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# ENGINE

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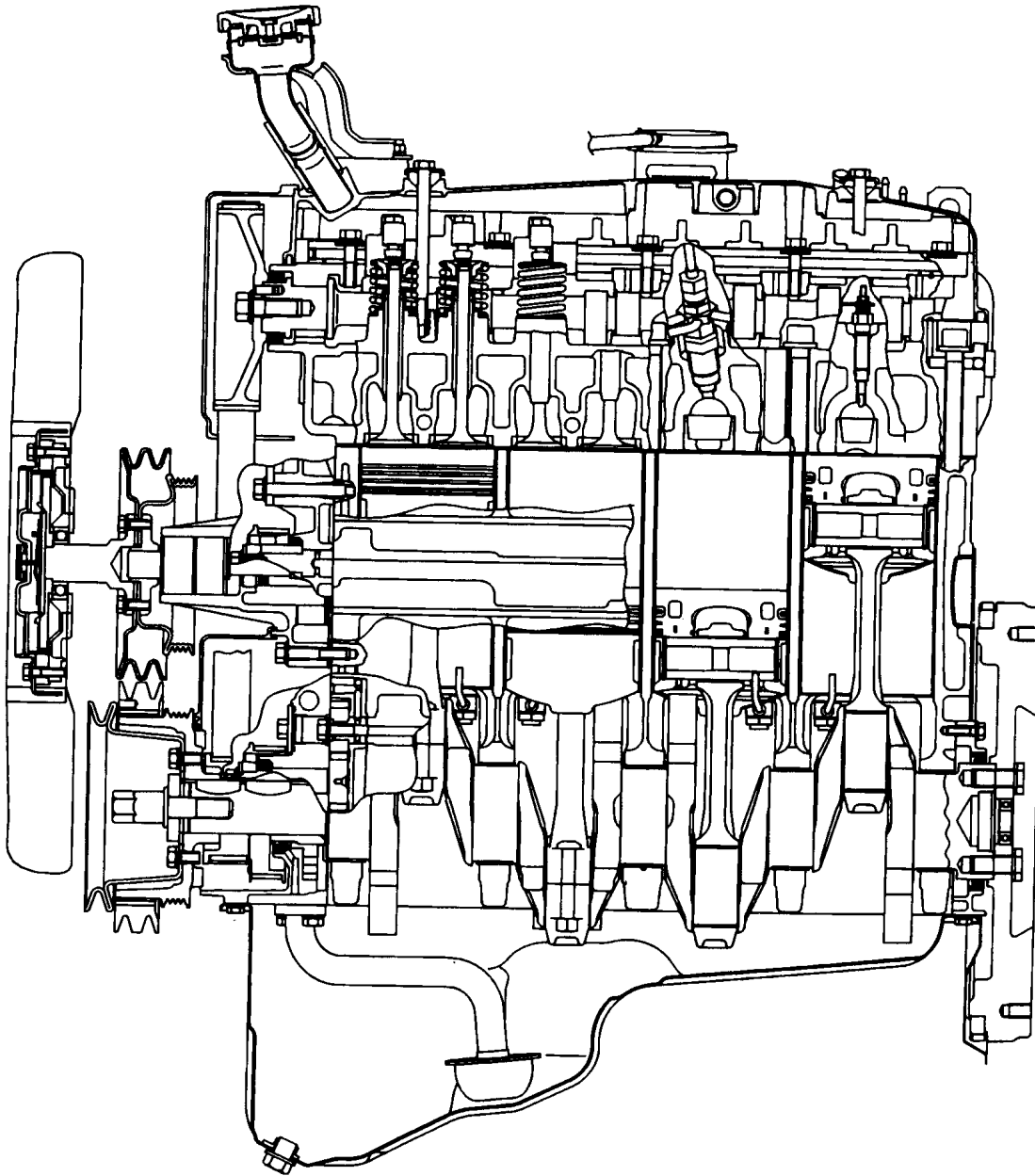
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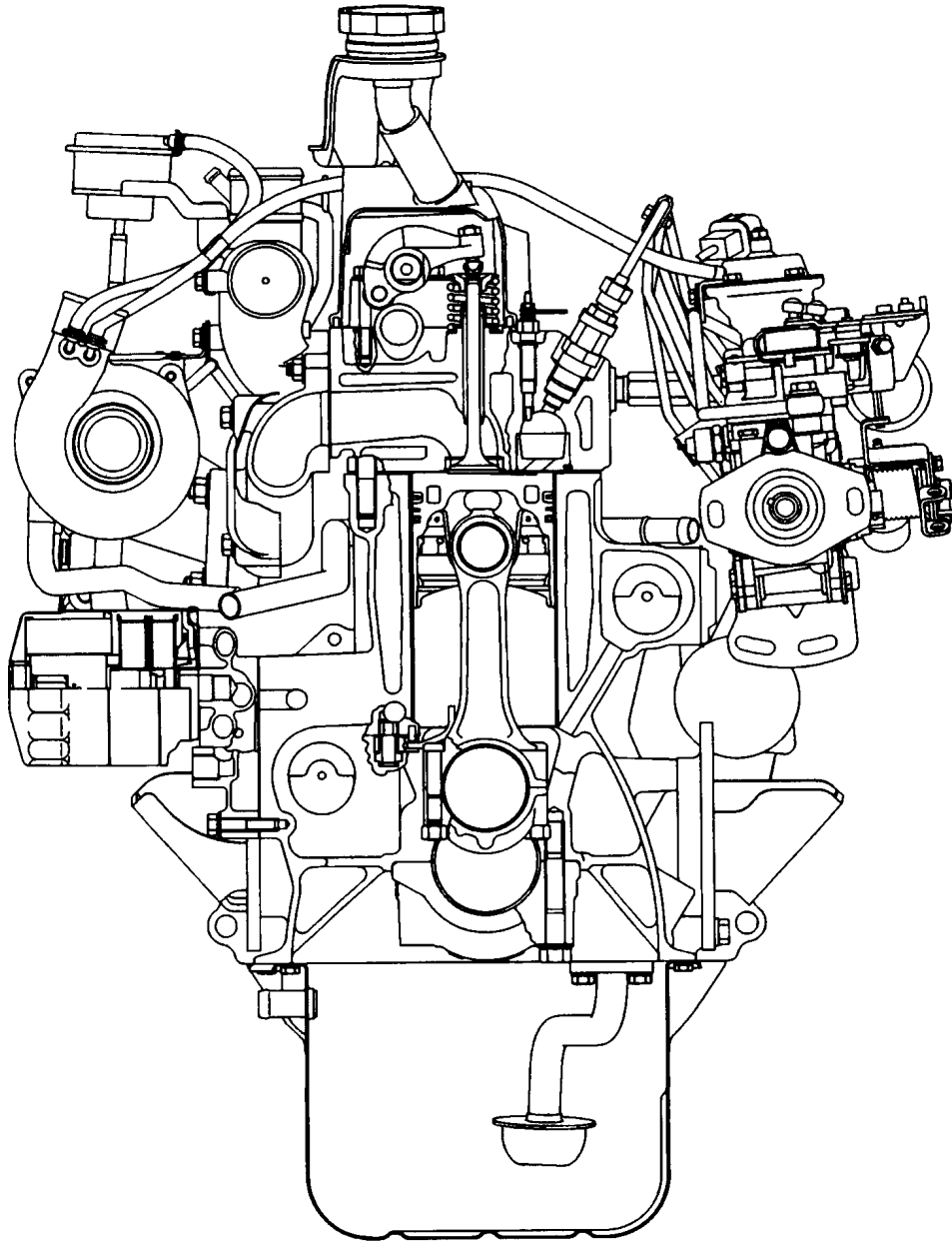
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# GENERAL INFORMATION

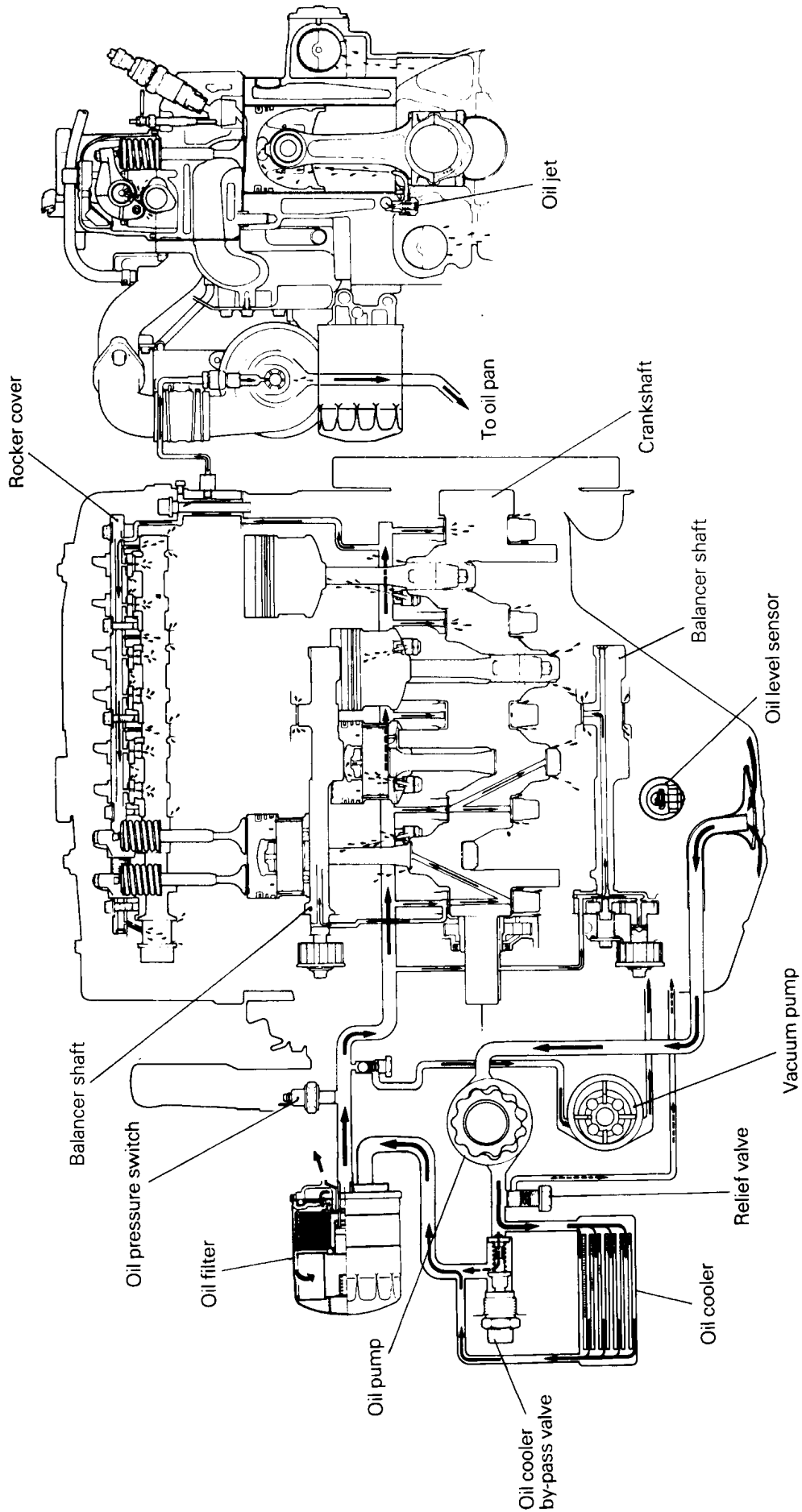
## ENGINE SECTIONAL VIEW



DEN0110



LUBRICATION SYSTEM



DLU0017

# 1. SPECIFICATIONS

## GENERAL SPECIFICATIONS

Description	Specifications
Type	Diesel engine
No. and arrangement of cylinders	4 in-line, longitudinal
Combustion chamber	Swirl chamber
Total displacement	2,477 cc (151.2 cu.in.)
Cylinder bore x stroke	91.1 x 95 mm (3.59 x 3.74 in.)
Valve mechanism	Single overhead camshaft
Rocker arm	Roller follower type
Compression ratio	21
Valve timing	
Intake valve	Open ..... 20° BTDC
	Close ..... 49° ABDC
Exhaust valve	Open ..... 55° BBDC
	Close ..... 22° ATDC
Lubrication system	Pressure feed, full-flow filtration
Oil pump	Trochoid type
Fuel system	Distributor type injection pump
Turbocharger	Water-cooled
Cooling system	Water-cooled
Water pump type	Centrifugal impeller type

## SERVICE SPECIFICATIONS

mm (in.)

	Standard	Limit
<b>Cylinder head</b>		
Flatness of gasket surface .....	0.05 (0.002) .....	*0.2 (0.008)
* Grinding is not suitable for correction.		
Flatness of manifold mounting surface .....	0.15 (0.0059) .....	0.3 (0.012)
Overall height .....	93.9 – 94.1 (3.697 – 3.705)	
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 .....	43.300 – 43.325 (1.7047 – 1.7057)	
0.60 .....	43.600 – 43.625 (1.7165 – 1.7175)	
Oversize rework dimensions of exhaust valve seat ring hole		
0.30 .....	37.300 – 37.325 (1.4685 – 1.4695)	
0.60 .....	37.600 – 37.625 (1.4803 – 1.4813)	
<b>Camshaft</b>		
Cam height		
Identification mark: R .....	36.55 (1.4390) .....	36.05 (1.4193)
Identification mark: E .....	36.59 (1.4405) .....	36.09 (1.4209)
NOTE: The camshaft identification mark is stamped on the rear end of the camshaft.		
Journal diameter .....	29.935 – 29.950 (1.1785 – 1.1791)	
Oil clearance .....	0.05 – 0.08 (0.0020 – 0.0031)	
<b>Rocker arm</b>		
I.D. ....	18.910 – 18.928 (0.7444 – 0.7452)	
Rocker arm-to-shaft clearance .....	0.012 – 0.050 (0.0005 – 0.0020)	
<b>Rocker shaft</b>		
O.D. ....	18.878 – 18.898 (0.7432 – 0.7440)	
Overall length .....	451.5 (17.78)	
<b>Valve</b>		
Stem diameter		
Intake .....	7.960 – 7.975 (0.3134 – 0.3140)	
Exhaust.....	7.930 – 7.950 (0.3122 – 0.3130)	
Face angle.....	45° – 45.5°	
Thickness of valve head (margin)		
Intake .....	2 (0.08) .....	1.0 (0.04)
Exhaust .....	2 (0.08) .....	1.0 (0.04)
Stem-to guide clearance		
Intake .....	0.03 – 0.06 (0.0012 – 0.0024) .....	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		
Identification color: Green .....	49.1 (1.933) .....	48.1 (1.894)
Identification color: Yellow .....	47.9 (1.886) .....	46.9 (1.846)
Load/installed height		
N (kg, lbs.)/mm (in.)		
Identification color: Blue .....	271 (27.6, 61)/40.4 (1.591)	
Identification color: Yellow .....	271 (27.6, 61)/38.5 (1.516)	
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 .....	40.95 (1.612) .....	41.45 (1.632)
Service size .....	0.3 (0.012), 0.6 (0.024) oversize	
<b>Balancer shaft</b>		
Journal diameter		
Right (front) .....	18.467 – 18.480 (0.7270 – 0.7276)	
(rear) .....	43.009 – 43.025 (1.6933 – 1.6939)	
Left (front) .....	18.959 – 18.980 (0.7464 – 0.7472)	
(rear) .....	43.009 – 43.025 (1.6933 – 1.6939)	
Oil clearance		
Front .....	0.02 – 0.06 (0.0008 – 0.0024)	
Rear .....	0.06 – 0.10 (0.0024 – 0.0039)	
<b>Piston</b>		
O.D. ....	91.08 – 91.09 (3.5858 – 3.5862)	
	T/C 91.06 – 91.07 (3.5850 – 3.5854)	
Piston-to-cylinder clearance .....	0.02 – 0.04 (0.0008 – 0.0016)	
	T/C 0.04 – 0.06 (0.0016 – 0.0024)	
Ring groove width		
No. 1 ring .....	2.62 – 2.64 (0.1031 – 0.1039)	
	T/C 2.61 – 2.63 (0.1028 – 0.1035)	
No. 2 ring .....	2.04 – 2.06 (0.0803 – 0.0811)	
	T/C 2.10 – 2.12 (0.0827 – 0.0835)	
Oil ring .....	4.010 – 4.035 (0.1579 – 0.1589)	
Service size .....	0.50 (0.020), 1.00 (0.039) oversize	

	Standard	Limit
<b>Piston ring</b>		
End gap		
No. 1 ring	0.25 – 0.40 (0.0098 – 0.0157)	0.8 (0.0315)
	T/C 0.35 – 0.50 (0.0138 – 0.020)	0.8 (0.0315)
No. 2 ring	0.25 – 0.45 (0.0098 – 0.0177)	0.8 (0.0315)
	T/C 0.25 – 0.40 (0.0098 – 0.0157)	0.8 (0.0315)
Oil ring	0.25 – 0.45 (0.0098 – 0.0177)	0.8 (0.0315)
Ring-to-ring groove clearance		
No. 1 ring	0.13 – 0.17 (0.0051 – 0.0067)	0.20 (0.0079)
	T/C 0.06 – 0.08 (0.0024 – 0.0031)	0.15 (0.0059)
No. 2 ring	0.05 – 0.09 (0.0020 – 0.0035)*	0.15 (0.0059)
	0.03 – 0.07 (0.0012 – 0.0028)	0.15 (0.0059)
	T/C 0.05 – 0.07 (0.0020 – 0.0028)	0.15 (0.0059)
Oil ring	0.02 – 0.07 (0.0008 – 0.0028)	0.10 (0.0039)
Service size	0.50 (0.020), 1.00 (0.039) oversize	
*: Pistons with ring carrier		
<b>Piston pin</b>		
O.D.	28.994 – 29.000 (1.1411 – 1.1417)	
<b>Connecting rod</b>		
Big end center-to-small end center length	157.95 – 158.05 (6.218 – 6.222)	
Bend	0.05 (0.0020)	
Twist	0.1 (0.004)	
Big end side clearance	0.10 – 0.25 (0.0039 – 0.0098)	0.40 (0.0157)
<b>Crankshaft</b>		
End play	0.05 – 0.18 (0.002 – 0.007)	0.25 (0.0098)
Journal O.D.	66 (2.60)	
Pin O.D.	53 (2.09)	
Out-of-roundness and taper of journal and pin	Within 0.005 (0.00020)	
Concentricity of journal	Within 0.015 (0.0006)	
Oil clearance of journal	0.02 – 0.05 (0.0008 – 0.0020)	0.10 (0.0039)
Oil clearance of pin	0.02 – 0.05 (0.0008 – 0.0020)	0.10 (0.0039)
Journal		
0.25 U.S.	65.735 – 65.750 (2.588 – 2.589)	
0.50 U.S.	65.485 – 65.500 (2.578 – 2.579)	
0.75 U.S.	65.235 – 65.250 (2.568 – 2.569)	
Pin		
0.25 U.S.	52.735 – 52.750 (2.0762 – 2.0768)	
0.50 U.S.	52.485 – 52.500 (2.0663 – 2.0670)	
0.75 U.S.	52.235 – 52.250 (2.0565 – 2.0571)	
<b>Cylinder block</b>		
Cylinder I.D.	91.10 – 91.13 (3.5866 – 3.5878)	
Flatness of gasket surface	0.05 (0.0020)	0.10 (0.0039)
Overall height	318.45 – 318.55 (12.5374 – 12.5413)	
<b>Flywheel</b>		
Runout		0.13 (0.0051)



mm (in.)

Standard

Limit

**Oil pump**

Tip clearance .....	0.11 – 0.24 (0.0043 – 0.0094)	
Side clearance .....	0.04 – 0.10 (0.0016 – 0.0039)	
Body clearance .....	0.10 – 0.18 (0.0039 – 0.0071)	0.35 (0.0138)

**Glow pug**

Resistance

Metal type .....	0.9 – 1.1 $\Omega$ [at 20°C (68°F)]
Ceramic type .....	0.4 – 0.6 $\Omega$ [at 20°C (68°F)]

**Drive belt**

Deflection

Adjuster type .....	13 – 16 (0.51 – 0.63)
Brace bolt type	
New belt .....	9 – 12 (0.35 – 0.47)
Used belt .....	11 – 14 (0.43 – 0.55)

**Injection nozzle**

Injection start pressure

Assembly No.: 0010 .....	11,770 – 12,750 kPa (120 – 130 kp/cm <sup>2</sup> , 1701 – 1849 psi)
Assembly No.: 0180 .....	14,700 – 15,690 kPa (150 – 160 kp/cm <sup>2</sup> , 2133 – 2276 psi)

**Fuel injection pump**

Lift of plunger

Identification mark: A or B .....	0.97 – 1.03 (0.038 – 0.041) at 7°ATDC
Identification mark: C or D .....	0.97 – 1.03 (0.038 – 0.041) at 9°ATDC

NOTE: The camshaft identification mark is stamped at the top of the cylinder head.

## NOTE

O.D.: Outer diameter  
 I.D.: Inner diameter  
 U.S.: Undersize diameter  
 O.S.: Oversize diameter

## TORQUE SPECIFICATIONS

	Nm	Torque kgm	ft.lbs.
<b>Drive belt and glow plug</b>			
Cooling fan bolt .....	11	1.1	8
Fan clutch bolt .....	11	1.1	8
Vacuum pipe bolt (L400) .....	10	1.0	7
Vacuum pipe bolt (1997 L200 and after) .....	23	2.4	17
Vacuum pipe bolt (2001 model PAJERO)			
M8 x 16 .....	12	1.2	9
M8 x 20 .....	22	2.2	16
Eye bolt .....	17	1.7	12
Auto tensioner bolt .....	44	4.5	33
Power steering pump bracket bolt (Washer) .....	22	2.2	16
Power steering pump bracket bolt (Flange) .....	24	2.4	17
Alternator pivot bolt			
M8 .....	23	2.3	17
M10 .....	44	4.5	33
Brace bolt .....	14	1.4	10
Lock bolt .....	23	2.3	17
Adjusting bolt .....	10	1.0	7
Crankshaft pulley bolt .....	25	2.5	18
Crankshaft bolt .....	117	18.0	130
Oil level gauge guide bolt			
M6 (L400) .....	11	1.1	8
M8 (Except L400) .....	24	2.4	17
Glow plug plate nut (Except 2001 PAJERO) .....	1.3	0.13	0.9
Glow plug plate nut (2001 PAJERO) .....	1.8	0.18	1.3
Glow plug .....	18	1.8	13
<b>Timing belt</b>			
Timing belt cover bolt .....	11	1.1	8
Flange bolt .....	10	1.0	7
Tensioner spacer nut .....	25	2.6	19
Timing belt tensioner bolt .....	25	2.6	19
Camshaft sprocket bolt .....	67	7.0	51
Injection pump sprocket nut .....	83	8.5	61
Balancer shaft sprocket bolt and nut .....	36	3.7	27
Timing belt rear cover bolt .....	11	1.1	8
<b>Fuel injection pump and injection nozzle</b>			
Injection pump protector .....	14	1.4	10
Injection pipe clamp bolt .....	5	0.5	3.7
Injection pipe union nut. ....	29	3.0	22
Injection pump nut .....	19	1.9	14
Injection pump bolt .....	24	2.4	17
Injection pump bracket .....	22	2.2	16
Fuel return pipe nut .....	27	2.8	20
Injection nozzle .....	54	5.5	40
<b>Injection nozzle holder</b>			
Retaining nut .....	37	3.8	27

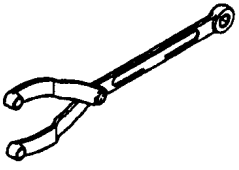
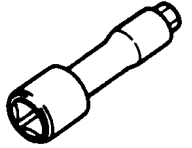
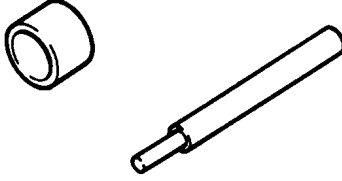
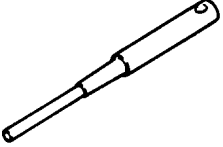



	Nm	Torque kgm	ft.lbs.
<b>Intake and exhaust manifolds</b>			
Air pipe bracket bolt .....	22	2.2	16
Vacuum pipe bolt			
M8 .....	24	2.4	17
M6 .....	10	1.0	7
Waste gate actuator bolt (Except 2001 PAJERO) .....	19	1.9	14
Waste gate actuator bolt (2001 PAJERO) .....	12	1.2	9
EGR pipe bolt nut .....	18	1.8	13
EGR valve bolt .....	18	1.8	13
Eyebolt (water pipe) .....	42	4.3	31
Eyebolt (oil pipe) .....	17	1.7	12
Heat protector bolt			
M6 .....	9	0.9	7
M8 .....	14	1.4	10
Oil return pipe bolt .....	9	0.9	7
Exhaust fitting nut .....	59	6.0	43
Turbocharger nut .....	59	6.0	43
Relief valve .....	49	5.0	36
Air inlet fitting bolt .....	12	1.2	9
Intake manifold bolt .....	18	1.8	13
Exhaust manifold nut. ....	18	1.8	13
<b>Turbocharger</b>			
Coupling bolt .....	5	0.5	4
<b>Water pump, thermostat, hose and pipe</b>			
Water pipe bolt			
M6 .....	11	1.1	8
M8 .....	14	1.4	10
Coolant temperature gauge unit .....	34	3.5	25
Water outlet fitting bolt .....	12	1.2	9
Water inlet fitting bolt			
Bolt with spring washer .....	12	1.2	9
Flange bolt .....	14	1.4	10
Thermostat housing bolt .....	14	1.4	10
Plate .....	10	1.0	7
Water pump bolt			
M8 x 20, M8 x 25, M8 x 40 .....	14	1.4	10
M8 x 70, M8 x 85 .....	24	2.4	17
<b>Rocker arms, rocker shaft and camshaft</b>			
Oil filler bolt .....	13	1.3	9
Rocker cover bolt .....	6	0.6	4
Rocker shaft bolt .....	37	3.8	27
Lock nut .....	15	1.5	11
Camshaft bearing cap bolt .....	20	2.0	14
<b>Cylinder head, valves and valve spring</b>			
Cylinder head bolt .....	118	12.0	87

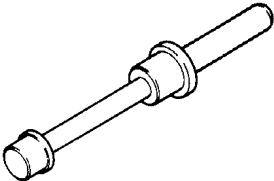
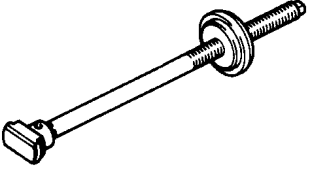
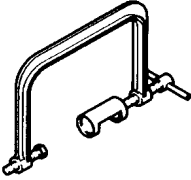
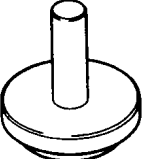
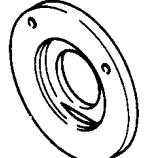

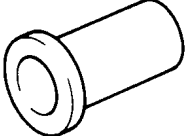
	Nm	Torque kgm	ft.lbs.
<b>Front case and oil pan</b>			
Oil cooler by-pass valve .....	54	5.5	40
Oil pressure switch .....	10	1.0	7
Oil filter bracket bolt (Except 2001 PAJERO) .....	14	1.4	10
Oil filter bracket bolt (2001 PAJERO)			
M6 .....	11	1.0	7
M8 .....	23	2.3	17
Oil drain plug .....	39	4.0	29
Oil level sensor bolt .....	9	0.9	7
Oil pan bolt .....	7	0.7	5
Oil screen bolt and nut .....	19	1.9	14
Front upper case bolt .....	13	1.3	9
Plug cap .....	24	2.4	17
Balancer shaft driven gear bolt .....	36	3.7	27
Front lower case bolt			
M8 x 90 .....	24	2.4	17
Except M8 x 90 .....	13	1.3	9
Oil pump cover bolt .....	12	1.2	9
Balancer shaft gear cover .....	24	2.4	17
Check valve .....	32	3.3	24
Stiffener bolt .....	19	1.9	13
<b>Piston and connecting rod</b>			
Connecting rod cap nut .....	46	4.7	34
<b>Crankshaft and cylinder block</b>			
Flywheel bolt .....	132	13.5	98
Drive plate bolt .....	132	13.5	98
Rear plate bolt .....	9	0.9	7
Bell housing cover bolt .....	9	0.9	7
Oil seal case bolt .....	11	1.1	8
Bearing cap bolt .....	78	8.0	58
Cover bolt .....	6	0.6	4
Engine support bracket (Except 2001 PAJERO)			
Head mark "7" .....	44	4.5	33
Head mark "8" .....	55	5.5	40
Engine support bracket bolt (2001 PAJERO)			
M8 .....	22	2.2	16
M10 .....	44	4.5	33

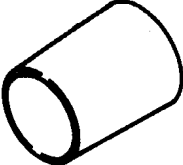
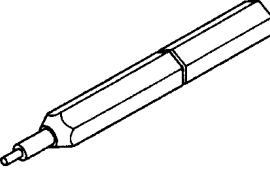

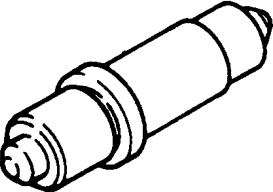
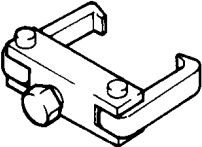
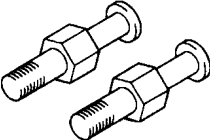
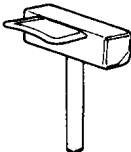
**SEALANT**

	Specified sealant	Quantity
Semi-circular packing .....	3M ATD Part No. 8660 or equivalent .....	As required
Oil pan gasket .....	MITSUBISHI GENUINE Part No. MD970389 .....	As required or equivalent
Oil pressure switch .....	3M ATD Part No. 8660 or equivalent .....	As required
Coolant temperature gauge unit .....	3M Nut Locking Part No. 4171 .....	As required or equivalent

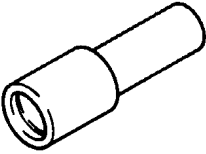
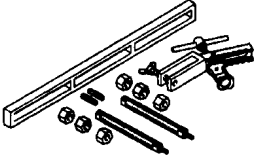
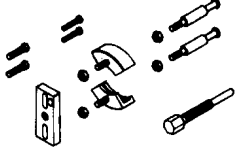
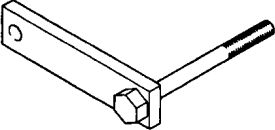
## 2. SPECIAL TOOLS

Tool	Number	Name	Use
	MB990767	End yoke holder	Holding camshaft sprocket or fuel injection pump sprocket when loosening or tightening bolts. (Use with MD998719)
	MD998051	Cylinder head bolt wrench	Loosening and tightening of cylinder head bolts
	MD998115	Valve guide installer	Removal and installation of valve guide
	MD998148	Valve seat cutter pilot	Correction of valve seat
	MD998158	Valve seat cutter 45°	Correction of valve seat
	MD998165	Valve seat cutter 65°	Correction of valve seat
	MD998175	Valve seat cutter 30°	Correction of valve seat

Tool	Number	Name	Use
	MD998250	Balancer shaft bearing installer	Installation of silent shaft rear bearing
	MD998251	Balancer shaft bearing puller	Removal of silent shaft rear bearing
	MD998303	Valve spring compressor	Compression of valve spring
	MD998376	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal
	MD998380	Bearing installer stopper	Guide for removal and installation of silent shaft right rear bearing
	MD998381	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998382	Crankshaft front oil seal guide	Guide for installation of crankshaft front oil seal

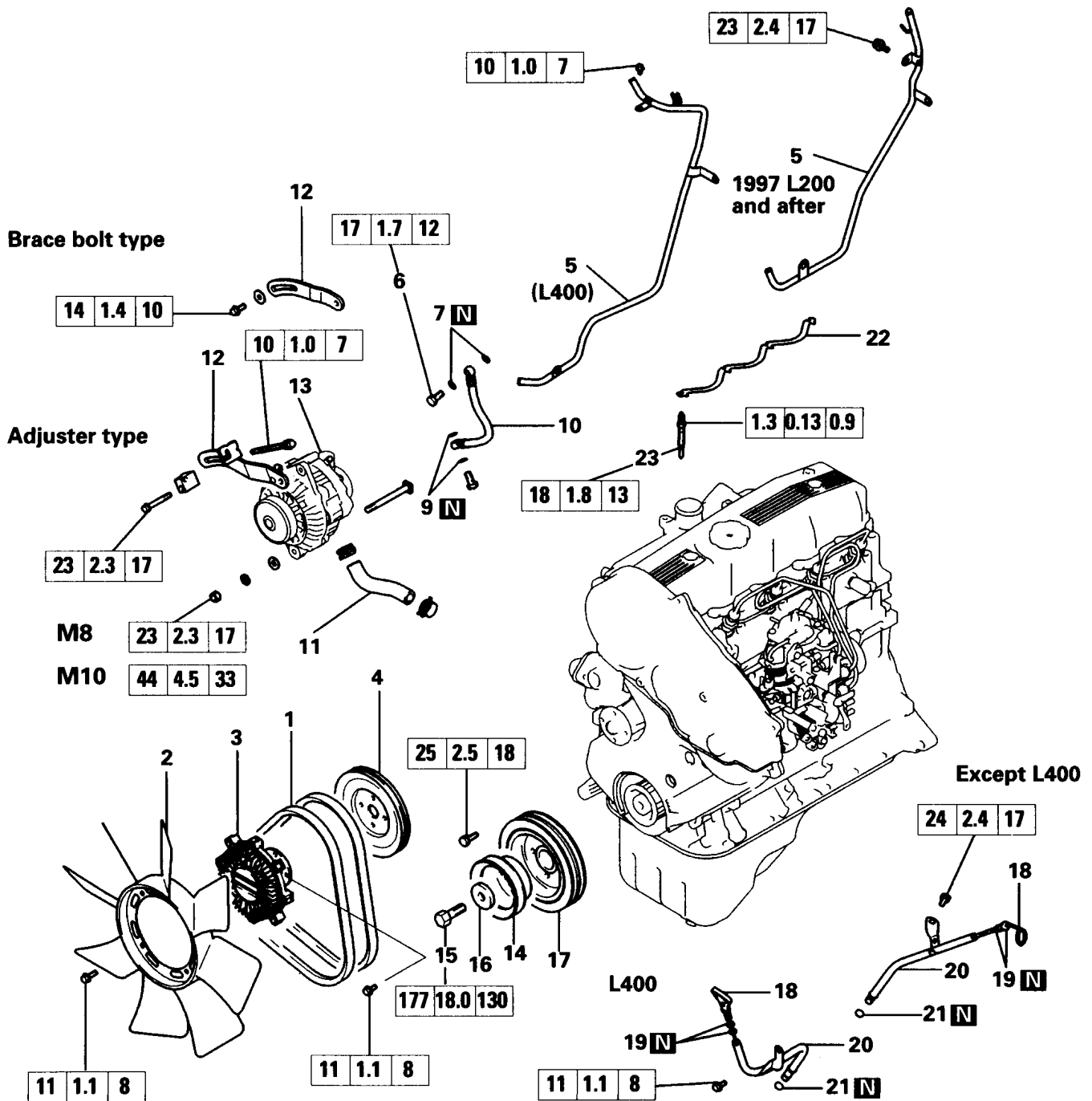
Tool	Number	Name	Use
	MD998383	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MD998384	Prestroke measuring adapter	Adjustment of injection timing
	MD998385	Balancer shaft drive gear oil seal guide	Installation of silent shaft drive oil seal
	MD998386	Connecting-rod small-end bushing replacement tool	Replacement of connecting-rod small-end bushing
	MD998388	Injection pump sprocket puller	Removal of injection pump sprocket
	MD998719	Pulley holder pin (2)	Use with MB990767
	MD998727	Oil pan sealer cutter	Removal of oil pan



Tool	Number	Name	Use
	MD998729	Valve stem seal installer	Installation of valve stem seal
	MD998772	Valve spring compressor	Compression of valve spring
	MD998778	Crankshaft sprocket puller	Removal of crankshaft sprocket
	MD998781	Flywheel stopper	Holding flywheel and drive plate

### 3. DRIVE BELT AND GLOW PLUG

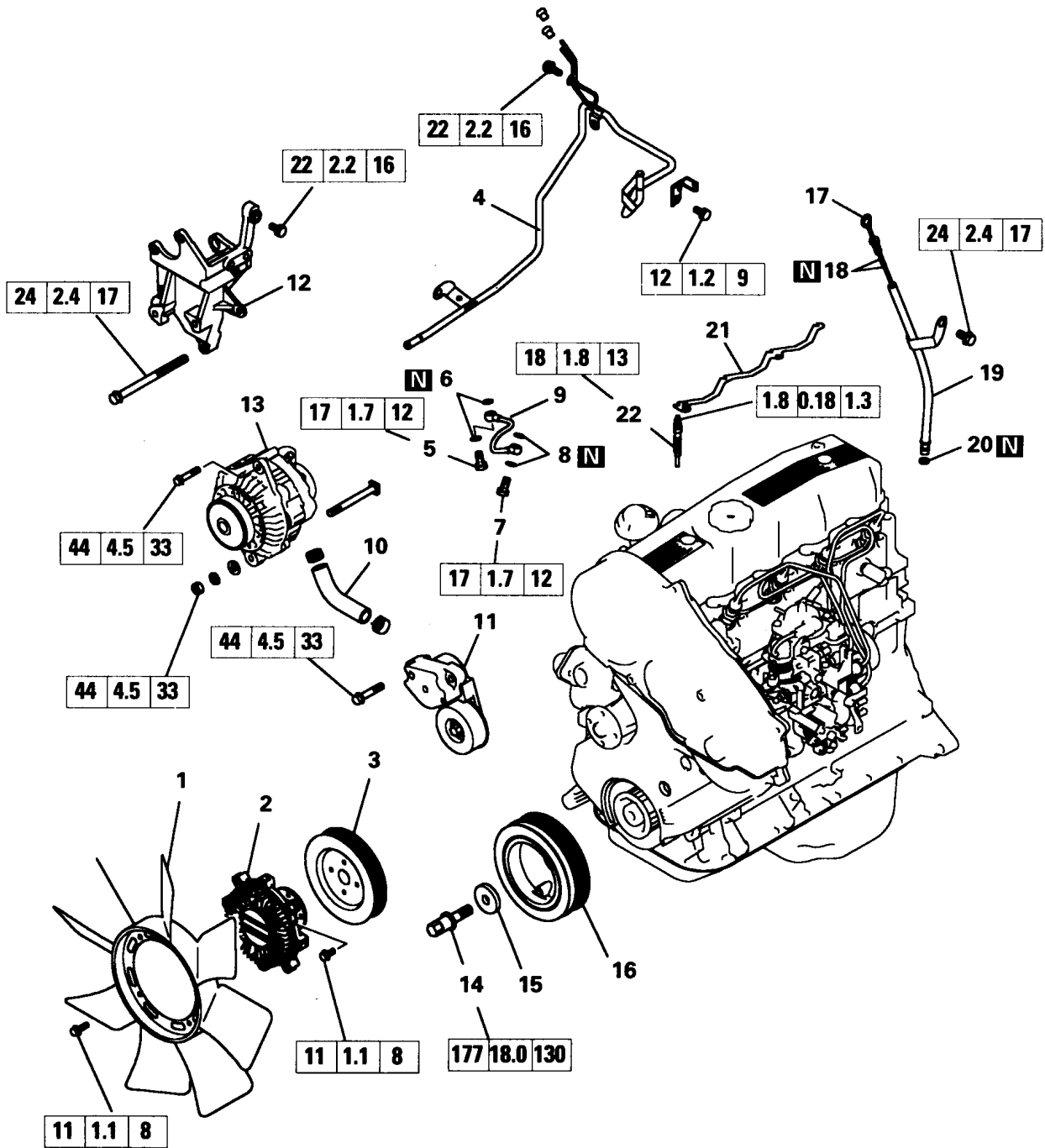
#### REMOVAL AND INSTALLATION <PAJERO (Up to 2000 model), L200, L300, L400>



**Removal steps**

- |  |  |
|--|--|
| <p>▶D◀ 1. Drive belt<br/>2. Cooling fan<br/>3. Fan clutch<br/>4. Water pump pulley<br/>5. Vacuum pipe<br/>6. Eyebolt<br/>7. Gasket<br/>8. Eyebolt<br/>9. Gasket<br/>10. Oil tube<br/>▶C◀ 11. Oil hose<br/>12. Alternator brace</p> | <p>13. Alternator<br/>14. Crankshaft pulley (for A/C)<br/>◀A▶ ▶B◀ 15. Crankshaft bolt<br/>16. Special washer<br/>17. Crankshaft pulley<br/>18. Oil level gauge<br/>19. O-ring<br/>20. Oil level gauge guide<br/>21. O-ring<br/>◀B▶ ▶A◀ 22. Glow plug plate<br/>23. Glow plug</p> |
|--|--|

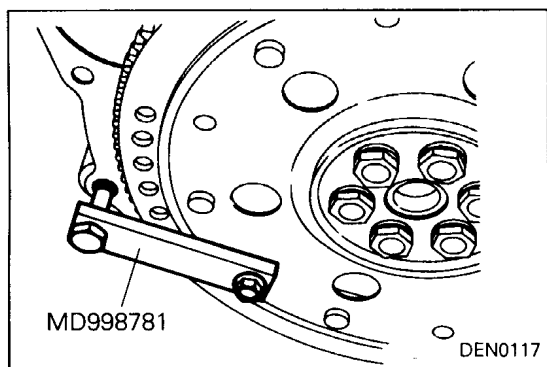
REMOVAL AND INSTALLATION <PAJERO (From 2001 model)>



Removal steps

- |                      |                                 |
|----------------------|---------------------------------|
| 1. Cooling fan       | 12. Power steering pump bracket |
| 2. Fan clutch        | 13. Alternator                  |
| 3. Water pump pulley | 14. Crankshaft bolt             |
| 4. Vacuum pipe       | 15. Special washer              |
| 5. Eyebolt           | 16. Crankshaft pulley           |
| 6. Gasket            | 17. Oil level gauge             |
| 7. Eyebolt           | 18. O-ring                      |
| 8. Gasket            | 19. Oil level gauge guide       |
| 9. Oil tube          | 20. O-ring                      |
| ▶C◀ 10. Oil hose     | 21. Glow plug plate             |
| 11. Auto tensioner   | ◀B▶ ▶A◀ 22. Glow plug           |

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## REMOVAL SERVICE POINTS

### ◊A◊ CRANKSHAFT PULLEY BOLT REMOVAL

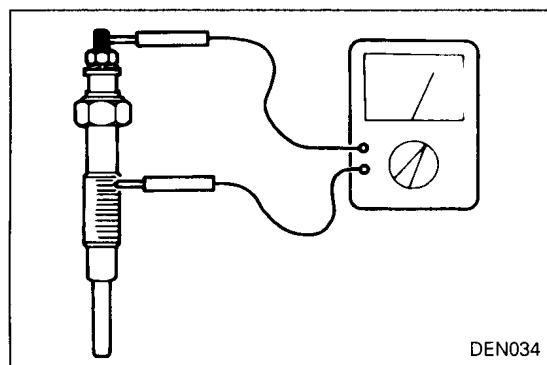
- (1) Hold the flywheel or drive plate in position with the special tool before removing the crankshaft pulley bolts.

### ◊B◊ GLOW PLUG REMOVAL (CERAMIC TYPE ONLY)

- (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.



## INSPECTION

### GLOW PLUG

- (1) Check the continuity between the terminal and body as illustrated. Replace if there is no continuity or if there is a large resistance.

#### Standard value:

<b>Metal type</b>	<b>0.9 – 1.1 <math>\Omega</math> [at 20°C (68°F)]</b>
<b>Ceramic type</b>	<b>0.4 – 0.6 <math>\Omega</math> [at 20°C (68°F)]</b>

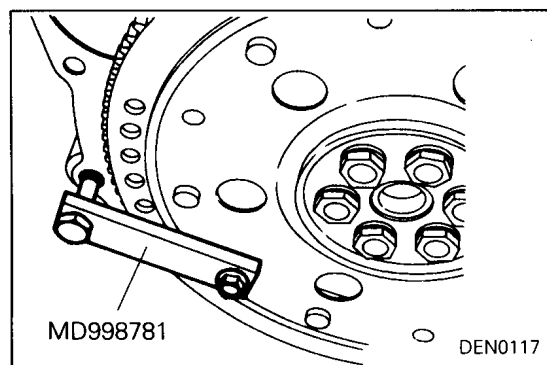
## INSTALLATION SERVICE POINTS

### ◊A◊ GLOW PLUG INSTALLATION (CERAMIC TYPE ONLY)

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

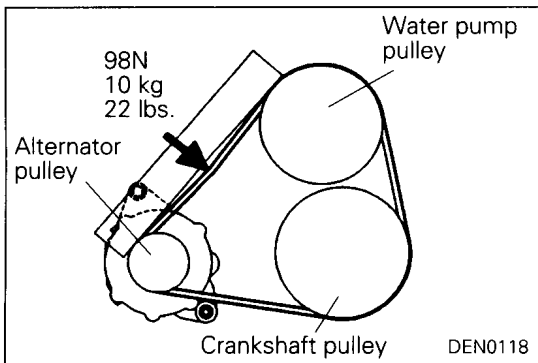
### ◊B◊ CRANKSHAFT PULLEY BOLT INSTALLATION

- (1) Hold the flywheel or drive plate in position with the special tool before installing the crankshaft pulley bolts.



### ◆C◆ OIL HOSE INSTALLATION

- (1) Install the hose with its identification color painted end to the oil pan.

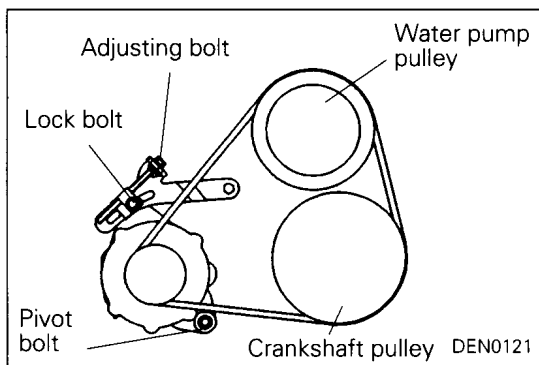


### ◆D◆ DRIVE BELT TENSION ADJUSTMENT ADJUSTER TYPE

- (1) Apply a force of 98 N (10 kg, 22 lbs.) to the position shown by the arrow in the illustration and measure the belt deflection. Adjust the belt deflection to the standard value by the adjusting bolt.

**Standard value: 13 – 16 mm**

- (2) Tighten nut for pivot bolt to the specified torque.
- (3) Tighten lock bolt to the specified torque.
- (4) Tighten adjusting bolt to the specified torque.



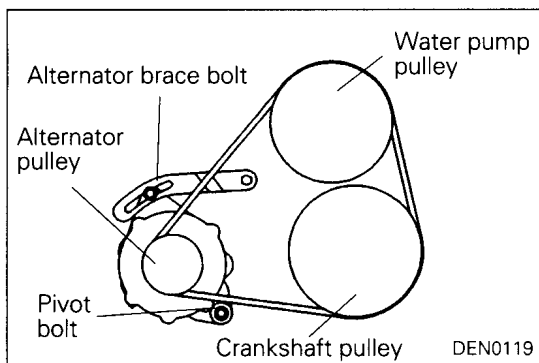
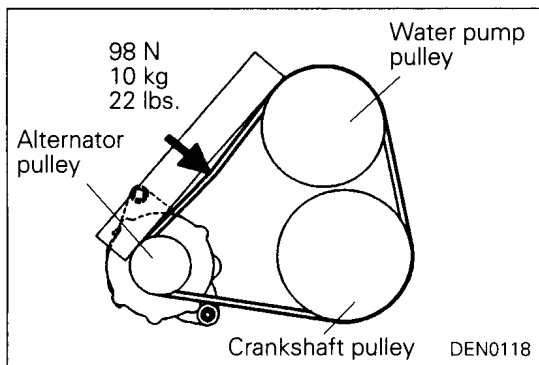
### BRACE BOLT TYPE

- (1) Apply a force of 98 N (10 kg, 22 lbs.) to the position shown by the arrow in the illustration and measure the belt deflection. Adjust the belt deflection to the standard value by moving the alternator.

**Standard value:**

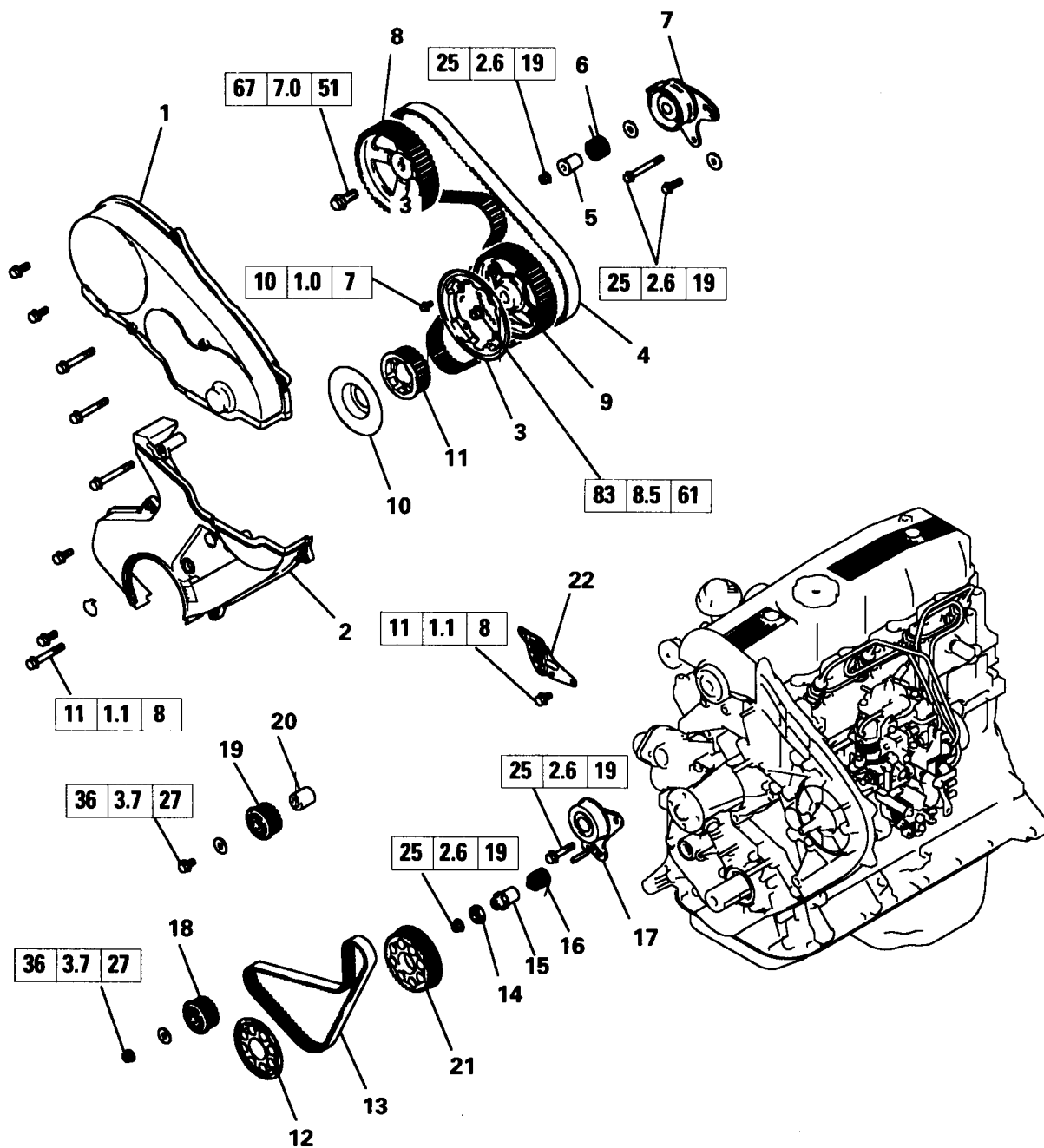
**New belt** 9 – 12 mm (0.35 – 0.47 in.)  
**Used belt** 11 – 14 mm (0.43 – 0.55 in.)

- (3) Tighten brace bolt to the specified torque.
- (2) Tighten nut for pivot bolt to the specified torque.



## 4. TIMING BELT

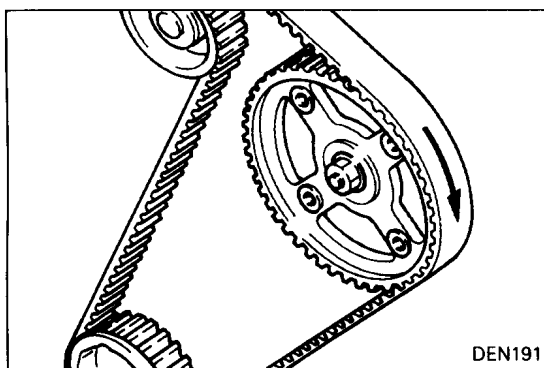
### REMOVAL AND INSTALLATION



#### Removal steps

- |         |   |         |                                    |  |
|---------|---|---------|------------------------------------|--|
|         | 1. Timing belt upper cover              |         |                                    |  |
|         | 2. Timing belt lower cover              |         |                                    |  |
|         | 3. Flange                               |         |                                    |  |
| ◀A▶ ▶J▶ | 4. Timing belt                          |         |                                    |  |
|         | 5. Tensioner spacer                     |         |                                    |  |
|         | 6. Tensioner spring                     |         |                                    |  |
|         | 7. Timing belt tensioner                |         |                                    |  |
| ◀B▶ ▶I▶ | 8. Camshaft sprocket                    |         |                                    |  |
| ◀C▶ ▶H▶ | 9. Injection pump sprocket              |         |                                    |  |
| ◀D▶ ▶G▶ | 10. Front flange<br>(2001 model PAJERO) |         |                                    |  |
|         | 11. Crankshaft sprocket                 |         |                                    |  |
|         |   | ▶F▶     | 12. Flange                         |  |
|         |   | ◀E▶ ▶E▶ | 13. Timing belt "B"                |  |
|         |   |         | 14. Gasket                         |  |
|         |   |         | 15. Tensioner spacer "B"           |  |
|         |   |         | 16. Tensioner spring "B"           |  |
|         |   | ▶D▶     | 17. Timing belt tensioner          |  |
|         |   | ◀F▶ ▶C▶ | 18. Balancer shaft sprocket, right |  |
|         |   | ◀G▶ ▶B▶ | 19. Balancer shaft sprocket, left  |  |
|         |   | ▶A▶     | 20. Spacer                         |  |
|         |   | ◀H▶     | 21. Crankshaft sprocket "B"        |  |
|         |   |         | 22. Timing belt rear cover         |  |

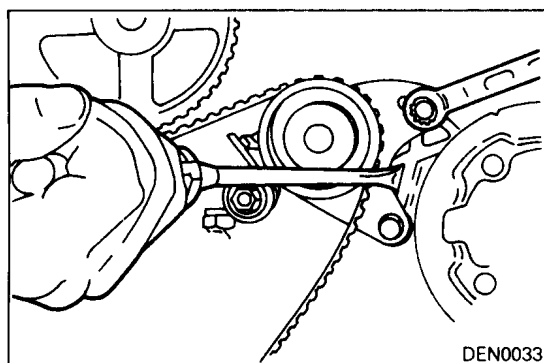
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## SERVICE POINTS OF REMOVAL

### ◊A◊ TIMING BELT REMOVAL

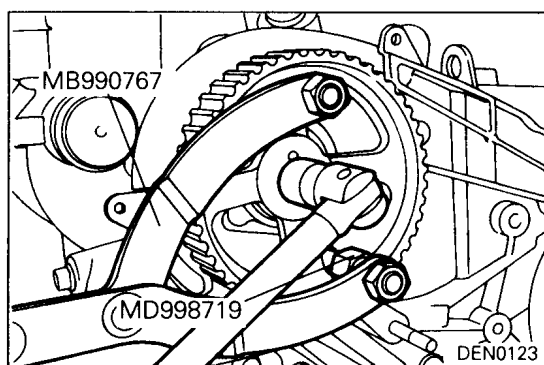
- (1) Using chalk, etc., mark an arrow on the back of the timing belt to indicate the direction of rotation. This is to ensure correct installation of the belt in case it is reused.



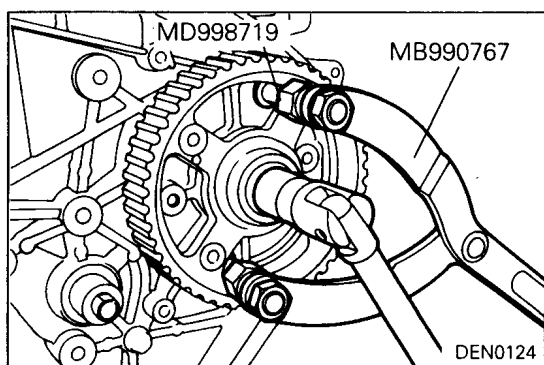
- (2) Push the timing belt tensioner toward the water pump and temporarily tighten the tensioner mounting bolt so that the tensioner cannot return.
- (3) Remove the timing belt.

#### NOTE

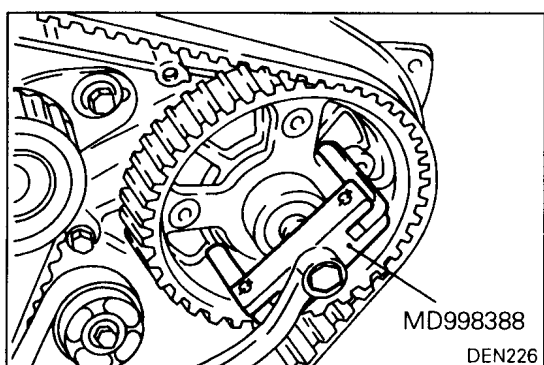
- (1) Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. Do not immerse parts in cleaning solvent.
- (2) If there is oil or water on any part, check front case oil seals, camshaft oil seal and water pump for leaks.



### ◊B◊ CAMSHAFT SPROCKET REMOVAL



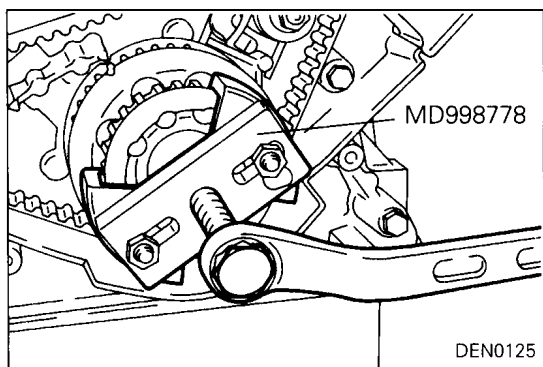
### ◊C◊ INJECTION PUMP SPROCKET REMOVAL



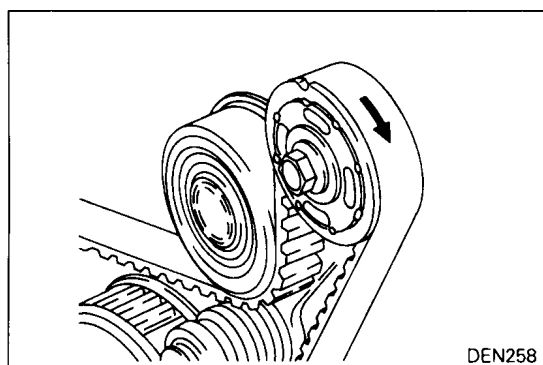
#### Caution

- Never strike the shaft or sprocket to remove the sprocket. This may cause malfunction in the injection pump. Be sure to use a puller to remove the sprocket.





### ◊D◊ CRANKSHAFT SPROCKET REMOVAL

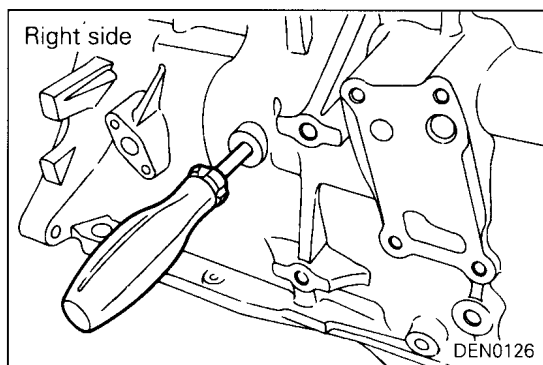


### ◊E◊ TIMING BELT "B" REMOVAL

- (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.

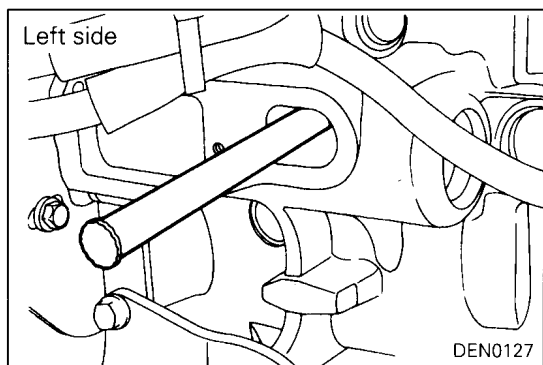
#### NOTE

- (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 front case oil seals, camshaft oil seal and water pump for leaks.



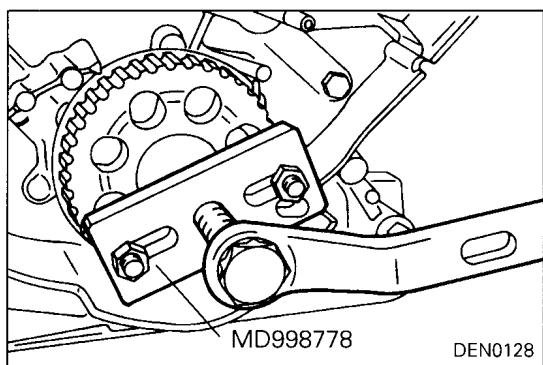
### ◊F◊ BALANCER SHAFT, RIGHT REMOVAL

- (1) Remove the plug at the right side of the cylinder block.
- (2) Insert a Phillips screwdriver [shank diameter 8 mm (0.32 in.)] through the plug hole and lock the balancer shaft.
- (3) Loosen the balancer shaft sprocket nut.



### ◊G◊ BALANCER SHAFT, LEFT REMOVAL

- (1) Remove the cover at the left side of the cylinder block.
- (2) Insert a wrench extension bar or similar rod and lock the balancer shaft.
- (3) Loosen the balancer shaft sprocket bolt.



### ◊H◊ 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)

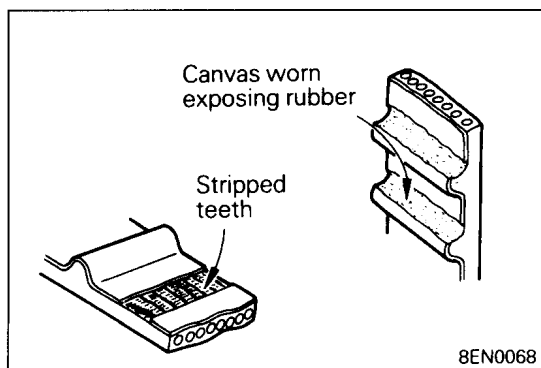
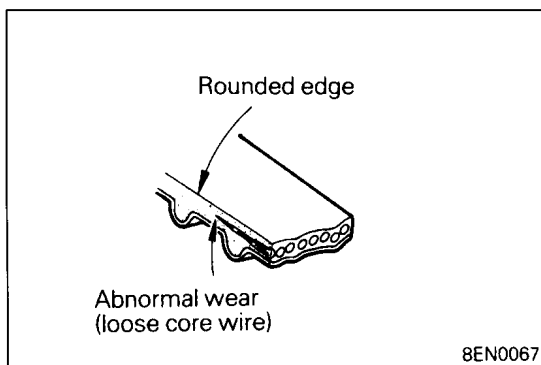
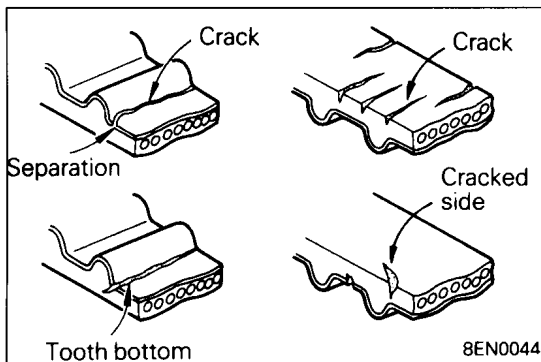
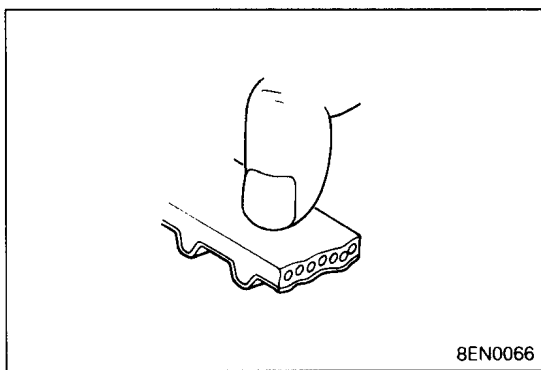
**Last stage:**

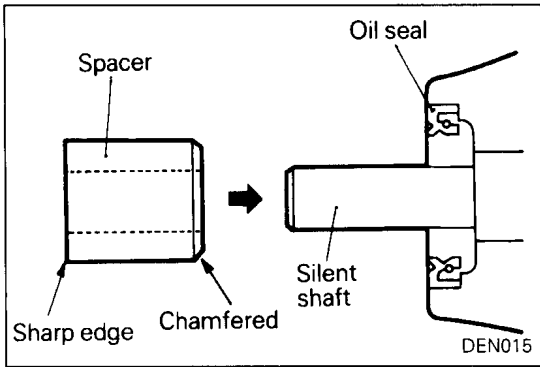
Canvas on load side tooth flank worn down and rubber exposed (tooth width reduced)

- (8) Missing tooth

**TIMING BELT TENSIONER**

Replace the timing belt tensioner if the pulley rotates unsmoothly, has excessive play, or causes noise.

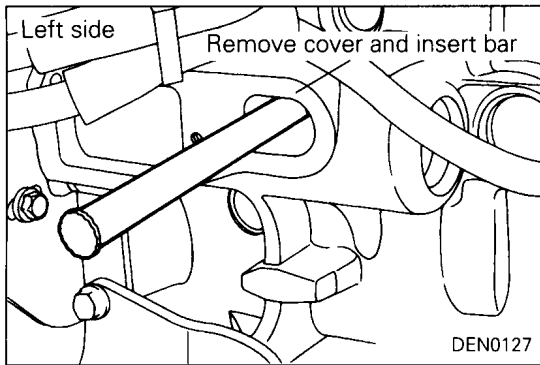




**INSTALLATION SERVICE POINTS**

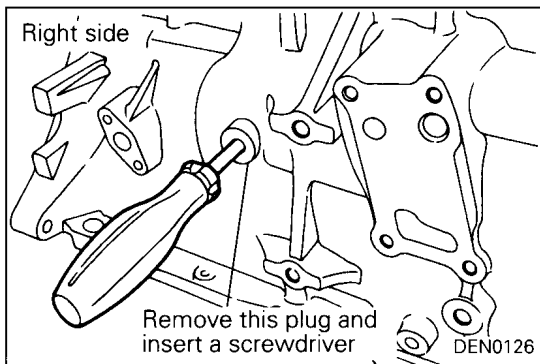
**◆A◆ SPACER INSTALLATION**

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



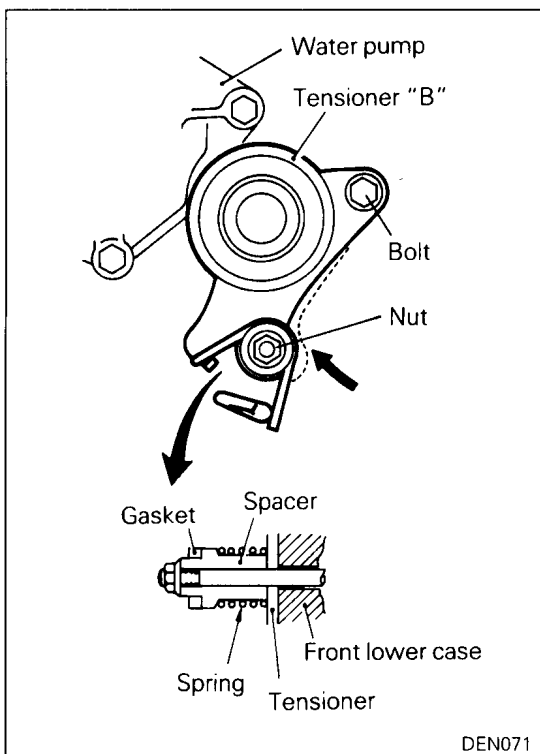
**◆B◆ BALANCER SHAFT SPROCKET, LEFT INSTALLATION**

- (1) Lock the balancer shaft in the same way as used in the removal procedure.
- (2) Install the balancer shaft sprocket and tighten the bolt to the specified torque.



**◆C◆ BALANCER SHAFT SPROCKET, RIGHT INSTALLATION**

- (1) Lock the balancer shaft in the same way as used in the removal procedure.
- (2) Install the balancer shaft sprocket and tighten the nut to the specified torque.



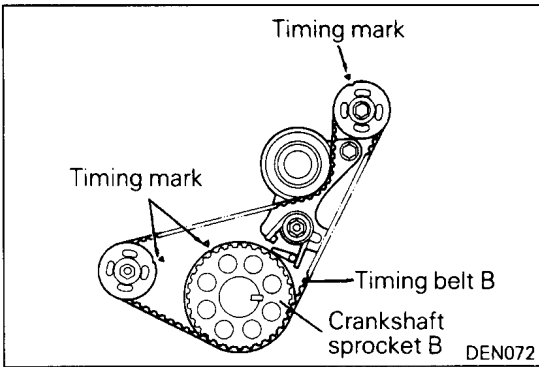
**◆D◆ TIMING BELT TENSIONER "B" INSTALLATION**

- (1) Install the tensioner, tensioner spring and spacer.

**NOTE**

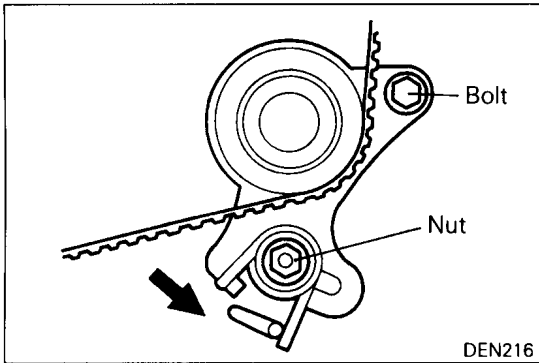
Be sure to install the tensioner spring with its shorter end toward the water pump.

- (2) Move tensioner "B" toward water pump and tighten mounting nut and bolt.



**◆E◆ TIMING BELT "B" INSTALLATION**

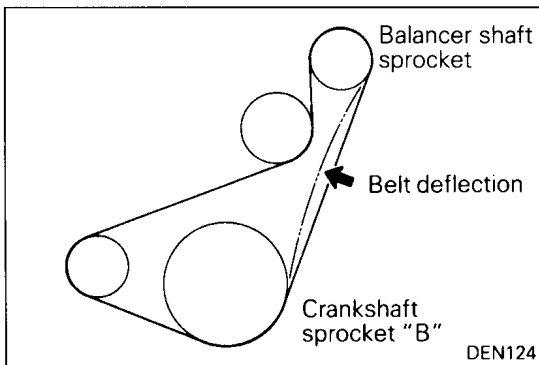
- (1) Align timing marks on the crankshaft sprocket "B", and silent shaft sprockets with their timing marks.
- (2) Install timing belt "B" onto sprockets and ensure that its tension side is not slack.



- (3) Loosen tensioner "B" mounting bolt and nut, one to two turns.
- (4) Tighten the tensioner "B" attaching nut.
- (5) Tighten the tensioner "B" attaching bolt.

**NOTE**

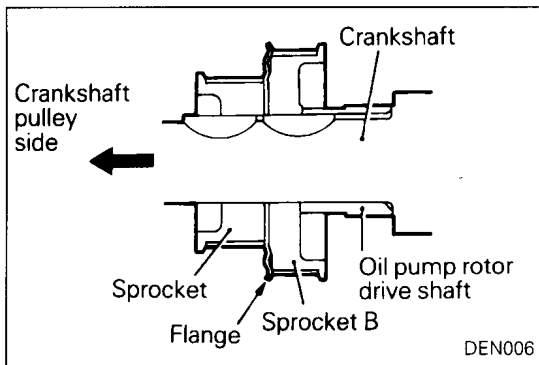
If the bolt is tightened first, the tension "B" should be turned together, resulting in reduced timing belt "B" tension.



- (6) Ensure that the deflection is specified when the belt is pushed by the index finger at the position indicated by an arrow.

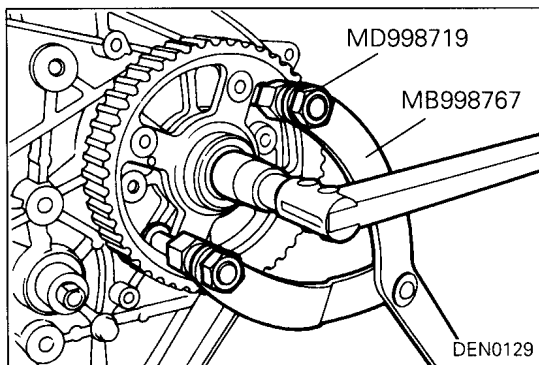
**Belt deflection:**

**4 - 5 mm (0.16 - 0.20 in.)**



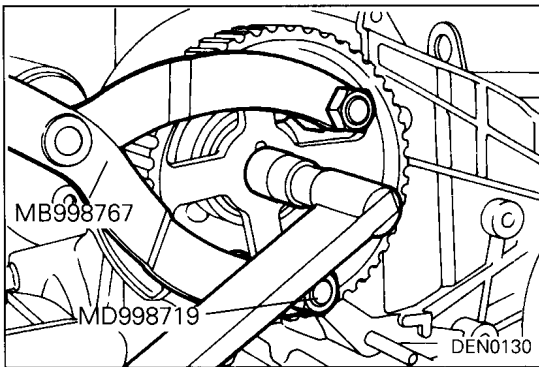
**◆F◆ FLANGE / CRANKSHAFT SPROCKET INSTALLATION**

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



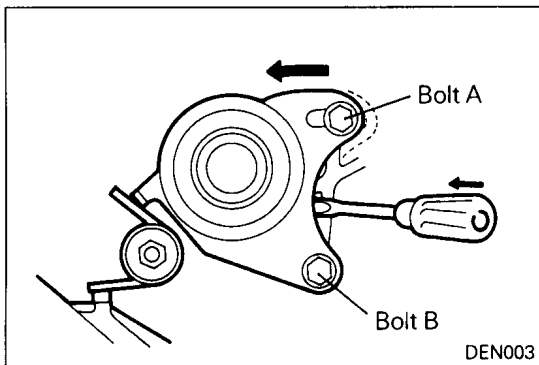
**◆G◆ INJECTION PUMP SPROCKET INSTALLATION**

**▶H▶ CAMSHAFT SPROCKET INSTALLATION**



**▶I▶ TIMING BELT TENSIONER INSTALLATION**

- (1) Move tensioner toward water pump and tighten mounting bolts.

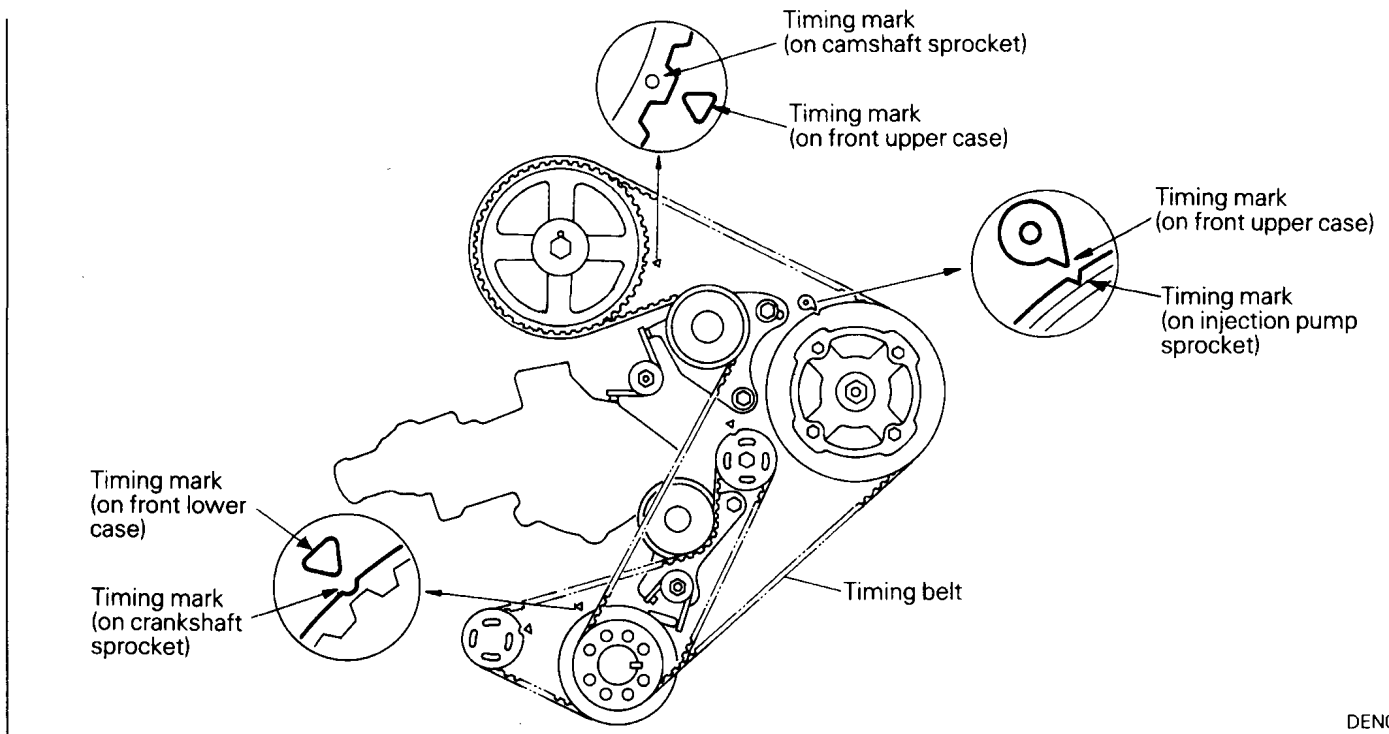


**▶J▶ TIMING BELT INSTALLATION**

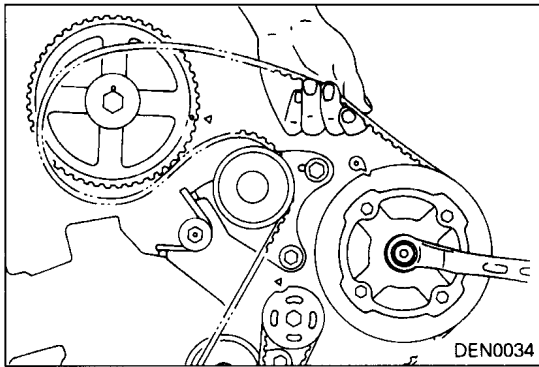
- (1) Align the timing marks on the three sprockets with their mating marks.

**NOTE:**

If the injection pump sprocket is freed, the timing mark on it will move back counterclockwise by about one tooth. Therefore, align the mark while engaging the timing belt.



DEN002



- (2) Install the timing belt over the crankshaft sprocket.
- (3) Align the timing mark on the injection pump sprocket and while holding the sprocket to prevent rotation, install the timing belt.

## NOTE:

Make sure that the timing belt does not become loose on the tension side.

- (4) Install the timing belt over the tensioner pulley.
- (5) While tensioning the timing belt on the tension side, install the timing belt over the camshaft sprocket.
- (6) Check if all timing marks are aligned correctly.
- (7) Back off tensioner bolt "A", that have previously been secured to the water pump side, one to two turns to give tension to the belt using tensioner spring tension.
- (8) Confirm that the timing belt is correctly engaged with three sprockets.

- (9) Turn crankshaft clockwise by the two teeth of the camshaft sprocket and keep the position.

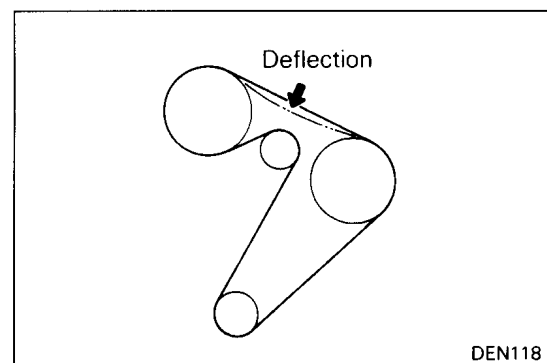
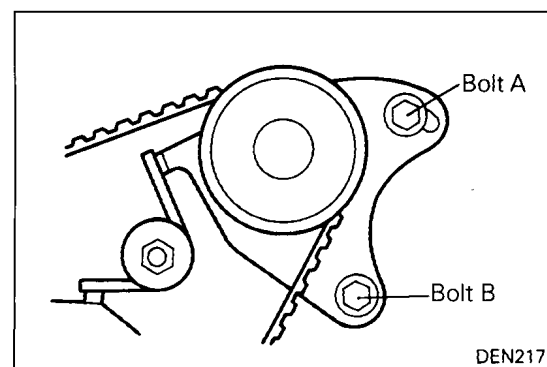
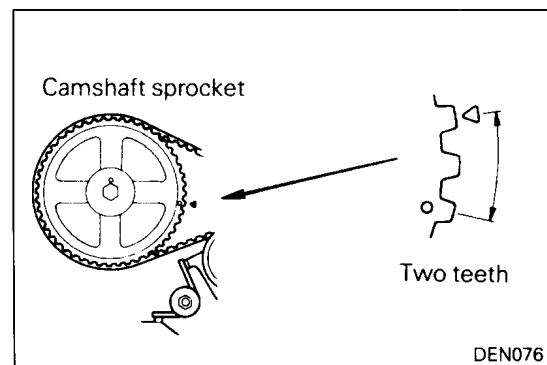
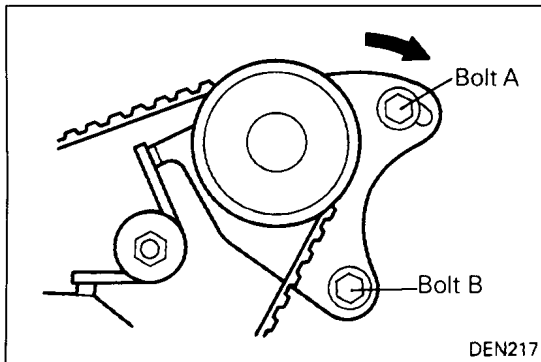
- (10) Tighten the tensioner bolt "A".
- (11) Tighten the tensioner bolt "B".

## NOTE

If the bolt "B" is tightened first, the tensioner should be turned together, causing an undue tension to be applied to the timing belt.

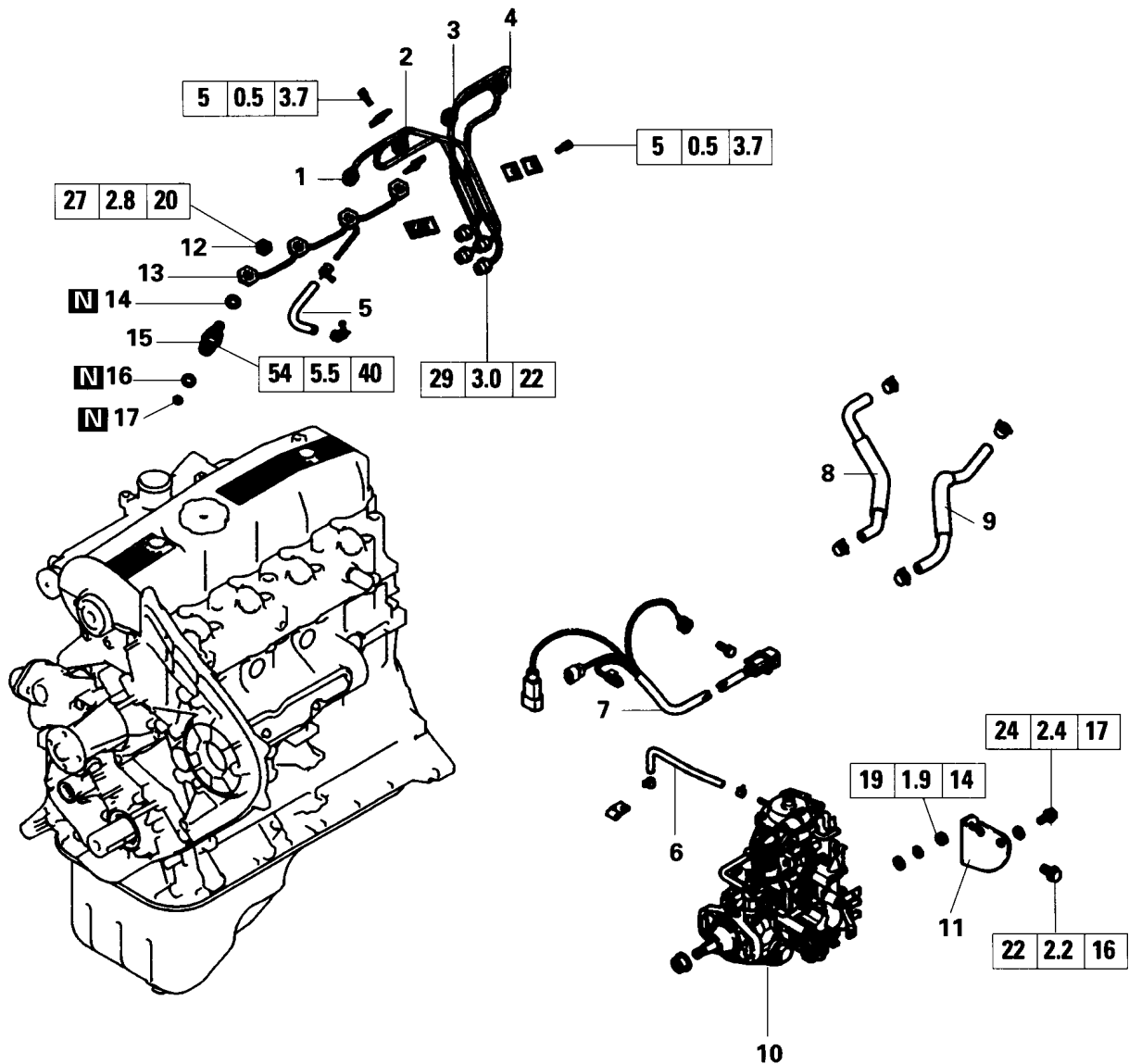
- (12) Turn the crankshaft in the direction of backward rotation to line up timing marks. In this condition, ensure that the deflection is specified when the center of belt is pushed by the index finger.

**Belt deflection:**  
4 - 5 mm (0.16 - 0.20 in.)



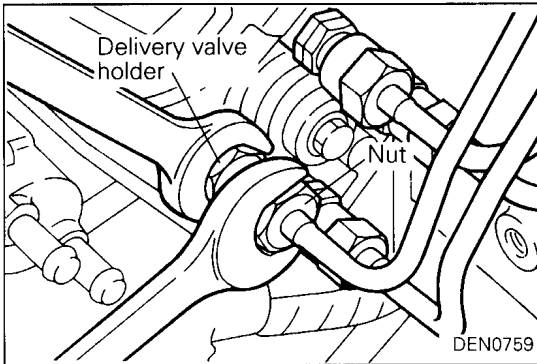
## 5. FUEL INJECTION PUMP AND INJECTION NOZZLE

### 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. Tube (Engines with turbocharger)
- 7. Injection pump harness assembly
- 8. Water hose } Engines with cold
- 9. Water hose } start device
- ◁B▷ 10. Fuel injection pump
- 11. Injection pump bracket
- ◁C▷ ▷C◁ 12. Fuel return pipe nut
- 13. Fuel return pipe
- 14. Gasket
- ◁D▷ ▷B◁ 15. Injection nozzle
- ▷A◁ 16. Holder gasket
- ▷A◁ 17. Nozzle gasket



## REMOVAL SERVICE POINTS

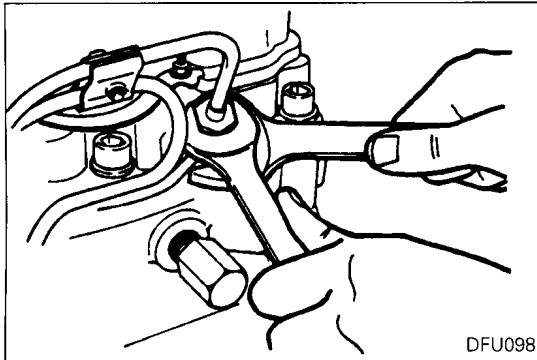
### ◊A◊ INJECTION PIPE REMOVAL

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

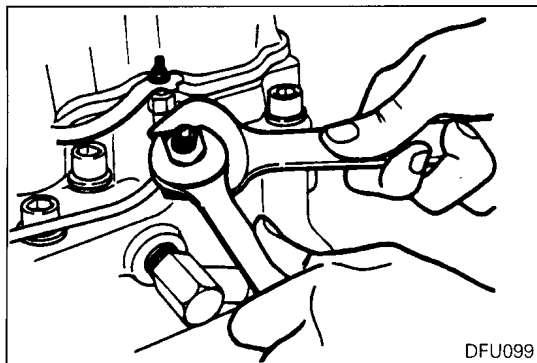


### ◊B◊ FUEL INJECTION PUMP REMOVAL

- (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 fuel return pipe with a wrench.

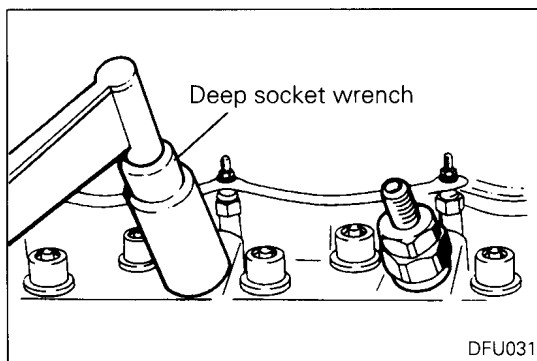


### ◊D◊ INJECTION NOZZLE REMOVAL

- (1) When removing the injection nozzle, write the number of the cylinder on the injection nozzle that has been removed.

#### Caution

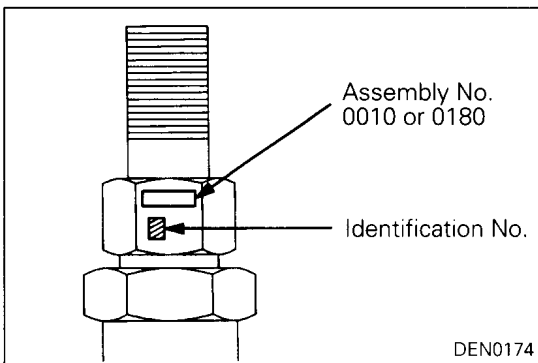
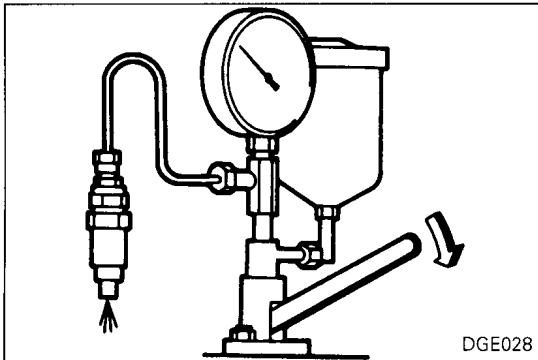
- Cover the opening with an appropriate cap to prevent entry of dust, water and foreign material into the fuel passage and combustion chamber.





**INSPECTION****INJECTION NOZZLE****Warning**

- **When testing injection nozzles, do not expose your hands or any other parts of your body to the injector spray. Working pressure can cause the fuel oil to penetrate the skin. Do not smoke or work near heaters or other fire hazards. Have a fire extinguisher handy.**

**Breaking Pressure Test**

- (1) Install the injection nozzle to the nozzle tester.
- (2) Operate the lever of the nozzle tester to inject fuel oil two or three times and bleed air from the nozzle.
- (3) Slowly push down the nozzle tester lever.
- (4) Monitor the pressure indicated when the injection nozzle starts operation. Be sure that a pressure of standard value is indicated.

**Standard value:**

**<Assembly No. "0010">**

**11,770 – 12,750 kPa**

**(120 – 130 kg/cm<sup>2</sup>, 1,707 – 1,849 psi)**

**<Assembly No. "0180">**

**14,700 – 15,690 kPa**

**(150 – 160 kg/cm<sup>2</sup>, 2,133 – 2,276 psi)**

**NOTE**

The assembly number is stamped at the position shown in the illustration.

- (5) If necessary, adjust the pressure by replacing the shims in accordance with INJECTION NOZZLE HOLDER.

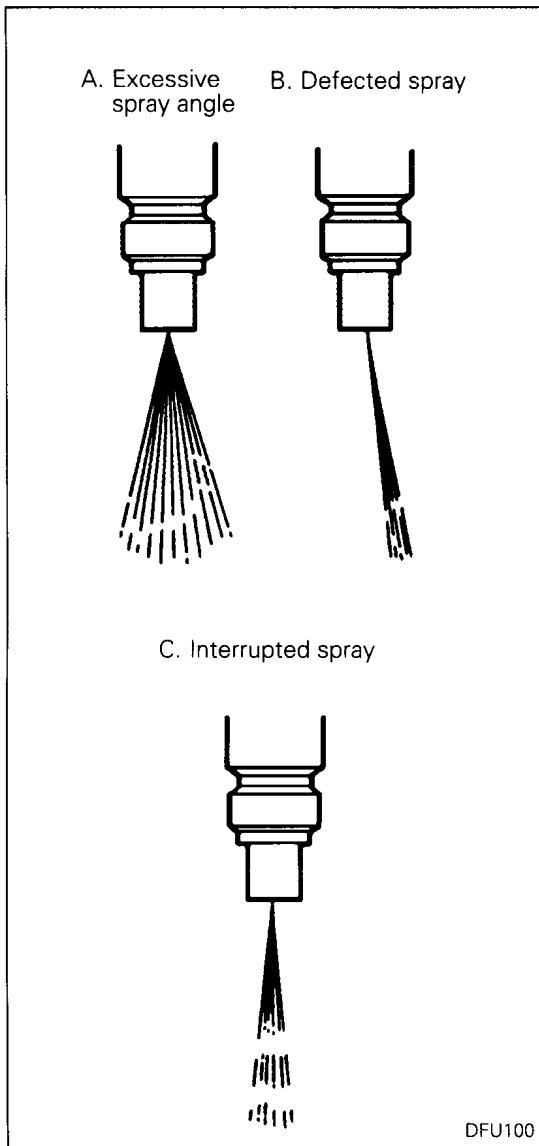
**NOTE**

1. There are 10 shims for adjustment, with thickness in the range 0.10 – 0.80 mm (0.0039 – 0.0315 in.)
2. When the shim thickness is increased by 0.1 mm (0.039 in.), the fuel injection initial pressure increases by 2,350 kPa (24 kg/cm<sup>2</sup>, 341 psi).

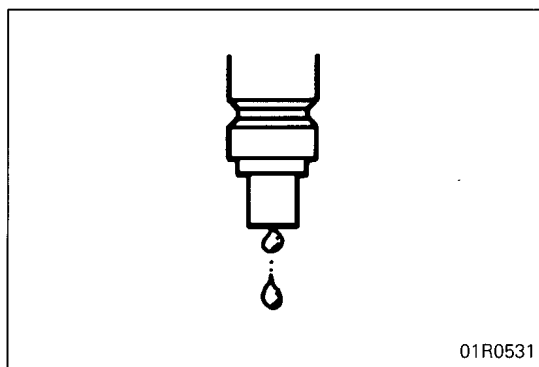
**SPRAY TEST**

- (1) Move the nozzle tester lever with a fast and short stroke (four to six strokes per second) to make sure that the sprays from the nozzle are uniform and have good patterns.  
The spray patterns shown at left indicate that the nozzle is defective.

Assembly No.	Identification No.	Spray angle (deg.)
0010	1	0
	None	15
0180	None	10

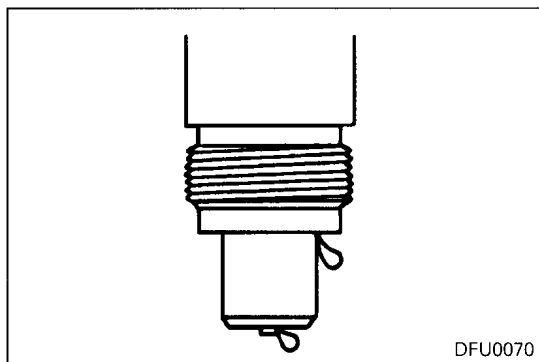


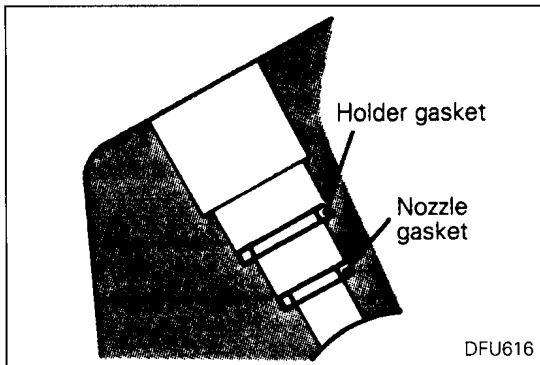
- (2) Be sure that the nozzle has no drip.  
(3) Repair or replace the defective injection nozzle.



**Leakage Test**

- (1) Slowly push down the nozzle tester lever until the nozzle pressure (pressure gauge reading) reaches a pressure of 1,960 kPa (20 kg/cm<sup>2</sup>, 284 psi) lower than the nozzle breaking pressure and hold the pressure for approx. 10 seconds. Make sure that no fuel oil leaks from the nozzle tip during this period.  
(2) Disassemble the defective injection nozzle and replace the nozzle tip or replace the nozzle holder assembly.

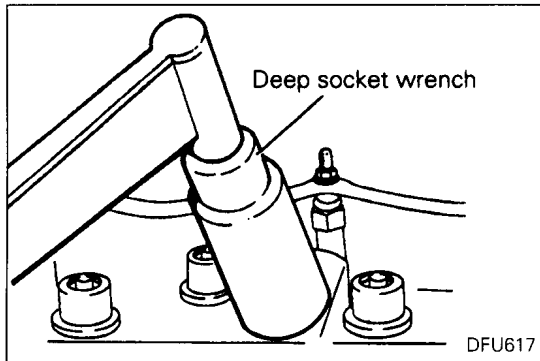




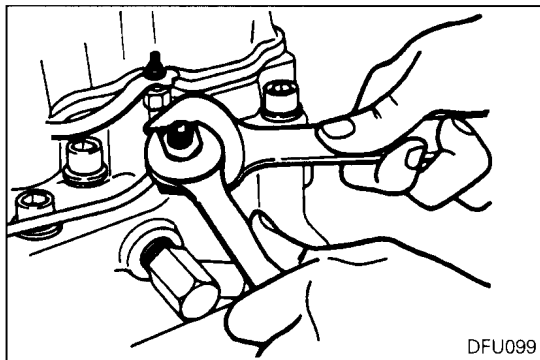
## INSTALLATION SERVICE POINTS

### ◆A◆ NOZZLE GASKET / HOLDER GASKET INSTALLATION

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

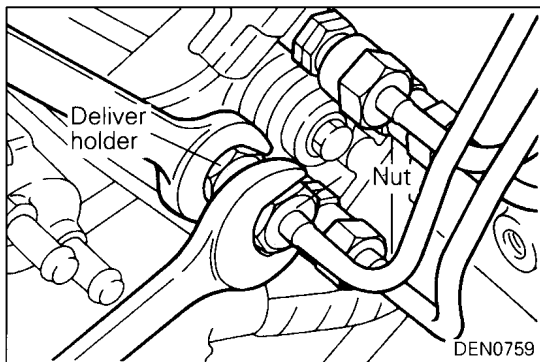


### ◆B◆ INJECTION NOZZLE INSTALLATION



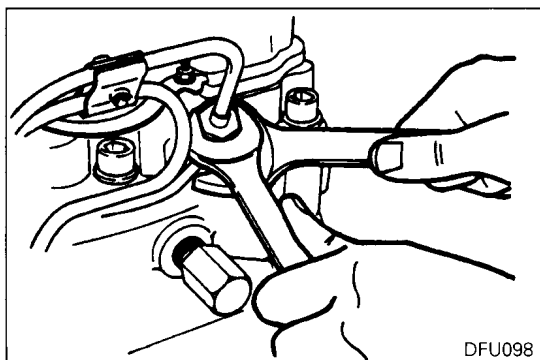
### ◆C◆ FUEL RETURN PIPE NUT INSTALLATION

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

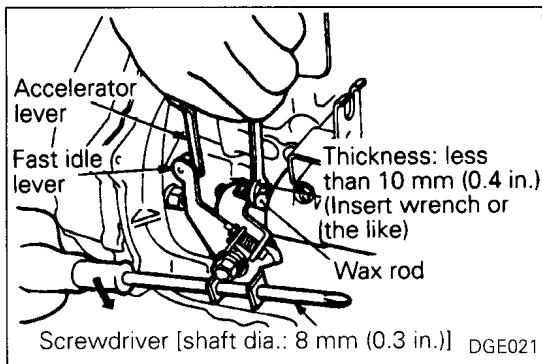


### ◆D◆ INJECTION PIPE INSTALLATION

- (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 return pipe with a spanner in order to prevent it from rotating along with the nut.



## INJECTION TIMING ADJUSTMENT

- (1) Release the fast idle mechanism.
  - (a) Insert a screwdriver [shaft dia.: 8 mm (0.3 in.)] into the holes at the bottom of the fast idle lever and turn the lever in the direction of the arrow as shown.

### Caution

- **In order to prevent weakening of the spring, do not turn the lever any more than necessary.**

- (b) Insert a wrench or similar tool [thickness approx. 10 mm (0.4 in.)] between the wax rod and the adjusting screw.

### Caution

- **Do not turn the adjusting screw.**

- (c) Remove the screwdriver.

- (2) Loosen (but do not remove) two nuts and two bolts holding the injection pump.

- (3) Loosen (but do not remove) the 4 nuts on the injection pump side which hold the injection pipes.

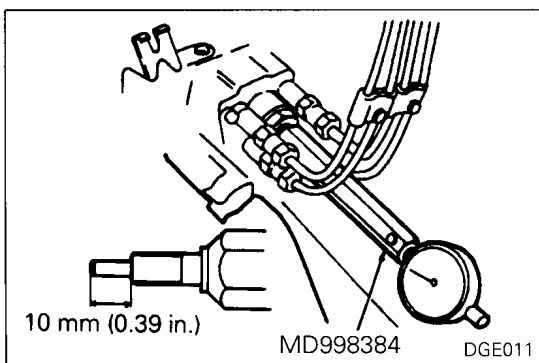
### Caution

- **When loosening the nuts, hold the delivery valve holder with a wrench to prevent it from turning along with the nut.**

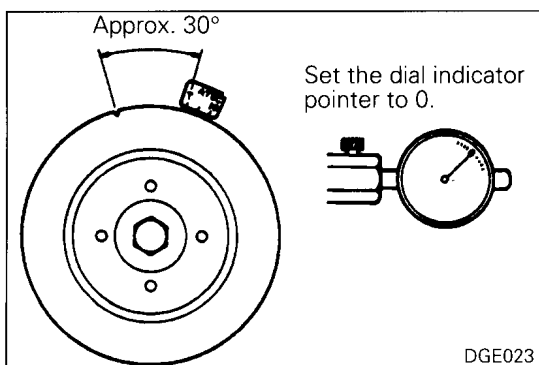
- (4) Remove the plug from the rear of injection pump, and attach the special tool and dial indicator.

### Caution

- **Before installing the adapter, make sure that the push rod projects 10 mm (0.39 in.). Push rod projection can be adjusted by means of the interior nut.**



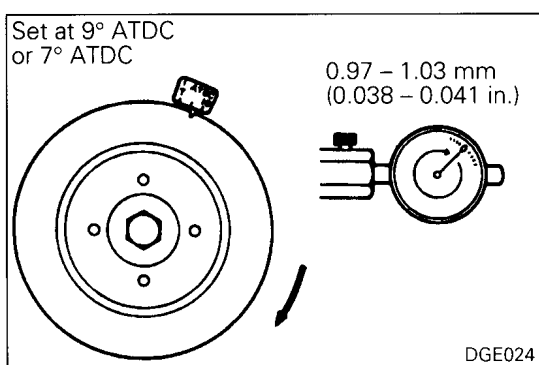
- (5) Set the notch on the crank pulley at approximately 30° BTDC of the compression stroke of the No. 1 cylinder. With the notch in this position, set the dial indicator at zero. Turn the crank pulley slightly in both directions to make sure that the dial indicator pointer does not deviate from the zero position. If the pointer deviates, the notch position is not correct. Readjust it to 30° BTDC.

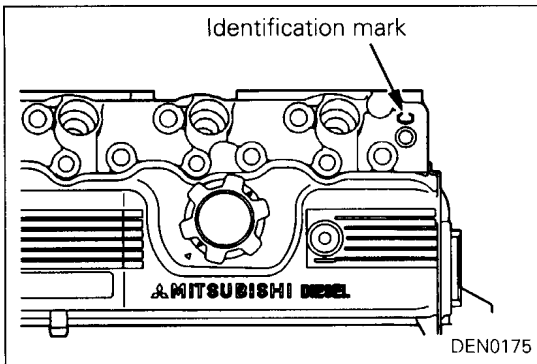


- (6) Turn the crankshaft clockwise to bring the notch on the pulley to 9° ATDC or 7° ATDC and check to be sure that the dial indicator reading is within the standard value range.

### Standard value:

**0.97 - 1.03 mm (0.038 - 0.041 in.)**

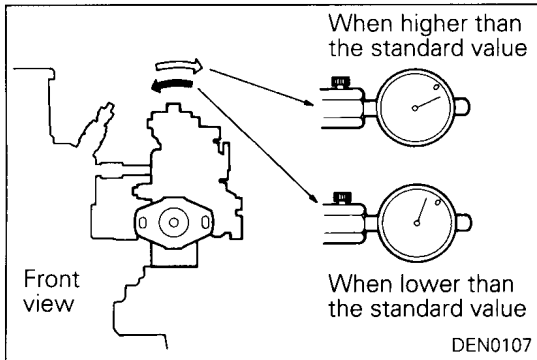




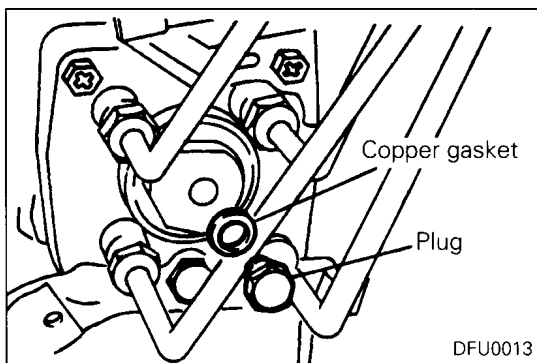
## NOTE

The injection timing can be known from the identification mark stamped on the cylinder head at the position shown in the illustration.

Identification mark	Injection timing
A or B	7° ATDC
C or D	9° ATDC



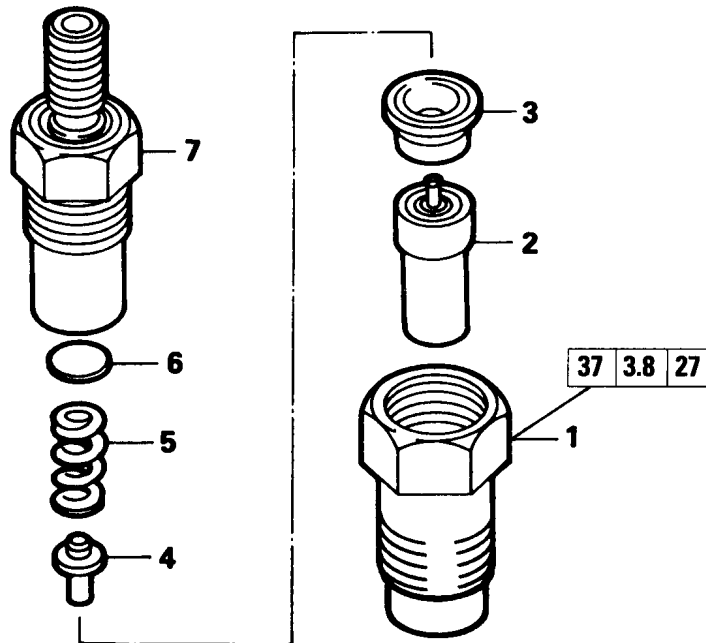
- (7) If dial indicator reading is not within the standard value range, tilt the injection pump body to the right or left until the reading is within the standard value range. Then, temporarily tighten the injection pump nuts and bolts.
- (8) Repeat Steps (5) and (6) to make sure that the adjustment has been correctly performed.
- (9) Tighten the injection pump mounting bolts and nuts to the specified torque.
- (10) Remove the dial indicator and the special tool.



- (11) install new copper gasket and plug, then tighten the plug to specified torque.

## 6. INJECTION NOZZLE HOLDER

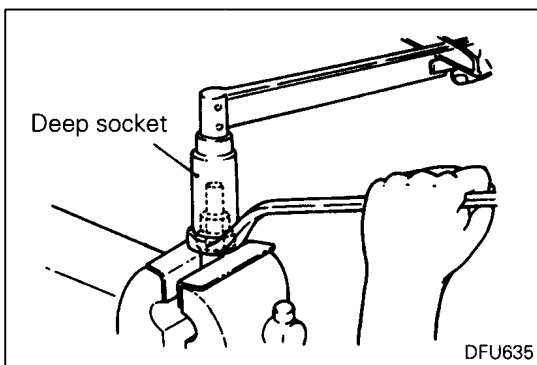
### DISASSEMBLY AND REASSEMBLY



#### Disassembly steps

- ◁A▷ ▷A◁
1. Retaining nut
  2. Nozzle tip
  3. Distance piece
  4. Retaining pin
  5. Pressure spring
  6. Shim
  7. Nozzle holder body

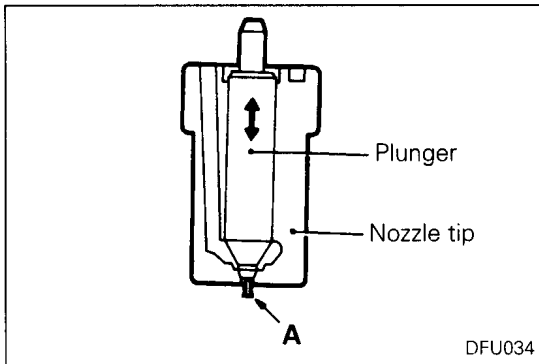
DFU634



#### DISASSEMBLY SERVICE POINT

##### ◁A▷ RETAINING NUT DISASSEMBLY

- (1) Lightly clamp the retaining nut in a vise with soft jaws.
- (2) Hold the retaining nut with a box wrench, and loosen the nozzle holder body using a deep socket.



## INSPECTION

### NOZZLE TIP

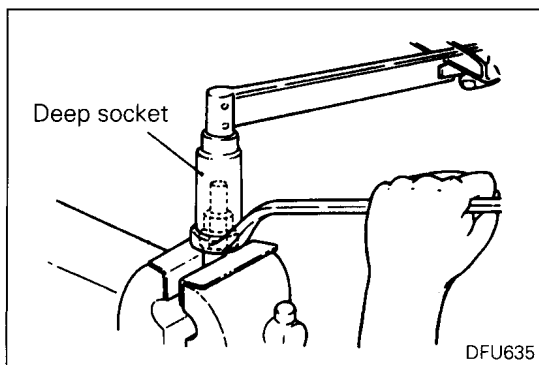
- (1) Check the nozzle tip for carbon deposits. Scrape off carbon deposits with a piece of wood and clean each part with petrol. After cleaning, keep parts submerged in diesel fuel. Take particular care to protect the nozzle tip needle valve from damage.
- (2) While the nozzle tip is submerged in diesel fuel, check that the needle valve slides smoothly. If the needle valve does not slide smoothly, replace the nozzle tip. When replacing the nozzle tip, completely wash off the anticorrosive oil from the new nozzle tip with clean diesel fuel before using it.
- (3) Check plunger tip "A" for deformation and breakage. If "A" is damaged or broken, replace it.

### DISTANCE PIECE

- (1) Check the surface in contact with the nozzle holder body by using minimum.

### PRESSURE SPRING

- (1) Check spring for weakness and breakage.



## REASSEMBLY SERVICE POINT

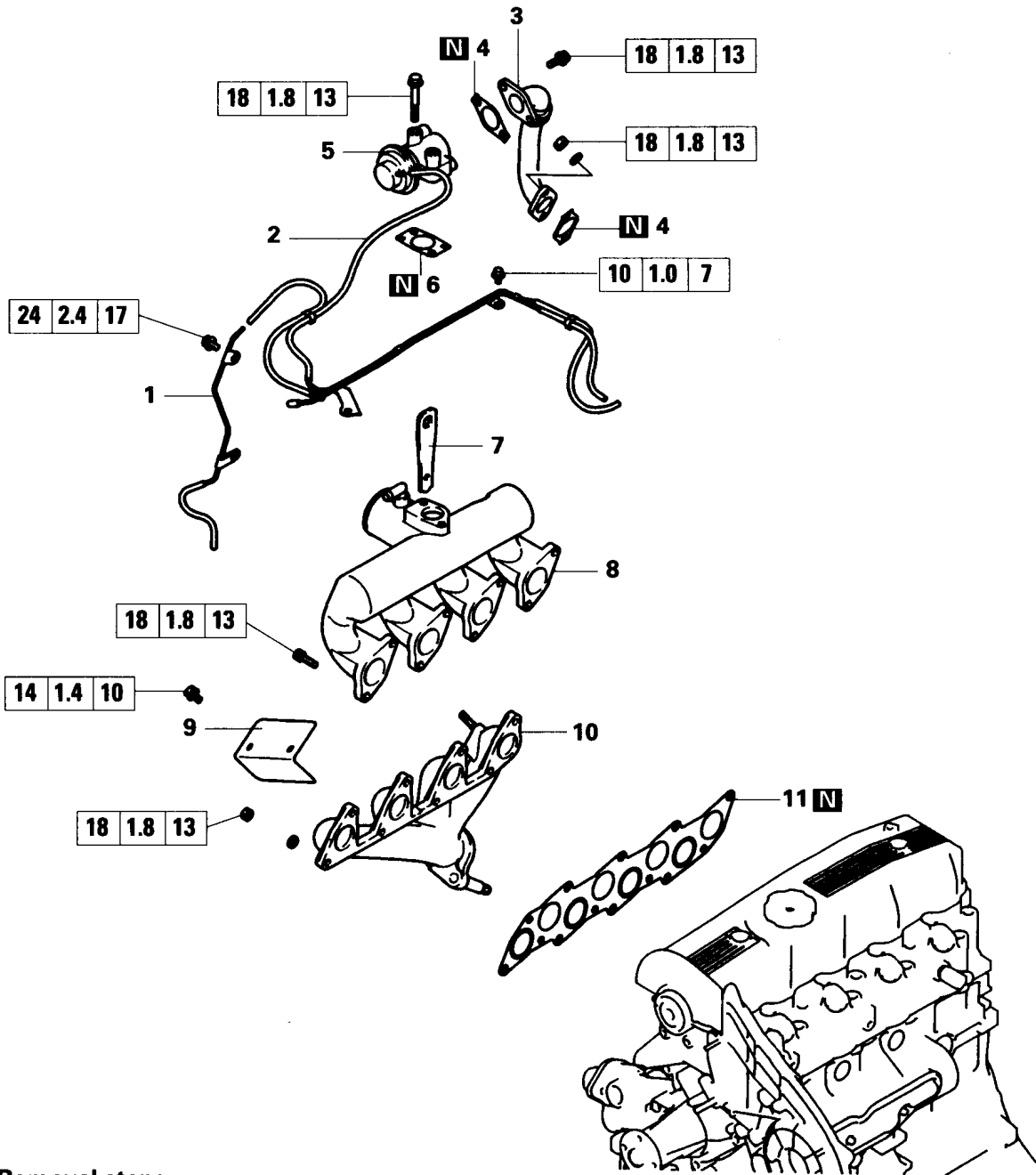
### ◆A◆ RETAINING NUT REASSEMBLY

- (1) Finger-tighten the nozzle holder body.
- (2) Lightly clamp the retaining nut in a vise with soft jaws.
- (3) While holding the retaining nut with a box wrench, tighten the nozzle holder body to the specified torque with a deep socket.

# 7. INTAKE AND EXHAUST MANIFOLDS

## REMOVAL AND INSTALLATION

### Engines without turbocharger

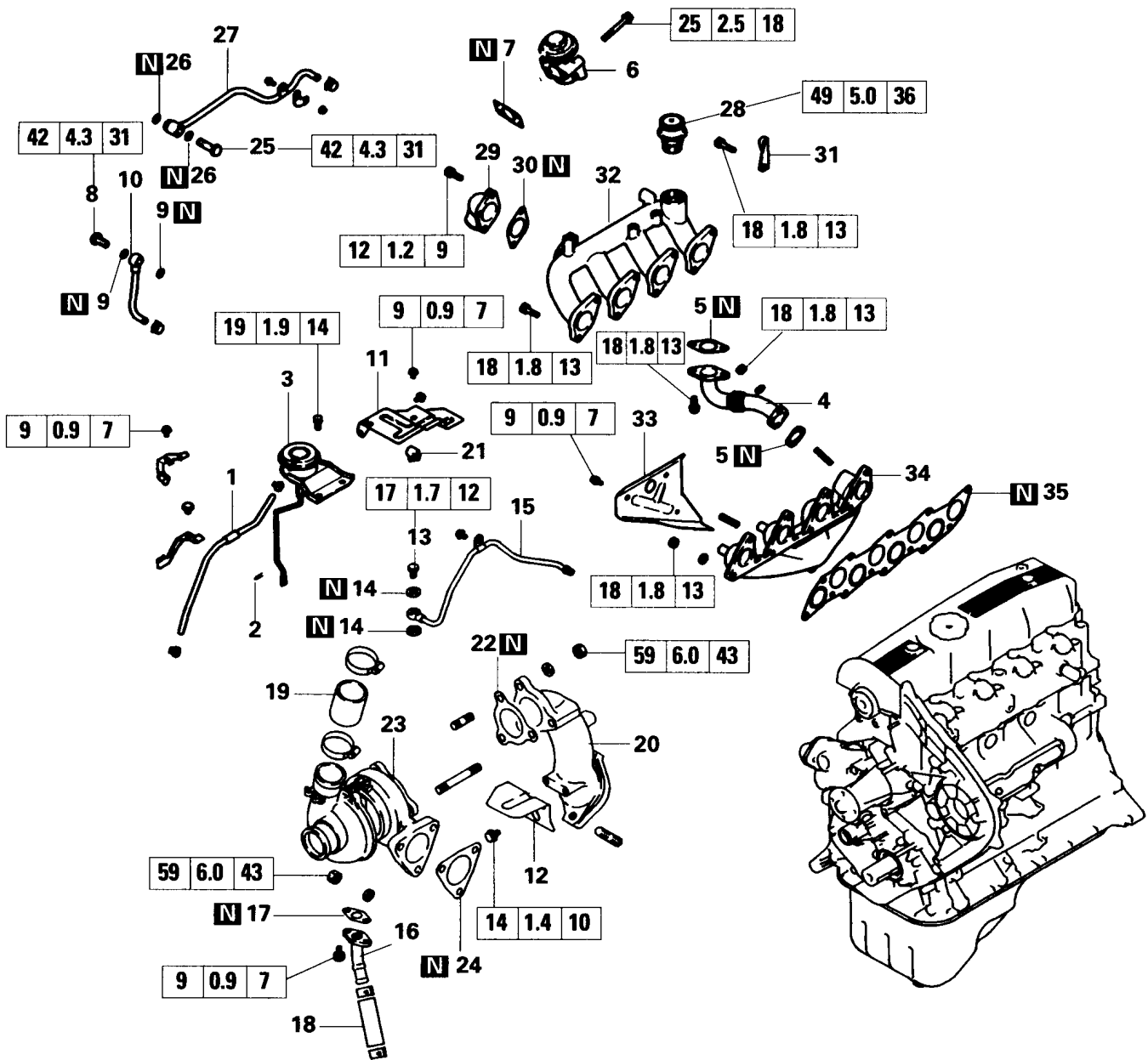


#### Removal steps

- |                                  |                              |
|----------------------------------|------------------------------|
| 1. Vacuum pipe and hose assembly | } Engines with<br>EGR system |
| 2. Vacuum pipe and hose assembly |                              |
| 3. EGR pipe                      |                              |
| 4. Gasket                        |                              |
| 5. EGR valve                     |                              |
| 6. Gasket                        |                              |
| 7. Engine hanger                 |                              |
| 8. Intake manifold               |                              |
| 9. Heat protector                |                              |
| 10. Exhaust manifold             |                              |
| 11. Manifold gasket              |                              |



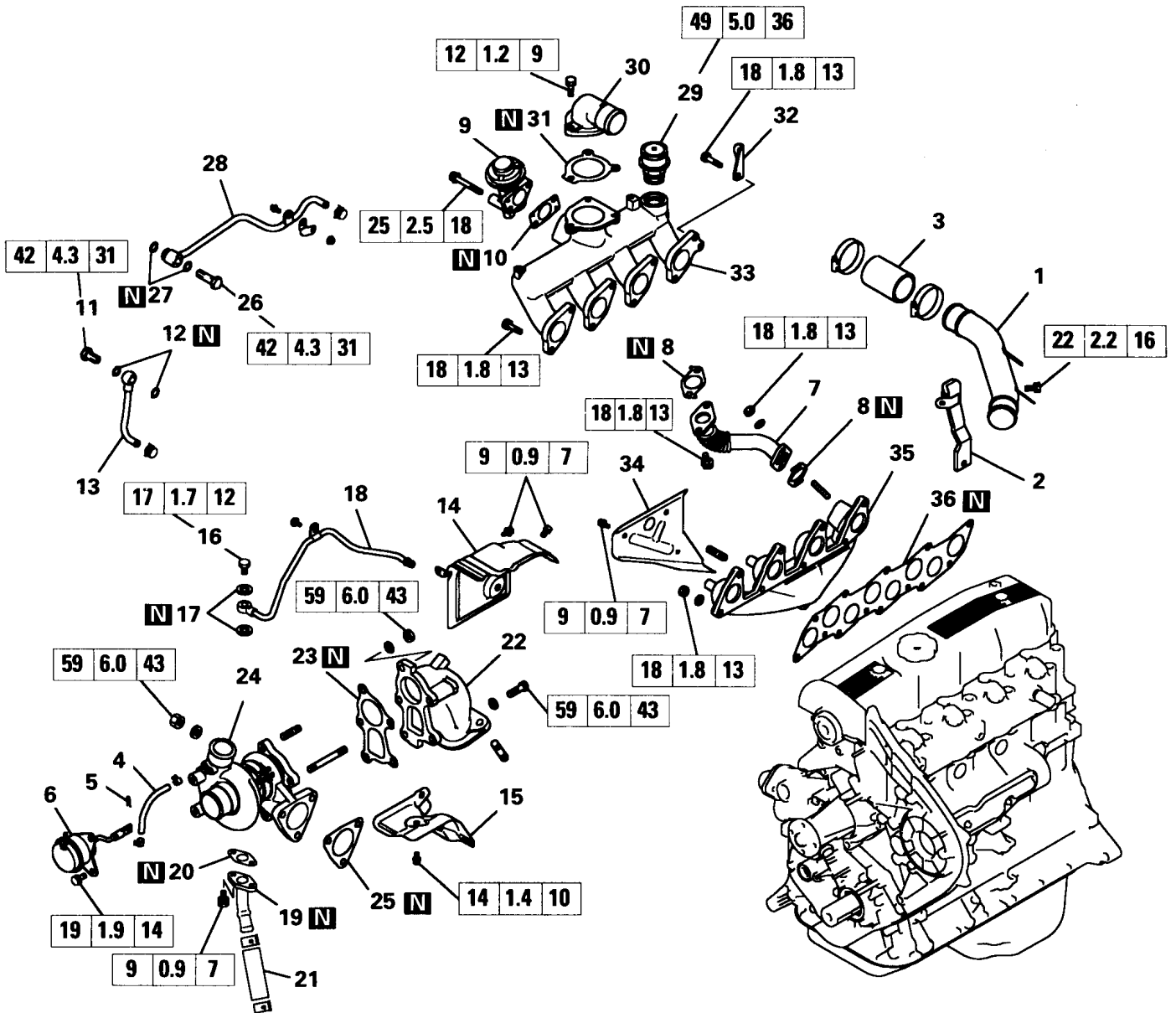
Engines with turbocharger <PAJERO (Up to 2000 model) L200, L300 (except P15T)>



**Disassembly steps**

- |                        |  |
|------------------------|--|
| 1. Boost hose          | 19. Air hose (Engines without intercooler) |
| 2. Snap ring           | 20. Exhaust fitting                        |
| 3. Waste gate actuator | 21. Stay                                   |
| 4. EGR pipe            | 22. Gasket                                 |
| 5. Gasket              | 23. Turbocharger assembly                  |
| 6. EGR valve           | 24. Gasket                                 |
| 7. Gasket              | 25. Eyebolt                                |
| 8. Eyebolt             | 26. Gasket                                 |
| 9. Gasket              | 27. Water pipe                             |
| 10. Water pipe         | 28. Relief valve                           |
| 11. Heat protector A   | 29. Air inlet fitting                      |
| 12. Heat protector C   | 30. Gasket                                 |
| ▶A◀ 13. Eyebolt        | 31. Engine hanger                          |
| 14. Gasket             | 32. Intake manifold                        |
| 15. Oil pipe           | 33. Heat protector                         |
| 16. Oil return pipe    | 34. Exhaust manifold                       |
| 17. Gasket             | 35. Manifold gasket                        |
| 18. Oil hose           |  |

Engines with turbocharger <PAJERO (From 2001 model)>

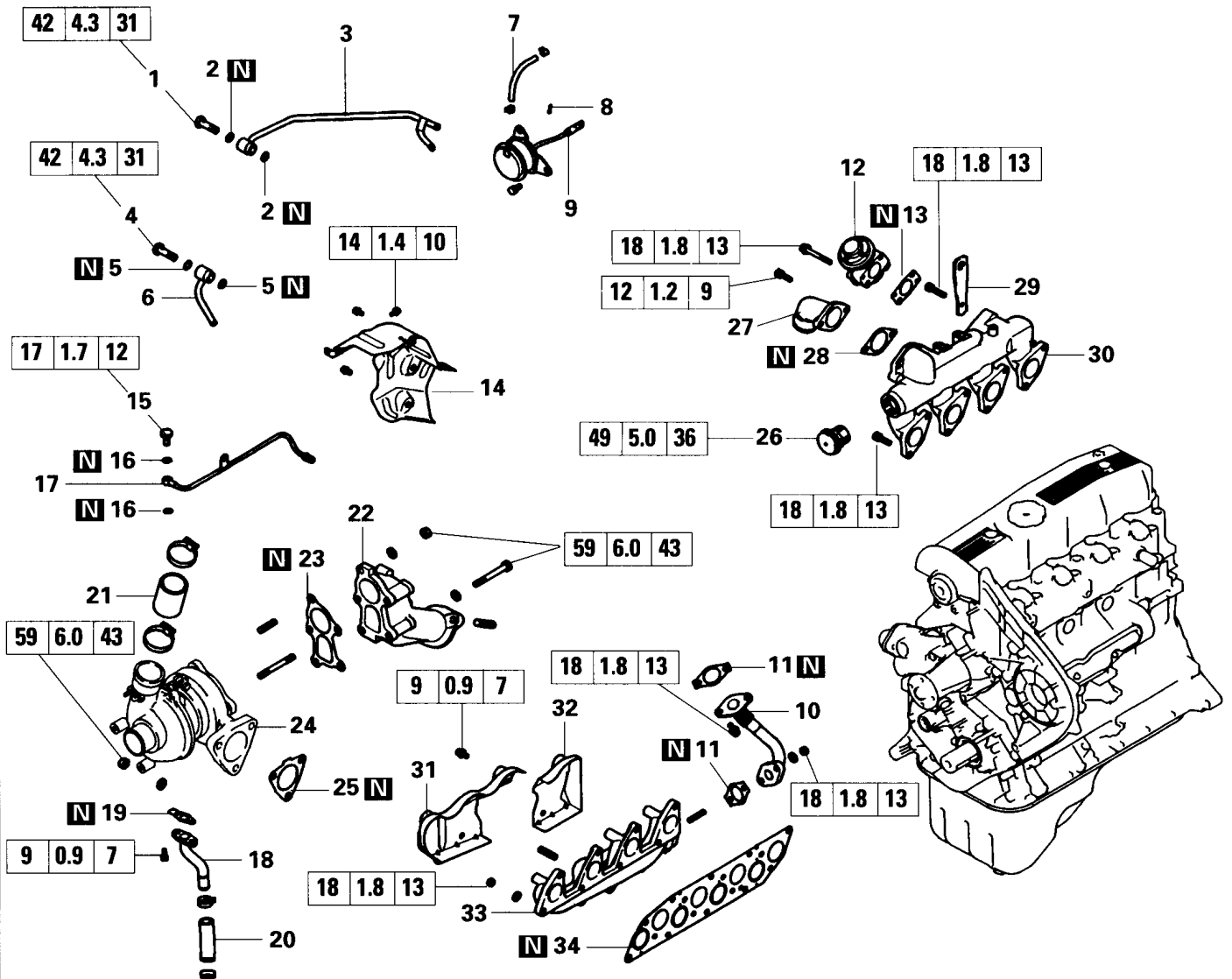


Disassembly steps

- |                                   |                           |
|-----------------------------------|---------------------------|
| 1. Air pipe                       | 19. Oil return pipe       |
| 2. Air pipe bracket               | 20. Gasket                |
| 3. Air intake hose                | 21. Oil hose              |
| 4. Boost hose                     | 22. Exhaust fitting       |
| 5. Snap ring                      | 23. Gasket                |
| 6. Waste gate actuator            | 24. Turbocharger assembly |
| 7. EGR pipe                       | 25. Gasket                |
| 8. Gasket                         | 26. Eyebolt               |
| 9. EGR valve                      | 27. Gasket                |
| 10. Gasket                        | 28. Water pipe            |
| 11. Eyebolt                       | 29. Relief valve          |
| 12. Gasket                        | 30. Air inlet fitting     |
| 13. Water pipe                    | 31. Gasket                |
| 14. Turbochargr Heat protector    | 32. Engine hanger         |
| 15. Exhaust fittingHeat protector | 33. Intake manifold       |
| ▶A◀ 16. Eyebolt                   | 34. Heat protector        |
| 17. Gasket                        | 35. Exhaust manifold      |
| 18. Oil pipe                      | 36. Manifold gasket       |

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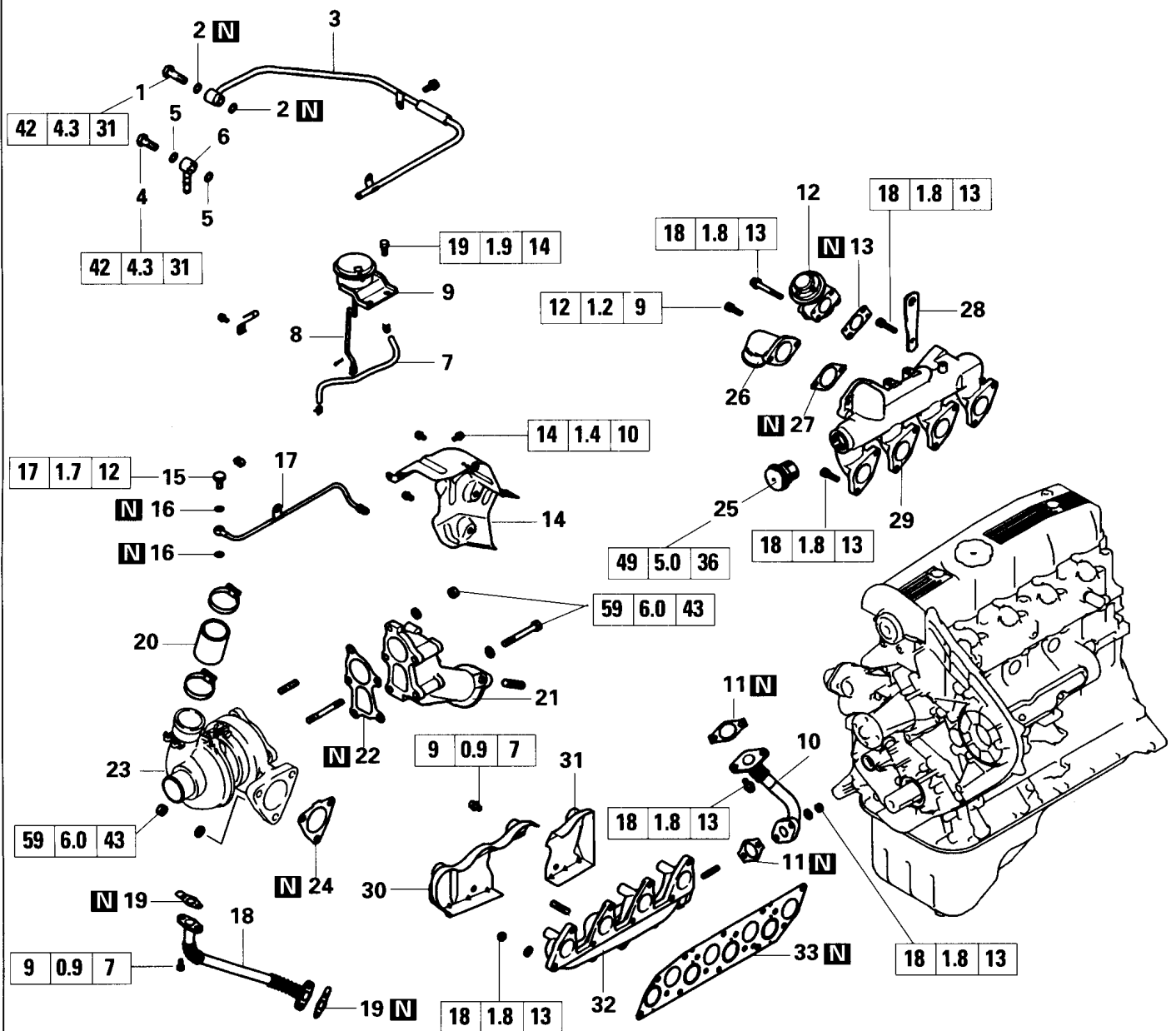
Engines with turbocharger <L300 (P15T)>



**Disassembly steps**

- |                        |                           |
|------------------------|---------------------------|
| 1. Eyebolt             | 18. Oil return pipe       |
| 2. Gasket              | 19. Gasket                |
| 3. Water pipe B        | 20. Oil hose              |
| 4. Eyebolt             | 21. Air hose              |
| 5. Gasket              | 22. Exhaust fitting       |
| 6. Water pipe A        | 23. Gasket                |
| 7. Boost hose          | 24. Turbocharger assembly |
| 8. Snap ring           | 25. Gasket                |
| 9. Waste gate actuator | 26. Relief valve          |
| 10. EGR pipe           | 27. Air inlet fitting     |
| 11. Gasket             | 28. Gasket                |
| 12. EGR valve          | 29. Engine hanger         |
| 13. Gasket             | 30. Intake manifold       |
| 14. Heat protector B   | 31. Heat protector, front |
| 15. Eyebolt            | 32. Heat protector, rear  |
| 16. Gasket             | 33. Exhaust manifold      |
| 17. Oil pipe           | 34. Gasket                |

Engines with turbocharger <L400>

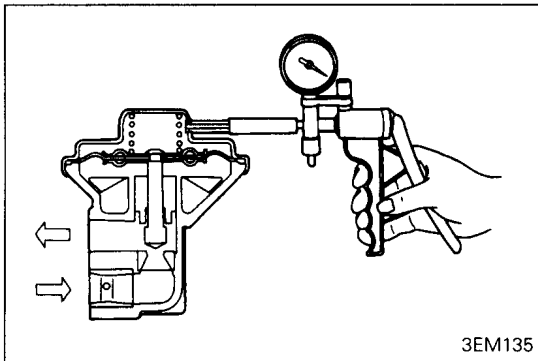


**Disassembly steps**

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>1. Eyebolt</li> <li>2. Gasket</li> <li>3. Water pipe "B"</li> <li>4. Eyebolt</li> <li>5. Gasket</li> <li>6. Water pipe "A"</li> <li>7. Boost hose</li> <li>8. Snap ring</li> <li>9. Waste gate actuator</li> <li>10. EGR pipe</li> <li>11. Gasket</li> <li>12. EGR valve</li> <li>13. Gasket</li> <li>14. Heat protector "B"</li> <li>15. Eyebolt</li> <li>16. Gasket</li> <li>17. Oil pipe</li> </ul> | <ul style="list-style-type: none"> <li>18. Oil return pipe</li> <li>19. Gasket</li> <li>20. Air hose</li> <li>21. Exhaust fitting</li> <li>22. Gasket</li> <li>23. Turbocharger assembly</li> <li>24. Gasket</li> <li>25. Relief valve</li> <li>26. Air inlet fitting</li> <li>27. Gasket</li> <li>28. Engine hanger</li> <li>29. Intake manifold</li> <li>30. Heat protector, front</li> <li>31. Heat protector, rear</li> <li>32. Exhaust manifold</li> <li>33. Gasket</li> </ul> |
|---|---|

**INSPECTION****EGR VALVE**

- (1) Remove the EGR valve and check it for sticking, deposit of carbon, etc.  
If such condition exists, clean with adequate solvent to ensure correct valve seat contact.



- (2) Connect a hand vacuum pump to the EGR valve.
- (3) Apply a vacuum of 500 mmHg (19.7 in.Hg) and check air tightness.
- (4) Blow in air from one passage of the EGR to check condition as follows.

Vacuum	Normal condition
20 mmHg (0.8 in.Hg) or lower	Air does not blow through
570 mmHg (22.4 in.Hg) or higher	Air blows through

- (5) Replace the gasket with a new one and tighten the EGR valve to specified torque.

**INSTALLATION SERVICE POINTS****◆A◆ EYEBOLT INSTALLATION**

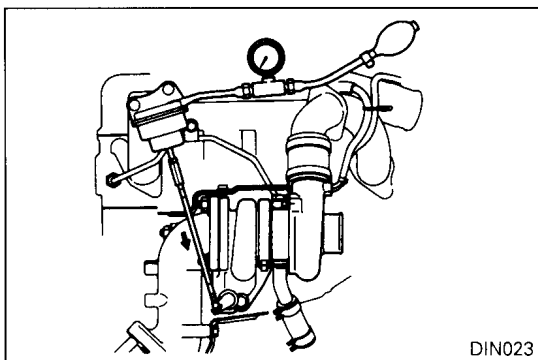
- (1) Before installing the oil pipe eyebolt (at top of the turbocharger), fill the turbocharger with clean engine oil.

**INSPECTION OF WASTE GATE ACTUATOR OPERATION**

- (1) After installation of the actuator, check that the rod moves when approx. 83 kPa (0.84 kg/cm<sup>2</sup>, 11.9 psi) <models without intercooler> or approx. 92 kPa (0.94 kg/cm<sup>2</sup>, 13.4 psi) <models with intercooler> is applied to the actuator using a tester.

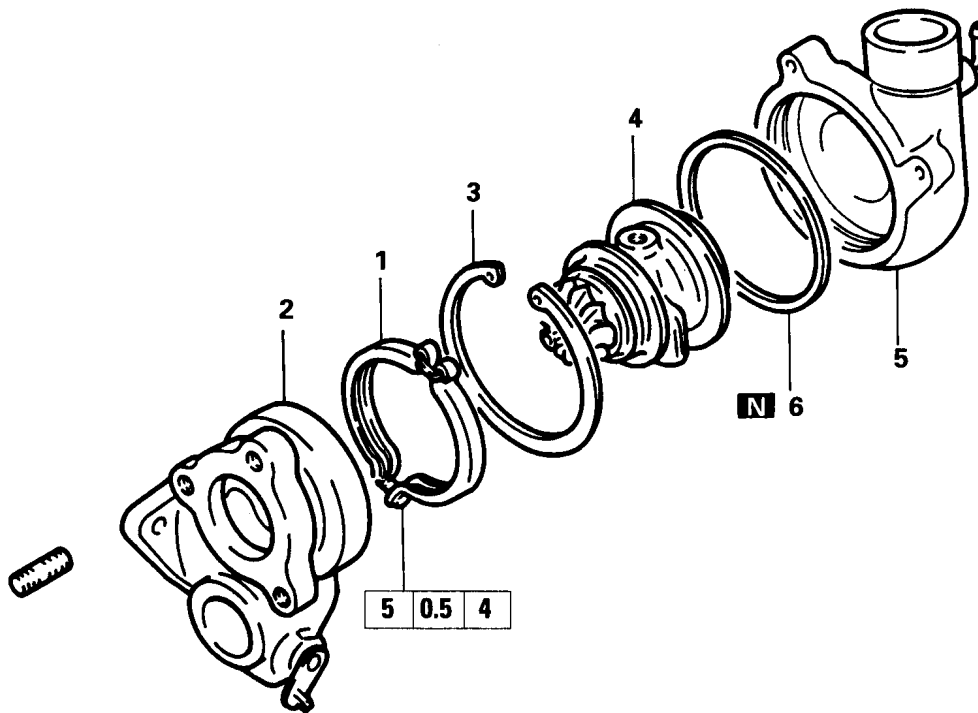
**Caution**

- The diaphragm may break if a pressure exceeding 88 kPa (0.9 kg/cm<sup>2</sup>, 12.8 psi) <models without intercooler> or 108 kPa (1.1 kg/cm<sup>2</sup>, 15.6 psi) <models with intercooler> is applied.



## 8. TURBOCHARGER

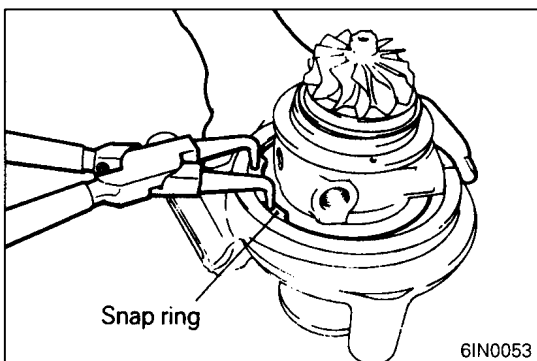
### REMOVAL AND REASSEMBLY



#### Disassembly steps

- ◆E◆ 1. Coupling
- ◆D◆ 2. Turbine housing
- ◇A◇ ◆C◆ 3. Snap ring
- ◇B◇ ◆B◆ 4. Turbine wheel assembly
- 5. Compressor cover
- ◆A◆ 6. O-ring

DIN024



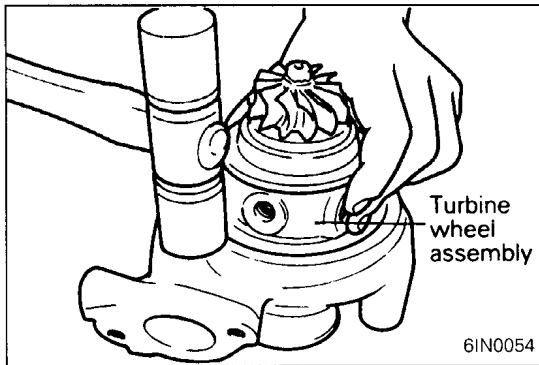
#### DISASSEMBLY SERVICE POINTS

##### ◇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.

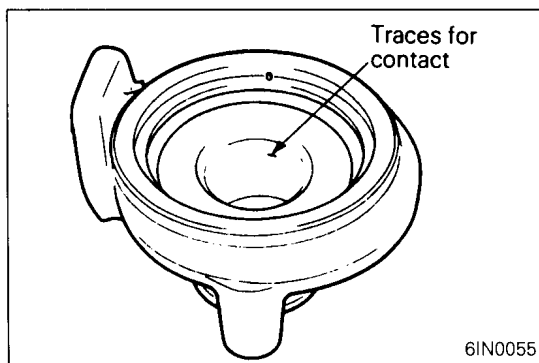


### ⇄B⇄ TURBINE WHEEL ASSEMBLY REMOVAL

- (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

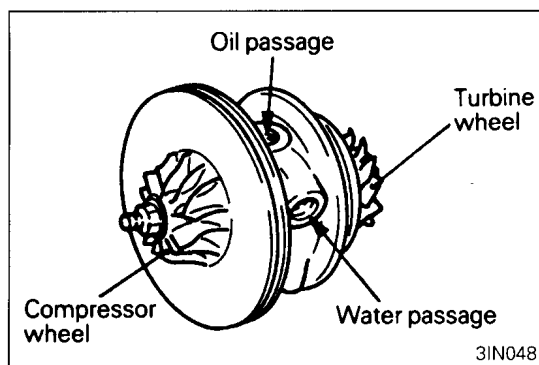
- (1) Check the housing for traces of contact with the turbine wheel, cracks due to overheating, pitching, deformation and other damage. Replace with a new turbine housing if cracked.
- (2) Operate the waste gate valve lever manually to check that the gate can be opened and closed smoothly.

#### COMPRESSOR COVER

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

#### TURBINE WHEEL ASSEMBLY

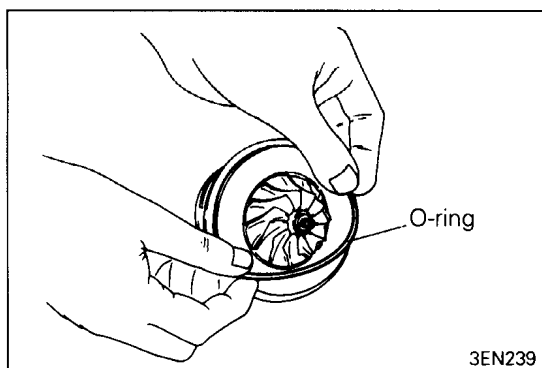
- (1) Check the turbine and compressor wheel blades for bend, burr, damage, corrosion and traces of contact on the back side and replace if defective.
- (2) Check the oil passage of the turbine wheel assembly for deposit and clogging.
- (3) In the case of water cooled type, check also the water passage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





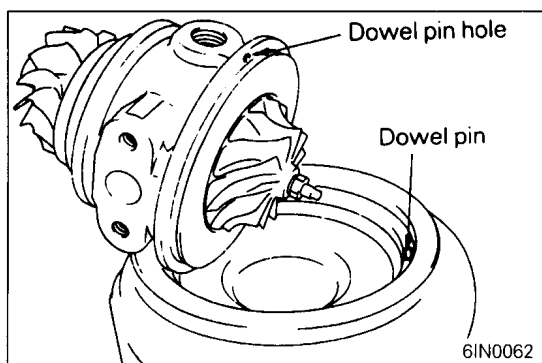
## REASSEMBLY SERVICE POINTS

### ◆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.**

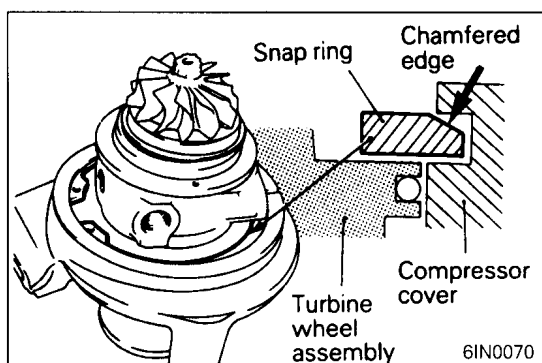


### ◆B◆ TURBINE WHEEL ASSEMBLY

- (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 in relation to the dowel pin.

#### Caution

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

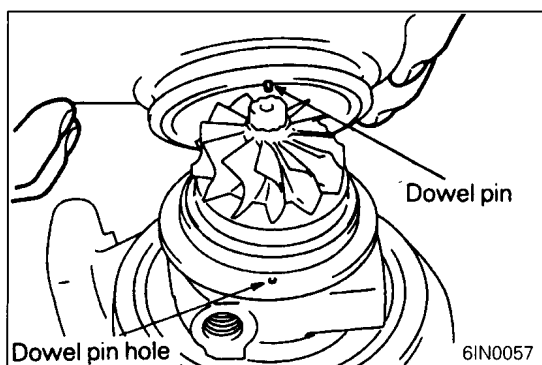


### ◆C◆ SNAP RING INSTALLATION

- (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.**

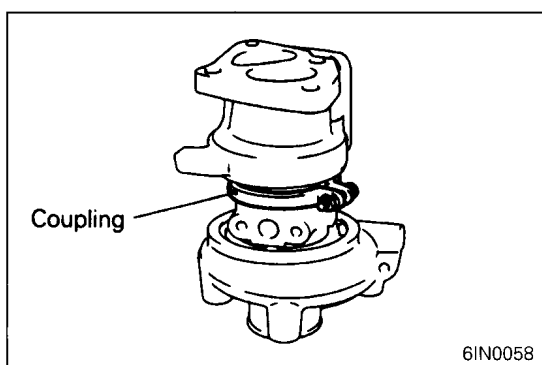


### ◆D◆ TURBINE HOUSING INSTALLATION

- (1) Install the turbine housing in relation to the dowel pin.

#### Caution

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



### ◆E◆ COUPLING INSTALLATION

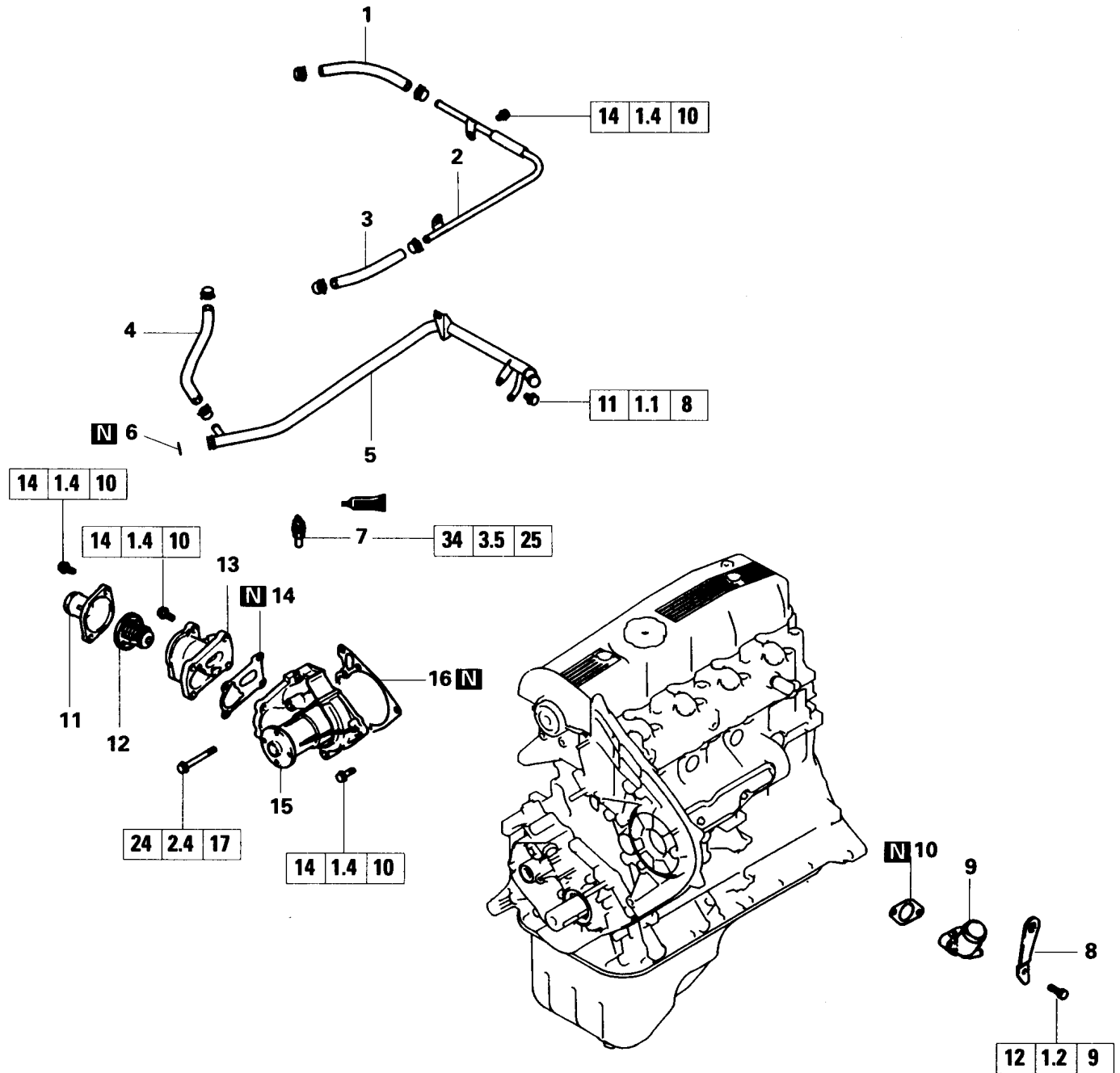
- (1) Install the coupling and tighten to specified torque.

## 9. WATER PUMP, THERMOSTAT, HOSE AND PIPE

### REMOVAL AND INSTALLATION

Engines with intercooler and turbocharger

<PAJERO (Up to 2000 model), L200, L300, L400>

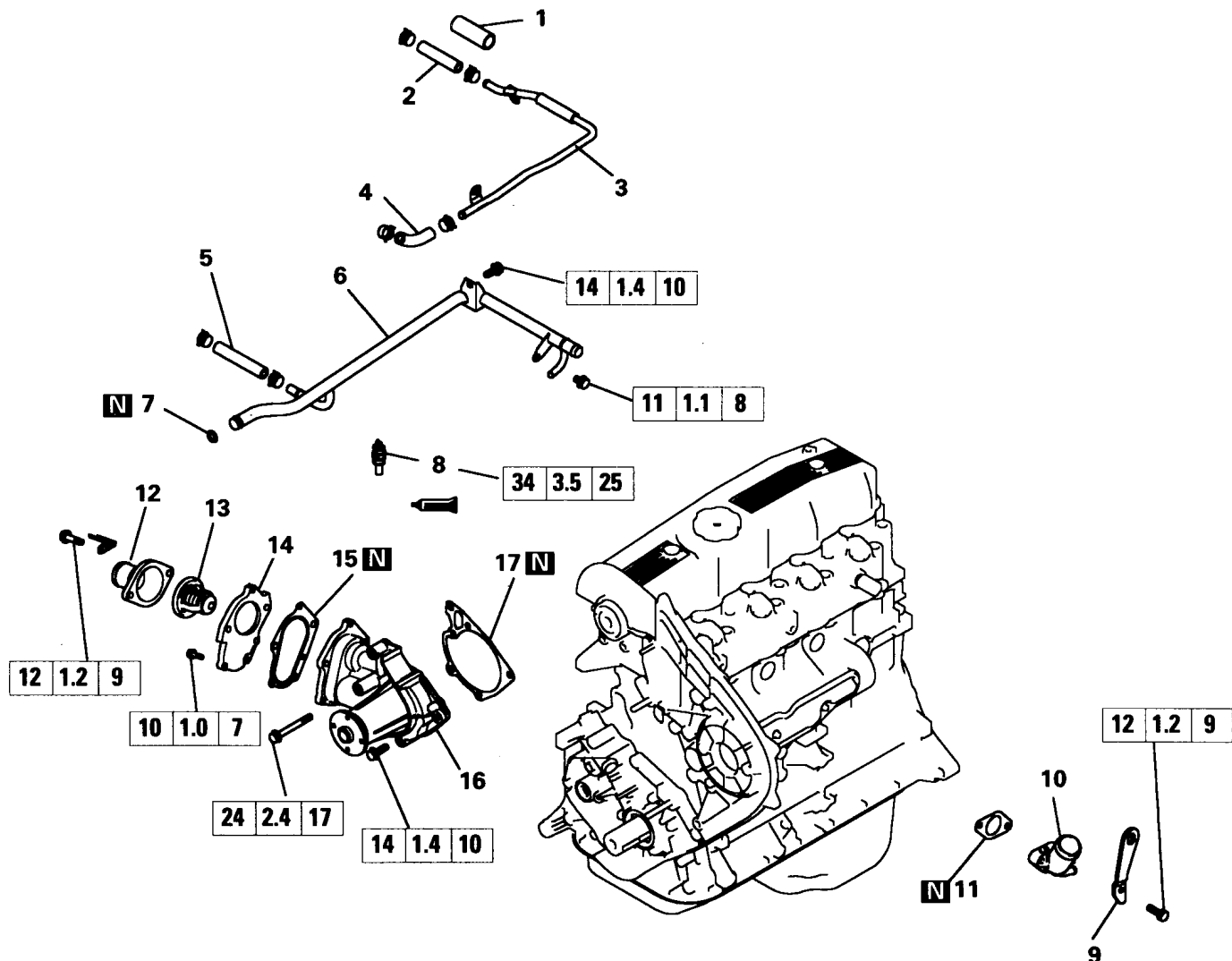


#### Removal steps

- |   |  |
|---|--|
| <p>1. Water hose<br/>2. Water pipe<br/>3. Water hose<br/>4. Water hose<br/>5. Water pipe<br/>6. O-ring<br/>7. Coolant temperature gauge unit<br/>8. Engine hanger</p> | <p>9. Water outlet fitting<br/>10. Gasket<br/>11. Water inlet fitting<br/>12. Thermostat<br/>13. Thermostat housing<br/>14. Gasket<br/>15. Water pump<br/>16. Gasket</p> |
|---|--|



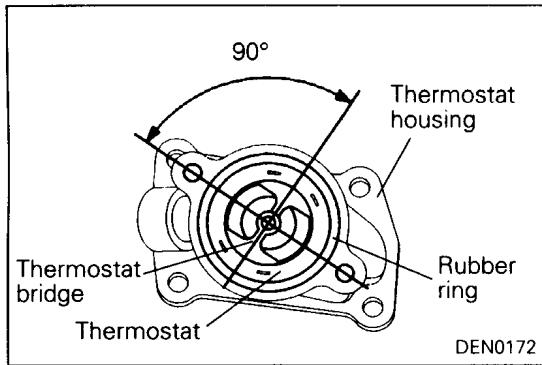
**Except engines with intercooler and turbocharger<PAJERO (From 2001 model)>**



**Removal steps**

- |     |                                   |                          |
|-----|-----------------------------------|--------------------------|
|     | 1. Hose protector                 | 10. Water outlet fitting |
|     | 2. Water hose                     | 11. Gasket               |
|     | 3. Water pipe                     | 12. Water inlet fitting  |
|     | 4. Water hose                     | ▶B◀ 13. Thermostat       |
|     | 5. Water hose                     | 14. Plate                |
|     | 6. Water pipe                     | 15. Gasket               |
| ▶D◀ | 7. O-ring                         | 16. Water pump           |
| ▶C◀ | 8. Coolant temperature gauge unit | 17. Gasket               |
|     | 9. Engine hanger                  |                          |

Intentionally blank



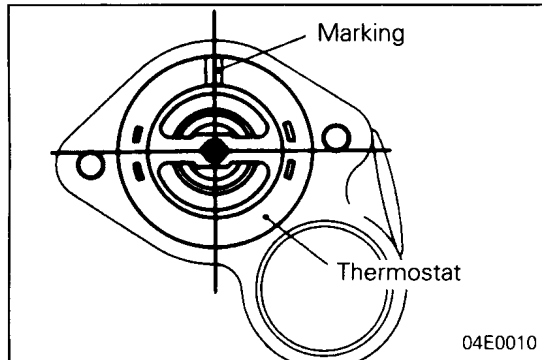
## INSTALLATION SERVICE POINTS

### ◆A◆ THERMOSTAT INSTALLATION <Engines with turbocharger and intercooler>

- (1) Install the thermostat respecting the shown angle and being careful not to tear off or damage its rubber ring.

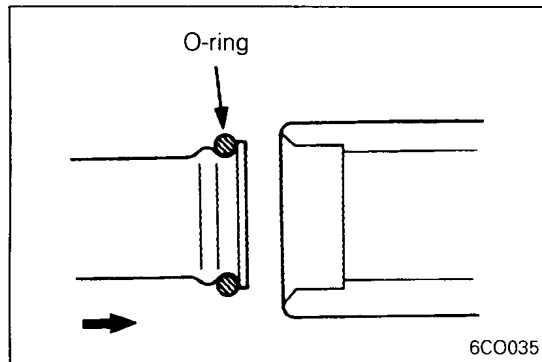
#### Caution

- Never adhere oils and greases on the rubber ring of the thermostat.



### ◆B◆ THERMOSTAT INSTALLATION <Except engines with turbocharger and intercooler>

- (1) Install the thermostat with its marking positioned at the top.

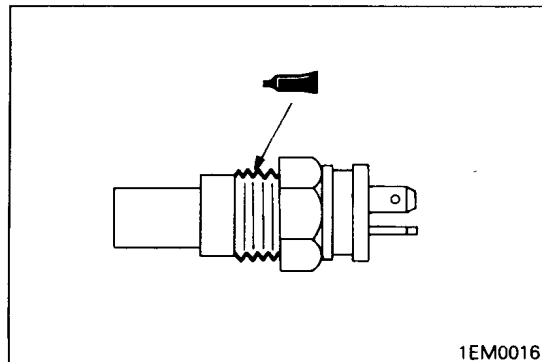


### ◆C◆ O-RING INSTALLATION

- (1) Set the O-ring in the groove of the water pipe and apply water to the outer circumference of the O-ring.

#### Caution

- Never adhere oils and greases on the O-ring.



### ◆D◆ COOLANT TEMPERATURE GAUGE UNIT INSTALLATION

- (1) Apply sealant to threads.

#### Specified sealant:

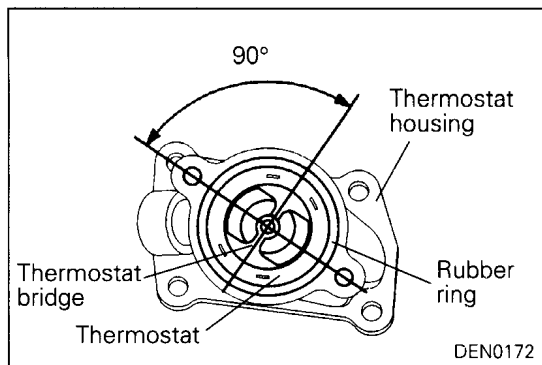
**3M Nut locking Part No. 4171 or equivalent**

**INSTALLATION SERVICE POINTS****◆A◆ THERMOSTAT INSTALLATION <Engines with turbocharger and intercooler>**

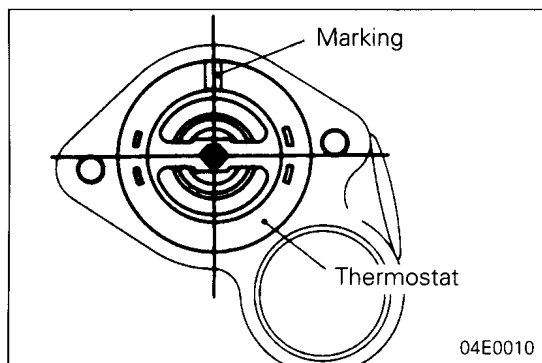
- (1) Install the thermostat respecting the shown angle and being careful not to tear off or damage its rubber ring.

**Caution**

- **Never adhere oils and greases on the rubber ring of the thermostat.**

**◆B◆ THERMOSTAT INSTALLATION <Except engines with turbocharger and intercooler>**

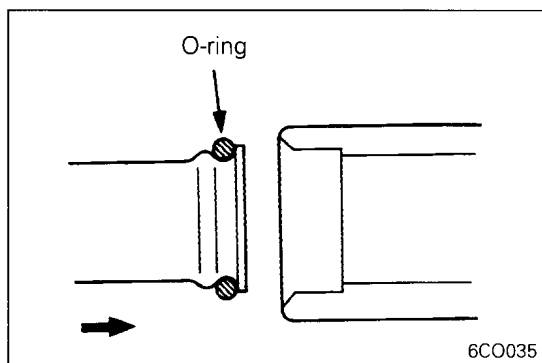
- (1) Install the thermostat with its marking positioned at the top.

**◆C◆ O-RING INSTALLATION**

- (1) Set the O-ring in the groove of the water pipe and apply water to the outer circumference of the O-ring.

**Caution**

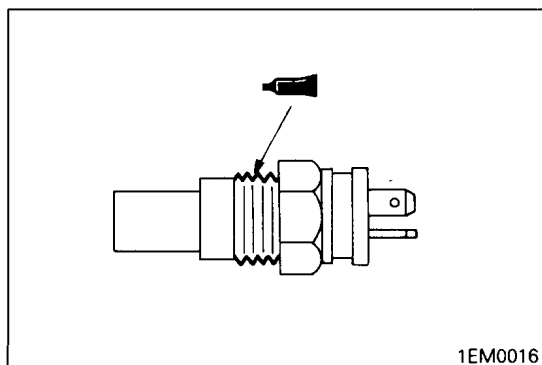
- **Never adhere oils and greases on the O-ring.**

**◆D◆ COOLANT TEMPERATURE GAUGE UNIT INSTALLATION**

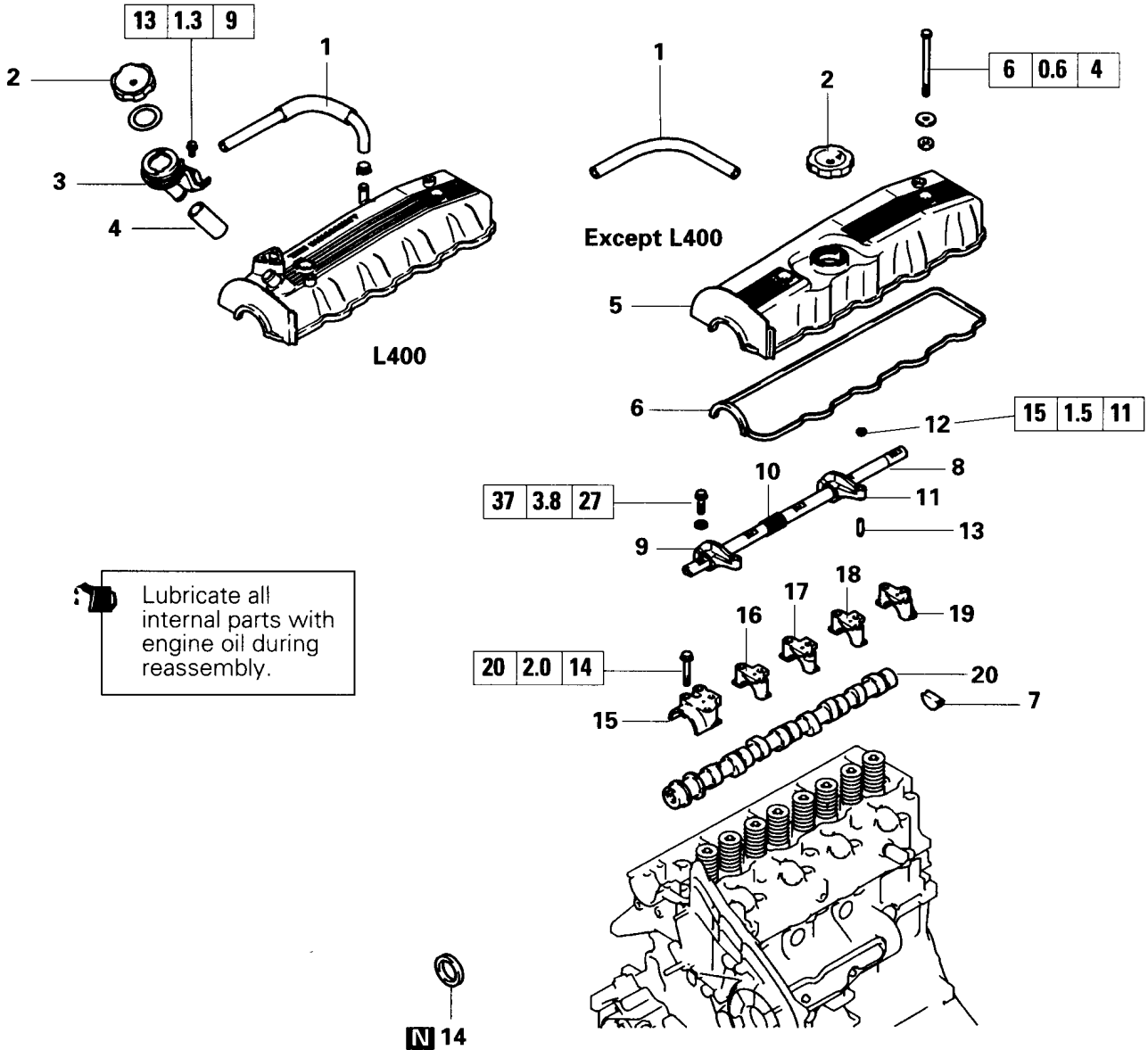
- (1) Apply sealant to threads.

**Specified sealant:**

**3M Nut locking Part No. 4171 or equivalent**

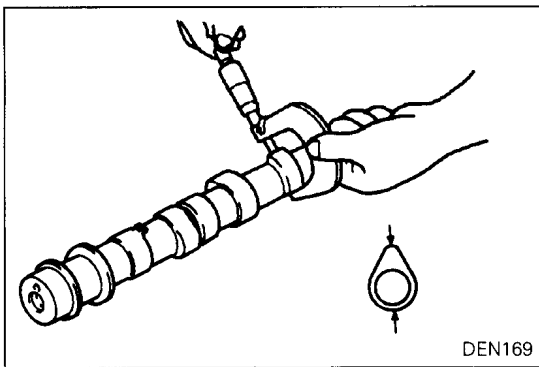


# 10. ROCKER ARMS, ROCKER SHAFT AND CAMSHAFT REMOVAL AND INSTALLATION



### Removal steps

- |                              |                                    |
|------------------------------|------------------------------------|
| 1. Breather hose             | ◆C◆ 11. Rocker arm, intake         |
| 2. Oil filler cap            | 12. Lock nut                       |
| 3. Oil filler <L400>         | 13. Adjusting screw                |
| 4. Tube <L400>               | ◆B◆ 14. Camshaft oil seal          |
| 5. Rocker cover              | 15. Camshaft bearing cap, front    |
| 6. Rocker cover gasket       | ◆A◆ 16. Camshaft bearing cap, No.2 |
| ◆E◆ 7. Semi-circular packing | ◆A◆ 17. Camshaft bearing cap, No.3 |
| ◆D◆ 8. Rocker shaft          | ◆A◆ 18. Camshaft bearing cap, No.4 |
| ◆C◆ 9. Rocker arm, exhaust   | 19. Camshaft bearing cap, rear     |
| 10. Rocker shaft spring      | 20. Camshaft                       |



## INSPECTION

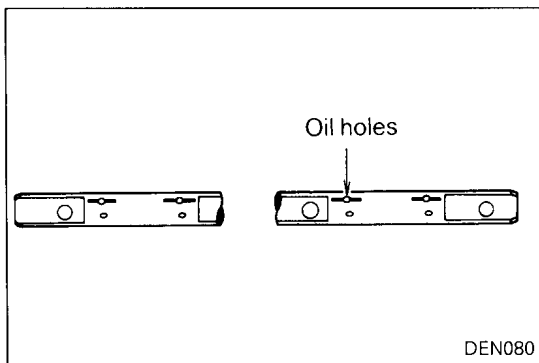
### CAMSHAFT

- (1) Measure the cam height.

Identification mark	Standard value mm (in.)	Limit mm (in.)
R	36.55 (1.4390)	36.05 (1.4193)
E	36.59 (1.4405)	36.09 (1.4209)

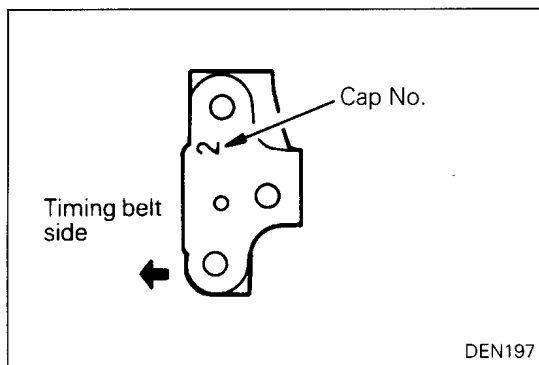
#### NOTE

The identification mark is stamped at the rear end of the camshaft.



### ROCKET SHAFT

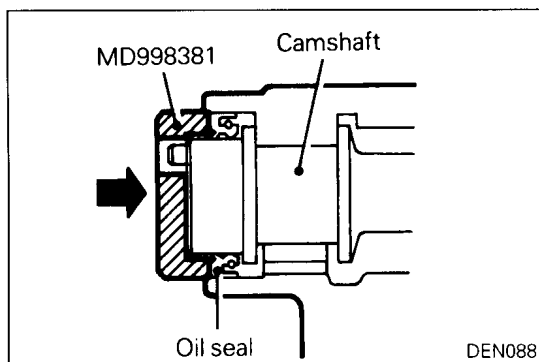
- (1) Check the oil holes for clogging and clean if clogged.
- (2) Check the outer circumference of the portion where the rocker arm is installed and replace if either damage or seizure are evident.



## INSTALLATION SERVICE POINTS

### ▶A▶ CAMSHAFT BEARING CAP INSTALLATION

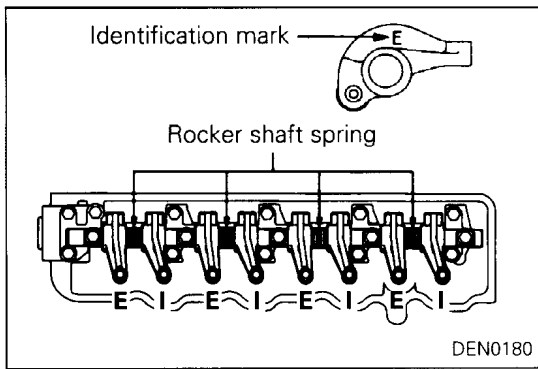
- (1) Install the bearing caps No. 2, 3 and 4 in their designated positions confirming the cap numbers stamped at their tops.



### ▶B▶ CAMSHAFT OIL SEAL INSTALLATION

- (1) Apply oil to the oil seal lips.
- (2) Using Camshaft Oil Seal Installer (special tool), press-fit a new camshaft oil seal into the front bearing cap.



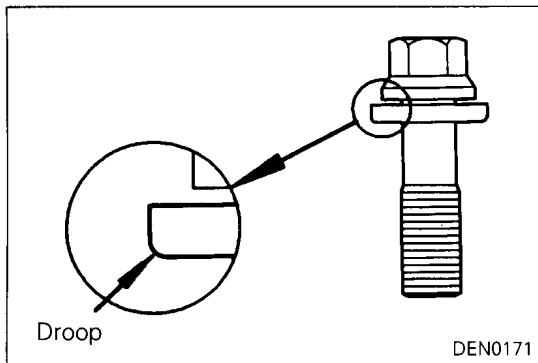


### ⇨⇩ ROCKER ARM INSTALLATION

- (1) Install the rocker arms and rocker shaft springs on the rocker shaft as shown in the illustration, while paying attention to the identification marks on the rocker arms.

#### Identification mark:

I ..... Intake  
E ..... Exhaust



### ⇨⇩ ROCKER SHAFT INSTALLATION

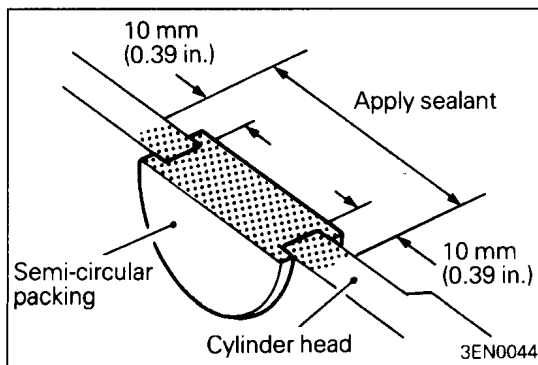
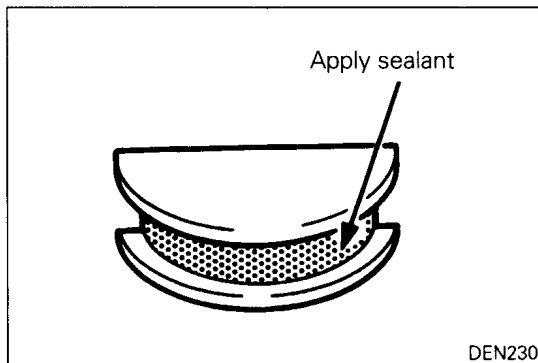
- (1) Install the rocker shaft with its oil holes facing downward.
- (2) Set the washer with its shear droop toward the bolt threads.

### ⇨⇩ SEMI-CIRCULAR PACKING INSTALLATION

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

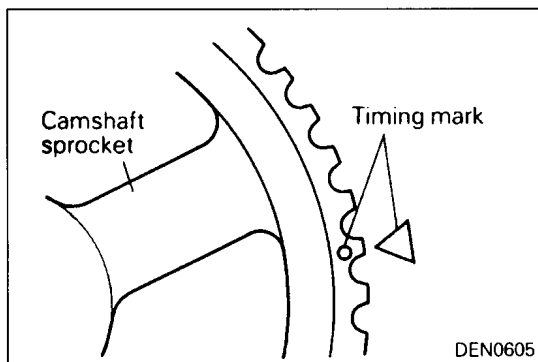
#### Specified sealant:

3M ATD Part No. 8660 or equivalent

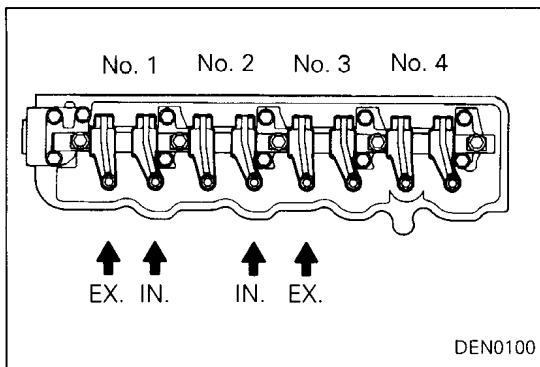


### VALVE CLEARANCE ADJUSTMENT

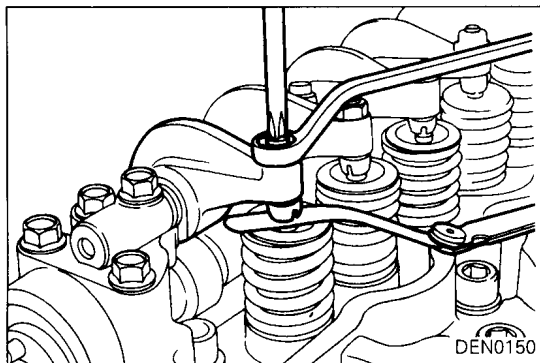
- (1) Turn the crankshaft clockwise and align the timing mark on camshaft sprocket with its mating mark.



## 11B-10-4 4D56 ENGINE <1994 -> - Rocker Arms, Rocker Shaft and Camshaft



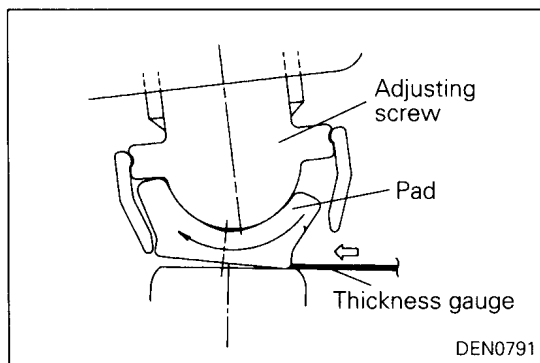
- (2) Adjust the valve clearance at points shown in the illustration.



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

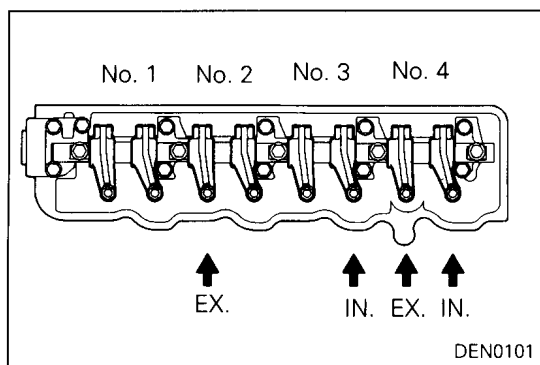
**Standard value (on cold engine): 0.15 mm (0.006 in.)**

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



### NOTE

If the elephant foot type adjusting screw is provided, insertion of a thickness gauge may be hindered by the slanted pad when rechecking the clearance after adjustment. To avoid this, insert a thickness gauge in the direction from the center line of the cylinder head to outside.



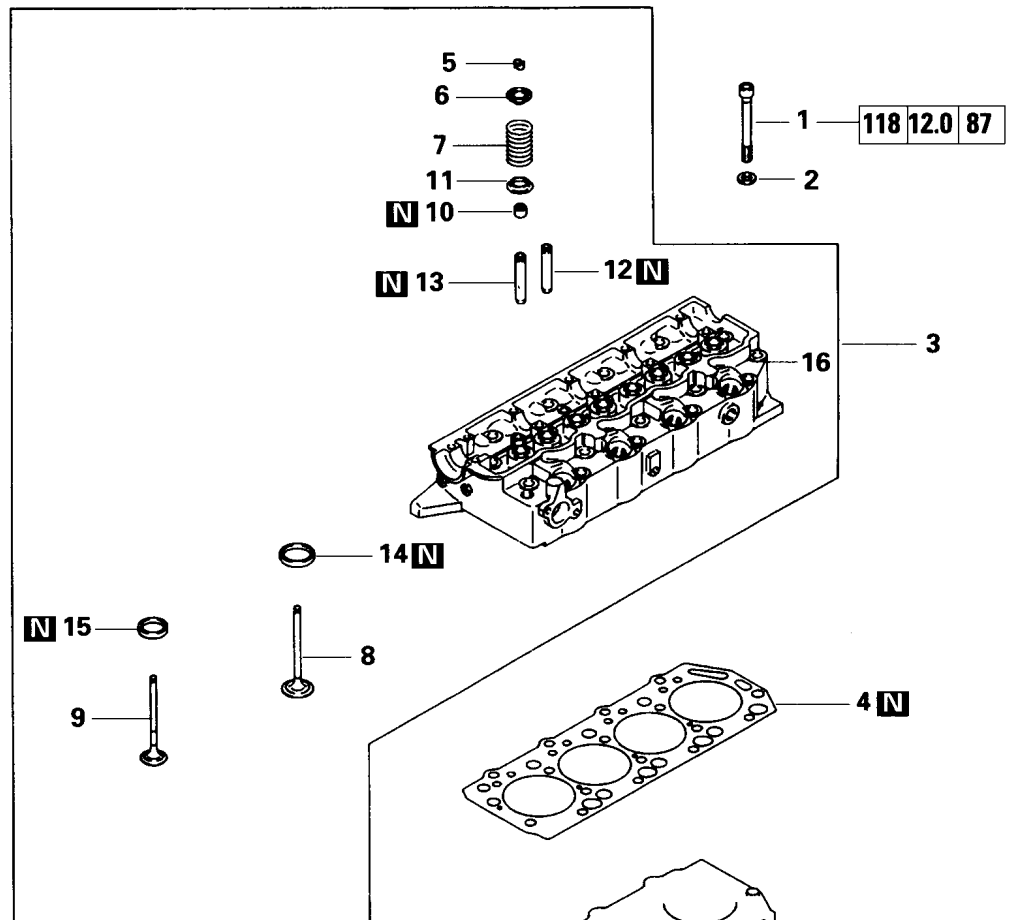
- (6) Rotate clockwise the crankshaft one complete turn (360 degree).
- (7) Adjust the valve clearance at points shown in the illustration.
- (8) Repeat steps (3) to (5) to adjust the valve clearance of remaining valves.

### NOTE

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

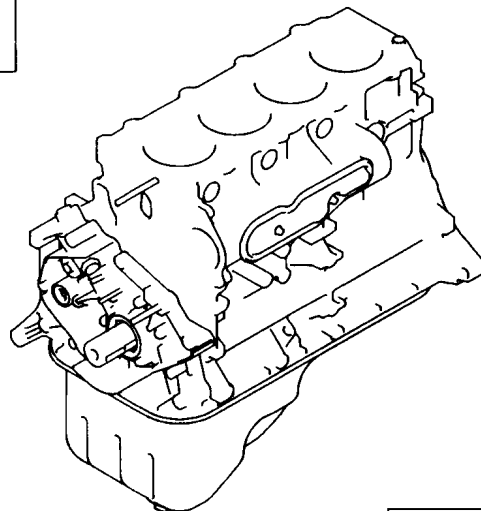
# 11. CYLINDER HEAD AND VALVES


## REMOVAL AND INSTALLATION

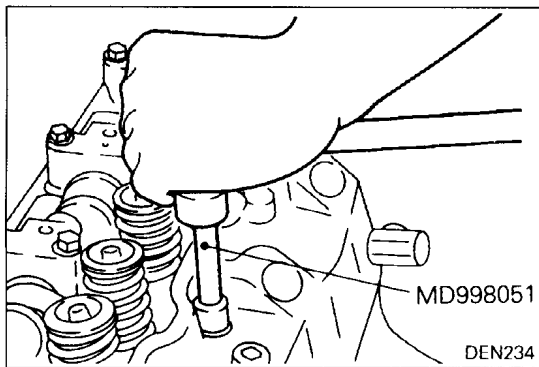
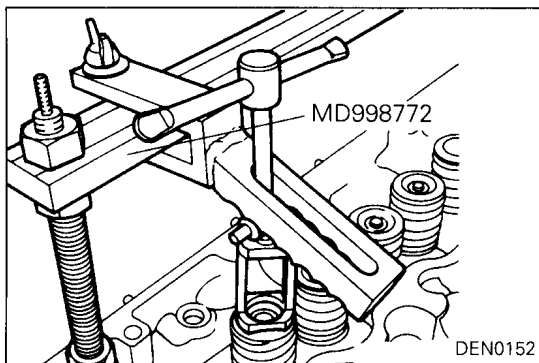


### Removal steps

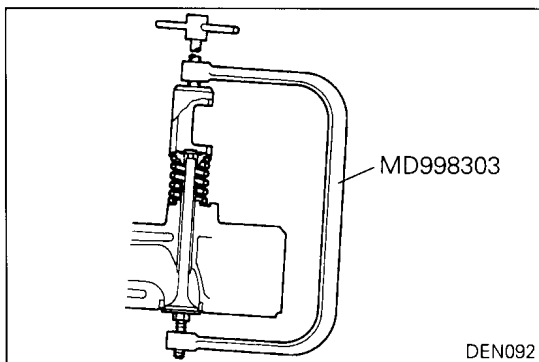
- ◊A◊ ▶E◊ 1. Cylinder head bolt
- 2. Cylinder head bolt washer
- 3. Cylinder head assembly
- ▶D◊ 4. Cylinder head gasket
- ◊B◊ ▶C◊ 5. Valve spring retainer lock
- 6. Valve spring retainer
- ▶B◊ 7. Valve spring
- 8. Intake valve
- 9. Exhaust valve
- ◊C◊ ▶A◊ 10. Valve stem seal
- 11. Spring seat
- 12.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



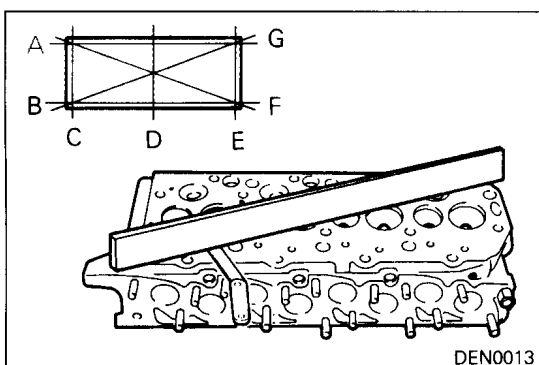
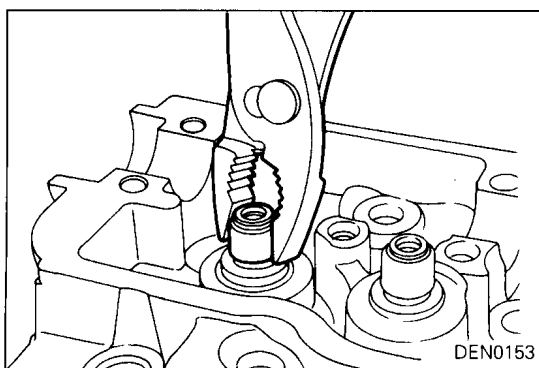
 Lubricate all internal parts with engine oil during reassembly.

**REMOVAL SERVICE POINT****◊A◊ CYLINDER HEAD BOLTS REMOVAL****◊B◊ VALVE SPRING 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****Caution**

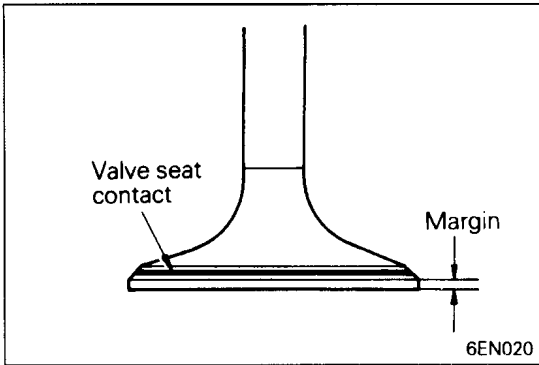
- Do not reuse removed valve stem seals.

**INSPECTION****CYLINDER HEAD**

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

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

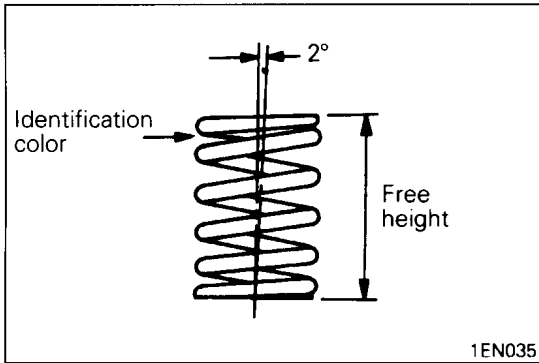
**Limit: 0.2 mm (0.008 in.)**



**VALVE**

- (1) Check the valve face for correct contact. If incorrect, reface using 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: 2.0 mm (0.08 in.)**  
**Limit: 1.0 mm (0.04 in.)**



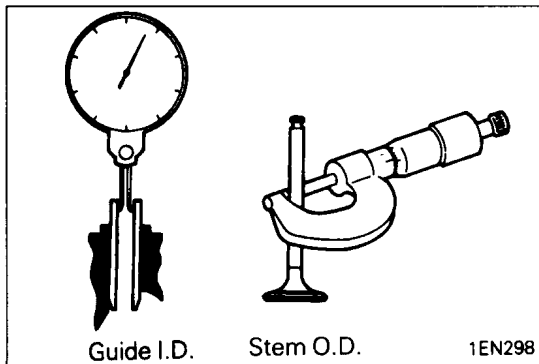
**VALVE SPRING**

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

Identification color	Standard value mm (in.)	Limit mm (in.)
Green	49.1 (1.933)	48.1 (1.894)
Yellow	47.9 (1.886)	46.9 (1.846)

- (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:**  
 0.03 - 0.06 mm (0.0012 - 0.0024 in.) .....Intake  
 0.05 - 0.09 mm (0.0020 - 0.0035 in.) .....Exhaust  
**Limit:**  
 0.10 mm (0.0039 in.) .....Intake  
 0.15 mm (0.0059 in.) .....Exhaust

**VALVE SEAT RECONDITIONING PROCEDURE**

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

**Available Valve Seat Cutter Types**

Cutter angle	Tool number	
	Intake/exhaust	
45°	MD998158	
65°	MD998165	
30°	MD998175	

- (3) After correction, 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: 40.95mm (1.612 in.)**  
**Limit: 41.45 mm (1.632 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 cylinder head to the oversize valve seat diameter.

**Intake valve seat hole diameter**

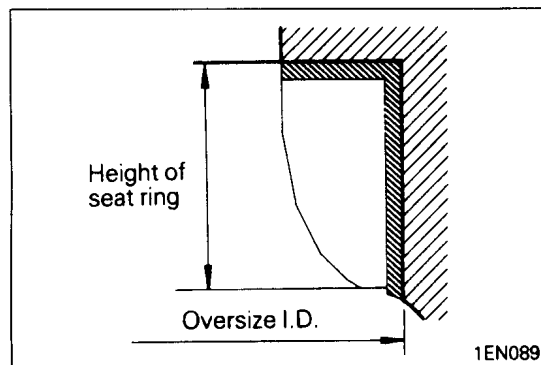
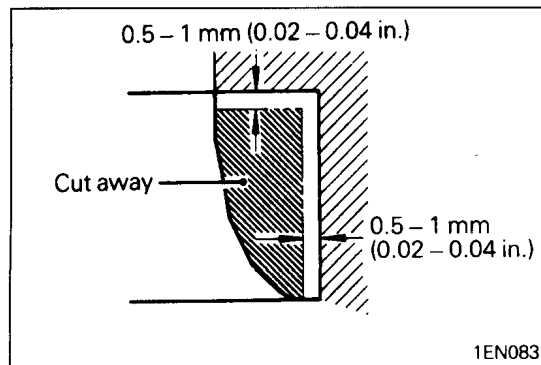
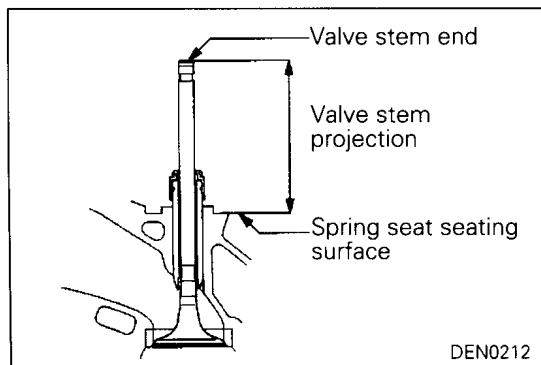
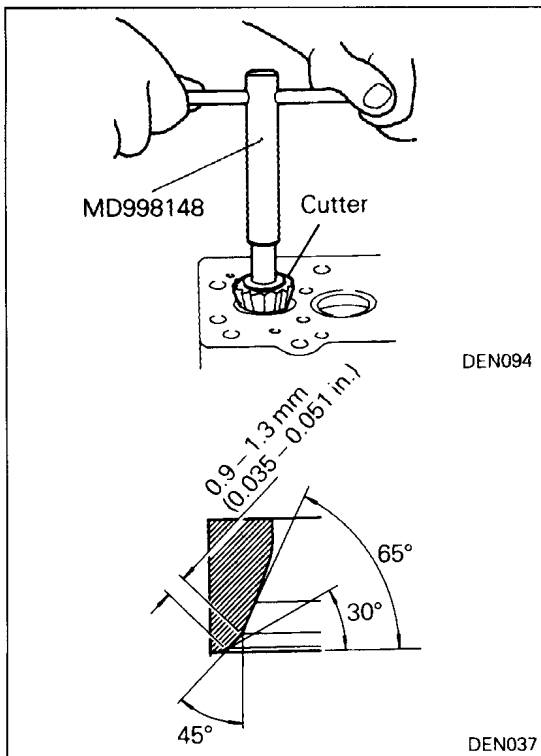
**0.30 O.S.: 43.300 – 43.325 mm**  
**(1.7047 – 1.7057 in.)**

**0.60 O.S.: 43.600 – 43.625 mm**  
**(1.7165 – 1.7175 in.)**

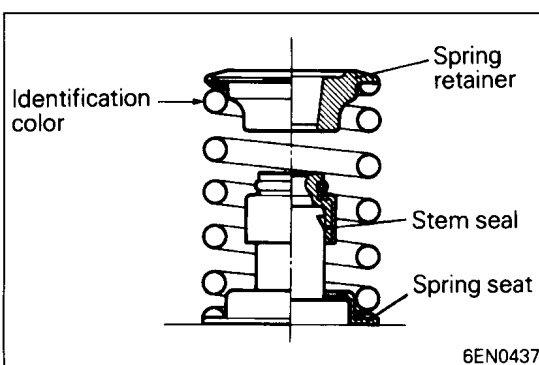
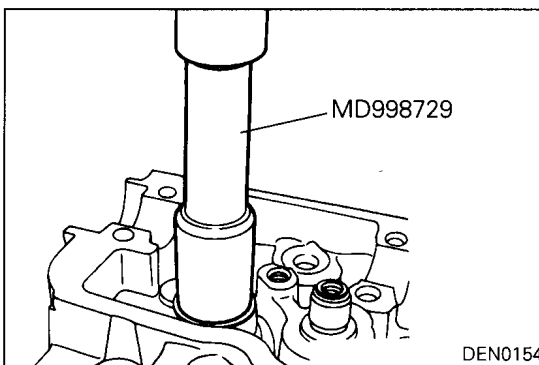
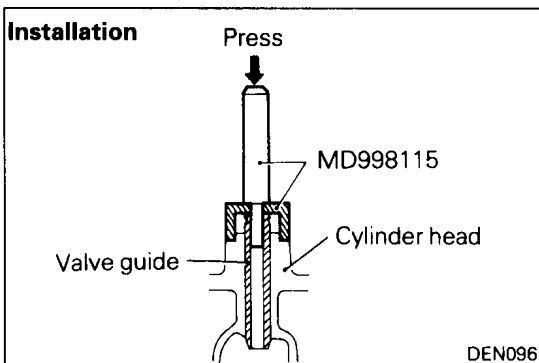
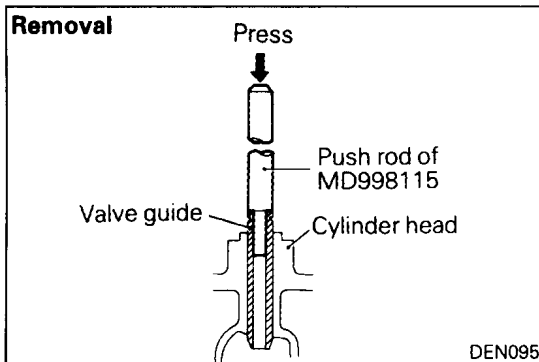
**Exhaust valve seat hole diameter**

**0.30 O.S.: 37.300 – 37.325 mm**  
**(1.4685 – 1.4695 in.)**

**0.60 O.S.: 37.600 – 37.625 mm**  
**(1.4803 – 1.4813 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 valve seat cutter, correct the valve seat to the specified width and angle.  
See "VALVE SEAT RECONDITIONING PROCEDURE."



## VALVE GUIDE REPLACEMENT PROCEDURE

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

### Valve guide hole diameter

<b>0.05 O.S.:</b>	<b>13.050 – 13.068 mm</b> <b>(0.5138 – 0.5145 in.)</b>
<b>0.25 O.S.:</b>	<b>13.250 – 13.268 mm</b> <b>(0.5217 – 0.5224 in.)</b>
<b>0.50 O.S.:</b>	<b>13.500 – 13.518 mm</b> <b>(0.5315 – 0.5322 in.)</b>

### NOTE

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

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

## SERVICE POINTS OF INSTALLATION

### ◆A◆ VALVE STEM SEAL INSTALLATION

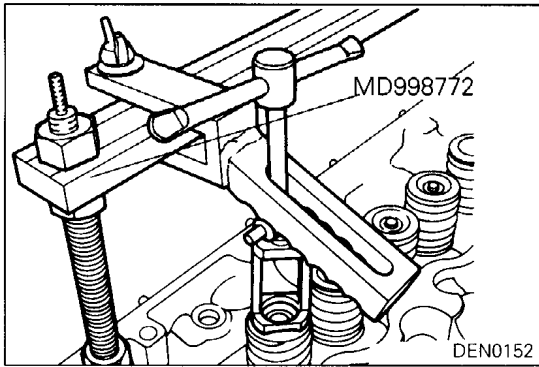
- (1) Install the valve spring seat.
- (2) The special tool must be used to install the valve stem seal. Improper installation could result in oil consumption through valve guide.

### Caution

- Do not reuse removed valve stem seals.

### ◆B◆ VALVE SPRING INSTALLATION

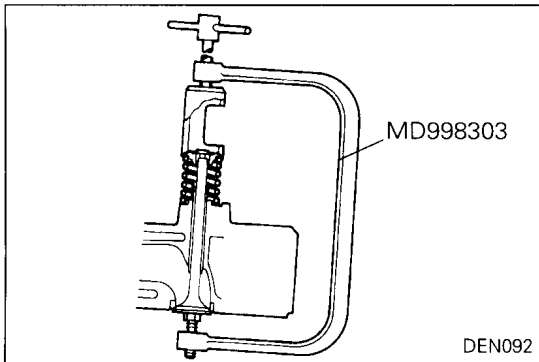
- (1) Direct the valve spring end with identification color toward the spring retainer.



◆C◆ RETAINER LOCK INSTALLATION

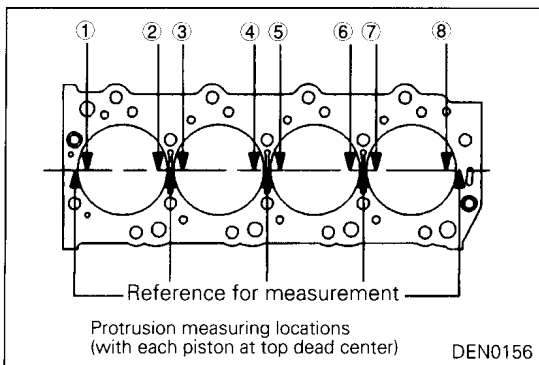
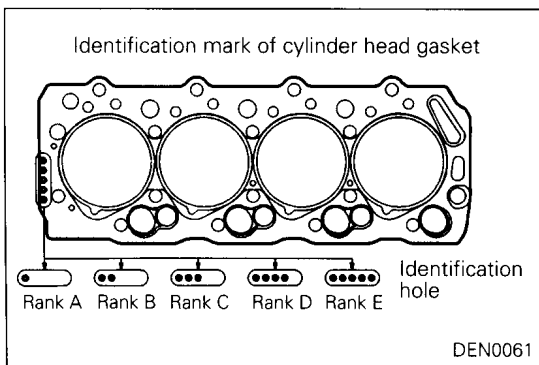
Caution

- 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

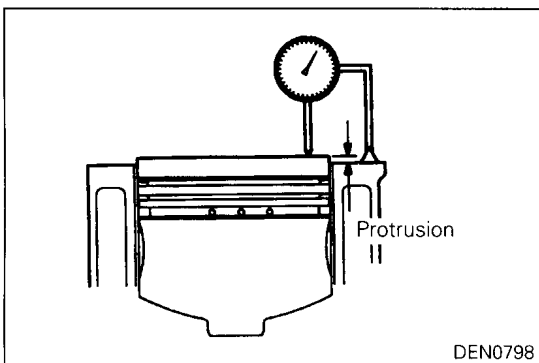
- (1) In case any of the cylinder block, piston, connecting rod and crankshaft has not been replaced, install the gasket of the same rank as before which can be identified by the mark shown in the illustration at left.
- (2) In case any of the cylinder block, piston, connecting rod and crankshaft have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



Engines without turbocharger

mm (in.)

Rank	Average value of piston protrusions	Protrusion tolerance for each rank	Thickness of selected gasket (when tightened)
A	0.562 – 0.620 (0.0221 – 0.0244)	0.670 (0.0264)	1.35 ± 0.05 (0.0531 ± 0.0020)
B	0.620 – 0.680 (0.0244 – 0.0268)	0.730 (0.0287)	1.40 ± 0.05 (0.0551 ± 0.0020)
C	0.680 – 0.744 (0.0268 – 0.0293)	0.794 (0.0313)	1.45 ± 0.05 (0.0571 ± 0.0020)





**Engines with turbocharger**

mm (in.)

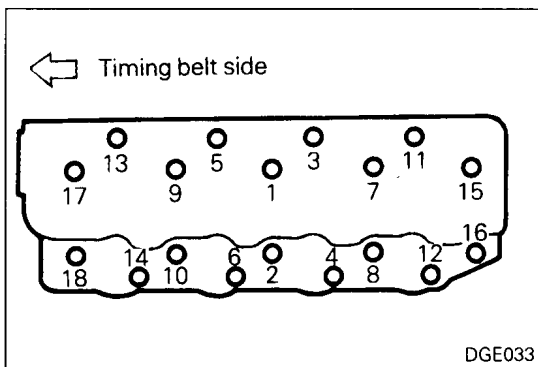
Rank	Average value of piston protrusions	Protrusion tolerance for each rank	Thickness of selected gasket (when tightened)
C	0.562 – 0.620 (0.0221 – 0.0244)	0.670 (0.0264)	1.45 ± 0.05 (0.0571 ± 0.0020)
D	0.620 – 0.680 (0.0244 – 0.0268)	0.730 (0.0287)	1.50 ± 0.05 (0.0590 ± 0.0020)
E	0.680 – 0.744 (0.0268 – 0.0293)	0.794 (0.0313)	1.55 ± 0.05 (0.0610 ± 0.0020)

**NOTE**

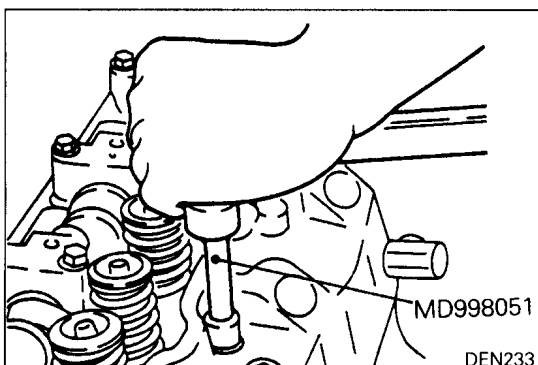
If the piston projection exceeds the tolerance, replace the piston, connecting rod, crankshaft or cylinder block and check again.

**⇨E⇩ CYLINDER HEAD BOLT INSTALLATION**

- (1) Set the cylinder head bolt washer with its shear droop toward the bolt head.



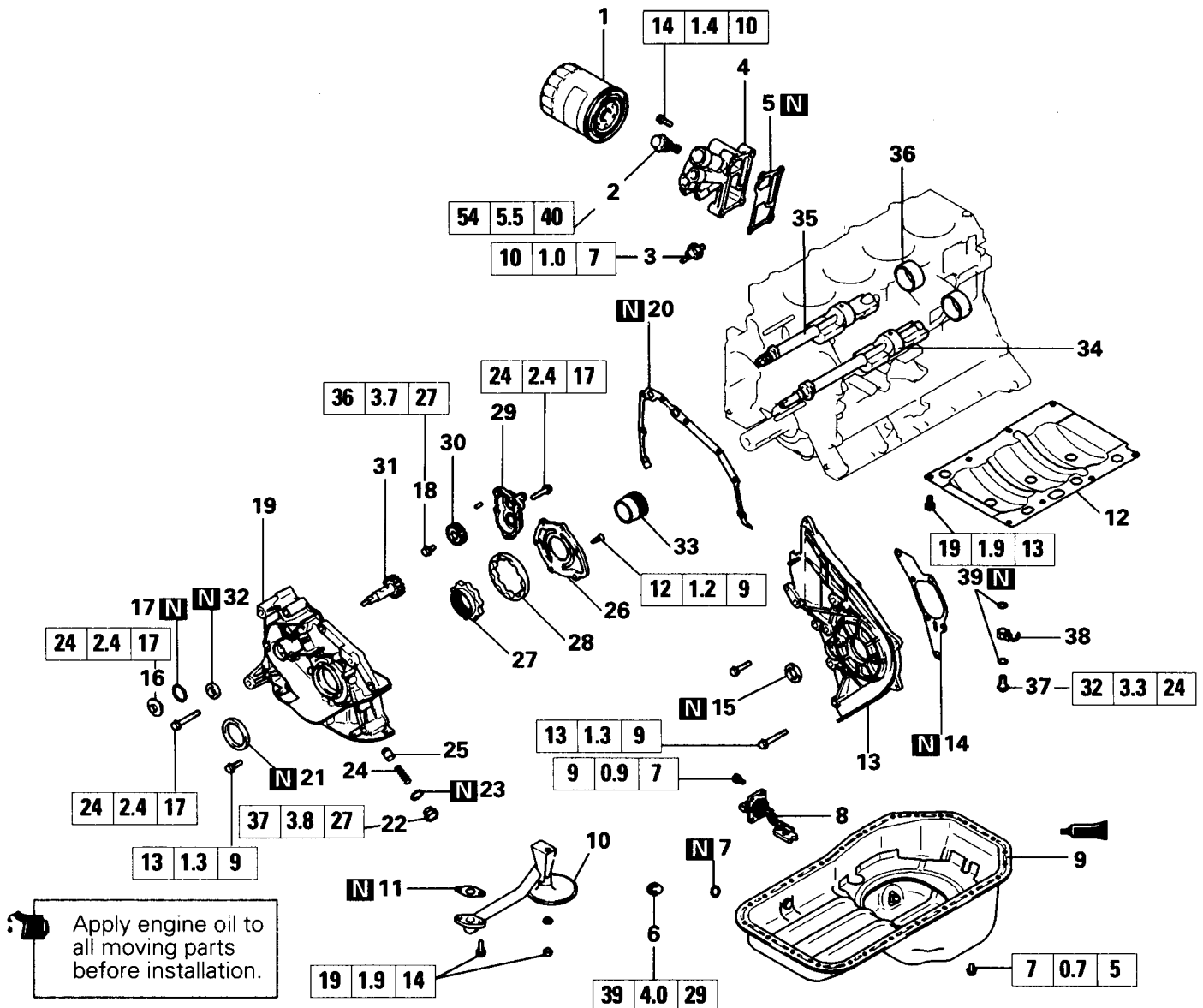
- (2) Using the special tool and torque wrench, tighten bolts in the shown sequence.



- (3) Repeat the tightening sequence several times, and tighten the bolts to specification in the final sequence.

## 12. FRONT CASE AND OIL PAN

### REMOVAL AND INSTALLATION <PAJERO (Up to 2000 model), L200, L300, L400>



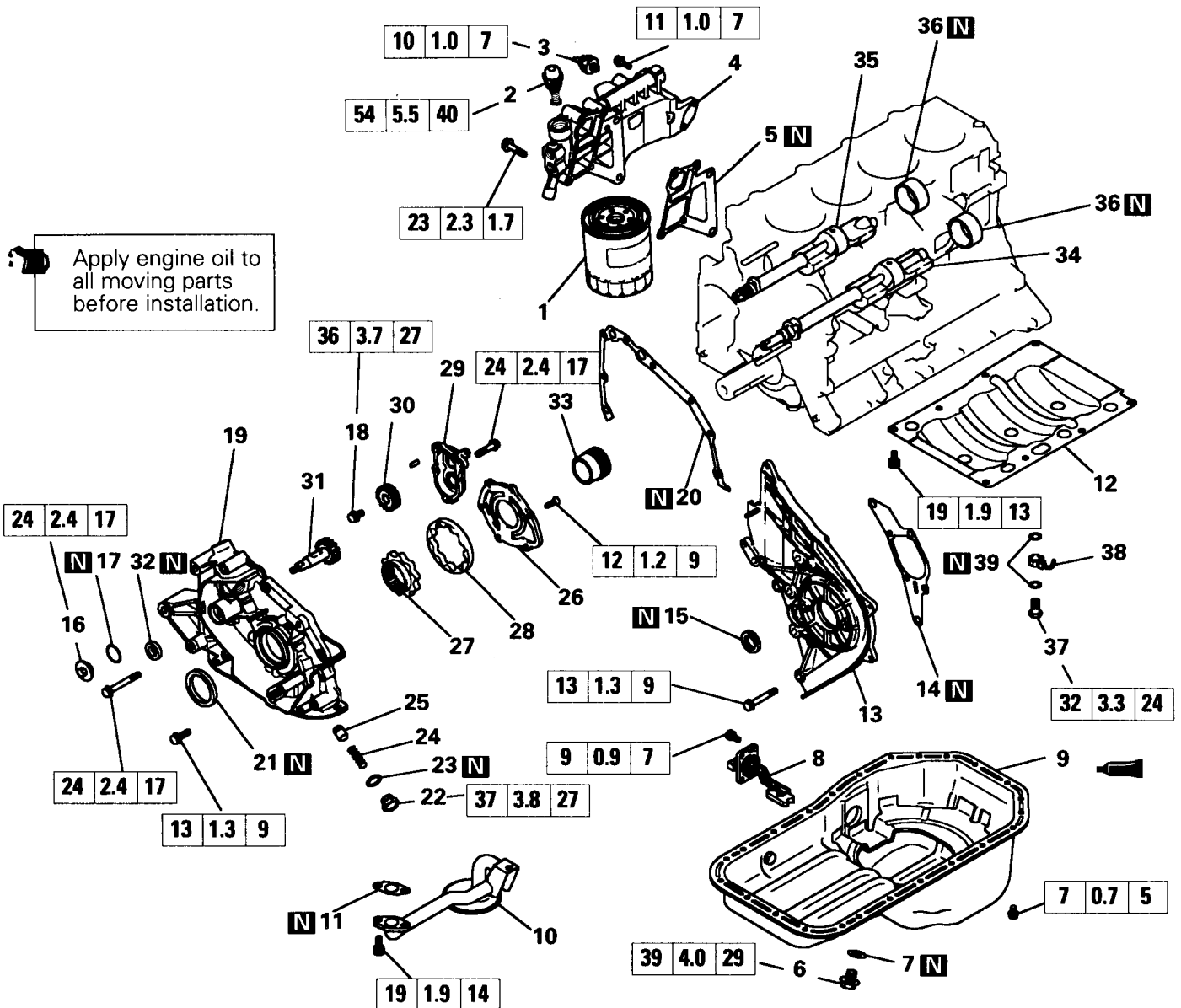
#### Removal steps

- |         |                              |         |                                    |
|---------|------------------------------|---------|------------------------------------|
| ▶K◀     | 1. Oil filter                | ▶F◀     | 21. Crankshaft front oil seal      |
| ▶J◀     | 2. Oil cooler by-pass valve  |         | 22. Plug                           |
|         | 3. Oil pressure switch       |         | 23. Gasket                         |
|         | 4. Oil filter bracket        |         | 24. Relief spring                  |
|         | 5. Oil filter bracket gasket |         | 25. Relief plunger                 |
|         | 6. Oil drain plug            |         | 26. Oil pump cover                 |
| ▶I◀     | 7. Oil drain plug gasket     | ◀C▶ ▶E◀ | 27. Inner rotor                    |
| ◀A▶ ▶H◀ | 8. Oil level sensor          | ◀C▶ ▶E◀ | 28. Outer rotor                    |
|         | 9. Oil pan                   | ▶D▶ ▶B◀ | 29. Balancer shaft gear cover      |
|         | 10. Oil screen               | ▶D▶ ▶B◀ | 30. Balancer shaft driven gear     |
|         | 11. Oil screen gasket        | ▶C▶ ▶B◀ | 31. Balancer shaft drive gear      |
|         | 12. Stiffener                |         | 32. Oil seal                       |
|         | 13. Front upper case         |         | 33. Oil pump gear drive gear shaft |
|         | 14. Front upper case gasket  |         | 34. Balancer shaft, left           |
|         | 15. Oil seal                 |         | 35. Balancer shaft, right          |
|         | 16. Plug cap                 | ◀D▶ ▶B◀ | 36. Balancer shaft bearing         |
| ◀B▶ ▶G▶ | 17. O-ring                   | ▶A▶     | 37. Check valve                    |
|         | 18. Flange bolt              |         | 38. Oil jet                        |
|         | 19. Front lower case         |         | 39. Gasket                         |
|         | 20. Front lower case gasket  |         |                                    |

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## 12. FRONT CASE AND OIL PAN

## REMOVAL AND INSTALLATION &lt;PAJERO (From 2001 model)&gt;

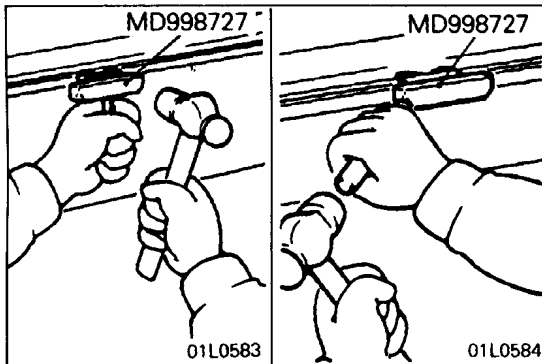


## Removal steps

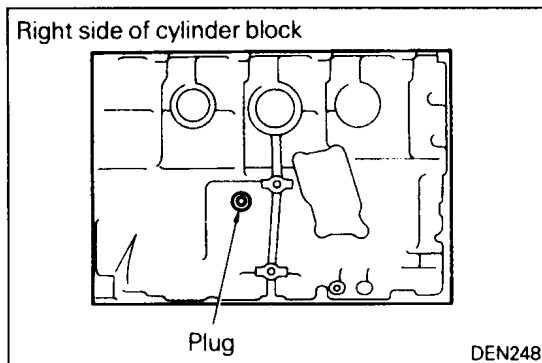
- |     |                              |                               |                                    |
|-----|------------------------------|-------------------------------|------------------------------------|
| ▶K◀ | 1. Oil filter                | ▶F◀                           | 21. Crankshaft front oil seal      |
| ▶J◀ | 2. Oil cooler by-pass valve  | 22. Plug                      | 22. Plug                           |
|     | 3. Oil pressure switch       | 23. Gasket                    | 23. Gasket                         |
|     | 4. Oil filter bracket        | 24. Relief spring             | 24. Relief spring                  |
|     | 5. Oil filter bracket gasket | 25. Relief plunger            | 25. Relief plunger                 |
|     | 6. Oil drain plug            | 26. Oil pump cover            | 26. Oil pump cover                 |
| ▶I◀ | 7. Oil drain plug gasket     | 27. Inner rotor               | 27. Inner rotor                    |
| ◀A▶ | 8. Oil level sensor          | 28. Outer rotor               | 28. Outer rotor                    |
| ▶H◀ | 9. Oil pan                   | 29. Balancer shaft gear cover | 29. Balancer shaft gear cover      |
|     | 10. Oil screen               | ▶D◀                           | 30. Balancer shaft driven gear     |
|     | 11. Oil screen gasket        | ▶D◀                           | 31. Balancer shaft drive gear      |
|     | 12. Stiffener                | ▶C◀                           | 32. Oil seal                       |
|     | 13. Front upper case         | ▶C◀                           | 33. Oil pump gear drive gear shaft |
|     | 14. Front upper case gasket  | ◀D▶                           | 34. Balancer shaft, left           |
|     | 15. Oil seal                 | ▶B◀                           | 35. Balancer shaft, right          |
|     | 16. Plug cap                 | ▶B◀                           | 36. Balancer shaft bearing         |
|     | 17. O-ring                   | 37. Check valve               | 37. Check valve                    |
| ◀B▶ | 18. Flange bolt              | ▶A◀                           | 38. Oil jet                        |
| ▶G◀ | 19. Front lower case         |                               | 39. Gasket                         |
|     | 20. Front lower case gasket  |                               |                                    |

DEN0305

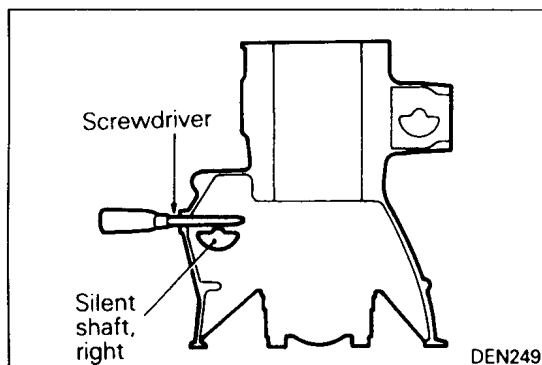
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**REMOVAL SERVICE POINTS****◊A◊ OIL PAN REMOVAL**

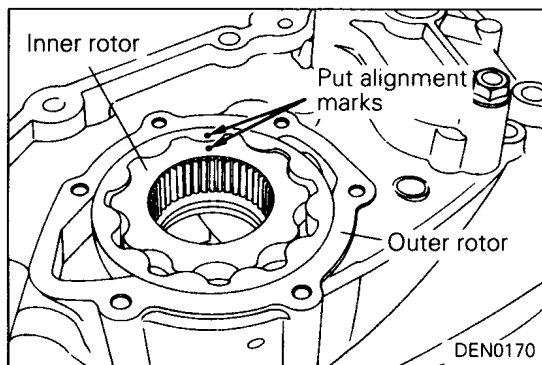
- (1) Knock the special tool deeply between the oil pan and the cylinder block.
- (2) Hitting the side of the special tool, slide the special tool along the oil pan to remove it.

**◊B◊ FLANGE BOLT REMOVAL**

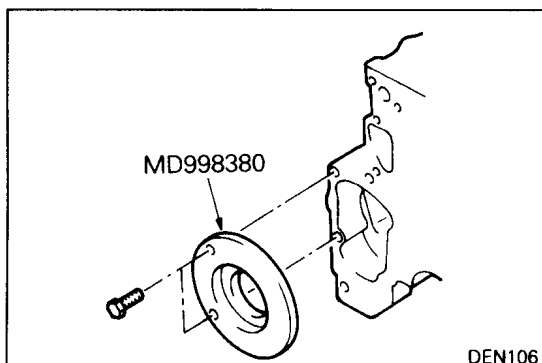
- (1) Remove the plug on the right side of cylinder block.



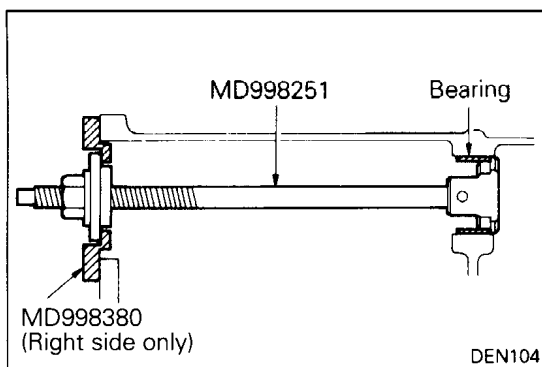
- (2) Insert a Phillips screwdriver into the plug hole to lock the silent shaft in position.
- (3) Remove the flange bolt.

**◊C◊ OUTER ROTOR / INNER ROTOR REMOVAL**

- (1) Put alignment marks on the outer and inner rotors for reference in reassembly.

**◊D◊ SILENT SHAFT BEARING REMOVAL**

- (1) Install the special tool to the cylinder block. This is used to hold the special tool.

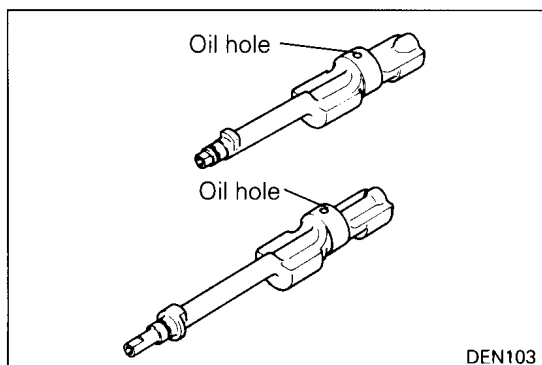


- (2) Pull out the rear bearing from the cylinder block using the special tool.

## INSPECTION

### FRONT LOWER CASE

- (1) The front case parts must be free from damage and cracks.
- (2) Install the oil pump rotor or gear into the front case and make sure that the rotor or gear turns smoothly with no excessive play in it.
- (3) The front case and oil pump cover surfaces in contact with the pump rotor or gear side face must be free from ridge wear.



### BALANCER SHAFT

- (1) Check oil holes must be free from clogging.
- (2) Check journal for seizure, damage, and contact with bearing. If defects are evident, replace the balancer shaft, bearing, or front case assembly.
- (3) Check the balancer shaft oil clearance. If wear is excessive, replace the balancer shaft bearing, balancer shaft or front case assembly.

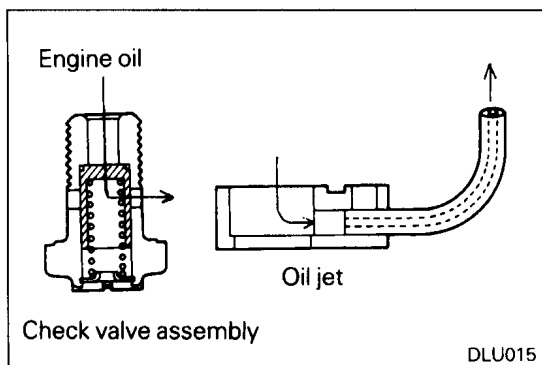
#### Standard value:

##### Front

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

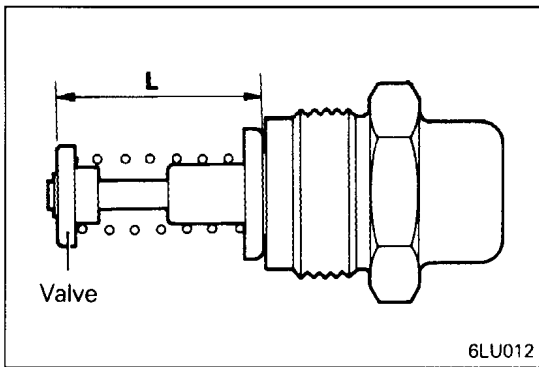
**Left** ..... 0.02 – 0.05 mm (0.0008 – 0.0020 in.)

**Rear** ..... 0.06 – 0.10 mm (0.0024 – 0.0039 in.)



### OIL JET, CHECK VALVE

- (1) Check the oil jet and check valve for clogging.
- (2) Check the oil jet for damage and deformation.

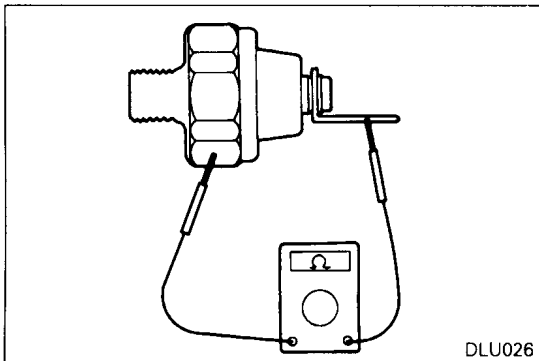
**OIL COOLER BYPASS VALVE**

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

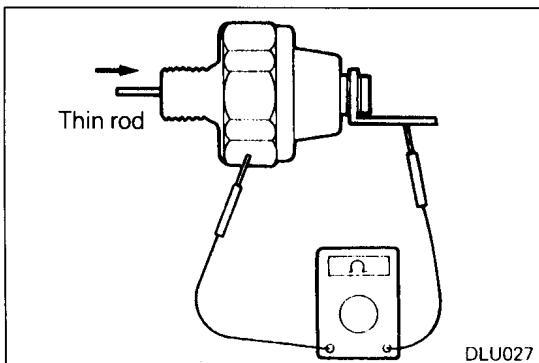
**Dimension L: 34.5 mm (1.358 in.)**

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

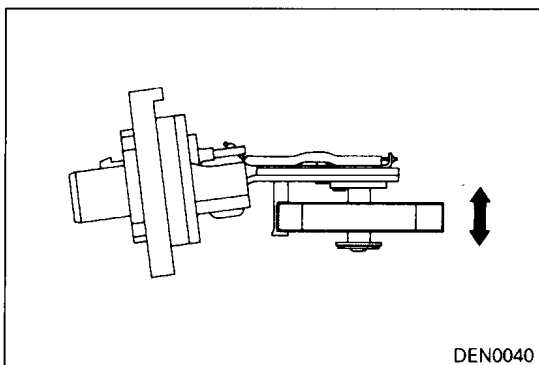
**Dimension L: 40 mm (1.57 in.) or more**

**OIL PRESSURE SWITCH**

- (1) Connect a tester (ohm range) between the terminal and the body of the switch to check for continuity. The switch is normal if there is continuity. If there is no continuity, replace the switch.

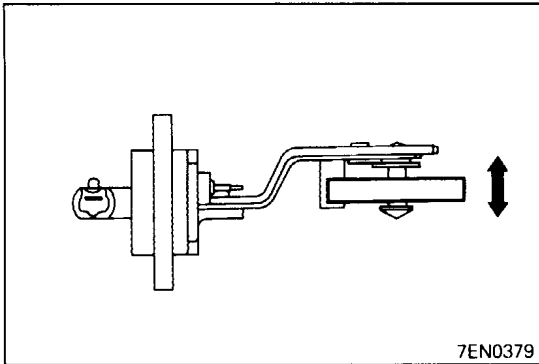


- (2) Insert a thin rod in the oil hole of the switch and push it in lightly. The switch is normal if no continuity is detected (infinite resistance on the tester). If there is continuity, replace the switch.
- (3) Apply a 49 kPa (0.5 kg/cm<sup>2</sup>, 7 psi) pressure to the oil hole. The switch is normal if there is no continuity. Also check for air leaks. If any air leaks are detected, the cause may be a broken diaphragm. Replace the switch if it leaks.

**OIL LEVEL SENSOR (FOR EUROPE AND AUSTRALIA)****<L300>**

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

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



**<PAJERO and L400>**

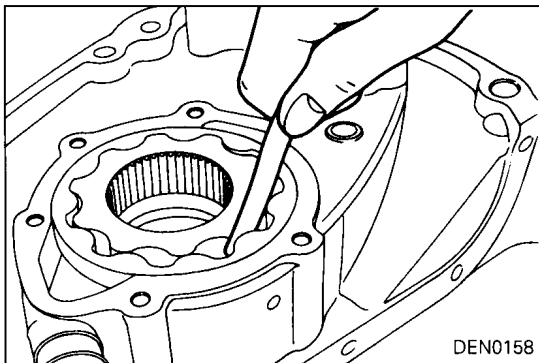
- (1) Immerse the oil level sensor and check continuity with its float positioned both up and down at oil temperatures both below 40°C (104°F) and above 80°C (176°F).

40°C (104°F)

Float position	Switch ON/OFF
Condition when down	ON (continuity)
Condition when up	ON (continuity)

80°C (176°F)

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

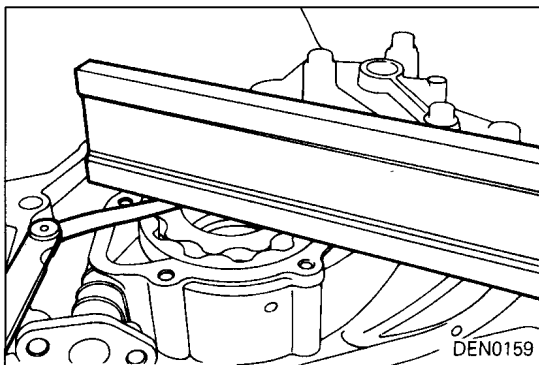


**OIL PUMP**

- (1) Install the inner and outer rotors in the front case.  
 (2) Check the tip clearance using a thickness gauge.

**Standard value:**

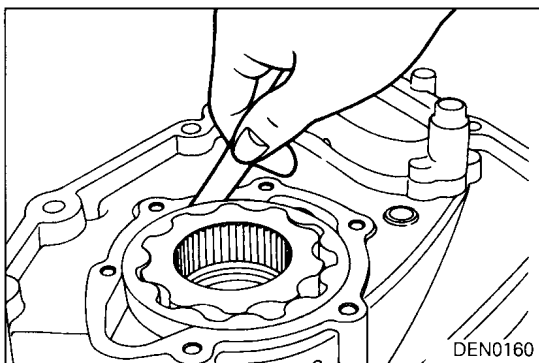
**0.11 – 0.24 mm (0.0043– 0.0094 in.)**



- (3) Check the side clearance using a straight edge and a thickness gauge.

**Standard value:**

**0.04 – 0.10 mm (0.0016 – 0.0039 in.)**



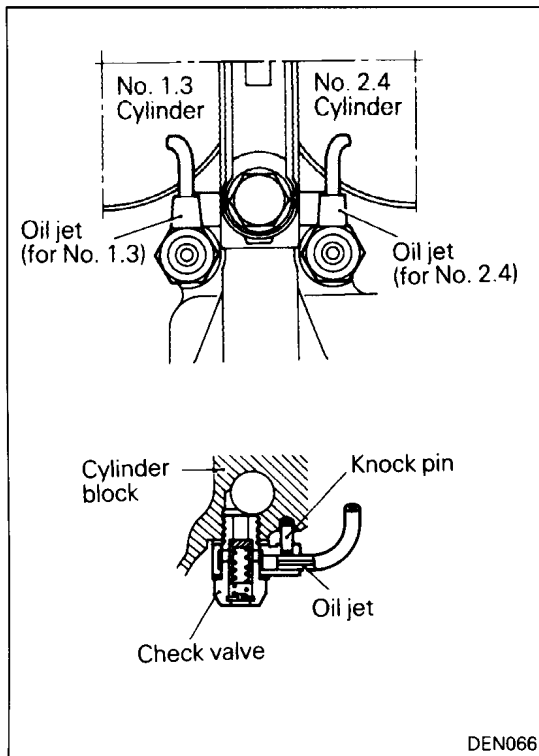
- (4) Check the body clearance using a thickness gauge.

**Standard value:**

**0.10 – 0.18 mm (0.0039 – 0.0071 in.)**

**Limit: 0.35 mm (0.0138 in.)**

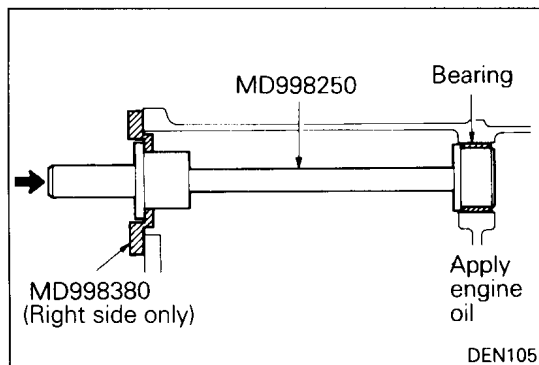




## INSTALLATION SERVICE POINTS

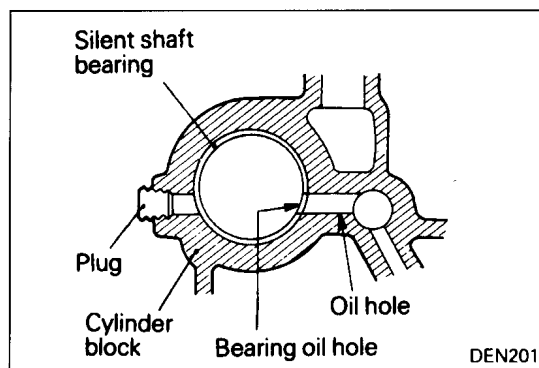
### ◆A◆ OIL JET INSTALLATION

- (1) There are two types of oil jets installed: one for No. 1 and 3 and the other for No. 2 and 4. Make sure that the correct one is installed with correct direction as shown.

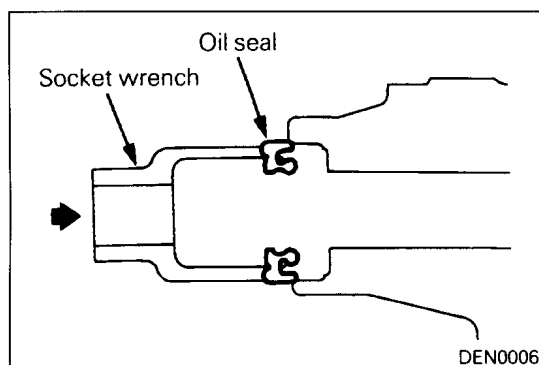


### ◆B◆ BALANCER SHAFT BEARING INSTALLATION

- (1) Using the special tool, press-fit the bearing into the cylinder block. Before press-fitting the bearing, apply an ample amount of engine oil to the bearing surfaces as well as bearing hole in the cylinder block.

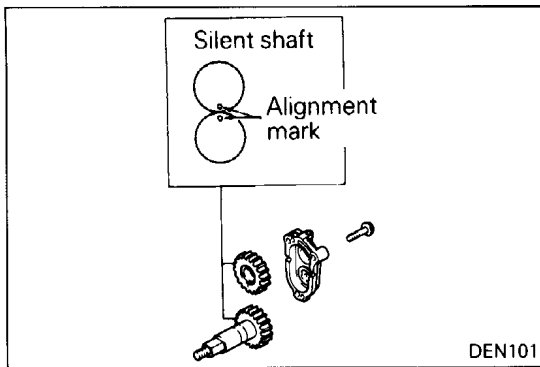


- (2) When press-fitting the right bearing into position, make sure that the oil hole in bearing is aligned with that in cylinder block.



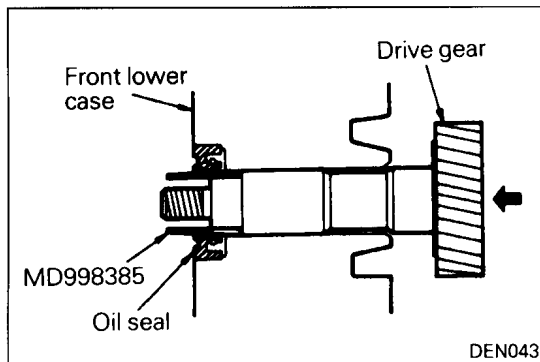
### ◆C◆ OIL SEAL INSTALLATION

- (1) Apply engine oil to the oil seal outer surface and drive in with a socket wrench.

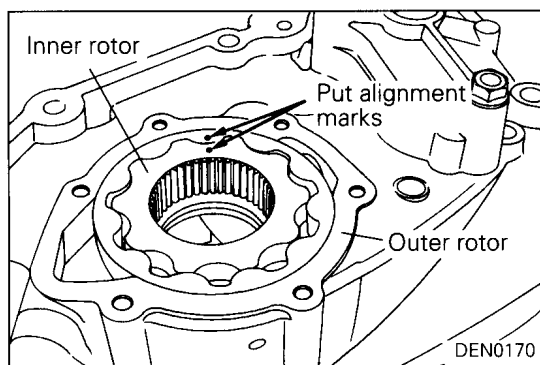


### ◆D◆ BALANCER SHAFT DRIVE GEAR / BALANCER SHAFT DRIVEN GEAR INSTALLATION

- (1) Install the silent shaft drive and driven gears to the front lower case. Make sure that the alignment marks are in line.

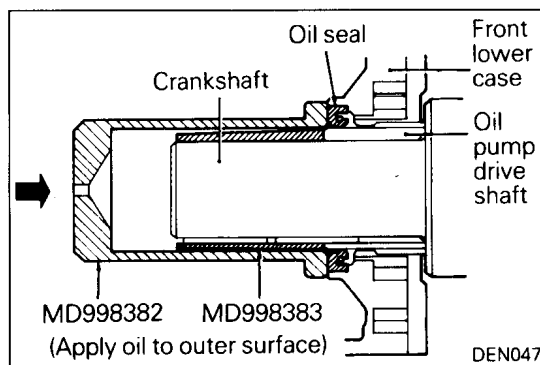


- (2) Install the special tool to the drive gear. Apply engine oil to the outer surface of the special tool and the drive gear shaft and install the drive gear as shown.



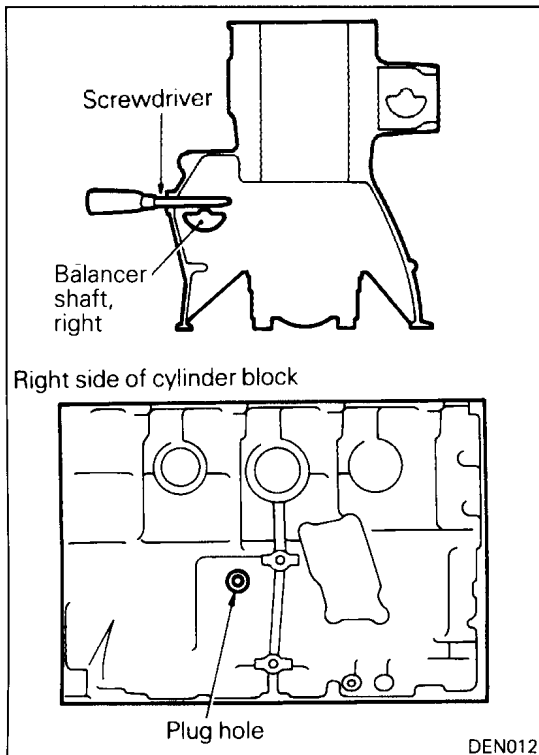
### ◆E◆ INNER ROTOR / OUTER ROTOR INSTALLATION

- (1) Install the outer rotor in the same direction as before noting the mark put at the time of removal. Apply engine oil to the entire rotor surface.



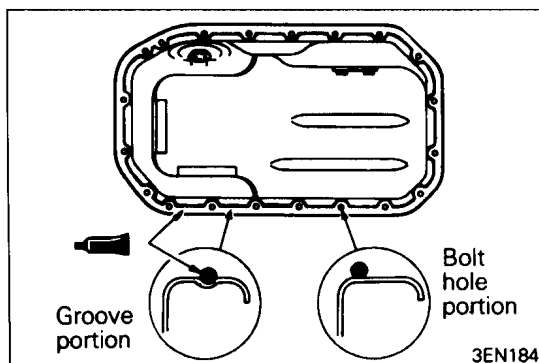
### ◆F◆ CRANKSHAFT FRONT OIL SEAL INSTALLATION

- (1) Attach the special tool to the crankshaft and apply engine oil to the outer surface of the tool.
- (2) Using the special tool, install the front oil seal into the front lower case.



### ◆G◆ FLANGE BOLT INSTALLATION

- (1) Insert a Phillips screwdriver into the plug hole to block the balancer shaft.
- (2) Install the flange bolt and tighten to the specification.
- (3) Remove the screwdriver and install the plug.



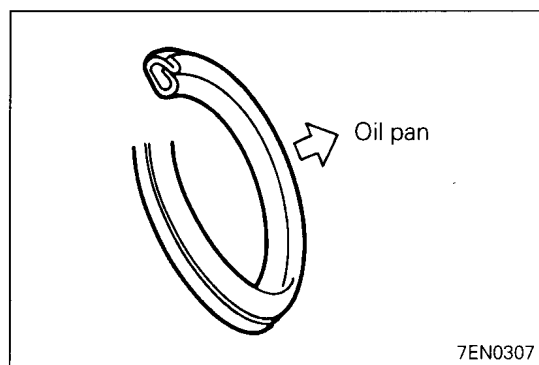
### ◆H◆ OIL PAN INSTALLATION

- (1) Clean both mating surfaces 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:

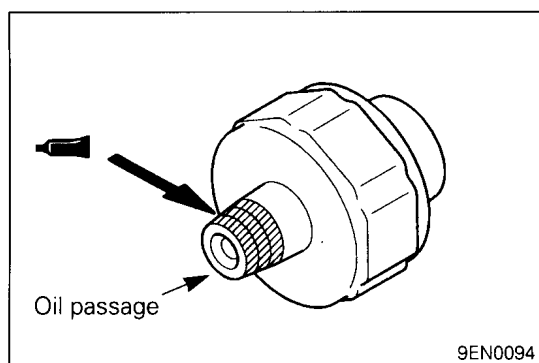
**MITSUBISHI GENUINE Part No. MD970389 or equivalent**

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



### ◆I◆ OIL DRAIN PLUG GASKET INSTALLATION

- (1) Replace the gasket with a new one and install it in the direction shown in the illustration.



### ◆J◆ OIL PRESSURE SWITCH INSTALLATION

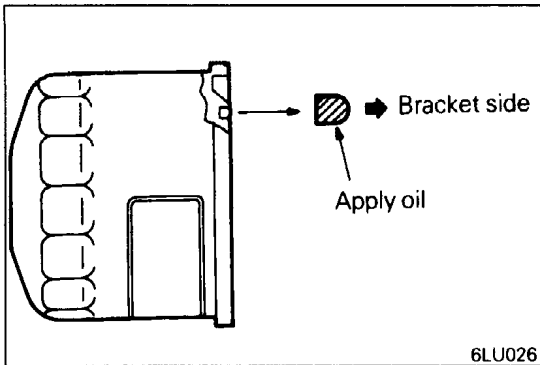
- (1) Apply sealant to the threads of the switch.

#### Specified sealant:

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

#### Caution

- Use care not to allow the sealant to plug the oil passage.

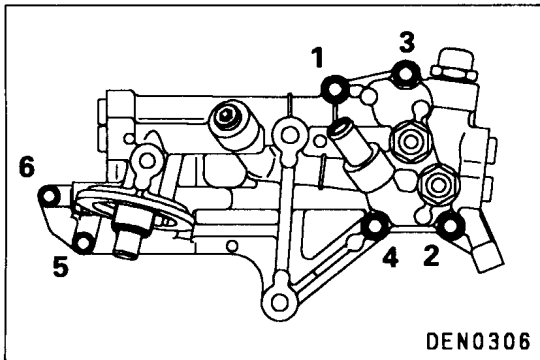


### ►K◄ OIL FILTER INSTALLATION

- (1) Clean the filter mounting surface of the oil filter bracket.
- (2) Apply engine oil to the O-ring of the oil filter.
- (3) Screw in the oil filter until its O-ring contacts the mounting surface of the bracket, and then turn further 5/8 turn (MD069782 filter) or 3/4 turn (MD184086 filter).

#### NOTE

This corresponds to the tightening torque of approx. 20 Nm (2.0 kgm, 14 ft.lbs.).

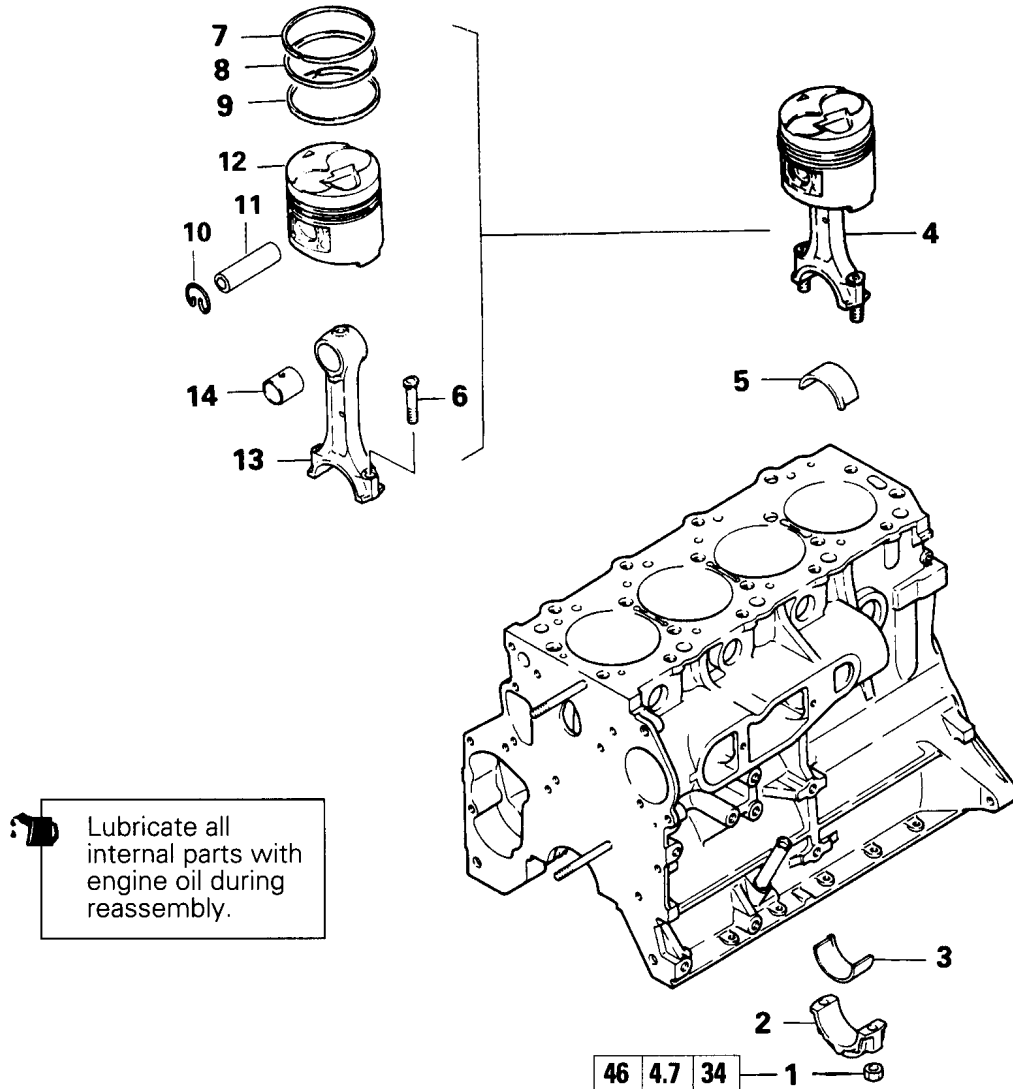


### ►L◄ OIL FILTER BRACKET INSTALLATION

Tighten the oil filter bracket mounting bolts in the sequence shown in the illustration.

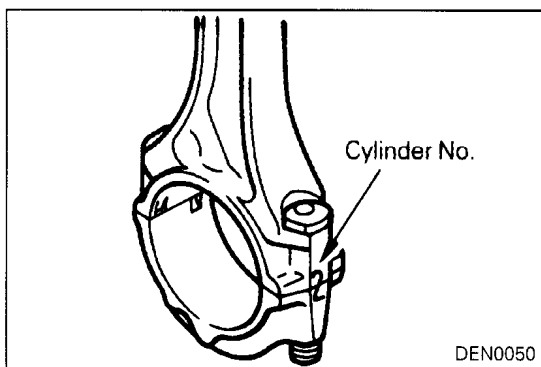
# 13. PISTON AND CONNECTING ROD

## REMOVAL AND INSTALLATION



### Removal steps

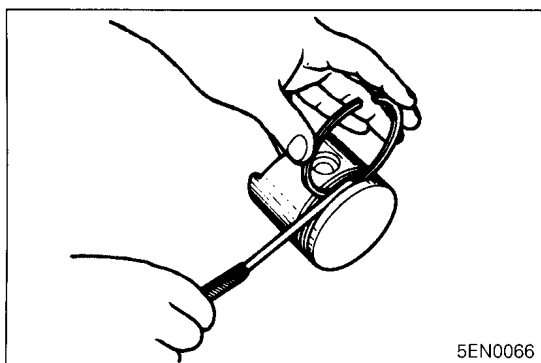
1. Nut
- ↻A↻ ↻D↻ 2. Connecting rod cap
3. Connecting rod bearing
- ↻C↻ 4. Piston and connecting rod assembly
5. Connecting rod bearing
6. Bolt
- ↻B↻ 7. Piston ring No. 1
- ↻B↻ 8. Piston ring No. 2
- ↻C↻ 9. Oil ring
- ↻B↻ 10. Snap ring
- ↻A↻ 11. Piston pin
- ↻A↻ 12. Piston
- ↻A↻ 13. Connecting rod
14.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



## REMOVAL SERVICE POINTS

### ◇A◇ CONNECTING ROD CAP REMOVAL

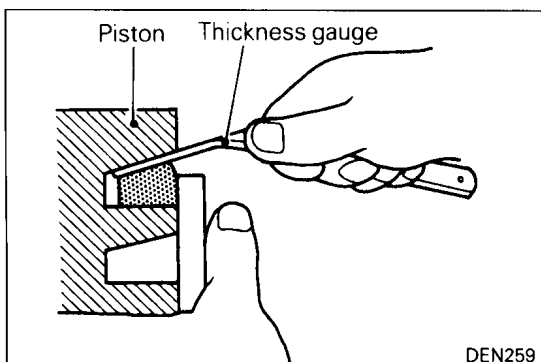
- (1) Mark the cylinder number on the side of the connecting rod big end for correct reassembly.



## INSPECTION

### PISTON RING

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



## NOTE

In cases of keystone type, measure the ring to groove clearance as shown.

### Standard value:

#### Engines without turbocharger

No. 1	0.13 – 0.17 mm (0.0051 – 0.0067 in.)
No. 2	0.05 – 0.09 mm (0.0012 – 0.0028 in.)*
	0.03 – 0.07 mm (0.0012 – 0.0028 in.)
Oil	0.02 – 0.07 mm (0.0008 – 0.0028 in.)

#### Engines with turbocharger

No. 1	0.06 – 0.08 mm (0.0024 – 0.0031 in.)
No. 2	0.05 – 0.07 mm (0.0020 – 0.0028 in.)
Oil	0.02 – 0.07 mm (0.0008 – 0.0028 in.)

### Limit

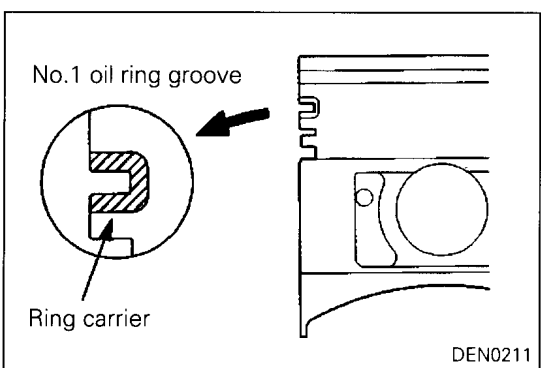
#### Engines without turbocharger

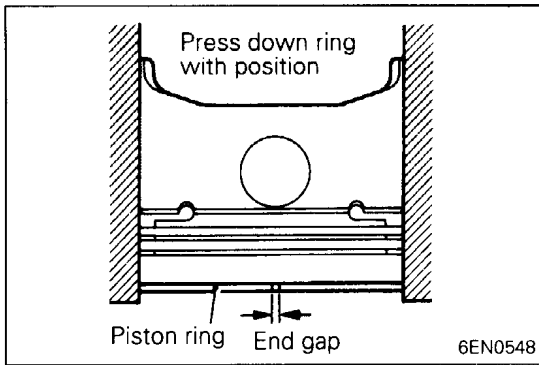
No. 1	0.20 mm (0.0079 in.)
No. 2	0.15 mm (0.0059 in.)
Oil	0.10 mm (0.0039 in.)

#### Engines with turbocharger

No. 1	0.15 mm (0.0059 in.)
No. 2	0.15 mm (0.0059 in.)
Oil	0.10 mm (0.0039 in.)

\*: Pistons with ring carrier





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

**Standard value:****Engines without turbocharger**

**No. 1** 0.25 – 0.40 mm (0.0098 – 0.0157 in.)

**No. 2** 0.25 – 0.45 mm (0.0098 – 0.0177 in.)

**Oil** 0.25 – 0.45 mm (0.0098 – 0.0177 in.)

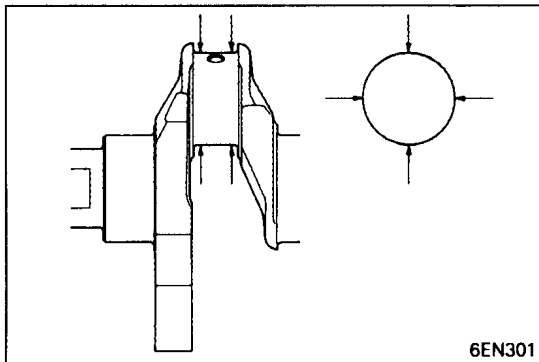
**Engines with turbocharger**

**No. 1** 0.30 – 0.43 mm (0.0118 – 0.0169 in.)

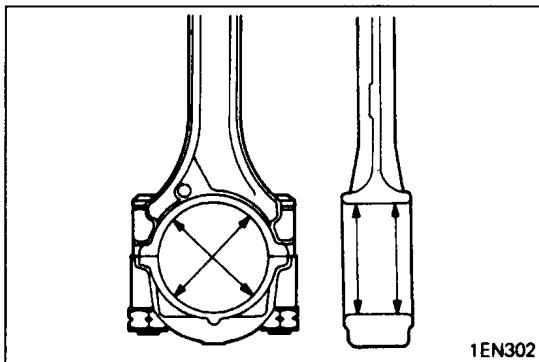
**No. 2** 0.41 – 0.54 mm (0.0161 – 0.0213 in.)

**Oil** 0.25 – 0.45 mm (0.0098 – 0.0177 in.)

**Limit: 0.8 mm (0.0315 in.)**

**CONNECTING ROD BEARING**

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



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

**Standard value:**

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

**Limit: 0.10 mm (0.0039 in.)**

**Crankshaft pin diameter:**

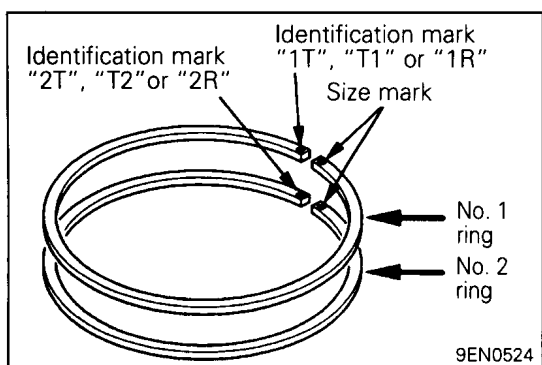
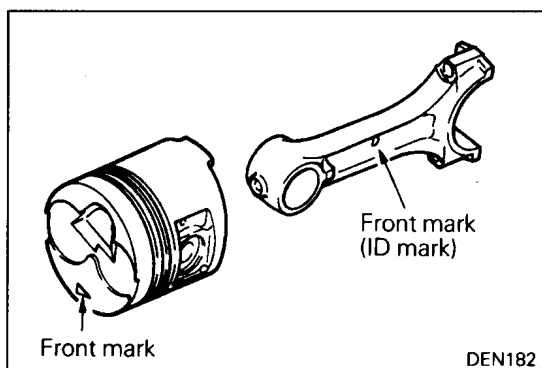
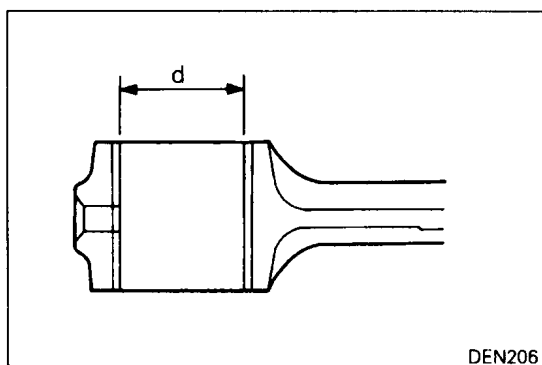
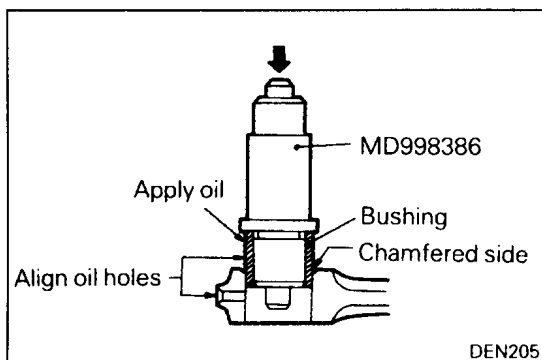
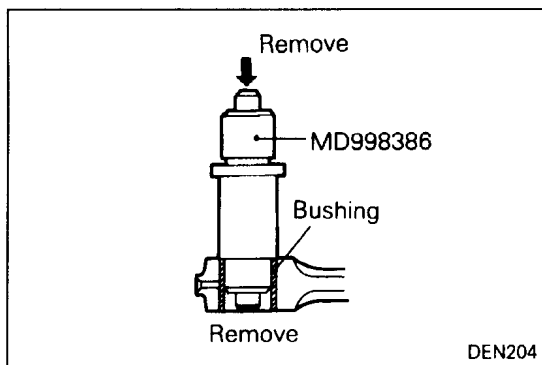
**0.25 U.S. ...52.734 – 52.750 mm (2.0761 – 2.0768 in.)**

**0.50 U.S. ...52.484 – 52.500 mm (2.0662 – 2.0669 in.)**

**0.75 U.S. ...52.234 – 52.250 mm (2.0565 – 2.0571 in.)**

**NOTE**

Refer to CRANKSHAFT for the measurement of oil clearance using a plastic gauge.



## CONNECTING ROD BUSHING REPLACEMENT PROCEDURE

(1) Using Connecting Rod Bushing Remover and Installer (special tool), remove the bushing.

(2) Using the special tool, press-fit the bushing into position. At the time, make sure that the oil hole in the bushing is aligned with that in the connecting rod small end.

(3) Machine the bushing I.D. to the standard value.

### Bushing I.D. standard value:

29.015 – 29.025 mm (1.1423 – 1.1427 in.)

### Big-to-small-end center parallelism:

0.05 mm (0.002 in.)

Torsion: 0.1 mm (0.004 in.)

## INSTALLATION SERVICE POINTS

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

- (1) Mate the piston with the connecting rod.
- (2) Line up the front marks and insert the piston pin. The piston pin must be smoothly pressed by hand into position. Replace the piston pin if there is an excessive play.

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

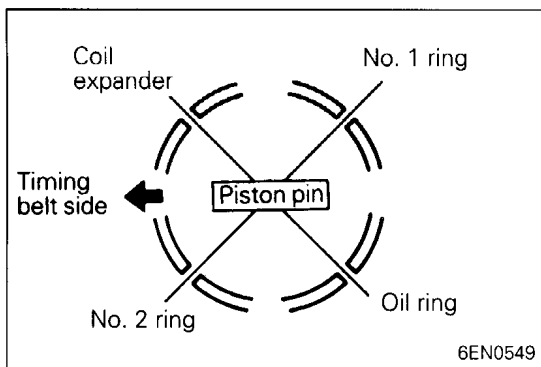
- (1) Install the coil expander and the oil ring in the piston.
- (2) Then, install the piston ring No. 2 followed by piston ring No. 1. Install the rings with their side having identification mark and size mark facing up (on the piston crown side).

#### Identification mark:

No. 1 ring "1T", "1T" or "1R"

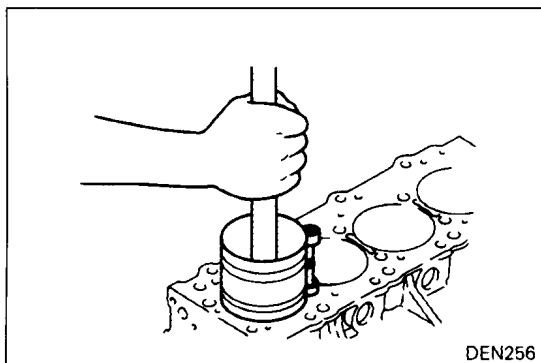
No. 2 ring "2T", "2T" or "2R"





### ▶C▶ PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION

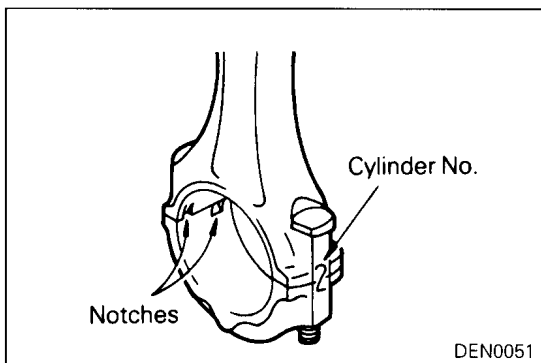
- (1) Liberally coat engine oil on the circumference of the piston, piston ring, and oil ring.
- (2) Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the figure.
- (3) Rotate crankshaft so that crank pin is on center of cylinder bore.



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

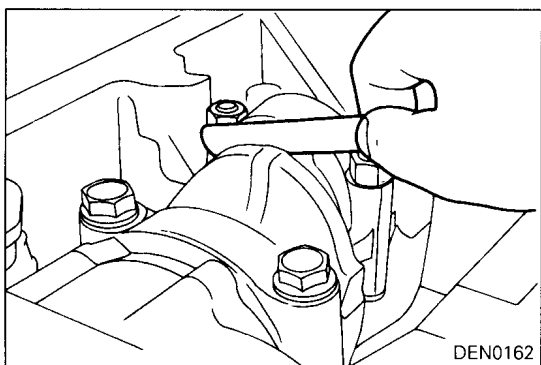
#### Caution

- Insert with the front mark (arrow) on the piston head directed toward the engine front (timing belt side).



### ▶D▶ 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 connecting rod big end side clearance meets the specification.

**Standard value: 0.10 – 0.25 mm (0.0039 – 0.0098 in.)**  
**Limit: 0.40 mm (0.0157 in.)**

# 14. CRANKSHAFT AND CYLINDER BLOCK

## REMOVAL AND INSTALLATION <PAJERO (Up to 2000 model), L200, L300, L400>

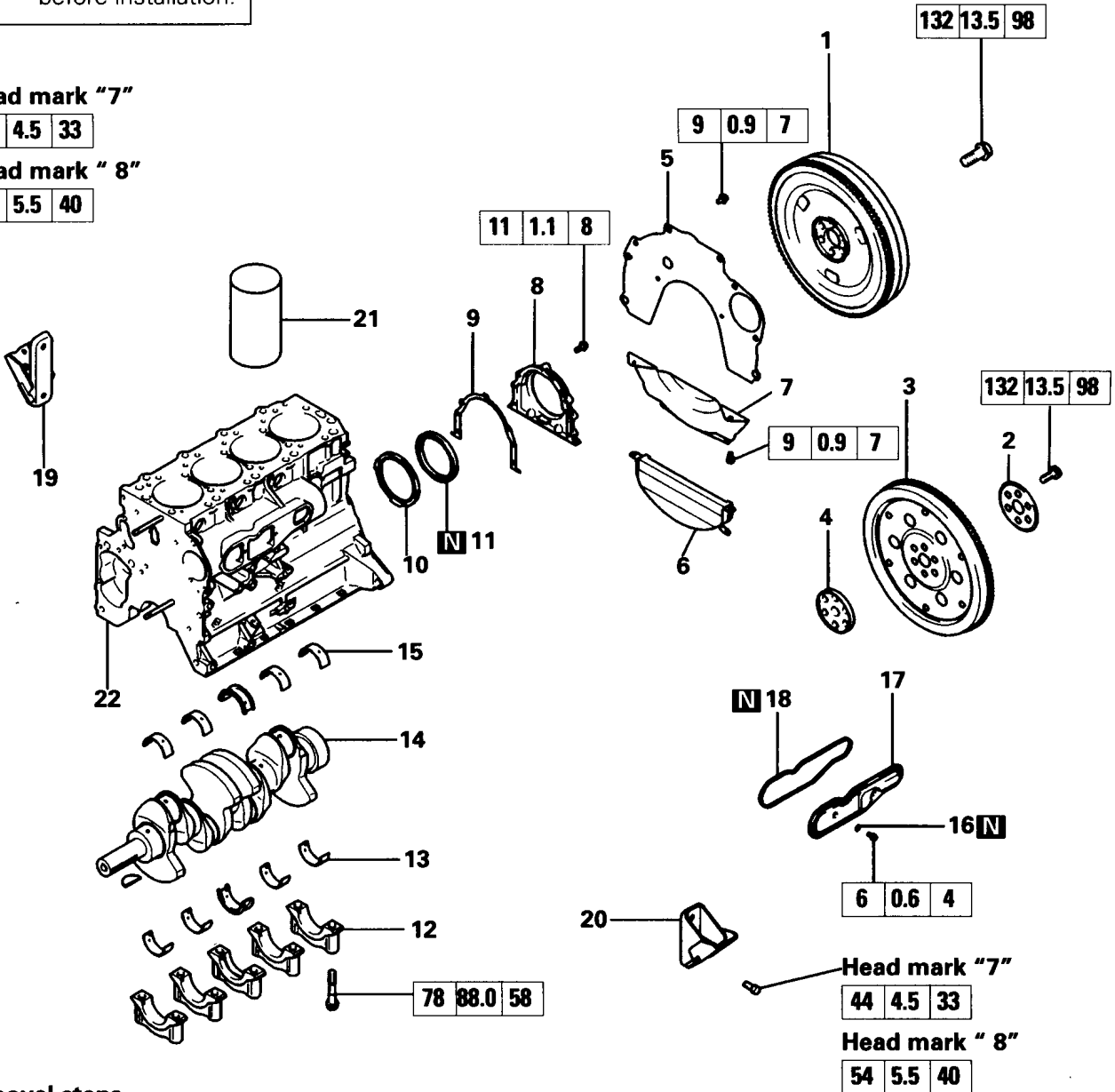
Apply engine oil to all moving parts before installation.

Head mark "7"

44 4.5 33

Head mark "8"

54 5.5 40



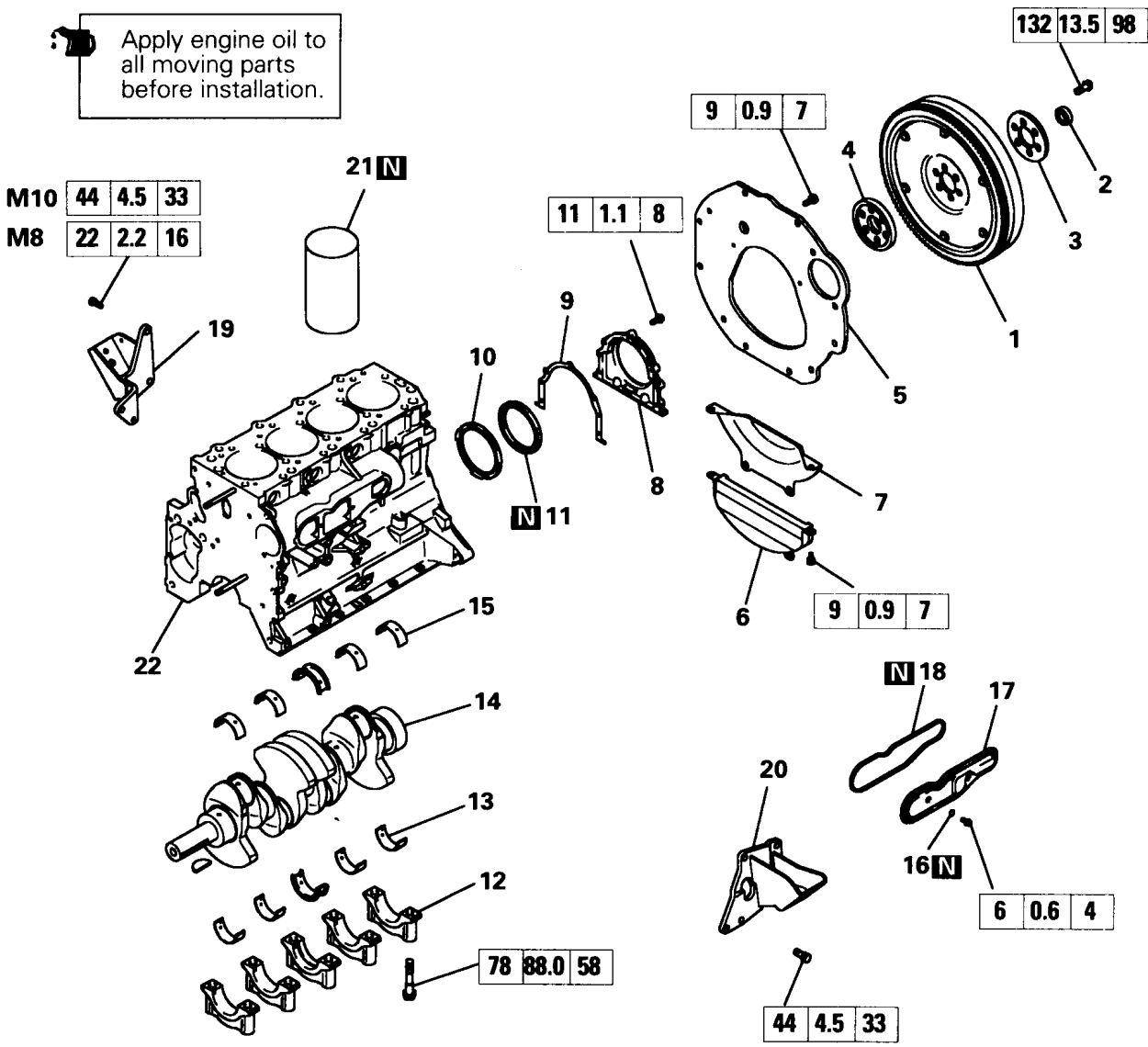
### Removal steps

- 1. Flywheel assembly – For manual transmission
- 2. Adapter plate
- 3. Drive plate
- 4. Crankshaft adapter
- 5. Rear plate
- 6. Space rubber
- 7. Bell housing cover
- 8. Oil seal case
- 9. Gasket
- ▶D◀ 10. Oil separator
- ▶C◀ 11. Rear oil seal
- ▶B◀ 12. Bearing cap
- ▶A◀ 13. Crankshaft bearing, lower
- 14. Crankshaft
- ▶A◀ 15. Crankshaft bearing, upper
- 16. O-ring
- 17. Cover
- 18. Packing
- 19. Engine bracket, right
- 20. Engine bracket, left
- 21. Cylinder sleeve
- 22. Cylinder block

REMOVAL AND INSTALLATION <PAJERO (From 2001 model)>



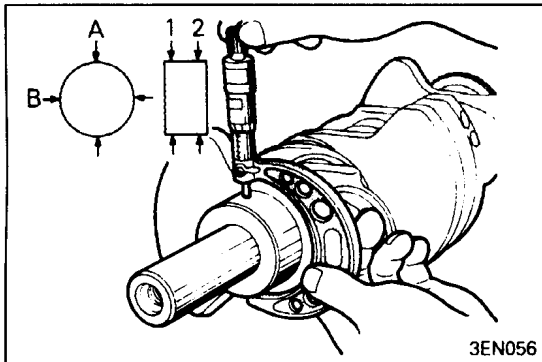
Apply engine oil to all moving parts before installation.



Removal steps

1. Flywheel assembly – For manual transmission
2. Ball bearing
3. Adapter plate
4. Crankshaft adapter
5. Rear plate
6. Space rubber
7. Bell housing cover
8. Oil seal case
9. Gasket
- ▶D◀ 10. Oil separator
- ▶C◀ 11. Rear oil seal
- ▶B◀ 12. Bearing cap
- ▶A◀ 13. Crankshaft bearing, lower
14. Crankshaft
- ▶A◀ 15. Crankshaft bearing, upper
16. O-ring
17. Cover
18. Packing
19. Engine bracket, right
20. Engine bracket, left
21. Cylinder sleeve
22. Cylinder block

Intentionally blank

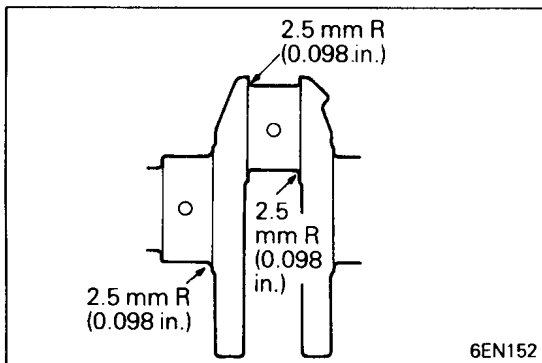
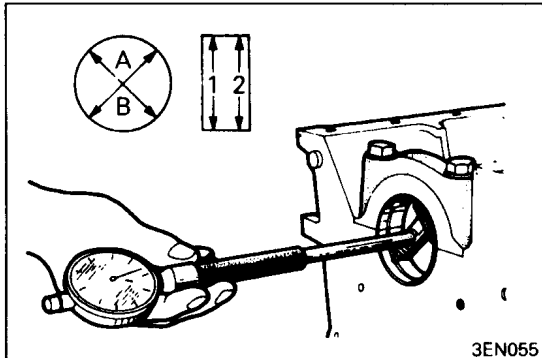
**INSPECTION****CRANKSHAFT**

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

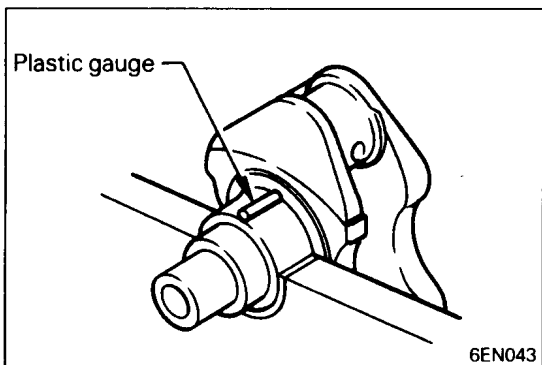
**Standard value:**

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

**Limit: 0.1 mm (0.0039 in.)**

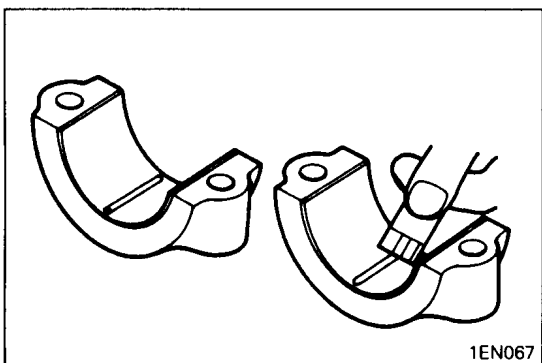


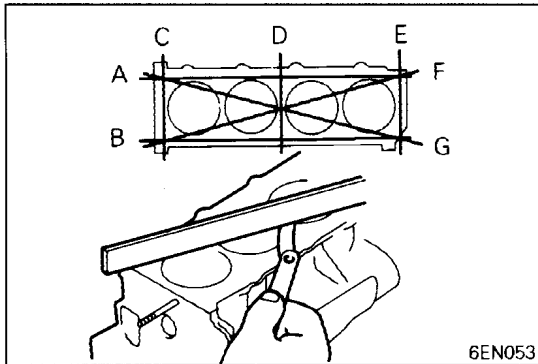
- (2) When the crankshaft is machined to undersize, finish the fillets of journals and pins to the specified radius.

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

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

- (1) Remove oil and grease and any other foreign matters from crankshaft journal and bearing inner surface.
- (2) Install the crankshaft.
- (3) Cut the plastic gauge to the same length as the width of bearing and place it on journal in parallel with its axis.
- (4) Gently place the crankshaft bearing cap over it and tighten the bolts to the specified torque.
- (5) Remove the bolts and gently remove the crankshaft bearing cap.
- (6) Measure the width of the smashed plastic gauge at its widest section by using a scale printed on the plastic gauge bag.





## INSPECTION

### CYLINDER BLOCK

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

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

**Limit: 0.1 mm (0.0039 in.)**

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

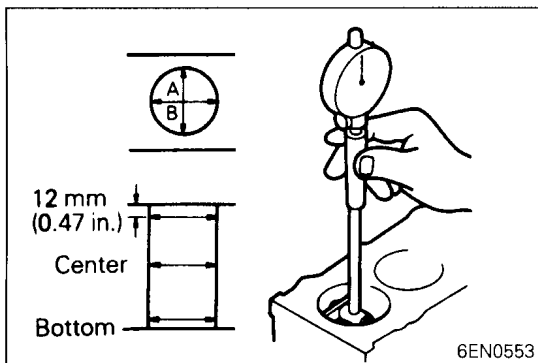
- (3) Check cylinder walls for scratches and seizure. If defects are evident, correct (bored to oversize) or replace.

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

**Standard value:**

**Cylinder I.D.: 91.10 – 91.13 mm (3.5866 – 3.5878 in.)**

**Cylindricity: 0.015 mm (0.0006 in.)**



### BORING CYLINDER

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

#### Piston size identification

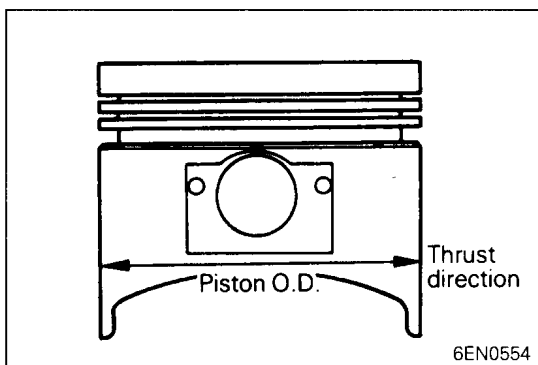
Size	Identification mark
0.50 mm (0.02 in.) O.S.	0.50
1.00 mm (0.04 in.) O.S.	1.00

#### NOTE

Size mark is stamped on piston top.

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

**Boring finish dimension = Piston O.D. +  
Clearance between piston O.D. and cylinder –  
0.02 mm (0.0008 in.) (honing margin)**



- (4) Bore all cylinders to calculated boring finish dimension.

**Caution**

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

- (5) Hone to final finish dimension (piston O.D. + clearance between piston O.D. and cylinder).  
 (6) Check clearance between piston and cylinder.

**Clearance between piston and cylinder:**

**Engines without turbocharger**

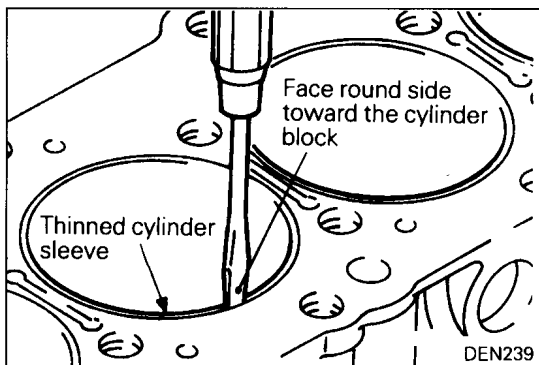
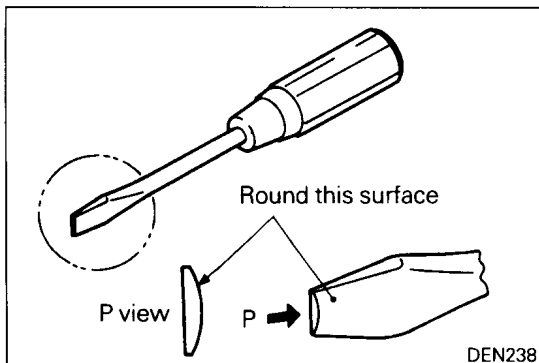
0.02 – 0.04 mm (0.00079 – 0.00157 in.)

**Engines with turbocharger**

0.04 – 0.06 mm (0.00157 – 0.00236 in.)

**NOTE**

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



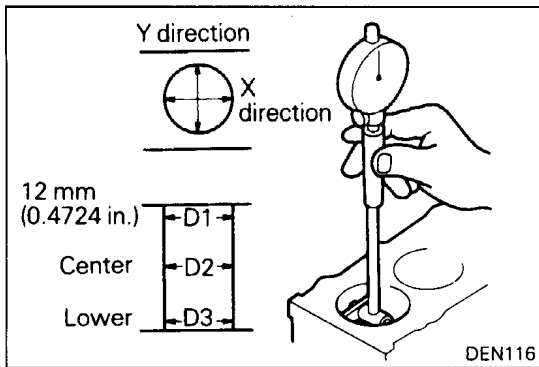
## CYLINDER SLEEVE CHANGE PROCEDURES

### 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 (0.0197 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.
- (2) If there is damage, insufficient tightening allowance or other problems, bore the cylinder block sleeve hole to an oversize.

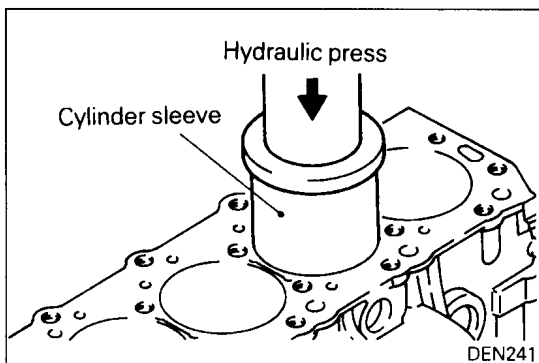


- (3) To measure the tightening allowance, measure both the cylinder sleeve O.D. and cylinder block sleeve hole I.D. at the position illustrated.

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 (0.0197 in.) oversize and install the 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.**

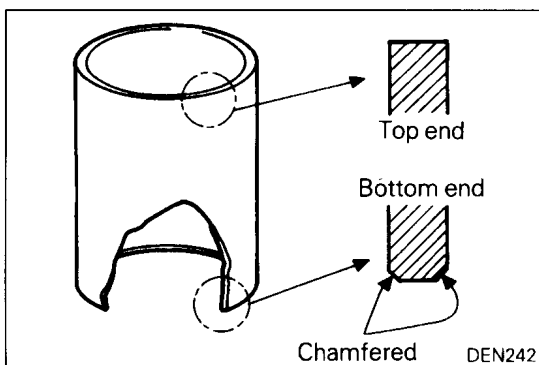


#### INSTALLATION

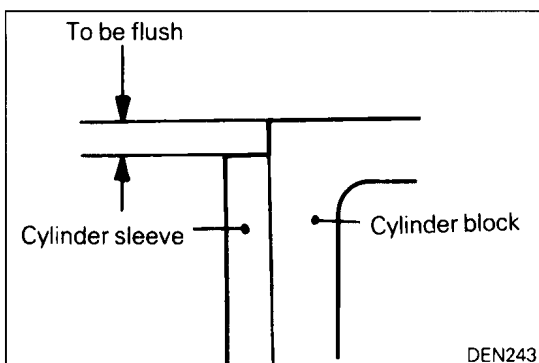
##### When Cylinder Block Sleeve Hole Has Not Been Bored

- (1) 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**

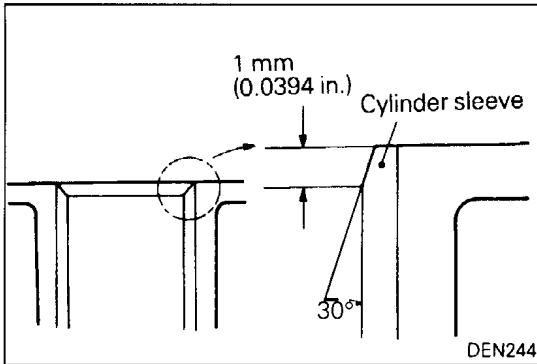


- (3) Install with the chamfered end first as illustrated. Continue until the sleeve upper end is flush with the block upper end.



- (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 (0.0079 in.).





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

- (6) The service cylinder sleeve has the I.D. machined to 89.9 to 90.1 mm (3.539 to 3.547 in.). After installation of the sleeve, therefore, hone the I.D. to the standard value.

**Cylinder I.D.: 91.10 – 91.13 mm (3.5866 – 3.5878 in.)**

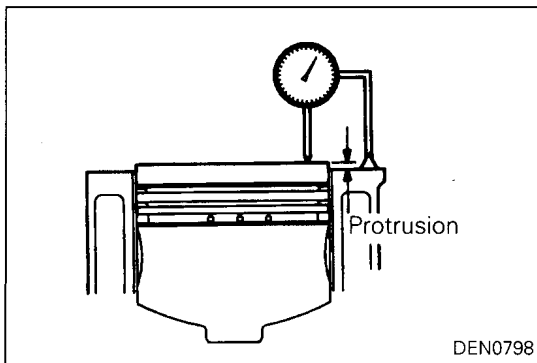
**Honing finished surface roughness: 2 – 4  $\mu$**

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

**Cylinder bore squareness: 0.05 mm (0.0197 in.)**

#### When Boring the Cylinder Block Sleeve Hole

- (1) Prepare a cylinder sleeve of 0.5 mm (0.0197 in.) oversize (identification color: red).
- (2)hone the cylinder block sleeve hole to 94.025 to 94.050 mm (3.7018 to 3.7027 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 combination of piston, connecting rod and cylinder 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: 0.974 mm (0.0383 in.)**

**INSTALLATION SERVICE POINTS**

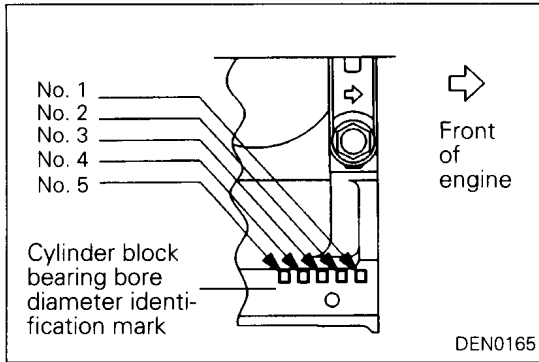
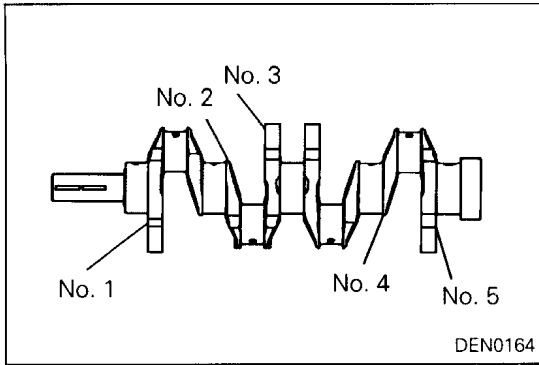
**◆A◆ CRANKSHAFT BEARING INSTALLATION**

(1) When the bearing needs replacing, select a proper bearing by the following procedure.

**NOTE**

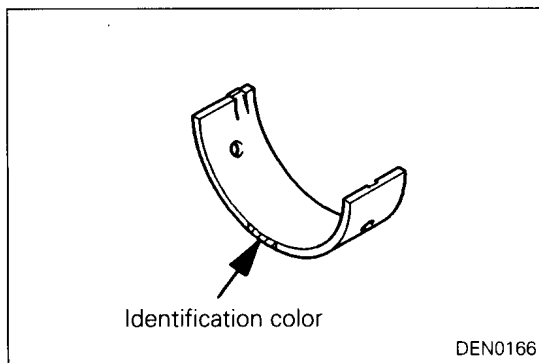
If the crankshaft is machined to an undersize, bearings for undersized crankshaft should be used and therefore the following selection procedure is unnecessary.

1. Measure the crankshaft journal diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification colors of its journals and painted at the positions shown in the illustration.
2. The cylinder block bearing bore diameter identification marks are stamped at the position shown in the illustration from front to rear beginning at No. 1.



Combination of crankshaft journal diameter and cylinder block bearing bore diameter				Cylinder block bearing bore diameter identification mark	Bearing identification color (for service part)
Classification	Identification color		O.D. mm (in.)		
	Production part	Service part			
1	None	Yellow	65.994 – 66.000 (2.5982 – 2.5984)	A	Green
				B	Yellow
				C	None
2	None	None	65.988 – 65.994 (2.5979 – 2.5982)	A	Yellow
				B	None
				C	Blue
3	None	White	65.982 – 65.988 (2.5977 – 2.5979)	A	None
				B	Blue
				C	Red

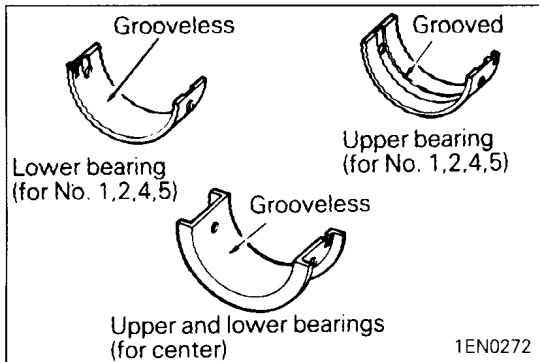
3. Select proper bearings from the above table on the basis of the identification data confirmed under Items 1 and 2.



[Example]

- ① If the measured value of a crankshaft journal outer diameter is 65.997 mm (2.5983 in.), the journal is classified as "1" in the table. In case the crankshaft is also replaced by a spare part, check the identification colors of the journals painted on the new crankshaft. If the color is yellow, for example, the journal is classified as "1".

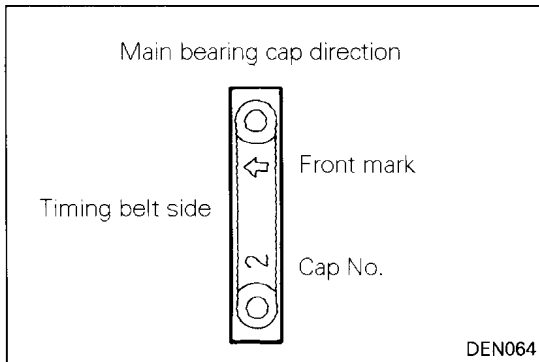
- ② Next, check the cylinder block bearing bore identification mark stamped on the cylinder block. If it is "A", read the "Bearing identification color" column to find the identification color of the bearing to be used. In this case, it is "Green".



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

### ▶B▶ BEARING CAP INSTALLATION

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

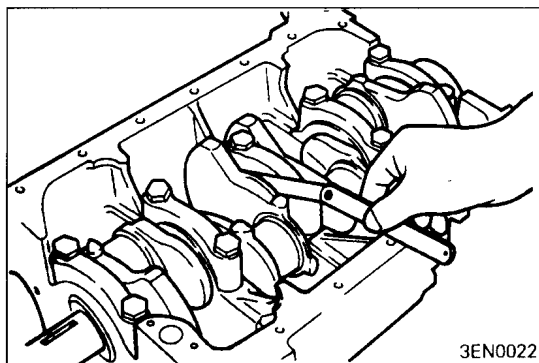


- (2) After installing the bearing caps, make sure that the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace crankshaft bearings.

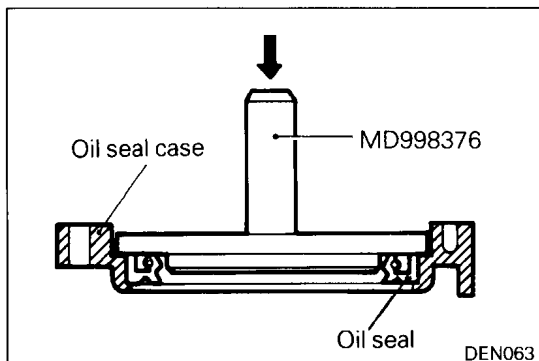
**Standard value:**

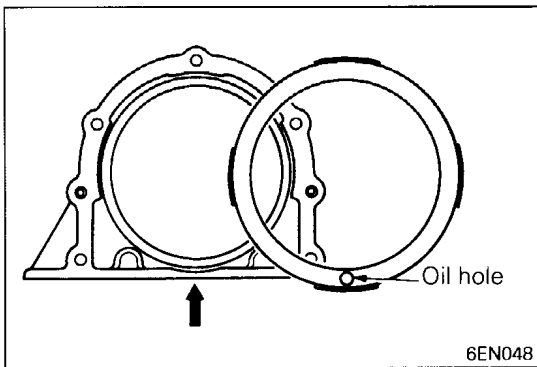
0.05 – 0.18 mm (0.0020 – 0.0071 in.)

**Limit: 0.25 mm (0.0098 in.)**



### ▶C▶ OIL SEAL INSTALLATION



**◆◆ OIL SEPARATOR INSTALLATION**

- (1) Push the oil separator into the oil seal case, with its oil hole at the case bottom (indicated by an arrow in illustrations).