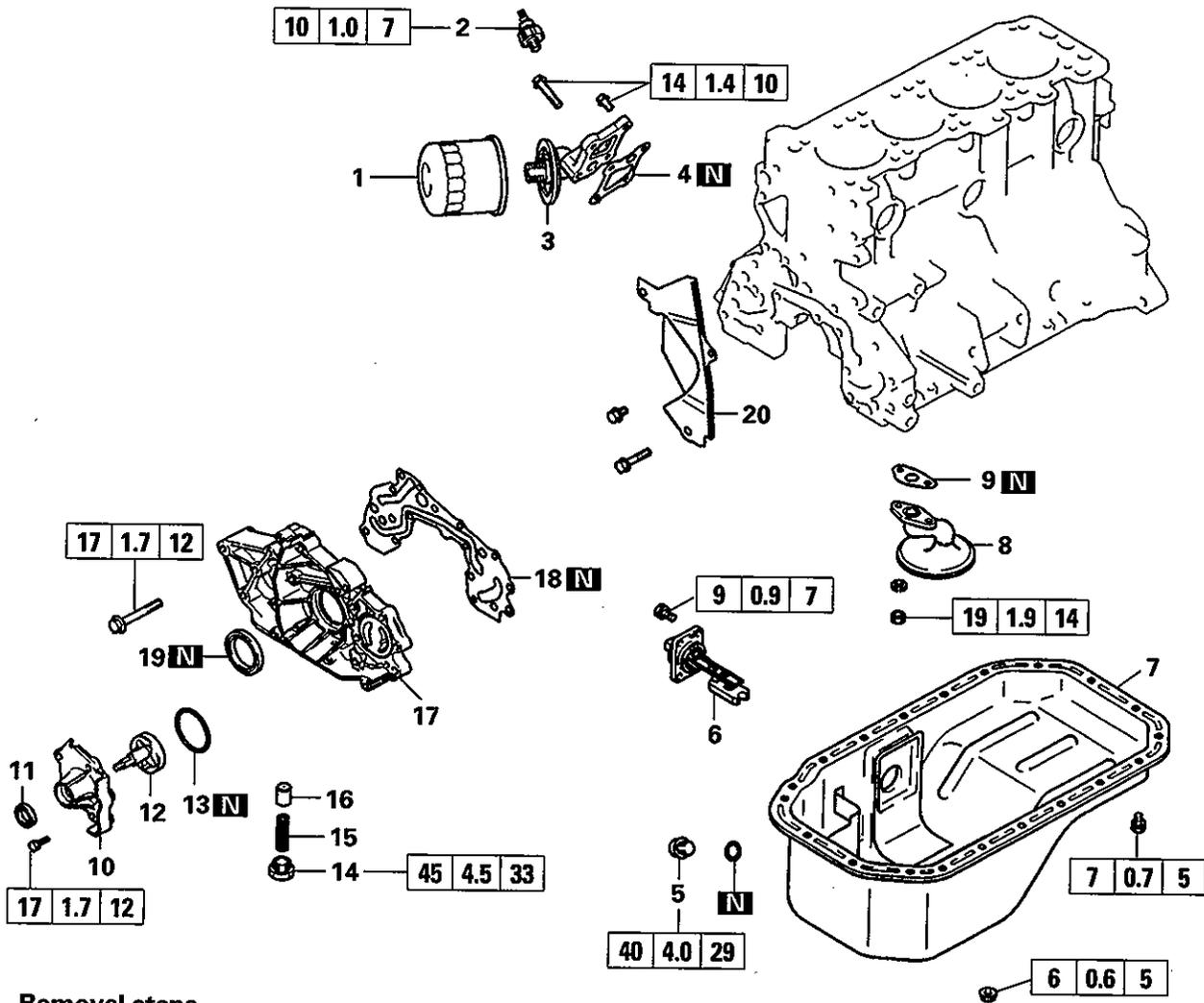
(1) Tighten the cylinder head bolts in the sequence shown. Each bolt should be tightened in two to three steps, torquing progressively. Tighten to specified torque in the final sequence.



NOTES

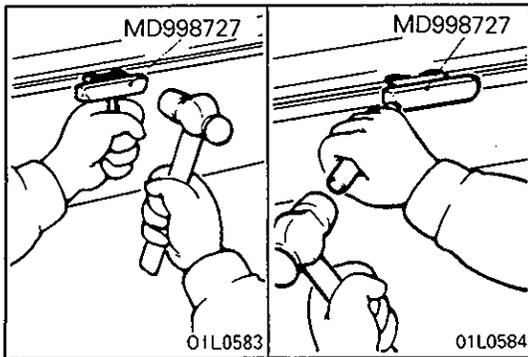
REMOVAL AND INSTALLATION

<ENGINE WITHOUT SILENT SHAFTS>

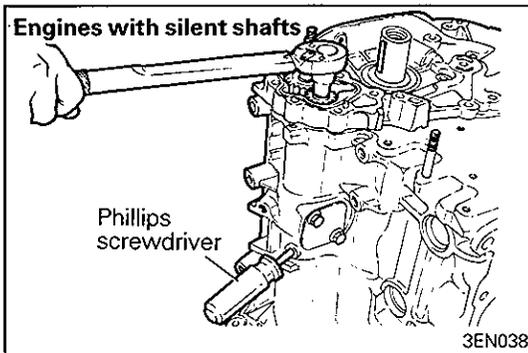


Removal steps

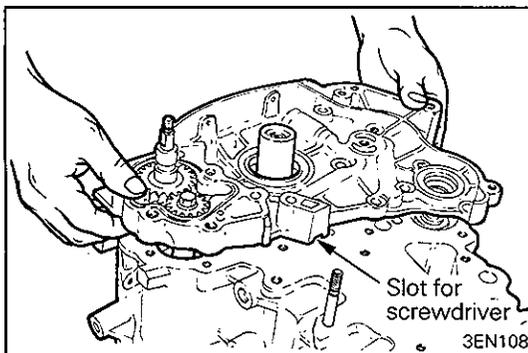
- ▶M▶ 1. Oil filter
- ▶L▶ 2. Oil pressure switch
- ▶ 3. Oil filter bracket
- ▶ 4. Gasket
- ▶ 5. Drain plug
- ▶ 6. Oil level sensor
- ◊A◊ ▶K▶ 7. Oil pan
- ▶ 8. Oil screen
- ▶ 9. Oil screen gasket
- ▶ 10. Oil pump cover
- ▶J▶ 11. Oil pump oil seal
- ▶I▶ 12. Oil pump rotor assembly
- ▶H▶ 13. Oil pump cover gasket
- ▶ 14. Plug
- ▶ 15. Relief spring
- ▶ 16. Relief plunger
- ◊C◊ ▶E▶ 17. Front case
- ▶C▶ 18. Front case gasket
- ▶ 19. Crankshaft oil seal
- ▶ 20. Timing belt under lower cover

**SERVICE POINTS OF REMOVAL****◁A▷ REMOVAL OF OIL PAN**

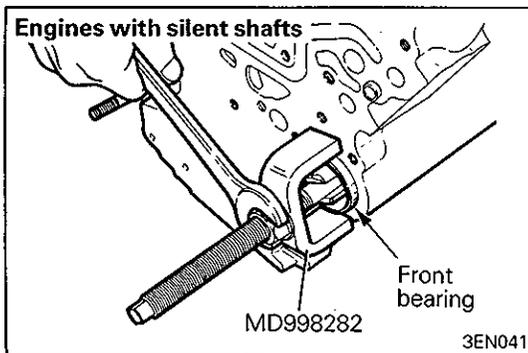
- (1) Knock the special tool deeply between the oil pan and the cylinder block.
- (2) Hitting the side of the special tool, slide the special tool along the oil pan to remove it.

**◁B▷ REMOVAL OF FLANGE BOLT (ENGINES WITH SILENT SHAFTS)**

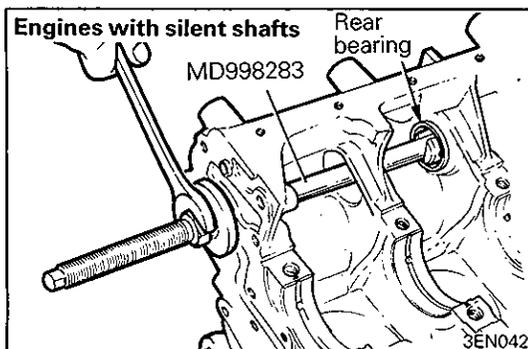
- (1) When loosening the oil pump driven gear flange bolt, first insert a Phillips screwdriver [shank diameter 8 mm (0.32 in.)] into the plug hole on the left side of cylinder block to block the silent shaft.

**◁C▷ REMOVAL OF FRONT CASE**

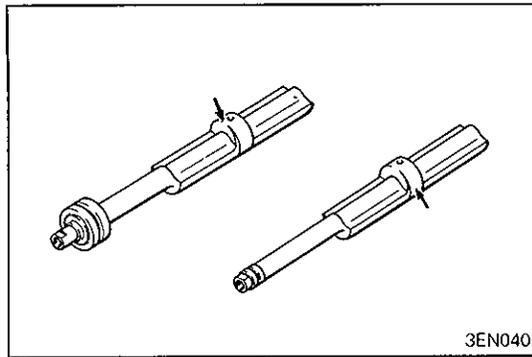
- (1) The front case may be sticking to the cylinder block. In such a case, insert a screwdriver into the slot shown in the illustration and pry up. Never attempt to pry at any other positions where flange is thinner. Also avoid applying impact to the front case for removal.

**◁D▷ REMOVAL OF SILENT SHAFT FRONT BEARING (ENGINES WITH SILENT SHAFTS)**

- (1) Using the special tool, remove the front bearing from cylinder block.

**◁E▷ REMOVAL OF SILENT SHAFT REAR BEARING (ENGINES WITH SILENT SHAFTS)**

- (1) Using the special tool, remove the rear bearings from cylinder block.



INSPECTION

SILENT SHAFT

- (1) Check oil holes for clogging.
- (2) Check journal for seizure, damage, and contact with bearing. If there is anything wrong with the journal, replace silent shaft, bearing or front case assembly.
- (3) Check the silent shaft oil clearance. If the clearance is excessively due to wear, replace the silent shaft bearing, silent shaft or front case assembly.

Standard:

Right

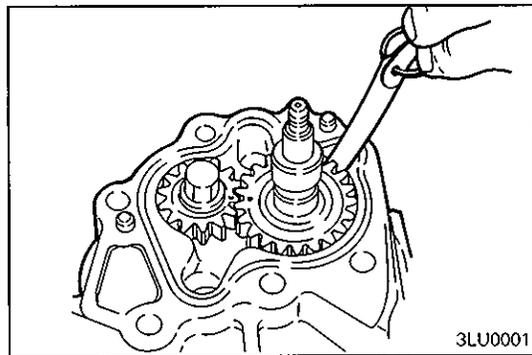
0.02 – 0.06 mm (0.0008 – 0.0024 in.) Front

0.02 – 0.05 mm (0.0008 – 0.0020 in.) Rear

Left

0.05 – 0.09 mm (0.0020 – 0.0035 in.) Front

0.05 – 0.09 mm (0.0020 – 0.0035 in.) Rear



OIL PUMP – Involute gear type

- (1) Install the oil pump gears in the front case and check the tip clearance of each gear using a thickness gauge.

Standard value:

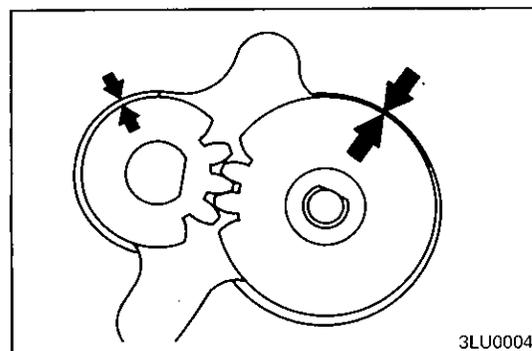
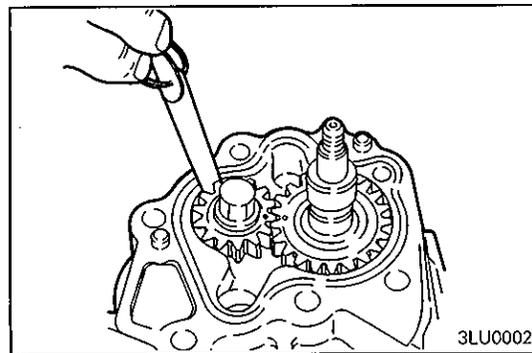
0.15 – 0.25 mm (0.0059 – 0.0098 in.) Drive gear

0.10 – 0.20 mm (0.0039 – 0.0079 in.) Driven gear

Limit:

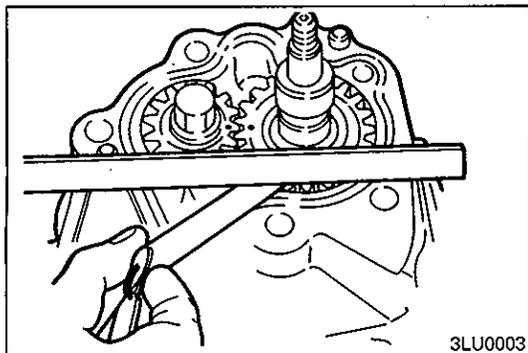
0.35 mm (0.0138 in.) Drive gear

0.30 mm (0.0118 in.) Driven gear



NOTE

Check the tip clearance of each gear at position indicated by an arrow.



(2) Check the side clearance of each gear.

Standard value:

0.08 – 0.14 mm (0.0031 – 0.0055 in.) ... Drive gear

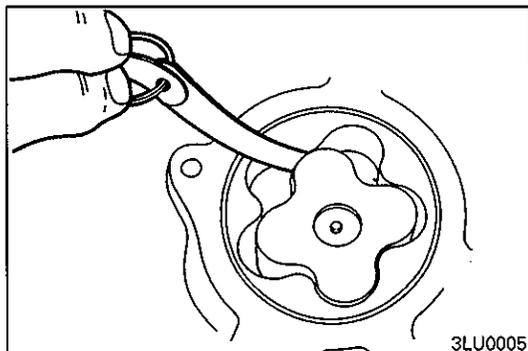
0.06 – 0.12 mm (0.0024 – 0.0047 in.) ... Driven gear

Limit:

0.18 mm (0.0071 in.) Drive gear

0.15 mm (0.0059 in.) Driven gear

(3) Check for ridge wear on the surface of the oil pump cover that are in contact with the pump gear side.



OIL PUMP – Trochoid type

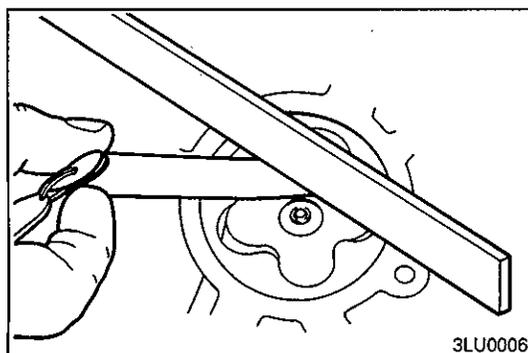
(1) With the oil pump rotors installed in the front case, check for each clearance of rotor with a thickness gauge.

(2) Check the tip clearance.

Standard value:

0.04 – 0.12 mm (0.0016 – 0.0047 in.)

Limit: 0.18 mm (0.0071 in.)

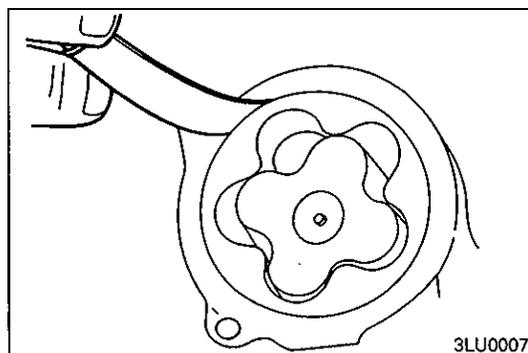


(3) Check the side clearance.

Standard value:

0.06 – 0.12 mm (0.0024 – 0.0047 in.)

Limit: 0.15 mm (0.0059 in.)



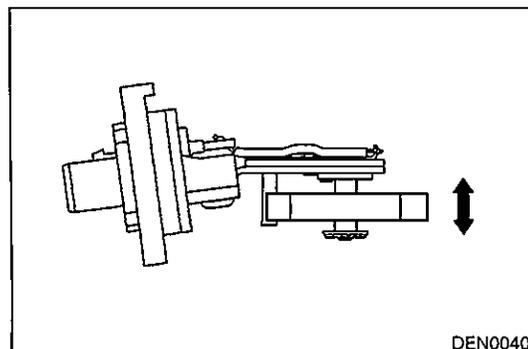
(4) Check the body clearance.

Standard value:

0.10 – 0.16 mm (0.0039 – 0.0063 in.)

Limit: 0.2 mm (0.0079 mm)

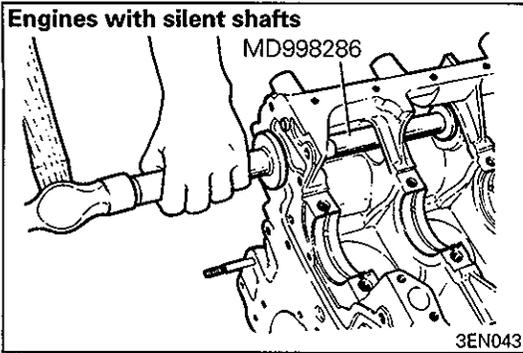
(5) Check for ridge wear on the surface of the oil pump cover that are in contact with the pump gear side.



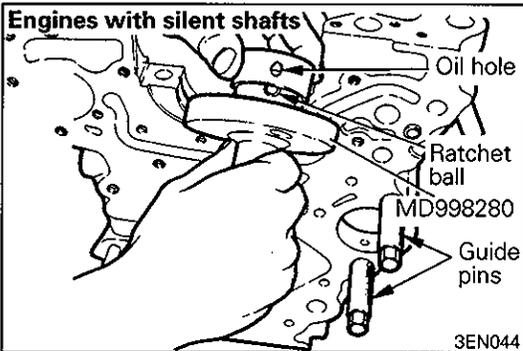
OIL LEVEL SENSOR

(1) Check continuity of the oil level sensor with the float moving up and down.

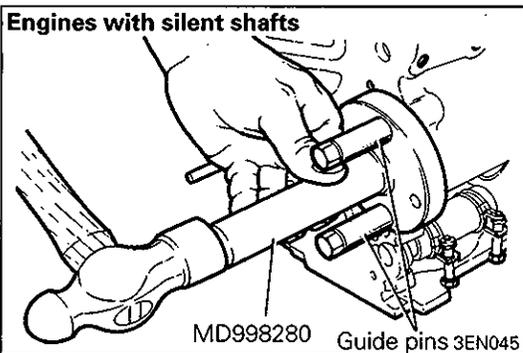
Float position	Switch ON/OFF
Condition when down	OFF (no continuity)
Condition when up	ON (continuity)

**SERVICE POINTS OF INSTALLATION****◆A◆ INSTALLATION OF SILENT SHAFT REAR BEARING (ENGINES WITH SILENT SHAFTS)**

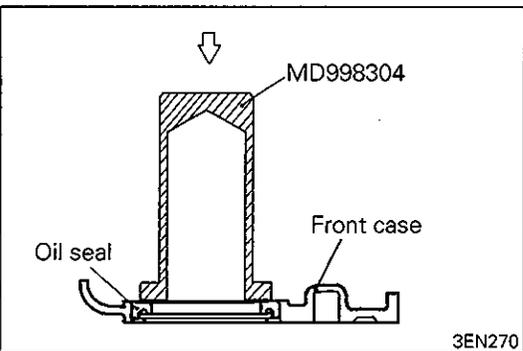
- (1) Apply engine oil to the rear bearing outer circumference and bearing hole in cylinder block.
- (2) Using the special tool and a hammer, drive the rear bearing into cylinder block.

**◆B◆ INSTALLATION OF SILENT SHAFT FRONT BEARING (ENGINES WITH SILENT SHAFTS)**

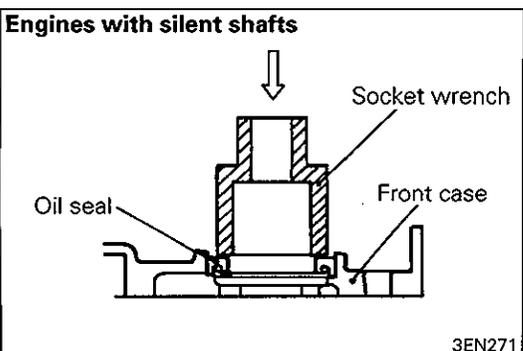
- (1) Install two guide pins included in the special tool set to the threaded holes in cylinder block.
- (2) Set the front bearing on the special tool so that the ratchet ball of special tool fits in the oil hole in bearing.
- (3) Apply engine oil to the bearing outer circumference and bearing hole in cylinder block.



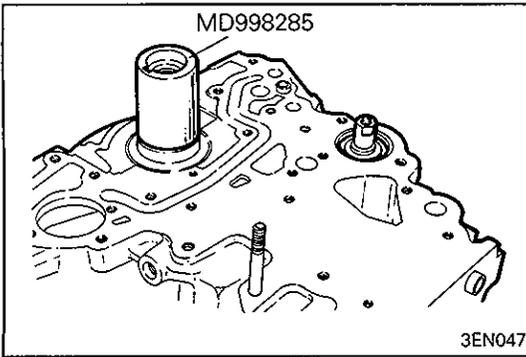
- (4) Set the special tool on guide pins and drive the bearing into cylinder block.

**◆C◆ INSTALLATION OF CRANKSHAFT OIL SEAL**

- (1) Using the special tool, install the crankshaft oil seal into front case.

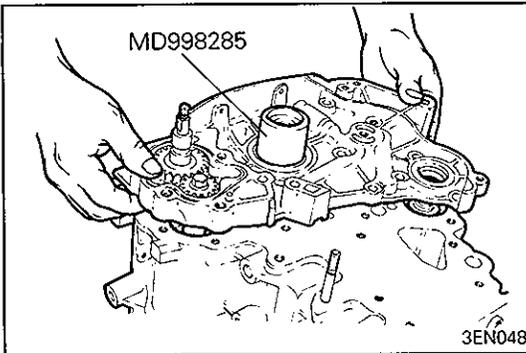
**◆D◆ INSTALLATION OF SILENT SHAFT OIL SEAL (ENGINES WITH SILENT SHAFTS)**

- (1) Using a socket wrench, press-in the silent shaft oil seal into front case.

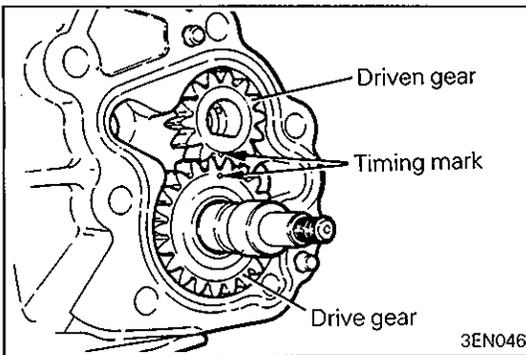


▶E▶ INSTALLATION OF FRONT CASE

- (1) Set the special tool on the front end of crankshaft and apply engine oil to the outer circumference of the special tool.

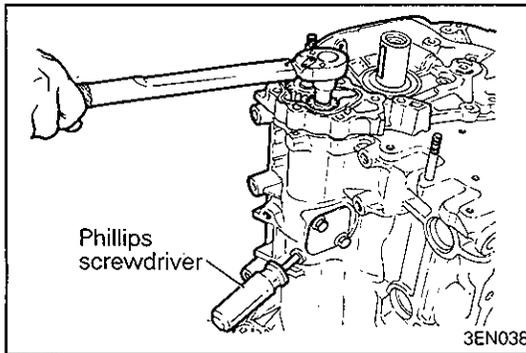


- (2) Install the front case.



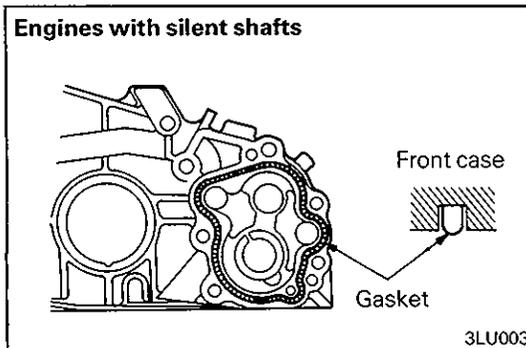
▶F▶ INSTALLATION OF OIL PUMP DRIVEN GEAR / OIL PUMP DRIVE GEAR

- (1) Install the oil pump drive gear and driven gear to the front case, lining up the timing marks. Apply lubricate the gears with engine oil.



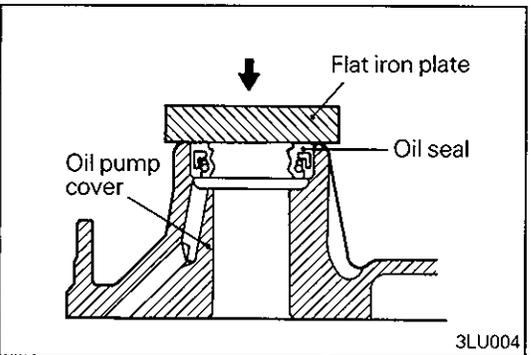
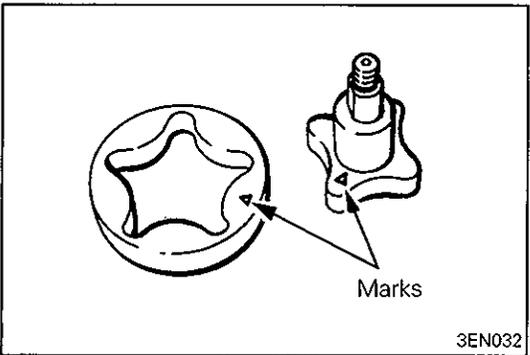
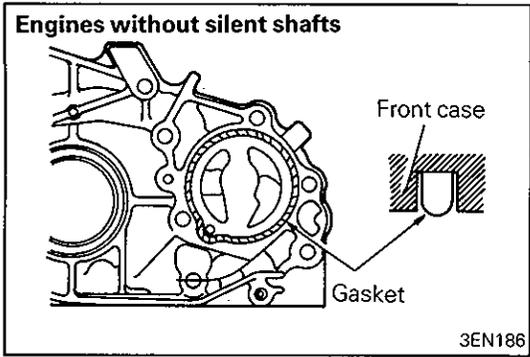
▶G▶ INSTALLATION OF FLANGE BOLT

- (1) Insert a Phillips screwdriver [shank diameter 8 mm (0.32 in.)] into the plug hole on the left side of cylinder block to block the silent shaft, then tighten the flange bolt.



▶H▶ INSTALLATION OF OIL PUMP COVER GASKET

- (1) Install a new oil pump cover gasket in the groove of the front case. When installing the gasket, face the round side to the oil pump cover.



SERVICE POINTS OF REASSEMBLY

◆◆ INSTALLATION OF OIL PUMP ROTOR ASSEMBLY

- (1) Apply engine oil to the entire surfaces of inner and outer rotors.
Then, install the rotors into the oil pump cover. There are Δ marking stamped on the front end face of inner and outer rotors. Make sure that the markings are aligned when the rotors are installed.

◆◆ INSTALLATION OF OIL PUMP OIL SEAL

- (1) Install the oil seal into the oil pump cover, making sure that its lip is in correct direction.

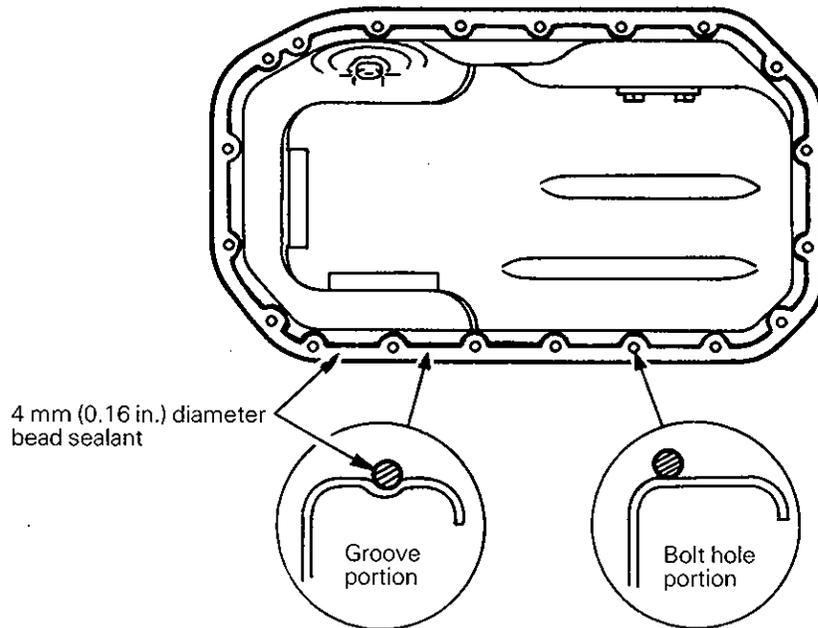
⇨K⇩ INSTALLATION OF OIL PAN

- (1) Clean mating surfaces of both the oil pan and cylinder block.
- (2) Apply a 4 mm (0.16 in.) diameter bead of sealant to the entire circumference of the oil pan flange.

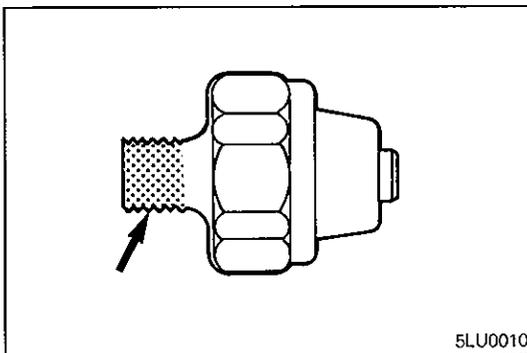
Specified sealant:

MITSUBISHI GENUINE Part No. MD997110 or equivalent

- (3) The oil pan should be installed within 15 minutes after the application of sealant.



3EN184



5LU0010

⇨L⇩ APPLICATION OF SEALANT TO OIL PRESSURE SWITCH

- (1) Coat the threads of switch with sealant and install the switch using the special tool.

Specified sealant:

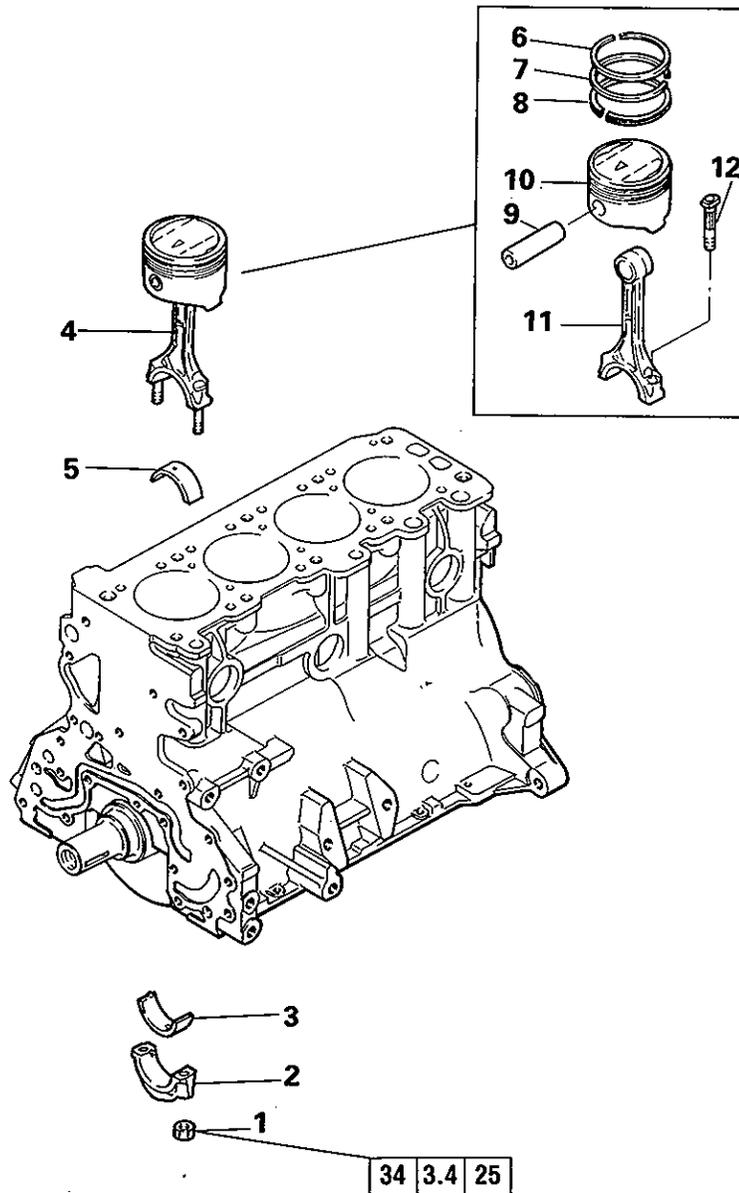
3M ATD Part No. 8660 or equivalent

Caution

- Keep the end of threaded portion clear of sealant.
- Avoid an overtightening.

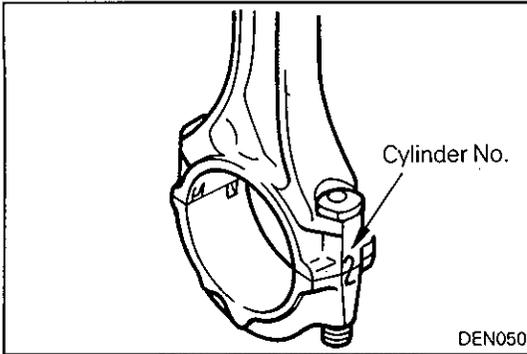
NOTES

10. PISTON AND CONNECTING ROD REMOVAL AND INSTALLATION

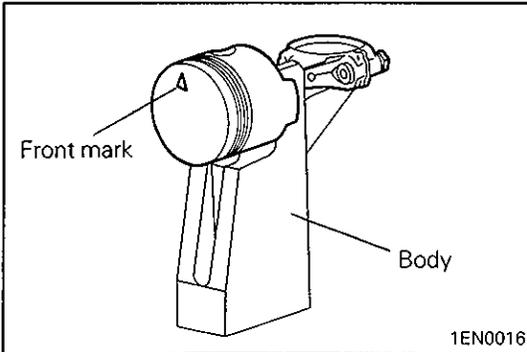


Removal steps

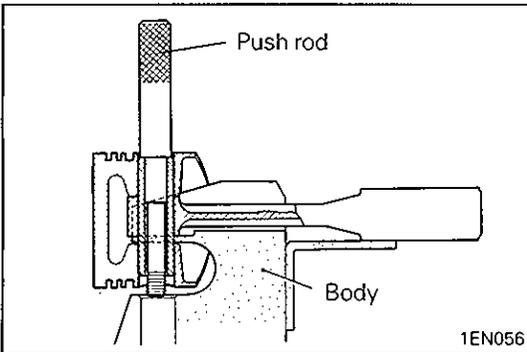
- 1. Nut
- ◁A▷ ▷E◁ 2. Connecting rod cap
- 3. Connecting rod bearing
- ▷D◁ 4. Piston and connecting rod assembly
- 5. Connecting rod bearing
- ▷C◁ 6. Piston ring No. 1
- ▷C◁ 7. Piston ring No. 2
- ▷B◁ 8. Oil ring
- ◁B▷ ▷A◁ 9. Piston pin
- 10. Piston
- 11. Connecting rod
- 12. Connecting rod bolt

**SERVICE POINTS OF REMOVAL****◁A▷ REMOVAL OF CONNECTING ROD CAP**

- (1) Mark the cylinder number on the side of the connecting rod big end for correct reassembly.

**◁B▷ REMOVAL OF PISTON PIN**

- (1) Place piston and connecting rod assembly into the special tool body with front mark (arrow mark) toward up.



- (2) Insert push rod in piston pin and remove piston pin with press.

NOTE

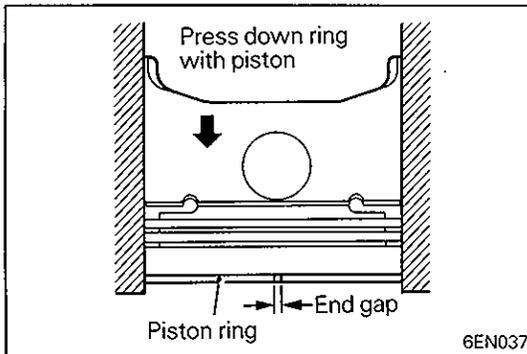
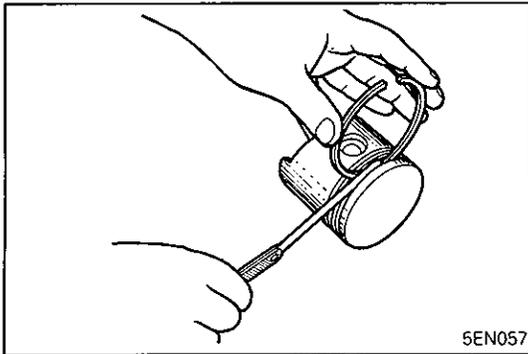
Keep disassembled piston, pin and connecting rod of a cylinder separate from those of another cylinder.

INSPECTION**PISTON**

- (1) Replace the piston if scratches or seizure is evident on its surfaces (especially the thrust surface). Replace the piston if it is cracked.

PISTON PIN

- (1) Insert the piston pin into the piston pin hole with a thumb. You should feel a slight resistance. Replace the piston pin if it can be easily inserted or there is an excessive play.
- (2) The piston and piston pin must be replaced as an assembly.

**PISTON RING**

- (1) Check for side clearance.
If the limit is exceeded, replace the ring or piston, or both.

Standard value:

0.03 – 0.09 mm (0.0012 – 0.0035 in.)	.....	No. 1
0.02 – 0.06 mm (0.0008 – 0.0024 in.)	.....	No. 2

- (2) Insert the piston ring into cylinder bore. Force it down with a piston, its crown being in contact with the ring, to correctly position it at right angles to the cylinder wall. Then, measure the end gap with a thickness gauge. If the end gap is excessive, replace piston ring.

Standard value:**No. 1**

0.25 – 0.45 mm (0.0098 – 0.0177 in.)	.....	4G33
0.25 – 0.40 mm (0.0098 – 0.0157 in.)	.....	4G32
0.30 – 0.45 mm (0.0118 – 0.0177 in.)	.....	4G37

No. 2

0.25 – 0.45 mm (0.0098 – 0.0177 in.)	.....	4G33
0.20 – 0.35 mm (0.0079 – 0.0138 in.)	.....	4G32
0.20 – 0.55 mm (0.0079 – 0.0217 in.)	.....	4G37

Oil 0.20 – 0.70 mm (0.0079 – 0.0276 in.)

Limit:

0.8 mm (0.031 in.)	.....	No. 1, No. 2
1.0 mm (0.039 in.)	.....	Oil

CONNECTING ROD BEARING

- (1) Visually check the bearing surface for uneven contact, streaks, scratches, and seizure. Replace if defects are evident. If streaks and seizure are excessive, check also the crankshaft. If damage is present on the crankshaft, replace crankshaft or regrind to undersize for reuse.

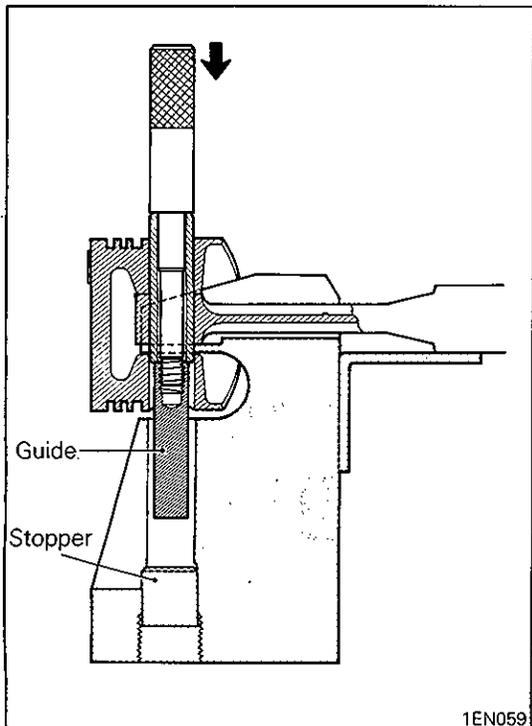
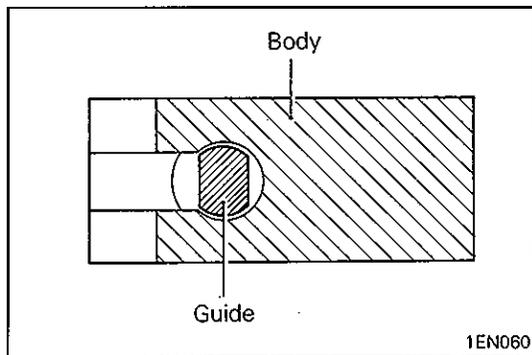
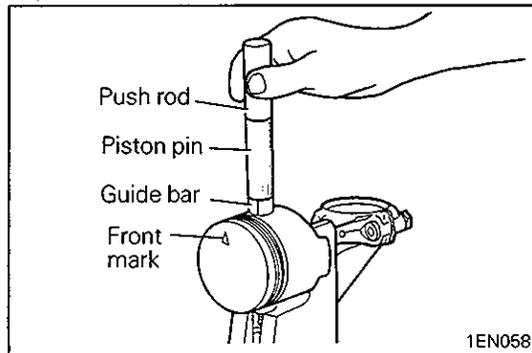
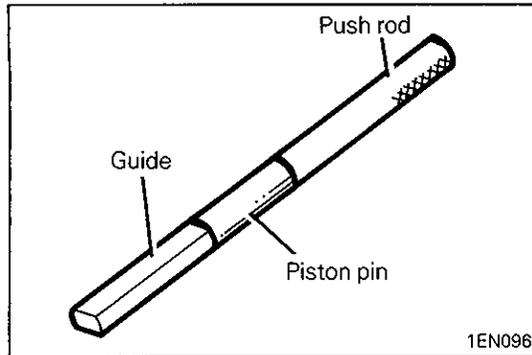
Caution

- **Do not attempt an undersize machining on crankshaft with special surface treatment. This type of crankshaft can be identified by its dull gray appearance.**

- (2) Measure the connecting rod bearing I.D. and crankshaft pin O.D. If the oil clearance exceeds the limit, replace bearing, and crankshaft if necessary.
Or, regrind the crankshaft to an undersize and replace bearing with an undersize one.

Standard value: 0.02 – 0.05 mm (0.0008 – 0.0020 in.)

Limit: 0.10 mm (0.0039 in.)



SERVICE POINTS OF INSTALLATION

▶▶ INSTALLATION OF PISTON PIN

- (1) Attach the push rod and guide bar included in the special tool set to the piston pin.
- (2) Apply engine oil to the outer circumference of piston pin.

- (3) Place the piston and connecting rod on the special tool body with their front marks (arrow mark for piston and embossed mark for connecting rod) facing upward.
- (4) Insert the piston pin, guide bar and push rod assembled in step (1) into the piston and connecting rod.

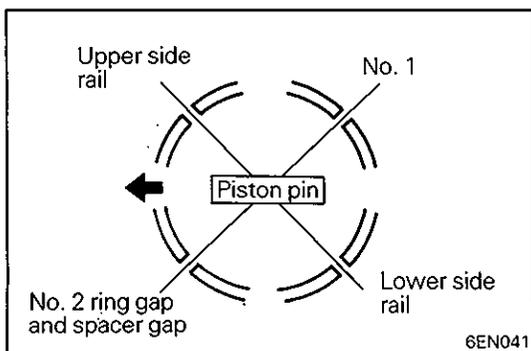
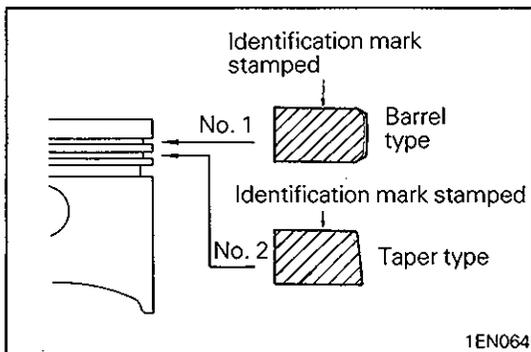
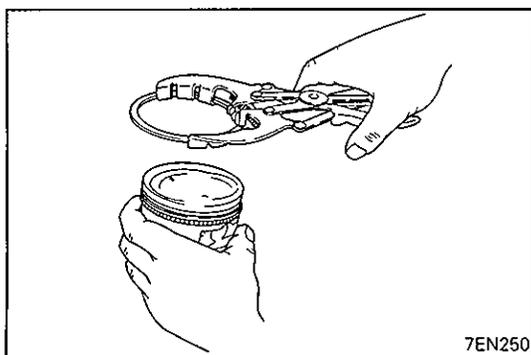
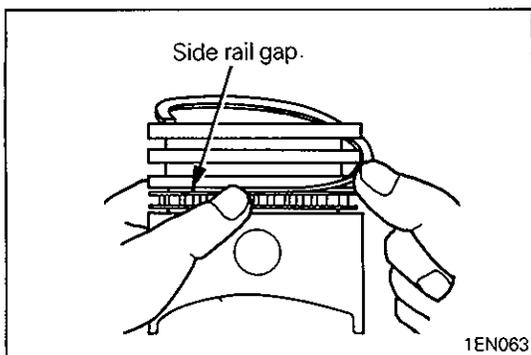
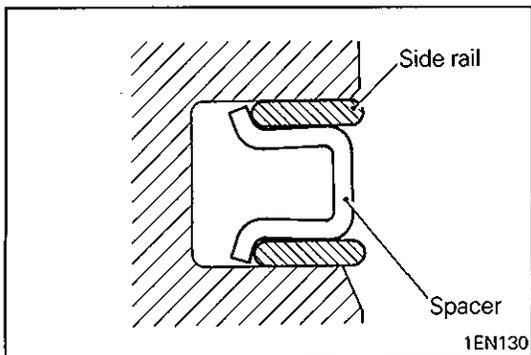
- (5) Position the guide so its two surfaces running in parallel to each other are oriented as shown.

- (6) Install the piston pin into connecting rod with a press until the guide reaches to the stopper.
- (7) If the press-fitting load is out of specification, replace the piston pin and piston set or connecting rod, or both.

Piston pin press-fitting load:

5,000 – 15,000 N

(500 – 1,500 kg, 1,102 – 3,307 lbs.)



◆B◆ INSTALLATION OF OIL RING

- (1) Fit the oil ring spacer into the piston ring groove.

NOTE

The side rails and spacer may be installed in either direction.

- (2) Install the upper side rail.

To install the side rail, first fit one end of the rail into the piston groove, then press the remaining portion into position by finger. See illustration.

NOTE

Do not use piston ring expander when installing side rail.

- (3) Install the lower side rail in the same procedure as described in step (2).
- (4) Make sure that the side rails move smoothly in either direction.

◆C◆ INSTALLATION OF PISTON RING NO. 2 / PISTON RING NO. 1

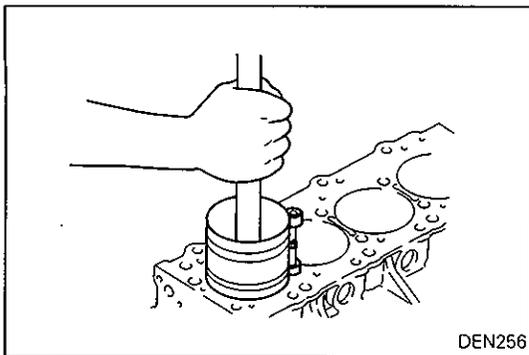
- (1) Using piston ring expander, fit No. 2 and then No. 1 piston ring into position.

NOTE

- (1) Note the difference in shape between No. 1 and No. 2 piston ring.
- (2) Install piston rings No. 1 and No. 2 with their side having marks facing up (on the piston crown side).

◆D◆ INSTALLATION OF PISTON AND CONNECTING ROD ASSEMBLY

- (1) Apply engine oil on the circumferences of the piston, piston ring and oil ring.
- (2) Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the figure.
- (3) Rotate the crankshaft so that the crank pin is on the center of the cylinder bore.



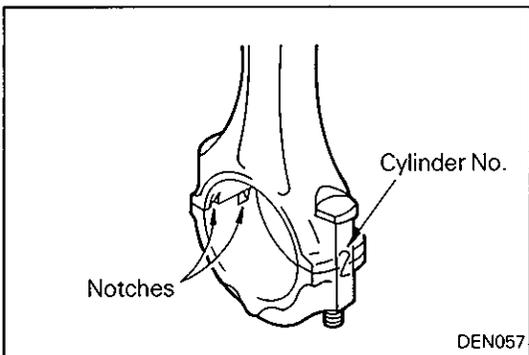
(4) Use appropriate thread protectors on connecting rod bolts before inserting the piston and connecting rod assembly into the cylinder block.

Be careful not to nick the crank pin.

(5) Using an appropriate piston ring compressor, install the piston and connecting rod assembly into the cylinder block.

Caution

- Face the front mark (arrow) on the piston top towards the engine front (timing belt).

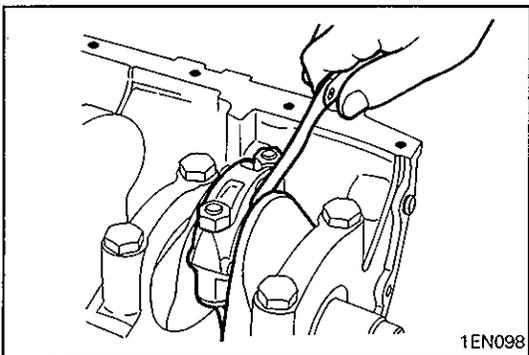


⇄ INSTALLATION OF CONNECTING ROD CAP

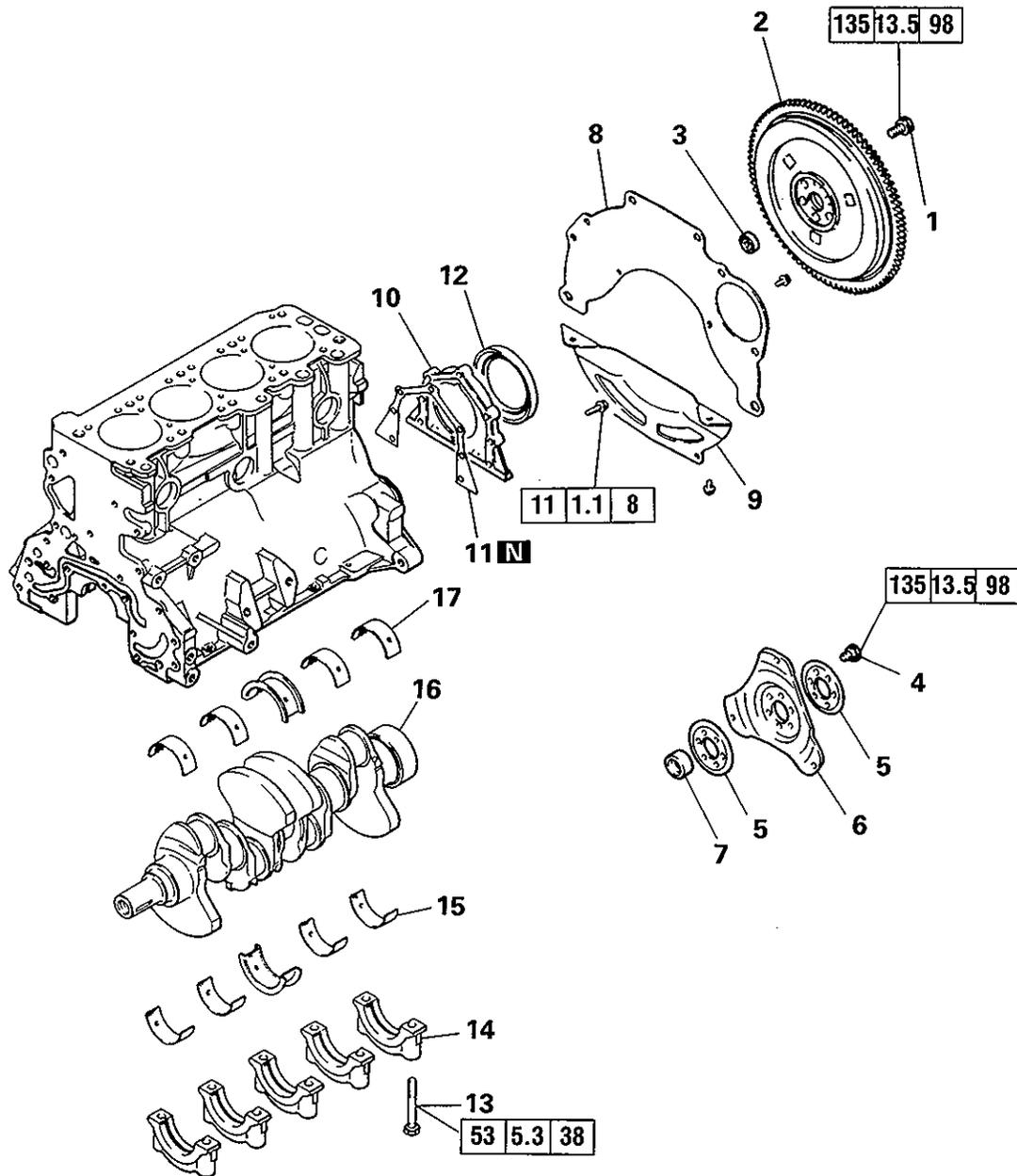
(1) Verifying the mark made during disassembly, install the bearing cap to the connecting rod. If the connecting rod is new with no index mark, make sure that the bearing locking notches come on the same side as shown.

(2) Make sure that connecting rod big end side clearance meets the specification.

Standard value: 0.10 – 0.25 mm (0.0039 – 0.0098 in.)
Limit: 0.4 mm (0.016 in.)



11. CRANKSHAFT, FLYWHEEL AND DRIVE PLATE REMOVAL AND INSTALLATION



Removal steps

1. Flywheel bolt
2. Flywheel
3. Ball bearing*
4. Drive plate bolt
5. Adaptor
6. Drive plate
7. Crankshaft bushing
8. Rear plate
9. Bell housing cover
10. Oil seal case
11. Gasket
- ◆D◆ 12. Oil seal
13. Bearing cap bolt
- ◆C◆ 14. Bearing cap
- ◆B◆ 15. Crankshaft bearing (lower)
16. Crankshaft
- ◆A◆ 17. Crankshaft bearing (upper)

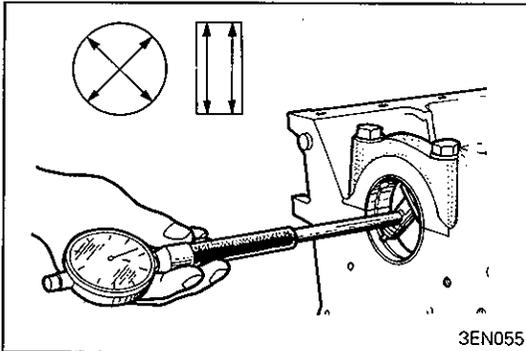
NOTE

*: Engines for rear wheel drive vehicles

3EN0036

INSPECTION**CRANKSHAFT**

- (1) Check the crankshaft journals and pins for streaks and seizure. Replace if necessary.



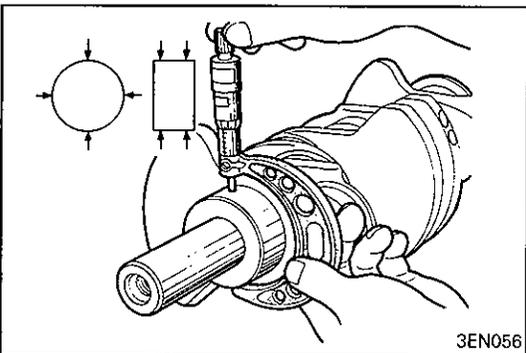
- (2) Measure the outside diameter of journal and inside diameter of crankshaft bearing. If the difference between them (oil clearance) exceeds the limit, replace the crankshaft bearing and, if necessary, crankshaft. When the crankshaft is to be reused by machining to undersize, the crankshaft bearings should be changed to undersized ones.

Standard value: 0.02 – 0.05 mm
(0.0008 in. – 0.0020 in.)

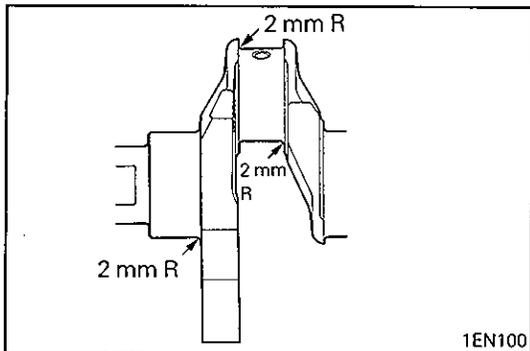
Limit: 0.1 mm (0.0039 in.)

Caution

- Do not attempt an undersized machining on the crankshaft with special surface treatment. This crankshaft can be identified by its dull gray appearance.

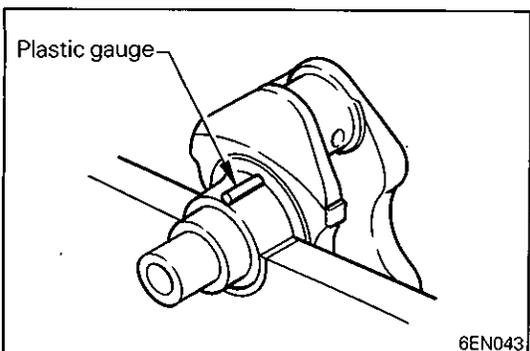


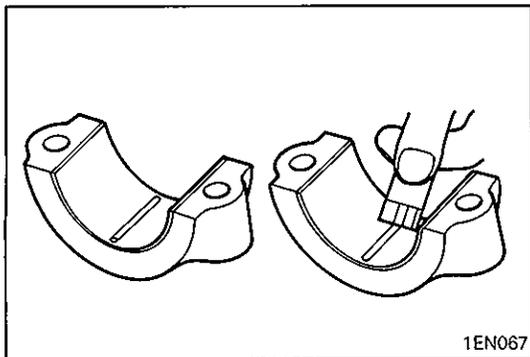
- (3) When the crankshaft is machined to undersize, finish the fillets of journals and pins to the specified radius.

**CRANKSHAFT OIL CLEARANCE (PLASTIC GAUGE METHOD)**

The crankshaft oil clearance can be measured easily by using a plastic gauge, as follows:

- (1) Remove oil and grease and any other foreign matters from crankshaft journal and bearing inner surface.
- (2) Install the crankshaft.
- (3) Cut the plastic gauge to the same length as the width of bearing and place it on journal in parallel with its axis.



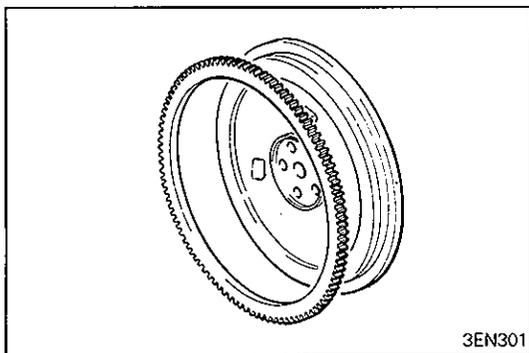


1EN067

- (4) Gently place the crankshaft bearing cap over it and tighten the bolts to the specified torque.
- (5) Remove the bolts and gently remove the crankshaft bearing cap.
- (6) Measure the width of the smashed plastic gauge at its widest section by using a scale printed on the plastic gauge bag.

CRANKSHAFT REAR OIL SEAL

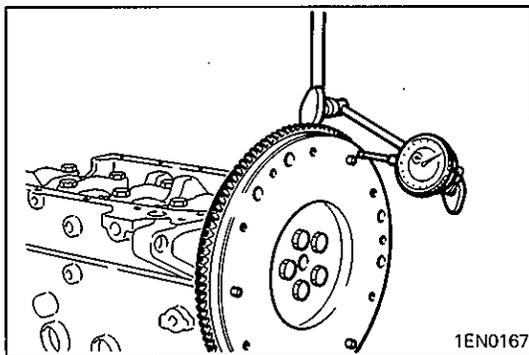
- (1) Check oil seal lip for wear and damage.
- (2) Check rubber for deterioration or hardening.
- (3) Check oil seal case for cracks and damage.



3EN301

RING GEAR

- (1) Check teeth of ring gear for wear and damage. If necessary, replace the ring gear.
- (2) If the ring gear teeth are worn or damaged, also check the starter motor pinion.
- (3) To remove the ring gear, strike the ring gear at several points on its outer circumference. The ring gear cannot be removed if it is heated.
To install the ring gear, heat the ring gear to 260 – 280°C (500 – 536 °F) for shrink fit.



1EN0167

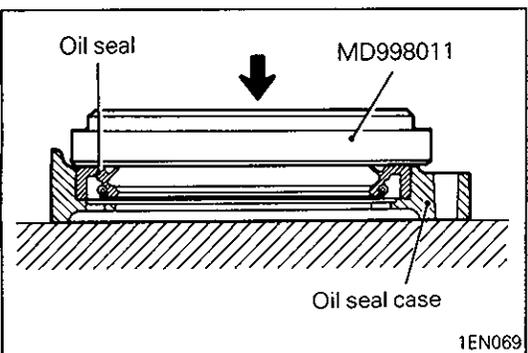
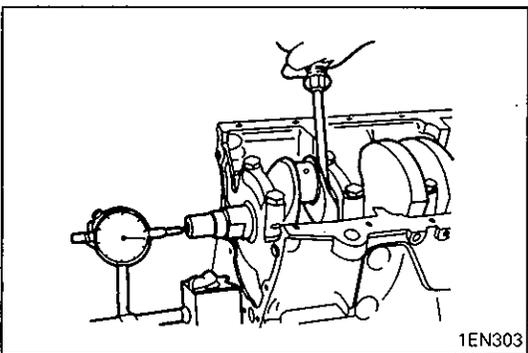
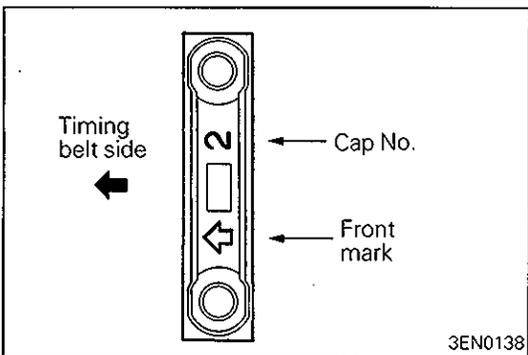
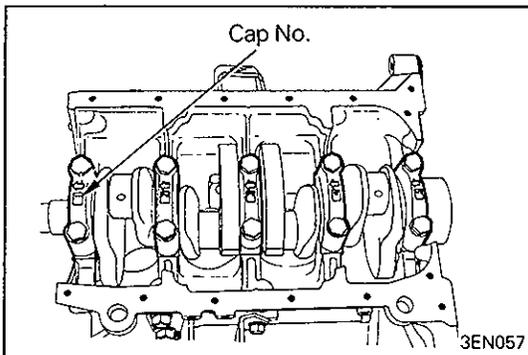
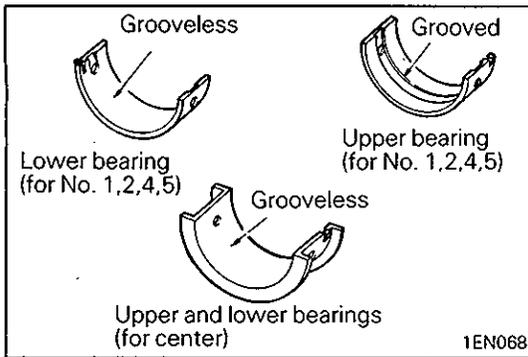
FLYWHEEL

- (1) Check the clutch disc friction surface for ridge wear, streaks, and seizure. If necessary, replace flywheel.
- (2) If the runout of flywheel exceeds the limit, replace.

Limit: 0.13 mm (0.0051 in.)

DRIVE PLATE

- (1) Check the drive plate for deformation, damage and cracks. If necessary, replace.



SERVICE POINTS OF REASSEMBLY

▶▶ INSTALLATION OF CRANKSHAFT BEARING (UPPER)

- (1) Install the upper crankshaft bearing to the cylinder block. There is an oil groove in the upper crankshaft bearing. There is no difference between upper and lower bearings for the center (with flange).

▶▶ INSTALLATION OF CRANKSHAFT BEARING (LOWER)

- (1) Install the lower crankshaft bearing (with no oil groove; there is no difference for center) to each bearing cap and apply engine oil to bearing surfaces.

▶▶ INSTALLATION OF BEARING CAP

- (1) Install according to the front mark and cap No.

- (2) After installing the bearing caps, make sure that the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace crankshaft bearings.

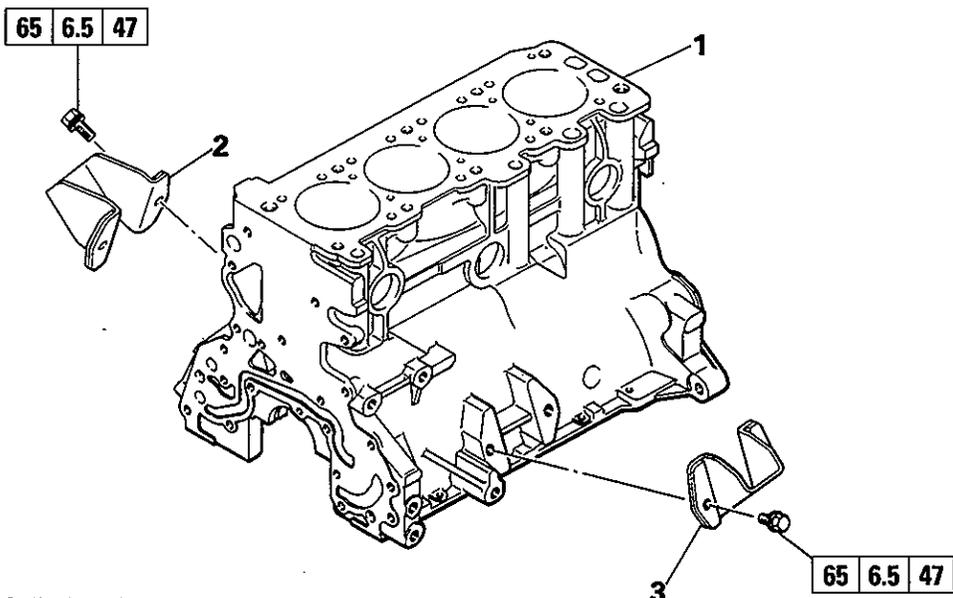
Standard value: 0.05 – 0.18 mm (0.0020 – 0.0071 in.)

Limit: 0.25 mm (0.0098 in.)

▶▶ INSTALLATION OF OIL SEAL

12 CYLINDER BLOCK

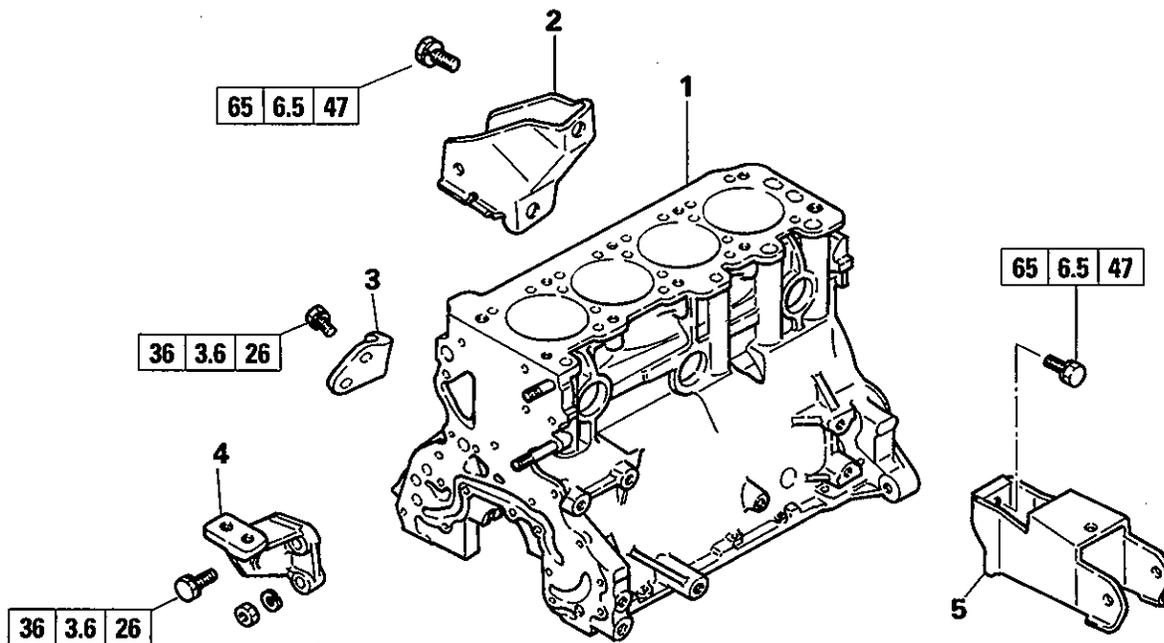
ENGINES FOR REAR WHEEL DRIVE VEHICLES



- 1. Cylinder block
- 2. Engine support bracket, right
- 3. Engine support bracket, left

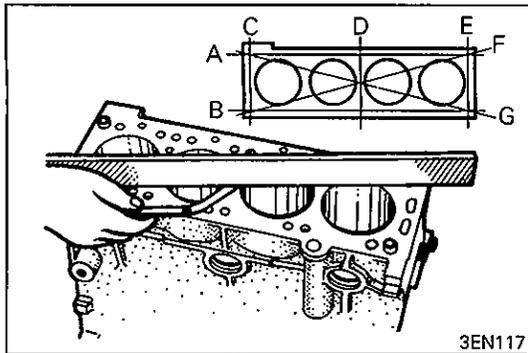
3EN296

ENGINES FOR FRONT WHEEL DRIVE VEHICLES



- 1. Cylinder block
- 2. Roll stopper bracket, front
- 3. Engine support bracket, right
- 4. Engine support bracket, left
- 5. Roll stopper bracket, rear

3EN278



**INSPECTION
CYLINDER BLOCK**

(1) Using a straightedge and feeler gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other foreign matters.

Standard value: 0.05 mm (0.0020 in.)
Limit: 0.1 mm (0.0039 in.)

(2) If the distortion is excessive, correct within the allowable limit or replace.

Grinding limit: 0.2 mm (0.008 in.)*

* Maximum of 0.2 mm (0.008 in.) for grinding is permitted.

Caution

- This is a combined total dimension of stock removal from cylinder head (if any) and block top surface.

Cylinder block height (When new):
285.1 – 285.3 mm (11.224 – 11.232 in.)

(3) Check cylinder walls for scratches and seizure. If defects are evident, correct (bored to oversize) or replace.

(4) Using cylinder gauge, measure the cylinder bore and cylindricity. If worn badly, correct cylinder to an oversize and replace piston and piston rings. Measure at the points shown in illustration.

Standard value:

Cylinder I.D.

73.00 – 73.03 mm (2.8740 – 2.8752 in.) 4G33

76.90 – 76.93 mm (3.0278 – 3.0287 in.) 4G32

80.60 – 80.63 mm (3.1732 – 3.1744 in.) 4G37

Cylindricity: 0.01 mm (0.0004 in.)

BORING CYLINDER

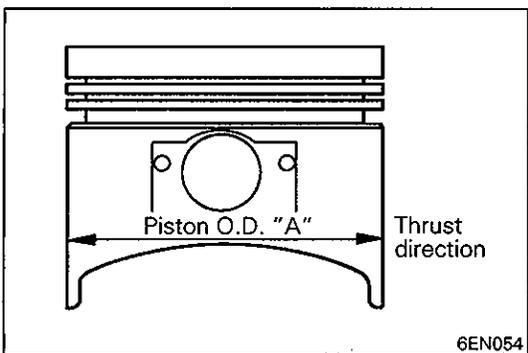
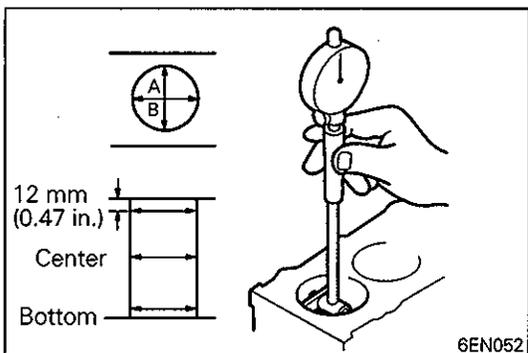
(1) Oversize pistons to be used should be determined on the basis of the largest bore cylinder.

Piston size identification

Size	Identification mark
0.50 mm (0.02 in.) O.S.	0.50
1.00 mm (0.04 in.) O.S.	1.00

NOTE

Size mark is stamped on piston top.



- (2) Measure outside diameter of piston to be used. Measure it in thrust direction as shown.
- (3) Based on measured piston O.D. calculate boring finish dimension.

Boring finish dimension = Piston O.D. + (clearance between piston O.D. and cylinder) – 0.02 mm (0.0008 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. + clearance between piston O.D. and cylinder.]
- (6) Check clearance between piston and cylinder.

**Clearance between piston and cylinder:
0.01 – 0.03 mm (0.0004 – 0.0012 in.)**

NOTE

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

NOTES