ENGINE

CONTENTS

N09AA--

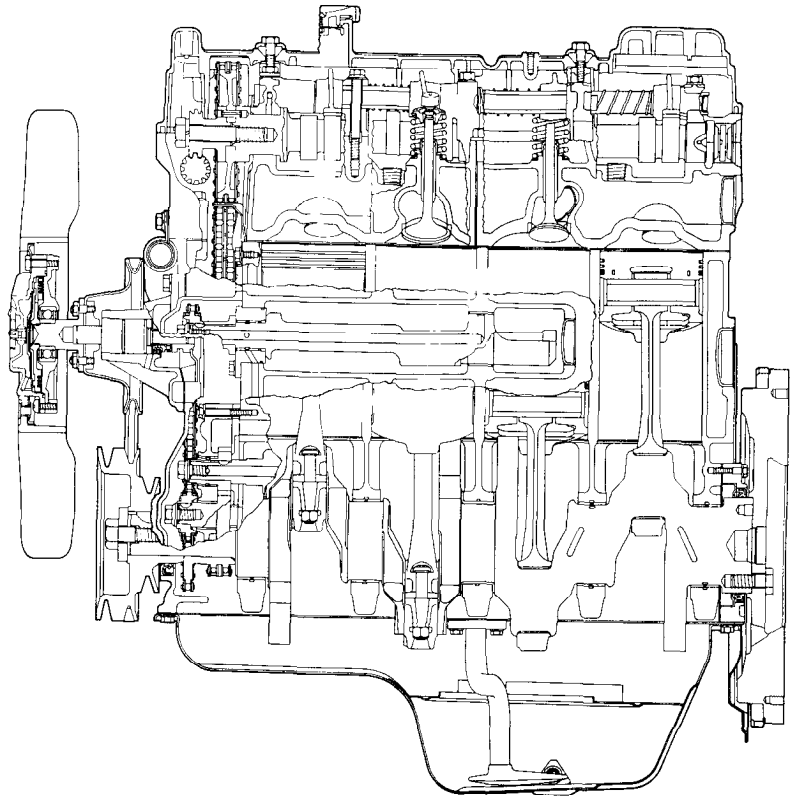
GENERAL INFORMATION

N09BACB

The 2.6L (157 cu.in.) displacement engine is a four cylinder overhead camshaft power plant with a cast iron cylinder block, an aluminum cylinder head and a silent shaft system.
The forged steel crankshaft is supported by five main bearings.
The cylinder block is a siamese type water jacket which ensures high cooling efficiency and uniform cooling of the cylinders.
Two counterbalance shafts (silent shafts) are incorporated in the cylinder block to reduce engine noise and vibration.
The pistons are made of aluminum alloy casting.
The piston pin is floating in the piston and pressed-in to the forged steel connecting rod. The piston pin is offset from the piston center toward the thrust side.
The oil pump is a gear type pump and also drives the right (front) silent shaft. The oil pump and left (rear) silent shaft are chain driven through sprockets by crankshaft.
The silent shaft system cancels the vertical vibration force of the engine and secondary vibrating forces such as the vibrating moment in the volling direction. The silent shafts are located in the upper left (rearward side) and lower right (forward side) of the cylinder block. The left shaft rotates in the same direction as the crankshaft while the right shaft rotates in the opposite direction at twice crankshaft speed. Each silent shaft is supported by two aluminum bearings.
The cylinder head is an aluminum alloy casting with compact type combustion chambers. The intake and exhaust valves are made of heat resistant steel and arranged in a "V" with the camshaft on center. The jet valve assembly consisting of the jet valve, jet body, stem seal, spring, retainer and retainer lock, is screwed into the cylinder head.
The cast iron camshaft is supported by five bearing journals and is driven by the crankshaft sprocket and camshaft sprocket by the timing belt. The distributor drive gear is mounted on the front of the camshaft. The camshaft drive belt is a cogged type belt. To provide the belt with the proper tension and ensure quiet operation at all times, tensioner is installed on the slack side.
Two rocker arms are used with one actuating the exhaust valves and the other the intake valves and jet valves. The rocker arm is a die cast aluminum alloy part with carbide alloy slipper and auto-lash adjuster and does not require adjustment of intake and exhaust valve clearance. The oil pump is a internal/external involute gear type pump and is driven by crankshaft. The oil filter, a paper filter element cartridge type, is mounted on the front facing side of the engine.

SECTIONAL VIEW

N09BACB



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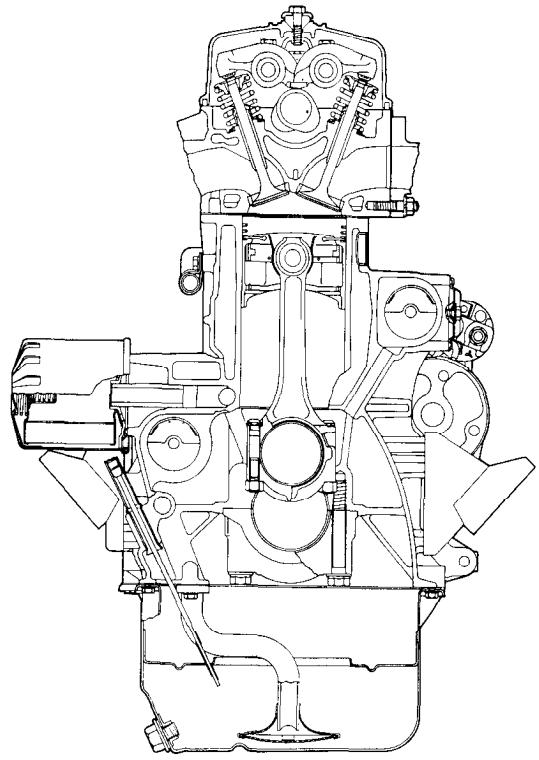

5EN145

SPECIFICATIONS

GENERAL SPECIFICATIONS

N09CA–B

Items	Specifications
Type	In-line OHC
Number of cylinders	4
Bore mm (in.)	91.1 (3.5866)
Stroke mm (in.)	98 (3.8583)
Piston displacement cc (cu.in.)	2555 (155.9)
Compression ratio	7.0
Firing order	1–3–4–2
Valve timing	
Intake valve	
Opens (BTDC)	25°
Closes (ABDC)	59°
Exhaust valve	
Opens (BBDC)	64°
Closes (ATDC)	20°
Jet valve	
Opens (BTDC)	25°
Closes (ABDC)	59°
Valve overlap	45°
Intake valve duration	264°
Exhaust valve duration	264°
Jet valve duration	264°

SERVICE SPECIFICATIONS

N09CB–

Items	Specifications
Standard value	
Cylinder head	
Overall height mm (in.)	90.0 (3.5433)
Flatness of gasket surface mm (in.)	Max. 0.05 (0.020)
Flatness of manifold mounting surface mm (in.)	Max. 0.15 (.0059)
Oversize rework dimension of valve seat hole mm (in.)	
Intake 0.3 mm (.012 in) O.S.	47.300–47.325 (1.8622–1.8632)
0.6 mm (.024 in) O.S.	47.600–47.625 (1.8740–1.8750)
Exhaust 0.3 mm (.012 in) O.S.	40.300–40.325 (1.5866–1.5876)
0.6 mm (.024 in) O.S.	40.600–40.625 (1.5984–1.5994)
Oversize rework of valve guide hole (both intake and exhaust) mm (in.)	
0.05 mm (.002 in) O.S.	13.050–13.068 (.5138–.5145)
0.25 mm (.010 in) O.S.	13.250–13.268 (.5217–.5224)
0.50 mm (.020 in) O.S.	13.500–13.518 (.5315–.5422)
Timing chain	
No. of links	102
Pitch mm (in.)	9.5 (.3740)

STB Revision

Items	Specifications
Timing chain "B" for silent shaft drive	
No. of links	90
Pitch mm (in.)	8.0 (.3150)
Clearance between chain and chain guide mm (in.)	0.2–0.8 (.0079–.0315)
Camshaft	
Cam height mm (in.)	
Intake	42.4 (1.6693)
Exhaust	42.4 (1.6693)
Fuel pump drive cam O.D. mm (in.)	37 (1.4567)
Journal diameter mm (in.)	34 (1.3386)
Oil clearance mm (in.)	0.03–0.05 (.0012–.0020)
End play mm (in.)	0.1–0.2 (.004–.008)
Rocker arm	
I.D. mm (in.)	18.9 (.7441)
Clearance (Rocker arm-to-shaft) mm (in.)	0.01–0.04 (.0004–.0016)
Rocker arm shaft	
O.D. mm (in.)	18.9 (.7441)
Valve	
Valve length mm (in.)	
Intake	107.96 (4.2504)
Exhaust	105.86 (4.1677)
Stem O.D mm (in.)	
Intake	8.0 (.3150)
Exhaust	8.0 (.3150)
Face angle	45°–45°.30
Thickness of valve head (Margin) mm (in.)	
Intake	1.2 (.047)
Exhaust	2.0 (.079)
Valve stem to valve guide clearance mm (in.)	
Intake	0.03–0.06 (.0012–.0024)
Exhaust	0.05–0.09 (.0020–.0035)
Valve guide	
Length mm (in.)	
Intake	47 (1.8504)
Exhaust	52 (2.0474)
Oversize mm (in.)	0.05 (.0020) 0.25 (.010) 0.50 (.020)
Valve seat insert	
Width of seat contact mm (in.)	0.7–1.2 (.0276–.0472)
Seat angle	45°
Oversize rework of valve seat insert height mm (in.)	
Intake 0.3 mm (.012 in)	7.9–8.1 (.3110–.3189)
0.6 mm (.024 in)	8.2–8.4 (.3228–.3307)
Exhaust 0.3 mm (.012 in)	7.9–8.1 (.3110–.3189)
0.6 mm (.024 in)	8.2–8.4 (.3228–.3307)

STB Revision

Items	Specifications
Valve spring	
Free length mm (in.)	49.8 (1.961)
Load N (lbs.)	322.6 (72.5) at installed height
Installed height mm (in.)	40.4 (1.591)
Out of square	2°
Jet valve	
Length mm (in.)	91.58 (3.6055)
Stem O.D. mm (in.)	4.3 (.1693)
Seat angle	45°
Valve clearance-Hot engine mm (in)	0.25 (.010)
Valve clearance-Cold engine (reference) mm (in)	0.17 (.007)
Jet valve spring	
Free length mm (in.)	29.6 (1.1654)
Load N (lbs.)	34.3 (7.7) at Installed height
Installed height mm (in.)	21.5 (.846)
Out of squareness	Max 1.5°
Cylinder block	
Cylinder bore mm (in.)	91.1 (3.5866)
Out-of-roundness and taper of cylinder bore mm (in.)	Max. 0.02 (.0008)
Over height mm (in.)	316 (12.4409)
Flatness of gasket surface mm (in.)	Max 0.05 (.0020)
Right silent shaft	
Front journal diameter mm (in.)	21 (.8268)
Rear journal diameter mm (in.)	43 (1.6929)
Oil clearance mm (in.)	
Rear	0.10–0.13 (.0039–.0053)
Left silent shaft	
Front journal diameter mm (in.)	23 (.9055)
Rear journal diameter mm (in.)	43 (1.6929)
Oil clearance mm (in.)	
Front	0.02–0.06 (.0008–.0024)
Rear	0.10–0.13 (.0039–.0053)
Piston	
O.D. mm (in.)	91.1 (3.5866)
Clearance (Piston-to-cylinder) mm (in.)	0.02–0.04 (.0008–.0016)
Ring groove width mm (in.)	
No. 1 and No. 2	1.5 (.591)
Oil	4.0 (.1575)
Compression pressure kPa (psi)	1200 (170) 960 (136)
Pressure difference between cylinders kPa (psi)	Max. 100 (14)
Oversize mm (in.)	0.25 (.010) 0.50 (.020) 0.75 (.030) 1.00 (.039)
Piston ring	
Side clearance mm (in.)	
No. 1	0.05–0.09 (.0020–.0035)
No. 2	0.02–0.06 (.0008–.0024)

Items	Specifications
End gap mm (in.)	
No. 1	0.30–0.45 (.0112–.0177)
No. 2	0.25–0.40 (.0098–.0158)
Oil ring side rail	0.30–0.80 (.0118–.0315)
Oversize mm (in.)	0.25 (.010) 0.50 (.020) 0.75 (.030) 1.00 (.039)
Connecting rod	
Bend mm (in.)	0.05(.0020) or less per 100 (3.937)
Twist mm (in.)	0.10 (.0039) or less per 100 (3.937)
Connecting rod big end side clearance mm (in.)	0.1–0.25 (.0039–.0098)
Piston pin press-in load N(lbs.)	7350–17150 (1650–3860)
Connecting rod oil clearance	
Oil clearance mm (in.)	0.02–0.05 (.0008–.0020)
Under size mm (in.)	0.25 (.010) 0.50 (.020) 0.75 (.030)
Crankshaft main bearing	
Oil clearance mm (in.)	0.02–0.05 (.0008–.0020)
Under size mm (in.)	0.25 (.010) 0.50 (.020) 0.75 (.030)
Crankshaft	
Pin O.D. mm (in.)	53 (2.0866)
Journal O.D. mm (in.)	60 (2.3622)
Out-of-roundness and taper of journal and pin mm (in.)	Max. 0.01 (.0004)
End play mm (in.)	0.05–0.18 (.0020–.0071)
Undersize rework dimension of pin mm (in.)	
0.25 mm (.010 in.) U.S.	52.735–52.750 (2.0762–2.0763)
0.50 mm (.020 in.) U.S.	52.485–52.500 (2.0663–2.0669)
0.75 mm (.030 in.) U.S.	52.235–52.250 (2.0565–2.0571)
Undersize rework dimension of journal mm (in.)	
0.25 mm (.010 in.) U.S.	59.735–59.750 (2.3518–2.3524)
0.50 mm (.020 in.) U.S.	59.485–59.500 (2.3419–2.3425)
0.75 mm (.030 in.) U.S.	59.235–52.250 (2.3321–2.3327)
Oil pressure at curb idle speed [Conditions: Oil temperature is 75 to 90°C (167 to 194°F)] kPa (psi)	Min. 80 (11.4)
Oil pump	
Driven gear	
Tip clearance mm (in.)	0.11–0.15 (.0043–.0059)
Side clearance mm (in.)	0.04–0.10 (.0016–.0039)
Drive gear	
Tip clearance mm (in.)	0.11–0.15 (.0043–.0059)
Side clearance mm (in.)	0.05–0.11 (.0020–.0043)
Relief spring Free height mm (in.)	46.4 (1.8346)
Load N (lbs.)	60 (13.4) at 40.1 mm (1.5787 in.)
Limit	
Cylinder head	
Overall height mm (in.)	* – 0.2 * (– .0079)
Flatness of gasket surface mm (in.)	0.2 (.0079)
Flatness of manifold mounting mm (in.)	0.3 (.0118)

* Must be – 0.2 mm (– .0079 in.) or less (combined with the amount of grinding of the cylinder block's gasket surface.)

STB Revision

Items	Specifications
Camshaft	
Cam height mm (in.)	
Intake	41.9 (1.6496)
Exhaust	41.9 (1.6496)
End play mm (in.)	0.4 (.016)
Valve	
Thickness of valve head (Margin) mm (in.)	
Intake	0.7 (.028)
Exhaust	1.5 (.059)
Valve stem to valve guide clearance mm (in.)	
Intake	0.1 (.0039)
Exhaust	0.15 (.0059)
Valve spring	
Free length mm (in.)	48.8 (1.922)
Installed height mm (in.)	41.40 (1.6299)
Out of squareness	4°
Cylinder block	
Over height mm (in.)	* – 0.2 *(– .0079)
Flatness of gasket surface mm (in.)	0.1 (.0039)
Piston	
Compression pressure kPa (psi)	960 (136)
Piston ring	
Side clearance mm (in.)	
No. 1	0.12 (.005)
No. 2	0.1 (.004)
End gap mm (in.)	
No. 1	0.8 (.031)
No. 2	0.8 (.031)
Oil ring side rail	1.0 (.039)
Connecting rod	
Connecting rod big end side clearance mm (in.)	0.4 (.016)
Connecting rod oil clearance	
Oil clearance mm (in.)	0.1 (.004)
Crankshaft main bearing	0.1 (.004)
Crankshaft	
End play mm (in.)	0.4 (.016)
Fly wheel	
Runout mm (in.)	0.13 (.0051)
Oil pump	
Driven gear	
Tip clearance mm (in.)	0.2 (.0079)
Side clearance mm (in.)	0.15 (.0006)
Drive gear	
Tip clearance mm (in.)	0.2 (.0079)
Side clearance mm (in.)	0.15 (.0006)

* Must be – 0.2 mm (– .0079 in.) or less (combined with the amount of grinding of the cylinder head's gasket surface.)

STB Revision

TORQUE SPECIFICATIONS

N09CC-

Items	Nm	ft.lbs
Cylinder head bolts–Cold engine	90–100	65–72
Cylinder head bolts–Hot engine	100–110	73–79
Cylinder head bolts (M8 bolt)	15–22	11–15
Camshaft bearing cap bolts	19–21	14–15
Camshaft sprocket bolts	50–60	37–43
Rocker cover bolts	5–7	4–5
Jet valve assembly	18–22	13–15
Rocker arm adjusting nuts for jet valve	8–10	9–13
Main bearing cap bolts	75–85	55–61
Connecting rod cap nuts	45–48	33–34
Dumper pulley bolts	110–130	80–94
Oil pump driven gear bolt	60–70	44–50
Silent shaft sprocket bolt	60–70	44–50
Silent shaft chamber cover bolts	4–6	4–5
Flywheel bolts	130–140	94–101
Drive plate bolts	130–140	94–101
Engine support brackets bolts	50–60	37–43
Chain guide"B" bolt (Upper)	8–10	6–7
Chain guide "B" bolt (Lower)	15–22	11–15
Oil pump cover bolt	10–12	7.5–8.5
Oil pump body bolt	10–12	7.5–8.5
Oil pump assembly mounting bolt	10–12	7.5–8.5
Thrust plate bolt	10–12	7.5–8.5
Oil pan bolt	6–8	4.5–5.5
Oil pan drain plug	35–45	26–32
Oil screen bolt	15–22	11–15
Oil relief valve plug	30–45	22–32
Oil pressure switch	8–12	6–8
Air filter mounting nut	16–19	12–14
Exhaust manifold to front exhaust pipe	20–30	15–22
Engine mounting front insulator to body	30–40	22–29
Engine to engine mounting front insulator	13–20	9–15
No. 2 crossmember to body	55–75	40–54
Plate to body	18–25	13–18
Plate to transfer mounting insulator	18–25	13–18
Transfer mounting insulator to transfer mounting bracket	30–42	22–29
Transfer mounting bracket to transfer	18–25	13–18
No. 2 crossmember to engine mounting rear insulator	18–25	13–18
Engine mounting rear insulator to engine	18–25	13–18
Engine support rear bracket to engine	18–25	13–18
Engine mounting rear insulator to engine support rear bracket	18–25	13–18
Rear engine support member to No. 2 crossmember	18–25	13–18
Rear engine support member to engine mounting rear insulator	30–42	22–29
Radiator mounting bolts	8–11	6–8
Shroud mounting bolts	3–7	2–5

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Items	Nm	ft.lbs.
Power steering pressure hose to oil pump	16–24	12–17
Control lever assembly to transfer	15–22	11–16
Cross shaft bracket to body	10–13	7–9
Clutch release cylinder to transmission	31–42	22–29
Rear propeller shaft to rear differential	50–60	36–43
Front propeller shaft to front differential	50–60	36–43
Air-conditioner compressor to discharge hose	20–25	15–18
Air-conditioner compressor to suction hose	30–35	22–25

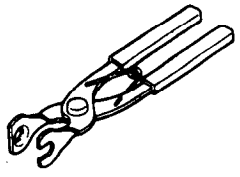
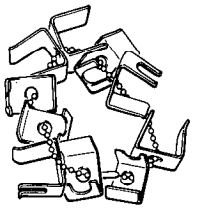
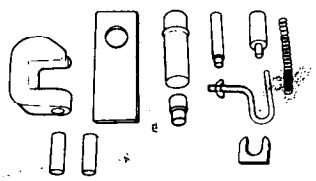
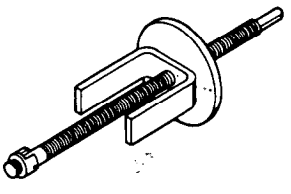
SEALANTS AND ADHESIVES

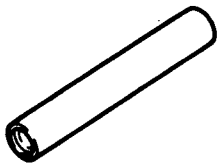
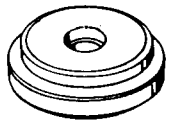
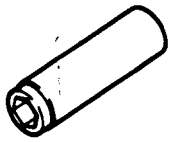
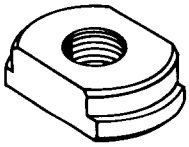
N09CE--

Items	Specified sealants and adhesives	Quantity
Semi-circular packing	3M ART Part No. 8660 or equivalent	As required
Cylinder block lower surface (4 places)	3M ART Part No. 8660 or equivalent	As required
Oil pressure switch	3M ART Part No. 8660 or equivalent	As required

SPECIAL TOOLS

N09DA-C

Tool (Number and name)	Use	Tool (Number and name)	Use
MD998377-01 Installer, valve stem seal 	Installing valve stem seals	MD998250-01 Installer, silent shaft bearing (For rear bearing) [Used with MB990938-01] 	Press-fitting of silent shaft bearing
MD998309 Prier, jet valve spring 	Assembling and disassembly of jet valve assembly	MD998443-01 Holder, auto-lash adjuster 	Auto-lash adjuster holding
MD998184-01 Setting tool, piston pin 	Removal and installation of piston pin	MIT304204 Remover, silent shaft front bearing 	Removal of silent shaft bearing

Tool (Number and name)	Use	Tool (Number and name)	Use
MD998308-01 Installer, jet valve stem seal 	Installation of jet valve stem seal	MD998376-01 Installer, crankshaft rear oil seal [Used with MB990938-01] 	Installation of crankshaft rear oil seal
MD998310 Wrench, jet valve 	Removal and installation of jet valve assembly	MB990938-01 Installer, right silent shaft front bearing 	Installation of silent shaft bearing
MD998251-01 Puller, silent shaft bearing (For rear bearing) [Used with MIT304204] 	Removal of silent shaft bearing		

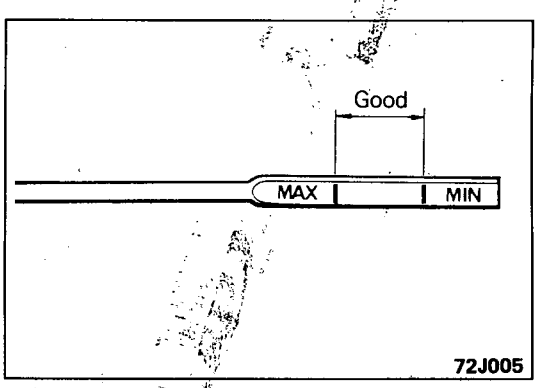
TROUBLESHOOTING

N09EAAE

Symptom	Probable cause	Remedy	Reference page
Compression too low	Cylinder head gasket blown	Replace gasket	9-39
	Piston ring worn or damage	Replace rings	9-56
	Piston or cylinder worn	Repair or replace piston and/or cylinder block	9-54 9-65
	Valve seat worn or damage	Repair or replace valve and/or seat ring	–
Oil pressure drop	Engine oil level too low	Check engine oil level	9-12
	Oil pressure switch faulty	Replace oil pressure switch	9-64
	Oil filter clogged	Install new filter	9-50
	Oil pump gears or body worn	Replace gears and/or body	9-50
	Thin or diluted engine oil	Change engine oil to correct viscosity	9-50
	Oil relief valve stuck (opened)	Repair relief valve	9-50
	Excessive bearing clearance	Replace bearings	9-50

STB Revision

Symptom	Probable cause	Remedy	Reference page
Oil pressure too high	Oil relief valve stuck (closed)	Repair relief valve	9-50
Noisy valves	Incorrect auto-lash adjuster	Replace auto-lash adjuster	9-33
	Thin or diluted engine oil (low oil pressure)	Change engine oil	9-12
	Valve stem or valve guide worn or damage	Replace valve and/or guide	9-44
Connecting rod noise/ main bearing noise	Insufficient oil supply	Check engine oil level	9-12
	Low oil pressure	Refer to "Oil pressure drop"	9-11
	Thin or diluted engine oil	Change engine oil	9-12
	Excessive bearing clearance	Replace bearings	9-54
Timing chain noise	Incorrect chain tension	Adjust chain tension	9-28
Excessive engine rolling and vibration	Loose No. 2 member	Retighten	9-20, 21
	Broken mount insulator	Replace	9-20, 21



SERVICE ADJUSTMENT PROCEDURES N09FAAA1

CHECKING ENGINE OIL

(1) Check to ensure that the engine oil level is within the level range indicated on the oil level gauge.
(2) Check to ensure that the oil is not noticeably dirty or mixed with coolant or gasoline, and that it has the proper viscosity.

REPLACEMENT OF ENGINE OIL N09FBAA1

Refer to GROUP 0 LUBRICATION AND MAINTENANCE–Maintenance Service.

REPLACEMENT OF ENGINE OIL FILTER N09FCAA1

Refer to GROUP 0 LUBRICATION AND MAINTENANCE–Maintenance Service.

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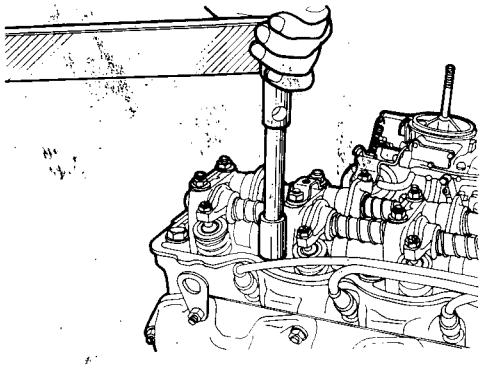

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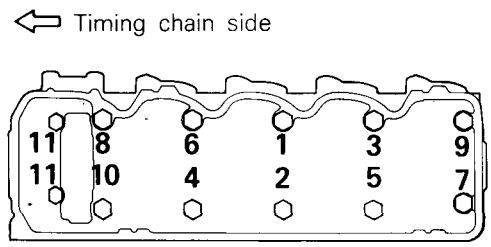


5EN016

RETORQUING OF CYLINDER HEAD BOLTS N09FDAD

(1) Using torque wrench, first slightly loosen cylinder head bolts and then tighten to specified torque.

Tightening torque
Cylinder head bolt (No. 1 to 10)
Cold engine : 90–100 Nm (65–72 ft.lbs.)
Hot engine : 100–110 Nm (73–79 ft.lbs.)
Cylinder head bolt (No. 11)
Cold engine : 15–22 Nm (11–15 ft.lbs.)
Hot engine : 15–22 (11–15 ft.lbs.)

(2) Be sure to follow the specific torquing sequence.

NOTE
Run engine until normal operating temperature is reached, allow it to cool down, and then retorque bolts to specification for best results.

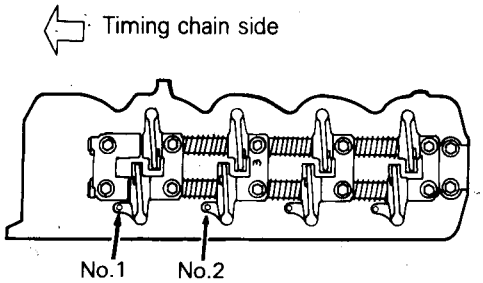
ADJUSTMENT OF VALVE CLEARANCE

CHECKING INTAKE AND EXHAUST VALVES N09FEAB1

As the intake and exhaust valves are equipped with auto-lash adjustment mechanisms, there is no need for valve clearance adjustment. The proper functioning of the auto-lash mechanism may be determined by checking for tappet noise. When there is tappet noise or any unusual noise, check the the auto-lash by removing it.

CHECKING AND ADJUSTING JET VALVE CLEARANCE N09FJAC

(1) Idle the engine until radiator coolant reaches 80–90°C (176–194°F).
(2) Remove all the spark plugs from the cylinder head.
(3) Remove the rocker cover.



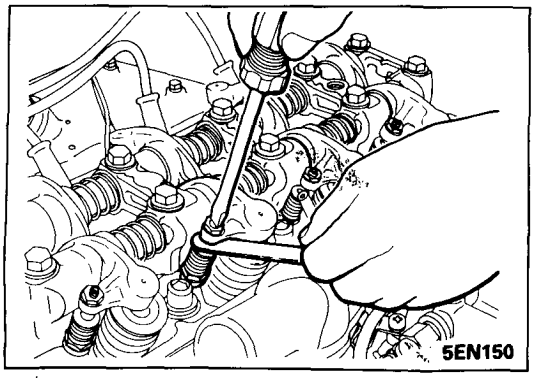
5EN213

(4) Rotate the crankshaft clockwise until the No. 1 cylinder is at compression TDC.
(5) Measure jet valve clearance at the positions indicated by arrows in the illustration.

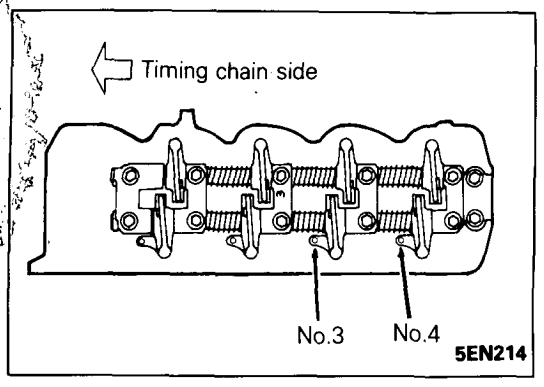
Standard value : 0.25 mm (.010 in.) when warm.

Caution
As jet valve spring tension is low, be careful not to push the jet valve in.

STB Revision



(6) When out of specification, loosen the lock nut and adjust clearance with a feeler gauge while turning the adjusting screw.
(7) Holding the adjusting screw with a screwdriver so that it won't turn, tighten the lock nut to the specified torque.

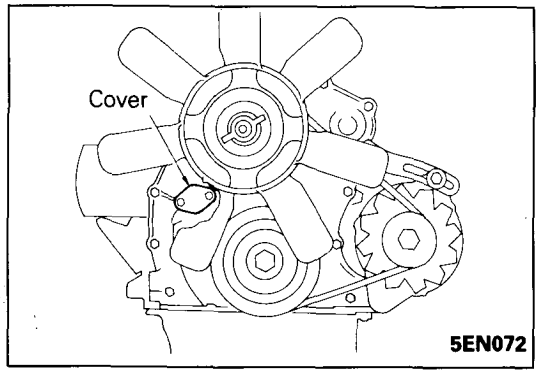


(8) Turn the crankshaft 360° until the No. 4 cylinder is at compression top dead center.
(9) Measure jet valve clearance where indicated by arrows in the illustration.

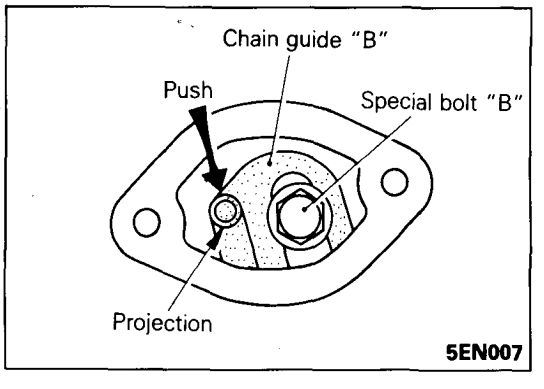
Standard value : 0.25 mm (.010 in.) when warm

(10) When out of specification, adjust according to the procedures given in (6) and (7) above.

SILENT SHAFT DRIVE CHAIN TENSION ADJUSTMENT PROCEDURE N09FIAA



When a loose silent shaft drive chain is suspected as the probable cause of abnormal noise, the tension must be readjusted. Tension of silent shaft drive chain can be adjusted without removing timing chain cover as follows:
1. Remove cover from access hole provided at center of chain case (under water pump).

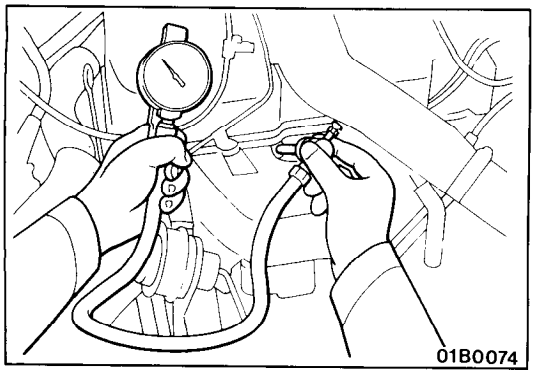


2. Loosen special bolt "B".
3. Using your finger push projection on chain guide "B" in direction of arrow. Do not push projection with a screwdriver or other tool. Improperly chain tension will cause abnormal noise.
4. Tighten special bolt "B".
5. Install cover. Do not reuse damaged gasket.

Cover bolt tightening torque : 10–11 Nm (7.5–8.5 ft. lbs.)

CHECKING COMPRESSION PRESSURE N09FFAA

(1) Before checking compression, ensure that engine oil, the starter motor, and battery are all in normal operating condition.
(2) Start the engine and wait until engine coolant temperature has risen to 80°–90°C (176–194°F).
(3) Stop the engine and pull the spark plug cables.
(4) Remove the spark plugs.
(5) Crank the engine to remove any foreign objects in the cylinders.



Caution
Cover the spark plug holes with waste cloth, etc., in order to keep expelled foreign objects from flying out, and keep away from the holes. When measuring compression with water, oil, or fuel having entered the cylinder through a crack, etc., these will come flying out of the spark plug hole hot and fast, so to sure to take the proper precautions.

(6) Set the compression gauge to the spark plug hole.
(7) Holding the throttle valve full open, crank the engine and measure compression.

Standard value : 1200 kPa (170 psi) [250–400]
Limit : 960 kPa (136 psi) [250–400 rpm]

(8) Perform (6) and (7) above for all the cylinders, ensuring that compression for each of the cylinders is within the specified limit.

Limit : Max 100 kPa (14 psi)

(9) If a cylinder's compression or pressure differential exceeds the limit, add a small amount of oil through the spark plug hole and repeat steps (6) to (8).
① If the addition of oil brings compression up, it is possible that there is harmful friction between the piston ring and cylinder wall.
② If not compression up, valve seizure, poor valve seating, or a compression leak from the gasket are all possible.

ON-VEHICLE SERVICE

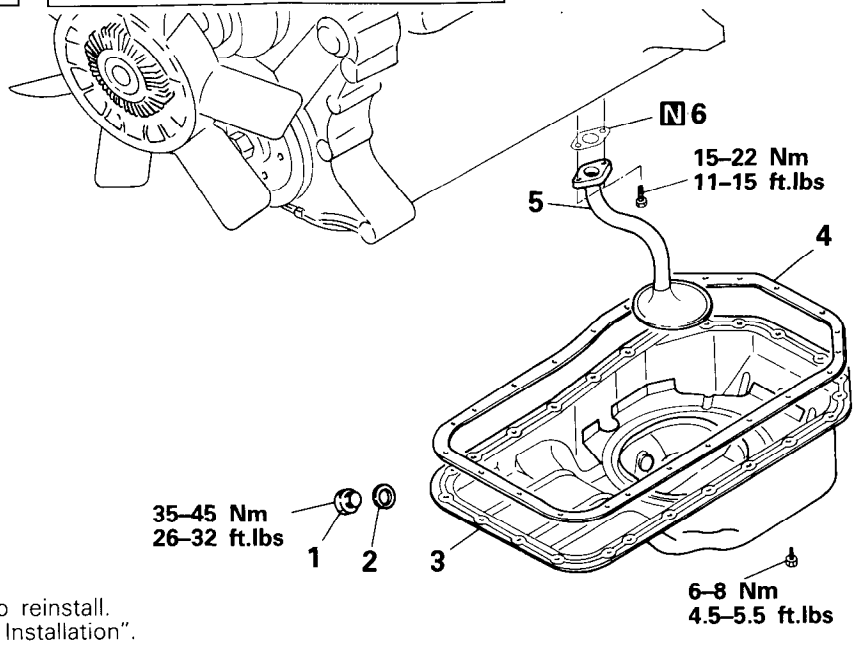
OIL PAN AND SCREEN

REMOVAL AND INSTALLATION

N09HA--

Pre-removal Operation
- Removal of the Undercover and the Under Skid Plate (Refer to GROUP 23 BODY – Under Cover)
- Draining of the Engine Oil (Refer to GROUP 0, LUBRICATION AND MAINTENANCE – Meintenance Service.)

Post-installation Operation
- Installation of the Undercover and the Under Skid Plate (Refer to GROUP 23 BODY – Under Cover.)
- Supplying of Engine Oil (Refer to GROUP 0 LUBRICATION AND MAINTENANCE – Meintenance Service)



Removal steps

1. Drain plug
2. Drain plug gasket
3. Oil pan
- ◆◆ 4. Oil pan gasket
5. Oil screen
6. Oil screen gasket

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Installation".
(3) N : Non-reusable parts

5EN205
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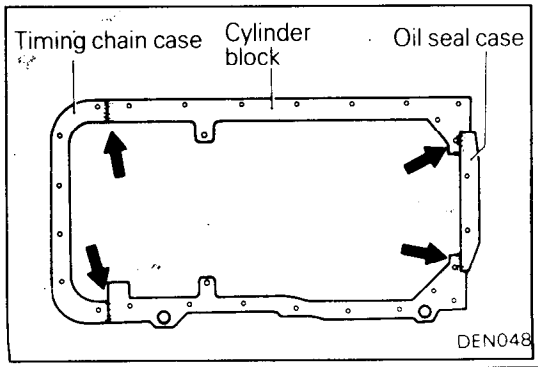
INSPECTION

N09HCAB

- Check the oil pan for cracks.
- Check the oil pan fitting surface for damage and deformation.
- Check the oil screen for cracked, clogged or damaged wire net and pipe.



SERVICE POINTS OF INSTALLATION

N09HDAI

4. INSTALLATION OF OIL PAN GASKET

Apply a coating of the specified sealant (where shown in the figure) to the lower surface (the surface where the oil pan is installed) of the cylinder block.

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

STB Revision

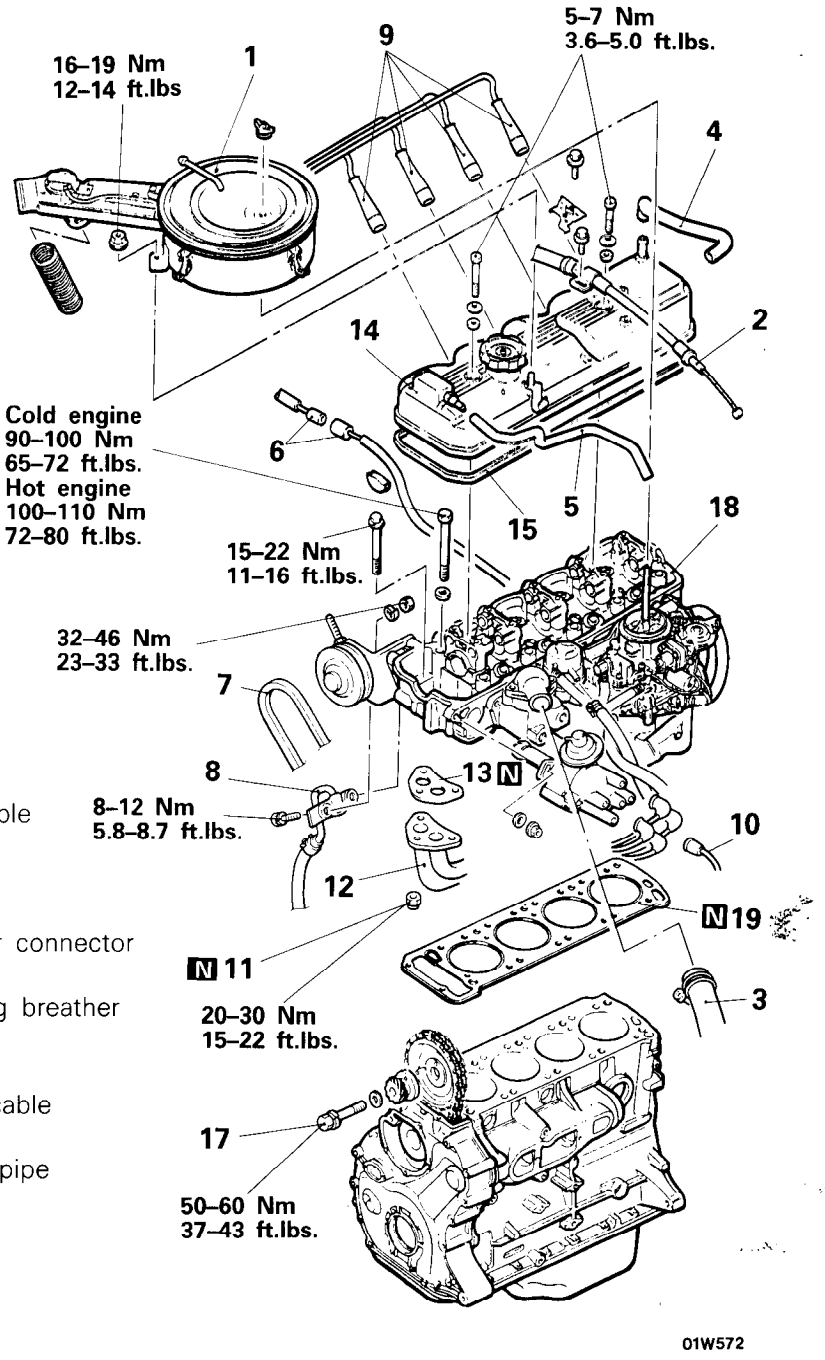
CYLINDER HEAD GASKET

REMOVAL AND INSTALLATION

N09JA--

Pre-removal Operation
- Draining of the Coolant (Refer to GROUP 0 LUBRICATION AND MAINTENANCE – Maintenance Service.)

Post-installation Operation
- Supplying of Coolant (Refer to GROUP 0 LUBRICATION AND MAINTENANCE – Maintenance Service.)
- Adjustment of the Tension of the Air Conditioner Drive Belt (Refer to GROUP 24 HEATERS AND AIR-CONDITIONING – Drive Belt Tension Adjustment.)



Removal steps

◆◆ ▶◀ 1. Air filter
▶◀ 2. Connection of accelerator cable
3. Radiator upper hose
4. Breather hose
5. P.C.V hose
6. Connection of oxygen sensor connector
◆◆ 7. Air-conditioner drive belt
8. Connection of power steering breather pipe
9. Spark plug cable
10. Connection of high tension cable
11. Self locking nut
12. Connection of front exhaust pipe
13. Gasket
▶◀ 14. Rocker cover assembly
15. Rocker cover gasket
◆◆ Fixing to No. 1 cylinder TDC
▶◀ 16. Distributor
◆◆ ▶◀ 17. Camshaft sprocket bolt
◆◆ ▶◀ 18. Cylinder head assembly
▶◀ 19. Cylinder head gasket

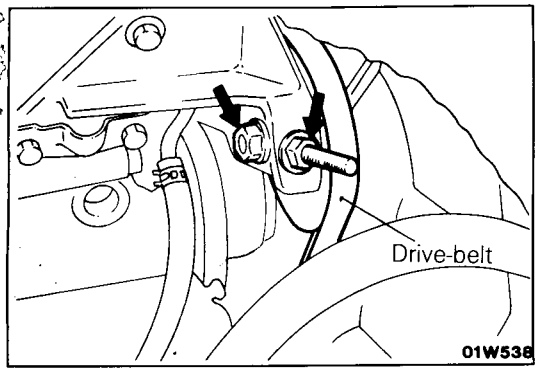
NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Removal".
(3) ▶◀ : Refer to "Service Points of Installation".
(4) N : Non-reusable parts

SERVICE POINTS OF REMOVAL

N09JBAF

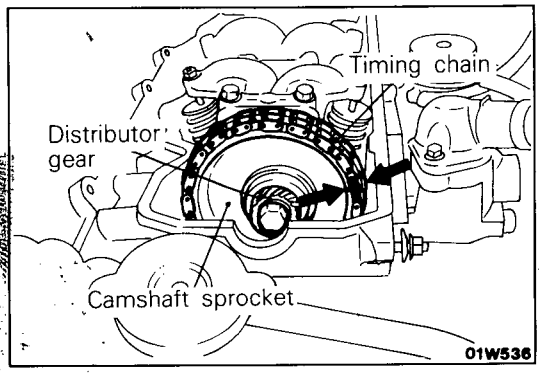
1. REMOVAL OF AIR FILTER

Refer to GROUP 11 INTAKE AND EXHAUST SYSTEM – Air Filter



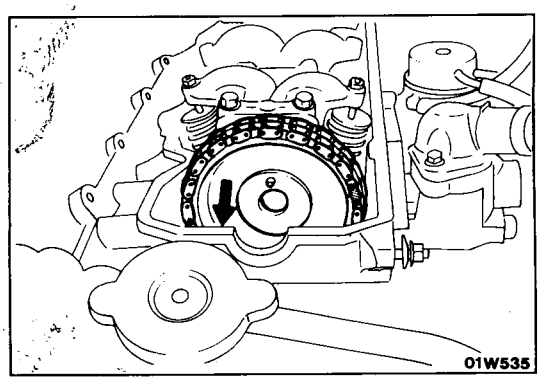
7. REMOVAL OF AIR-CONDITIONER DRIVE BELT

Loosen the tension-adjustment nuts of the air-conditioner drive belt and remove the air-conditioner drive belt from the tension pulley.



• FIXING TO NO. 1 CYLINDER TDC

Turn the crankshaft. Check to be sure that the camshaft sprocket's timing mark and the timing chain's timing mark (shiny white leaf plate) are aligned.

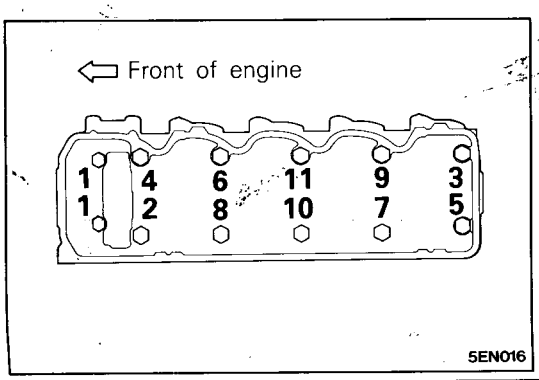


17. REMOVAL OF CAMSHAFT SPROCKET BOLT

Pull the camshaft sprocket (with the timing chain attached) out from the camshaft, and place it on top of the camshaft sprocket holder.

Caution

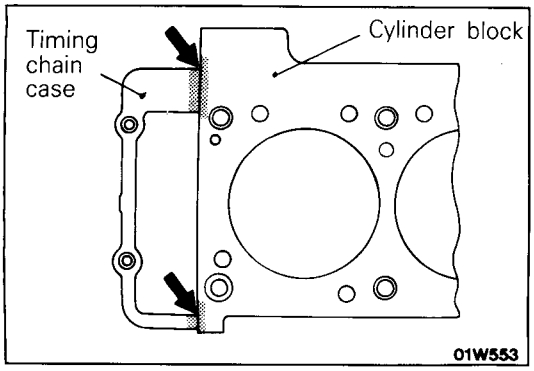
1. **The crankshaft must not be rotated after the camshaft sprocket is pulled out from the camshaft.**
2. **Be careful not to allow the timing chain to come off from the camshaft sprocket.**

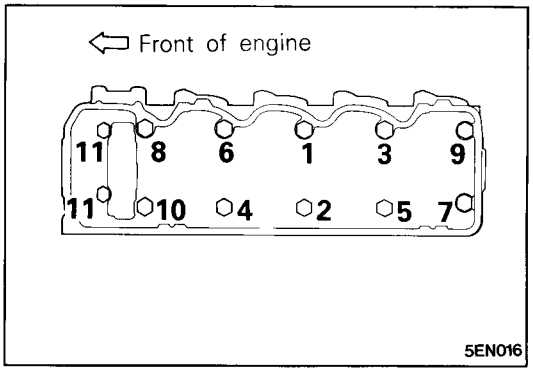


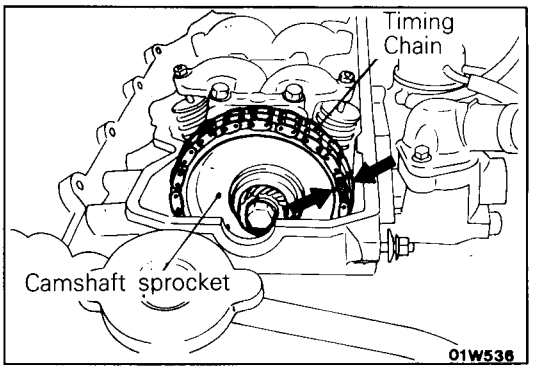
18. REMOVAL OF CYLINDER HEAD ASSEMBLY

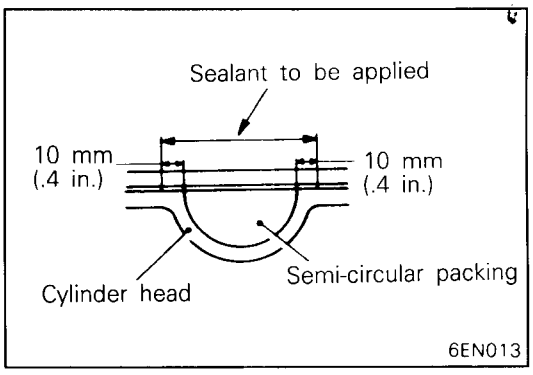
(1) Disconnect the fuel hose, vacuum hose and wiring harness connected to the intake manifold and carburetor.
Refer to GROUP 11 INTAKE AND EXHAUST – Intake Manifold and GROUP 14 FUEL SYSTEM-Carburetor.
(2) Loosen the bolts (in the order indicated in the figure) in 2 or 3 steps, and remove from the cylinder head.

STB Revision









SERVICE POINTS OF INSTALLATION N09JDCE

19. INSTALLATION OF CYLINDER HEAD GASKET

Before cylinder head gasket is installed, apply specified sealant to top surface of each butt joint between cylinder block and timing chain case.

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

Caution
Be careful not to allow sealant to enter the oil hole in the cylinder block.

18. INSTALLATION OF CYLINDER HEAD ASSEMBLY

(1) Tighten the bolts (in the order indicated in the figure) in 2 or 3 steps, and finally tighten them at the specified torque.
(2) Connect the fuel hose, vacuum hose and wiring harness connected to the intake manifold and carburetor.
Refer to GROUP 11 INTAKE AND EXHAUST – Intake Manifold and GROUP 14 FUEL SYSTEM – Carburetor.

17. INSTALLATION OF CAMSHAFT SPROCKET BOLT

Install the camshaft sprocket to the camshaft. Check to be sure that the timing chain's timing mark and the camshaft sprocket's timing mark are aligned.

16. INSTALLATION OF DISTRIBUTOR

Refer to GROUP 8 ELECTRICAL – Ignition System.

14. INSTALLATION OF ROCKER COVER ASSEMBLY

Apply a coating of the specified sealant to the semicircular packing and the cylinder head top surfaces, and then tighten the rocker cover assembly at the specified torque.

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

Caution
If they are overtorqued, a deformed rocker cover or oil leakage could result.

2. ADJUSTMENT OF ACCELERATOR CABLE

Refer to GROUP 14 FUEL SYSTEM – Accelerator.

1. INSTALLATION OF AIR FILTER

Refer to GROUP 11 INTAKE AND EXHAUST – Air Filter.

ENGINE MOUNTING

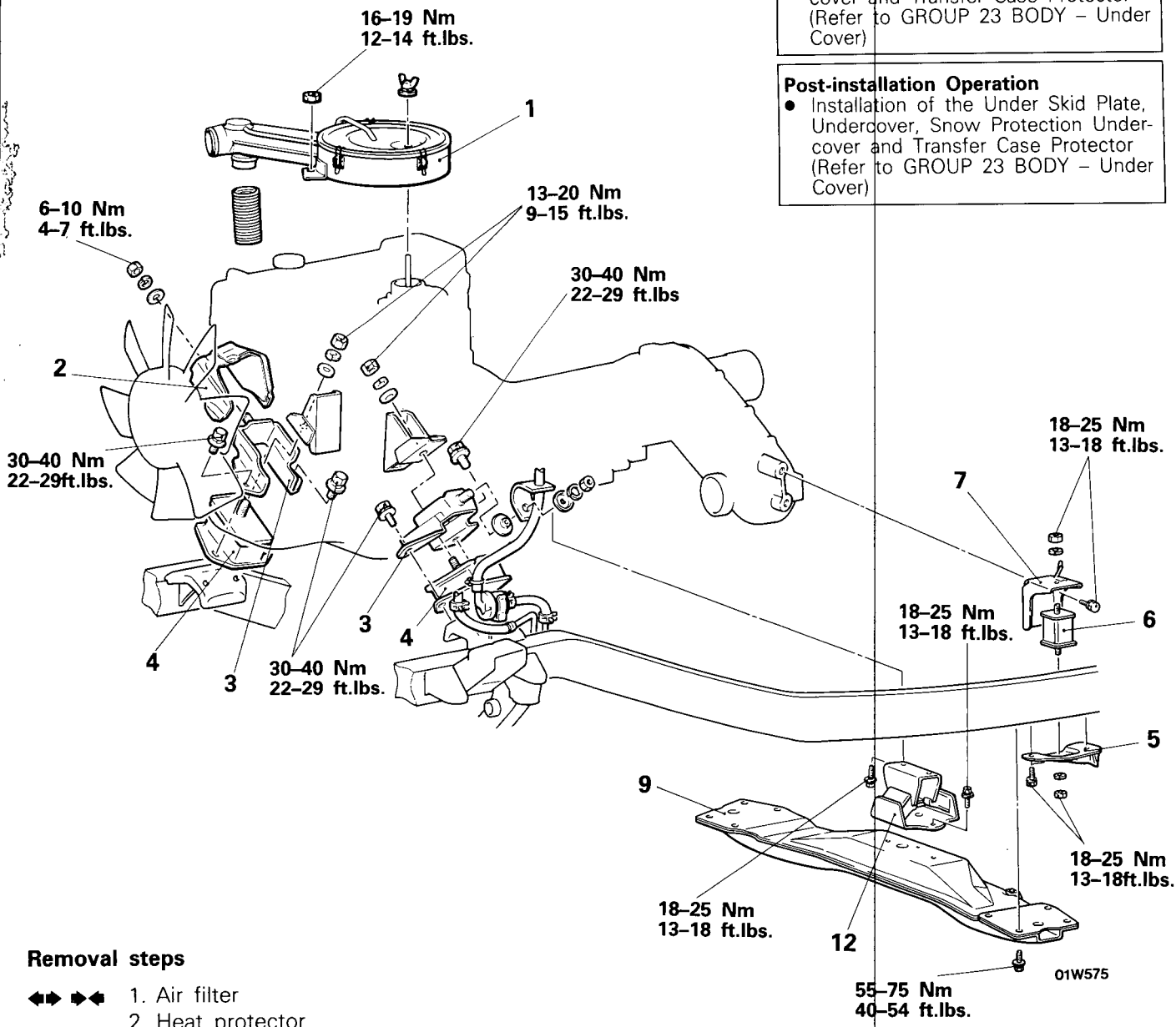
REMOVAL AND INSTALLATION

N09GA--

Vehicles with a manual transmission

Pre-removal Operation
- Removal of the Under Skid Plate, Undercover, Snow Protection Undercover and Transfer Case Protector (Refer to GROUP 23 BODY – Under Cover)

Post-installation Operation
- Installation of the Under Skid Plate, Undercover, Snow Protection Undercover and Transfer Case Protector (Refer to GROUP 23 BODY – Under Cover)



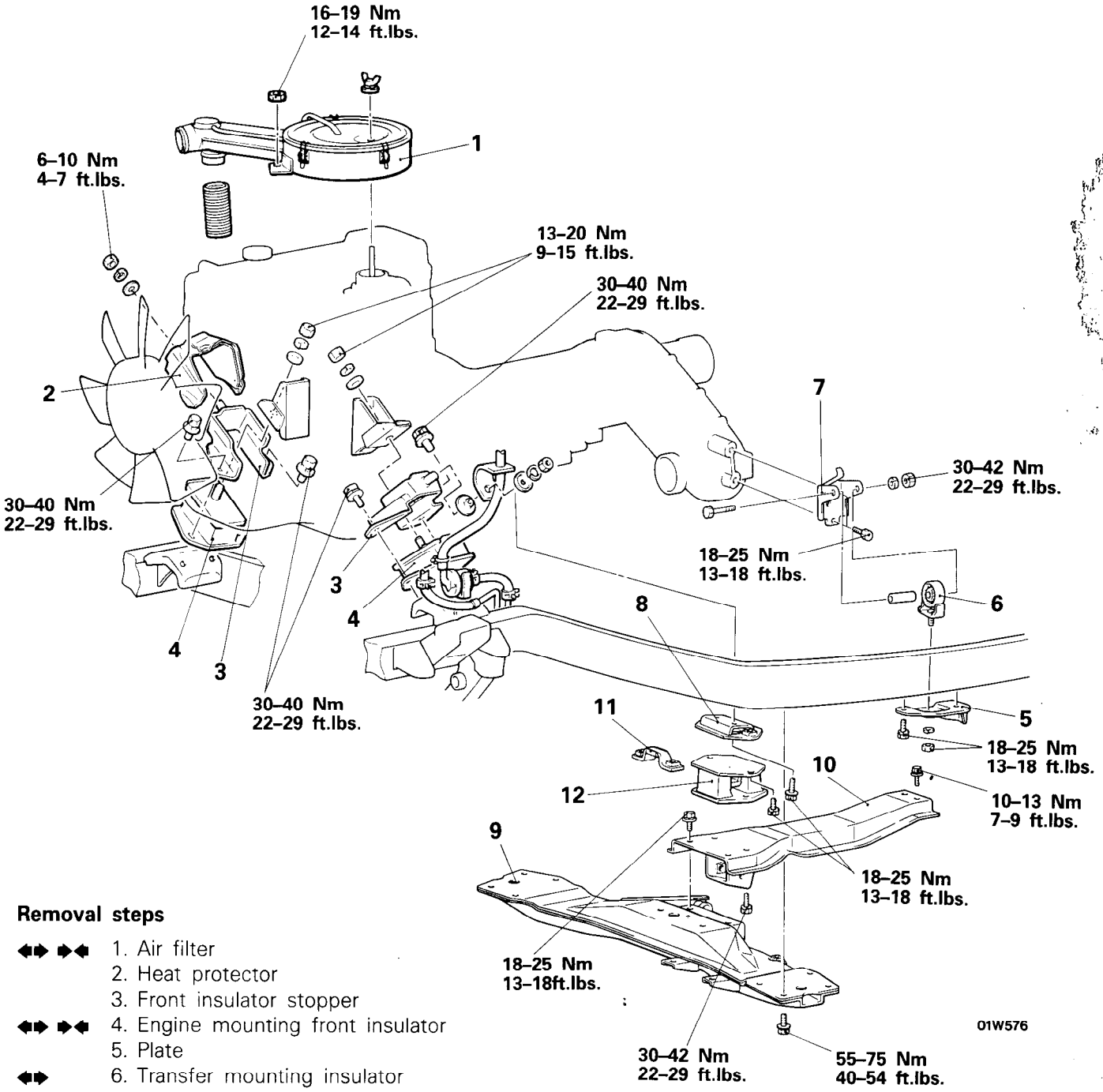
Removal steps

◀▶ ▶◀ 1. Air filter
2. Heat protector
3. Front insulator stopper
◀▶ ▶◀ 4. Engine mounting front insulator
5. Plate
◀▶ 6. Transfer mounting insulator
7. Transfer mounting bracket
9. No. 2 crossmember
12. Engine mounting rear insulator

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◀▶ : Refer to "Service Points of Removal".
(3) ▶◀ : Refer to "Service Points of Installation".

STB Revision

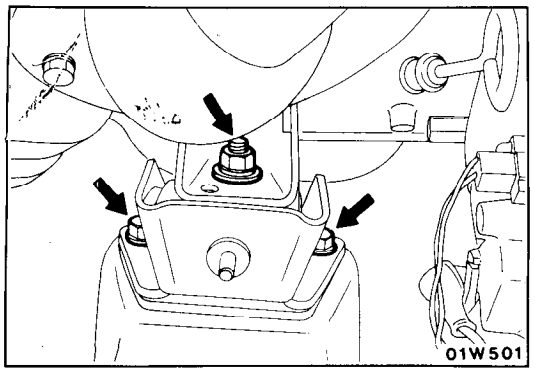
Vehicles with an automatic transmission



Removal steps

◆◆ ◆◆ 1. Air filter
2. Heat protector
3. Front insulator stopper
◆◆ ◆◆ 4. Engine mounting front insulator
5. Plate
◆◆ 6. Transfer mounting insulator
7. Transfer mounting bracket
8. Engine support rear bracket
9. No. 2 crossmember
10. Rear engine support member
11. Support plate
12. Engine mounting rear insulator

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Removal".
(3) ◆◆ : Refer to "Service Points of Installation".



SERVICE POINTS OF REMOVAL N09GBAD

1. REMOVAL OF AIR FILTER

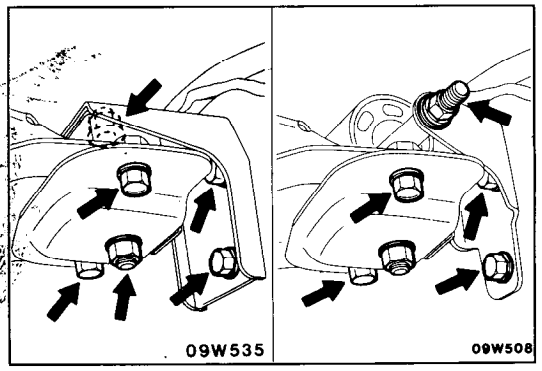
Refer to GROUP 11 INTAKE AND EXHAUST – Air Filter.

4. REMOVAL OF ENGINE MOUNTING FRONT INSULATOR

(1) Attach a chain to the engine hangers.
(2) Using a chain block-and-tackle, hang the engine slightly up so that the insulator is free of engine weight.
(3) Remove the engine mounting front insulator.

NOTE
Hang the engine with a chain until installing the engine mounting front insulator.

Caution
Avoid applying a strain on the radiator and fuel hoses and cables by raising the engine too high.

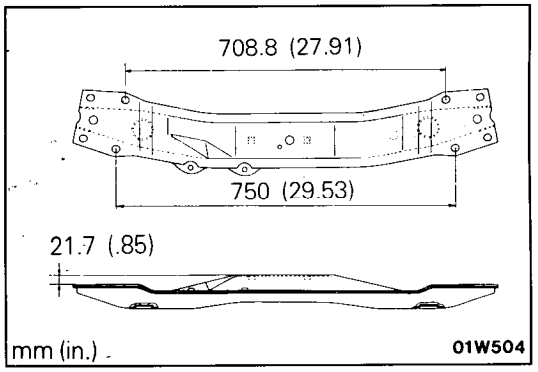


6. REMOVAL OF TRANSFER MOUNTING INSULATOR

(1) Support the transfer with a jack.

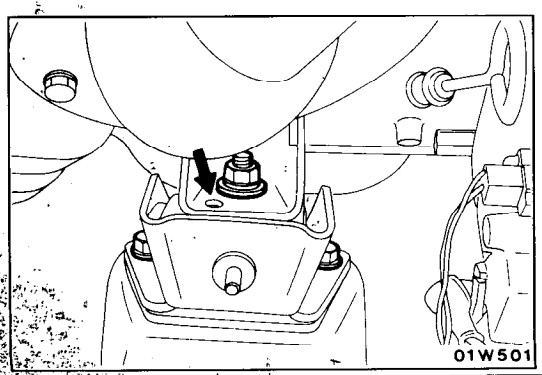
NOTE
Support the transfer with a jack until installing the transfer mounting insulator.

(2) Remove the transfer mounting insulator.



INSPECTION N09GCAE

- Check the insulators for cracks, separation or deformation.
- Check the front insulator stoppers for deformation.
- Check the transfer mounting bracket for deformation or corrosion.
- Check the plate for deformation or corrosion.
- Check the No. 2 crossmember for deformation or corrosion.



SERVICE POINTS OF INSTALLATION N09GDAG

4. INSTALLATION OF ENGINE MOUNTING FRONT INSULATOR

Make sure that the locating boss and hole are in alignment.

Caution
Do not distort rubber portions, and never stain rubber portions with fuel or oil.

1. INSTALLATION OF AIR FILTER

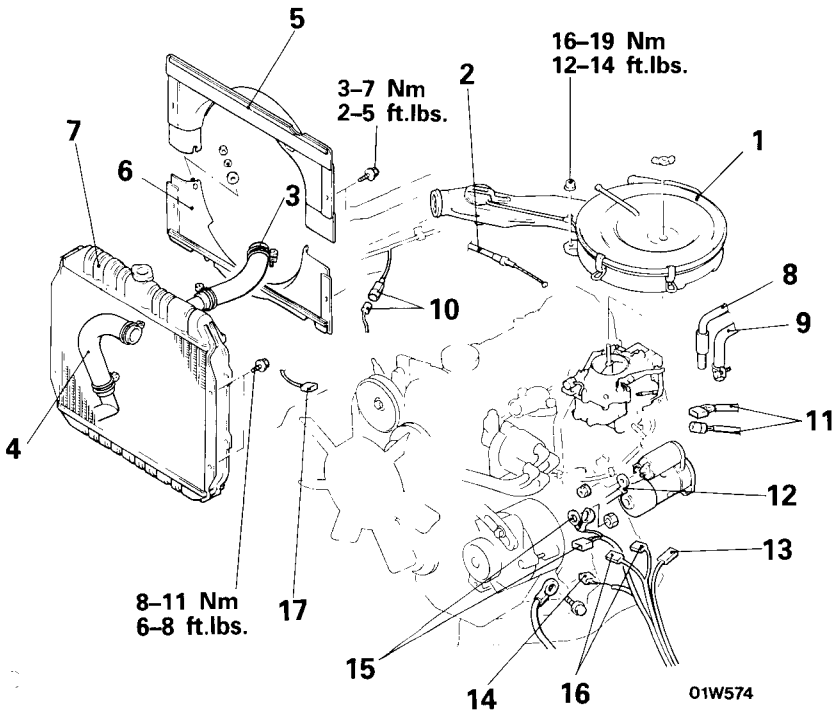
Refer to GROUP 11 INTAKE AND EXHAUST – Air Filter.

ENGINE AND TRANSMISSION ASSEMBLY
REMOVAL AND INSTALLATION

N09SA-B

Pre-removal Operation
- Removal of the hood (Refer to GROUP 23 BODY – Hood.)
- Under Cover, Under Skid Plate, Transfer Case Protector, Cross Shaft Protector, Snow-protector (Refer to GROUP 23 BODY – Under Cover.)
- Draining of the Transmission Fluid or Oil and Transfer Case Oil (Refer to GROUP 21 TRANSMISSION – Transmission and Transfer Oil Change and Inspection.)
- Draining of the steering fluid (Refer to GROUP 19 STEERING – Replacement of fluid.)
- Draining of the Refrigerant (Refer to GROUP 24 HEATERS AND AIR-CONDITIONING – Refrigerant Leak Repair procedure.)

Post-installation Operation
- Supplying of Transmission Fluid or Transfer Case Oil (Refer to GROUP 21 TRANSMISSION – Transmission and Transfer Oil Change and Inspection.)
- Supplying of Steering Fluid (Refer to GROUP 19 POWER STEERING – Replacement of Fluid.)
- Supplying of Refrigerant (Refer to GROUP 24 HEATERS AND AIR-CONDITIONING – Refrigerant Leak Repair Procedure.)
- Installation of the Undercover, Under Skid Plate, Transfer Case Protector, Cross-shaft Protector and Snow Protector. (Refer to GROUP 23 BODY – Under Cover.)
- Installation of the Hood (Refer to GROUP 23 BODY – Hood.)

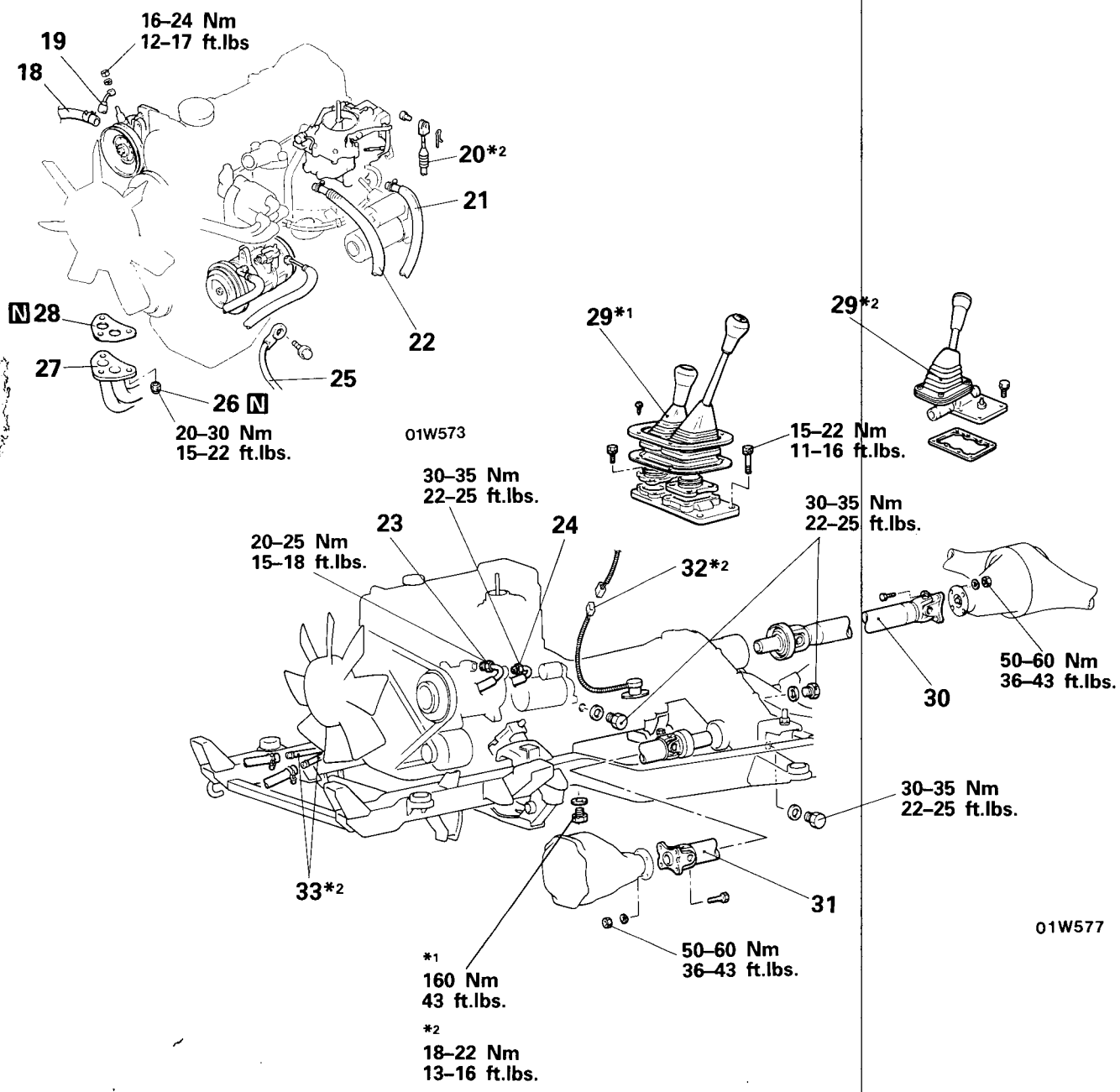


Removal steps

◆▶ ▶◀ 1. Air filter
▶◀ 2. Connection of accelerator cable
3. Radiator upper hose
4. Radiator lower hose
5. Upper shroud
6. Lower shroud
◆▶ ▶◀ 7. Radiator
8. Connection of brake booster vacuum hose
9. Connection of heater hose
10. Connection of oxygen sensor connector
11. Connection of control harness connector
12. Connection of battery positive cable
13. Connection of starter motor connector
14. Connection of air conditioner harnness connector (Vehicles with an air conditioner)
15. Connection of alternator connector
16. Connection of water temperature gauge unit switch and sensor connector
17. Connection of oil pressure gauge unit connecter.

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆▶ : Refer to "Service Points of Removal".
(3) ▶◀ : Refer to "Service Points of Installation".

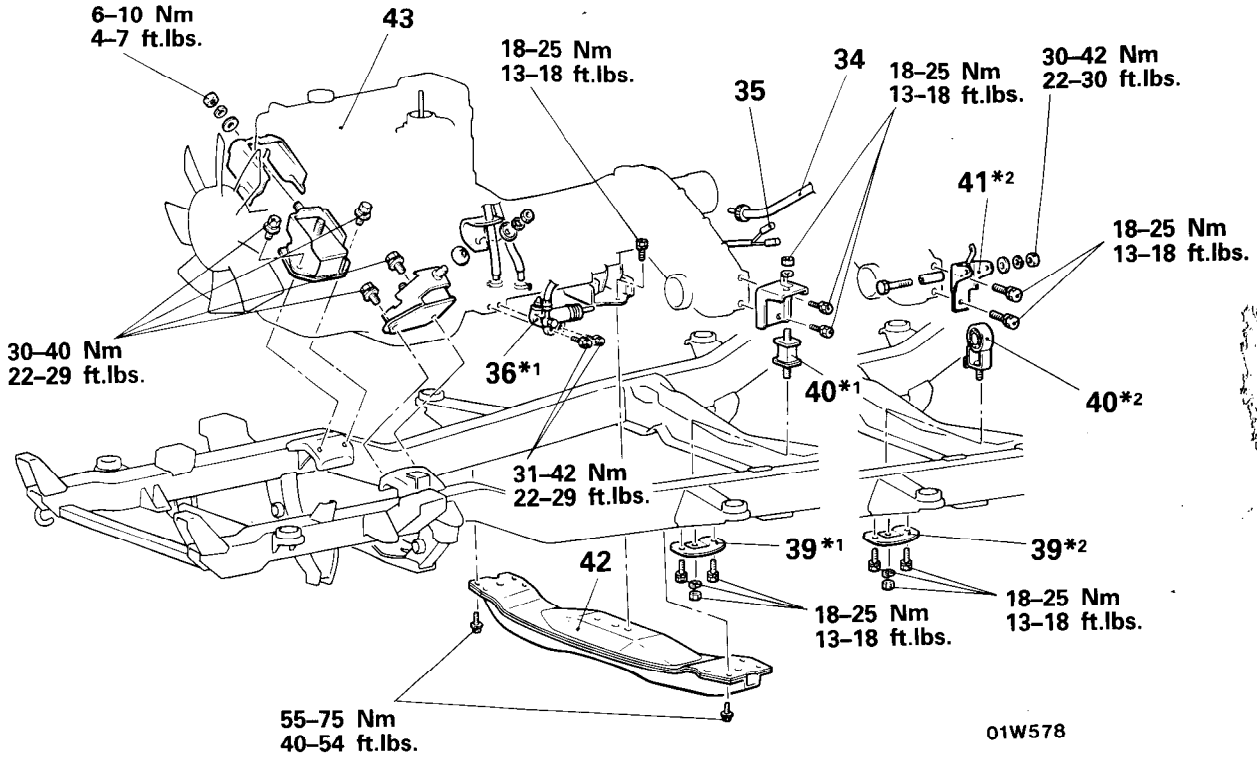
STB Revision

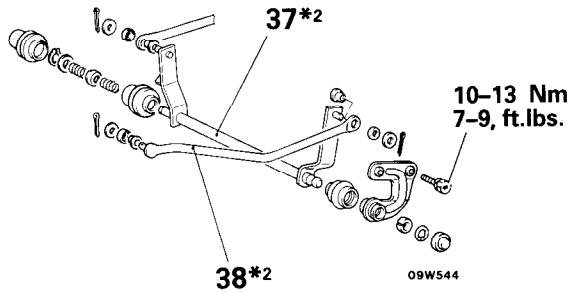


18. Connection of power steering return hose
19. Connection of power steering pressure hose
20. Connection of throttle control cable
21. Connection of fuel main hose
22. Connection of fuel return hose
23. Connection of the air conditioner compressor and discharge hose (vehicles with an air-conditioner)
24. Connection of the air conditioner compressor and suction hose (vehicles with an air-conditioner)
25. Connection of ground cable
26. Self locking nut
27. Connection of front exhaust pipe
28. Gasket
29. Control lever assembly
30. Rear propeller shaft
31. Front propeller shaft
32. Connection of the connector for the OD solenoid valve
33. Connection of oil cooler feed tube and return tube

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◀▶ : Refer to "Service Points of Removal".
(3) ▶◀ : Refer to "Service Points of Installation".
(4) N : Non-reusable parts.
(5) *1 : Vehicles with a manual transmission.
(6) *2 : Vehicles with an automatic transmission.

STB Revision





- ◆◆ 34. Connection of speedometer cable
- 35. Connection of 4WD indicator light switch
- ◆◆ ◆◆ 36. Clutch release cylinder
- ◆◆ ◆◆ 37. Select cross shaft
- ◆◆ ◆◆ 38. Transmission control rod
- 39. Plate
- 40. Transfer mounting insulator
- 41. Transfer mounting bracket
- 42. No. 2 crossmember
- ◆◆ ◆◆ 43. Engine and transmission assembly

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Removal".
(3) ◆◆ : Refer to "Service Points of Installation".
(4) N : Non-reusable parts.
(5) *1 : Vehicles with a manual transmission.
(6) *2 : Vehicles with an automatic transmission.

SERVICE POINTS OF REMOVAL N09SBCC

1. REMOVAL OF AIR FILTER

Refer to GROUP 11 INTAKE AND EXHAUST – Air Filter.

7. REMOVAL OF RADIATOR

Refer to GROUP 7 COOLING – Radiator.

29. REMOVAL OF CONTROL LEVER ASSEMBLY

Refer to GROUP 21 TRANSMISSION – Gearshift Lever Assembly (Manual transmission) or Transfer Control (Automatic transmission).

30. REMOVAL OF REAR PROPELLER SHAFT/31. FRONT PROPELLER SHAFT

Refer to GROUP 16 PROPELLER SHAFT AND UNIVERSAL JOINTS – Propeller shaft.

36. REMOVAL OF CLUTCH RELEASE CYLINDER

Refer to GROUP 6 CLUTCH – Clutch Release Cylinder.

37. REMOVAL OF SELECT CROSS SHAFT/38. TRANSMISSION CONTROL ROD

Refer to GROUP 21 TRANSMISSION – Transmission Control.

43. REMOVAL OF ENGINE AND TRANSMISSION ASSEMBLY

With the engine and transmission assembly tilted at an angle, slowly remove from the engine compartment.

Caution
Check to be sure that all cables, harnesses, connectors, etc. are disconnected from the engine and transmission assembly.

SERVICE POINTS OF INSTALLATION N09SDAG

43. INSTALLATION OF ENGINE AND TRANSMISSION ASSEMBLY

(1) While checking the connections of the harnesses, pipes, hoses, etc., and making sure that none of them are being caught, damaged, etc., install the engine and transmission assembly.
(2) Then, after the weight of the engine and transmission assembly has been put on each insulator, tighten to specified torque.

38. INSTALLATION OF TRANSMISSION CONTROL ROD/37. SELECT CROSS SHAFT

Refer to GROUP 21 TRANSMISSION – Transmission Control.

36. INSTALLATION OF CLUTCH RELEASE CYLINDER

Refer to GROUP 6 CLUTCH – Clutch Release Cylinder.

34. CONNECTION OF SPEEDOMETER CABLE

Refer to GROUP 21 TRANSMISSION – Replacement of the Speedometer Cable.

31. INSTALLATION OF FRONT PROPELLER SHAFT/30. REAR PROPELLER SHAFT

Refer to GROUP 16 PROPELLER SHAFT AND UNIVERSAL JOINTS – Propeller shaft.

29. INSTALLATION OF CONTROL LEVER ASSEMBLY

Refer to GROUP 21 TRANSMISSION – Gearshift Lever Assembly (Manual transmission) or Transfer Control (Automatic transmission).

20. CONNECTION OF THROTTLE CONTROL CABLE

Refer to GROUP 21 TRANSMISSION – Adjustment of Throttle Control Cable.

7. INSTALLATION OF RADIATOR

Refer to GROUP 7 COOLING – Radiator.

2. ADJUSTMENT OF ACCELERATOR CABLE

Refer to GROUP 14 FUEL SYSTEM – Accelerator

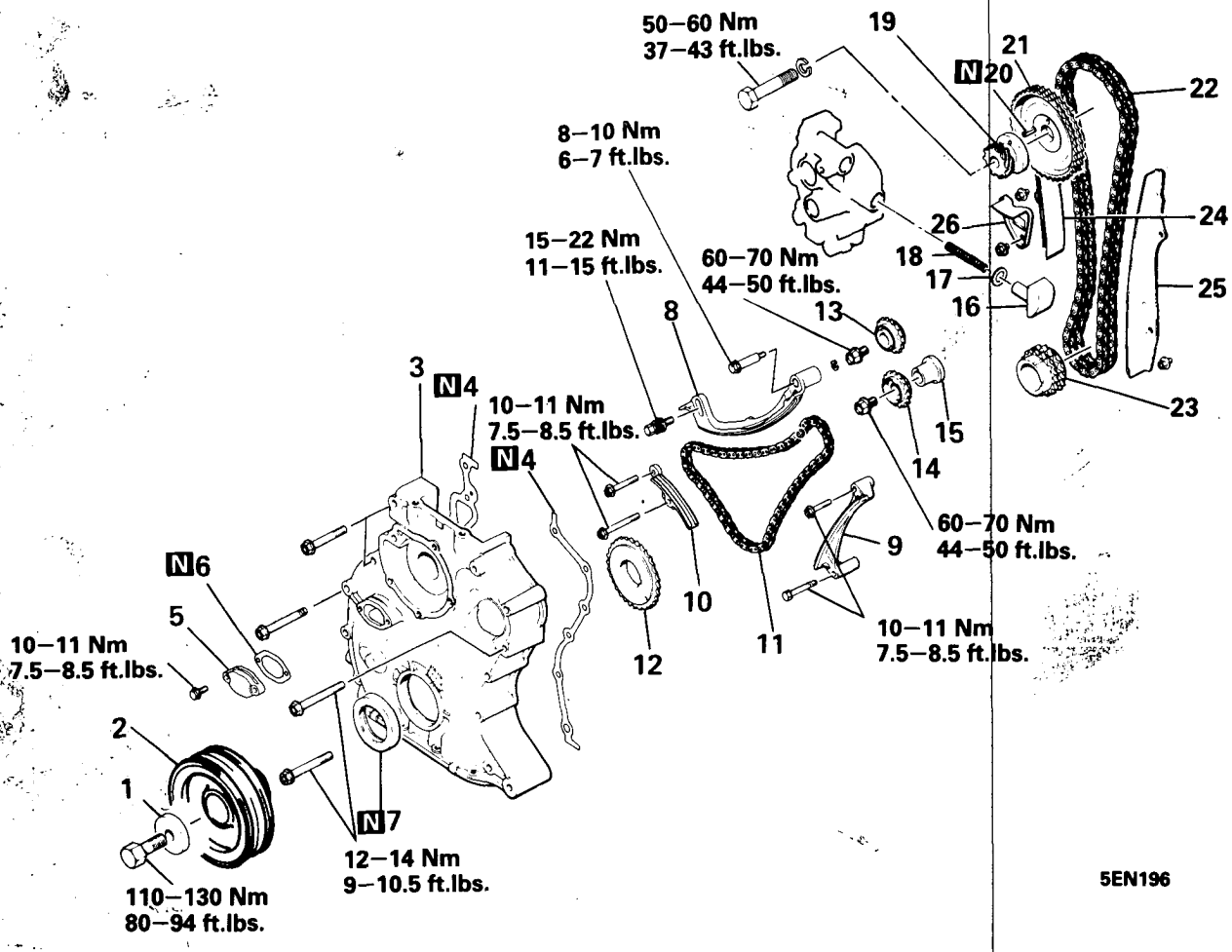
1. INSTALLATION OF AIR FILTER

Refer to GROUP 11 INTAKE AND EXHAUST – Air Filter.

TIMING CHAIN TRAIN

N09WA--

REMOVAL AND INSTALLATION



Removal steps

1. Special washer
2. Crankshaft pulley
3. Timing chain case
4. Chain case gasket
5. Chain guide access hole cover
6. Chain guide access hole gasket
7. Oil seal
8. Chain guide "B"
9. Chain guide "A"
10. Chain guide "C"
11. Chain "B"
12. Crankshaft sprocket "B"
13. Oil pump sprocket
14. Left silent shaft sprocket
15. Spacer
16. Tension sleeve
17. Rubber sheet
18. Tensioner spring
19. Distributor gear
20. Spring pin
◆◆ 21. Camshaft sprocket
◆◆ 22. Timing chain
◆◆ 23. Crankshaft sprocket
24. Loose side chain guide
25. Tension side chain guide
26. Sprocket holder

Installation steps

26. Sprocket holder
25. Tension side chain guide
24. Loose side chain guide
◆◆ 18. Tensioner spring
◆◆ 17. Rubber sheet
◆◆ 16. Tension sleeve
23. Crankshaft sprocket
◆◆ 22. Timing chain
21. Camshaft sprocket
20. Spring pin
19. Distributor gear
15. Spacer
◆◆ 14. Left silent shaft sprocket
13. Oil pump sprocket
◆◆ 12. Crankshaft sprocket "B"
◆◆ 11. Chain "B"
10. Chain guide "C"
9. Chain guide "A"
8. Chain guide "B"
◆◆ 7. Oil seal
6. Chain guide access hole gasket
5. Chain guide access hole cover
4. Chain case gasket
◆◆ 3. Timing chain case
2. Crankshaft pulley
1. Special washer

NOTE
(1) ◆◆ : Refer to "Service Points of Removal".
(2) ◆◆ : Refer to "Service Points of Installation".
(3) N : Non-reusable parts

STB Revision

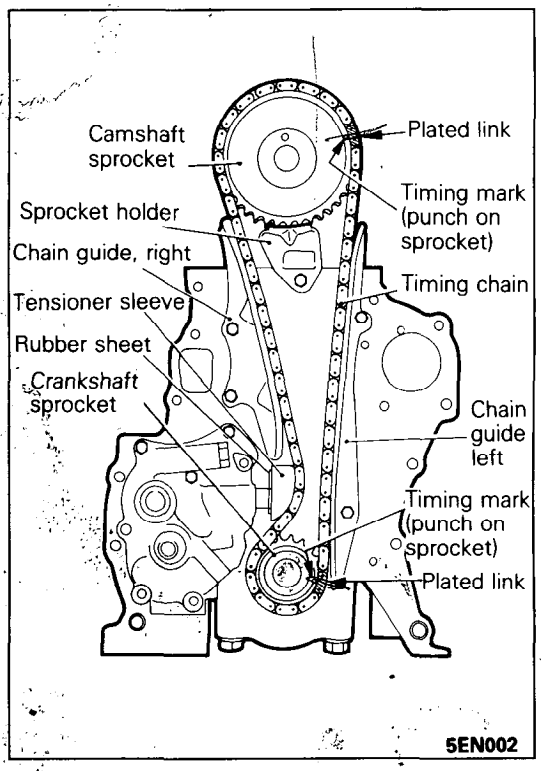
SERVICE POINTS OF REMOVAL N09WBAA

21. REMOVAL OF CAMSHAFT SPROCKET/22. TIMING CHAIN/23. CRANKSHAFT SPROCKET

Remove the timing chain combined with camshaft sprocket and crankshaft sprocket.

INSPECTION N09WCAA

- Check the timing chain for roller play, wear, damage or disconnected links.
  Replace if necessary.
- Check the tensioner and chain guide rubber shoe for wear or damage.
  Replace if necessary.



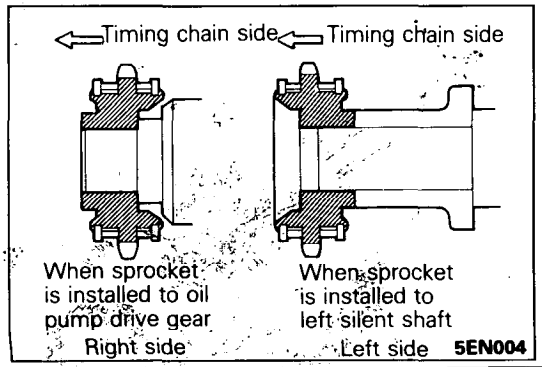
SERVICE POINTS OF INSTALLATION N09WDAA

18. INSTALLATION OF TENSIONER SPRING/17. RUBBER SHEET/16. TENSIONER SLEEVE

Install tensioner spring, sleeve and rubber sheet to oil pump, and then install the oil pump.

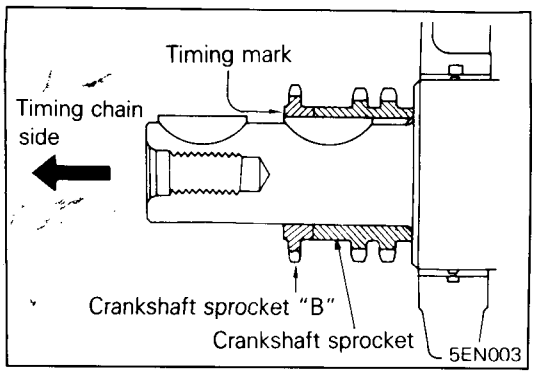
22. INSTALLATION OF TIMING CHAIN

(1) Turn crankshaft until piston of No. 1 cylinder is at top dead center.
(2) Line up plated links of timing chain and timing marks on sprockets as chain and sprockets are assembled.
(3) While sliding crankshaft sprocket onto crankshaft, install chain and sprocket. Place camshaft sprocket on sprocket holder.



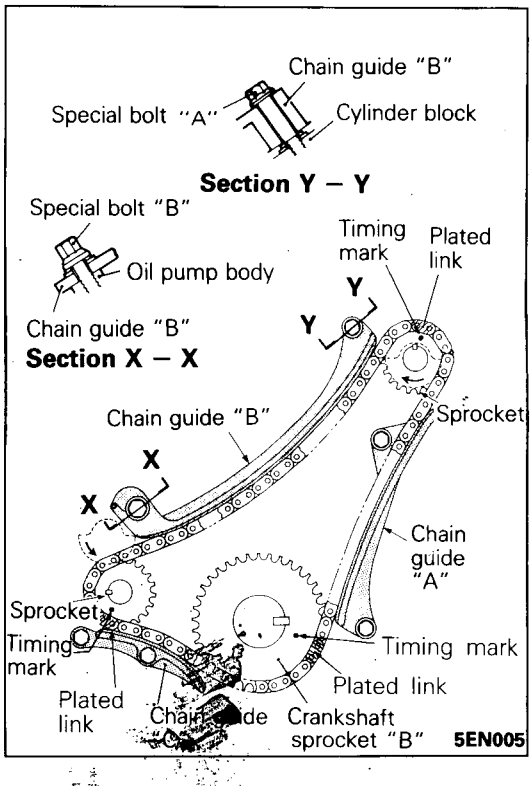
14. INSTALLATION OF LEFT SILENT SHAFT SPROCKET

(1) Assemble silent shaft sprockets to chain "B". Make sure that timing marks are in alignment with plated links.
(2) Use care not to confuse right and left sprockets, as they are installed in opposite directions.



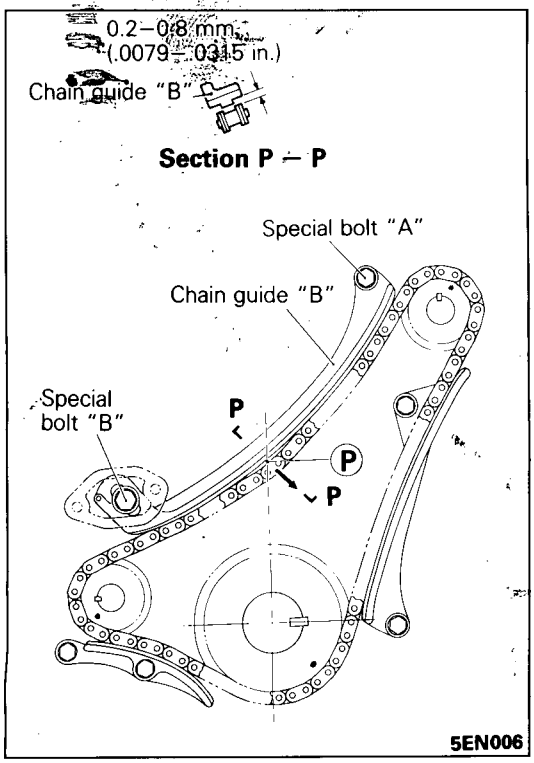
12. INSTALLATION OF CRANKSHAFT SPROCKET "B"

Install crankshaft sprocket "B" (for driving silent shafts) on crankshaft.



11. INSTALLATION OF CHAIN "B"

(1) Holding assembled sprockets and chain "B", align timing mark on crankshaft sprocket "B" with that on chain "B", and install sprockets to oil pump drive gear and left silent shaft. Partially tighten bolt.

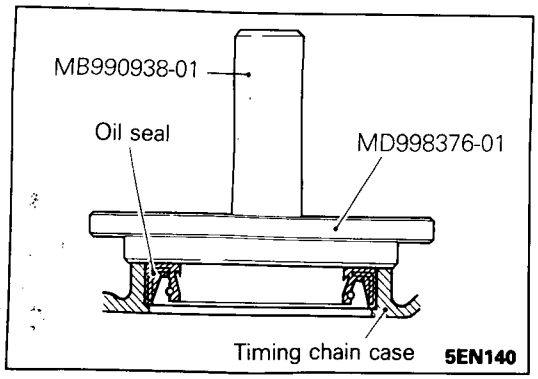


(2) Rotate both silent shaft sprockets slightly to position chain slack at point P.

(3) Adjust position of chain guide "B" so that when chain is pulled in direction of arrow with finger tips, clearance between chain guide "B" and links of chain "B".

Chain and chain guide "B" gap
Standard value : 0.2–0.8 mm (.0079–.0315 in.)

STB Revision



7. INSTALLATION OF OIL SEAL

Using special tools, install the oil seal.

3. INSTALLATION OF TIMING CHAIN CASE

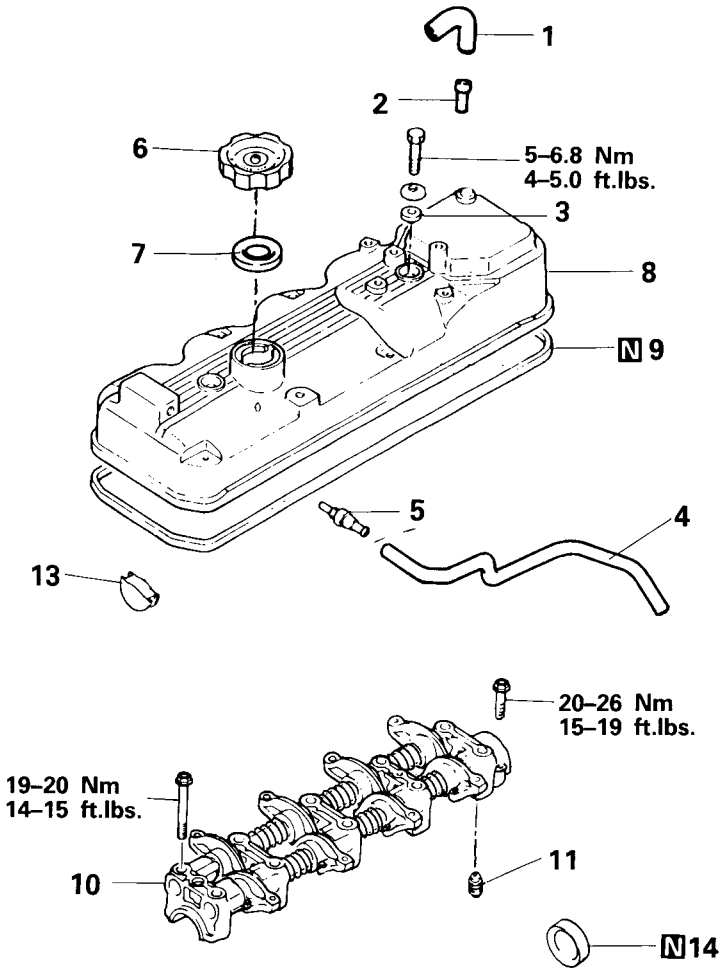
(1) Clean the gasket surfaces of chain case and cylinder block.
(2) Install the chain case gaskets and chain case to the cylinder block.

STB Revision

ROCKER ARMS, ROCKER ARM SHAFTS AND CAMSHAFT

REMOVAL AND INSTALLATION

N09LA--



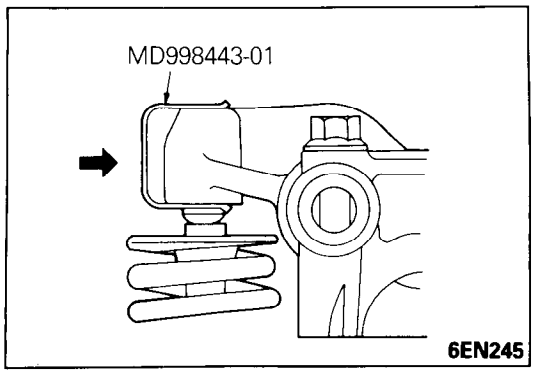
Removal steps

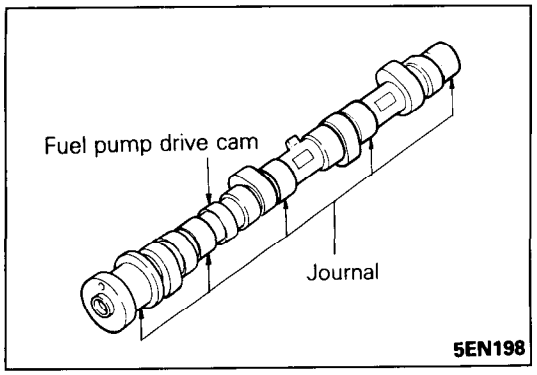
1. Breather hose
2. Pipe
3. Oil seal
4. P.C.V. hose
5. P.C.V. valve
6. Oil filler cap
7. Packing
8. Rocker cover
9. Rocker cover gasket

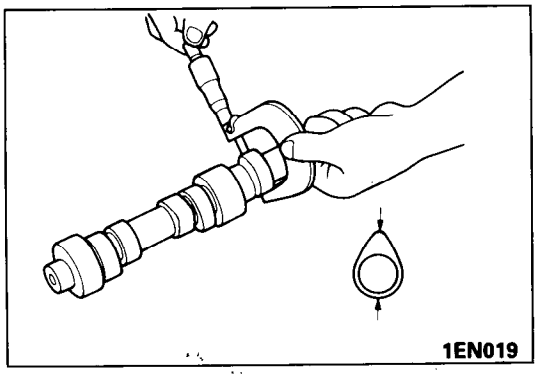
◆◆ ◆◆ 10. Rocker arm and shaft assembly
◆◆ ◆◆ 11. Auto-lash adjuster
◆◆ 12. Camshaft
◆◆ 13. Semi-circular packing
◆◆ 14. Circular packing

NOTE
(1) Reverse the removal procedures to reinstall
(2) ◆◆ : Refer to "Service Points of Removal".
(3) ◆◆ : Refer to "Service Points of Installation".
(4) N: Non-reusable parts

5EN197







SERVICE POINTS OF REMOVAL N09LBCA

10. REMOVAL OF ROCKER ARM AND SHAFT ASSEMBLY/11. AUTO-LASH ADJUSTER

Before removing the rocker arm and shaft assembly, use the special tool to ensure that the auto-lash adjuster doesn't fall out.

Caution
Put the rocker arms and auto-lash adjusters in order in cylinder No. separated places with clear distinction between the intake and exhaust ones to prevent confusion.

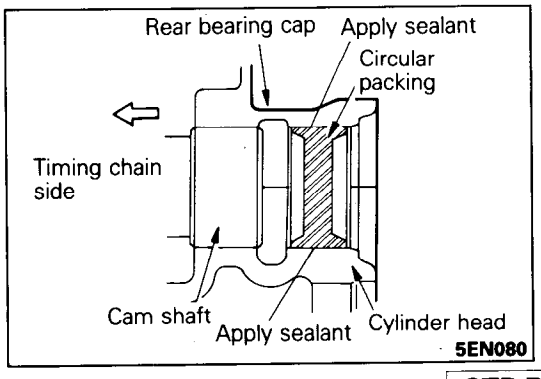
INSPECTION N09LCCA

- Check camshaft journals for wear or damage. Replace if necessary. If journals are damaged, also inspect camshaft bearings for wear or damage. If camshaft bearing is badly worn, replace cylinder head.
- Check the fuel pump drive cam and distributor drive gear teeth for wear or damage. Replace if necessary.

Camshaft
Standard value
Height of fuel pump drive cam : 37 mm (1.4567 in.)
Journal diameter : 34 mm (1.3386 in.)
Oil clearance : 0.03–0.05 mm (.0012–.0020 in.)

- Check for unusual cam face wear or damage, replace the part if required. Measure cam height (i.e., its diameter), replace the cam if outside of the limit.

Cam height
Standard value
Intake : 42.4 mm (1.6693 in.)
Exhaust : 42.4 mm (1.6693 in.)
Limit
Intake : 41.9 mm (1.6496 in.)
Exhaust : 41.9 mm (1.6496 in.)
End play
Standard value : 0.1–0.2 mm (.004–.008 in.)
Limit : 0.4 mm (.016 in.)

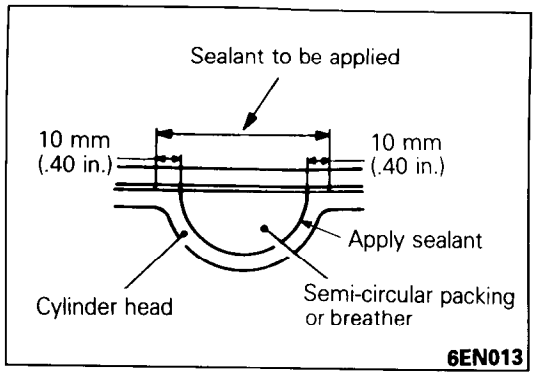


SERVICE POINTS OF INSTALLATION N09LDCB

14. INSTALLATION OF CIRCULAR PACKING

Coat the sealant to the O.D. of circular packing and install the circular packing to cylinder head.

STB Revision



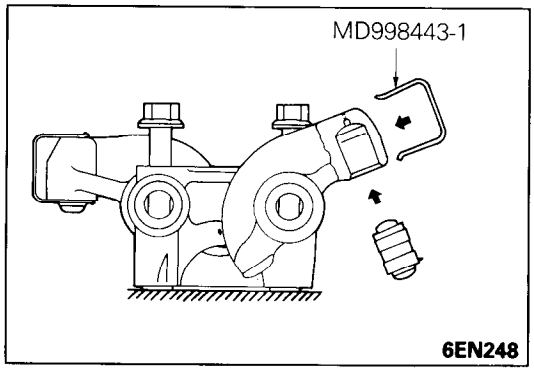
13. APPLY SEALANT TO SEMI-CIRCULAR PACKING

Apply sealant to the top of the packing and semi-circle.

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

12. INSTALLATION OF CAMSHAFT

Apply engine oil to the journals of camshaft and install it to cylinder head.



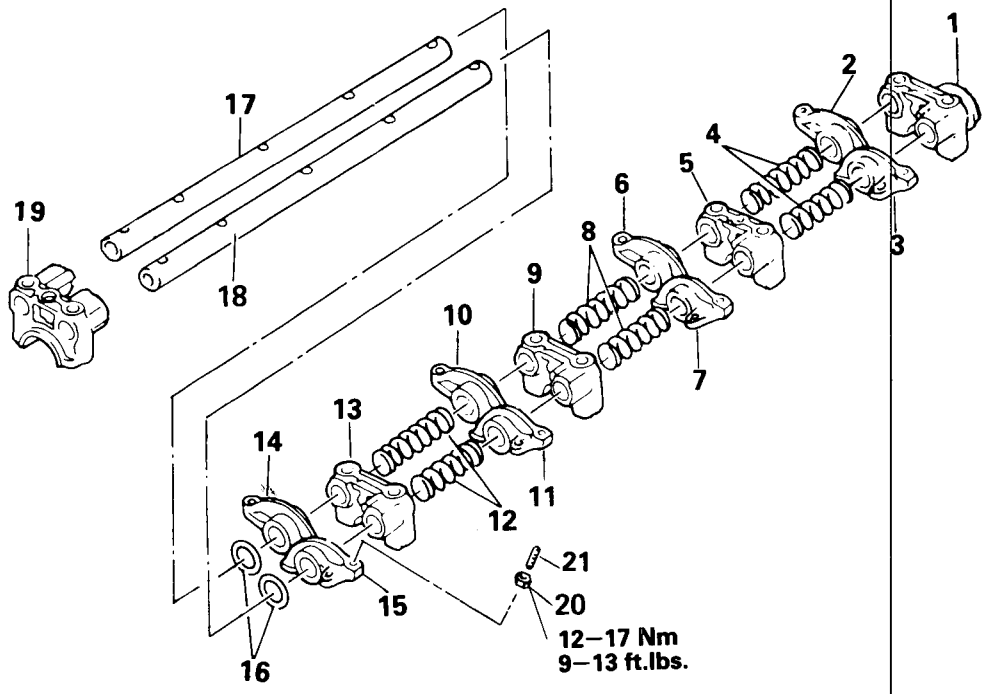
11. INSTALLATION OF AUTO-LASH ADJUSTER/10. ROCKER ARM AND SHAFT ASSEMBLY

(1) Insert the auto-lash adjuster from below as illustrated, being careful not to spill the diesel oil inside it. Then use the special tool to prevent adjuster from falling while installing it.
(2) Place the rocker arm and shaft assembly on the cylinder head and tighten the bearing cap bolt.
(3) Remove the special tool.

ROCKER ARM AND SHAFT ASSEMBLY

N09NE–B

DISASSEMBLY AND REASSEMBLY



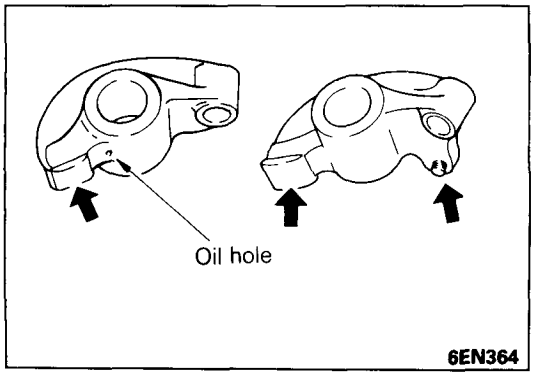
5EN199

Disassembly steps

1. Rear bearing cap
2. Rocker arm "C"
3. Rocker arm "A"
4. Rocker shaft spring
- ◆◆ 5. Bearing cap No.4
6. Rocker arm "C"
7. Rocker arm "A"
8. Rocker shaft spring
- ◆◆ 9. Bearing cap No.3
10. Rocker arm "C"
11. Rocker arm "A"
12. Rocker shaft spring
- ◆◆ 13. Bearing cap No.2
14. Rocker arm "C"
15. Rocker arm "A"
- ◆◆ 16. Wave washer
- ◆◆ 17. Right rocker arm shaft
- ◆◆ 18. Left rocker arm shaft
- ◆◆ 19. Front bearing cap
20. Nut
21. Adjusting screw

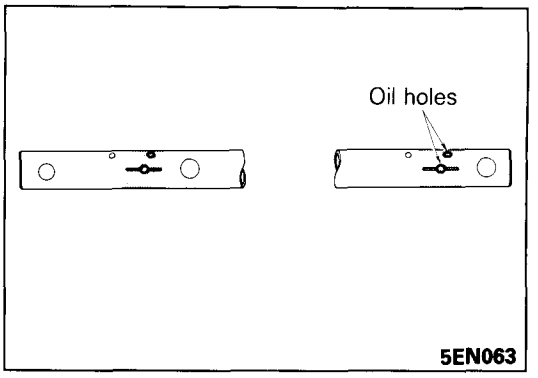
NOTE
(1) Reverse the disassembly procedures to reassemble.
(2) ◆◆ : Refer to "Service Points of Reassembly".

STB Revision

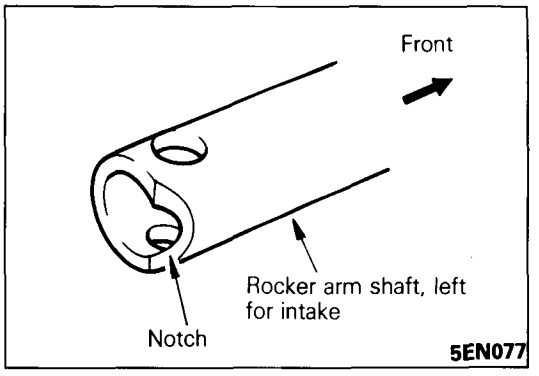


INSPECTION N09NGAD1

- **ROCKER ARM**
  (1) Check rocker arms for wear or damage. Replace if necessary.
  (2) Check to ensure that oil holes are clear.



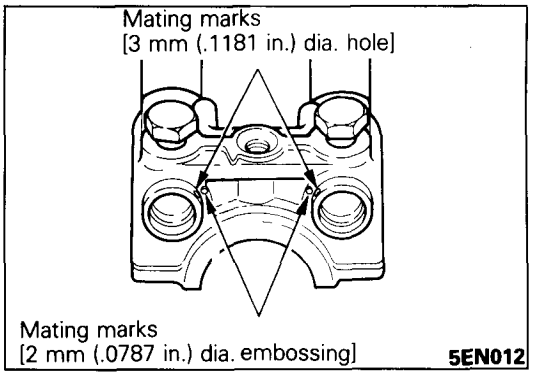
- **ROCKER ARM SHAFT**
  (1) Check rocker arm mounting portions of rocker arm shaft for wear or damage. Replace as necessary.
  (2) Check to ensure that oil holes are clear.



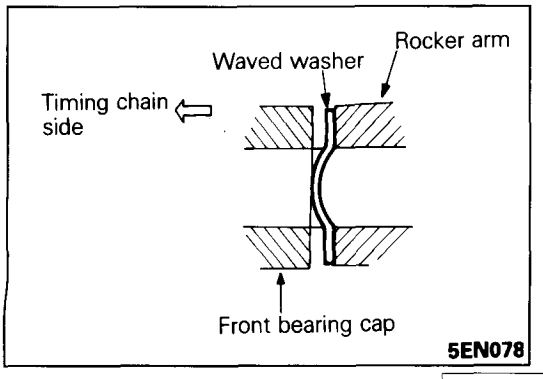
SERVICE POINTS OF REASSEMBLY N09NHCA

19. INSTALLATION OF FRONT BEARING CAP/18. LEFT ROCKER ARM SHAFT/17. RIGHT ROCKER ARM SHAFT

(1) Insert the left and right rocker shafts into the front bearing cap. The rear end of left (intake) rocker arm shaft has a notch.
(2) Align the mating mark of the rocker arm shaft front end to the mating mark of the front bearing cap. Then insert the bolts to hold shafts in bearing cap.

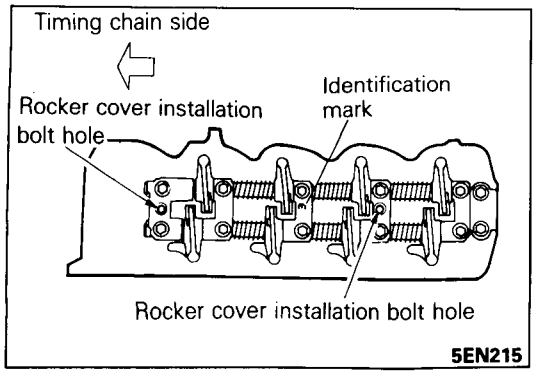


(3) Assemble the rocker arm shaft so that the alignment mark at the front end matches the alignment mark of the front bearing cap.



16. INSTALLATION OF WAVE WASHER

Install the waved washer in the direction shown in the illustration.



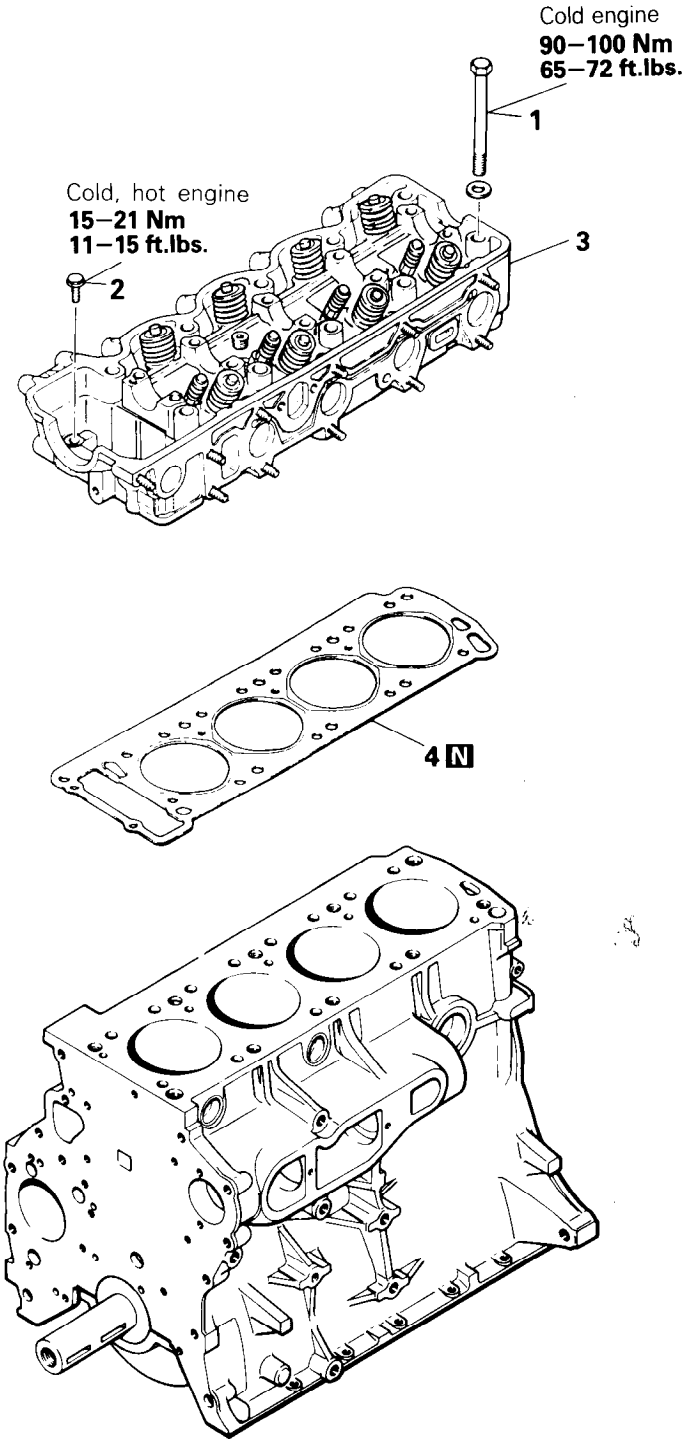
13.9.5. INSTALLATION OF BEARING CAP

Caps 2, 3 and 4 are of similar shape and require attention to the cap number during assembly.

CYLINDER HEAD

N09OA–B

REMOVAL AND INSTALLATION

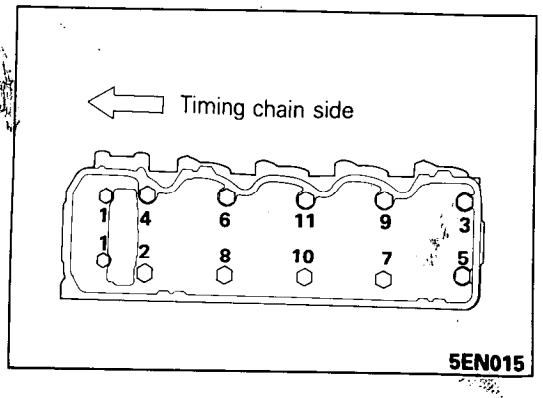


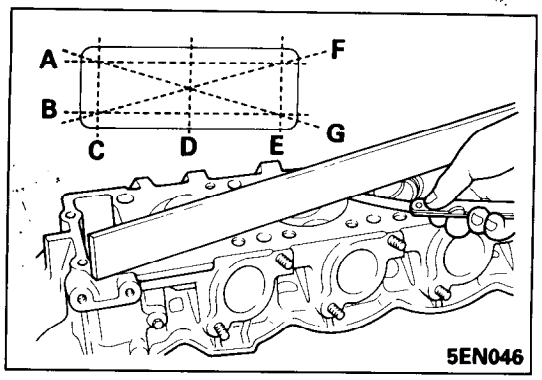
Removal steps

◆◆▶◆ 1. Cylinder head bolt
◆◆▶◆ 2. Bolt
3. Cylinder head
▶◆ 4. Cylinder head gasket

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Removal".
(3) ▶◆ : Refer to "Service Points of Installation".
(4) N : Non-reusable parts

STB Revision





SERVICE POINTS OF REMOVAL N09OBAB

1. REMOVAL OF CYLINDER HEAD BOLT/2. BOLT

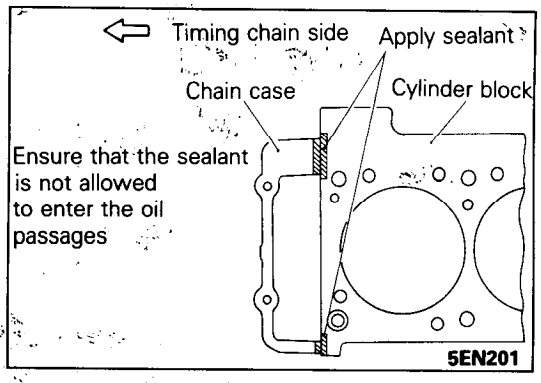
Remove cylinder head bolts in sequence shown in illustration.

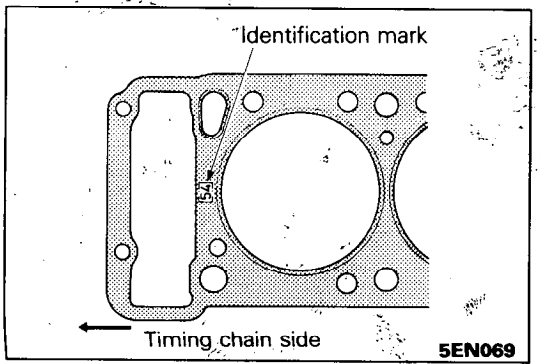
INSPECTION N09OCAE

- Remove scale, sealing compound and carbon deposits completely. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.
- Check the jet air passage and EGR gas passage for clogging.
- Visually check the cylinder head for cracks, damage and water leakage.
- Check cylinder head gasket surface for flatness with a straight edge as shown in illustration.
- If flatness exceeds limit in any direction, either replace cylinder head or lightly machine the cylinder head gasket surface.

Flatness of cylinder head gasket surface
Standard value : Max. 0.05 mm (.002 in.)
Limit : 0.2 mm (.0079 in.)
Overall height
Standard value : 90 mm (3.5433 in.)
Limit
(amount of cylinder head gasket surface grind) :
−0.2 mm (−.0079 in.)

Caution
The cylinder head gasket surface should be ground to within 0.2 mm (.0079 in.) even with the grind of the cylinder block gasket surface.





SERVICE POINTS OF INSTALLATION N09ODAB

4. INSTALLATION OF CYLINDER HEAD GASKET

(1) Clean gasket surfaces of cylinder head and cylinder block.
(2) Apply a sufficient amount of sealant or similar material to the two guides on the cylinder block and chain case as illustrated.

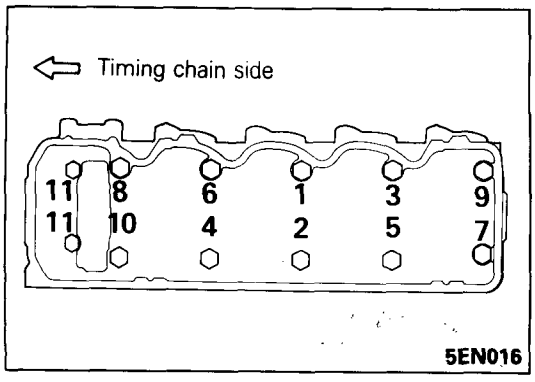
Specified sealant : 3M ART Part No. 8660 or equivalent

(3) Be sure to position the gasket on the cylinder block with the identification mark up.

Identification mark : "54"

(4) Align with the mark on the top of the cylinder head when installing.

Caution
Do not apply sealant to cylinder head gasket.



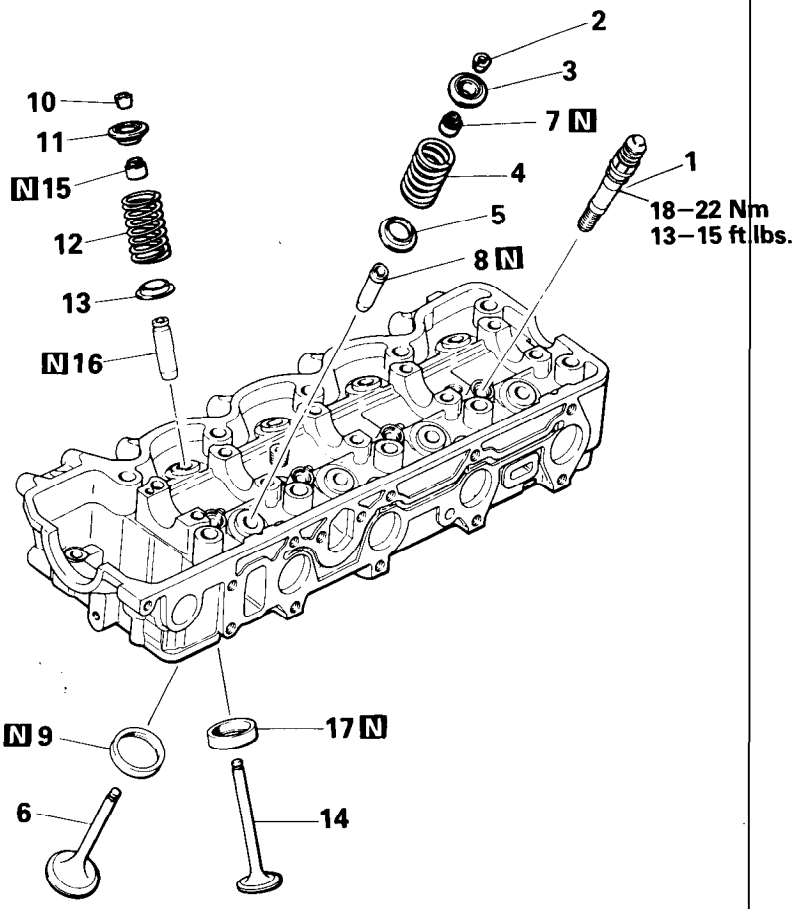
2. INSTALLATION OF BOLT/1. CYLINDER HEAD BOLT

Install cylinder head bolts. Starting at top center, tighten all cylinder head bolts to 1/2 of specified torque in sequence shown in illustration.

VALVES AND VALVE SPRINGS

N09PE–B

DISASSEMBLY AND REASSEMBLY



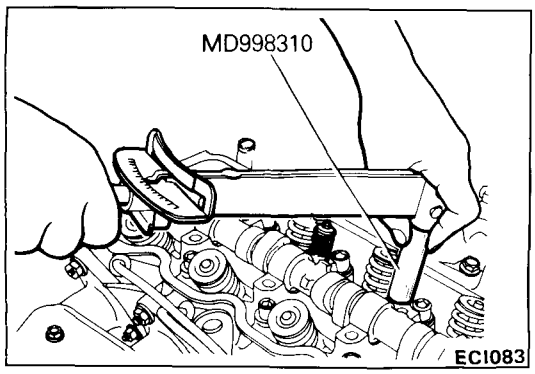
5EN212

Disassembly steps

◆◆▶◆ 1. Jet valve assembly
◆◆▶◆ 2. Retainer lock
3. Valve spring retainer
▶◆ 4. Valve spring
▶◆ 5. Valve spring seat
▶◆ 6. Intake valve
◆◆▶◆ 7. Valve stem seal
8. Intake valve guide
9. Intake valve seat
◆◆▶◆ 10. Retainer lock
11. Valve spring retainer
▶◆ 12. Valve spring
▶◆ 13. Valve spring seat
▶◆ 14. Exhaust valve
◆◆▶◆ 15. Valve stem seal
16. Exhaust valve guide
17. Exhaust valve seat

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Disassembly".
(3) ▶◆ : Refer to "Service Points of Reassembly".
(4) N : Non-reusable parts

STB Revision

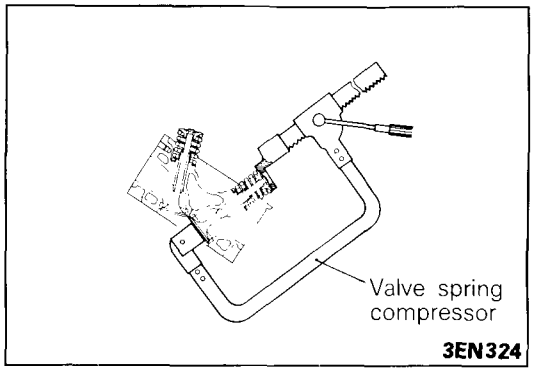


SERVICE POINTS OF DISASSEMBLY N09PFAB

1. REMOVAL OF JET VALVE ASSEMBLY

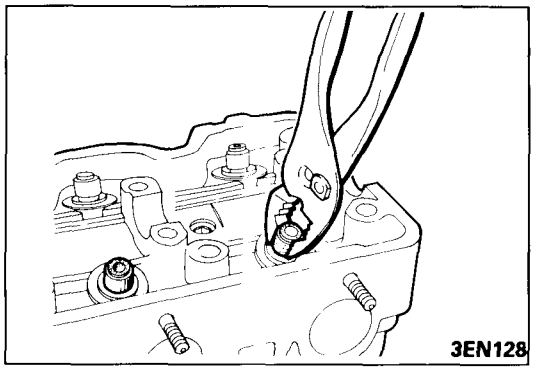
Using special tool, remove the jet valve assembly.

Caution
When special tool is used, make certain that the wrench is not tilted with respect to the center of the jet valve. If the tool is tilted, the valve stem might be bent by the force exerted on the valve spring retainer, resulting in defective jet valve operation.



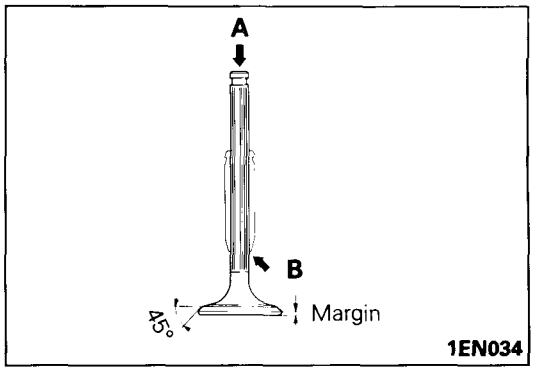
2.10. REMOVAL OF RETAINER LOCK

(1) Using valve spring compressor, remove the retainer lock.
(2) Keep these parts in order so that they can be reinstalled in their original positions.



7.15. REMOVAL OF VALVE STEM SEAL

Remove the valve stem seals with pliers and discard them.

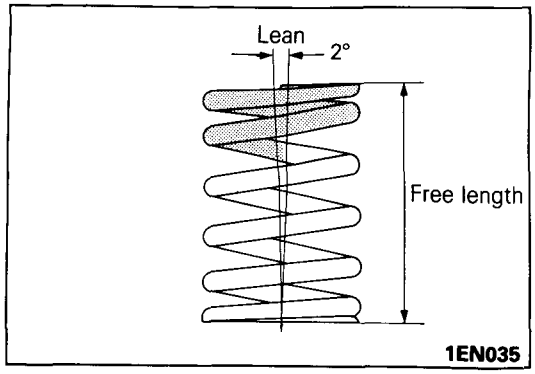


INSPECTION N09PGAC1

- **VALVES**

(1) Check each valve for wear, damage and deformation of head and stem at "B". Repair or replace excessively worn, demaged or deformed valves.
(2) If stem tip "A" has been pitted, correct with oil stone or other means. This correction must be limited to a minimum. Also reface the valve.
(3) Replace the valve if the face margin has decreased to less than limit.

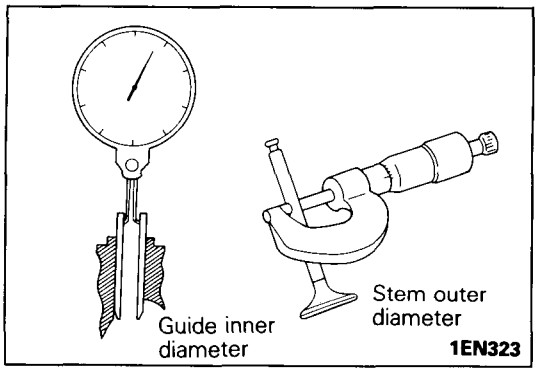
Margin
Standard value
Intake : 1.2 mm (.047 in.)
Exhaust : 2.0 mm (.079 in.)
Limit
Intake : 0.7 mm (.028 in.)
Exhaust : 1.5 mm (.059 in.)



- **VALVE SPRINGS**

(1) Check free length of each valve spring and replace if necessary.
(2) Using a square, test squareness of each valve spring. If spring is excessively out of square, replace it.

Valve spring
Standard value
Free length : 49.8 mm (1.961 in.)
Load : 322.6 N (72.5 lbs.) at installed height
Installed height : 40 4 mm (1.591 in.)
Out of squareness : Within 2°
Limit
Free length : 48.8 mm (1.922 in.)
Installed height : 41.40 mm (1.6299 in.)
Out of squareness : 4°



- **VALVE GUIDES** N09PGCB

Check the valve stem-to-guide clearance. If the clearance exceeds the limit, replace the valve guide with new oversize part.

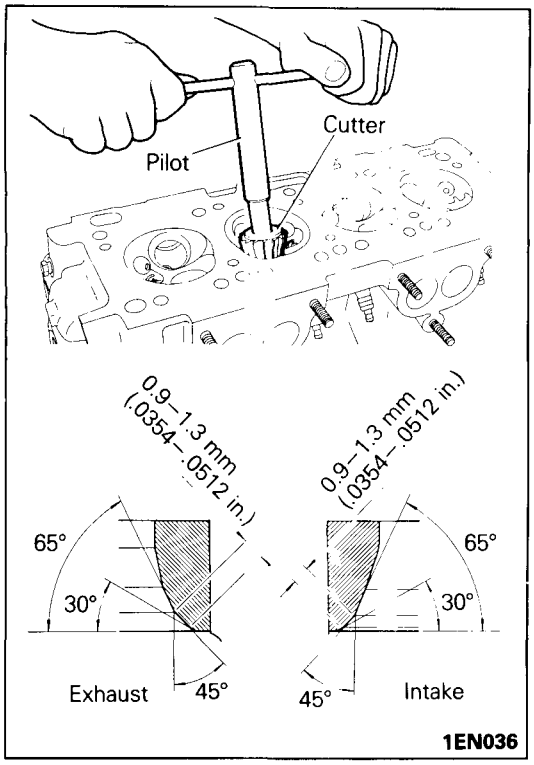
Valve stem-to-guide clearance
Standard value
Intake : 0.03–0.06 mm (.0012–.0024 in.)
Exhaust : 0.05–0.09 mm (.0020–.0035 in.)

Valve Guide Oversizes

Size mm (in.)	Size mark	Cylinder head hole size mm (in.)
0.05 (.002) O.S.	5	13.050–13.068 (.5138–.5145)
0.25 (.010) O.S.	25	13.250–13.268 (.5217–.5224)
0.50 (.020) O.S.	50	13.500–13.518 (.5315–.5422)

Limit
Intake : 0.1 mm (.0039 in.)
Exhaust : 0.15 mm (.0059 in.)

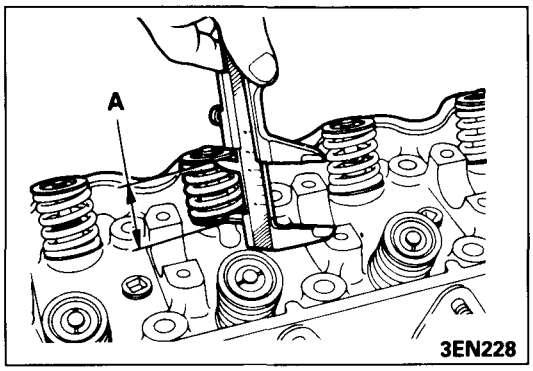
STB Revision



VALVE SEAT RECONDITIONING PROCEDURES

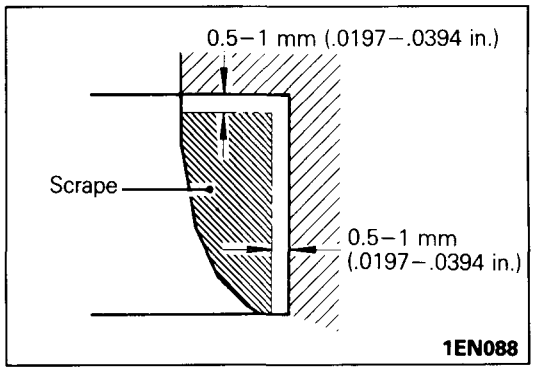
N09PHAC 1

(1) Check the valve guide for wear. Replace the worn guide.
(2) Reconditon the valve seat with a seat grinder or cutter. The valve seat contact width should be of the specified size at the center of the valve face.
(3) The valve and valve seat should be lapped lightly with a lapping compound.



(4) Check valve seat insert sinkage. If the sinkage exceeds the service limit, replace the insert with an oversize part as described below.
(5) Measure the installed height of spring between the spring seat and the retainer with the valve spring seat, spring retainer and retainer lock installed. The amount of sinkage can be judged from the measured value.

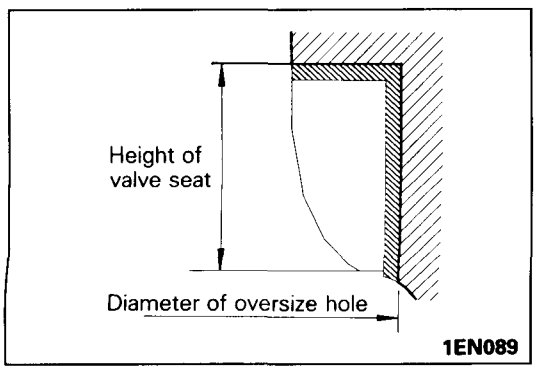
Installed height of spring A (both intake and exhaust)
Standard value : 40.4 mm (1.5905 in.)
Limit : 41.4 mm (1.6299 in.)



VALVE SEAT INSERT REPLACEMENT PROCEDURES

N09PIAE

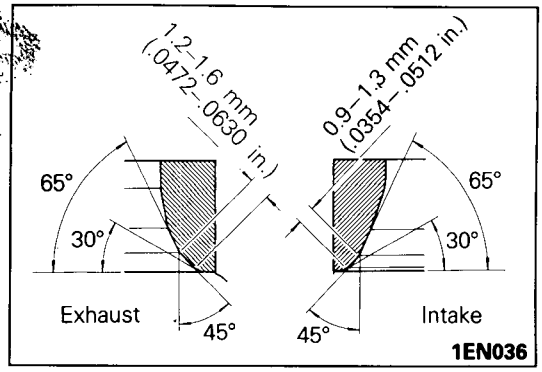
(1) To replace : scrape the inner face of the valve seat to reduce the wall thickness, and remove.



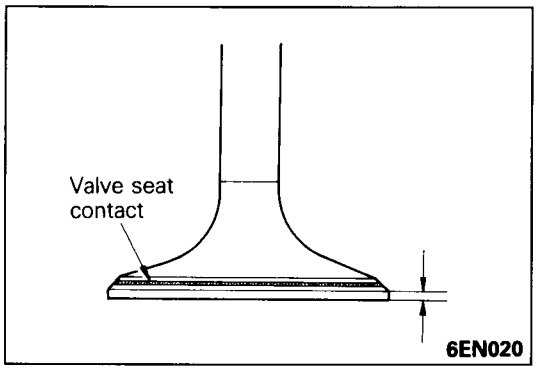
(2) Adjust the press fit diameter of the valve seat on the cylinder head side so that it matches the diameter of the oversize valve seat.

Valve Seat Insert Oversizes

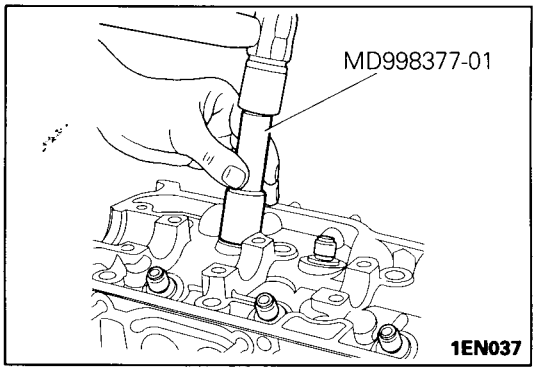
Description	Size mm (in.)	Size mark	Insert height H mm (in.)	Cylinder head I.D. mm (in.)
Intake valve seat insert	0.3 (.012) O.S.	30	7.9–8.1 (.3110–.3189)	47.30–47.33 (1.8622–1.8632)
	0.6 (.024) O.S.	60	8.2–8.4 (.3228–.3307)	47.60–47.63 (1.8740–1.8750)
Exhaust valve seat insert	0.3 (.012) O.S.	30	7.9–8.1 (.3110–.3189)	40.30–40.33 (1.5866–1.5876)
	0.6 (.024) O.S.	60	8.2–8.4 (.3228–.3307)	40.60–40.63 (1.5984–1.5994)



(3) Heat the cylinder head to about 250°C (480°F) and press in an oversie seat insert fit to the insert bore in the cylinder head at normal temperature.
(4) Treat the valve seat in the way shown in the diagram.
(5) Use the lapping compound, and lap the valve.



(9) Ensure that the seat is properly centered on the valve face.



SERVICE POINTS OF REASSEMBLY N09PKDB

15.7. INSTALLATION OF VALVE STEM SEAL/13.5. VALVE SPRING SEAT

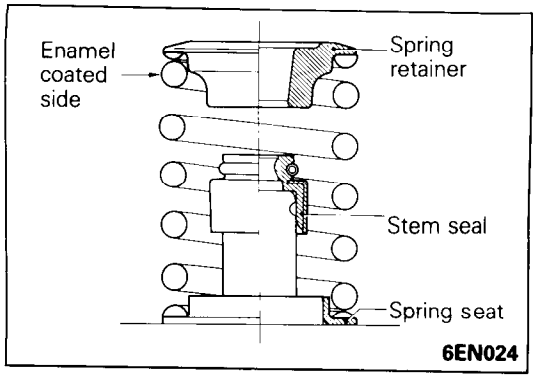
Install the spring seat, then using special tool, install the stem seal by lightly tapping the tool. Seal is installed in specified position, using the special tool.

Caution

1. **Incorrect installation of the seal wituout using special tool will result in poor sealing and cause oil leakage down valve guide.**
2. **Do not reuse stem seal.**

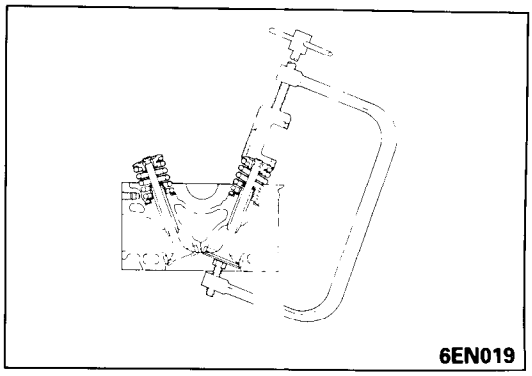
14. INSTALLATION OF EXHAUST VALVE/6. INTAKE VALVE

Apply engine oil to each valve, insert valves into the valve guides. Avoid inserting the valve into the seal with force. After insertion, check to see if the valve moves smoothly.



12.4. INSTALLATION OF VALVE SPRING

Valve springs should be installed with the enamel coated side toward the valve spring retainer.

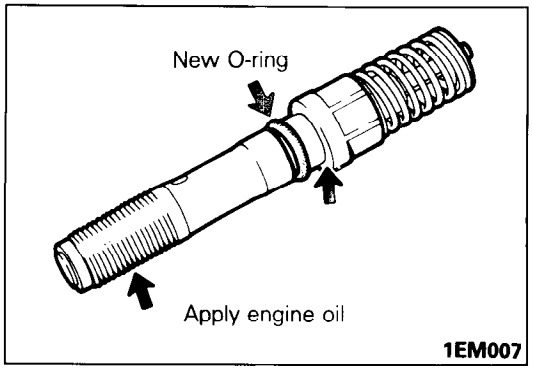


10.2. INSTALLATION OF RETAINER LOCK

(1) Using the valve spring compressor, compress the valve spring and install the retainer lock.

Caution
When compressing the spring with the Valve Spring Compressor, check to see that the valve stem seal is not pressed to the bottom of the retainer. Then start installing the retainer lock.

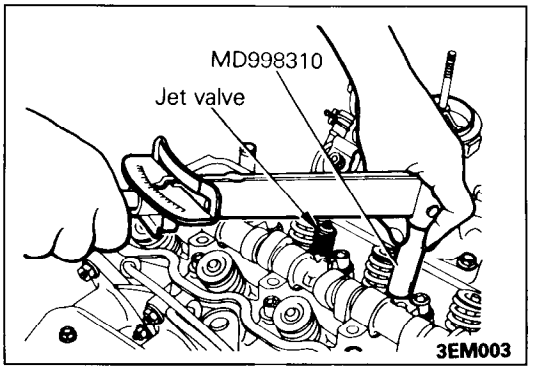
(2) Make certain that retainer locks are positively installed.



1. INSTALLATION OF JET VALVE ASSEMBLY

(1) Apply engine oil to the O-ring, jet body threads and seat surface.

Caution
Make sure that the O-ring is a new one.

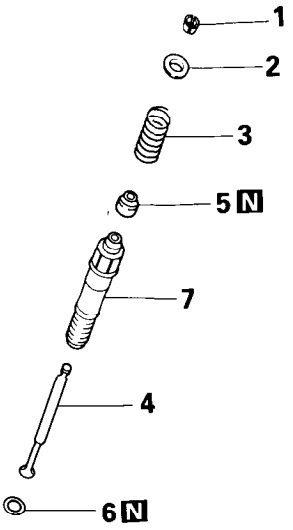


(2) Screw the jet valve assembly into cylinder head by hand. Tighten the jet valve to the specified torque with Special Tool and a torque wrench while holding the special tool in line with the jet valve center line.

JET VALVE ASSEMBLY

N09QE-B

DISASSEMBLY AND REASSEMBLY

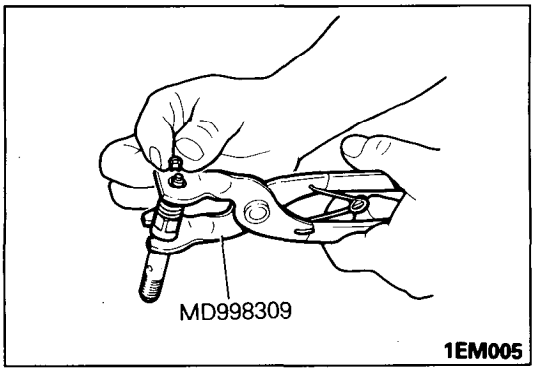


1EM177

Disassembly steps

◆◆▶◆ 1. Retainer lock
▶◆ 2. Valve spring retainer
▶◆ 3. Valve spring
▶◆ 4. Jet valve
▶◆ 5. Stem seal
6. O-ring
7. Jet body

NOTE
(1) Reverse the disassembly procedures to reassemble.
(2) ◆◆▶ : Refer to "Service Points of Disassembly".
(3) ▶◆ : Refer to "Service Points of Reassembly".
(4) N : Non-reusable parts



1EM005

SERVICE POINTS OF DISASSEMBLY

N09QFAA1

1. REMOVAL OF RETAINER LOCK

Using special tool, remove the retainer lock.

INSPECTION

N09QGAA1

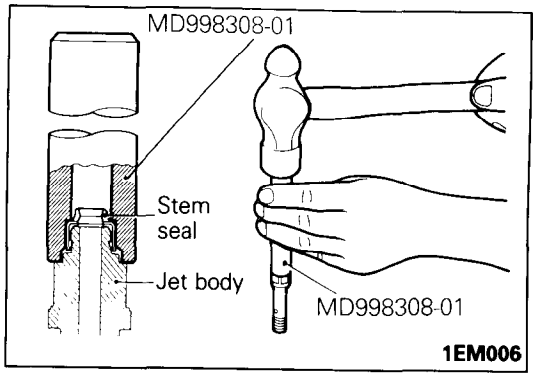
- Make sure that the jet valve slides smoothly in the jet body and has no play.

Caution
Combination of the jet valve and jet body should not be disturbed and the jet valve and jet body should be replaced as an assembly.

- Check the valve head and valve seat for damage or seizure.
- Check the spring for sag, cracks or breakage.

STB Revision

Standard value
Jet valve
Length : 91.58 mm (3.6055 in.)
Stem O.D. : 4.3 mm (.1693 in.)
Seat angle : 45°
Jet valve spring
Free length : 29.60 mm (1.1654 in.)
Load : 34.3 N (7.7 lbs.) at installed height
Installed height : 21.5 mm (.846 in.)
Out of squareness : Max.1.5°



SERVICE POINTS OF REASSEMBLY

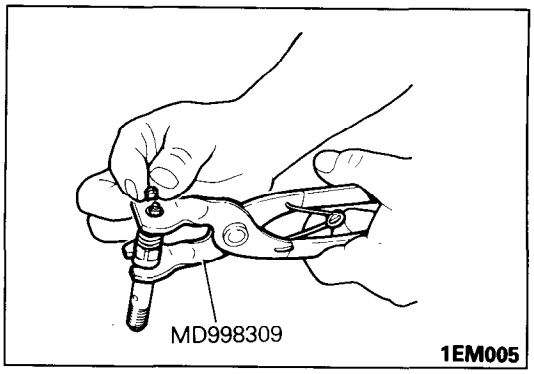
N09QHAB

5. INSTALLATION OF STEM SEAL

Using special tool, install the stem seal.

4. INSTALLATION OF JET VALVE

(1) Apply engine oil to the stem of the jet valve.
(2) Use care to prevent damage to the new seal lips.
(3) Check to ensure that the valve sliders smoothly.



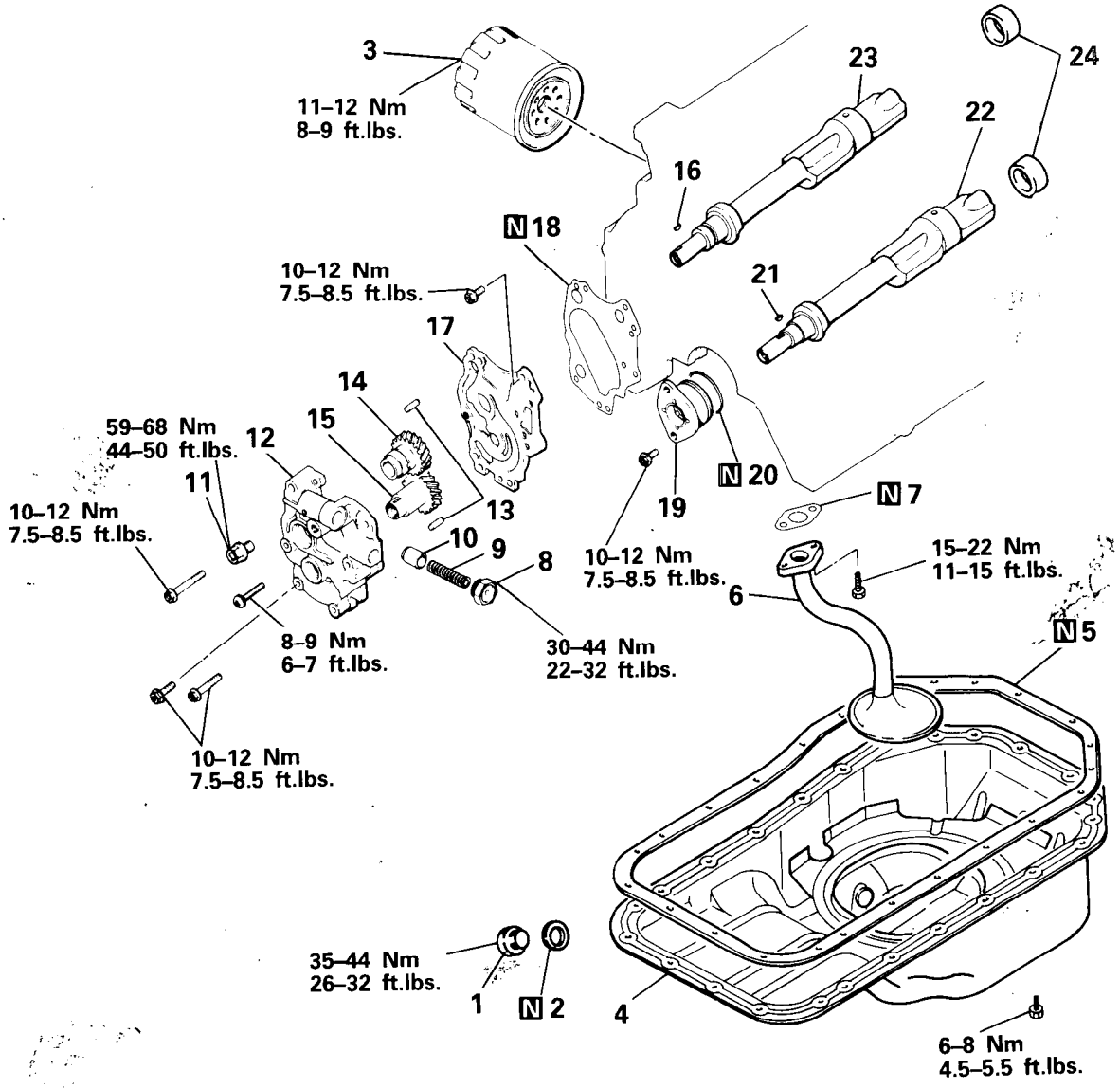
3. INSTALLATION OF VALVE SPRING/2. VALVE SPRING RETAINER/1. RETAINER LOCK

(1) Mount the valve spring and valve spring retainer on jet body.
(2) Compress the valve spring with special tool, using care not to damage the valve stem by the bottom of valve spring retainer.
(3) While the spring being kept compressed, install the retainer lock.

FRONT CASE, OIL PUMP AND SILENT SHAFT

REMOVAL AND INSTALLATION

N09RA--



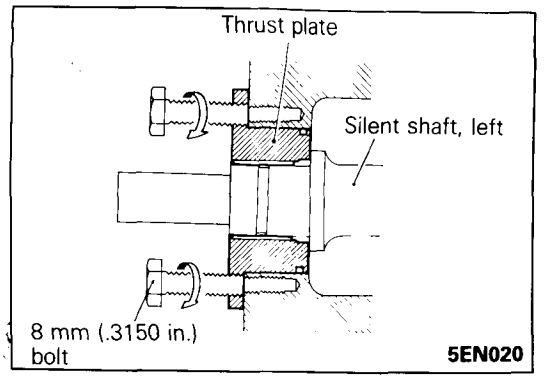
5EN205

Removal steps

1. Oil drain plug
2. Oil drain plug gasket
3. ◆◆ Oil filter
4. ◆◆ Oil pan
5. Gasket
6. Oil screen
7. Oil screen gasket
8. Plug
9. Relief spring
10. Relief plunger
11. Flange bolt
12. ◆◆ Oil pump body
13. Pin
14. ◆◆ Driven gear
15. ◆◆ Drive gear
16. Woodruff key
17. Oil pump cover
18. Oil pump gasket
19. ◆◆ ◆◆ Thrust plate (with front bearing)
20. ◆◆ O-ring
21. ◆◆ Woodruff key
22. ◆◆ Left silent shaft
23. Right silent shaft
24. Rear bearing

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Removal.".
(3) ◆◆ : Refer to "Service Points of Installation".
(4) N : Non-reusable parts.

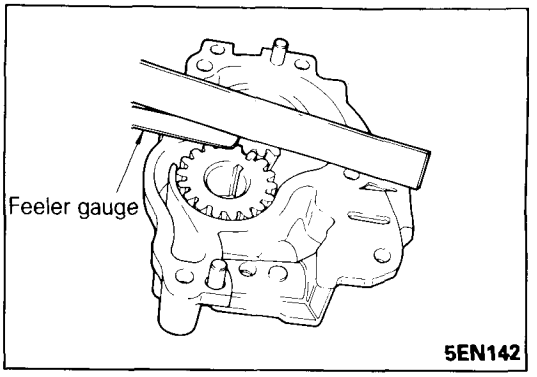
STB Revision



SERVICE POINTS OF REMOVAL N09RBAE

19. REMOVAL OF THRUST PLATE

Install 8 mm (.3150 in.) dia. bolts into threaded holes of flange and turn bolts in to remove the thrust plate.



INSPECTION N09RCGB

- **OIL PUMP**

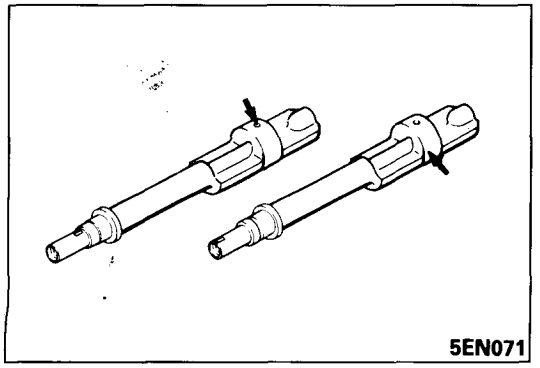
(1) Check gear contacting surfaces of cover for step wear.
(2) Check the clearance of drive and driven gears. If clearance is excessive, replace case and cover assembly and/or gears.

Standard value
Driven gear
Tip clearance : 0.11–0.15 mm (.0043–.0059 in.)
Side clearance : 0.04–0.10 mm (.0016–.0039 in.)
Drive gear
Tip clearance : 0.11–0.15 mm (.0043–.0059 in.)
Side clearance : 0.05–0.11 mm (.0020–.0043 in.)
Limit
Driven gear
Tip clearance : 0.2 mm (.0079 in.)
Side clearance : 0.15 mm (.0060 in.)
Drive gear
Tip clearance : 0.2 mm (.0079 in.)
Side clearance : 0.15 mm (.0060 in.)

- **RELIEF PLUNGER AND SPRING** N09RCHA

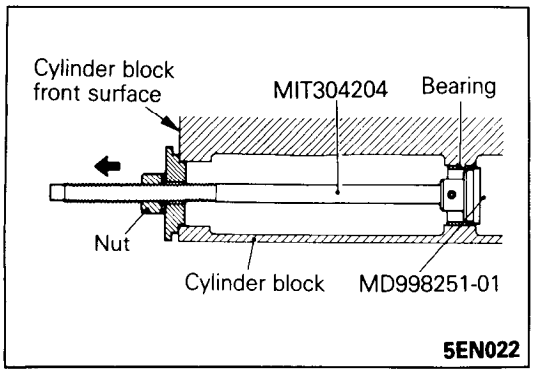
(1) Insert the relief plunger in the front case and check to see if it operates smoothly.
(2) Check the relief spring for breakage or sagging.

Standard value
Relief spring
Free length : 46.4 mm (1.8346 in.)
Load : 60 N/40.1 mm (13.4 lbs./1.5787 in.)



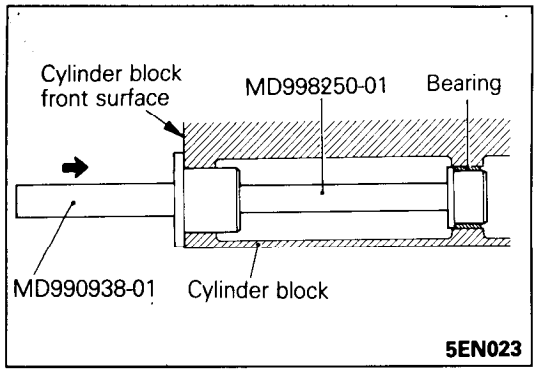
- **SILENT SHAFT** N09RCIA

(1) Check journals for wear, damage and seizure. If excessive damage or seizure is evident, check bearing as well. If necessary, replace silent shaft or bearing or both.
(2) Check oil hole (passage) for clogging. Clean or repair as necessary.

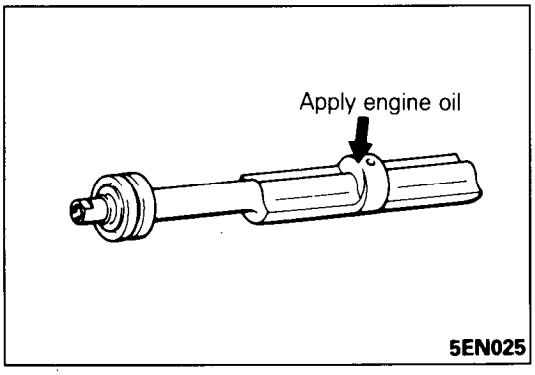


SILENT SHAFT BEARING REPLACEMENT PROCEDURE N09REAA

(1) Using special tool, remove silent shaft rear bearing.



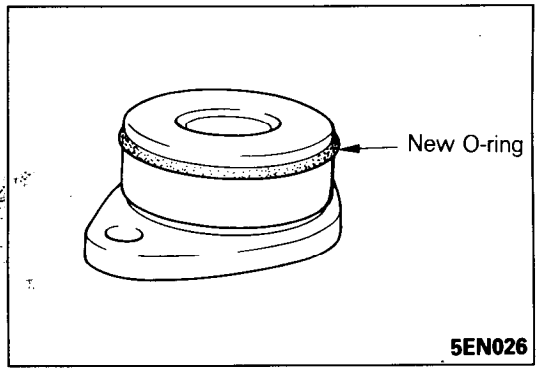
(2) Apply engine oil to O.D. of bearing, using special tool, install silent shaft bearing to cylinder block.



SERVICE POINTS OF INSTALLATION N09RDCE

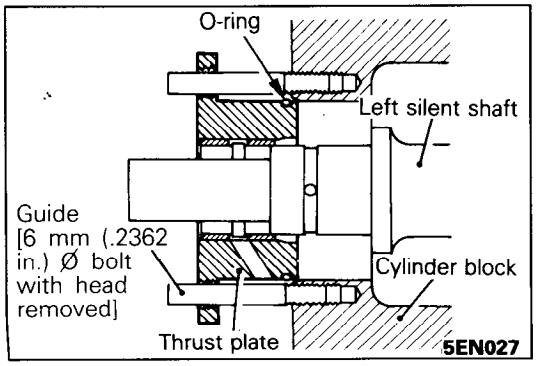
22. INSTALLATION OF LEFT SILENT SHAFT

(1) Apply engine oil to journal of left silent shaft.
(2) Insert left silent shaft into cylinder block. Insert silent shaft carefully to prevent damage to the bearing.



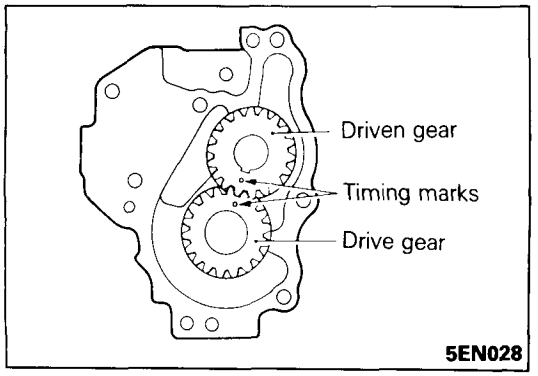
20. INSTALLATION OF O-RING

(1) Install o-ring in groove of thrust plate.
(2) Apply engine oil around O-ring.



19. INSTALLATION OF THRUST PLATE

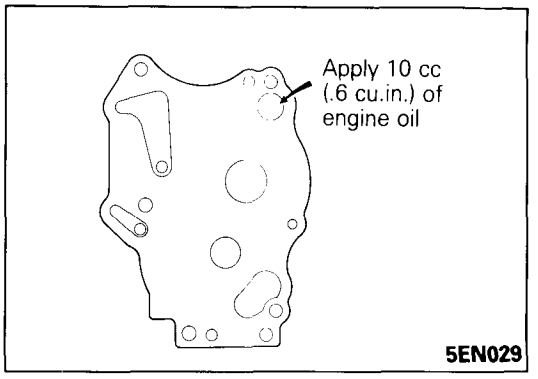
(1) Install two guides in threaded holes for mounting thrust plate. Guides should be fabricated by cutting off hexagon heads of bolts 6 mm (.2362 in.) in diameter and 50 mm (1.9685 in.) long.
(2) Install thrust plate into cylinder block along guides. Without use of guide, threaded holes will be hard to align.



15. INSTALLATION OF DRIVE GEAR/14. DRIVEN GEAR

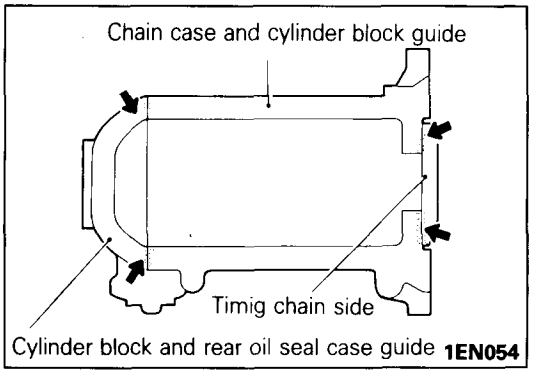
Install oil pump gears to oil pump body and align timing marks.

Caution
If timing marks are out of alignment, phase of silent shaft will change and vibration will result.



12. INSTALLATION OF OIL PUMP BODY

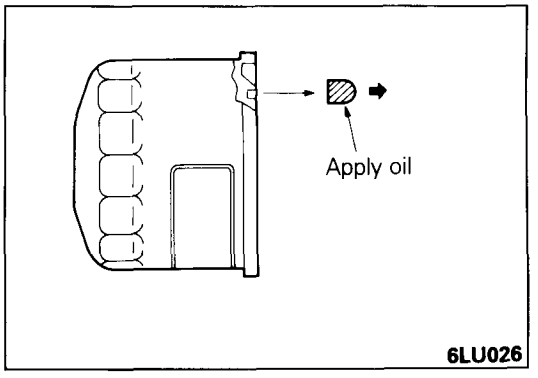
Place pump assembly in same position as it was installed on engine and put approx. 10 cc (.6 cu.in.) of clean engine oil in delivery port.



4. INSTALLATION OF OIL PAN

Apply sealant to four places on the cylinder block side of the hatched area.

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



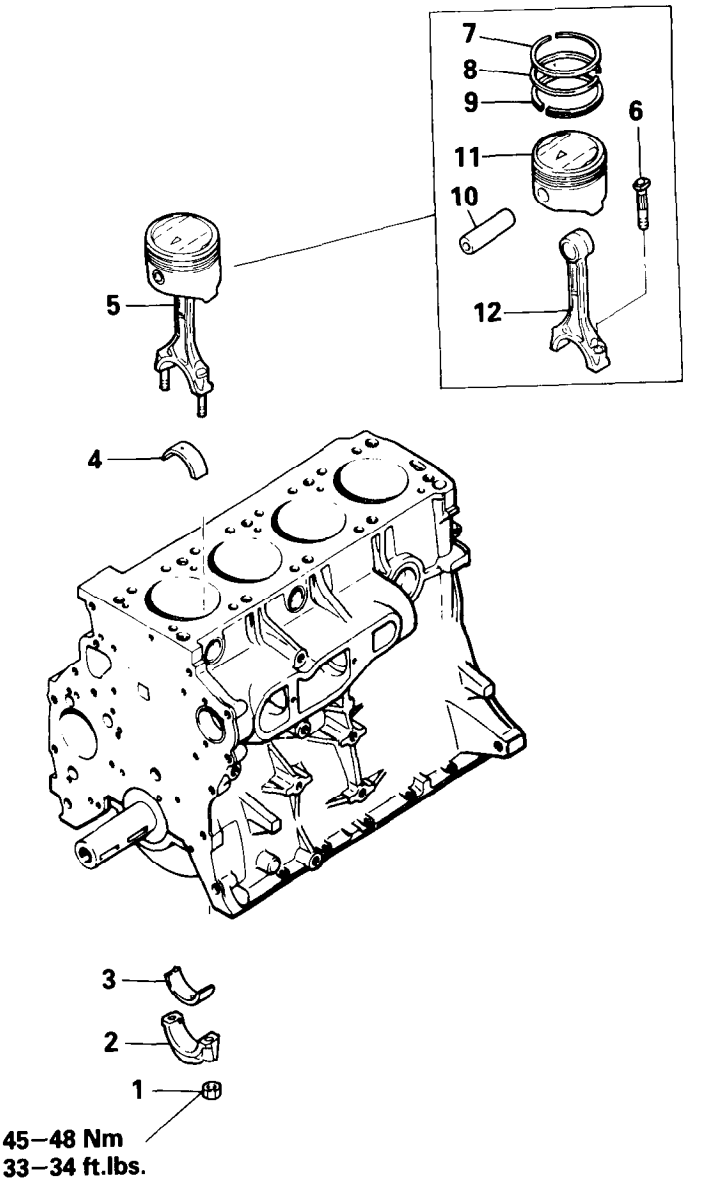
3. APPLICATION OF ENGINE OIL TO OIL FILTER

Apply engine oil to surface of packing. But must not protrude engine oil from case.

PISTON AND CONNECTING ROD

N09TA--

REMOVAL AND INSTALLATION

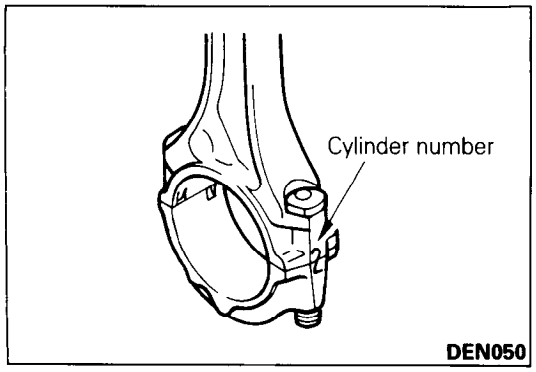


5EN030

Removal steps

1. Nut
◆■► ►◆ 2. Connecting rod cap
3. Bearing
4. Bearing
►◆ 5. Piston and connecting rod assembly
6. Bolt
◆■► ►◆ 7. No.1 piston ring
◆■► ►◆ 8. No.2 piston ring
►◆ 9. Oil ring
◆■► ►◆ 10. Piston pin
11. Piston
12. Connecting rod

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆■► : Refer to "Service Points of Removal".
(3) ►◆ : Refer to "Service Points of Installation".

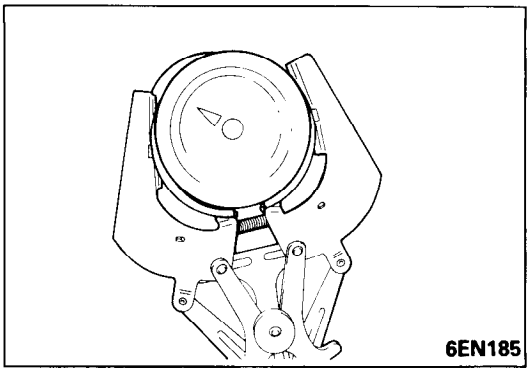


SERVICE POINTS OF REMOVAL

N09TBDA1

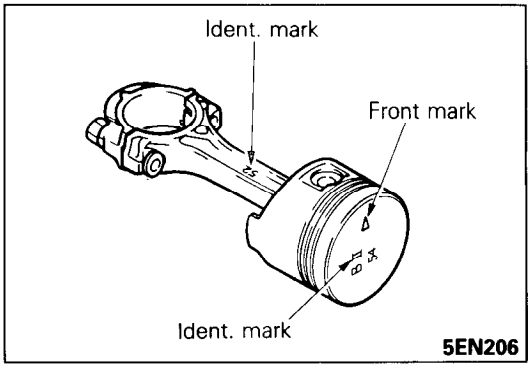
2. REMOVAL OF CONNECTING ROD CAP

Mark the large end of the connecting rod with the cylinder number for use during reassembly.



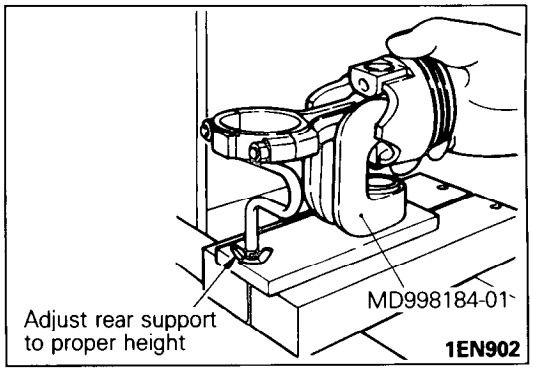
7. REMOVAL OF NO.1 PISTON RING/8. NO.2 PISTON RING

Remove the piston rings with a piston ring expander.

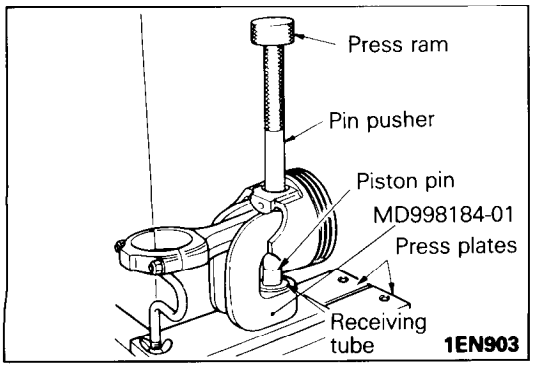


10. REMOVAL OF PISTON PIN

(1) Set piston and connecting rod assembly in tool body in such a way that front mark (arrow mark of piston or identification mark of connecting rod) will be faced upward.
(2) Press plates must be used to provide adequate support to the base during pressing operations.



(3) Place piston and connecting rod with arrow mark or identification mark upward over anvil so lip of insert in between connecting rod boss and inside surface of piston. The connecting rod boss should bear on as much of the insert surface as possible.
(4) Adjust connecting rod rear support until rod is horizontal to press bed surface. Misalignment of pin and receiving tube may result if support adjutment is not correct.



(5) Position piston pin pusher onto pin and remove pin with press ram.

Caution
As piston pin is removed, it must pass through receiving tube.
Check alignment and adjust if necessary.

INSPECTION

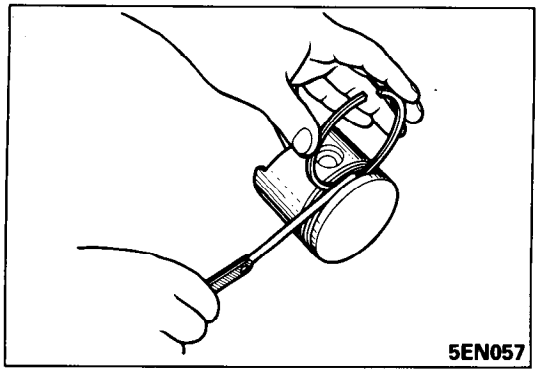
N09TCAC1

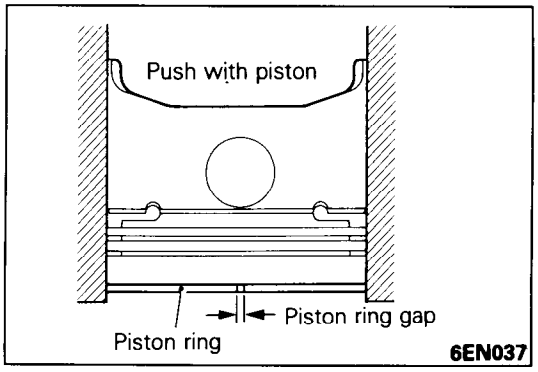
- **PISTON**

When there are streaks or signs of seizure on the outer surface of the piston (especially on the thrust side), or if there are cracks in the outer surface, replace.

- **PISTON PIN**

(1) The piston pin should be able to be inserted into the piston pin hole merely by pushing it in with your finger. If any resistance is noted or if the pin is loose, replace it.
(2) Piston pins should be replaced as a set.


5EN057



6EN037

- **PISTON RING**

N09TCBE

(1) Check for piston ring damage, wear, and bends, replaceing the rings if anything unusual is noted. Also be sure to change the piston rings when a new piston is installed.
(2) Check the clearance between the piston ring and the ring groove. When it exceeds the limit, replace the rings, the piston, or both.

Piston ring side clearance
Standard value
No.1 : 0.05–0.09 mm (.0020–.0035 in.)
No.2 : 0.02–0.06 mm (.0008–.0024 in.)
Limit
No.1 : 0.12 mm (.005 in.)
No.2 : 0.1 mm (.004 in.)

(3) Insert the piston ring into the cylinder bore putting it against the top of the piston head and pressing it in. When it makes a right angle, measure the piston ring gap with a feeler gauge. When the gap is too large, replace the piston ring.

Piston ring end gap
Standard value
No.1 : 0.30–0.45 mm (.0112–.0177 in.)
No.2 : 0.25–0.40 mm (.0098–.0158 in.)
Oil ring side rail : 0.30–0.80 mm (.0118–.0315 in.)
Limit
No.1 : 0.8 mm (.031 in.)
No.2 : 0.8 mm (.031 in.)
Oil ring side rail : 1.0 mm (.039 in.)

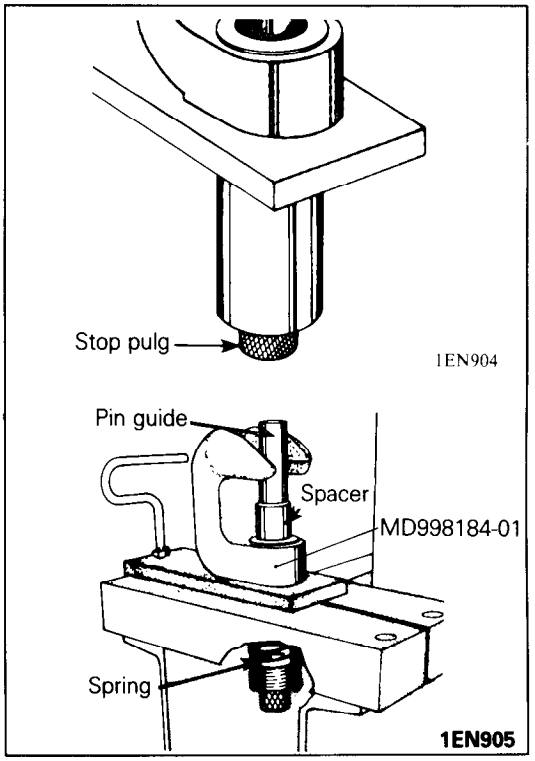
- **BEARING** N09TCDB1

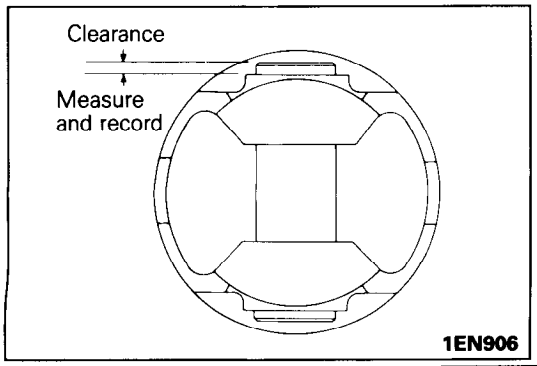
(1) Visually check the surface of the bearing, replaceing those which are lopsided, streaked, damaged, or show signs of seizure. When streaks or seizure are excessive, check the crankshaft. If damage is discovered on the crankshaft, either replace it or reuse it after undersize machining.

(2) Measure the inner diameter of the connecting rod bearing and the outer diameter of the crankshaft pin. If the gap (oil clearance) exceeds limit, replace the bearing, and, if necessary, the crankshaft. Or, undersize machine the crankshaft and replace the bearings with an appropriate undersized type.

Standard value : 0.02–0.05 mm (.0008–.0020 in.)
Limit : 0.1 mm (.004 in.)

NOTE
For the method by which the oil clearance is measured using a plastigauge, refer to the item on the crankshaft.



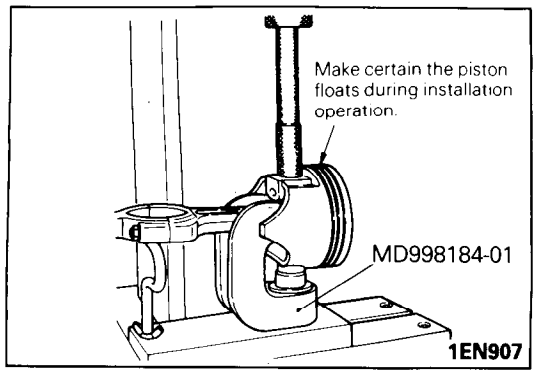


SERVICE POINTS OF INSTALLATION N09TDAI

10. INSTALLATION OF PISTON PIN

(1) Thread stop plug approximately half way into the bottom of the receiving tube.
(2) Select the largest diameter piston pin guide that will pass through piston and rod. Install spring, spacer, and guide into receiving tube.
(3) With connecting rod removed from piston, insert piston pin into piston bore. Carefully measure amount of pin that protrudes equally from both sides of piston. Record this measurement for furture use.
(4) Position connecting rod and piston over the anvil. The spring loaded piston guide will pass through piston and rod and align it. Lubricate pin and insert it into piston.
(5) Place piston pin pusher on piston pin and push pin through connecting rod until the pin protrudes some distance measured and recorded above in step 3.

Caution
The piston must be free to float during installation; check frequently.



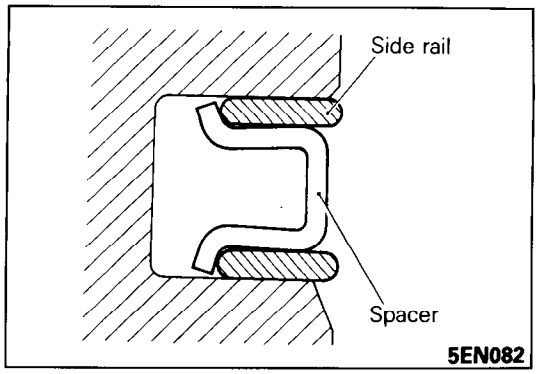
(6) Apply hydraulic pressure to pin and adjust stop plug until stop plug comes in contact with spacer.
(7) Remove piston and pin assembly from anvil and check piston pin to make sure it is centered. If it is not centered, adjust stop plug up or down to obtain proper centering. The pin stop is now set for any remaining pistons.

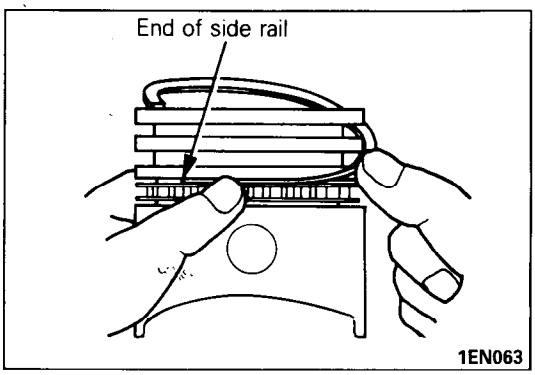
Caution
If the required installation load is out of specification, replace piston pin and/or connection rod.

Piston pin press in load : 7350–17150 N (1650–38 lbs.)

9. INSTALLATION OF OIL RING

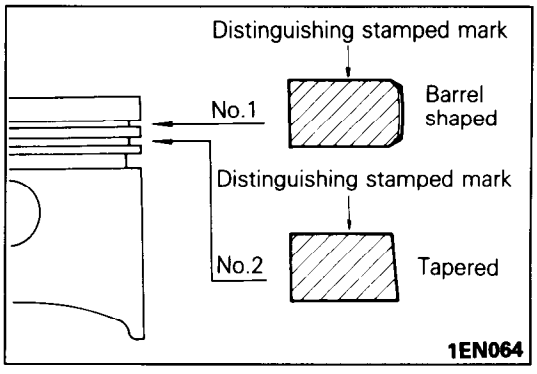
(1) Assemble the oil ring spacer into the piston ring groove. Then, after assembling the upper side rail, assemble the lower side rail. There is no difference between the upper and lower side rails or spacers.





(2) The side rail may be easily installed by pushing it in with your finger after fitting the end over the piston groove.

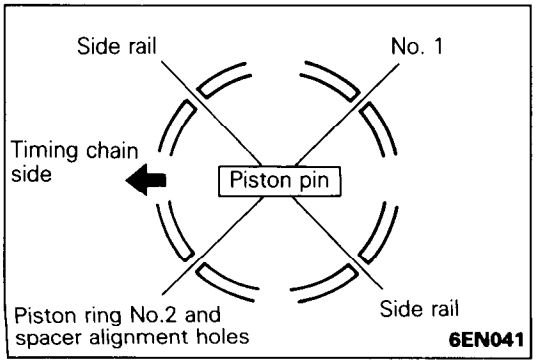
Caution
Do not use piston ring expander when installing side rail.



8. INSTALLATION OF NO.2 PISTON RING/ 7. NO.1 PISTON RING

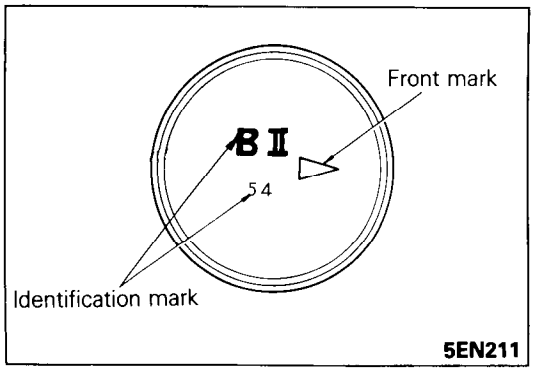
Using a piston ring expander, install No.2 and No.1 piston ring.

Caution
1. **Pay close attention to the differences in shape between nos. 1 and 2 to avoid confusing them.**
2. **Install piston rings 1 and 2 with the maker and size marks facing up (toward the top of the piston).**

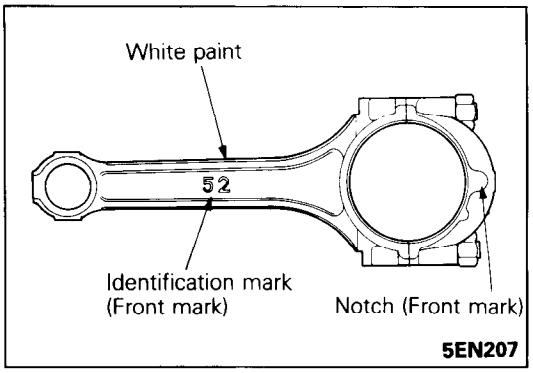


5. INSTALLATION OF PISTON AND CONNECTING ROD ASSEMBLY

(1) Apply plenty of engine oil to the outer piston surfaces, the piston ring and the oil ring.
(2) Align the mating holes in the piston and oil rings (side rail, spacer) as illustrated.

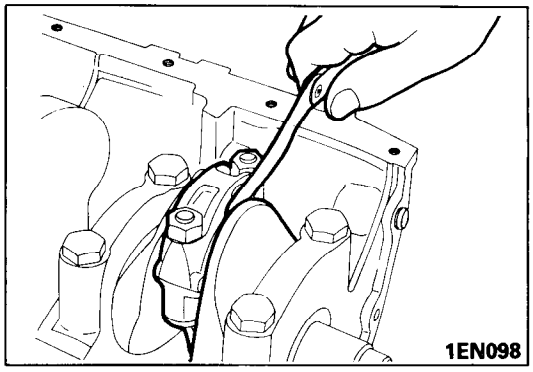


(3) Orient the piston and connecting rod assembly so that the front mark on the top of the piston and the front mark on the connecting rod (distinguishing mark) face toward the front of the engine (the timing belt side) and insert it into the cylinder.



2. INSTALLATION OF CONNECTING ROD CAP

(1) When the connecting rod is installed, make sure that identification mark and notch are on same side.



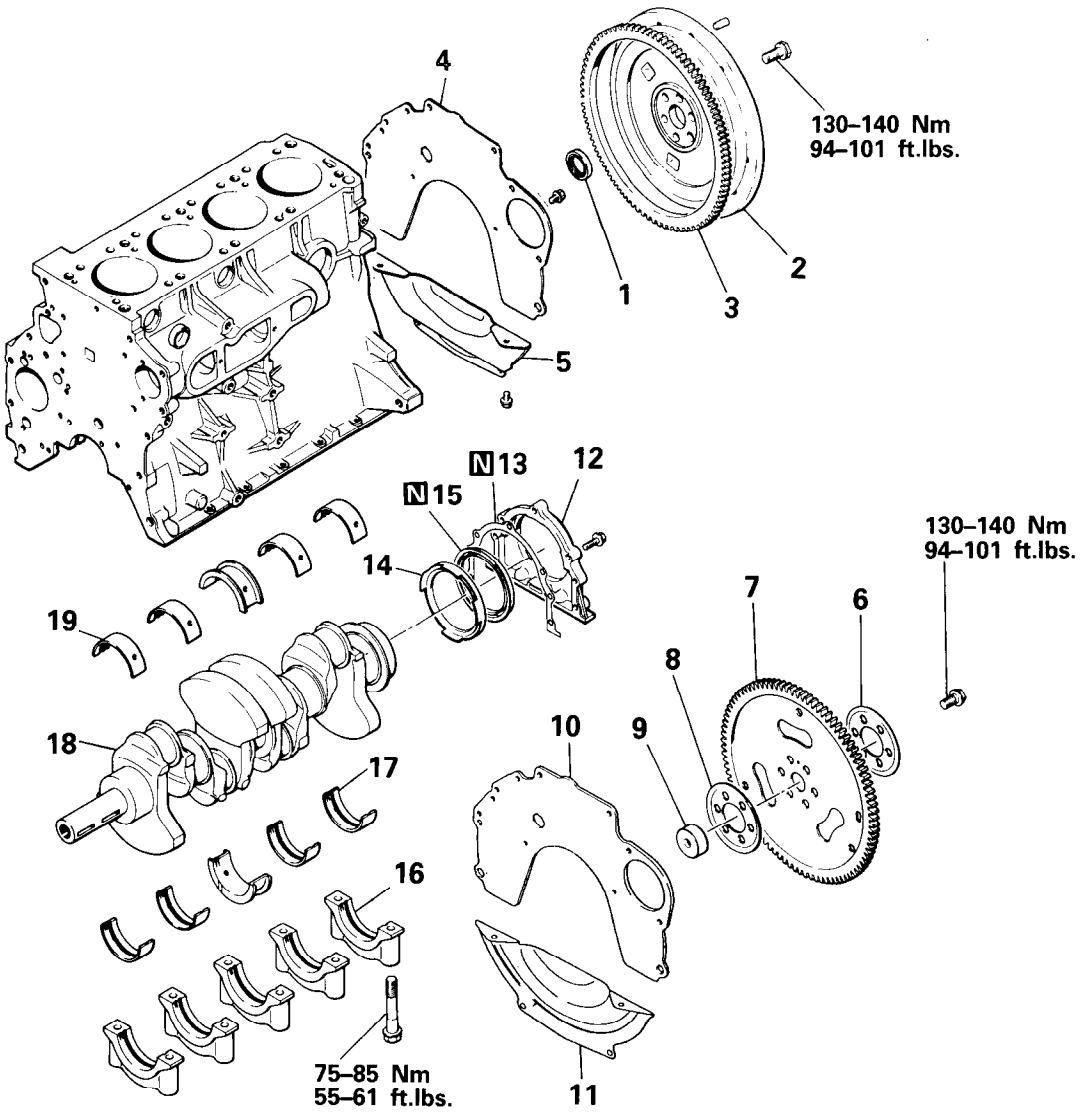
(2) Check the connecting rod big end side clearance.

Connecting rod big end side clearance
Standard value : 0.1—0.25 mm (.0039—.0098 in.)
Limit : 0.4 mm (.016 in.)

CRANKSHAFT, FLYWHEEL AND DRIVE PLATE

REMOVAL AND INSTALLATION

N09UA–



5EN219

Removal steps

- 1. Ball bearing
- 2. Flywheel
- 3. Ring gear
- 4. Rear plate
- 5. Bell housing cover

(for vehicles with manual transmission)

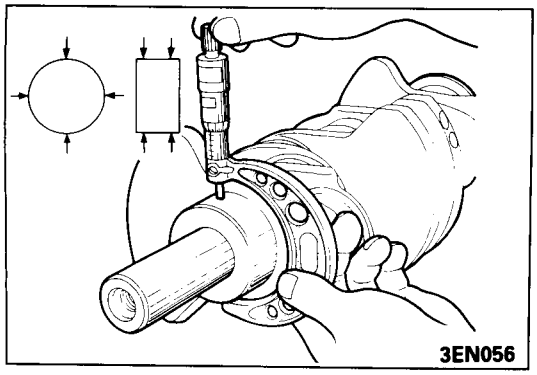
- 6. Adapter plate
- 7. Drive plate
- 8. Crankshaft adapter
- 9. Crankshaft bushing
- 10. Rear plate
- 11. Bell housing cover

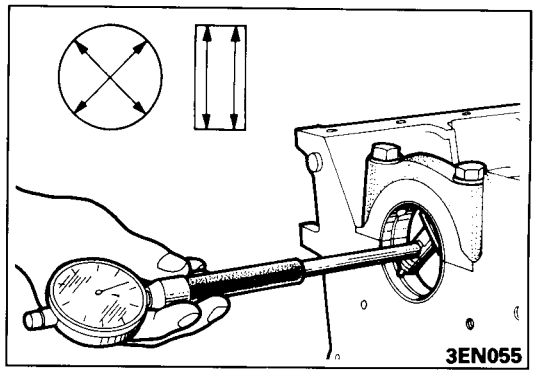
(for vehicles with automatic transmission)

- 12. Oil seal case
- 13. Oil seal case gasket
- ◆◆ 14. Oil separator
- ◆◆ 15. Oil seal
- ◆◆ 16. Bearing cap
- ◆◆ 17. Lower bearing
- 18. Crankshaft
- ◆◆ 19. Upper bearing

NOTE
(1) Reverse the removal procedures to reinstall.
(2) ◆◆ : Refer to "Service Points of Installation".
(3) N : Non-reusable parts

STB Revision


3EN056


3EN055

INSPECTION N09UCAC

- **CRANKSHAFT**

(1) Check the crankshaft journals and pins for damage, uneven wear and cranks. Also check oil holes for clogging. Correct or replace any defective part.
(2) Inspect out-of-roundness and taper of crankshaft journal and pin.

Standard value
Cransshaft journal O.D. : 60 mm (2.3622 in.)
Crank pin O.D. : 53 mm (2.0866 in.)
Limit
Out-of-roundness of journal and pin : 0.01 mm (.0004 in.)
Taper of journal and pin : 0.01 mm (.0004 in.)

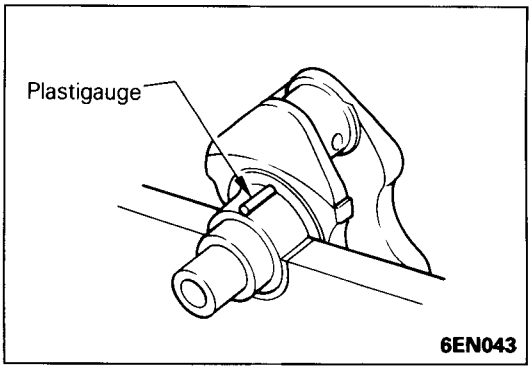
- **MAIN BEARINGS AND CONNECTING ROD BEARINGS** N09UCBA1

Visually inspect each bearing for peeling, melt, seizure and improper contact. Replace the defective bearings.

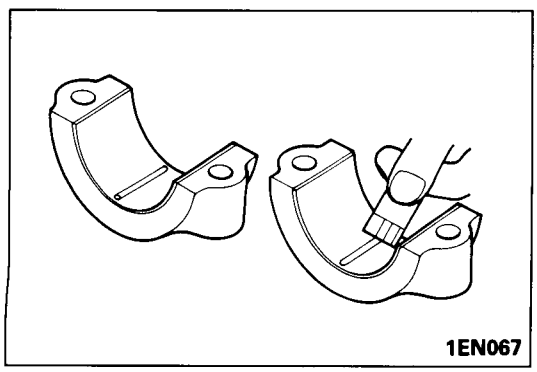
- **OIL CLEARANCE MEASUREMENT** N09UCCD1

To check the oil clearance, measure the outside diameter of the crankshaft journal and the crank pin and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside and inside diameters.

Standard value
Crankshaft main bearing : 0.02–0.05 mm (.0008–.0020 in.)
Connecting rod bearing : 0.02–0.05 mm (.0008–.0020 in.)



6EN043


1EN067

PLASTIGAUGE METHOD

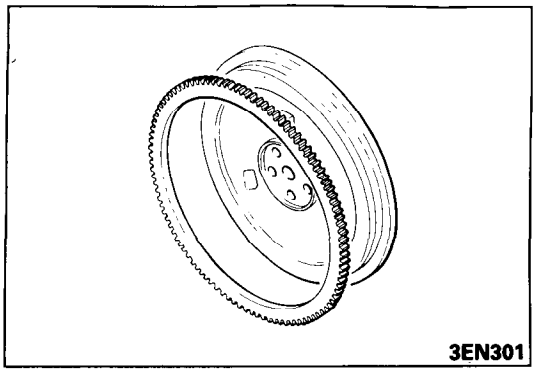
Plastigauge may be used to measure the clearance.

(1) Remove oil and grease and any other dirt from bearings and journals.
(2) Cut plastigauge to the same length as the width of the bearing and place it in parallel with the journal, off oil holes.
(3) Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do NOT turn the crankshaft.
(4) Remove the caps. Measure the width of the plastigauge at the widest part by using a scale printed on the plastigauge sleeve.
(5) If the clearance exceeds the repair limit, the bearing should be replaced or an undersize bearing used.
When installing a new crankshaft, be sure to use standard size bearings.
(6) Should the standard clearance not be obtained even after bearing replacement, the journal should be ground to undersize and a bearing of the same size should be installed.

STB Revision

- **OIL SEAL** N09UCDA 1

  Check front and rear oil seals for damage or worn lips. Replace any seat that is defective.


3EN301

- **RING GEAR (vehicles with manual transmission)** N09UCEC 1

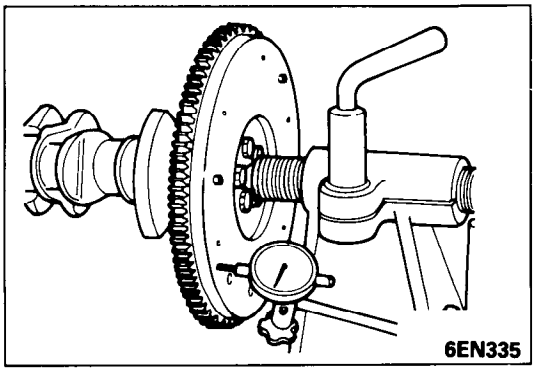
  When there is wear, cracks, or other damage to the ring gear teeth, replace the ring gear by the following procedure. Check the starter motor pinion.

  Ring gear replacement procedure :

  (1) Tap around the ring gear to loosen and remove it from the fly wheel.

  Caution
  The ring gear cannot be removed while it is hot.

  (2) Heat the ring gear to 360–380°C (500–536°F) and put it into the flywheel


6EN335

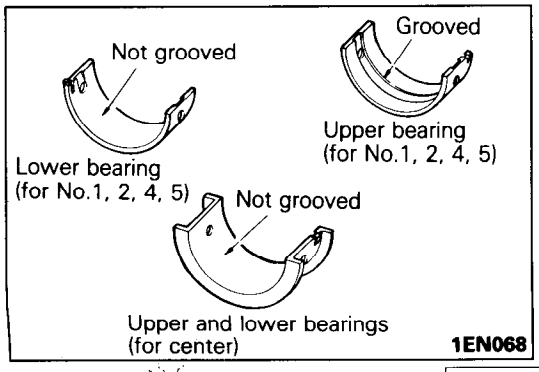
- **FLYWHEEL (vehicles with manual transmission)** N09UCFB 1

  (1) Make a visual inspection of the clutch disc. If stepped wear, streaking, or seizure are apparent, replace it.
  (2) If flywheel run out exceeds the limit, replace it.

  Limit : 0.13 mm (.005 in.)

- **DRIVE PLATE (vehicles with automatic transmission)** N09UCGB 1

  Replace deformed, damaged, or cracked drive plates.



SERVICE POINTS OF INSTALLATION N09UDAE

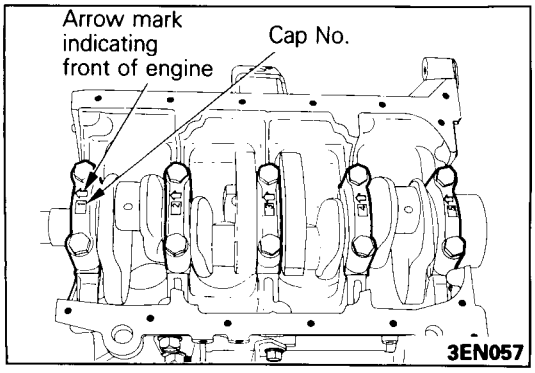
19. INSTALLATION OF UPPER BEARING

When reusing the main bearings, remember to install them by referring to location marks made at the time of removal.
Be sure oil holes in bearings align with oil hole in block.

17. INSTALLATION OF LOWER BEARING

Check to ensure that the lower bearing has no oil groove.

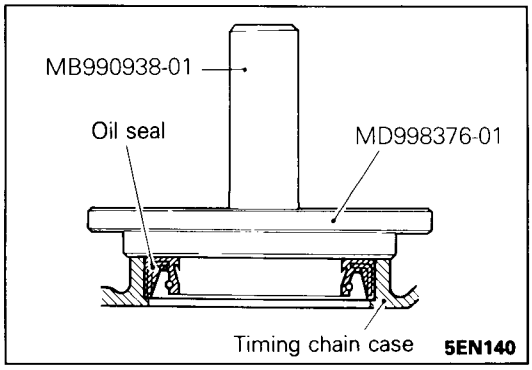
STB Revision



16. INSTALLATION OF BEARING CAP

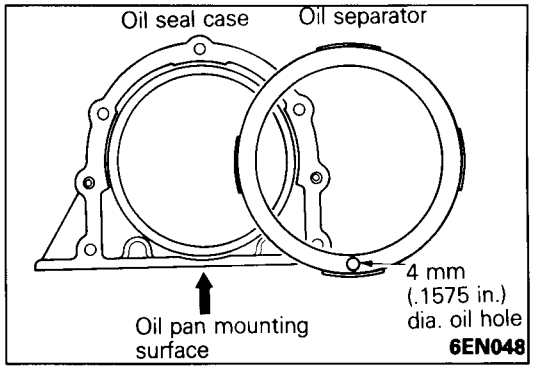
(1) The caps should be installed with the arrow mark directed toward the crank pulley side of engine. Cap numbers must be in correct order.
(2) Tighten cap bolts in sequence : Center, No.2, No.4, front and rear cap bolts.
(3) Cap bolts should be tightened evenly in 2 to 3 stages before they are finally tightened.
(4) Make certain that crankshaft turns freely and has the proper clearance between the center main bearing thrust flange and the connecting rod big end bearing.

Standard value : 0.05–0.18 mm (.0020–.0071 in.)
Limit : 0.4 mm (.016 in.)



15. INSTALLATION OF OIL SEAL

Using Special Tool, press fit the oil seal all the way in without tilting it.



14. INSTALLATION OF OIL SEPARATOR

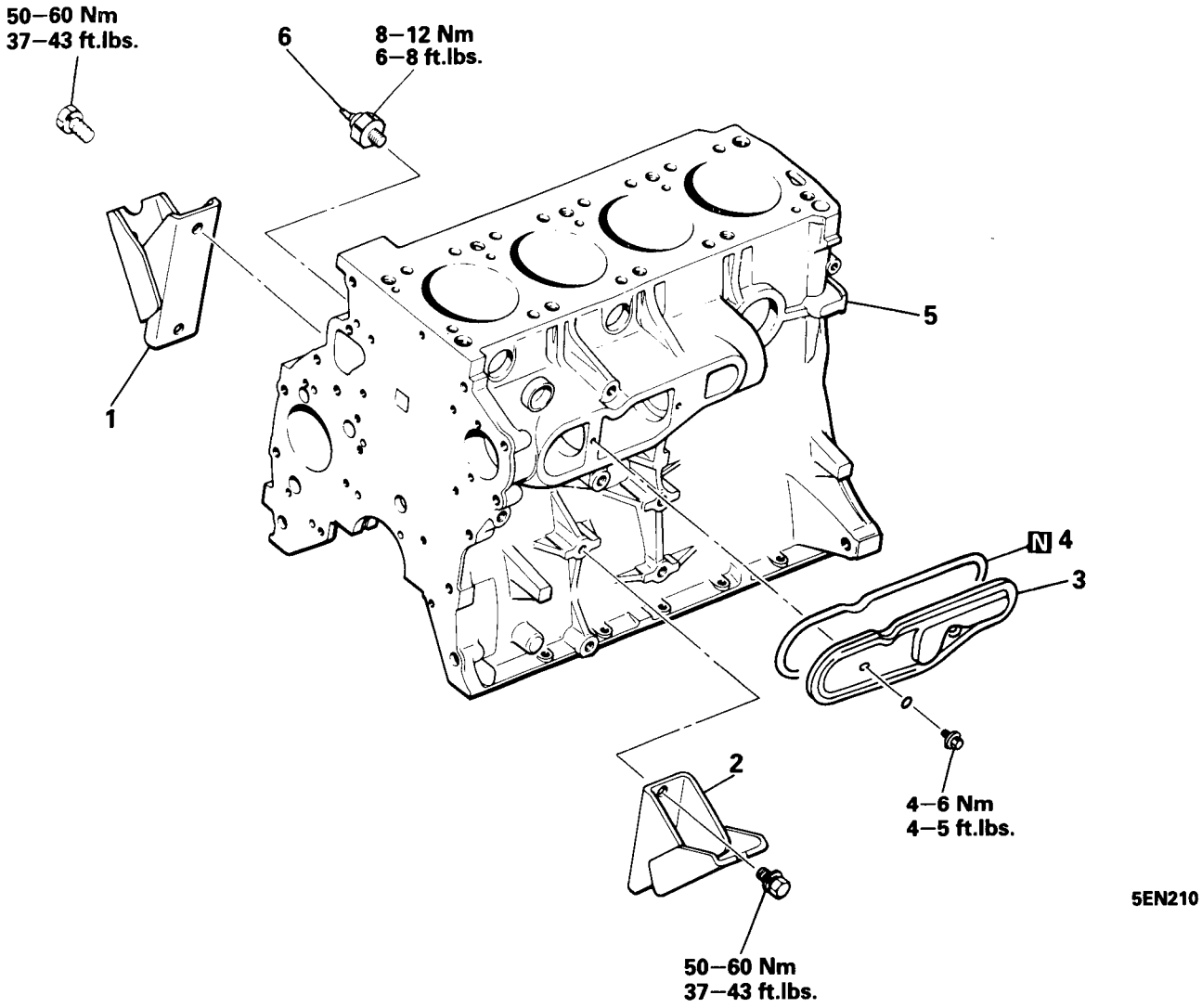
Press the oil separator into the oil seal case. Install it so that the separator oil hole is on the very bottom, as illustrated.

STB Revision

CYLINDER BLOCK

N09VA–A

REMOVAL AND INSTALLATION



1. Right engine support bracket
2. Left engine support bracket
3. Silent shaft chamber cover
4. Chamber cover gasket
5. Cylinder block
◆◆ ▶◆6. Oil pressure switch

NOTE
(1) ◆◆ : Refer to "Service Points of Removal".
(2) ▶◆ : Refer to "Service Points of Installation".

SERVICE POINTS OF REMOVAL

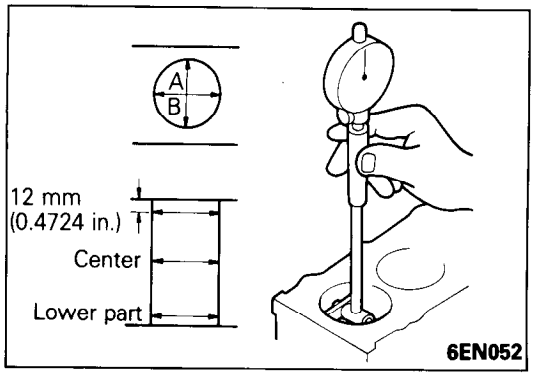
N09VBAD

6. REMOVAL OF OIL PRESSURE SWITCH

As sealant has been applied to the screw, remove it without bending it.

INSPECTION N09VCAD

- Visually check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects by using a flaw detecting agent (magnafluxing). Correct or replace the block if defective.
- Measure the cylinder bore with a cylinder gauge at three levels in the directions of A and B.
- If the cylinder bores show more than specified out-of-round or taper, or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed, and new oversize pistons and rings fitted.



Measuring points are as shown.

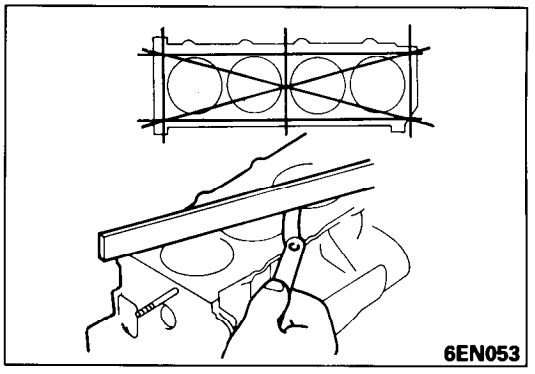
Standard value
Cylinder bore : 91.1 mm (3.5866 in.)
Out-of-roundness and taper of cylinder bore :
Max. 0.02 mm (.0008 in.)

- If cylinder top ridge is worn in stages, cut away with ridge reamer.
- Oversize pistons are available in four sizes.

Piston service size and mark
0.25 mm (.010 in.) O.S.: 0.25
0.50 mm (.020 in.) O.S.: 0.50
0.75 mm (.030 in.) O.S.: 0.75
1.00 mm (.039 in.) O.S.: 1.00

- To rebore the cylinder bore to oversize, keep the specified clearance between the oversize piston and the bore, and make sure that all pistons used are of the same oversize. The standard measurement of the piston outside diameter is taken at a level 2 mm (.0787 in.) above the bottom of the piston skirt and across the thrust faces.

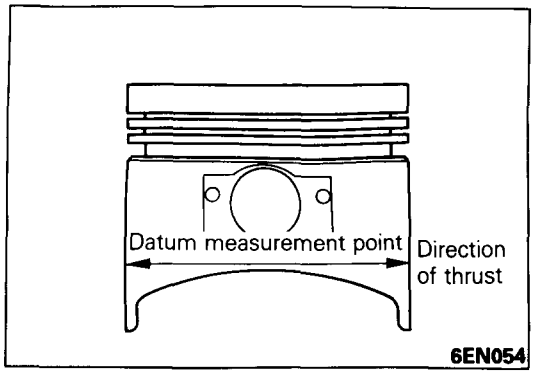
Standard value
Piston-to-cylinder wall clearance : 0.02–0.04 mm (.0008–.0016 in.)



- Check for damage and cracks.
- Check top surface for flatness. If excessive flatness is evident grind to minimum limit or replace.

Flatness of gasket surface
Standard dimension : Less than 0.05 mm (.0020 in.)
Limit : 0.1 mm (.0039 in.)
Overall height
Standard value : 316 mm (12.4409 in.)
Limit (amount of cylinder block gasket surface grind) : −0.2 mm (−.0079 in.)

Caution
The cylinder block gasket surface should be ground to within 0.2 mm (.0079 in.) even with the grind of cylinder head gasket surface.



BORING THE CYLINDER N09VEDA

(1) Based on the largest cylinder bore, determine the over sized piston to be used.
(2) Measure with the outside diameter of the piston as the datum measurement points.

NOTE
There are four sizes of oversize piston: 0.25 mm (.010 in.), 0.50 mm (.020 in.), 0.75 mm (.030 in.), 1.00 mm (.039 in.)

(3) Calculate the reground bore size based on the measured value of the outside piston diameter.
- Bore size = outside piston diameter + 0.01–0.03 mm (.0004–.0012 in.) (gap between cylinder and piston) – 0.02 mm (1.0008 in.) (honing)

(4) Hone each of the cylinders to the calculated measurement.

Caution
In order to avoid uneven boring due to the rise in temperature, bore the cylinders in the following sequence: #2, #4, #1, and #3.

(5) Hone the cylinders, finishing them to the proper dimension (outside piston diameter + gap with cylinder).
(6) Check the gap between the piston and cylinder.

Standard value : 0.01–0.03 mm (.0004–.0012 in.)

SERVICE POINTS OF INSTALLATION N09VDAF

6. INSTALLATION OF OIL PRESSURE SWITCH

Apply sealant to the screws and install.

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

Caution
Ensure that the sealant dose not extend beyond the screw tips.
Be sure not to tighten the screws too tight.