

MITSUBISHI

ENGINE

4G1 SERIES

WORKSHOP MANUAL

FOREWORD

This Workshop Manual contains procedures for removal, disassembly, inspection, adjustment, reassembly and installation, etc. for service mechanics.

Engine

11A

All information, illustrations and product descriptions contained in this manual are current as at the time of publication. We, however, reserve the right to make changes at any time without prior notice or obligation.

FILING INSTRUCTION

Please keep these manual pages in the binder No. BN890001.

File these pages according to the signs "Added", "Revised" and "Deleted" on the "List of effective pages" which are interpreted below.

Added: File the pages with this sign additionally in your manual.

Revised. Deleted: Replace the existing pages with the corresponding pages with this sign.

Missing sheets will be supplied upon request.



INTRODUCTION

EXPLANATION OF MANUAL CONTENTS

Maintenance and Servicing Procedures

- (1) A diagram of the component parts is provided near the front of each section in order to give the reader a better understanding of the installed condition of component parts.
- (2) The numbers provided within the diagram indicate the sequence for maintenance and servicing procedures; the symbol **N** indicates a non-reusable part; the tightening torque is provided where applicable.

- Removal steps:
The part designation number corresponds to the number in the illustration to indicate removal steps.
- Disassembly steps:
The part designation number corresponds to the number in the illustration to indicate disassembly steps.
- Installation steps:
Specified in case installation is impossible in reverse order of removal steps. Omitted if installation is possible in reverse order of removal steps.
- Reassembly steps:
Specified in case reassembly is impossible in reverse order of disassembly steps. Omitted if reassembly is possible in reverse order of disassembly steps.

Classification of Major Maintenance/Service Points

When there are major points relative to maintenance and servicing procedures (such as essential maintenance and service points, maintenance and service standard values, information regarding the use of special tools, etc.), these are arranged together as major maintenance and service points and explained in detail.

- ◊A◊: Indicates that there are essential points for removal or disassembly.
- ◆A◆: Indicates that there are essential points for installation or reassembly.

Symbols for Lubrication, Sealants and Adhesives

Information concerning the locations for lubrication and for application of sealants and adhesives is provided, by using symbols, in the diagram of component parts, or on the page following the component parts page, and explained.

- Grease
(multipurpose grease unless there is a brand or type specified)
- Sealant or adhesive
- Brake fluid, automatic transmission fluid
or air conditioner compressor oil
- Engine oil or gear oil

INTRODUCTION

Indicates the group title.

Indicates the section title.

Indicates the group number.

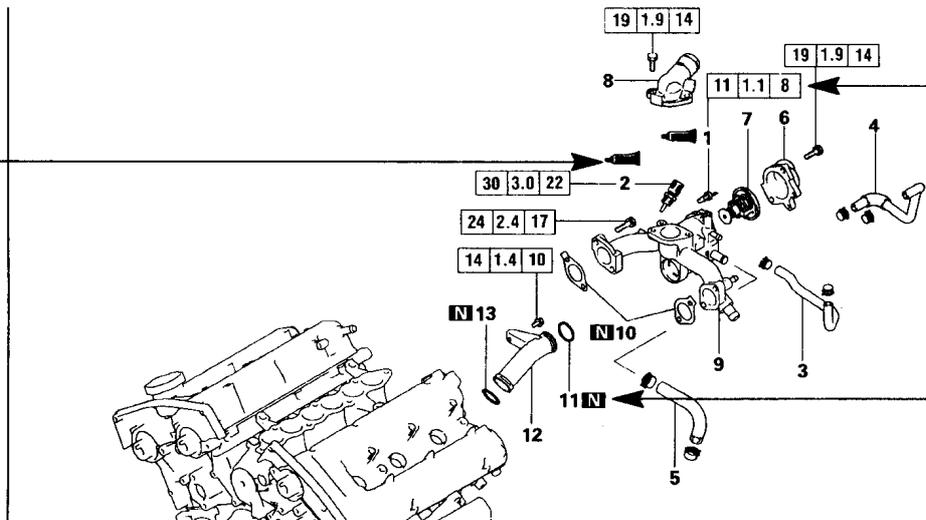
Indicates the section number.

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6A1 ENGINE – Water Pump and Water Pipe

11A-7-1

7. WATER PUMP AND WATER PIPE REMOVAL AND INSTALLATION

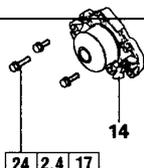


Denotes tightening torque.

Nm	kgm	ft.lbs.
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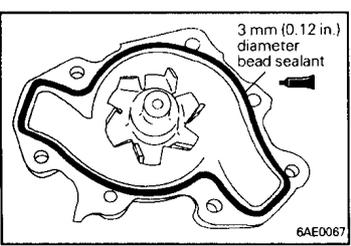
Denotes non-reusable part.

This number corresponds to the number appearing in "Removal steps", "Disassembly steps", "Installation steps" or "Reassembly steps".



- Removal steps**
- ⚡F 1. Engine coolant temperature gauge unit
 - ⚡E 2. Engine coolant temperature sensor
 - 3. Water hose
 - 4. Water hose
 - 5. Water hose
 - 6. Water inlet fitting
 - ⚡D 7. Thermostat
 - ⚡C 8. Water outlet fitting
 - 9. Thermostat housing
 - 10. Gasket
 - ⚡B 11. O-ring
 - ⚡B 12. Water pipe
 - ⚡B 13. O-ring
 - ⚡A 14. Water pump

Operating procedures, cautions, etc. on removal, installation, disassembly and reassembly are described.



INSTALLATION SERVICE POINTS

⚡A SEALANT APPLICATION TO WATER PUMP

Specified sealant:
Mitsubishi Genuine Part No. MD970389 or equivalent

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List of Effective Pages

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11A-6-6		Apr. 1990					

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ENGINE

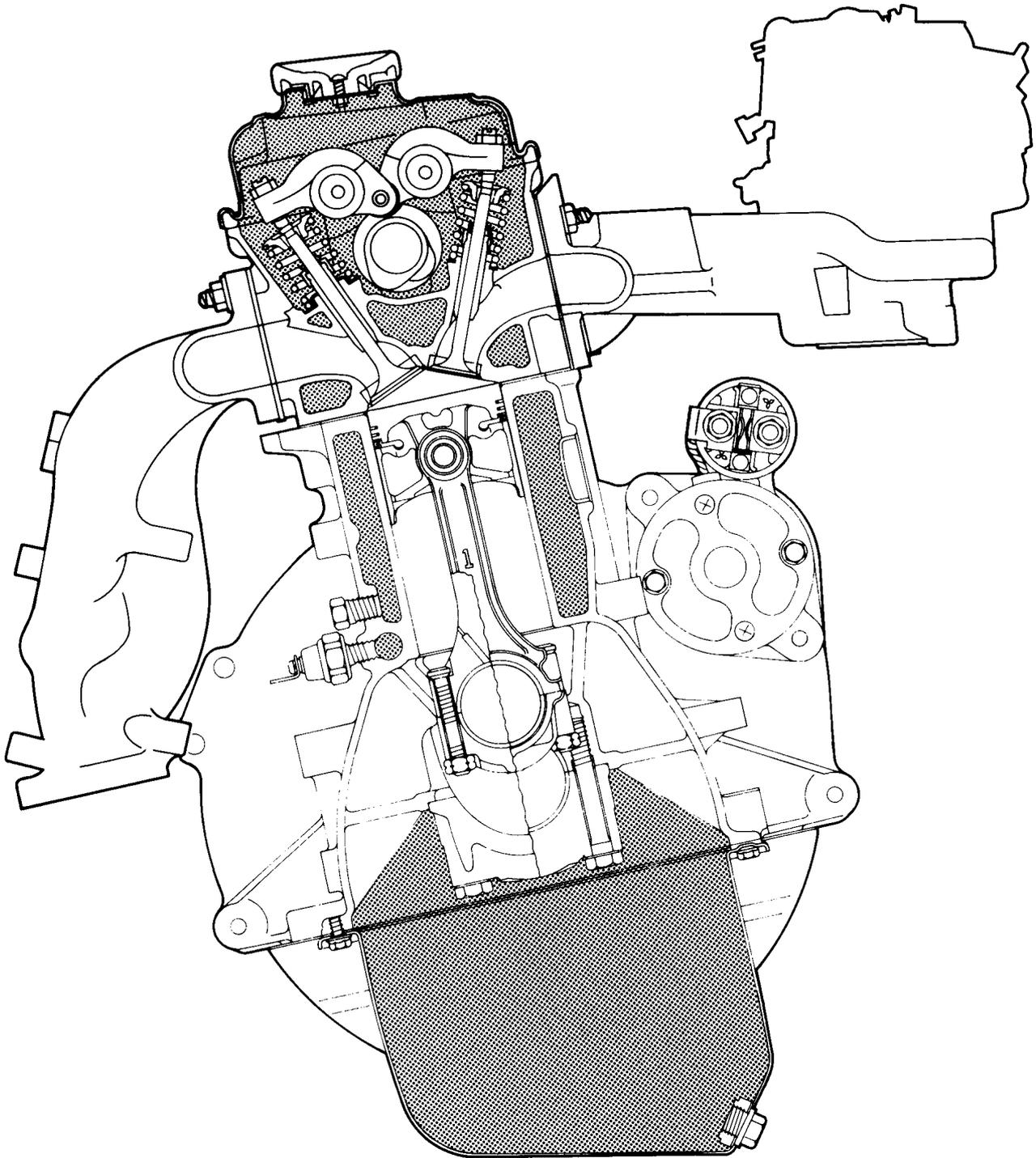
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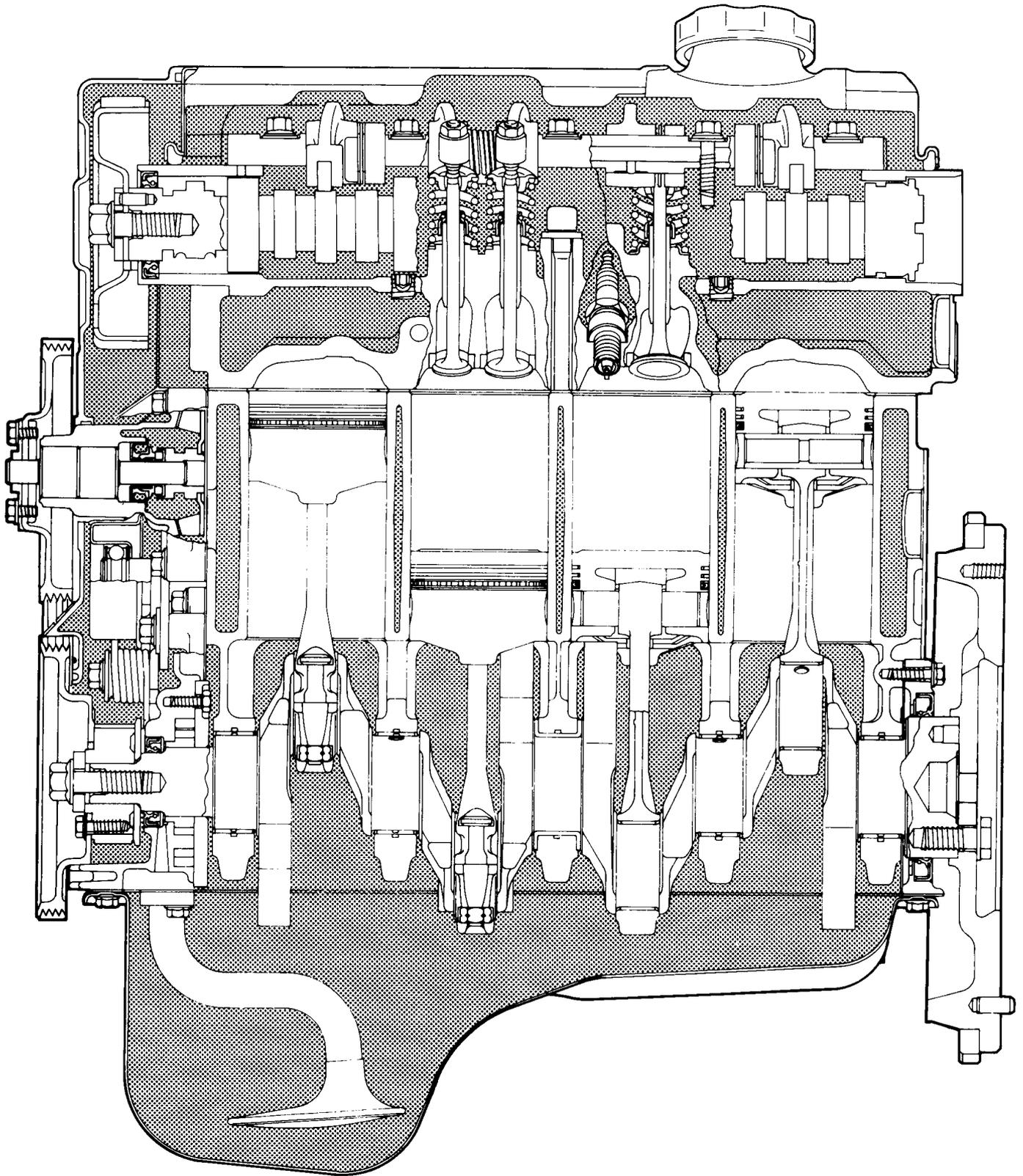
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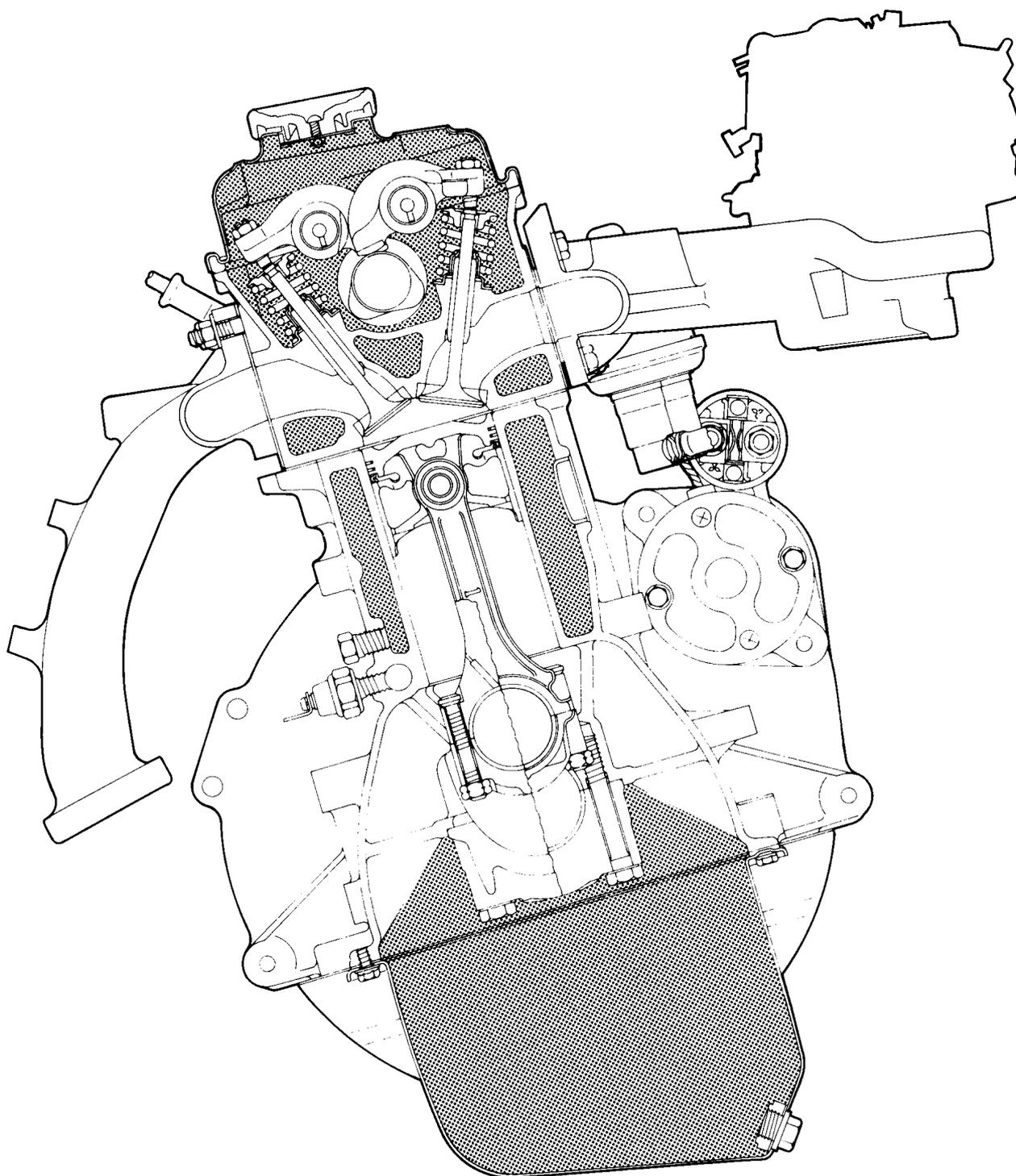
GENERAL INFORMATION

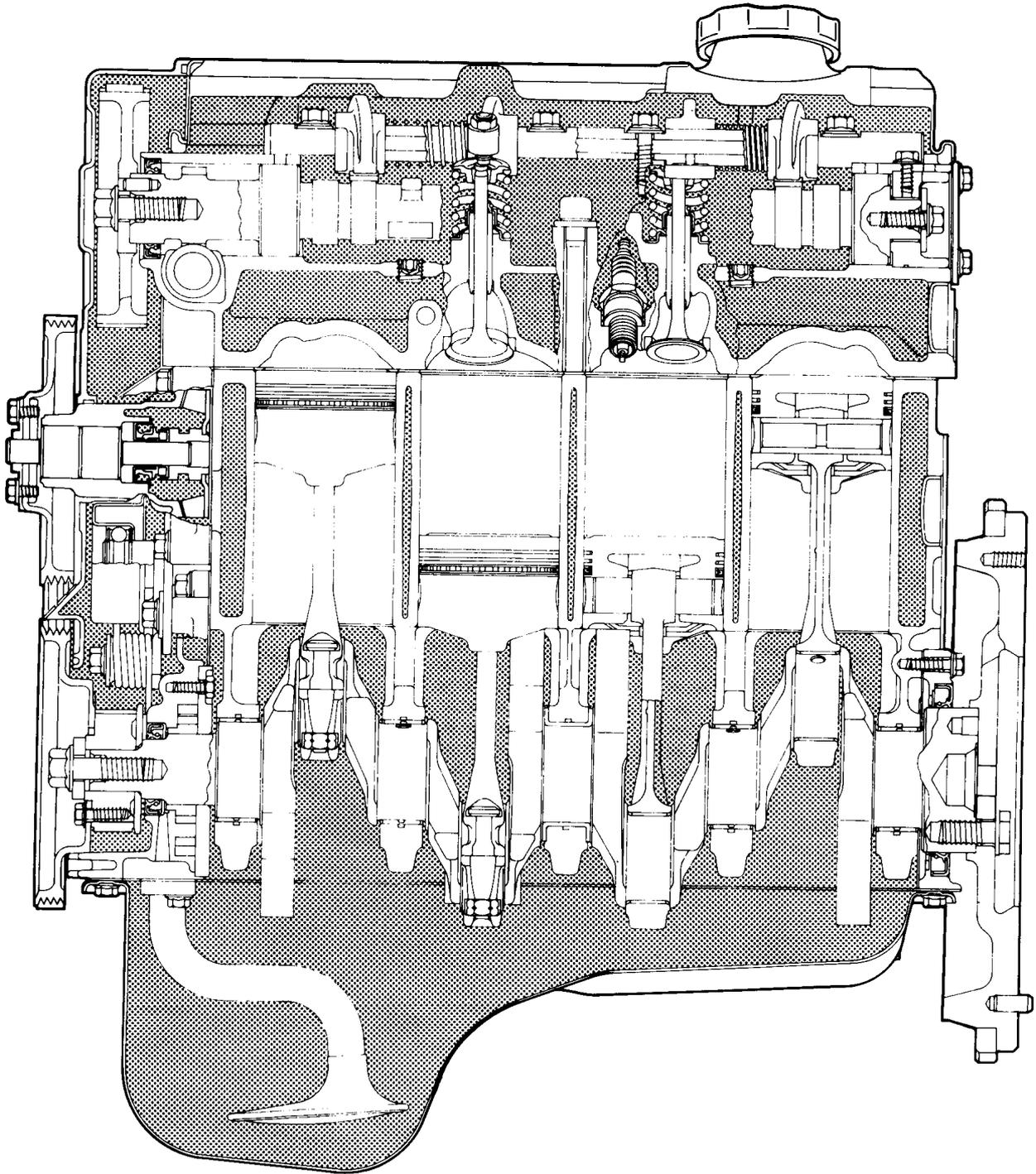
ENGINE SECTIONAL VIEW – 12-VALVE ENGINE



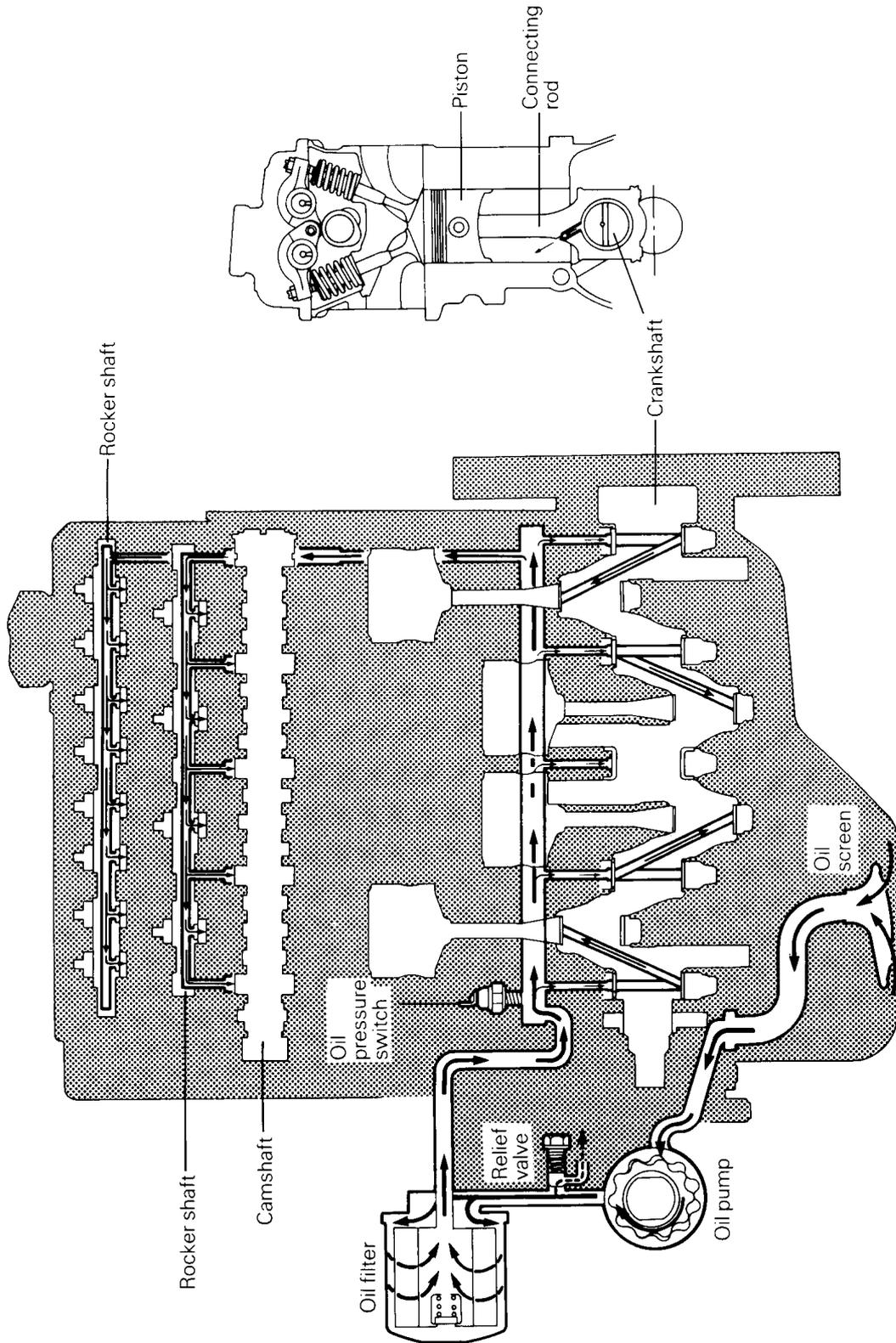


ENGINE SECTIONAL VIEW – 8-VALVE ENGINE

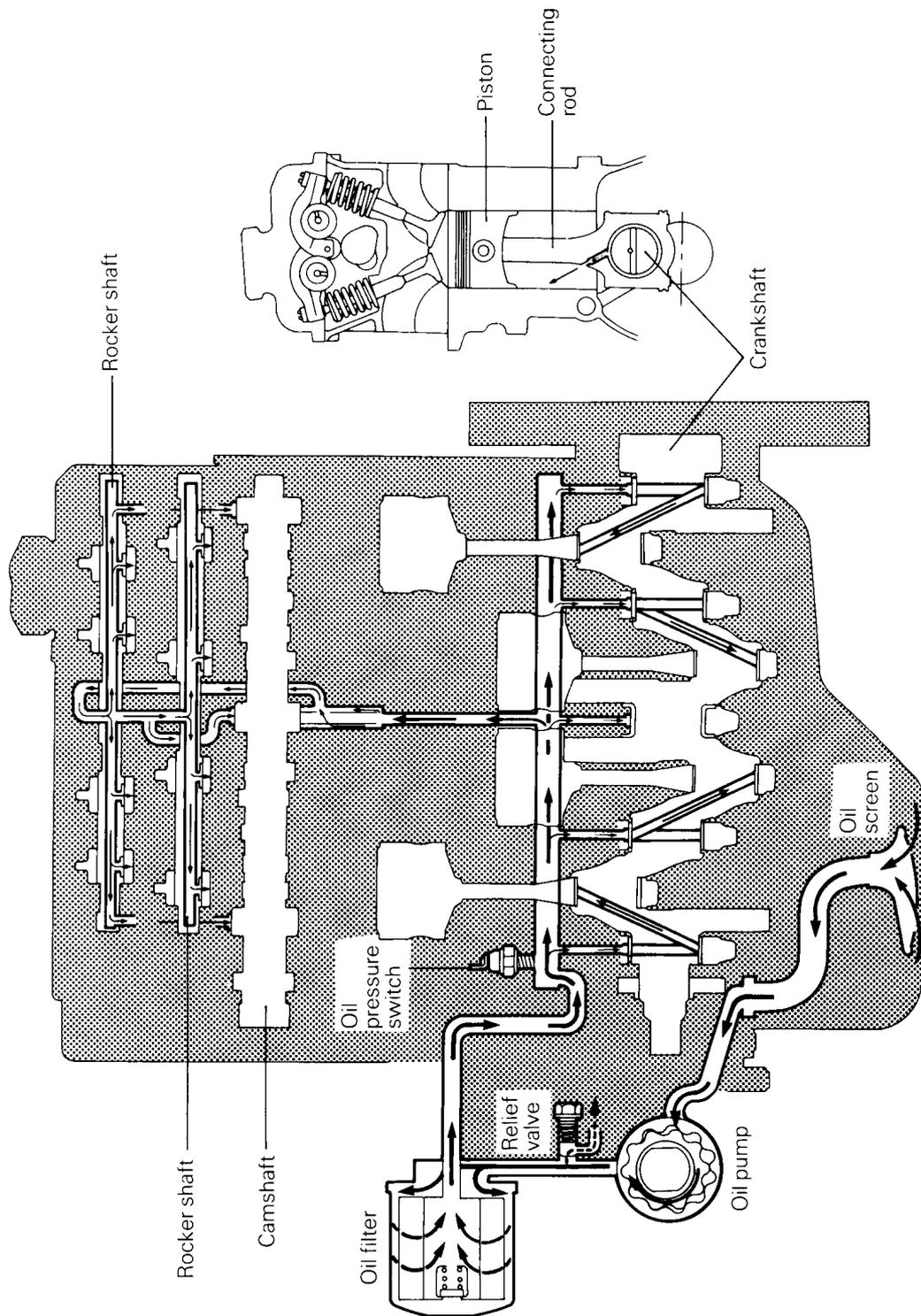




LUBRICATION SYSTEM – 12-VALVE ENGINE



LUBRICATION SYSTEM – 8-VALVE ENGINE



LIST OF MAJOR CHANGES

Description of change		Applicable Engine Model	Effective Date
①	Oil pump has been changed from gear type to trochoid type.	All	From Aug. 1988
②	The connecting rod and crankshaft have been changed for weight reduction of major moving parts. With this change, the tightening method of the connecting rod cap nut has also been changed.	All	From Aug. 1988
③	The crankshaft is now fillet rolled.	All	From Jan. 1989
④	According to the adoption of the selective connecting rod bearings and crankshaft bearings, the bearing selecting procedures have been added.	All	From May 1995

1. SPECIFICATIONS**GENERAL SPECIFICATIONS – 12-VALVE ENGINE**

Description	Specifications
Type	In-line OHV, SOHC
Number of cylinders	4
Combustion chamber	Pentroof type
Total displacement	
4G13	1,298 cc (79.21 cu.in.)
4G15	1,468 cc (89.58 cu.in.)
Cylinder bore	
4G13	71 mm (2.795 in.)
4G15	75.5 mm (2.972 in.)
Piston stroke	82 mm (3.228 in.)
Compression ratio	
4G13	9.5
4G15	9.2
Valve timing: 4G13 and 4G15 carburetor engine	
Intake valve	
Opens	15° BTDC
Closes	53° ABDC
Exhaust valve	
Opens	57° BBDC
Closes	15° ATDC
Valve timing: 4G15 multi-point fuel injection engine for Europe and General Export	
Intake valve	
Opens	17° BTDC
Closes	55° ABDC
Exhaust valve	
Opens	59° BBDC
Closes	17° ATDC
Valve timing: 4G15 multi-point fuel injection engine for Australia	
Intake valve	
Opens	14.5° BTDC
Closes	51.5° ABDC
Exhaust valve	
Opens	51.5° BBDC
Closes	14.5° ATDC
Lubrication system	Pressure feed, full-flow filtration
Oil pump type	Trochoid type
Cooling system	Water-cooled forced circulation
Water pump type	Centrifugal impeller type

GENERAL SPECIFICATIONS – 8-VALVE ENGINE

Description	Specifications
Type	In-line OHV, SOHC
Number of cylinders	4
Combustion chamber	Compact type
Total displacement	
4G16	1,198 cc (73.11 cu.in.)
4G13, G13B	1,298 cc (79.21 cu.in.)
4G15, G15B	1,468 cc (89.58 cu.in.)
Cylinder bore	
4G16	68.2 mm (2.685 in.)
4G13, G13B	71 mm (2.795 in.)
4G15, G15B	75.5 mm (2.972 in.)
Piston stroke	82 mm (3.228 in.)
Compression ratio	
4G16	9.5
4G13, G13B	9.7
4G15, G15B	9.4
Valve timing: 4G16, 4G13 and 4G15	
Intake valve	
Opens	19° BTDC
Closes	57° ABDC
Exhaust valve	
Opens	57° BBDC
Closes	19° ATDC
Valve timing: 4G15 multi-point fuel injection engine for Australia	
Intake valve	
Opens	18.5° BTDC
Closes	51.5° ABDC
Exhaust valve	
Opens	51.5° BBDC
Closes	18.5° ATDC
Valve timing: G13B and G15B	
Intake valve	
Opens	18° BTDC
Closes	49° ABDC
Exhaust valve	
Opens	49° BBDC
Closes	18° ATDC
Lubrication system	Pressure feed, full-flow filtration
Oil pump type	
Up to July 1988	Involute gear type
From August 1988	Trochoid type
Cooling system	Water-cooled forced circulation
Water pump type	Centrifugal impeller type

SERVICE SPECIFICATIONS

		mm (in.)
	Standard	Limit
Cylinder head – 12-valve engine		
Flatness of gasket surface	0.05 (0.0020)	0.2 (0.008)
Grinding limit		*0.2 (0.008)
*If cylinder block gasket surface has already been ground, thickness of the removed stock should be included in the grinding limit of 0.2 mm (0.008 in.).		
Flatness of manifold mounting surface	0.15 (0.0059)	0.3 (0.012)
Overall height	106.9 – 107.1 (4.209 – 4.217)	
Oversize rework dimensions of valve guide hole (both intake and exhaust)		
0.05	12.050 – 12.068 (0.4744 – 0.4751)	
0.25	12.250 – 12.268 (0.4823 – 0.4830)	
0.50	12.500 – 12.518 (0.4921 – 0.4928)	
Oversize rework dimensions of intake valve seat ring hole (primary)		
0.3	27.300 – 27.325 (1.0748 – 1.0758)	
0.6	27.600 – 27.625 (1.0866 – 1.0876)	
Oversize rework dimensions of intake valve seat ring hole (secondary)		
0.3	32.300 – 32.325 (1.2717 – 1.2726)	
0.6	32.600 – 32.625 (1.2835 – 1.2845)	
Oversize rework dimensions of exhaust valve seat ring hole		
0.3	35.300 – 35.325 (1.3898 – 1.3907)	
0.6	35.600 – 35.625 (1.4016 – 1.4026)	
Cylinder head – 8-valve engine		
Flatness of gasket surface	0.05 (0.0020)	0.2 (0.008)
Grinding limit		*0.2 (0.008)
*If cylinder block gasket surface has already been ground, thickness of the removed stock should be included in the grinding limit of 0.2 mm (0.008 in.).		
Flatness of manifold mounting surface	0.15 (0.0059)	0.3 (0.012)
Overall height	106.9 – 107.1 (4.209 – 4.217)	
Oversize rework dimensions of valve guide hole (both intake and exhaust)		
0.05	12.050 – 12.068 (0.4744 – 0.4751)	
0.25	12.250 – 12.268 (0.4823 – 0.4830)	
0.50	12.500 – 12.518 (0.4921 – 0.4928)	
Oversize rework dimensions of intake valve seat ring hole		
0.3	36.300 – 36.325 (1.4291 – 1.4301)	
0.6	36.600 – 36.625 (1.4409 – 1.4419)	
Oversize rework dimensions of exhaust valve seat ring hole		
0.3	32.300 – 32.325 (1.2717 – 1.2726)	
0.6	32.600 – 32.625 (1.2835 – 1.2845)	

	Standard	Limit
Camshaft – 12-valve engine		
Cam height		
Intake	38.75 (1.5256)	38.25 (1.5059)
Exhaust	39.10 (1.5394)	38.60 (1.5197)
Fuel pump driving cam diameter	38.0 (1.500)	37.5 (1.476)
Journal diameter	45.925 – 45.940 (1.8081 – 1.8087)	
Oil clearance	0.06 – 0.10 (0.0024 – 0.0039)	
End play	0.05 – 0.20 (0.0020 – 0.0079)	0.4 (0.016)
Camshaft – 8-valve engine		
Cam height		
Intake	38.08 (1.4992)	37.58 (1.4795)
	*38.91 (1.5319)	38.41 (1.5122)
Exhaust	38.15 (1.5020)	37.65 (1.4823)
	*38.97 (1.5342)	38.47 (1.5146)
Fuel pump driving cam diameter	38.0 (1.500)	37.5 (1.476)
Journal diameter	45.925 – 45.940 (1.8081 – 1.8087)	
Oil clearance	0.06 – 0.10 (0.0024 – 0.0039)	
End play	0.05 – 0.20 (0.0020 – 0.0079)	0.4 (0.016)
*Multi-point fuel injection engine for Australia		
Rocker arm		
I.D.	18.910 – 18.928 (0.7445 – 0.7452)	
Rocker arm-to-shaft clearance	0.01 – 0.04 (0.0004 – 0.0016)	0.1 (0.004)
Rocker shaft – 12-valve engine		
O.D.	18.885 – 18.898 (0.7435 – 0.7440)	
Overall length		
Intake	365 (14.37)	
Exhaust	346 (13.62)	
Rocker shaft – 8-valve engine		
O.D.	18.885 – 18.898 (0.7435 – 0.7440)	
Overall length		
Intake	340 (13.39)	
Exhaust	327 (12.87)	
Valve – 12-valve engine		
Overall length		
Intake	100.75 (3.9665)	
Exhaust	101.05 (3.9783)	
Stem diameter		
Intake	6.565 – 6.580 (0.2585 – 0.2591)	
Exhaust	6.530 – 6.550 (0.2571 – 0.2579)	
Face angle	45° – 45°30'	
Thickness of valve head (margin)		
Intake	1.0 (0.039)	0.5 (0.020)
Exhaust	1.5 (0.059)	1.0 (0.039)
Stem-to-guide clearance		
Intake	0.02 – 0.05 (0.0008 – 0.0020)	0.10 (0.0039)
Exhaust	0.05 – 0.09 (0.0020 – 0.0035)	0.15 (0.0059)

mm (in.)

	Standard	Limit
Valve stem projection		
Intake	43.70 (1.7205)	44.20 (1.7402)
Exhaust	43.30 (1.7047)	43.80 (1.7244)
Valve – 8-valve engine		
Overall length		
Intake (Carburetor)	102.1 (4.020)	
(MPI)	101.6 (4.000)	
Exhaust	100.9 (3.972)	
Stem diameter		
Intake	6.565 – 6.580 (0.2585 – 0.2591)	
Exhaust	6.530 – 6.550 (0.2571 – 0.2579)	
Face angle	45° – 45°30'	
Thickness of valve head (margin)		
Intake	1.0 (0.039)	0.5 (0.020)
Exhaust	1.5 (0.059)	1.0 (0.039)
Stem-to-guide clearance		
Intake	0.02 – 0.05 (0.0008 – 0.0020)	0.10 (0.0039)
Exhaust	0.05 – 0.09 (0.0020 – 0.0035)	0.15 (0.0059)
Valve stem projection		
Intake	41.45 (1.6319)	41.95 (1.6516)
Exhaust	41.35 (1.6279)	41.85 (1.6476)
Valve spring – 12-valve engine		
Free height		
Intake	46.1 (1.815)	45.1 (1.776)
Exhaust	46.8 (1.843)	45.8 (1.803)
Load/installed height N (kg, lbs.)/mm (in.)		
Intake	230 (23, 51)/40 (1.57)	
Exhaust	290 (29, 64)/40 (1.57)	
Out-of-squareness	Max. 2°	4°
Valve spring – 8-valve engine		
Free height	44.6 (1.756)	43.6 (1.717)
Load/installed height N (kg, lbs.)/mm (in.)	242 (24.2, 53)/37.3 (1.469)	
Out-of-squareness	Max. 2°	4°
Valve guide		
Overall length		
Intake	44 (1.732)	
Exhaust	49.5 (1.949)	
I.D.	6.600 – 6.615 (0.2598 – 0.2604)	
O.D.	12.055 – 12.065 (0.4746 – 0.4750)	
Service size	0.05 (0.002), 0.25 (0.01), 0.50 (0.02) oversize	
Press-in temperature	Room temperature	
Valve seat		
Seat angle	45°	
Valve contact width	0.9 – 1.3 (0.035 – 0.051)	
Sinkage		0.2 (0.008)
Service size	0.3 (0.012), 0.6 (0.024) oversize	

	Standard	Limit
Jet valve (G13B and G15B only)		
Overall height	97.53 (3.8398)	
Stem diameter	4.3 (0.169)	
Face angle	45°	
Jet valve spring (G13B and G15B only)		
Free height	29.60 (1.1654)	28.60 (1.1260)
Load/installed height N (kg, lbs.)/mm (in.)	35 (3.5, 7.7)/21.5 (0.846)	
Piston		
O.D.	4G16:68.17 – 68.20 (2.6839 – 2.6850) 4G13, G13B:70.97 – 71.00 (2.7941 – 2.7953) 4G15, G15B:75.47 – 75.50 (2.9713 – 2.9724)	
Piston-to-cylinder clearance	0.02 – 0.04 (0.0008 – 0.0016)	
Ring groove width		
No. 1 ring	1.52 – 1.54 (0.0598 – 0.0606)	
No. 2 ring	1.51 – 1.53 (0.0594 – 0.0602)	
Oil ring	4.02 – 4.05 (0.1583 – 0.1594)	
Service size	0.25 (0.01), 0.50 (0.02), 0.75 (0.03), 1.00 (0.04) oversize	
Piston ring		
End gap		
No. 1 ring	0.20 – 0.35 (0.0079 – 0.0138)	0.8 (0.031)
	*0.20 – 0.40 (0.0079 – 0.0157)	0.8 (0.031)
*Multi-point fuel injection engine for Australia		
No. 2 ring	0.20 – 0.35 (0.0079 – 0.0138)	0.8 (0.031)
	*0.20 – 0.40 (0.0079 – 0.0157)	0.8 (0.031)
*8-valve engines 4G16, G13B, 4G13 and 4G15 for Europe and General Export		
Oil ring	0.20 – 0.70 (0.0079 – 0.0276)	1.0 (0.039)
Ring-to-ring groove clearance		
No. 1 ring	0.03 – 0.07 (0.0012 – 0.0028)	0.1 (0.004)
No. 2 ring	0.02 – 0.06 (0.0008 – 0.0024)	0.1 (0.004)
Service size	0.25 (0.01), 0.50 (0.02), 0.75 (0.03), 1.00 (0.04) oversize	
Piston pin		
O.D.	18.01 (0.7091)	
Press-in load N (kg, psi)	5,000 – 15,000 (500 – 1,500, 1,102 – 3,307)	
Press-in temperature	Room temperature	
Connecting rod		
Big end center-to small end center length	130.95 – 131.05 (5.1555 – 5.1594)	
Bend	0.05 (0.0020)	
Twist	0.1 (0.004)	
Big end side clearance	0.10 – 0.25 (0.0039 – 0.0098)	0.4 (0.016)

mm (in.)

	Standard	Limit
Crankshaft		
End play	0.05 – 0.18 (0.0020 – 0.0071)	0.25 (0.0098)
Journal O.D.	48 (1.89)	
Pin O.D.	42 (1.65)	
Out-of-roundness and taper of journal and pin	0.05 (0.0020)	
Concentricity of journal	0.015 (0.0006)	
Oil clearance of journal	0.02 – 0.07 (0.0008 – 0.0028)	0.15 (0.0059)
Oil clearance of pin	0.02 – 0.06 (0.0008 – 0.0024)	0.15 (0.0059)
Journal under size		
0.25 U.S.	47.740 – 47.725 (1.8795 – 1.8789)	
0.50 U.S.	47.490 – 47.475 (1.8697 – 1.8691)	
0.75 U.S.	47.240 – 47.225 (1.8598 – 1.8593)	
Pin under size		
0.25 U.S.	41.740 – 41.725 (1.6433 – 1.6427)	
0.50 U.S.	41.490 – 41.475 (1.6335 – 1.6329)	
0.75 U.S.	41.240 – 41.225 (1.6236 – 1.6230)	
Cylinder block		
I.D.	4G16: 68.20 – 68.23 (2.6850 – 2.6862) 4G13, G13B: 71.00 – 71.03 (2.7953 – 2.7965) 4G15, G15B: 75.50 – 75.53 (2.9724 – 2.9736)	
Flatness of gasket surface	0.05 (0.020)	0.1 (0.004)
Grinding limit		*0.2 (0.008)
*If cylinder head gasket surface has already been ground, thickness of the removed stock should be included in the grinding limit of –0.2 mm (–0.008 in.).		
Overall height	255.9 – 256.1 (10.075 – 10.083)	
Flywheel		
Runout		0.13 (0.0051)
Oil pump (Involute gear type)		
Tip clearance		
Inner gear	0.21 – 0.34 (0.0083 – 0.0134)	0.5 (0.020)
Outer gear	0.22 – 0.44 (0.0087 – 0.0173)	0.6 (0.024)
Side clearance	0.04 – 0.10 (0.0016 – 0.0039)	0.15 (0.006)
Body clearance	0.10 – 0.20 (0.0039 – 0.0079)	0.30 (0.012)
Oil pump (Trochoid type)		
Tip clearance	0.06 – 0.18 (0.0024 – 0.0071)	0.35 (0.0138)
Side clearance	0.04 – 0.10 (0.0016 – 0.0039)	0.2 (0.0079)
Body clearance	0.10 – 0.18 (0.0039 – 0.0071)	0.35 (0.0138)
Drive belt deflection		
New belt	5.5 – 7.0 (0.22 – 0.28)	
Used belt	8.0 (0.32)	

Standard

Limit

Thermostat

Identification mark "82"

Initial opening temperature	82°C (179°F)
Fully opened temperature	95°C (203°F)
Lift	8 (0.32) or more

Identification mark "88"

Initial opening temperature	88°C (179°F)
Fully opened temperature	100°C (212°F)
Lift	8 (0.32) or more

Coolant temperature gauge unit

Resistance	230Ω at 50°C (122°F)
	104Ω at 70°C (158°F)

Coolant temperature sensor

Resistance	5.9kΩ at 0°C (32°F)
	2.5kΩ at 20°C (68°F)
	1.1kΩ at 40°C (104°F)
	0.3kΩ at 80°C (176°F)

TORQUE SPECIFICATIONS

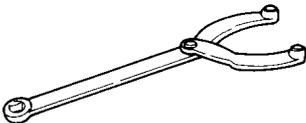
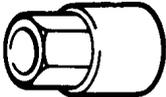
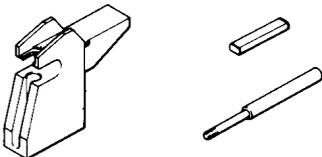
	Torque		
	Nm	kgm	ft.lbs.
Drive belt and timing belt			
Water pump pulley bolt	9	0.9	7
Crankshaft pulley bolt	14	1.4	11
Crankshaft bolt	105	10.5	76
Timing belt tensioner bolt	24	2.4	18
Camshaft sprocket bolt	70	7.0	51
Intake manifold			
Cable bracket bolt	14	1.4	11
Coolant temperature gauge unit	11	1.1	8
Coolant temperature sensor	30	3.0	22
Water outlet fitting bolt	19	1.9	14
Thermostat housing bolt and nut	19	1.9	14
Intake manifold stay bolt			
MPI engine	22	2.2	16
Carburetor engine	26	2.6	19
Intake manifold bolt and nut	18	1.8	13
Air intake plenum stay bolt	18	1.8	13
Air intake plenum bolt and nut	18	1.8	13
Exhaust manifold and water pump			
Exhaust manifold cover "A" bolt	30	3.0	22
Exhaust manifold cover "A" and "B" mounting bolt	9	0.9	7
Exhaust manifold cover "A" bolt	24	2.4	18
Water inlet pipe bolt	14	1.4	11
Water pump bolt	14	1.4	11
Alternator brace installed portion	24	2.4	18
Rocker arms and camshaft			
Rocker cover bolt	1.8	0.18	1.3
Rocker arm shaft bolt			
12-valve engine	32	3.2	24
8-valve engine	24	2.4	18
Rocker arm lock nut			
Intake and exhaust	15	1.5	11
Jet valve	9	0.9	7
Cylinder head and valves			
Cylinder head bolt	73	7.3	53
Jet valve assembly (with engine oil applied to threads and seat surface)	20	2.0	15

	Nm	Torque kgm	Nm
Front case and oil pump			
Oil pan drain plug	40	4.0	29
Oil pan bolt	7	0.7	5
Oil screen bolt	19	1.9	14
Oil relief valve plug	45	4.5	33
Front case bolt	14	1.4	11
Oil pump cover screw	9	0.9	7
Piston and connecting rod			
Connecting rod cap nut			
M7	20 + 1/4 turns	2.0 + 1/4 turns	15 + 1/4 turns
M8	34	3.4	25
Crankshaft, flywheel and drive plate			
Flywheel and drive plate	135	13.5	98
Bell housing cover bolt	9	0.9	7
Oil seal case bolt	11	1.1	8
Bearing cap bolt	53	5.3	38
Cylinder block			
Engine support bracket, front	60	6.0	64
Engine support bracket, left	36	3.6	26
Roll stopper bracket, front	65	6.5	47
Roll stopper bracket, left	65	6.5	47
Oil pressure switch	19	1.9	14

SEALANT

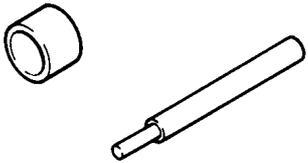
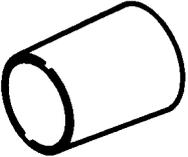
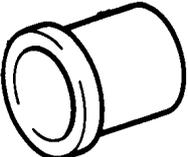
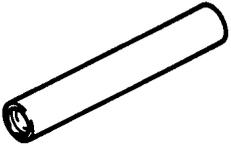
	Specified sealant	Quantity
Engine coolant temperature sensor	3M Nut Locking part No. 4171 or equivalent	As required
Engine coolant temperature gauge unit	3M ATD Part No. 8660 or equivalent	As required
Oil pan	3M ATD Part No. 8660 or equivalent	As required
Oil pressure switch threads	3M ATD Part No. 8660 or equivalent	As required

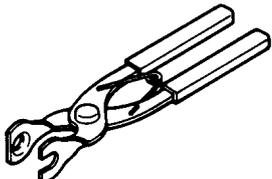
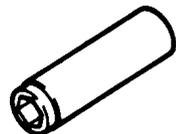
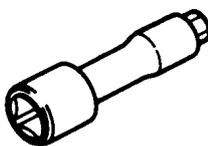
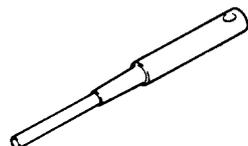
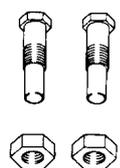
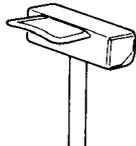
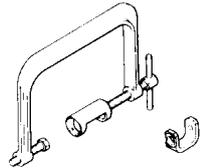
2. SPECIAL TOOLS

Tool	Number	Name	Use
	MB990767	End yoke holder	Holding of sprocket when loosening or tightening camshaft sprocket bolt [used with MD998719]
	MD998011	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal
	MD998054	Oil pressure switch wrench	Removal and installation of oil pressure switch
	MD998158 (in-take) MD998156 (exhaust)	Valve seat cutter 45°	Correction of valve seat
	MD998165 (in-take) MD998614 (exhaust)	Valve seat cutter 65°	Correction of valve seat
	MD998173 (in-take) MD998171 (exhaust)	Valve seat cutter 30°	Correction of valve seat
	MD998300	Piston pin setting tool	Removal and installation of piston pin <8-valve engine> [Guide is only for vehicles built up to August 1988]

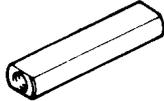
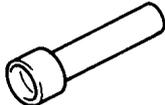
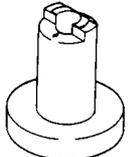
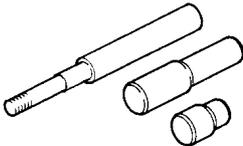
11A-2-2

ENGINE – Special Tools

Tool	Number	Name	Use
	MD998301	Valve guide installer	Removal and installation of valve guide
	MD998302	Valve stem seal installer	Installation of valve stem seal <8-valve engine>
	MD998304	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MD998305	Crankshaft front oil seal guide	Guide for installation of crankshaft front oil seal
	MD998306	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998307	Camshaft oil seal guide	Guide for installing camshaft oil seal (Used with MD998306)
	MD998308	Jet valve stem seal installer	Installation of jet valve stem seal oil seal

Tool	Number	Name	Use
	MD998309	Jet valve spring pliers	Compression of jet valve spring
	MD998310	Jet valve socket wrench	Removal and installation of jet valve
	MD998360	Cylinder head bolt wrench	Removal and installation of cylinder head bolt
	MD998615	Valve seat cutter pilot	Correction of valve seat
	MD998715	Pin	Holding of sprocket when loosening or tightening camshaft sprocket bolt [used with MD990767]
	MB998727	Oil pan remover	Removal of oil pan
	MD998735	Valve spring compressor	Compression of valve spring

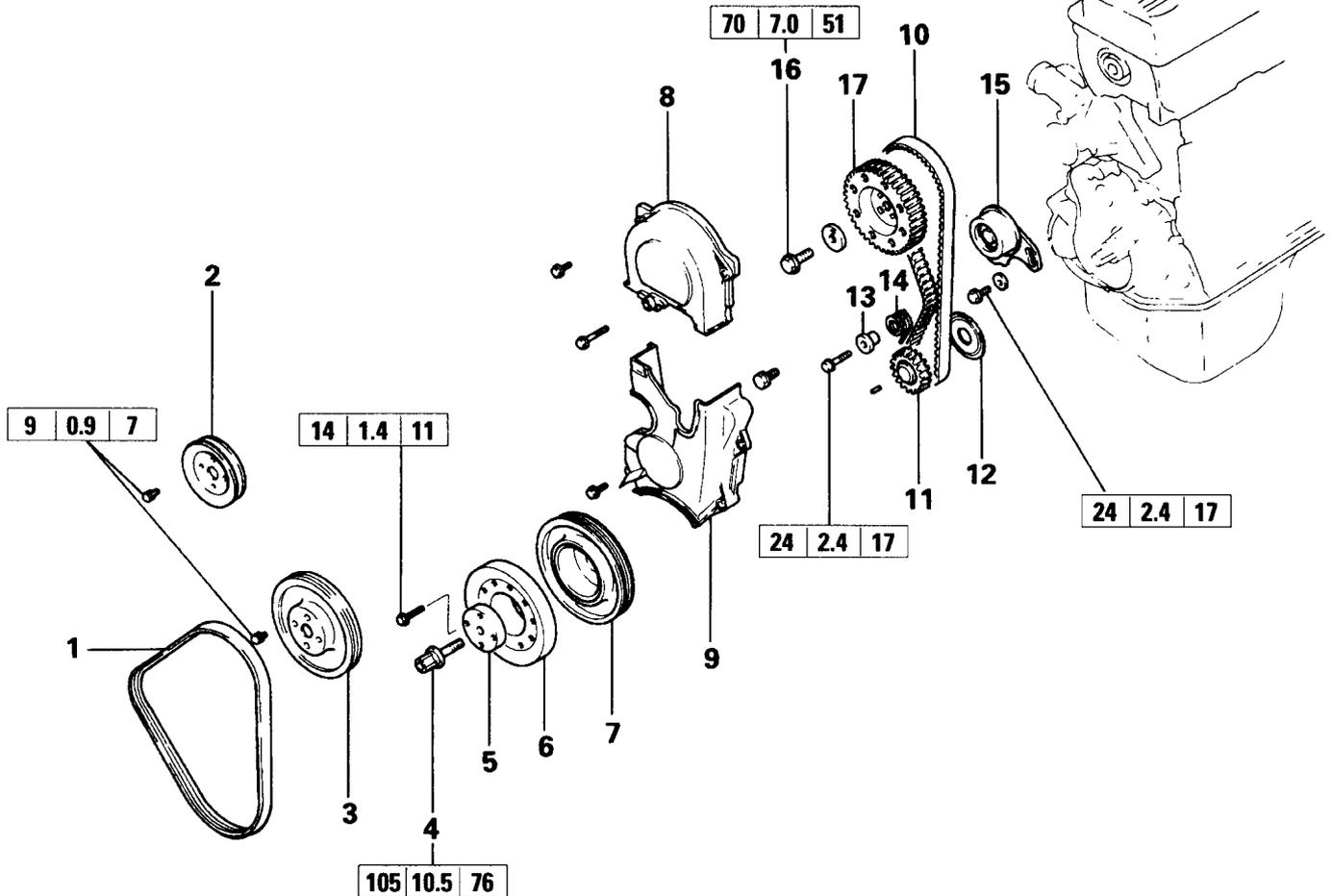
11A-2-4**ENGINE – Special Tools**

Tool	Number	Name	Use
	MD998756	Guide	Installation of piston pin <8-valve engine> [For vehicles built from September 1988. Used in combination with MD998300]
	MD998760	Valve stem seal installer	Installation of valve stem seal <12-valve engine>
	MD998764	Piston pin setting base	Removal and installation of piston pin <12-valve engine> [used with MD998766]
	MD998766	Push rod & guide set	Removal and installation of piston pin <12-valve engine> [used with MD998764]

3. DRIVE BELT AND TIMING BELT REMOVAL AND INSTALLATION

Pre-removal/post-installation operations

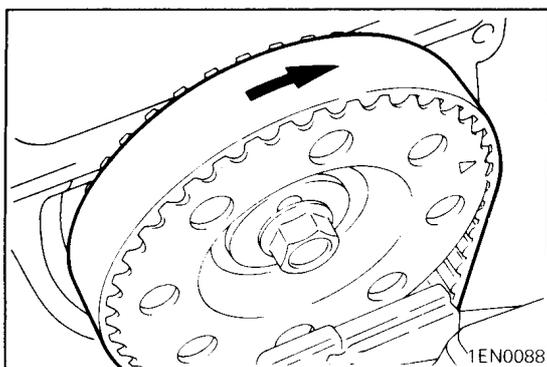
- Removal/installation of alternator
(See Group 16A).



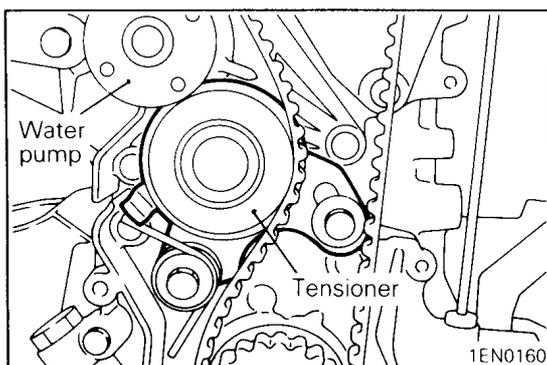
Removal steps

- ▶E▶ 1. Drive belt
- 2. Pulley (for power steering pump drive)
- 3. Water pump pulley
- 4. Crankshaft pulley bolt
- 5. Special washer
- 6. Crankshaft pulley
- 7. Damper pulley
- 8. Timing belt upper cover
- 9. Timing belt lower cover
- ◁A▶▶D▶ 10. Timing belt
- 11. Crankshaft sprocket
- ▶C▶ 12. Flange
- 13. Tensioner spacer
- 14. Tensioner spring
- ▶B▶ 15. Timing belt tensioner
- ◁B▶▶A▶ 16. Camshaft sprocket bolt
- 17. Camshaft sprocket

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**SERVICE POINTS OF DISASSEMBLY****◊A◊ REMOVAL OF TIMING BELT**

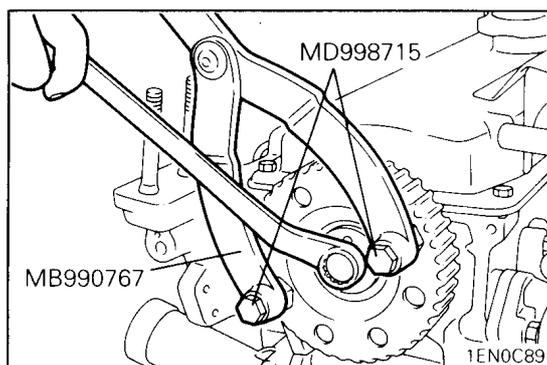
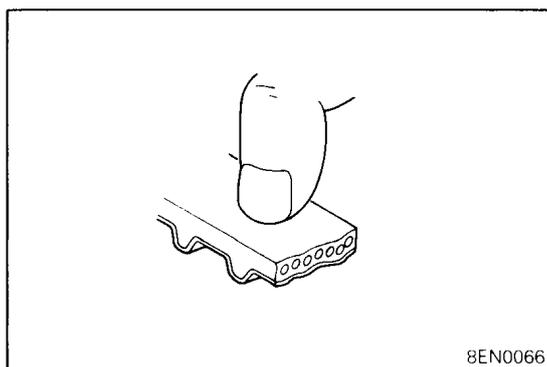
- (1) Using chalk, etc., mark an arrow on the back of the timing belt to indicate the direction of rotation. This is to ensure correct installation of the belt in case it is reused.



- (2) Slide the tensioner toward the pump as illustrated and tighten the bolt.
- (3) Remove the timing belt.

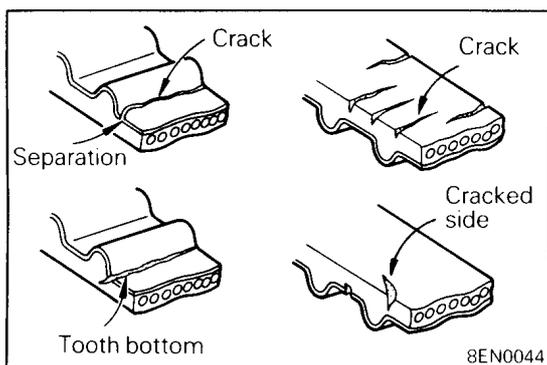
NOTE

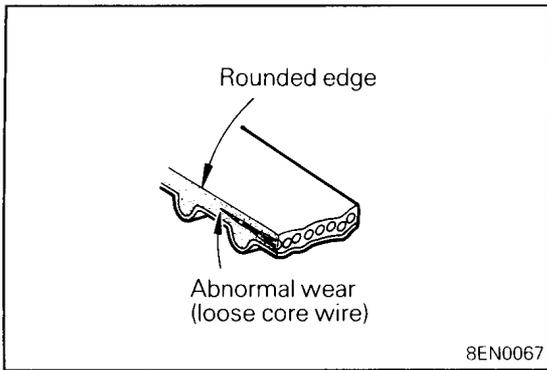
- (1) Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. Do not immerse parts in cleaning solvent.
- (2) If there is oil or water on any part, check front case oil seal, camshaft oil seal and water pump for leaks.

**◊B◊ LOOSENING OF CAMSHAFT SPROCKET BOLT****INSPECTION****TIMING BELT**

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

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

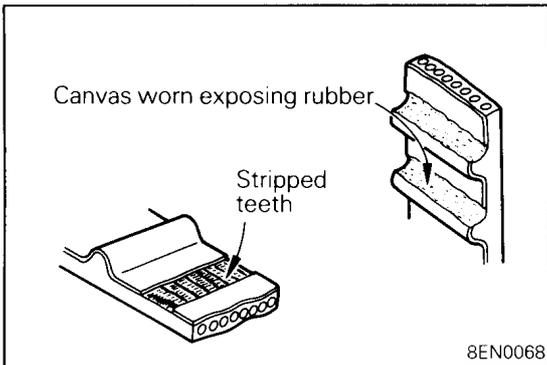




(6) Abnormal wear on side

NOTE

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



(7) Abnormal wear in teeth

Initial stage:

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

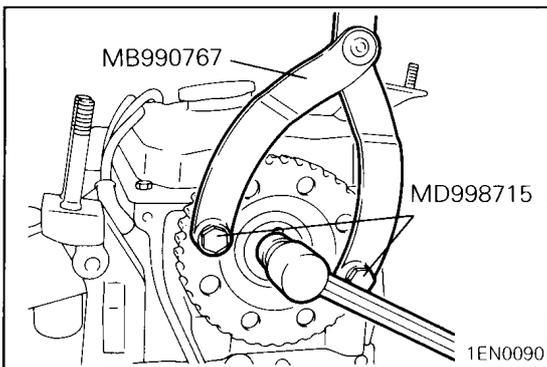
Final stage:

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

(8) Missing tooth

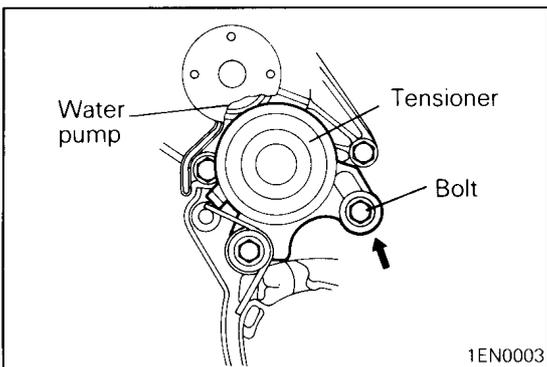
SERVICE POINTS OF REASSEMBLY

◆A◆ TIGHTENING OF CAMSHAFT SPROCKET BOLT



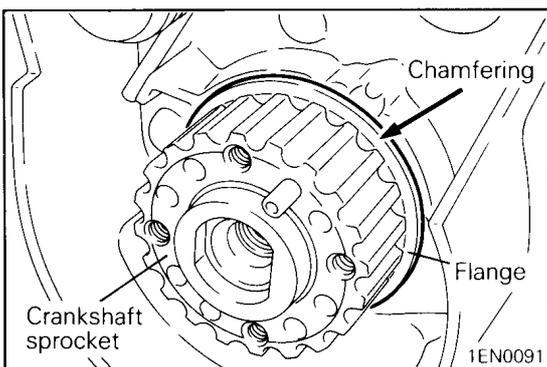
◆B◆ INSTALLATION OF TIMING BELT TENSIONER

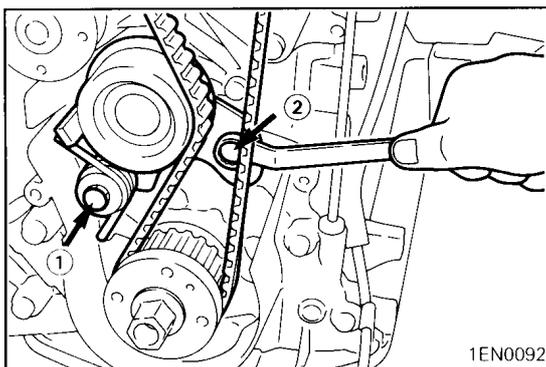
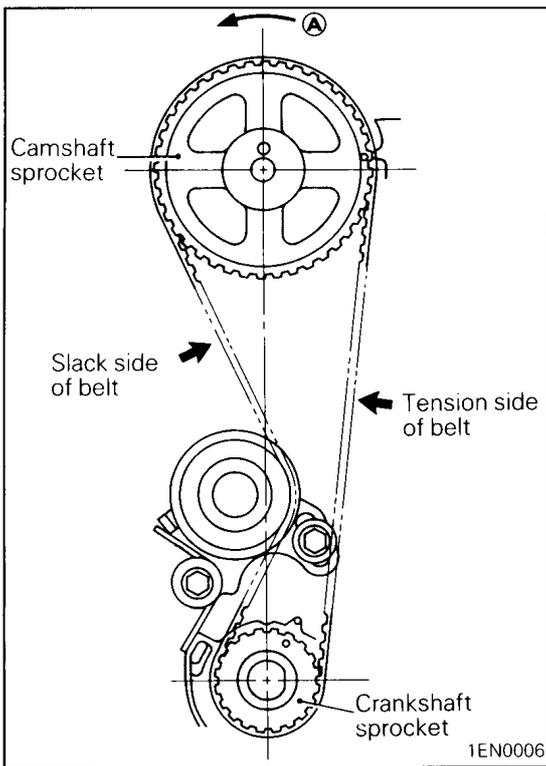
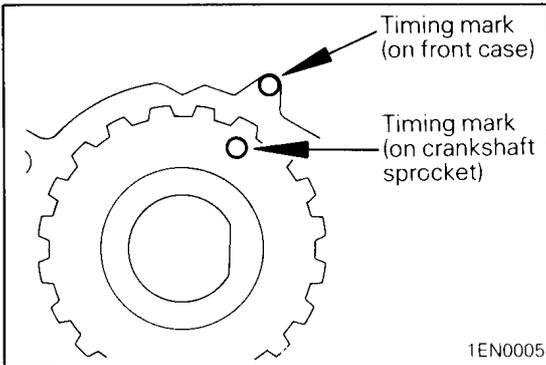
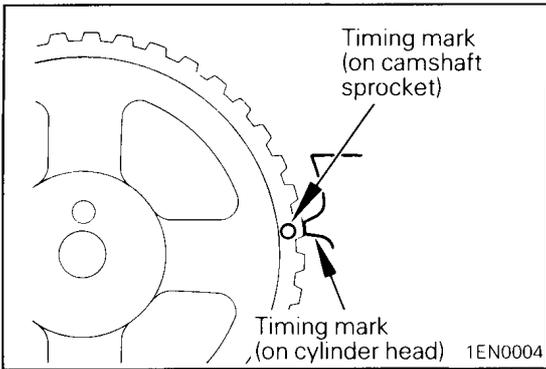
(1) Move tensioner pulley toward water pump and tighten tensioner mounting bolts.



◆C◆ INSTALLATION OF FLANGE

(1) Flange must be installed with its chamfered face toward the sprocket.





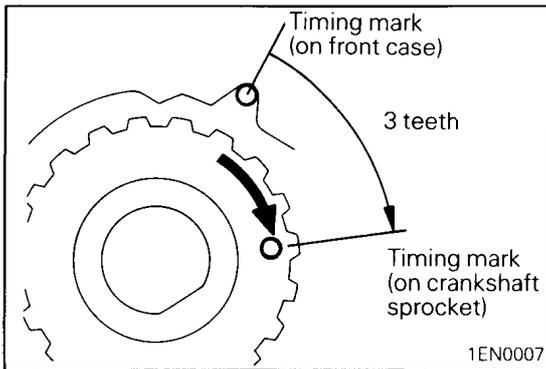
INSTALLATION OF TIMING BELT

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

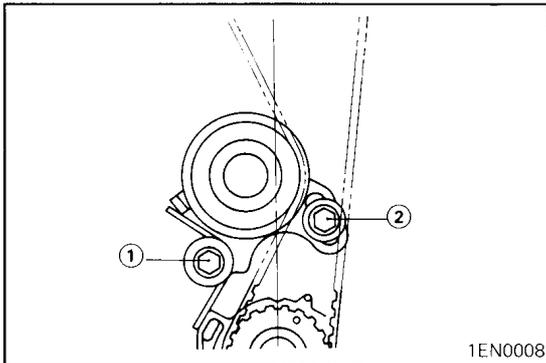
(2) Set the timing belt first on crankshaft sprocket and then keeping the tension side belt tight, set on the camshaft sprocket.

(3) Loosen the tensioner mounting bolts ① and ② to apply tension to the belt by tensioner spring force.

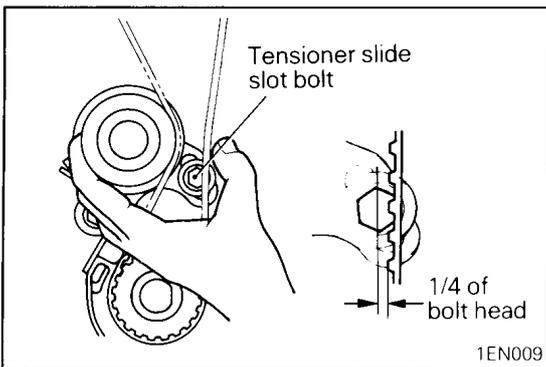
(4) Check that the belt completely meshes with the sprocket. Also check the alignment of the timing marks on the sprockets.



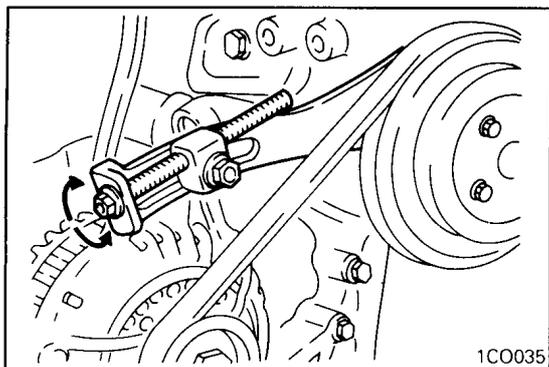
- (5) Turn the crankshaft clockwise by 3 teeth of crankshaft sprocket.



- (6) Tighten the bolt ② first and then tighten the bolt ①. Do not tighten the bolt ① first, otherwise the tensioner will move with the bolt when tightening, resulting in an overtensioned belt.



- (7) Check the belt tension. Hold the tensioner and timing belt together by hand and give the belt a slight thumb pressure at a point level with tensioner center. Make sure that belt cog crest comes as deep as about 1/4 of the width of the slot side tensioner bolt head.



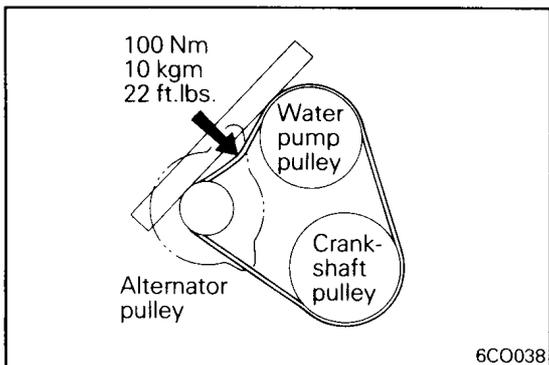
◆E◆ ADJUSTMENT OF DRIVE BELT TENSION

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

Standard value:

New belt: 5.5 – 7.0 mm (0.22 – 0.28 in.)

Used belt: 8.0 mm (0.32 in.)



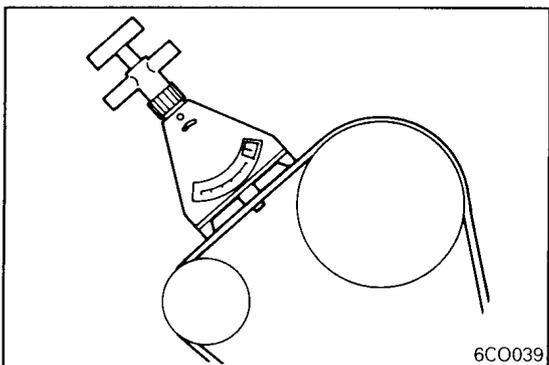
Or using tension gauge, turn adjusting bolt to adjust tension to standard value.

Standard value:

New belt: 500 – 700 N (50 – 70 kg, 110 – 154 lbs.)

Used belt: 400 N (40 kg, 88 lbs.)

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



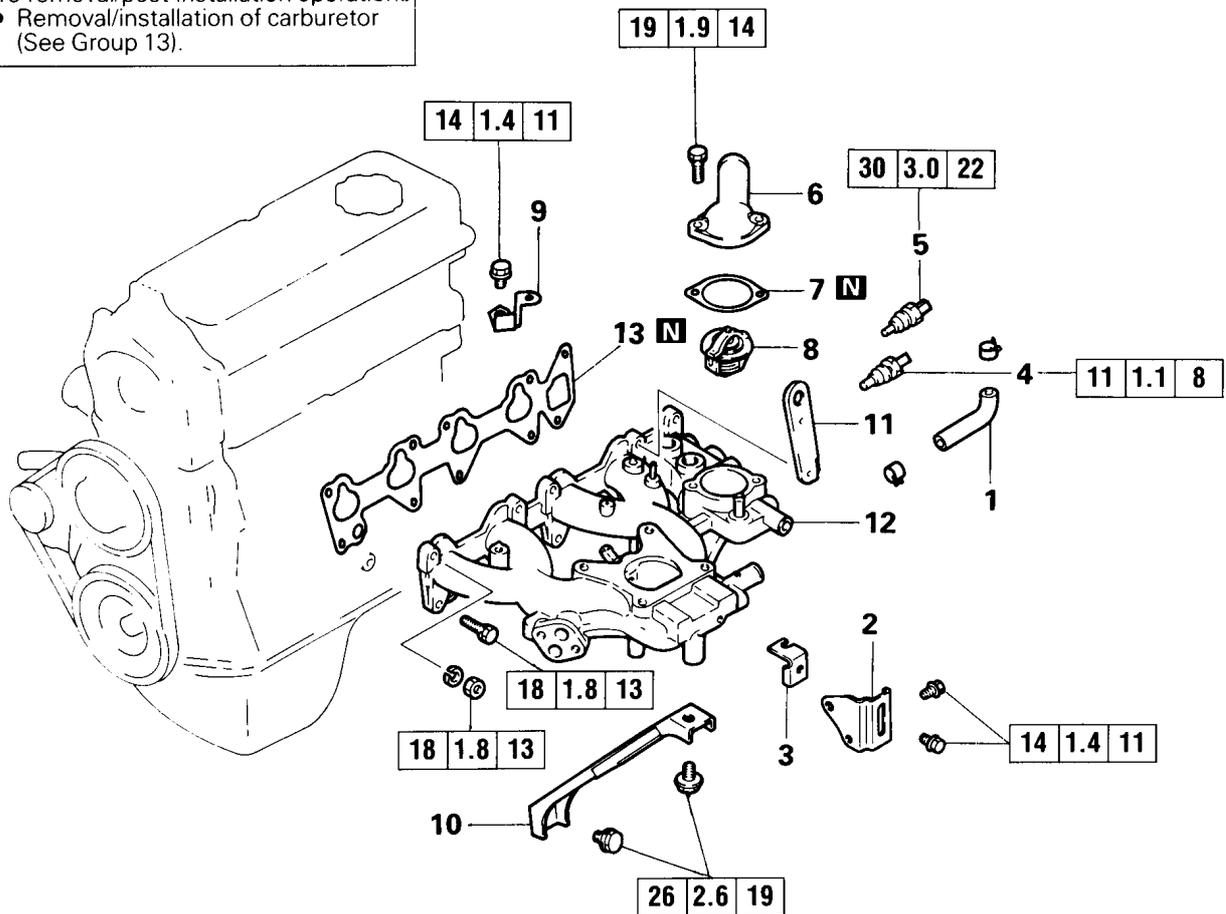
4. INTAKE MANIFOLD

REMOVAL AND INSTALLATION

<12-VALVE ENGINE – CARBURETOR TYPE>

Pre-removal/post-installation operations

- Removal/installation of carburetor (See Group 13).



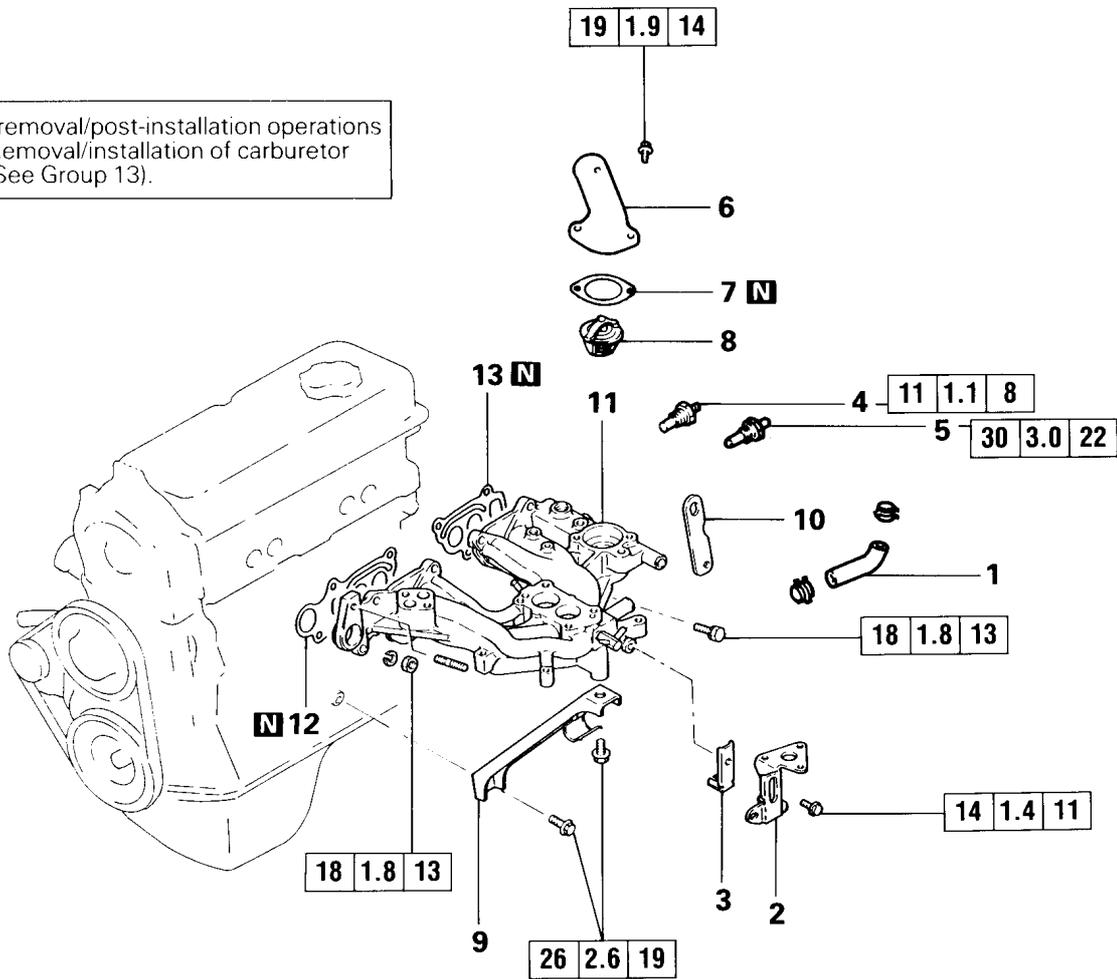
Removal steps

1. Water hose
2. Cable bracket, outer
3. Cable bracket, inner } (A/T only)
- ◆C◆ 4. Coolant temperature gauge unit
- ◆B◆ 5. Coolant temperature sensor (Only for engine with electronic control carburetor)
6. Water outlet fitting
- ◆A◆ 7. Water outlet fitting gasket
8. Thermostat
9. Bracket
10. Intake manifold stay
11. Engine hanger
12. Intake manifold
13. Intake manifold gasket

REMOVAL AND INSTALLATION

<8-VALVE ENGINE – CARBURETOR TYPE>

Pre-removal/post-installation operations
 • Removal/installation of carburetor
 (See Group 13).



Removal steps

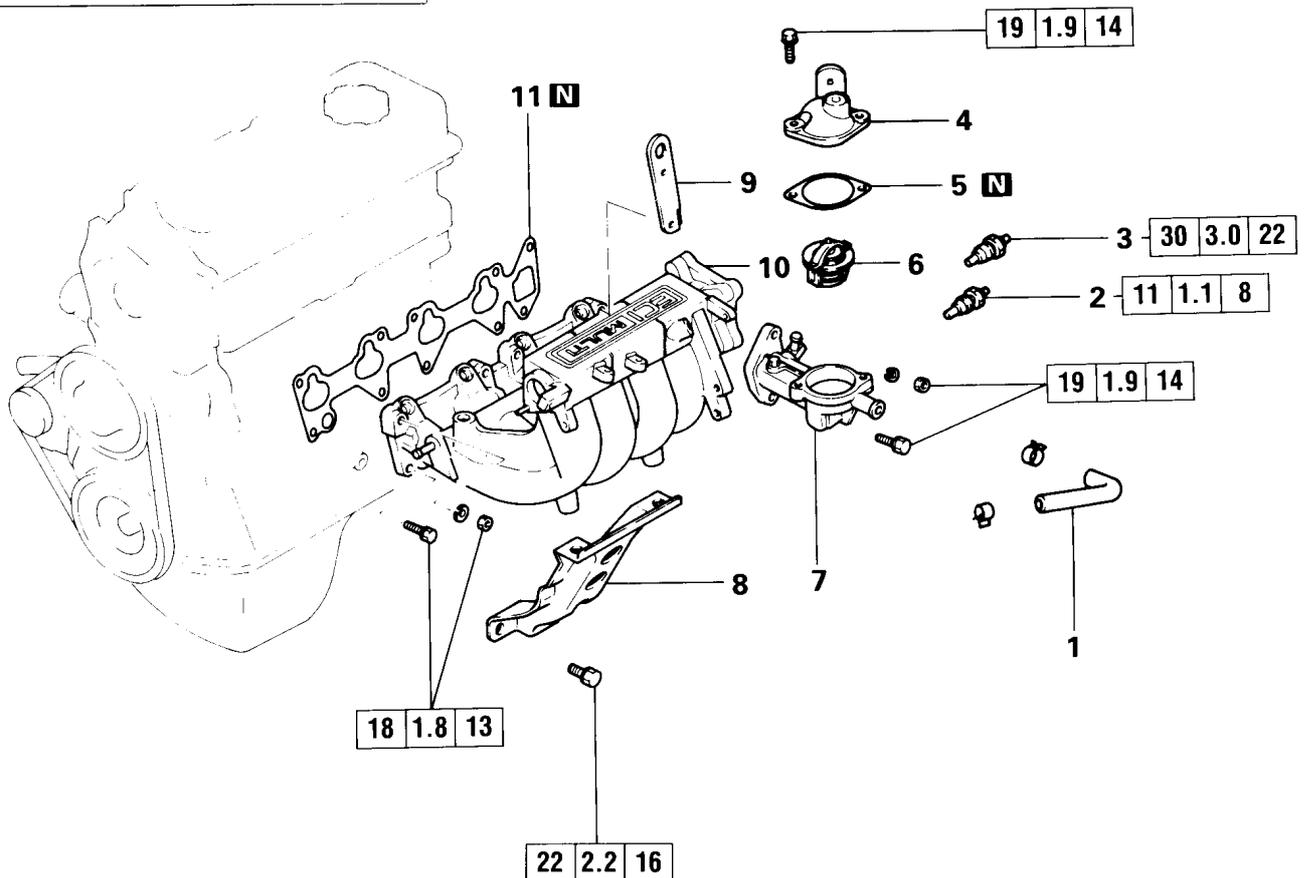
1. Water hose
2. Cable bracket, outer } (A/T only)
3. Cable bracket, inner }
- ◆C◆ 4. Coolant temperature gauge unit
- ◆B◆ 5. Coolant temperature sensor (Only for engine with electronic control carburetor)
6. Water outlet fitting
- ◆A◆ 7. Water outlet fitting gasket
8. Thermostat
9. Intake manifold stay
10. Engine hanger
11. Intake manifold
12. Intake manifold gasket, front
13. Intake manifold gasket, rear

REMOVAL AND INSTALLATION

<12-VALVE ENGINE – MULTI-POINT FUEL INJECTION TYPE>

Pre-removal/post-installation operations

- Removal/installation of throttle body (See Group 13).



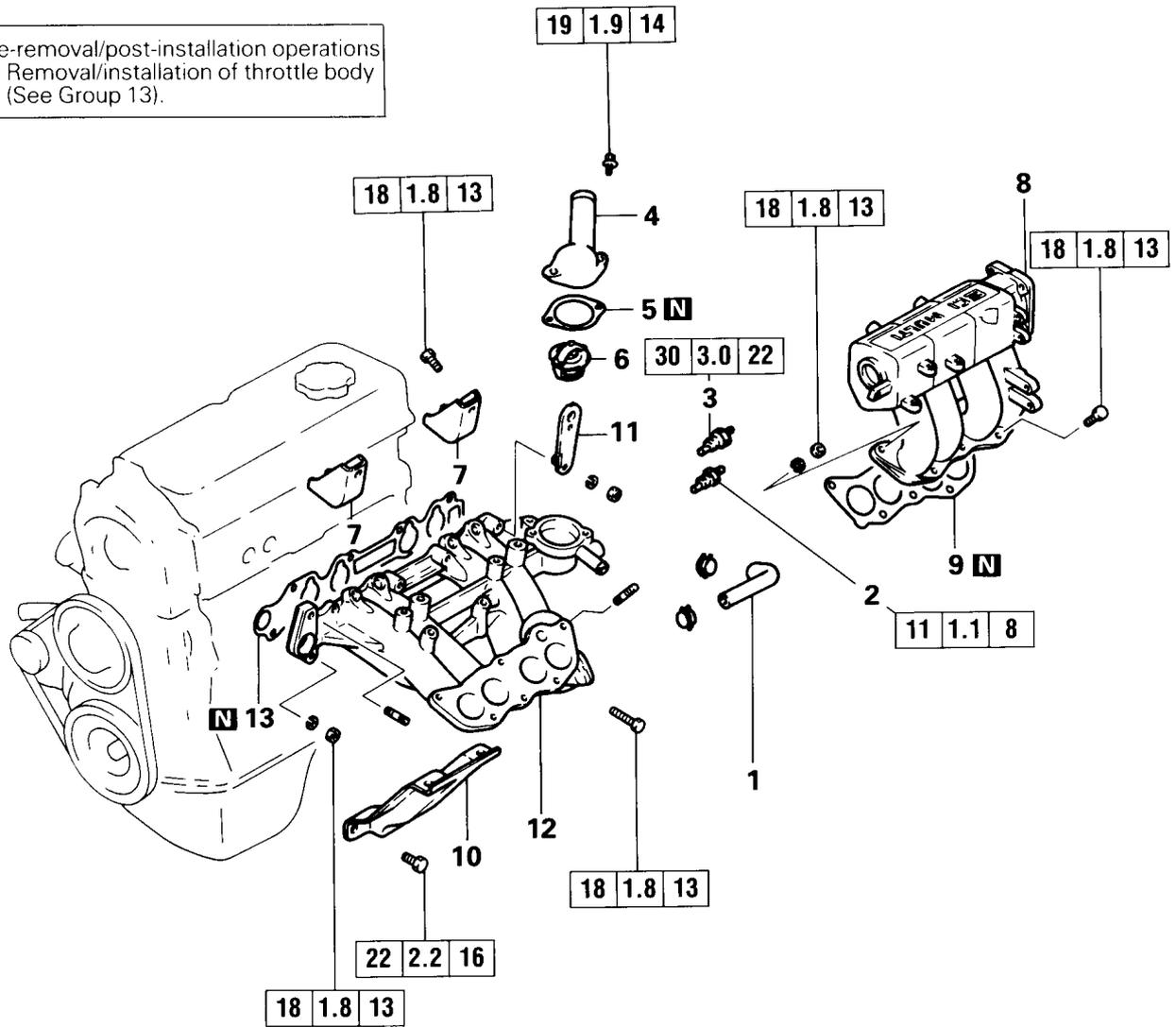
Removal steps

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

REMOVAL AND INSTALLATION

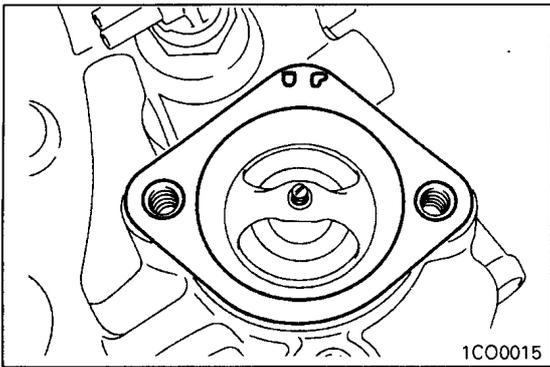
<8-VALVE ENGINE – MULTI-POINT FUEL INJECTION TYPE>

Pre-removal/post-installation operations
 • Removal/installation of throttle body
 (See Group 13).

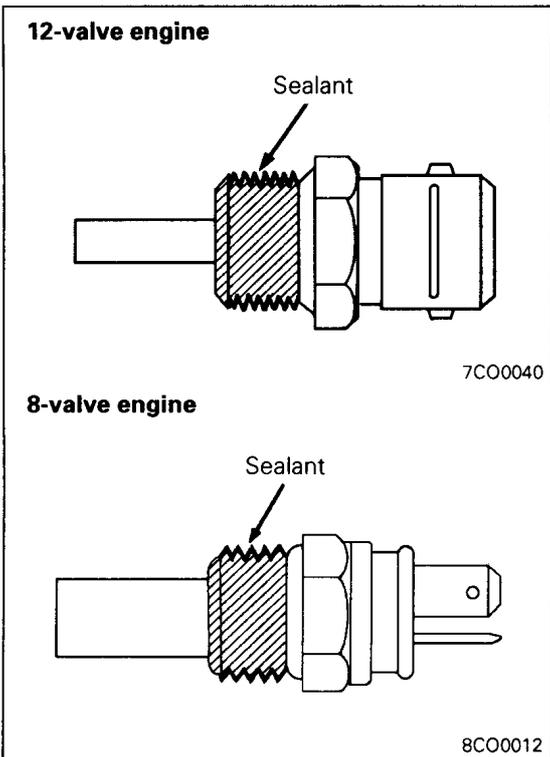


Removal steps

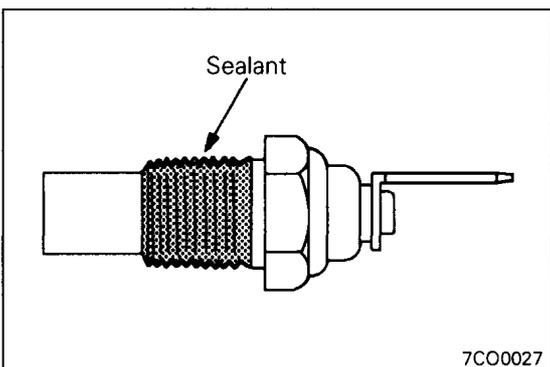
1. Water hose
- ▶C▶ 2. Coolant temperature gauge unit
- ▶B▶ 3. Coolant temperature sensor
- ▶A▶ 4. Water outlet fitting
5. Water outlet fitting gasket
6. Thermostat
7. Air intake plenum stay
8. Air intake plenum
9. Air intake plenum gasket
10. Intake manifold stay
11. Engine hanger
12. Intake manifold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

**SERVICE POINTS OF INSTALLATION****◆A◆ INSTALLATION OF WATER OUTLET FITTING GASKET FOR RUBBER COATED METAL GASKET ONLY**

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

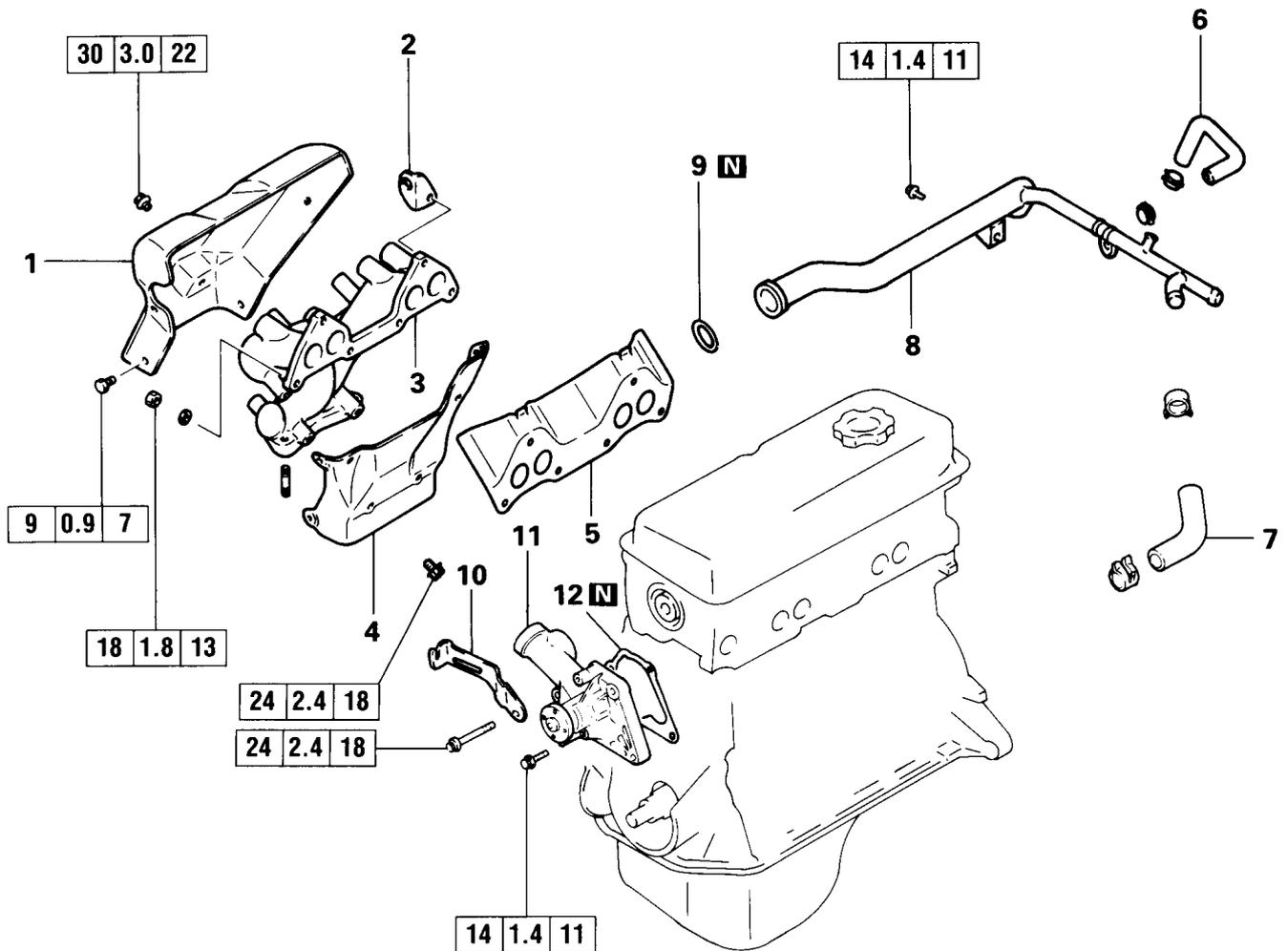
**◆B◆ APPLICATION OF SEALANT TO WATER TEMPERATURE SENSOR**

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

**◆C◆ APPLICATION OF SEALANT TO WATER TEMPERATURE GAUGE UNIT**

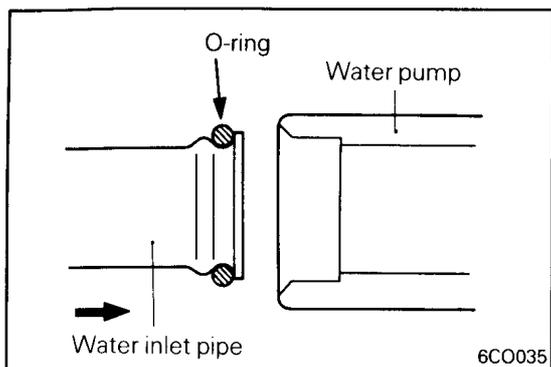
Specified sealant:
3M ATD Part No. 8660 or equivalent

5. EXHAUST MANIFOLD AND WATER PUMP REMOVAL AND INSTALLATION



Removal steps

1. Exhaust manifold cover "A"
2. Engine hanger
3. Exhaust manifold
4. Exhaust manifold cover "B"
5. Exhaust manifold gasket
6. Water hose
7. Water by-bass hose (Carburetor type only)
- ▶▶ 8. Water inlet pipe
- ▶▶ 9. O-ring
10. Alternator brace
11. Water pump
12. Water pump gasket

**SERVICE POINTS OF INSTALLATION****◆A◆ INSTALLATION OF WATER PIPE / O-RING**

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

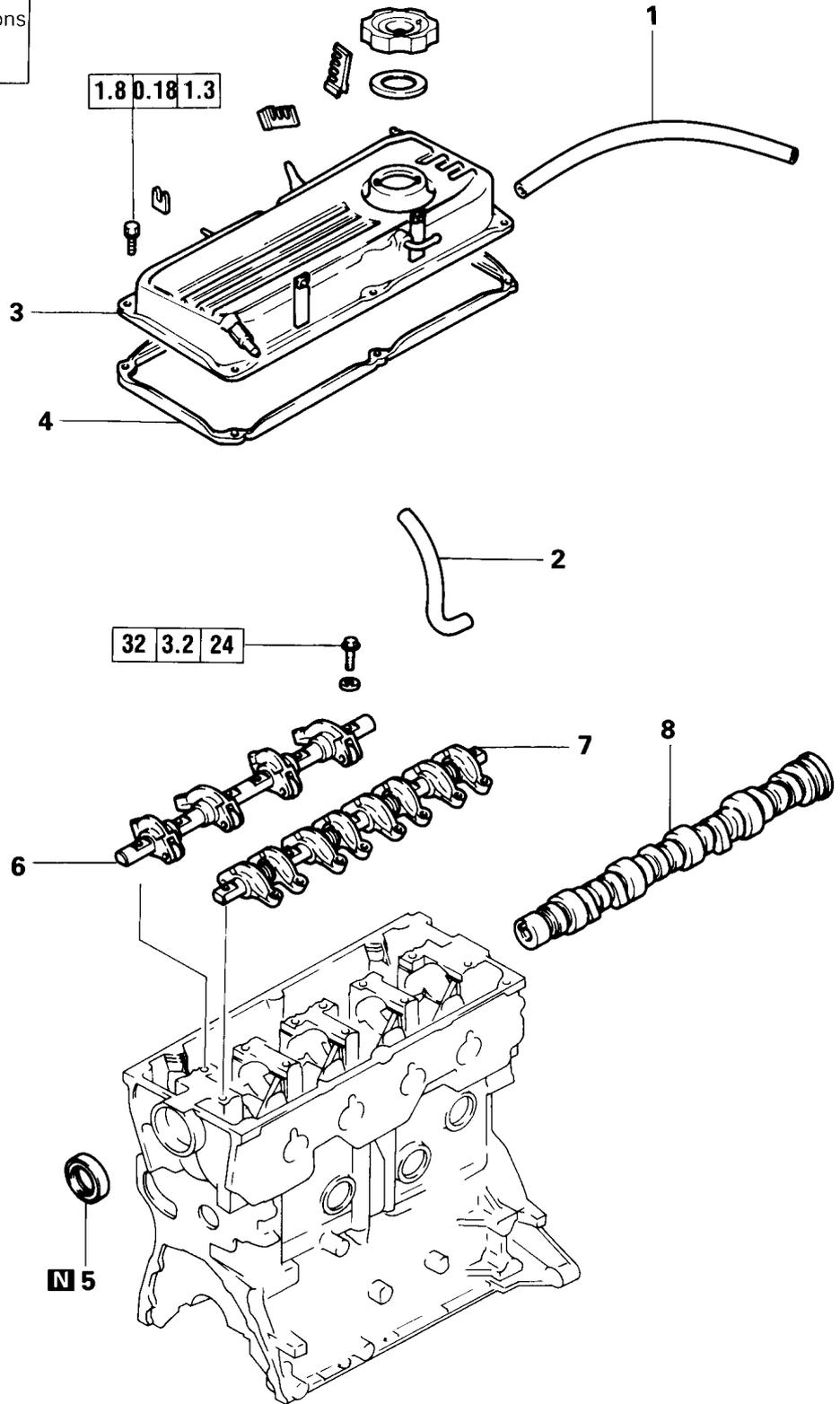
Caution

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

6. ROCKER ARMS AND CAMSHAFT

REMOVAL AND INSTALLATION <12-VALVE ENGINE>

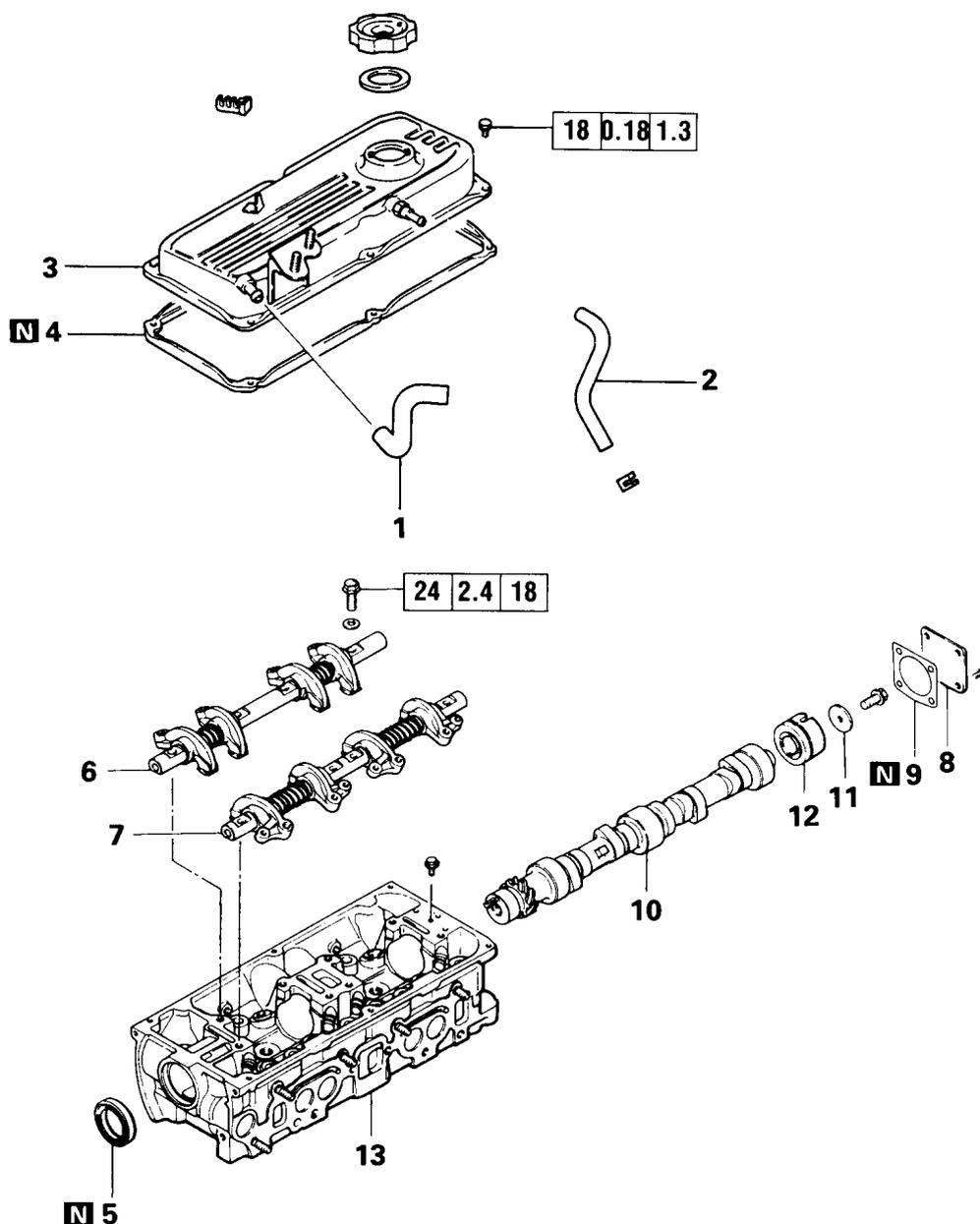
Pre-removal/post-installation operations
 • Removal/installation of distributor
 (See Group 16C).



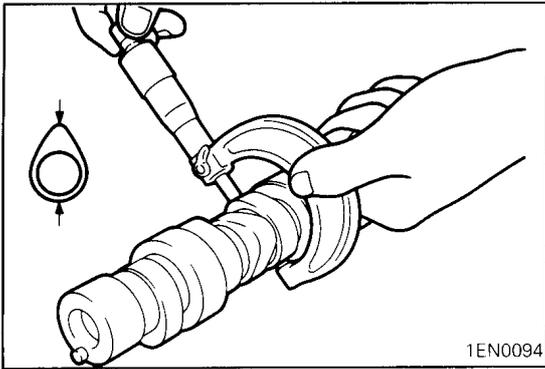
Removal steps

1. Breather hose
2. PCV hose
3. Rocker cover
4. Rocker cover gasket
- ▶C▶ 5. Oil seal
- ▶A▶ 6. Rocker arm and shaft assembly
7. Rocker arm and shaft assembly
- ▶A▶ 8. Camshaft

REMOVAL AND INSTALLATION <8-VALVE ENGINE>

**Removal steps**

1. Breather hose
2. PCV hose
3. Rocker cover
4. Rocker cover gasket
- ◆C◆ 5. Oil seal
6. Rocker arm and shaft assembly
7. Rocker arm and shaft assembly
8. Rear cover
9. Rear cover gasket
- ◆A◆ 10. Camshaft
11. Thrust plate
- ◆B◆ 12. Camshaft thrust case
13. Cylinder head



INSPECTION

CAMSHAFT

(1) Measure the cam height.

12-VALVE ENGINE

Standard value:

Intake	38.75 mm (1.5256 in.)
Exhaust	39.10 mm (1.5394 in.)

Limit:

Intake	38.25 mm (1.5059 in.)
Exhaust	38.60 mm (1.5197 in.)

8-VALVE ENGINE

Standard value:

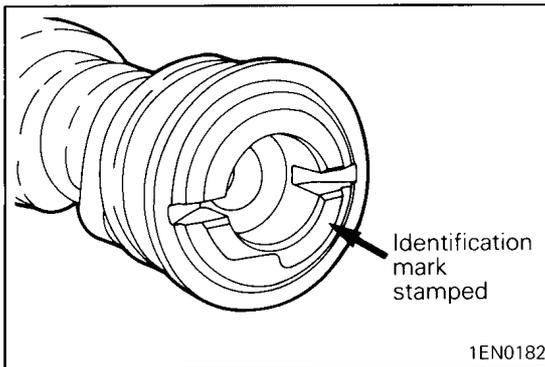
Intake	38.08 mm (1.4992 in.)
	38.91 mm (1.5319 in.)*
Exhaust	38.15 mm (1.5020 in.)
	38.97 mm (1.5342 in.)*

Limit:

Intake	37.58 mm (1.4795 in.)
	38.41 mm (1.5122 in.)*
Exhaust	37.65 mm (1.4823 in.)
	38.47 mm (1.5146 in.)*

NOTE

*4G15 Multi-point fuel injection for Australia only.

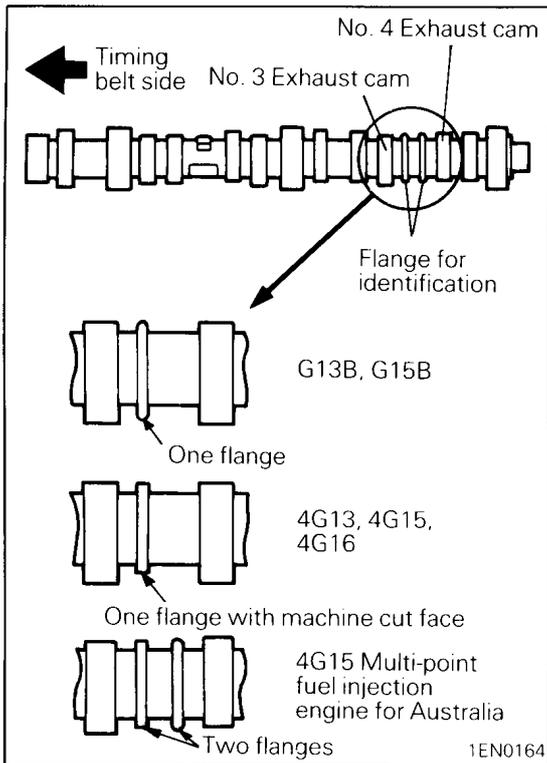


SERVICE POINTS OF INSTALLATION

◆A◆ IDENTIFICATION OF CAMSHAFT – 12-VALVE ENGINE

Identification mark:

Multi-point fuel injection engine for Australia	1
Carburetor engine	3
Multi-point fuel injection engine	4
for Europe and General Export	



◆A◆ IDENTIFICATION OF CAMSHAFT – 8-VALVE ENGINE

◆B◆ INSTALLATION OF CAMSHAFT THRUST CASE

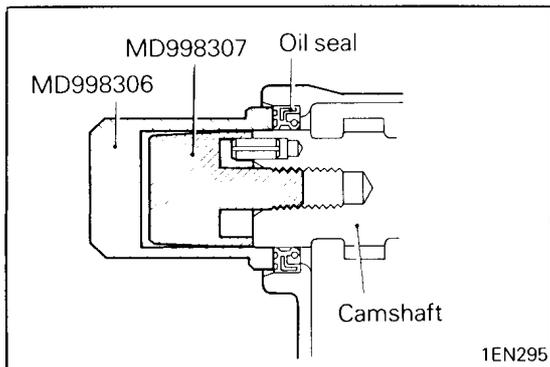
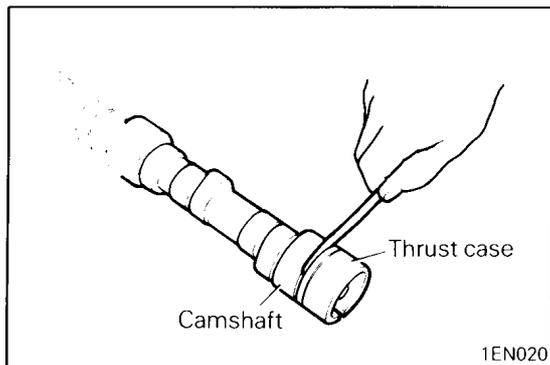
- (1) Install the thrust case to the camshaft.
- (2) Measure the camshaft end play using a feeler gauge. If it exceeds the limit, replace the thrust case.

Standard value: 0.05 – 0.20 mm (0.0020 – 0.0079 in.)

Limit: 0.4 mm (0.0157 in.)

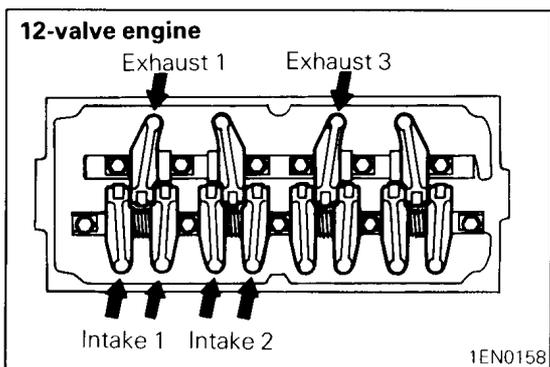
◆C◆ INSTALLATION OF OIL SEAL

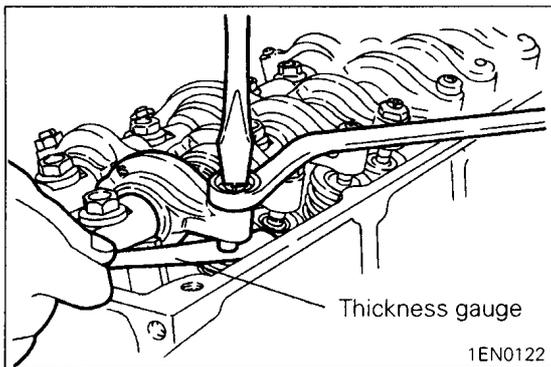
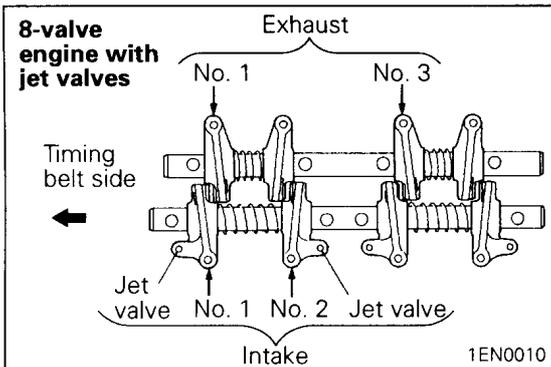
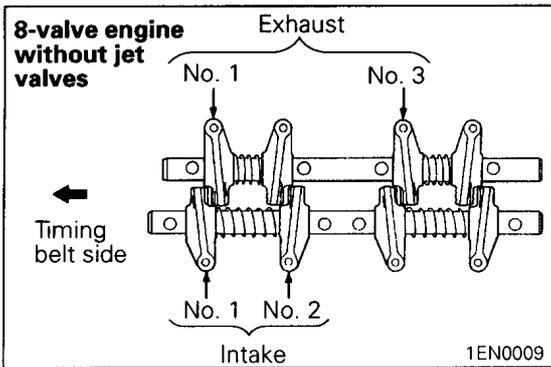
- (1) Install the special tool, Guide, on the camshaft.
- (2) Apply oil to the oil seal and insert the oil seal along the Guide until it contacts the cylinder head.
- (3) Using the special tool, Installer, press-fit the oil seal into the cylinder head.



VALVE CLEARANCE ADJUSTMENT

- (1) Position the No. 1 cylinder at top dead center on the compression stroke.
- (2) Adjust the valve clearance at the points shown in the illustration.



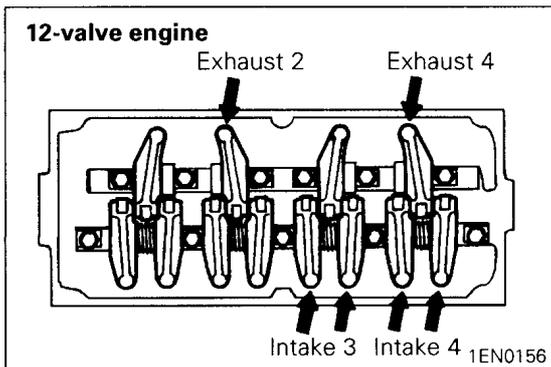


- (3) Loosen the adjusting screw locknut.
- (4) Using a feeler gauge, adjust the valve clearance by turning the adjusting screw.

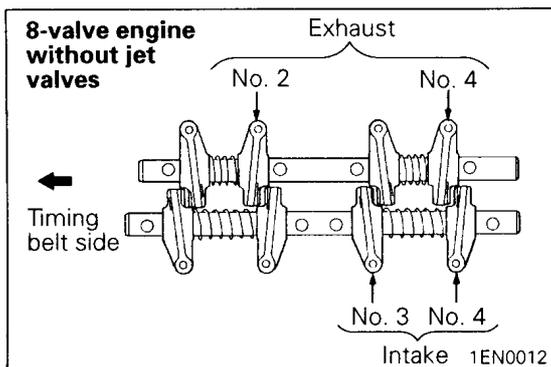
Standard value: on cold engine

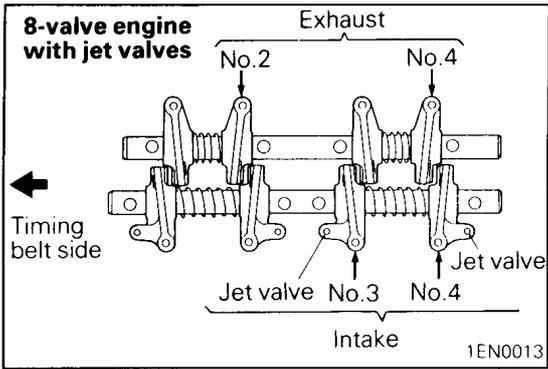
Intake	0.09 mm (0.0035 in.)
Exhaust	0.17 mm (0.0067 in.)
Jet valve	0.17 mm (0.0067 in.)

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



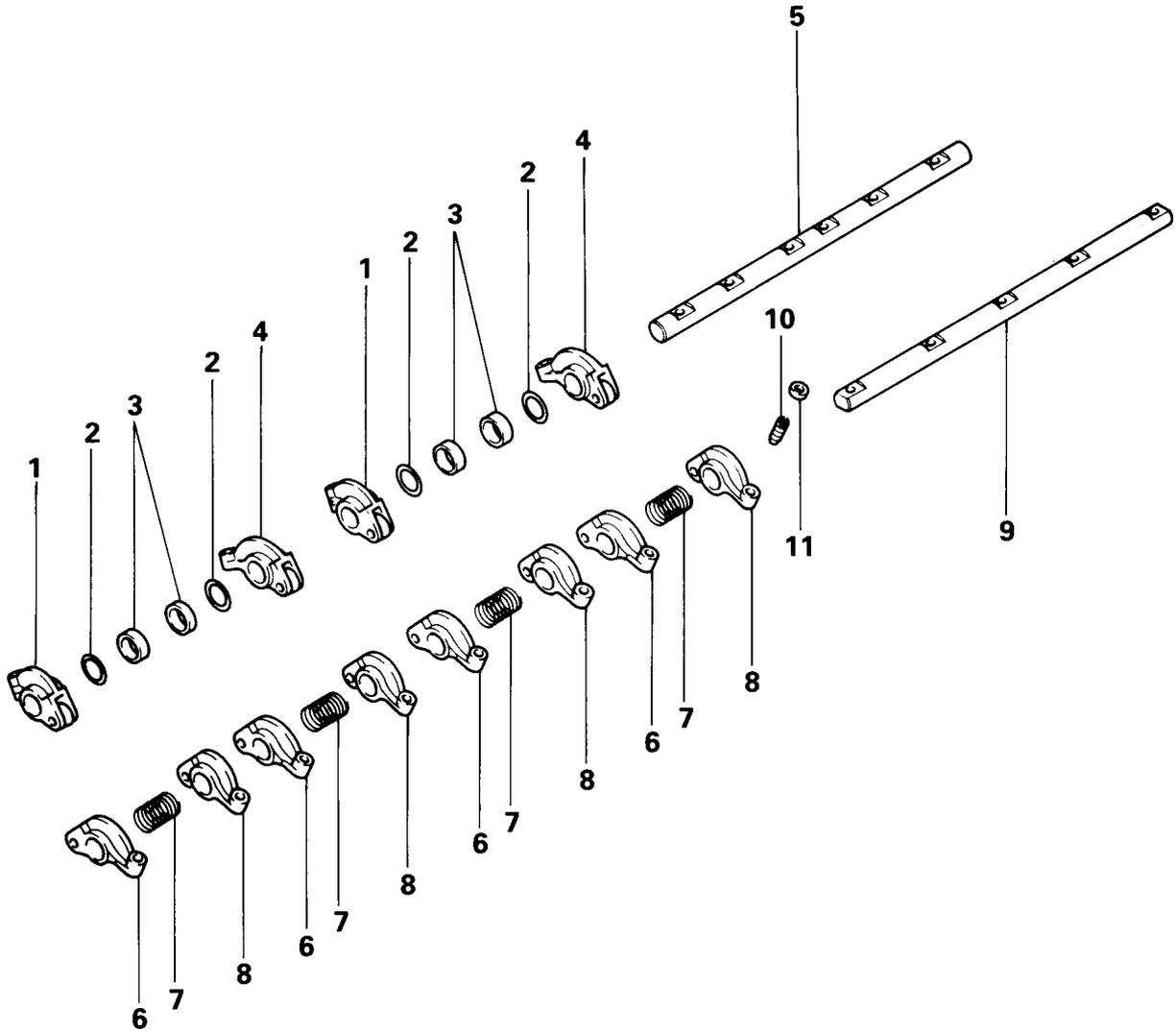
- (6) Rotate clockwise the crankshaft one complete turn (360° degree).
- (7) Adjust the valve clearance at points as shown in the illustration.
- (8) Repeat steps (3) to (5) to adjust the valve clearance of remaining valves.





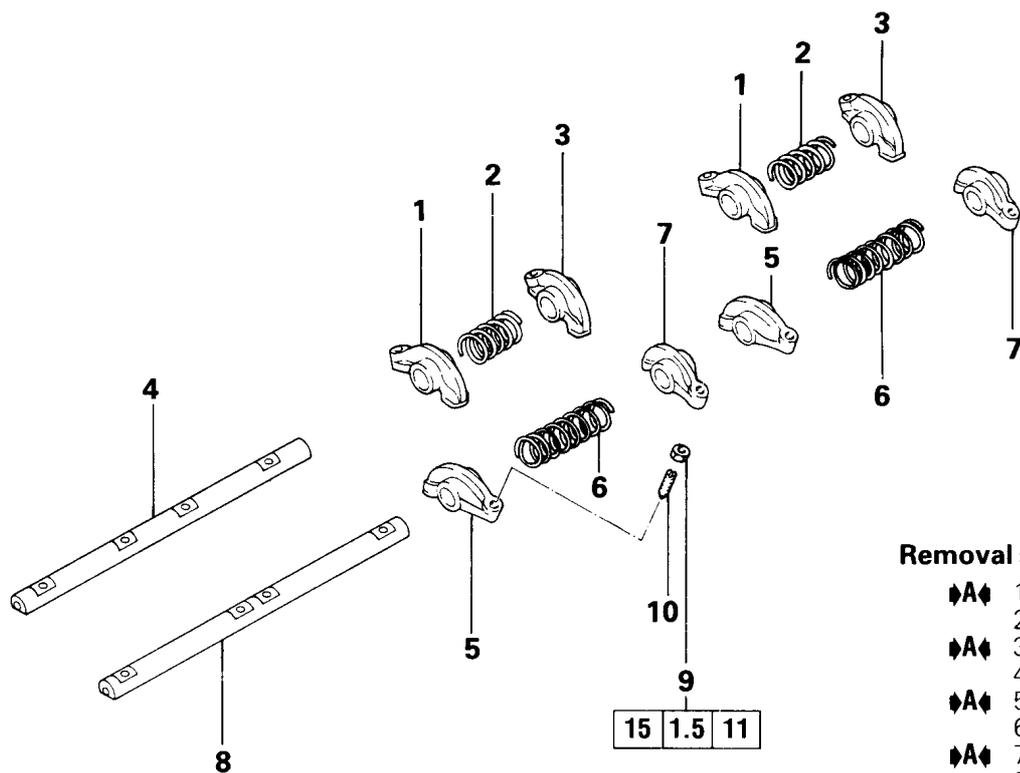
7. ROCKER ARMS AND ROCKER SHAFTS

REMOVAL AND INSTALLATION <12-VALVE ENGINE>

**Disassembly steps**

- ◆A◆ 1. Rocker arm "D"
- 2. Wave washer
- 3. Spacer
- ◆A◆ 4. Rocker arm "C"
- 5. Rocker shaft (exhaust side)
- ◆A◆ 6. Rocker arm "B"
- 7. Rocker arm spring
- ◆A◆ 8. Rocker arm "A"
- 9. Rocker shaft (intake side)
- 10. Adjusting screw
- 11. Nut

REMOVAL AND INSTALLATION <8-VALVE ENGINE WITHOUT JET VALVES>

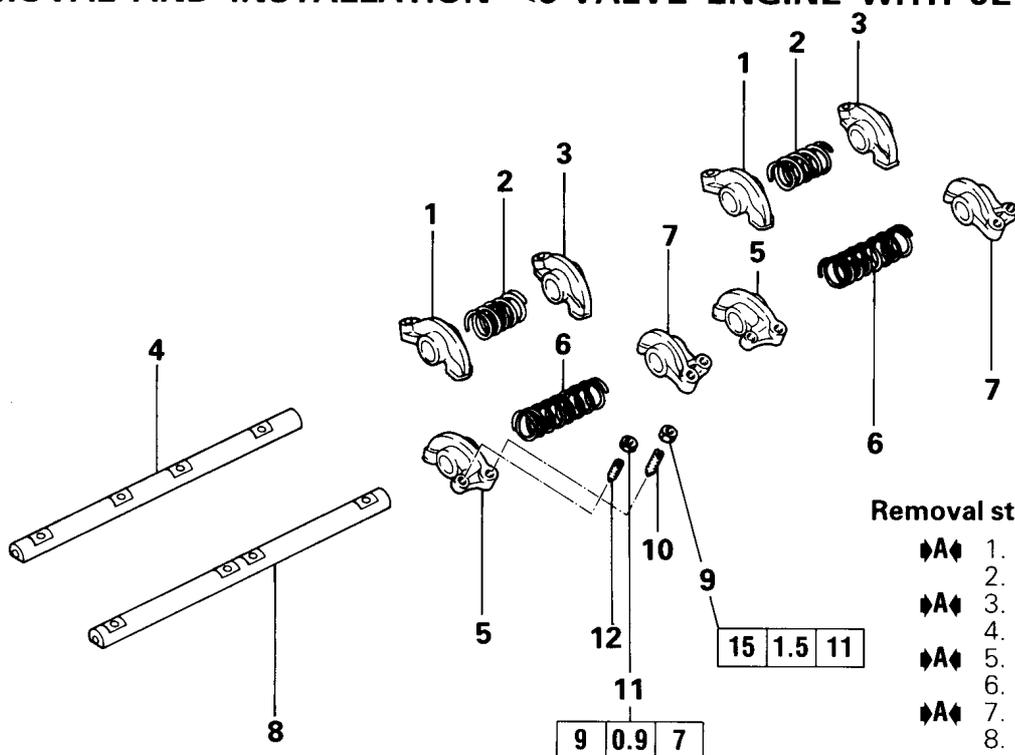


Removal steps

- ◆A◆ 1. Rocker arm (1-3)
- ◆A◆ 2. Rocker shaft spring
- ◆A◆ 3. Rocker arm (2-4)
- ◆A◆ 4. Rocker shaft (exhaust)
- ◆A◆ 5. Rocker arm (1-3)
- ◆A◆ 6. Rocker shaft spring
- ◆A◆ 7. Rocker arm (2-4)
- ◆A◆ 8. Rocker shaft (intake)
- ◆A◆ 9. Adjusting screw
- ◆A◆ 10. Nut

1EN0175

REMOVAL AND INSTALLATION <8-VALVE ENGINE WITH JET VALVES>



Removal steps

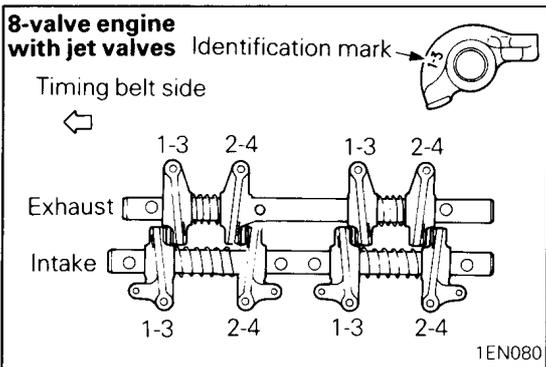
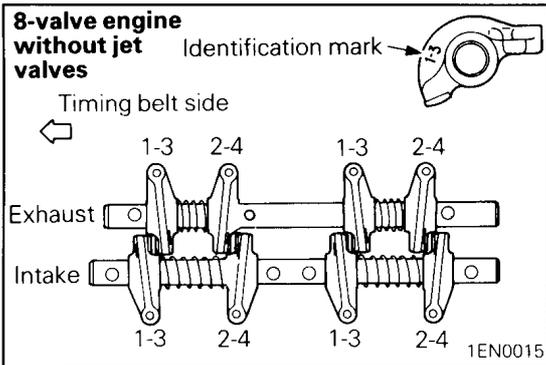
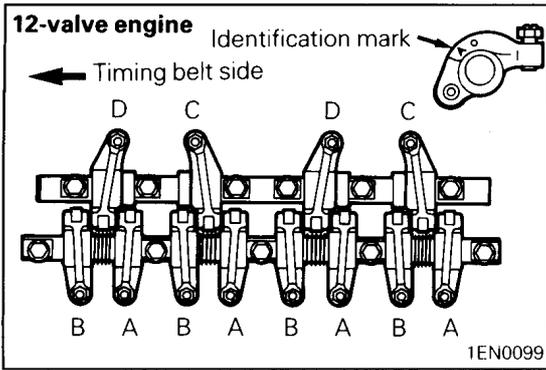
- ◆A◆ 1. Rocker arm (1-3)
- ◆A◆ 2. Rocker shaft spring
- ◆A◆ 3. Rocker arm (2-4)
- ◆A◆ 4. Rocker shaft (exhaust)
- ◆A◆ 5. Rocker arm (1-3)
- ◆A◆ 6. Rocker shaft spring
- ◆A◆ 7. Rocker arm (2-4)
- ◆A◆ 8. Rocker shaft (intake)
- ◆A◆ 9. Nut
- ◆A◆ 10. Adjusting screw
- ◆A◆ 11. Nut (jet valve)
- ◆A◆ 12. Adjusting screw (jet valve)

1EN0176

SERVICE POINTS OF INSTALLATION

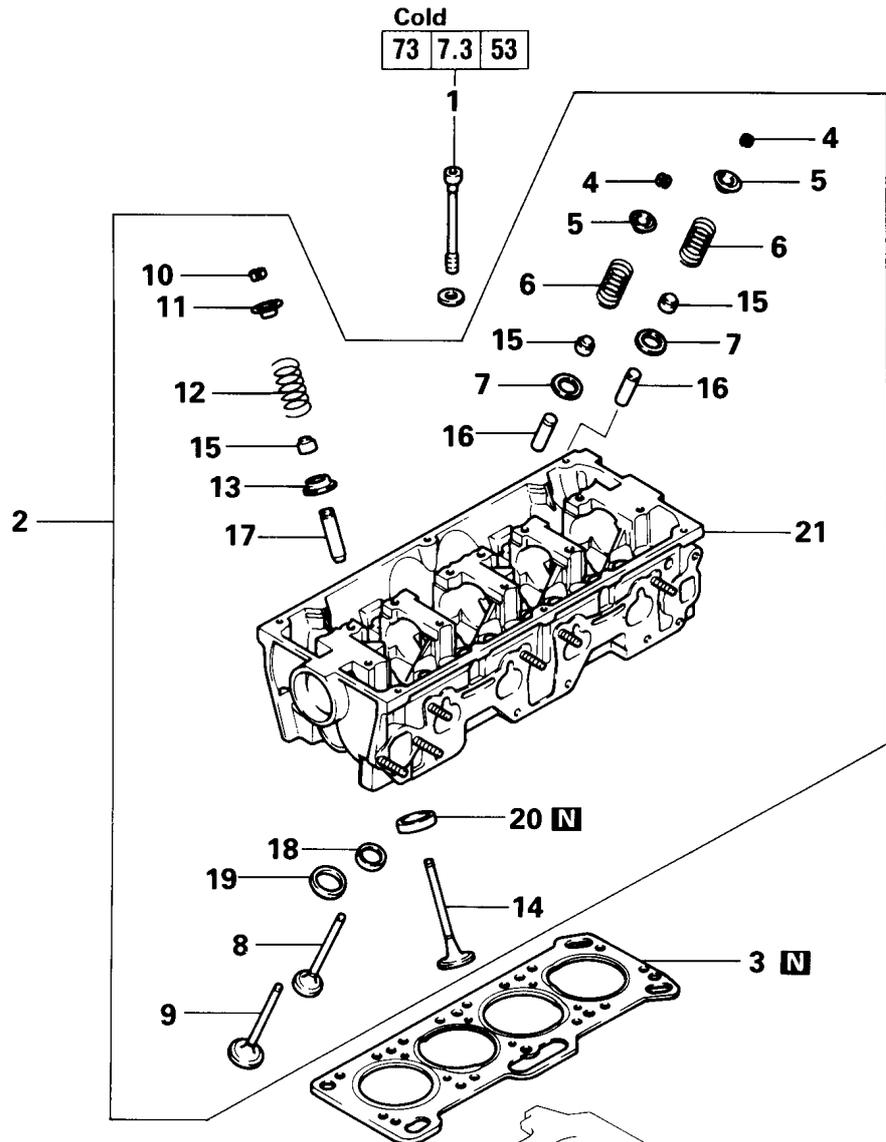
◆A◆ INSTALLATION OF ROCKER ARMS

- (1) Install the rocker arms paying attention to the identification marks.



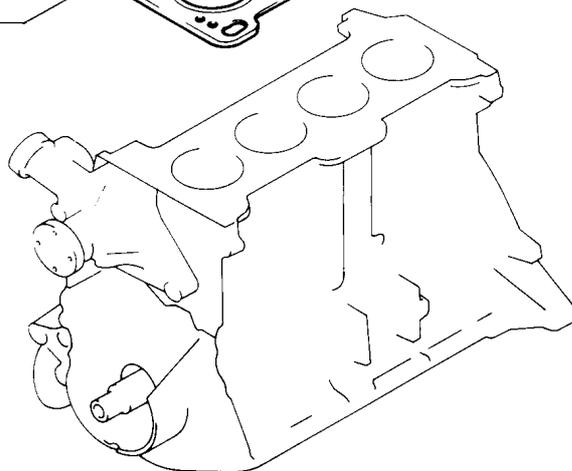
8. CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION <12-VALVE ENGINE>

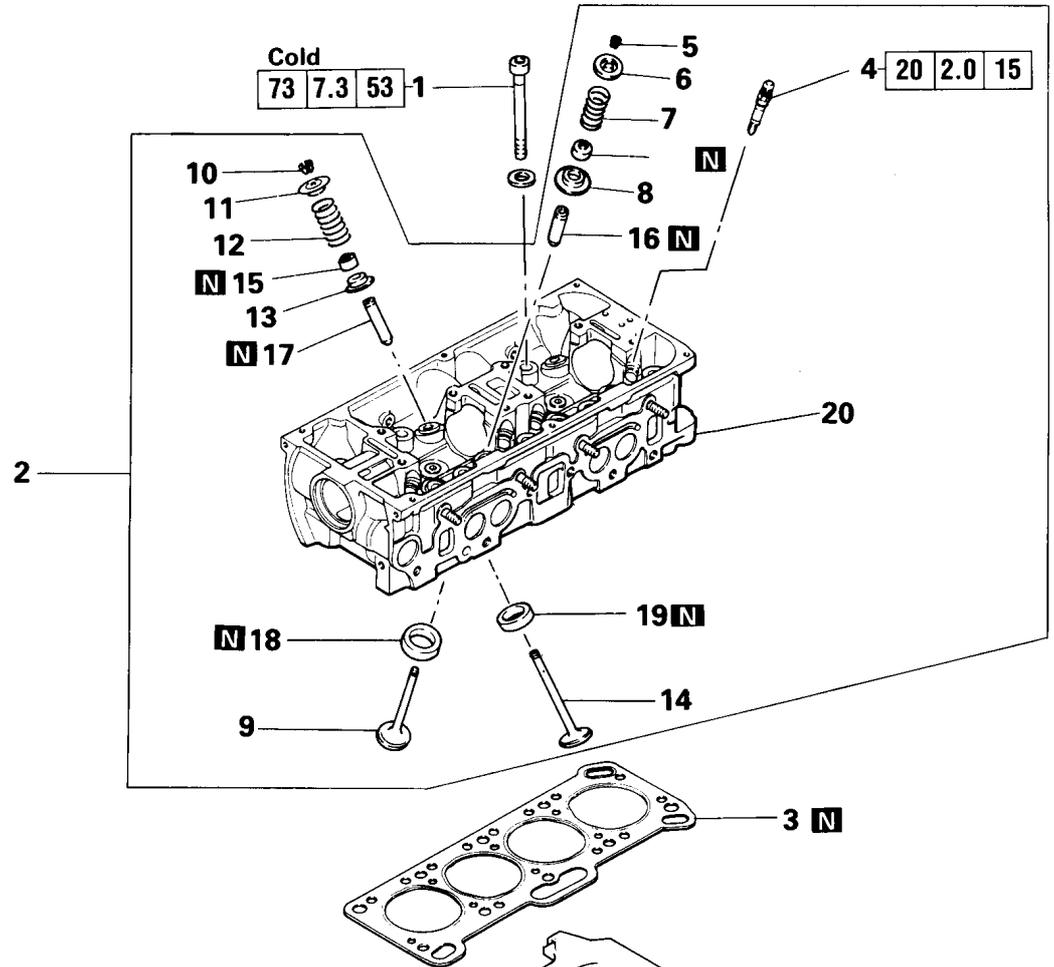


Removal steps

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

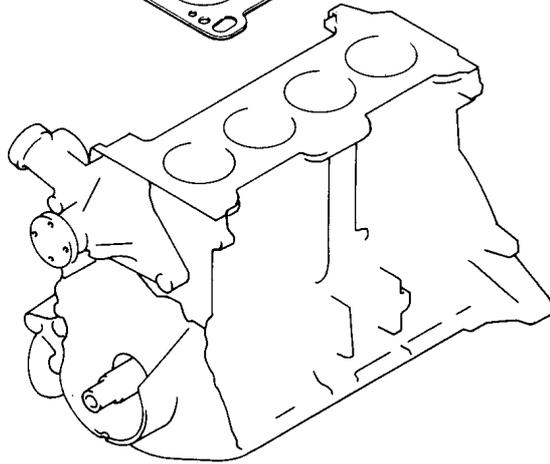


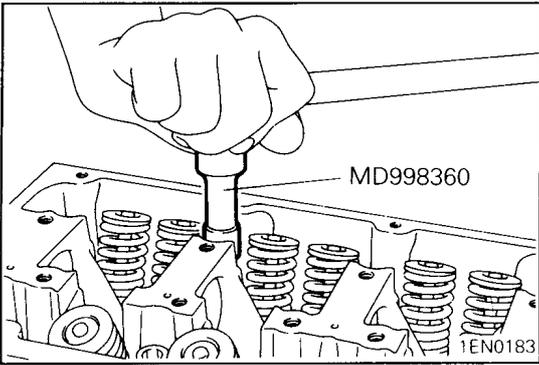
REMOVAL AND INSTALLATION <8-VALVE ENGINE>



Removal steps

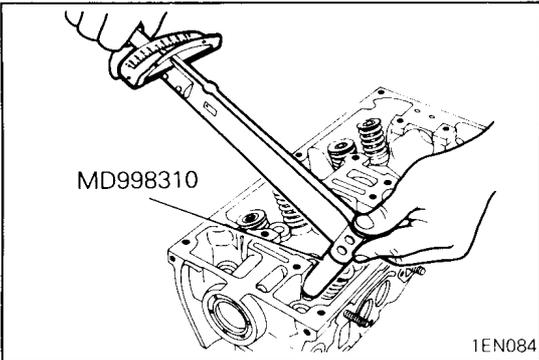
- ◊A◊ ◊E◊ 1. Cylinder head bolt
- 2. Cylinder head assembly
- ◊D◊ 3. Cylinder head gasket
- ◊B◊ ◊C◊ 4. Jet valve ass'y (G13B, G15B)
- ◊C◊ ◊B◊ 5. Retainer lock
- 6. Valve spring retainer
- 7. Valve spring
- 8. Valve spring seat
- 9. Inlet valve
- ◊C◊ ◊B◊ 10. Retainer lock
- 11. Valve spring retainer
- 12. Valve spring
- 13. Valve spring seat
- 14. Exhaust valve
- ◊D◊ ◊A◊ 15. Valve stem seal
- 16. Intake valve guide
- 17. Exhaust valve guide
- 18. Intake valve seat
- 19. Exhaust valve seat
- 20. Cylinder head





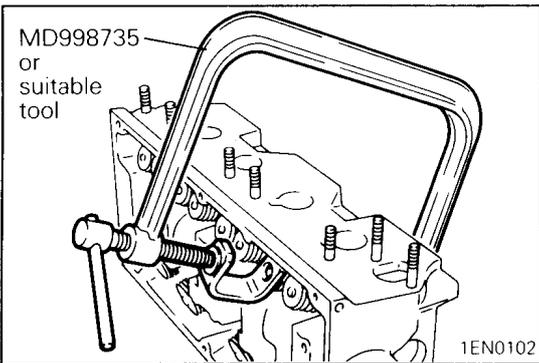
SERVICE POINTS OF REMOVAL

◊A◊ REMOVAL OF CYLINDER HEAD BOLT



◊B◊ REMOVAL OF JET VALVE

- (1) When loosening a jet valve, hold the special tool securely so that it is not tilted with respect to the jet valve center line. Also avoid applying force abruptly.



◊C◊ REMOVAL OF RETAINER LOCK

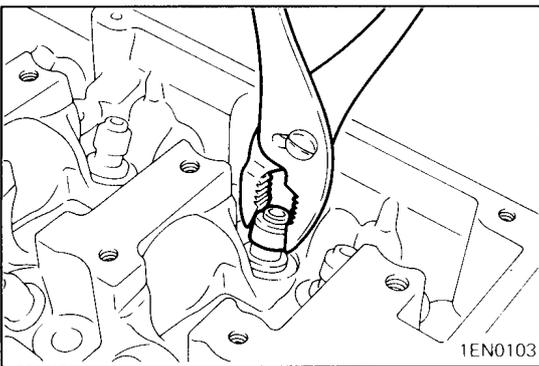
- (1) Store removed valves, springs and other parts, tagged to indicate their cylinder No. and location for reassembly.

NOTE

The valve spring retainers of the 12-valve engine differ in size between the intake and exhaust sides. Therefore, use the following retainer holders.

Identification mark:

Intake	A
Exhaust	B



◊D◊ REMOVAL OF VALVE STEM SEAL

Caution

- The stem seal is not reusable.

INSPECTION

CYLINDER HEAD

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

Standard value: 0.05 mm (0.0020 in.)

Limit: 0.2 mm (0.008 in.)

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

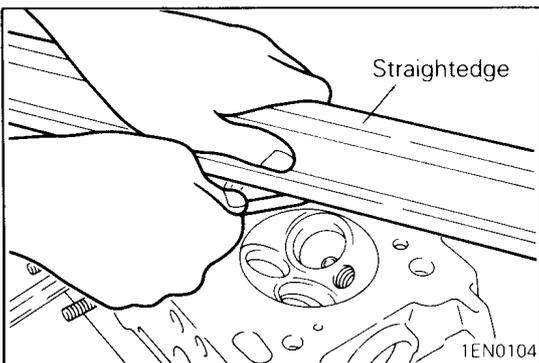
Grinding limit: 0.2 mm (0.008 in.)

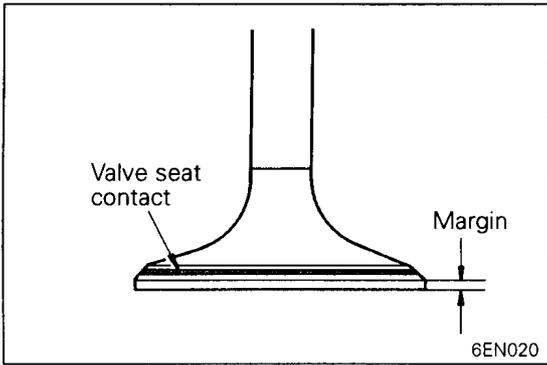
Caution

- The total thickness of the stock allowed to be removed from cylinder head and mating cylinder block is 0.2 mm (0.008 in.) in thickness.

Cylinder head height (Specification when new):

106.9 – 107.1 mm (4.209 – 4.217 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:

Intake	1.0 mm (0.039 in.)
Exhaust	1.5 mm (0.059 in.)

Limit:

Intake	0.5 mm (0.020 in.)
Exhaust	1.0 mm (0.039 in.)

VALVE SPRING

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

12-VALVE ENGINE

Standard value:

Intake	46.1 mm (1.815 in.)
Exhaust	46.8 mm (1.843 in.)

Limit:

Intake	45.1 mm (1.776 in.)
Exhaust	45.8 mm (1.803 in.)

8-VALVE ENGINE

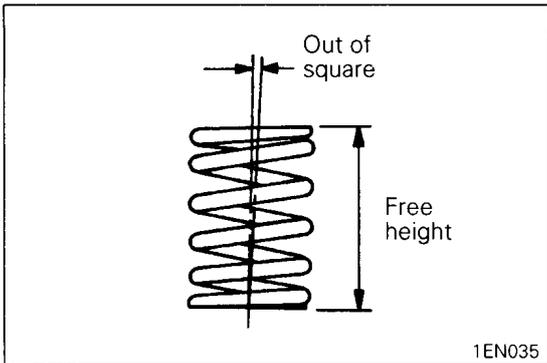
Standard value: 44.6 mm (1.756 in.)

Limit: 43.6 mm (1.717 in.)

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

Standard value: 2° or less

Limit: 4°



VALVE GUIDE

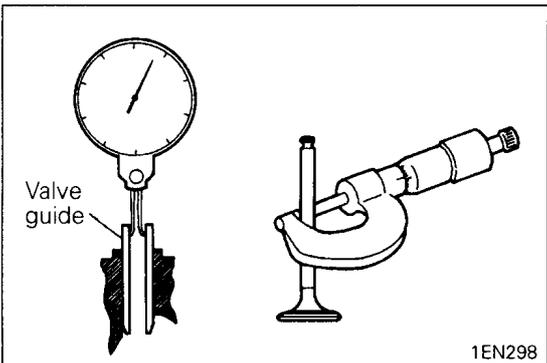
- (1) Measure the clearance between the valve guide and valve stem. If the limit is exceeded, replace the valve guide or valve, or both.

Standard value:

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

Limit:

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



VALVE SEATS

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

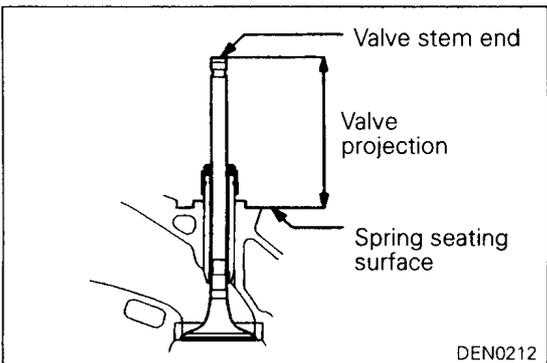
8-VALVE ENGINE

Standard value:

Intake	41.45 mm (1.6319 in.)
Exhaust	41.35 mm (1.6279 in.)

Limit:

Intake	41.95 mm (1.6516 in.)
Exhaust	41.85 mm (1.6476 in.)



12-VALVE ENGINE

Standard value:

Intake 43.70 mm (1.7205 in.)
Exhaust 43.30 mm (1.7047 in.)

Limit:

Intake 44.20 mm (1.7402 in.)
Exhaust 43.80 mm (1.7244 in.)

VALVE SEAT RECONDITIONING PROCEDURE – 12-VALVE ENGINE

- (1) Before attempting reconditioning of the valve seat, check the valve guide-to-valve stem clearance and replace the valve guide if necessary.
- (2) Recondition to the specified seat width and seat angle.
- (3) After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection (refer to VALVE SEAT in INSPECTION).

VALVE SEAT RECONDITIONING PROCEDURE – 8-VALVE ENGINE

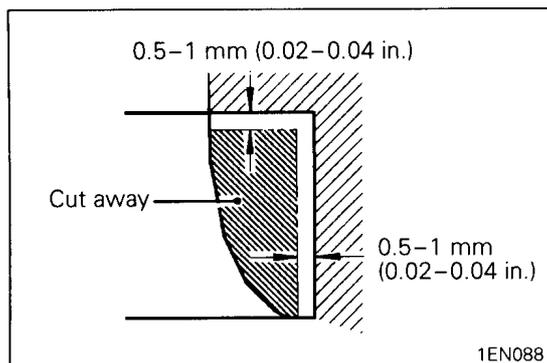
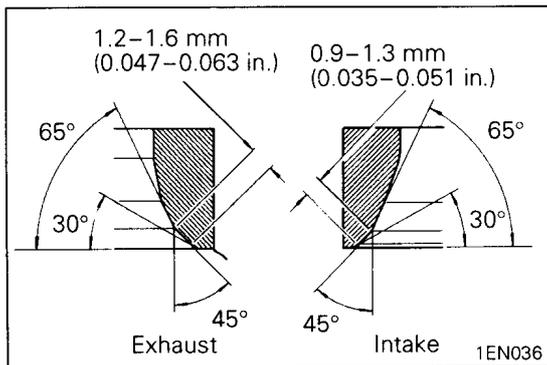
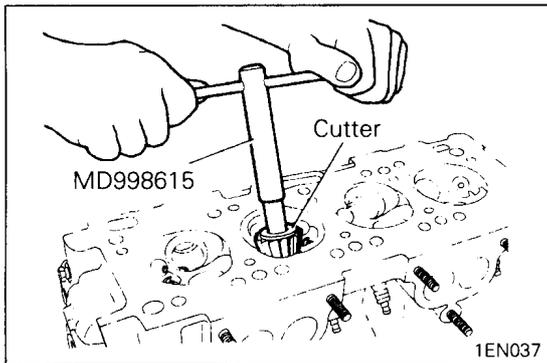
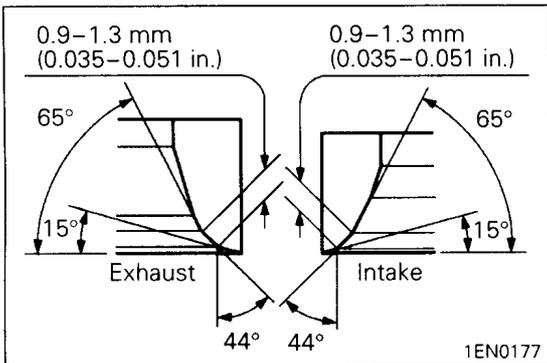
- (1) Before correcting the valve seat, check for clearance between the valve guide and valve and, if necessary, replace the valve guide.
- (2) Using the special tool or seat grinder, correct to obtain the specified seat width and angle.

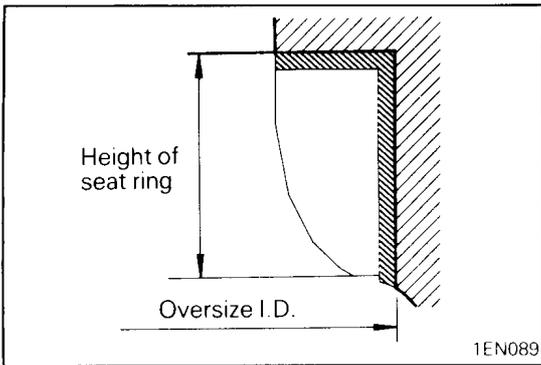
Cutter angle	Tool number	
	Intake	Exhaust
45°	MD998158	MD998156
65°	MD998165	MD998614
30°	MD998173	MD998171

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

VALVE SEAT REPLACEMENT PROCEDURE

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





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

Seat ring hole diameter:

12-valve engine

Intake (primary) 0.30 O.S.	27.421 – 27.441 mm (1.0796 – 1.0804 in.)
0.60 O.S.	27.721 – 27.741 mm (1.0914 – 1.0922 in.)
Intake (secondary) 0.30 O.S.	32.425 – 32.445 mm (1.2766 – 1.2774 in.)
0.60 O.S.	32.725 – 32.745 mm (1.2884 – 1.2892 in.)
Exhaust 0.30 O.S.	35.425 – 35.445 mm (1.3947 – 1.3955 in.)
0.60 O.S.	35.725 – 35.745 mm (1.4065 – 1.4073 in.)

8-valve engine

Intake 0.30 O.S.	36.300 – 36.325 mm (1.4291 – 1.4301 in.)
0.60 O.S.	36.600 – 36.625 mm (1.4409 – 1.4419 in.)
Exhaust 0.30 O.S.	32.300 – 32.325 mm (1.2717 – 1.2726 in.)
0.60 O.S.	32.600 – 32.625 mm (1.2835 – 1.2845 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 – 12-VALVE ENGINE

- (1) Push out the valve guide toward the combustion chamber side using a press.
- (2) Rebore the valve guide hole of the cylinder head to the size of the oversize valve guide to be installed.

Caution

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

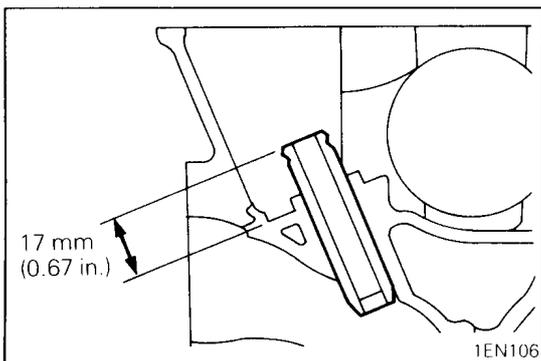
Valve guide hole diameter

0.05 O.S	12.050 – 12.068 mm (0.4744 – 0.4751 in.)
0.25 O.S	12.250 – 12.268 mm (0.4823 – 0.4830 in.)
0.50 O.S	12.500 – 12.518 mm (0.4921 – 0.4928 in.)

- (3) Install the valve guide until it projects 17 mm (0.67 in.) as illustrated.

NOTE

- (1) The valve guide must be installed from the upper side of the cylinder head.
- (2) Note that the valve guides differ in length 44 mm (1.732 in.) on intake side, 49.5 mm (1.949 in.) on exhaust side.
- (3) After installation of the valve guide, install a new valve and check that it slides smoothly.



VALVE GUIDE REPLACEMENT PROCEDURE – 8-VALVE ENGINE

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

Valve guide hole diameter:

0.05 O.S. 12.050 – 12.068 mm (0.4744 – 0.4751 in.)

0.25 O.S. 12.250 – 12.268 mm (0.4823 – 0.4830 in.)

0.50 O.S. 12.500 – 12.518 mm (0.4921 – 0.4928 in.)

NOTE

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

- (3) Using the special tool, press-fit the valve guide, working from the cylinder head top surface.

NOTE

Intake valve guide [44 mm (1.732 in.)] is different in length from exhaust valve guide [49.5 mm (1.949 in.)].

Make sure to install them in their correct positions.

- (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 REASSEMBLY**◆A◆ INSTALLATION OF VALVE STEM SEAL**

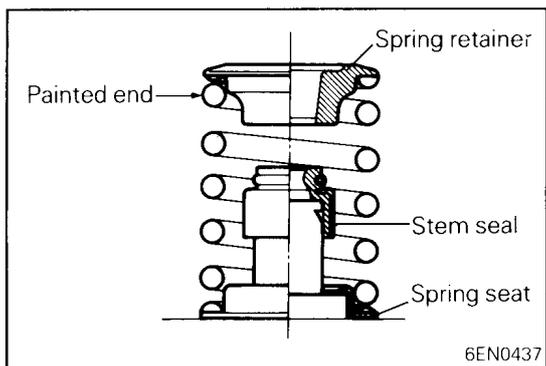
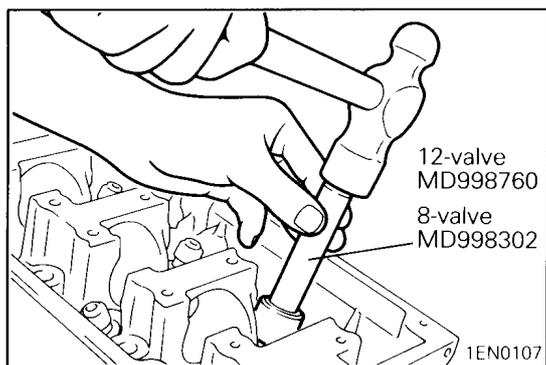
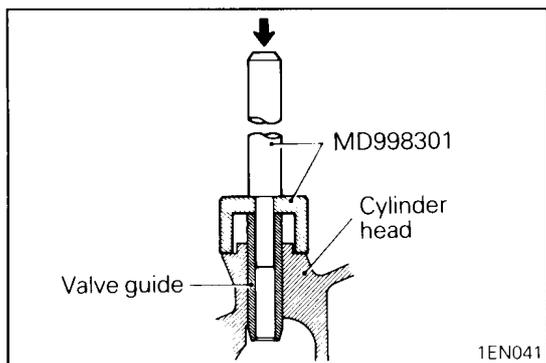
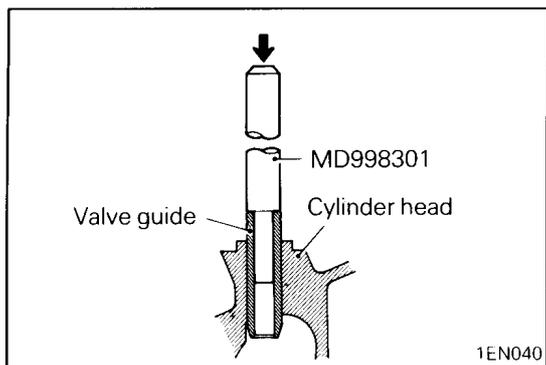
- (1) Install the valve spring seat.
- (2) The special tool must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.

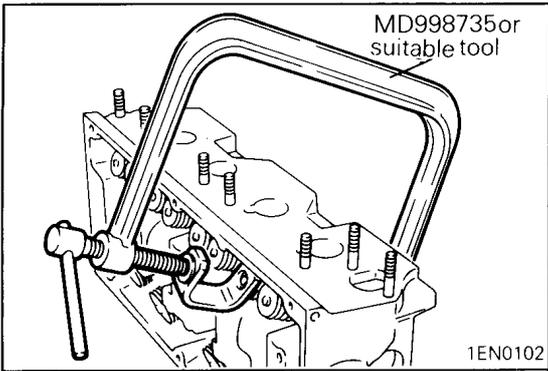
NOTE

The valve stem seal cannot be reused.

◆B◆ INSTALLATION OF VALVE SPRING

- (1) Install the valve spring with the painted end on the rocker arm side.





◆C◆ INSTALLATION OF RETAINER LOCK

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

NOTE

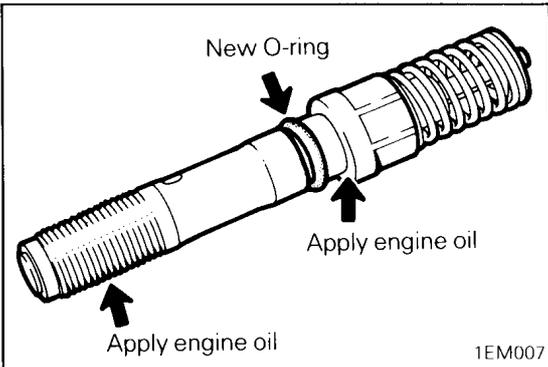
The valve spring retainers differ in size between the intake and exhaust sides. Therefore, use the following retainer holders.

Identification mark:

Intake	B
Exhaust	A

◆D◆ INSTALLATION OF JET VALVE

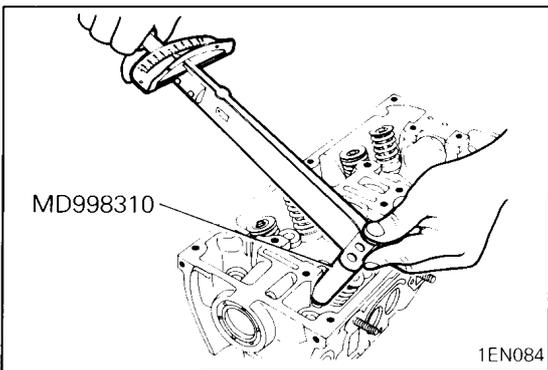
- (1) Install a new O-ring to the jet body.
- (2) Apply engine oil to threads and seat surface of jet body.



- (3) Install the jet valve in the cylinder head finger tight.
- (4) Using the special tool and torque wrench, tighten the jet valve to the specified torque.

Caution

- **Hold the special tool securely not to tilt with respect to center of jet valve.**

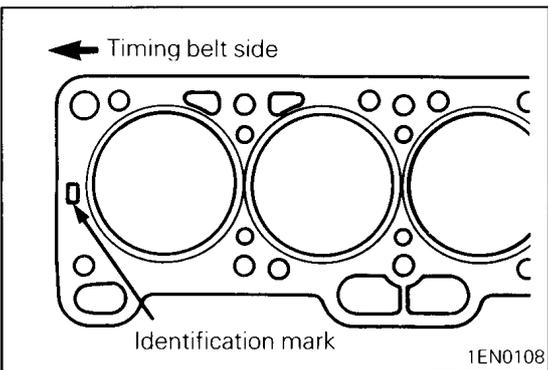


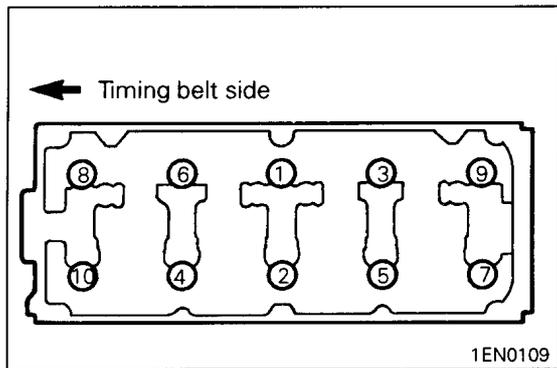
◆E◆ INSTALLATION OF CYLINDER HEAD GASKET

- (1) Clean both gasket surfaces of cylinder block and cylinder head.
- (2) Confirm identification mark on cylinder head gasket. The identification mark is stamped on the front end upper surface of gasket.

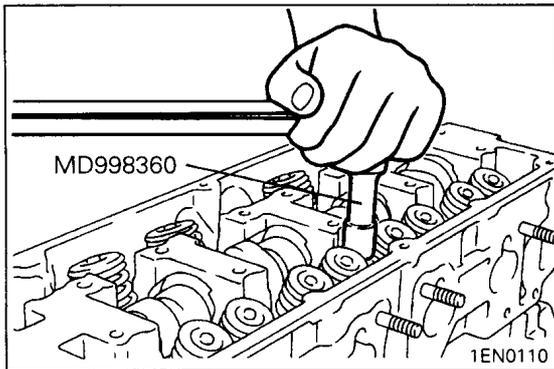
Identification mark:

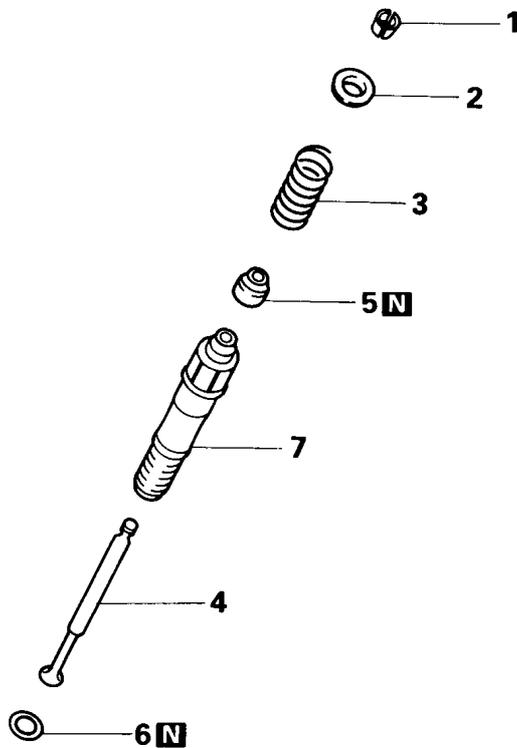
12-Valve engine	3V
8-Valve engine	
4G16	11
4G13.G13B	13
4G15.G15B	15



**◆F◆ INSTALLATION OF CYLINDER HEAD BOLT**

- (1) Using the special tool and torque wrench, tighten bolts in the shown sequence.
- (2) Repeat the tightening sequence several times, and torque the bolts to specification in the final sequence.



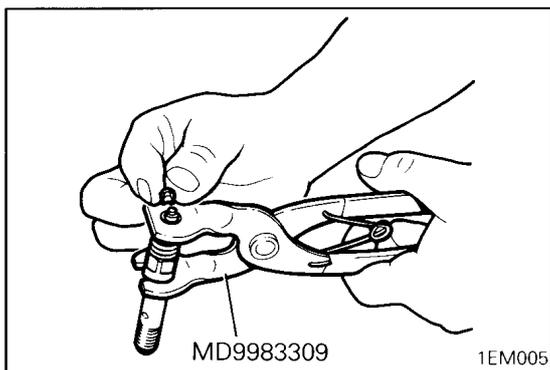
9. JET VALVE (ENGINE WITH JET VALVES)**DISASSEMBLY AND REASSEMBLY****Disassembly steps**

- ◁A▷ ▷B◁ 1. Retainer lock
 2. Valve spring retainer
 3. Valve spring
 4. Jet valve
 ▷A◁ 5. Stem seal
 6. O-ring
 7. Jet body

1EM177

SERVICE POINT OF DISASSEMBLY**◁A▷ REMOVAL OF RETAINER LOCK**

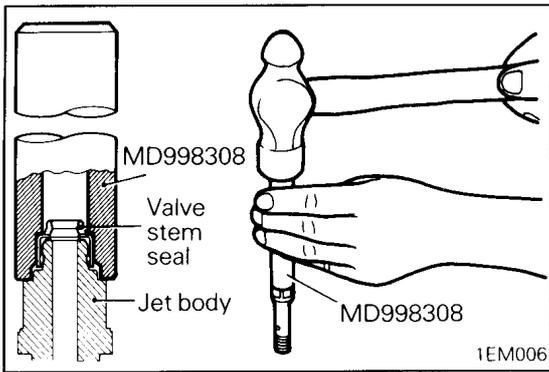
- (1) Keep disassembled parts neatly arranged for each cylinder.

**INSPECTION**

- Insert a jet valve into jet body and check for sliding conditions. If it does not slide smoothly, or too loose in the body, replace.

NOTE

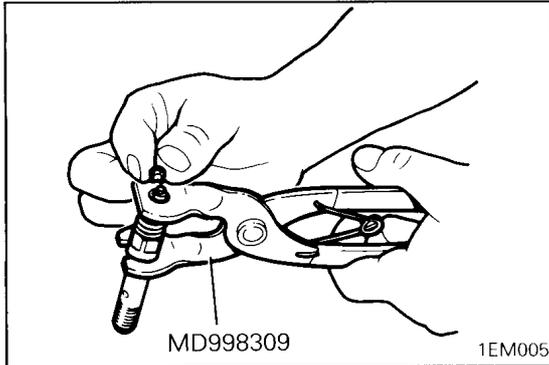
Replace jet valve and jet body as an assembly.

**SERVICE POINTS OF REASSEMBLY****◆A◆ INSTALLATION OF STEM SEAL**

- (1) Incorrect installation of valve stem seal could cause an ingress of oil into cylinder. Make sure to use the special tool to install the seal.

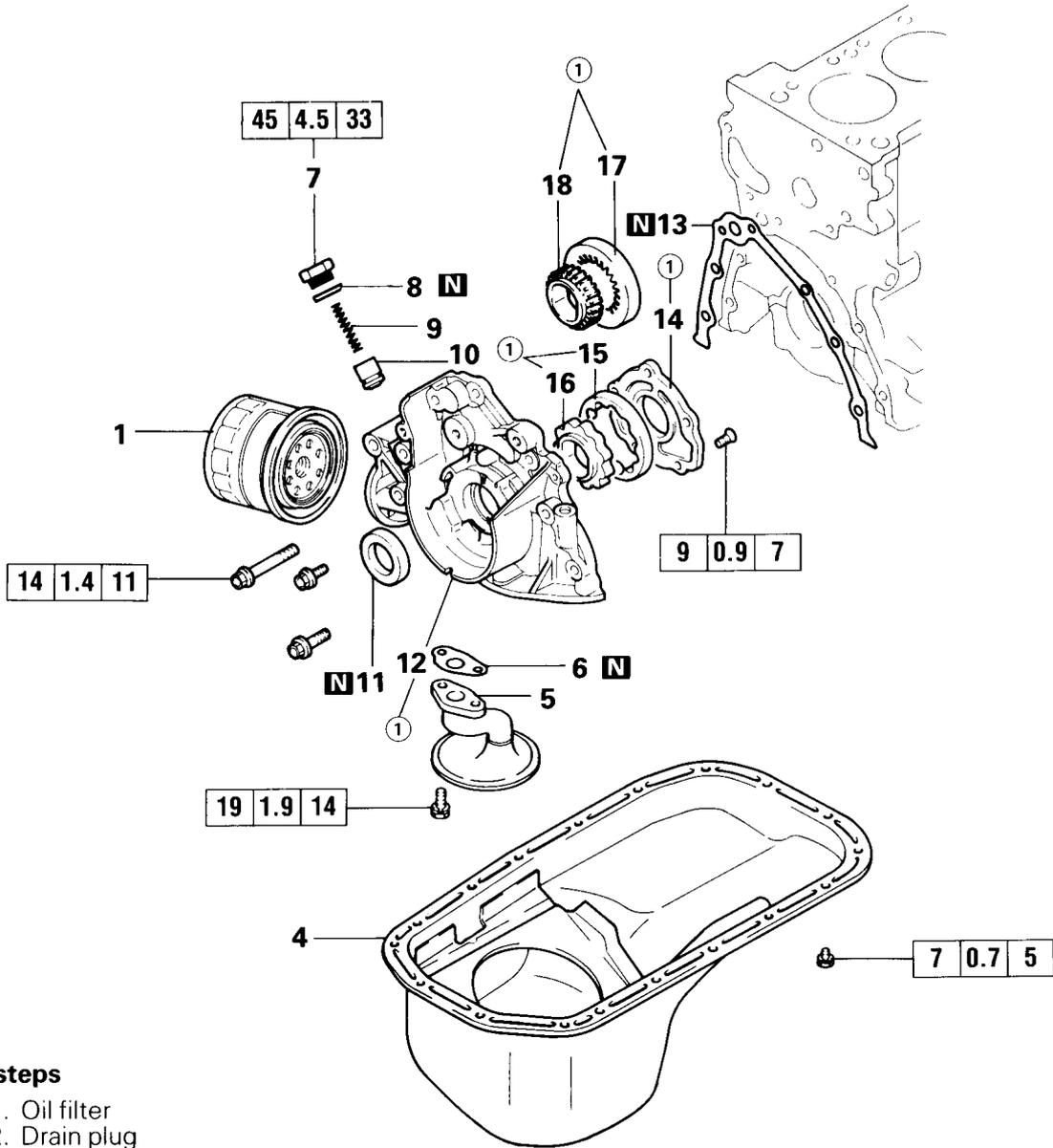
Caution

- **Valve stem seal cannot be reused.**

**◆B◆ INSTALLATION OF RETAINER LOCK**

- (1) While compressing the valve spring with the special tool, install the retainer lock. Use care not to damage the valve stem seal with the retainer bottom edge when compressing the spring.

10. FRONT CASE AND OIL PUMP REMOVAL AND INSTALLATION



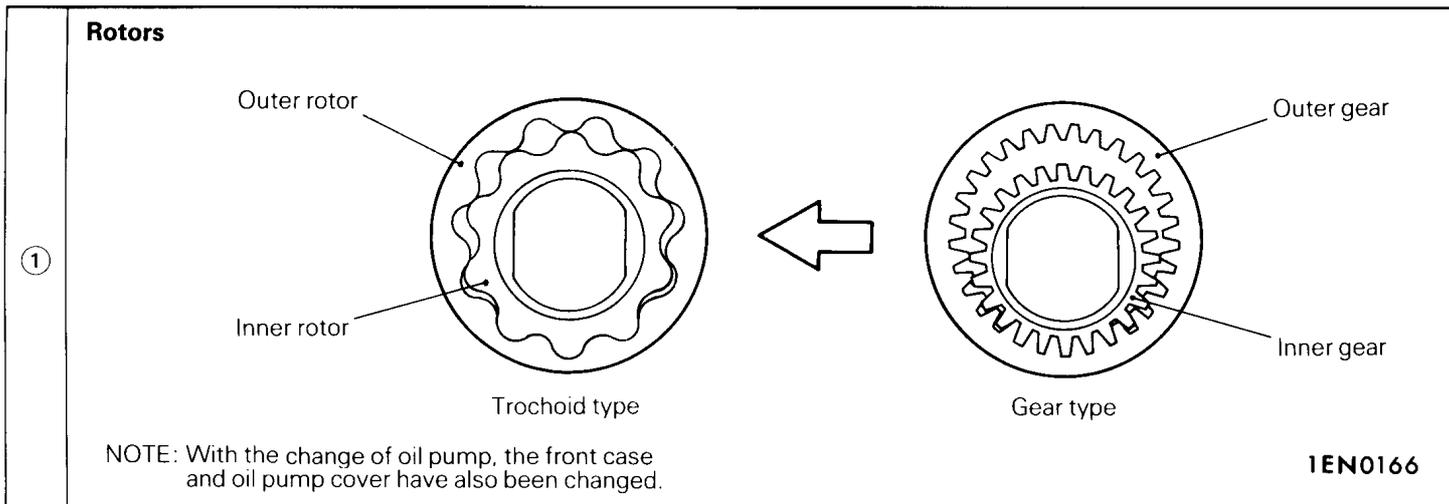
Removal steps

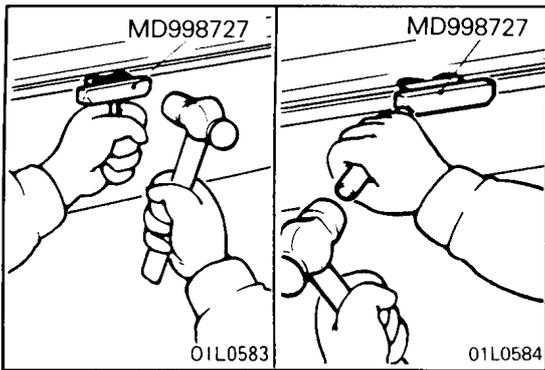
- ◆D◆ 1. Oil filter
- 2. Drain plug
- 3. Drain plug gasket
- ◇A◇ ◆C◆ 4. Oil pan
- 5. Oil screen
- 6. Oil screen gasket
- 7. Relief plug
- 8. Gasket
- 9. Relief spring
- 10. Relief plunger
- ◆B◆ 11. Oil seal
- 12. Front case
- 13. Front case gasket
- 14. Oil pump cover
- ◇B◇ ◆A◆ 15. Outer rotor } Trochoid type
- ◇B◇ ◆A◆ 16. Inner rotor } Trochoid type
- ◇B◇ ◆A◆ 17. Outer gear } Gear type
- ◇B◇ ◆A◆ 18. Inner gear } Gear type

NOTE

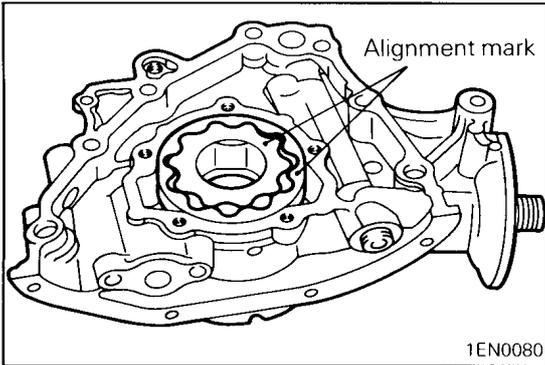
①: See "Details of Change" table.

Details of Change

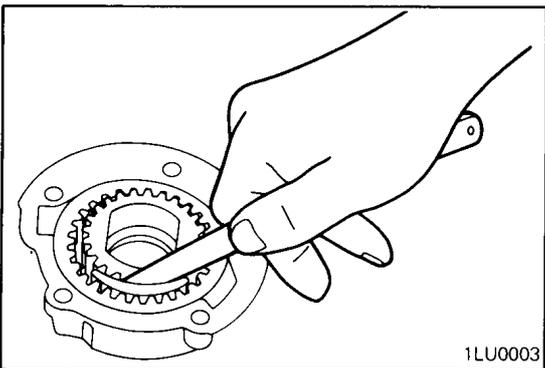


**SERVICE POINTS OF REMOVAL****◁A▷ REMOVAL OF OIL PAN**

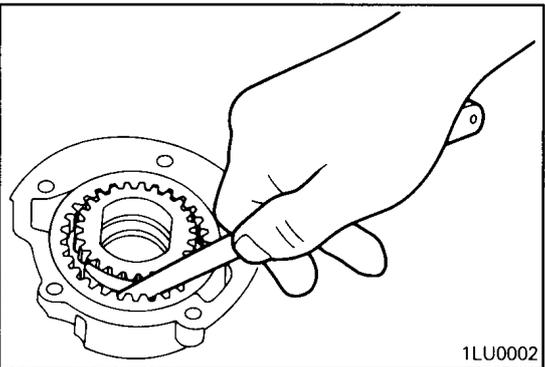
- (1) Knock the special tool deeply between the oil pan and the cylinder block.
- (2) Hitting the side of the special tool, slide the special tool along the oil pan to remove it.

**◁B▷ REMOVAL OF OUTER ROTOR / INNER ROTOR / OUTER GEAR / INNER GEAR**

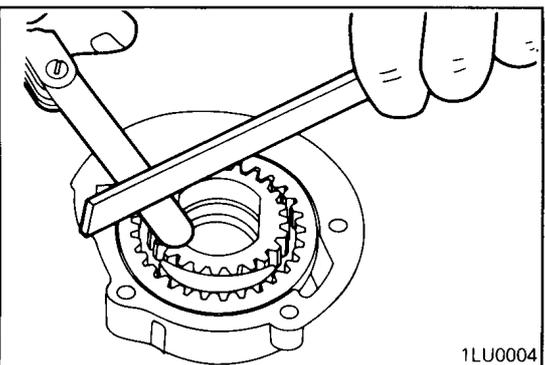
- (1) Put alignment marks on the outer and inner rotors or outer and inner gears for reference in reassembly.

**INSPECTION****OIL PUMP – Gear type**

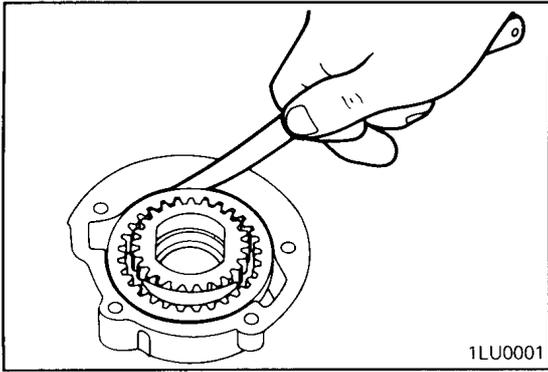
- (1) Check the inner gear tooth to crescent clearance.
Standard value: 0.21 – 0.34 mm (0.0083 – 0.0134 in.)
Limit: 0.5 mm (0.020 in.)



- (2) Check the outer gear tooth to crescent clearance.
Standard value: 0.22 – 0.44 mm (0.0087 – 0.0173 in.)
Limit: 0.6 mm (0.024 in.)

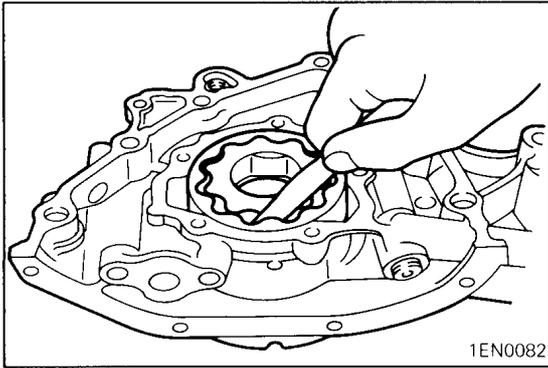


- (3) Check the inner gear and outer gear side clearance.
Standard value: 0.04 – 0.10 mm (0.0016 – 0.0039 in.)
Limit: 0.15 mm (0.006 in.)



- (4) Check the outer gear outer circumference to front case clearance (body clearance).

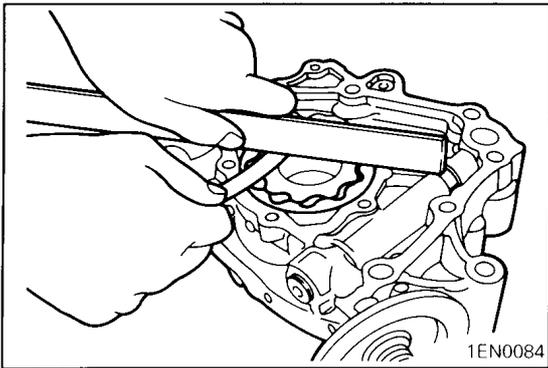
Standard value: 0.10 – 0.20 mm (0.0039 – 0.0079 in.)
Limit: 0.3 mm (0.012 in.)



OIL PUMP – Trochoid type

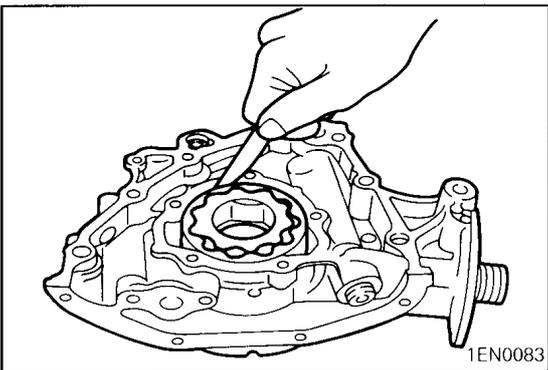
- (1) Check the tip clearance.

Standard value: 0.06 – 0.18 mm (0.0024 – 0.0071 in.)
Limit: 0.35 mm (0.0138 in.)



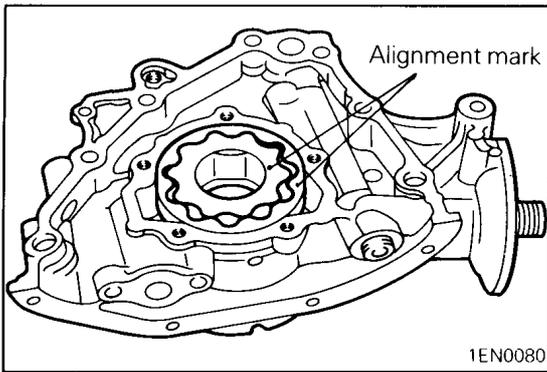
- (2) Check the side clearance.

Standard value: 0.04 – 0.10 mm (0.0016 – 0.0039 in.)
Limit: 0.2 mm (0.0079 in.)

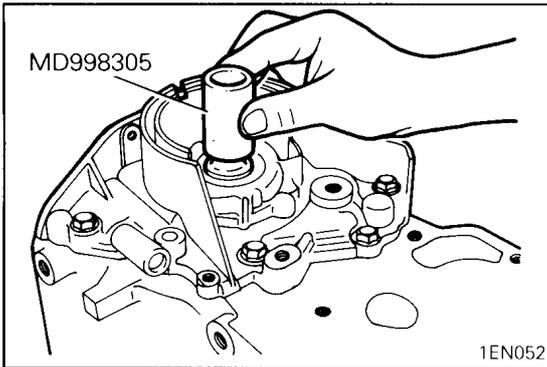


- (3) Check the body clearance.

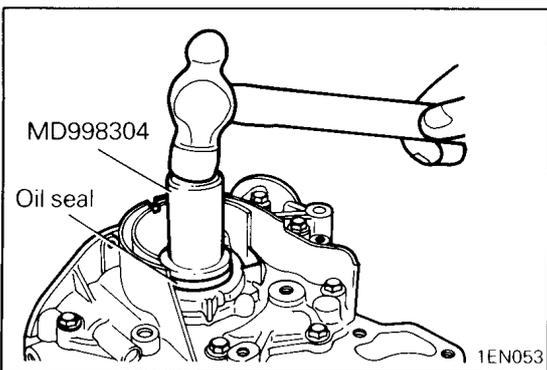
Standard value: 0.10 – 0.18 mm (0.0039 – 0.0071 in.)
Limit: 0.35 mm (0.0138 mm)

**SERVICE POINTS OF INSTALLATION****◆A◆ INSTALLATION OF INNER GEAR / OUTER GEAR / INNER ROTOR / OUTER ROTOR**

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

**◆B◆ INSTALLATION OF CRANKSHAFT FRONT OIL SEAL**

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



- (2) Apply a light coat of engine oil to the oil seal lip and then insert the oil seal along the special tool by hand until it touches to the front case. Install the oil seal in the front case using the special tool.

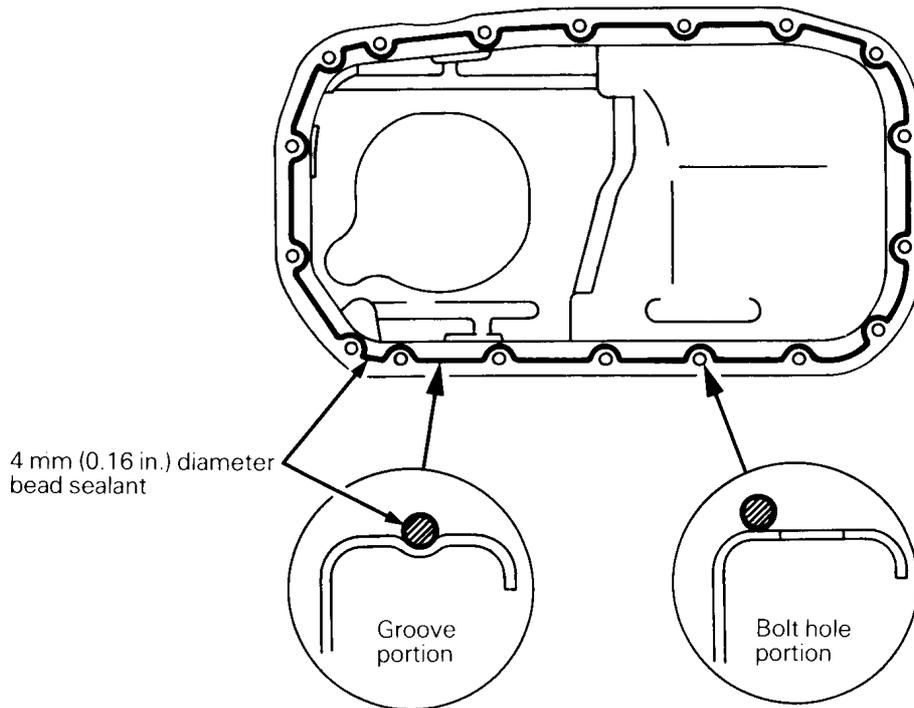
◆C◆ INSTALLATION OF OIL PAN

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

Specified sealant:

Mitsubishi Genuine Part No. MD997110 or equivalent

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



1EN0112

◆D◆ INSTALLATION OF OIL FILTER

- (1) Clean the installation surface of the filter bracket side.
- (2) Apply engine oil to the O-ring of the oil filter.

12-VALVE ENGINE

- (3) Screw in the oil filter until the O-ring is seated on the flange surface. Then tighten one turn 12 to 16 Nm (1.2 to 1.6 kgm, 9 to 11 ft.lbs.).

NOTE

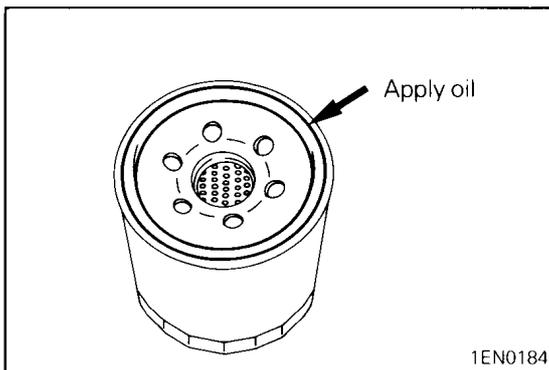
- Tighten the oil filter using a filter wrench (commercial tool), etc. Tightening by hand can result in insufficient tightening and oil leaks.

8-VALVE ENGINE

- (3) Tighten the oil filter by hand.

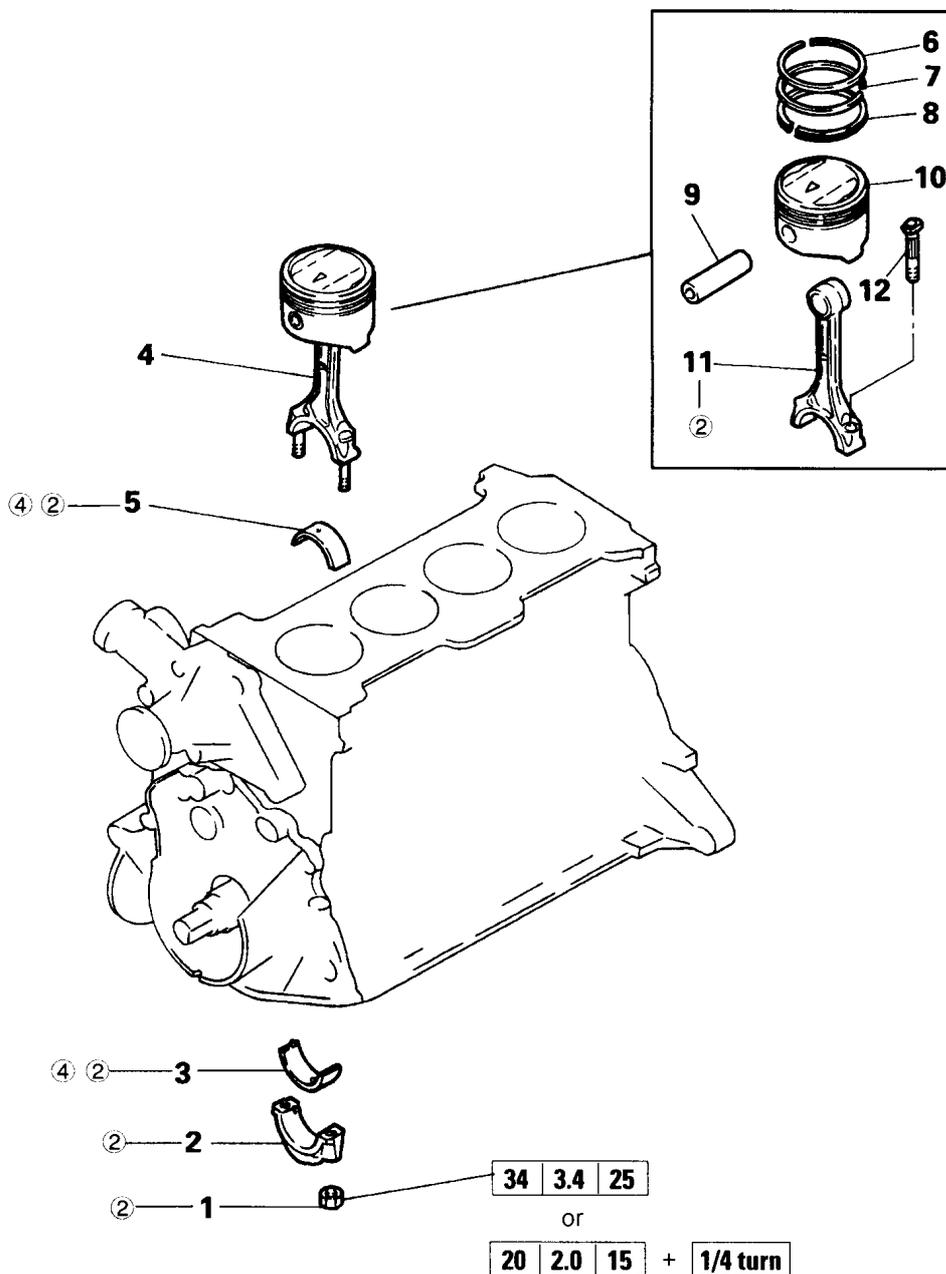
Caution

- **Never use a wrench to tighten the oil filter.**



11. PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION



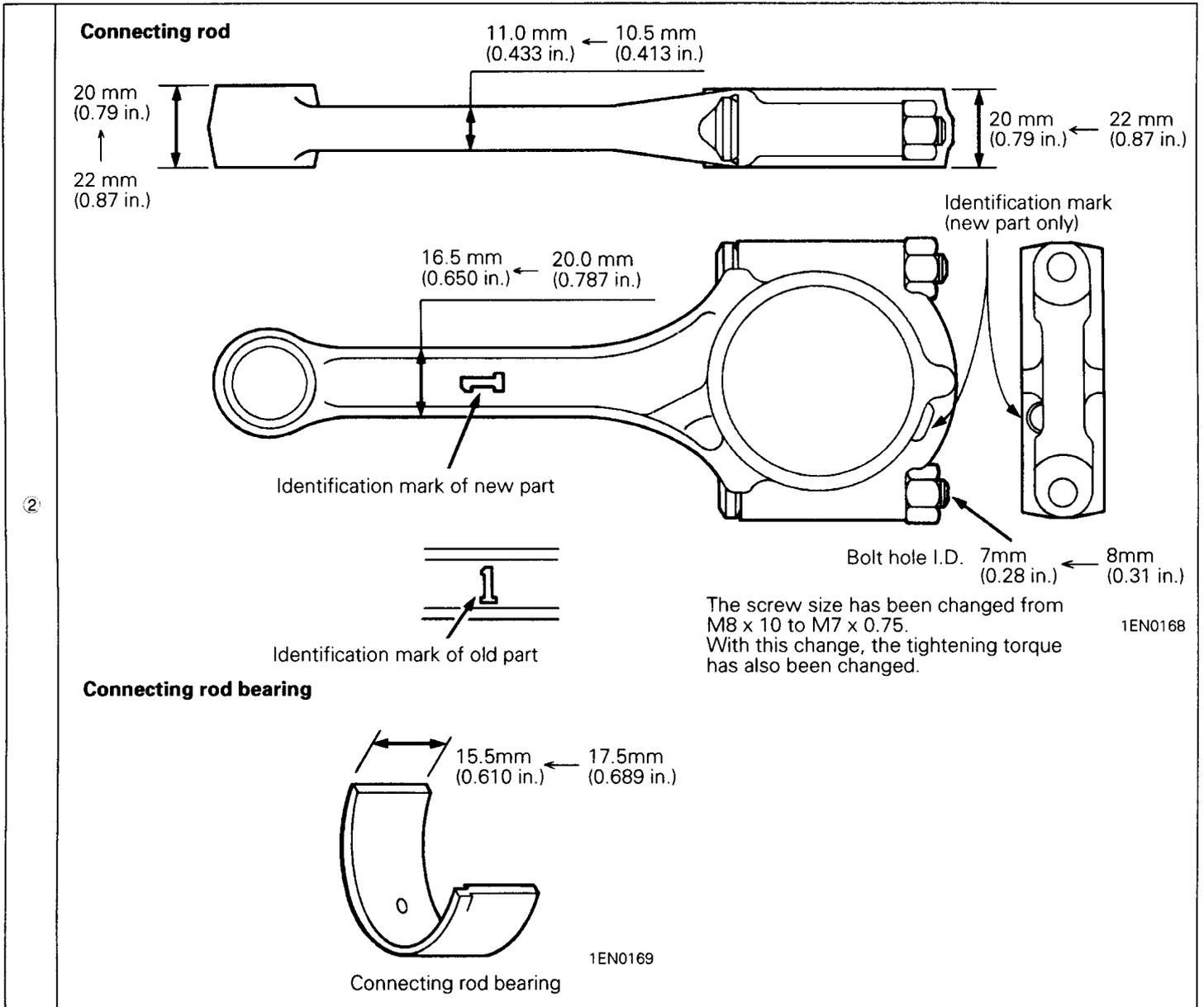
Disassembly steps

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

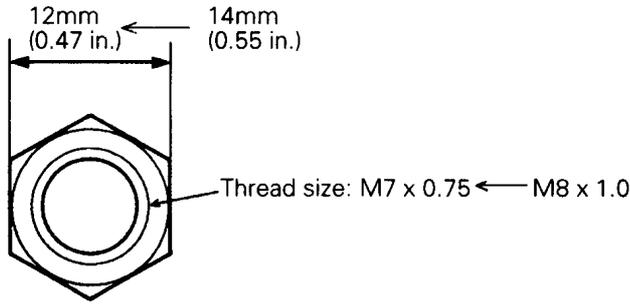
NOTE

- ②: See "Details of Change" table.
- ④: See "Details of Change" table.

Details of Change



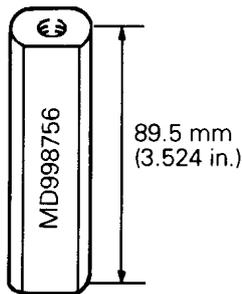
Connecting rod cap nut



1EN0170

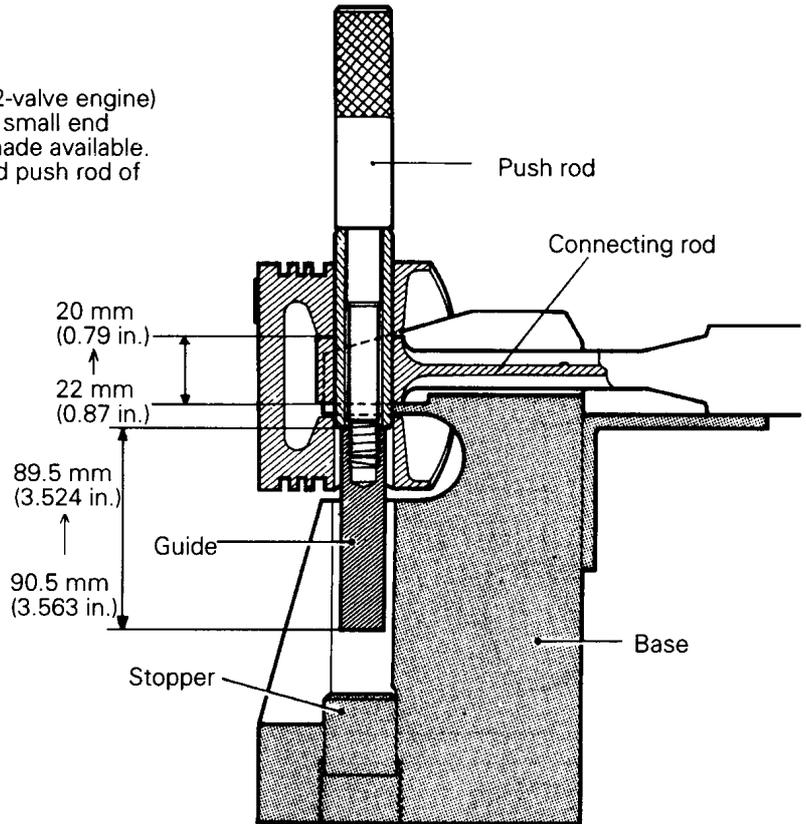
Piston pin installation tool (excluding 12-valve engine)
 With the change of the connecting rod small end dimension, a new piston pin guide is made available.
 (Used in combination with the base and push rod of piston pin setting tool MD998300.)

②



Newly-introduced guide MD998756

1EN0171

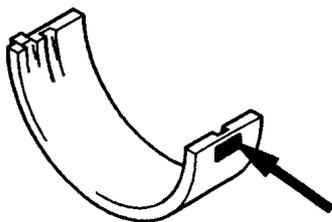


1EN059

Connecting rod bearing

According to the adoption of the selective connecting rod bearings, the bearing identification mark has been added.

④



Identification mark position

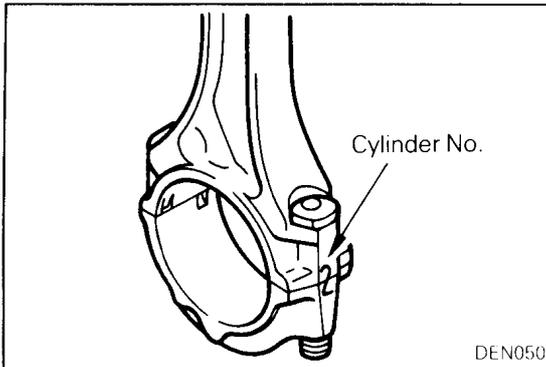
1EN0402

New
 Identification mark and bearing thickness

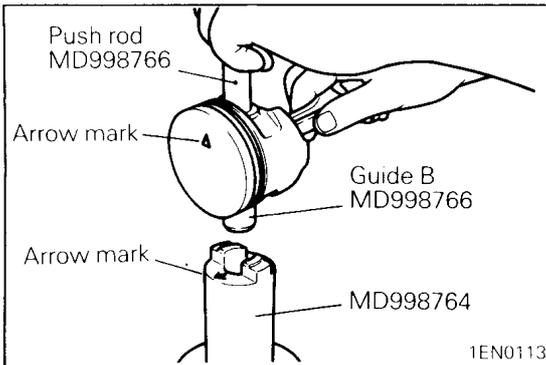
Identification mark	Bearing thickness mm (in.)
1	1.488 – 1.493 (0.5858 – 0.5878)
2	1.493 – 1.498 (0.5878 – 0.5898)
3	1.498 – 1.503 (0.5898 – 0.5917)

Old

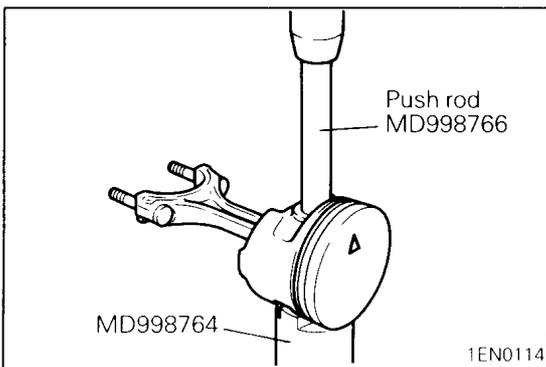
Bearing thickness mm (in.)
1.488 – 1.493 (0.5858 – 0.5878)

**SERVICE POINTS OF DISASSEMBLY****◊A◊ REMOVAL OF CONNECTING ROD CAP**

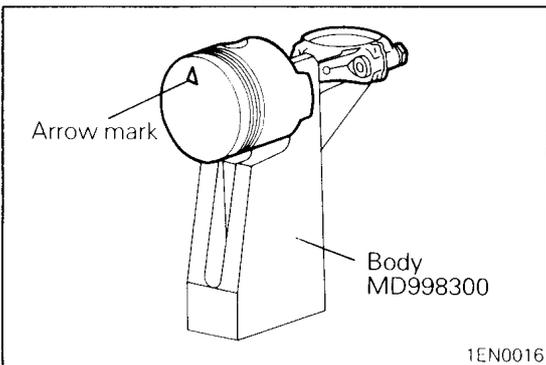
- (1) Mark the cylinder number on the side of the connecting rod big end for correct reassembly.

**◊B◊ REMOVAL OF PISTON PIN – 12-VALVE ENGINE**

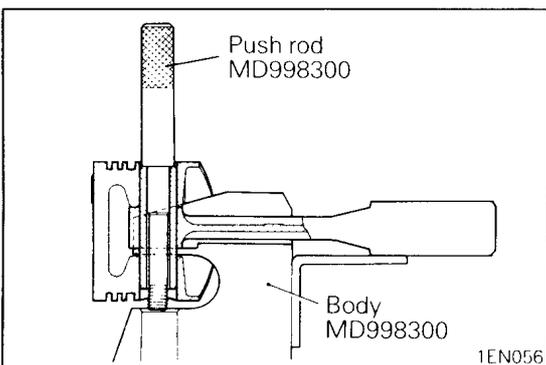
- (1) Insert the push rod (special tool) into the piston from its front arrow mark side and install the guide B.
- (2) With the piston front mark facing up, set the piston so that the piston top is on the arrow mark side of the piston pin setting base (special tool).
- (3) Using a press, remove the piston pin.

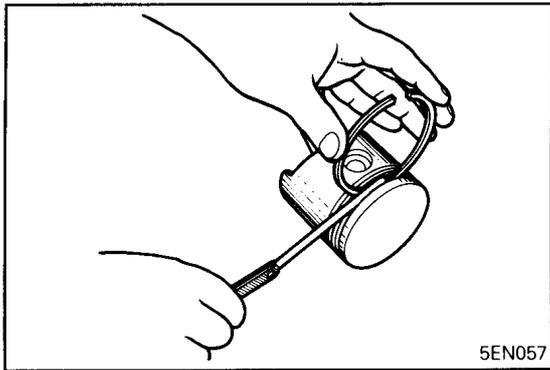
**◊B◊ REMOVAL OF PISTON PIN – 8-VALVE ENGINE**

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



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





INSPECTION

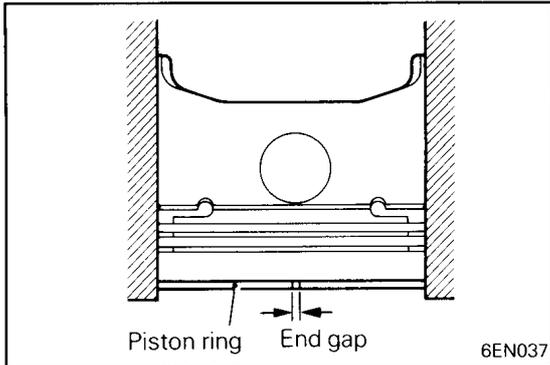
PISTON RING

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

Standard value:

No. 1	0.03 – 0.07 mm (0.0012 – 0.0028 in.)
No. 2	0.02 – 0.06 mm (0.0008 – 0.0024 in.)

Limit: 0.1 mm (0.0039 in.)



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

Standard value:

No. 1

Other than 12-valve engine	0.20 – 0.35 mm
for Australia	(0.0079 – 0.0138 in.)
12-valve engine for Australia	0.20 – 0.40 mm
	(0.0079 – 0.0157 in.)

No. 2

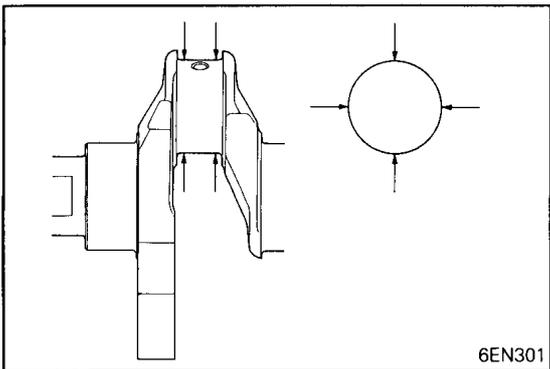
12-valve engine	0.20 – 0.35 mm
	(0.0079 – 0.0138 in.)
G15 and 4G15 8-valve engine	0.20 – 0.35 mm
for Australia	(0.0079 – 0.0138 in.)
G13B, 4G13, 4G15 8-valve engine	
(excluding those for Australia)	0.20 – 0.40 mm
	(0.0079 – 0.0157 in.)
Oil	0.20 – 0.70 mm (0.0079 – 0.0276 in.)

Limit:

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

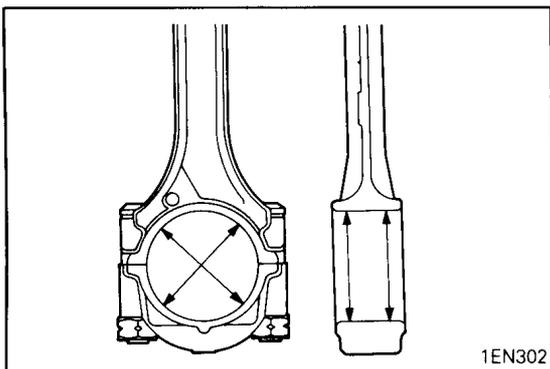
CONNECTING ROD BEARING

- (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.
In the case of fillet rolled crankshaft, do not machine the pin and journal to an undersize diameter.
(See "Crankshaft" Section)



- (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 – 0.06 mm (0.0008 – 0.0024 in.)
Limit: 0.15 mm (0.0059 in.)



Crankshaft pin diameter:

0.25 U.S. 41.740 – 41.725 mm (1.6236 – 1.6230 in.)

0.50 U.S. 41.490 – 41.475 mm (1.6335 – 1.6329 in.)

0.75 U.S. 41.240 – 41.225 mm (1.6433 – 1.6427 in.)

NOTE

For the oil clearance measuring method using a plastic gauge, refer to the section CRANKSHAFT

SERVICE POINTS OF REASSEMBLY**◆A◆ INSTALLATION OF PISTON PIN – 12-VALVE ENGINE**

- (1) Assemble the piston and connecting rod, matching the front marks (arrow mark on the piston and embossed mark "1" on the connecting rod).
- (2) Insert the guide A from the side opposite to the front marked side.
- (3) Apply engine oil to the outside of the piston pin.
- (4) Combine the piston pin with the push rod (special tool) and insert them into the piston from the front marked side and install against guide A.

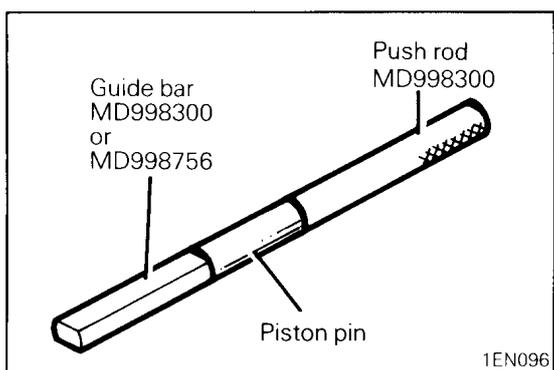
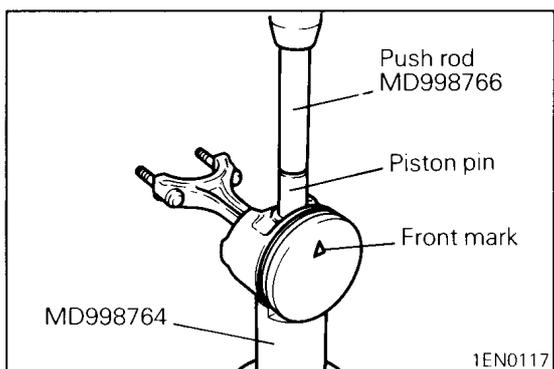
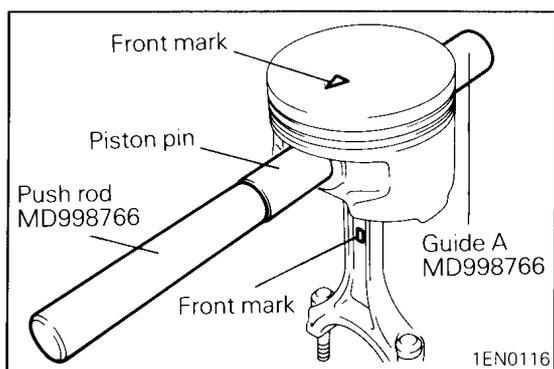
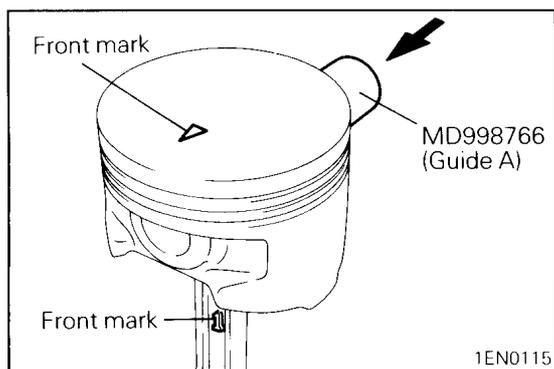
- (5) With the piston front mark facing up, set so that the piston top faces the front (arrow) mark side of the piston pin setting base (special tool).
- (6) Using a press, install the piston pin.
If the installation load is smaller than specified, replace the piston pin (piston assembly) and/or the connecting rod.

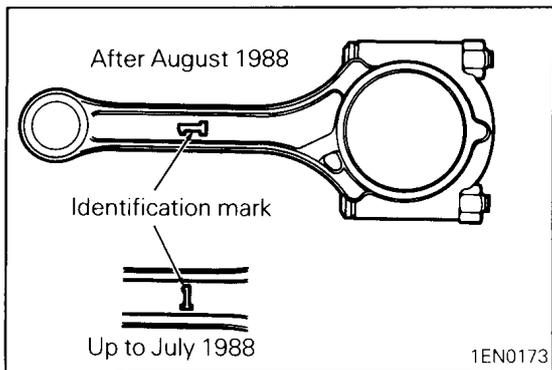
Piston pin press-fitting load:

5,000 – 15,000 N (500 – 1,500 kg, 1,102 – 3,307 lbs.)

◆A◆ INSTALLATION OF PISTON PIN – 8-VALVE ENGINE

- (1) Attach the push rod and guide bar of the special tool to the piston pin.

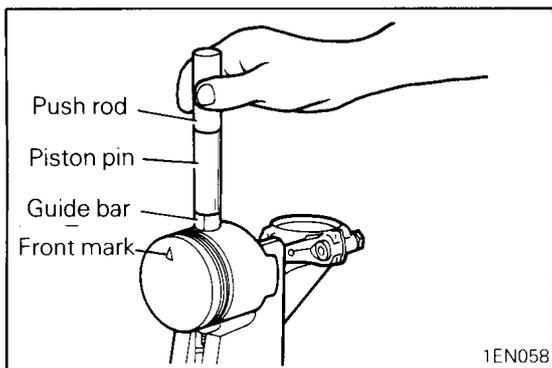




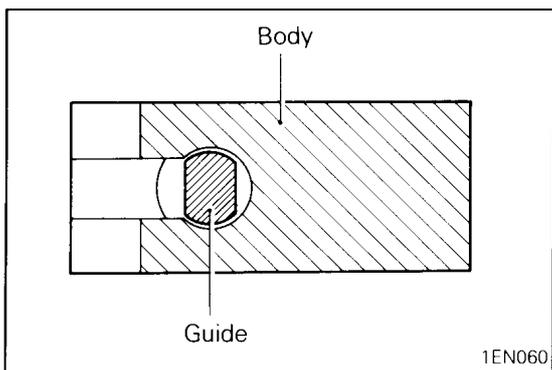
NOTE

Engine produced up to July 1988 and those produced after August 1988 use different connecting rods, and the guide bar (special tool) required differs accordingly.

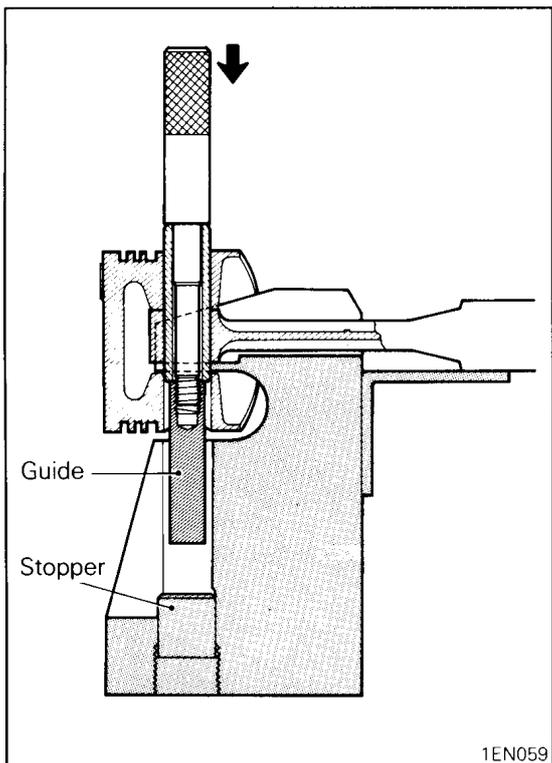
Up to July 1988 MD998300
 After August 1988 MD998756



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



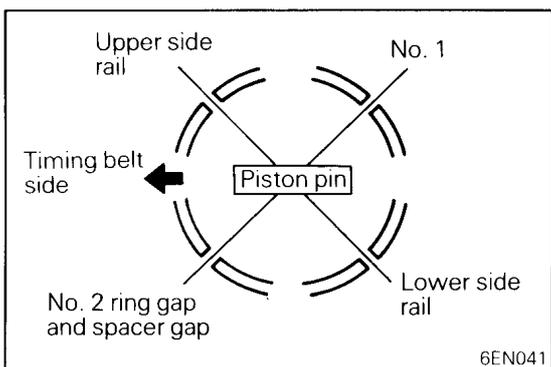
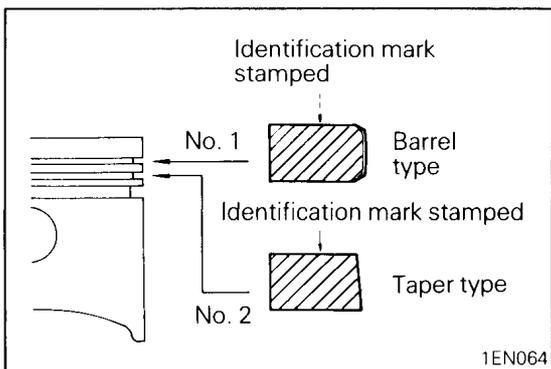
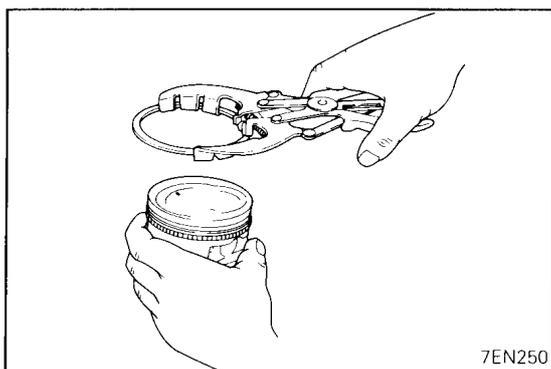
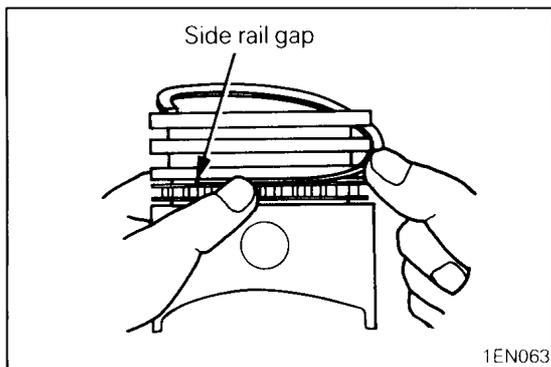
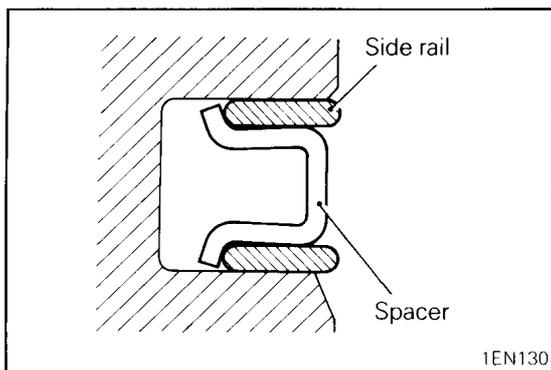
- (5) Position the guide so its two surfaces running in parallel to each other are oriented as shown.



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

Piston pin press-fitting load:

5,000 – 15,000 N
(500 – 1,500 kg, 1,102 – 3,307 lbs.)



◆B◆ INSTALLATION OF OIL RING

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

NOTE

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

- (2) Install the upper side rail.

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

Caution

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

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

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

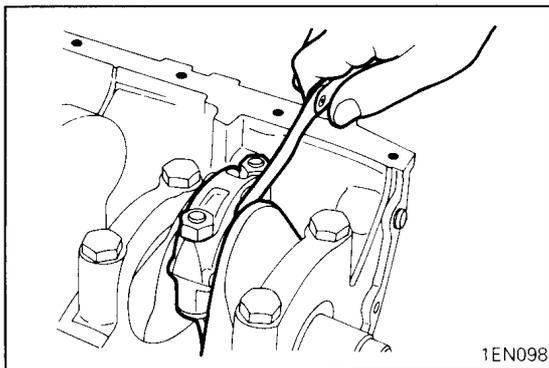
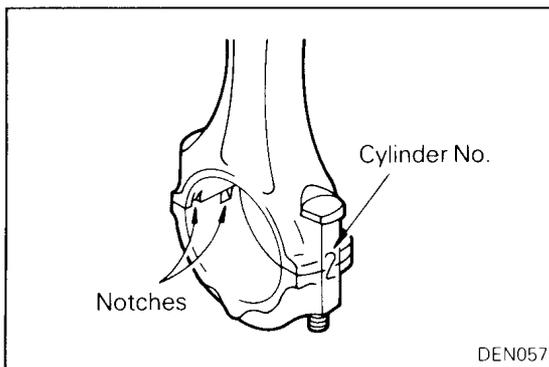
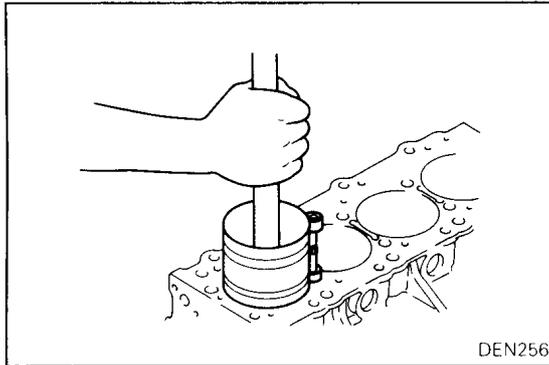
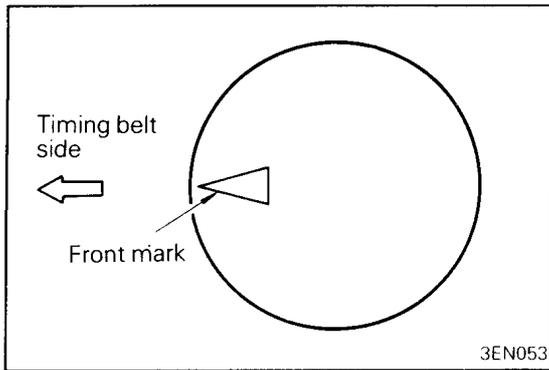
- (1) Using piston ring expander, fit No. 2 and then No. 1 piston ring into position.

NOTE

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

◆D◆ INSTALLATION OF PISTON AND CONNECTING ROD ASSEMBLY

- (1) Apply engine oil to the piston surface, piston rings, and oil ring.
- (2) Align gaps of piston rings and oil ring (side rails and spacer) as shown in the illustration.



- (3) Rotate crankshaft so that the crank pin is on the center of the cylinder bore.
- (4) Use suitable thread protectors on the connecting rod bolts before inserting 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 the piston and connecting rod assembly into the cylinder block.

◆E◆ INSTALLATION OF CONNECTING ROD CAP

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

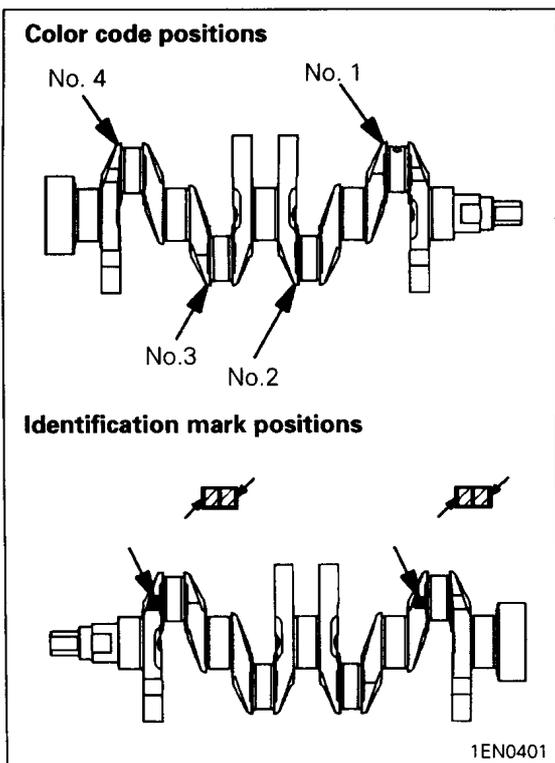
- (2) Make sure that connecting rod big end side clearance meets the specification.

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

◆F◆ INSTALLATION OF CONNECTING ROD CAP NUT

(Engine produced after August 1988 only)

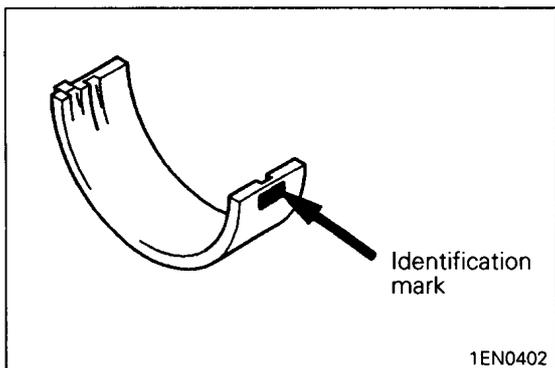
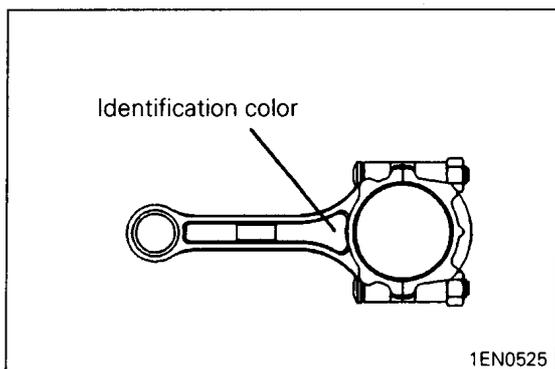
- (1) Before reusing the connecting rod bolts and nuts, check for stretching of the bolt. To check for stretching, screw the nut over the bolt with fingers to the end of the threaded section. If the nut cannot be fitted smoothly all the way, the bolt's threaded section is stretched and the bolt must be replaced.
- (2) Before tightening the nut, apply engine oil to the threads.
- (3) Tighten the nut to 20 Nm (2.0 kgm, 15 ft.lbs.).
- (4) Tighten further 1/4 turn.



◆G◆ CONNECTING ROD BEARING INSTALLATION (SELECTIVE BEARING)

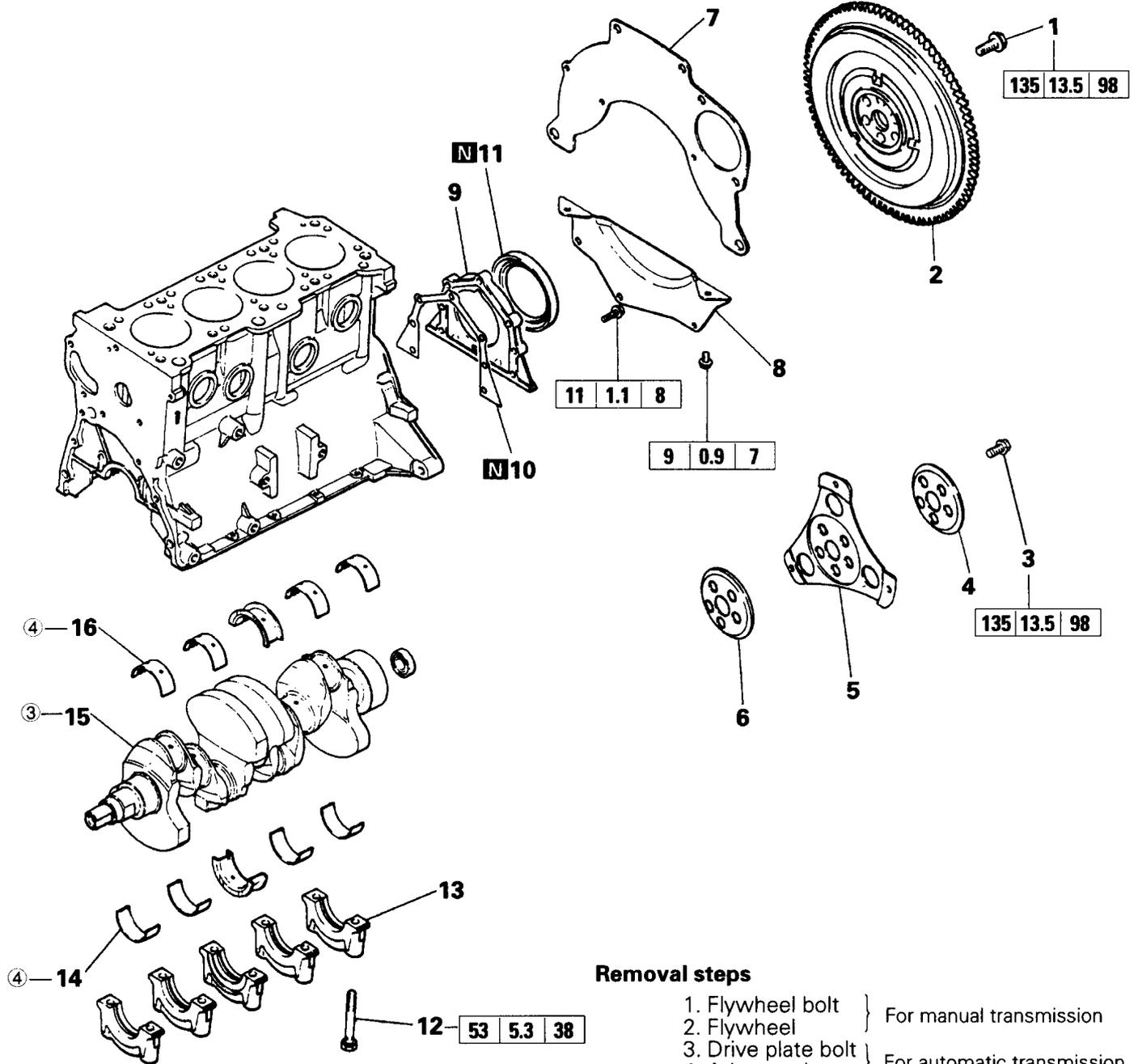
(1) Select bearings according to the crankshaft and connecting rod identification marks or color codes at the positions shown in the illustration, referring to the following table.

Crankshaft identification mark and color	Connecting rod identification color	Bearing identification mark
I and yellow	White	1
	None	1
	Yellow	2
II and none	White	1
	None	2
	Yellow	3
III and white	White	2
	None	3
	Yellow	3



12. CRANKSHAFT, FLYWHEEL AND DRIVE PLATE

REMOVAL AND INSTALLATION



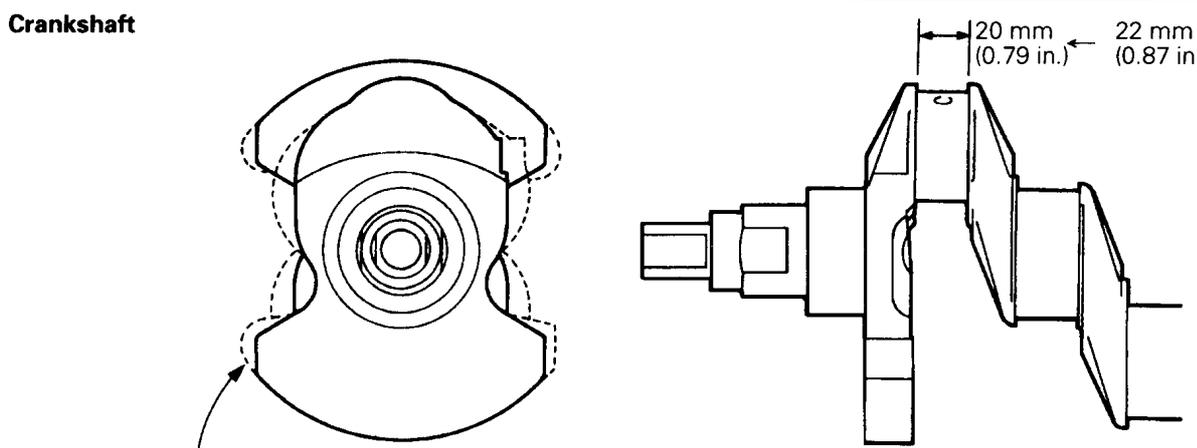
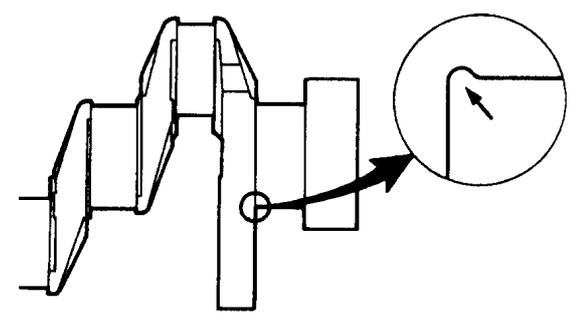
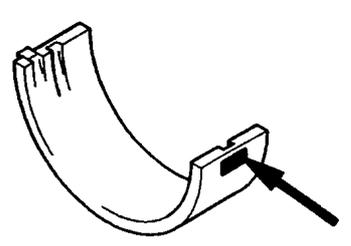
Removal steps

1. Flywheel bolt } For manual transmission
2. Flywheel } For manual transmission
3. Drive plate bolt } For automatic transmission
4. Adaptor plate } For automatic transmission
5. Drive plate
6. Adaptor plate
7. Rear plate
8. Bell housing cover
9. Oil seal case
10. Oil seal case gasket
- ◆D◆ 11. Rear oil seal
- ◆C◆ 12. Bearing cap bolt
- ◆C◆ 13. Bearing cap
- ◆A◆ 14. Crankshaft bearing (lower)
15. Crankshaft
- ◆A◆ 16. Crankshaft bearing (upper)

NOTE

- ③: See "Details of Change" table.
- ④: See "Details of Change" table.

Details of Change

<p>2</p>	<p>Crankshaft</p>  <p>Broken line: Former shape</p> <p>(1) The pin width has been changed. (2) The counter weight shape has been changed.</p> <p style="text-align: right;">1EN0174</p>																				
<p>3</p>	<p>Crankshaft</p>  <p>Fillet rolled section</p> <p style="text-align: center;">1EN0147</p> <p>Note: In the case of fillet rolled crankshaft, do not machine the pin and journal to an undersize diameter.</p>																				
<p>4</p>	<p>Crankshaft bearing</p> <p>According to the adoption of the selective crankshaft bearings, the bearing identification mark has been added.</p>  <p>Identification mark position</p> <p style="text-align: center;">1EN0402</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">New</th> <th style="text-align: center;">Old</th> </tr> <tr> <th colspan="2" style="text-align: center;">Identification mark and bearing thickness</th> <th></th> </tr> <tr> <th style="text-align: center;">Identification mark</th> <th style="text-align: center;">Bearing thickness mm (in.)</th> <th style="text-align: center;">Bearing thickness mm (in.)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">1</td> <td style="text-align: center;">1.988 – 1.991 (0.7827 – 0.7839)</td> <td rowspan="5" style="text-align: center; vertical-align: middle;">1.987 – 1.991 (0.7823 – 0.7839)</td> </tr> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">1.991 – 1.994 (0.7839 – 0.7850)</td> </tr> <tr> <td style="text-align: center;">3</td> <td style="text-align: center;">1.994 – 1.997 (0.7850 – 0.7862)</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">1.997 – 2.000 (0.7862 – 0.7874)</td> </tr> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">2.000 – 2.003 (0.7874 – 0.7886)</td> </tr> </tbody> </table>	New		Old	Identification mark and bearing thickness			Identification mark	Bearing thickness mm (in.)	Bearing thickness mm (in.)	1	1.988 – 1.991 (0.7827 – 0.7839)	1.987 – 1.991 (0.7823 – 0.7839)	2	1.991 – 1.994 (0.7839 – 0.7850)	3	1.994 – 1.997 (0.7850 – 0.7862)	4	1.997 – 2.000 (0.7862 – 0.7874)	5	2.000 – 2.003 (0.7874 – 0.7886)
New		Old																			
Identification mark and bearing thickness																					
Identification mark	Bearing thickness mm (in.)	Bearing thickness mm (in.)																			
1	1.988 – 1.991 (0.7827 – 0.7839)	1.987 – 1.991 (0.7823 – 0.7839)																			
2	1.991 – 1.994 (0.7839 – 0.7850)																				
3	1.994 – 1.997 (0.7850 – 0.7862)																				
4	1.997 – 2.000 (0.7862 – 0.7874)																				
5	2.000 – 2.003 (0.7874 – 0.7886)																				

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.

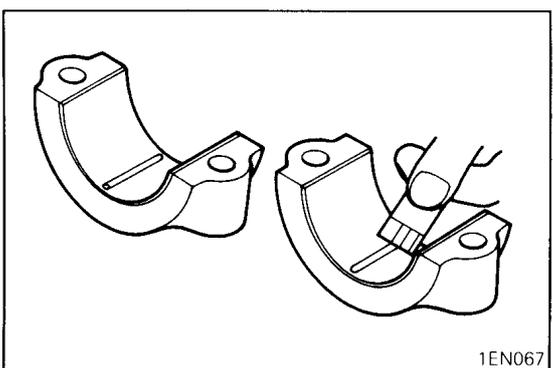
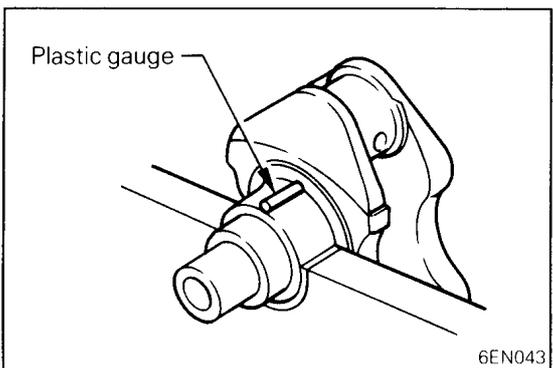
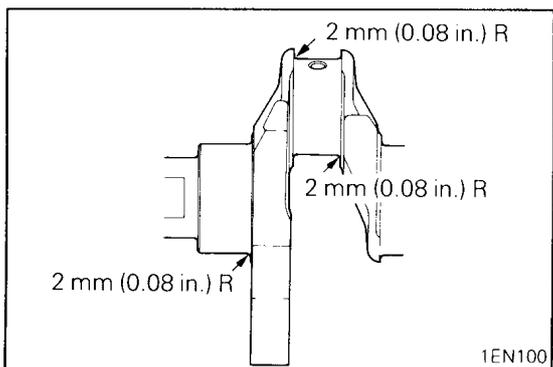
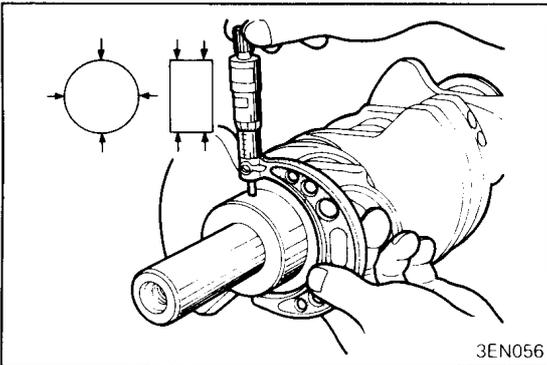
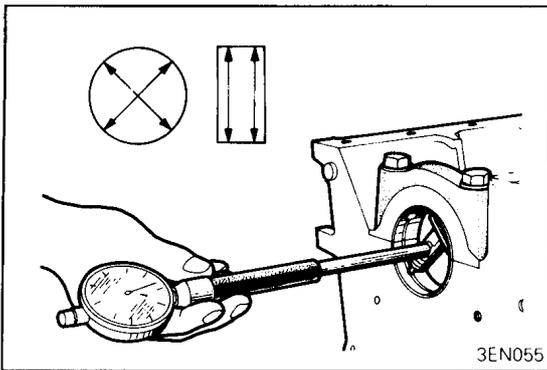
Standard value: 0.02 – 0.07 mm
(0.0008 in. – 0.0028 in.)
Limit: 0.15 mm (0.0059 in.)

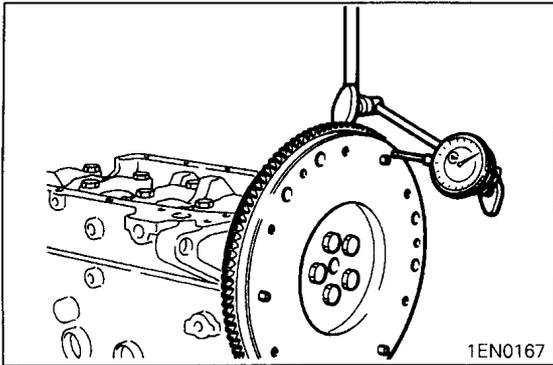
- (2) When the crankshaft is machined to undersize, finish the fillets of journals and pins to the specified radius.

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.





FLYWHEEL

(1) Check the runout of flywheel.

Limit: Max. 0.13 mm (0.0051 in.)

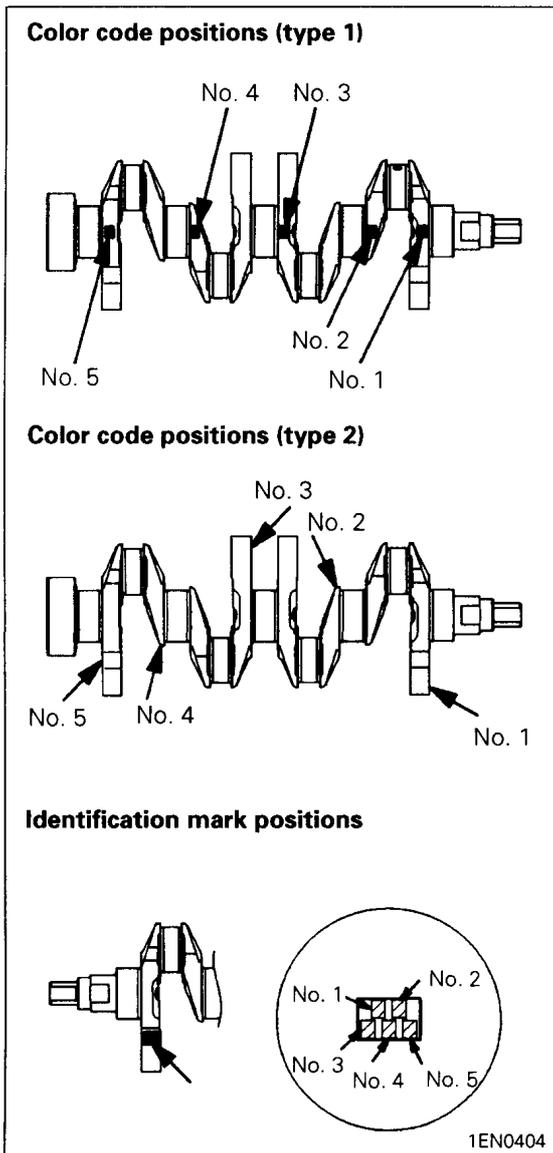
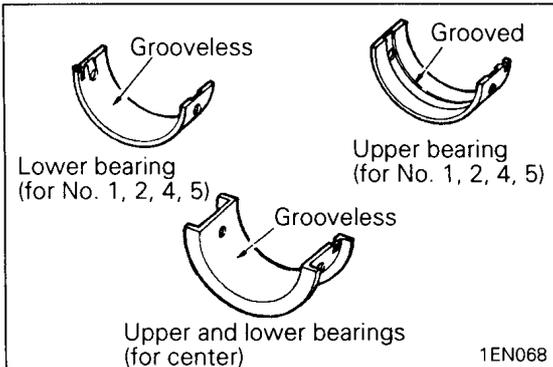
SERVICE POINTS OF REASSEMBLY

◆A◆ INSTALLATION OF CRANKSHAFT BEARING

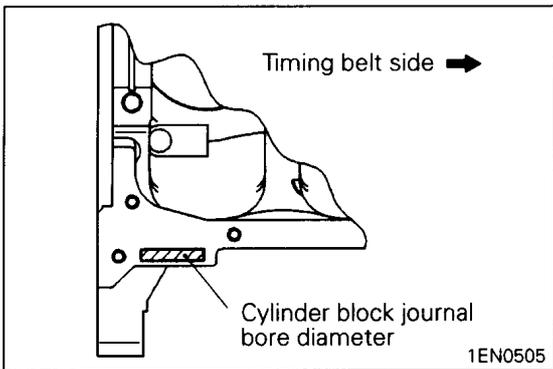
(1) Except for the center bearing, all the upper bearings are grooved. The center bearings are grooveless and have flanges. The center bearings are the same at the top and bottom.

(2) The lower bearings are all grooveless.

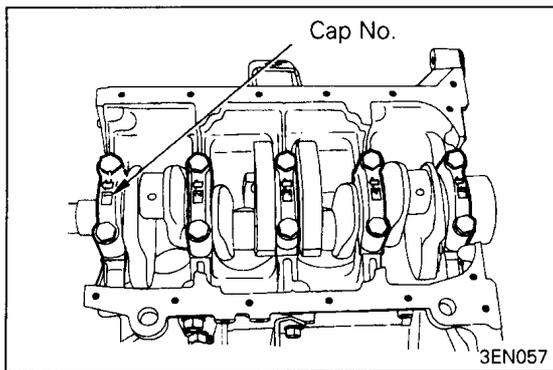
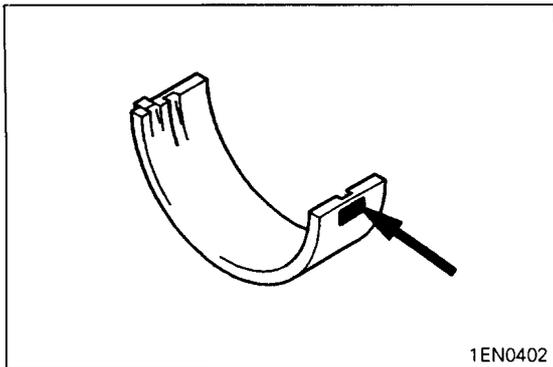
(3) Select bearings according to the crankshaft identification marks or color codes, referring to the following table. If they are not identifiable, measure the crankshaft journals and choose bearings to match the measurements.



Crankshaft journal				Cylinder block bearing bore diameter	Bearing
Range	Color code	Identification mark	Journal diameter mm (in.)	Identification mark	Identification mark
1	Yellow	I	47.995 -48.000 (1.8896 -1.8898)	0	1
				1	2
				2	3
2	None	II	47.985 -47.995 (1.8892 -1.8896)	0	2
				1	3
				2	4
3	White	III	47.980 -47.985 (1.8890 -1.8892)	0	3
				1	4
				2	5

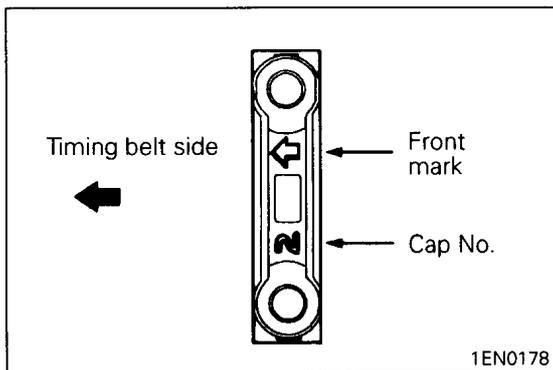


- (4) Identification marks showing the cylinder block bearing bore diameter are stamped in the position shown, with No. 1 at the front of the engine. Bearings must be selected and installed in accordance with these identification marks.
- (5) Based on the identification markings verified in steps (3) and (4), select bearings from table above. See the following example:
 1. If the measured crankshaft journal diameter is 48.000 mm (1.8898 in.), this corresponds to classification 1 in the above table.
 2. If the identification mark on the cylinder block bearing hole is "1", select a bearing with an identification mark of "2".



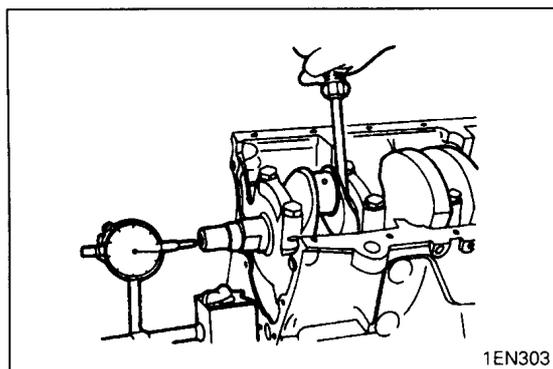
INSTALLATION OF BEARING CAP

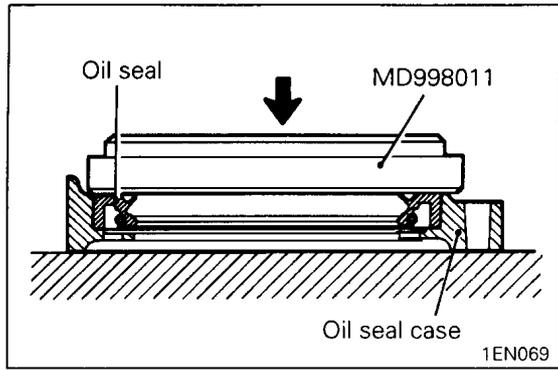
- (1) Install according to the front mark and cap No.



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

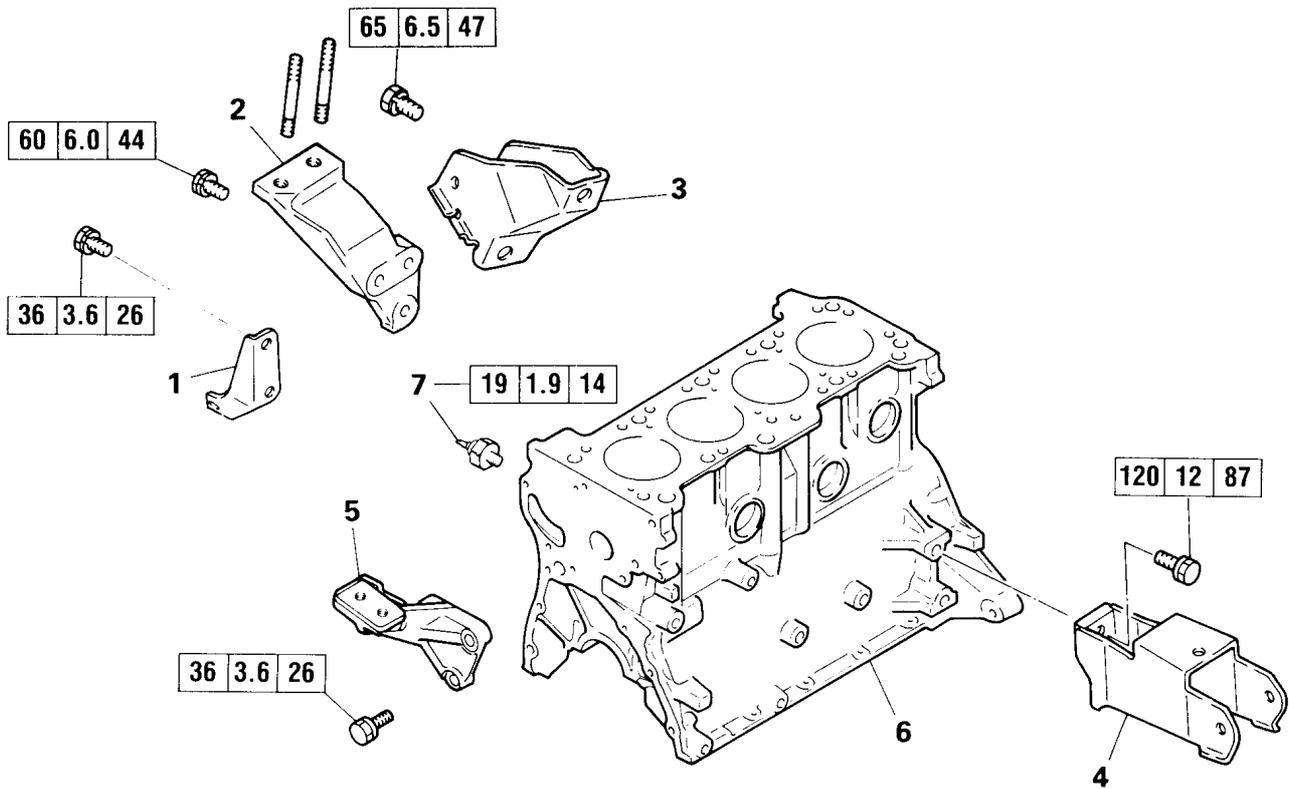
Standard value: 0.05 – 0.18 mm (0.0020 – 0.0071 in.)
Limit: 0.25 mm (0.0098 in.)





⇨D⇨ INSTALLATION OF OIL SEAL

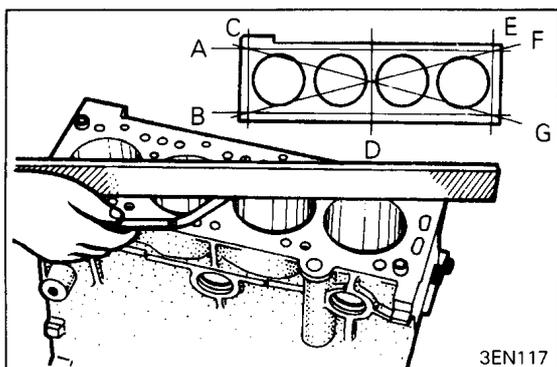
13 CYLINDER BLOCK REMOVAL AND INSTALLATION



Removal steps

1. Exhaust pipe support bracket
2. Engine support bracket, front
3. Roll stopper bracket, front
4. Roll stopper bracket, rear
5. Engine support bracket, left
6. Cylinder block
7. Oil pressure switch

1EN329



INSPECTION

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

Standard value: 0.05 mm (0.0020 in.)

Limit: 0.1 mm (0.0039 in.)

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

Grinding limit: 0.2 mm (0.0079 in.)

The total thickness of stock allowed to be removed from cylinder block and mating cylinder head is 0.2 mm (0.0079 in.) at maximum.

Cylinder block height (When new):

255.9 – 256.1 mm (10.075 – 10.083 in.)

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

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

Standard value: Cylinder I.D.

4G16 68.20 – 68.23 mm (2.6850 – 2.6862 in.)

4G13, G13B 71.00 – 71.03 mm (2.7953 – 2.7965 in.)

4G15, G15B 75.50 – 75.53 mm (2.9724 – 2.9736 in.)

Cylindricity: 0.01 mm (0.0004 in.) or less

BORING CYLINDER

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

Piston size identification

Up to 1993 models

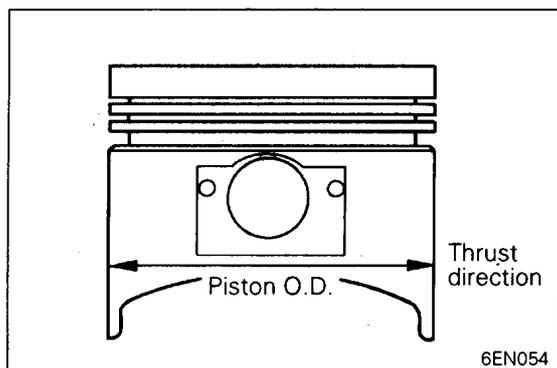
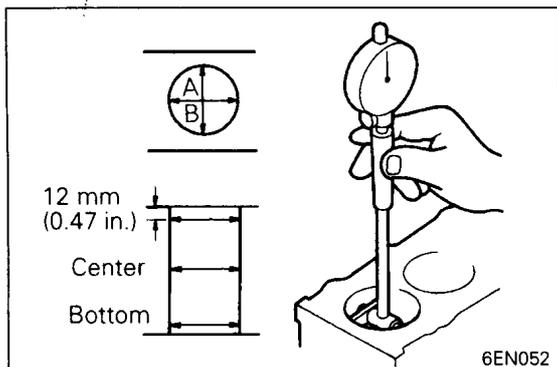
Size	Identification mark
0.25 mm (0.01 in.) O.S.	0.25
0.50 mm (0.02 in.) O.S.	0.50
0.75 mm (0.03 in.) O.S.	0.75
1.00 mm (0.04 in.) O.S.	1.00

From 1994 models

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

NOTE

Size mark is stamped on piston top.



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

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

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

Caution

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

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

**Clearance between piston and cylinder:
0.02 – 0.04 mm (0.0008 – 0.0016 in.)**

NOTE

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