

# ENGINE

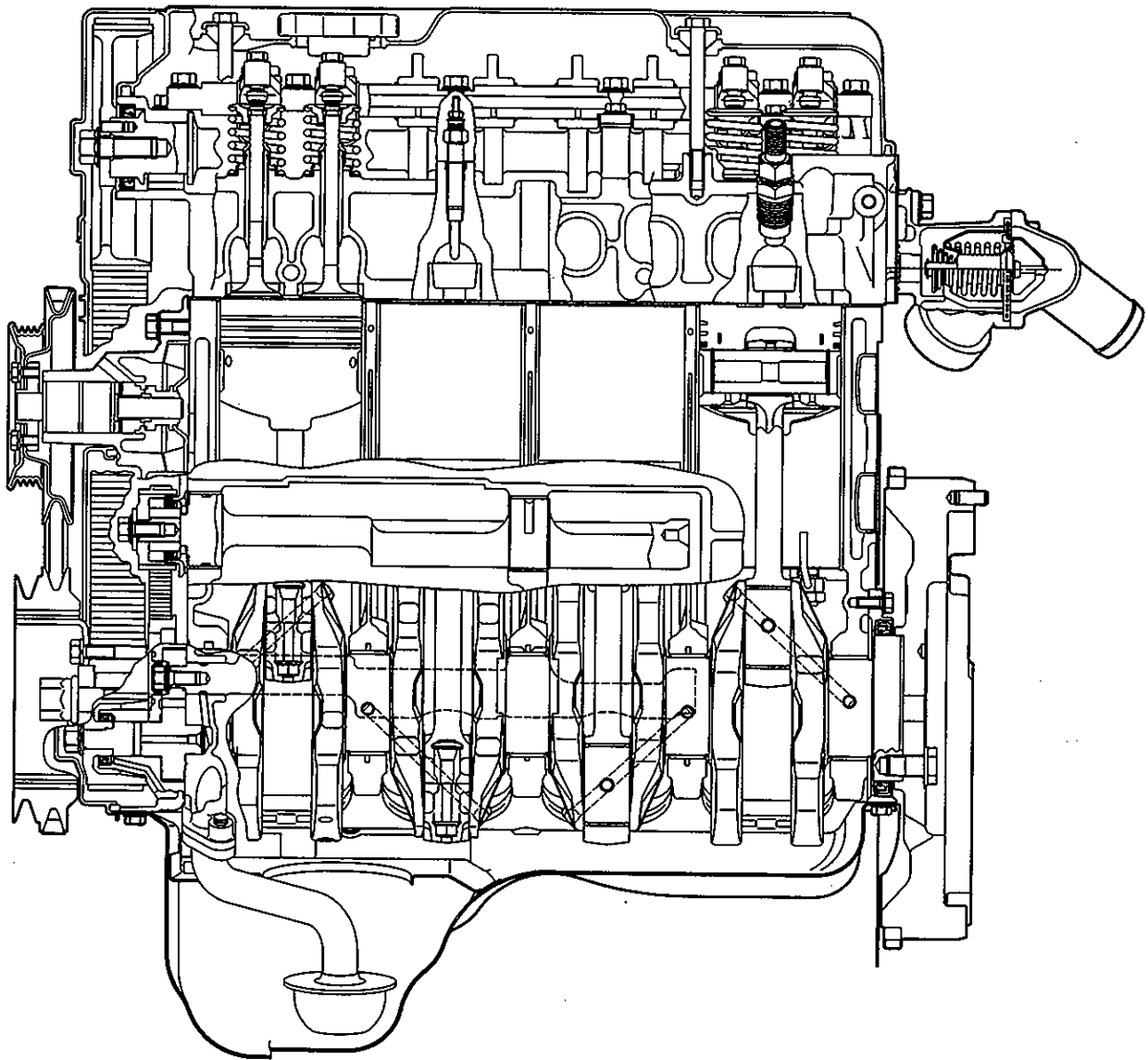
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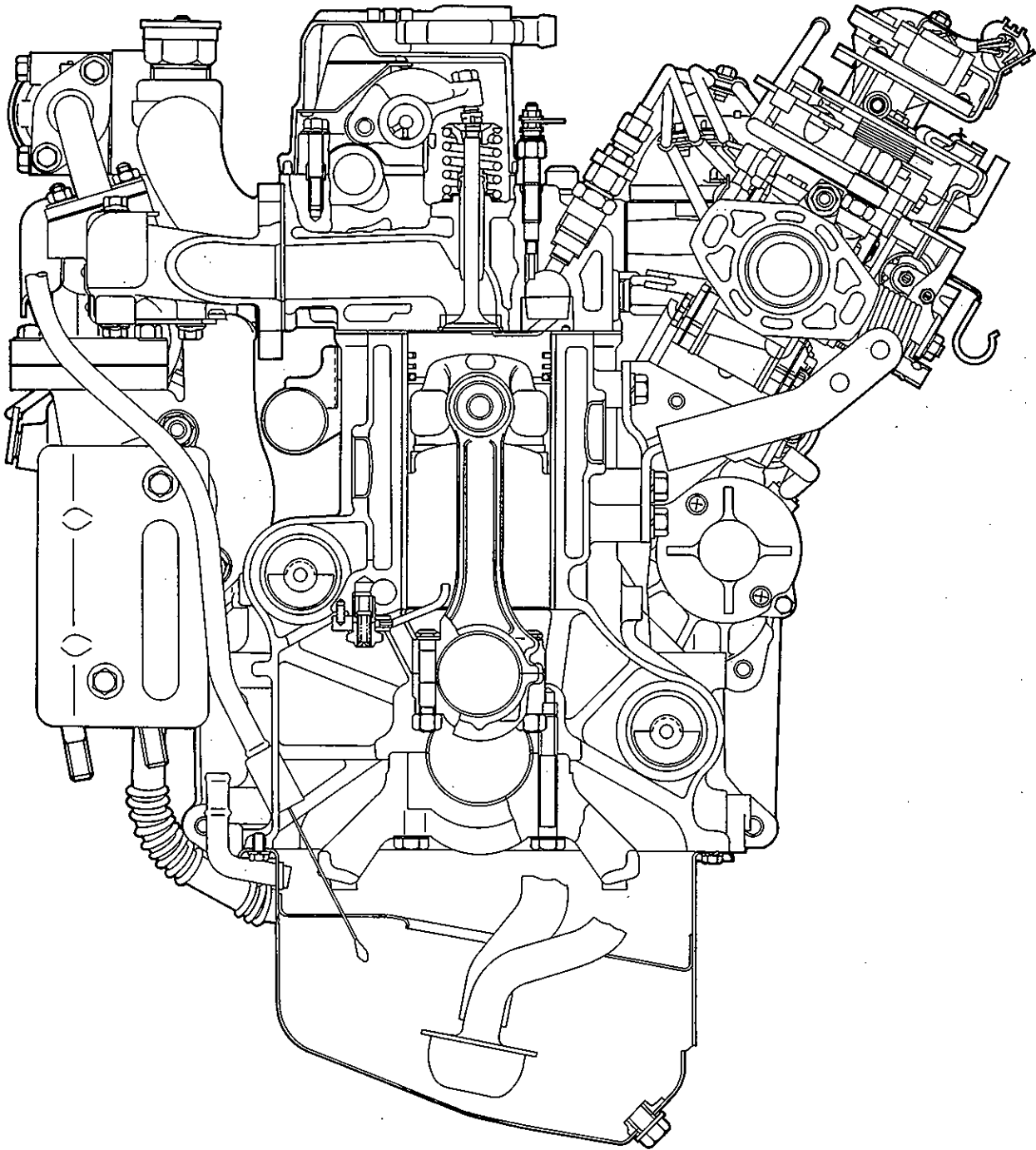
### CONTENTS

<b>GENERAL INFORMATION</b> .....	<b>11B- 0- 3</b>
<b>1. SPECIFICATIONS</b> .....	<b>11B- 1- 1</b>
<b>GENERAL SPECIFICATIONS</b> .....	<b>11B- 1- 1</b>
<b>SERVICE SPECIFICATIONS</b> .....	<b>11B- 1- 2</b>
<b>TORQUE SPECIFICATIONS</b> .....	<b>11B- 1- 5</b>
<b>SEALANT</b> .....	<b>11B- 1- 8</b>
<b>2. SPECIAL TOOLS</b> .....	<b>11B- 2- 1</b>
<b>3. DRIVE BELT AND GLOW PLUG</b> .....	<b>11B- 3- 1</b>
<b>4. TIMING BELT</b> .....	<b>11B- 4- 1</b>
<b>5. GLOW PLUGS, FUEL INJECTION PUMP AND INJECTION NOZZLES</b>	<b>11B- 5- 1</b>
<b>6. INTAKE AND EXHAUST MANIFOLDS</b> .....	<b>11B- 6- 1</b>
<b>7. TURBOCHARGER</b> .....	<b>11B- 7- 1</b>
<b>8. WATER PUMP, THERMOSTAT, HOSES AND PIPES</b> .....	<b>11B- 8- 1</b>
<b>9. ROCKER ARMS, ROCKER SHAFT AND CAMSHAFT</b> .....	<b>11B- 9- 1</b>
<b>10. CYLINDER HEAD, VALVES AND VALVE SPRINGS</b> .....	<b>11B-10- 1</b>
<b>11. FRONT CASE, SILENT SHAFTS AND OIL PAN</b> .....	<b>11B-11- 1</b>
<b>12. PISTONS AND CONNECTING RODS</b> .....	<b>11B-12- 1</b>
<b>13. CRANKSHAFT, CYLINDER BLOCK AND FLYWHEEL</b> .....	<b>11B-13- 1</b>

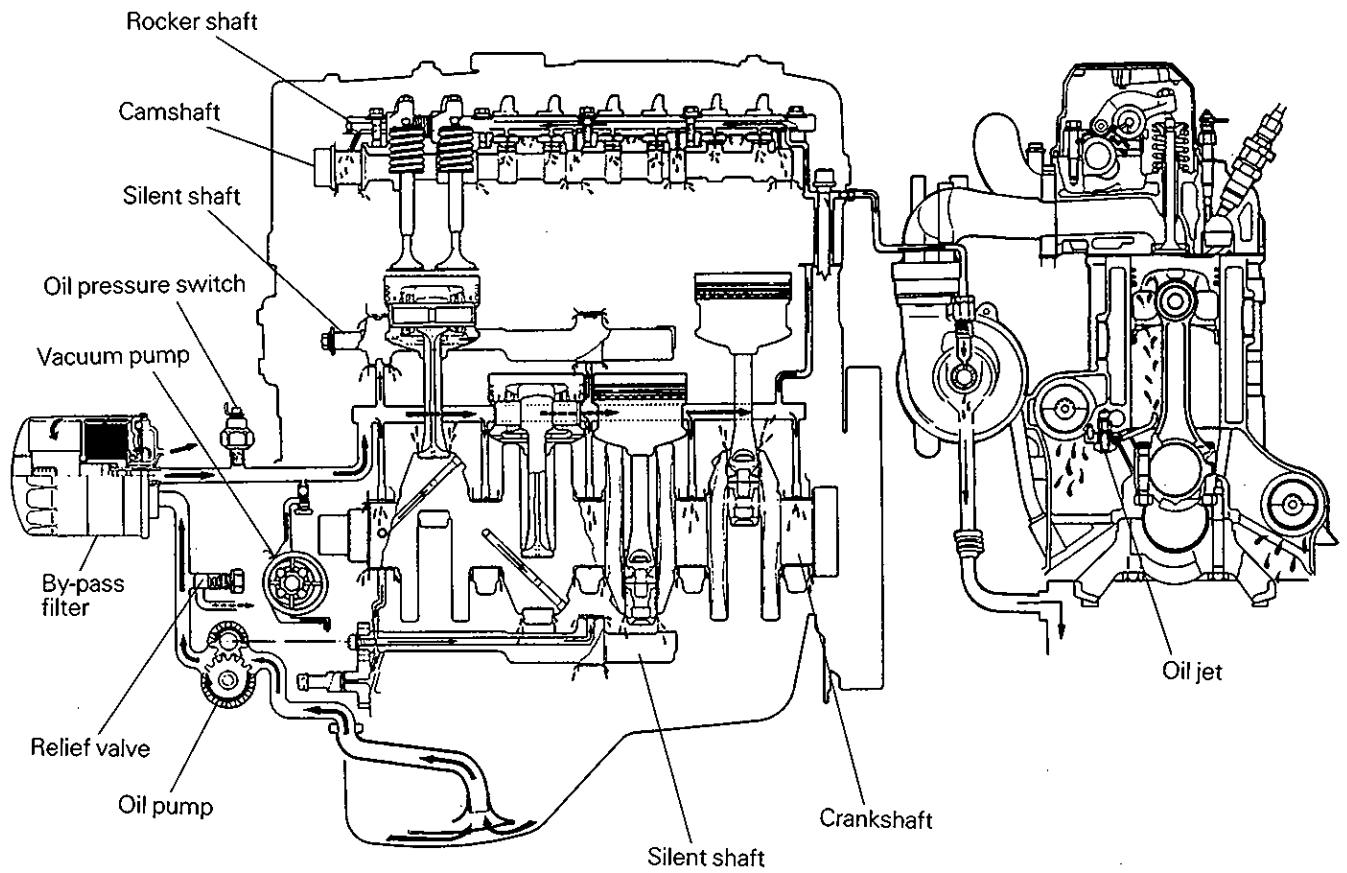
# GENERAL INFORMATION

## ENGINE SECTIONAL VIEW





LUBRICATION SYSTEM



DLU0737

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## NOTES

# 1. SPECIFICATIONS

## GENERAL SPECIFICATIONS

Description	Specifications
<b>Type</b> .....	Diesel engine
<b>No. and arrangement of cylinders</b> .....	4 in-line
<b>Combustion chamber</b> .....	Swirl chamber
<b>Total displacement</b> .....	1,998 cm <sup>3</sup> (121.9 cu.in.)
<b>Cylinder bore x stroke</b> .....	82.7 x 93.0 mm (3.26 x 3.66 in.)
<b>Compression ratio</b> .....	22.4
<b>Valve mechanism</b> .....	Single overhead camshaft
<b>Rocker arm</b> .....	Roller follower type
<b>Valve timing</b>	
Intake valve	
Open .....	20°BTDC
Close .....	48°ABDC
Exhaust valve	
Open .....	54°BBDC
Close .....	22°ATDC
<b>Lubrication system</b> .....	Pressure feed, full-flow filtration
<b>Oil pump type</b> .....	External gear type
<b>Turbocharger</b> .....	Water-cooled
<b>Cooling system</b> .....	Water-cooled, electric cooling fan
<b>Water pump type</b> .....	Centrifugal impeller type

## SERVICE SPECIFICATIONS

mm (in.)

	Standard	Limit
<b>Cylinder head</b>		
Flatness of gasket surface .....	0.05 (0.0020) .....	*0.2 (0.008)
* Grinding is not allowed for correction.		
Flatness of manifold mounting surface .....	0.15 (0.0059) .....	0.3 (0.012)
Overall height .....	86.9 – 87.1 (3.421 – 3.429)	
Oversize rework dimensions of valve guide hole (both intake and exhaust)		
0.05 .....	13.050 – 13.068 (0.5138 – 0.5145)	
0.25 .....	13.250 – 13.268 (0.5217 – 0.5224)	
0.50 .....	13.500 – 13.518 (0.5315 – 0.5322)	
Oversize rework dimensions of intake valve seat ring hole		
0.30 .....	38.300 – 38.325 (1.5079 – 1.5089)	
0.60 .....	38.600 – 38.625 (1.5197 – 1.5207)	
Oversize rework dimensions of exhaust valve seat ring hole		
0.30 .....	34.300 – 34.325 (1.3504 – 1.3514)	
0.60 .....	34.600 – 34.625 (1.3622 – 1.3632)	
<b>Camshaft</b>		
Cam height		
Intake .....	41.84 (1.6472) .....	41.34 (1.6276)
Exhaust .....	41.84 (1.6472) .....	41.34 (1.6276)
Journal diameter .....	29.935 – 29.950 (1.1785 – 1.1791)	
Oil clearance .....	0.05 – 0.09 (0.0020 – 0.0035)	
<b>Rocker arm</b>		
I.D. ....	18.910 – 18.928 (0.7445 – 0.7452)	
Rocker arm-to-shaft clearance .....	0.01 – 0.05 (0.0004 – 0.0020)	
<b>Rocker shaft</b>		
O.D. ....	18.878 – 18.898 (0.7432 – 0.7440)	
Overall length .....	410 (16.14)	
<b>Valve</b>		
Overall length		
Intake .....	114.05 (4.490)	
Exhaust .....	113.80 (4.480)	
Stem diameter		
Intake .....	N/A: 7.960 – 7.975 (0.3134 – 0.3140) T/C: 7.930 – 7.950 (0.3122 – 0.3130)	
Exhaust .....	7.930 – 7.950 (0.3122 – 0.3130)	
Face angle .....	45° – 45°30'	
Thickness of valve head (margin)		
Intake .....	1.5 (0.059) .....	0.7 (0.028)
Exhaust .....	1.5 (0.059) .....	0.7 (0.028)
Stem-to-guide clearance		
Intake .....	N/A: 0.03 – 0.06 (0.0012 – 0.0024) .....	0.10 (0.0039)
	T/C: 0.05 – 0.09 (0.0020 – 0.0035) .....	0.10 (0.0039)
Exhaust .....	0.05 – 0.09 (0.0020 – 0.0035) .....	0.15 (0.0059)

mm (in.)

	Standard	Limit
<b>Valve spring</b>		
Free height .....	49.1 (1.934) .....	48.1 (1.895)
Load/installed height .....	276 (27.6, 61)/40.4 (1.591)	
N (kg, lbs.)/mm (in.)		
Out-of squareness .....	.2° or less .....	Max 4°
<b>Valve guide</b>		
I.D. ....	8.000 – 8.018 (0.3150 – 0.3157)	
O.D. ....	13.06 – 13.07 (0.5142 – 0.5146)	
Service size .....	0.05 (0.002), 0.25 (0.010), 0.50 (0.020) oversize	
Press-in temperature .....	Room temperature	
<b>Valve seat</b>		
Seat angle .....	45°	
Valve contact width .....	0.9 – 1.3 (0.035 – 0.051)	
Valve stem projection .....	43.45 (1.7106) .....	43.95 (1.7303)
Service size .....	0.30 (0.012), 0.60 (0.024) over size	
<b>Silent shaft</b>		
Journal diameter		
Right (front) .....	41.959 – 41.975 (1.6519 – 1.6526)	
(rear) .....	40.951 – 40.967 (1.6122 – 1.6129)	
Left (front) .....	18.467 – 18.480 (0.7270 – 0.7276)	
(rear) .....	40.951 – 40.967 (1.6122 – 1.6129)	
Oil clearance		
Right (front) .....	0.02 – 0.06 (0.0008 – 0.0024)	
(rear) .....	0.05 – 0.09 (0.0020 – 0.0036)	
Left (front) .....	0.02 – 0.05 (0.0008 – 0.0020)	
(rear) .....	0.05 – 0.09 (0.0020 – 0.0036)	
<b>Piston</b>		
O.D. ....	82.66 – 82.69 (3.2543 – 3.2555)	
Piston-to-cylinder clearance .....	0.03 – 0.05 (0.0012 – 0.0020)	
<b>Piston ring</b>		
End gap		
No. 1 ring .....	0.20 – 0.32 (0.0079 – 0.0126) .....	0.8 (0.031)
No. 2 ring .....	0.35 – 0.50 (0.0138 – 0.0197) .....	0.8 (0.031)
Oil ring .....	0.10 – 0.30 (0.0039 – 0.0118) .....	0.8 (0.031)
Ring-to-ring groove clearance		
No. 1 ring .....	0.05 – 0.07 (0.0020 – 0.0028) .....	0.1 (0.004)
No. 2 ring .....	N/A: 0.02 – 0.06 (0.0008 – 0.0024) .....	0.1 (0.004)
	T/C: 0.05 – 0.07 (0.0020 – 0.0028) .....	0.1 (0.004)
Oil ring .....	0.02 – 0.07 (0.0008 – 0.0028) .....	0.1 (0.004)
Service size .....	0.25 (0.010), 0.50 (0.020), 0.75 (0.030), 1.00 (0.039) oversize	



	Standard	Limit	mm (in.)
<b>Piston pin</b>			
O.D. ....	24.994 – 25.000 (0.9840 – 0.9843)		
<b>Connecting rod</b>			
Big end center-to-small end center length .....	149.9 – 150.0 (5.902 – 5.906)		
Bend .....	0.05 (0.0020)		
Twist .....	0.10 (0.0039)		
Big end side clearance .....	0.10 – 0.25 (0.0039 – 0.0098)	0.4 (0.016)	
<b>Crankshaft</b>			
End play .....	0.05 – 0.18 (0.0020 – 0.0071)	0.25 (0.0098)	
Journal O.D. ....	56.98 – 57.00 (2.2433 – 2.440)		
Pin O.D. ....	44.98 – 45.00 (1.7709 – 1.7717)		
Out-of-roundness and taper of journal .....	0.005 (0.0002)		
and pin			
Concentricity of journal .....	0.015 (0.0006)		
Oil clearance of journal .....	0.02 – 0.04 (0.0008 – 0.0016)	0.1 (0.004)	
Oil clearance of pin .....	0.02 – 0.05 (0.0008 – 0.0020)	0.1 (0.004)	
<b>Cylinder block</b>			
Cylinder I.D. ....	82.70 – 82.73 (3.2559 – 3.2571)		
Flatness of gasket surface .....	0.05 (0.002)	*0.1 (0.004)	
*Grinding is not allowed for correction.			
Overall height .....	289.95 – 290.05 (11.4153 – 11.4193)		
<b>Oil pump</b>			
Side clearance			
Drive gear .....	0.08 – 0.14 (0.0031 – 0.0055)		
Driven gear .....	0.06 – 0.12 (0.0024 – 0.0047)		
Drive belt			
Deflection .....	7 – 10 (0.28 – 0.39)		

## NOTE

O.D.: Outer Diameter

I.D.: Inner Diameter

U.S.: Undersize Diameter

**TORQUE SPECIFICATIONS**

	Nm	Torque kgm	ft.lbs.
<b>Drive belt and glow plug</b>			
Oil level gauge guide bolt	M6 ..... 10	1.0	7
	M8 ..... 14	1.4	11
Water pump pulley bolt	9	0.9	7
Eye bolt	17	1.7	12
Generator brace bolt	14	1.4	10
Generator pivot bolt	23	2.3	17
Crankshaft pulley bolt	25	2.5	18
Glow plug	18	1.8	13
<b>Timing belt</b>			
Timing belt tensioner bolt	49	4.9	35
Tensioner spacer bolt	14	1.4	11
Timing belt idler bolt	49	4.9	35
Camshaft sprocket bolt	90	9.0	65
Injection pump sprocket nut	85	8.5	61
Crankshaft sprocket bolt	120	12.0	87
Oil pump sprocket nut	55	5.5	40
Silent shaft sprocket bolt	46	4.6	33
Timing belt "B" tensioner bolt	19	1.9	14
Crankshaft position sensor bolt	9	0.9	7
<b>Fuel injection pump and injection nozzle</b>			
Injection pipe union nut	30	3.0	22
Injection pipe clamp bolt	9	0.9	6.5
Engine hanger nut	12	1.2	9
Fuel injection pump nut	24	2.4	17
Injection pump stay bolt	19	1.9	14
Injection pump-to-pump stay bolt	24	2.4	17
Pump stay-to-cylinder block bolt	36	3.6	26
Fuel return pipe nut	30	3.0	22
Injection nozzle	55	5.5	40
Injection pump bracket nut	24	2.4	17
<b>Intake and exhaust manifolds</b>			
EGR valve bolt			
CB8A and CB8W only	25	2.5	18
Except CB8A and CB8W	18	1.8	13
EGR pipe bolt and nut	18	1.8	13
Eye bolt (oil pipe)	17	1.7	12
Oil return pipe bolt	9	0.9	7
Exhaust fitting bolt and nut	60	6.0	43
Eye bolt (water pipe)	31	3.1	24
Turbocharger bolt	60	6.0	43
Water pipe bolt	10	1.0	7

	Nm	Torque kgm	ft.lbs.
Air intake fitting bolt .....	18	1.8	13
Intake fitting stay bolt .....	18	1.8	13
Intake manifold bracket bolt .....	14	1.4	11
Relief valve .....	50	5.0	36
Intake manifold bolt and nut .....	18	1.8	13
Heat protector bolt			
Engine without turbocharger .....	30	3.0	22
Engine with turbocharger .....	14	1.4	11
Exhaust manifold nut			
Engine without turbocharger .....	18	1.8	13
Engine with turbocharger .....	28	2.8	20
<b>Turbocharger</b>			
Waste gate actuator bolt .....	12	1.2	9
Coupling bolt .....	5	0.5	4
<b>Water pump, thermostat, hose and pipe</b>			
Engine coolant temperature gauge unit			
Except SPACE RUNNER 1997 models and on ...	35	3.5	25
SPACE RUNNER 1997 models and on .....	11	1.1	8
Engine coolant temperature sensor .....	36	3.6	26
Engine coolant temperature switch			
Engine with turbocharger .....	8	0.8	6
N18W and N38W only .....	30	3.0	22
Water pump bolt			
Bolt which also tightens generator brace .....	24	2.4	17
Bolt not tightening generator brace .....	14	1.4	10
Water inlet pipe bolt .....	13	1.3	9
Water inlet fitting bolt .....	13	1.3	9
Water outlet fitting bolt .....	24	2.4	17
Thermostat housing bolt .....	24	2.4	17
<b>Rocker arm, rocker shaft and camshaft</b>			
Rocker cover bolt .....	6	0.6	4
Rocker shaft support bolt .....	20	2.0	14
Rocker shaft bolt .....	30	3.0	22
Camshaft bearing cap bolt .....	20	2.0	14
Rocker arm adjusting screw lock nut .....	15	1.5	11
<b>Cylinder head, valves and valve spring</b>			
Cylinder head bolt .....	40+1/4 turns +1/4 turns	4.0+1/4 turn +1/4 turn	29+1/4 turn +1/4 turn
<b>Front case, silent shaft and oil pan</b>			
Oil drain plug .....	40	4.0	29
Oil level sensor .....	9	0.9	7
Oil pan bolt .....	7	0.7	5
Oil screen bolt .....	19	1.9	14
Oil cooler by-pass valve .....	55	5.5	40
Oil pressure switch .....	10	1.0	7

	Nm	Torque kgm	ft.lbs.
<b>Front case, silent shaft and oil pan</b>			
Relief plug .....	45	4.5	33
Oil filter bracket bolt .....	19	1.9	14
Plug .....	24	2.4	17
Left silent shaft flange bolt .....	37	3.7	27
Front case bolt .....	24	2.4	17
Oil pump cover screw .....	10	1.0	7
Oil pump cover bolt .....	17	1.7	12
Check valve .....	33	3.3	24
Stiffener plate bolt .....	22	2.2	16
<b>Piston and connecting rod</b>			
Connecting rod cap nut .....	20+1/4 turns	2.0+1/4 turns	14.5+1/4 turns
<b>Crankshaft, cylinder block and flywheel</b>			
Front engine support bracket .....	60	6.0	43
Flywheel bolt .....	135	13.5	98
Oil seal case bolt .....	11	1.1	8
Bearing cap bolt .....	25+1/4 turns	2.5+1/4 turns	18+1/4 turns

### **NEW TIGHTENING METHOD – BY USE OF BOLTS TO BE TIGHTENED IN PLASTIC AREA**

A new type of bolts, to be tightened in plastic area, is currently used in some parts of the engine. The tightening method for the bolts is different from the conventional one. Be sure to observe the method described in the text when tightening the bolts.

Service limits are provided for the bolts. Make sure that the service limits described in the text are strictly observed.

- Areas where the bolts are in use:
  - (1) Cylinder head bolts
  - (2) Main bearing cap bolts
  - (3) Connecting rod cap bolts

- Tightening Method

After tightening the bolts to the specified torque, tighten them another 90° or 180° (twice 90°). The tightening method varies on different areas. Observe the tightening method described in the text.

**SEALANT**

	Specified sealant	Quantity
Thermostat housing .....	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Water outlet fitting .....	Mitsubishi Genuine Part No. MD970389 or equivalent	As required
Engine coolant temperature gauge unit .....	3M Nut Locking Part No. 4171 or equivalent	As required
Engine coolant temperature sensor .....	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 No. MD970389 or equivalent	As required
Oil pressure switch .....	3M ATD Part No. 8660 or equivalent	As required
Oil seal case .....	Mitsubishi Genuine Part No. MD970389 or equivalent	As required

## FORM-IN-PLACE GASKET

The engine has several areas where the form-in-place gasket (FIPG) is in use. To ensure that the gasket fully serves its purpose, it is necessary to observe some precautions when applying the gasket. Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other hand, could be squeezed out of location, causing blocking or narrowing of the fluid feed line. To eliminate the possibility of leaks from a joint, therefore, it is absolutely necessary to apply the gasket evenly without a break, while observing the correct bead size.

The FIPG used in the engine is a room temperature vulcanization (RTV) type and is supplied in a 100-gram tube (Part No. MD970389 or MD997110). Since the RTV hardens as it reacts with the moisture in the atmospheric air, it is normally used in the metallic flange areas. The FIPG, Part No. MD970389, can be used for sealing both engine oil and coolant, while Part No. 997110 can only be used for engine oil sealing.

### Disassembly

The parts assembled with the FIPG can be easily disassembled without use of a special method. In some cases, however, the sealant between the joined surfaces may have to be broken by lightly striking with a mallet or similar tool. A flat and thin gasket scraper may be lightly hammered in between the joined surfaces. In this case, however, care must be taken to prevent damage to the joined surfaces. For removal of the oil pan, the special tool "Oil Pan Remover" (MD998727) is available. Be sure to use the special tool to remove the oil pan.

### Surface Preparation

Thoroughly remove all substances deposited on the gasket application surfaces, using a gasket scraper or wire brush. Check to ensure that the surfaces to which the FIPG is to be applied is flat. Make sure that there are no oils, greases and foreign substances deposited on the application surfaces. Do not forget to remove the old sealant remaining in the bolt holes.

### Form-In Place Gasket Application

When assembling parts with the FIPG, you must observe some precautions, but the procedure is very simple as in the case of a conventional pre-cut gasket.

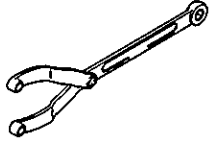
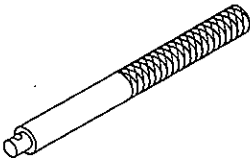
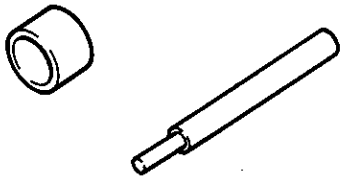
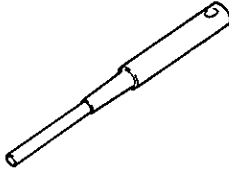



Applied FIPG bead should be of the specified size and without breaks. Also be sure to encircle the bolt hole circumference with a completely continuous bead. The FIPG can be wiped away unless it is hardened. While the FIPG is still moist (in less than 15 minutes), mount the parts in position. When the parts are mounted, make sure that the gasket is applied to the required area only.

The FIPG application procedure may vary on different areas. Observe the procedure described in the text when applying the FIPG.


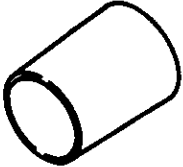
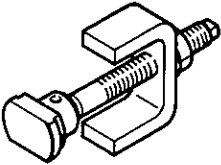
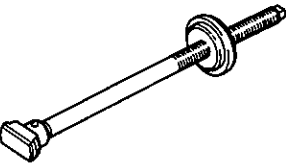
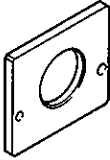
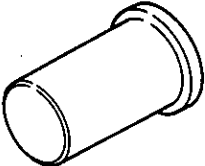
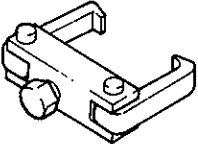
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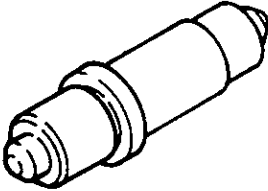
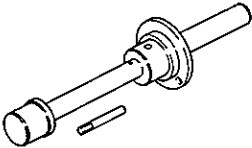

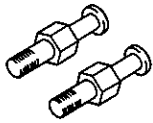
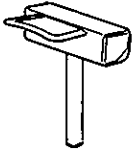
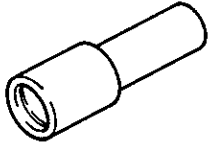
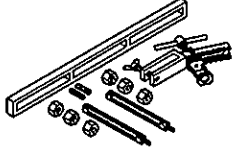
## NOTES

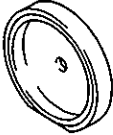
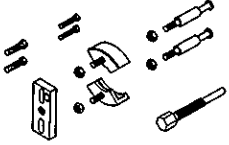
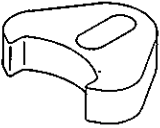
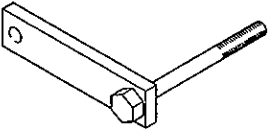
## 2. SPECIAL TOOLS

Tool	Number	Name	Use
	MB990767	End yoke holder	Holding camshaft sprocket or fuel injection pump when loosening or tightening bolts. Use with MD998719
	MD990938	Handle	Installation of crankshaft rear oil seal (Use with MD998776)
	MD998115	Valve guide installer	Removal and installation of valve guide
	MD998148	Valve seat cutter pilot	Correction of valve seat
	MD998158 (intake) MD998159 (exhaust)	Valve seat cutter 45°	Correction of valve seat
	MD998162	Plug wrench	Removal and installation of front case cap plug
	MD998165	Valve seat cutter 65°	Correction of valve seat

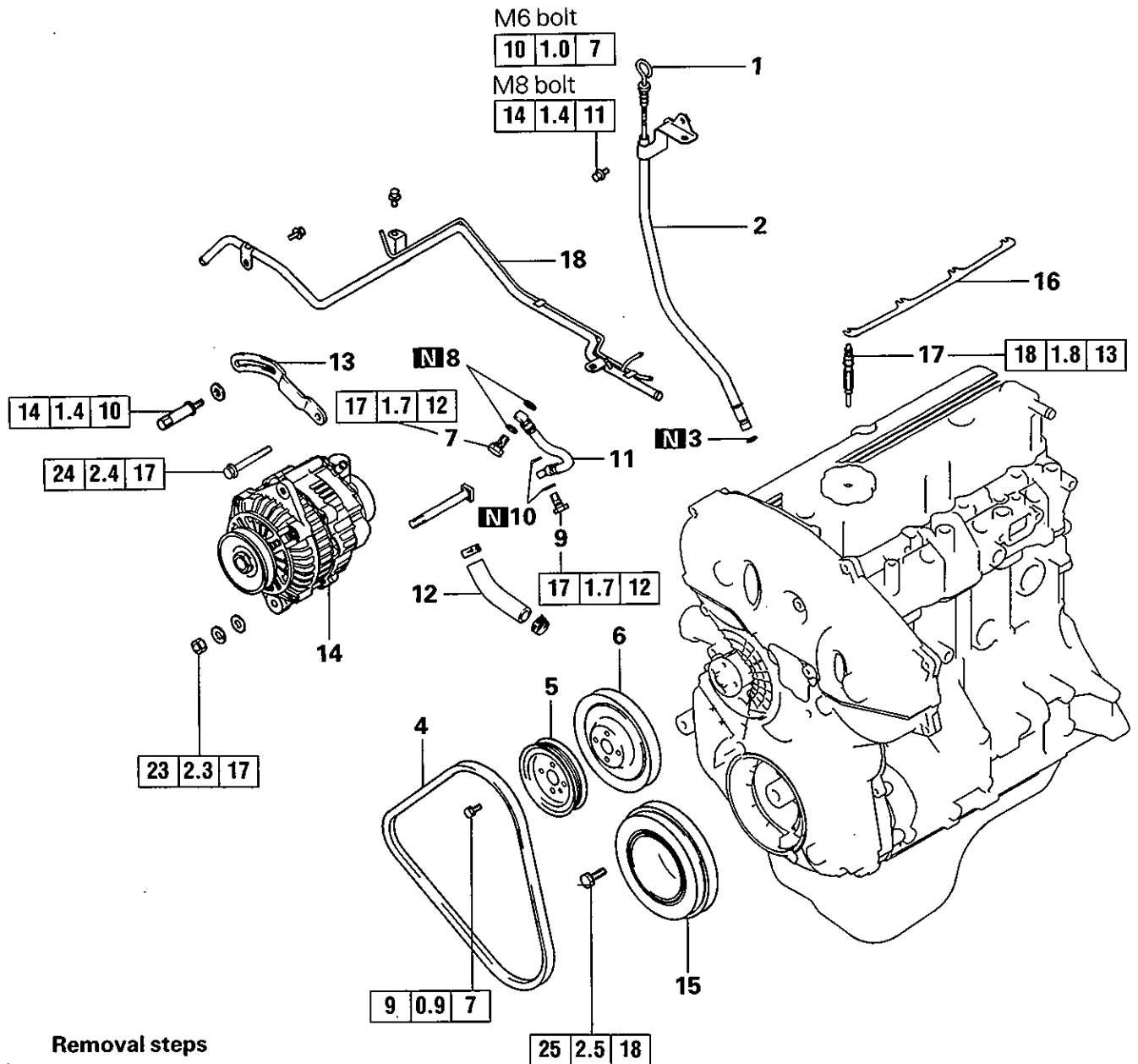


Tool	Number	Name	Use
	MD998173 (exhaust) MD998175 (intake)	Valve seat cutter 30°	Correction of valve seat
	MD998285	Crankshaft front oil seal guide	Guide for installation of crankshaft front oil seal
	MD998371	Silent shaft bearing puller	Removal of silent shaft front bearing
	MD998372	Silent shaft bearing puller	Removal of silent shaft rear bearing
	MD998374	Bearing installer stopper	A guide for removal and installation of silent shaft left rear bearing
	MD998375	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MD998388	Injection pump sprocket puller	Removal of injection pump sprocket

Tool	Number	Name	Use
	MD998702	Connecting-rod small-end bushing replacement tool	Replacement of connecting-rod small-end bushing
	MD998705	Silent shaft bearing installer	Installation of silent shaft bearing
	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998719	Pulley holder pin (2)	Use with MB990767
	MD998727	Oil pan sealer cutter	Removal of oil pan
	MD998729	Valve stem seal installer	Installation of valve stem seal
	MD998772	Valve spring compressor	Compression of valve spring

Tool	Number	Name	Use
	MD998776	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal (Use with MB990938)
	MD998778	Crankshaft sprocket puller	Removal of crankshaft sprocket
	MD998779	Sprocket stopper	Holding of silent shaft sprocket
	MD998781	Flywheel stopper	Holding of flywheel and drive plate

### 3. DRIVE BELT AND GLOW PLUG REMOVAL AND INSTALLATION



**Removal steps**

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
- ▶B▶ 4. Drive belt (V-type)
5. Pulley (for power steering pump drive)
6. Water pump pulley
7. Eye bolt
8. Gasket
9. Eye bolt
10. Gasket
11. Oil tube
12. Oil hose
13. Generator brace
14. Generator
15. Crankshaft pulley
16. Glow plug plate
- ◁A▶▶A▶▶ 17. Glow plug
18. Vacuum pipe

**REMOVAL SERVICE POINTS****◁A▷ GLOW PLUG REMOVAL**

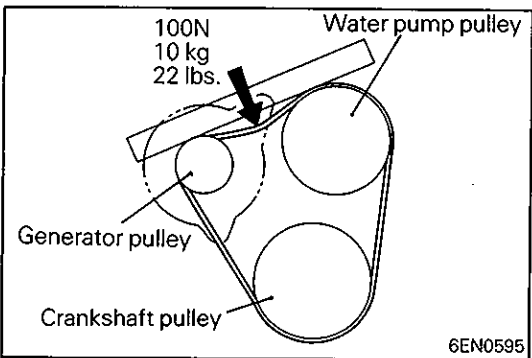
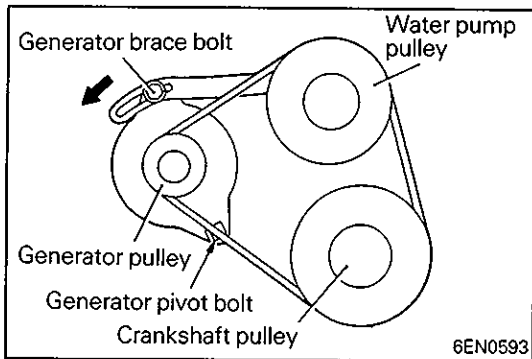
- (1) When removing the glow plug, you may loosen using a tool up to the point where one or more threads are left in engagement. Beyond this point, loosen with fingers.

**Caution**

- Do not reuse a glow plug that has been dropped from a height of 10 cm (4 in.) or more.

**INSTALLATION SERVICE POINTS****▷A◁ GLOW PLUG INSTALLATION**

- (1) When installing the glow plug, screw in one thread or more with fingers and then tighten with a tool.

**▷B◁ DRIVE BELT TENSION ADJUSTMENT**

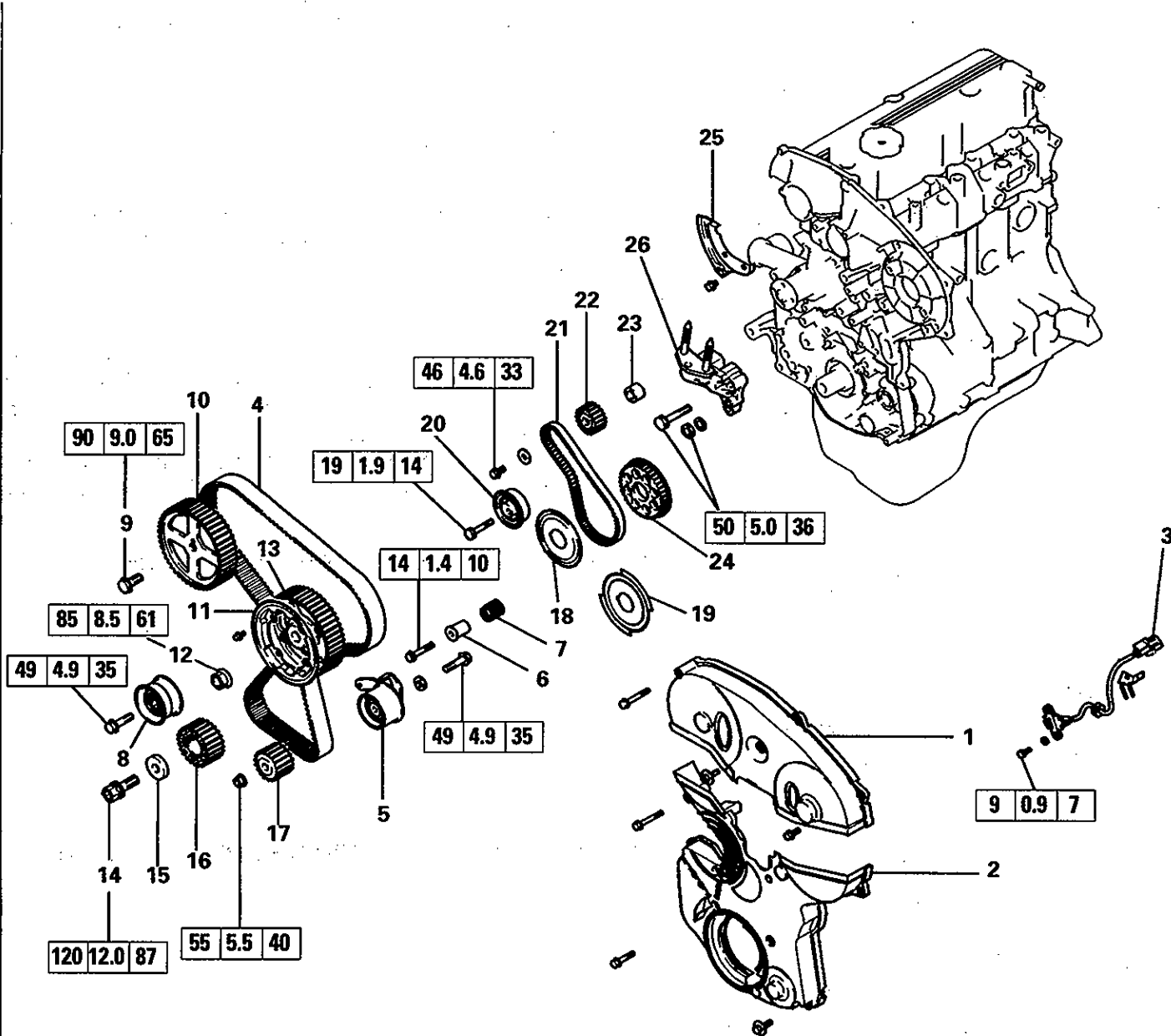
- (1) Loosen the nut for the generator pivot bolt.
- (2) Loosen the generator brace bolt.
- (3) Move the generator to give greater tension to the belt so that the specified deflection is obtained.

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

- (4) Tighten the generator brace bolt.
- (5) Tighten the nut for the generator support bolt.

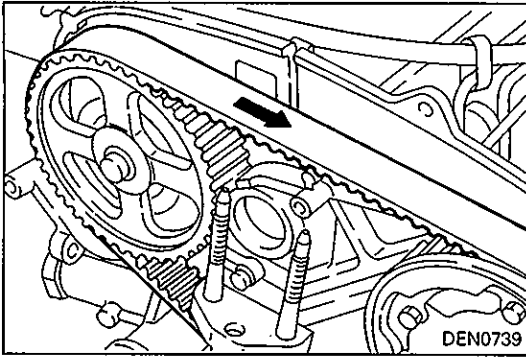
# 4. TIMING BELT

## REMOVAL AND INSTALLATION



### Removal steps

1. Timing belt upper cover
2. Timing belt lower cover
3. Crankshaft position sensor
- ◊A◊ ◊I◊ 4. Timing belt
- ◊H◊ 5. Timing belt tensioner
6. Tensioner spacer
7. Tensioner spring
- ◊B◊ ◊G◊ 8. Timing belt idler
9. Camshaft sprocket bolt
10. Camshaft sprocket
11. Flange
- ◊C◊ ◊F◊ 12. Injection pump sprocket nut
- ◊D◊ 13. Injection pump sprocket
- ◊E◊ ◊E◊ 14. Crankshaft bolt
15. Special washer
- ◊F◊ 16. Crankshaft sprocket
- ◊G◊ ◊D◊ 17. Oil pump sprocket
18. Flange
19. Crankshaft sensing blade
20. Tensioner
- ◊H◊ ◊C◊ 21. Timing belt "B"
- ◊I◊ ◊B◊ 22. Silent shaft sprocket
- ◊A◊ 23. Spacer
- ◊J◊ 24. Crankshaft sprocket "B"
25. Cover
26. Engine support bracket, left



## REMOVAL SERVICE POINTS

### ◊A◊ TIMING BELT REMOVAL

- (1) Using chalk, etc., mark an arrow on the back of the timing belt to indicate the direction of rotation. This is to ensure correct installation of the belt in case it is reused.

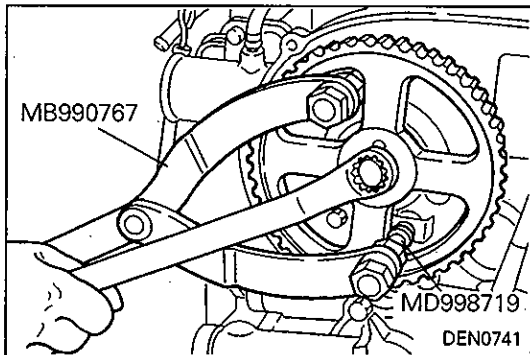
- (2) With the timing belt tensioner pushed down, tighten the tensioner mounting bolt temporarily to hold the tensioner in place.

- (3) Remove the timing belt.

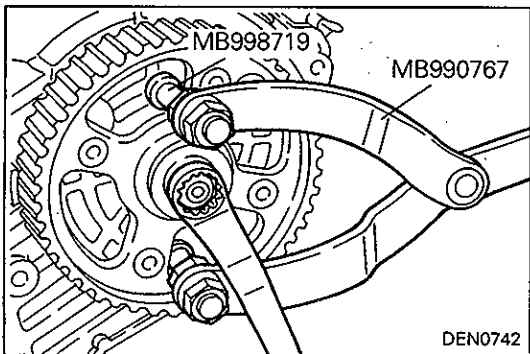
#### NOTE

- (1) Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. Do not immerse parts in cleaning solvent.
- (2) If there is oil or water on any part, check the front case oil seals, camshaft oil seal and water pump for leaks.

### ◊B◊ CAMSHAFT SPROCKET BOLT LOOSENING

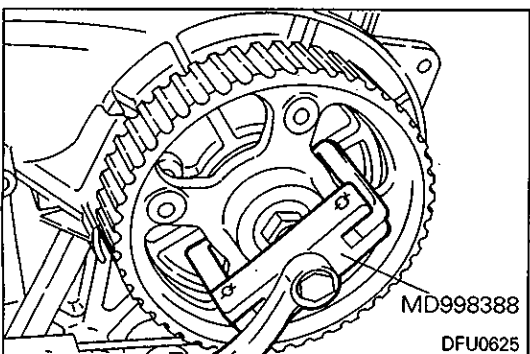


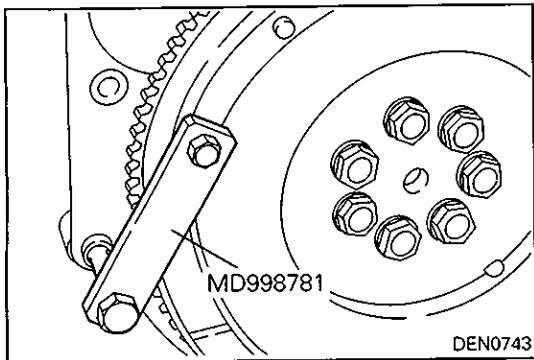
### ◊C◊ INJECTION PUMP SPROCKET NUT LOOSENING



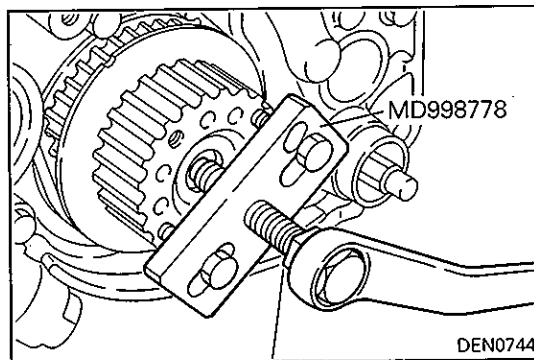
### ◊D◊ INJECTION PUMP SPROCKET REMOVAL

- (1) Do not strike the sprocket and drive shaft to remove these parts.

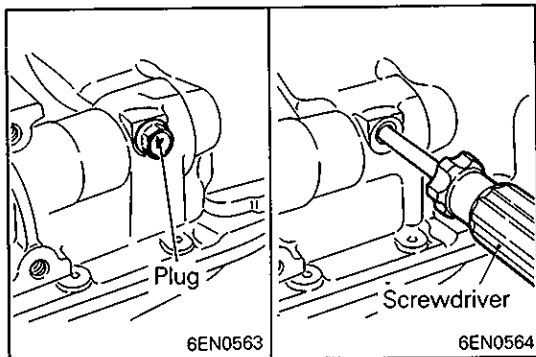




### ◁E▷ CRANKSHAFT BOLT LOOSENING



### ◁F▷ CRANKSHAFT SPROCKET REMOVAL

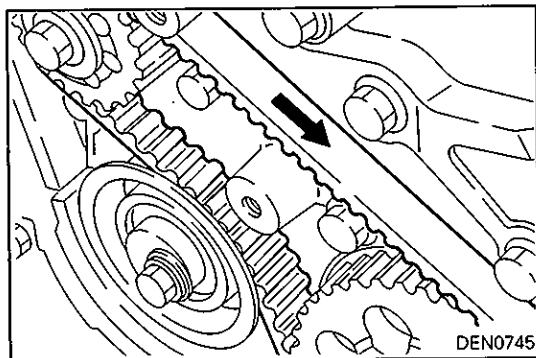


### ◁G▷ OIL PUMP SPROCKET REMOVAL

- (1) Before loosening the oil pump sprocket nut (flange nut), remove the timing belt and then the plug at the left side of the cylinder block and insert a Phillips screwdriver [shank diameter 8 mm (0.31 in.)] through the plug hole to keep the left silent shaft in position.

#### Caution

- If the nut is loosened without removing the timing belt, the force produced by loosening the nut will be borne by the belt and can cause damage to the belt cogs.

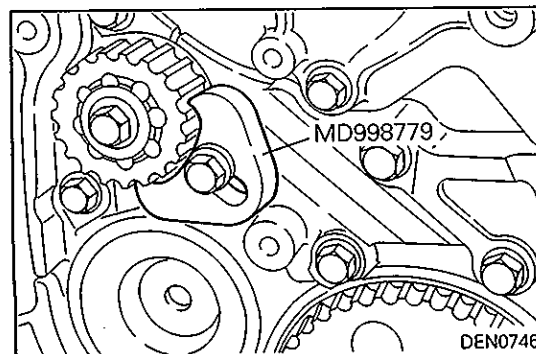


### ◁H▷ TIMING BELT "B" REMOVAL

- (1) Using chalk, etc., mark an arrow on the back of the timing belt to indicate the direction of rotation. This is to ensure correct installation of the belt in case it is reused.

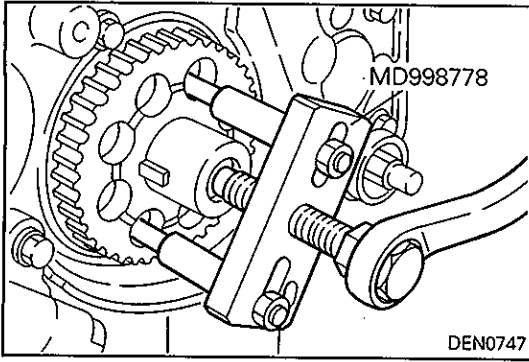
#### NOTE

- (1) Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. Do not immerse parts in cleaning solvent.
- (2) If there is oil or water on any part, check the front case oil seals, camshaft oil seal and water pump for leaks.



### ◁I▷ SILENT SHAFT SPROCKET REMOVAL





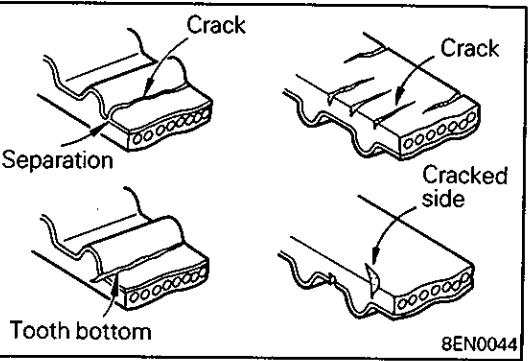
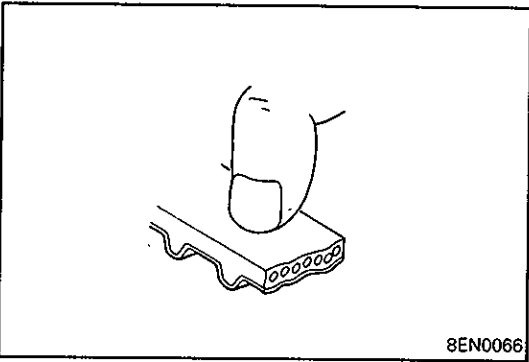
◁J▷ **CRANKSHAFT SPROCKET "B" REMOVAL**

**INSPECTION**

**TIMING BELTS**

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

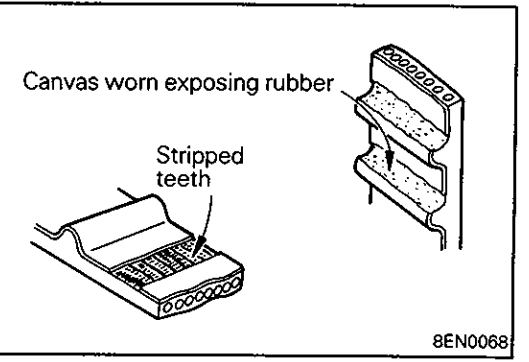
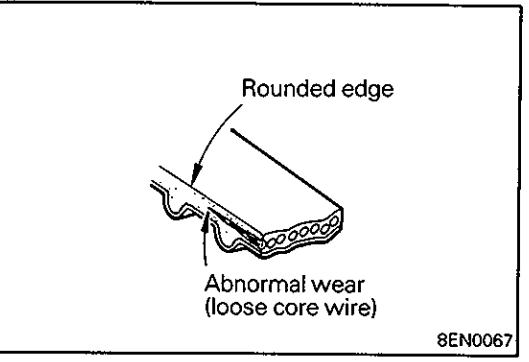
- (1) Hardened back surface rubber  
Glossy, non-elastic, and so hard that no mark is produced even when scratched by fingernails.
- (2) Cracked back surface rubber
- (3) Cracked or separated canvas
- (4) Cracked tooth bottom
- (5) Cracked side



- (6) Abnormal wear on side

**NOTE**

Normal belt should have clear-cut sides as if cut by a sharp knife.



- (7) Abnormal wear in teeth

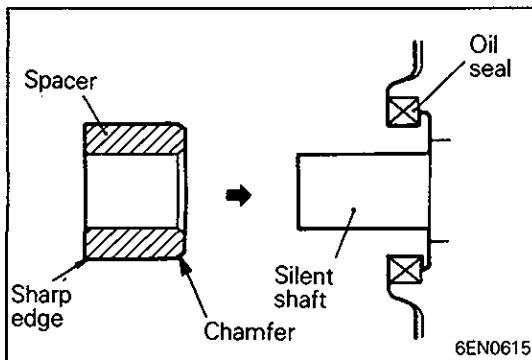
**Initial stage:**

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

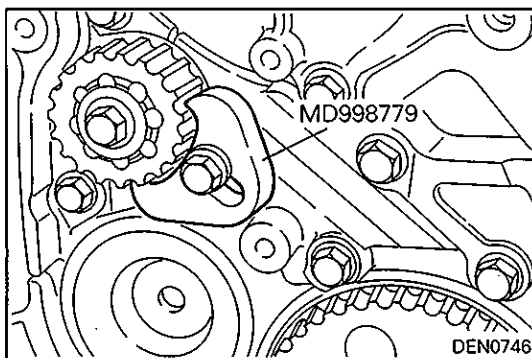
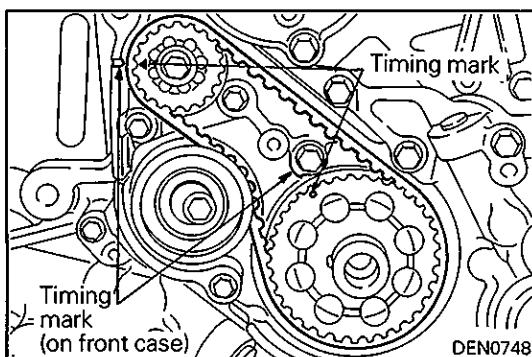
**Final stage:**

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

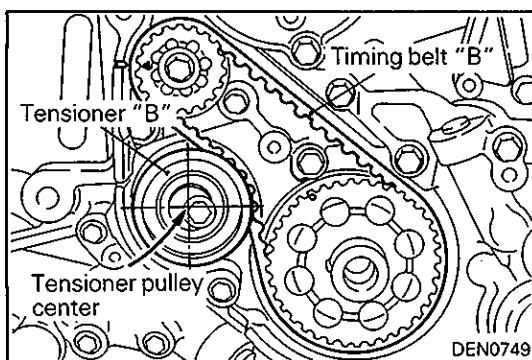
- (8) Missing tooth

**INSTALLATION SERVICE POINTS****◆A◆ SPACER INSTALLATION**

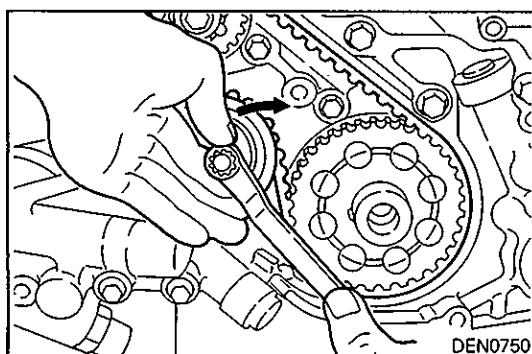
- (1) Install the spacer with the chamfered end toward the oil seal.

**◆B◆ SILENT SHAFT SPROCKET INSTALLATION****◆C◆ TIMING BELT "B" INSTALLATION**

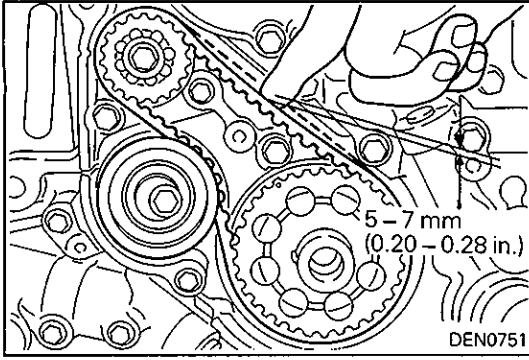
- (1) Align the timing marks on the crankshaft sprocket "B" and silent shaft sprocket with the marks on the front case respectively.
- (2) Install the timing belt "B" on the crankshaft sprocket "B" and silent shaft sprocket. There should be no slack on the tension side.



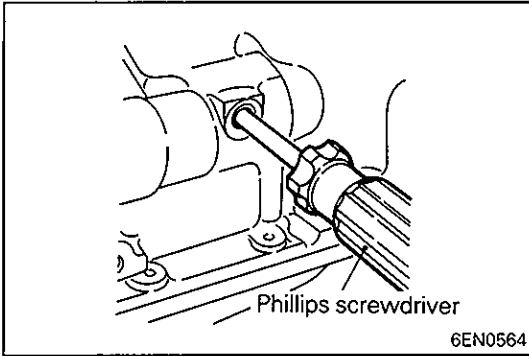
- (3) Make sure that the pulley center and the bolt center are located as shown in the illustration.



- (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 the timing belt. In this condition, tighten the bolt to secure tensioner "B". When the bolt is tightened, use care to prevent the shaft from turning together. If the shaft is turned together, the belt will be overtensioned.

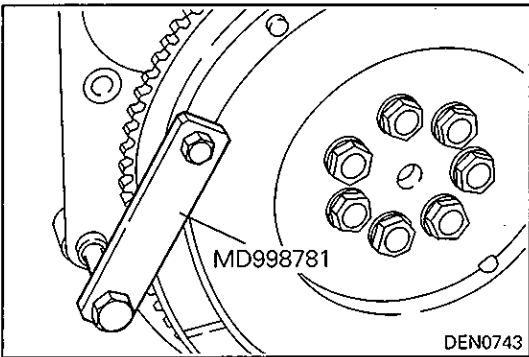


- (5) Check to ensure that the timing marks on the sprockets and the front case are in alignment.
- (6) Press with index finger the center of span on the tension side of timing belt "B". The bolt must deflect 5 to 7 mm (0.20 to 0.28 in.)

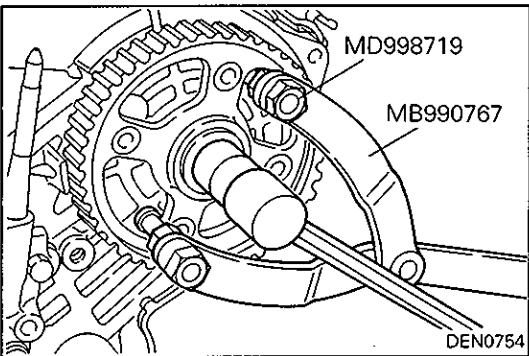


#### ▶D◀ OIL PUMP SPROCKET INSTALLATION

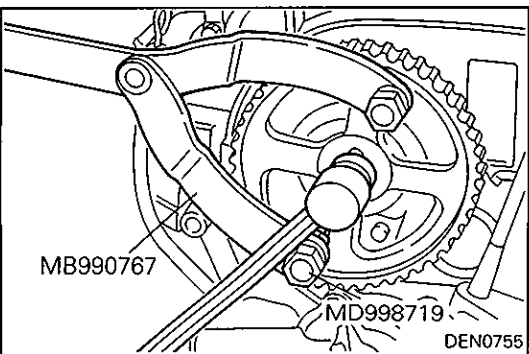
- (1) Keep the silent shaft in position in the same way as when it was loosened.
- (2) Install the oil pump sprocket.
- (3) Apply a minimum quantity of engine oil to the bearing surface of the nut.
- (4) Tighten the nuts to the specified torque.



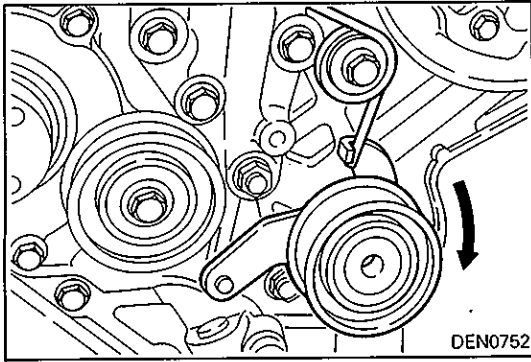
#### ▶E◀ CRANKSHAFT BOLT TIGHTENING



#### ▶F◀ INJECTION PUMP SPROCKET NUT TIGHTENING



#### ▶G◀ CAMSHAFT SPROCKET BOLT TIGHTENING

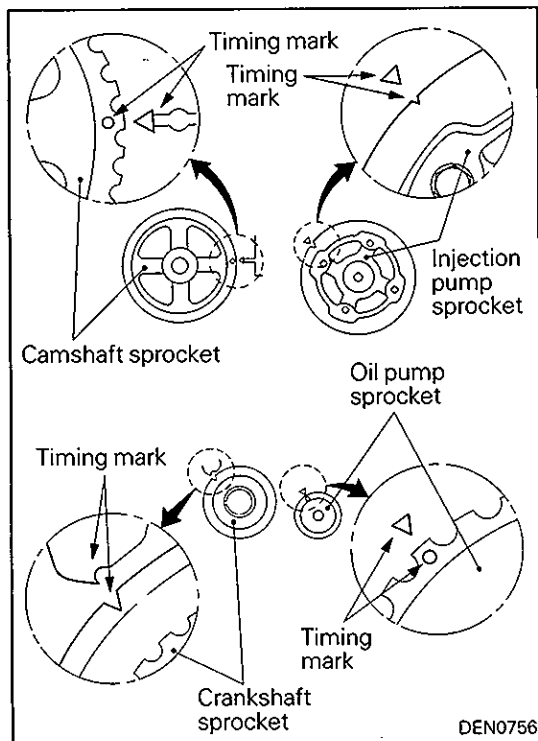


### ◆H◆ TIMING BELT TENSIONER INSTALLATION

- (1) Hook the tensioner spring ends to the engine support bracket projection and the tensioner bracket.
- (2) With the timing belt tensioner pushed down, temporarily tighten the tensioner mounting bolt to hold the tensioner in place.

### ◆I◆ TIMING BELT INSTALLATION

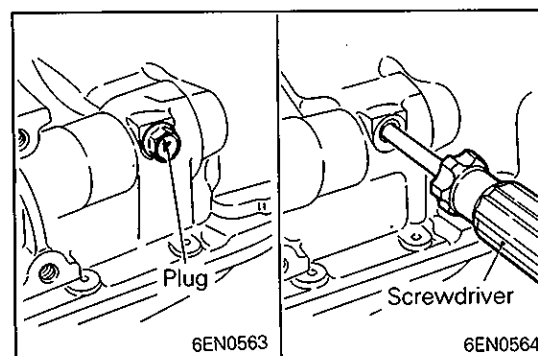
- (1) Temporarily fix the tensioner at the most lower position in the injection pump bracket slot.



- (2) Turn the crankshaft to bring the No. 1 piston at the top dead center on the compression stroke.
- (3) Align the timing marks of all sprockets with their mating marks as shown.

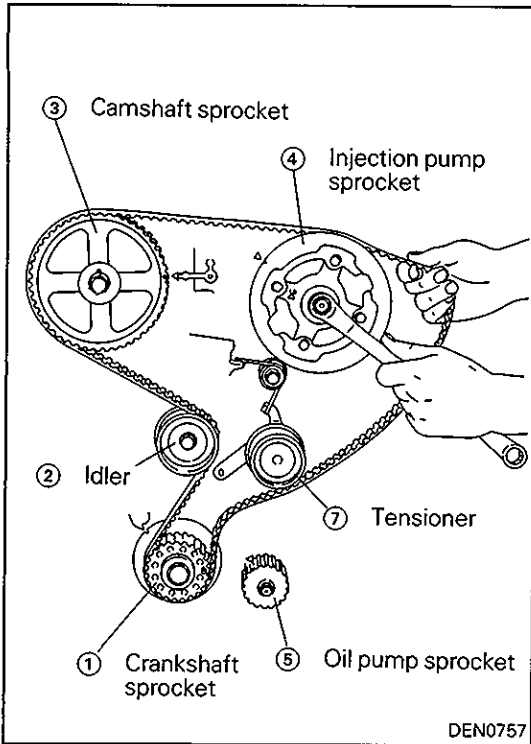
#### NOTE

If the injection pump sprocket is released, it turns about one tooth in a counterclockwise direction. Therefore, the timing mark of the injection pump sprocket should be aligned when the timing belt is installed.



- (4) Remove the plug on the 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 – 25 mm (0.8 – 1.0 in.), turn the oil pump sprocket one turn and realign the 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 the timing belt is finished.



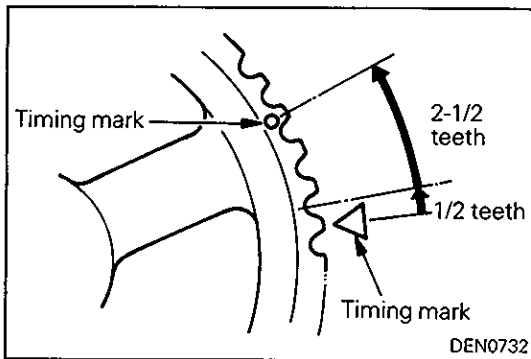
(5) Install the timing belt on the sprockets in the following sequence while taking care so that the belt is not slack between sprockets or between sprocket and pulley.

- ① Crankshaft sprocket
- ② Timing belt idler
- ③ Camshaft sprocket
- ④ Injection pump sprocket
- ⑤ Oil pump sprocket
- ⑥ Turn the crankshaft in the reverse direction by 1/2 tooth of the camshaft sprocket to remove the slackness of the belt on the idler side.
- ⑦ Timing belt tensioner

#### NOTE

To install the timing belt on the injection pump sprocket, use an offset wrench or a similar tool and align the injection pump sprocket timing mark with the mark on the engine.

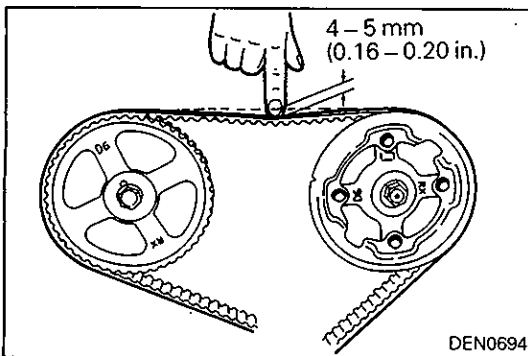
(6) Loosen the tensioner mounting bolt 1/4 – 1/3 turn and allow the spring tension to move the tensioner against the belt.



(7) Turn the crankshaft counterclockwise by three teeth of the cam sprocket from the timing mark and hold this position. Check that the belt is in complete mesh with the sprockets.

(8) Fix the tensioner.

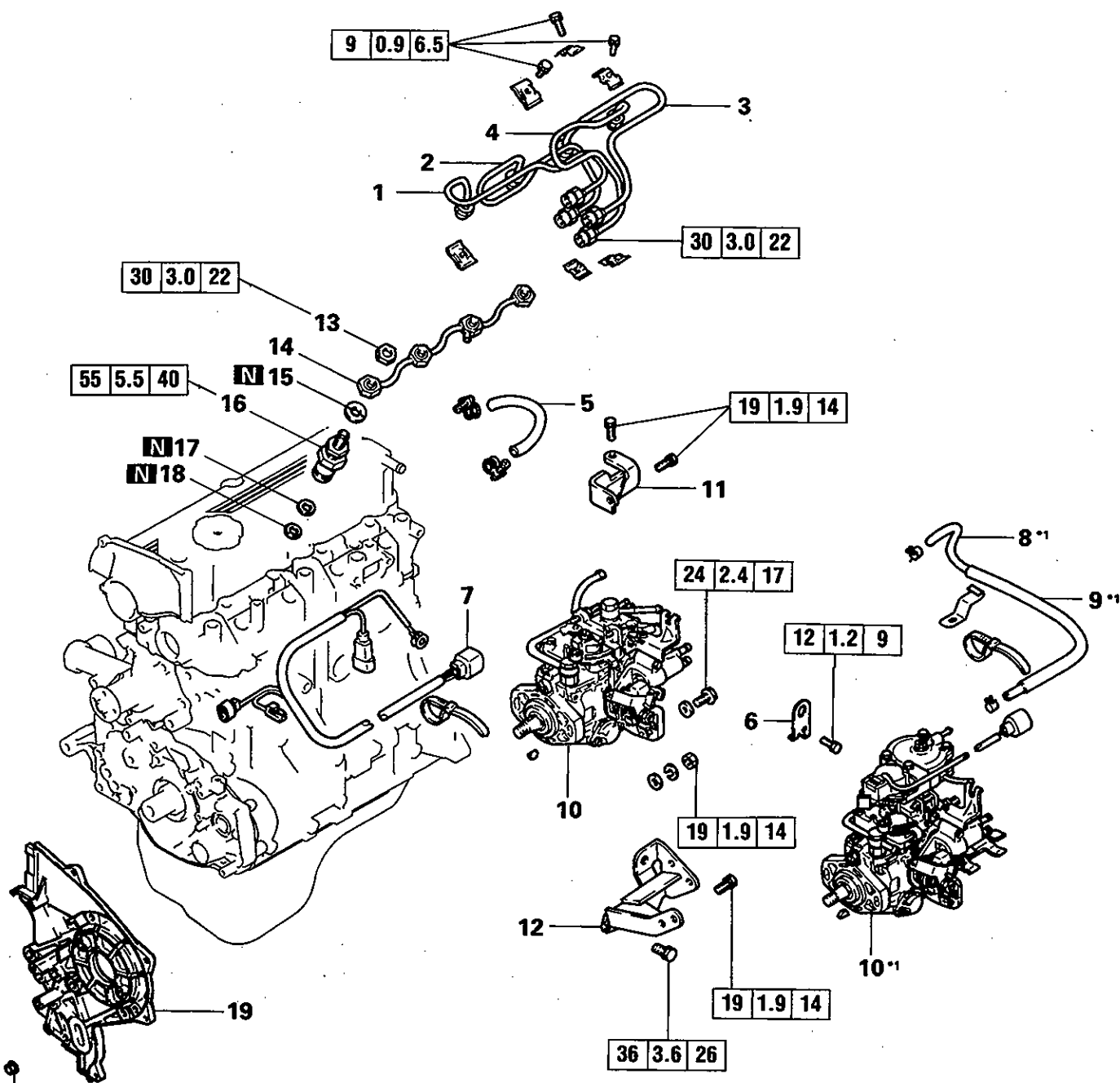
(9) Turn the crankshaft clockwise to align the timing marks.



(10) Check that the belt deflects 4 – 5 mm (0.16 – 0.20 in.) when its midpoint is pushed by index finger.

(11) Check that the timing marks of all sprockets are aligned.

# 5. GLOW PLUG, FUEL INJECTION PUMP AND INJECTION NOZZLE REMOVAL AND INSTALLATION



**Removal steps**

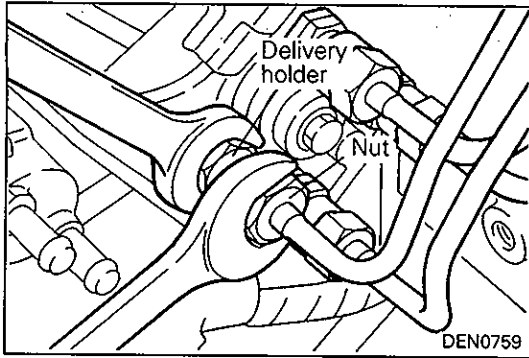
- ◇A◇ ▶D◇ 1. Injection pipe No. 1
- ◇A◇ ▶D◇ 2. Injection pipe No. 2
- ◇A◇ ▶D◇ 3. Injection pipe No. 3
- ◇A◇ ▶D◇ 4. Injection pipe No. 4
- 5. Fuel hose
- 6. Engine hanger
- 7. Injection pump harness assembly
- 8. Hose
- 9. Tube

- ◇B◇ 10. Fuel injection pump
- 11. Injection pump stay, upper
- 12. Injection pump stay, lower
- ◇C◇ ▶C◇ 13. Fuel return pipe nut
- 14. Fuel return pipe
- 15. Fuel return pipe gasket
- ◇D◇ ▶B◇ 16. Injection nozzle
- ▶A◇ 17. Holder gasket
- ▶A◇ 18. Nozzle gasket
- 19. Injection pump bracket

**NOTE**

\*1: Engines with turbocharger (except SPACE RUNNER 1997 models and on)

24 2.4 17



## REMOVAL SERVICE POINTS

### ◊A◊ INJECTION PIPE REMOVAL

- (1) When loosening the union nuts on the injection pump, hold the delivery valve holder on the fuel injection pump head with a spanner to prevent it from rotating along with the union nut.

#### Caution

- If the injection pipe has been removed, plug the delivery valve holder to prevent foreign matter from entering the injection pump.

- (2) When loosening the union nuts on the injection nozzles hold, the hexagon nut of the fuel return pipe with a spanner to prevent it from rotating along with the union nut.

### ◊B◊ FUEL INJECTION PUMP REMOVAL

- (1) Do not hold the injection pump by the accelerator lever or the fast idle lever. These levers must not be removed.

### ◊C◊ FUEL RETURN PIPE NUT REMOVAL

- (1) When removing the fuel return pipe nut, hold the hexagon nut of the fuel return pipe with a spanner.

### ◊D◊ INJECTION NOZZLE REMOVAL

- (1) Write the cylinder number on the injection nozzle that has been removed.

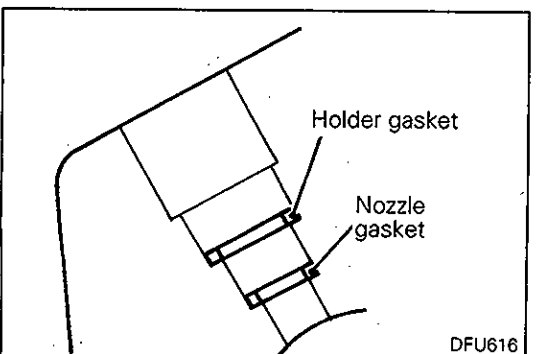
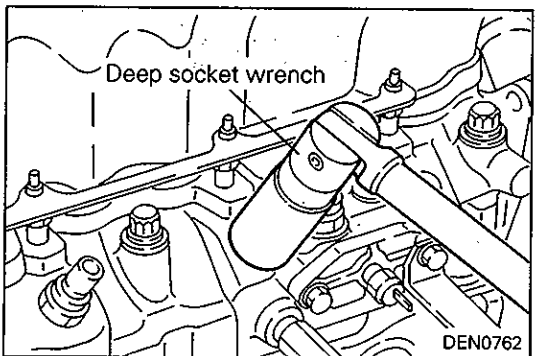
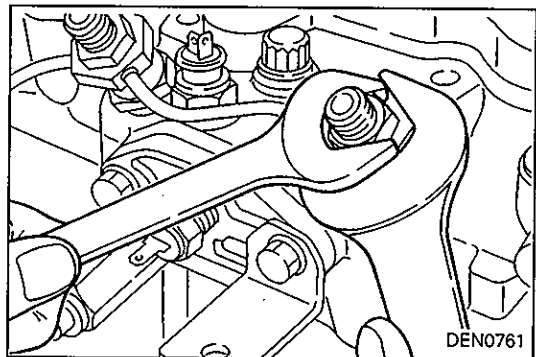
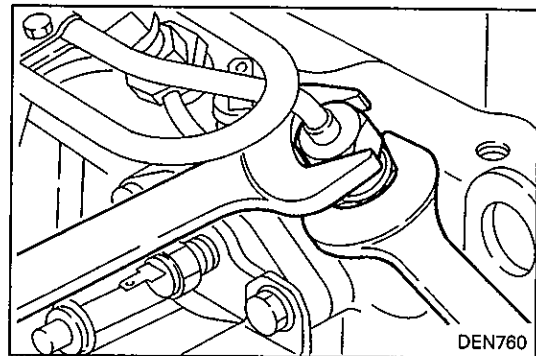
#### Caution

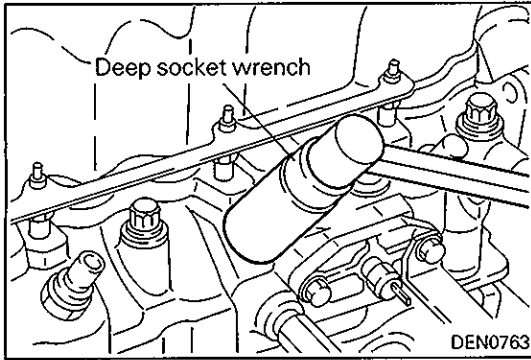
- Cover the opening with an appropriate cap to prevent entry of dust, water and foreign material into the fuel passage and combustion chamber.

## INSTALLATION SERVICE POINTS

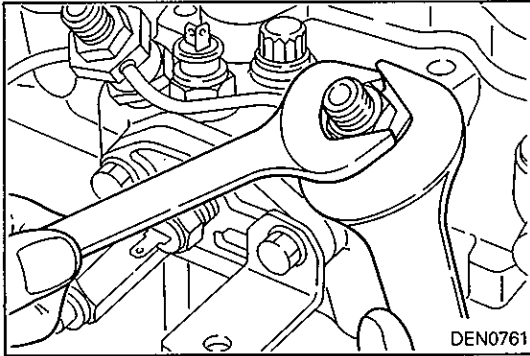
### ◊A◊ NOZZLE GASKET / HOLDER GASKET INSTALLATION

- (1) Clean nozzle holder installation areas of the cylinder head.
- (2) Fit a new nozzle gasket and holder gasket into the nozzle holder hole in the cylinder head.



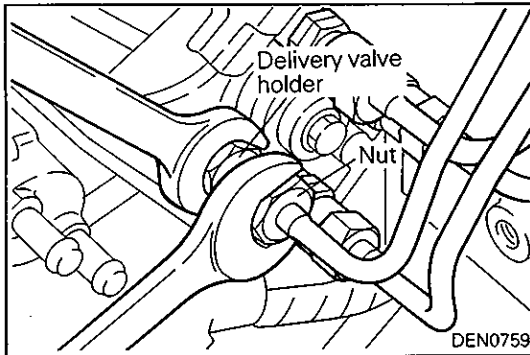


### ◆B◆ INJECTION NOZZLE INSTALLATION



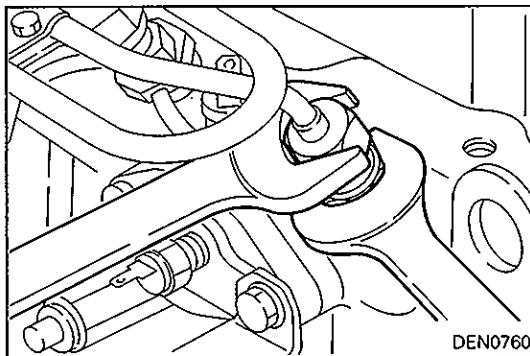
### ◆C◆ FUEL RETURN PIPE NUT INSTALLATION

- (1) While holding the fuel hexagon nut of the fuel return pipe with a wrench, tighten the fuel return pipe nut to the specified torque.



### ◆D◆ INJECTION PIPE INSTALLATION

- (1) When tightening the injection pipe nuts, hold the delivery valve holder with a spanner in order to prevent it from rotating along with the nut.



- (2) When tightening the injection pipe nuts, hold the hexagon nut of the return pipe with a spanner in order to prevent it from rotating along with the nut.



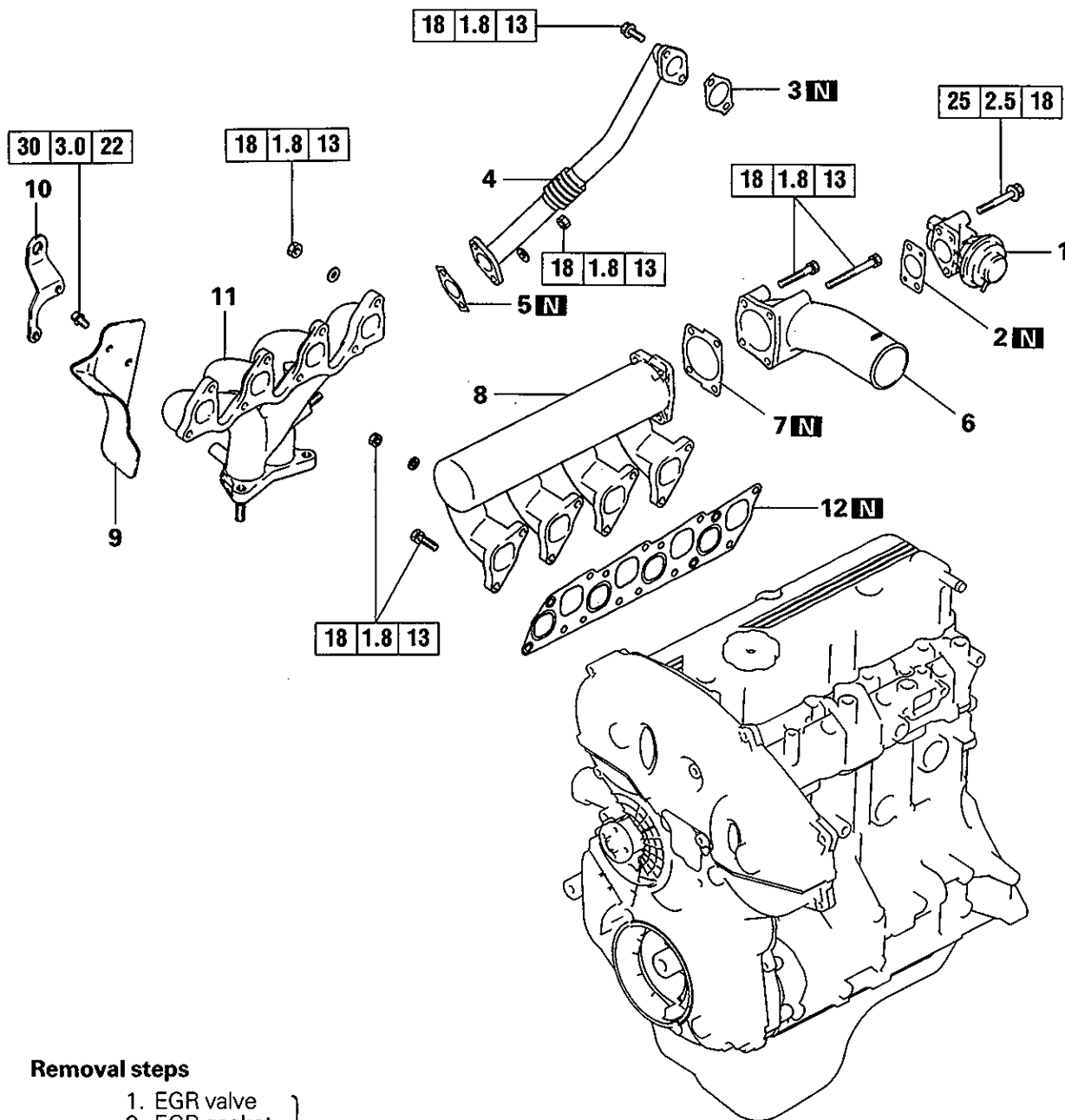
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## NOTES

## 6. INTAKE AND EXHAUST MANIFOLDS

### REMOVAL AND INSTALLATION

<Engine without turbocharger – CB8A, CB8W>

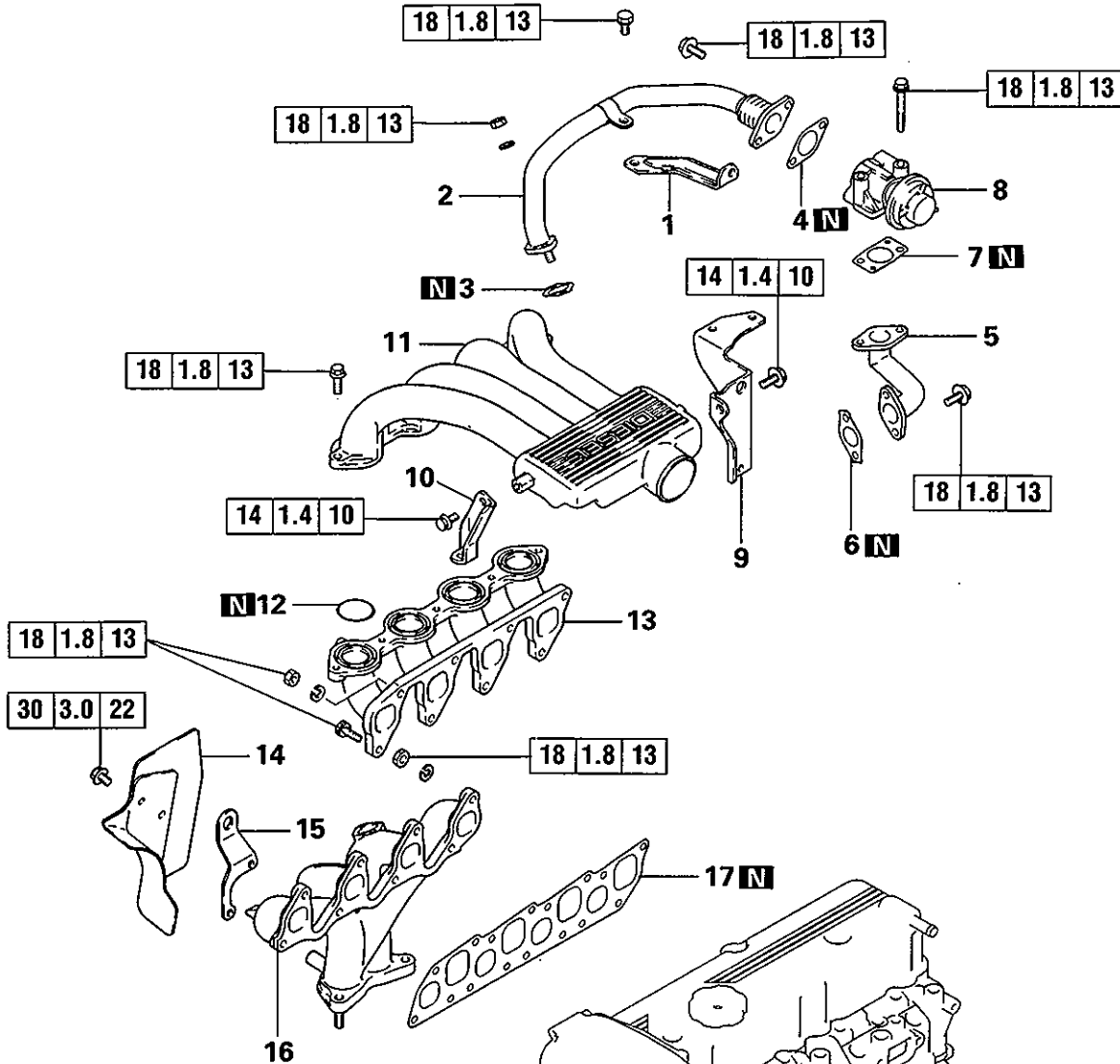


#### Removal steps

- |                             |                          |
|-----------------------------|--------------------------|
| 1. EGR valve                | } Engine with EGR system |
| 2. EGR gasket               |                          |
| 3. Gasket                   |                          |
| 4. EGR pipe                 |                          |
| 5. Gasket                   |                          |
| 6. Air inlet fitting        |                          |
| 7. Gasket                   |                          |
| 8. Intake manifold          |                          |
| 9. Heat protector           |                          |
| 10. Engine hanger           |                          |
| 11. Exhaust manifold        |                          |
| 12. Exhaust manifold gasket |                          |

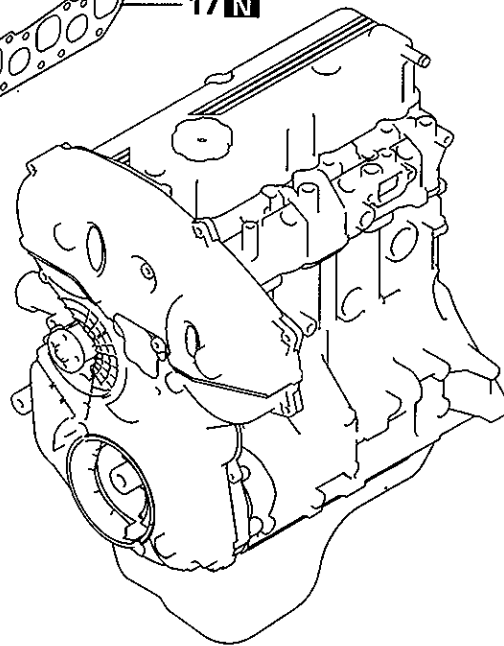
## REMOVAL AND INSTALLATION

&lt;Engine without turbocharger – C67A&gt;



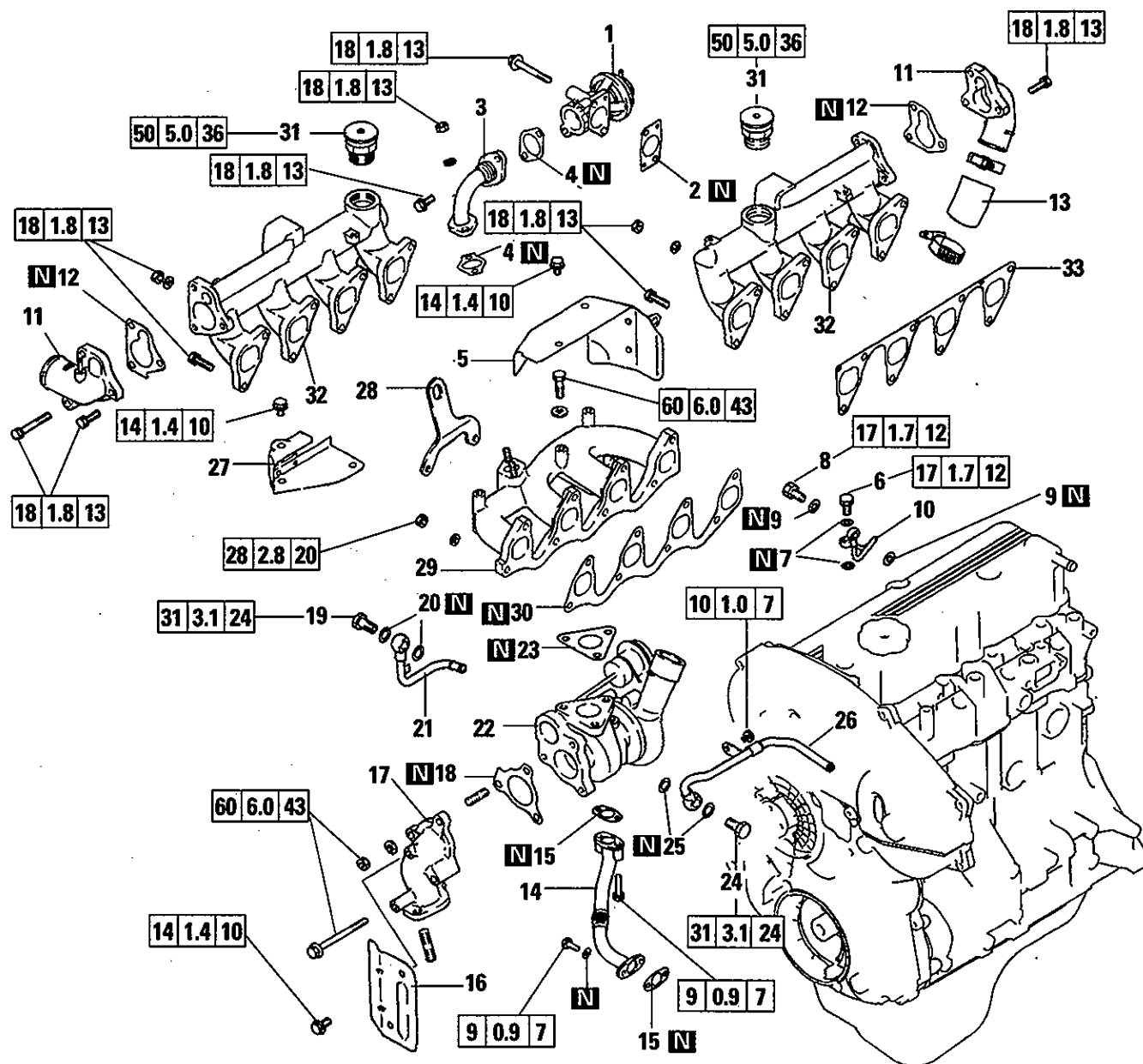
## Removal steps

1. EGR valve stay
2. EGR pipe "A"
3. Gasket
4. Gasket
5. EGR pipe "B"
6. Gasket
7. Gasket
8. EGR valve
9. Bracket "B"
10. Bracket "A"
11. Intake manifold "A"
- ▶A▶ 12. O-ring
13. Intake manifold "B"
14. Heat protector
15. Engine hanger
16. Exhaust manifold
17. Exhaust manifold gasket



## REMOVAL AND INSTALLATION

&lt;Engine with turbocharger (except SPACE RUNNER 1997 models and on)&gt;



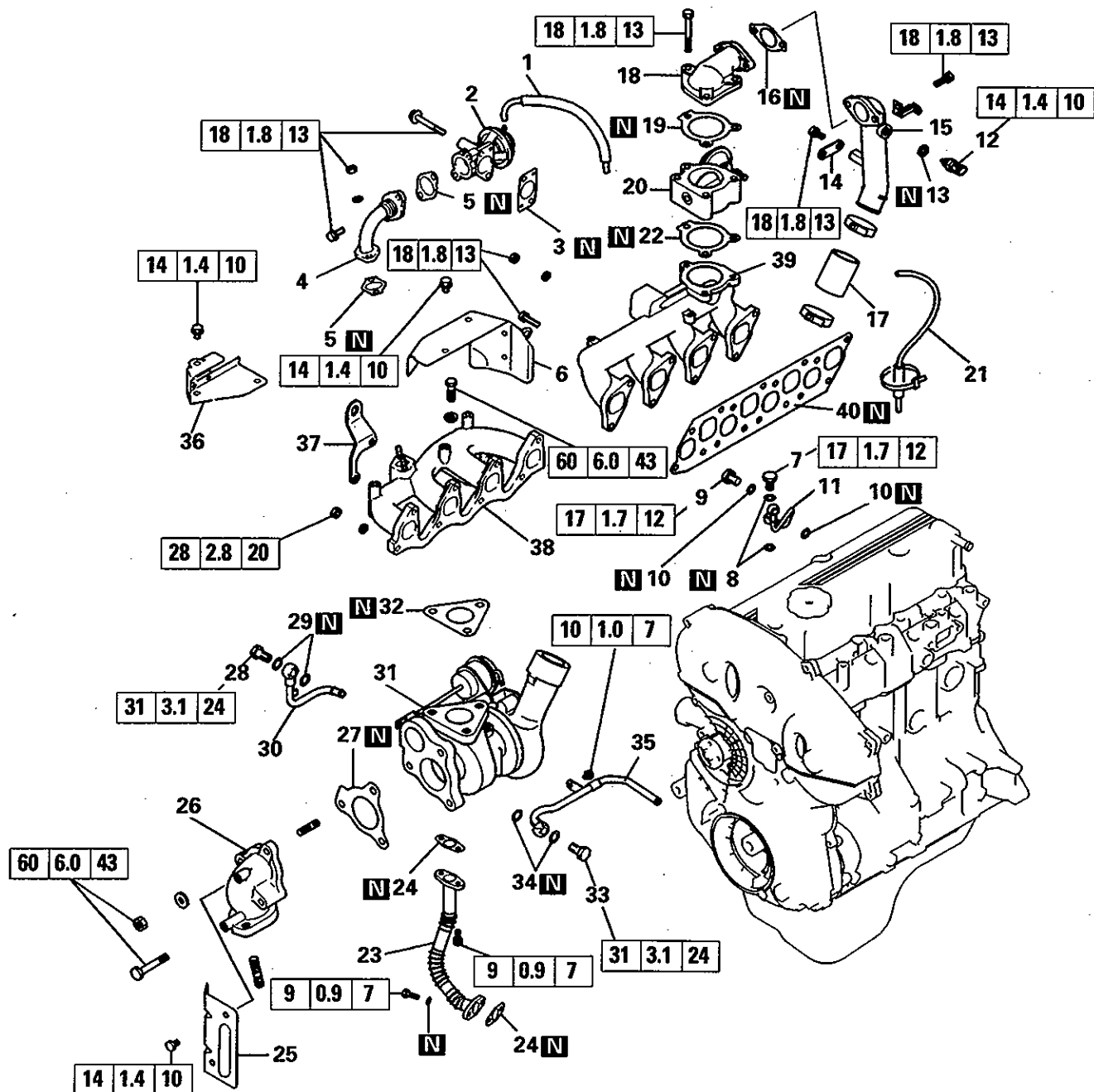
## Removal steps

- |   |                             |
|---|-----------------------------|
| 1. EGR valve                                | 17. Exhaust fitting         |
| 2. EGR gasket                               | 18. Gasket                  |
| 3. EGR pipe                                 | 19. Eyebolt                 |
| 4. Gasket                                   | 20. Gasket                  |
| 5. Heat protector "A"                       | 21. Water pipe "B"          |
| ▶B◀ 6. Eyebolt                              | 22. Turbocharger assembly   |
| ▶B◀ 7. Gasket                               | 23. Gasket                  |
| 8. Eyebolt                                  | 24. Eyebolt                 |
| 9. Gasket                                   | 25. Gasket                  |
| 10. Oil pipe                                | 26. Water pipe "A"          |
| 11. Air intake fitting                      | 27. Heat protector "B"      |
| 12. Intake fitting gasket                   | 28. Engine hanger           |
| 13. Air hose <Vehicles without intercooler> | 29. Exhaust manifold        |
| 14. Oil return pipe                         | 30. Exhaust manifold gasket |
| 15. Oil return pipe gasket                  | 31. Relief valve            |
| 16. Heat protector "C"                      | 32. Intake manifold         |
|   | 33. Intake manifold gasket  |

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## REMOVAL AND INSTALLATION

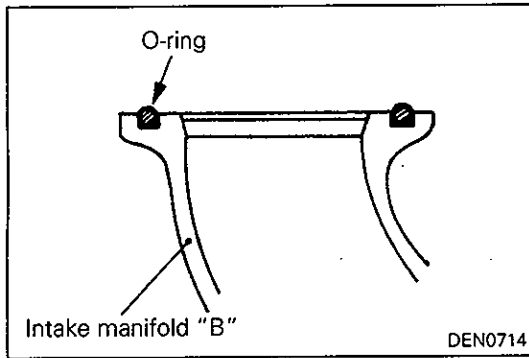
&lt;SPACE RUNNER 1997 models and on&gt;



## Removal steps

- |                            |                            |                           |
|----------------------------|----------------------------|---------------------------|
| 1. Vacuum hose             | 16. Gasket                 | 31. Turbocharger assembly |
| 2. EGR valve               | 17. Air hose               | 32. Gasket                |
| 3. Gasket                  | 18. Air intake fitting "B" | 33. Eye bolt              |
| 4. EGR pipe                | 19. Gasket                 | 34. Gasket                |
| 5. Gasket                  | 20. Throttle body assembly | 35. Water pipe "A"        |
| 6. Heat protector "A"      | 21. Vacuum hose            | 36. Heat protector "B"    |
| ▶B 7. Eye bolt             | 22. Gasket                 | 37. Engine hanger         |
| 8. Gasket                  | 23. Oil return pipe        | 38. Exhaust manifold      |
| ▶B 9. Eye bolt             | 24. Gasket                 | 39. Intake manifold       |
| 10. Gasket                 | 25. Heat protector "C"     | 40. Gasket                |
| 11. Oil pipe               | 26. Exhaust fitting        |                           |
| 12. Air temperature sensor | 27. Gasket                 |                           |
| 13. Gasket                 | 28. Eye bolt               |                           |
| 14. Intake fitting stay    | 29. Gasket                 |                           |
| 15. Air intake fitting "A" | 30. Water pipe "B"         |                           |

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**INSTALLATION SERVICE POINTS****▶A◀ O-RING**

- (1) When installing the intake manifold "A", be sure to fit four O-rings in the intake manifold "B".

**▶B◀ EYEBOLT**

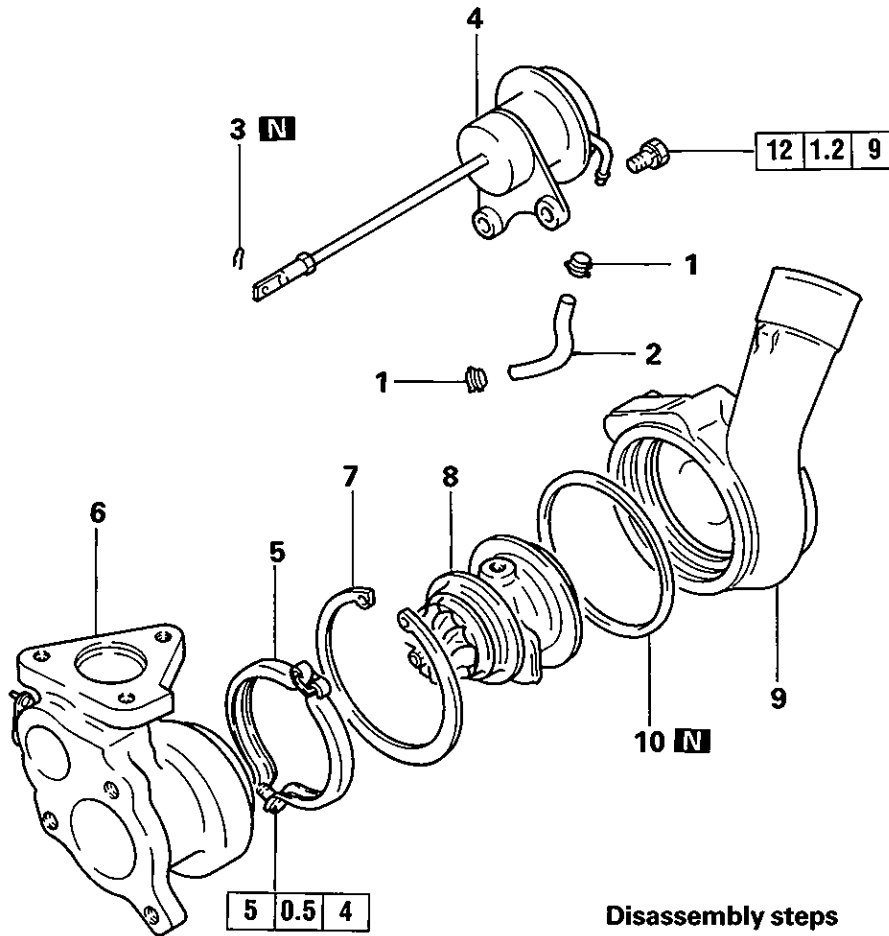
- (1) Before installing the oil pipe eyebolt (at top of the turbocharger), fill the turbocharger with clean engine oil.

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## NOTES

# 7. TURBOCHARGER

## DISASSEMBLY AND REASSEMBLY

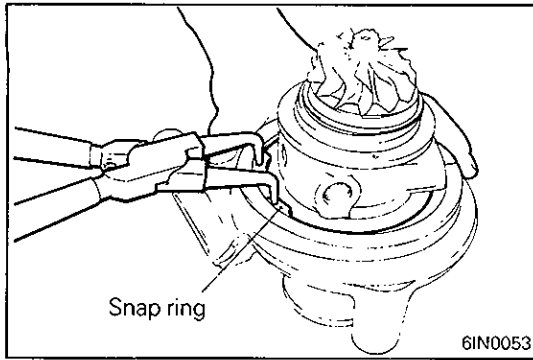


### Disassembly steps

1. Hose clip
2. Hose
3. Snap pin
4. Turbocharger waste gate actuator
5. Coupling
6. Turbine housing
7. Snap ring
8. Turbine wheel assembly
9. Compressor cover
10. O-ring

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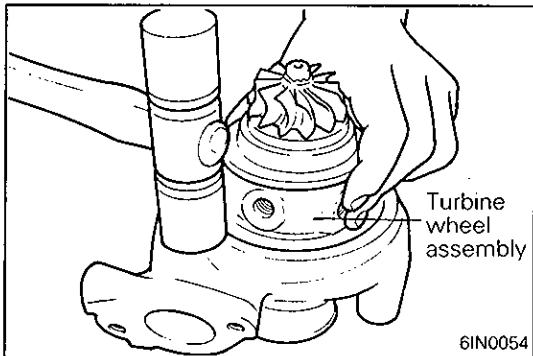
## DISASSEMBLY SERVICE POINTS

### ◁A▷ SNAP RING REMOVAL

- (1) Lay the unit with the compressor cover side facing down and using snap ring pliers, remove the compressor cover attaching snap ring.

#### Caution

- When removing the snap ring, hold it with fingers to prevent it from springing away.

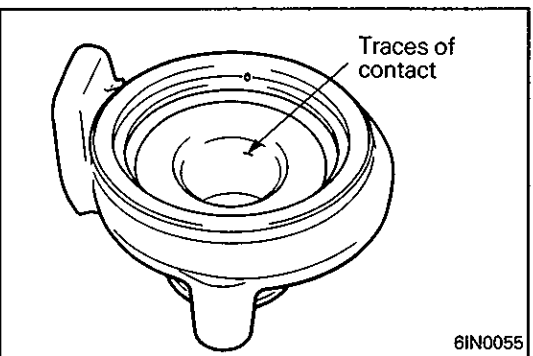


### ◁B▷ TURBINE WHEEL ASSEMBLY REMOVAL

- (1) Remove the turbine wheel assembly, striking the circumference of the compressor cover with a plastic hammer.  
The turbine wheel assembly may be a little hard to remove due to an O-ring put on the outer circumference.

## CLEANING

- (1) Use a clean cleaning oil commercially available. Do not use corrosive cleaning oils as they could damage to some parts.
- (2) Use a plastic scraper or hard brush to clean aluminum parts.



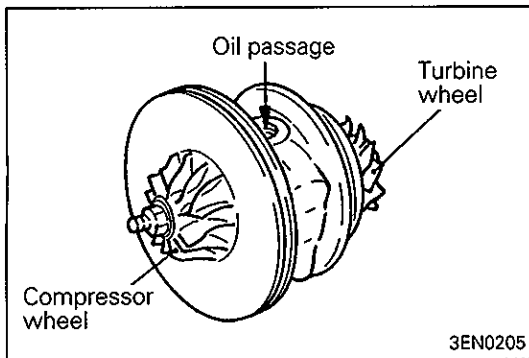
## INSPECTION

### TURBINE HOUSING

- (1) Check the housing for traces of contact with the turbine wheel, cracks due to overheating, pitching, deformation and other damage. Replace with a new turbine housing if cracked.
- (2) Operate the turbocharger waste gate valve lever manually to check that the gate can be opened and closed smoothly.

### COMPRESSOR COVER

- (1) Check the compressor cover for traces of contact with the compressor wheel and other damage.

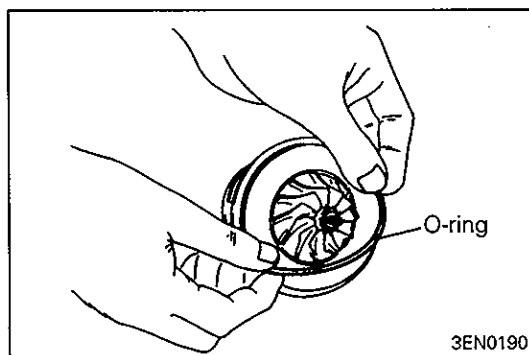


### TURBINE WHEEL ASSEMBLY

- (1) Check the turbine and compressor wheel blades for bend, burr, damage, corrosion and traces of contact on the back side and replace if defective.
- (2) Check the oil passage of the turbine wheel assembly for deposit and clogging.
- (3) Check also the water passage for deposit and clogging.
- (4) Check the turbine wheel and compressor wheel for light and smooth turning.

### OIL PIPE/OIL RETURN PIPE

- (1) Correct or replace the oil pipe and oil return pipe if clogged, collapsed, deformed or otherwise damaged.



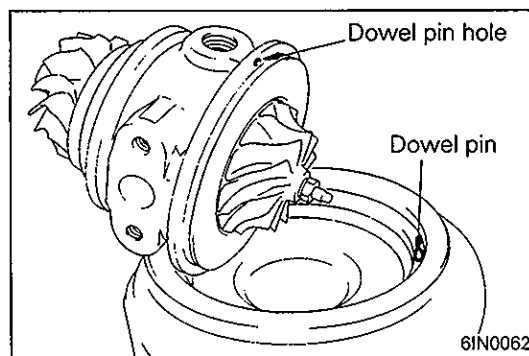
### REASSEMBLY SERVICE POINTS

#### ◆A◆ O-RING INSTALLATION

- (1) Apply a light coat of engine oil to a new O-ring and fit in the turbine wheel assembly groove.

#### Caution

- **When installing the O-ring, use care not to damage it. A damaged O-ring causes oil leaks.**

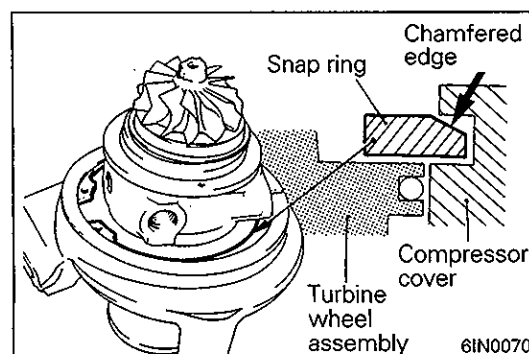


#### ◆B◆ TURBINE WHEEL ASSEMBLY INSTALLATION

- (1) Apply a light coat of engine oil to the periphery of the O-ring.
- (2) Install the turbine wheel assembly to the compressor cover while aligning the dowel pin with the hole.

#### Caution

- **Use care not to damage the blades of turbine wheel and compressor wheel.**

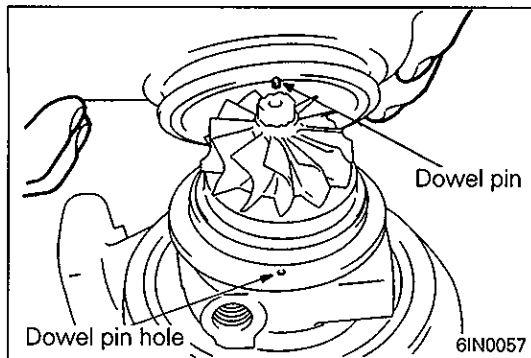


#### ◆C◆ SNAP RING INSTALLATION

- (1) Lay the assembly with the compressor cover facing down and fit the snap ring.

#### Caution

- **Fit the snap ring with its chamfered side facing up.**

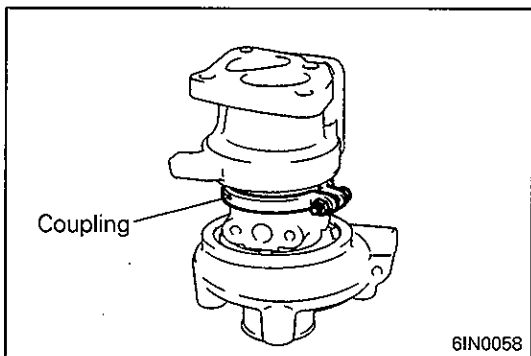


### ▶D◀ TURBINE HOUSING INSTALLATION

- (1) Install the turbine housing while aligning the dowel pin and the hole.

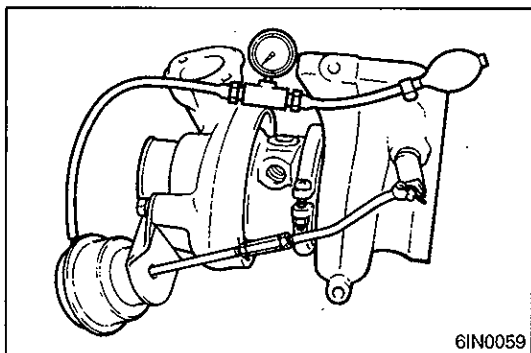
#### Caution

- Use care not to damage the blades of the turbine wheel.



### ▶E◀ COUPLING INSTALLATION

- (1) Install the coupling and tighten to the specified torque.



### ▶F◀ TURBOCHARGER WASTE GATE ACTUATOR OPERATION INSPECTION

- (1) Using a tester, apply pressure to the actuator and check the pressure when the rod starts moving [moves approx. 1 mm (0.04 in.)].

#### Standard value:

**Vehicles without intercooler: Approx. 63.3 kPa  
(0.65 kg/cm<sup>2</sup>, 9.2 psi)**

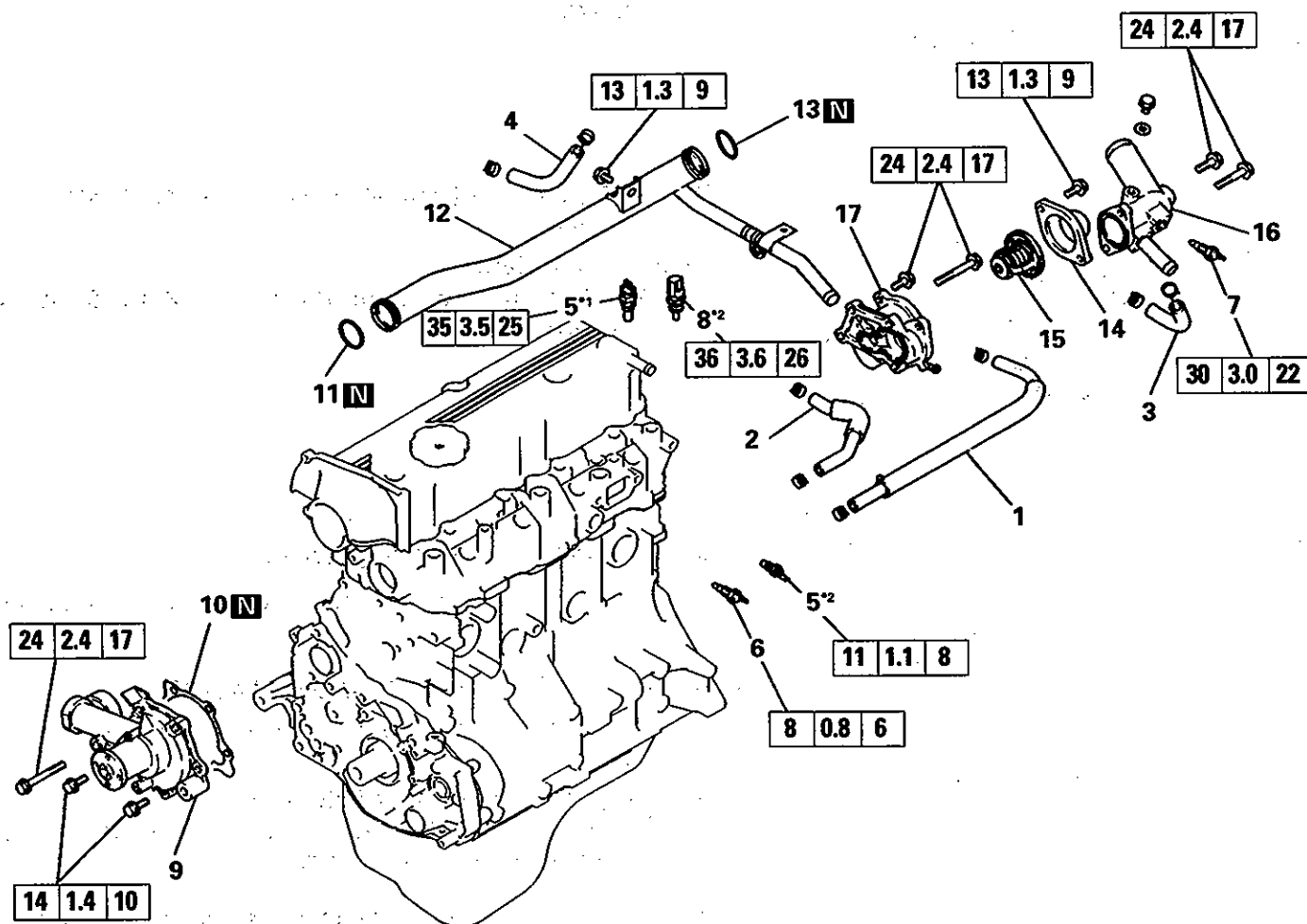
**Vehicles with intercooler: Approx. 76.7 kPa  
(0.78 kg/cm<sup>2</sup>, 11 psi)**

#### Caution

- Do not apply a pressure of more than 71.7 kPa (0.73 kg/cm<sup>2</sup>, 10 psi) <Vehicles without intercooler> or 103 kPa (1.05 kg/cm<sup>2</sup>, 15 psi) <Vehicles with intercooler> to the actuator. Otherwise, diaphragm may be damaged. Never attempt to adjust the turbocharger waste gate valve.

## 8. WATER PUMP, THERMOSTAT, HOSES AND PIPES

### REMOVAL AND INSTALLATION

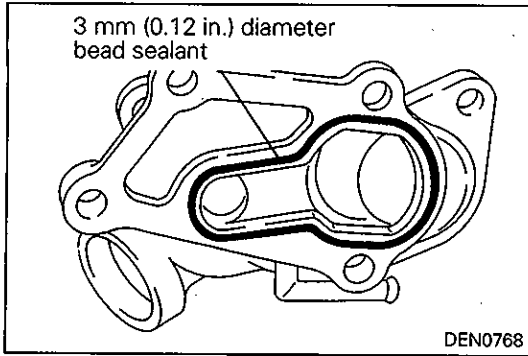


#### Removal steps

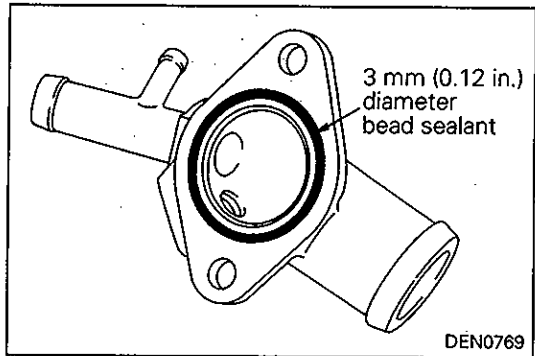
1. Water hose
  2. Water hose
  3. Water hose
  4. Water hose
  5. Engine coolant temperature gauge unit
  6. Engine coolant temperature switch — Engine with turbocharger
  7. Engine coolant temperature switch — N18W and N38W only
  8. Engine coolant temperature sensor
  9. Water pump
  10. Water pump gasket
  11. O-ring
  12. Water inlet pipe
  13. O-ring
  14. Water inlet fitting
  15. Thermostat
  16. Water outlet fitting
  17. Thermostat housing
- } Except SPACE RUNNER 1997 models and on
- } Engine with turbocharger

#### NOTE

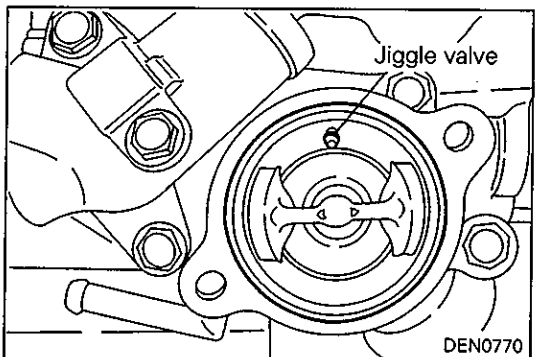
- \*1: Except SPACE RUNNER 1997 models and on  
 \*2: SPACE RUNNER 1997 models and on

**INSTALLATION SERVICE POINTS****▶A▶ SEALANT APPLICATION TO THERMOSTAT HOUSING**

Specified sealant:  
**Mitsubishi Genuine Part No. MD970389 or equivalent**

**▶B▶ SEALANT APPLICATION TO WATER OUTLET FITTING**

Specified sealant:  
**Mitsubishi Genuine Part No. MD970389 or equivalent**

**▶C▶ THERMOSTAT INSTALLATION**

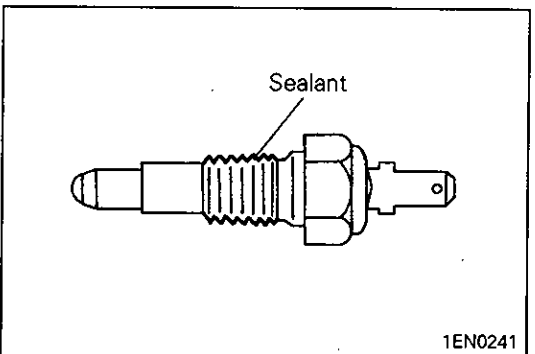
(1) Install the thermostat with the jiggle valve up as shown in the illustration.

**▶D▶ WATER PIPE / O-RING INSTALLATION**

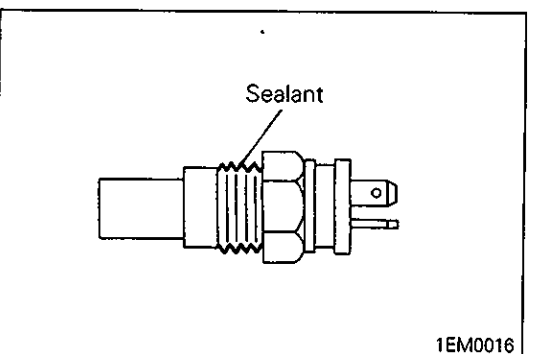
(1) Wet the O-ring (with water) to facilitate assembly.

**Caution**

- Keep the O-ring free of oil or grease
- Secure the water pipe after the thermostat housing has been installed.

**▶E▶ SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE SWITCH**

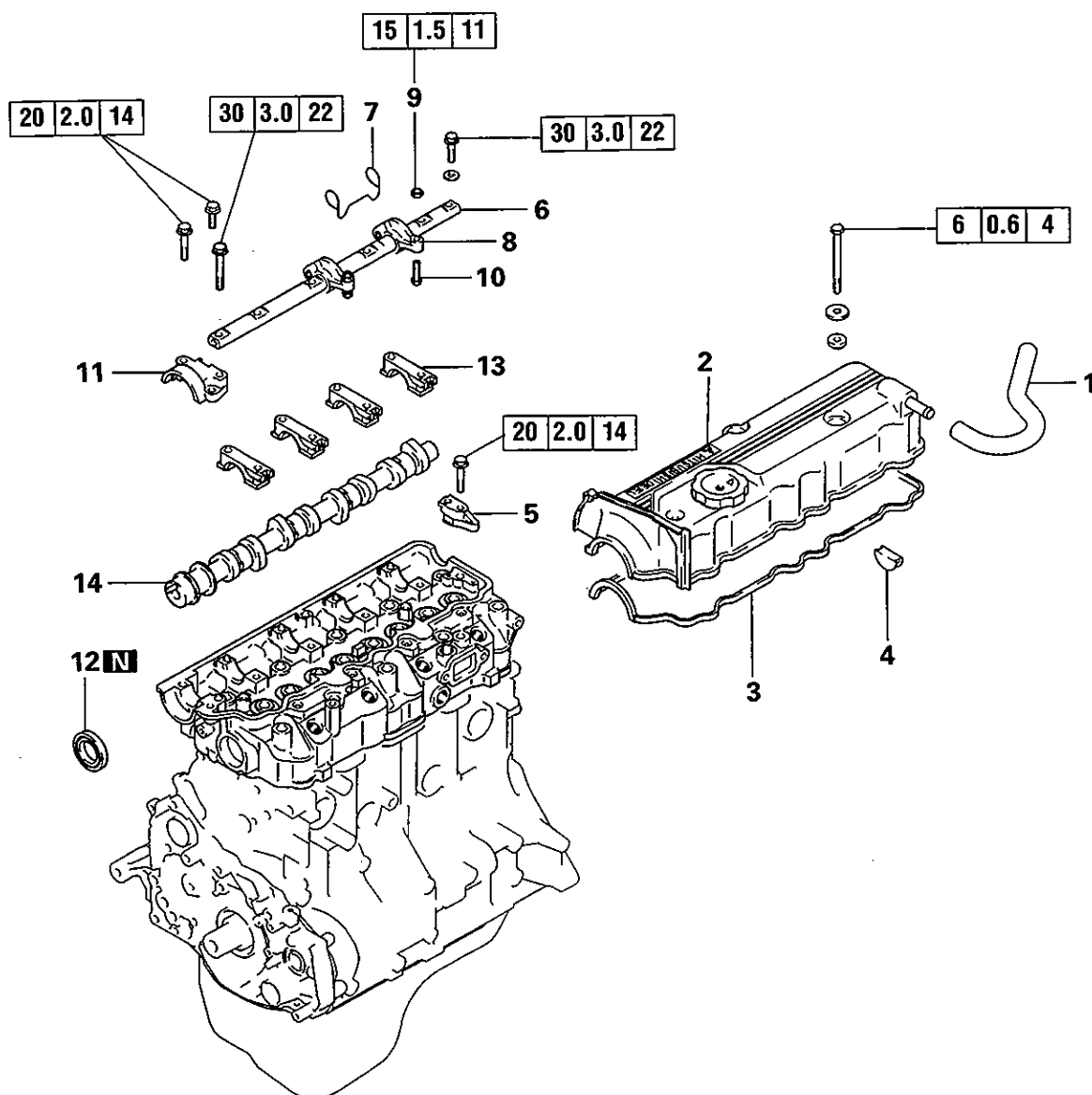
Specified sealant:  
**3M ATD Part No. 8660 or equivalent**

**▶F▶ SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE GAUGE UNIT**

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

## 9. ROCKER ARMS, ROCKER SHAFT AND CAMSHAFT

## REMOVAL AND INSTALLATION

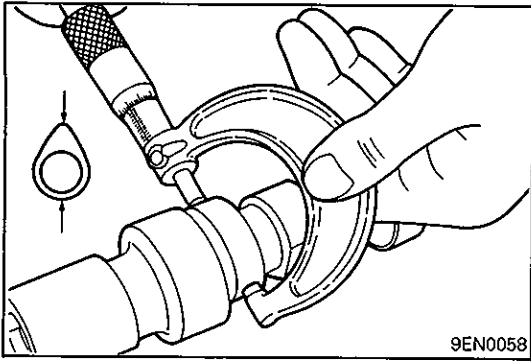


## Removal steps

1. Breather hose
2. Rocker cover
3. Rocker cover gasket
4. Semi-circular packing
5. Rocker shaft support
6. Rocker shaft
7. Rocker shaft spring
8. Rocker arm
9. Nut
10. Rocker arm adjusting screw
11. Front camshaft bearing cap
12. Camshaft oil seal
13. Camshaft bearing cap
14. Camshaft

## Installation steps

14. Camshaft
- ▶A▶ 13. Camshaft bearing cap
11. Front camshaft bearing cap
10. Rocker arm adjusting screw
9. Nut
8. Rocker arm
- ▶B▶ 7. Rocker shaft spring
6. Rocker shaft
5. Rocker shaft support
- ▶C▶ 12. Camshaft oil seal
- ▶D▶ 4. Semi-circular packing
3. Rocker cover gasket
2. Rocker cover
1. Breather hose

**INSPECTION****CAMSHAFT**

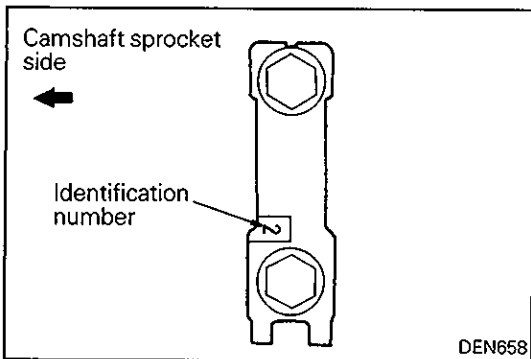
- (1) Measure the cam height.

**Standard value: 41.84 mm (1.6472 in.)**

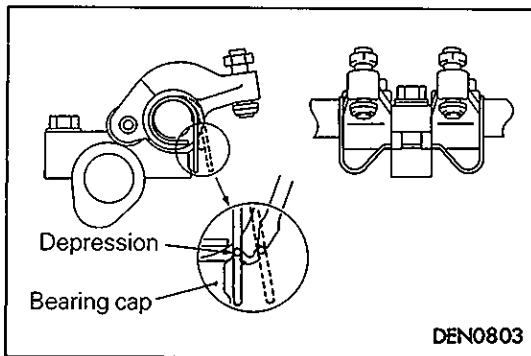
**Limit: 41.34 mm (1.6276 in.)**

**ROCKER ARM SHAFT**

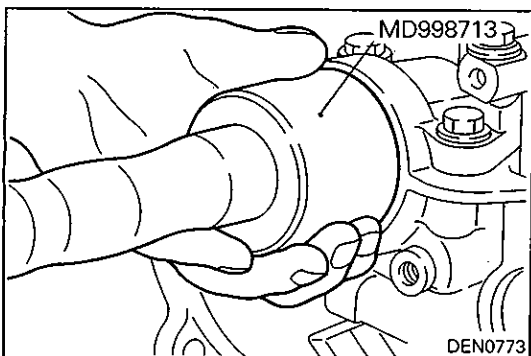
- (1) Check the oil holes for clogging and clean if clogged.
- (2) Check the outer circumference of the portion where the rocker arm is installed and replace if damage or seizure is evident.

**◆A◆ CAMSHAFT BEARING CAP INSTALLATION**

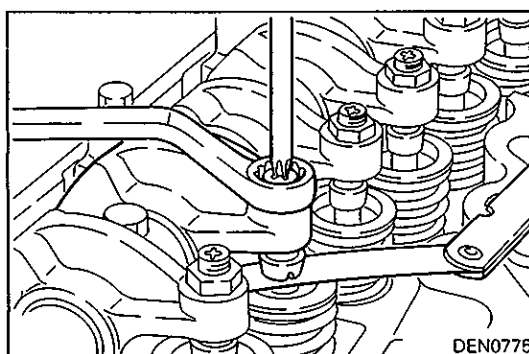
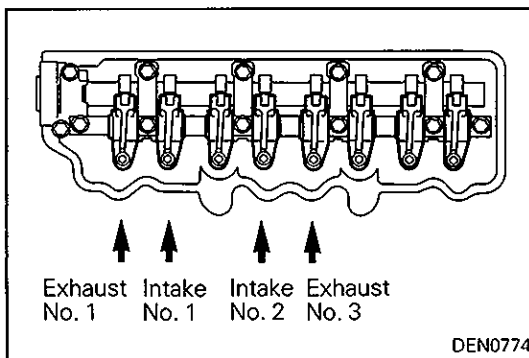
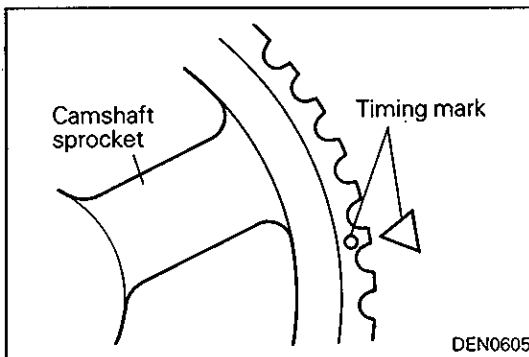
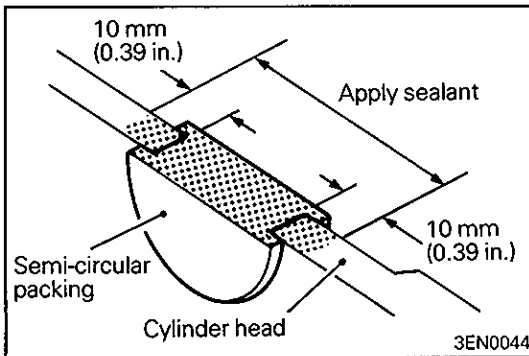
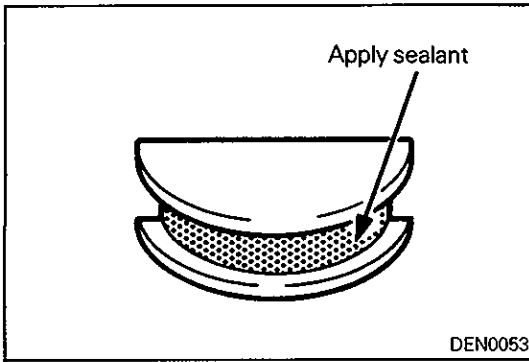
- (1) Install the bearing caps in the designated position confirming the identification numbers stamped on the cap front. The No.5 cap has no identification number stamped.

**◆B◆ ROCKER SHAFT SPRING INSTALLATION**

- (1) Hook the rocker shaft spring to the depression of the bearing cap.

**◆C◆ CAMSHAFT OIL SEAL INSTALLATION**

- (1) Using the special tool, install a new camshaft oil seal into the front bearing cap.



## SEMI-CIRCULAR PACKING INSTALLATION

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

**Specified sealant:**

**3M ATD Part No. 8660 or equivalent**

## VALVE CLEARANCE ADJUSTMENT

- (1) Turn the crankshaft clockwise and align the timing mark on camshaft sprocket with that on the injection pump bracket.

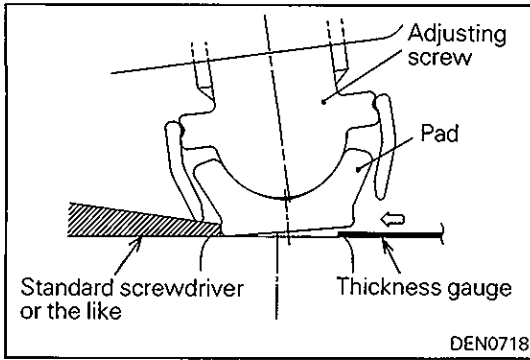
- (2) Adjust the valve clearance at the points shown in the illustration.

- (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):**

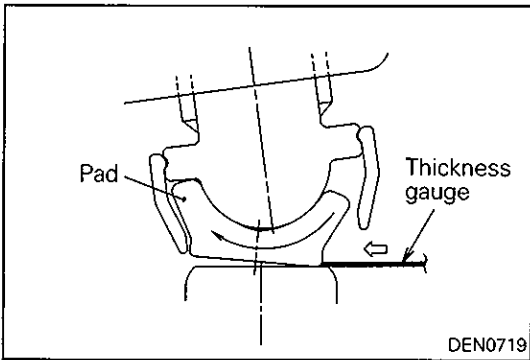
Intake	0.15 mm (0.0059 in.)
Exhaust	0.15 mm (0.0059 in.)



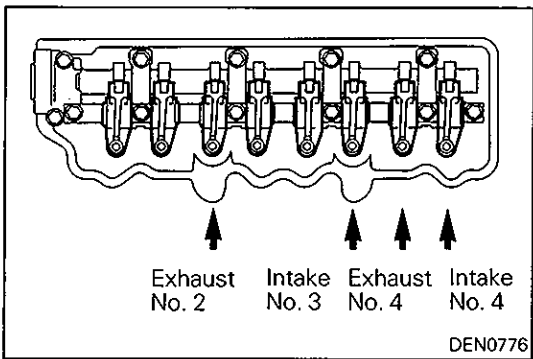


NOTE

Before insertion of a thickness gauge, provide clearance for inserting the gauge by pushing the pad with a standard screwdriver or the like from the opposite side.



If an attempt is made to insert the thickness gauge without providing the clearance for it in advance by pushing the pad with a standard screwdriver or the like, the pad will tilt as shown in the illustration, preventing insertion of the thickness gauge.

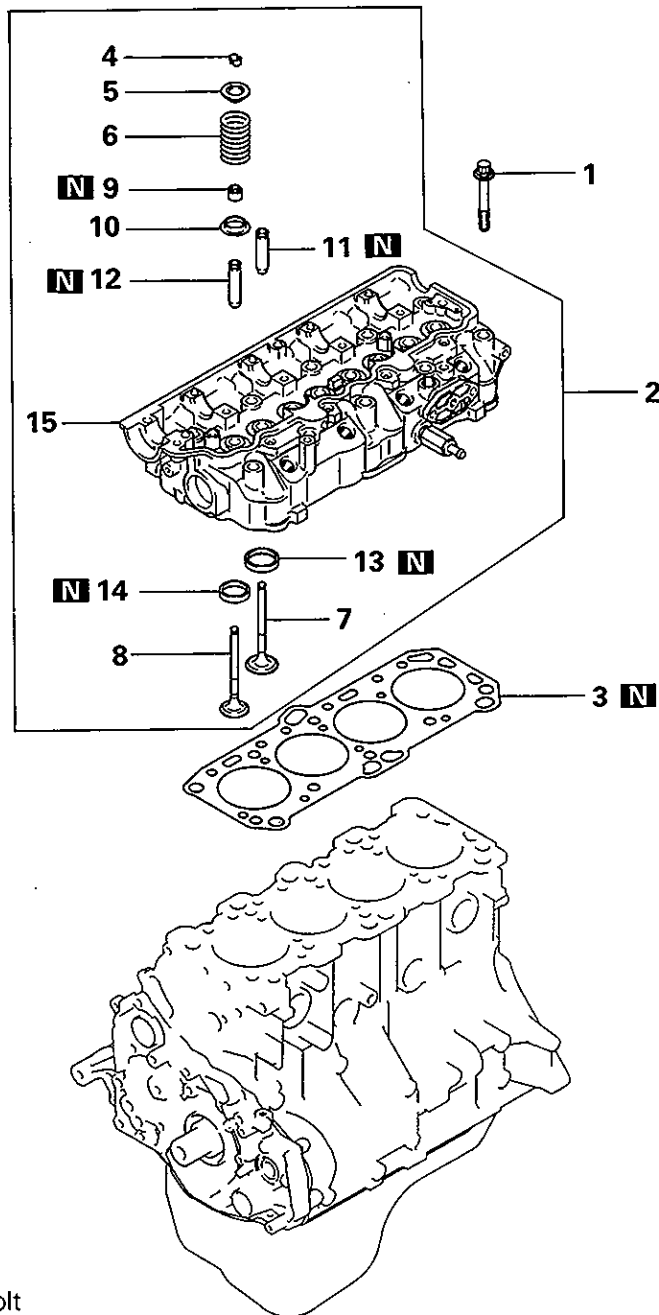


- (5) While holding the adjusting screw with a screwdriver, tighten the lock nut.
- (6) Rotate clockwise the crankshaft one complete turn (360° degrees).
- (7) Adjust the valve clearance at the points shown in the illustration.
- (8) Repeat steps (3) to (5) to adjust the valve clearance of the remaining valves.

NOTE

With the engine mounted on vehicle, warm up the engine. Then, check for valve clearance on hot engine and adjust if necessary.

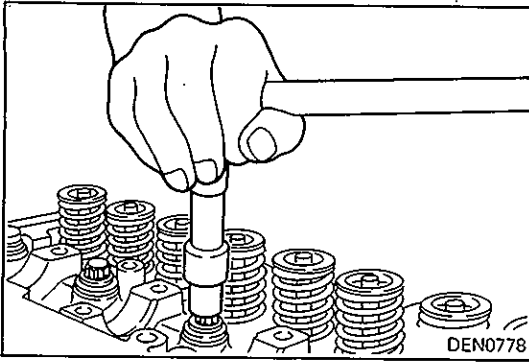
## 10. CYLINDER HEAD, VALVES AND VALVE SPRINGS REMOVAL AND INSTALLATION



### Removal steps

- ◊A◊ ◊E◊ 1. Cylinder head bolt
- 2. Cylinder head assembly
- ◊D◊ 3. Cylinder head gasket
- ◊B◊ ◊C◊ 4. Valve spring retainer lock
- 5. Valve spring retainer
- ◊B◊ 6. Valve spring
- 7. Intake valve
- 8. Exhaust valve
- ◊C◊ ◊A◊ 9. Valve stem seal
- 10. Spring seat
- 11. Intake valve guide
- 12. Exhaust valve guide
- 13. Intake valve seat
- 14. Exhaust valve seat
- 15. Cylinder head

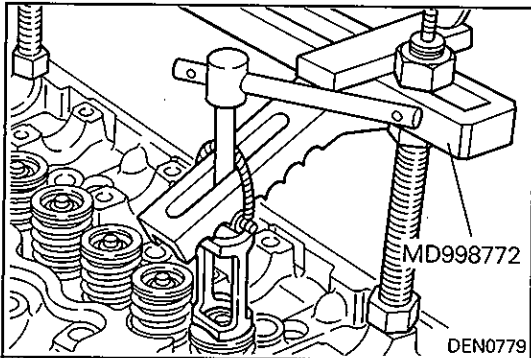
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### REMOVAL SERVICE POINTS

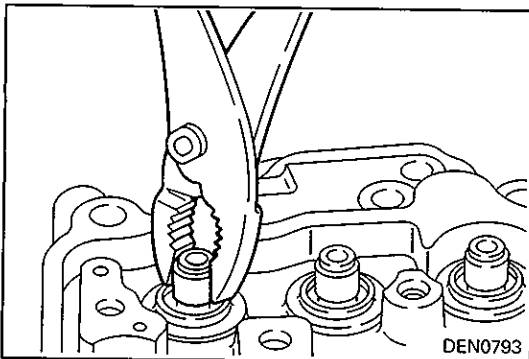
#### ◊A◊ CYLINDER HEAD BOLT REMOVAL

- (1) Using a 12 mm – 12 points socket wrench, loosen the cylinder head bolts.



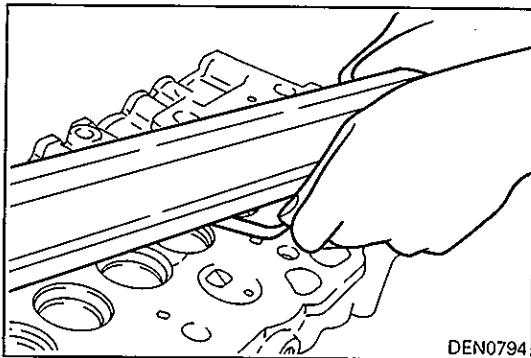
#### ◊B◊ RETAINER LOCK REMOVAL

- (1) Store removed valves, springs and other parts, tagged to indicate their cylinder No. and location for reassembly.



#### ◊C◊ VALVE STEM SEAL REMOVAL

- (1) Do not reuse removed stem seals



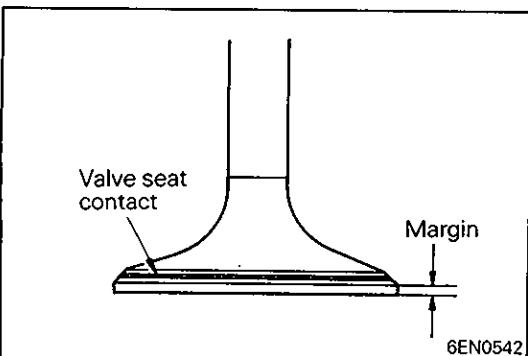
### INSPECTION

#### CYLINDER HEAD

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

**Standard value: 0.05 mm (0.0020 in.)**

**Limit: 0.2 mm (0.008 in.)**

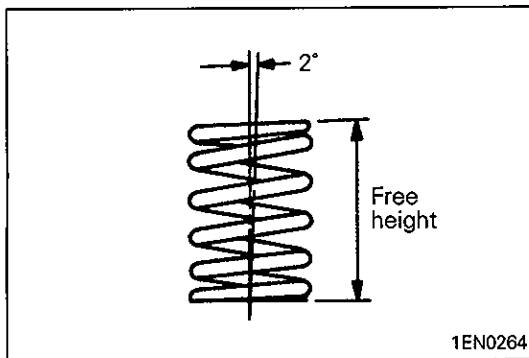


#### VALVE

- (1) Check the valve face for correct contact. If incorrect, reface using a valve refacer. Valve seat contact should be maintained uniform at the center of valve face.
- (2) If the margin is smaller than the service limit, replace the valve.

**Standard value: 1.5 mm (0.059 in.)**

**Limit: 0.7 mm (0.028 in.)**



**VALVE SPRING**

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

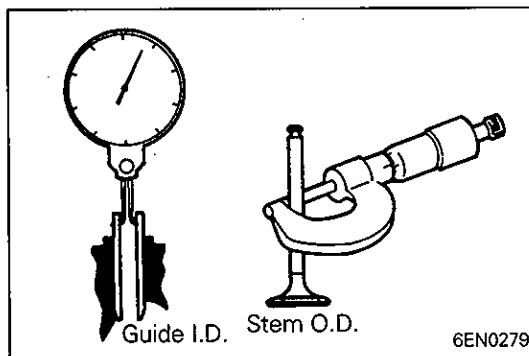
**Standard value: 49.1 mm (1.933 in.)**

**Limit: 48.1 mm (1.894 in.)**

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

**Standard value: 2° or less**

**Limit: Max. 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:**

**Intake**

**Engines without turbocharger**

**0.03 – 0.06 mm (0.0012 – 0.0024 in.)**

**Engines with turbocharger**

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

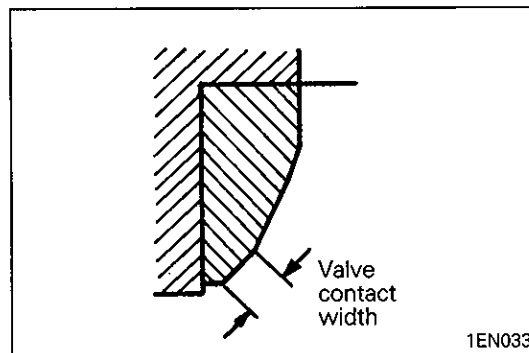
**Exhaust**

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

**Limit:**

**Intake 0.10 mm (0.0039 in.)**

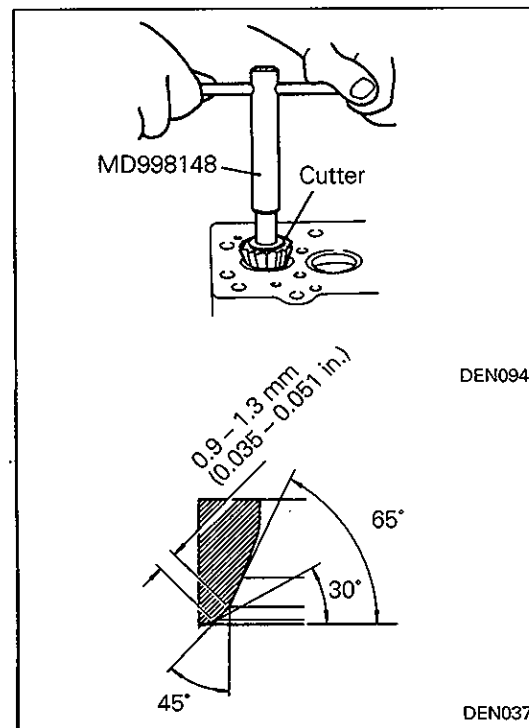
**Exhaust 0.15 mm (0.0059 in.)**



**VALVE SEAT**

- (1) Check the valve seat for trace of overheat and contact with valve surface.

**Standard value: 0.9 – 1.3 mm (0.035 – 0.051 in.)**

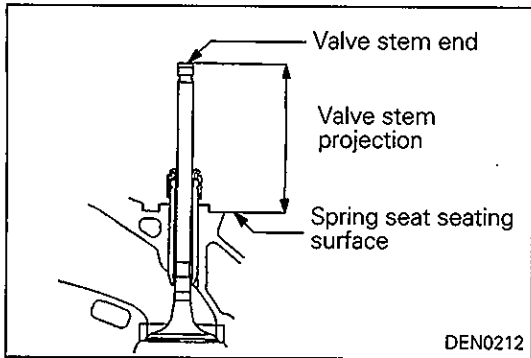


**VALVE SEAT RECONDITIONING PROCEDURE**

- (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 a seat grinder, correct to obtain the specified seat width and angle.

Cutter angle	Tool number	
	Intake	Exhaust
45°	MD998159	MD998158
65°	MD998165	MD998165
30°	MD998175	MD998173

- (3) After correction, the valve and valve seat should be lapped with a lapping compound.



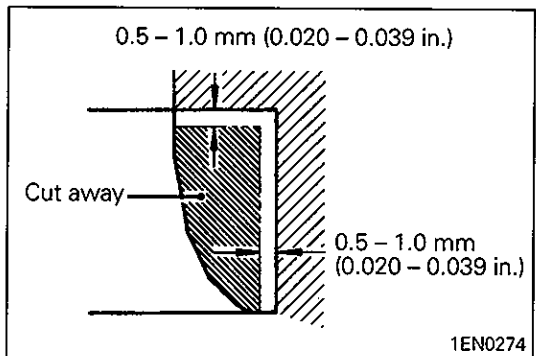
- (4) Install the valve and, while pressing the valve against the valve seat, measure the valve stem projection between the valve stem end and the valve spring seat seating surface.

**Standard value: 43.45 mm (1.7106 in.)**

**Limit: 43.95 mm (1.7303 in.)**

### 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 the cylinder head to a selected oversize valve seat diameter.

#### Intake valve seat hole diameter

**0.30 O.S.: 38.300 – 38.325 mm  
(1.5079 – 1.5089 in.)**

**0.60 O.S.: 38.600 – 38.625 mm  
(1.5197 – 1.5207 in.)**

#### Exhaust valve seat hole diameter

**0.30 O.S.: 34.300 – 34.325 mm  
(1.3504 – 1.3514 in.)**

**0.60 O.S.: 34.600 – 34.625 mm  
(1.3622 – 1.3632 in.)**

- (3) Before fitting the valve seat, either heat the cylinder head up to approximately 250°C (482°F) or cool the valve seat using cooling spray, to prevent the cylinder head bore from galling.

- (4) Using a 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 the cylinder head gasket surface.

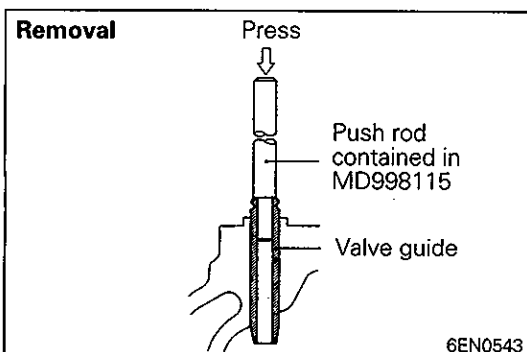
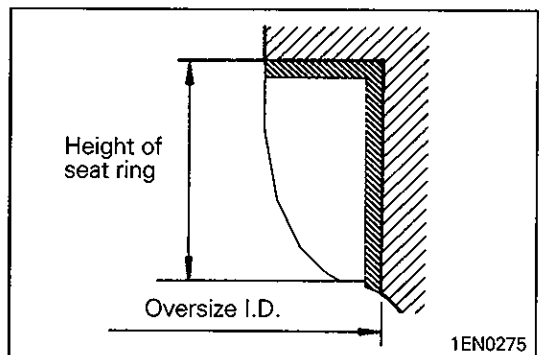
- (2) Rebore the valve guide hole to the new oversize valve guide outside diameter.

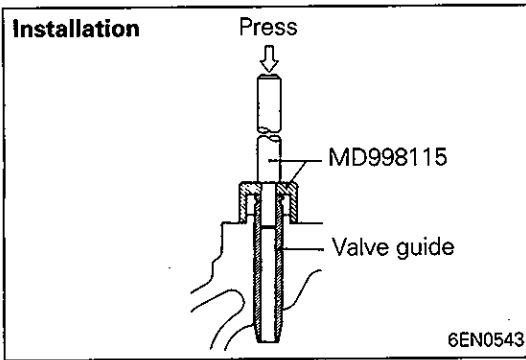
#### Valve guide hole diameter

**0.05 O.S.: 13.050 – 13.068 mm  
(0.5138 – 0.5145 in.)**

**0.25 O.S.: 13.250 – 13.268 mm  
(0.5217 – 0.5224 in.)**

**0.50 O.S.: 13.500 – 13.518 mm  
(0.5315 – 0.5322 in.)**



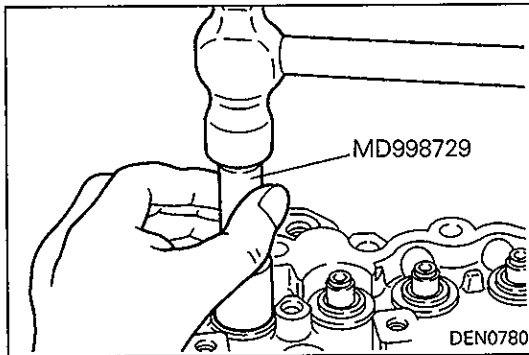


**NOTE**

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.



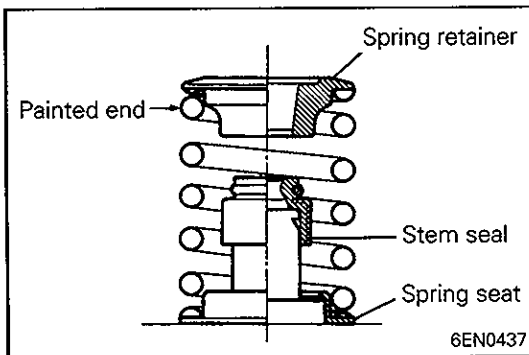
**INSTALLATION SERVICE POINTS**

**▶A◀ VALVE STEM SEAL INSTALLATION**

- (1) Install the valve spring seat.
- (2) The special tool must be used to install valve stem seals. Improper installation could result in oil leaks past the valve guide.

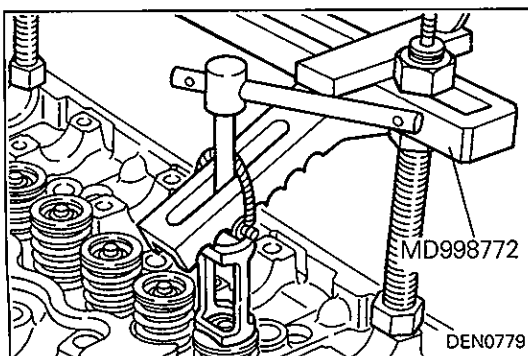
**Caution**

- Do not reuse removed valve stem seals.



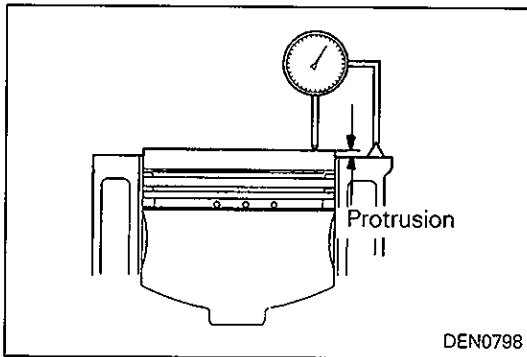
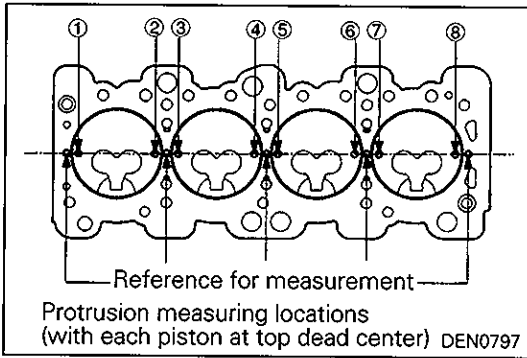
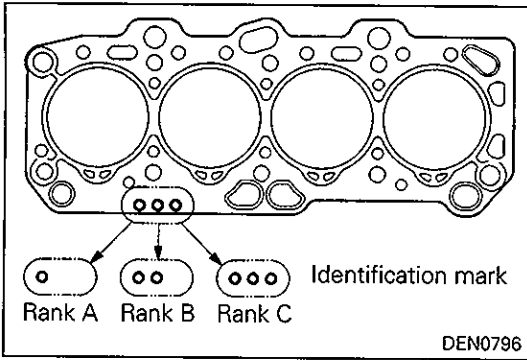
**▶B◀ VALVE SPRING INSTALLATION**

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



**▶C◀ RETAINER LOCK INSTALLATION**

- (1) The valve spring, if excessively compressed, causes the bottom end of the retainer to be in contact with, and damage, the stem seal.



### ◆D◆ CYLINDER HEAD GASKET INSTALLATION

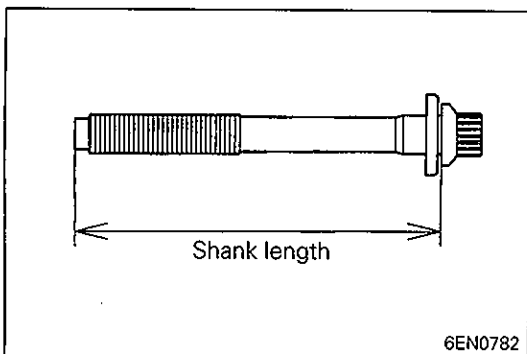
(1) In case any of the cylinder block, piston, connecting rod and crankshaft has not been replaced, install the gasket of the same rank as before which can be identified by the mark shown in the illustration at left.

(2) In case any of the cylinder block, piston, connecting rod and crankshaft have been replaced, reselect and install the gasket in accordance with the following procedure.

① With each piston held at the top dead center, measure its protrusion from the upper block surface at the locations shown in the illustration at left (total of eight locations). Be sure to take measurements on the crankshaft center line.

② Using the average of the eight measurements, select the gasket rank (A, B or C) in accordance with the table given below. If, however, the maximum protrusion at any one location exceeds the protrusion tolerance shown for any rank in the following table, use the gasket one rank higher than that rank.

Rank	Average value of piston protrusions	Protrusion tolerance for each rank	mm (in.)
			Thickness of selected gasket (when tightened)
A	0.641 – 0.700 (0.0252 – 0.0276)	0.750 (0.0295)	1.40±0.05 (0.055±0.002)
B	0.700 – 0.760 (0.0276 – 0.0299)	0.810 (0.0319)	1.45±0.05 (0.057±0.002)
C	0.760 – 0.823 (0.0299 – 0.0324)		1.50±0.05 (0.059±0.002)

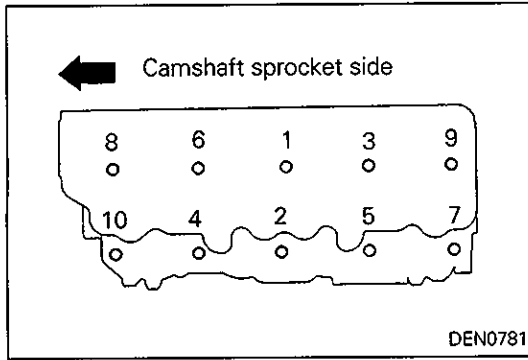


### ◆E◆ CYLINDER HEAD BOLT INSTALLATION

(1) When installing the cylinder head bolts, check that the shank length of each bolt meets the limit. If the limit is exceeded, replace the bolt.

**Limit: max. 119.7 mm (4.71 in.)**

(2) Apply engine oil to the bolt threads and washers.



- (3) According to the tightening sequence, tighten the bolts to 90 Nm (9.0 kgm, 65 ft.lbs.) using a 12 mm – 12 points socket wrench.
- (4) Loosen the bolts completely.
- (5) Torque the bolts to 40 Nm (4.0 kgm, 29 ft.lbs.).
- (6) Tighten the bolts 1/4 turns (90°) more.
- (7) Tighten the bolts 1/4 turns (90°) additionally.

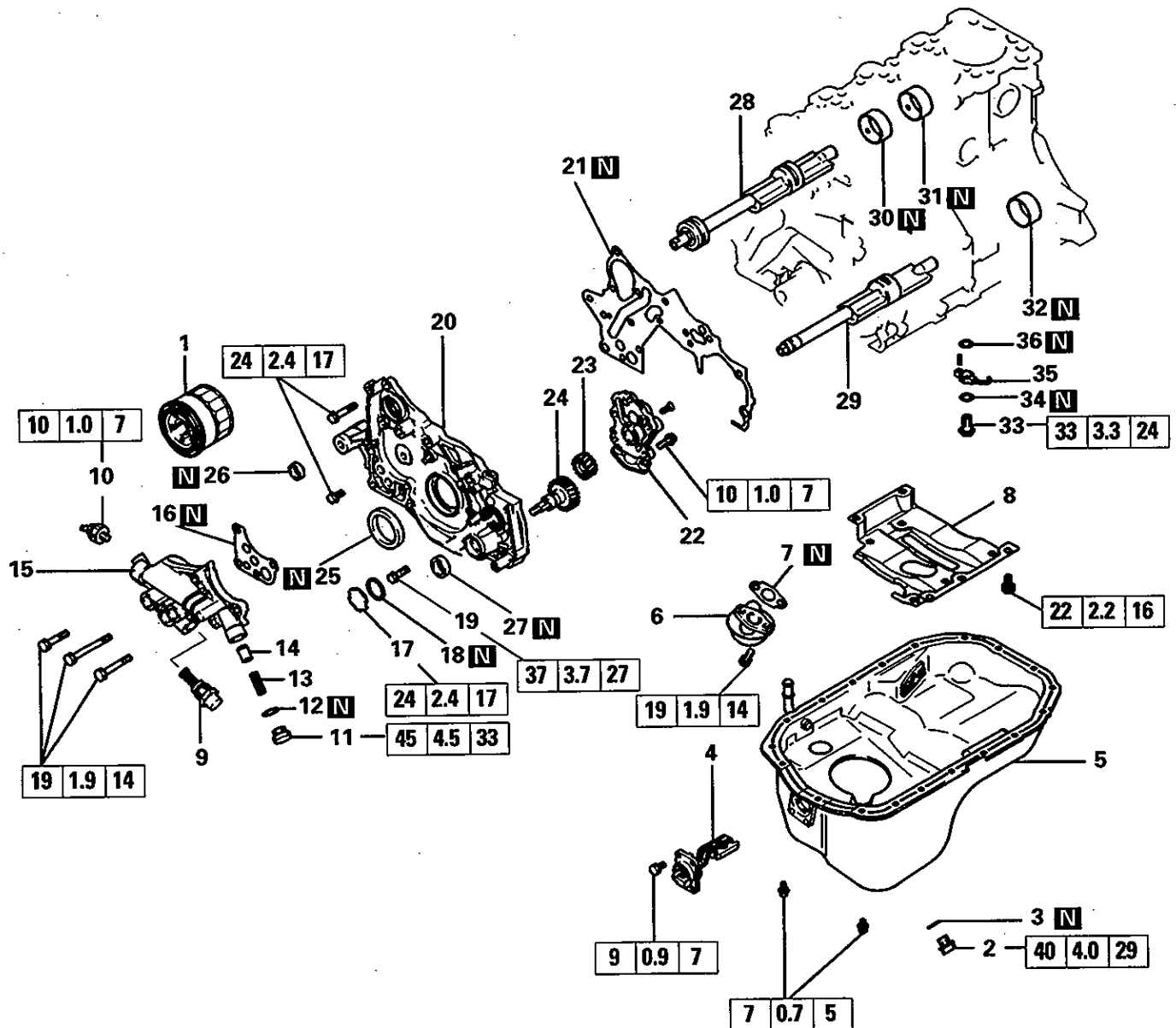


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## NOTES

## 11. FRONT CASE, SILENT SHAFTS AND OIL PAN

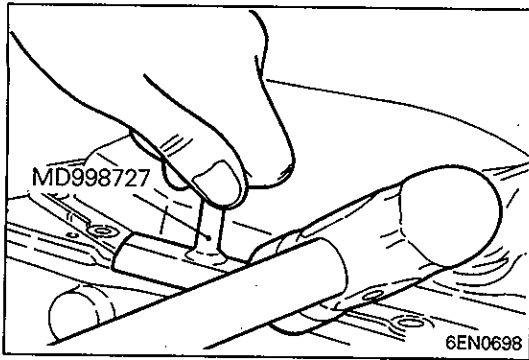
## REMOVAL AND INSTALLATION



## Removal steps

- 1. Oil filter
- 2. Drain plug
- 3. Drain plug gasket
- 4. Oil level sensor
- 5. Oil pan
- 6. Oil screen
- 7. Oil screen gasket
- 8. Stiffener plate
- 9. Oil cooler bypass valve
- 10. Oil pressure switch
- 11. Plug
- 12. Gasket
- 13. Relief spring
- 14. Relief plunger
- 15. Oil filter bracket
- 16. Oil filter bracket gasket
- 17. Plug
- 18. O-ring

- 19. Flange bolt
- 20. Front case
- 21. Front case gasket
- 22. Oil pump cover
- 23. Oil pump driven gear
- 24. Oil pump drive gear
- 25. Crankshaft front oil seal
- 26. Silent shaft oil seal
- 27. Oil pump oil seal
- 28. Silent shaft, right
- 29. Silent shaft, left
- 30. Silent shaft front bearing
- 31. Silent shaft rear bearing, right
- 32. Silent shaft rear bearing, left
- 33. Check valve
- 34. Gasket
- 35. Oil jet
- 36. Gasket



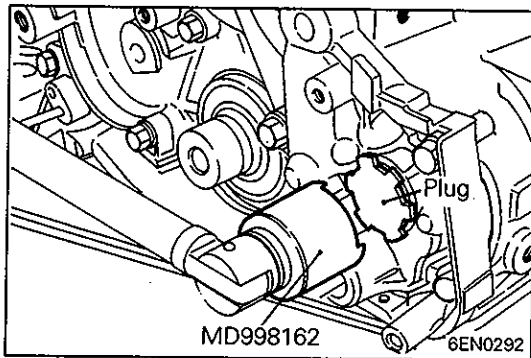
## REMOVAL SERVICE POINTS

### ◁A▷ OIL PAN REMOVAL

- (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.

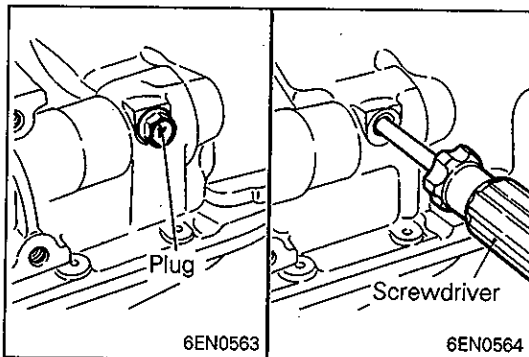
### ◁B▷ PLUG REMOVAL

- (1) If the plug is tightened too firmly to loosen, tap the plug head two or three times with a hammer, and the plug will loosen easily.

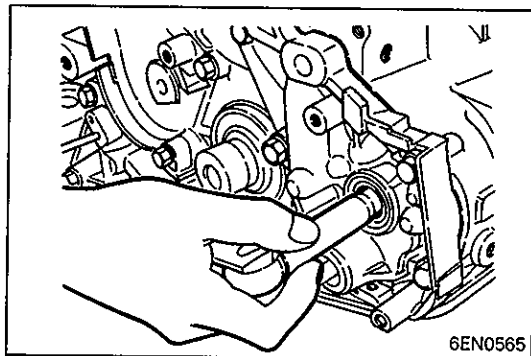


### ◁C▷ FLANGE BOLT REMOVAL

- (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 the cylinder block to block the silent shaft.



- (2) Loosen the flange bolt.

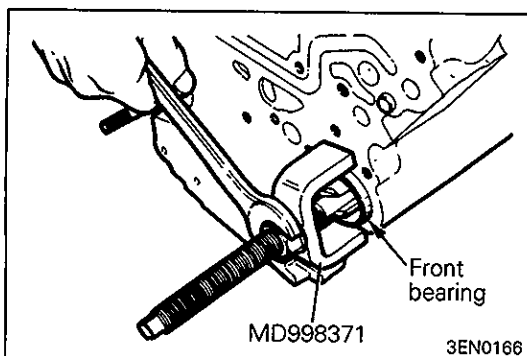


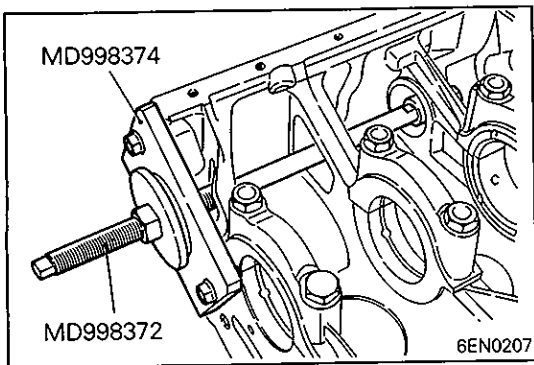
### ◁D▷ SILENT SHAFT FRONT BEARING REMOVAL

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

#### NOTE

Be sure to remove the front bearing first. If it has not been removed, the Rear Bearing Puller cannot be used.





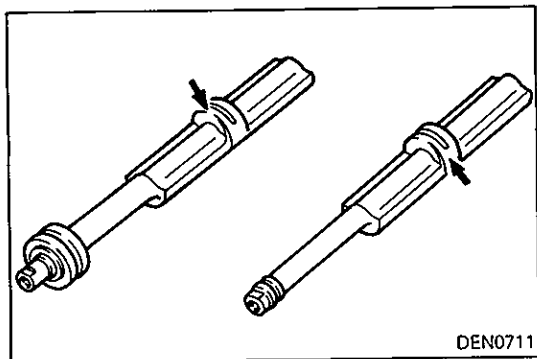
**RIGHT SILENT SHAFT REAR BEARING / LEFT SILENT SHAFT REAR BEARING REMOVAL**

- (1) Using the special tool, remove two rear bearings from the cylinder block.
- (2) To remove the left rear bearing, install the special tool, Silent Shaft Bearing Installer Stopper, to the front of the cylinder block, then remove the bearing using the special tool, Silent Shaft Bearing Puller.

**INSPECTION**

**FRONT CASE**

- (1) Check the oil holes for clogging and clean if necessary.
- (2) Check the left silent shaft front bearing section for wear, damage and seizure. If there is anything wrong with the section, replace the front case.
- (3) Check the front case for cracks and other damage. Replace cracked or damaged front case.



**SILENT SHAFT**

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

**Standard value:**

**Front**

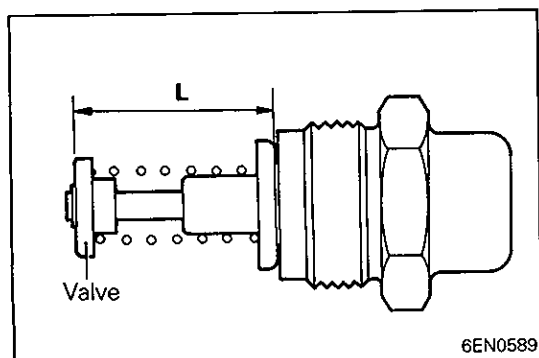
0.02 – 0.06 mm (0.0008 – 0.0024 in.) ..... **Right**

0.02 – 0.05 mm (0.0008 – 0.0020 in.) ..... **Left**

**Rear**

0.05 – 0.09 mm (0.0020 – 0.0036 in.) ..... **Right**

0.05 – 0.09 mm (0.0020 – 0.0036 in.) ..... **Left**



**OIL COOLER BYPASS VALVE (Models with oil cooler)**

- (1) Make sure that the valve moves smoothly.
- (2) Ensure that the dimension L measures the standard value under normal temperature and humidity.

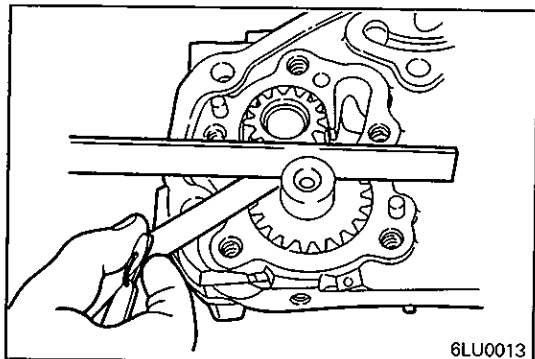
**Dimension L: 34.5 mm (1.358 in.)**

- (3) The dimension must be the standard value when measured after the valve has been dipped in 100°C (212°F) oil.

**Dimension L: 40 mm (1.57 in.) or more**

**OIL PUMP**

- (1) Assemble the oil pump gear to the front case and rotate it to ensure smooth rotation with no looseness.
- (2) Ensure that there is no ridge wear on the contact surface between the front case and the gear surface of the oil pump cover.



- (3) Check the side clearance

**Standard value:**

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

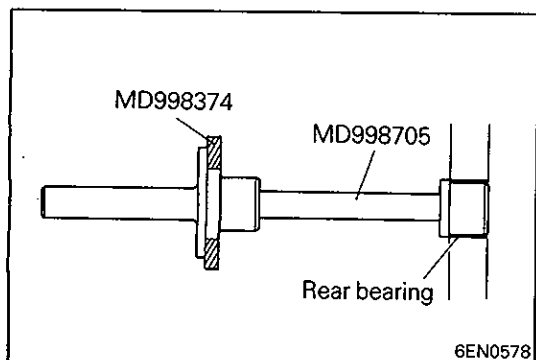
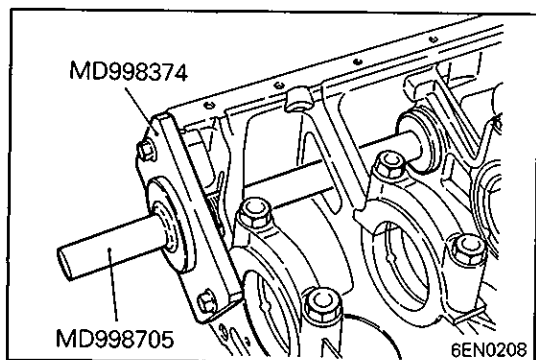
**Driven gear** 0.06 – 0.12 mm (0.0024 – 0.0047 in.)

**OIL SEAL**

- (1) Check the oil seal lip for wear and damage. Replace the oil seal if necessary.
- (2) Check the the oil seal lip for deterioration. Replace oil seal if necessary.

**INSTALLATION SERVICE POINTS****◆◆ LEFT SILENT SHAFT REAR BEARING INSTALLATION**

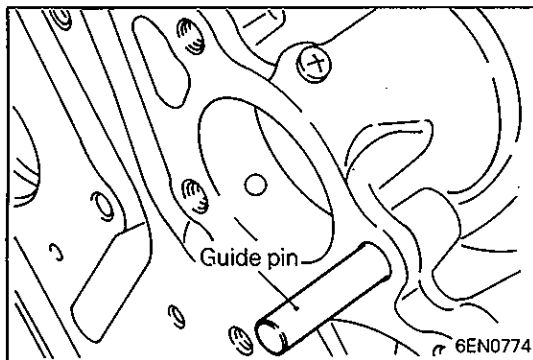
- (1) Install the special tool in the cylinder block.
- (2) Apply engine oil to the rear bearing outer circumference and bearing hole in the cylinder block.



- (3) Using the special tool, install the bearing.

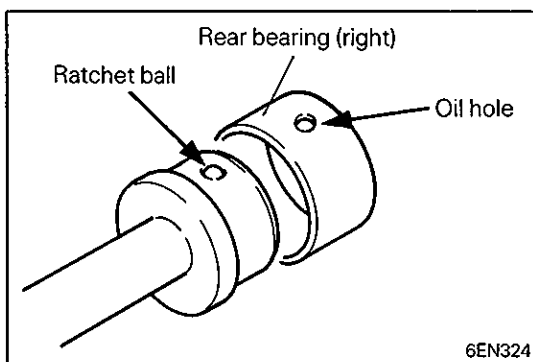
**NOTE**

The left side bearing is provided with no oil hole.

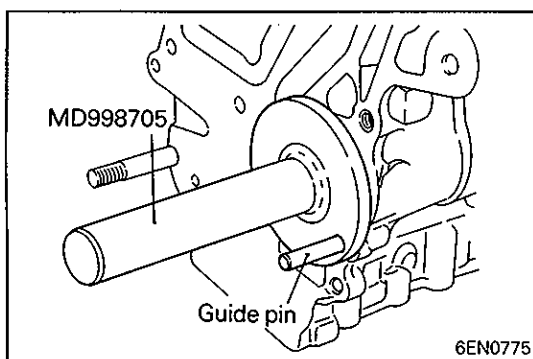


### ▶B▶ RIGHT SILENT SHAFT REAR BEARING INSTALLATION

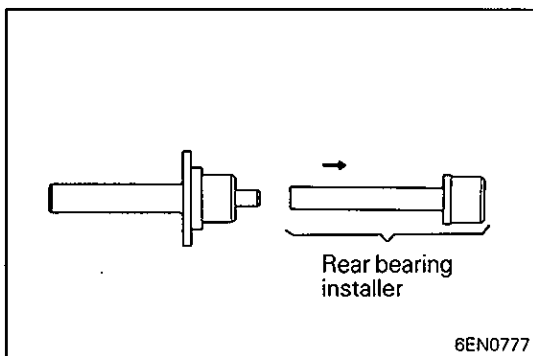
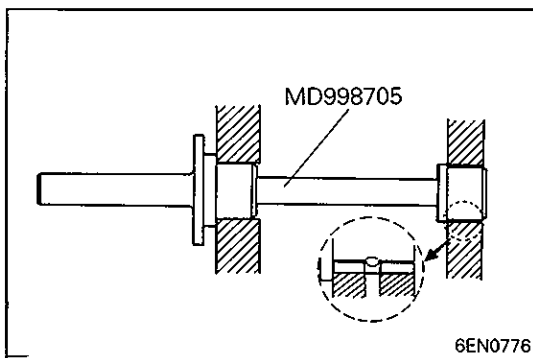
- (1) Install the guide pin of the special tool to the threaded hole of the cylinder block as illustrated.



- (2) Install the bearing to the special tool, aligning the ratchet ball of the special tool with the oil hole of the rear bearing.
- (3) Apply engine oil to the outer circumference of the bearing and to the bearing hole of the cylinder block.

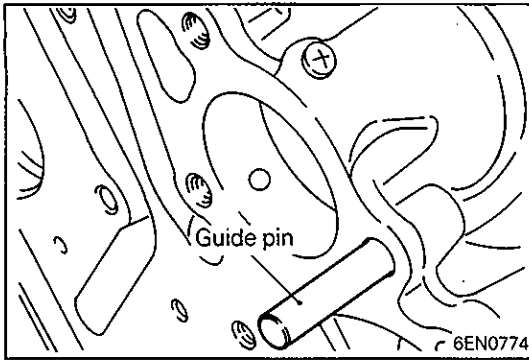


- (4) Insert the installer aligning with the guide pin and install the bearing.

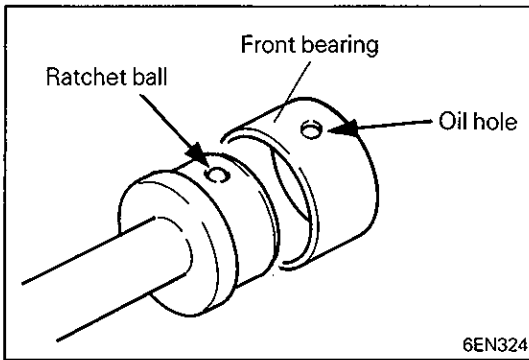


### ▶C▶ SILENT SHAFT FRONT BEARING INSTALLATION

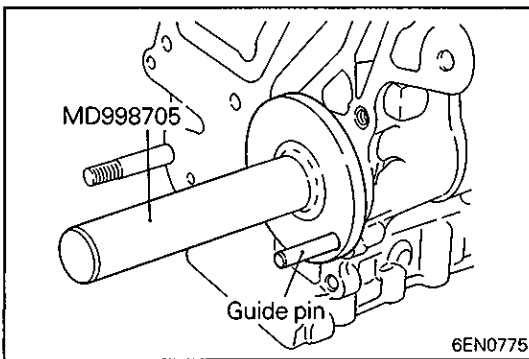
- (1) Remove the rear bearing installing portion from the special tool.



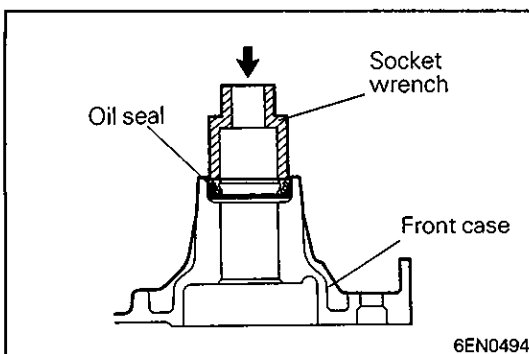
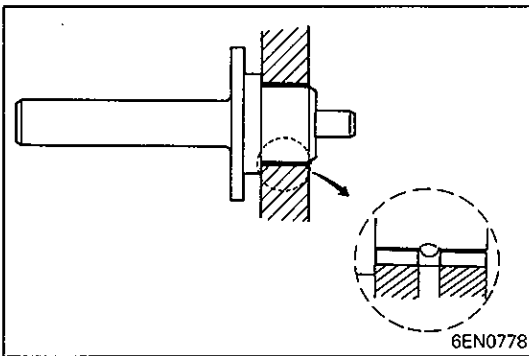
- (2) Install the guide pin of the special tool to the threaded hole of the cylinder block as illustrated.



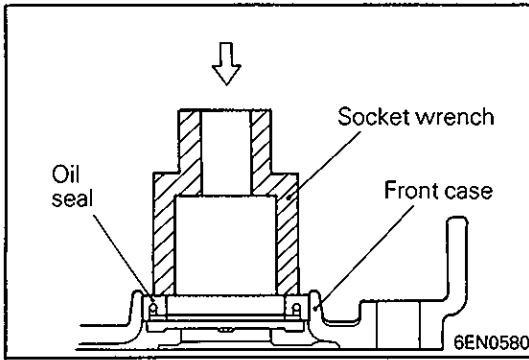
- (3) Install the bearing to the special tool, aligning the ratchet ball of the special tool with the oil hole of the front bearing.  
 (4) Apply engine oil to the outer circumference of the bearing and to the bearing hole of the cylinder block.



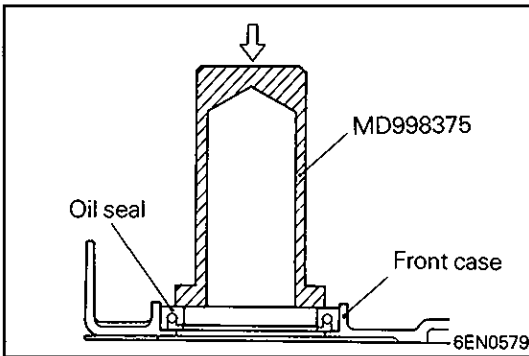
- (5) Insert the installer aligning with the guide pin and install the bearing.



#### ⇄ OIL PUMP OIL SEAL INSTALLATION

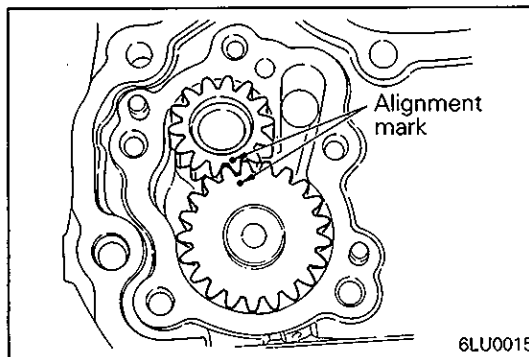


#### ▶E◀ SILENT SHAFT OIL SEAL INSTALLATION



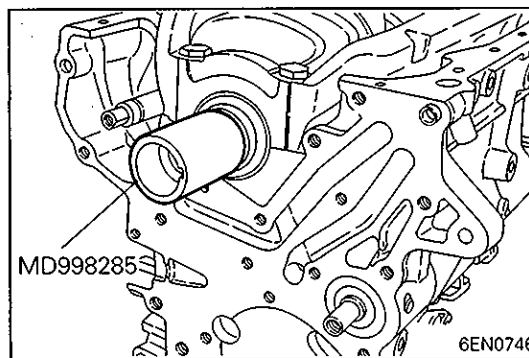
#### ▶F◀ CRANKSHAFT FRONT OIL SEAL INSTALLATION

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



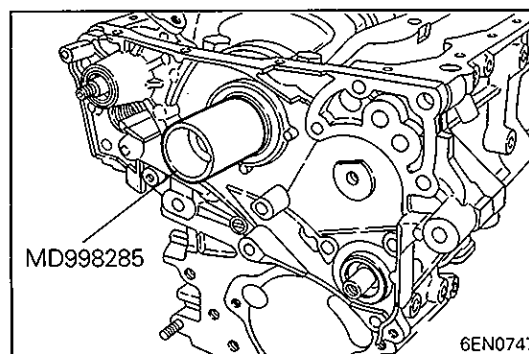
#### ▶G◀ OIL PUMP DRIVEN GEAR / OIL PUMP DRIVE GEAR INSTALLATION

- (1) Apply engine oil amply to the gears and line up the alignment marks.



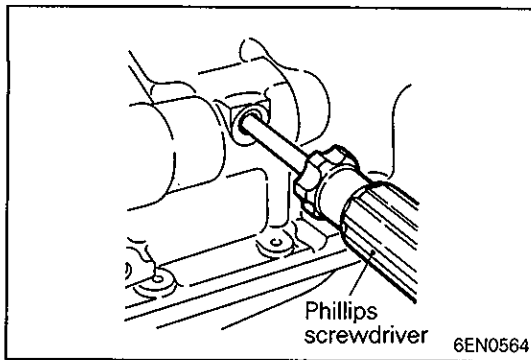
#### ▶H◀ FRONT CASE INSTALLATION

- (1) Install the special tool at the front end of the crankshaft and apply a thin coat of engine oil to the outer circumference. In case an oil seal has been installed to the front case, be sure to use the guide.



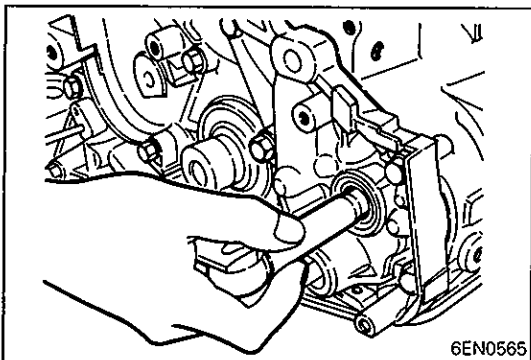
- (2) Install the front case assembly via a new front case gasket and temporarily tighten the flange bolts (other than those for tightening the filter bracket.)
- (3) Install the oil filter bracket via the oil filter bracket gasket and temporarily tighten four bolts with washers.
- (4) Tighten the front case bolts to the specified torque.





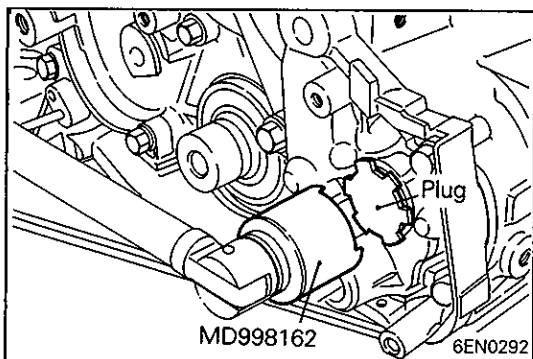
### ◆I◆ FLANGE BOLT INSTALLATION

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



### ◆J◆ PLUG INSTALLATION

- (1) Install the plug using the special tool.

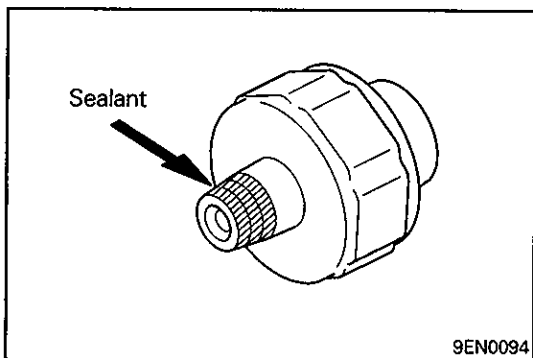


### ◆K◆ SEALANT APPLICATION TO OIL PRESSURE SWITCH

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

#### Caution

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

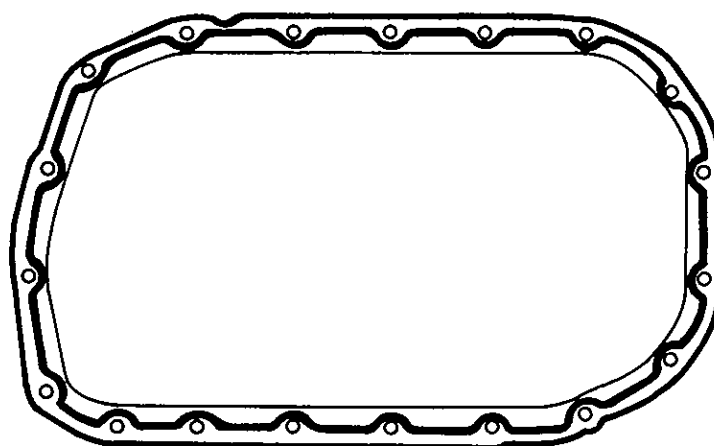


**⇄ OIL PAN INSTALLATION**

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

**Specified sealant:****MITSUBISHI GENUINE PART No. MD970389 or equivalent**

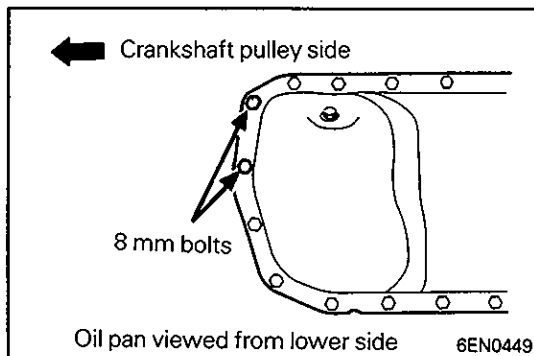
- (3) The oil pan should be installed in 15 minutes after application of sealant.

Bolt hole  
portion

Groove portion



6EN0213



← Crankshaft pulley side

8 mm bolts

Oil pan viewed from lower side

6EN0449

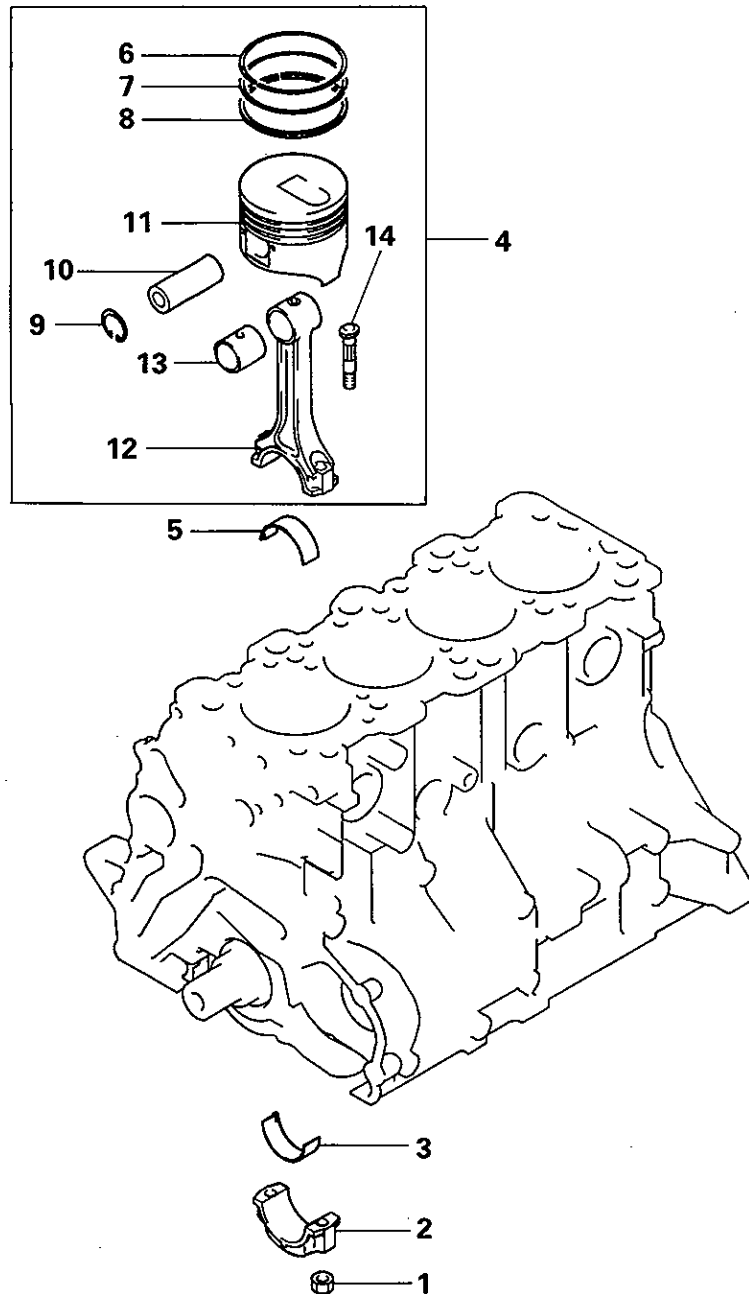
- (4) Note the difference in bolt lengths at the location shown.

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## NOTES

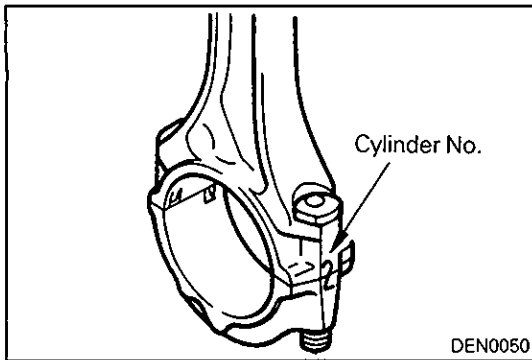
## 12. PISTONS AND CONNECTING RODS

### REMOVAL AND INSTALLATION



#### Removal steps

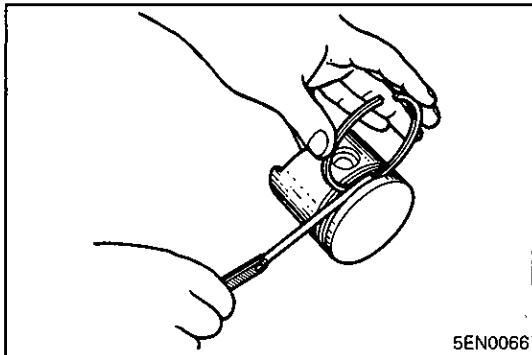
- ↔F↔ 1. Nut
- ↔A↔ ↔E↔ 2. Connecting rod cap
- ↔C↔ 3. Connecting rod bearing
- ↔D↔ 4. Piston and connecting rod assembly
- ↔C↔ 5. Connecting rod bearing
- ↔B↔ 6. Piston ring No. 1
- ↔B↔ 7. Piston ring No. 2
- ↔B↔ 8. Oil ring
- ↔B↔ 9. Snap ring
- ↔A↔ 10. Piston pin
- ↔A↔ 11. Piston
- ↔A↔ 12. Connecting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



## REMOVAL SERVICE POINTS

### ◁A▷ CONNECTING ROD CAP REMOVAL

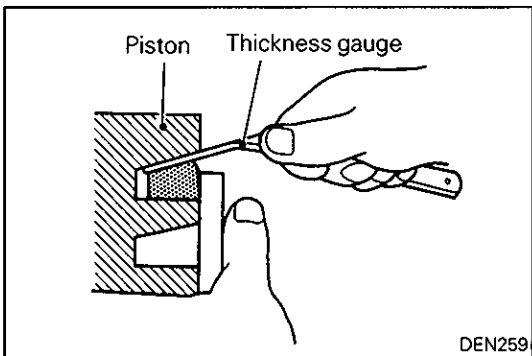
- (1) Mark the cylinder number on the side of the connecting rod big end for correct reassembly.



## INSPECTION

### PISTON RING

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



- (2) In the case of semi-keystone type piston rings, check the ring to ring groove clearance as illustrated.

#### Standard value:

No. 1 0.05 – 0.07 mm (0.0020 – 0.0028 in.)

No. 2

**Engines without turbocharger**

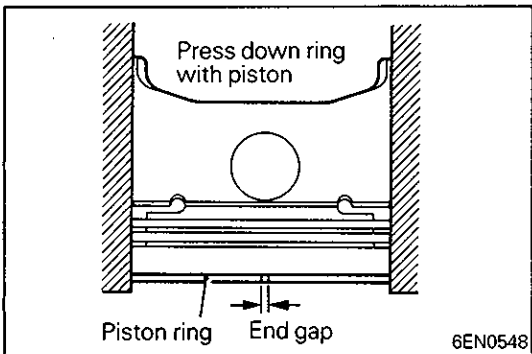
0.02 – 0.06 mm (0.0008 – 0.0024 in.)

**Engines with turbocharger**

0.05 – 0.07 mm (0.0020 – 0.0028 in.)

**Oil** 0.02 – 0.07 mm (0.0008 – 0.0028 in.)

**Limit: 0.1 mm (0.004 in.)**



- (4) Insert the piston ring into the 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 the piston ring.

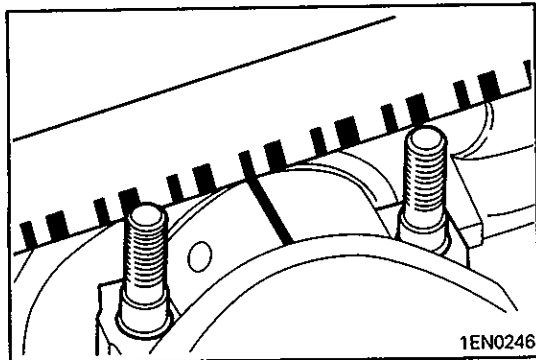
#### Standard value:

No. 1 0.20 – 0.32 mm (0.0079 – 0.0126 in.)

No. 2 0.35 – 0.50 mm (0.0138 – 0.0197 in.)

**Oil** 0.10 – 0.30 mm (0.0039 – 0.0118 in.)

**Limit: 0.8 mm (0.031 in.)**

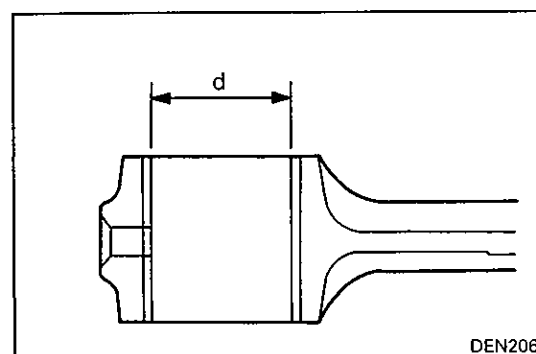
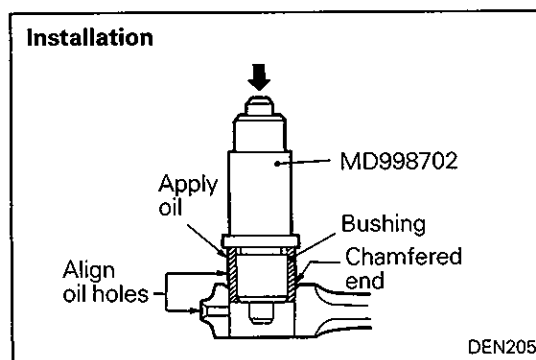
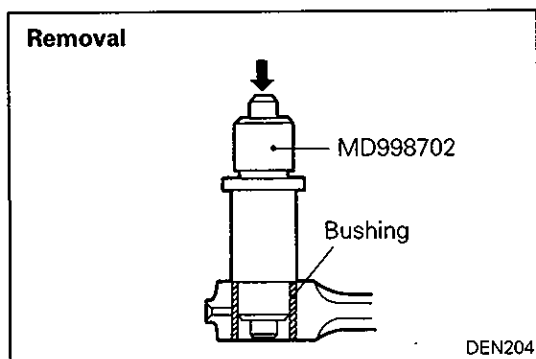


### CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGE METHOD)

- (1) Remove oil from the crankshaft pin and the connecting rod bearing.
- (2) Cut the plastic gauge to the same length as the width of the bearing and place it on the crankshaft pin in parallel with its axis.
- (3) Install the connecting rod cap carefully and tighten the bolts to the specified torque.
- (4) Carefully remove the connecting rod cap.
- (5) Measure the width of the plastic gauge at its widest part by using scale printed on the plastic gauge package.

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

**Limit: 0.1 mm (0.004 in.)**



### CONNECTING ROD BUSHING REPLACEMENT

- (1) Using the special tool, remove the bushing.
- (2) Using the special tool, install the bushing, aligning the oil hole of the bushing with the oil hole at the small end of the connecting rod.

- (3) Finish the bushing I.D. to the standard value.

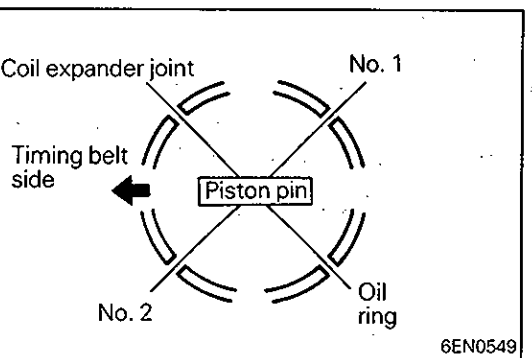
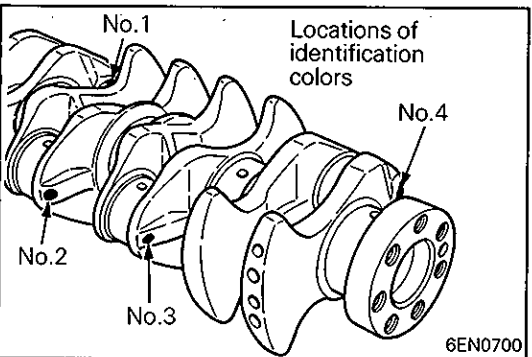
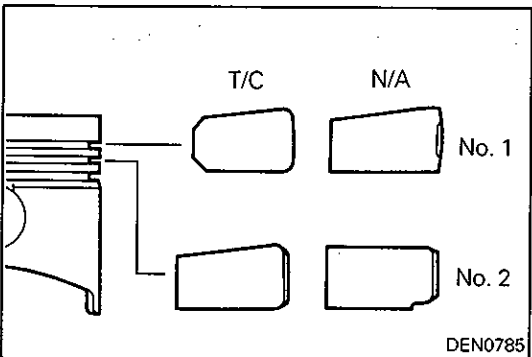
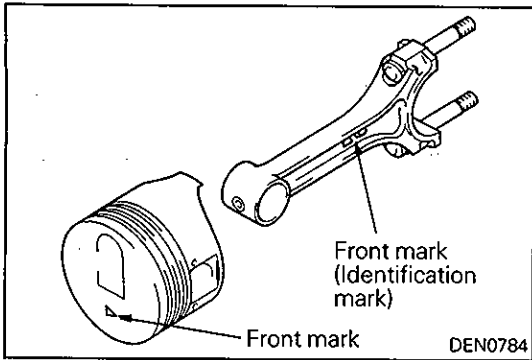
**Bushing I.D. (d) standard value:**

**25.015 – 25.025 mm (0.9848 – 0.9852 in.)**

**Bend (Parallelism between big end center line and small end center line): 0.03 mm (0.0012 in.)**

**Twist (Deflection between big end center line and small end center line): 0.03 mm (0.0012 in.)**

**Twist (Deflection between big end center line and small end center line): 0.03 mm (0.0012 in.)**



**INSTALLATION SERVICE POINTS**

**◆A◆ PISTON PIN / PISTON / CONNECTING ROD INSTALLATION**

- (1) Assemble the piston and connecting rod, directing the front marks in the same direction.
- (2) Insert the piston pin. The pin should be inserted by hand. Replace if there is a play.

**◆B◆ PISTON RING NO. 1 / PISTON RING NO. 2 / OIL RING INSTALLATION**

- (1) Install the oil ring expander and oil ring to the piston.
- (2) Install No. 2 piston ring and then No. 1 piston ring, directing the side with manufacturer's mark and size mark toward the piston top.

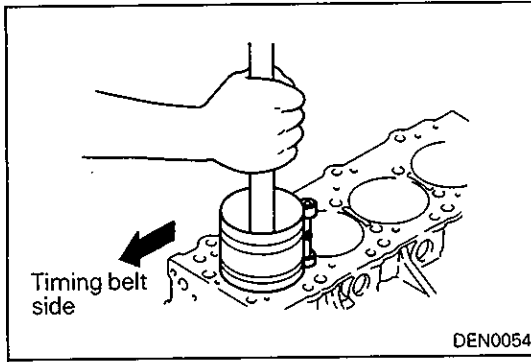
**◆C◆ CONNECTING ROD BEARING INSTALLATION**

- (1) When the bearings are replaced, select and install them according to the identification colors on the crankshaft.

Crank pin O.D. identification color	Connecting rod bearing identification mark
Yellow	1
None	2
White	3

**◆D◆ PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION**

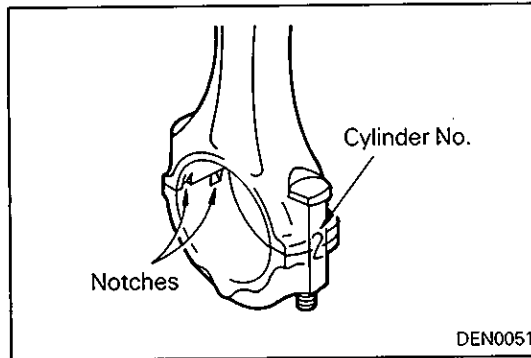
- (1) Liberally coat engine oil on the circumference of the piston, piston ring, and oil ring.
- (2) Arrange the piston ring and oil ring gaps as shown in the illustration.
- (3) Rotate the crankshaft so that the crank pin is on the center of the cylinder bore.



- (4) Use suitable thread protectors on the connecting rod bolts before inserting the piston and connecting rod assembly into the cylinder block. Care must be taken not to nick the crank pin.
- (5) Using a suitable piston ring compressor tool, install the piston and connecting rod assembly into the cylinder block.

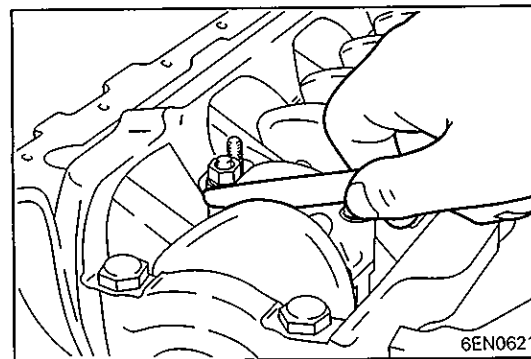
#### Caution

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



#### ◆E◆ CONNECTING ROD CAP INSTALLATION

- (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 the 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.)**

#### ◆F◆ CONNECTING ROD CAP NUT INSTALLATION

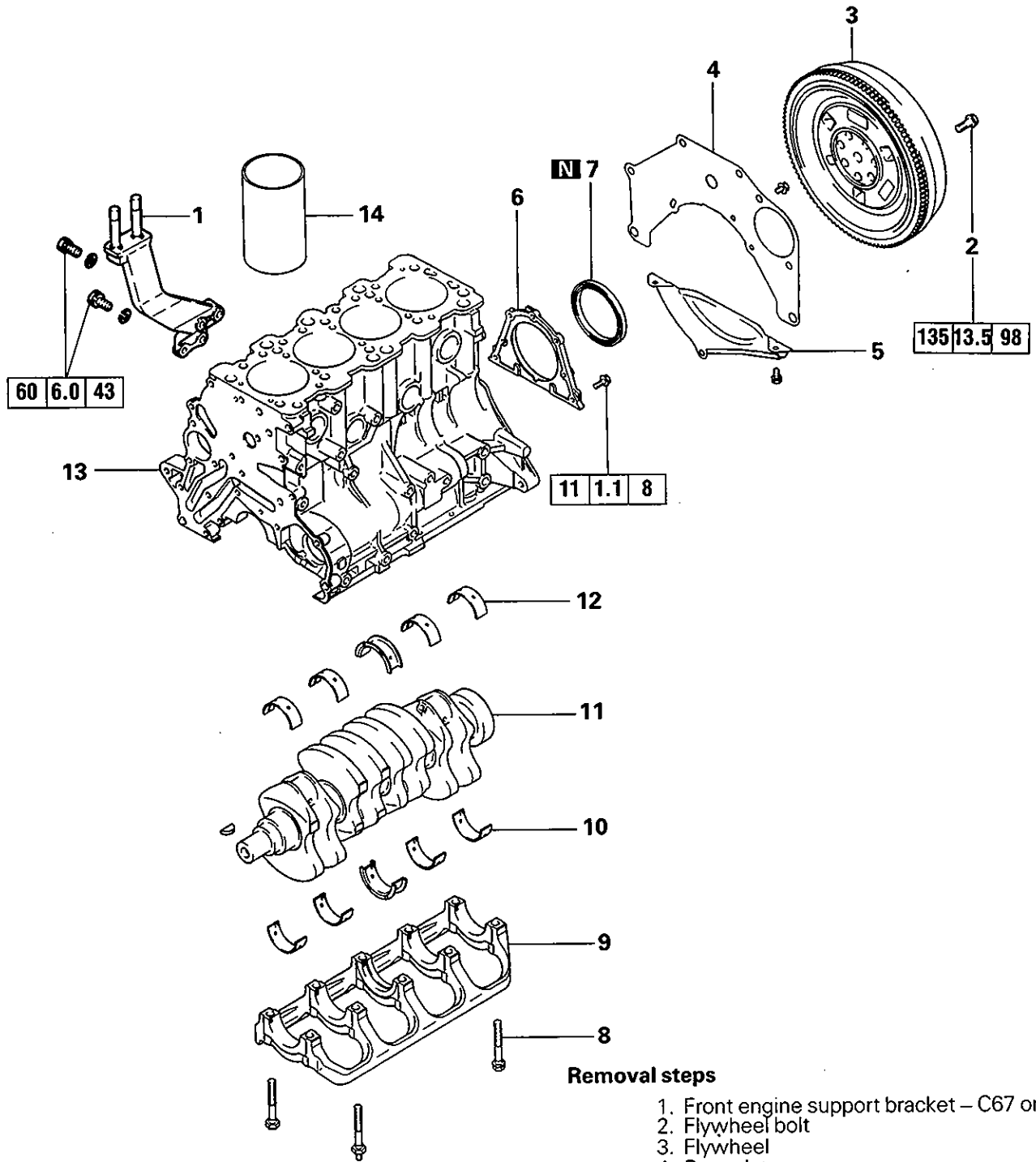
- (1) Since the connecting rod bolts and nuts are torqued using a new procedure, they should be examined BEFORE reuse. If the bolt threads are "necked down", the bolts should be replaced.  
 Necking can be checked by running a nut with fingers to the full length of the bolt's thread. If the nut does not run down smoothly, the bolt should be replaced.
- (2) Install the connecting rod cap on the big end of the connecting rod.
- (3) Before installing the nuts, the threads should be oiled with engine oil.
- (4) Install both nuts on the connecting rod bolts finger tight, then alternately torque each nut to assemble the cap properly.
- (5) Tighten the nuts to 20 Nm (2 kgm, 14.5 ft.lbs.) and plus 1/4 (90°) turn.



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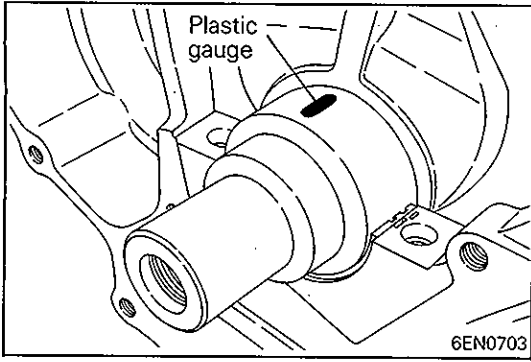
## NOTES

# 13. CRANKSHAFT, CYLINDER BLOCK AND FLYWHEEL REMOVAL AND INSTALLATION



**Removal steps**

1. Front engine support bracket – C67 only
2. Flywheel bolt
3. Flywheel
4. Rear plate
5. Bell housing cover
- ▶D▶ 6. Oil seal case
- ▶C▶ 7. Oil seal
- ▶B▶ 8. Bearing cap bolt
- ▶B▶ 9. Bearing cap
- ▶A▶ 10. Crankshaft bearing, lower
- ▶A▶ 11. Crankshaft
- ▶A▶ 12. Crankshaft bearing, upper
13. Cylinder block
14. Cylinder sleeve

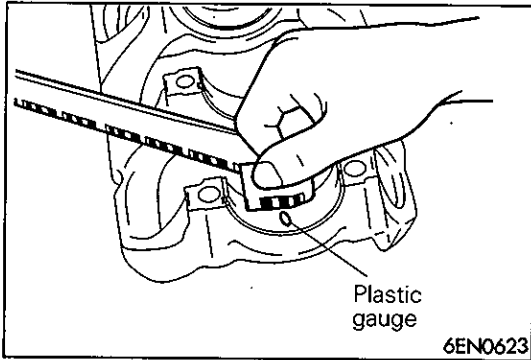


**INSPECTION**

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

- (1) Remove oil from the crankshaft journal and the crankshaft bearing.
- (2) Install the crankshaft.
- (3) Cut the plastic gauge to the same length as the width of the bearing and place it on the journal in parallel with its axis.
- (4) Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
- (5) Carefully remove the crankshaft bearing cap.
- (6) Measure the width of the plastic gauge at its widest part by using a scale printed on the plastic gauge package.

**Standard value: 0.02 – 0.04 mm (0.0008 – 0.0016 in.)**  
**Limit: 0.1 mm (0.004 in.)**

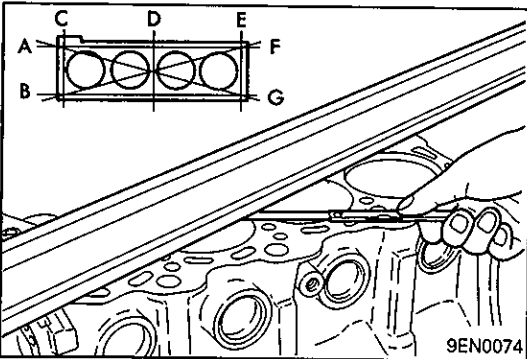


**CYLINDER BLOCK**

- (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 matter.

**Standard value: 0.05 mm (0.0020 in.) or less**  
**Limit: 0.1 mm (0.004 in.)**

- (2) If the distortion is excessive, replace the cylinder block.

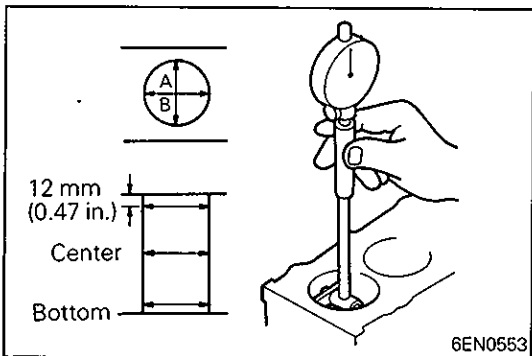


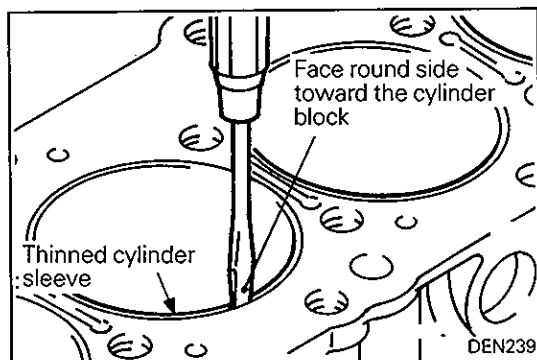
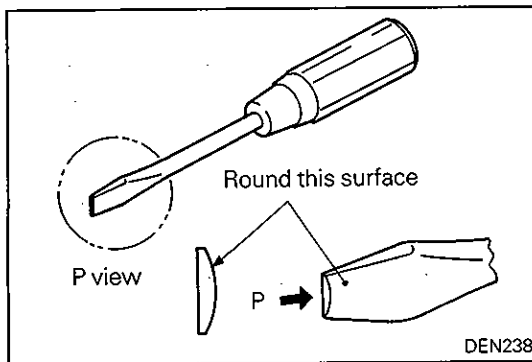
- (3) Check the cylinder walls for scratches and seizure. If defects are evident, correct (bored to oversize) or replace.
- (4) Using a cylinder gauge, measure the cylinder bore and clindricity. If badly worn, correct the cylinder to an oversize and replace the piston and piston rings. Measure at the points shown in the illustration.

**Standard value:**

**Cylinder I.D.: 82.70 – 82.73 mm (3.2559 – 3.2571 in.)**

**Out-of-roundness and taper of cylinder bore:**  
**0.01 mm (0.0004 in.) or less**





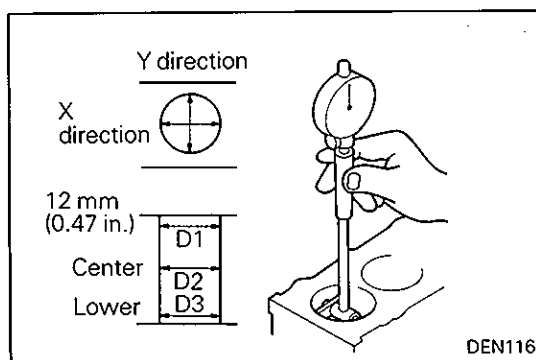
## CYLINDER SLEEVE CHANGE PROCEDURES

### REMOVAL

- (1) Fix the cylinder block to a boring machine and center it. Center at the lower portion of the cylinder sleeve where there is less uneven wear.
- (2) Bore to the sleeve wall thickness of about 0.5 mm (0.02 in.).
- (3) Machine the screwdriver as illustrated and insert it between the cylinder sleeve and cylinder block. Lightly hit it to break the sleeve.  
When doing so, be careful not to damage the cylinder block wall.

### INSPECTION

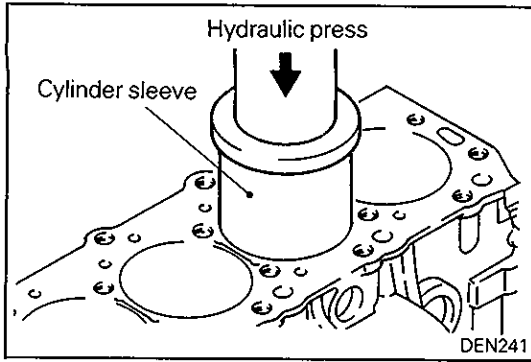
- (1) After removing the cylinder sleeve, check the cylinder block sleeve hole surface.  
If there is damage, insufficient interference-fit-margin or other problems, bore the cylinder block sleeve hole to an oversize.



- (3) To check the interference, measure both the cylinder sleeve O.D. and cylinder block sleeve hole I.D. at the position illustrated. Measure D1, D2, and D3 in both x and Y directions and if the average is smaller than 0.12 mm (0.0047 in.), then bore the sleeve hole to 0.5 mm (0.02 in.) oversize and install an oversize sleeve.

### Caution

- If one cylinder requires oversize machining, oversize it with the other cylinder sleeves removed. Machining while the sleeves remain in the other cylinders may disturb roundness.



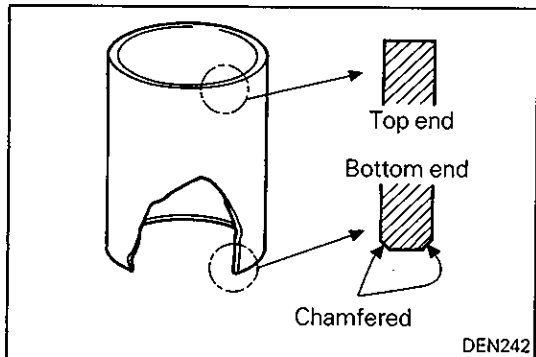
## INSTALLATION

### When cylinder block sleeve hole has not been bored

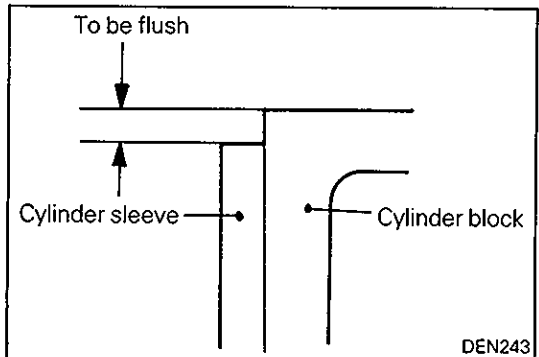
- (1) Amply apply press oil to the cylinder block sleeve hole and sleeve outer circumference.
- (2) Apply a disc [diameter 100 mm (3.94 in.), thickness 20 mm (0.79 in.) or more] to the top of the sleeve and press fit using a hydraulic press.

**Installation load: 22,000 N (2,200 kg, 4,850 lbs.) or more**

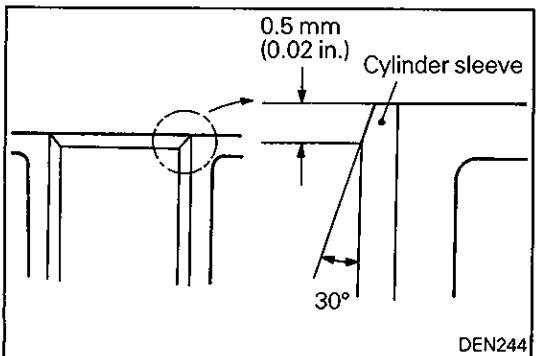
- (3) Install with the chamfered end first as illustrated. Continue until the sleeve upper end is flush with the block upper end.



- (4) Cut off the top end of the cylinder block in order to make the cylinder block flush with the sleeve. Cut off the minimum top end portion of the cylinder block necessary to make them flush. Do not cut off more than 0.2 mm (0.008 in.).



- (5) Chamfer the cylinder sleeve top end as illustrated.



- (6) The service cylinder sleeve has the I.D. machined to 81.5 to 81.7 mm (3.209 to 3.217 in.). After installation of the sleeve, therefore, hone the I.D. to the standard value.

**Cylinder I.D.: 82.70 – 82.73 mm (3.2559 – 3.2571 in.)**

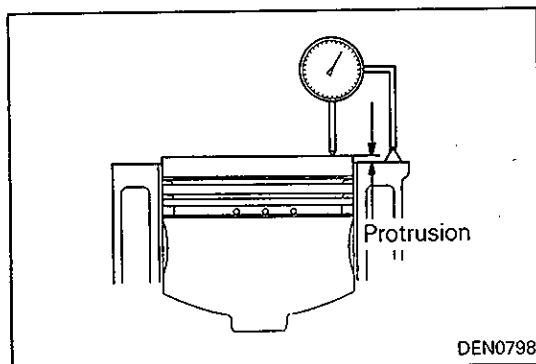
**Honing finished surface roughness: 2 – 4 μ**

**Honing cross hatch angle: 15 – 25°**

**Cylinder bore squareness: 0.05 mm (0.002 in.)**

**When boring the cylinder block sleeve hole**

- (1) Prepare a cylinder sleeve of 0.5 mm (0.02 in.) oversize (identification color: red)
- (2) Hone the cylinder block sleeve hole to 86.13 to 86.15 mm (3.3909 to 3.3917 in.).
- (3) Install the cylinder sleeve and finish the I.D. The installation and machining procedures are the same as in the case when the block sleeve hole has not been bored.



**INSPECTION AFTER ASSEMBLY**

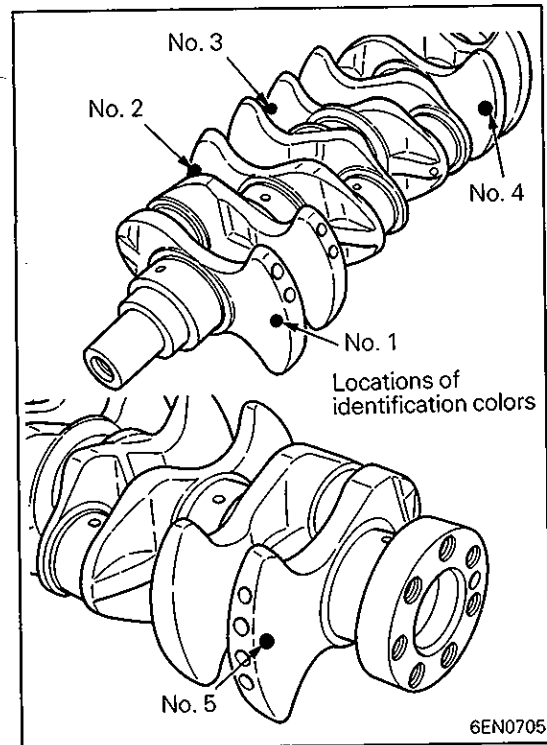
- (1) After assembling the crankshaft, piston, etc., check the piston protrusion.  
If the protrusion exceeds the limit, change the piston and connecting rod in order to reduce the protrusion to within the limit.
- (2) If the protrusion still exceeds the limit after piston reassembly, replace the cylinder block.

**Limit: 0.823 mm (0.0324 in.)**

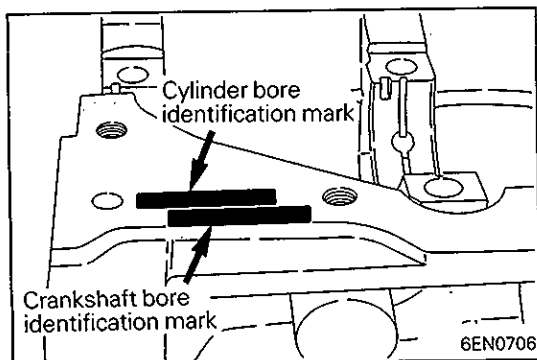
**INSTALLATION SERVICE POINTS**

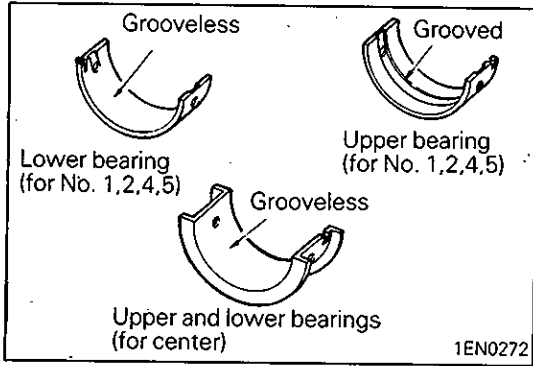
**◆A◆ CRANKSHAFT BEARING INSTALLATION**

- (1) When the bearings are replaced, select and install them according to the identification colors on the crankshaft and the identification marks stamped on the cylinder block.

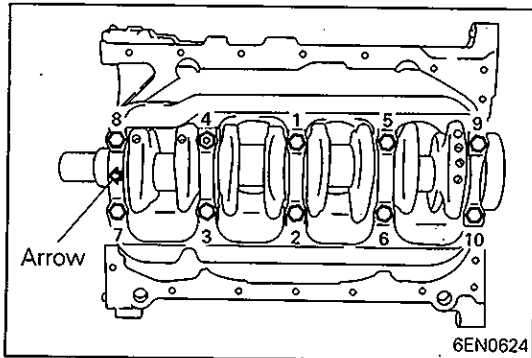


Journal OD identification color	Identification mark for cylinder block bearing support section ID	Crankshaft bearing identification mark
Yellow	0	1
	1	2
	2	3
None	0	2
	1	3
	2	4
White	0	3
	1	4
	2	5



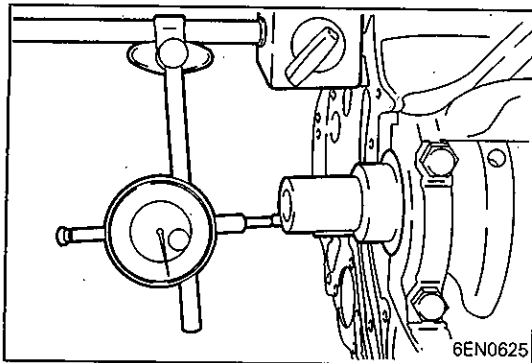


- (2) Install the upper crankshaft bearings to the cylinder block. There is an oil groove in the upper crankshaft bearing. There is no difference between upper and lower bearings for the center (with flange).
- (3) Install the lower crankshaft bearing (with no oil groove; there is no difference for center) to bearing cap and apply engine oil to the bearing surfaces.



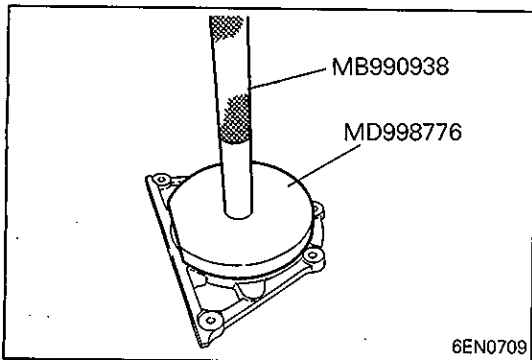
**◆B◆ BEARING CAP / BEARING CAP BOLT INSTALLATION**

- (1) Install the bearing cap so that its arrow is positioned on the timing belt side.
  - (2) When installing the bearing cap bolts, check that the shank length of each bolt meets the limit. If the limit is exceeded, replace the bolt.
- Limit: max. 71.1 mm (2.79 in.)**
- (3) Torque the bearing cap bolts to 25 Nm (2.5 kgm, 18 ft.lbs.) in order shown in the illustration then, retighten them 1/4 (90°) turns more in the same order.

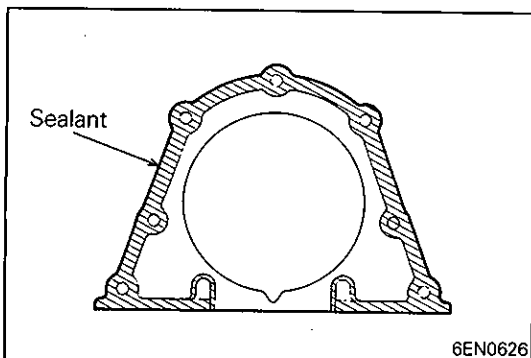


- (4) After installing the bearing caps, make sure that the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace the crankshaft bearings.

**Standard value: 0.05 – 0.18 mm (0.0020 – 0.0071 in.)**  
**Limit: 0.25 mm (0.010 in.)**



**◆C◆ OIL SEAL INSTALLATION**



**◆D◆ SEALANT APPLICATION TO OIL SEAL CASE**

**Specified sealant:**  
**Mitsubishi Genuine Part No. MD970389 or equivalent**