

ENGINE

4G9 SERIES

CONTENTS

GENERAL INFORMATION	11A-0-3
1. SPECIFICATIONS	11A-1-1
SERVICE SPECIFICATIONS	11A-1-1
REWORK DIMENSIONS	11A-1-4
TORQUE SPECIFICATIONS	11A-1-5
NEW TIGHTENING METHOD-BY USE OF BOLTS TO BE TIGHTENED IN PLASTIC AREA	11A-1-7
SEALANT	11A-1-7
FORM-IN-PLACE GASKET	11A-1-8
2. SPECIAL TOOLS	11A-2-1
3. ALTERNATOR AND IGNITION SYSTEM	11A-3-1
4. TIMING BELT	11A-4-1
5. FUEL AND EMISSION CONTROL SYSTEM	11A-5-1
5a. THROTTLE BODY AND EGR SYSTEM (GDI)	11A-5a-1
6. INTAKE AND EXHAUST MANIFOLD	11A-6-1
6a. INTAKE MANIFOLD (GDI)	11A-6a-1
6b. EXHAUST MANIFOLD (GDI)	11A-6b-1
6c. INJECTOR AND FUEL PUMP ASSEMBLY (GDI)	11A-6c-1
6d. INTAKE AND EXHAUST MANIFOLD <4G94-GDI for PAJERO io>	11A-6d-1
7. WATER PUMP AND WATER HOSE	11A-7-1
8. ROCKER ARMS AND CAMSHAFTS	11A-8-1
8a. ROCKER COVER AND CAMSHAFTS (MIVEC)	11A-8a-1
8b. ROCKER ARMS AND ROCKER SHAFT CAPS (MIVEC)	11A-8b-1
9. CYLINDER HEAD AND VALVES	11A-9-1
10. FRONT CASE AND OIL PUMP	11A-10-1
11. PISTON AND CONNECTING ROD	11A-11-1
12. CRANKSHAFT, CYLINDER BLOCK, FLYWHEEL AND DRIVE PLATE	11A-12-1

NOTES

GENERAL INFORMATION

4G92

Descriptions			4G92- SOHC	4G92- DOHC- MIVEC
Type			In-line OHV, SOHC	In-line OHV, DOHC
Number of cylinders			4	4
Combustion chamber			Pentroof type	Pentroof type
Total displacement dm ³			1,597	1,597
Cylinder bore mm			81.0	81.0
Piston stroke mm			77.5	77.5
Compression ratio			10.0	11.0
Valve timing	Intake valve	Opens (BTDC)	20°, 14°*	17° (Low-speed cam) 47.5° (High-speed cam)
		Closes (ABDC)	42°, 58°*	31° (Low-speed cam) 72.5° (High-speed cam)
	Exhaust valve	Opens (BBDC)	54°, 52°*	41° (Low-speed cam) 70° (High-speed cam)
		Closes (ATDC)	2°, 16°*	11° (Low-speed cam) 35° (High-speed cam)
Lubrication system			Pressure feed, full-flow filtration	Pressure feed, full-flow filtration
Oil pump type			Trochoid type	Trochoid type
Cooling system			Water-cooled forced circulation	Water-cooled forced circulation
Water pump type			Centrifugal impeller type	Centrifugal impeller type

*: LANCER for general export and CARISMA for 6B model

4G93

Descriptions			4G93 - SOHC	4G93 - DOHC	4G93 - DOHC - GDI
Type			In-line OHV, SOHC	In-line OHV, DOHC	In-line OHV, DOHC
Number of cylinders			4	4	4
Combustion chamber			Pentroof type	Pentroof type	Pentroof type
Total displacement dm ³			1,834	1,834	1,834
Cylinder bore mm			81.0	81.0	81.0
Piston stroke mm			89.0	89.0	89.0
Compression ratio			10.0, 9.5	10.5	11.7* ¹ , 12.0* ²
Valve timing	Intake valve	Opens (BTDC)	14°	20°	15°
		Closes (ABDC)	50°	60°	56°
	Exhaust valve	Opens (BBDC)	58°	61°	55°
		Closes (ATDC)	10°	15°	15°
Lubrication system			Pressure feed, full-flow filtration	Pressure feed, full-flow filtration	Pressure feed, full-flow filtration
Oil pump type			Trochoid type	Trochoid type	Trochoid type
Cooling system			Water-cooled forced circulation	Water-cooled forced circulation	Water-cooled forced circulation
Water pump type			Centrifugal impeller type	Centrifugal impeller type	Centrifugal impeller type

*1: Up to 1999 model

*2: From 2000 model

4G94

Descriptions			4G94–SOHC	4G94–DOHC–GDI
Type			In-line OHV, SOHC	In-line OHV, DOHC
Number of cylinders			4	4
Combustion chamber			Pentroof type	Pentroof type
Total displacement dm ³			1,999	1,999
Cylinder bore mm			81.5	81.5
Piston stroke mm			95.8	95.8
Compression ratio			9.5	10.6
Valve timing	Intake valve	Opens (BTDC)	2°	15°
		Closes (ABDC)	58°	51°
	Exhaust valve	Opens (BBDC)	58°	55°
		Closes (ATDC)	10°	15°
Lubrication system			Pressure feed, full-flow filtration	Pressure feed, full-flow filtration
Oil pump type			Trochoid type	Trochoid type
Cooling system			Water-cooled forced circulation	Water-cooled forced circulation
Water pump type			Centrifugal impeller type	Centrifugal impeller type

1. SPECIFICATIONS

SERVICE SPECIFICATIONS

Items			Standard value	Limit
Timing belt				
Auto-tensioner rod protrusion amount (When removed from engine) mm			11	—
Auto-tensioner rod stroke mm			Within 1	—
Auto-tensioner rod protrusion amount (When checking with installed on engine) mm			3.8 – 4.5	—
Rocker arms and camshaft				
Camshaft cam height mm	4G92–SOHC*1	Intake	37.34	36.84
		Exhaust	36.79	36.29
	4G92–SOHC*2	Intake	37.78	37.28
		Exhaust	37.83	37.33
	4G92–SOHC*3	Intake	36.92	36.42
		Exhaust	36.70	36.65
	4G93–SOHC*4	Intake	37.53	37.03
		Exhaust	37.64	37.14
	4G93–SOHC*5	Intake	37.11	36.61
		Exhaust	37.15	36.65
	4G94–SOHC	Intake	37.91	37.41
		Exhaust	37.70	37.20
	4G93–DOHC	Intake	35.31	34.81
		Exhaust	35.20	34.70
	4G93–DOHC–GDI	Intake	35.49	34.99
		Exhaust	34.73	34.23
	4G94–DOHC–GDI	Intake	35.49	34.99
		Exhaust	34.91	34.41
Valve clearance mm		Intake	0.09	—
		Exhaust	0.20	—
Camshaft journal O.D. mm		SOHC	26.0	—
		DOHC	45.0	—
Rocker cover and camshaft (MIVEC)				
Camshaft height mm		Intake A	36.41	36.91
		Intake B	33.58	33.08
		Exhaust A	35.83	35.33
		Exhaust B	34.24	33.74
Valve clearance (cold engine) mm		Intake	0.1	—
		Exhaust	0.2	—

*1: LANCER for Europe and CARISMA for Europe

*2: LANCER for general export and CARISMA for 6B model

*3: LANCER for Europe (from 2001 model) and CARISMA for Europe (from 2001 model)

*4: Except for Europe

*5: For Europe

Items			Standard value	Limit
Cylinder head and valve				
Cylinder head gasket surface flatness mm			Less than 0.03	0.2
Grinding limit of cylinder head gasket surface mm *Total resurfacing depth of both cylinder head and cylinder block			–	0.2*
Cylinder head overall height mm		SOHC	119.9 – 120.1	–
		DOHC	131.9 – 132.1	–
		DOHC–MIVEC	119.8 – 120.0	–
		DOHC–GDI	131.9 – 132.1	–
Thickness of valve head (margin) mm	SOHC	Intake	1.0	0.5
		Exhaust	1.3	0.8
	DOHC	Intake	1.0	0.5
		Exhaust	1.2	0.7
Valve overall height mm	SOHC	Intake	110.15	109.65
		Exhaust	113.70	113.20
	DOHC	Intake	104.19	103.69
		Exhaust	103.87	103.37
	DOHC–MIVEC	Intake	115.63	115.13
		Exhaust	115.63	115.13
	DOHC–GDI	Intake	104.19	103.69
		Exhaust	103.87	103.37
Valve spring free length mm		SOHC (with lash ad-juster)	50.9	49.9
		SOHC (with adjust-ing screw)	49.5	48.5
		DOHC	45.0	44.0
		DOHC–MIVEC	51.5	50.5
		DOHC–GDI	44.8	43.8
Valve spring out-of-squareness			Max. 2°	4°
Valve stem to valve guide clearance mm	Except DOHC–GDI for PAJERO io	Intake	0.02 – 0.05	0.10
		Exhaust	0.05 – 0.09	0.15
	DOHC–GDI for PAJERO io	Intake	0.02 – 0.05	0.10
		Exhaust	0.04– 0.06	0.15
Valve seat valve contact width mm			0.9 – 1.3	–
Valve guide projection from cylinder head upper surface mm		SOHC	14.0	–
		DOHC	19.0	–

Items			Standard value	Limit	
Valve stem projec- tion mm	SOHC	Intake	49.30	49.80	
		Exhaust	49.35	49.85	
	DOHC	Intake	46.70	47.20	
		Exhaust	46.65	47.15	
	DOHC–MIVEC	Intake	58.13	58.63	
		Exhaust	57.85	58.35	
	DOHC–GDI	Intake	46.70	47.20	
		Exhaust	46.65	47.15	
Cylinder head bolt shank length mm			–	96.4	
Valve stem O.D. mm			6.0	–	
Valve face angle			45° – 45.5°	–	
Valve spring load/installed height N/mm	SOHC	216/44.2	–		
	DOHC	255/44.5	–		
	DOHC–MIVEC	255/44.5	–		
	DOHC–GDI	196/37.5	–		
Valve guide I.D. mm			6.0	–	
Font case, oil pump and oil pan					
Oil pump tip clearance mm			0.06 – 0.18	–	
Oil pump side clearance mm			0.04 – 0.10	–	
Oil pump body clearance mm			0.10 – 0.18	0.35	
Piston and connecting rod					
Piston ring to piston ring groove clearance mm	No. 1	0.03 – 0.07	0.1		
	No. 2	0.02 – 0.06	0.1		
Piston ring end gap mm	No. 1	4G92, 4G93	0.25 – 0.40	0.8	
		4G94	0.15 – 0.30	0.8	
	No. 2	0.40 – 0.55		0.8	
		Oil ring	SOHC (4G92, 4G93)	0.20 – 0.60	1.0
			SOHC (4G94), DOHC	0.10 – 0.35	1.0
Crankshaft pin oil clearance mm			0.02 – 0.05	0.1	
Piston pin press-in load N [Room temperature]			4,500 – 14,700	–	
Connecting rod big end side clearance mm			0.10 – 0.25	0.4	
Piston pin O.D. mm			19.0	–	
Piston O.D. mm	4G92, 4G93	81.0	–		
	4G94	81.5	–		
Crankshaft, cylinder block, flywheel and drive plate					
Crankshaft journal oil clearance mm			0.02 – 0.04	0.1	
Cylinder block gasket surface flatness mm			0.05	0.1	
Grinding limit of cylinder block gasket surface mm			–	0.2*	
*Total resurfacing depth of both cylinder head and cylinder block					

Items		Standard value	Limit
Cylinder block overall height mm	4G92	243.5	–
	4G93	263.5	–
	4G94	286.7	–
Cylinder block I.D. mm	4G92, 4G93	81.0	–
	4G94	81.5	–
Piston to cylinder clearance mm		0.02 – 0.04	–
Bearing cap bolt shank length mm		–	71.1
Crankshaft end play mm		0.05 – 0.25	0.4
Crankshaft journal O.D. mm		50	–
Crankshaft pin O.D. mm		45	–

REWORK DIMENSIONS

Items			Standard value
Cylinder head and valve			
Oversize rework dimensions of valve guide hole (both intake and exhaust) mm		0.05 O.S.	11.05 – 11.07
		0.25 O.S.	11.25 – 11.27
		0.50 O.S.	11.50 – 11.52
Oversize rework dimensions of intake valve seat hole mm	SOHC	0.30 O.S.	31.80 – 31.83
		0.60 O.S.	32.10 – 32.13
	DOHC	0.30 O.S.	34.30 – 34.32
		0.60 O.S.	34.60 – 34.62
Oversize rework dimensions of exhaust valve seat hole mm	SOHC	0.30 O.S.	29.30 – 29.32
		0.60 O.S.	29.60 – 29.62
	DOHC	0.30 O.S.	30.80 – 30.82
		0.60 O.S.	31.10 – 31.13
Crankshaft, flywheel and drive plate			
Crankshaft out of roundness and taper of journal and pin mm			0.005

NOTE

O.D.: Outer diameter

I.D.: Inner diameter

O.S.: Oversize diameter

TORQUE SPECIFICATIONS

Items	Nm
Alternator and ignition system	
Oil level gauge	13
Distributor	12
Ignition coil	10
Spark plug	25
Crankshaft bolt	182 ± 4
Alternator brace (M8)	23
Alternator brace (M10)	49
Lock bolt	23
Adjusting bolt	5
Power steering pump pulley	25
Power steering pump bracket stay	49
Power steering pump bracket (M8)	21
Power steering pump bracket (M10)	44
Alternator pivot bolt	44
Center cover	3
Ignition failure sensor (M6)	5
Ignition failure sensor (M8)	23
Ignition failure sensor bracket	10
Cam position sensor	9
Cam position sensor support	13
Cam position sensing cylinder	21
Engine cover	2.9
Timing belt	
Camshaft sprocket bolt	88
Cam position sensor	9.8
Crank angle sensor	9.8
Timing belt rear cover	11
Timing belt rear upper cover	11
Timing belt tensioner	24
Engine support bracket, right	49
Accessory mount	49
Timing belt cover	11
Tensioner pulley bolt	49
Tensioner arm bolt	44
Auto-tensioner bolt	13
Idler pulley bolt	36

Items	Nm
Fuel system and emission system	
Breather tube	21
Fuel pump	18
Carburetor	17
EGR valve	21
Cover <Without EGR valve>	12
Fuel return pipe	9
Delivery pipe	12
Fuel pressure regulator	9
Throttle body stay <MIVEC>	23
Throttle body stay <4G94>	24
Throttle body	19
Throttle cable bracket	19
Stay	24
Harness bracket	11
Vacuum hose and pipe assembly <Engine with solenoid valve> (Flange bolt)	11
Vacuum hose and pipe assembly <Engine with solenoid valve> (Bolt and washer assembly)	9
Vacuum hose and pipe assembly <Engine without solenoid valve>	10
Solenoid valve assembly	9
Throttle body and EGR system (GDI)	
Air intake resonator	9
Intake manifold stay (M8)	20
Intake manifold stay (M10)	30
Water hose clamp	13
Water pipe	11
Throttle body	18
Throttle body stay <CARISMA from 2001 model, SPACE STAR from 2001 model, GALANT>	24
Throttle body stay <For PAJERO io – 4G94>	18
EGR valve (Bolt and washer assembly)	18
EGR valve (Flange bolt)	24
Engine hanger	18
EGR valve support bolt	18
EGR valve support nut	23
Air by-pass valve	9

Items	Nm
Intake manifold and exhaust manifold	
Exhaust manifold (M8)	18
Exhaust manifold (M10)	29
Exhaust manifold bracket (M8)	19
Exhaust manifold bracket (M10 Bolt and washer assembly)	35
Exhaust manifold bracket (M10 Flange bolt)	98
Engine hanger (Bolt with head mark “4”)	12
Engine hanger (Bolt with head mark “7”)	19
Oil level gauge guide	14
Boost sensor	5
Intake air temperature sensor	13
Heat protector	13
Intake manifold	20
Intake manifold stay	31
Oxygen sensor	44
Intake manifold (GDI)	
Vacuum pipe and hose <Except for PAJERO io>	11
Vacuum pipe and hose <For PAJERO io>	9
Solenoid valve	9
Fuel pump protector	23
Connector bracket	11
Branch tube (M6 x 14)	11
Branch tube (M6 x 18)	9
Intake manifold stay	30
Accelerator cable bracket	9
Vacuum pipe	11
Intake manifold	19
Exhaust manifold (GDI)	
Oil level gauge guide	13
Exhaust manifold cover	13
Engine hanger bolt	24
Engine hanger nut (M8)	18
Engine hanger nut (M10)	29
Exhaust manifold bracket (M8 × 20)	18
Exhaust manifold bracket (M8 × 22)	35
Exhaust manifold bracket (M8 × 25)	19
Exhaust manifold bracket (M10)	35
Exhaust manifold bracket <For PAJERO io>	98

Items	Nm
Exhaust manifold (M8)	17
Exhaust manifold (M10)	29
Injector and fuel pump assembly (GDI)	
Fuel low pressure pipe (M6)	18
Fuel low pressure pipe (M8)	9
Fuel nipple	9
Clamp	9
Fuel feed pipe	11
Fuel pump	17
Harness bracket	11
Fuel pipe	11
Fuel return pipe	11
Fuel return pipe clamp	9
Fuel high pressure regulator	18
Fuel pressure sensor <Except for PAJERO io>	23
Fuel pressure sensor <For PAJERO io>	18
Spacer	18
Pump camshaft case	23
Injector holder	22
Delivery pipe and injector	11
Intake and exhaust manifold <4G94–GDI for PAJERO io>	
Vacuum pipe and hose	9
Solenoid valve	9
Fuel pump protector	23
Connector bracket	11
Intake manifold stay nut	29
Intake manifold stay bolt	31
Low pressure fuel pipe	9
Intake manifold	20
Exhaust manifold cover	13
Engine hanger	18
Exhaust manifold bracket	98
Exhaust manifold (M8)	17
Exhaust manifold (M10)	29
Water pump and water hose	
Water pump	24
Water inlet pipe	14
Thermostat case	24

Items	Nm
Water inlet fitting <Except PAJERO io>	19
Water inlet fitting <PAJERO io>	24
Water by-pass fitting	24
Water pipe	14
Water outlet fitting <Except PAJERO io>	19
Water outlet fitting <PAJERO io>	24
Engine coolant temperature gauge unit	10
Engine coolant temperature sensor	29
Water fitting	24
Rocker arms and camshaft	
Lock nut	9
Rocker arm shaft	31
Harness bracket	10
Rocker cover	3.5
Bearing cap bolt (M6)	11
Bearing cap bolt (M8)	24
Beam camshaft cap (M6)	11
Beam camshaft cap (M8)	21
Rocker cover and camshafts (MIVEC)	
Rocker cover	4
Oil pump	11
Arm spring holder	11
Camshaft bearing cap (M6)	11
Camshaft bearing cap (M8)	23
Oil control valve	9
Rocker arms and rocker shaft caps (MIVEC)	
Rocker shaft cap	11
Cylinder head and valves	
Cylinder head bolt	74 Nm and then completely loosen, finally tighten 20 Nm + 90° + 90°
Oil pressure switch	10
Front case and oil pump	
Oil pump cover	10
Oil pump case	14
Relief plug	44
Oil screen	19
Oil pan	9
Upper oil pan (M6)	9

Items	Nm
Upper oil pan (M8)	24
Lower oil pan	11
Cover	7
Baffle plate <DOHC-MPI>	7
Baffle plate <Except DOHC-MPI>	11
Drain plug	39
Oil pressure switch	10
Transmission stay	23
Piston and connecting rod	
Connecting rod cap nut	20 + 90° to 100°
Crankshaft, cylinder block, flywheel and drive plate	
Bearing cap bolt	25 + 90° to 100°
Oil seal case	11
Bell housing cover (Flange bolt)	10
Bell housing cover (Bolt and washer assembly)	9
Rear plate <SPACE STAR>	10
Rear plate <Except SPACE STAR>	11
Drive plate bolt	98
Flywheel bolt	98
Baffle plate	9
Knock sensor	23

NEW TIGHTENING METHOD - BY USE OF BOLTS TO BE TIGHTENED IN PLASTIC AREA

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

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

- Areas where the bolts are in use:
 - (1) Cylinder head bolts
 - (2) Main bearing cap bolts
 - (3) Connecting rod cap bolts
- Tightening method
 After tightening the bolts to the specified torque, tighten them another 90° or 180° (twice 90°). The tightening method varies on different areas. Observe the tightening method described in the text.

SEALANT

Items	Specified sealant	Quantity
Water pump	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Thermostat case	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Water by-pass fitting	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Water fitting	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
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
Camshaft bearing cap	3M ATD Part No.8660 or equivalent	As required
Semi-circular packing	3M ATD Part No.8660 or equivalent	As required
Rocker cover	3M ATD Part No.8660 or equivalent	As required
Beam camshaft cap	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Cover	3M ATD Part No.8660 or equivalent	As required
Cylinder head	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Oil pressure switch	3M ATD Part No.8660 or equivalent	As required
Water outlet fitting	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Oil pump case	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Oil pan/Upper oil pan/Lower oil pan	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Oil seal case	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Drive plate bolt	3M Nut Locking Part No.4171 or equivalent	As required
Flywheel bolt	3M Nut Locking Part No.4171 or equivalent	As required
Cam position sensor support	Mitsubishi Genuine Part No.MD970389 or equivalent	As required
Oil control valve	3M ATD Part No.8660 or equivalent	As required
Camshaft holder	3M ATD Part No.8660 or equivalent	As required

FORM-IN-PLACE GASKET

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

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

Disassembly

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

Surface Preparation

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

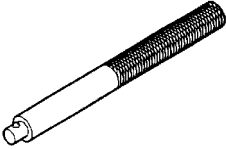
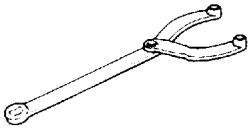
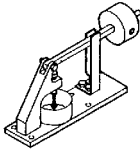
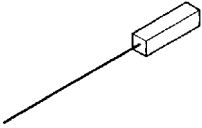
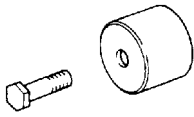
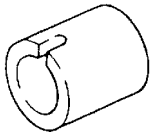
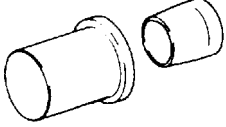
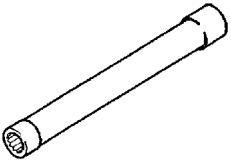
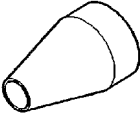
Form-In-Place Gasket Application

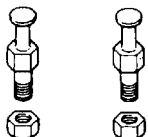

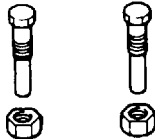
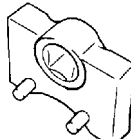
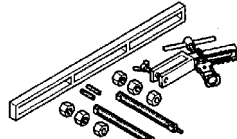
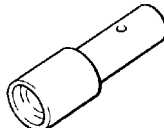
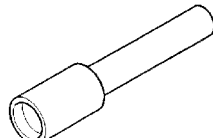
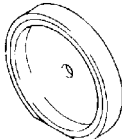
When assembling parts with the FIPG, you must observe some precautions, but the procedures is very simple as in the case of a conventional precut gasket.

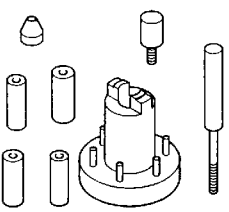
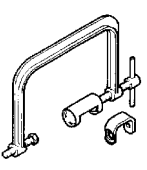
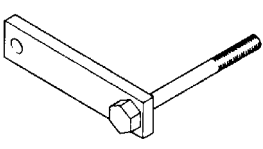
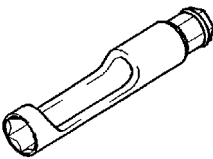
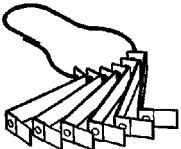
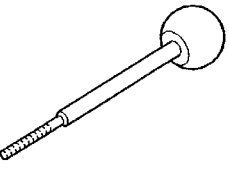
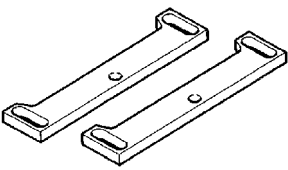
Applied FIPG bead should be of the specified size and without breaks. Also be sure to encircle the bolt hole circumference with a completely continuous bead. The FIPG can be wiped away unless it is hardened. While the FIPG is still moist (in less than 15 minutes), mount the parts in position. When the parts are mounted, make sure that the gasket is applied to the required area only. In addition, do not apply any oil or water to the sealing locations or start the engine until a sufficient amount of time (about one hour) has passed after installation is completed.

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

2. SPECIAL TOOLS

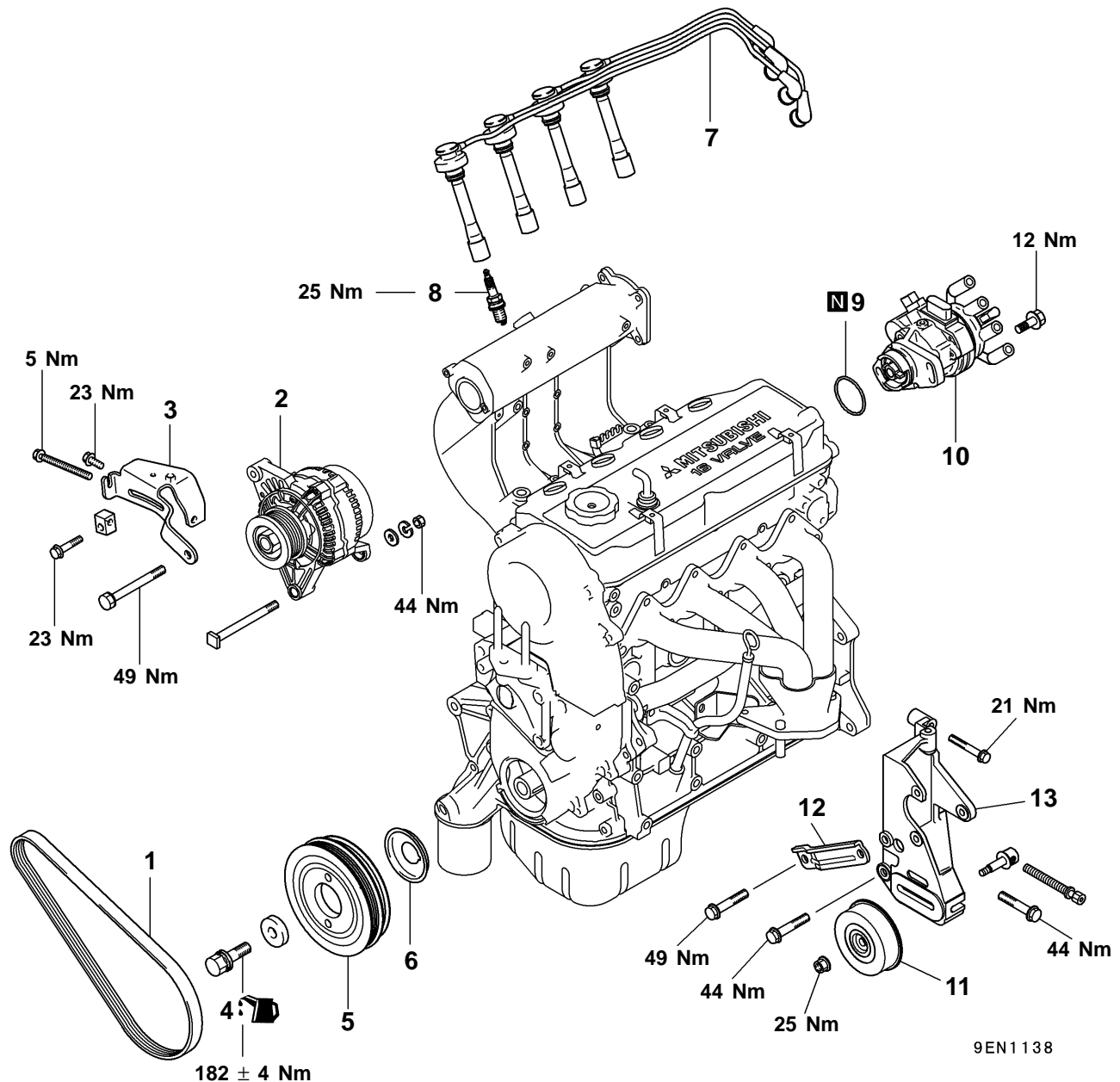
Tool	Number	Name	Use
	MB990938	Handle	Use with MD998776
	MB990767	Crankshaft pulley holder	Holding camshaft sprocket when loosening and tightening of bolt. Use with MD998719
	MD998440	Leak-down tester	Leak-down test of lash adjuster
	MD998442	Air bleed wire	Air bleeding of lash adjuster
	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998716	Crankshaft wrench	Rotation of crankshaft when installing piston and timing belt.
	MD998717	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
	MB991653	Cylinder head bolt wrench	Tightening and loosening of cylinder head bolt
	MB991659	Guide D	Removal of piston pin (Use with MD998780)

Tool	Number	Name	Use
	MD998719	Pulley holder pin (2)	Use with MB990767
	MD998727	Oil pan remover	Removal of the oil pan
	MD998754	Pin	Use with MB990767
	MD998767	Tensioner pulley socket wrench	Adjustment of timing belt tension
	MD998772	Valve spring compressor	Removal and installation of valve and related parts
	MD998774	Valve stem seal installer	Installation of valve stem seal
	MD998775	Valve stem seal installer	Installation of valve stem seal
	MD998776	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal Use with MB990938

Tool	Number	Name	Use
	MD998780	SETTING TOOL Piston pin	Removal and installation of piston pin
	MD998735	Valve spring compressor	Compression of valve spring
	MD998781	Flywheel stopper	Holding flywheel and drive plate
	MB991477	Valve adjusting wrench	Adjustment of valve clearance (MIVEC)
	MB991478	Valve adjusting wrench feeler gauge set	Adjustment of valve clearance (MIVEC)
	MB991479	Rocker arm piston checker	Adjustment of valve clearance (MIVEC)
	MD998784	Valve spring compressor adapter	Compression of valve spring (MIVEC) (Use with MD998772)

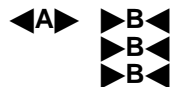
3. ALTERNATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION <SOHC> (Engines with distributor)



Removal steps

1. Drive belt*
2. Alternator
3. Alternator brace
4. Crankshaft bolt
5. Crankshaft pulley
6. Front flange
7. Spark plug cable



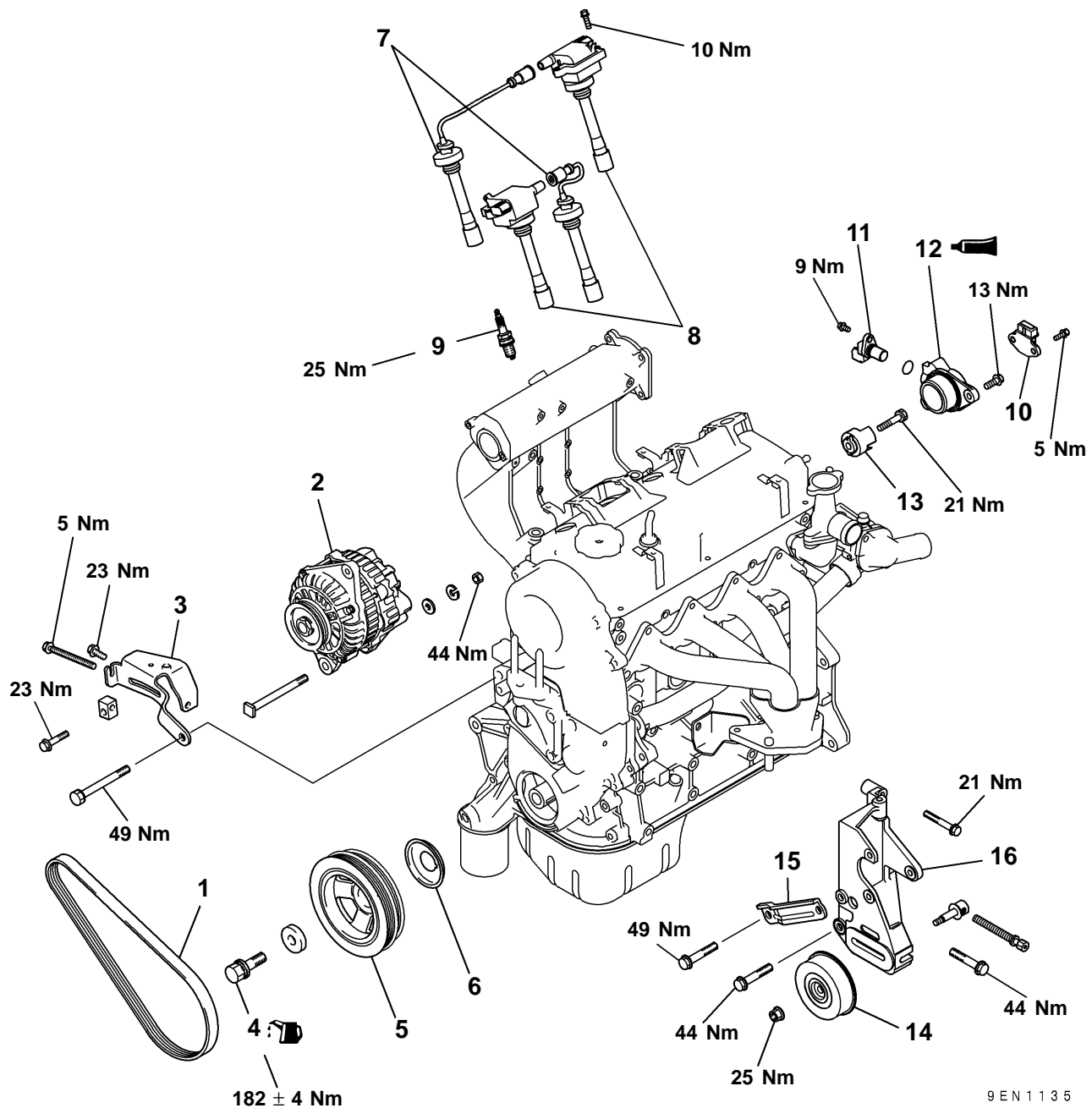
8. Spark plug
9. O-ring
10. Distributor
11. Power steering pump pulley
12. Power steering pump bracket stay
13. Power steering pump bracket

NOTE:

*: For details of adjustment, refer to the relevant model's chassis workshop manual.

9EN1138

REMOVAL AND INSTALLATION <SOHC for other than PAJERO io> (Engines without distributor)



9 EN 1135

Removal steps

1. Drive belt*
2. Alternator
3. Alternator brace
4. Crankshaft bolt
5. Crankshaft pulley
6. Front flange
7. Spark plug cable
8. Ignition coil
9. Spark plug
10. Ignition failure sensor (From 2001 model vehicles for Europe)

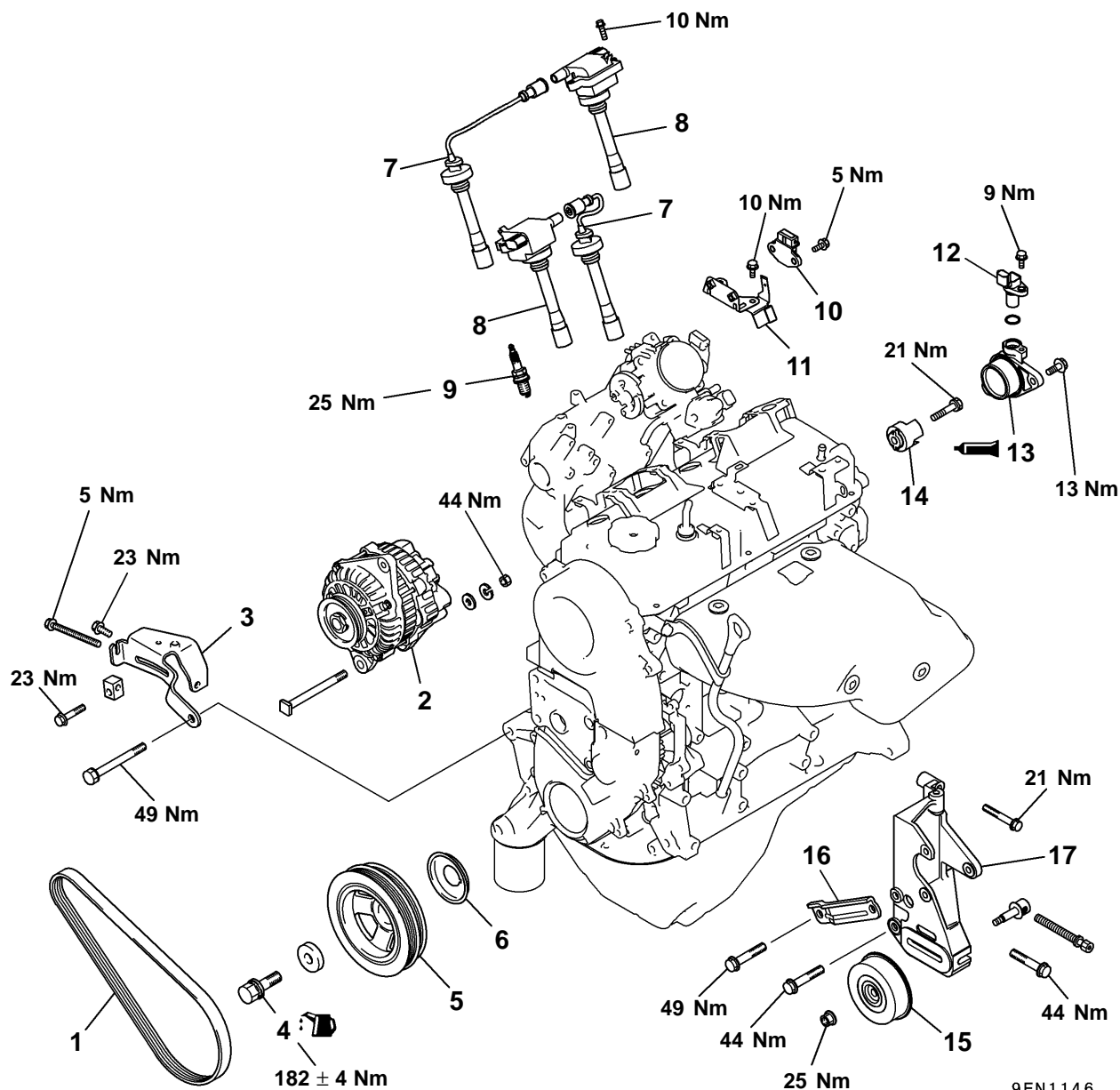


11. Cam position sensor
12. Cam position sensor support
13. Cam position sensing cylinder
14. Power steering pump pulley
15. Power steering pump bracket stay
16. Power steering pump bracket

NOTE:

*: For details of adjustment, refer to the relevant model's chassis workshop manual.

REMOVAL AND INSTALLATION <SOHC for PAJERO io> (Engines without distributor)



Removal steps

1. Drive belt*
2. Alternator
3. Alternator brace
4. Crankshaft bolt
5. Crankshaft pulley
6. Front flange
7. Spark plug cable
8. Ignition coil
9. Spark plug

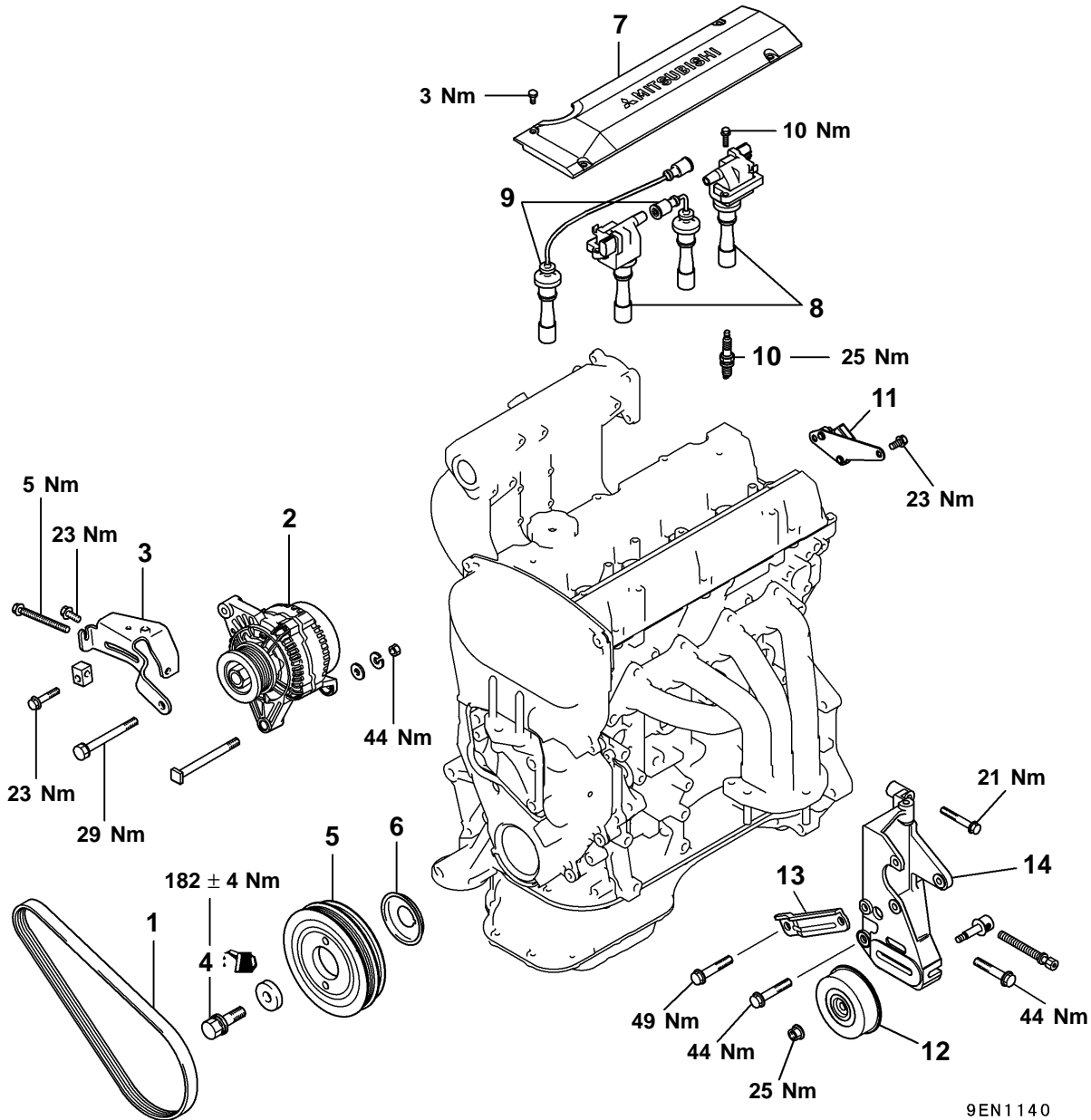
10. Ignition failure sensor (For Europe)
11. Ignition failure sensor bracket (For Europe)
12. Cam position sensor
13. Cam position sensor support
14. Cam position sensing cylinder
15. Power steering pump pulley
16. Power steering pump bracket stay
17. Power steering pump bracket

NOTE

*: For details of adjustment, refer to the relevant model's chassis workshop manual.

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REMOVAL AND INSTALLATION <DOHC>



Removal steps

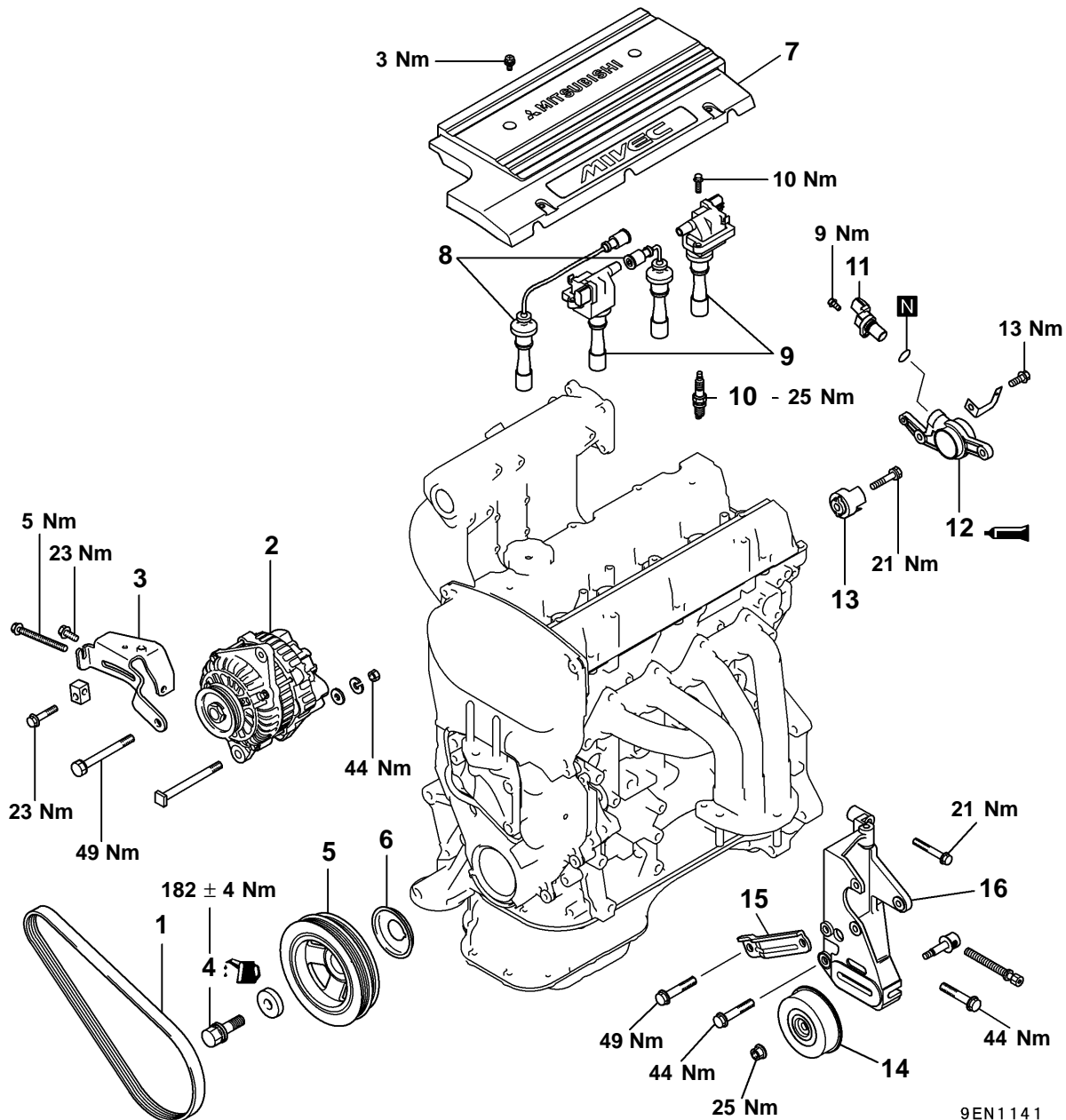
1. Drive belt*
2. Alternator
3. Alternator brace
4. Crankshaft bolt
5. Crankshaft pulley
6. Front flange
7. Center cover
8. Ignition coil

9. Spark plug cable
10. Spark plug
11. Ignition failure sensor
12. Power steering pump pulley
13. Power steering pump bracket stay
14. Power steering pump bracket

NOTE:

*: For details of adjustment, refer to the relevant model's chassis workshop manual.

REMOVAL AND INSTALLATION <DOHC-MIVEC>



Removal steps

1. Drive belt*
2. Alternator
3. Alternator brace
4. Crankshaft bolt
5. Crankshaft pulley
6. Front flange
7. Center cover
8. Spark plug cable
9. Ignition coil

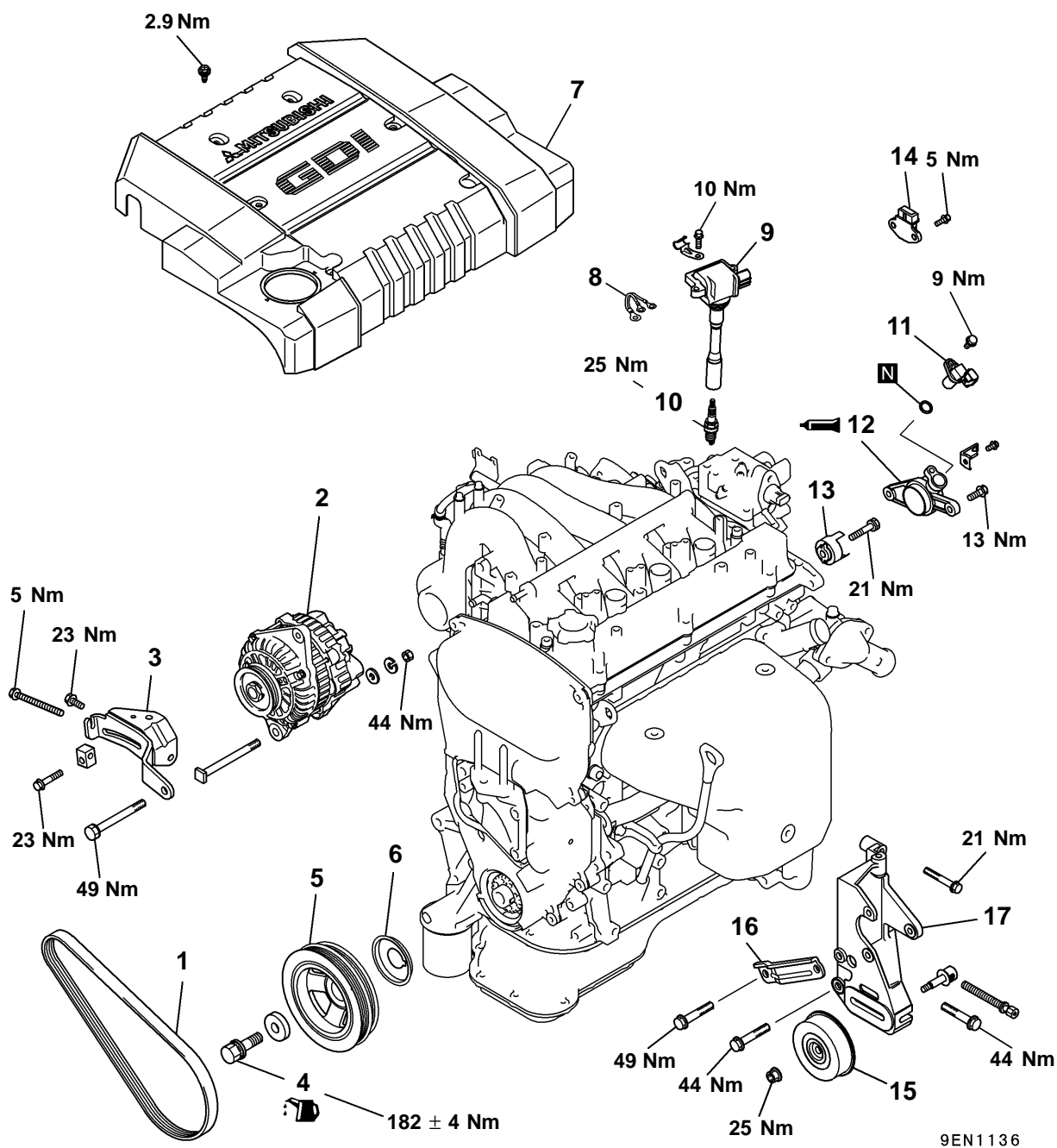
10. Spark plug
11. Cam position sensor
12. Cam position sensor support
13. Cam position sensing cylinder
14. Power steering pump pulley
15. Power steering pump bracket stay
16. Power steering pump bracket

NOTE:

*: For details of adjustment, refer to the relevant model's chassis workshop manual.

REMOVAL AND INSTALLATION

<DOHC-GDI for CARISMA, SPACE STAR, SPACE RUNNER, GALANT>



9EN1136

Removal steps

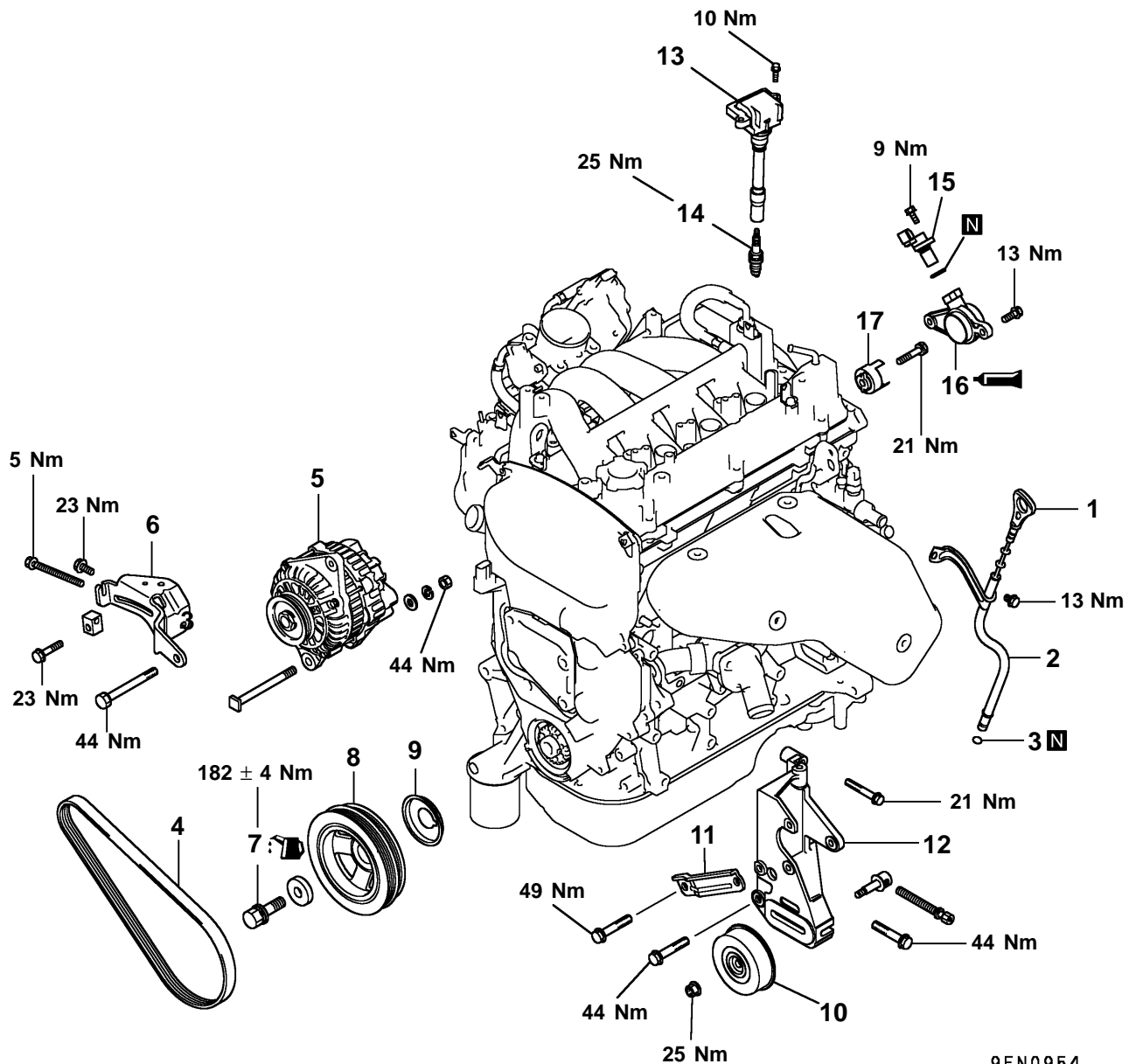
1. Drive belt*
2. Alternator
3. Alternator brace
4. Crankshaft bolt
5. Crankshaft pulley
6. Front flange
7. Engine cover
8. Earth strap (From 2001 model for CARISMA, From 2001 model for SPACE STAR)
9. Ignition coil
10. Spark plug

11. Cam position sensor
12. Cam position sensor support
13. Cam position sensing cylinder
14. Ignition failure sensor (From 2001 model for CARISMA, From 2001 model for SPACE STAR)
15. Power steering pump pulley
16. Power steering pump bracket stay
17. Power steering pump bracket

NOTE:

*: For details of adjustment, refer to the relevant model's chassis workshop manual.

REMOVAL AND INSTALLATION <DOHC-GDI for PAJERO io>



9EN0954

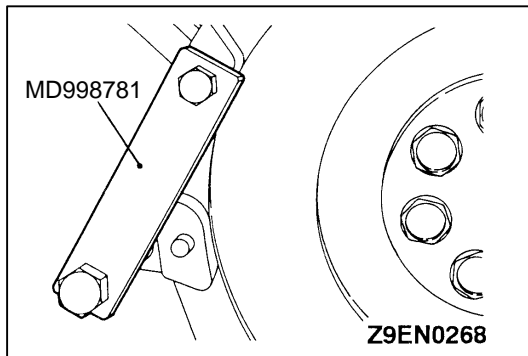
Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Drive belt*
5. Alternator
6. Alternator brace
7. Crankshaft bolt
8. Crankshaft pulley
9. Front flange

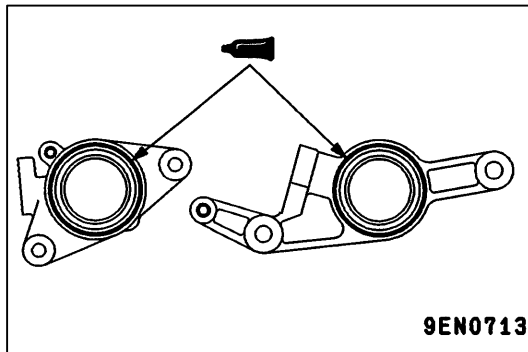
10. Power steering pump pulley
11. Power steering pump bracket stay
12. Power steering pump bracket
13. Ignition coil
14. Spark plug
15. Cam position sensor
16. Cam position sensor support
17. Cam position sensing cylinder

NOTE:

*: For details of adjustment, refer to the relevant model's chassis workshop manual.

**REMOVAL SERVICE POINT****◀A▶ CRANKSHAFT BOLT REMOVAL**

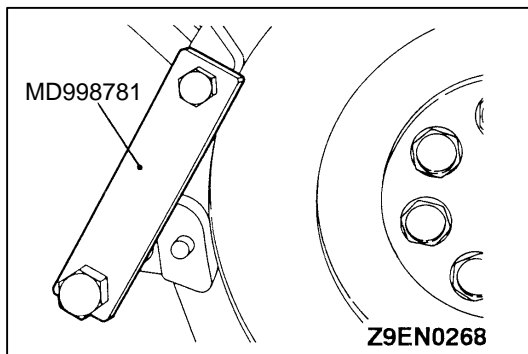
- (1) Use the special tool to hold the flywheel or the drive plate, and then loosen the crankshaft mounting bolts.

**INSTALLATION SERVICE POINTS****▶A◀ CAM POSITION SENSOR SUPPORT INSTALLATION**

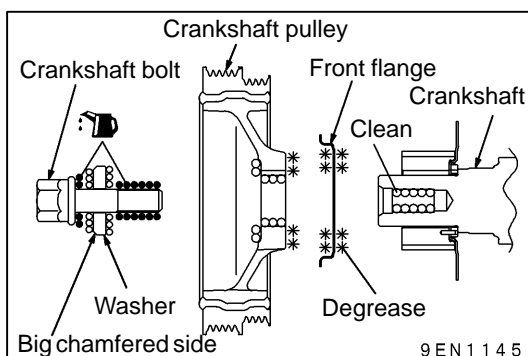
- (1) Apply a 3 mm bead of form-in-place gasket (FIPG) to the area shown.

Specified sealant:

Mitsubishi Genuine Part No. MD970389 or equivalent.

**▶B◀ FRONT FLANGE / CRANKSHAFT PULLEY / CRANKSHAFT BOLT INSTALLATION**

- (1) Use the special tool to hold the flywheel or the drive plate.



- (2) Clean and then degrease the front flange contacting surface of the crankshaft pulley.

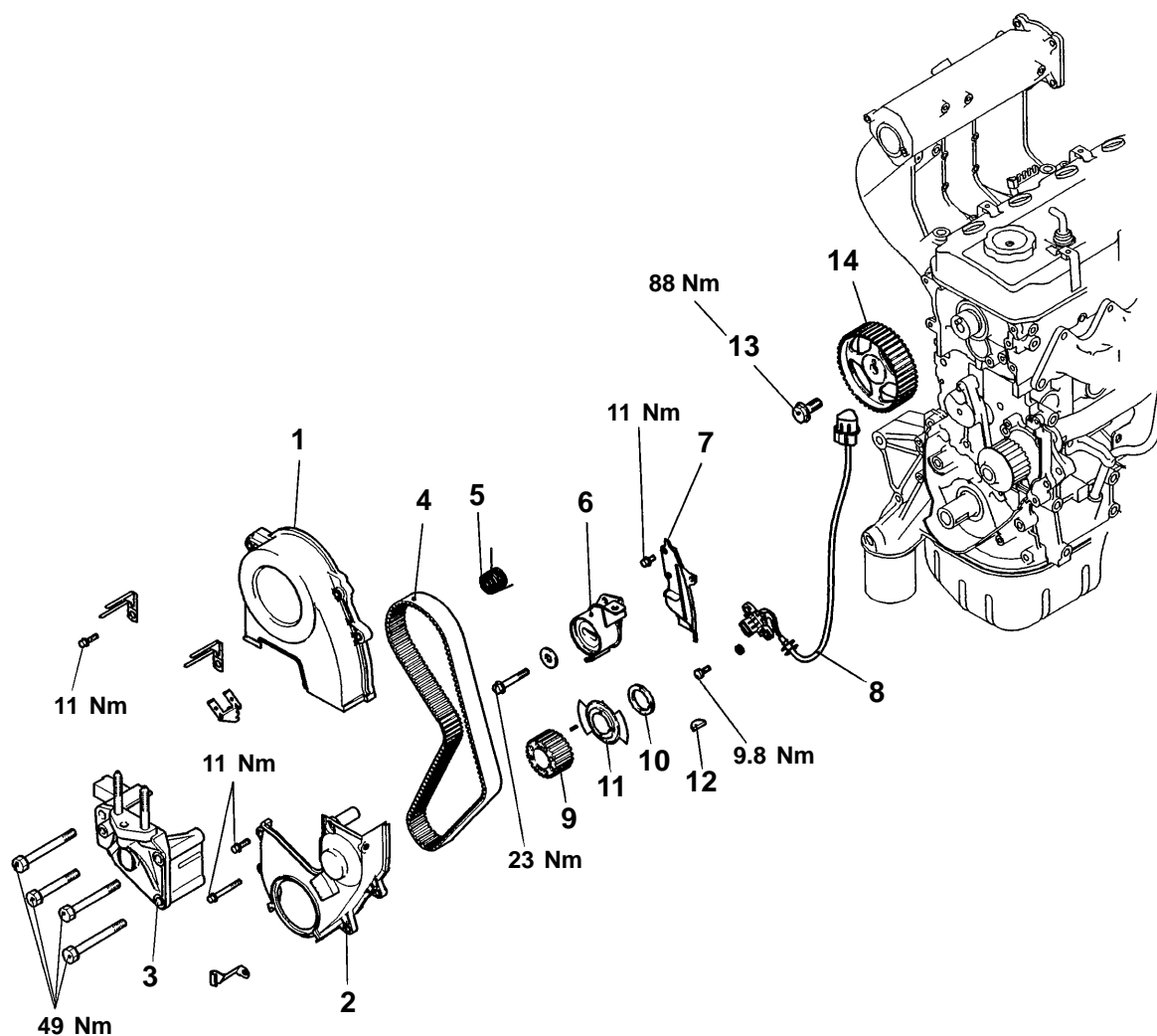
NOTE

Degreasing is necessary to prevent decrease in the friction between contacting surfaces.

- (3) Clean the bolt hole in the crankshaft, the crankshaft contacting surface and washer contacting surface of the crankshaft pulley, and the washer.
- (4) Apply an appropriately small amount of oil to the threads and seating surface of the crankshaft bolt.
- (5) Tighten the crankshaft bolt to the specified torque of 182 ± 4 Nm.

4. TIMING BELT

REMOVAL AND INSTALLATION <SOHC for CARISMA (Up to 1999 model), LANCER (Except from 2001 model for Europe), GALANT>



9EN0618

Removal steps

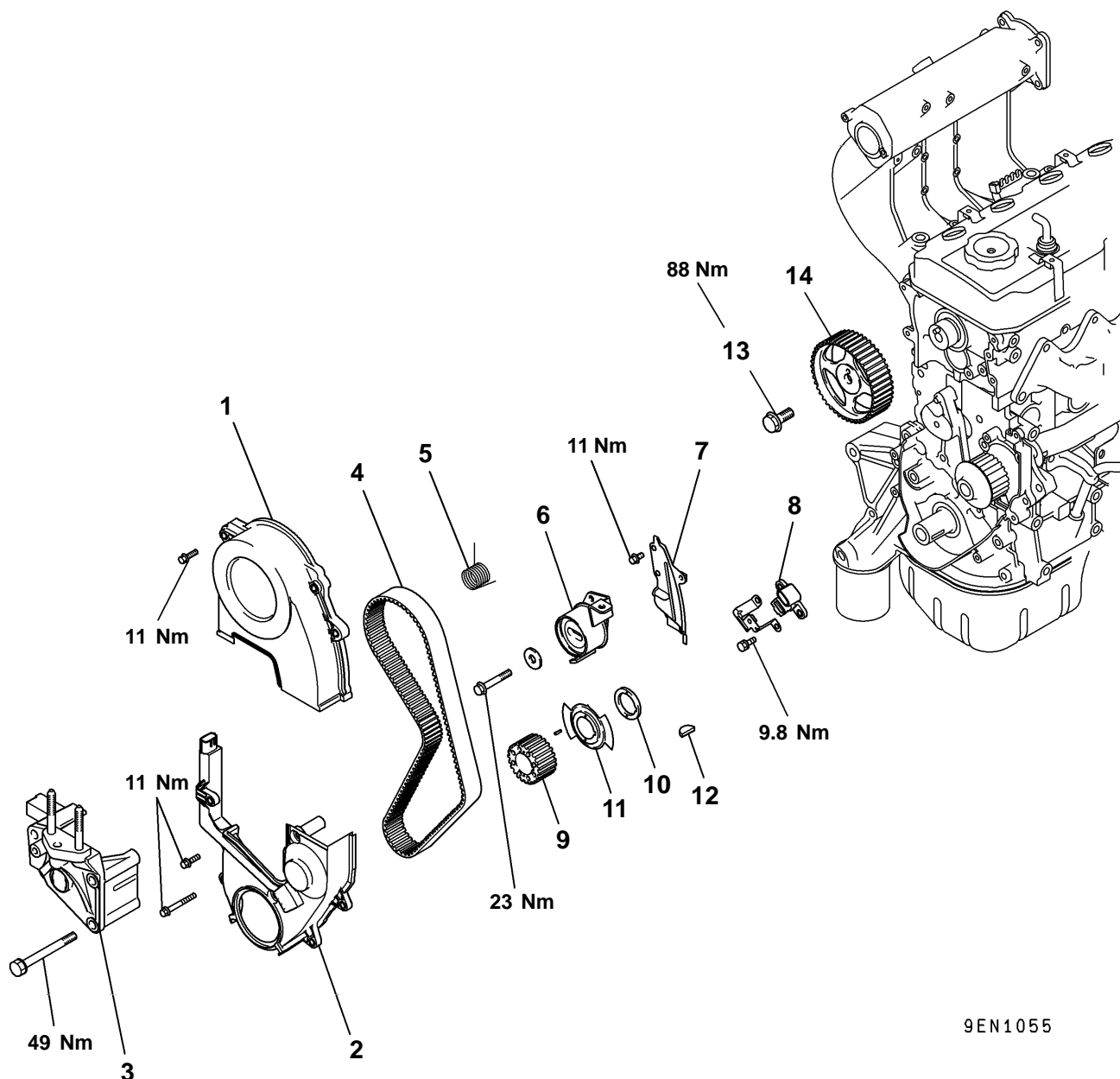
1. Timing belt front upper cover
2. Timing belt front lower cover
3. Engine support bracket, right
4. Timing belt
5. Tensioner spring
6. Timing belt tensioner
7. Timing belt rear cover

8. Crankshaft angle sensor
(Engines without distributor)
9. Crankshaft sprocket
10. Crankshaft spacer
(Engines without distributor)
11. Crankshaft sensing blade
(Engines without distributor)
12. Crankshaft key
13. Camshaft sprocket bolt
14. Camshaft sprocket



REMOVAL AND INSTALLATION

<SOHC for CARISMA (From 2000 model), LANCER (From 2001 model for Europe), SPACE STAR>



9EN1055

Removal steps

1. Timing belt front upper cover
2. Timing belt front lower cover
3. Engine support bracket, right
4. Timing belt
5. Tensioner spring
6. Timing belt tensioner
7. Timing belt rear cover
8. Crankshaft angle sensor
(Engines without distributor)

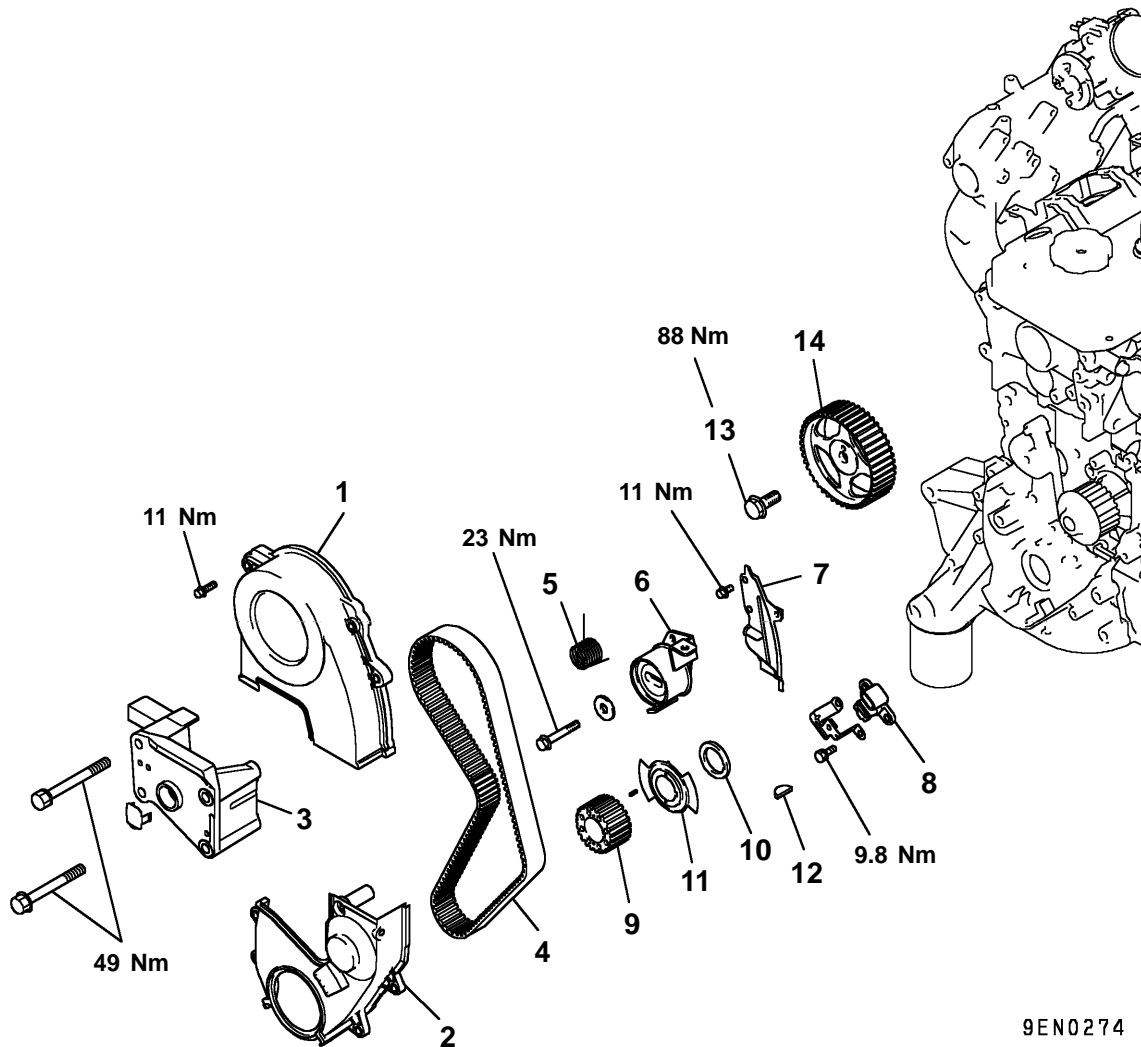


9. Crankshaft sprocket
10. Crankshaft spacer
(Engines without distributor)
11. Crankshaft sensing blade
(Engines without distributor)
12. Crankshaft key
13. Camshaft sprocket bolt
14. Camshaft sprocket



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REMOVAL AND INSTALLATION <SOHC for PAJERO io>



9EN0274

Removal steps

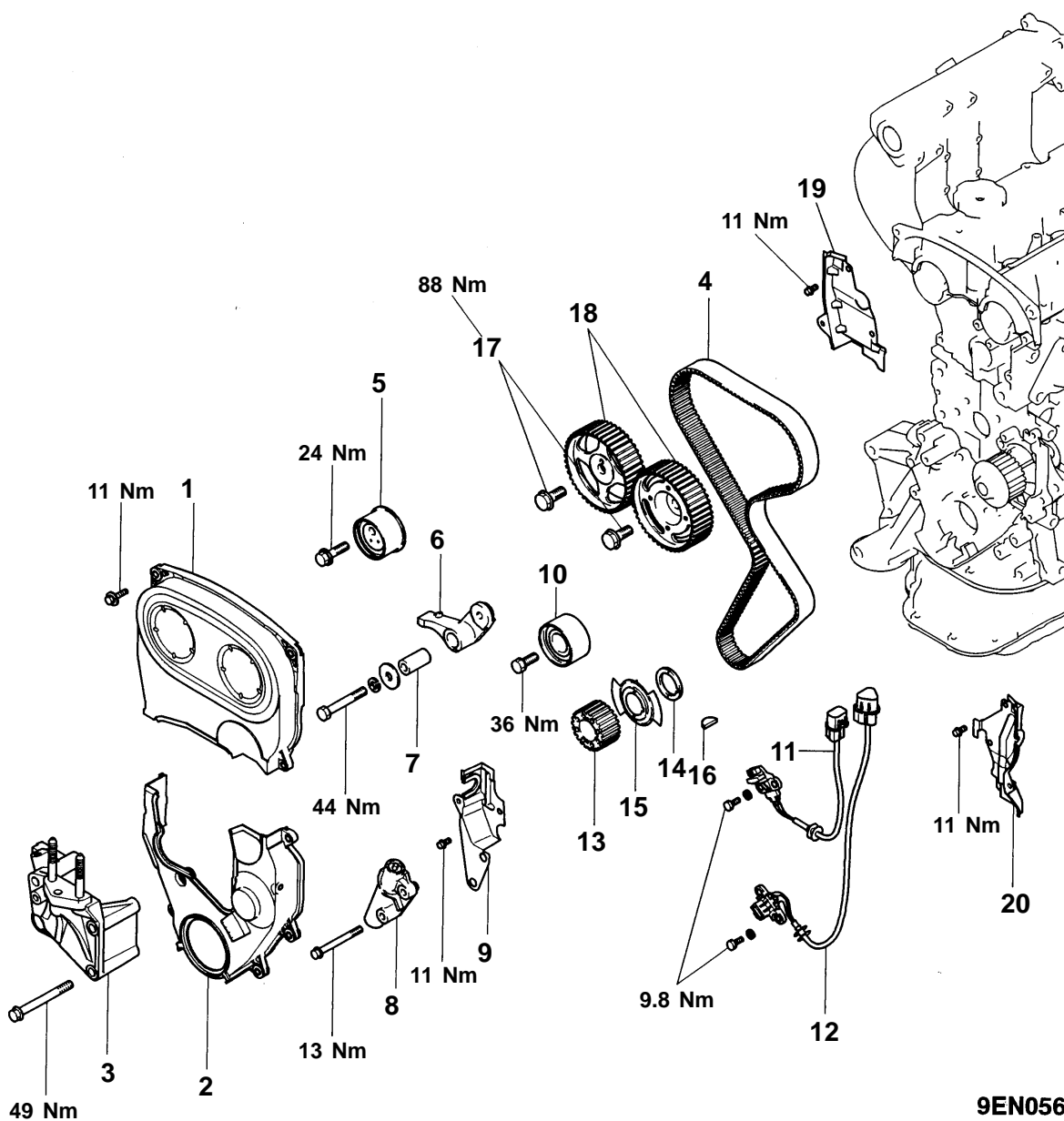
1. Timing belt front upper cover
2. Timing belt front lower cover
3. Accessory mount
4. Timing belt
5. Tensioner spring
6. Timing belt tensioner
7. Timing belt rear cover



8. Crankshaft angle sensor
9. Crankshaft sprocket
10. Crankshaft spacer
11. Crankshaft sensing blade
12. Crankshaft key
13. Camshaft sprocket bolt
14. Camshaft sprocket



REMOVAL AND INSTALLATION <DOHC>



9EN0567

Removal steps

1. Timing belt upper cover
2. Timing belt lower cover
3. Engine support bracket
4. Timing belt
5. Tensioner pulley
6. Tensioner arm
7. Shaft
8. Auto-tensioner
9. Timing belt rear cover
10. Idler pulley

11. Cam position sensor
12. Crankshaft angle sensor
13. Crankshaft sprocket
14. Crankshaft spacer
15. Crankshaft sensing blade
16. Crankshaft sprocket key
17. Camshaft sprocket bolt
18. Camshaft sprocket
19. Timing belt rear cover
20. Timing belt rear cover

◀A▶ ▶F▶

▶E▶

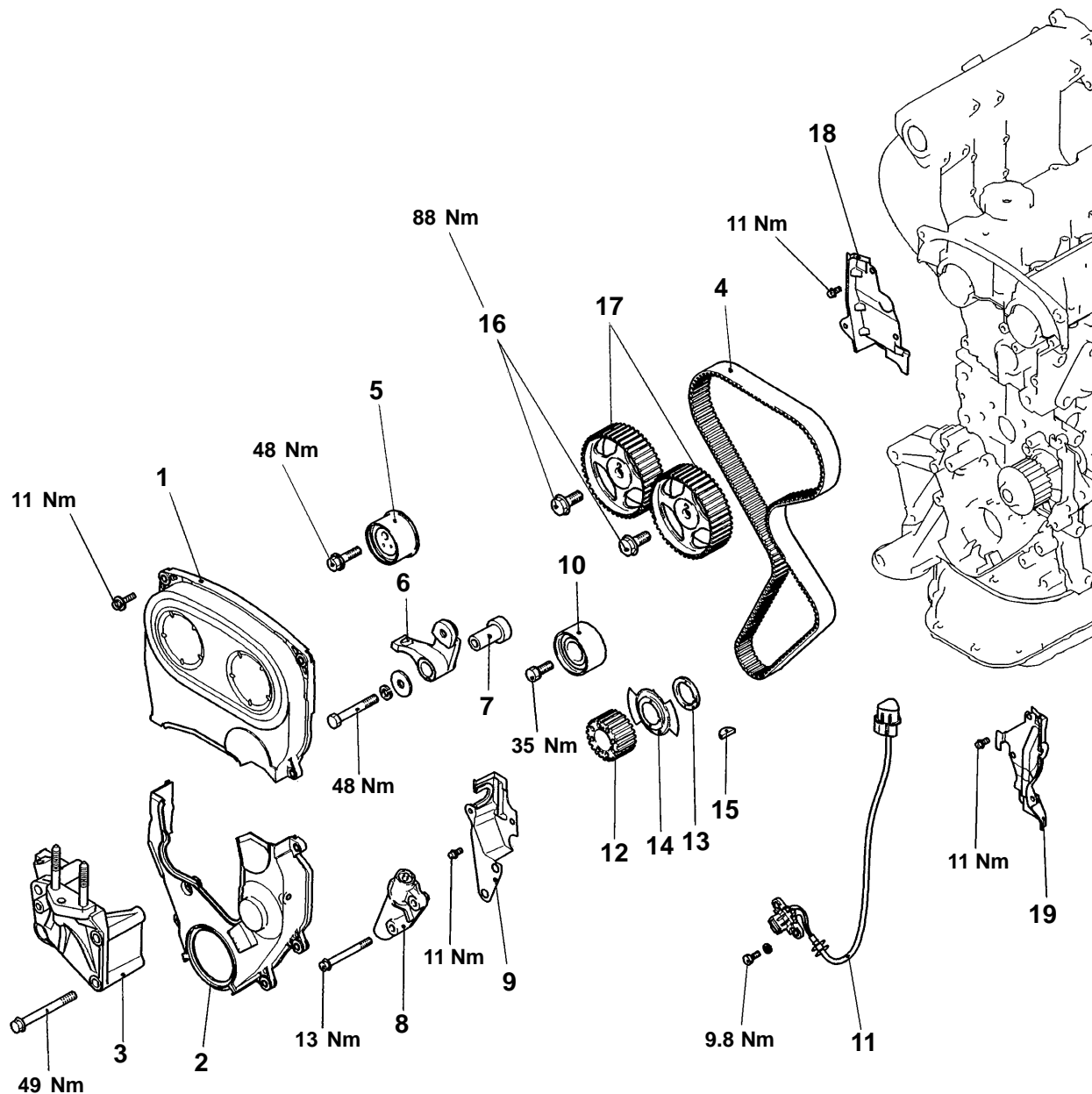
◀B▶ ▶A▶

▶G▶

▶G▶

▶G▶

REMOVAL AND INSTALLATION <DOHC-MIVEC>



9EN0619

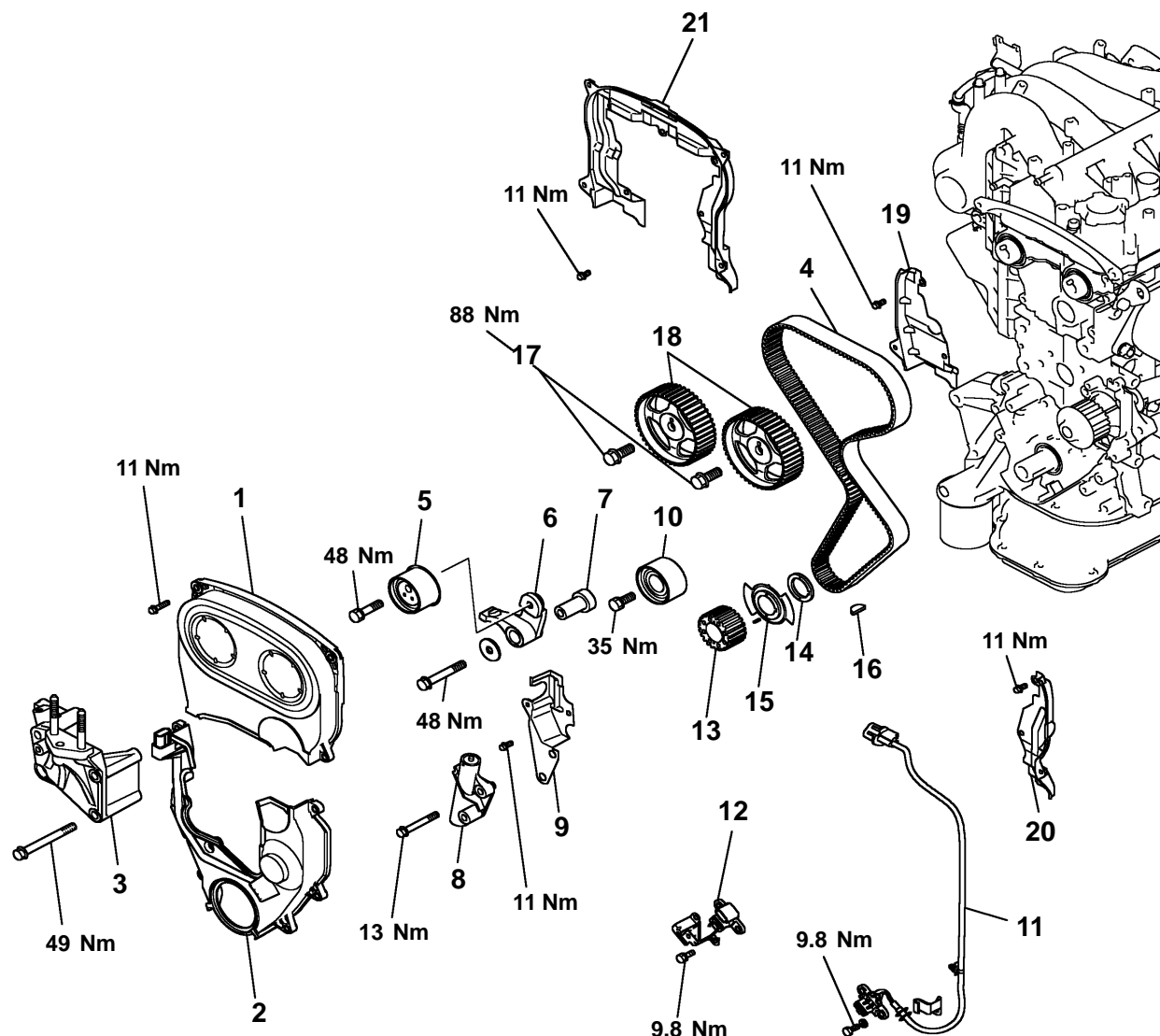
Removal steps

- ◀A▶ ▶F▶
 1. Timing belt front upper cover
 2. Timing belt front lower cover
 3. Engine support bracket, right
 4. Timing belt
 5. Tensioner pulley
 6. Tensioner arm
 7. Shaft
 ▶E▶
 8. Auto tensioner
 9. Timing belt rear cover
 10. Idler pulley

- ▶G▶
 ▶G▶
 ▶G▶
 ▶B▶ ▶A▶
 11. Crankshaft angle sensor
 12. Crankshaft sprocket
 13. Crankshaft spacer
 14. Crankshaft sensing blade
 15. Crankshaft key
 16. Camshaft sprocket bolt
 17. Camshaft sprocket
 18. Timing belt rear cover
 19. Timing belt rear cover

REMOVAL AND INSTALLATION

<DOHC-GDI for CARISMA, SPACE STAR, SPACE RUNNER>

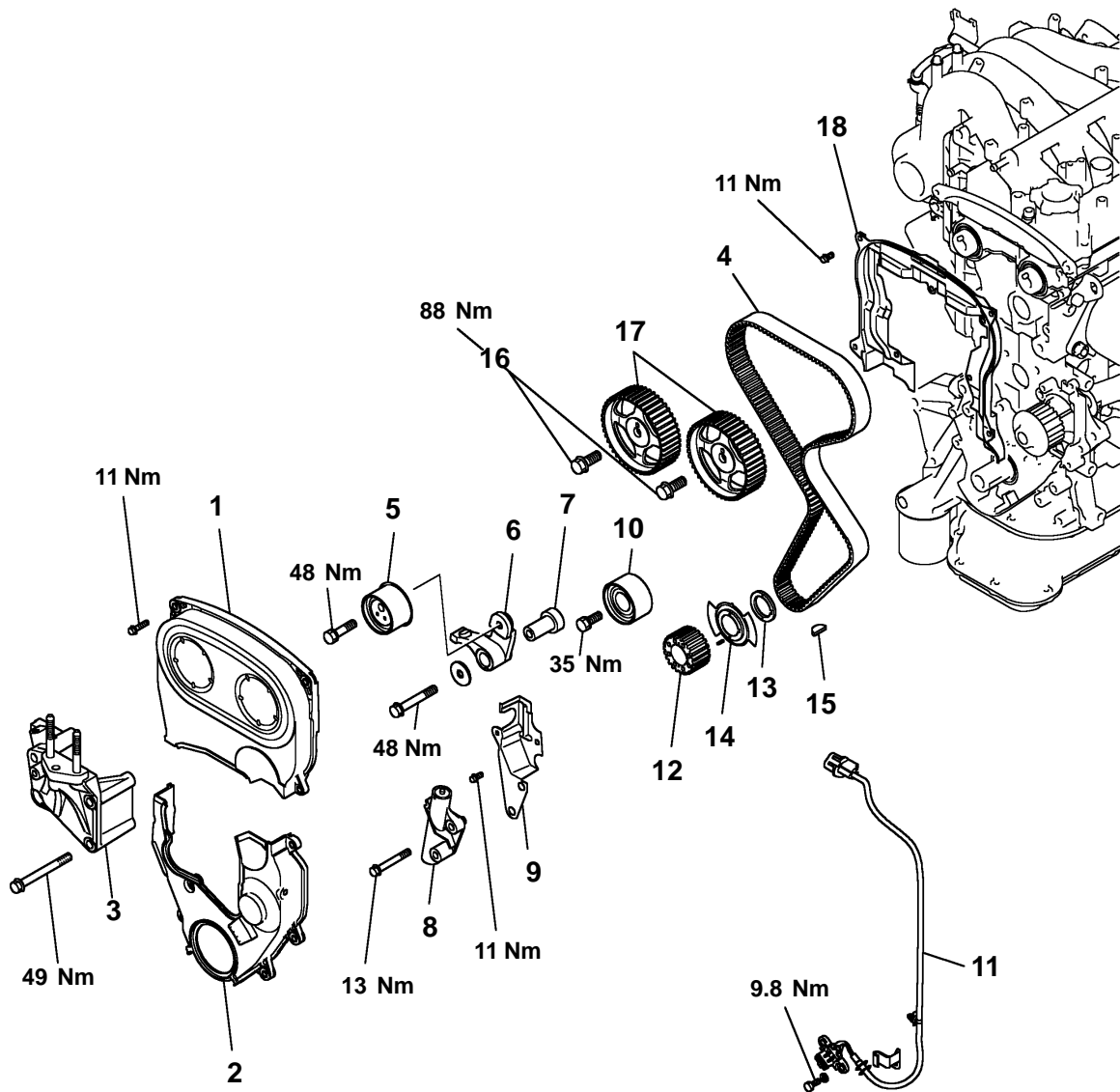


9EN1056

Removal steps

- | | | | |
|---------|---|---------|---|
| ◀A▶ ▶F▶ | 1. Timing belt front upper cover | ▶G▶ | 13. Crankshaft sprocket |
| | 2. Timing belt front lower cover | ▶G▶ | 14. Crankshaft spacer |
| | 3. Engine support bracket, right | ▶G▶ | 15. Crankshaft sensing blade |
| | 4. Timing belt | ▶B▶ ▶A▶ | 16. Crankshaft key |
| ▶E▶ | 5. Tensioner pulley | | 17. Camshaft sprocket bolt |
| | 6. Tensioner arm | | 18. Camshaft sprocket |
| | 7. Shaft | | 19. Timing belt rear cover
(Up to 2000 model) |
| | 8. Auto tensioner | | 20. Timing belt rear cover
(Up to 2000 model) |
| | 9. Timing belt rear cover | | 21. Timing belt rear upper cover
(From 2001 model) |
| | 10. Idler pulley | | |
| | 11. Crankshaft angle sensor
(Up to 1999 model) | | |
| | 12. Crankshaft angle sensor
(From 2000 model) | | |

REMOVAL AND INSTALLATION <DOHC-GDI for GALANT>



9EN1057

Removal steps

1. Timing belt front upper cover
2. Timing belt front lower cover
3. Engine support bracket, right
4. Timing belt
5. Tensioner pulley
6. Tensioner arm
7. Shaft
8. Auto tensioner
9. Timing belt rear cover

10. Idler pulley
11. Crankshaft angle sensor
12. Crankshaft sprocket
13. Crankshaft spacer
14. Crankshaft sensing blade
15. Crankshaft key
16. Camshaft sprocket bolt
17. Camshaft sprocket
18. Timing belt rear upper cover

◀A▶ ▶F▶

▶E▶

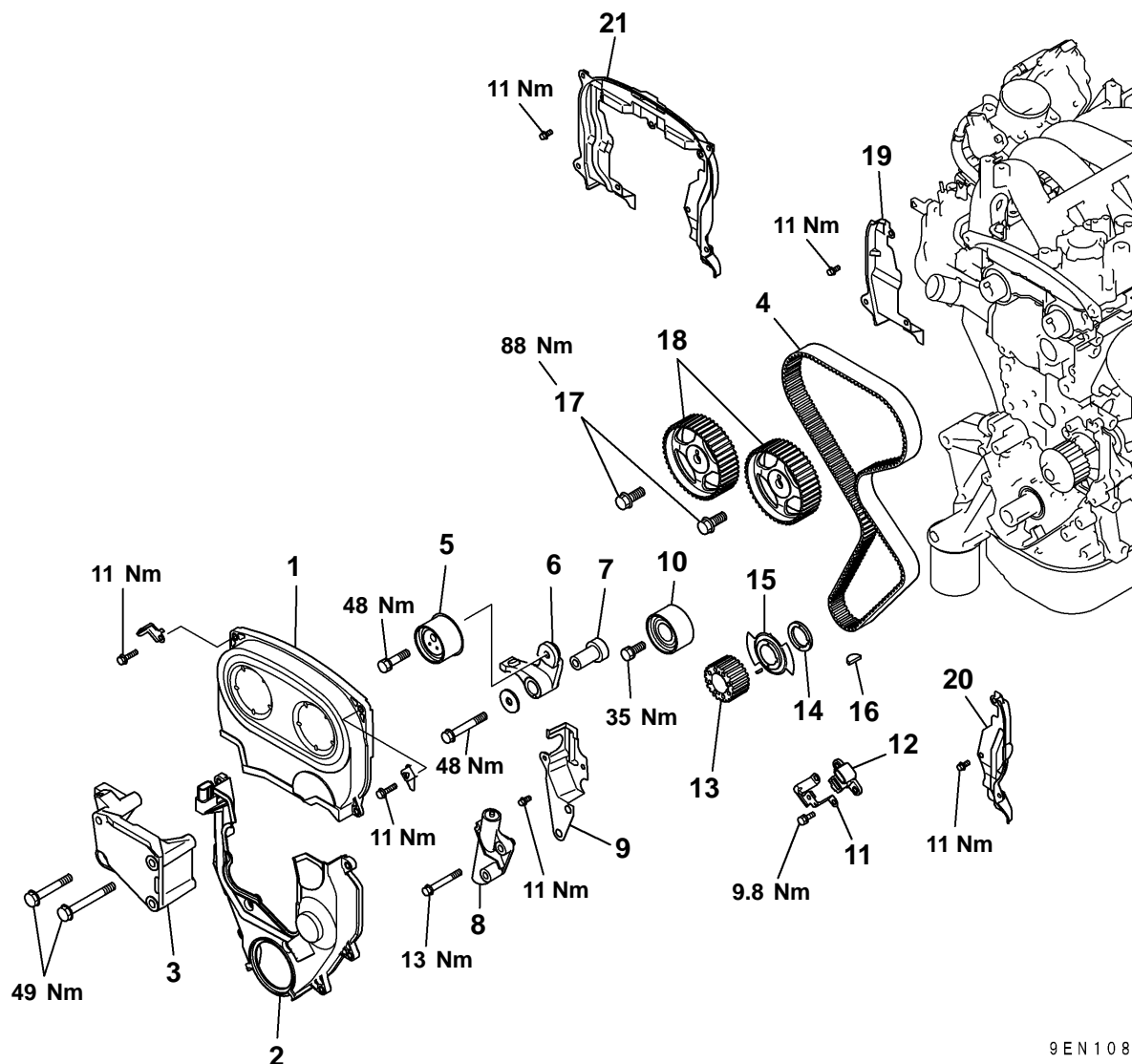
◀B▶ ▶A▶

▶G▶

▶G▶

▶G▶

REMOVAL AND INSTALLATION <DOHC-GDI for PAJERO io>



9EN1087

Removal steps

1. Timing belt front upper cover
2. Timing belt front lower cover
3. Accessory mount
4. Timing belt
5. Tensioner pulley
6. Tensioner arm
7. Shaft
8. Auto tensioner
9. Timing belt rear cover
10. Idler pulley

11. Bracket
12. Crankshaft angle sensor
13. Crankshaft sprocket
14. Crankshaft spacer
15. Crankshaft sensing blade
16. Crankshaft key
17. Camshaft sprocket bolt
18. Camshaft sprocket
19. Timing belt rear cover <4G93>
20. Timing belt rear cover <4G93>
21. Timing belt rear upper cover <4G94>

◀A▶ ▶F▶

▶E▶

◀B▶

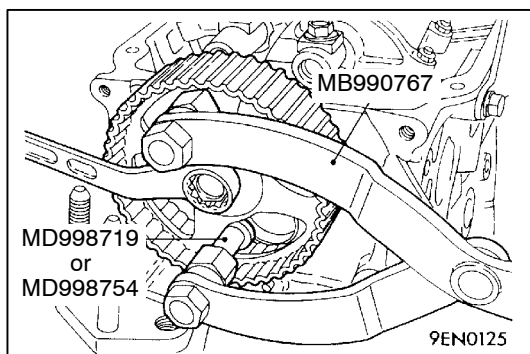
▶G▶
▶G▶
▶G▶

▶A▶

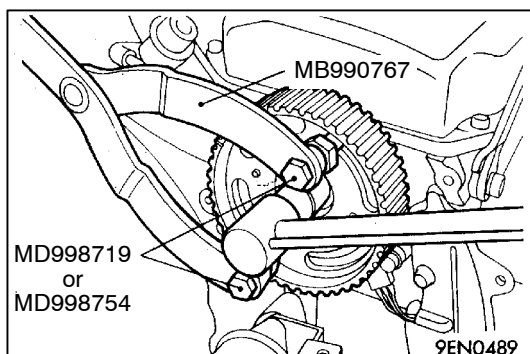
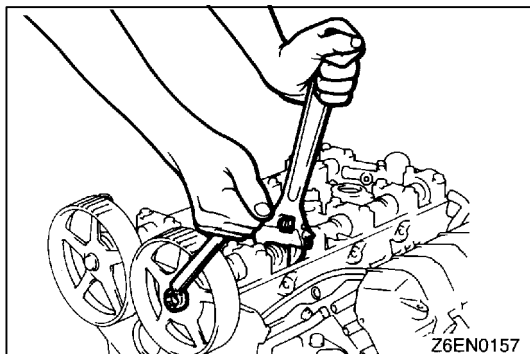
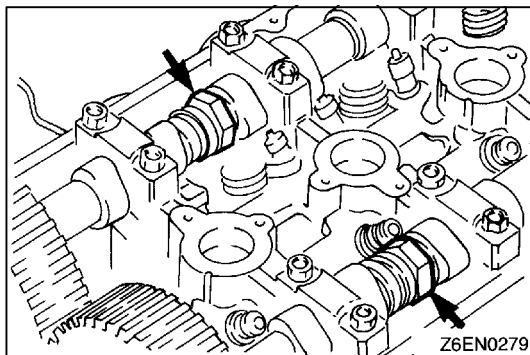
Intentionally blank

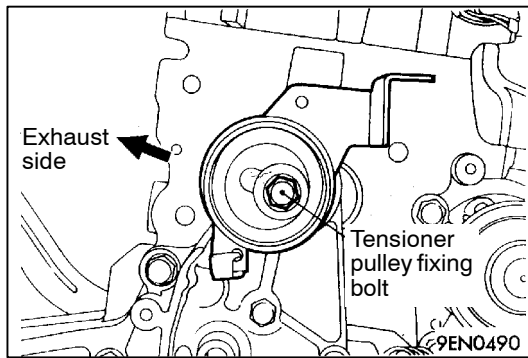
REMOVAL SERVICE POINTS**◀A▶ TIMING BELT REMOVAL**

- (1) Mark belt running direction for reinstallation.

**◀B▶ CAMSHAFT SPROCKET BOLT REMOVAL****<With rocker cover removed> (Except SOHC)**

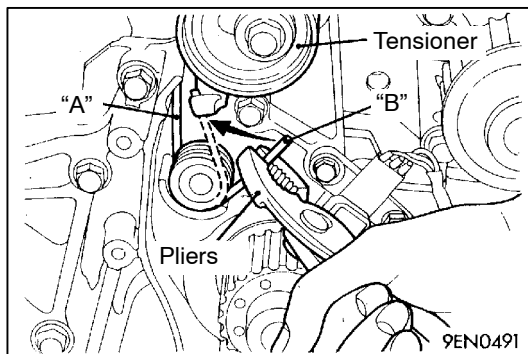
- (1) Use a wrench to hold the hexagonal part of the camshaft, and then remove the camshaft sprocket mounting bolt.

**INSTALLATION SERVICE POINTS****▶A◀ CAMSHAFT SPROCKET BOLT INSTALLATION**



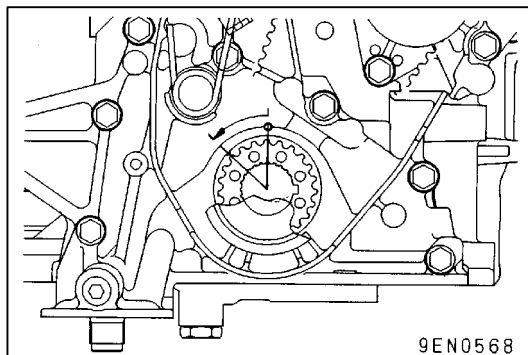
►B◄ TIMING BELT TENSIONER INSTALLATION

- (1) Let the pulley of the timing belt tensioner come closest to the exhaust side. Temporarily tighten the tensioner pulley fixing bolt.



►C◄ TENSIONER SPRING INSTALLATION

- (1) Insert the tip A (shorter one) of the tensioner spring into the oil pump case.
- (2) Use pliers or similar tool to pinch the tip B (longer one), and then hook it to the tensioner bracket arm.

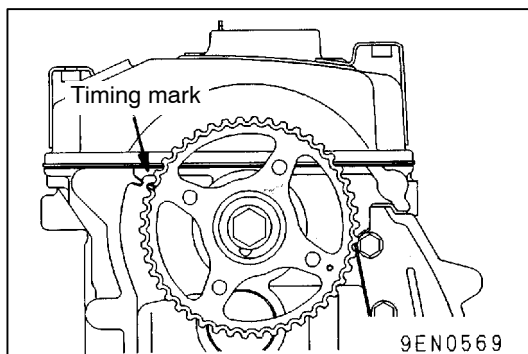


►D◄ TIMING BELT INSTALLATION

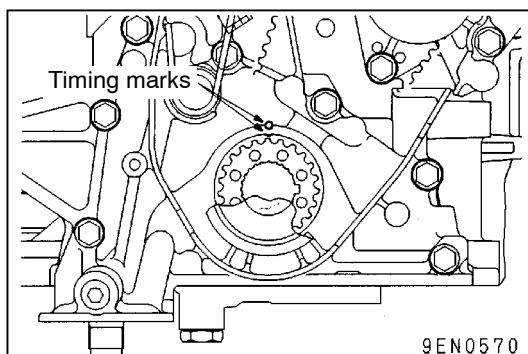
- (1) Turn the crankshaft sprocket by three teeth from the timing mark.

Caution

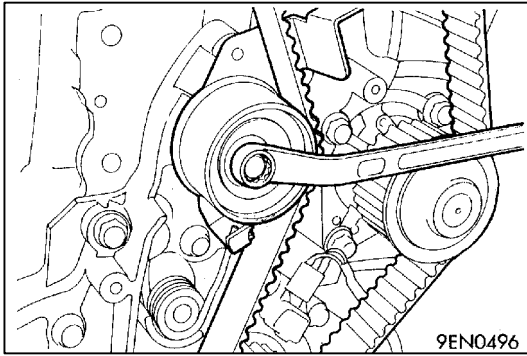
Aligning the timing marks positions the piston to the top dead centre. Then, if the camshaft turns, the valves may hit and damage the pistons.



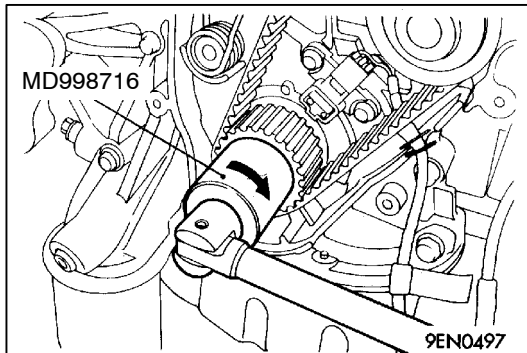
- (2) Check that the timing belt tensioner and tensioner spring are installed correctly. (Refer to the service points B and C.)
- (3) Align the timing marks on the camshaft sprocket to that on the cylinder head.



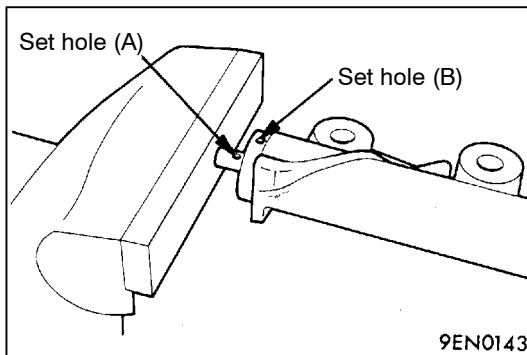
- (4) Align the timing mark on the crankshaft sprocket to that on the oil pump case.
- (5) Place the timing belt over the sprocket according in the following order.
 1. Crankshaft sprocket
 2. Water pump sprocket
 3. Camshaft sprocket
 4. Tension pulley



- (6) Slightly loosen the tensioner pulley fixing bolt which is tightened temporarily to tighten the belt by a force of the tensioner spring.

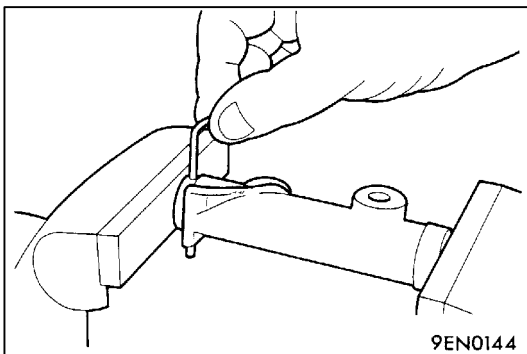


- (7) Turn the crankshaft clockwise by two turns.
 (8) Check that the timing marks are aligned.
 (9) Tighten the fixing bolt of the tensioner pulley.

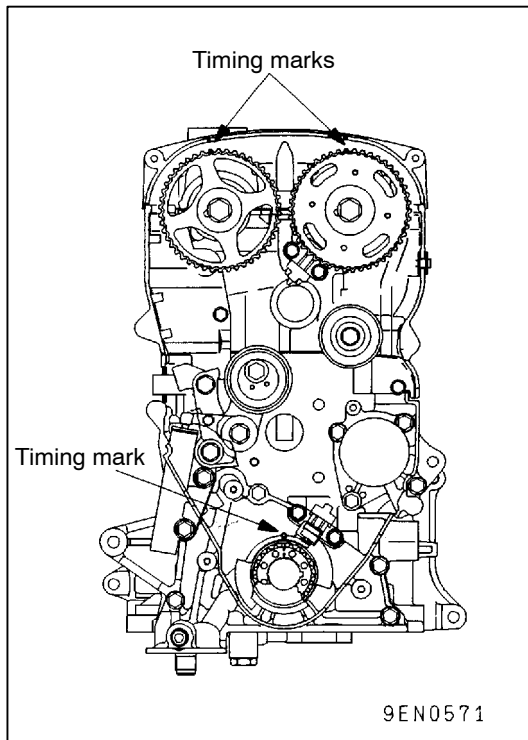


►E◄ AUTO-TENSIONER INSTALLATION

- (1) If the auto-tensioner rod is fully extended, set it in the retracted position with the following procedure.
- 1) Hold the auto-tensioner in a vice, being careful not to tilt it.
 - 2) Slowly close the vice to force the rod in to align hole (A) of the rod with the set hole (B).
 - 3) Insert a 2.0-mm-Allen key in diameter or similar into the set holes.
 - 4) Remove the auto-tensioner from the vice.

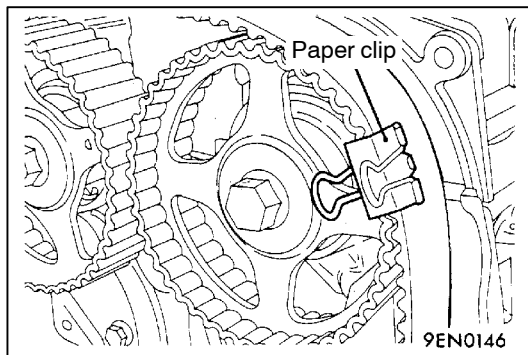


- (2) Install the auto-tensioner
 Leave the align key until installation of the timing belt is completed.

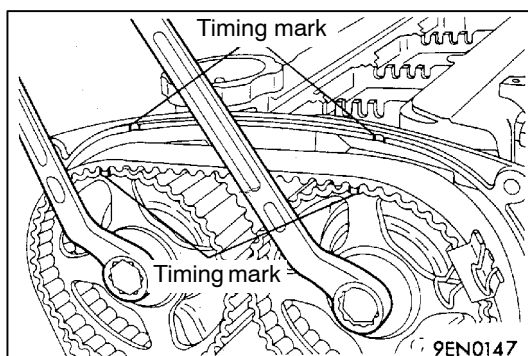


►F◄ TIMING BELT INSTALLATION

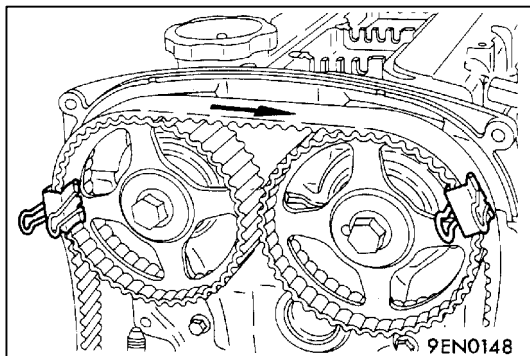
- (1) Make sure that the auto-tensioner is installed properly. (Refer to service point F.)
- (2) Align the timing mark on each sprocket with the corresponding mark on the timing belt.
- (3) Turn the crankshaft sprocket one half the tooth width counterclockwise.



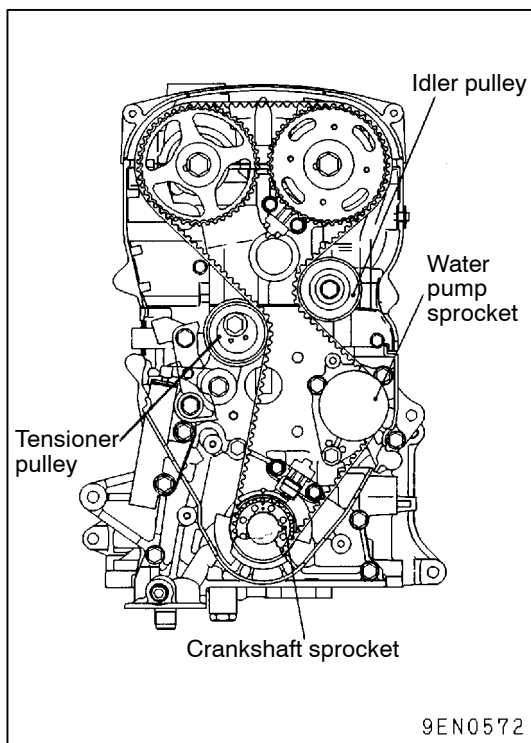
- (4) Fit the timing belt to the intake camshaft sprocket and secure with a paper clip at the illustrated position.



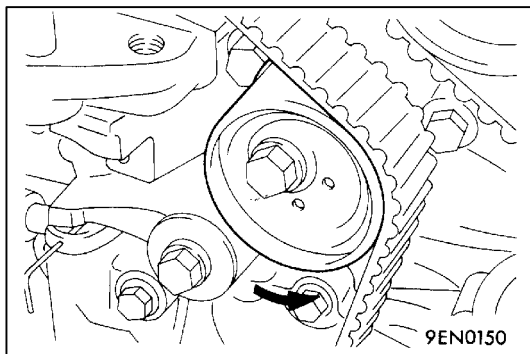
- (5) Use two wrenches to fit the timing belt to the exhaust sprocket while aligning the timing marks.



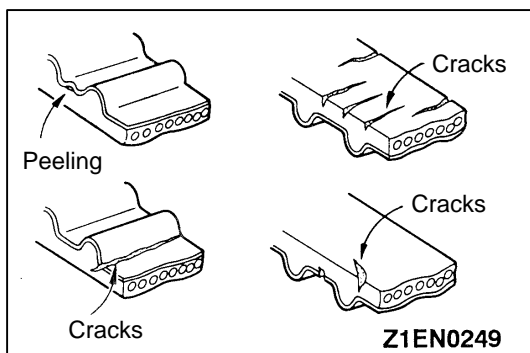
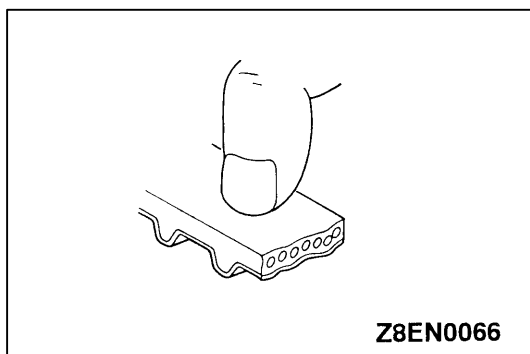
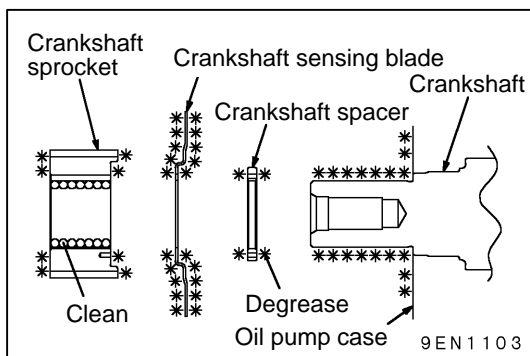
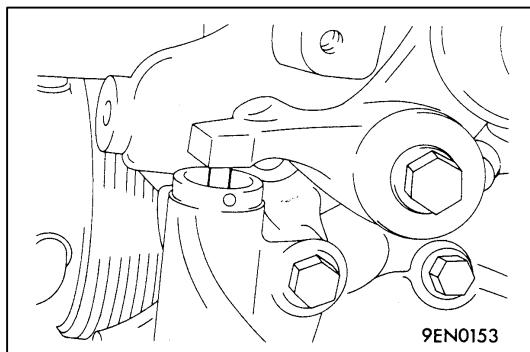
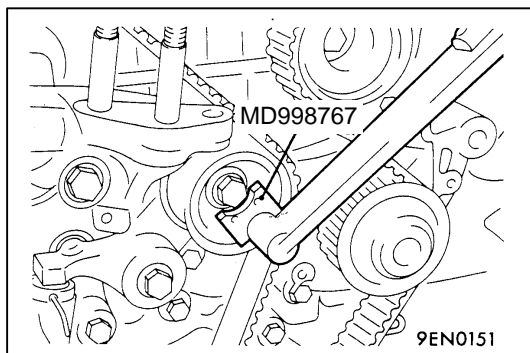
- (6) Secure the timing belt with a paper clip at the illustrated position.



- (7) Fit the belt to the idler pulley water pump sprocket, crankshaft sprocket and tensioner pulley in that order.



- (8) Raise the tensioner pulley in the direction of an arrow and tighten the tensioner pulley bolt.
(9) Remove the two paper clips.
(10) Make sure that all timing marks are in alignment.
(11) Give a 1/4 counterclockwise turn to the crankshaft. Then turn the crankshaft clockwise to align the timing marks again.



- (12) Install the special tool and a torque wrench to the tensioner pulley.
- (13) Using torque wrench, torque to 2.6 Nm.
- (14) While holding the tensioner pulley to prevent it from turning, tighten the center bolt to the specified torque.
- (15) Give two clockwise turns to the crankshaft and leave as it is for approx. 15 minutes.
- (16) Check if the Allen wrench inserted during installation of the auto-tensioner can be pulled out lightly. If it can be pulled out lightly, the belt is properly tensioned. Therefore, pull out the wrench. The belt is also properly tensioned if the auto-tensioner projection is of standard value.

Standard value: 3.8 – 4.5 mm

- (17) If the wrench cannot be pulled out lightly, repeat the steps (12) through (15) to obtain appropriate belt tension.

NOTE

Check the tightening torque of the crankshaft bolt always after rotating the crankshaft counterclockwise using the crankshaft bolt. Retighten the bolt if the tightening torque is not up to specification.

►G◄ CRANKSHAFT SENSING BLADE / CRANKSHAFT SPACER / CRANKSHAFT SPROCKET INSTALLATION

- (1) Clean and then degrease the following surfaces and parts: front surface of oil pump case, sprocket mounting surface of crankshaft, crankshaft spacer, crankshaft sensing blade, and crankshaft sprocket.

NOTE

Degreasing is necessary to prevent decrease in the friction between contacting surfaces.

- (2) Clean the crankshaft contacting surface of the crankshaft sprocket.

INSPECTION

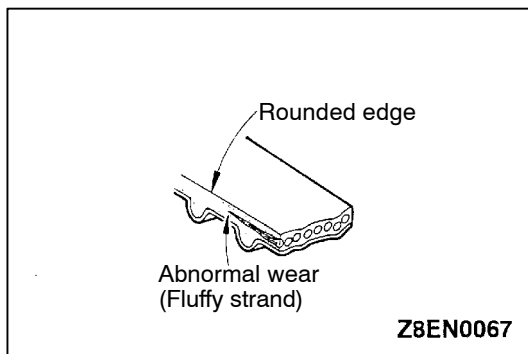
11300200077

TIMING BELT

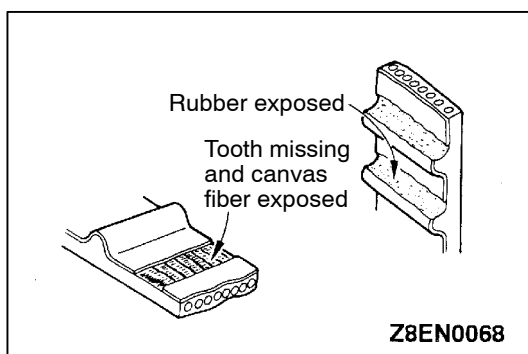
Replace belt if any of the following conditions exist.

- (1) Hardening of back rubber.
Back side is glossy without resilience and leaves no indent when pressed with fingernail.

- (2) Cracks on rubber back.
- (3) Cracks or peeling of canvas.
- (4) Cracks on tooth bottom.
- (5) Cracks on belt sides.

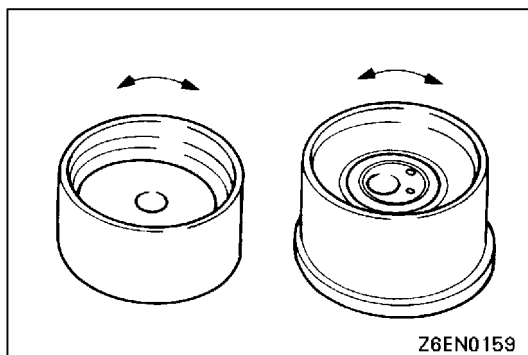


- (6) Abnormal wear of belt sides. The sides are normal if they are sharp as if cut by a knife.



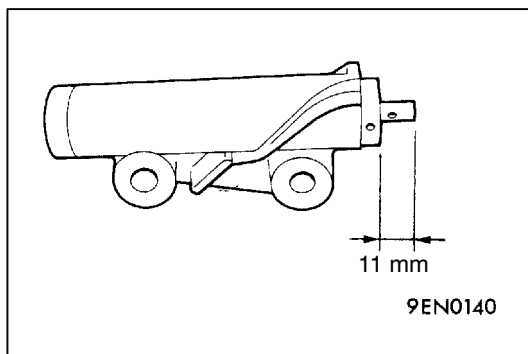
- (7) Abnormal wear on teeth.

- (8) Missing tooth.



TENSIONER PULLER, IDLER PULLEY

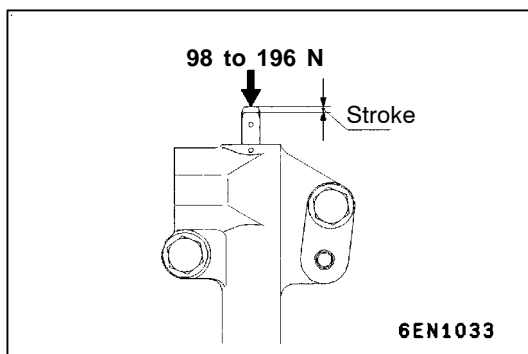
- (1) Check the pulley for smooth rotation, excessive play, abnormal noise. Replace it if necessary.



AUTO-TENSIONER

- (1) Check the tensioner for oil leaks. Replace it if necessary.
 (2) Check the rod end for wear or damage. Replace the tensioner if necessary.
 (3) Measure the rod projection length. If not within the standard value, replace the tensioner.

Standard value: 11 mm

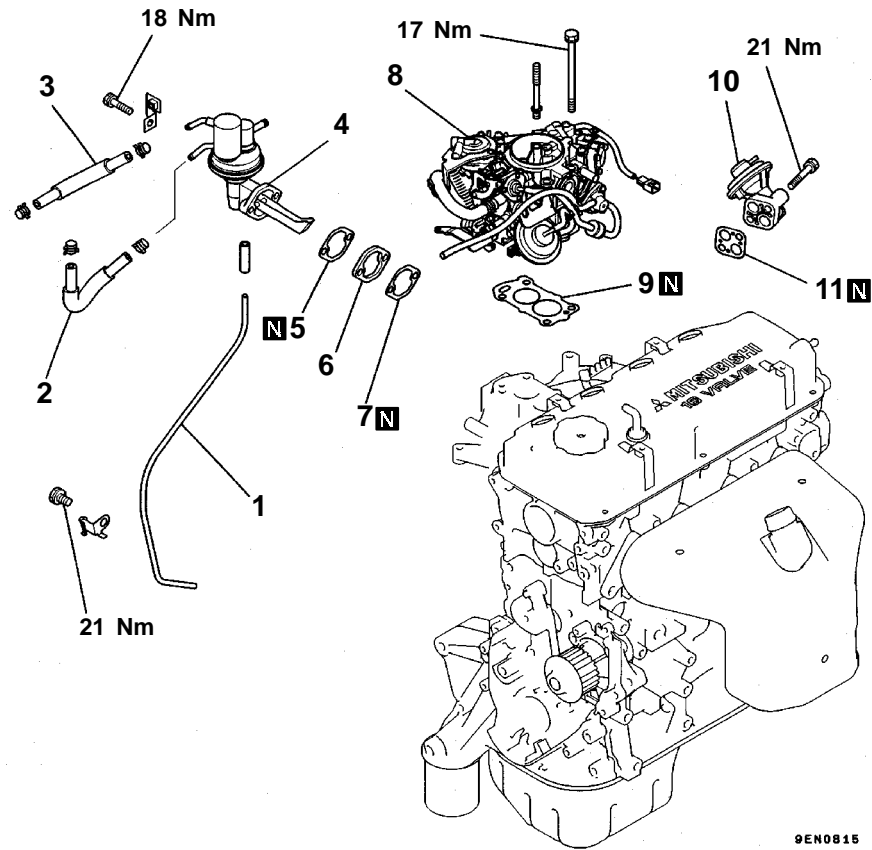


- (4) Press the rod by a force of 98 to 196 N and measure the rod stroke. If not within the standard value, replace the tensioner.

Standard value: 1 mm or less

5. FUEL AND EMISSION CONTROL SYSTEM

REMOVAL AND INSTALLATION <SOHC-CARBURETOR>



Removal steps

1. Breather tube
2. Fuel hose
3. Fuel hose
4. Fuel pump
5. Gasket
6. Insulator
7. Gasket
8. Carburetor
9. Gasket
10. EGR valve
11. Gasket

REMOVAL AND INSTALLATION <SOHC-MPI for other than PAJERO io>



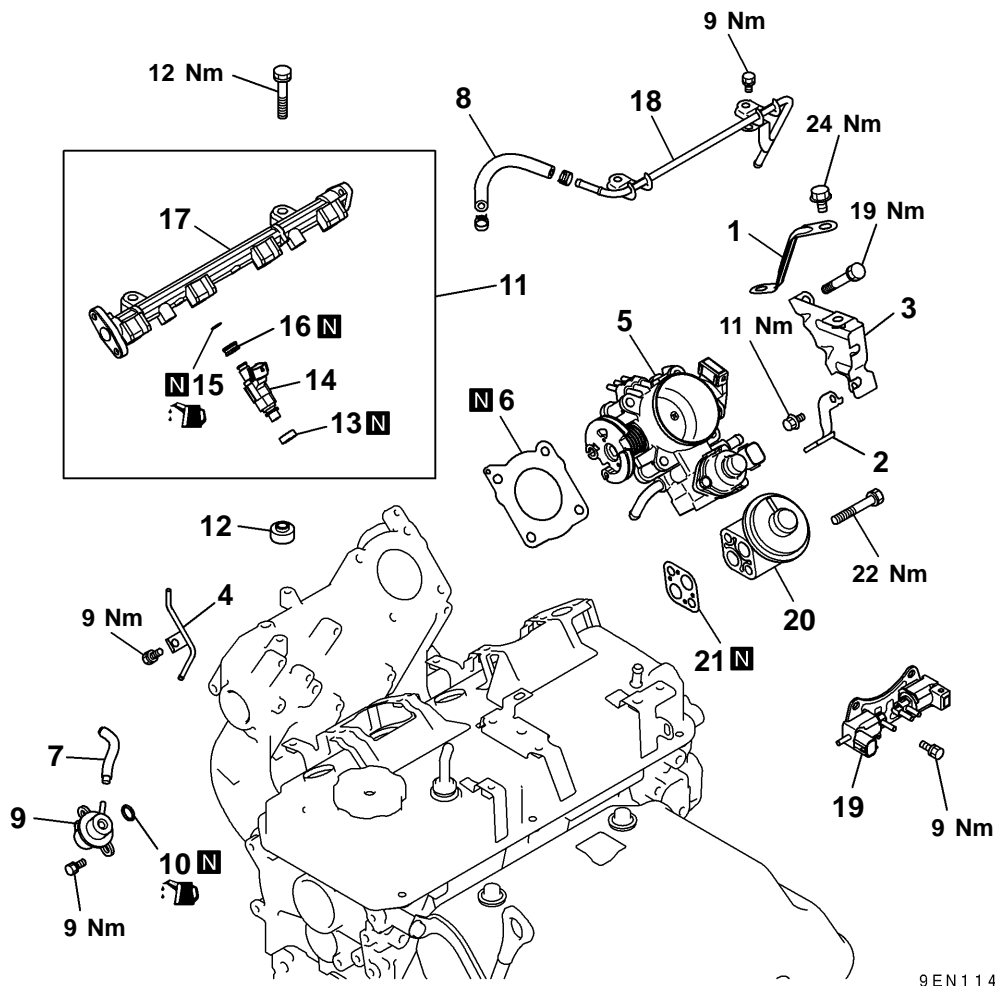
Removal steps

- ▶C◀**

- B◄**

- ▶A◀**

REMOVAL AND INSTALLATION <SOHC-MPI for PAJERO io>



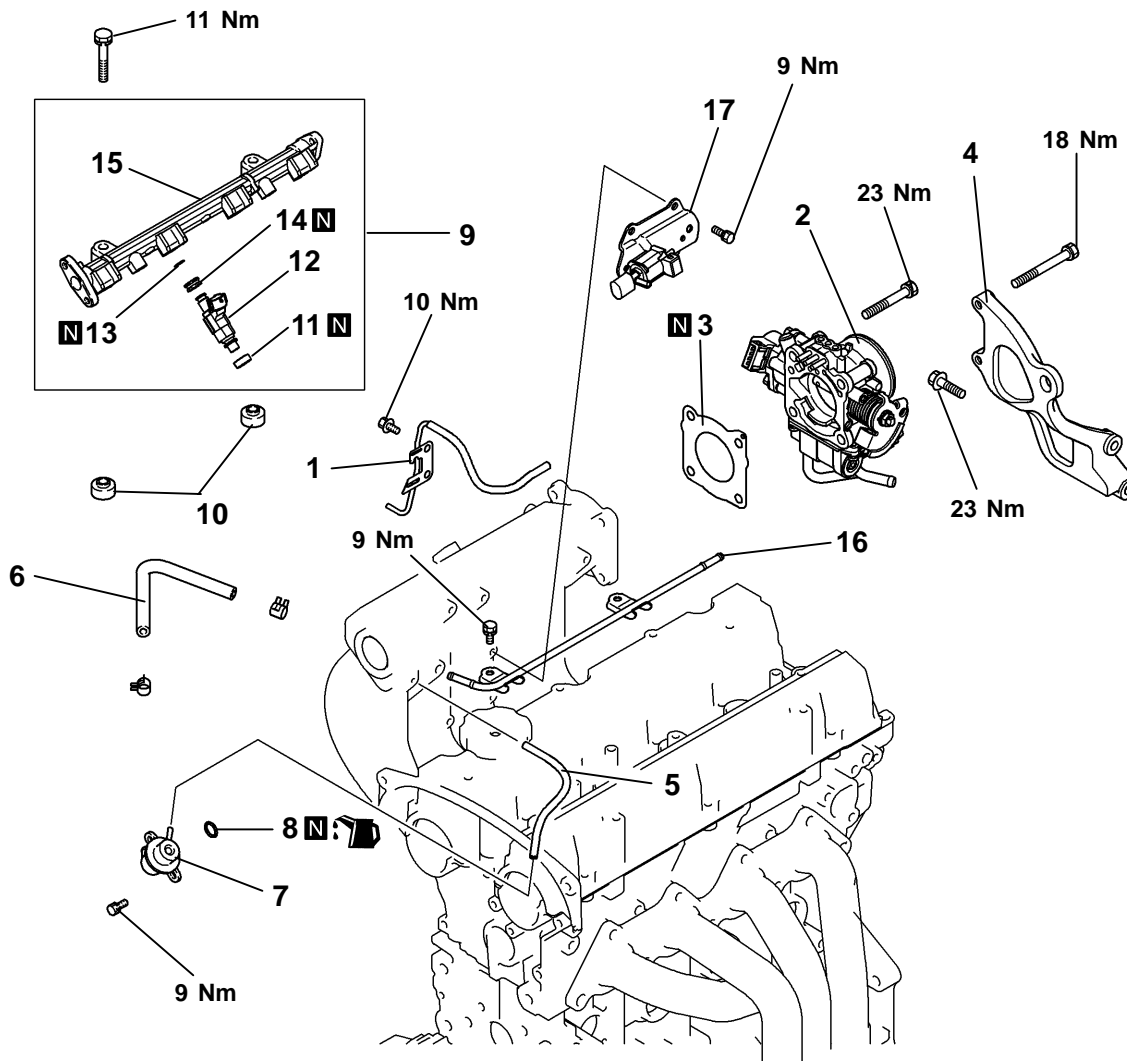
9EN1147

Removal steps

- ▶C◀ 1. Stay (From 2002 model)
 2. Harness bracket
 3. Throttle cable bracket
 4. Vacuum hose and pipe assembly
 5. Throttle body
 ▶C◀ 6. Gasket
 7. Vacuum hose
 ▶B◀ 8. Fuel hose
 9. Fuel pressure regulator
 10. O-ring
 11. Delivery pipe and injector

- ▶A◀ 12. Insulator
 13. Insulator
 14. Injector
 15. O-ring
 16. Grommet
 17. Delivery pipe
 18. Fuel return pipe
 19. Solenoid valve assembly
 20. EGR valve
 21. Gasket

REMOVAL AND INSTALLATION <DOHC>



9EN1157

Removal steps

- C◄ 1. Vacuum pipe assembly
- 2. Throttle body assembly
- 3. Gasket
- 4. Throttle body stay (MIVEC)
- 5. Vacuum hose
- 6. Fuel hose
- B◄ 7. Fuel pressure regulator
- 8. O-ring
- 9. Delivery pipe and injector

- A◄ 10. Insulator
- 11. Insulator
- 12. Injector
- 13. O-ring
- 14. Grommet
- 15. Delivery pipe
- 16. Fuel return pipe
- 17. Solenoid valve

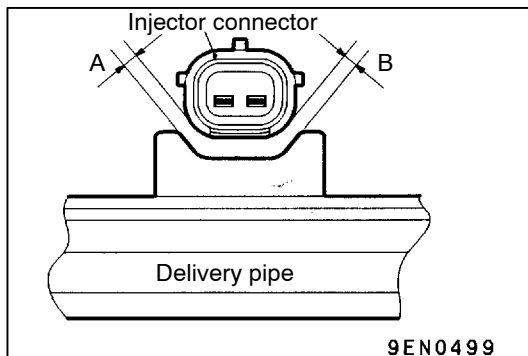
INSTALLATION SERVICE POINTS**►A◄ INJECTORS INSTALLATION**

- (1) Apply a small amount of new engine oil to the O-ring.

Caution

Be sure not to let engine oil get into the delivery pipe.

- (2) While turning the injector to the left and right, install it to the delivery pipe.
- (3) Check that the injector turns smoothly. If it does not turn smoothly, the O-ring may be trapped. Remove the injector and check the O-ring for damage, and then re-insert it into the delivery pipe and check once again.
- (4) Check that the clearance between the injector connector and the delivery pipe is uniform (A = B).

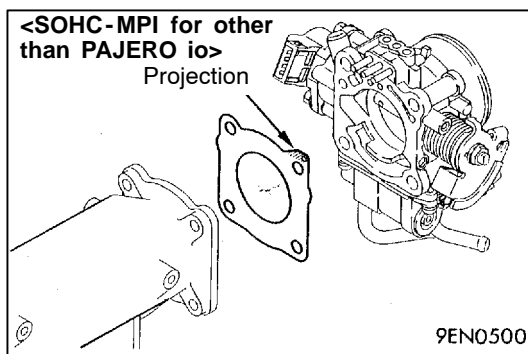
**►B◄ FUEL PRESSURE REGULATOR INSTALLATION**

- (1) Apply a small amount of new engine oil to the O-ring. Insert the fuel pressure regulator into the delivery pipe being careful not to damage the O-ring.

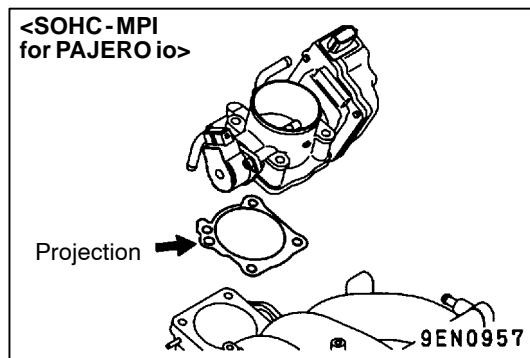
Caution

Be sure not to let engine oil get into the delivery pipe.

- (2) Check that the fuel pressure regulator turns smoothly. If it does not turn smoothly, the O-ring may be trapped. Remove the fuel pressure regulator and check the O-ring for damage, and then re-insert it into the delivery pipe and check once again.

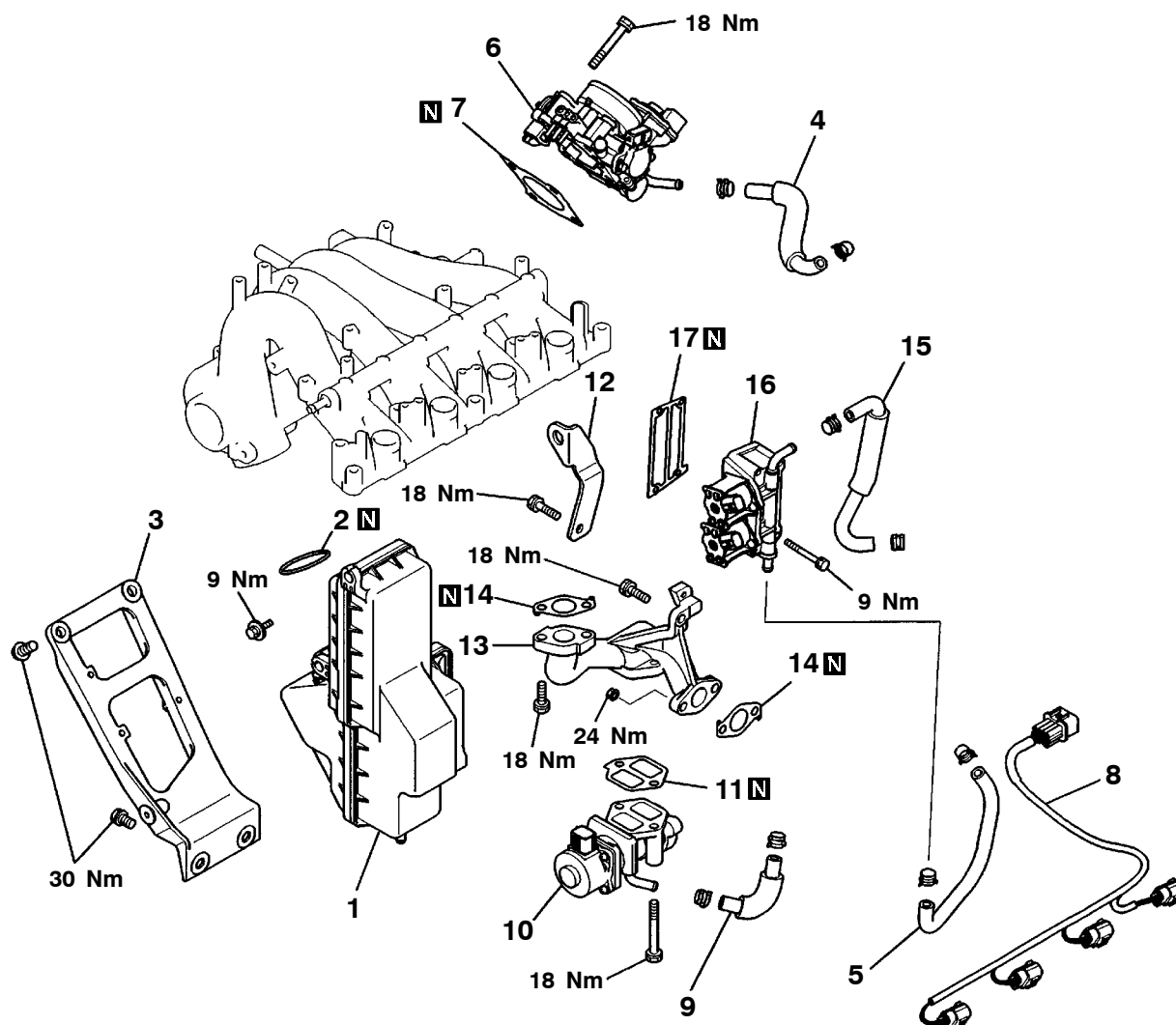
**►C◄ GASKET INSTALLATION**

- (1) Position the projection as shown in the illustration.



5a. THROTTLE BODY AND EGR SYSTEM (GDI)

REMOVAL AND INSTALLATION <Up to 2000 model for CARISMA, 1999 model for SPACE STAR, SPACE RUNNER>



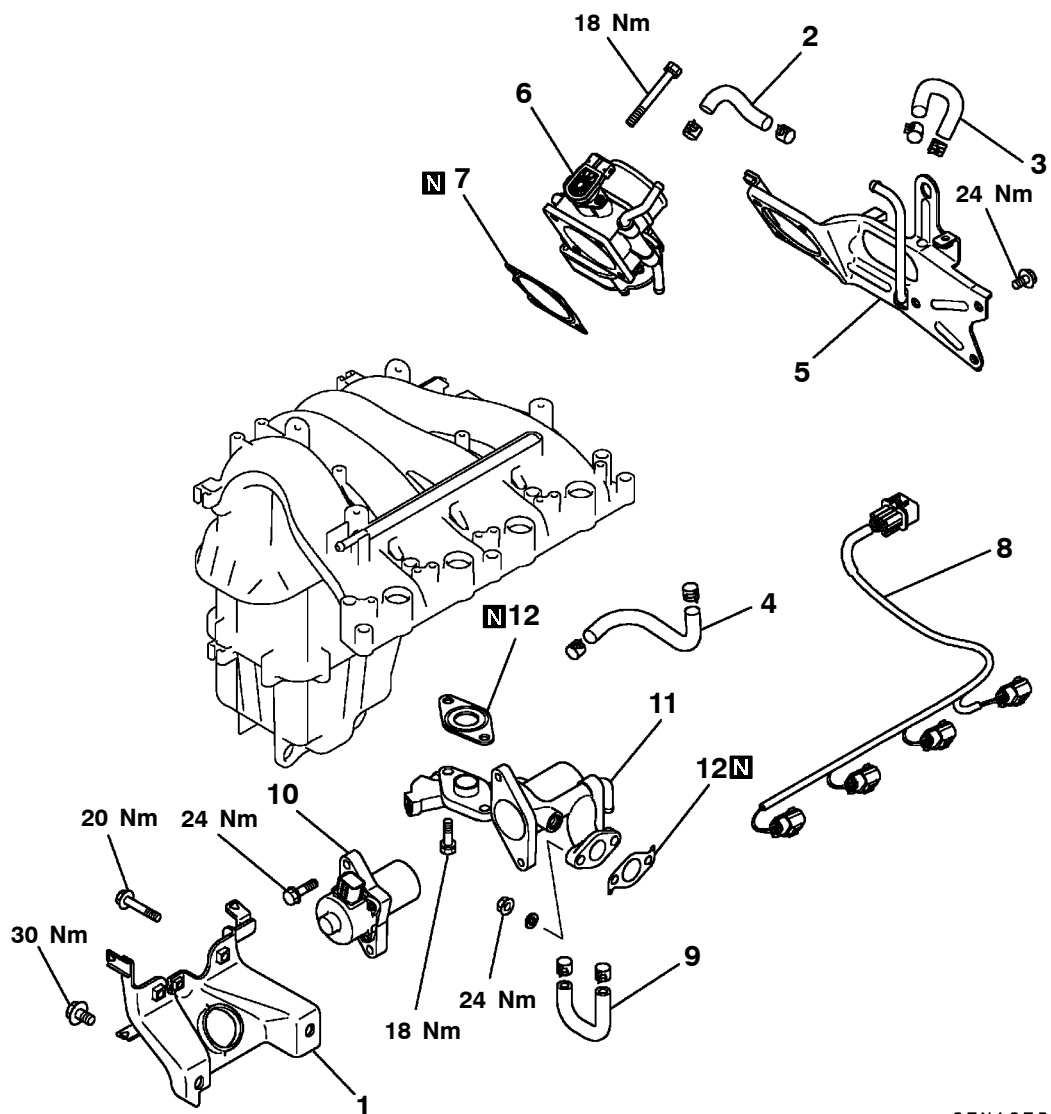
9EN0881

Removal steps

- | | | |
|-----|--|---|
| | 1. Air intake plenum resonator | 12. Engine hanger |
| | 2. O-ring | 13. EGR valve support |
| ►B◄ | 3. Intake manifold stay | 14. Gasket |
| | 4. Water hose | 15. Water hose (Up to 1998 model for CARISMA, SPACE RUNNER) |
| | 5. Water hose (Up to 1998 model for CARISMA, SPACE RUNNER) | 16. Air by-pass valve (Up to 1998 model for CARISMA, SPACE RUNNER) |
| ►A◄ | 6. Throttle body | 17. Air by-pass valve gasket (Up to 1998 model for CARISMA, SPACE RUNNER) |
| | 7. Throttle body gasket | |
| | 8. Ignition harness | |
| | 9. Water hose | |
| | 10. EGR valve | |
| | 11. EGR valve gasket | |

REMOVAL AND INSTALLATION

<From 2001 model for CARISMA, From 2001 model for SPACE STAR, GALANT>



9EN1058

Removal steps

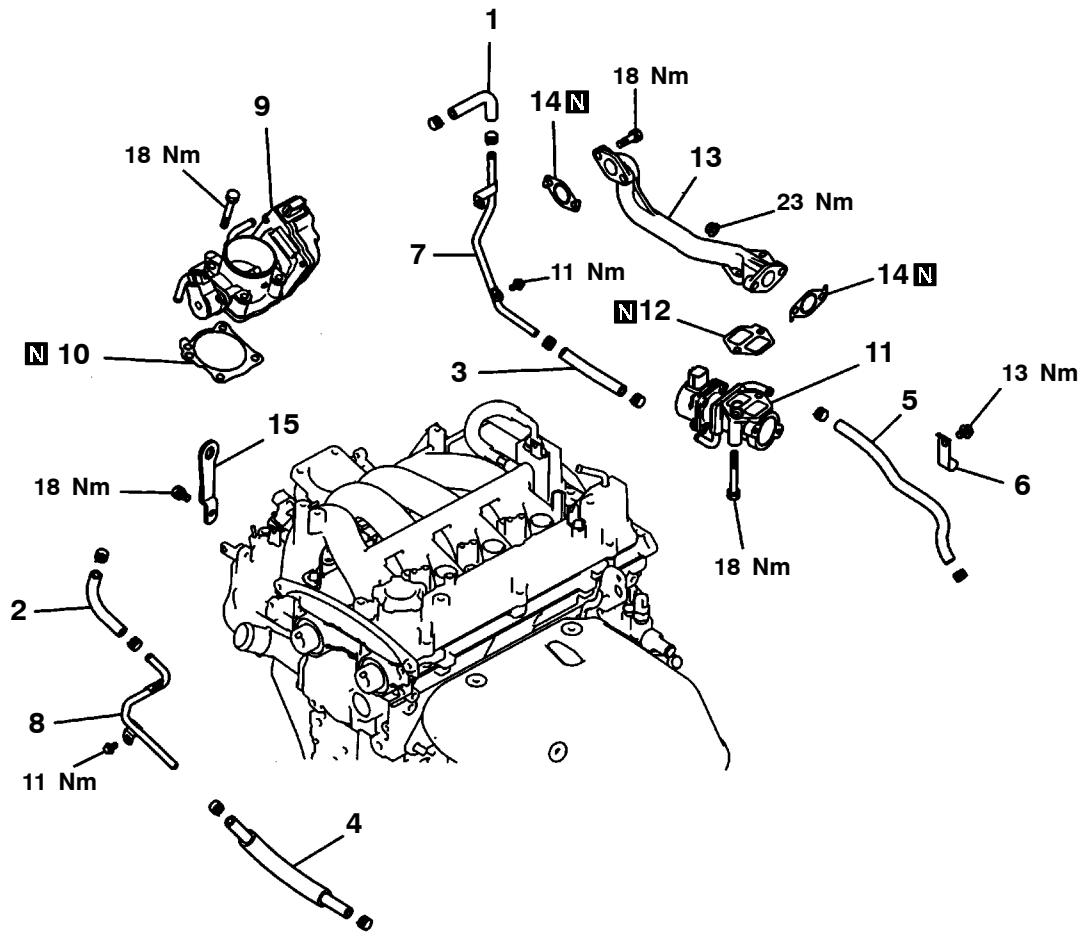


1. Intake manifold stay (For GALANT)
2. Water hose
3. Water hose
4. Water hose
5. Throttle body stay
6. Throttle body



7. Throttle body gasket
8. Ignition harness
9. Water hose
10. EGR valve
11. EGR valve support
12. Gasket

REMOVAL AND INSTALLATION <For PAJERO io - 4G93>

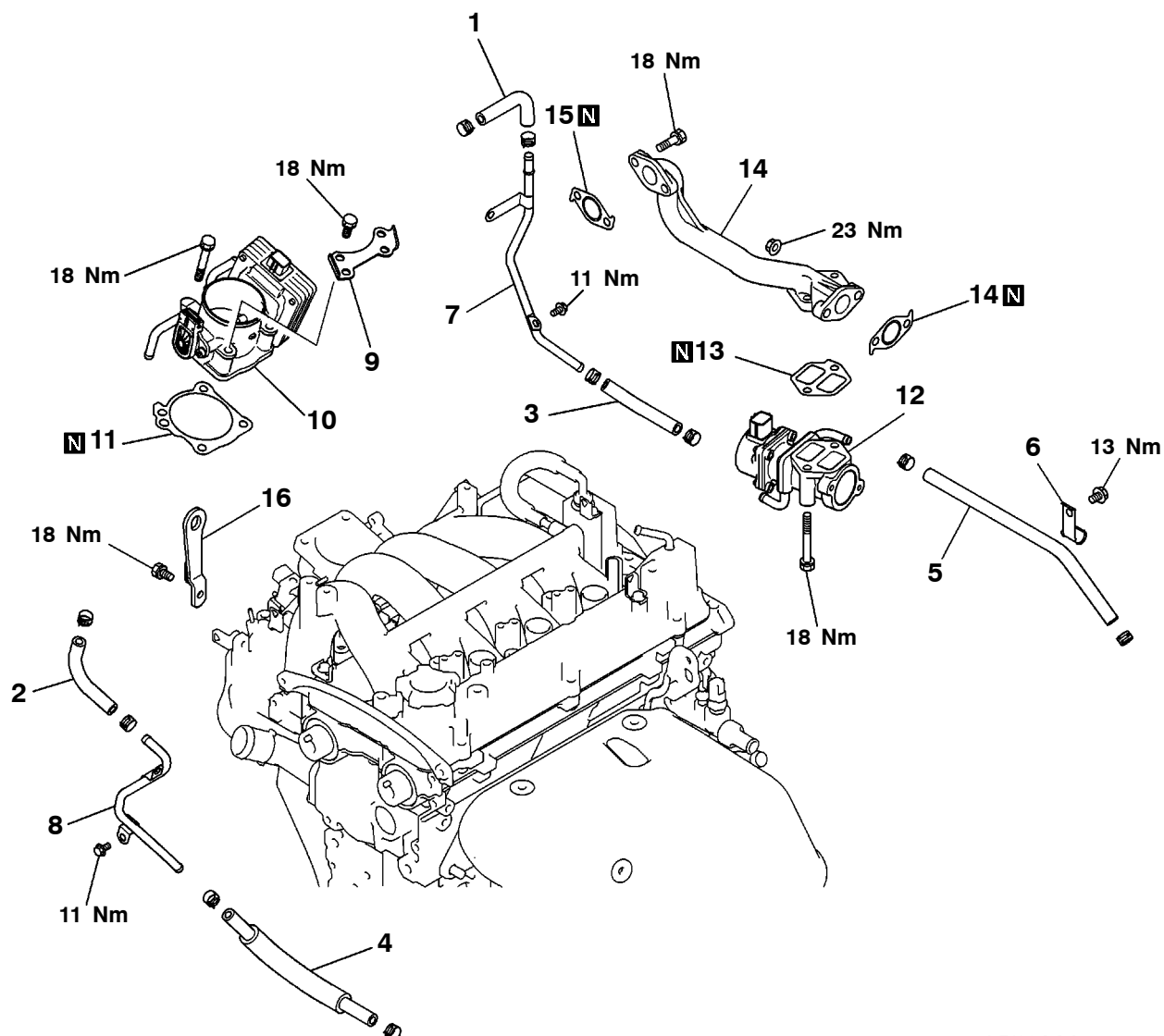


9EN0956

Removal steps

1. Water hose
2. Water hose
3. Water hose
4. Water hose
5. Water hose
6. Water hose clamp
7. Water pipe
8. Water pipe

- A◄
9. Throttle body
 10. Throttle body gasket
 11. EGR valve
 12. EGR valve gasket
 13. EGR valve support
 14. Gasket
 15. Engine hanger

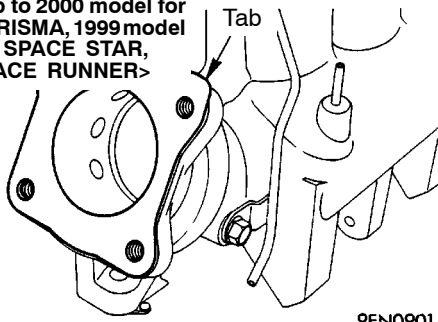


9EN1088

1. Water hose
2. Water hose
3. Water hose
4. Water hose
5. Water hose
6. Water hose clamp
7. Water pipe
8. Water pipe

9. Throttle body stay
10. Throttle body
▶ A ◀ 11. Throttle body gasket
12. EGR valve
13. EGR valve gasket
14. EGR valve support
15. Gasket
16. Engine hanger

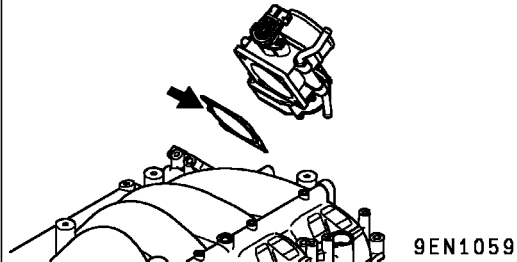
<Up to 2000 model for CARISMA, 1999 model for SPACE STAR, SPACE RUNNER>



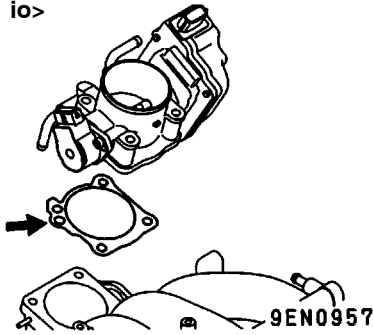
INSTALLATION SERVICE POINTS

►A◄ THROTTLE BODY GASKET

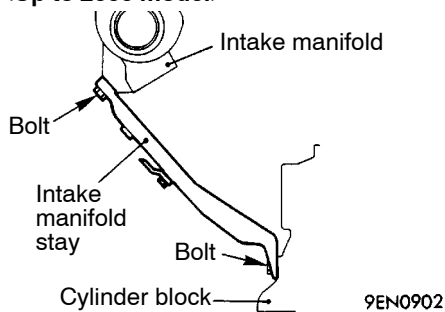
<From 2001 model for CARISMA, From 2001 model for SPACE STAR, GALANT>



<PAJERO io>



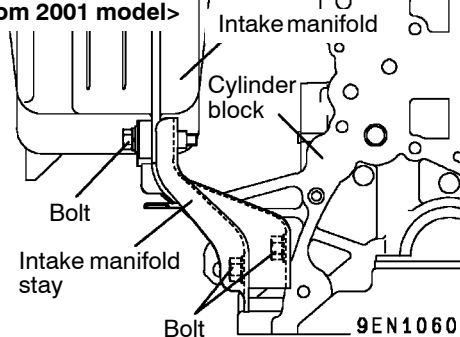
<Up to 2000 model>



►B◄ INTAKE MANIFOLD STAY INSTALLATION

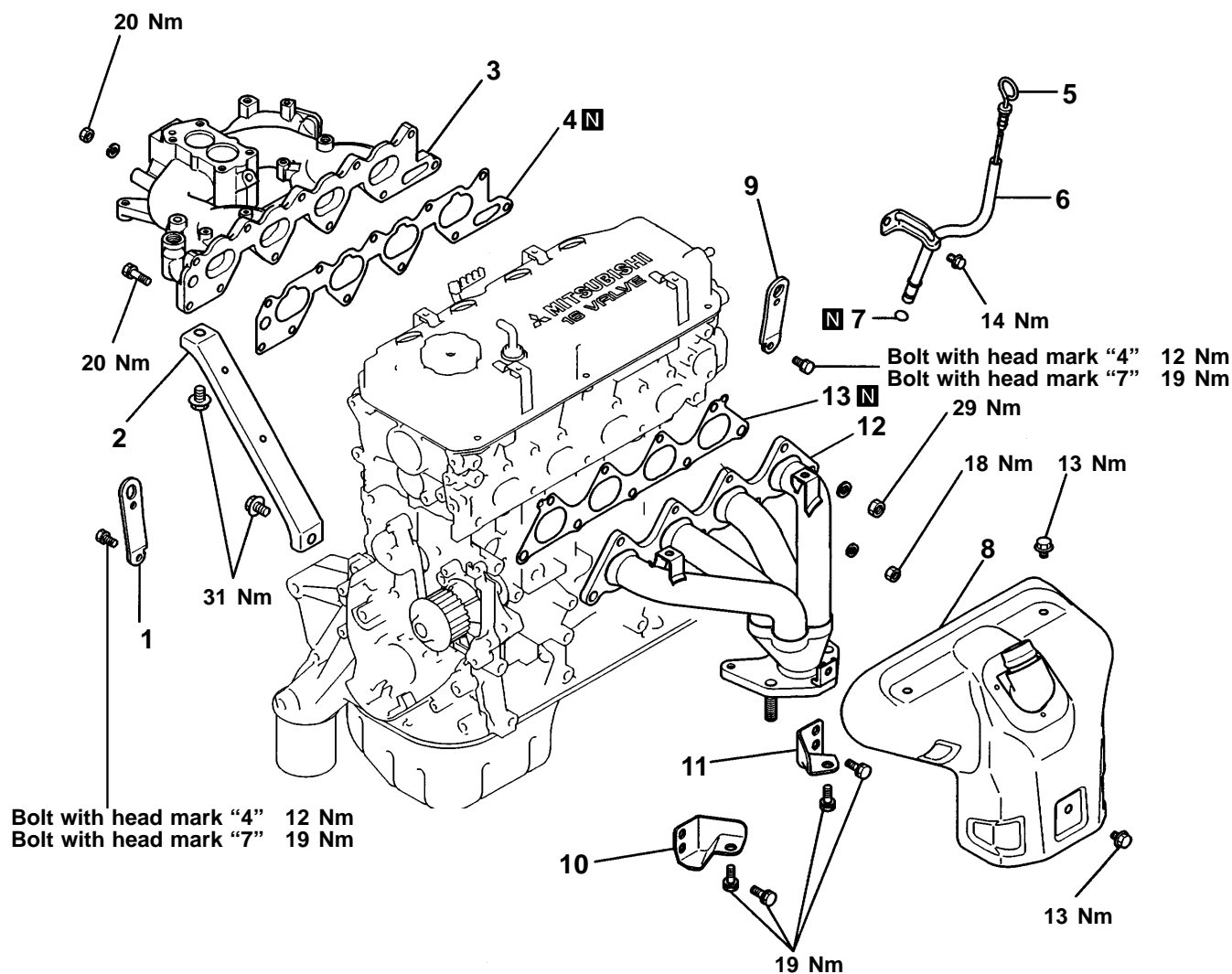
- (1) Tighten the four bolts at the top and bottom of the stay handtight.
- (2) Check that the stay seating surface is in close contact with the bosses on the intake manifold and the cylinder block.
- (3) Tighten the four bolts to the specified torque.

<From 2001 model>



6. INTAKE AND EXHAUST MANIFOLD

REMOVAL AND INSTALLATION <SOHC-CARBURETOR>

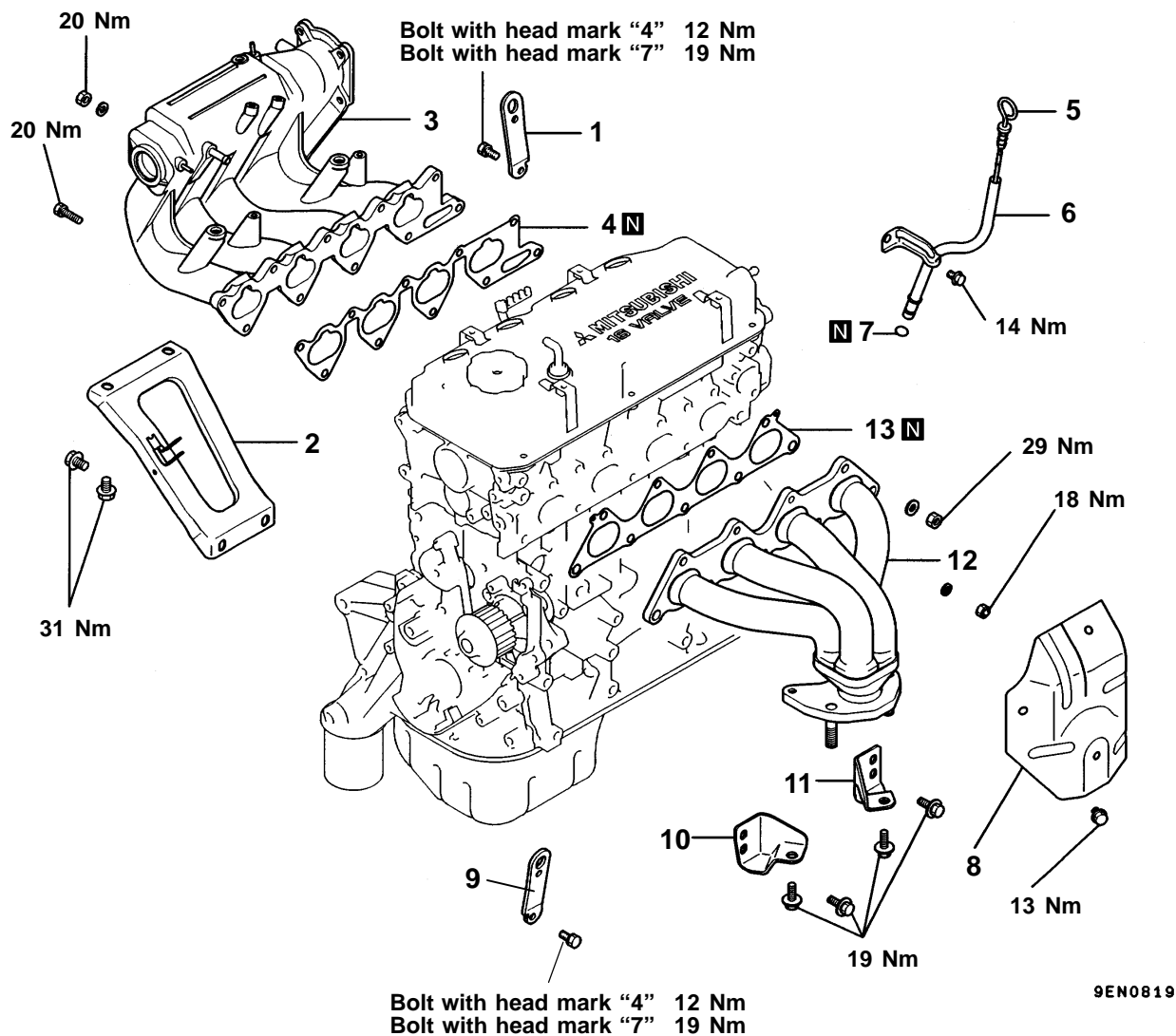


Removal steps

- B◄
1. Engine hanger
 2. Intake manifold stay
 3. Intake manifold
 4. Intake manifold gasket
 5. Oil level gauge
 6. Oil level gauge guide

- A◄
7. O-ring
 8. Exhaust manifold cover
 9. Engine hanger
 10. Exhaust manifold bracket A
 11. Exhaust manifold bracket B
 12. Exhaust manifold
 13. Exhaust manifold gasket

REMOVAL AND INSTALLATION <SOHC-MPI-FRONT WHEEL DRIVE (4G92 and 4G93-Except from 2001 model for Europe)>

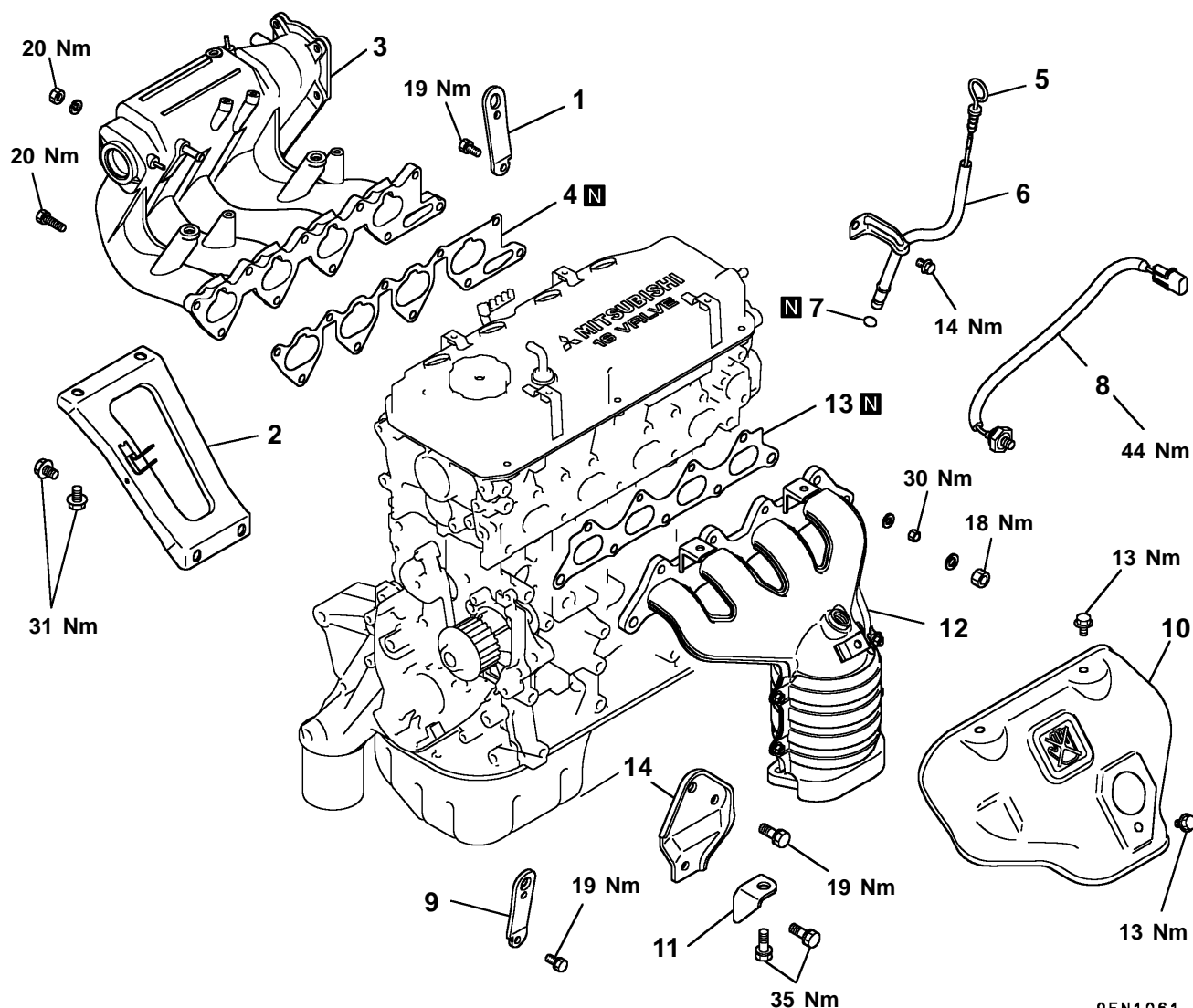


Removal steps

1. Engine hanger
2. Intake manifold stay
3. Intake manifold
4. Intake manifold gasket
5. Oil level gauge
6. Oil level gauge guide

7. O-ring
8. Exhaust manifold cover
9. Engine hanger
- ▶A◀ 10. Exhaust manifold bracket A
- ▶A◀ 11. Exhaust manifold bracket B
12. Exhaust manifold
13. Exhaust manifold gasket

REMOVAL AND INSTALLATION <SOHC-MPI-FRONT WHEEL DRIVE (4G92 and 4G93-From 2001 model for Europe)>

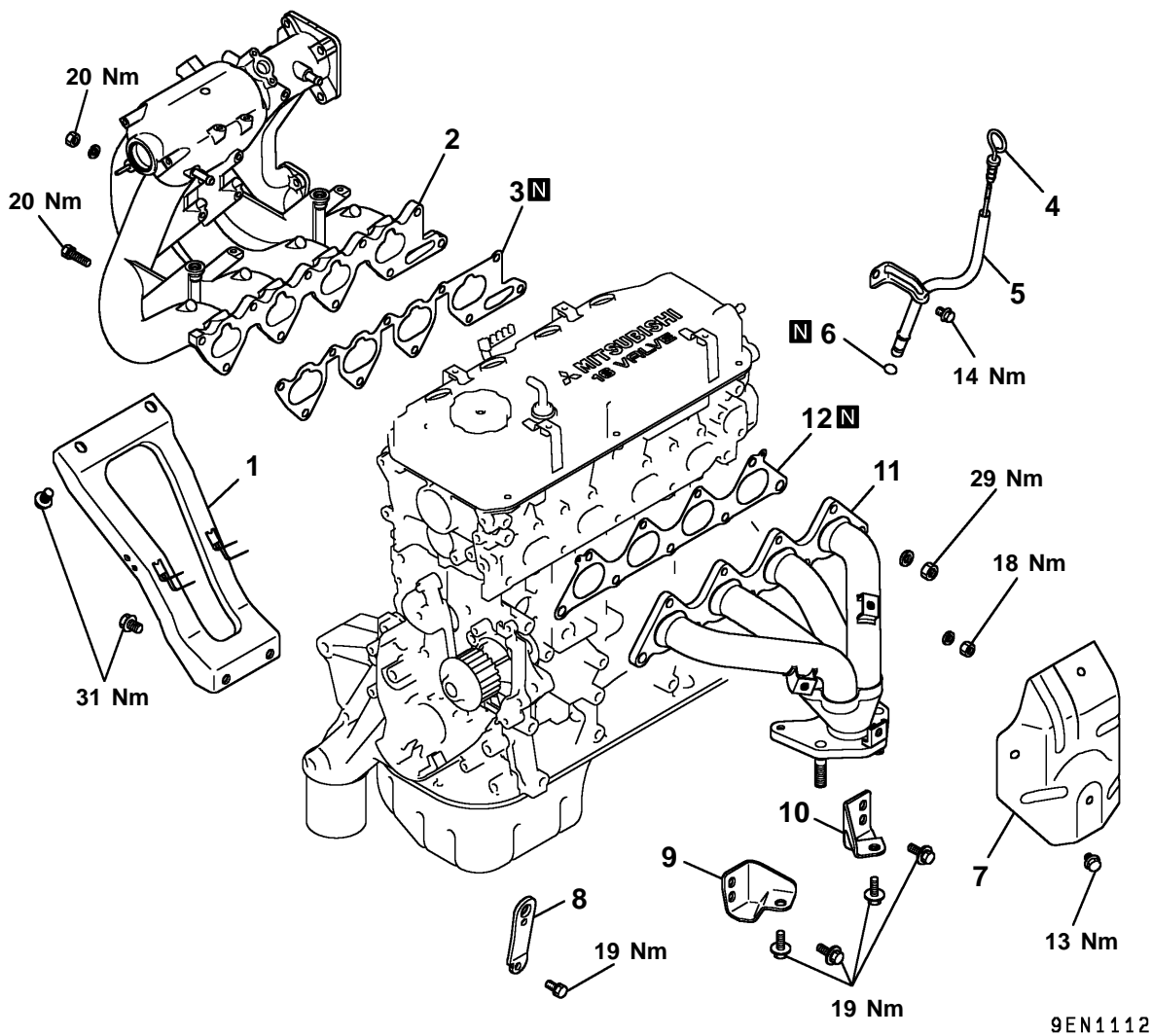


9EN1061

Removal steps

- | | |
|---------------------------|--------------------------------|
| 1. Engine hanger | 8. Oxygen sensor |
| 2. Intake manifold stay | 9. Engine hanger |
| 3. Intake manifold | 10. Exhaust manifold cover |
| 4. Intake manifold gasket | 11. Exhaust manifold bracket B |
| 5. Oil level gauge | 12. Exhaust manifold |
| 6. Oil level gauge guide | 13. Exhaust manifold gasket |
| 7. O-ring | 14. Exhaust manifold bracket A |

REMOVAL AND INSTALLATION <SOHC-MPI-FRONT WHEEL DRIVE (4G94)>

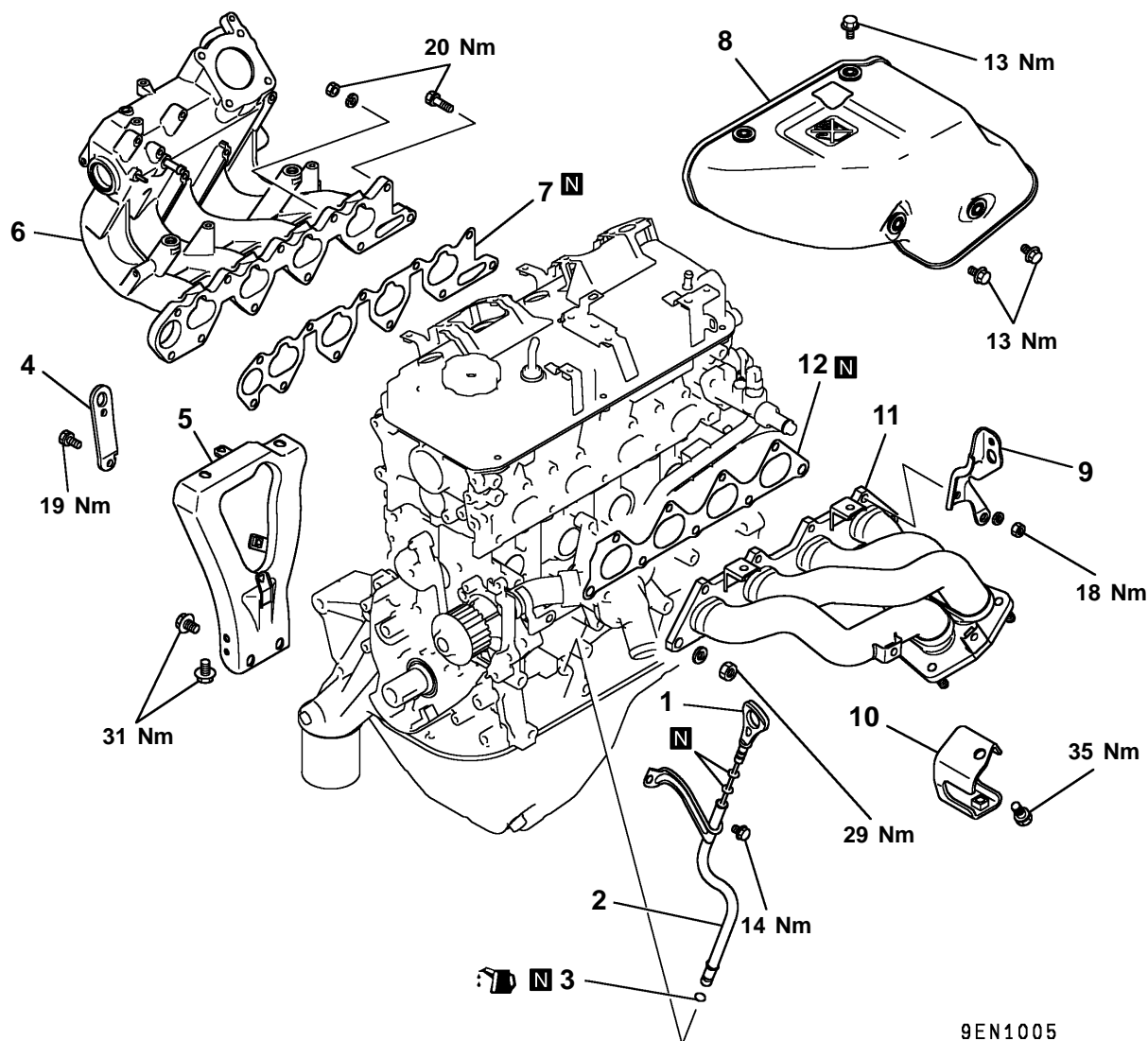
**Removal steps**

1. Intake manifold stay
2. Intake manifold
3. Intake manifold gasket
4. Oil level gauge
5. Oil level gauge guide
6. O-ring

7. Exhaust manifold cover
8. Engine hanger
9. Exhaust manifold bracket A
10. Exhaust manifold bracket B
11. Exhaust manifold
12. Exhaust manifold gasket

REMOVAL AND INSTALLATION

<SOHC-MPI – REAR WHEEL DRIVE (4G93 – Except from 2002 model for Europe)>

**Removal steps**

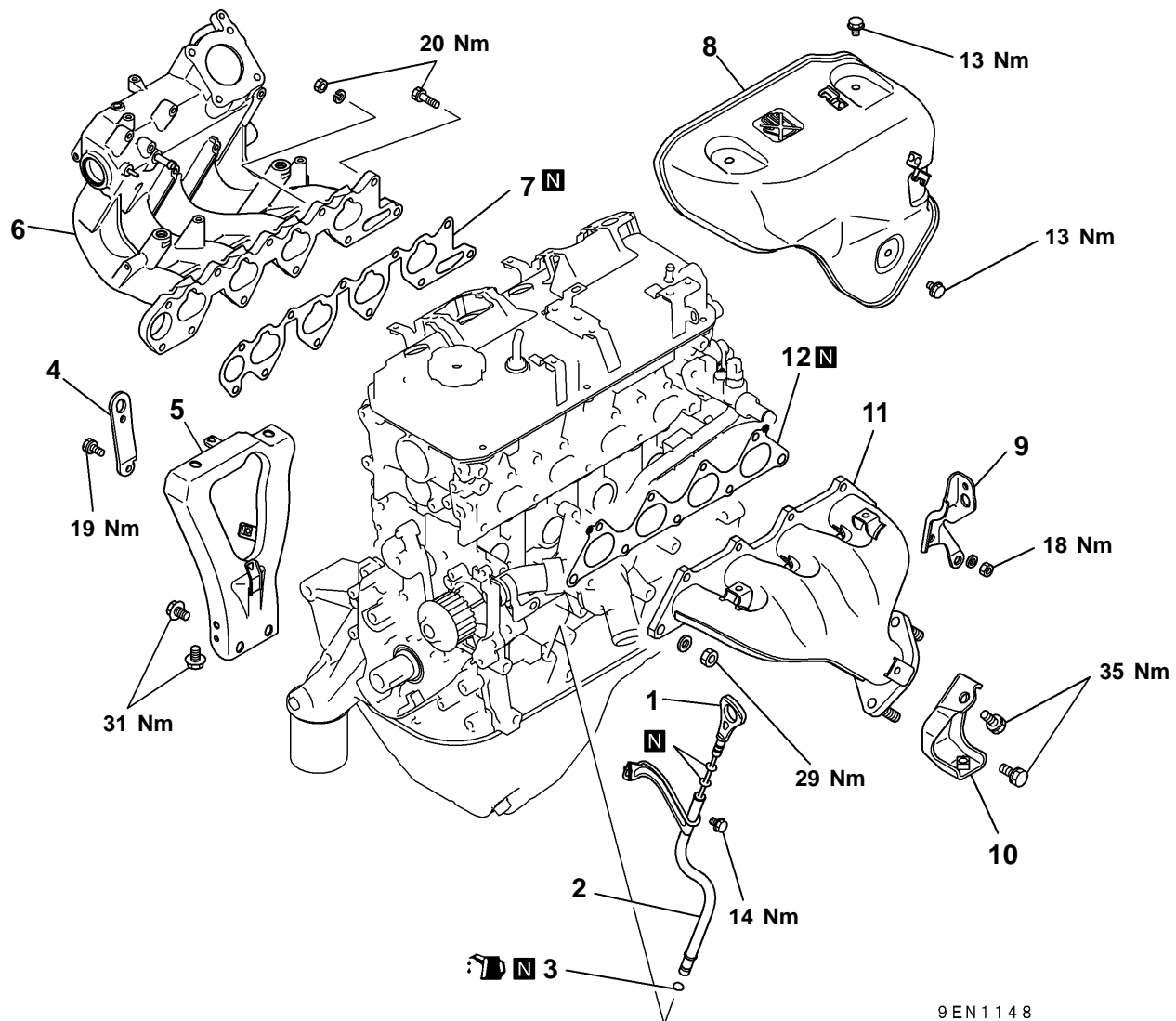
1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Engine hanger
5. Intake manifold stay
6. Intake manifold



7. Intake manifold gasket
8. Exhaust manifold cover
9. Engine hanger
10. Exhaust manifold bracket
11. Exhaust manifold
12. Exhaust manifold gasket

REMOVAL AND INSTALLATION

<SOHC-MPI – REAR WHEEL DRIVE (4G93 – from 2002 model for Europe)>



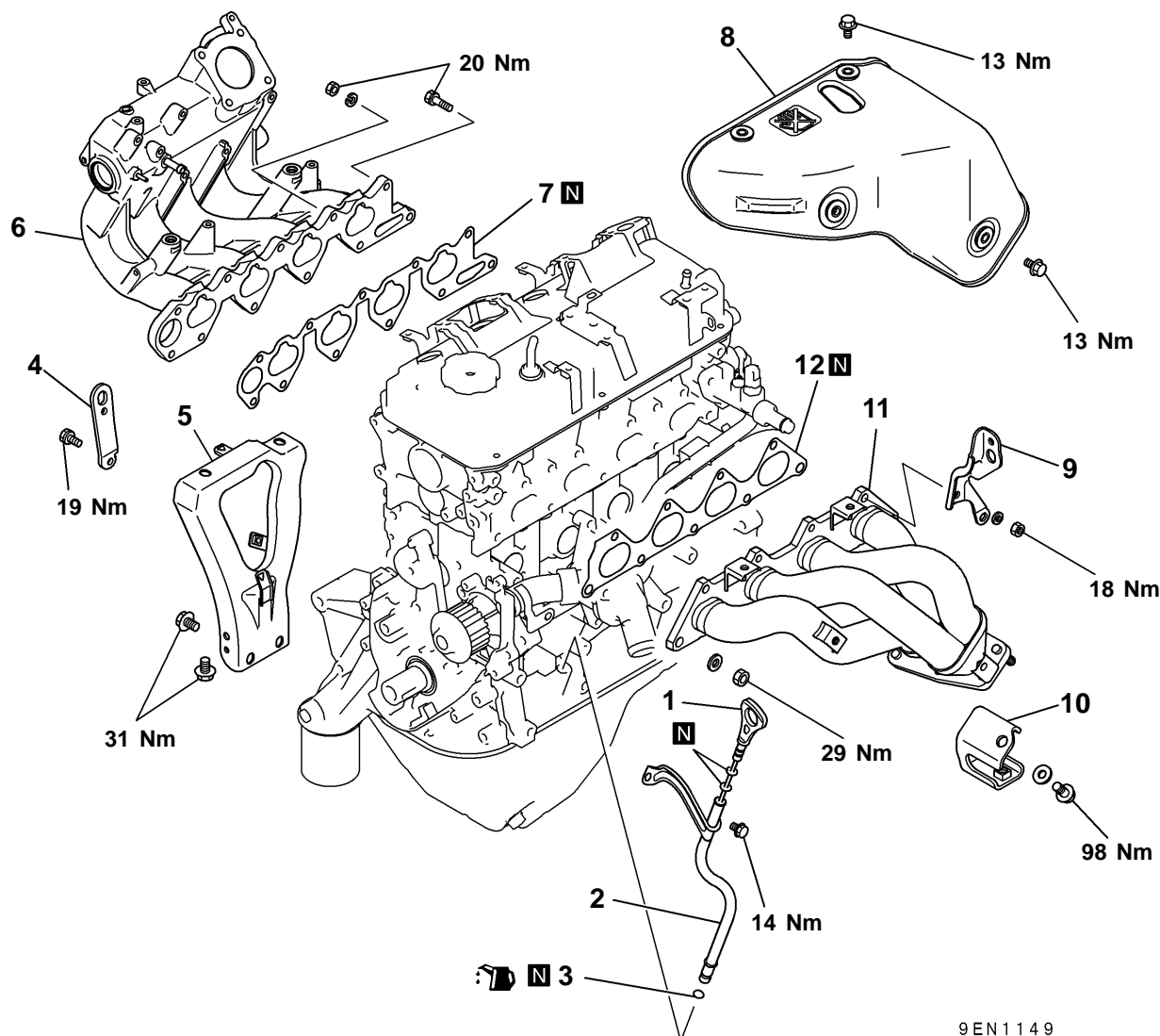
9 EN1148

Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Engine hanger
5. Intake manifold stay
6. Intake manifold

7. Intake manifold gasket
8. Exhaust manifold cover
9. Engine hanger
- ▶ A ◀ 10. Exhaust manifold bracket
11. Exhaust manifold
12. Exhaust manifold gasket

REMOVAL AND INSTALLATION <SOHC-MPI – REAR WHEEL DRIVE (4G94)>

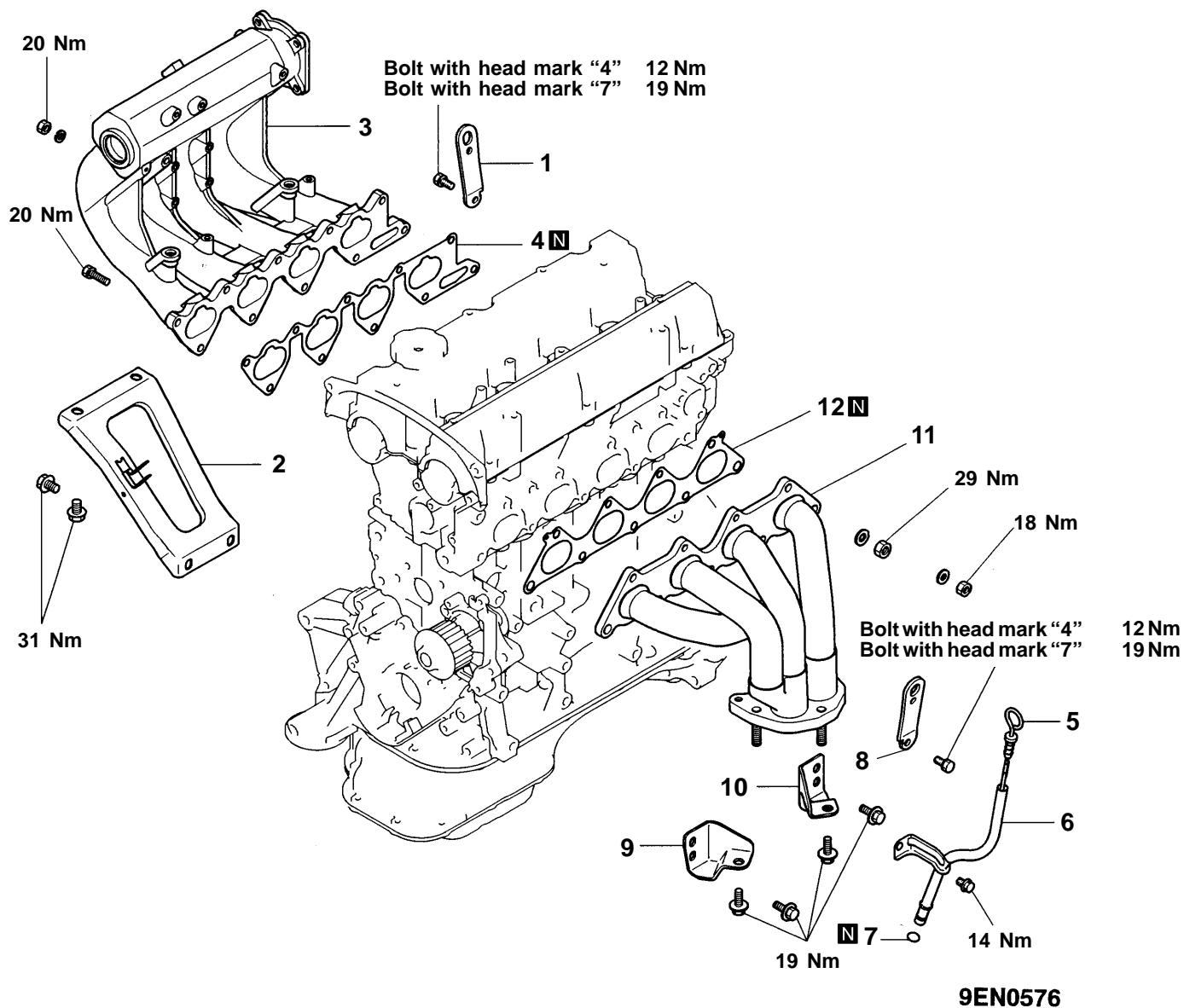
**Removal steps**

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Engine hanger
5. Intake manifold stay
6. Intake manifold

7. Intake manifold gasket
8. Exhaust manifold cover
9. Engine hanger
- ▶ A ◀ 10. Exhaust manifold bracket
11. Exhaust manifold
12. Exhaust manifold gasket

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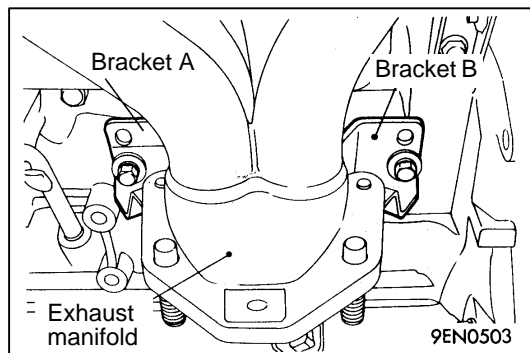
REMOVAL AND INSTALLATION <DOHC>



Removal steps

1. Engine hanger
2. Intake manifold stay
3. Intake manifold
4. Intake manifold gasket
5. Oil level gauge
6. Oil level gauge guide

7. O-ring
8. Engine hanger
9. Exhaust manifold bracket A
10. Exhaust manifold bracket B
11. Exhaust manifold
12. Exhaust manifold gasket

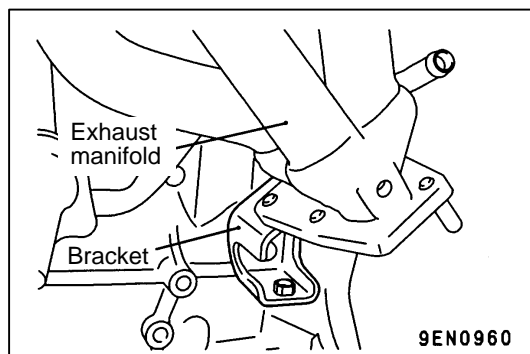


INSTALLATION SERVICE POINT

►A◄ EXHAUST MANIFOLD BRACKET INSTALLATION

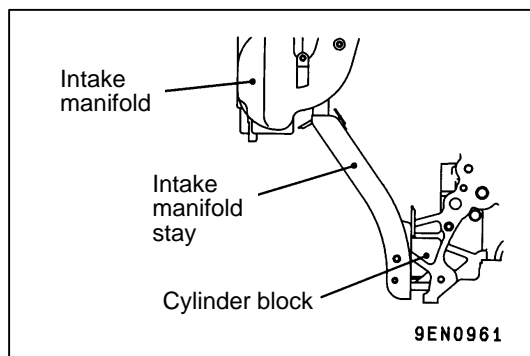
<FRONT WHEEL DRIVE>

- (1) Install temporarily the exhaust manifold brackets A and B as shown in the illustration.
- (2) Check that both brackets are in close contact with the bosses, and then tighten fully the bracket mounting bolts.



<REAR WHEEL DRIVE>

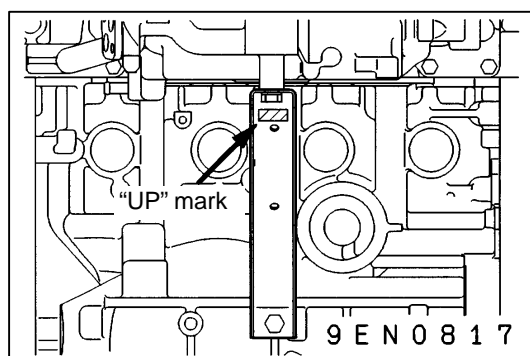
- (1) Temporarily install the exhaust manifold bracket as shown in the illustration.
- (2) Verify that the bracket is brought into close contact with the boss on the exhaust manifold, then tighten the bolts to the specified torque.



►B◄ INTAKE MANIFOLD STAY INSTALLATION

<FRONT WHEEL DRIVE>

- (1) Check to ensure that the intake manifold stay is in close contact with the intake manifold and the cylinder block before tightening the respective mounting bolts to the specified torque.

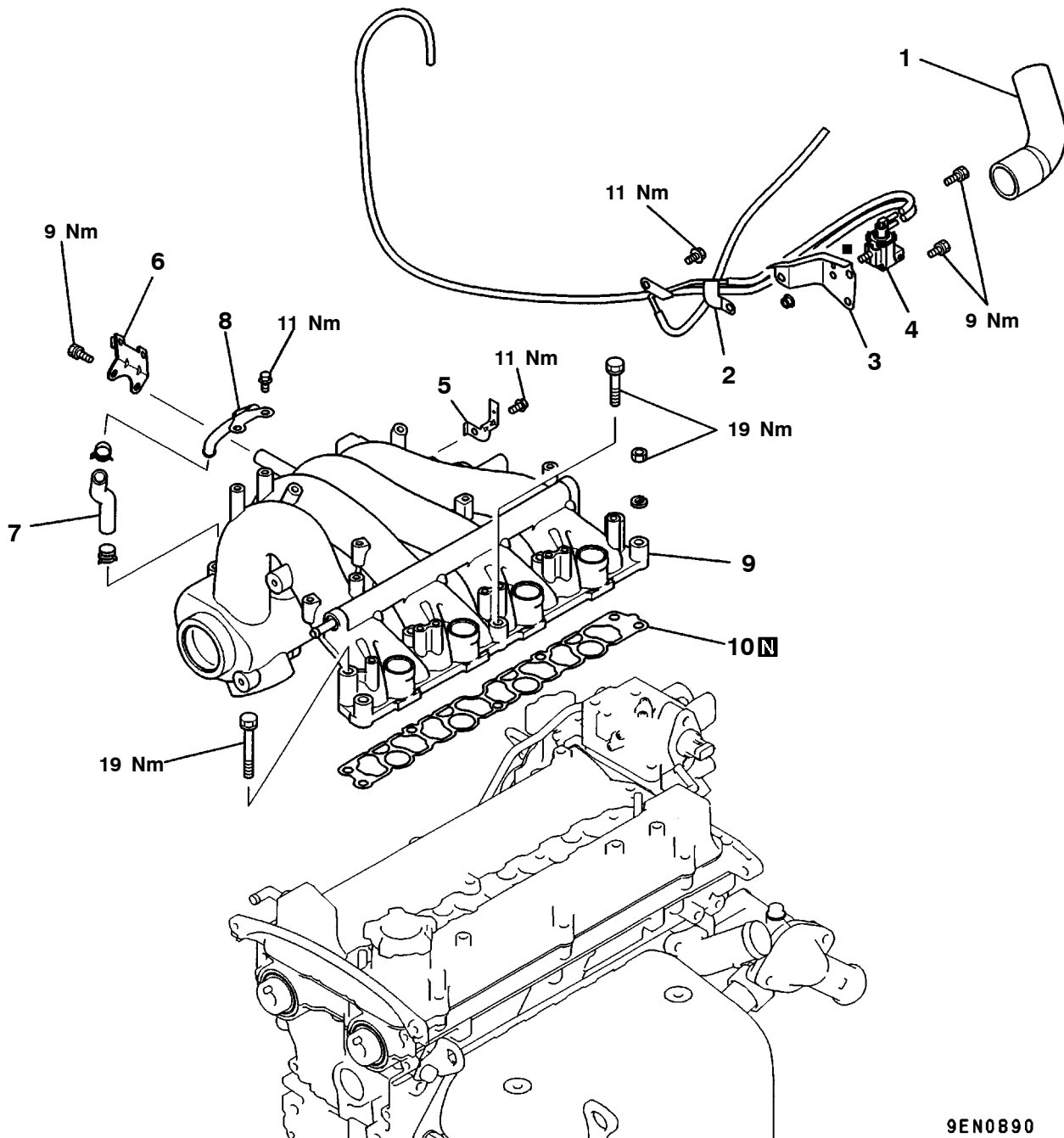


<REAR WHEEL DRIVE>

- (1) Install the intake manifold stay with its "UP" mark directed toward the intake manifold.

6a. INTAKE MANIFOLD (GDI)

REMOVAL AND INSTALLATION <Up to 2000 model for CARISMA, 1999 model for SPACE STAR, SPACE RUNNER>



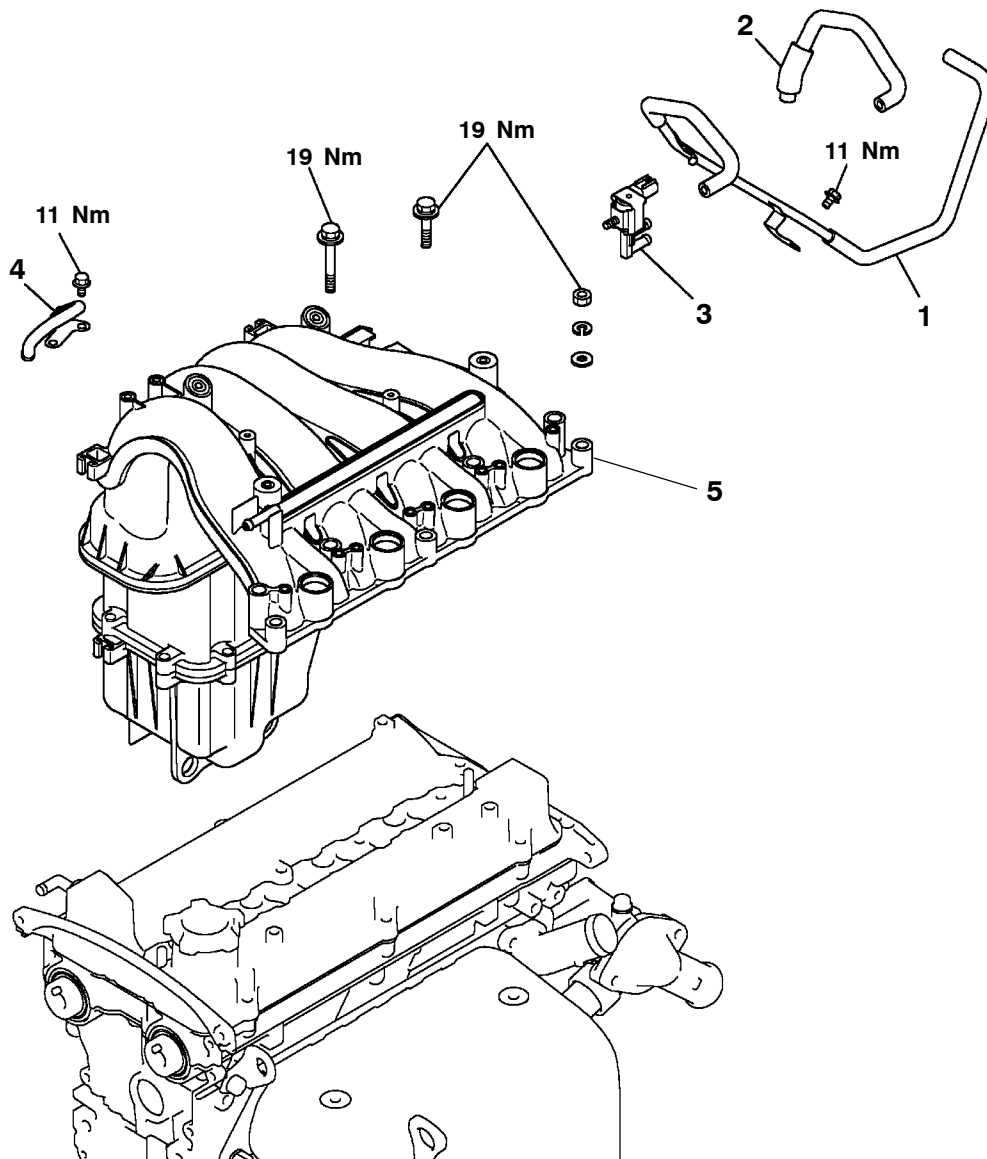
9EN0890

Removal steps

- | | |
|--|------------------------------|
| 1. Air by-pass hose
(Up to 1998 model for CARISMA,
SPACE RUNNER) | 5. Connector bracket |
| 2. Vacuum pipe and hose | 6. Accelerator cable bracket |
| 3. Bracket | 7. Vacuum hose |
| 4. Solenoid valve | 8. Vacuum pipe |
| | 9. Intake manifold |
| | 10. Intake manifold gasket |

REMOVAL AND INSTALLATION

<From 2001 model for CARISMA, From 2001 model for SPACE STAR, GALANT>



9EN1062

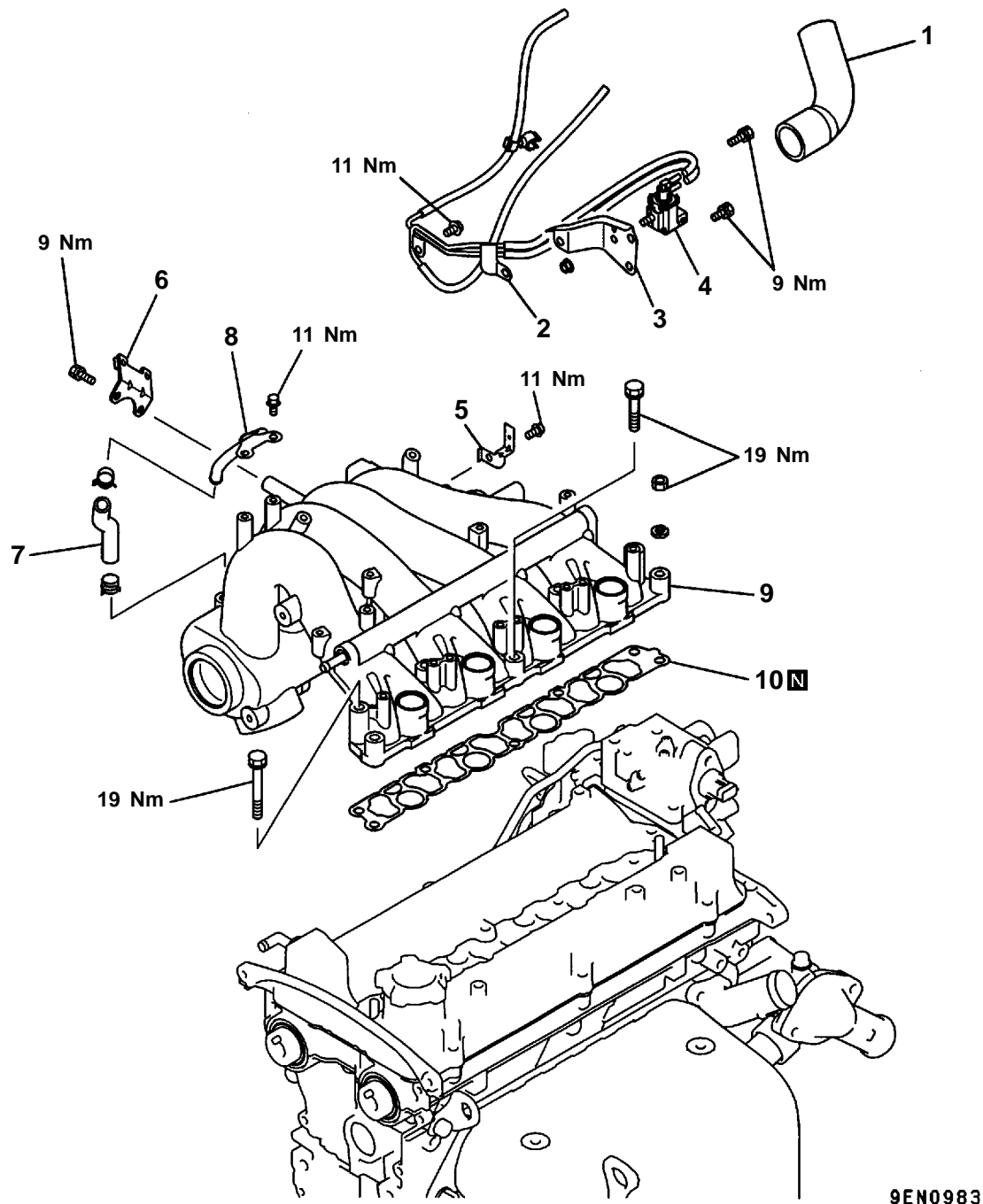
Removal steps

1. Vacuum pipe and hose
2. Purge hose
3. Solenoid valve

4. Vacuum pipe
5. Intake manifold

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REMOVAL AND INSTALLATION <For SPACE RUNNER>



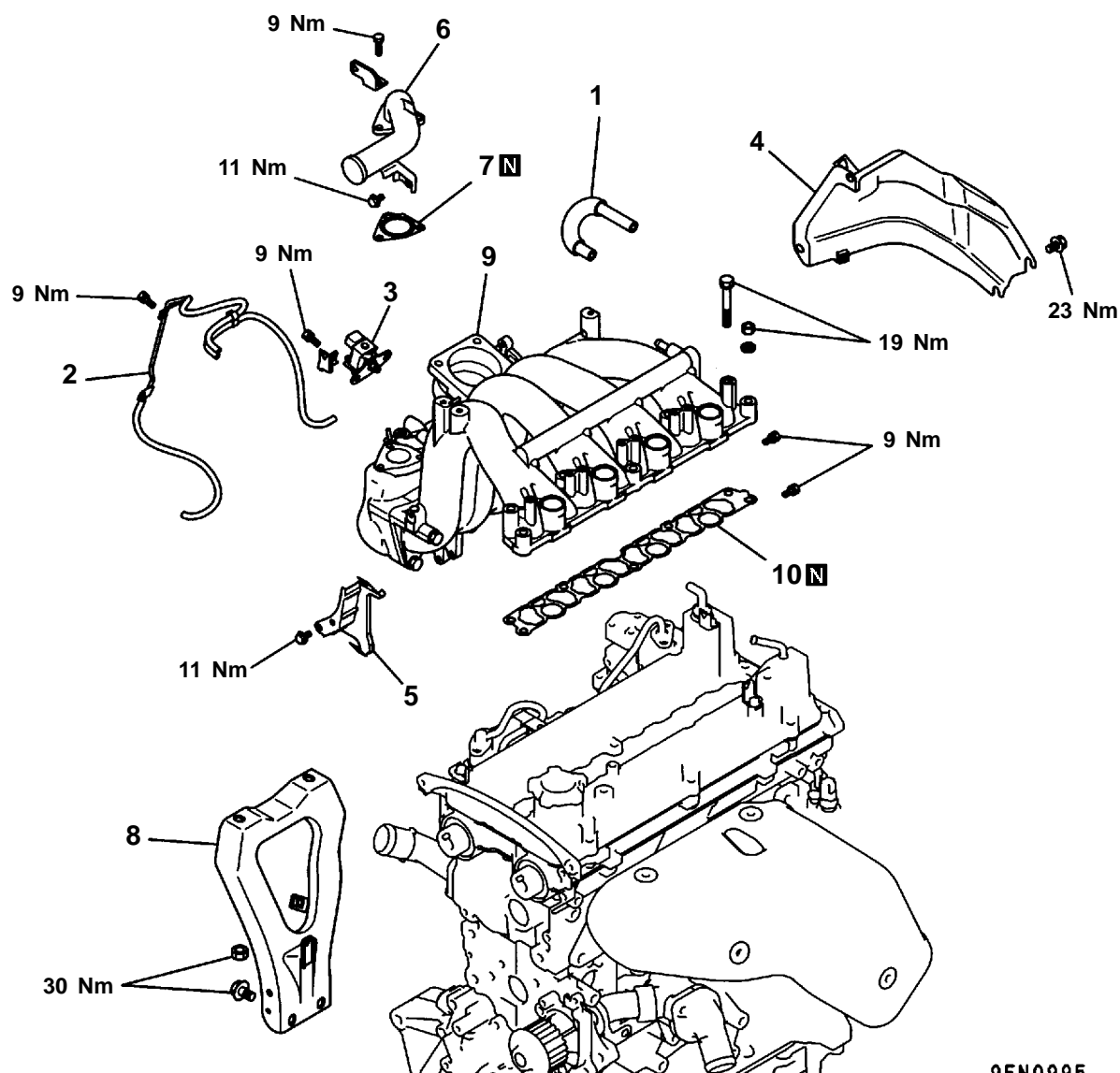
9EN0983

Removal steps

1. Air by-pass hose
2. Vacuum pipe and hose
3. Bracket
4. Solenoid valve
5. Connector bracket

6. Accelerator cable bracket
7. Vacuum hose
8. Vacuum pipe
9. Intake manifold
10. Intake manifold gasket

REMOVAL AND INSTALLATION <For PAJERO io>



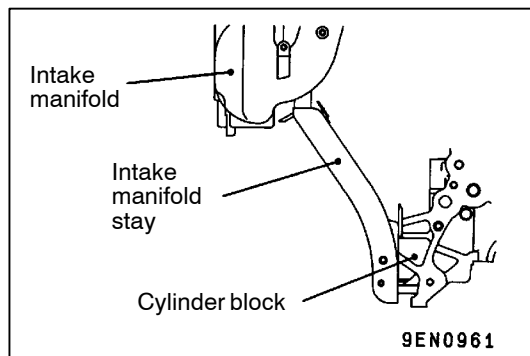
9EN0995

Removal steps

1. P.C.V. hose
2. Vacuum pipe and hose
3. Solenoid valve
4. Fuel pump protector
5. Connector bracket



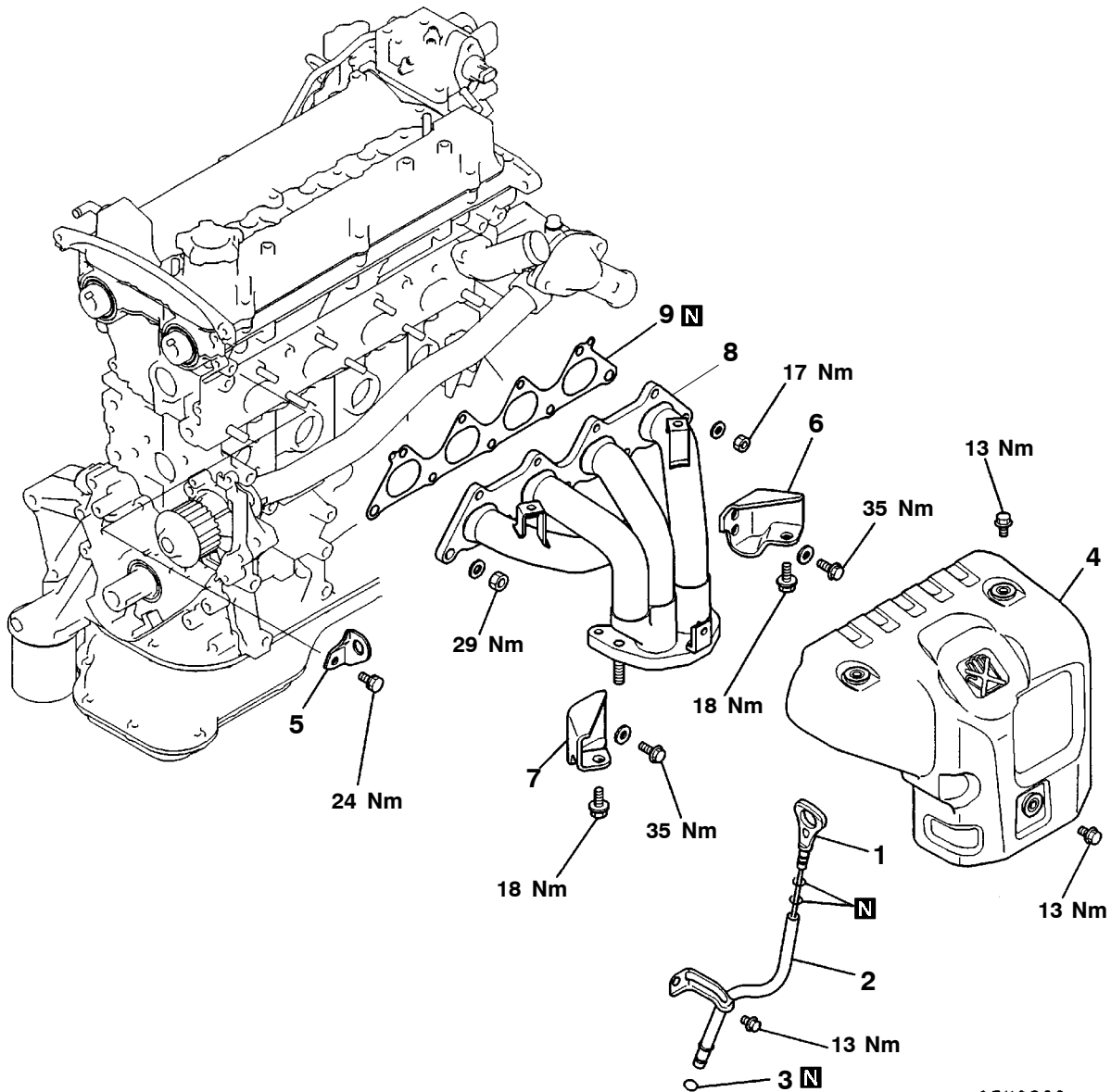
6. Branch tube
7. Gasket
8. Intake manifold stay
9. Intake manifold
10. Intake manifold gasket



INSTALLATION SERVICE POINT

►A◄ INTAKE MANIFOLD STAY INSTALLATION

- (1) Check to ensure that the intake manifold stay is in close contact with the intake manifold and the cylinder block before tightening the respective mounting bolts to the specified torque.

6b. EXHAUST MANIFOLD (GDI)**REMOVAL AND INSTALLATION <For CARISMA, SPACE STAR, SPACE RUNNER>**

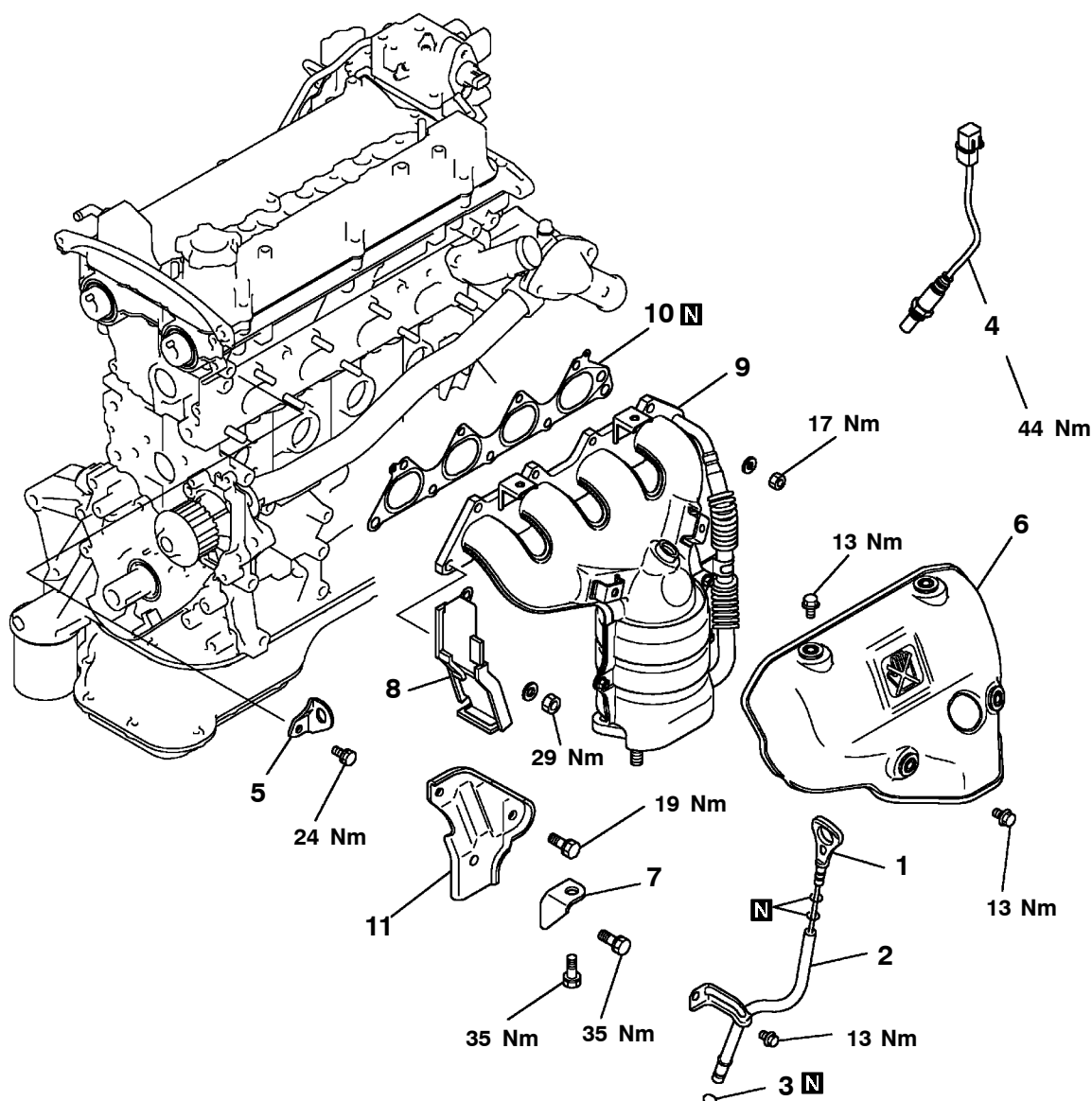
9EN0882

Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Exhaust manifold cover
5. Engine hanger
6. Exhaust manifold bracket A
7. Exhaust manifold bracket B
8. Exhaust manifold
9. Exhaust manifold gasket



REMOVAL AND INSTALLATION <For GALANT>



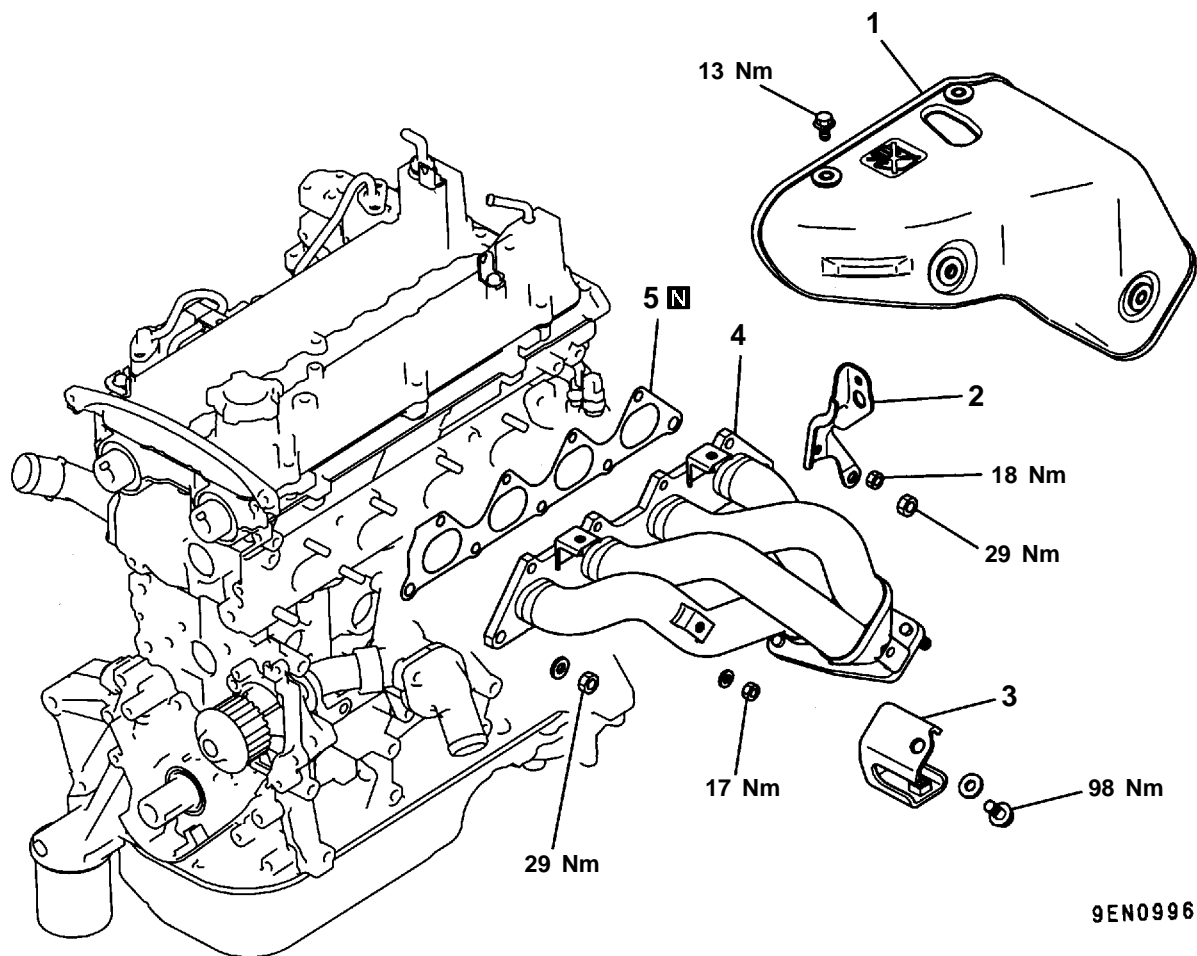
9EN1063

Removal steps

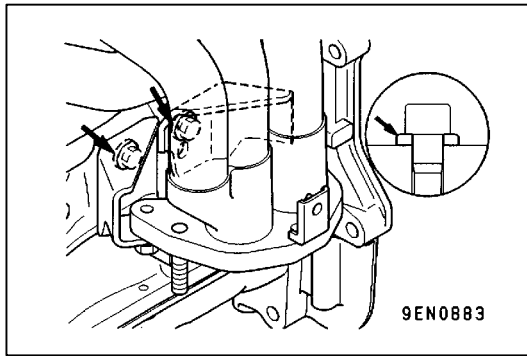
1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Oxygen sensor
5. Engine hanger
6. Exhaust manifold cover
7. Exhaust manifold bracket B
8. Heat protector
9. Exhaust manifold
10. Exhaust manifold gasket
11. Exhaust manifold bracket A

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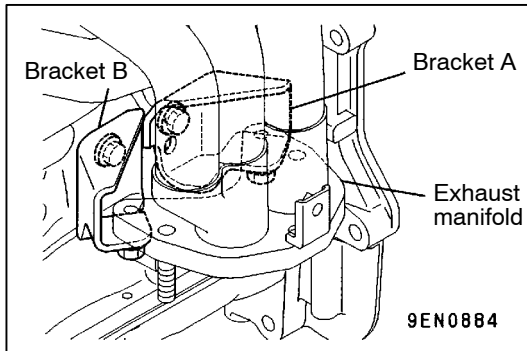
REMOVAL AND INSTALLATION <For PAJERO io>

**Removal steps**

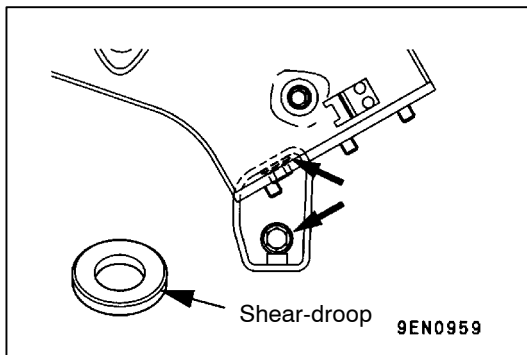
- B◄
1. Exhaust manifold cover
 2. Engine hanger
 3. Exhaust manifold bracket
 4. Exhaust manifold
 5. Exhaust manifold gasket

**INSTALLATION SERVICE POINTS****►A◄ EXHAUST MANIFOLD BRACKET INSTALLATION**

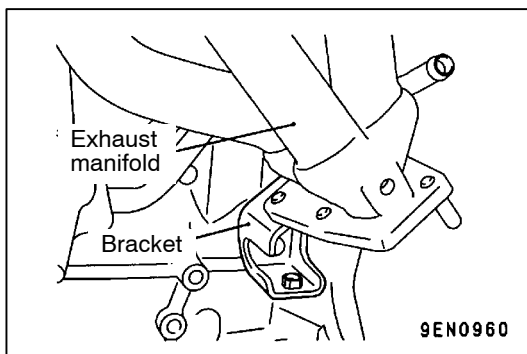
- (1) Slide the washers over the bolts with the chamfered side toward the bolt.



- (2) Install temporarily the exhaust manifold brackets A and B as shown in the illustration.
- (3) Check that both brackets are in close contact with the bosses, and then tighten fully the bracket mounting bolts.

**►B◄ EXHAUST MANIFOLD BRACKET INSTALLATION**

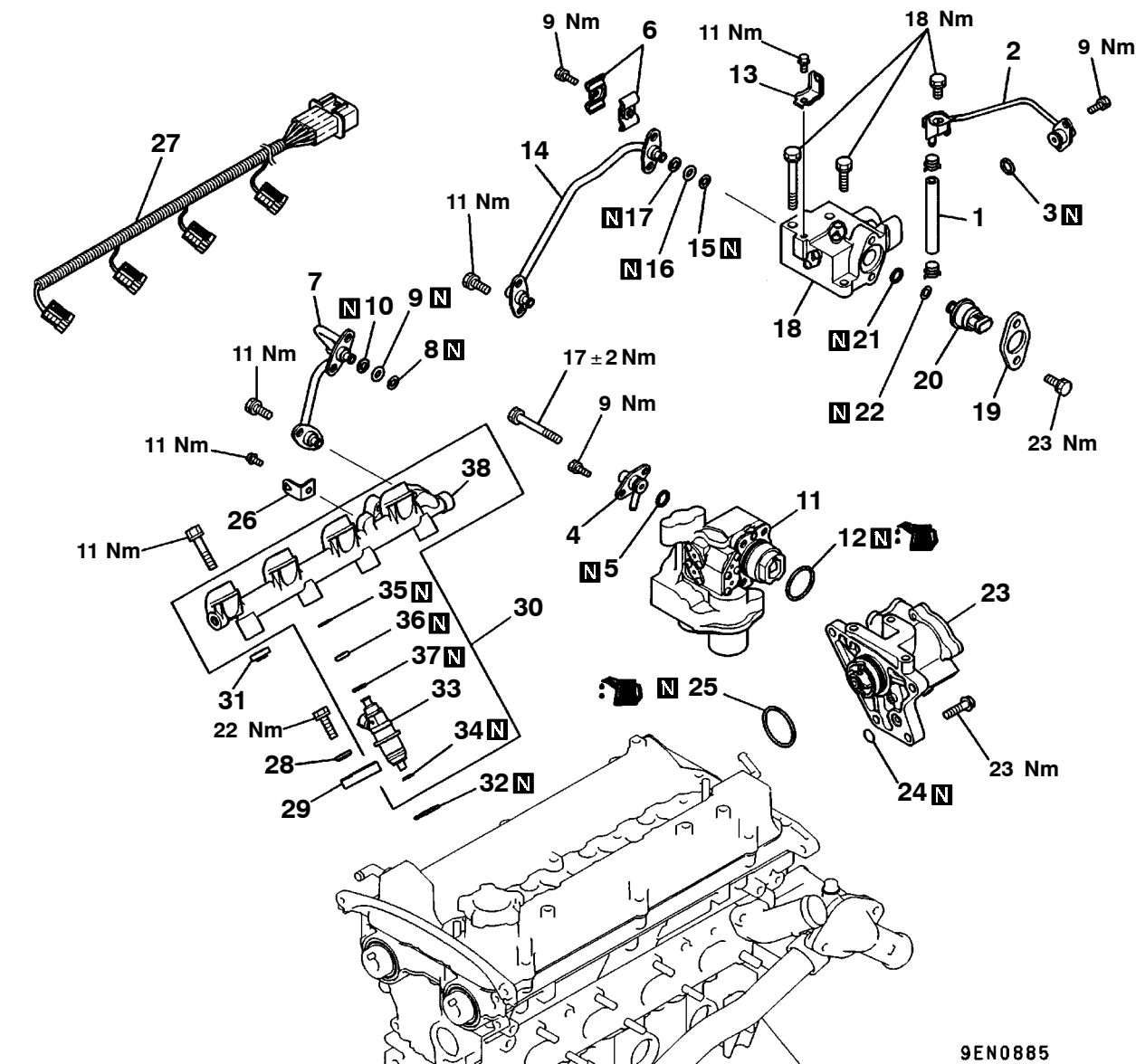
- (1) The washers must be installed with the shear-drooped side toward the bolts.



- (2) Temporarily install the exhaust manifold bracket as shown in the illustration.
- (3) Verify that the bracket is brought into close contact with the boss on the exhaust manifold, then tighten the bolts to the specified torque.

6c. INJECTOR AND FUEL PUMP ASSEMBLY (GDI)

REMOVAL AND INSTALLATION <Up to 2000 model for CARISMA, 1999 model for SPACE STAR, SPACE RUNNER>



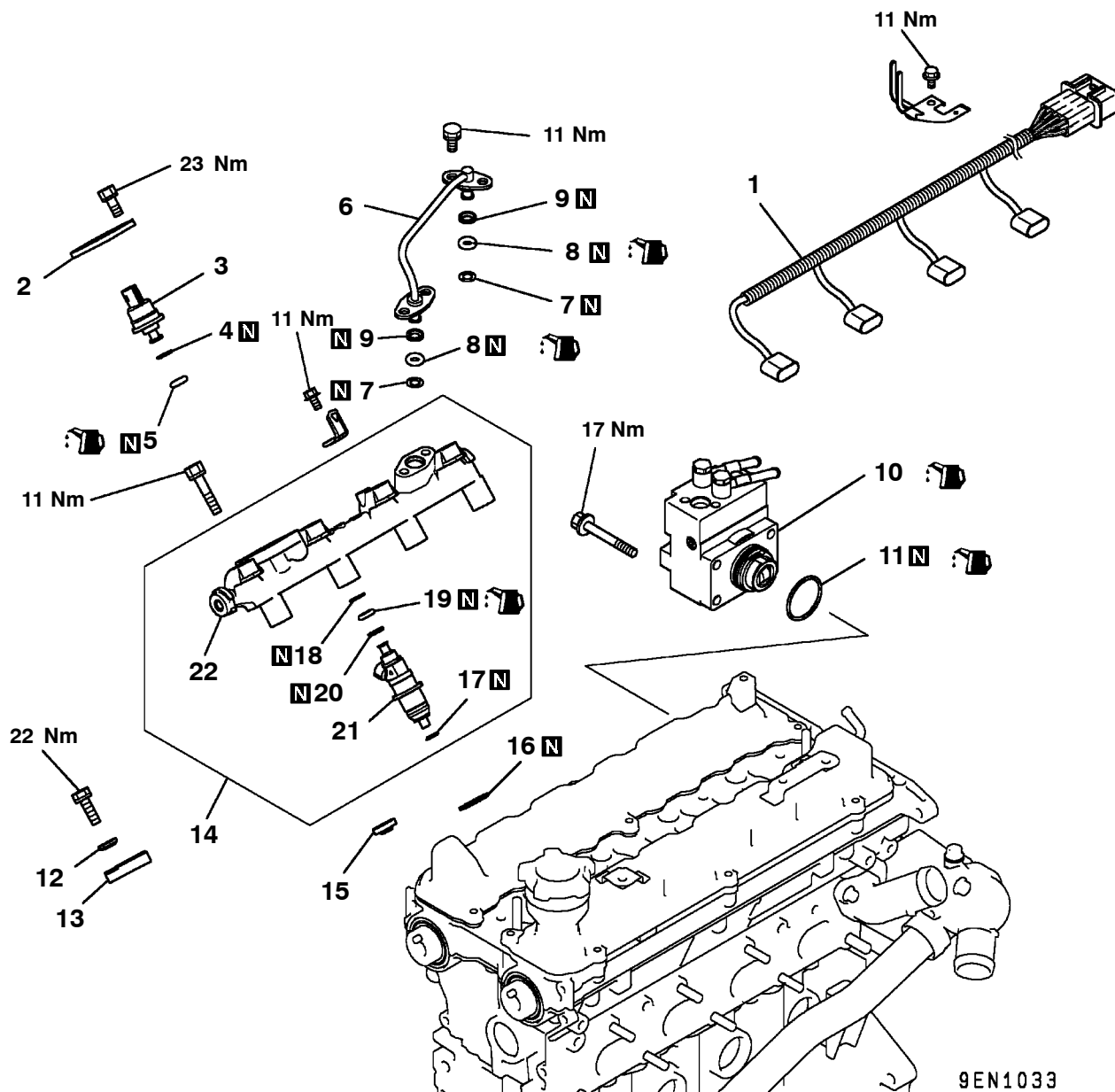
9EN0885

Removal steps

- | | | | |
|-----|----------------------------------|-----|--------------------------------|
| | 1. Fuel hose | ►D◄ | 20. Fuel pressure sensor |
| | 2. Fuel low pressure pipe | | 21. O-ring |
| | 3. O-ring | | 22. Backup ring |
| | 4. Fuel nipple | ►C◄ | 23. Pump camshaft case |
| | 5. O-ring | | 24. O-ring |
| | 6. Clamp | | 25. O-ring |
| ►F◄ | 7. Fuel feed pipe | | 26. Harness bracket |
| | 8. Backup ring | | 27. Injector harness |
| | 9. O-ring | | 28. Washer |
| ►F◄ | 10. Backup ring | | 29. Injector holder |
| | 11. Fuel pump | ►B◄ | 30. Delivery pipe and injector |
| | 12. O-ring | | 31. Insulator |
| | 13. Harness bracket | | 32. Injector gasket |
| | 14. Fuel return pipe | | 33. Injector |
| | 15. Backup ring | ►A◄ | 34. Corrugated washer |
| | 16. O-ring | ►A◄ | 35. Backup ring |
| | 17. Backup ring | ►A◄ | 36. O-ring |
| ►E◄ | 18. Fuel high pressure regulator | ►A◄ | 37. Backup ring |
| | 19. Flange | | 38. Delivery pipe |

REMOVAL AND INSTALLATION

<From 2001 model for CARISMA, From 2001 model for SPACE STAR, GALANT>



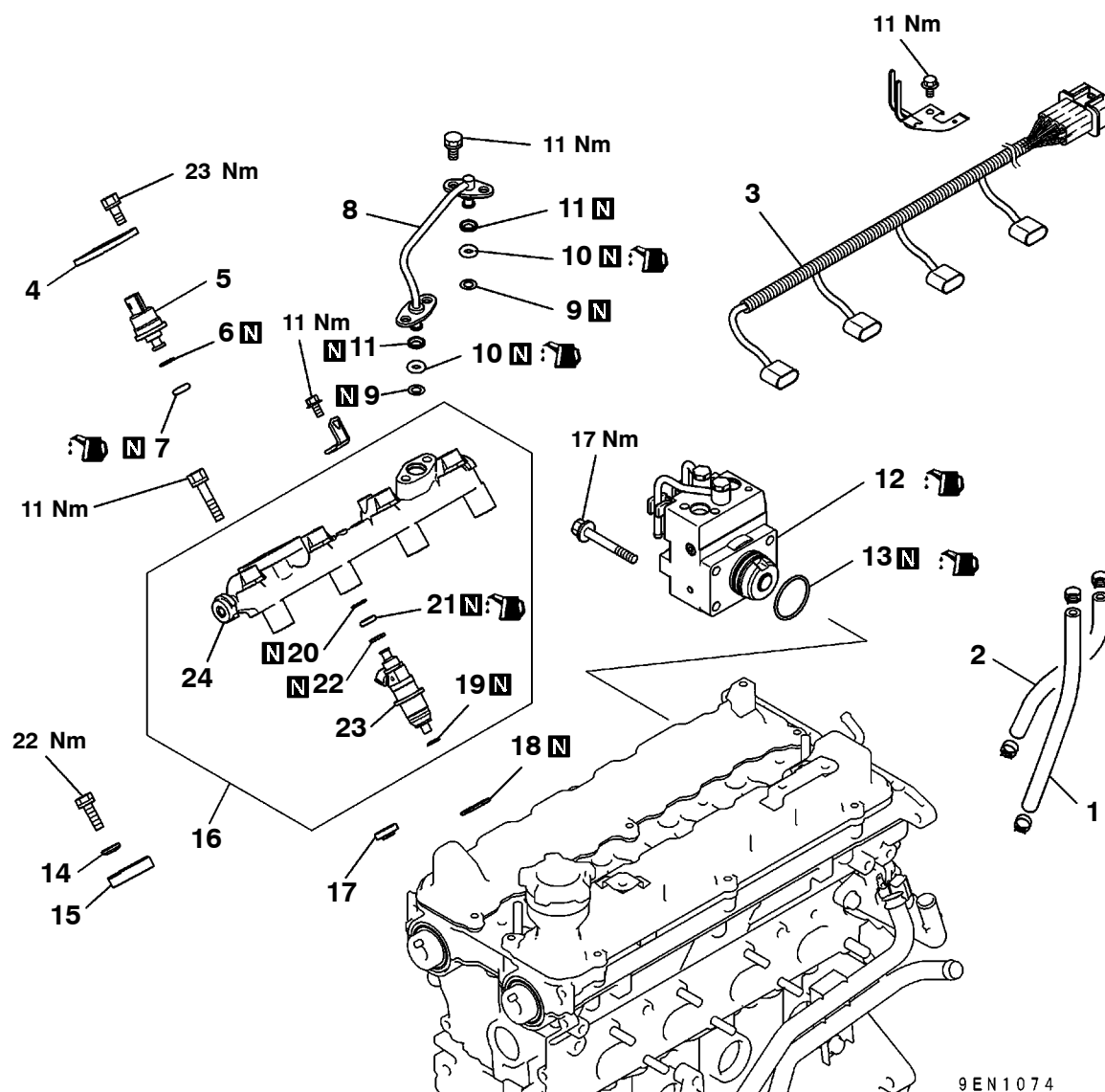
9EN1033

Removal steps

- 1. Injector harness
- 2. Flange
- 3. Fuel pressure sensor
- 4. Backup ring
- 5. O-ring
- 6. Fuel pipe
- 7. Backup ring
- 8. O-ring
- 9. Backup ring
- 10. Fuel pump
- 11. O-ring

- 12. Washer
- 13. Injector holder
- 14. Delivery pipe and injector
- 15. Insulator
- 16. Injector gasket
- 17. Corrugated washer
- 18. Backup ring
- 19. O-ring
- 20. Backup ring
- 21. Injector
- 22. Delivery pipe

REMOVAL AND INSTALLATION <For PAJERO io - 4G94>

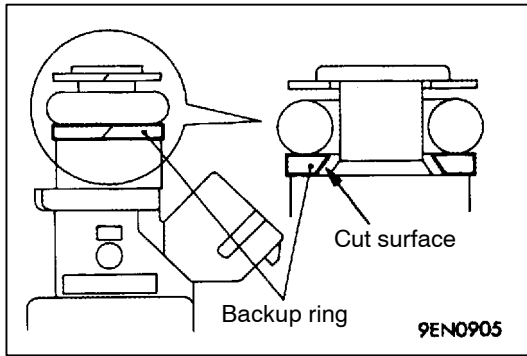


Removal steps

- | | |
|-------------------------|------------------------------------|
| 1. Fuel hose | ►J◄ 13. O-ring |
| 2. Fuel hose | 14. Washer |
| 3. Injector harness | 15. Injector holder |
| 4. Flange | ►B◄ 16. Delivery pipe and injector |
| 5. Fuel pressure sensor | 17. Insulator |
| 6. Backup ring | 18. Injector gasket |
| 7. O-ring | ►A◄ 19. Corrugated washer |
| 8. Fuel pipe | ►A◄ 20. Backup ring |
| 9. Backup ring | ►A◄ 21. O-ring |
| 10. O-ring | ►A◄ 22. Backup ring |
| 11. Backup ring | 23. Injector |
| 12. Fuel pump | 24. Delivery pipe |



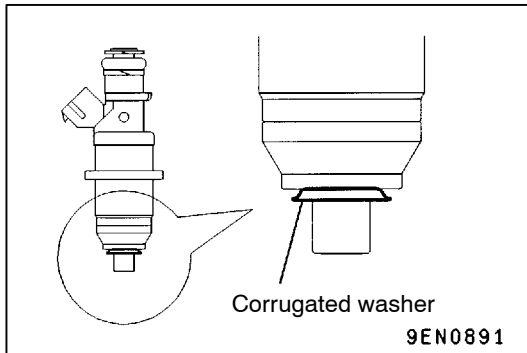
	1. Injector harness		▶E▶	20. Fuel high pressure regulator
	2. Fuel hose		▶D▶	21. Fuel pressure sensor
	3. Fuel hose			22. Backup ring
	4. Fuel hose			23. O-ring
	5. Fuel pipe			24. Spacer
	6. Fuel nipple			25. Washer
	7. O-ring			26. Injector holder
	8. Fuel nipple		▶B▶	27. Delivery pipe and injector
	9. O-ring			28. Insulator
▶F▶	10. Fuel feed pipe			29. Injector gasket
	11. Backup ring		▶A▶	30. Corrugated washer
	12. O-ring		▶A▶	31. Backup ring
	13. Backup ring		▶A▶	32. O-ring
▶F▶	14. Fuel pump		▶A▶	33. Backup ring
	15. O-ring			34. Injector
	16. Fuel return pipe			35. Delivery pipe
	17. Backup ring			
	18. O-ring			
	19. Backup ring			



INSTALLATION SERVICE POINTS

►A◄ BACKUP RING / O-RING / CORRUGATED WASHER INSTALLATION

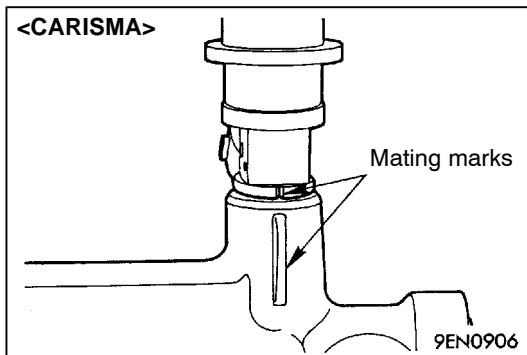
- (1) Attach the backup rings and O-ring to the injector. The thicker backup ring must be so installed that the inside cut surface is directed as shown in the illustration.



- (2) Coat the corrugated washer with white vaseline and install it to the injector as shown.

Caution

Always replace the corrugated washer with new one. Reused corrugated washer can cause fuel or gas leaks.

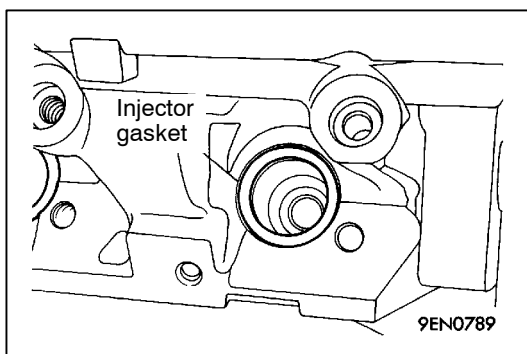
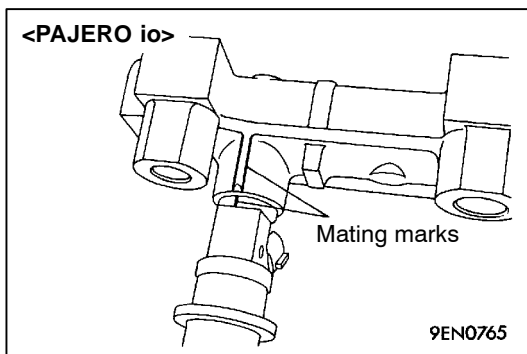


►B◄ DELIVERY PIPE AND INJECTOR ASSEMBLY INSTALLATION

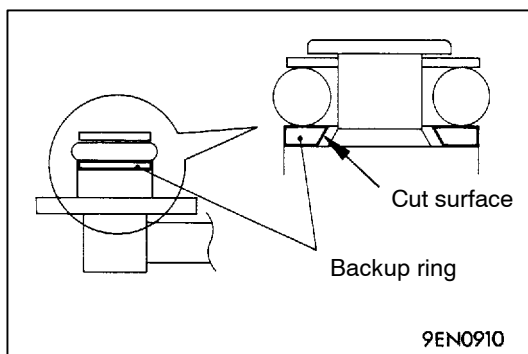
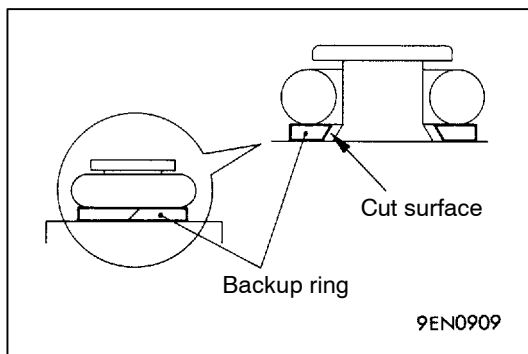
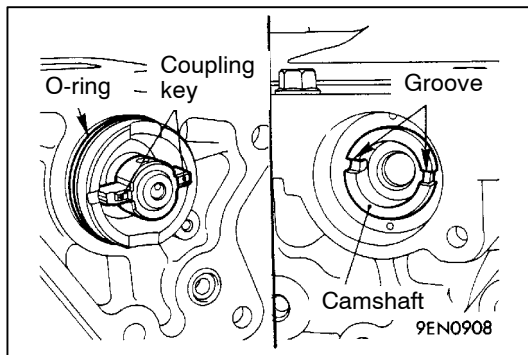
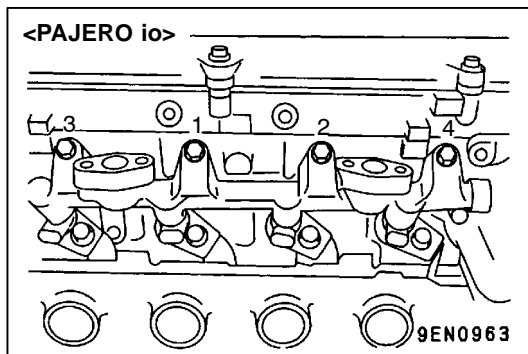
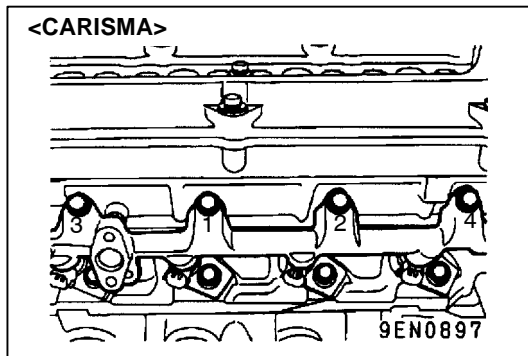
- (1) Lubricate O-ring in the injector with spindle oil or gasoline.
- (2) Insert the injector straight into the injector mounting hole in the delivery pipe.
- (3) Turn the injector clockwise and counterclockwise. If it does not rotate smoothly, remove it to check for damaged O-ring. Damaged O-ring must be replaced with a new one. Reinstall the injector and check for smooth rotation again.
- (4) Align the mating mark on the injector with that on the delivery pipe.
- (5) Install the injector gaskets and insulators on the cylinder head. The insulator can drop off easily. Apply vaseline to it before installation so that it may be held in position.
- (6) Install the delivery pipe and injector assembly onto the cylinder head, then tighten the fasteners temporarily.
- (7) Install the injector holders and the washers to the assembly and tighten the fasteners to the specified torque.

Caution

Strictly observe the specified torque.



11A-6c-4 4G9 ENGINE (E-W) - Injector and Fuel Pump Assembly (GDI)



- (8) Tighten the fasteners of the delivery pipe and injector assembly to the specified torque in the order given in the illustration.

►C◄ PUMP CAMSHAFT CASE INSTALLATION

- (1) Apply small amount of engine oil to the O-ring (larger one) on the case.
- (2) Install the pump camshaft case onto the cylinder head while aligning the coupling keys of the case with the grooves in the rear end face of the camshaft.

NOTE

The coupling keys and the grooves at the camshaft rear end are offset with respect to the camshaft center.

- (3) Tighten the case mounting bolts to the specified torque.

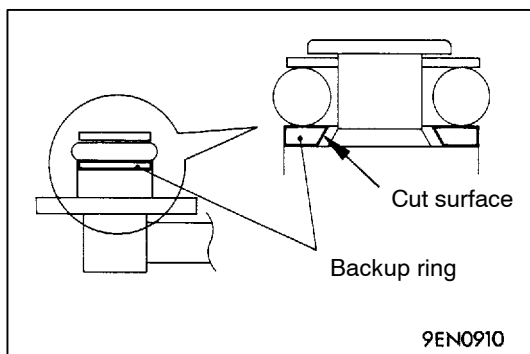
►D◄ FUEL PRESSURE SENSOR INSTALLATION

- (1) Install the backup ring to the fuel pressure sensor with its inside cut surface in the illustrated direction.
- (2) Install the fuel pressure sensor straight into the fuel pressure regulator with labeled surface upward.
- (3) Tighten the fuel pressure sensor mounting bolt to the specified torque.

►E◄ FUEL HIGH PRESSURE REGULATOR INSTALLATION

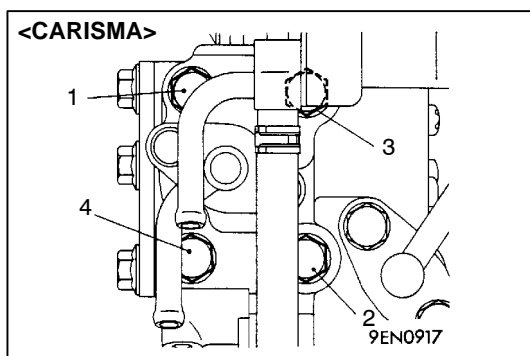
- (1) Install the fuel high pressure regulator on the pump camshaft case <for CARISMA> or onto the spacer <for PAJERO io> and tighten the 3 bolts lightly (with somewhat larger torque than fingertight). Tightening to the specification is to be carried out in the step described in ►F◄.

- (2) Fit the backup rings and the O-ring on both ends of the fuel return pipe. Note that the larger backup ring must be installed with the inside cut surface in the direction shown in the illustration.
- (3) Lubricate the O-rings on both ends of the pipe with spindle oil or gasoline.
- (4) Insert the fuel return pipe ends straight in the respective mounting holes of the pressure regulator and the delivery pipe. Be sure to insert the pipe fully to the stop using care not to twist it.
- (5) Tighten the bolts at both ends of the pipe to the specified torque.



►F◄ FUEL PUMP / FUEL FEED PIPE INSTALLATION

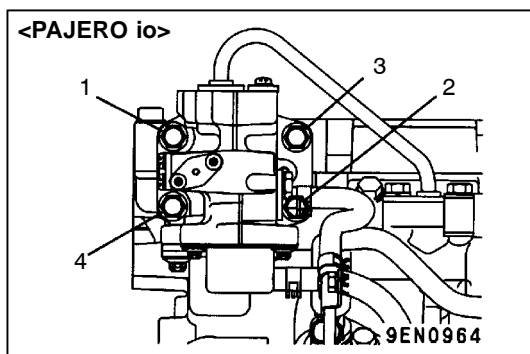
- (1) Insert the fuel pump into the mounting hole in the pump camshaft case <for CARISMA> or in the cylinder head <for PAJERO io>, and secure it temporarily with 4 bolts (tighten somewhat with a larger torque than fingertight).
- (2) Fit the backup rings and the O-ring on both ends of the feed pipe. Note that the larger backup ring must be installed with the inside cut surface in the direction shown in the illustration.
- (3) Lubricate the O-rings on both ends of the pipe with spindle oil or gasoline.
- (4) Insert the fuel feed pipe ends straight in the respective mounting holes of the fuel and the delivery pipe. Be sure to insert the pipe fully to the stop using care not to twist it.
- (5) Tighten the bolts at ends of the pipe to the specified torque.
- (6) Tighten the mounting bolts of the fuel pressure regulator to the specified torque.

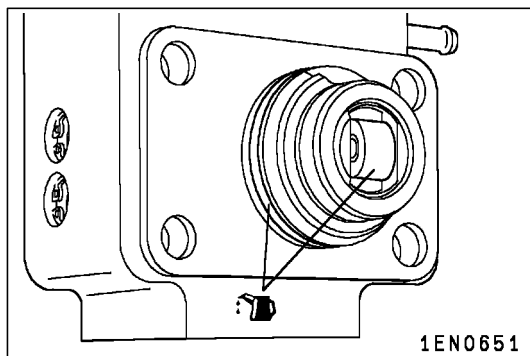


- (7) Using a torque wrench having the minimum scale of 0.5 Nm, tighten the fuel pump mounting bolts in the following order.
 - 1) Tighten the bolts to 5 Nm in the order given in the illustration.
 - 2) Tighten the bolts to 17 Nm in the order given in the illustration. The torque variation among 4 bolts must be within 2 Nm.

Caution

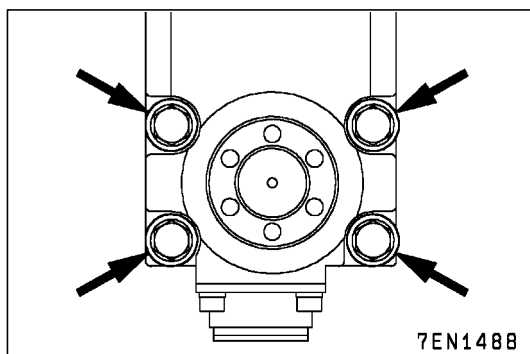
Strictly observe the specified tightening torque. Deviation from the specification can cause problems such as leakage or the like.



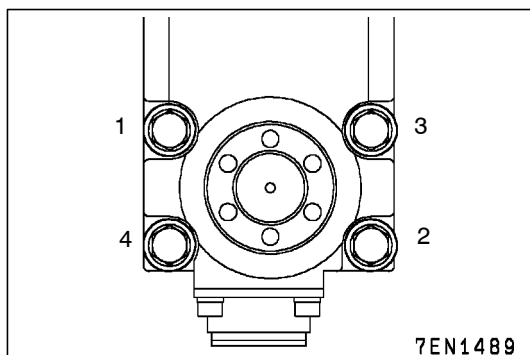


►G◄ O-RING / FUEL PUMP INSTALLATION

(1) Apply engine oil to the roller of the fuel pump and O-ring.



(2) Insert the fuel pump into the mounting hole in the cylinder head and lightly tighten the four bolts.

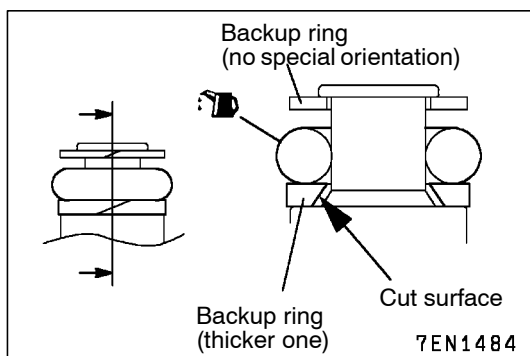


(3) Using a torque wrench (minimum graduations of 0.5 Nm), follow these steps to tighten the fuel pump mounting bolts.

- 1) Tighten the bolts to 4.9 Nm in the order shown.
- 2) Tighten the bolts to 17 ± 2 Nm in the order shown. Variations in torque among the four bolts should be within 2 Nm.

Caution

Strictly observe the tightening order. A leak and other problem could result if the torque specifications and torquing order are not met.



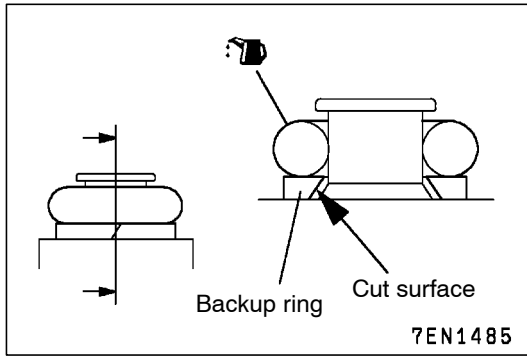
►H◄ O-RING / BACKUP RING / FUEL PIPE INSTALLATION

(1) Fit the backup rings and O-ring to both ends of the fuel pipe. Mount the backup ring (thicker one) so that its inner cut surface faces in the direction shown.

(2) Coat the O-rings on both ends of the pipe with spindle oil or gasoline.

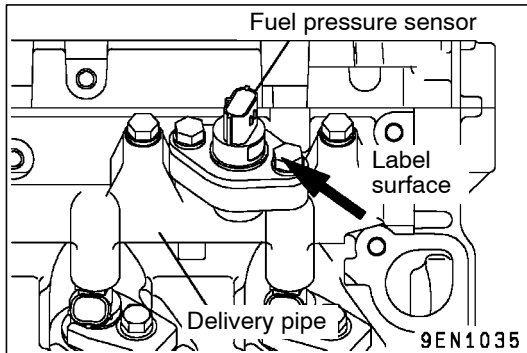
(3) Insert the fuel pipe straight into the mounting hole in the delivery pipe. Insert it all the way into the hole, ensuring that it does not twist.

(4) Tighten the bolts on both ends of the fuel pipe to the specified torque.

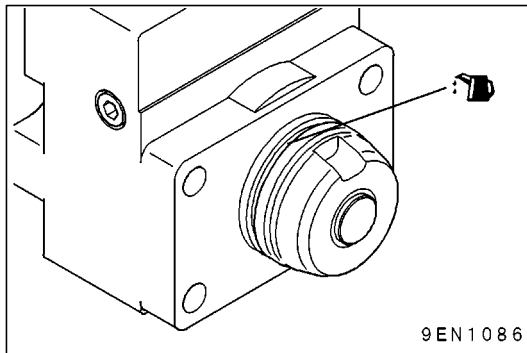


►I◄ O-RING / BACKUP RING / FUEL PRESSURE SENSOR INSTALLATION

- (1) Fit the backup ring to the fuel pressure sensor so that its inner cut surface faces in the direction shown.

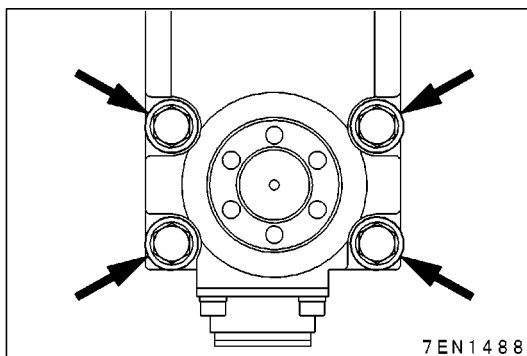


- (2) Being attentive to the shape of the connector and label surface of the fuel pressure sensor, install the fuel pressure sensor in the direction shown.

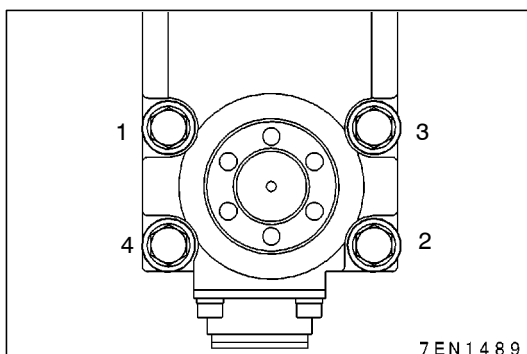


►J◄ O-RING / FUEL PUMP INSTALLATION

- (1) Apply engine oil to the O-ring.



- (2) Insert the fuel pump into the mounting hole in the cylinder head and lightly tighten the four bolts.



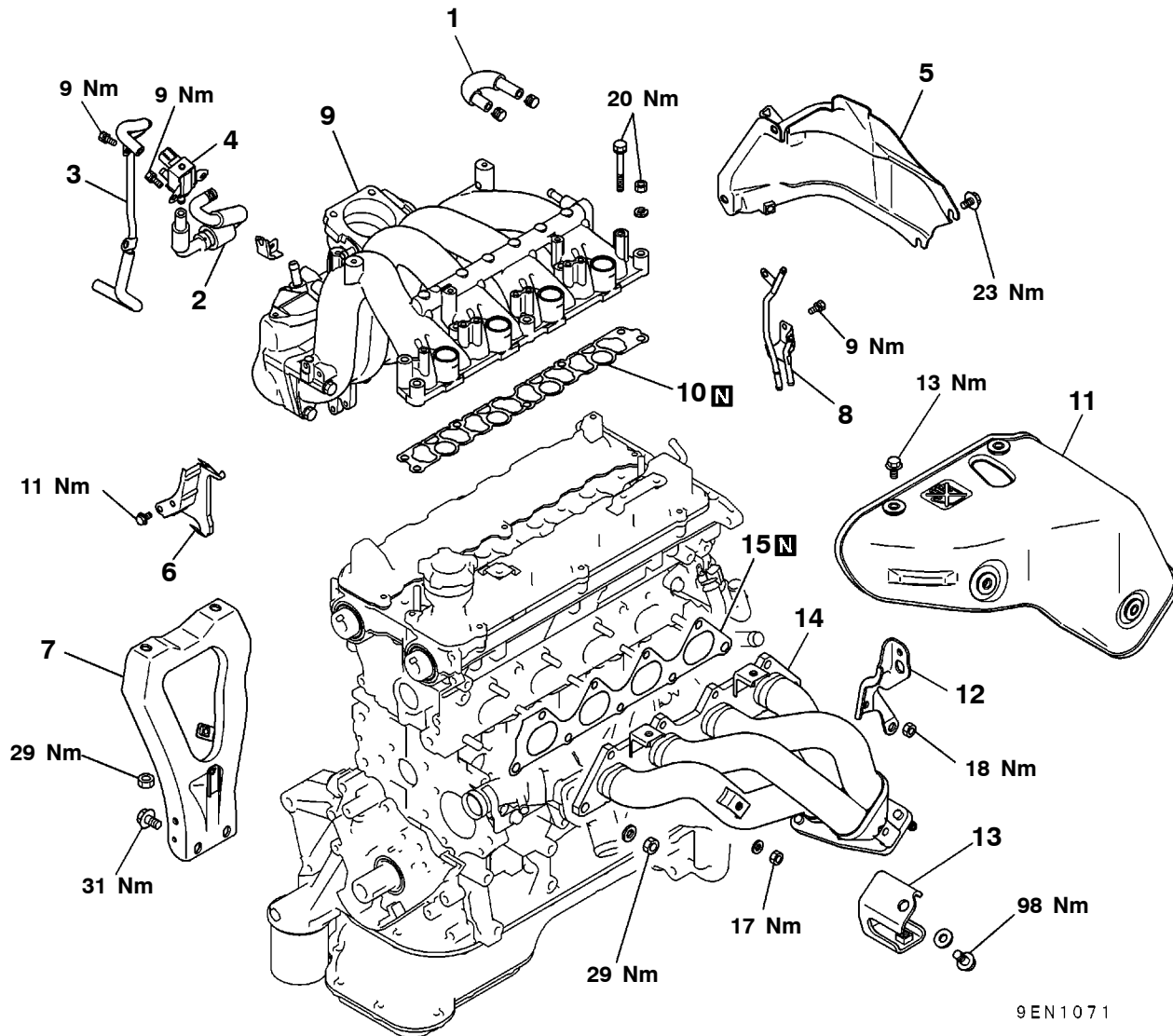
- (3) Using a torque wrench (minimum graduations of 0.5 Nm), follow these steps to tighten the fuel pump mounting bolts.
 - 1) Tighten the bolts to 4.9 Nm in the order shown.
 - 2) Tighten the bolts to 17 ± 2 Nm in the order shown. Variations in torque among the four bolts should be within 2 Nm.

Caution

Strictly observe the tightening order. A leak and other problem could result if the torque specifications and torquing order are not met.

6d. INTAKE AND EXHAUST MANIFOLD <4G94-GDI for PAJERO io>

REMOVAL AND INSTALLATION

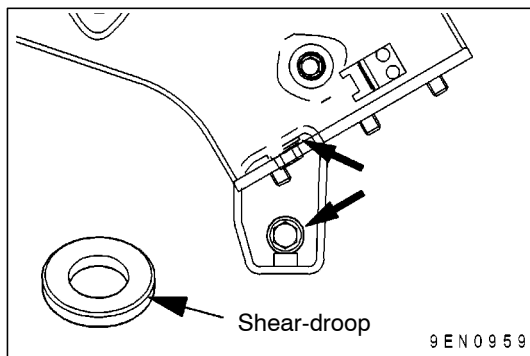


Removal steps

1. P.C.V. hose
2. Purge hose
3. Vacuum pipe and hose
4. Solenoid valve
5. Fuel pump protector
6. Connector bracket
7. Intake manifold stay
8. Low pressure fuel pipe



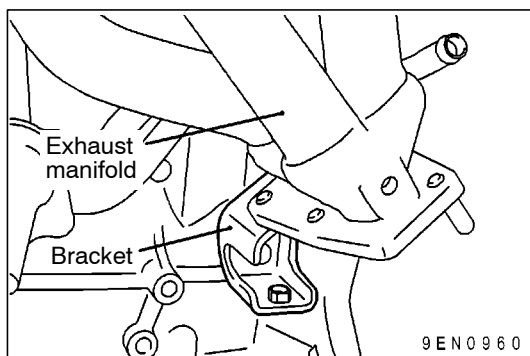
9. Intake manifold
10. Intake manifold gasket
11. Exhaust manifold cover
12. Engine hanger
13. Exhaust manifold bracket
14. Exhaust manifold
15. Exhaust manifold gasket



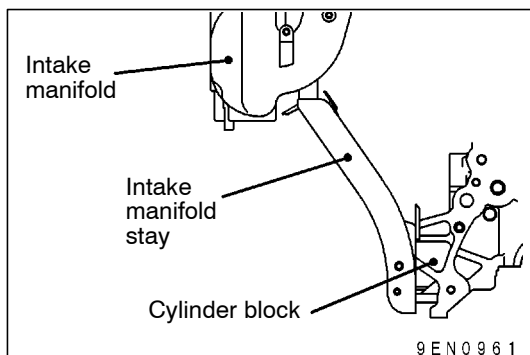
INSTALLATION SERVICE POINTS

►A◄ EXHAUST MANIFOLD BRACKET INSTALLATION

- (1) The washers must be installed with the shear-drooped side toward the bolts.



- (2) Temporarily install the exhaust manifold bracket as shown in the illustration.
- (3) Verify that the bracket is brought into close contact with the boss on the exhaust manifold, then tighten the bolts to the specified torque.



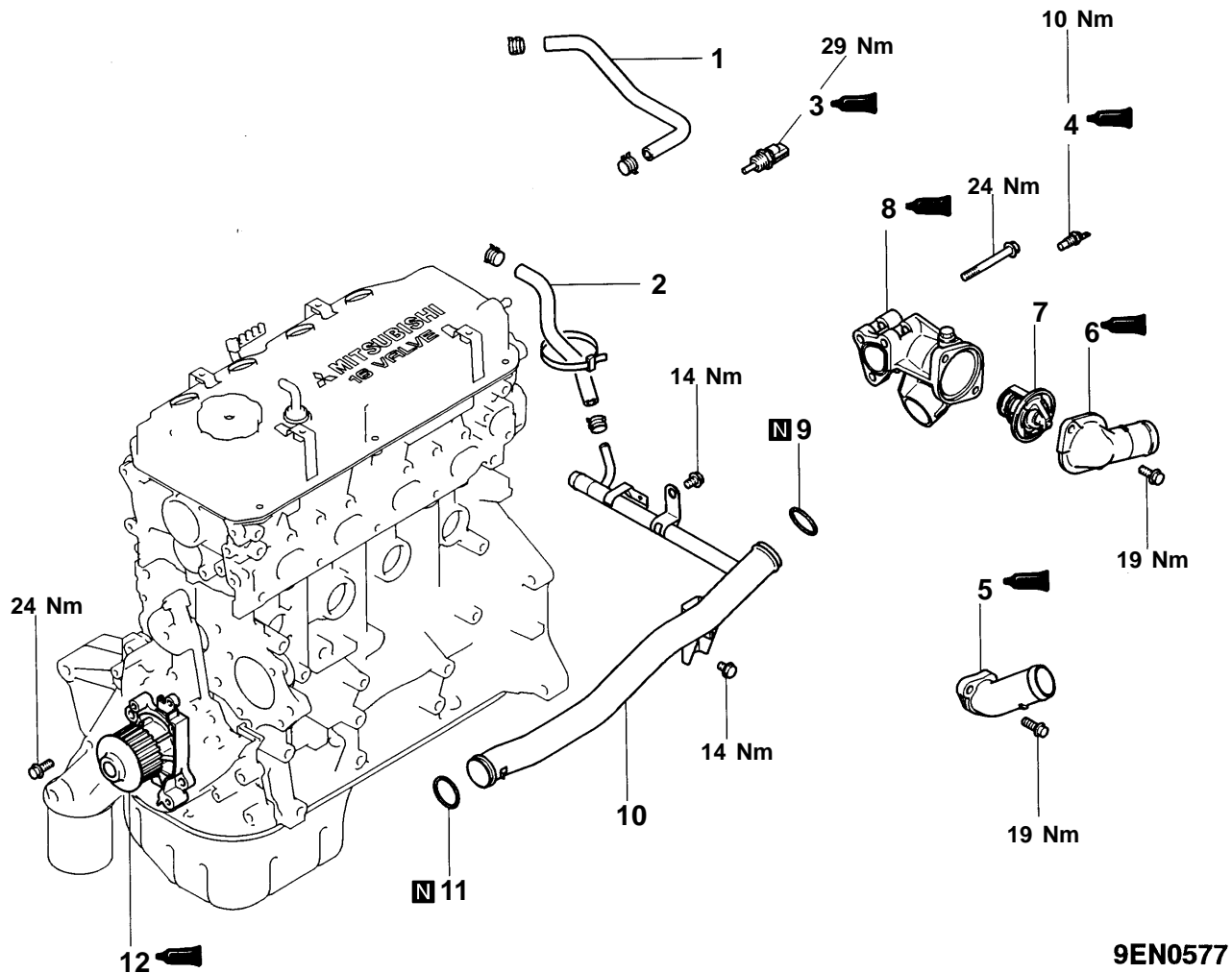
►B◄ INTAKE MANIFOLD STAY INSTALLATION

- (1) Check to ensure that the intake manifold stay is in close contact with the intake manifold and the cylinder block before tightening the respective mounting bolts to the specified torque.

11301790016

7. WATER PUMP AND WATER HOSE

REMOVAL AND INSTALLATION <SOHC – FRONT WHEEL DRIVE>



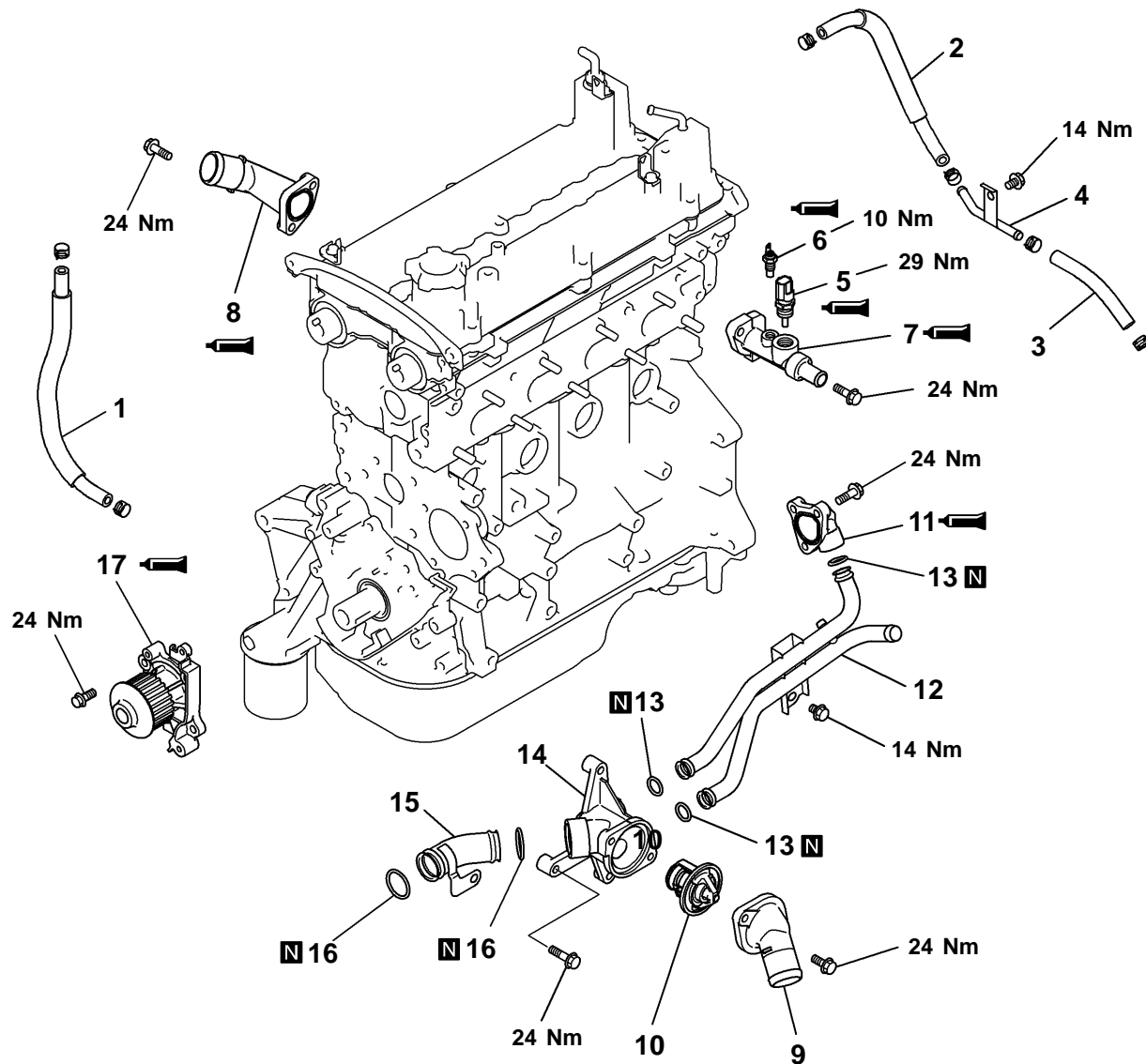
9EN0577

Removal steps

1. Water hose
(Except carburetor engines)
2. Water hose
- ▶G▶ 3. Engine coolant temperature sensor
- ▶F▶ 4. Engine coolant temperature gauge unit
- ▶E▶ 5. Water outlet fitting

- ▶D▶ 6. Water inlet fitting
- ▶C▶ 7. Thermostat
- ▶B▶ 8. Thermostat case
- ▶B▶ 9. O-ring
- ▶B▶ 10. Water inlet pipe
- ▶B▶ 11. O-ring
- ▶A▶ 12. Water pump

REMOVAL AND INSTALLATION <SOHC – REAR WHEEL DRIVE>



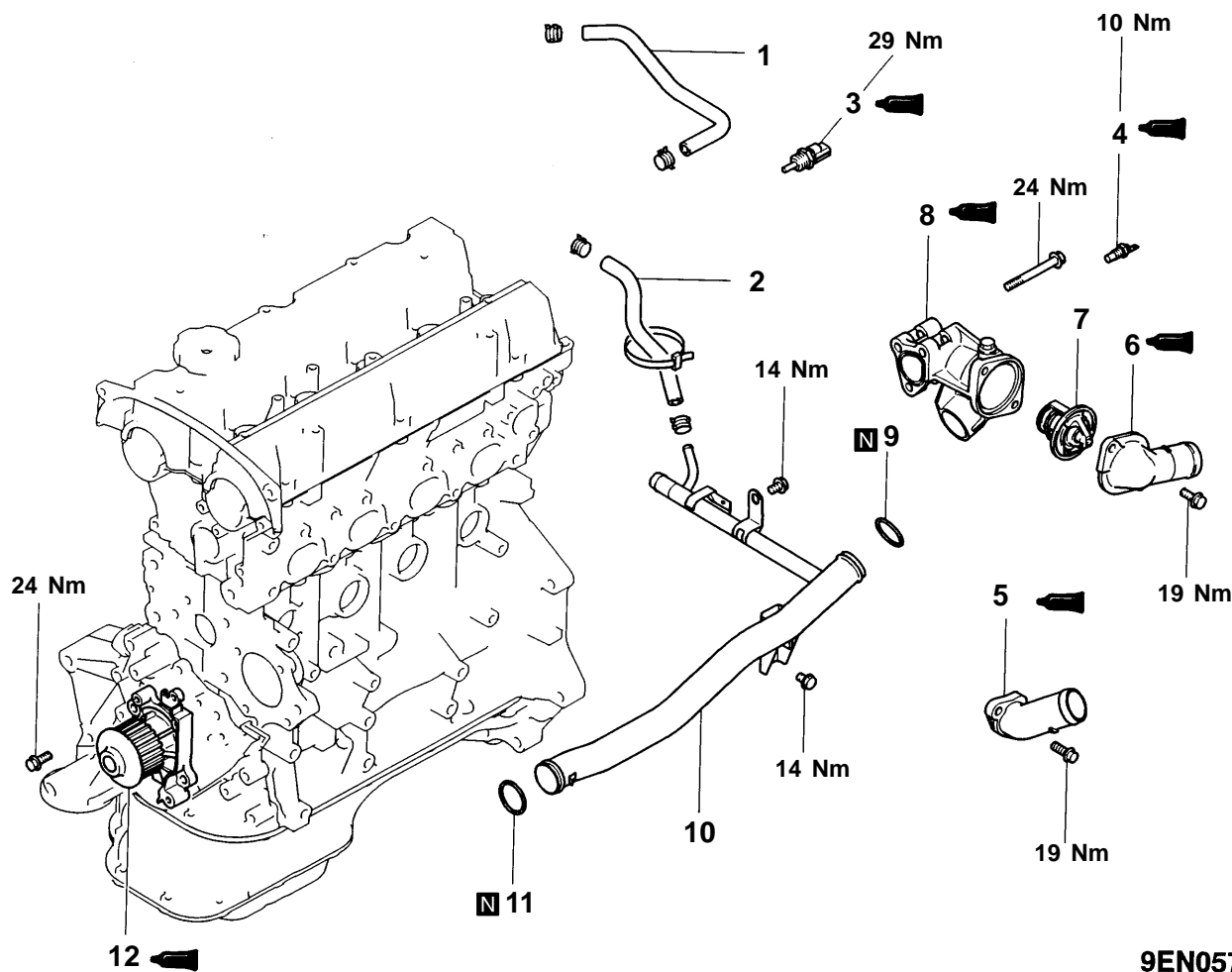
9EN1150

Removal steps

1. Water hose
2. Water hose
3. Water hose
4. Water pipe
- G** 5. Engine coolant temperature sensor
- F** 6. Engine coolant temperature gauge unit
- I** 7. Water fitting
- E** 8. Water outlet fitting

9. Water inlet fitting
- D** 10. Thermostat
- H** 11. Water by-pass fitting
- B** 12. Water pipe
- B** 13. O-ring
- C** 14. Thermostat case
- B** 15. Water pipe
- B** 16. O-ring
- A** 17. Water pump

REMOVAL AND INSTALLATION <DOHC – FRONT WHEEL DRIVE>



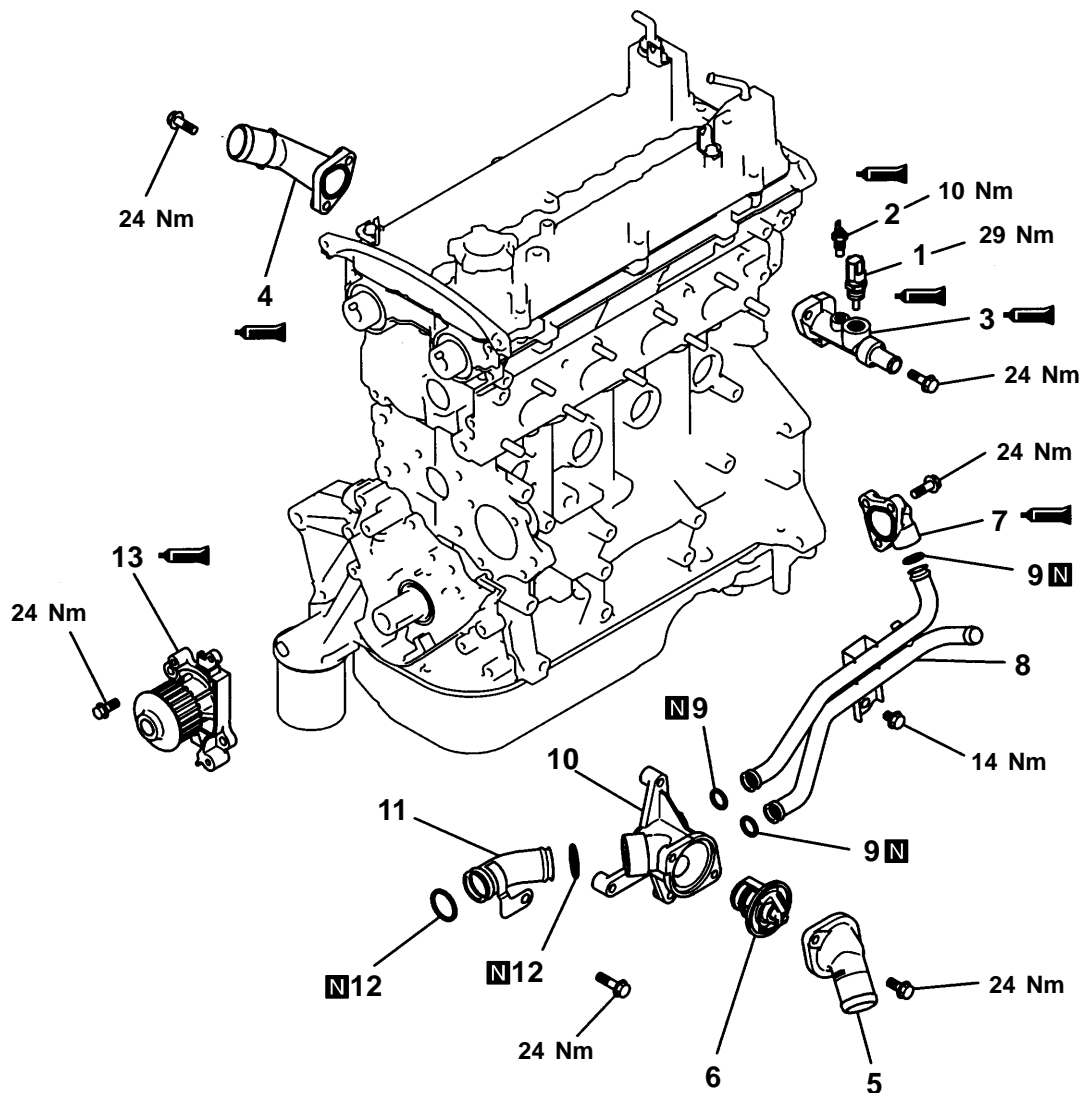
9EN0578

Removal steps

- 1. Water hose A (Except GDI engine)
- 2. Water hose B (Except GDI engine)
- ▶G▶F▶ 3. Engine coolant temperature sensor
- ▶E▶ 4. Engine coolant temperature gauge unit
- ▶E▶ 5. Water outlet fitting
- 6. Water inlet fitting

- ▶D▶ 7. Thermostat
- ▶C▶ 8. Thermostat case
- ▶B▶ 9. O-ring
- ▶B▶ 10. Water inlet pipe
- ▶B▶ 11. O-ring
- ▶A▶ 12. Water pump

REMOVAL AND INSTALLATION <DOHC – REAR WHEEL DRIVE>

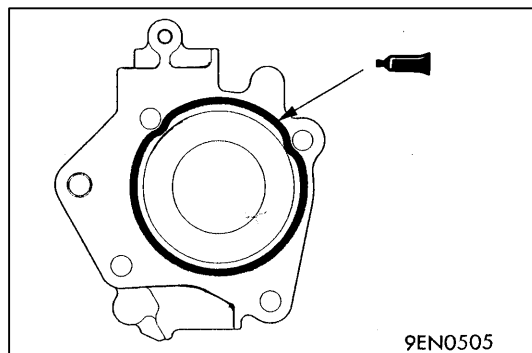


9EN0965

Removal steps

- ▶G◀ 1. Engine coolant temperature sensor
- ▶F◀ 2. Engine coolant temperature gauge unit
- ▶I◀ 3. Water fitting
- ▶E◀ 4. Water outlet fitting
- ▶D◀ 5. Water inlet fitting
- ▶D◀ 6. Thermostat

- ▶H◀ 7. Water by-pass fitting
- ▶B◀ 8. Water pipe
- ▶B◀ 9. O-ring
- ▶C◀ 10. Thermostat case
- ▶B◀ 11. Water pipe
- ▶B◀ 12. O-ring
- ▶A◀ 13. Water pump



INSTALLATION SERVICE POINTS

►A◄ WATER PUMP INSTALLATION

- (1) Apply 3 mm diameter of Form-In-Place Gasket (FIPG) to the location shown in the illustration.

Specified sealant:

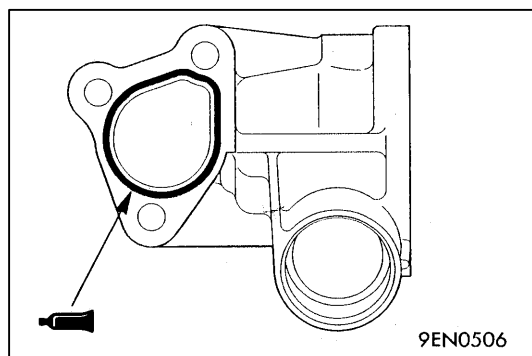
Mitsubishi Genuine Part No.MD970389 or equivalent

►B◄ WATER INLET PIPE <FRONT WHEEL DRIVE>/WATER PIPE <REAR WHEEL DRIVE>/O-RING INSTALLATION

- (1) Replace the O-ring of the water inlet pipe <FRONT WHEEL DRIVE> or water pipe <REAR WHEEL DRIVE>, and then apply water to the O-ring to make installation easy.

Caution

1. Never apply any oil or grease to the O-ring.
2. Secure the water pipe after the thermostat case has been installed.

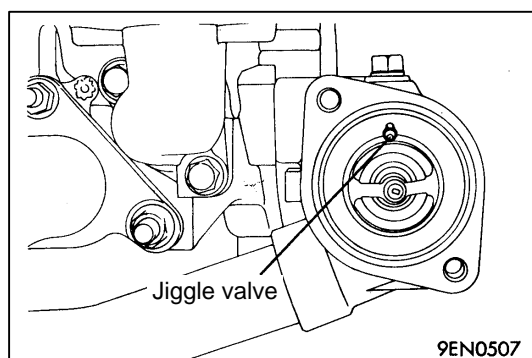


►C◄ THERMOSTAT CASE INSTALLATION

- (1) Apply 3 mm diameter of Form-In-Place Gasket (FIPG) to the location shown in the illustration.

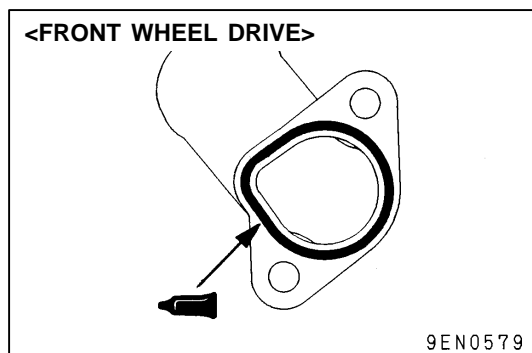
Specified sealant:

Mitsubishi Genuine Part No.MD970389 or equivalent



►D◄ THERMOSTAT INSTALLATION

- (1) Install the thermostat so that the jiggle valve is facing straight up.



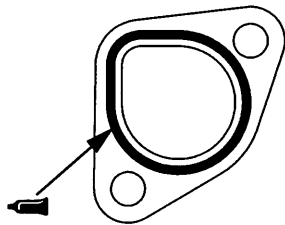
►E◄ WATER OUTLET FITTING INSTALLATION

- (1) Apply 3 mm diameter of Form-In-Place Gasket (FIPG) to the location shown in the illustration.

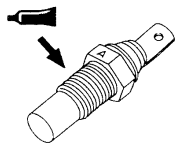
Specified sealant:

Mitsubishi Genuine Part No.MD970389 or equivalent

<REAR WHEEL DRIVE>



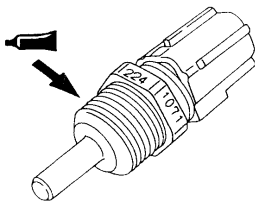
9EN0967



6AE0071

►F◄ ENGINE COOLANT TEMPERATURE GAUGE UNIT INSTALLATION

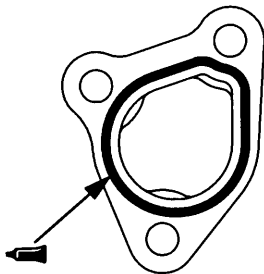
- (1) Apply the specified sealant to the threads.

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

6AE0070

►G◄ ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION

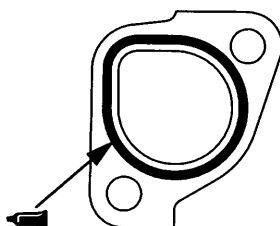
- (1) When reusing the sensor, apply the specified sealant to the threads.

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

9EN0966

►H◄ WATER BY-PASS FITTING INSTALLATION

- (1) Apply 3 mm diameter of Form-In-Place Gasket (FIPG) to the location shown in the illustration.

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

9EN0968

►I◄ WATER FITTING INSTALLATION

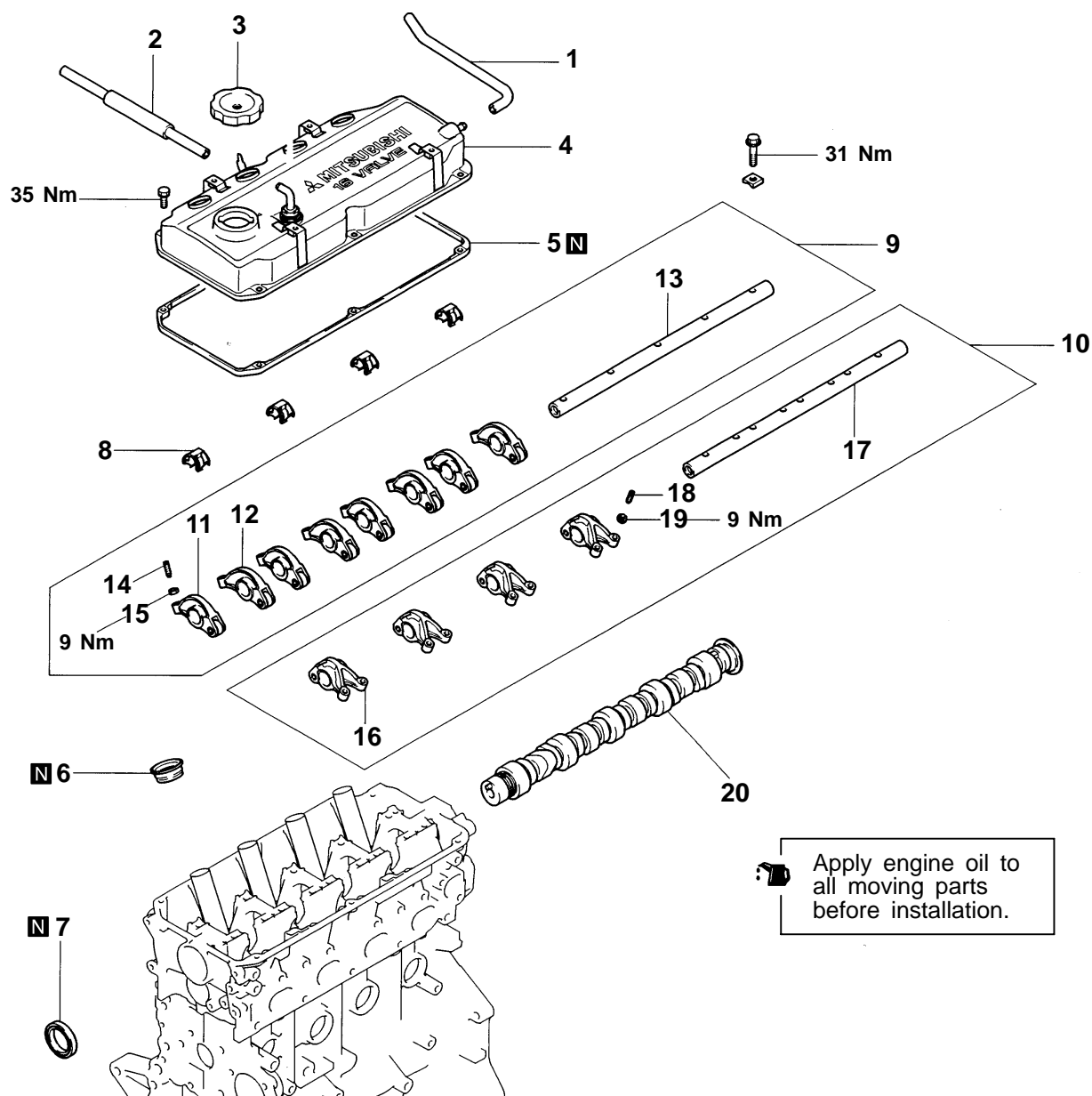
- (1) Apply 3 mm diameter of Form-In-Place Gasket (FIPG) to the location shown in the illustration.

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

11300540070

8. ROCKER ARMS AND CAMSHAFTS

REMOVAL AND INSTALLATION <SOHC (with Adjusting screw)>



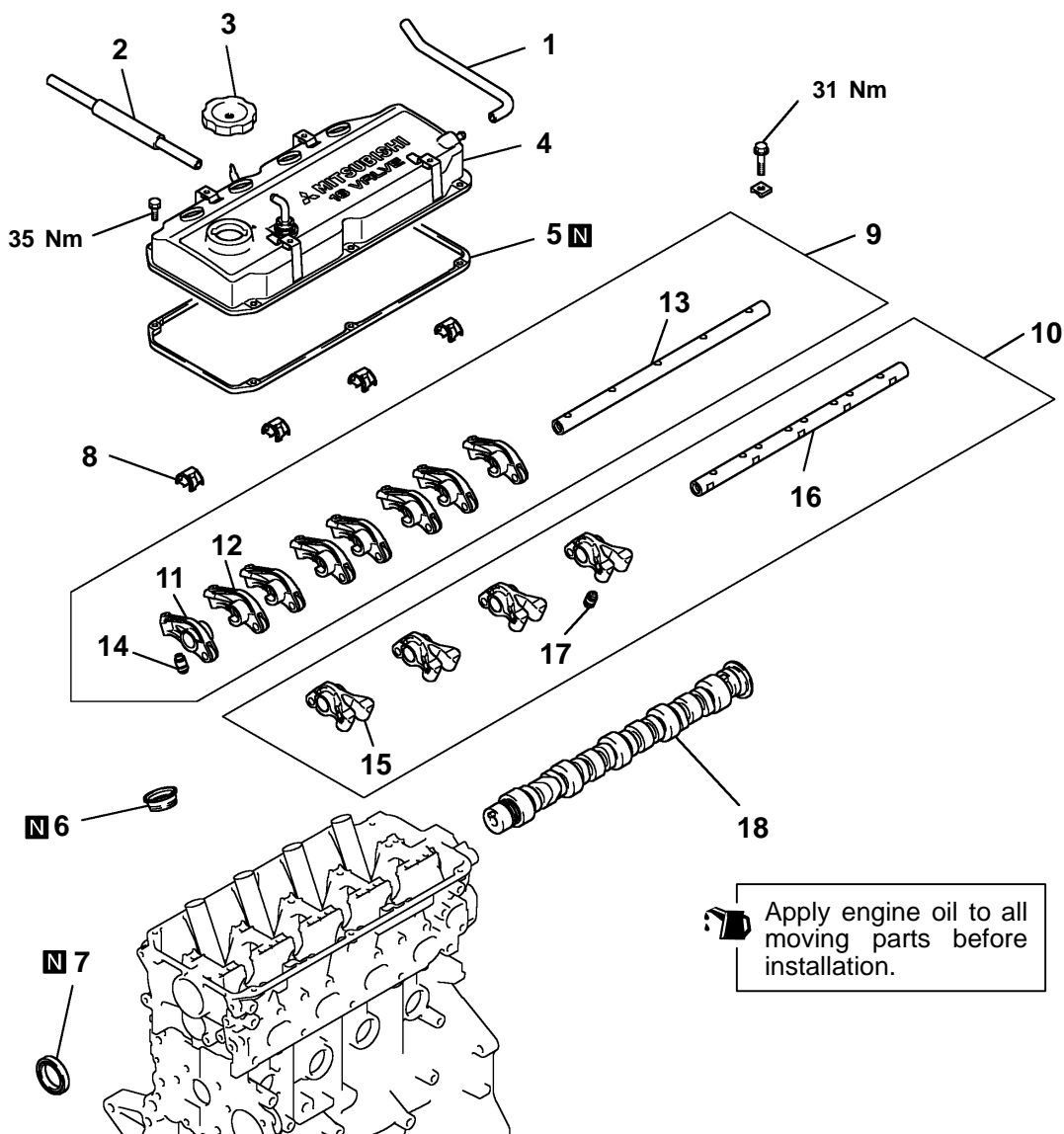
9EN0580

Removal steps

1. Breather hose
2. P.C.V. hose
3. Oil filler cap
4. Rocker cover
5. Rocker cover gasket
6. Oil seal
7. Oil seal
8. Rocker arm spring
9. Rocker arms and rocker arm shaft
IN
10. Rocker arms and rocker arm shaft
EX

11. Rocker arm B
12. Rocker arm A
13. Rocker arm shaft
14. Adjusting screw
15. Nut
16. Rocker arm C
17. Rocker arm shaft
18. Adjusting screw
19. Nut
20. Camshaft

REMOVAL AND INSTALLATION <SOHC (with Lash adjuster)>



9EN1064

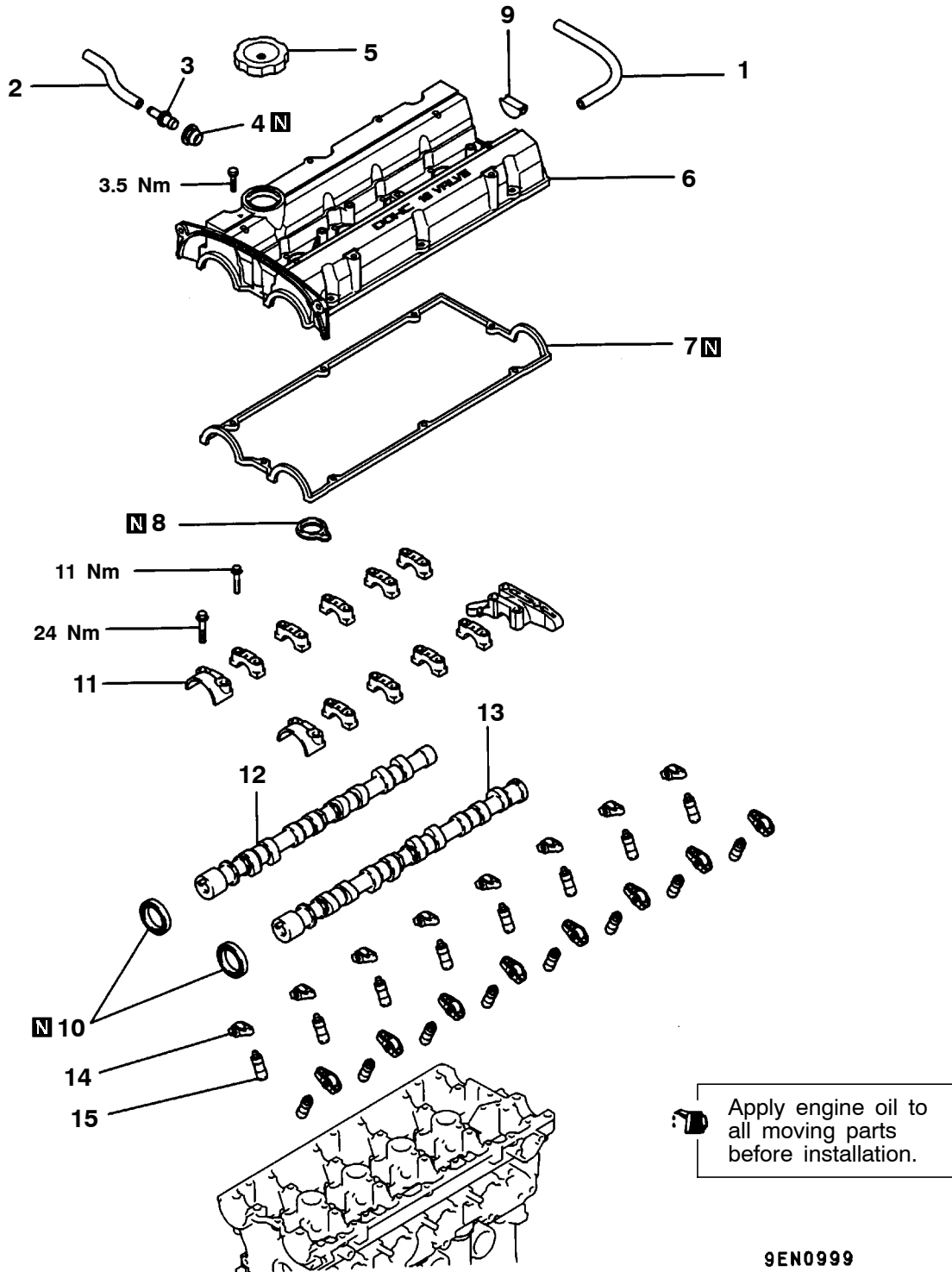
Removal steps

1. Breather hose
 2. P.C.V. hose
 3. Oil filler cap
 4. Rocker cover
 5. Rocker cover gasket
 6. Oil seal
 7. Oil seal
 8. Rocker arm spring
 9. Rocker arms and rocker arm shaft
 IN
 10. Rocker arms and rocker arm shaft
 EX

11. Rocker arm B
 12. Rocker arm A
 13. Rocker arm shaft
 14. Lash adjuster
 15. Rocker arm C
 16. Rocker arm shaft
 17. Lash adjuster
 18. Camshaft

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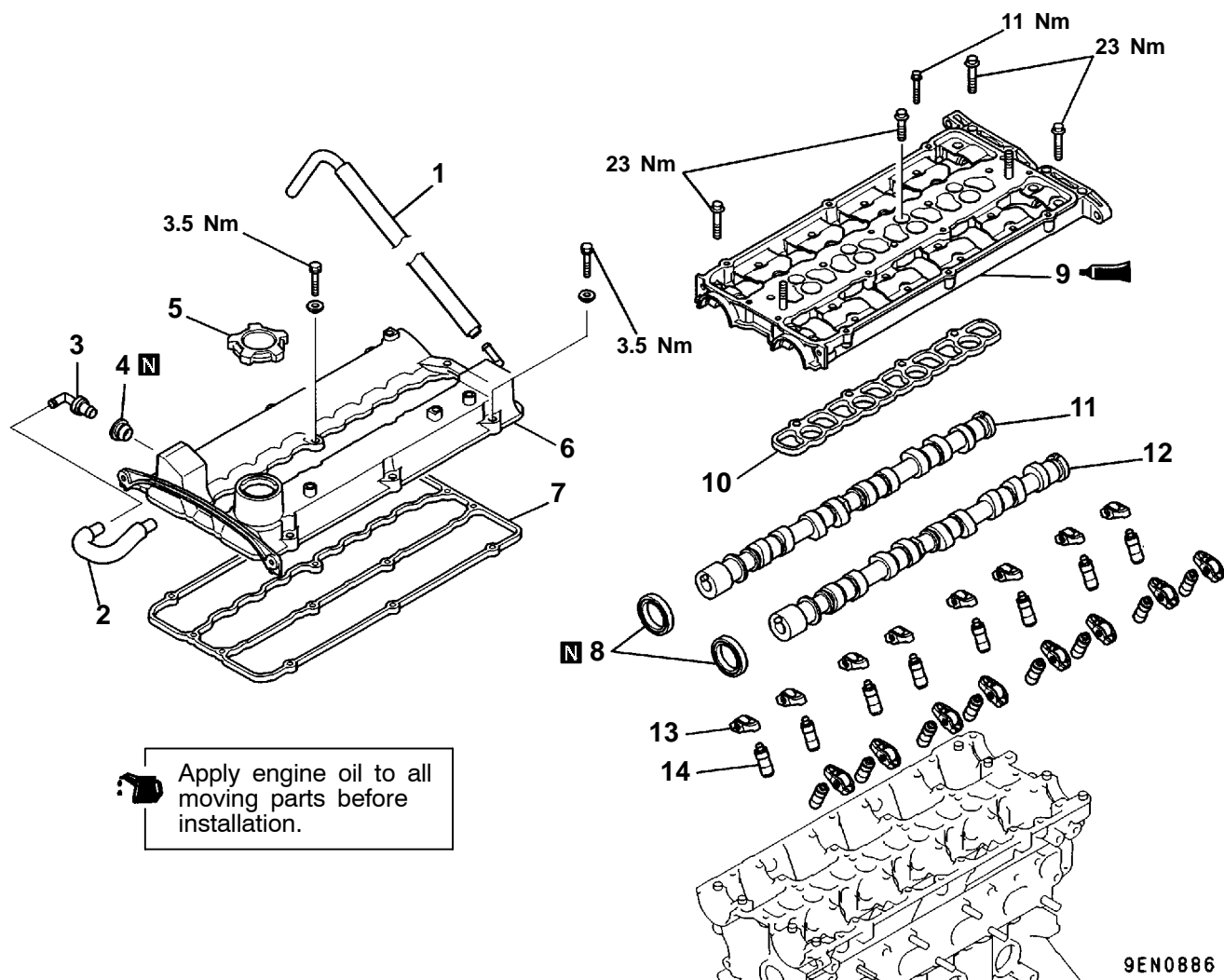
REMOVAL AND INSTALLATION <DOHC>



Removal steps

- | | |
|------------------------------|---------------------------|
| 1. Breather hose | 10. Oil seal |
| 2. P.C.V. hose | ▶H◀ 11. Bearing cap |
| 3. P.C.V. valve | ▶G◀ 12. Intake camshaft |
| 4. P.C.V. valve gasket | ▶G◀ 13. Exhaust camshaft |
| 5. Oil filler cap | 14. Rocker arm |
| ▶K◀ 6. Rocker cover | ◀A▶ ▶F◀ 15. Lash adjuster |
| 7. Rocker cover gasket A | |
| 8. Rocker cover gasket B | |
| ▶J◀ 9. Semi-circular packing | |

REMOVAL AND INSTALLATION <DOHC-GDI>

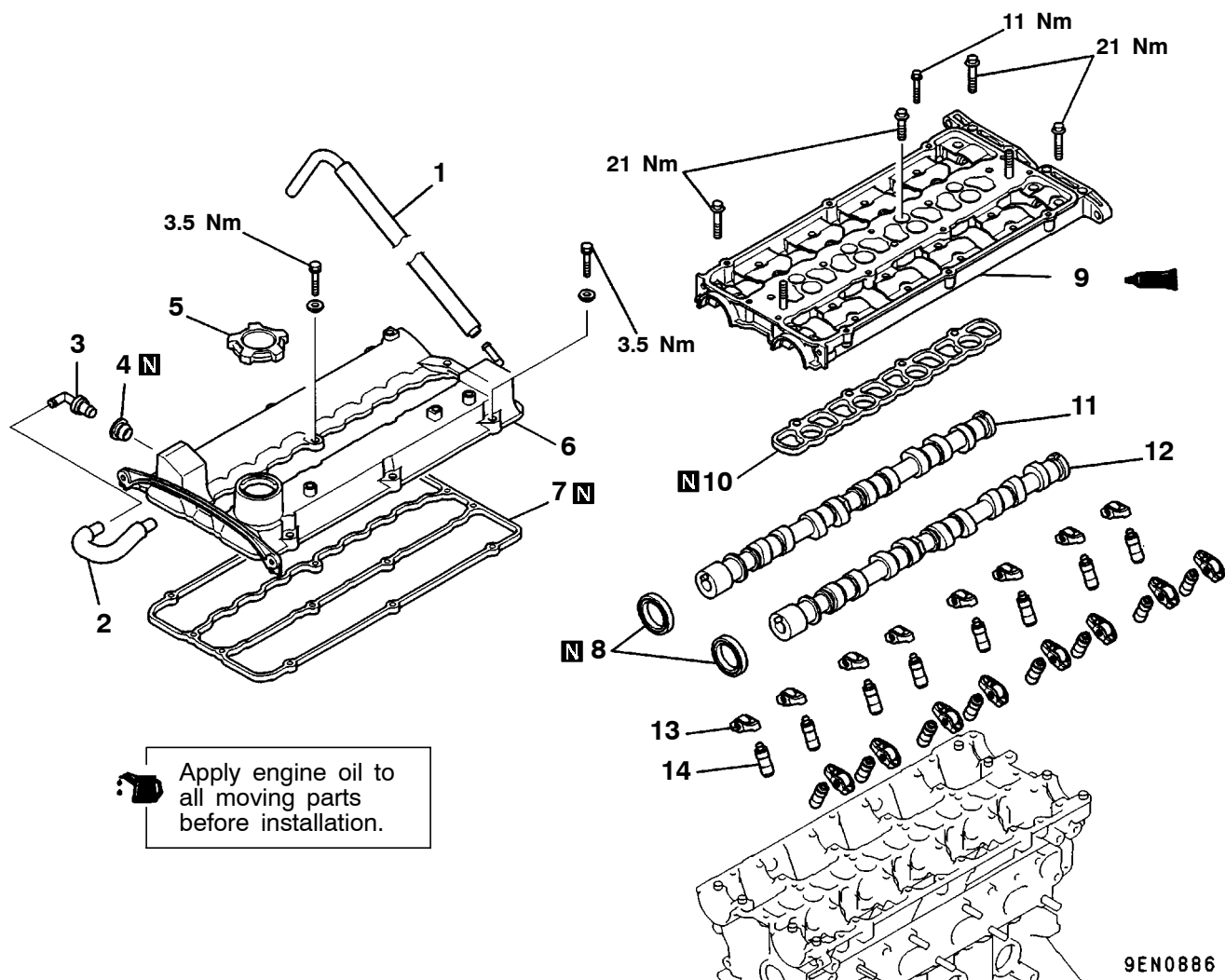
**Removal steps**

1. Breather hose
2. P.C.V hose
3. P.C.V valve
4. P.C.V valve gasket
5. Oil filler cap
6. Rocker cover
7. Rocker cover gasket

- | | |
|-----|----------------------|
| ▶L◀ | 8. Oil seal |
| ▶K◀ | 9. Beam camshaft cap |
| | 10. Gasket |
| ▶J◀ | 11. Intake camshaft |
| ▶J◀ | 12. Exhaust camshaft |
| | 13. Rocker arm |
| | 14. Lash adjuster |

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REMOVAL AND INSTALLATION <DOHC-GDI for CARISMA (Up to 2000 model), SPACE STAR (1999 model), SPACE RUNNER>

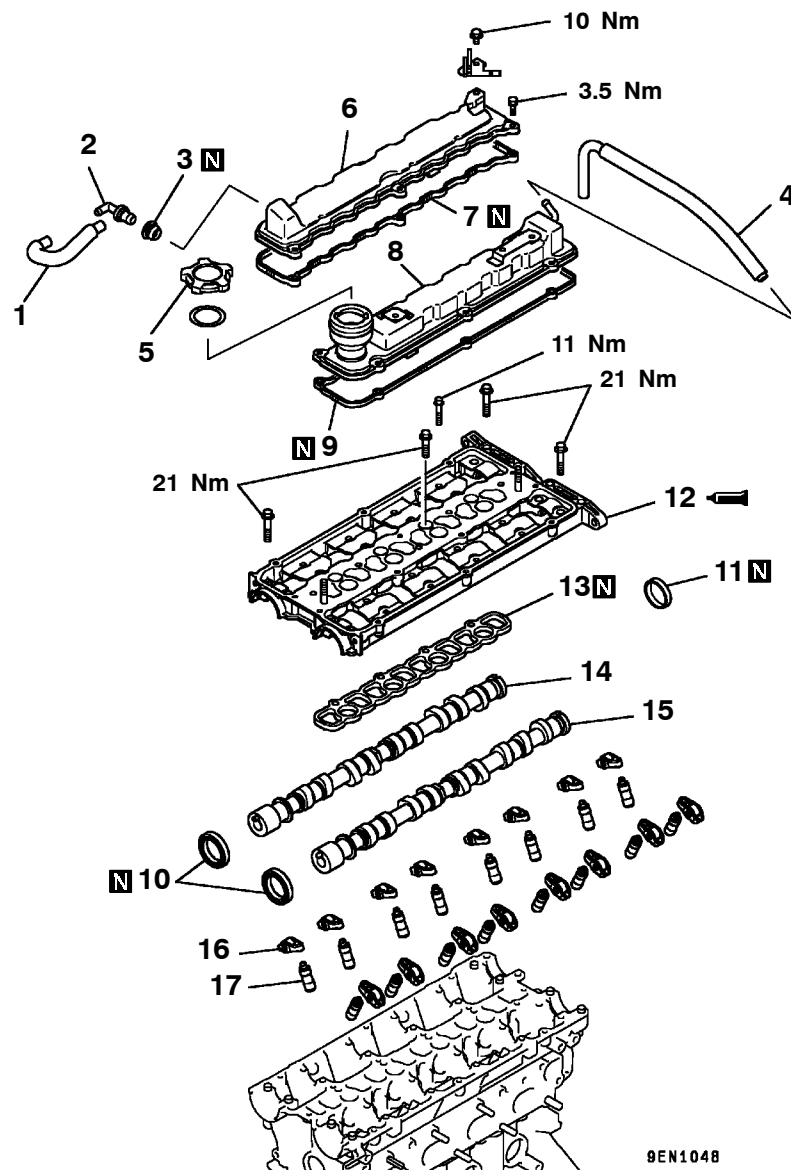


Removal steps

1. Breather hose
2. P.C.V. hose
3. P.C.V. valve
4. P.C.V. valve gasket
5. Oil filler cap
6. Rocker cover
7. Rocker cover gasket

8. Oil seal
9. Beam camshaft cap
10. Gasket
11. Intake camshaft
12. Exhaust camshaft
13. Rocker arm
14. Lash adjuster

REMOVAL AND INSTALLATION <DOHC-GDI for CARISMA (From 2001 model), SPACE STAR (From 2001 model), GALANT>

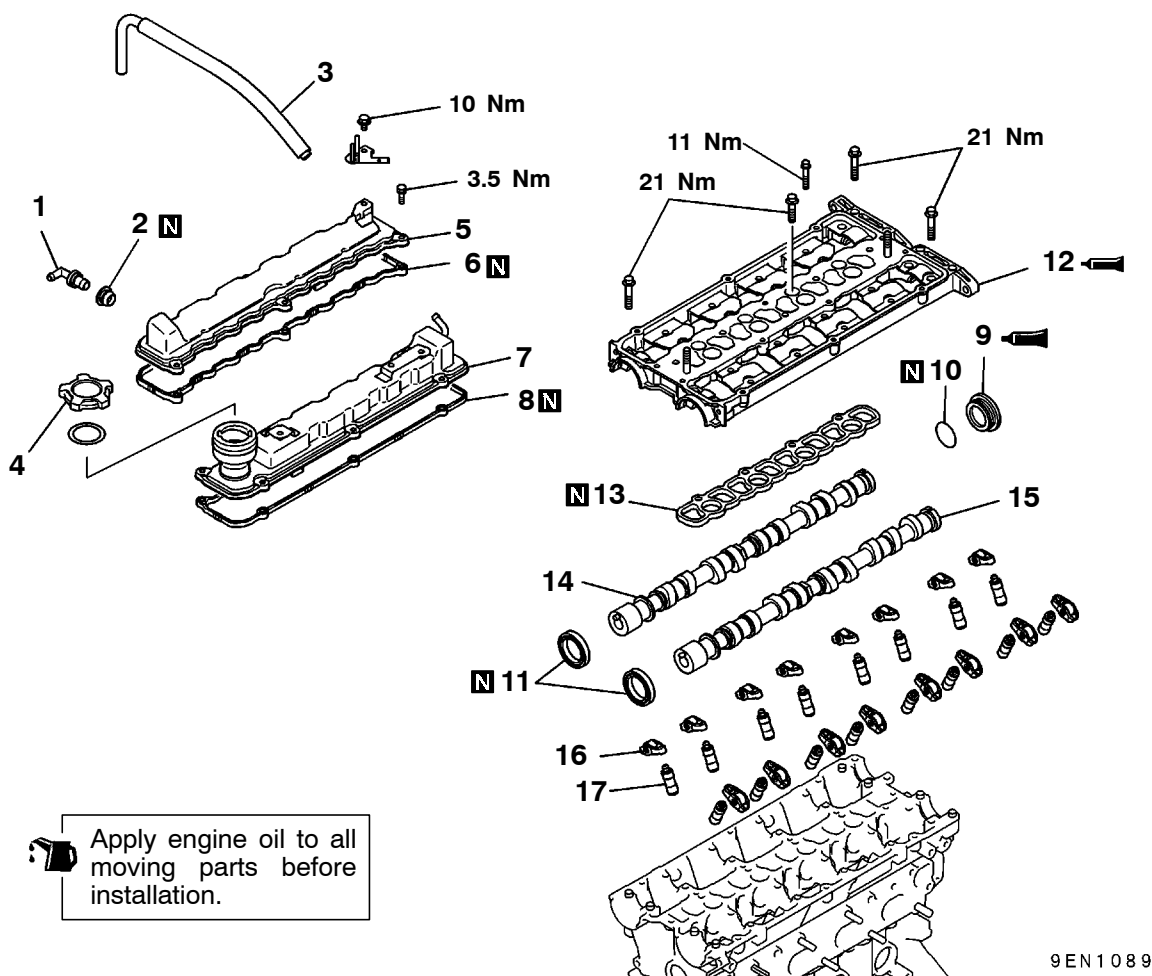


Removal steps

1. P.C.V. hose
2. P.C.V. valve
3. P.C.V. valve gasket
4. Breather hose
5. Oil filler cap
6. Rocker cover, intake
7. Rocker cover gasket, intake
8. Rocker cover, exhaust
9. Rocker cover gasket, exhaust

10. Oil seal
11. Circular packing
12. Beam camshaft cap
13. Beam camshaft cap gasket
14. Intake camshaft
15. Exhaust camshaft
16. Rocker arm
17. Lash adjuster

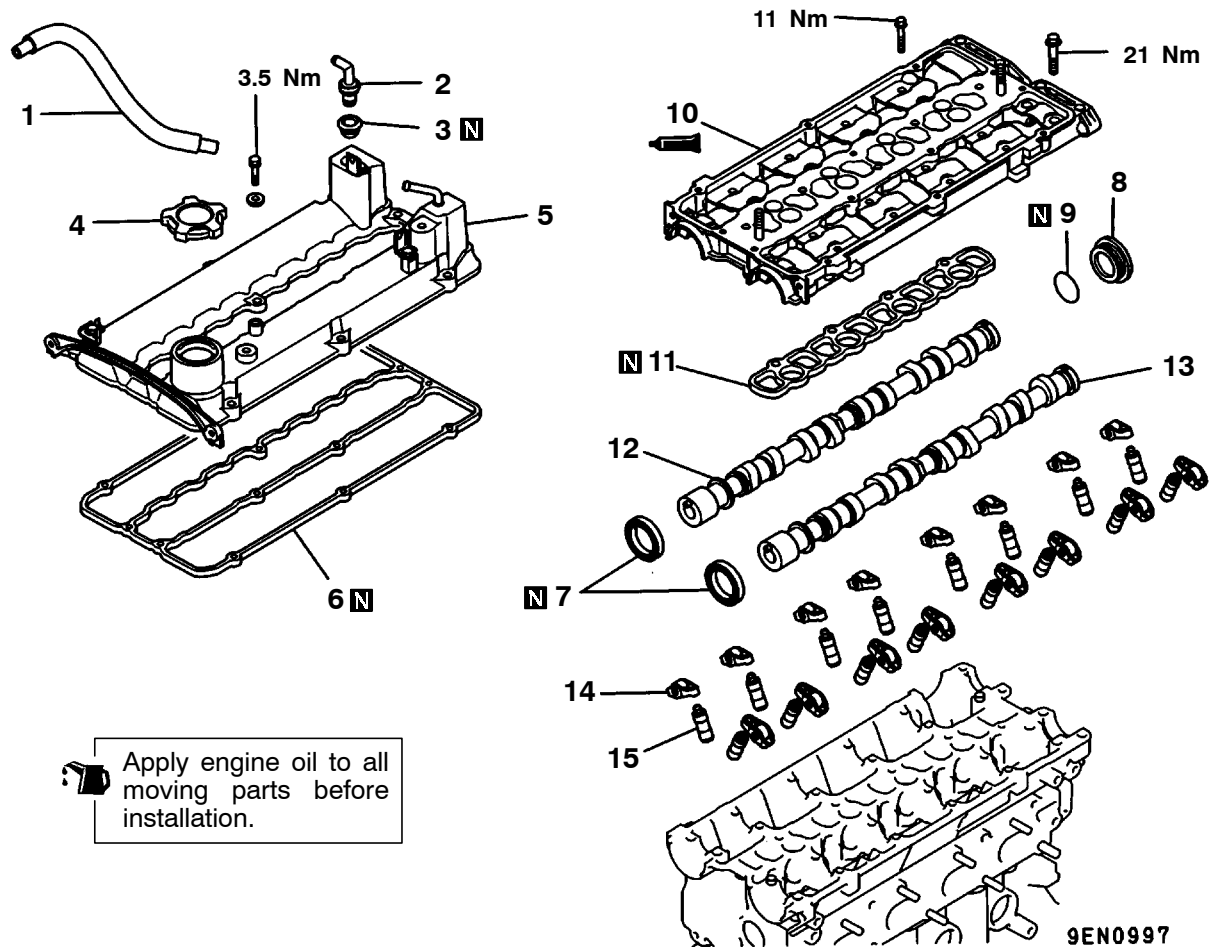
REMOVAL AND INSTALLATION <DOHC-GDI for PAJERO io - 4G94>

**Removal steps**

1. P.C.V. valve
2. P.C.V. valve gasket
3. Breather hose
4. Oil filler cap
5. Rocker cover, inlet
6. Rocker cover gasket, inlet
7. Rocker cover, exhaust
8. Rocker cover gasket, exhaust
9. Cover

10. O-ring
11. Oil seal
12. Beam camshaft cap
13. Beam camshaft cap gasket
14. Intake camshaft
15. Exhaust camshaft
16. Rocker arm
17. Lash adjuster

REMOVAL AND INSTALLATION <DOHC-GDI for PAJERO io - 4G93>

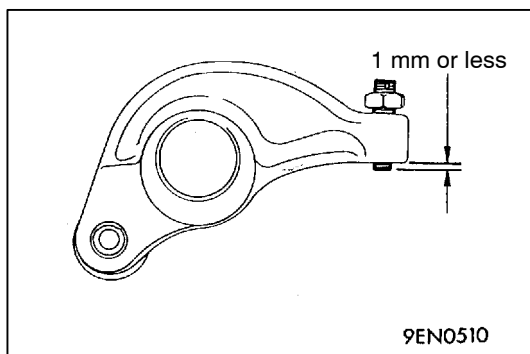
**Removal steps**

1. Breather hose
2. P.C.V. valve
3. P.C.V. valve gasket
4. Oil filler cap
5. Rocker cover
6. Rocker cover gasket
7. Oil seal
8. Thrust case

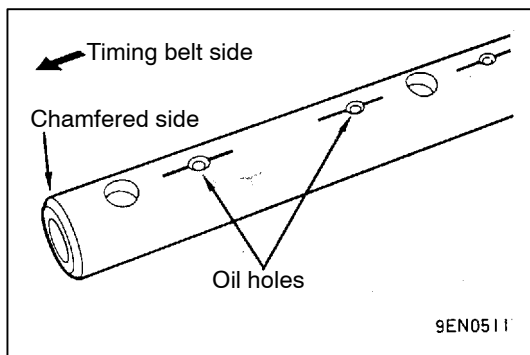
9. O-ring
- ▶I◀ 10. Beam camshaft cap
11. Gasket
12. Intake camshaft
13. Exhaust camshaft
14. Rocker arm
- ◀A▶ ▶F◀ 15. Lash adjuster

REMOVAL SERVICE POINT**◀A▶ LASH ADJUSTER REMOVAL****Caution**

- If the lash adjuster is re-used, clean the lash adjuster. (Refer to 11A-8-10.)

**INSTALLATION SERVICE POINTS****▶A◀ ADJUSTING SCREW INSTALLATION**

- (1) Install provisionally the screw to the rocker arm. Insert it so that the end of the screw is flush with the edge of the rocker arm or projects slightly (1 mm or less).

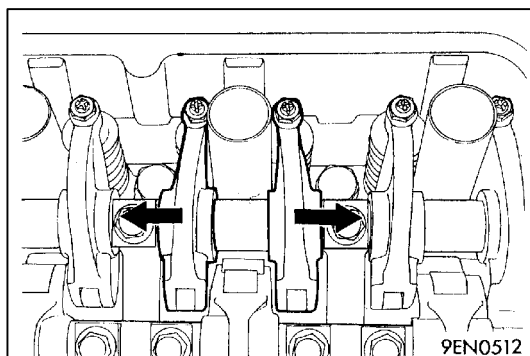
**▶B◀ ROCKER ARM SHAFT INSTALLATION**

- (1) Place the end with the larger chamfered side toward the timing belt side.

NOTE

The rocker arm shaft for intake valves has eight oil holes.

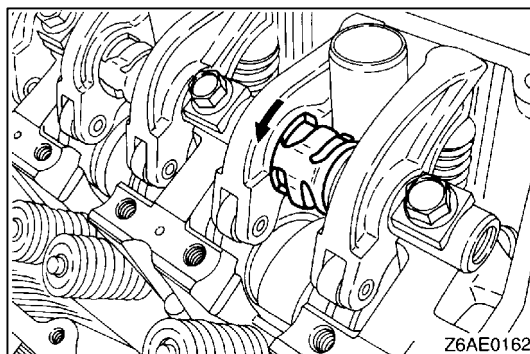
- (2) Install the shaft with the oil holes toward the cylinder head.

**▶C◀ ROCKER ARMS AND ROCKER ARM SHAFT INSTALLATION**

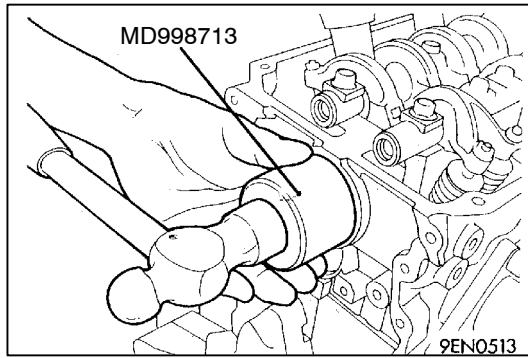
- (1) Move the rocker arms in the directions shown in the illustration before tightening the rocker arm shaft bolts.

NOTE

Move the rocker arms until they touch the rocker arm shaft mounting bosses on the cylinder head.

**▶D◀ ROCKER ARM SPRING INSTALLATION**

- (1) Insert the rocker arm spring at an angle to the spark plug guide and then install it so that it is at a right angle to the guide.



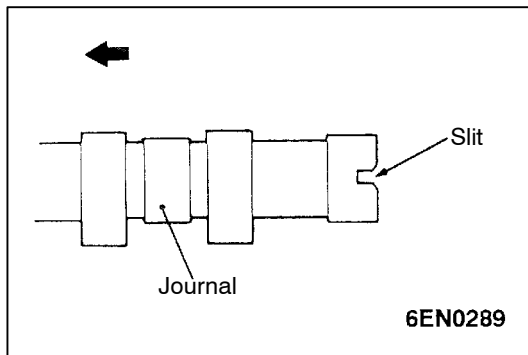
►E◄ OIL SEAL INSTALLATION

►F◄ LASH ADJUSTER INSTALLATION

Caution

- If the lash adjuster is re-used, clean the lash adjuster. (Refer to 11A-8-10.)

- (1) Fit the lash adjuster onto the cylinder head using care not to allow diesel fuel to spill out.

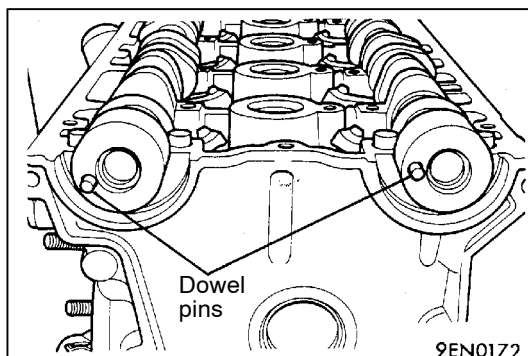


►G◄ CAMSHAFT INSTALLATION

- (1) Apply engine oil to the camshaft journals and cam before installing the camshaft. Use care not to confuse the intake camshaft with the exhaust camshaft.

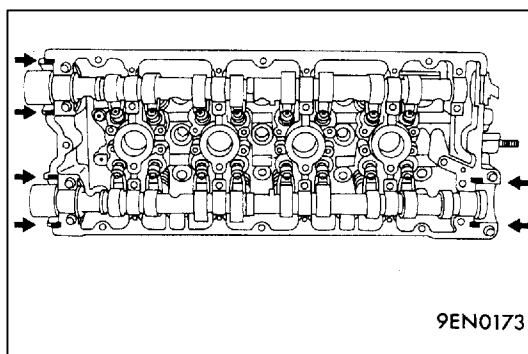
NOTE

The rear end of the intake camshaft is provided with a 4 mm-wide slit.



►H◄ BEARING CAP INSTALLATION

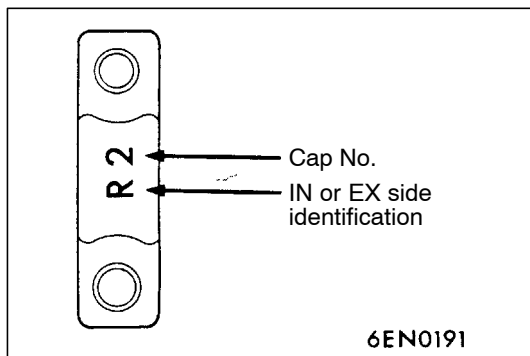
- (1) Locate the camshaft dowel pins as illustrated.



- (2) Apply sealant to the locations shown in the illustration.

Specified sealant:

3M ATD Part No. 8660 or equivalent



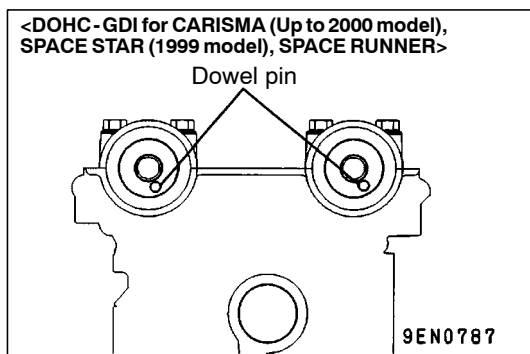
- (3) The bearing caps No. 2 through No. 5 are of the same shape. Before they are installed, check the cap number and the intake and exhaust identification marks.

Identification mark (stamped on front and No. 2 through No. 5 bearing caps)

L: Intake side

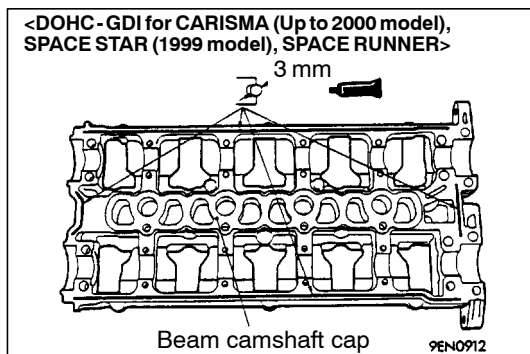
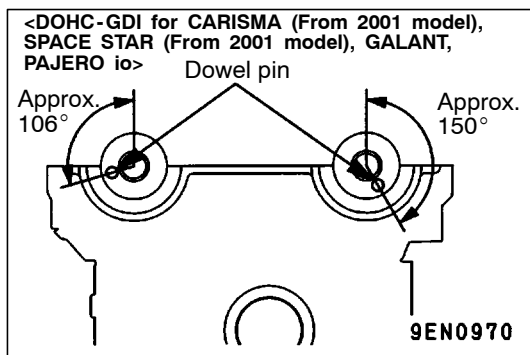
R: Exhaust side

- (4) Make sure that the rocker arms are installed in the specified locations.



▶◀ BEAM CAMSHAFT CAP INSTALLATION

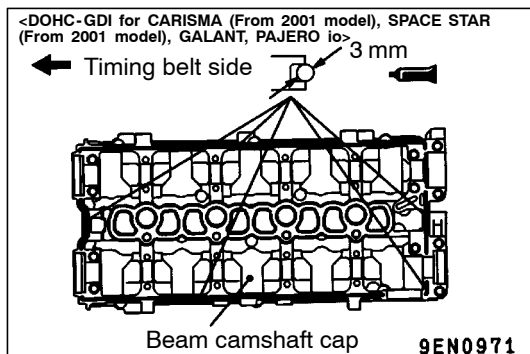
- (1) Locate the camshaft dowel pin as illustrated.



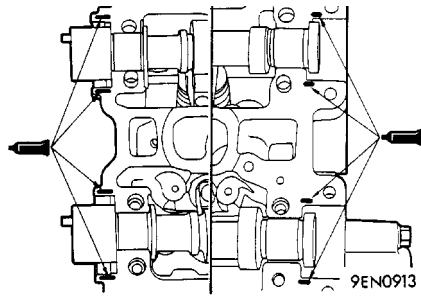
- (2) Turn the crankshaft anticlockwise a quarter turn (90°).
 (3) Apply a 3 mm thick continuous bead of sealant to the bottom surface of the beam camshaft cap along the groove.

Specified sealant:

Mitsubishi Genuine Part No. MD970389 or equivalent



<DOHC-GDI for CARISMA (Up to 2000 model), SPACE STAR (1999 model), SPACE RUNNER>

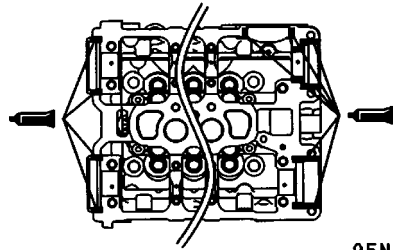


- (4) Apply sealant to the illustrated position of the cylinder head upper surface.

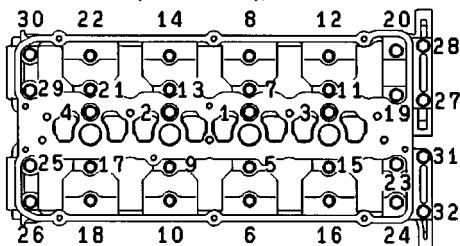
Specified sealant:

**Mitsubishi Genuine Part No. MD970389
or equivalent**

<DOHC-GDI for CARISMA (From 2001 model), SPACE STAR (From 2001 model), GALANT, PAJERO io>
← Engine front side



<DOHC-GDI for CARISMA (Up to 2000 model), SPACE STAR (1999 model), SPACE RUNNER>



- (5) Install the beam camshaft cap before the sealant applied becomes dry and hard.
(6) Tighten the bolts to the specified torque in the order shown in the illustration.

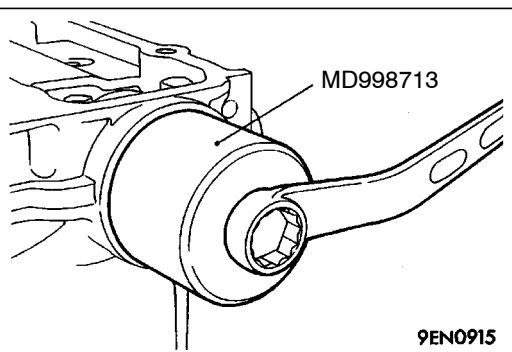
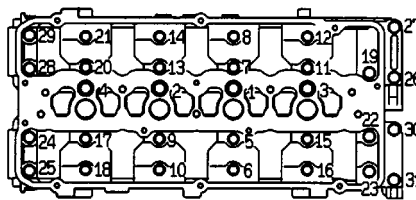
M6 bolt 11Nm
M8 bolt 21Nm

Caution

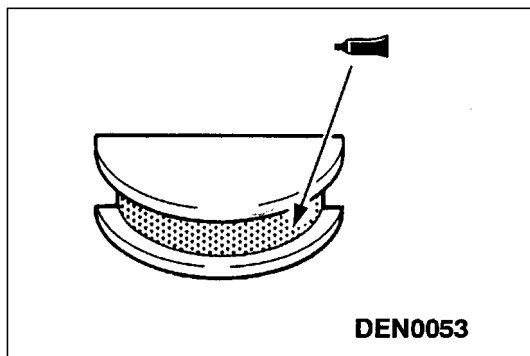
The M8 bolts plated green cannot be reused. Always replace such bolts with M8 bolts finished by glossy plating which are available separately.

The M8 bolt finished by glossy plating is reusable; if the caps have already been assembled with such bolts, then reassemble the caps using them.

<DOHC-GDI for CARISMA (From 2001 model), SPACE STAR (From 2001 model), GALANT, PAJERO io>
← Engine front side

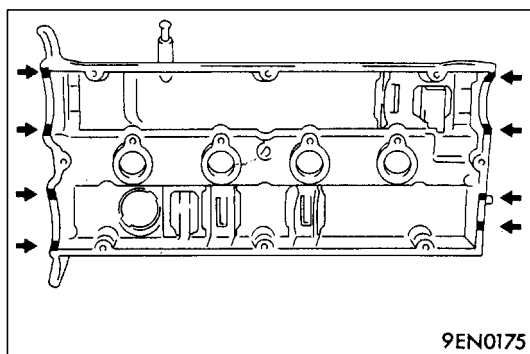


- (7) Install the camshaft oil seal (use the special tool) and the thrust case <DOHC-GDI for PAJERO io - 4G93> before the sealant applied becomes dry and hard.
(8) Wipe off squeezed out excess sealant from the circumference of the beam camshaft cap.



►J◄ SEALANT APPLICATION ON SEMI-CIRCULAR PACKING

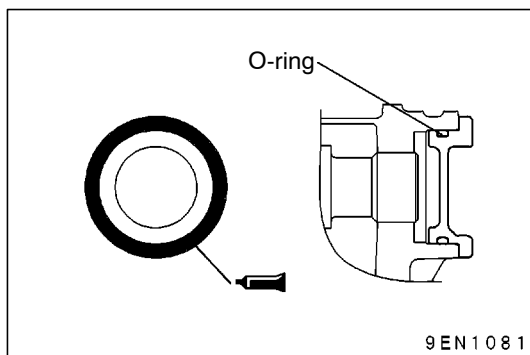
Specified sealant: 3M ATD Part No.8660 or equivalent



►K◄ SEALANT APPLICATION ON ROCKER COVER

(1) Apply sealant to the areas indicated in the illustration.

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

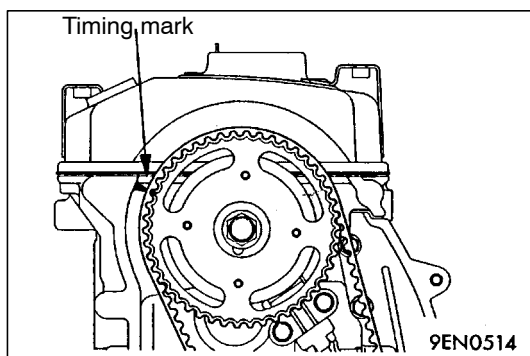


►L◄ O-RING / COVER INSTALLATION

(1) Apply liquid gasket on the illustrated position of the cover.

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

(2) Lubricate the O-ring in the cover with engine oil. Install the cover in place on the cylinder head and the beam camshaft cap.



VALVE CLEARANCE ADJUSTMENT

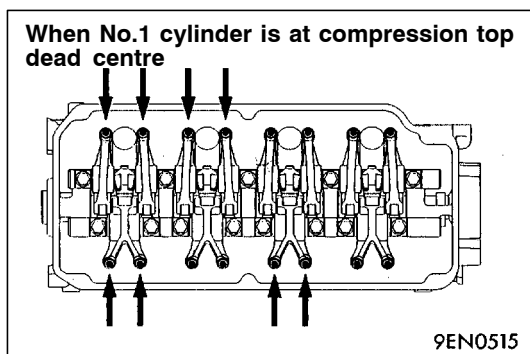
Adjust the valve clearance by the following procedure.

Adjustment values (when engine is cold):

Intake valve: 0.09 mm

Exhaust valve: 0.20 mm

(1) Turn the crankshaft in the clockwise direction to align the camshaft sprocket timing marks and to set the No.1 cylinder to the compression top dead centre position.



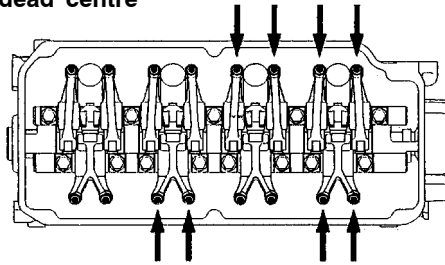
(2) The valve clearances at the places indicated by arrows in the illustration can be adjusted.

(3) Use a thickness gauge to adjust the clearance between the ends of the valve stems and the adjusting screws.

(4) Hold the adjusting screws with a screwdriver so that they do not turn, and then tighten the lock nuts.

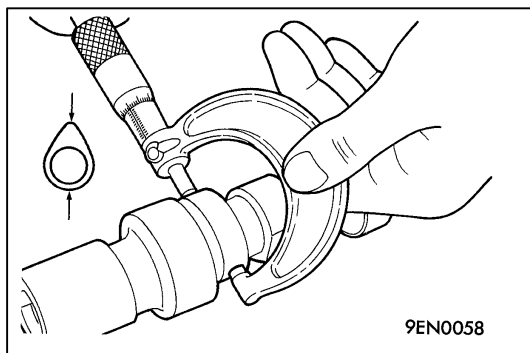
(5) Turn the crankshaft once in the clockwise direction to set the No.4 cylinder to the compression top dead centre position.

When No.4 cylinder is at compression top dead centre



- (6) Adjust the valve clearances indicated by arrows in the illustration by the same procedure as in steps (3) and (4) above.

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INSPECTION

CAMSHAFT

(1) Measure the cam height.

		Standard value mm	Limit mm
Intake side	4G92-SOHC*1	37.34	36.84
	4G92-SOHC*2	37.78	37.28
	4G92-SOHC*3	36.92	36.42
	4G93-SOHC*4	37.53	37.03
	4G93-SOHC*5	37.11	36.61
	4G94-SOHC	37.91	37.41
	4G93-DOHC	35.49	34.99
	4G93-DOHC-GDI	35.49	34.99
	4G94-DOHC-GDI	35.49	34.99
Exhaust side	4G92-SOHC*1	37.83	37.33
	4G92-SOHC*2	37.83	37.33
	4G92-SOHC*3	36.70	36.65
	4G93-SOHC*4	37.64	37.14
	4G93-SOHC*5	37.15	36.65
	4G94-SOHC	37.70	37.20
	4G93-DOHC	35.20	34.70
	4G93-DOHC-GDI	34.73	34.23
	4G94-DOHC-GDI	34.91	34.41

*1: LANCER for Europe and CARISMA for Europe

*2: LANCER for general export and CARISMA for 6B model

*3: LANCER for Europe (from 2001 model) and CARISMA for Europe (from 2001 model)

*4: Except for Europe

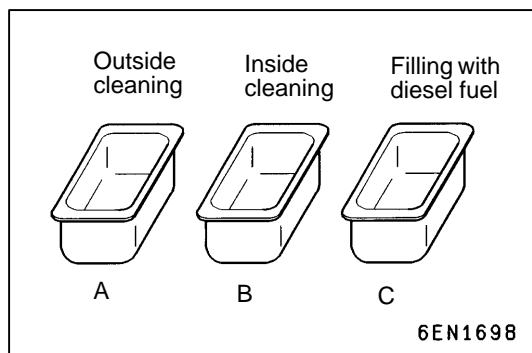
*5: For Europe

LASH ADJUSTER

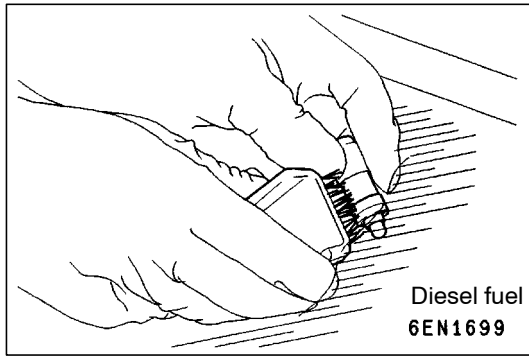
(SOHC)

Caution

1. The lash adjusters are precision-engineered mechanisms. Do not allow them to become contained by dirt or other foreign substances.
2. Do not attempt to disassemble the lash adjusters.
3. Use only fresh diesel fuel to clean the lash adjusters.



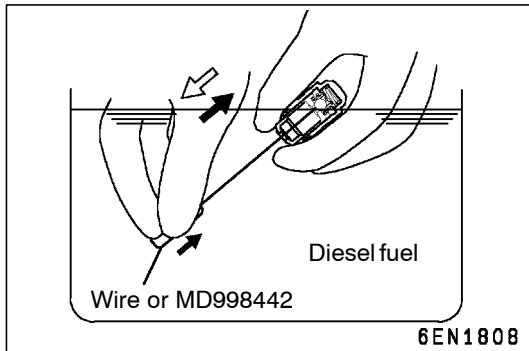
- (1) Prepare three containers and approximately five liters of diesel fuel. Into each container, pour enough diesel fuel to completely cover a lash adjuster when it is standing upright. Then, perform the following steps with each lash adjuster.



- (2) Place the lash adjuster in container A and clean its outside surface.

NOTE

Use a nylon brush if deposits are hard to remove.



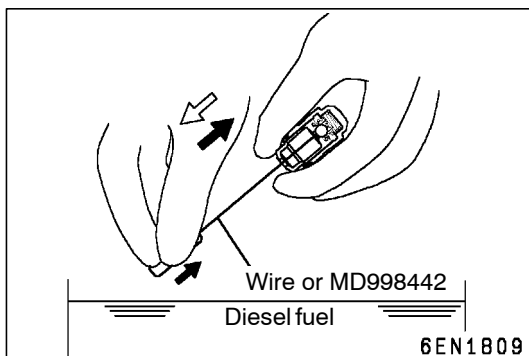
- (3) While gently pushing down the internal steel ball using special tool MD998442, move the plunger through 5 to 10 strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will remove dirty oil.

Caution

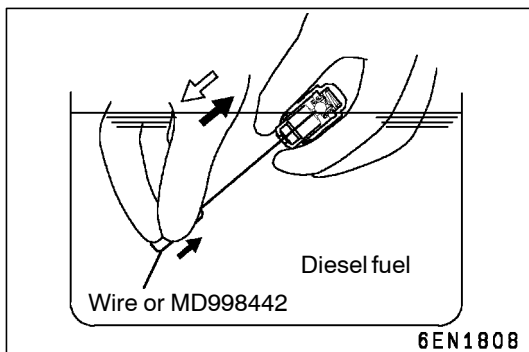
The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.

NOTE

If the plunger remains stiff or the mechanism appears otherwise abnormal, replace the lash adjuster.



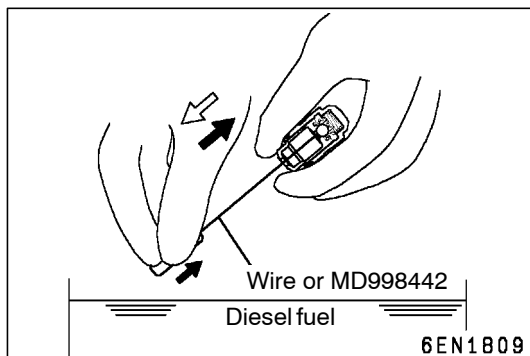
- (4) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.



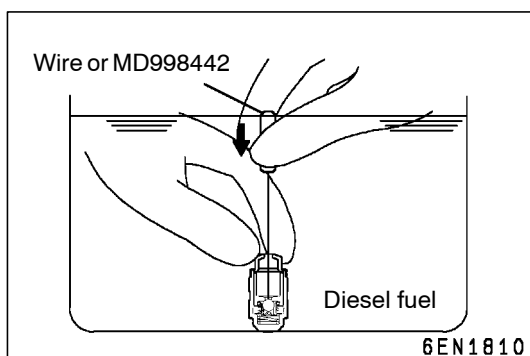
- (5) Place the lash adjuster in container B. Then, gently push down the internal steel ball using special tool MD998442 and move the plunger through 5 to 10 strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.

Caution

The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.



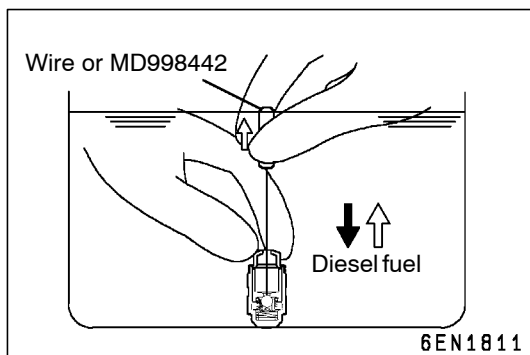
- (6) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.



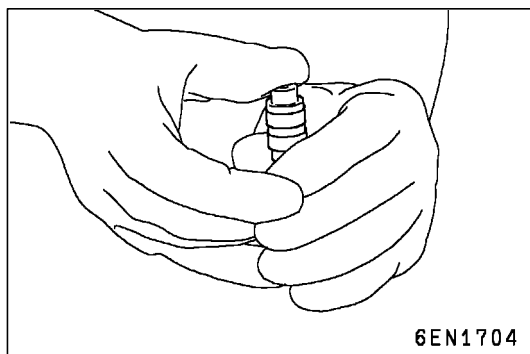
- (7) Place the lash adjuster in container C. Then, gently push down the internal steel ball using special tool MD998442.

Caution

Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when chamber is filled with diesel fuel.



- (8) Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.



- (9) Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move. Also, check that the lash adjuster's height matches that of a new lash adjuster.

NOTE

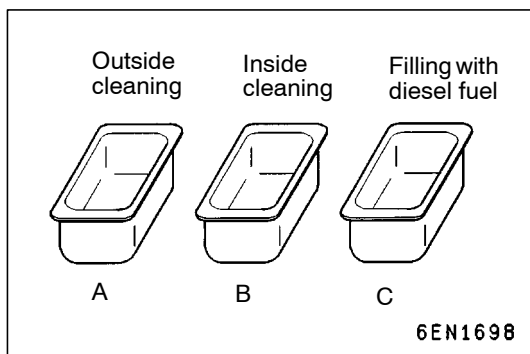
If lash adjuster contracts, perform the operations (7) through (9) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts after performing these steps.

- (10) Stand the lash adjuster upright to prevent diesel fuel from spilling out. Do not allow the lash adjuster to become contaminated by dirt or other foreign matter. Fit the lash adjuster onto the engine as soon as possible.

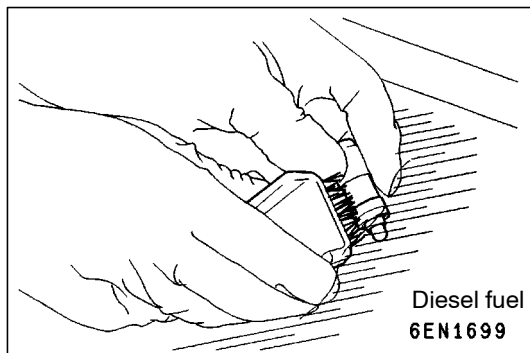
(DOHC)

Caution

1. The lash adjusters are precision-engineered mechanisms. Do not allow them to become contaminated by dirt or other foreign substances.
2. Do not attempt to disassemble the lash adjusters.
3. Use only fresh diesel fuel to clean the lash adjusters.



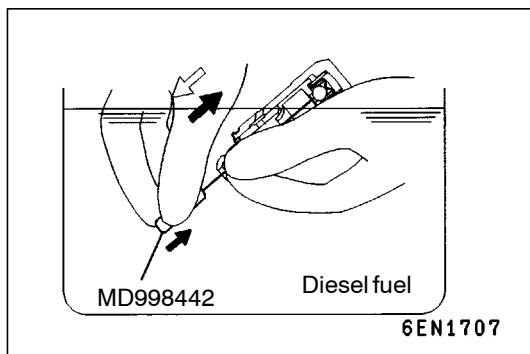
- (1) Prepare three containers and approximately five liters of diesel fuel. Into each container, pour enough diesel fuel to completely cover a lash adjuster when it is standing upright. Then, perform the following steps with each lash adjuster.



- (2) Place the lash adjuster in container A and clean its outside surface.

NOTE

Use a nylon brush if deposits are hard to remove.



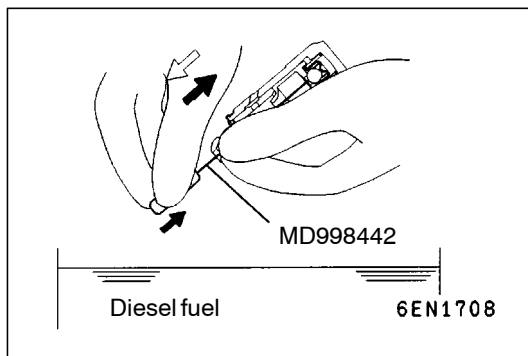
- (3) While gently pushing down the internal steel ball using special tool MD998442, move the plunger through 5 to 10 strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will remove dirty oil.

Caution

The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.

NOTE

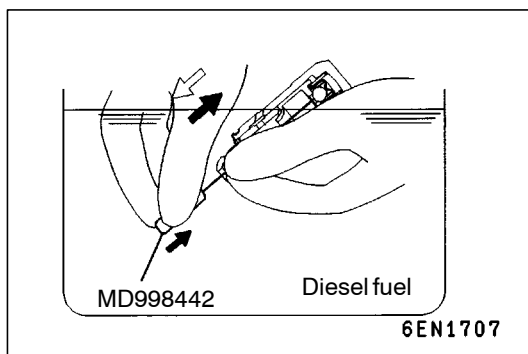
If the plunger remains stiff or the mechanism appears otherwise abnormal, replace the lash adjuster.



- (4) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

Caution

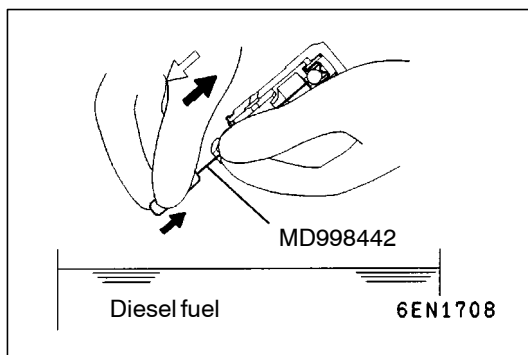
Make sure the oil hole in the side of the body is pointing toward container A. Do not point the oil hole at yourself or other people.



- (5) Place the lash adjuster in container B. Then, gently push down the internal steel ball using special tool MD998442 and move the plunger through 5 to 10 strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.

Caution

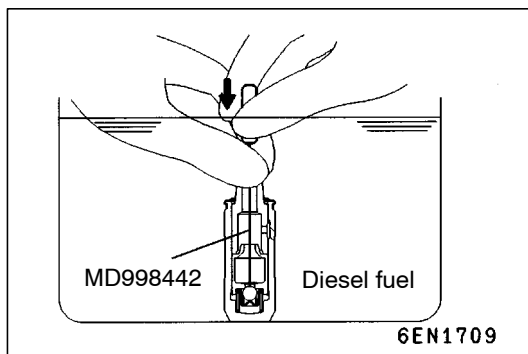
The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.



- (6) Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

Caution

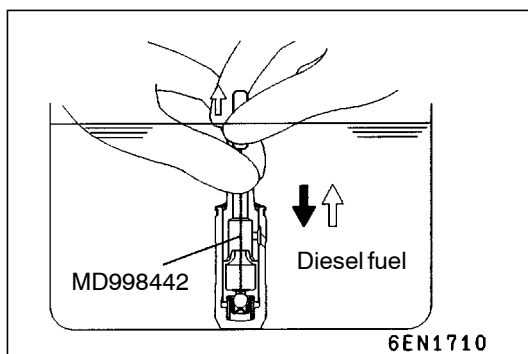
Make sure the oil hole in the side of the body is pointing toward container B. Do not point the oil hole at yourself or other people.



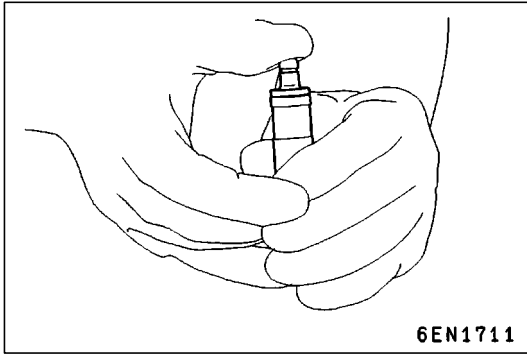
- (7) Place the lash adjuster in container C. Then, gently push down the internal steel ball using special tool MD998442.

Caution

Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when chamber is filled with diesel fuel.



- (8) Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.



- (9) Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move. Also, check that the lash adjuster's height matches that of a new lash adjuster.

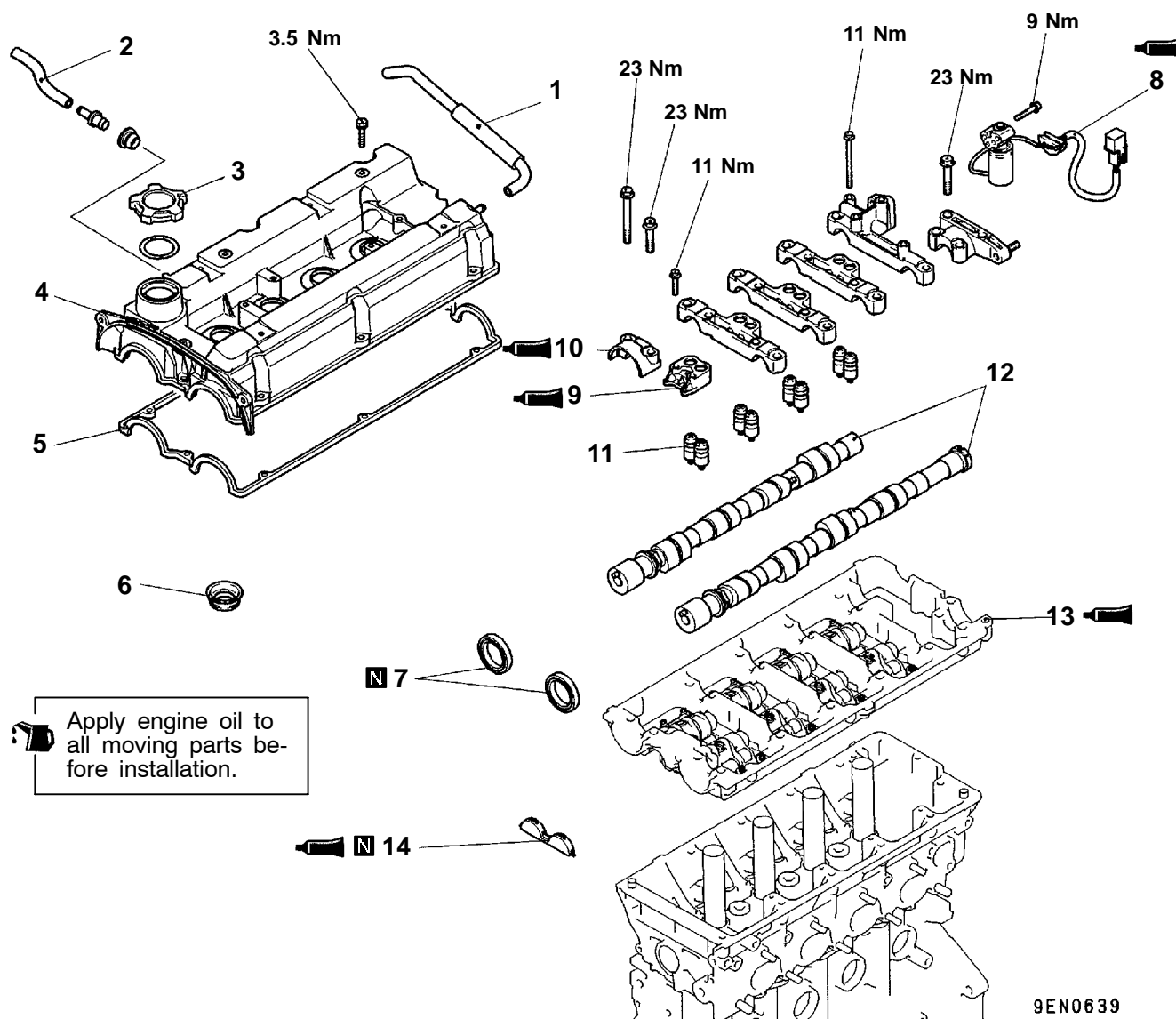
NOTE

If lash adjuster contracts, perform the operations (7) through (9) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts after performing these steps.

- (10) Stand the lash adjuster upright to prevent diesel fuel from spilling out. Do not allow the lash adjuster to become contaminated by dirt or other foreign matter. Fit the lash adjuster onto the engine as soon as possible.

8a. ROCKER COVER AND CAMSHAFTS (MIVEC)

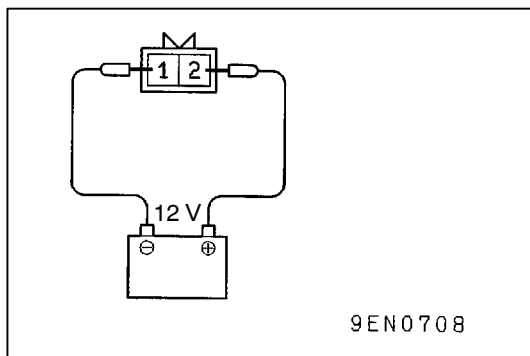
REMOVAL AND INSTALLATION



Removal steps

1. Breather hose
2. PCV hose
3. Oil filler cap
4. Rocker cover
5. Rocker cover gasket
6. Oil seal
7. Oil seal
8. Oil control valve

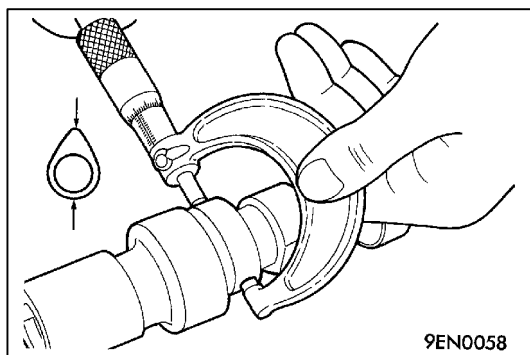
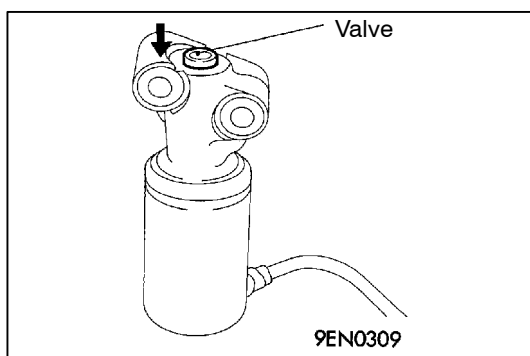
9. Arm spring holder
10. Camshaft bearing cap
11. Arm spring
12. Camshaft
13. Camshaft holder
14. Semi-circular packing



INSPECTION

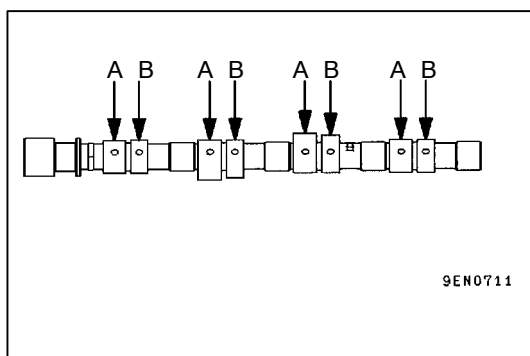
1. OIL CONTROL VALVE

- (1) Connect a 12VDC power supply between terminals (1) and (2) of the oil control valve and check if the valve operates smoothly.



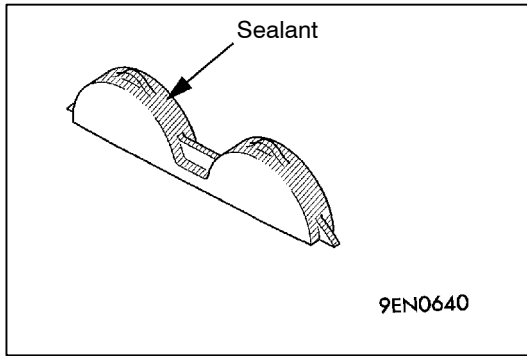
2. CAMSHAFT

- (1) Measure the cam heights. If the specified limit is exceeded, replace the camshaft.



Unit: mm

	Standard value	Limit
4G92 DOHC-MIVEC		
Intake A	36.41	35.91
Intake B	33.58	33.08
Exhaust A	35.83	35.33
Exhaust B	34.24	33.74



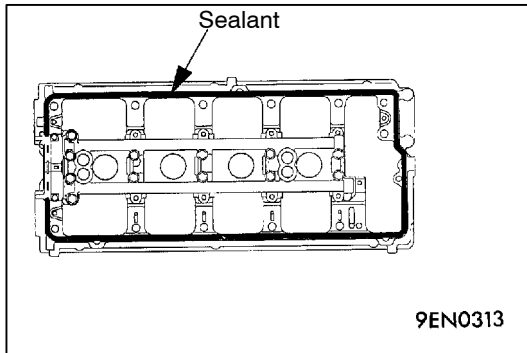
INSTALLATION SERVICE POINTS

►A◄ SEMI-CIRCULAR PACKING INSTALLATION

- (1) Apply the specified sealant to the area shown.

Specified sealant:

3M ATD Part No. 8660 or equivalent.



►B◄ CAMSHAFT HOLDER ASSEMBLY INSTALLATION

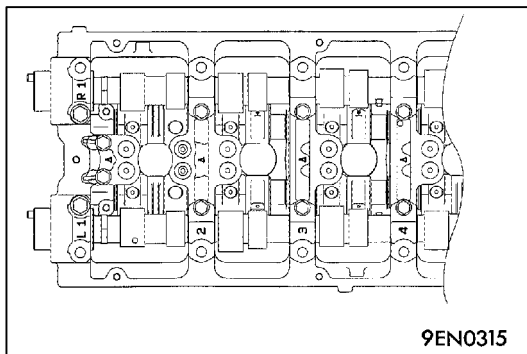
- (1) Apply the specified sealant to the area shown.

Specified sealant:

3M ATD Part No. 8660 or equivalent

►C◄ CAMSHAFT INSTALLATION

- (1) Ensure that the intake-side and exhaust-side camshafts are not reversed. The exhaust-side camshaft is longer and has a slot in its rear end.
- (2) Set the No. 1 piston at the top dead center and install the camshafts with their cams for No. 1 cylinder directed upward so that the No. 1 cylinder becomes the top dead center on the compression stroke.



►D◄ CAMSHAFT BEARING CAP / CAMSHAFT HOLDER INSTALLATION

- (1) Confirm the identification mark on each bearing cap to install the cap in the correct position.

Identification mark

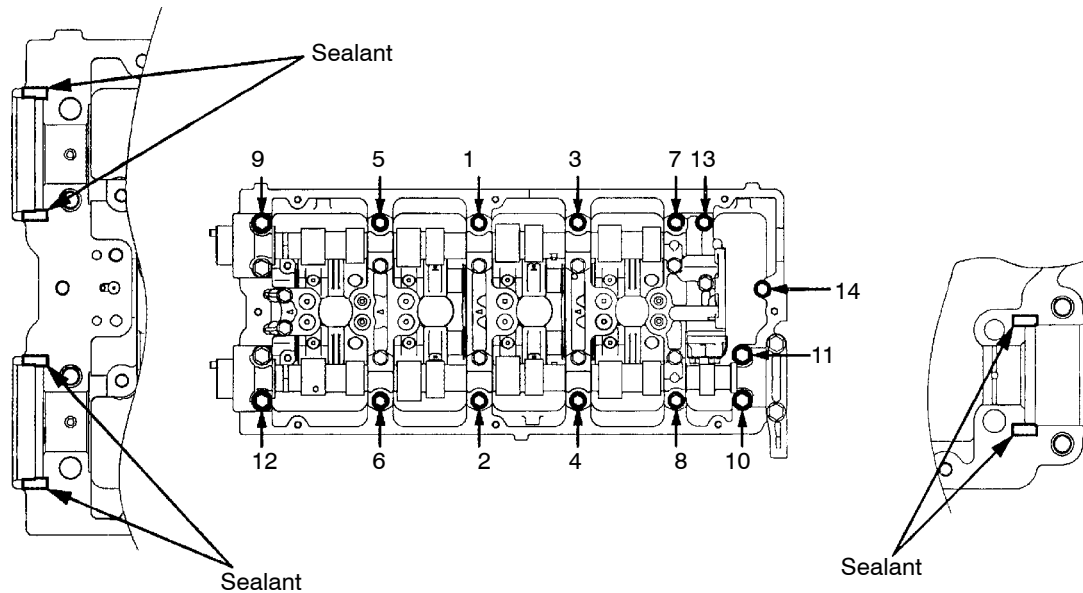
L1: Front bearing for exhaust camshaft

R1: Front bearing for intake camshaft

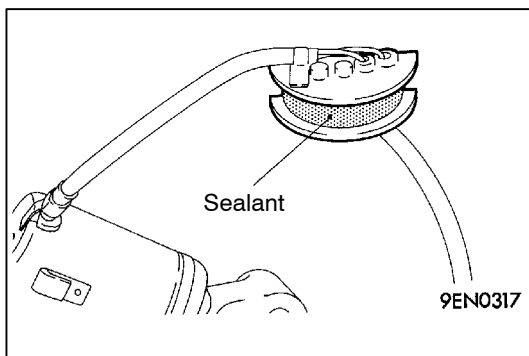
- (2) Apply the specified sealant to the front and rear camshaft bearing caps at the positions shown. Position the camshaft bearing caps and tighten their mounting bolts not numbered in the illustration. Then tighten the remaining (numbered) bolts in the order shown in the illustration to install the bearing caps and camshaft holder to the cylinder head.

Specified sealant:

3M ATD part No. 8660 or equivalent



9EN0316

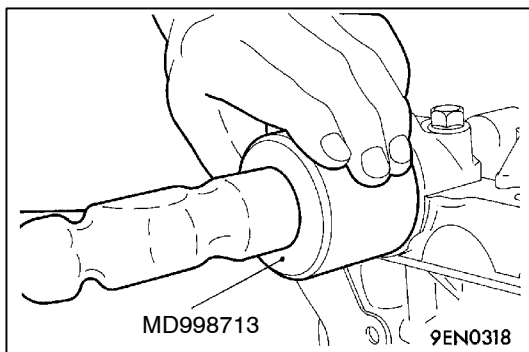


►E◄ OIL CONTROL VALVE INSTALLATION

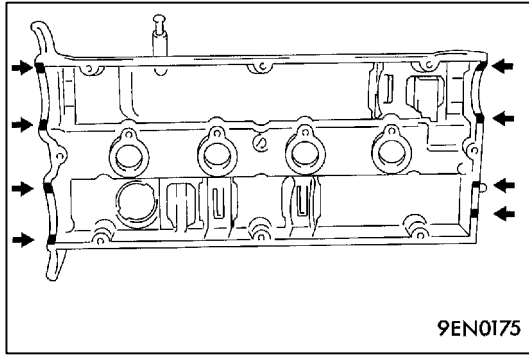
- (1) Apply the specified sealant to the area shown.

Specified sealant:

3M ATD Part No. 8660 or equivalent



►F◄ OIL SEAL INSTALLATION

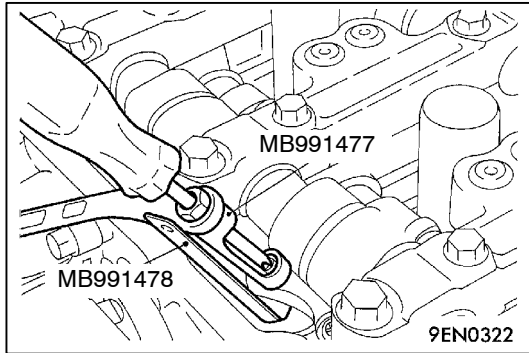


►G◄ROCKER COVER INSTALLATION

Apply the specified sealant to the area shown.

Specified sealant:

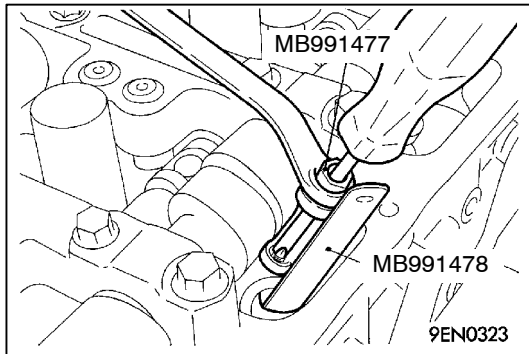
3M ATD part No. 8660 or equivalent



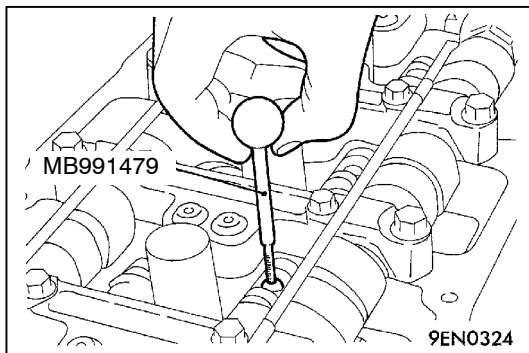
VALVE CLEARANCE ADJUSTMENT

Adjustment must be performed with the cylinder at the top dead center on the compression stroke.

- (1) Inserting the special tool between one of two adjusting screws and the valve and adjust the clearance.



- (2) Then adjust the other adjusting screw in the same way.

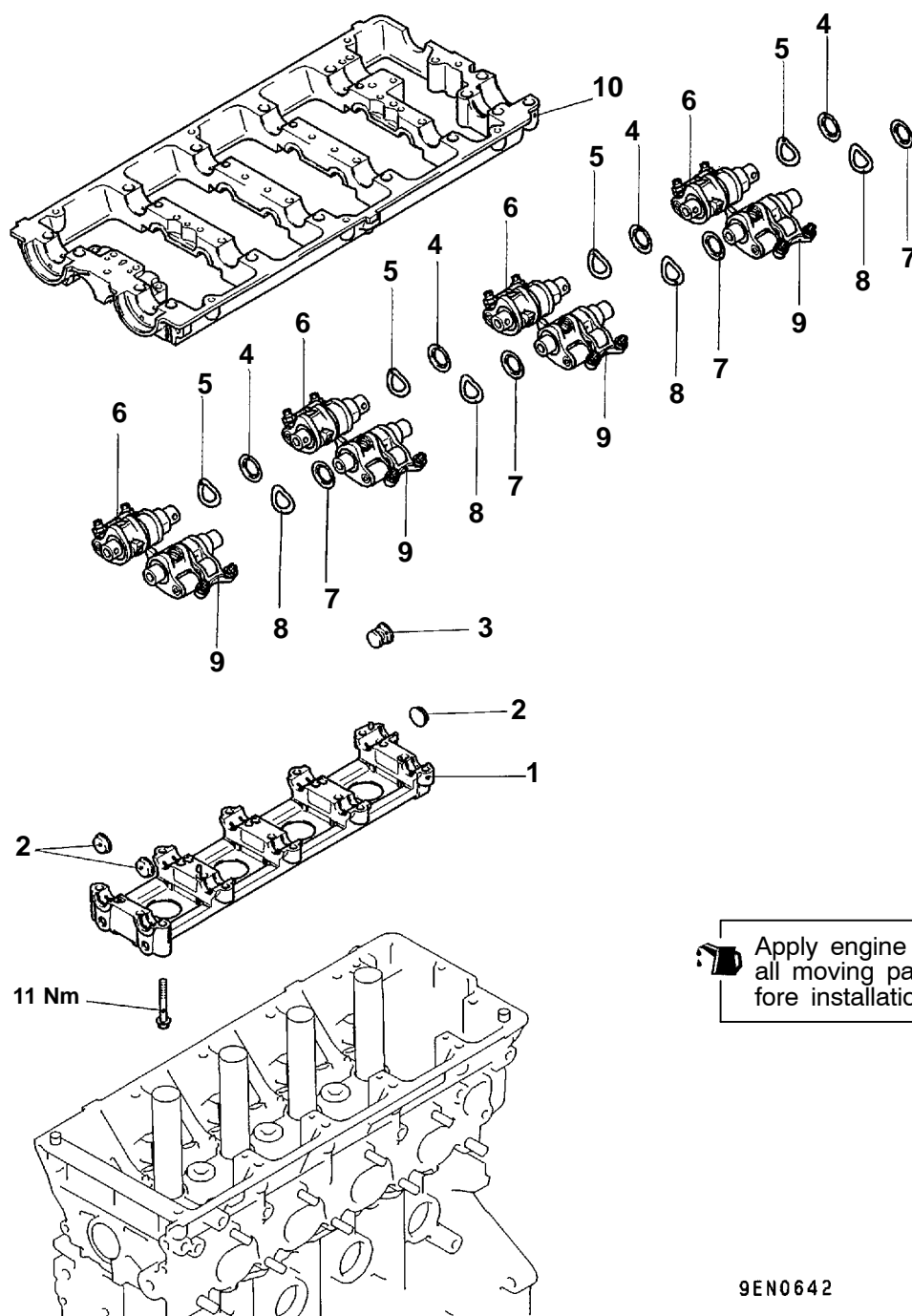


ROCKER ARM PISTON INSPECTION

- (1) Screw in the special tool to the rocker arm piston for high speed side rocker arm and check that the piston can be lifted up lightly by hand.

8b. ROCKER ARMS AND ROCKER SHAFT CAPS (MIVEC)

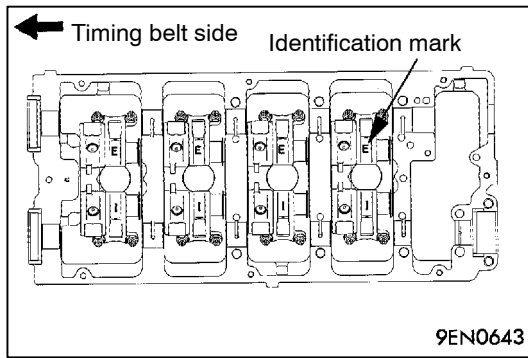
REMOVAL AND INSTALLATION



Removal steps

1. Rocker shaft cap
2. Seal cap "A"
3. Seal cap "B"
4. Spring guide
5. Wave washer

- A◀ 6. Intake rocker arm assembly "A"
7. Spring guide
8. Wave washer
- A◀ 9. Exhaust rocker arm assembly "A"
10. Camshaft holder



INSTALLATION SERVICE POINT

►A◄ ROCKER ARM ASSEMBLY INSTALLATION

- (1) Install the rocker arm assemblies while checking the identification marks at the positions shown to ensure that the intake and exhaust sides are not reversed.

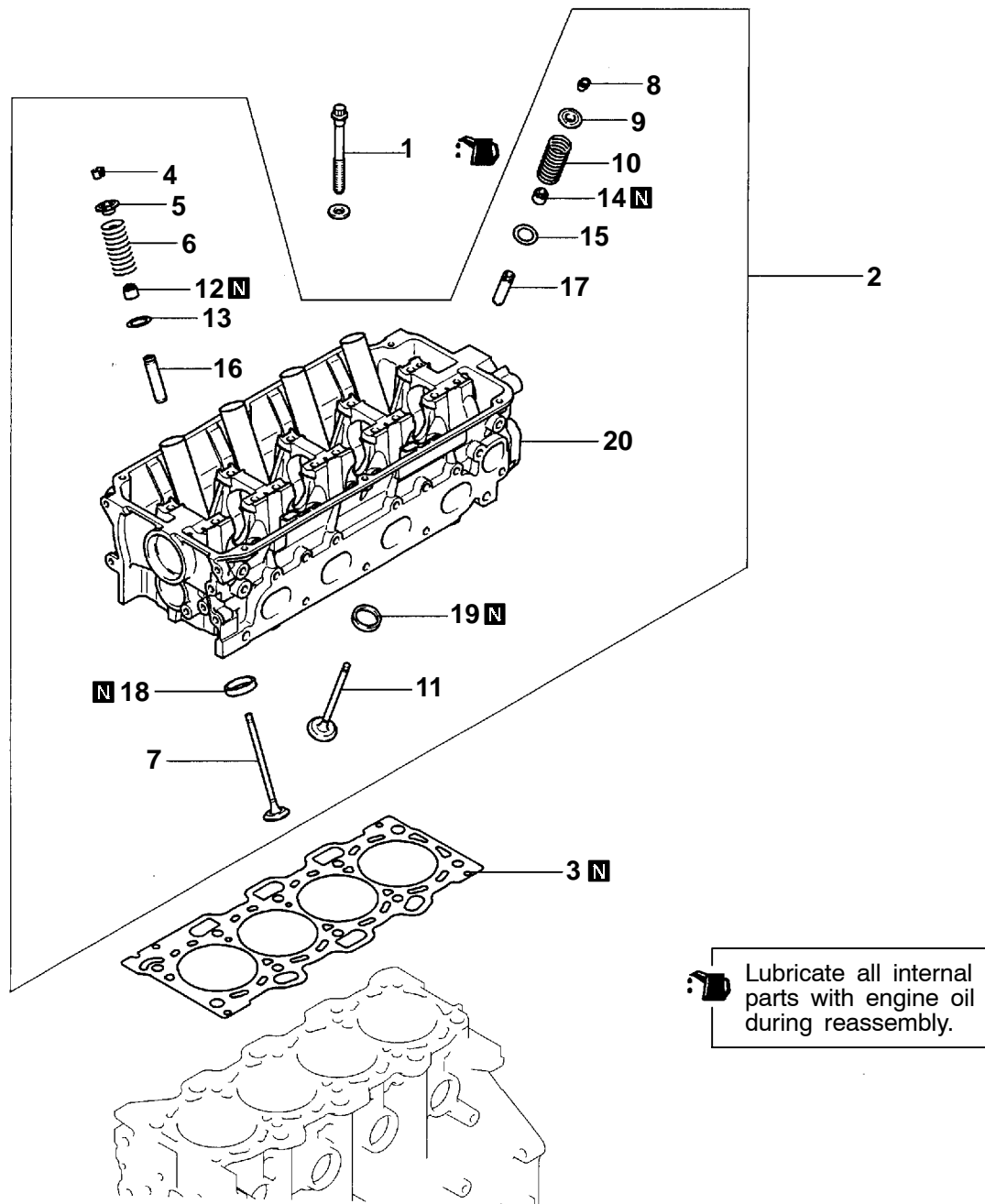
Identification marks:

E: Intake

I: Exhaust

9. CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION <SOHC>



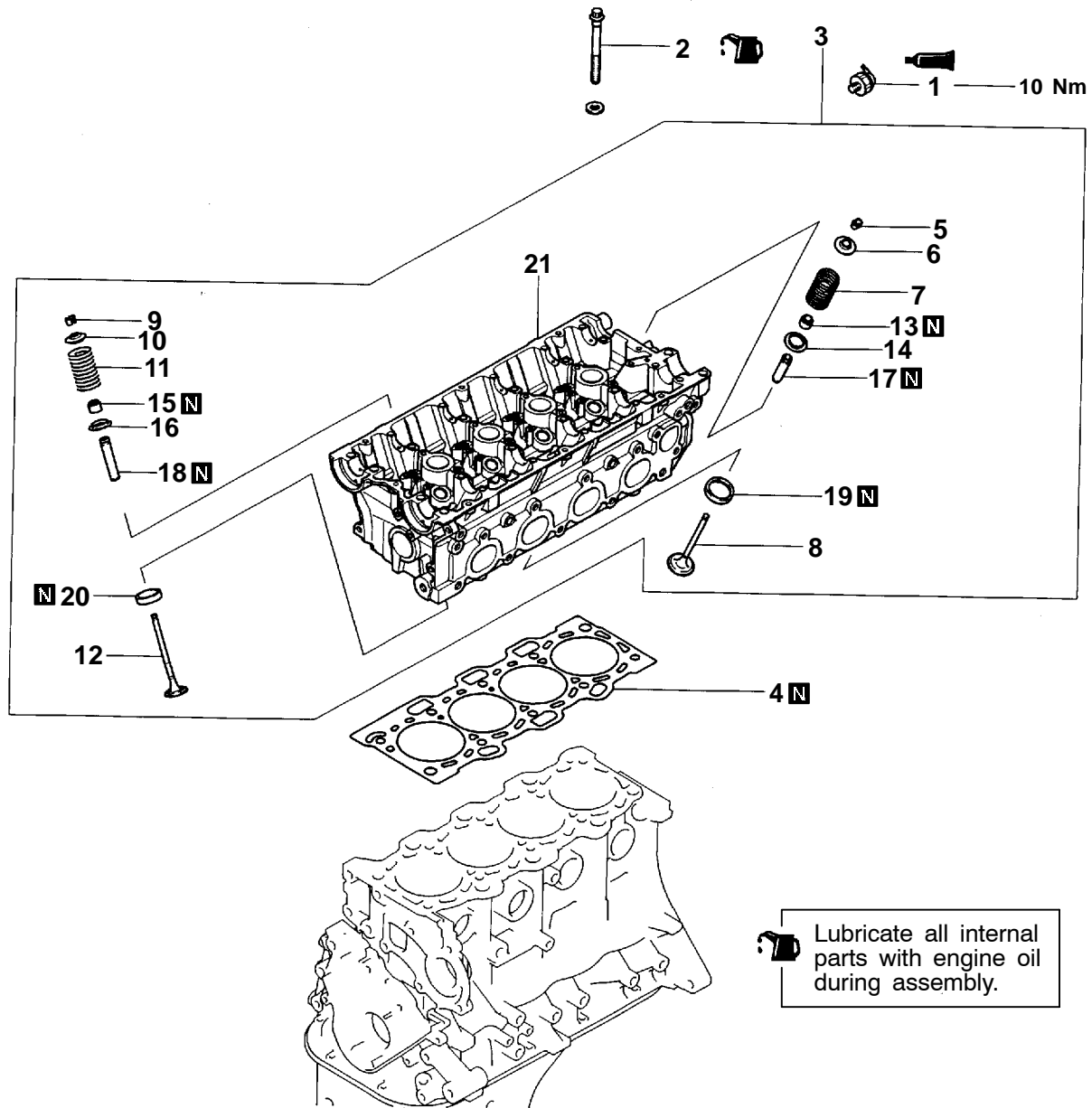
9EN0517

Removal steps

- ◀A▶ ▶D▶ 1. Cylinder head bolt
 ▶B▶ ▶C▶ 2. Cylinder head assembly
 ▶B▶ ▶C▶ 3. Cylinder head gasket
 ▶B▶ ▶C▶ 4. Retainer lock
 ▶B▶ ▶C▶ 5. Valve spring retainer
 ▶B▶ ▶C▶ 6. Valve spring
 ▶B▶ ▶C▶ 7. Exhaust valve
 ▶B▶ ▶C▶ 8. Retainer lock
 ▶B▶ ▶C▶ 9. Valve spring retainer
 ▶B▶ ▶C▶ 10. Valve spring

- ◀C▶ ▶A▶ 11. Intake valve
 ▶C▶ ▶A▶ 12. Valve stem seal
 ▶C▶ ▶A▶ 13. Valve spring seat
 ▶C▶ ▶A▶ 14. Valve stem seal
 ▶C▶ ▶A▶ 15. Valve spring seat
 ▶C▶ ▶A▶ 16. Exhaust valve guide
 ▶C▶ ▶A▶ 17. Intake valve guide
 ▶C▶ ▶A▶ 18. Exhaust valve seat
 ▶C▶ ▶A▶ 19. Intake valve seat
 ▶C▶ ▶A▶ 20. Cylinder head

REMOVAL AND INSTALLATION <DOHC>



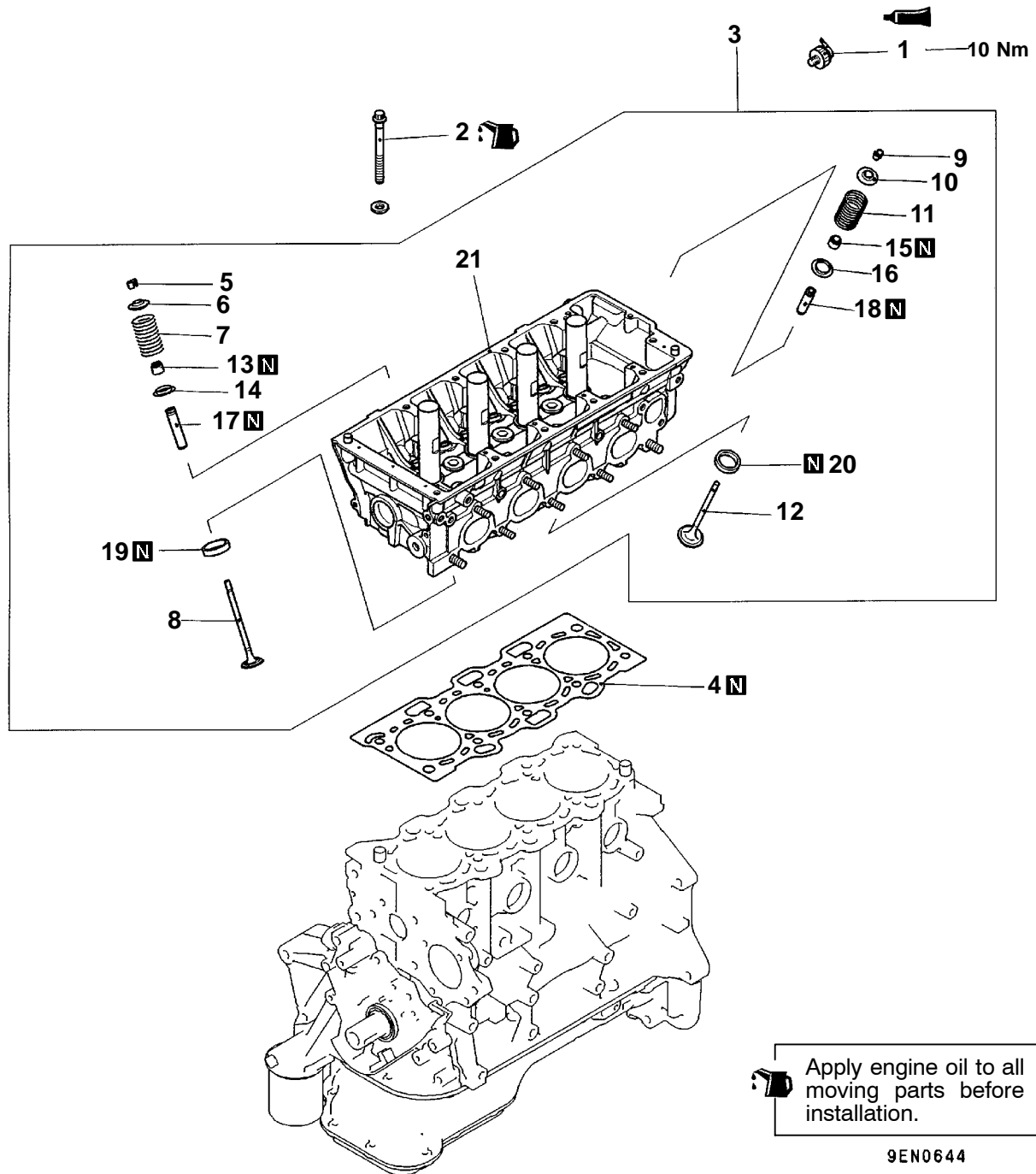
9EN0582

Removal steps

- ◀A▶ ▶E▶ 1. Oil pressure switch
 ▶D▶ 2. Cylinder head bolt
 3. Cylinder head assembly
 ▶B▶ ▶C▶ 4. Cylinder head gasket
 ▶B▶ 5. Retainer lock
 ▶B▶ 6. Valve spring retainer
 ▶B▶ 7. Valve spring
 ▶B▶ 8. Exhaust valve
 ▶B▶ ▶C▶ 9. Retainer lock
 ▶B▶ 10. Valve spring retainer
 ▶B▶ 11. Valve spring

- ▶C▶ ▶A▶ 12. Intake valve
 ▶C▶ ▶A▶ 13. Valve stem seal
 ▶C▶ ▶A▶ 14. Valve spring seat
 ▶C▶ ▶A▶ 15. Valve stem seal
 ▶C▶ ▶A▶ 16. Valve spring seat
 ▶C▶ ▶A▶ 17. Exhaust valve guide
 ▶C▶ ▶A▶ 18. Intake valve guide
 ▶C▶ ▶A▶ 19. Exhaust valve seat
 ▶C▶ ▶A▶ 20. Intake valve seat
 ▶C▶ ▶A▶ 21. Cylinder head

REMOVAL AND INSTALLATION <DOHC-MIVEC>

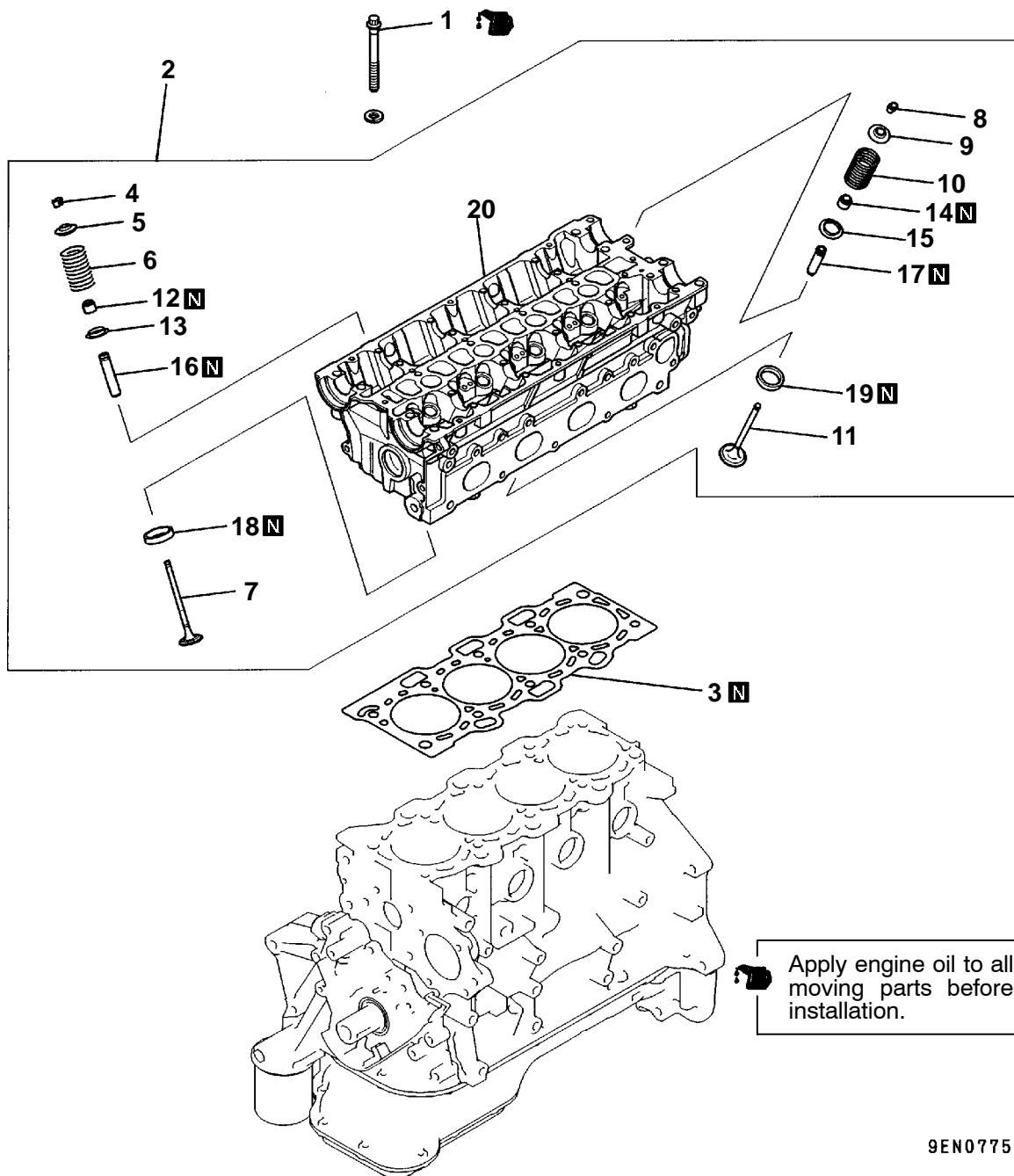


Removal steps

- ◀A▶ ▶E▶ 1. Oil pressure switch
 ▶D▶ 2. Cylinder head bolt
 3. Cylinder head assembly
 ▶B▶ ▶C▶ 4. Cylinder head gasket
 ▶B▶ 5. Retainer lock
 ▶C▶ 6. Valve spring retainer
 ▶B▶ 7. Valve spring
 ▶D▶ 8. Intake valve
 ▶B▶ ▶C▶ 9. Retainer lock
 ▶B▶ 10. Valve spring retainer
 ▶B▶ 11. Valve spring

- ▶D▶ ▶A▶ 12. Exhaust valve
 ▶C▶ ▶A▶ 13. Valve stem seal
 ▶C▶ ▶A▶ 14. Valve spring seat
 ▶C▶ ▶A▶ 15. Valve stem seal
 ▶C▶ ▶A▶ 16. Valve spring seat
 ▶C▶ ▶A▶ 17. Intake valve guide
 ▶C▶ ▶A▶ 18. Exhaust valve guide
 ▶C▶ ▶A▶ 19. Intake valve seat
 ▶C▶ ▶A▶ 20. Exhaust valve seat
 ▶C▶ ▶A▶ 21. Cylinder head

REMOVAL AND INSTALLATION <DOHC-GDI>



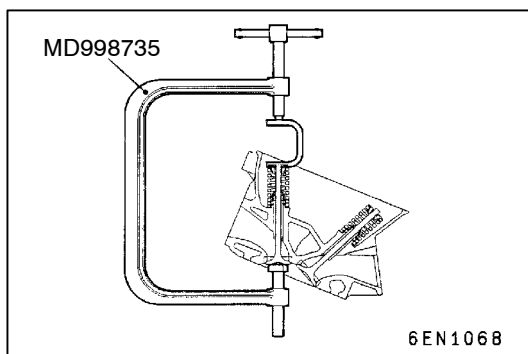
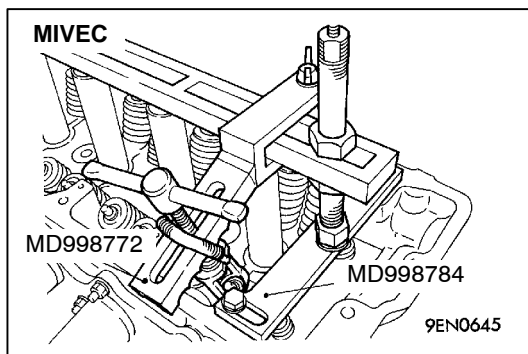
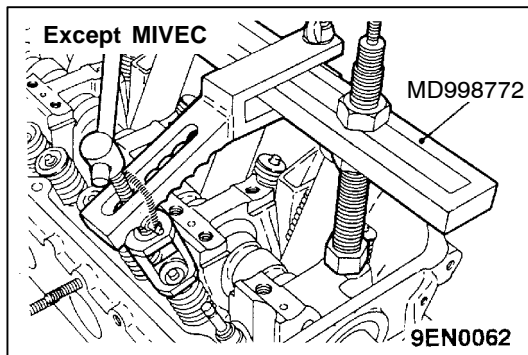
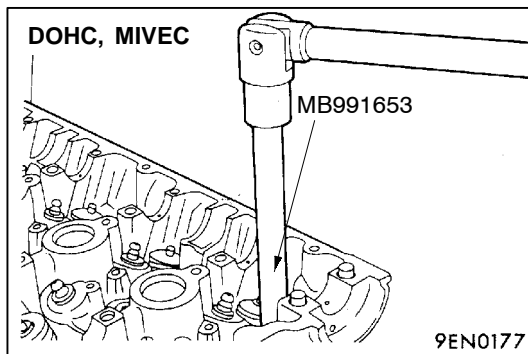
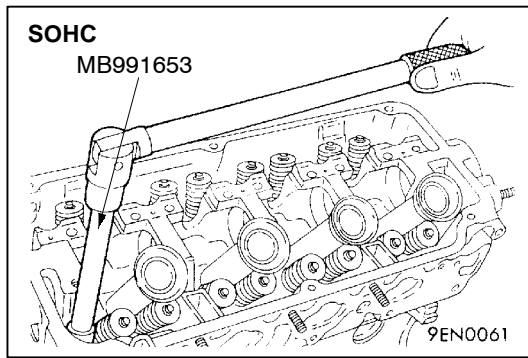
9EN0775

Removal steps

- ◀A▶ ▶D▶ 1. Cylinder head bolt
 2. Cylinder head assembly
 3. Cylinder head gasket
 ▶B▶ ▶C▶ 4. Retainer lock
 5. Valve spring retainer
 ▶B▶ ▶C▶ 6. Valve spring
 ▶D▶ ▶B▶ 7. Intake valve
 ▶B▶ ▶C▶ 8. Retainer lock
 9. Valve spring retainer
 ▶B▶ 10. Valve spring

- ▶D▶ ▶C▶ ▶A▶ 11. Exhaust valve
 ▶C▶ ▶A▶ 12. Valve stem seal
 13. Valve spring seat
 ▶C▶ ▶A▶ 14. Valve stem seal
 15. Valve spring seat
 16. Intake valve guide
 17. Exhaust valve guide
 18. Intake valve seat
 19. Exhaust valve seat
 20. Cylinder head

Intentionally blank



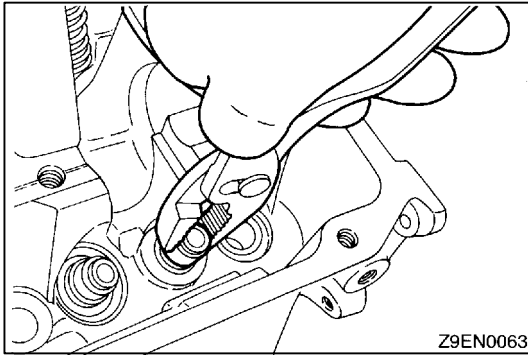
REMOVAL SERVICE POINTS

◀A▶ CYLINDER HEAD BOLT REMOVAL

- (1) Loosen the cylinder head bolts using the special tool.

◀B▶ RETAINER LOCK REMOVAL

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

**◀C▶ VALVE STEM SEAL REMOVAL****◀D▶ VALVE HANDLING PRECAUTIONS**

- (1) Sodium reacts violently with water or moisture generation heat and liberating hydrogen. It must be handled with utmost care because otherwise the following dangerous conditions may result:
Loss of eyesight if sodium gets in eyes.
Burns if sodium contact skin.
Fire hazard.
- (2) Handling of Sodium-filled Exhaust Valves
Sodium-filled exhaust valves are not dangerous and may be handled in the same way as ordinary valves unless they are broken.
Never try to break the valves and expose sodium to the air. When worn exhaust valves are to be discarded, have them disposed of by a salvage company equipped with special disposal system, notifying them that the valves contain sodium.
Should the exhaust valves be broken, neutralize sodium using the method described below, and discard the valves in the same way as ordinary valves.
- (3) How to Neutralize Sodium
Place a container filled with more than 10 liters of water in a well ventilated large space.
Wear rubber gloves and goggles, and carefully take out broken valves from the cylinder head.
Put a broken valve in the water-filled container and quickly get away from the container at least 2 or 3 m (6.6 or 10 ft.)

Caution

- Valves must be neutralized one at a time.
- Put a valve in the container only after sodium in the preceding one has completely reacted with water.

Keep fire away from the container during the neutralization. The resulting hydrogen gas is highly explosive.

When the reaction has finished (there is no more generation of hydrogen gas), take the valves out of the container with large tweezers or the like.

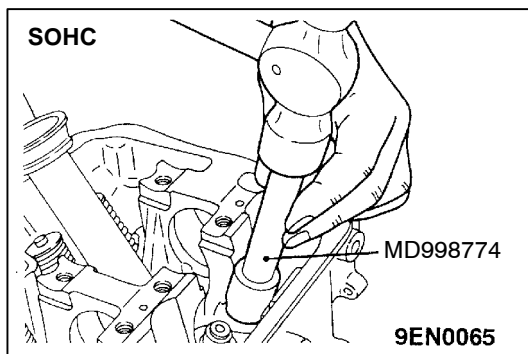
NOTE

The reaction occurs when water enters the cavity in the valve. Hydrogen gas may be trapped inside the valve, temporarily blocking the water passage. In such a case, wait until hydrogen gas is released and remaining sodium reacts with water.

After the neutralization of sodium, water in the container contains sodium hydroxide and is highly alkaline. The water solution should be disposed of according to local regulations.

Caution

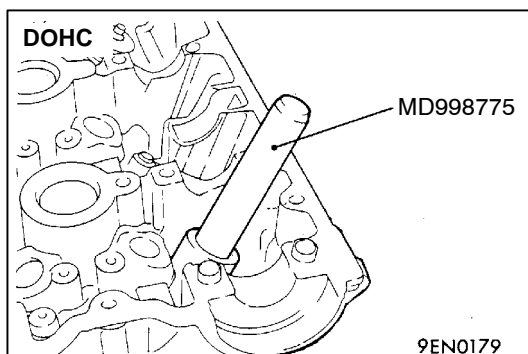
- Do not let the solution contact the eyes or the skin.
- Should it get in the eyes, immediately flush them with clean water thoroughly, and receive medical attention. When it contacts the skin, wash with ample amounts of clean water.

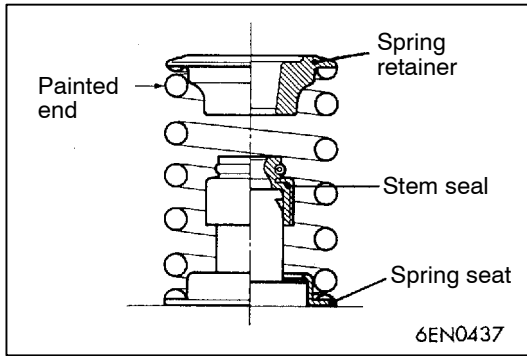
**INSTALLATION SERVICE POINTS****▶A◀ VALVE STEM SEAL INSTALLATION**

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

Caution

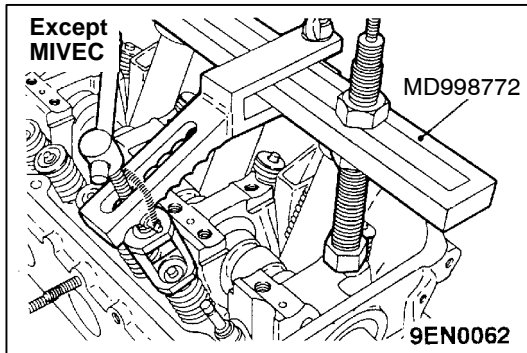
Do not reuse removed valve stem seals.





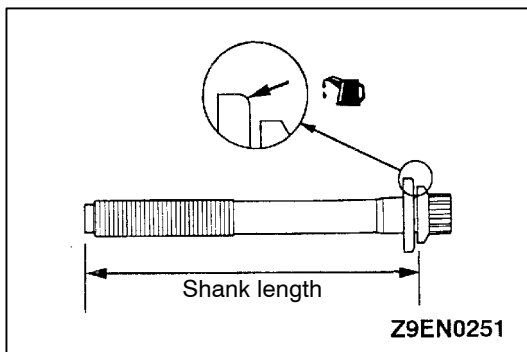
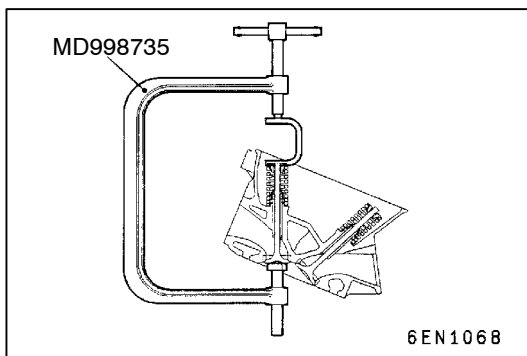
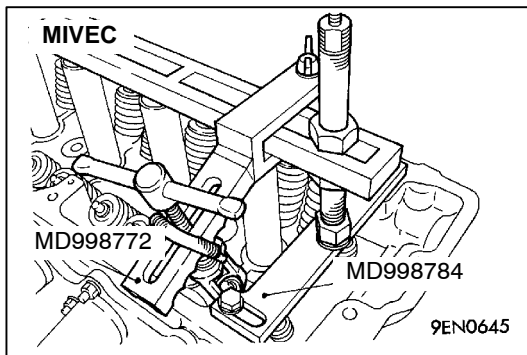
►B◄ VALVE SPRING INSTALLATION

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



►C◄ RETAINER LOCK INSTALLATION

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

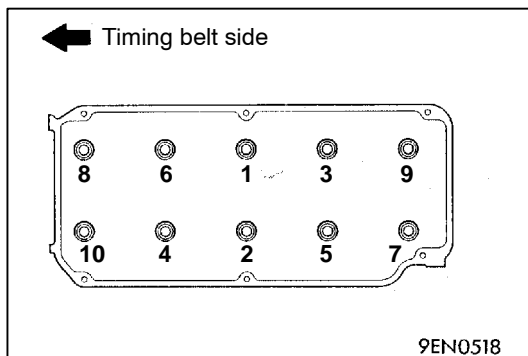


►D◄ CYLINDER HEAD BOLT INSTALLATION

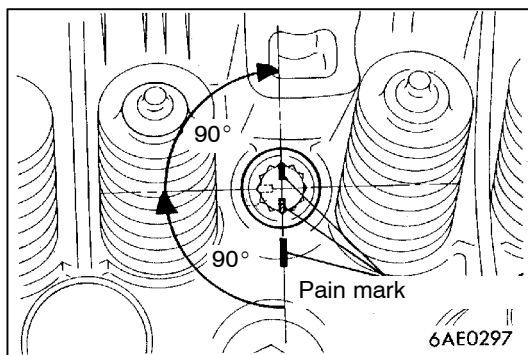
- (1) When installing the cylinder head bolts, check that the shank length of each bolt meets the limit. If the limit is exceeded, replace the bolts.

Limit: Max. 96.4 mm

- (2) Install the washers as illustrated.
- (3) Apply engine oil to the bolt threads and washers.

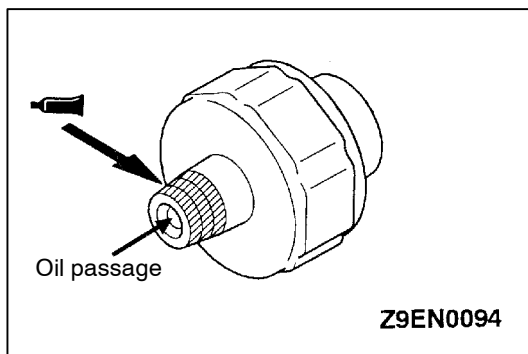


- (4) According to the tightening sequence, tighten the bolts to the specified torque 74 Nm.
- (5) Loosen all bolts fully.
- (6) Retighten the loosened bolts to a torque of 20 Nm in the specified tightening sequence.
- (7) Make paint marks on the cylinder head bolt heads and cylinder head.
- (8) Give a 90° turn to the cylinder head bolts in the specified tightening sequence.
- (9) Give another 90° turn to the cylinder head bolts and make sure that the paint mark on the head of each cylinder head bolt and that on the cylinder head are on the same straight line.



Caution

1. If the bolt is turned less than 90°, proper fastening performance may not be expected. When tightening the bolt, therefore, be careful to give a sufficient turn to it.
2. If the bolt is overtightened, loosen the bolt completely and then retighten it by repeating the tightening procedure from step (1).



►E◄ SEALANT APPLICATION TO OIL PRESSURE SWITCH

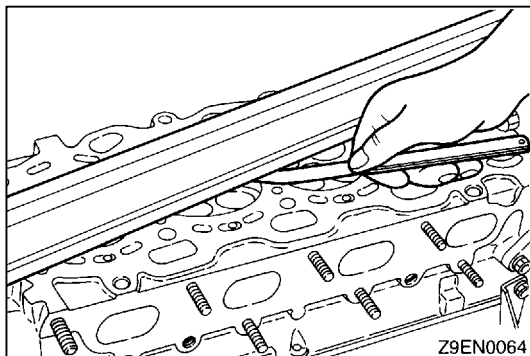
- (1) Apply sealant to the threads of the switch.

Specified sealant:

3M ATD Part No. 8660 or equivalent

Caution

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



INSPECTION

CYLINDER HEAD

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

Standard value: 0.03 mm

Limit: 0.2 mm

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

Grinding limit: *0.2 mm

*Includes/combined with cylinder block grinding

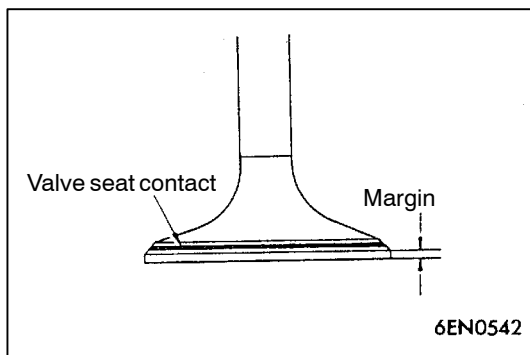
Cylinder head height (Specification when new):

119.9 - 120.1 mm <SOHC>

131.9 - 132.1 mm <DOHC>

119.8 - 120.0 mm <DOHC-MIVEC>

131.9 - 132.1 mm <DOHC-GDI>



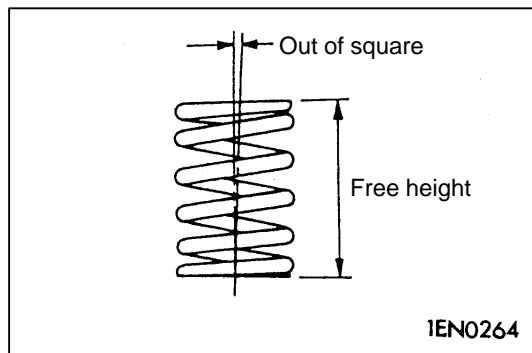
VALVE

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

		Standard value mm	Limit mm
Intake		1.0	0.5
Exhaust	SOHC	1.3	0.8
	DOHC	1.2	0.7

- (3) Measure the overall height of the valve. If the specified limit is exceeded, replace the valve.

		Standard value mm	Limit mm
Intake	SOHC	110.15	109.65
	DOHC	104.19	103.69
	DOHC-MIVEC	115.63	115.13
	DOHC-GDI	104.19	103.69
Exhaust	SOHC	113.70	113.20
	DOHC	103.87	103.37
	DOHC-MIVEC	115.63	115.13
	DOHC-GDI	103.87	103.37

**VALVE SPRING**

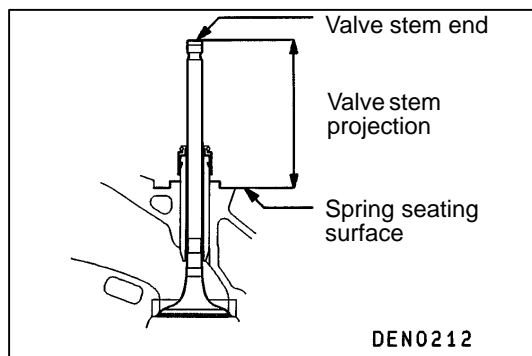
- (1) Measure the valve spring's free height. If the measurement is less than specified, replace the spring.

	Standard value mm	Limit mm
SOHC (with adjusting screw)	50.9	49.9
SOHC (with lash adjuster)	49.5	48.5
DOHC	45.0	44.0
DOHC-MIVEC	51.5	50.5
DOHC-GDI	44.8	43.8

- (2) Measure the squareness of the spring. If the measurement exceeds the specified limit, replace the spring.

Standard value: 2° or less

Limit: 4°

**VALVE SEAT**

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

		Standard value mm	Limit mm
Intake	SOHC	49.30	49.80
	DOHC	46.70	47.20
	DOHC-MIVEC	57.85	58.35
	DOHC-GDI	46.65	47.15
Exhaust	SOHC	49.35	49.85
	DOHC	46.65	47.15
	DOHC-MIVEC	58.13	58.63
	DOHC-GDI	46.70	47.20

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

Exhaust: 0.05 – 0.09 mm

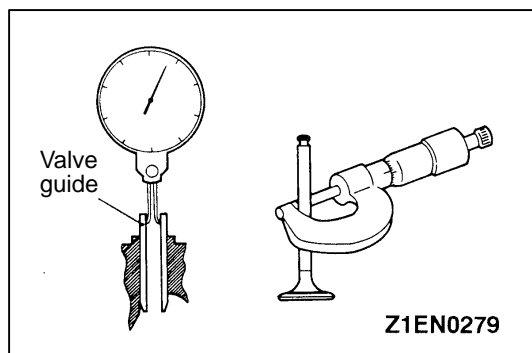
<SOHC, DOHC, DOHC-MIVEC, DOHC-GDI for CARISMA, SPACE STAR, SPACE RUNNER, GALANT>

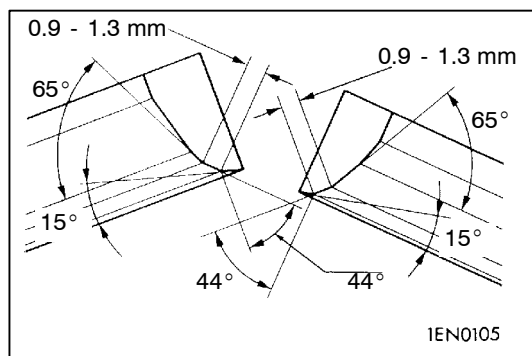
0.04 – 0.06 mm <DOHC-GDI for PAJERO io>

Limit:

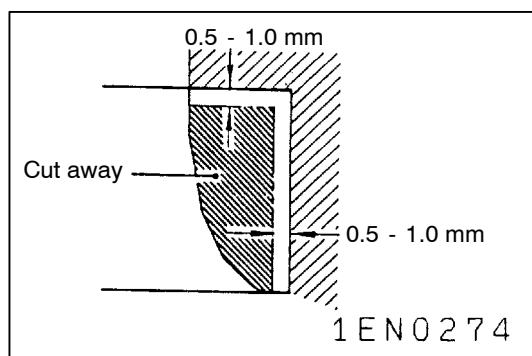
Intake: 0.10 mm

Exhaust: 0.15 mm



**VALVE SEAT RECONDITIONING PROCEDURE**

- (1) Before correcting the valve seat, check the clearance between the valve guide and valve. If necessary, replace the valve and/or valve guide.
- (2) Using the appropriate special tool or seat grinder, correct the valve seat to achieve the specified seat width and 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 REPLACEMENT PROCEDURE**

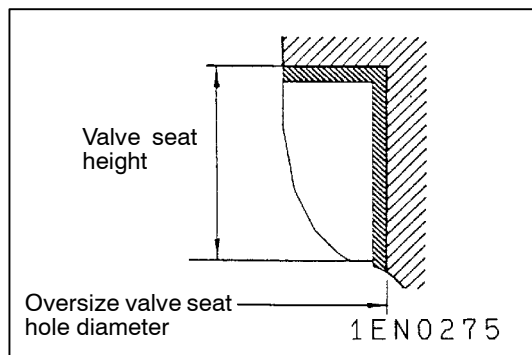
- (1) Cut the valve seat to be replaced from the inside to thin the wall thickness. Then, remove the valve seat.
- (2) Rebore the valve seat hole in the cylinder head to a selected oversize valve seat diameter.

Intake valve seat hole diameter

0.3 O.S.	<SOHC>: 31.80 - 31.83 mm
	<DOHC>: 34.30 - 34.33 mm
0.6 O.S.	<SOHC>: 32.10 - 32.13 mm
	<DOHC>: 34.60 - 34.63 mm

Exhaust valve seat hole diameter

0.3 O.S.	<SOHC>: 29.30 - 29.32 mm
	<DOHC>: 30.80 - 30.83 mm
0.6 O.S.	<SOHC>: 29.60 - 29.62 mm
	<DOHC>: 31.10 - 31.13 mm



- (3) Before fitting the valve seat, either heat the cylinder head up to approximately 250°C or cool the valve seat in liquid nitrogen, to prevent the cylinder head bore from galling.
- (4) Correct the valve seat to the specified width and angle.

VALVE GUIDE REPLACEMENT

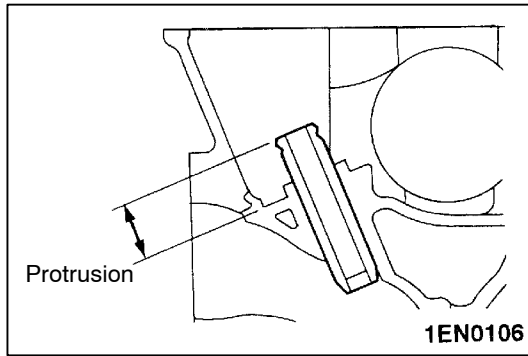
- (1) Force the valve guide out toward the cylinder block using a press.
- (2) Machine the valve guide hole in the cylinder head to the size of the oversize valve guide to be installed.

Caution

Do not use the valve guide of the same size as the removed one.

Valve guide hole diameters in cylinder head

0.05 O.S.:	11.05 - 11.07 mm
0.25 O.S.:	11.25 - 11.27 mm
0.50 O.S.:	11.50 - 11.52 mm



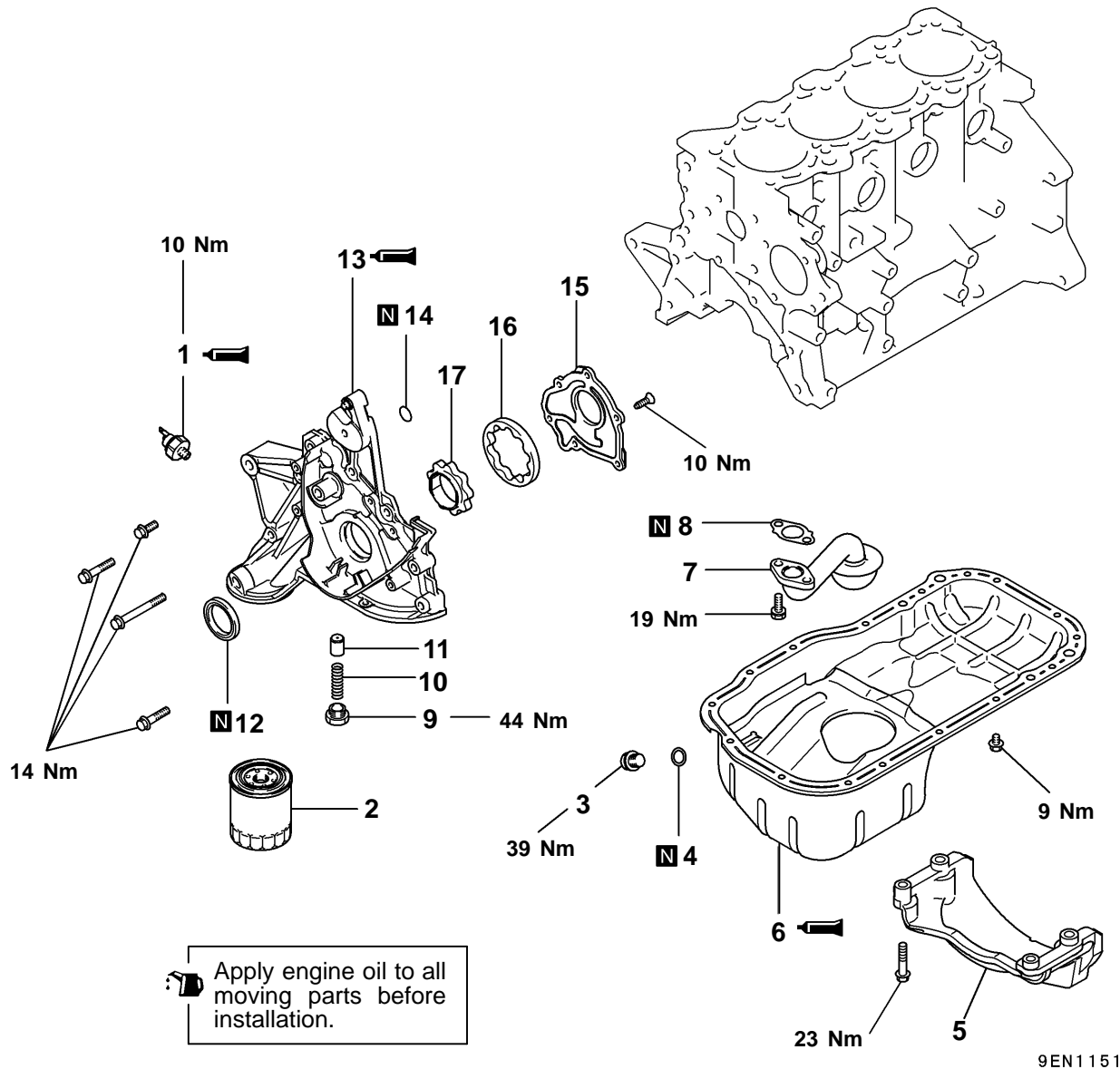
- (3) Press-fit the valve guide until it protrude specified value (SOHC: 14 mm, DOHC: 19 mm) as shown in the illustration.

Caution

1. Press the valve guide from the cylinder head top surface.
 2. Valve guide for intake valve and that for exhaust valve are different in length. (45.5 mm for intake valve; 50.5 mm for exhaust valve)
- (4) After the valve guide has been installed, insert a new valve to check for smooth sliding motion.

10. FRONT CASE AND OIL PUMP

REMOVAL AND INSTALLATION <SOHC (4G92, 4G93)>



Removal steps



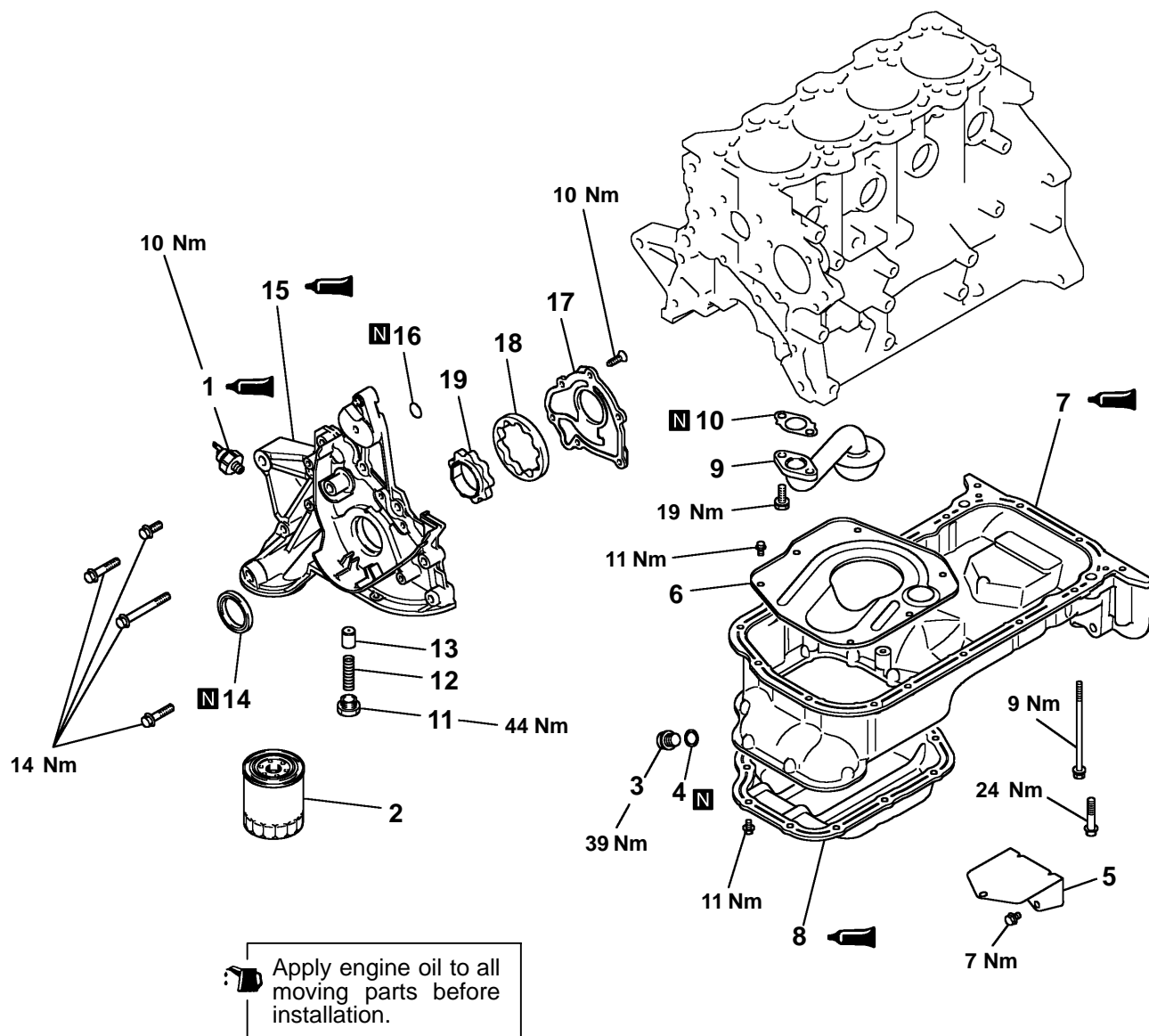
1. Oil pressure switch
2. Oil filter
3. Drain plug
4. Drain plug gasket
5. Transmission stay
6. Oil pan
7. Oil screen
8. Oil screen gasket
9. Relief plug



10. Relief spring
11. Relief plunger
12. Oil seal
13. Oil pump case
14. O-ring
15. Oil pump case cover
16. Outer rotor
17. Inner rotor



REMOVAL AND INSTALLATION <SOHC (4G94 Except for PAJERO io)>



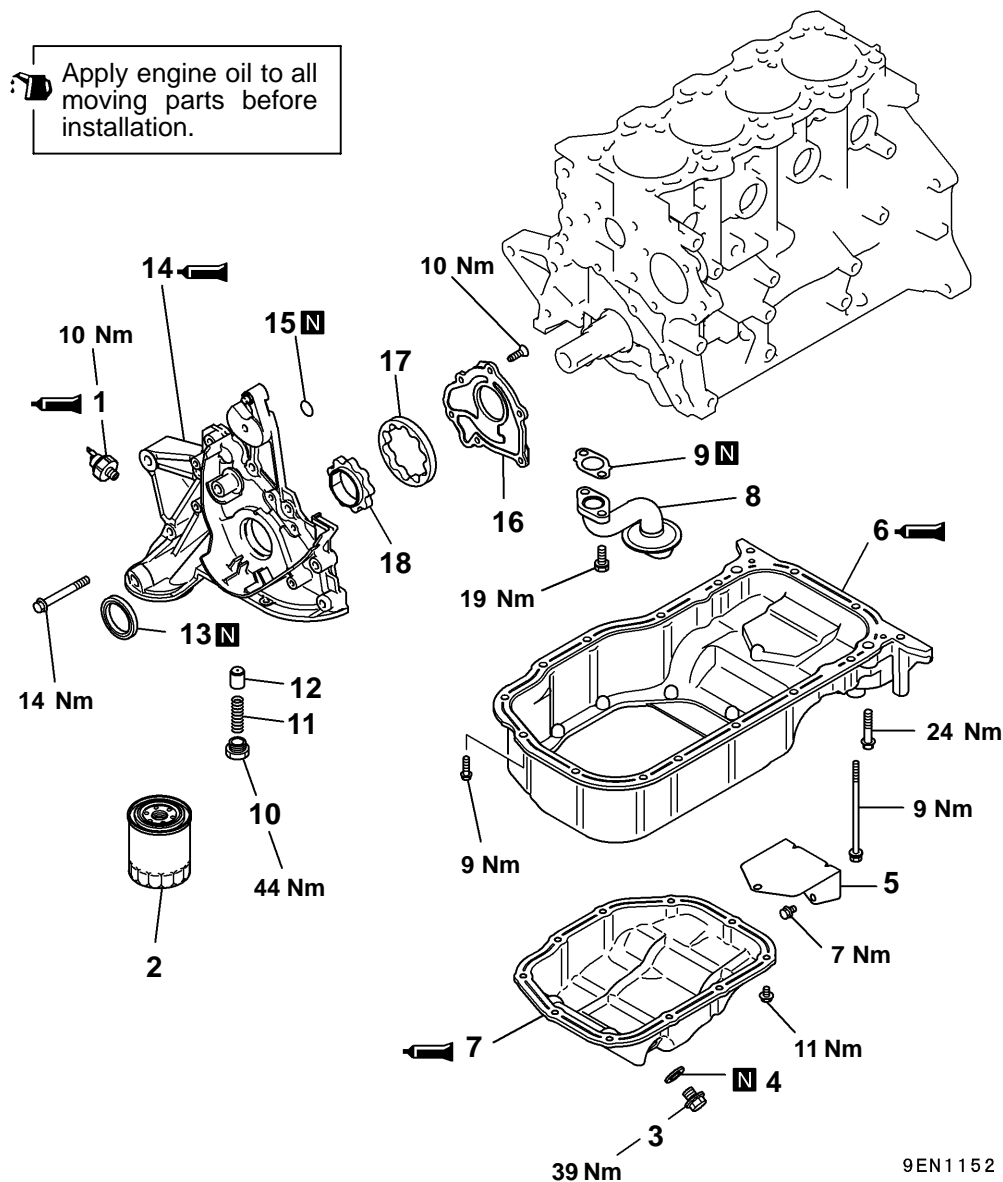
9EN1113

Removal steps

- F
 ➤E
 1. Oil pressure switch
 2. Oil filter
 3. Drain plug
 4. Drain plug gasket
 5. Cover
 6. Baffle plate
 7. Upper oil pan
 8. Lower oil pan
 9. Oil screen
 10. Oil screen gasket

11. Relief plug
 12. Relief spring
 13. Relief plunger
 14. Oil seal
 15. Oil pump case
 16. O-ring
 17. Oil pump case cover
 18. Outer rotor
 19. Inner rotor

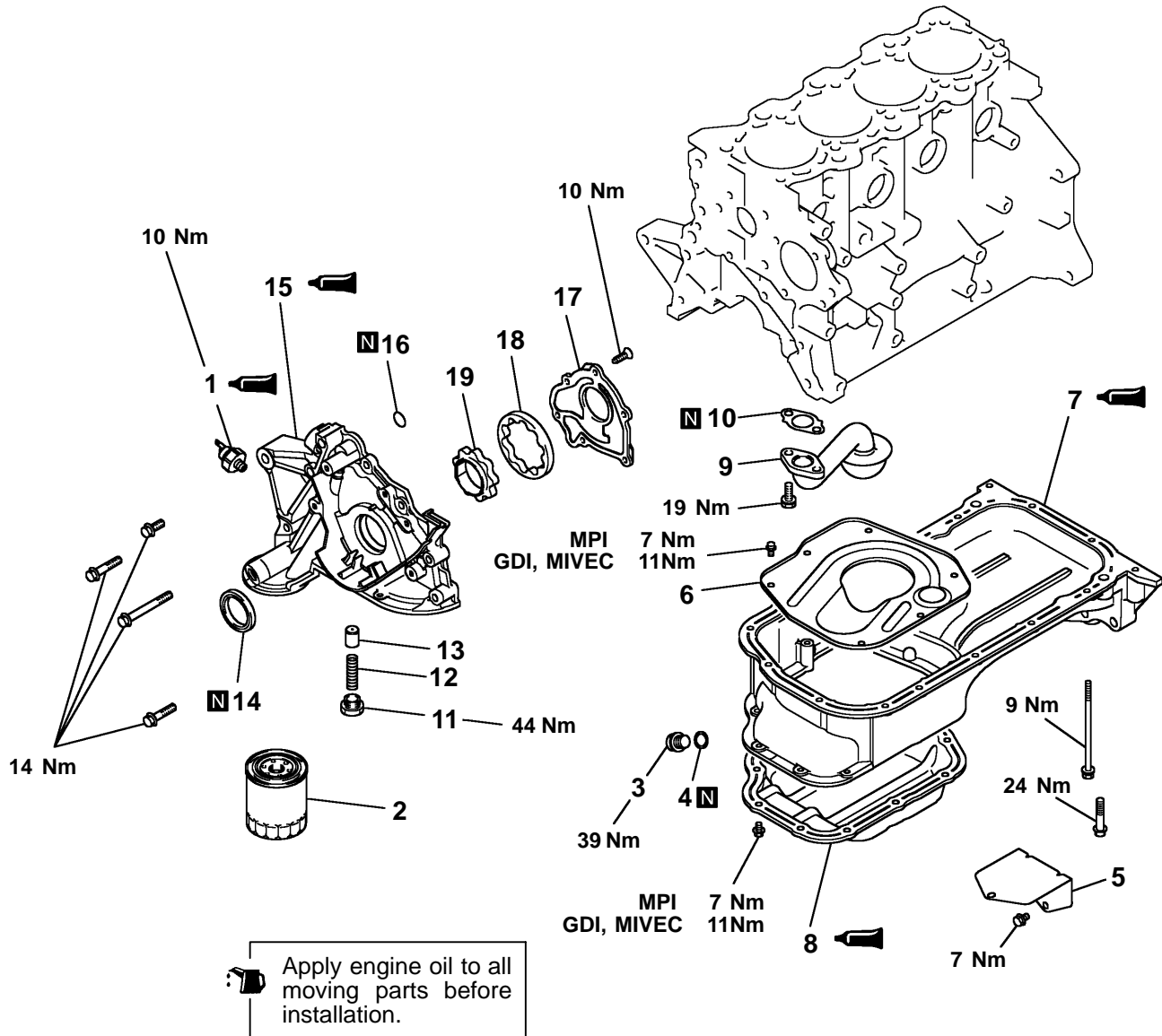
REMOVAL AND INSTALLATION <SOHC (4G94 for PAJERO io)>



Removal steps

- | | | |
|----|------------------------|-------------------------|
| ➤F | 1. Oil pressure switch | 10. Relief plug |
| ➤E | 2. Oil filter | 11. Relief spring |
| | 3. Drain plug | 12. Relief plunger |
| | 4. Drain plug gasket | ➤C |
| | 5. Cover | ➤B |
| ➤B | 6. Upper oil pan | 13. Oil seal |
| ➤D | 7. Lower oil pan | 14. Oil pump case |
| ➤D | 8. Oil screen | 15. O-ring |
| | 9. Oil screen gasket | 16. Oil pump case cover |
| | | 17. Outer rotor |
| | | ➤C |
| | | ➤A |
| | | 18. Inner rotor |

REMOVAL AND INSTALLATION <DOHC (Except GDI for PAJERO io)>



9EN1114

Removal steps



1. Oil pressure switch

2. Oil filter

3. Drain plug

4. Drain plug gasket

5. Cover (GDI, MIVEC)

6. Baffle plate

<Except SPACE RUNNER>

7. Upper oil pan

8. Lower oil pan

9. Oil screen

10. Oil screen gasket

11. Relief plug

12. Relief spring

13. Relief plunger

14. Oil seal

15. Oil pump case

16. O-ring

17. Oil pump case cover

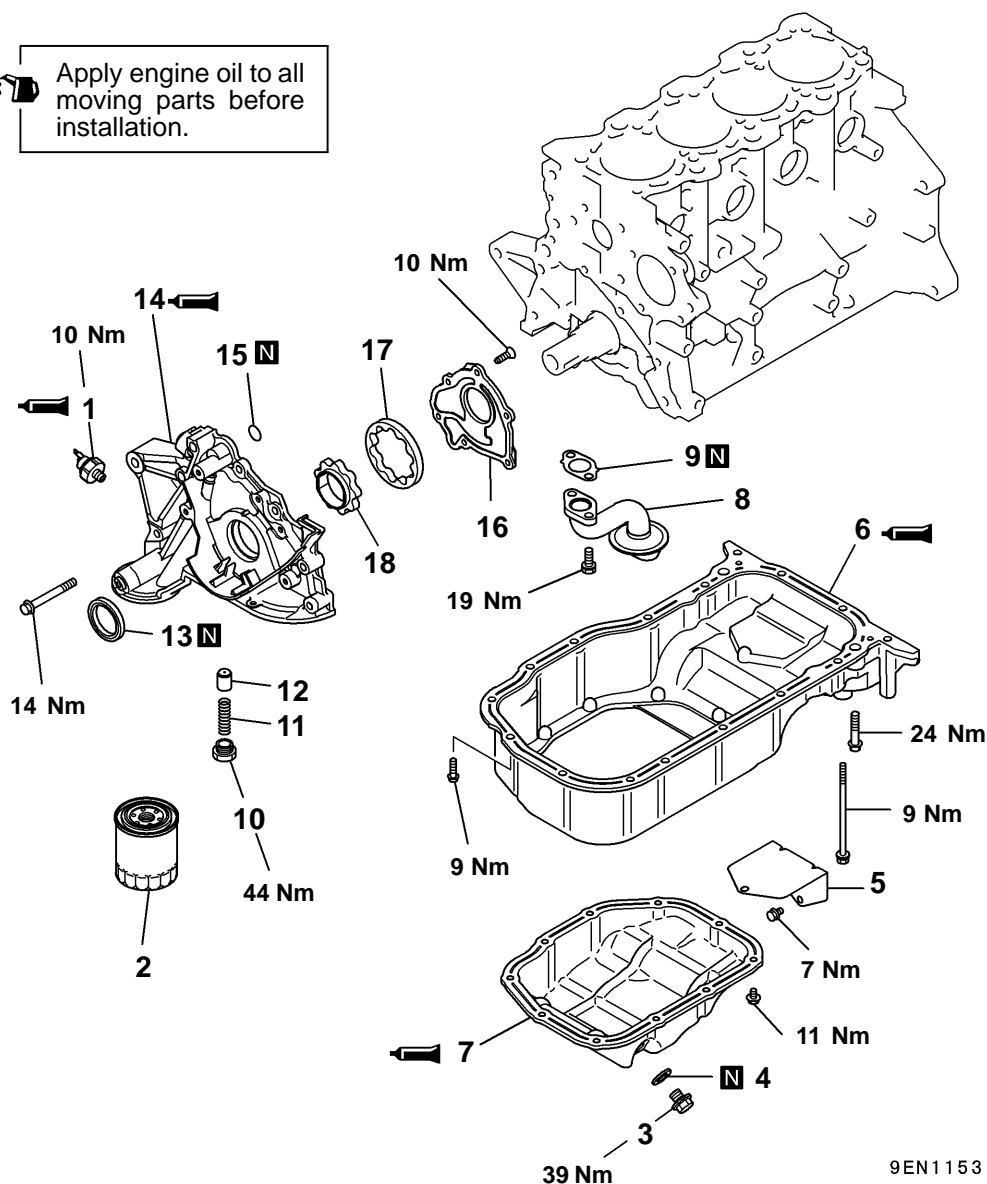
18. Outer rotor

19. Inner rotor



REMOVAL AND INSTALLATION <DOHC-GDI for PAJERO io>

Apply engine oil to all moving parts before installation.



9EN1153

Removal steps



1. Oil pressure switch
2. Oil filter
3. Drain plug
4. Drain plug gasket
5. Cover

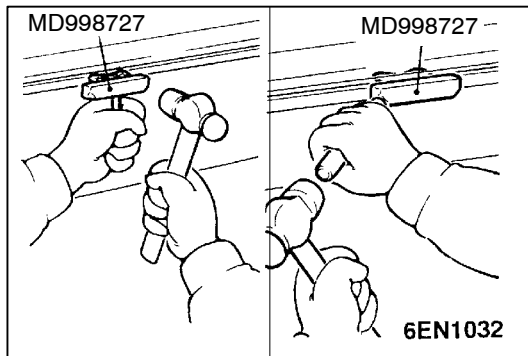


6. Upper oil pan
7. Lower oil pan
8. Oil screen
9. Oil screen gasket



10. Relief plug
11. Relief spring
12. Relief plunger
13. Oil seal
14. Oil pump case
15. O-ring
16. Oil pump case cover
17. Outer rotor
18. Inner rotor





REMOVAL SERVICE POINTS

◀A▶ OIL PAN REMOVAL

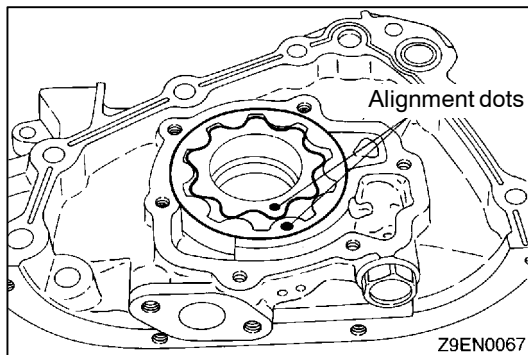
- (1) Knock in the special tool deeply between the oil pan and the cylinder block.
- (2) Hitting the side of the special tool, slide the special tool along the oil pan to remove the oil pan.

◀B▶ REMOVAL OF UPPER OIL PAN

- (1) At first remove the bolt (Length: 121 mm <DOHC, DOHC-GDI for CARISMA>, 116 mm <DOHC-GDI for PAJERO io>) which is nearest to flywheel, and then remove the other bolts.

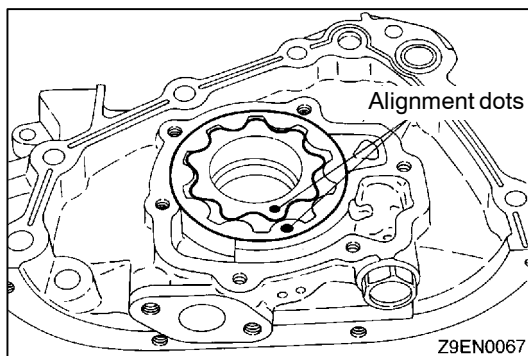
Caution

Never use the special tool (oil pan remover), etc.



◀C▶ OUTER ROTOR/INNER ROTOR REMOVAL

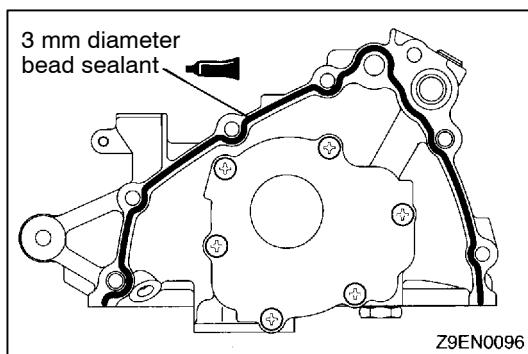
- (1) Make alignment dots on the outer and inner rotors for reference in reassembly.



INSTALLATION SERVICE POINTS

▶A▶ INNER ROTOR/OUTER ROTOR INSTALLATION

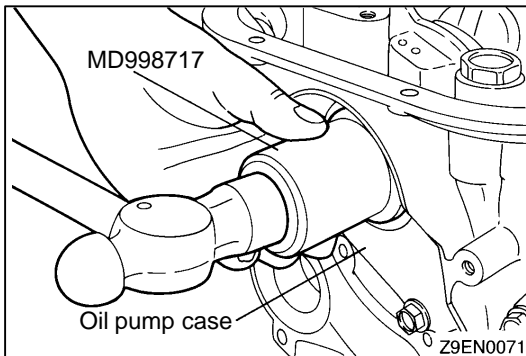
- (1) Apply engine oil to the rotors. Then, install the rotors ensuring that the alignment dots made at disassembly are properly aligned.



▶B▶ SEALANT APPLICATION TO OIL PUMP CASE

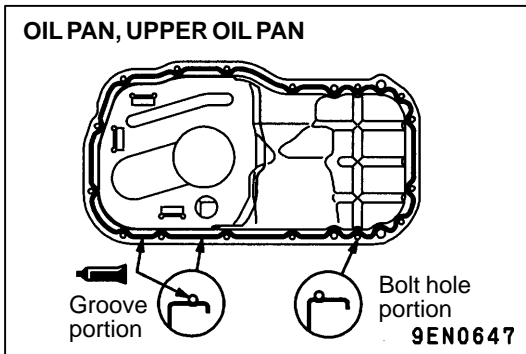
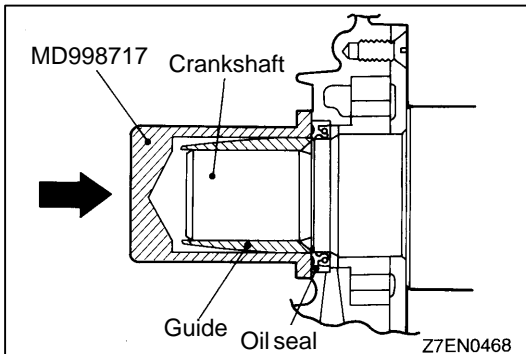
Specified sealant:

Mitsubishi Genuine Part No. MD970389 or equivalent



►C◄ CRANKSHAFT FRONT OIL SEAL INSTALLATION

Using the special tool, knock the oil seal into the oil pump case.



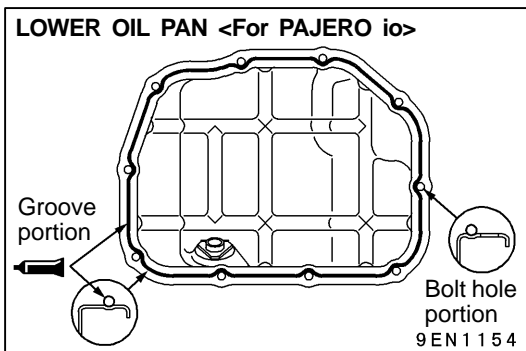
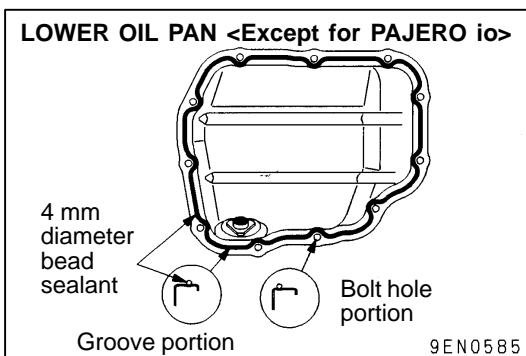
►D◄ OIL PAN/UPPER OIL PAN/LOWER OIL PAN INSTALLATION

- (1) Remove all the remaining gasket from the mating surfaces using a scraper or a wire brush.
- (2) Apply a 4 mm diameter bead of sealant to the oil pan flange.
See "Form-In-Place Gasket" in "SPECIFICATIONS".

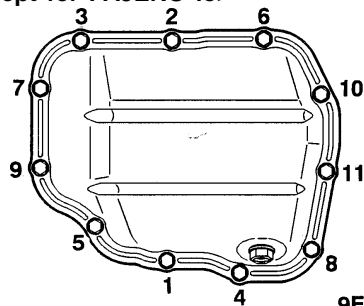
Specified sealant:

Mitsubishi Genuine Part No. MD970389 or equivalent

- (3) Install the oil pan within 15 minutes after applying the sealant.



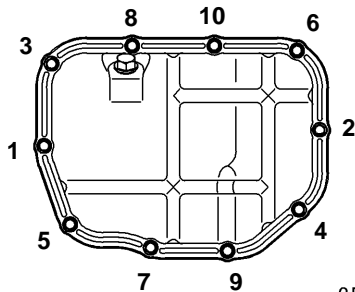
<Except for PAJERO io>



9EN0586

- (4) Tighten the lower oil pan mounting bolts in the sequence shown in the illustration.

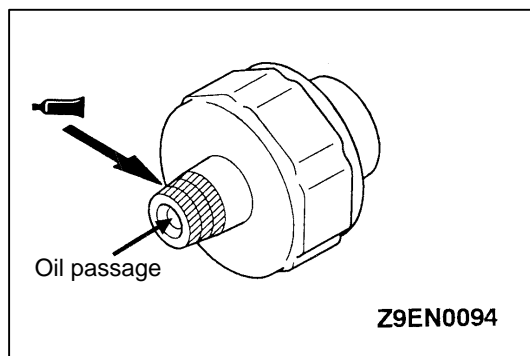
<For PAJERO io>



9EN1155

►E◄ OIL FILTER INSTALLATION

- (1) Clean the filter installation surface of the cylinder block.
- (2) Apply engine oil to the O-ring of the oil filter.
- (3) Screw in the oil filter until its O-ring comes in contact with the base. Then tighten one more turn.



Z9EN0094

►F◄ SEALANT APPLICATION TO OIL PRESSURE SWITCH

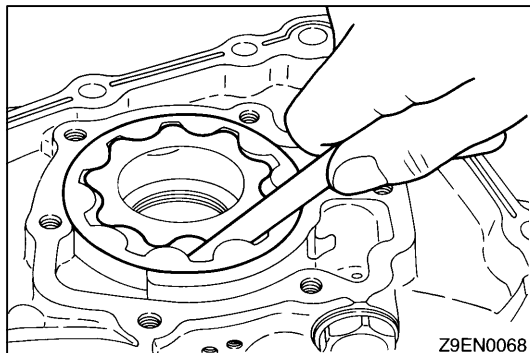
- (1) Apply sealant to the threads of the switch.

Specified sealant:

3M ATD Part No. 8660 or equivalent

Caution

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



Z9EN0068

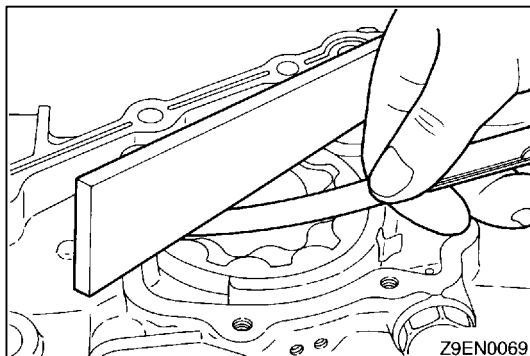
INSPECTION

OIL PUMP

- (1) Check the tip clearance.

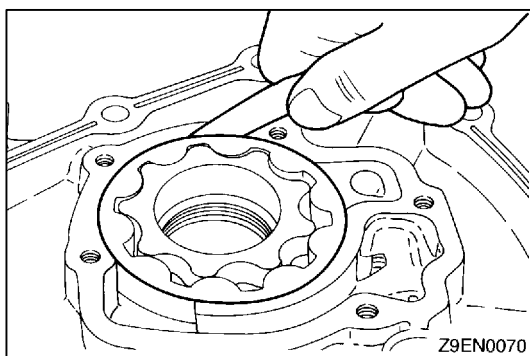
Standard value: 0.06 – 0.18 mm

11300730026



(2) Check the side clearance.

Standard value: 0.04 - 0.10 mm




(3) Check the body clearance.

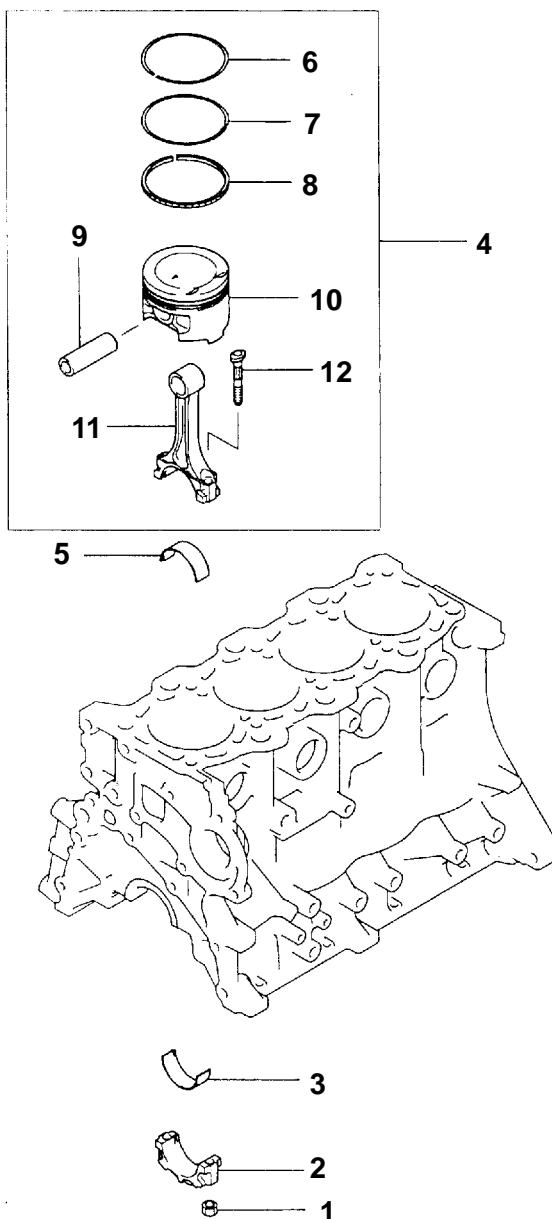
Standard value: 0.10 - 0.18 mm

Limit: 0.35 mm

11. PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

 Lubricate all internal parts with engine oil during re-assembly.

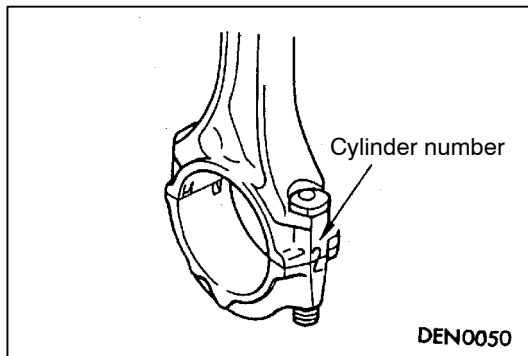


Z9EN0043

Removal steps

- ◀A▶
- ▶G▶ 1. Nut
 - ▶F▶ 2. Connecting rod cap
 - ▶E▶ 3. Connecting rod bearing
 - ▶D▶ 4. Piston and connecting rod
 - ▶E▶ 5. Connecting rod bearing
 - ▶C▶ 6. Piston ring No. 1

- ◀B▶
- ▶C▶ 7. Piston ring No. 2
 - ▶B▶ 8. Oil ring
 - ▶A▶ 9. Piston pin
 - 10. Piston
 - 11. Connecting rod
 - 12. Bolt



REMOVAL SERVICE POINTS

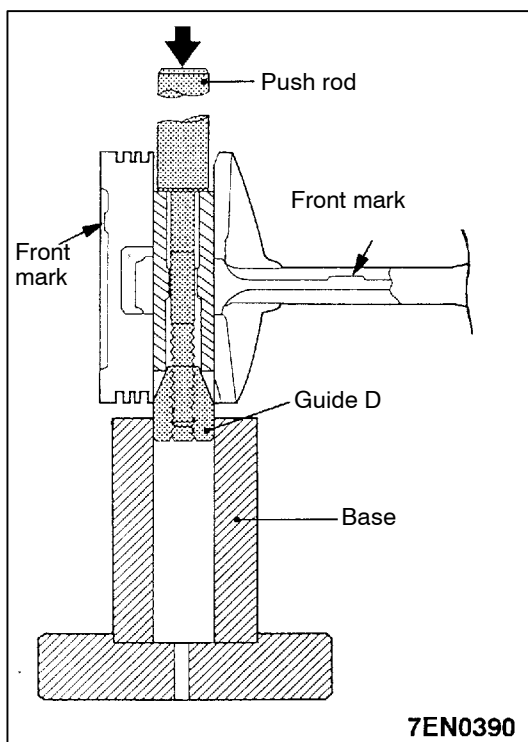
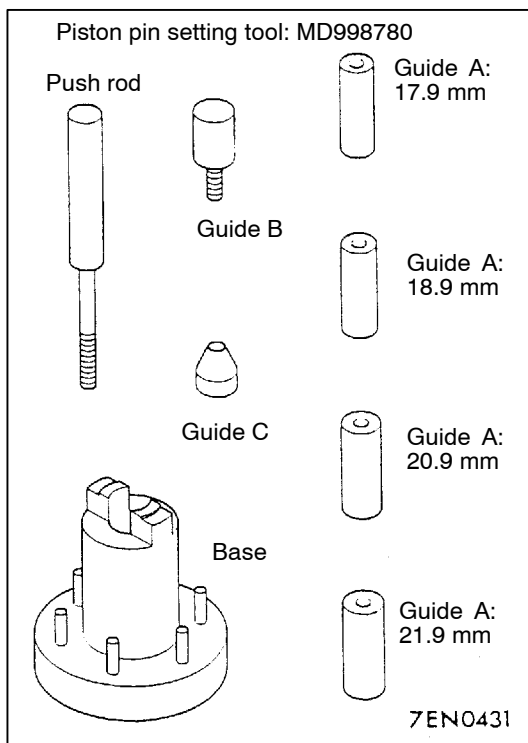
◀A▶ CONNECTING ROD CAP REMOVAL

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

◀B▶ PISTON PIN REMOVAL

Piston pin setting tool (MD998780) consists of the parts shown in the illustration at left.

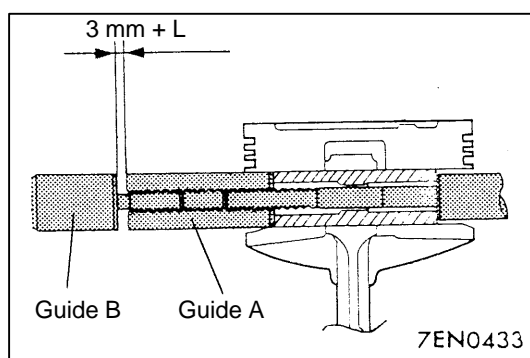
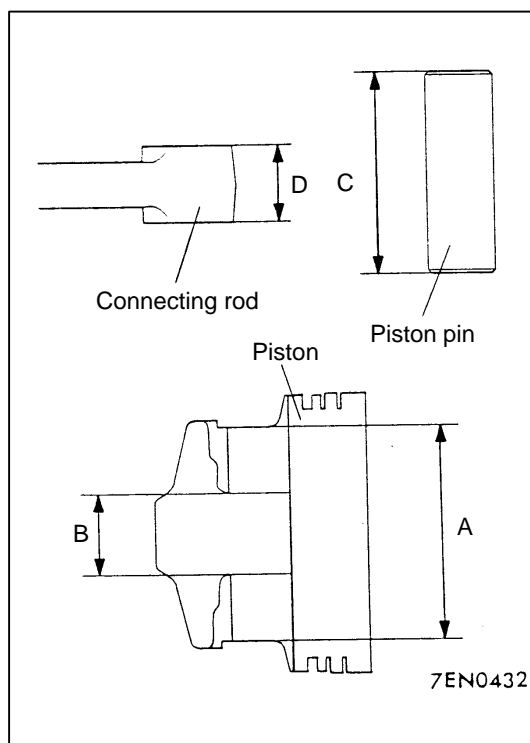
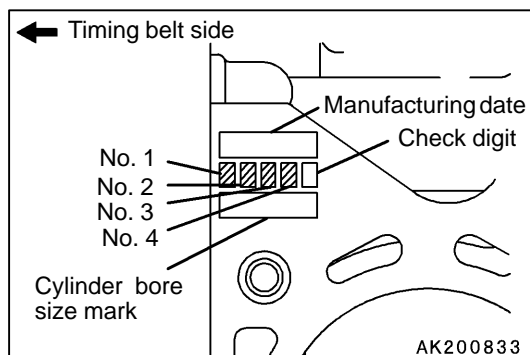
To remove the piston pin, Guide D (MB991659) is also used in combination with the Piston pin setting tool.



- (1) Insert the Push Rod (special tool) into the piston from the side on which the front mark is stamped in the piston head, and attach the guide D to the push rod end.
- (2) Place the piston and connecting rod assembly on the Piston Pin Setting Base (special tool) with the front mark facing upward.
- (3) Using a press, remove the piston pin.

NOTE

Keep the disassembled pistons, piston pins and connecting rods in order according to the cylinder number.



INSTALLATION SERVICE POINTS

►A◄ PISTON PIN INSTALLATION

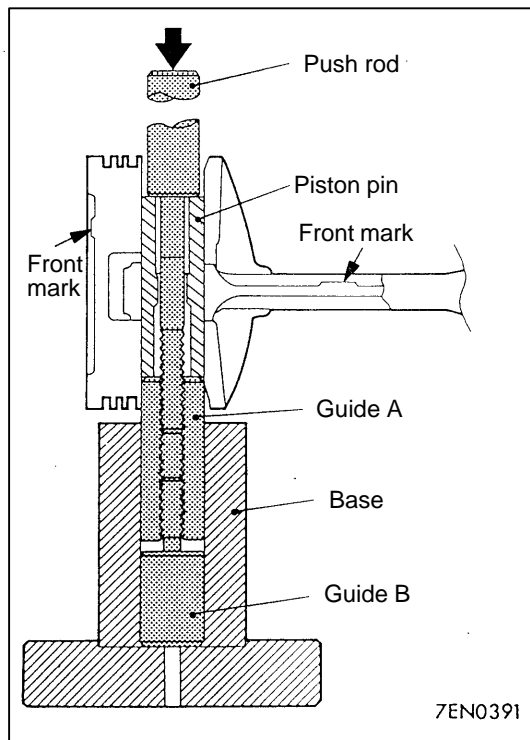
- (1) When replacing a piston, read off the cylinder bore size mark on the cylinder block as illustrated, and select a piston of proper size according to the following table.

Cylinder bore size mark	Piston class	Piston size mark
I	A	A
II	B	None
III	C	C

NOTE

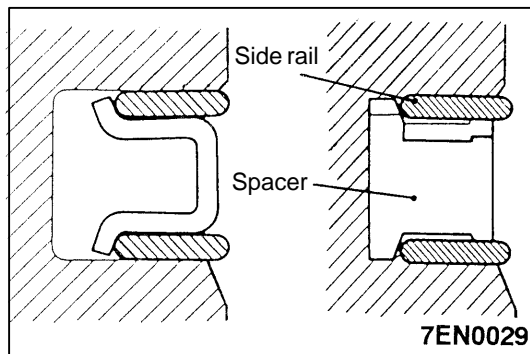
The piston size mark shows on the top of the piston.

- (2) Measure the following dimensions of the piston, piston pin and connecting rod.
A: Piston pin insertion hole length
B: Distance between piston bosses
C: Piston pin length
D: Connecting rod small end width
- (3) Calculate the following formula by substituting the measured value.
$$L = ((A - C) - (B - D))/2$$
- (4) Insert the Push Rod (special tool) into the piston pin and attach the guide A to the push rod end.
- (5) Assemble the connecting rod in the piston with their front marks facing the same direction.
- (6) Apply engine oil to the entire periphery of the piston pin.
- (7) Insert the piston pin, push rod and guide A assembly having assembled in step (3) from the guide A side into the piston pin hole on the front marked side.
- (8) Screw the guide B into the guide A until the gap between both guides amounts to the value L obtained in step (2) plus 3 mm.



- (9) Place the piston and connecting rod assembly onto the piston setting base with the front marks directed upward.
- (10) Press-fit the piston pin using a press. If the press-fitting force required is less than the standard value, replace the piston and piston pin set or/and the connecting rod.

Standard value: 4,500 – 14,700 N



►B◄ OIL RING INSTALLATION

- (1) Fit the oil ring spacer into the piston ring groove. Install the upper side rail, and then install the lower side rail.

NOTE

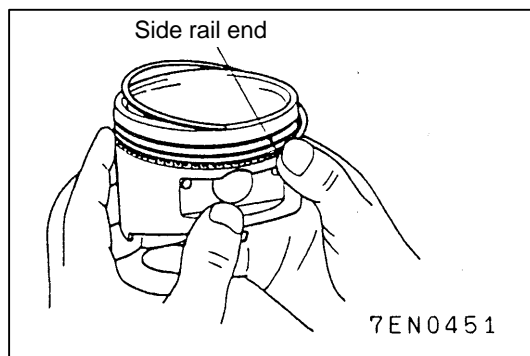
1. The side rails and spacer may be installed in either direction.
2. New spacer and side rail are painted with the following identification colour according to the size.

Size	Identification colour
Standard size	None* ¹ or red* ²
0.50 mm O.S.	Blue
1.00 mm O.S.	Yellow

*1: Except PAJERO io 4G94-16-valve for General Export, South Africa, Egypt

*2: PAJERO io 4G94-16-valve for General Export, South Africa, Egypt

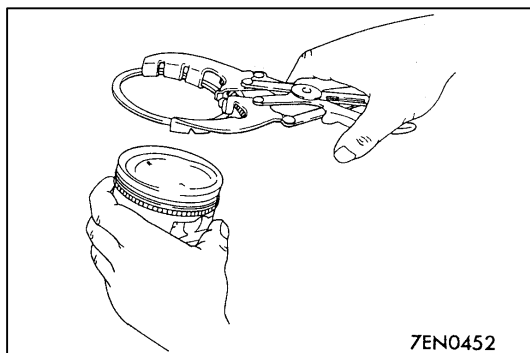
3. To install the side rail, first fit one end of the rail into the piston groove, then press the remaining portion into position by finger as shown in the illustration.



Caution

Do not use piston ring expander when installing side rail. Use of piston ring expander to expand the side rail end gap can break the side rail, unlike other piston rings.

- (2) Make sure that the side rails move smoothly in either direction.



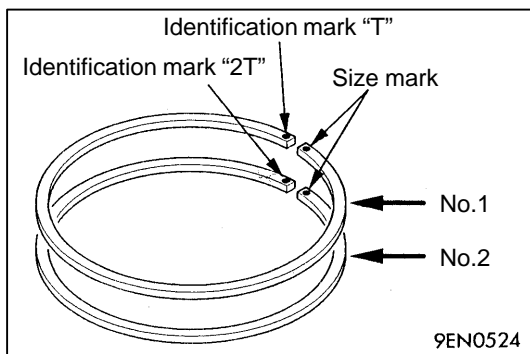
►C◄ PISTON RING NO.2/PISTON RING NO.1 INSTALLATION

- (1) Using piston ring expander, install the piston rings with their side having identification marks facing up.

Identification mark:

No.1 ring: T

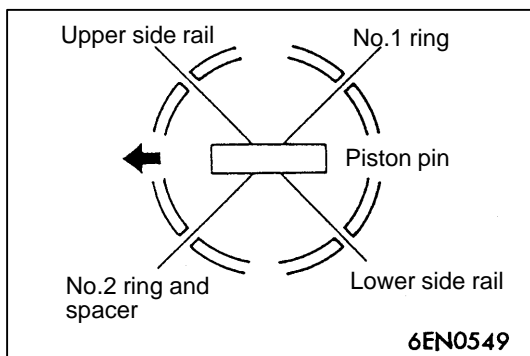
No.2 ring: 2T



NOTE

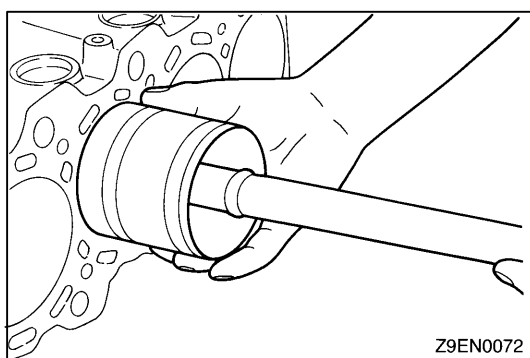
The piston ring is stamped with the following size mark.

Size	Size mark
Standard size	None
0.50 mm O.S.	50
1.00 mm O.S.	100



►D◄ PISTON AND CONNECTING ROD INSTALLATION

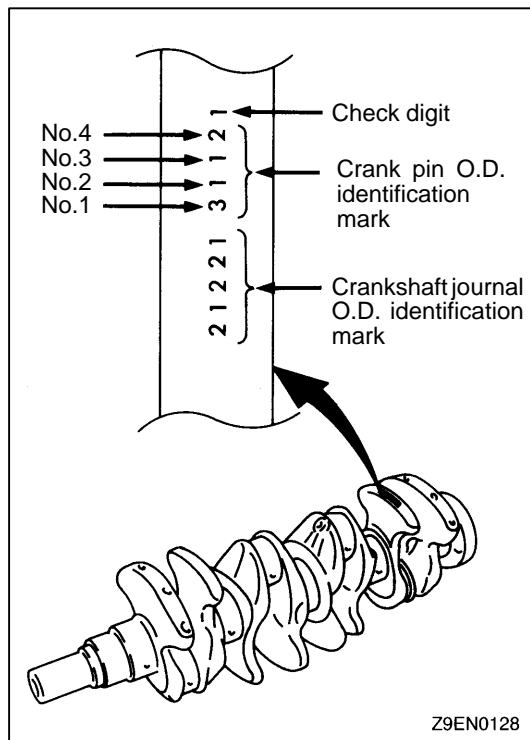
- (1) Liberally coat engine oil on the circumference of the piston, piston ring and oil ring.
- (2) Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the illustration.
- (3) Face the front mark (arrow) on the top of the piston toward the camshaft sprocket.



- (4) Using a suitable piston ring compressor tool, insert the piston and connecting rod assembly into the cylinder block.

Caution

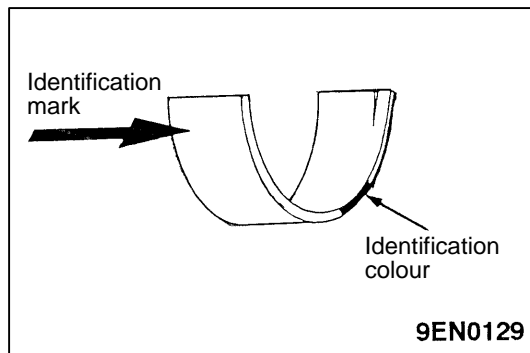
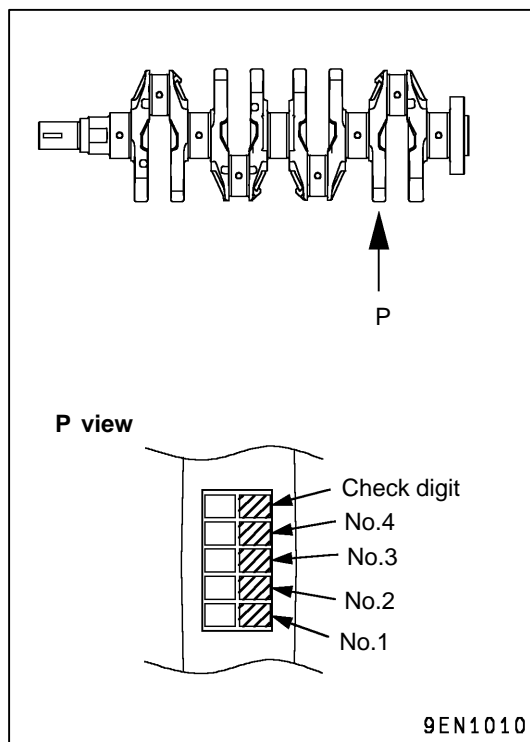
Do not strike the piston into the cylinder block because the piston ring or crank pin will be damaged.

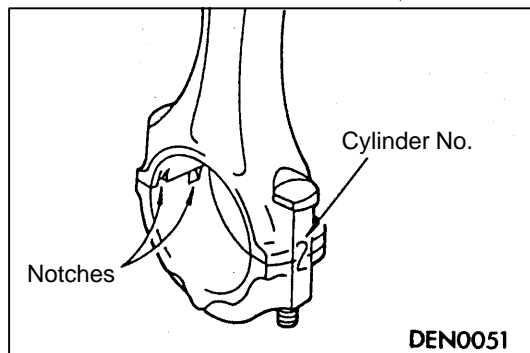


►E◄ CONNECTING ROD BEARING INSTALLATION

- (1) When the bearings are to be replaced, select correct ones according to the identification marks stamped in the crankshaft.

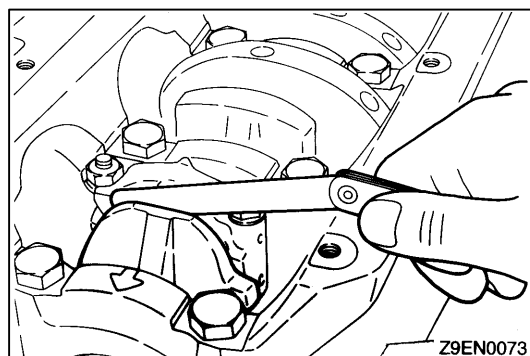
Crankshaft	Connecting rod bearing	
Pin O.D. identification mark	Identification mark (service part)	Identification colour (Line production part)
1	S1 or 1	Brown
2	S2 or 2	Black
3	S3 or 3	Green





►F◄ CONNECTING ROD CAP INSTALLATION

- (1) Mate the correct bearing cap with the correct connecting rod by checking with the alignment marks marked during disassembly. If a new connecting rod has no alignment mark, position the notches for locking the bearing on the same side.



- (2) Check if the thrust clearance in the connecting rod big end is correct.

Standard value: 0.10 – 0.25 mm

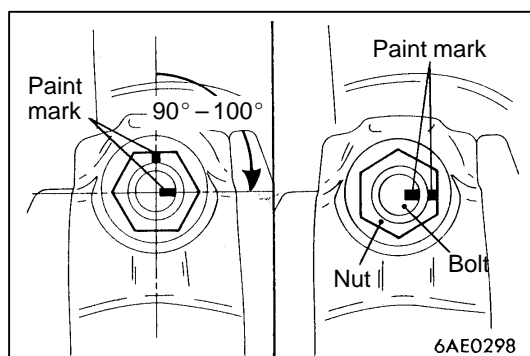
Limit: 0.4 mm

►G◄ CONNECTING ROD CAP NUT INSTALLATION

Caution

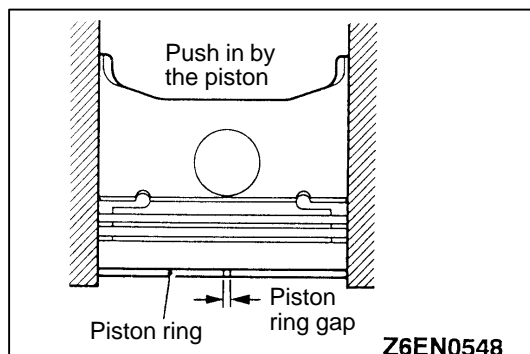
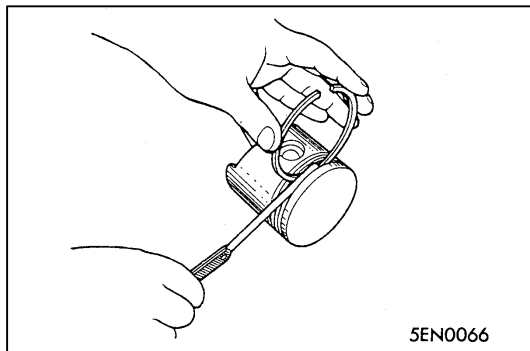
If the cylinder head has been installed before installing the connecting rod cap nut, be sure to remove the spark plugs.

- (1) Since the connecting rod cap bolts and nuts are torqued using the plastic area tightening method, the bolts should be examined BEFORE reuse. If the bolt threads are "necked down", the bolt should be replaced.
Necking can be checked by running a nut with fingers to the full length of the bolt threads. If the nut does not run down smoothly, the bolt should be replaced.
- (2) Before installation of each nut, apply engine oil to the thread portion and bearing surface of the nut.
- (3) Install each nut to the bolt and tighten it with fingers. Then tighten the nuts alternately to install the cap properly.
- (4) Tighten the nuts to a torque of 20 Nm.
- (5) Make a paint mark on the head of each nut.
- (6) Make a paint mark on the bolt end at the position 90° to 100° from the paint mark made on the nut in the direction of tightening the nut.
- (7) Give a 90° to 100° turn to the nut and make sure that the paint mark on the nut and that on the bolt are in alignment.



Caution

1. If the nut is turned less than 90°, proper fastening performance may not be expected. When tightening the nut, therefore, be careful to give a sufficient turn to it.
2. If the nut is overtightened (exceeding 100°), loosen the nut completely and then retighten it by repeating the tightening procedure from step (1).



INSPECTION

PISTON RING

- (1) Check the clearance between the piston ring and ring groove. If the limit is exceeded, replace the ring or piston, or both.

Standard value:

No.1: 0.03 – 0.07 mm

No.2: 0.02 – 0.06 mm

Limit:

No.1: 0.1 mm

No.2: 0.1 mm

Install the piston ring into the cylinder bore. Force the ring down with a piston, the piston 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 ring gap is excessive, replace the piston ring.

Standard value:

No.1: 0.25 – 0.40 mm (4G92, 4G93)

0.15 – 0.30 mm (4G94)

No.2: 0.40 – 0.55 mm

Oil:

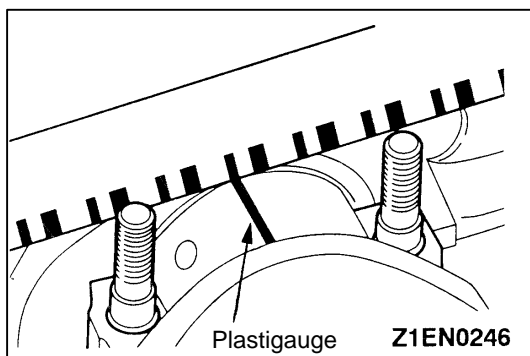
SOHC (4G92, 4G93): 0.20 – 0.60 mm

SOHC (4G94), DOHC: 0.10 – 0.35 mm

Limit:

No.1, No.2: 0.8 mm

Oil: 1.0 mm



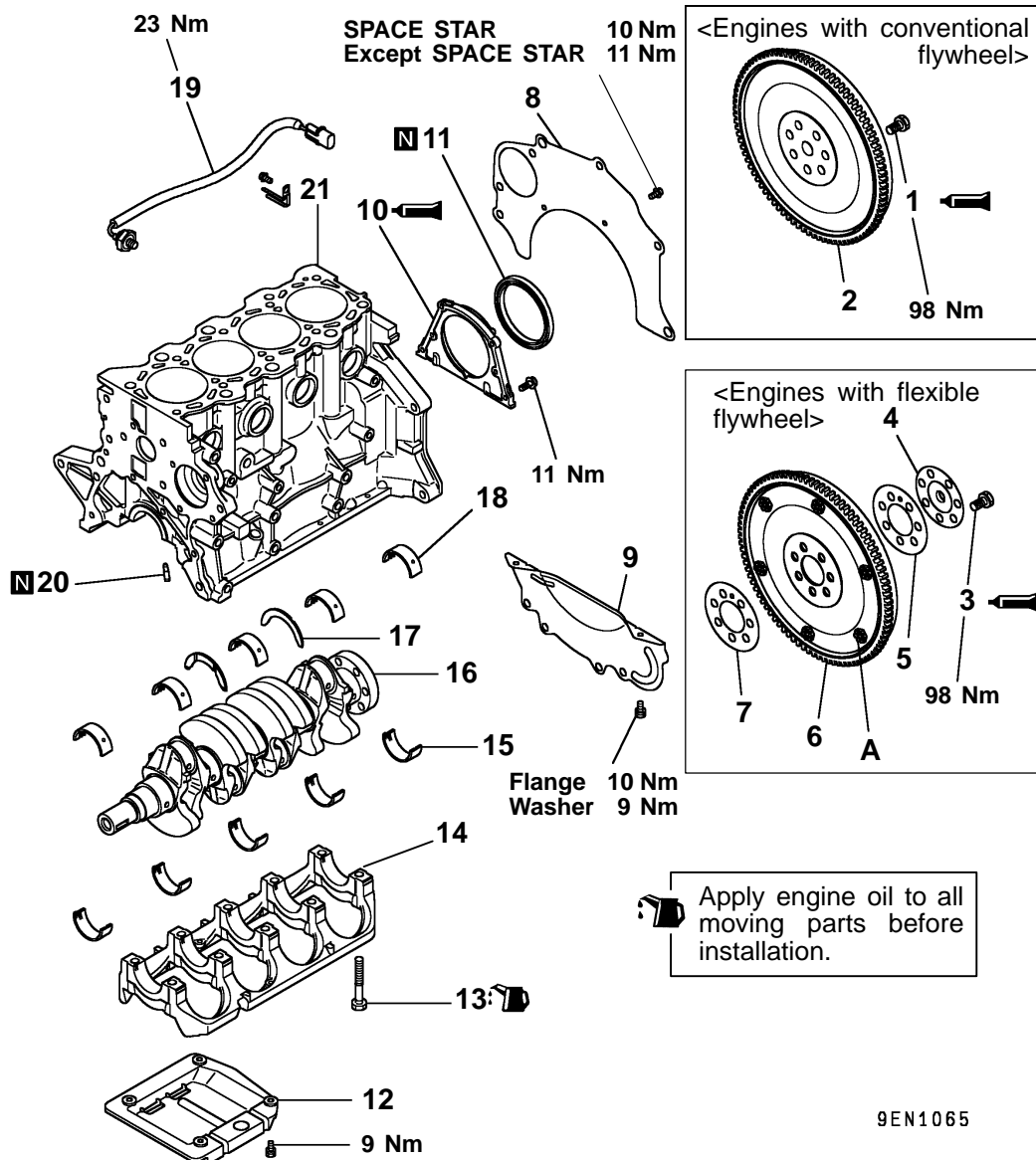
CRANKSHAFT PIN OIL CLEARANCE (PLASTIGAUGE METHOD)

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

Standard value: 0.02 – 0.05 mm

Limit: 0.1 mm

12. CRANKSHAFT, CYLINDER BLOCK, FLYWHEEL AND DRIVE PLATE REMOVAL AND INSTALLATION (MANUAL TRANSMISSION)



Removal steps

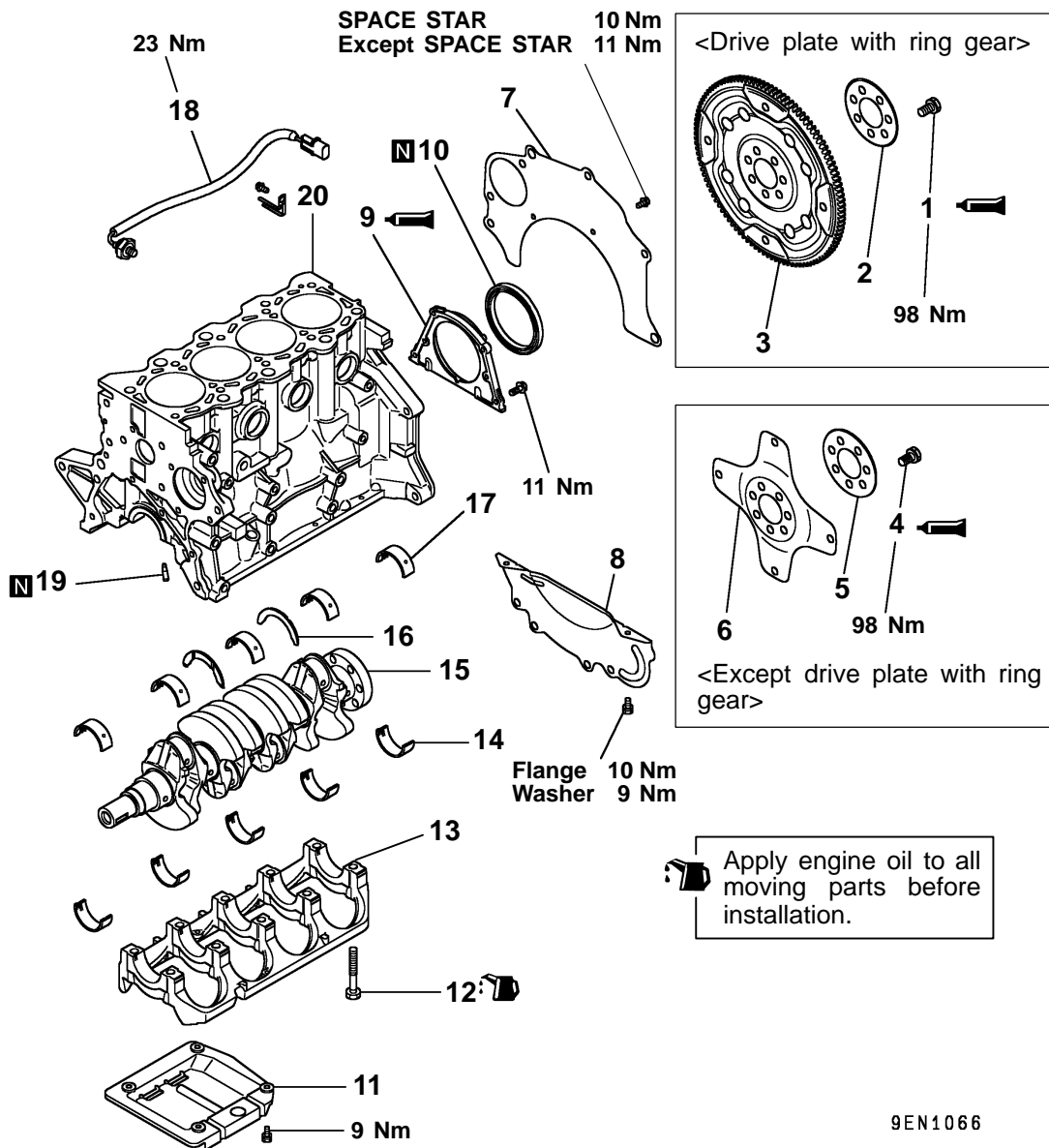
- | | | | |
|-----|---|---------|--|
| ►F◄ | 1. Flywheel bolt | ►C◄ | 13. Bearing cap bolt |
| ►F◄ | 2. Flywheel | ►C◄ | 14. Bearing cap |
| ►F◄ | 3. Flywheel bolt | ►B◄ | 15. Crankshaft bearing, lower |
| | 4. Plate | ►B◄ | 16. Crankshaft |
| | 5. Adapter plate | ►B◄ | 17. Thrust plate |
| | 6. Flywheel | ►B◄ | 18. Crankshaft bearing, upper |
| | 7. Adapter plate | | 19. Knock sensor |
| | 8. Rear plate | | <Except GALANT-CARBURETOR, LANCER for Australia> |
| | 9. Bell housing cover | ◄A► ►A◄ | 20. Oil jet |
| | <4G92-SOHC, 4G93-SOHC> | | <DOHC-MIVEC> |
| ►E◄ | 10. Rear oil seal case | | 21. Cylinder block |
| ►D◄ | 11. Oil seal | | |
| | 12. Baffle plate | | |
| | <MIVEC engine manufactured from Nov. 1995 to Dec. 1995> | | |

Caution

On the flexible wheel equipped engines, do not remove any of the bolts "A" of the flywheel shown in the illustration.

The balance of the flexible flywheel is adjusted in an assembled condition. Removing the bolt, therefore, can cause the flexible flywheel to be out of balance, giving damage to the flywheel.

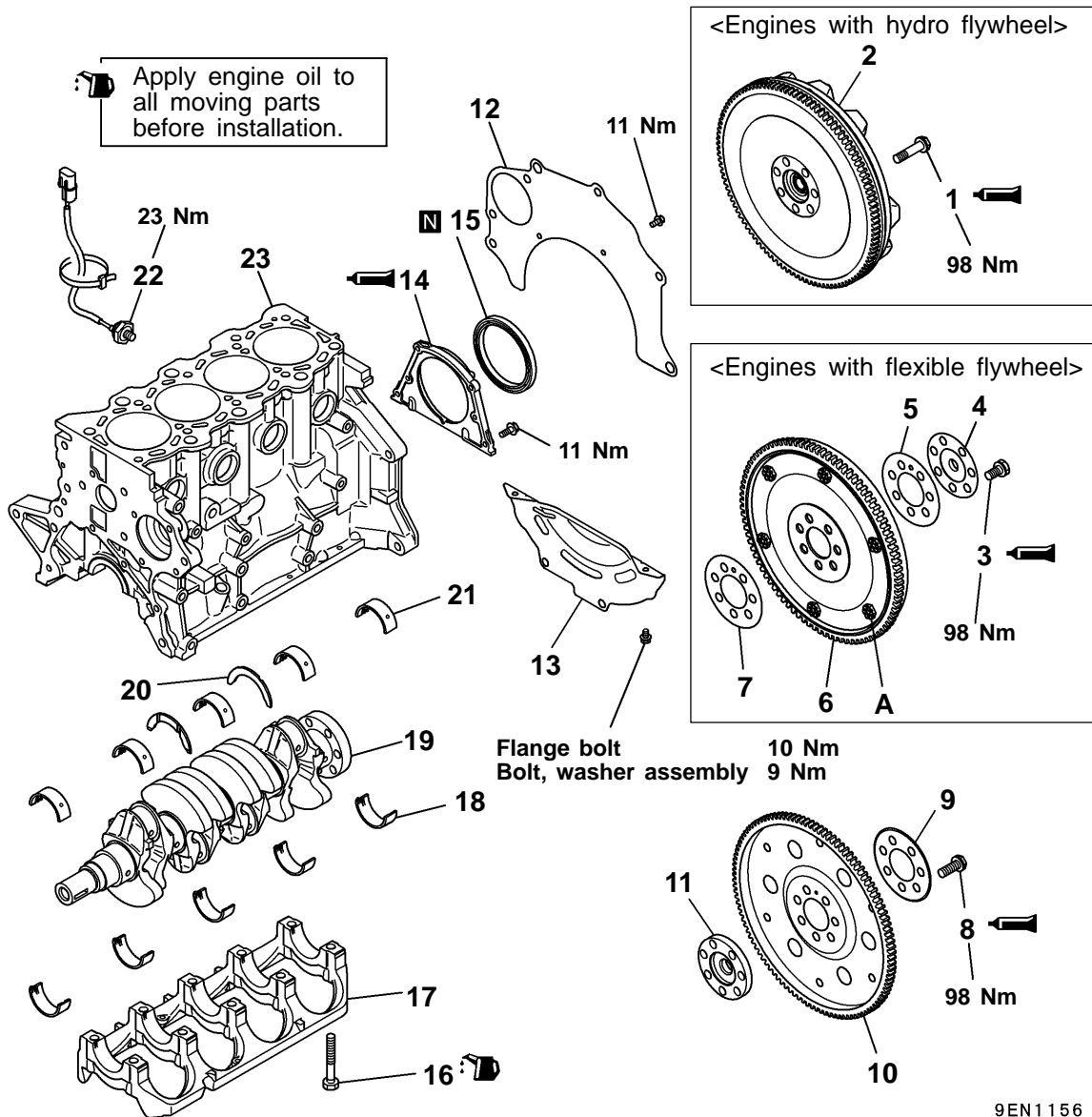
REMOVAL AND INSTALLATION (AUTOMATIC TRANSMISSION)



Removal steps

- | | | | |
|-----|--|---------|---|
| ►F◄ | 1. Flywheel bolt | ►C◄ | 12. Bearing cap bolt |
| | 2. Adapter plate | ►C◄ | 13. Bearing cap |
| | 3. Drive plate | ►B◄ | 14. Crankshaft bearing, lower |
| ►F◄ | 4. Drive plate bolt | | 15. Crankshaft |
| | 5. Adapter plate | ►B◄ | 16. Thrust plate |
| | 6. Drive plate | ►B◄ | 17. Crankshaft bearing, upper |
| | 7. Rear plate | | 18. Knock sensor |
| | 8. Bell housing cover | | <Except GALANT-CARBURETOR,
LANCER for Australia> |
| ►E◄ | 9. Rear oil seal case | ◄A► ►A◄ | 19. Oil jet <DOHC-MIVEC> |
| ►D◄ | 10. Oil seal | | 20. Cylinder block |
| | 11. Baffle plate | | |
| | <MIVEC engine manufactured from
Nov. 1995 to Dec. 1995> | | |

REMOVAL AND INSTALLATION <PAJERO io>



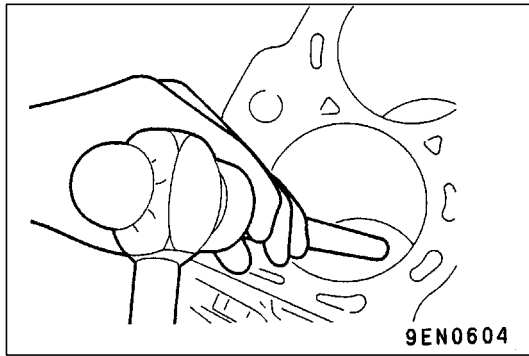
Removal steps

- | | | |
|-----|------------------------------|--|
| ►F◀ | 1. Flywheel bolt <M/T> | 13. Bell housing cover
<with transmission stay> |
| ►F◀ | 2. Flywheel <M/T> | ►E◀ 14. Rear oil seal case |
| ►F◀ | 3. Flywheel bolt <M/T> | ►D◀ 15. Oil seal |
| | 4. Plate <M/T> | ►C◀ 16. Bearing cap bolt |
| | 5. Adapter plate <M/T> | ►C◀ 17. Bearing cap |
| | 6. Flywheel <M/T> | ►B◀ 18. Crankshaft bearing, lower |
| ►F◀ | 7. Adapter plate <M/T> | 19. Crankshaft |
| | 8. Drive plate bolt <A/T> | ►B◀ 20. Thrust plate |
| | 9. Adapter plate <A/T> | ►B◀ 21. Crankshaft bearing, upper |
| | 10. Drive plate <A/T> | 22. Knock sensor |
| | 11. Crankshaft adaptor <A/T> | 23. Cylinder block |
| | 12. Rear plate | |

Caution

On the flexible wheel equipped engines, do not remove any of the bolts "A" of the flywheel shown in the illustration.

The balance of the flexible flywheel is adjusted in an assembled condition. Removing the bolt, therefore, can cause the flexible flywheel to be out of balance, giving damage to the flywheel.



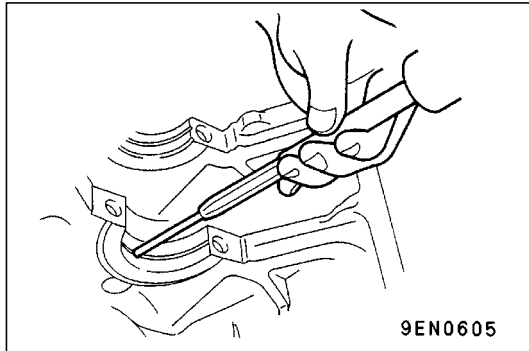
REMOVAL SERVICE POINT

◀A▶ OIL JET REMOVAL

- (1) Knock out the oil jets using an appropriate metal rod.

Caution

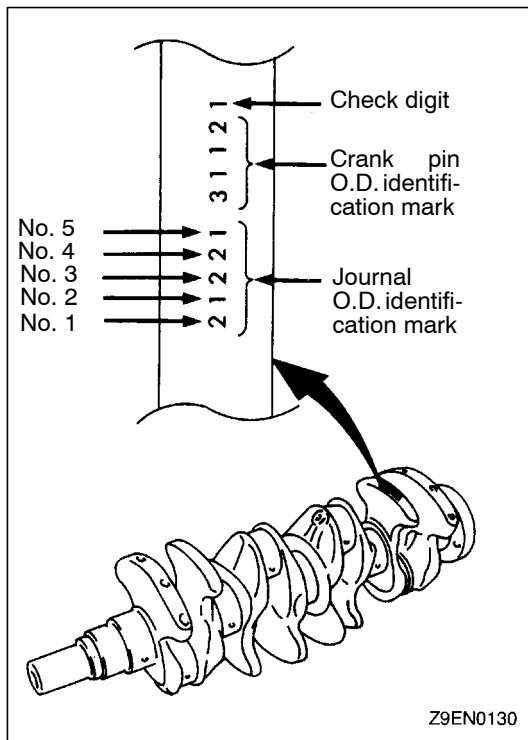
1. Be careful not to scratch the cylinder wall.
2. Do not reuse the removed oil jets.



INSTALLATION SERVICE POINTS

▶A◀ OIL JET INSTALLATION

- (1) Using a 4.5 mm diameter pin punch, drive in the oil jet to the crankshaft journal until it seats to the bottom.

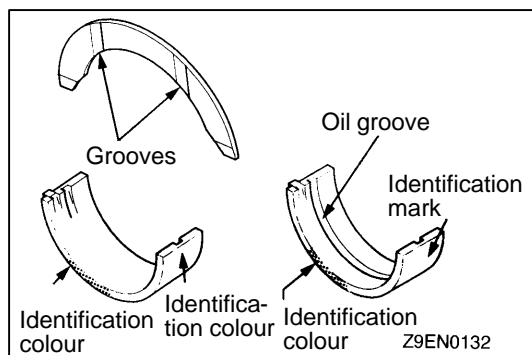
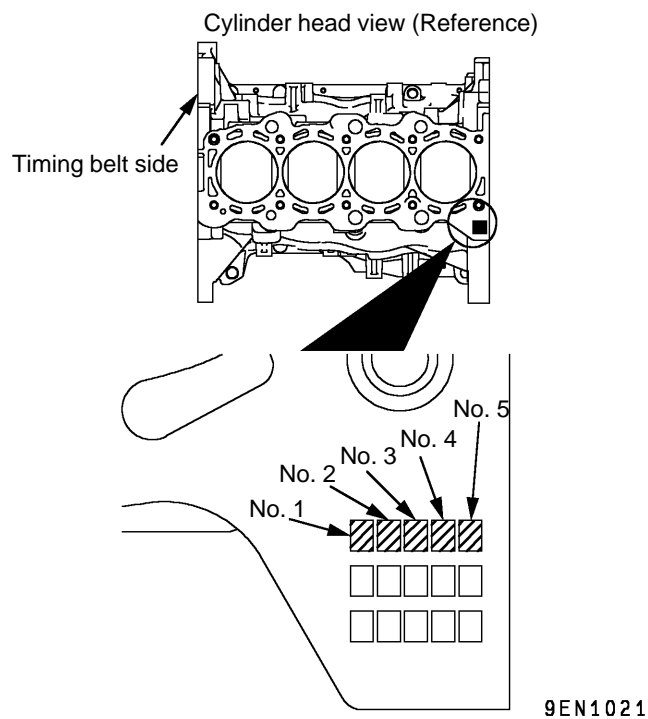
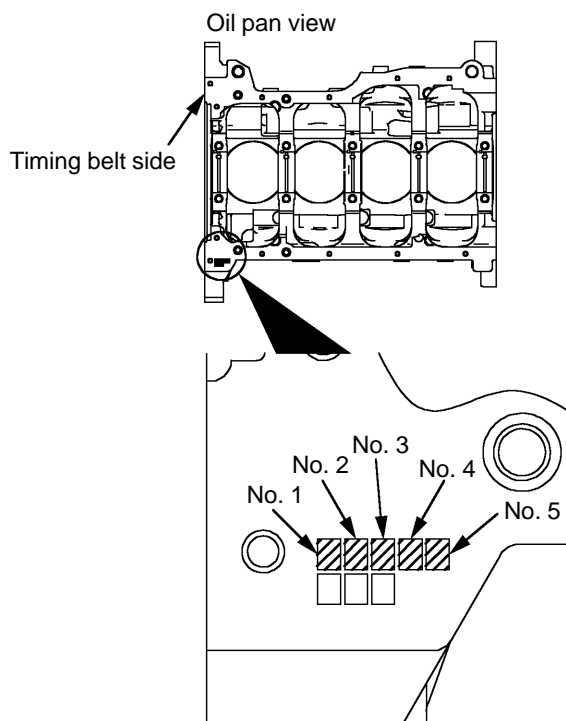
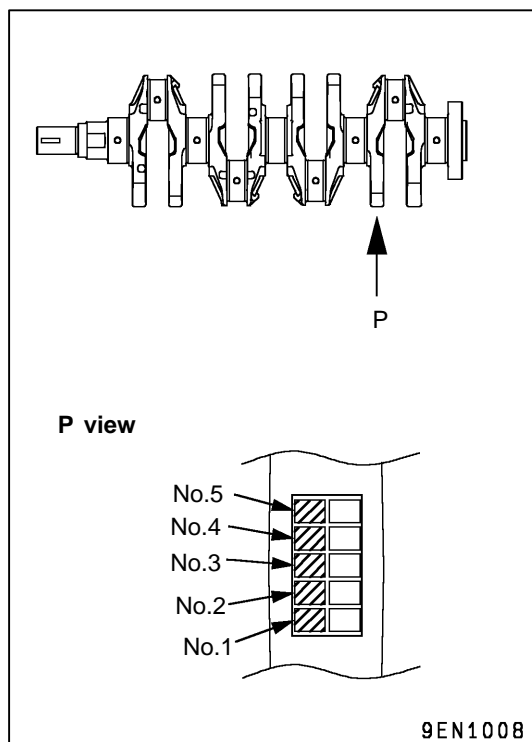


▶B◀ CRANKSHAFT BEARING INSTALLATION

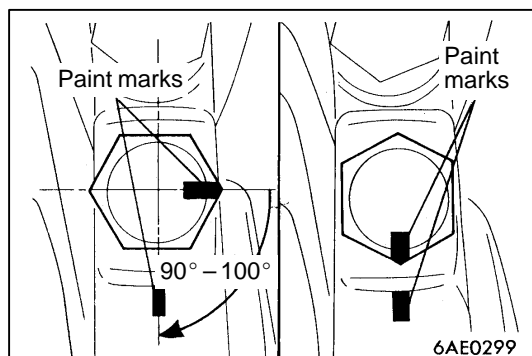
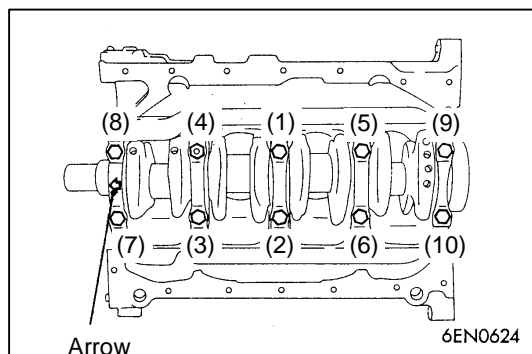
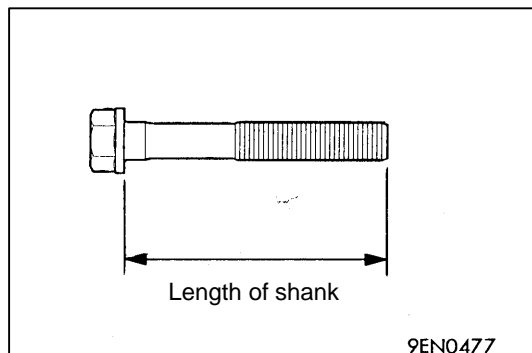
- (1) When the bearings are to be replaced, select correct ones and install them in the correct positions according to the identification marks stamped on the crankshaft and the top surface of the cylinder block.

Crankshaft journal	Cylinder block bearing bore	Crankshaft bearing	
Identification mark	Identification mark	Identification mark (service parts)	Identification colour (Line production parts)
1	0	S1	Brown
	1	S2	Black
	2	S3	Green
2	0	S2	Black
	1	S3	Green
	2	S4	Yellow
3	0	S3	Green
	1	S4	Yellow
	2	S5	Pink*

*: Older bearings may be marked in red.



- (2) Install the bearings having an oil groove to the cylinder block.
- (3) Install the bearings having no oil groove on the bearing caps.
- (4) Install the thrust bearings at the No. 3 upper bearing with the grooved side towards the crank web.



►C◄ BEARING CAP/BEARING CAP BOLT INSTALLATION

- (1) Install the bearing caps so that their arrows are positioned on the time belt side.
- (2) When installing the bearing cap bolts, check that the shank length of each bolt meets the limit. If the limit is exceeded, replace the bolt.

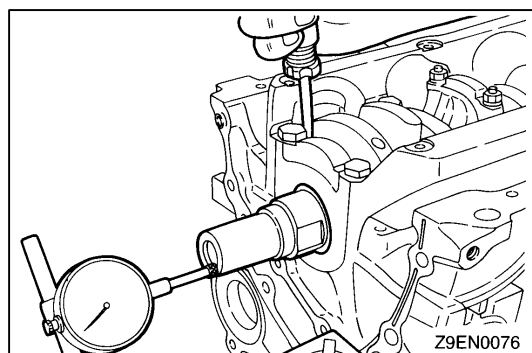
Limit: max. 71.1 mm

- (3) Apply engine oil to the threaded portion and bearing surface of the bolt.
- (4) Tighten the bearing cap bolts to 25 Nm torque in the tightening sequence.

- (5) Make a paint mark on the head of each bolt.
- (6) Make a paint mark on the area around the bolt bearing surface at location 90° to 100° in the direction of tightening the bolt, as referenced from the paint mark on the bolt head.
- (7) Give a 90° to 100° turn to the bolts in the tightening sequence. Make sure that the paint mark on the bolt and that on the area around the bolt bearing surface are in alignment.

Caution

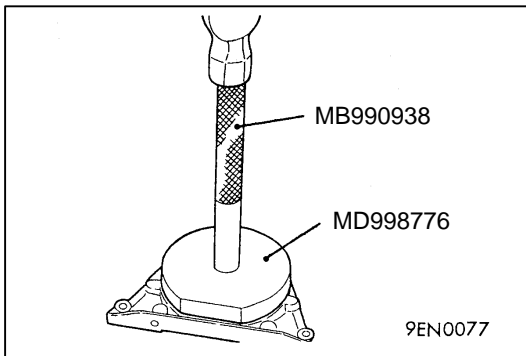
1. If the bolt is turned less than 90°, proper fastening performance may not be expected. When tightening the bolt, therefore, be careful to give a sufficient turn to it.
2. If the bolt is overtightened (exceeding 100°), loosen the bolt completely and then retighten it by repeating the tightening procedure from step (1).



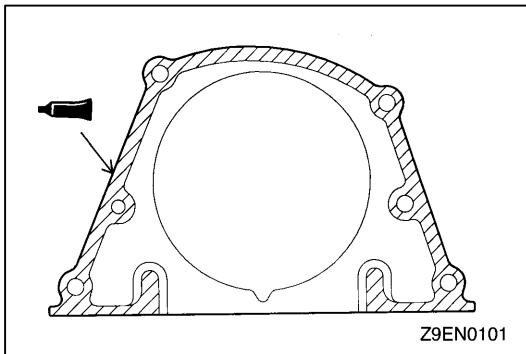
- (8) After installing the bearing caps, make sure that the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace crankshaft bearings.

Standard value: 0.05 – 0.25 mm

Limit: 0.4 mm



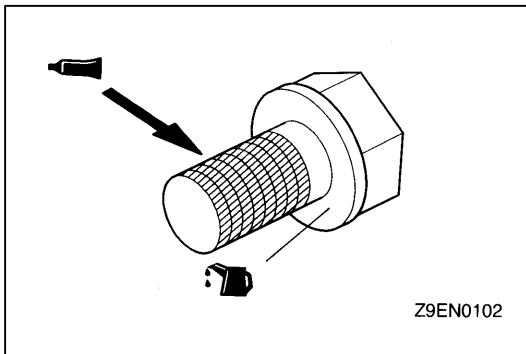
►D◄ OIL SEAL INSTALLATION



►E◄ SEALANT APPLICATION TO OIL SEAL CASE

Specified sealant:

Mitsubishi Genuine Part No. MD970389 or equivalent



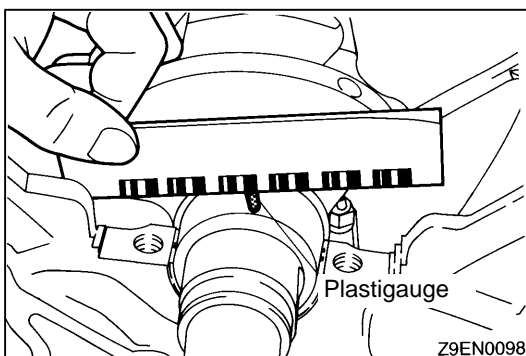
►F◄ DRIVE PLATE BOLT/FLYWHEEL BOLT INSTALLATION

- (1) Remove all the remaining sealant from bolts and thread holes of crankshaft.
- (2) Apply engine oil to the flange of bolt.
- (3) Apply engine oil into the thread holes of crankshaft.
- (4) Apply specified sealant to the thread of bolts.

Specified sealant:

3M Nut Locking Part No. 4171 or equivalent

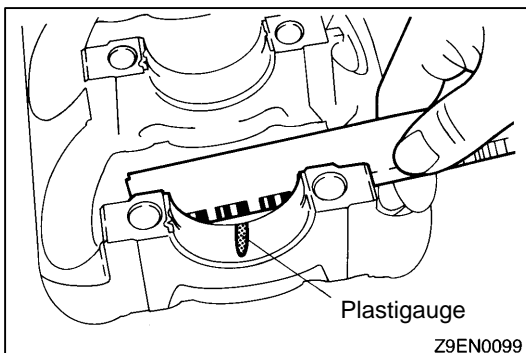
- (5) Tighten the bolts to specified torque.



INSPECTION

CRANKSHAFT JOURNAL OIL CLEARANCE (PLASTIGAUGE METHOD)

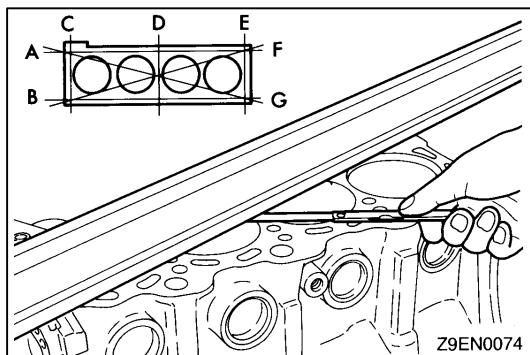
- (1) Remove oil from the crankshaft journal and the crankshaft bearing.
- (2) Install the crankshaft.
- (3) Cut the Plastigauge to the same length as the width of bearing and place it on the journal in parallel with its axis.



- (4) Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
- (5) Carefully remove the crankshaft bearing cap.
- (6) Measure the width of the Plastigauge at its widest part by using a scale printed on the Plastigauge package.

Standard value: 0.02 – 0.04 mm

Limit: 0.1 mm

**CYLINDER BLOCK**

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

Standard value: 0.05 mm or less

Limit: 0.1 mm

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

Grinding limit: 0.2 mm

The total thickness of the stock allowed to be removed from cylinder block and mating cylinder head 0.2 mm at maximum.

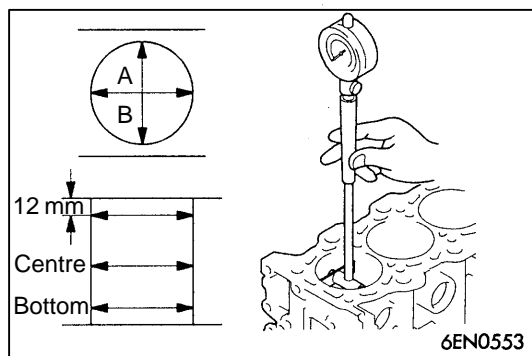
Cylinder block height (when new):

243.5 mm <4G92>

263.5 mm <4G93>

286.7 mm <4G94>

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



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

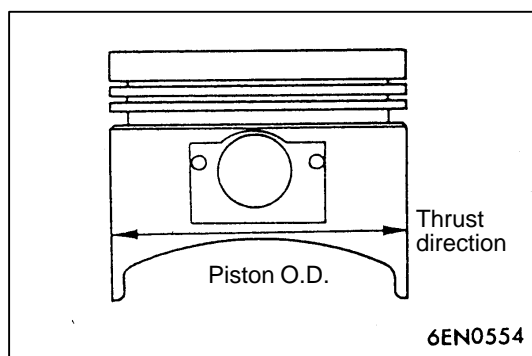
Standard value:

Cylinder inner diameter:

4G92, 4G93 81.00 – 81.03 mm

4G94 81.50 – 81.53 mm

Out-of-roundness and taper of cylinder bore: 0.01 mm or less

**BORING CYLINDER**

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

Piston size identification

Size	Identification mark
0.50 mm O.S.	0.50
1.00 mm O.S.	1.00

NOTE

Size mark is stamped on the piston top.

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

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

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

Caution

To prevent distortion that may result from temperature rise during honing, bore cylinders, in the order of No. 2, No. 4, No.1 and No. 3.

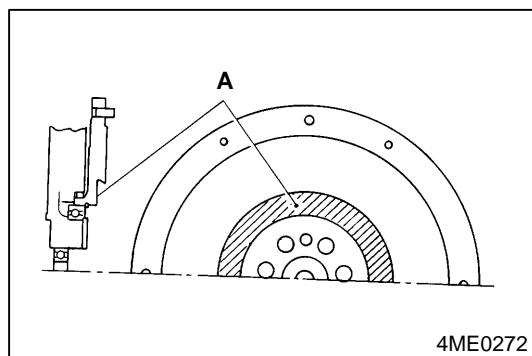
- (5) Hone to the final finish dimension (Piston O.D. + clearance between piston O.D. and cylinder.)
- (6) Check the clearance between piston and cylinder.

Clearance between piston and cylinder:

0.02 – 0.04 mm

NOTE

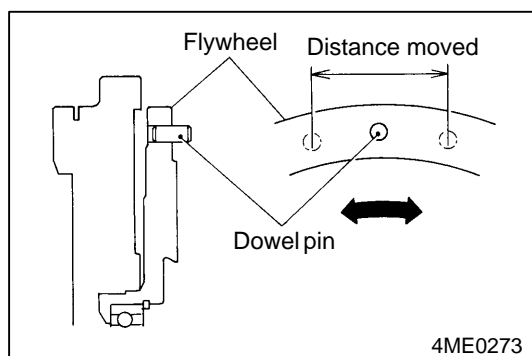
When boring cylinders, finish all of four cylinders to the same oversize. Do not bore only one cylinder to an oversize.

**HYDRO-FLYWHEEL <DOHC-GDI for PAJERO io>**

- (1) Check the rear side of the flywheel for color of the hatched area **A** in the illustration, and determine whether it is serviceable or not in accordance with the criteria given in the following table.

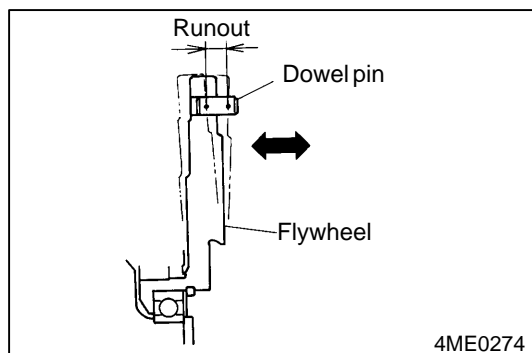
If judged unendurable for reuse, replace the flywheel assembly.

Color	Purple	Dark blue	Light blue	Gray
Judgment	Reusable	Not reusable		



- (2) Measure the play in the circumferential direction using the following procedure.
- (3) Turn the flywheel clockwise and anticlockwise to measure the distance over which the dowel pin moves freely.

Limit: 9 mm



- (4) Check the friction surface for runout in the following manner.
- (5) Apply a thrust force of approx. 98 N by hand on the flywheel to move it in the axial direction, and measure the runout at the dowel pin position. If the limit is exceeded, replace the flywheel assembly.

Limit: 0.75 mm

NOTES


Service Bulletins

Click on the applicable bookmark to select the Service Bulletin.



SERVICE BULLETIN

QUALITY INFORMATION ANALYSIS
OVERSEAS SERVICE DEPT. MITSUBISHI MOTORS CORPORATION

SERVICE BULLETIN		No.: MSB-99E11-001	
		Date: 1999-12-15	<Model> (EC) COLT (CJ,CK) 96-10 (EC) LANCER (CJ,CK) 96-10 (EC) SPACE STAR 96-10 (DG1A, DG5A) 96-10 (EC) CARISMA 96-10 (EC) SPACE RUNNER 96-10 (N60,N90) (EC) PAJERO iO (H6, H7)
Subject: CHANGE IN POSITIONS OF CRANKSHAFT IDENTIFICATION MARKS			
Group: ENGINE	Draft No.: 99EN531509		
INFORMATION	INTERNATIONAL CAR ADMINISTRATION OFFICE	 T.NITTA - PROJECT LEADER AFTER SALES SERVICE & CS PROMOTION	

1. Description:

This Service Bulletin informs you that the journal O.D. identification marks and the pin O.D. identification marks have been changed in their positions.

2. Applicable Manuals:

Manual	Pub. No.	Language	Page(s)
'98 4G9 Series (E-W) Engine Supplement	PWEE9502-E	(English)	11A-12-2
	PWES9503-E	(Spanish)	
	PWEF9504-E	(French)	
	PWEG9505-E	(German)	
	PWED9506-E	(Dutch)	
	PWEW9507-E	(Swedish)	
'96 4G9 Series Engine Supplement	PWEE9101-E	(English)	11A-18-6
	PWES9102-E	(Spanish)	
	PWEF9103-E	(French)	
	PWEG9104-E	(German)	
	PWED9105-E	(Dutch)	
	PWEW9106-E	(Swedish)	

3. Effective Date:

From September 1997
Effective model: 4G93-G-10Z3K (HP9123)

- Crankshaft weight

