GROUP 11B

ENGINE OVERHAUL

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HOW TO USE THIS MANUAL

M1113025100155

HOW TO USE THIS MANUAL

Scope of Service Explanations

This manual describes service procedures performed after removal of the engine from the vehicle.
For removal of the engine from the vehicle, installation of the engine in the vehicle, and on-vehicle inspection and service of the engine, please use the separate Workshop Manuals prepared for the vehicle.

How to Read Explanations

Service steps

(1) A component part drawing is shown at the beginning of each section to enable the technician to ascertain the installed condition of the component parts.
(2) Service steps are indicated by means of numbers in the component part drawing. Non-reusable parts are indicated as such, and tightening torques are shown.
- ·Removal steps
  The numbers of the part names match the numbers in the component part drawing and indicate the removal sequence.
- ·Installation steps
  Installation steps are omitted wherever installation can be achieved simply by performing the removal steps in reverse.
- ·Disassembly steps
  The numbers of the part names match the numbers in the component part drawing and indicate the disassembly sequence.
- ·Reassembly steps
  Reassembly steps are omitted wherever reassembly can be achieved simply by performing the disassembly steps in reverse.

Classification of Service Points

Key service points, service standards, and instructions for using special tools are collated as service points and explained in detail.

<<A>>: Outward-pointing brackets denote removal service points or disassembly service points.
>>A<<: Inward-pointing brackets denote installation service points or reassembly service points.

Lubricant and Sealant Symbols

Every location where a lubricant or sealant must be applied or added is indicated using a relevant symbol in the component part drawing and/or on the page after the component part drawing.

. . . . . Grease
. . . . . Sealant or form-in-place gasket (FIPG)
. . . . . Brake fluid
. . . . . Engine oil or gear oil

Inspection

Only those inspection procedures which use special tools or measuring appliances are described. You must perform general visual inspection and part cleaning whenever necessary although their procedures are not described in this manual.

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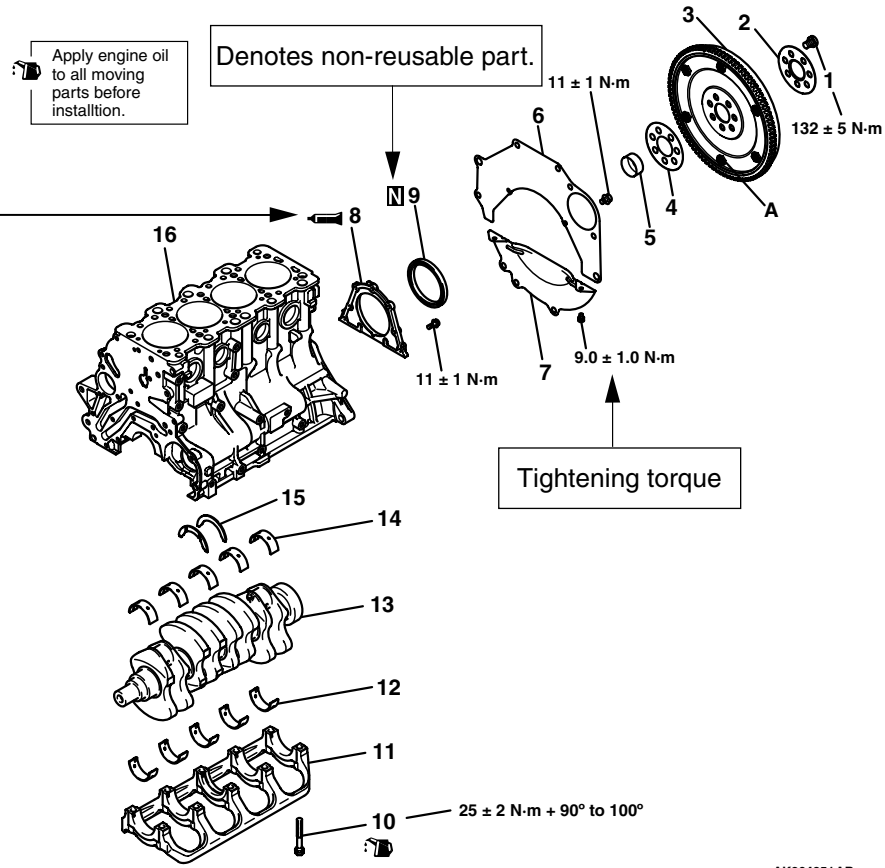
Page number

Section title

CRANKSHAFT AND CYLINDER BLOCK

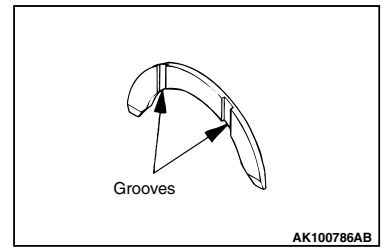
REMOVAL AND INSTALLATION



Removal steps
1. Drive plate bolt
2. Adapter plate
3. Drive plate
4. Crankshaft bushing
5. Rear plate
6. Bellhousing cover
>>E<< 7. Oil seal case
>>D<< 8. Oil seal
>>C<< 9. Bearing cap bolt
10. Bearing cap
>>B<< 11. Crankshaft bearing, lower
>>A<< 12. Crankshaft

INSTALLATION SERVICE POINTS

>>A<< THRUST BEARING INSTALLATION



The alphabetical character in this category of heading matches that of the relevant removal steps, installation steps, disassembly steps, or reassembly steps.

Procedures and cautions for removal, installation, disassembly, and reassembly are explained under this category of heading.

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GENERAL INFORMATION

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VEHICLE AND ENGINE MODELS

Vehicle name	Vehicle model	Engine model	Displacement mL	Specification
Outlander	CU2W	4G63-7	1,997	Double overhead camshaft, 16-valve

GENERAL SPECIFICATIONS

M1113000200478

Items		Specification
Bore × stroke mm		85 × 88
Displacement mL		1,997
Combustion chamber		Pentroof type
Number of cylinders		4
Valve mechanism	Type	Double overhead camshaft
	Number of intake valves	2
	Number of exhaust valves	2
	Lash adjusters	Hydraulic
	Rocker arms	Roller cam followers
Compresssion ratio		10.0
Fuel injection system		Electronically controlled multi-point injection (MPI) system
Ignition system		Electronically controlled two-coil system
Generator		Alternator (with built-in IC regulator)
Starter motor		Gear reduction drive type

SERVICE SPECIFICATIONS

M1113000300419

Items	Standard value	Limit
TIMING BELT		
Auto-tensioner rod extension length (with timing belt installed) mm	3.8 – 4.5	–
Auto-tensioner rod extension length (when free) mm	12.0	–
Auto-tensioner rod retraction length (when pressed with force of 98 to 196 N) mm	Less than 1	–
ROCKER ARMS AND CAMSHAFTS		
Cam height mm	34.91	34.41
CYLINDER HEAD AND VALVES		
Cylinder head gasket surface warp mm	Less than 0.05	0.2

Items		Standard value	Limit
Cylinder head gasket surface grinding limit (including cylinder block grinding amount) mm		–	0.2
Cylinder head overall height mm		131.9 – 132.1	–
Cylinder head bolt nominal length mm		–	99.4
Valve margin mm	Intake valves	1.0	0.5
	Exhaust valves	1.5	1.0
Valve stem diameter mm		6.6	–
Valve face angle		45.5°	–
Valve stem-to-guide clearance mm	Intake valves	0.02 – 0.05	0.10
	Exhaust valves	0.05 – 0.09	0.15
Valve height mm	Intake valves	109.5	109.0
	Exhaust valves	109.7	109.2
Valve stem projection mm	Intake valves	49.2	49.7
	Exhaust valves	48.4	48.9
Valve spring free height mm		48.3	47.3
Valve spring load/height N/mm		294/40	–
Valve spring squareness		1.5°or less	4°
Valve face-to-seat contact width mm		0.9 – 1.3	–
Valve guide inside diameter mm		6.6	–
Valve guide press-in height mm		19.2 – 19.8	–
OIL PAN AND OIL PUMP			
Oil pump gear side clearance mm	Drive gear	0.08 – 0.14	–
	Driven gear	0.06 – 0.12	–
PISTONS AND CONNECTING RODS			
Piston outside diameter mm		85.0	–
Piston ring side clearance in ring groove mm	No. 1	0.02 – 0.06	0.1
	No. 2	0.02 – 0.06	0.1
Piston ring end gap mm	No. 1	0.20 – 0.30	0.8
	No. 2	0.30 – 0.45	0.8
	Oil ring	0.10 – 0.40	1.0
Piston pin outside diameter mm		22.0	–
Piston pin press-in load (at ambient temperature) N		7,350 – 17,100	–
Oil clearance at crankshaft pins mm		0.03 – 0.05	0.1
Connecting rod big end thrust clearance mm		0.10 – 0.25	0.4
CRANKSHAFT AND CYLINDER BLOCK			
Crankshaft end play mm		0.05 – 0.25	0.4
Crankshaft journal diameter mm		57.0	–
Crankshaft pin diameter mm		45.0	–
Oil clearance at crankshaft journals mm		0.03 – 0.04	0.1
Cylinder block gasket surface warp mm		0.05	0.1

Items	Standard value	Limit
Cylinder block gasket surface grinding limit (including cylinder head grinding amount) mm	–	0.2
Cylinder block overall height mm	284	–
Cylinder bore diameter mm	85	–
Taper of cylinder mm	0.01 or less	–
Cylinder-to-piston clearance mm	0.02 – 0.04	–
Crankshaft bearing cap bolt nominal length mm	–	71.1

REWOK DIMENSIONS

M1113024300178

Items			Standard value
CYLINDER HEAD AND VALVES			
Diameter of oversize valve seat ring hole in cylinder head mm	Intake	0.03 oversize	35.30 – 35.33
		0.06 oversize	35.60 – 35.63
	Exhaust	0.03 oversize	33.30 – 33.33
		0.06 oversize	33.60 – 33.63
Diameter of oversize valve guide hole in cylinder head mm		0.05 oversize	12.05 – 12.07
		0.25 oversize	12.25 – 12.27
		0.50 oversize	12.50 – 12.52

TORQUE SPECIFICATIONS

M1113023400503

Items	Tightening torque N·m
ALTERNATOR AND IGNITION COIL	
Oil level gauge guide bolts	13 ± 1
Idler pulley bolt	79 ± 5
Auto-tensioner assembly bolts (M8)	22 ± 4
Auto-tensioner assembly bolts (M10)	44 ± 10
Water pump pulley bolt	8.8 ± 1.0
Alternator brace bolt (flange bolt)	23 ± 3
Alternator brace bolt (washer assembled bolt)	22 ± 4
Alternator nuts	44 ± 10
Crankshaft pulley bolt	25 ± 4
Center cover bolts	3.0 ± 0.5
Ignition coil bolts	10 ± 2
Spark plugs	25 ± 5
TIMING BELT	
Timing belt cover bolts (flange bolts)	11 ± 1
Timing belt cover bolts (washer-assembled bolts)	9.0 ± 1.0

Items	Tightening torque N·m
Power steering pump bracket bolts	49 ± 9
Tensioner pulley bolt	48 ± 5
Tensioner arm bolt	21 ± 4
Auto-tensioner bolts	23 ± 3
Idler pulley bolt	35 ± 6
Crank angle sensor bolts	8.8 ± 1.0
Oil pump sprocket nut	54 ± 4
Crankshaft bolt	167
Tensioner B bolt	19 ± 3
Counterbalance shaft sprocket bolt	45 ± 3
Rocker cover bolts	3.5 ± 0.5
Engine support bracket bolts	49 ± 5
Camshaft sprocket bolt	88 ± 10
FUEL SYSTEM	
Vacuum hose and pipe clamp bolt	11 ± 1
Throttle body bolts	19 ± 3
EGR valve bolts	20 ± 2
Fuel pressure regulator bolts	9.0 ± 2.0
Delivery pipe and injector assembly bolts	11 ± 1
Solenoid valve assembly bolts	9.0 ± 1.0
INTAKE MANIFOLD	
Intake manifold stay bolts	31 ± 3
Intake manifold bolts (M8)	20 ± 2
Intake manifold bolts and nuts (M10)	36 ± 6
Engine hanger bolt	19 ± 3
EXHAUST MANIFOLD	
Oxygen sensor	44 ± 5
Exhaust manifold cover bolts	14 ± 1
Exhaust manifold bracket bolt (Cylinder block side)	35 ± 6
Exhaust manifold bracket bolt (Exhaust manifold side)	44 ± 5
Exhaust manifold nuts (M8)	29 ± 3
Exhaust manifold nuts (M10)	49 ± 5
WATER PUMP AND WATER HOSE	
Coolant temperature sensor	29 ± 10
Coolant temperature gauge unit	10.8 ± 1.0
Water inlet fitting bolts	13 ± 2
Water outlet fitting bolts	13 ± 2
Thermostat housing bolts	23 ± 4
Water inlet pipe bolts	13 ± 2
Water pump bolts	14 ± 1

Items	Tightening torque N·m
Knock sensor	23 ± 2
ROCKER ARMS AND CAMSHAFTS	
Camshaft position sensor bolts	8.8 ± 1.0
Cover bolts	10 ± 2
Camshaft position sensing cylinder bolt	22 ± 4
Camshaft position sensor support bolts	14 ± 1
Bearing cap bolts	20 ± 1
Oil delivery body bolts	11 ± 1
CYLINDER HEAD AND VALVES	
Cylinder head bolts	78 ± 2 → loosen completely → 20 ± 2 → 90° + 90°
OIL PUMP CASE AND OIL PAN	
Drain plug	39 ± 5
Transmission stay bolts	22 ± 4
Oil pan upper section bolts	9.0 ± 3.0
Oil pan lower section bolts	9.0 ± 3.0
Oil screen bolts	19 ± 3
Oil pressure switch	19 ± 3
Relief plug	44 ± 5
Oil filter bracket bolts	19 ± 3
Plug cap	23 ± 3
Flange bolts	36 ± 3
Oil pump case bolts	23 ± 3
Oil pump cover bolts	17 ± 1
Oil pump cover screws	10 ± 2
PISTONS AND CONNECTING RODS	
Connecting rod cap nuts	20 ± 2 → 90° to 94°
CRANKSHAFT AND CYLINDER BLOCK	
Flywheel bolts	132 ± 5
Rear plate bolts	11 ± 1
Bell housing cover bolts	9.0 ± 1.0
Rear oil seal case bolts	11 ± 1
Beam bearing cap bolts	25 ± 2 → 90° to 100°

SEALANTS

M1113000500402

Items	Specified sealants
Engine support bracket bolts	Mitsubishi Genuine Part No.MD970389 or equivalent
Semicircular packing	3M ATD No.8660 or equivalent
Rocker cover	Mitsubishi Genuine Part No. MD970389 or equivalent
Engine coolant temperature sensor	3M Nut Locking Part No.4171 or equivalent
Engine coolant temperature e gauge unit	3M ATD No.8660 or equivalent
Water outlet fitting*	Mitsubishi Genuine Part No. MD970389 or equivalent
Thermostat housing*	
Cylinder head (camshaft bearing cap fitting section)	3M ATD No.8660 or equivalent
Camshaft position sensor support*	Mitsubishi Genuine Part No. MD970389 or equivalent
Oil pressure switch	3M ATD No.8660 or equivalent
Oil pan*	Mitsubishi Genuine Part No. MD970389 or equivalent
Rear oil seal case*	

*NOTE: *: Part to be sealed with a form-in-place gasket (FIPG)*

FORM-IN-PLACE GASKET (FIPG)

This engine has several areas where the form-in-place gasket (FIPG) is used for sealing. To ensure that the FIPG fully serves its purpose, it is necessary to observe some precautions when applying it.
Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other hand, could be squeezed out of location, causing blocking or narrowing of fluid passages. To prevent leaks or blocking of passages, therefore, it is absolutely necessary to apply the FIPG evenly without a break, while observing the correct bead size.
FIPG hardens as it reacts with the moisture in the atmospheric air, and it is usually used for sealing metallic flange areas.

REMOVAL OF FIPG SEALED PARTS

Parts sealed with a FIPG can be easily removed without need for the use of a special method. In some cases, however, the FIPG in joints may have to be broken by tapping parts with a mallet or similar tool. You can also tap a flat, thin gasket scraper into the joint to break the FIPG, taking extreme care not to damage the mating surfaces.The oil pan remover (MD998727) is available as a special tool for removing the oil pan. The tool, however, must not be

CLEANING FIPG APPLICATION SURFACE

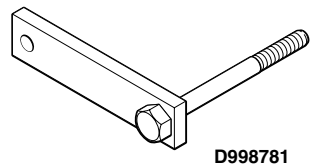
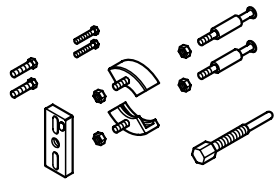
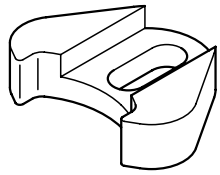
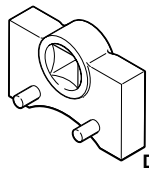
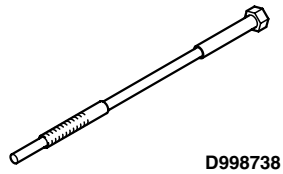
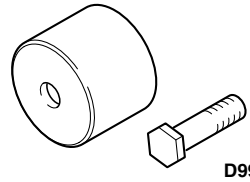
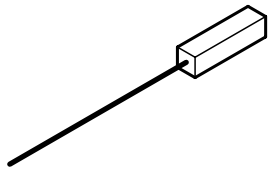
Thoroughly remove all substances deposited on the FIPG application surface, using a gasket scraper or wire brush. Make sure that the FIPG application surface is flat and smooth. Also make sure that the surface is free from oils, greases and foreign substances. Do not fail to remove old FIPG that may remain in the fastener fitting holes.

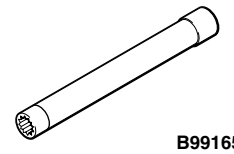
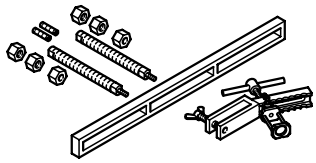
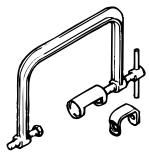
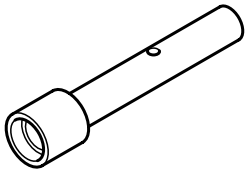
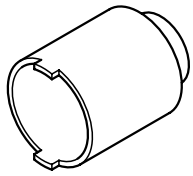
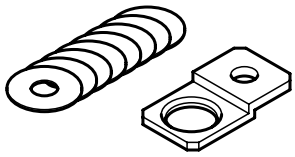
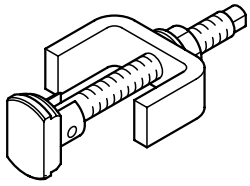
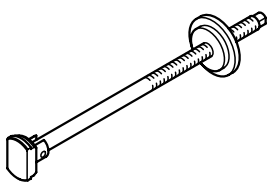
APPLICATION OF FIPG

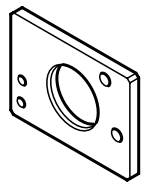
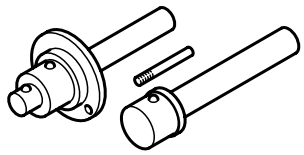
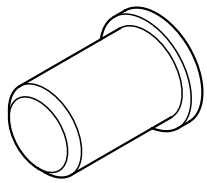
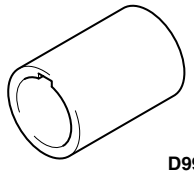
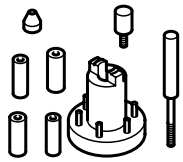
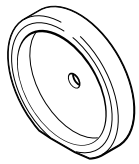
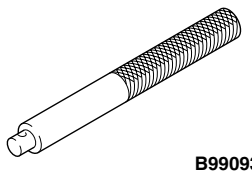
Applied FIPG bead should be of the specified size and free of any break. FIPG can be wiped away unless it has completely hardened. Install the mating parts in position while the FIPG is still wet (in less than 15 minutes after application). Do not allow FIPG to spread beyond the sealing areas during installation. Avoid operating the engine or letting oils or water come in contact with the sealed area before a time sufficient for FIPG to harden (approximately one hour) has passed. FIPG application method may vary from location to location. Follow the instruction for each particular case described later in this manual.

SPECIAL TOOLS

M1113000600465

Tool	Number	Name	Use
 D998781	MD998781	Flywheel stopper	Retention of flywheel
	MD998778	Crankshaft sprocket puller	Removal of crankshaft sprocket and crankshaft sprocket B
	MD998785	Sprocket stopper	Retention of counterbalancer shaft sprocket
 D998767	MD998767	Tension pulley socket wrench	Manipulation of tensioner pulley during adjustment of timing belt tension
 D998738	MD998738	Set screw	Retention of tentioner arm and auto-tensioner during timing belt installation
 D998713	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal
	MD998442	Air bleed wire	Air bleeding of lash adjuster

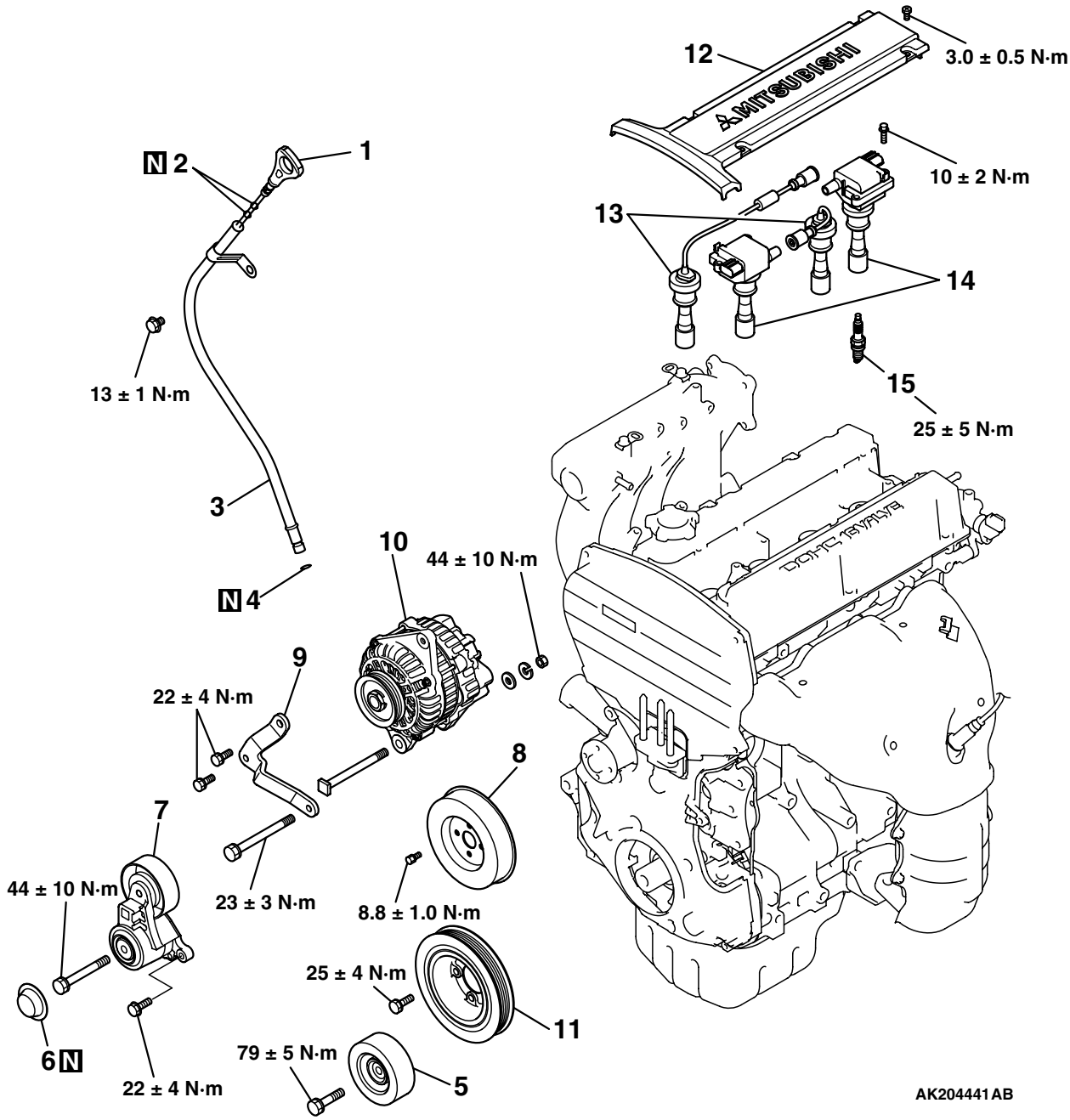
Tool	Number	Name	Use
 B991654	MB991654	Cylinder head bolt wrench	Removal and installation of cylinder head bolts
	MD998772	Valve spring compressor	Compression of valve spring
	MD998735	Valve spring compressor	Compression of valve spring
	MD998737	Valve stem seal installer	Installation of valve stem seal
	MD998162	Plug wrench	Removal and installation of front case plug cap (Use with MD998783.)
	MD998783	Plug wrench retainer	Removal and installation of front case plug cap (Use with MD998162.)
	MD998371	Silent shaft bearing puller	Removal of counterbalancer shaft front bearing
	MD998372	Silent shaft bearing puller	Removal of counterbalancer shaft front and rear bearings

Tool	Number	Name	Use
	MB991603	Silent shaft bearing installer stopper	Guide and stopper for removal and press-fitting of counterbalancer shaft rear bearing
	MD998705	Silent shaft bearing installer	Press-fitting of counterbalancer shaft front and rear bearings
	MD998375	Crankshaft front oil seal installer	Installation of crankshaft front oil seal
 D998285	MD998285	Crankshaft front oil seal guide	Guide for installation of crankshaft front oil seal
	MD998780	Piston pin setting tool	Removal and press-fitting of piston pin
 D998776	MD998776	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal
 B990938	MB990938	Handle	Installation of crankshaft rear oil seal (Use with MD998776.)

ALTERNATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION

M1113001000392



Removal steps

1. Oil level gauge
2. O-ring
3. Oil level gauge guide
4. O-ring
5. Idler pulley
6. Cap
7. Auto-tensioner assembly
8. Water pump pulley

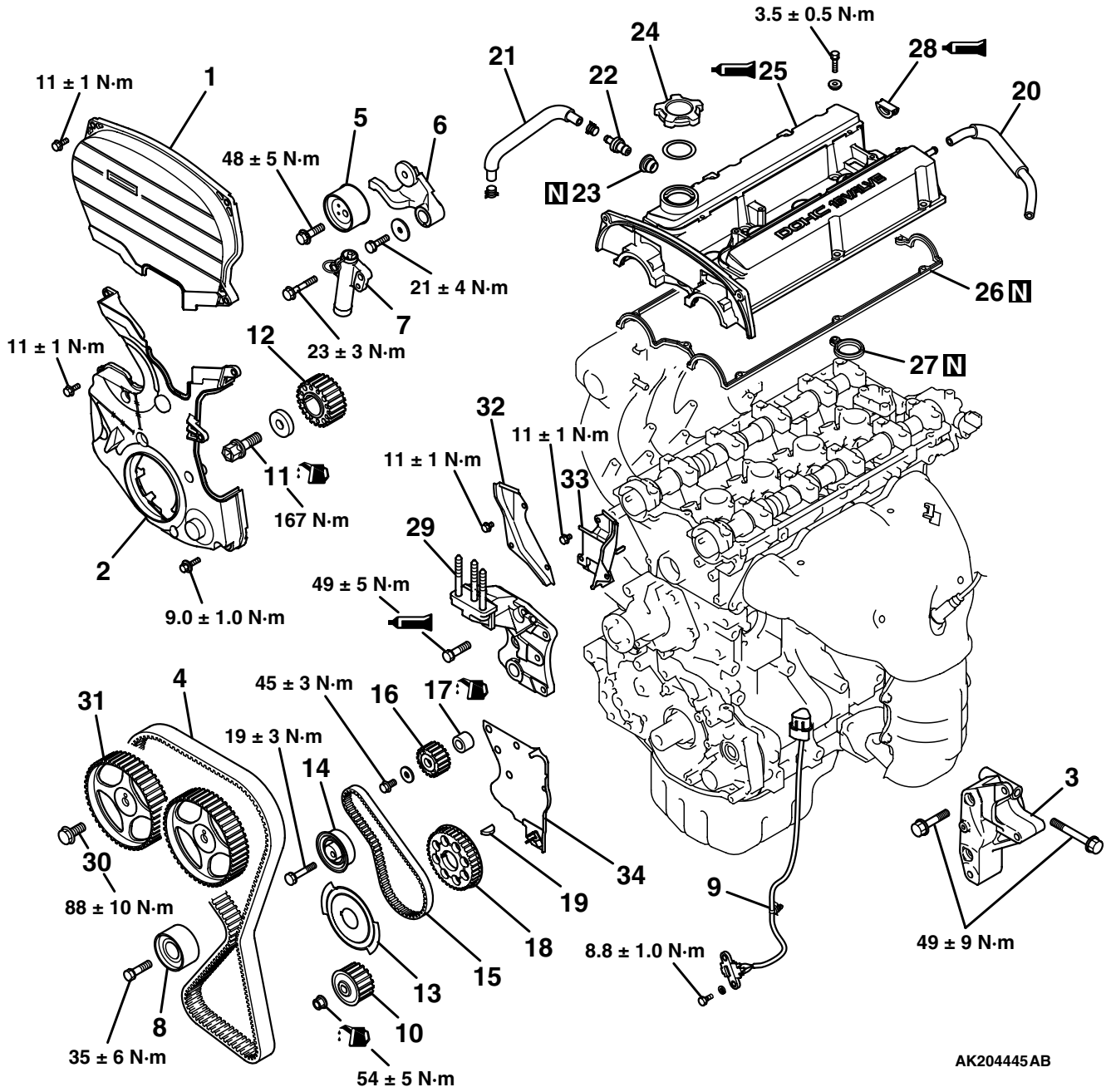
Removal steps (Continued)

9. Alternator brace
10. Alternator
11. Crankshaft pulley
12. Center cover
13. Spark plug cable
14. Ignition coil
15. Spark plug

TIMING BELT

REMOVAL AND INSTALLATION

M1113001900500



Removal steps

1. Timing belt front upper cover
2. Timing belt front lower cover
3. Power steering pump bracket

<<A>> >>M<< 4. Timing belt

>>L<< 5. Tensioner pulley

6. Tensioner arm

>>K<< 7. Auto-tensioner

8. Idler pulley
9. Crank angle sensor

<<B>> >>J<< 10. Oil pump sprocket

<<C>> >>I<< 11. Crankshaft bolt

Removal steps (Continued)

<<D>> >>I<< 12. Crankshaft sprocket

>>I<< 13. Crankshaft sensing blade

14. Tensioner B

<<E>> >>H<< 15. Timing belt B

<<F>> >>G<< 16. Counterbalancer shaft sprocket

>>F<< 17. Spacer

<<G>> >>E<< 18. Crankshaft sprocket B

19. Crankshaft key
20. Breather hose
21. Positive crankcase ventilation (PCV) hose

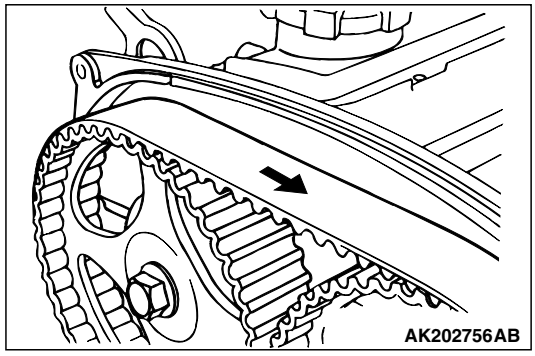
Removal steps (Continued)

22. PCV valve
23. PCV valve gasket
24. Oil filler cap

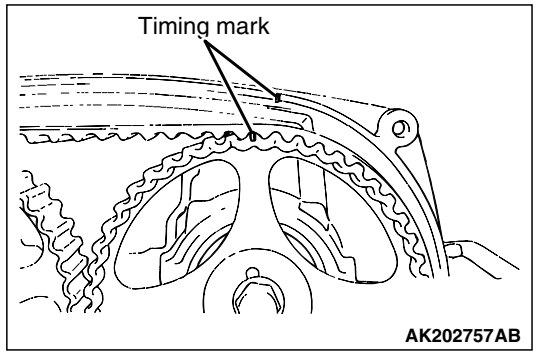
>>D<< 25. Rocker cover
>>D<< 26. Rocker cover gasket A
27. Rocker cover gasket B
>>C<< 28. Semicircular packing
>>B<< 29. Engine support bracket
<<H>> >>A<< 30. Camshaft sprocket bolt
31. Camshaft sprocket
32. Timing belt rear cover, right
33. Timing belt rear upper cover, left
34 Timing belt rear lower cover, left

REMOVAL SERVICE POINTS

<<A>> TIMING BELT REMOVAL



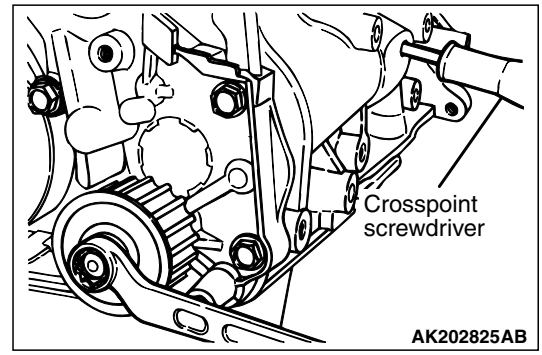
1. If the timing belt is to be reused, make an arrow mark with something like chalk on the back of the belt indicating the direction of rotation so it may be reinstalled in the same direction.



⚠ CAUTION
Never remove the timing belt with any piston at the top dead center (TDC). If a piston is at TDC, the exhaust valves of the cylinder are pushed by the exhaust cams, compressing the valve springs. If the belt is removed under this condition, the sprocket will be turned in the reverse direction by the force of the springs, incurring risk of injury.

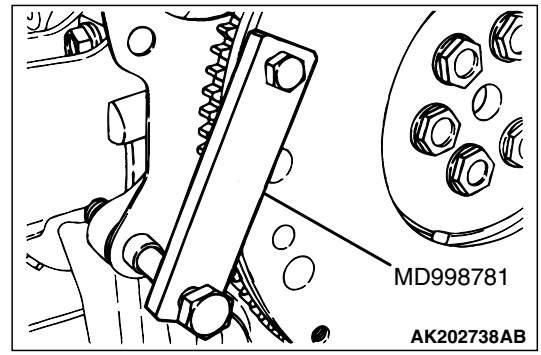
2. Set the timing mark of the exhaust camshaft sprocket to a point about one tooth before the TDC of the No.1 cylinder piston on compression stroke.
3. Loosen the lock nut of the tensioner pulley, then remove the timing belt.

<<B>> OIL PUMP SPROCKET REMOVAL



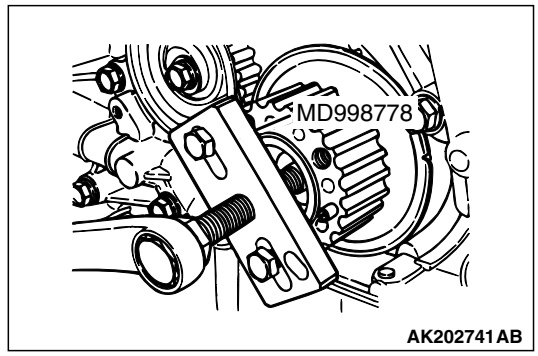
1. Remove the plug on the left side of cylinder block.
2. Insert a crosspoint screwdriver (shank diameter 8 mm) to prevent the counterbalancer shaft from rotating.
3. Remove the flange bolt.
4. Remove the oil pump sprocket.

<<C>> CRANKSHAFT BOLT REMOVAL



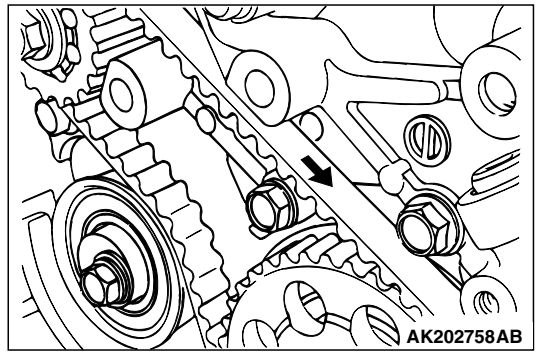
1. Hold the drive plate with the special tool Fly wheel stopper(MD998781).
2. Remove the crankshaft bolt.

<<D>> CRANKSHAFT SPROCKET REMOVAL



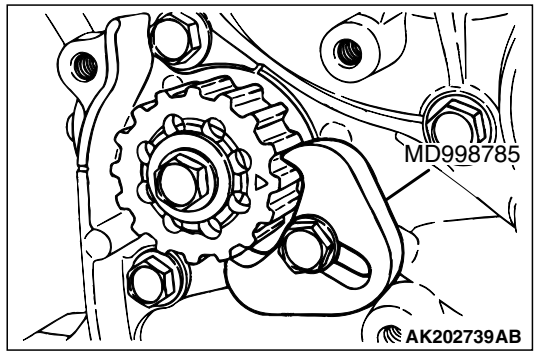
Use the special tool Crankshaft sprocket puller (MD998778) if the sprocket is stuck and hard to remove.

<<E>> TIMING BELT B REMOVAL



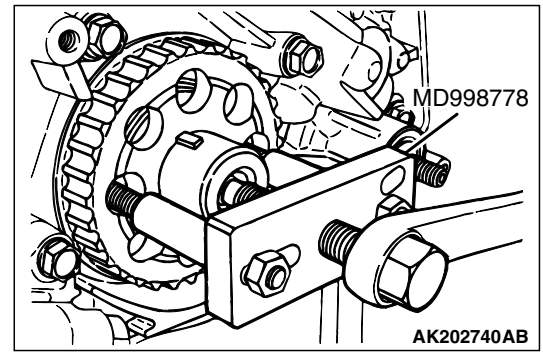
If the timing belt is to be reused, make an arrow mark with something like chalk on the back of the timing belt indicating the direction of rotation so it may be reinstalled in the same direction.

<<F>> COUNTERBALANCER SHAFT SPROCKET REMOVAL



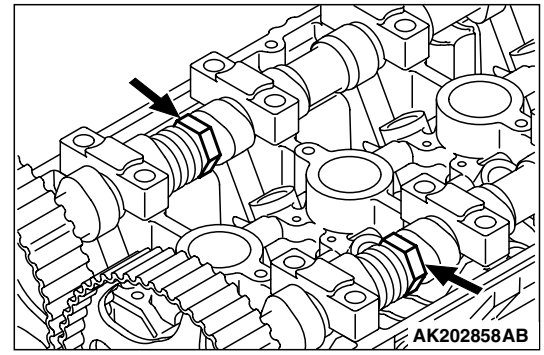
1. Use the special tool Sprocket stopper (MD998785) to prevent the counterbalancer shaft sprocket from rotating.
2. Remove the counterbalancer shaft mounting bolt.

<<G>> CRANKSHAFT SPROCKET B REMOVAL



Use the special tool Crankshaft sprocket puller (MD998778) if the sprocket is stuck and hard to remove.

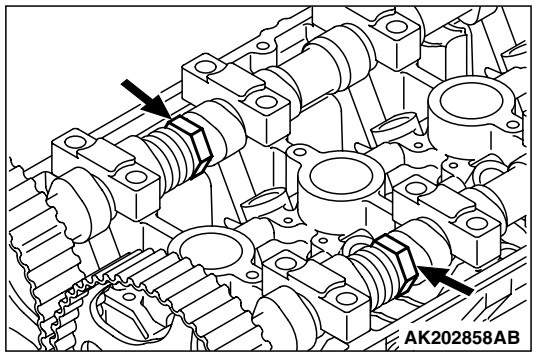
<<H>> CAMSHAFT SPROCKET BOLT REMOVAL

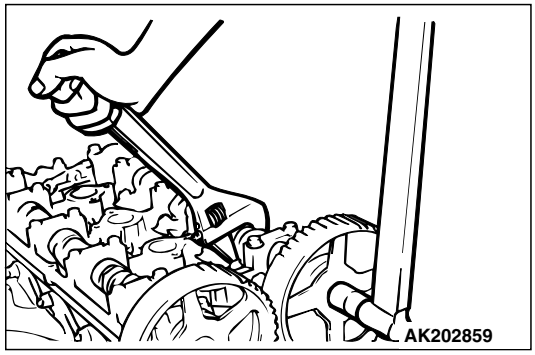


Remove the camshaft sprocket bolt while preventing the camshaft from rotation using a wrench fitted on the hexagonal portion of the camshaft.

INSTALLATION SERVICE POINTS

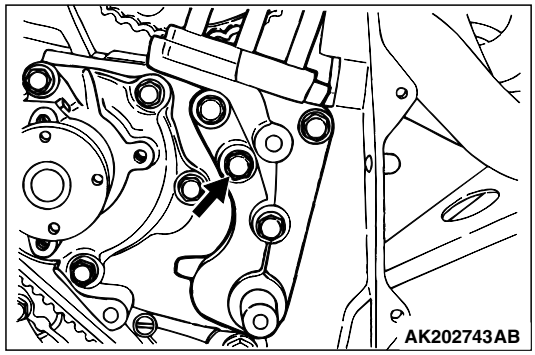
>>A<< CAMSHAFT SPROCKET BOLT INSTALLATION


AK202858AB


AK202859

Tighten the camshaft sprocket bolt to 88 ± 10 N·m while preventing the camshaft from rotation using a wrench fitted on the hexagonal portion of the camshaft.

>>B<< ENGINE SUPPORT BRACKET INSTALLATION

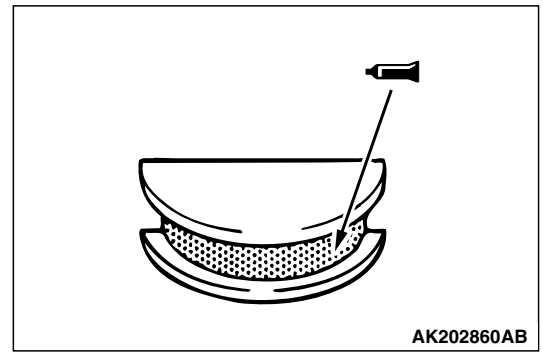

AK202743AB

1. Remove thoroughly the old sealant remaining on the indicated bolt and in its hole.
2. Coat the bolt with sealant, then install and tighten it.

Specified sealant:
Mitsubishi Genuine Part No.MD970389 or equivalent

>>C<< SEMICIRCULAR PACKING INSTALLATION

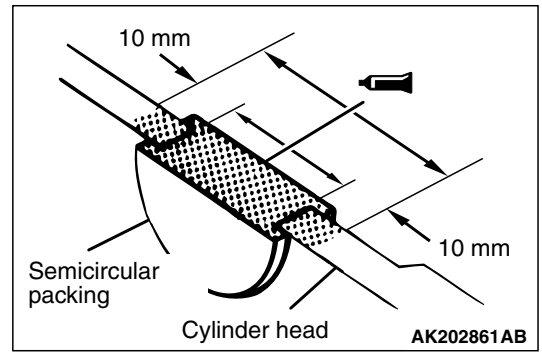
1. Remove thoroughly the old sealant and FIPG remaining on the semicircular packing, cylinder head, and rocker cover.


AK202860AB

2. Apply sealant to the surface indicated in the drawing of the semicircular packing.

Specified sealant:
3M ATD No.8660 or equivalent

3. Install the semicircular packing on the cylinder head.

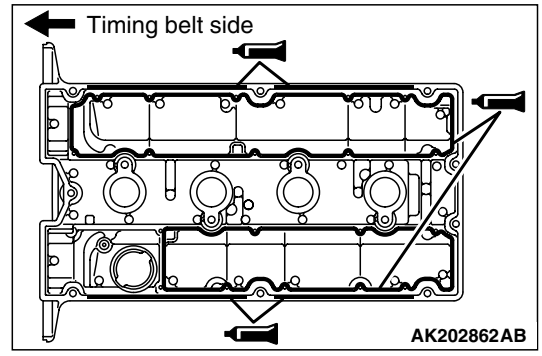


AK202861AB

4. Apply sealant to the area indicated in the drawing of the semicircular packing and cylinder head.

Specified sealant:
3M ATD No.8660 or equivalent

>>D<< ROCKER COVER/ROCKER COVER GASKET A INSTALLATION

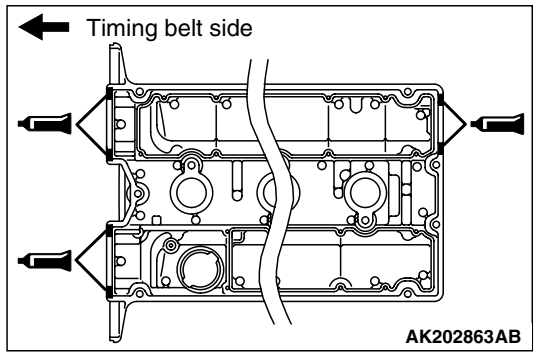


AK202862AB

1. Apply beads of FIPG on the surfaces of the rocker cover indicated in the drawing.

Specified sealant:
Mitsubishi Genuine Part No.MD970389 or equivalent

2. Install the rocker cover gasket A on the rocker cover before the FIPG hardens.

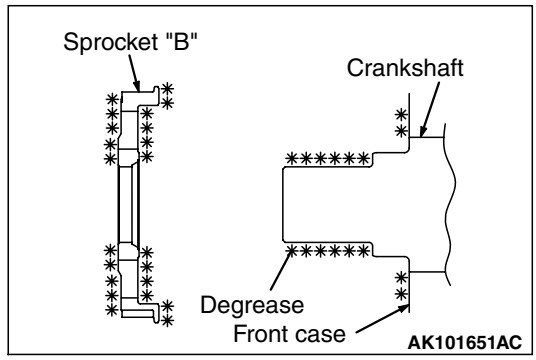


3. Apply beads of FIPG to the surfaces of the rocker cover indicated in the drawing.

Specified sealant:
Mitsubishi Genuine Part No.MD970389 or equivalent

4. Install the rocker cover on the cylinder head before the FIPG hardens.

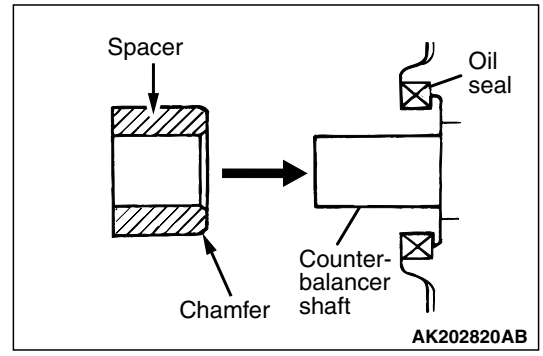
>>E<< CRANKSHAFT SPROCKET B INSTALLATION



Clean and then degrease the crankshaft sprocket B and the sprocket fitting surface of the crankshaft.

NOTE: Degreasing is necessary to prevent lack of frictional coefficient between the mating surfaces.

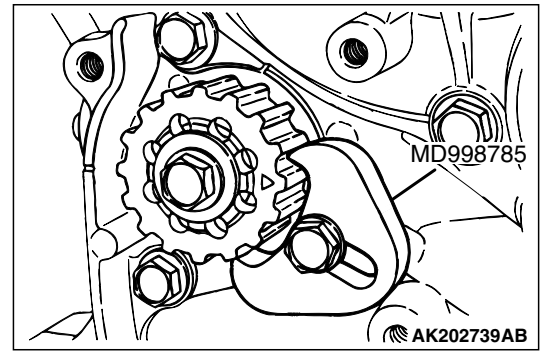
>>F<< SPACER INSTALLATION



⚠ CAUTION
If the spacer is opposite in direction to that shown in the drawing when installed, it will damage the oil seal lip.

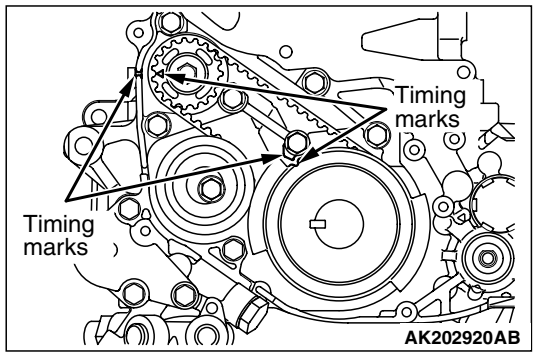
1. Smear slightly oil on the outer surface of the spacer that comes into contact with the oil seal.
2. Install the spacer with the chamfered end toward the oil seal.

>>G<< COUNTERBALANCER SHAFT SPROCKET INSTALLATION

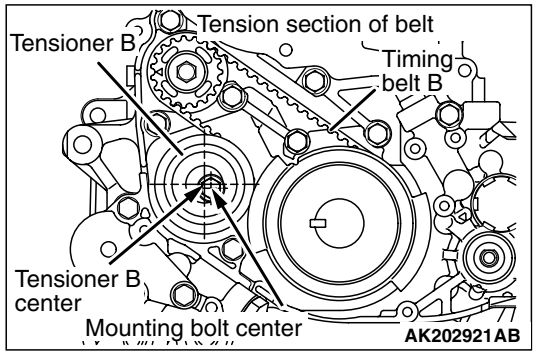


1. Use the special tool Sprocket stopper (MD998785) as shown in the drawing to prevent the counterbalancer shaft sprocket from rotating.
2. Tighten the sprocket mounting bolt to 45 ± 3 N·m.

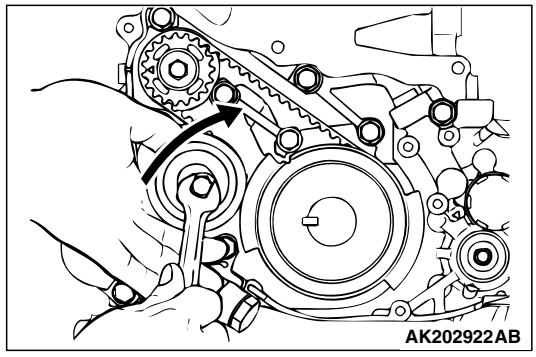
>>H<< TIMING BELT B INSTALLATION



1. Align the timing marks on the crankshaft sprocket B and counterbalancer shaft sprocket with the corresponding timing marks on the oil pump case.
2. Install the timing belt B on the crankshaft sprocket B and counterbalancer shaft sprocket. There should be no slack in the tension section of the belt.



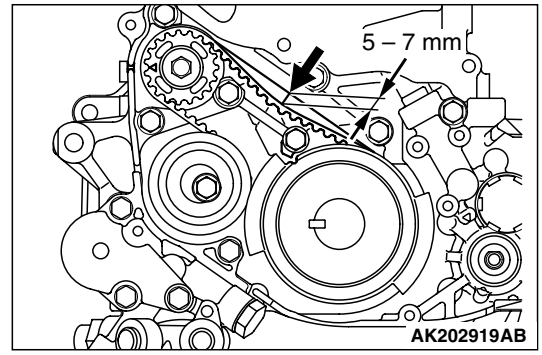
3. Make sure that the tensioner B center is positioned as shown in the drawing relative to the mounting bolt center.



4. Lift the tensioner B with fingers to move it in the direction of the arrow until the tension section of the timing belt becomes taut. While keeping the tensioner B in this position, tighten its bolt.

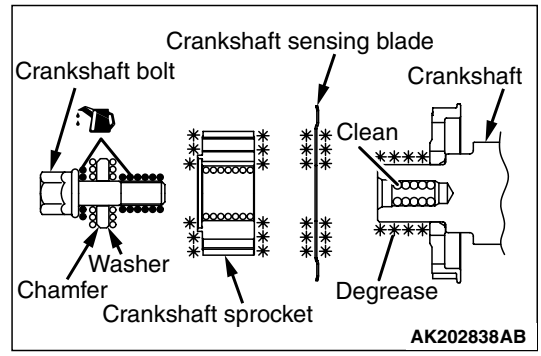
   NOTE: When the bolt is tightened, prevent the tensioner B shaft from turning. If the shaft turns, the belt will be overtightened.

5. Make sure that the timing marks on the oil pump case and those of the sprockets are all aligned with each other.

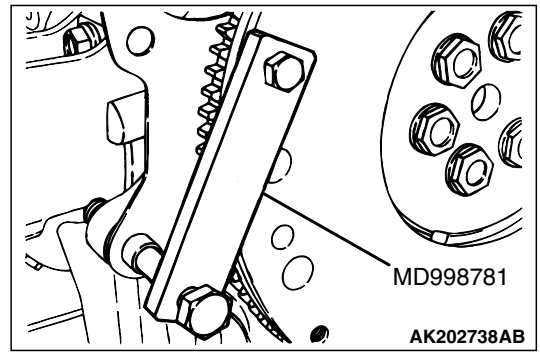


6. Push a central point of the timing belt B tension section lightly with an index to see if it deflects 5 – 7 mm.

>>I<< CRANKSHAFT BOLT/CRANKSHAFT SPROCKET/CRANKSHAFT SENSING BLADE INSTALLATION

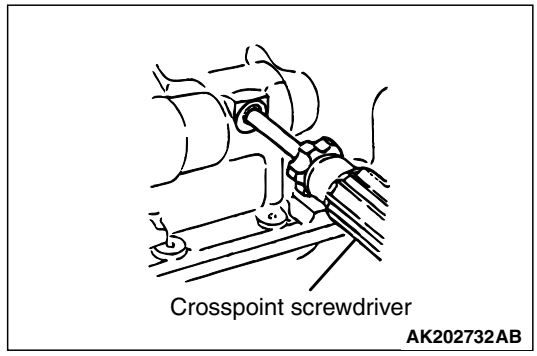


1. Clean and then degrease the crankshaft sprocket, sprocket fitting surface of the crankshaft, and crankshaft sensing blade. Install the crankshaft sprocket and crankshaft sensing blade on the crankshaft.
2. Clean the bolt hole in the crankshaft, and then washer.
3. Apply a necessary minimum amount of oil to the threads and seating surface of the crankshaft bolt.



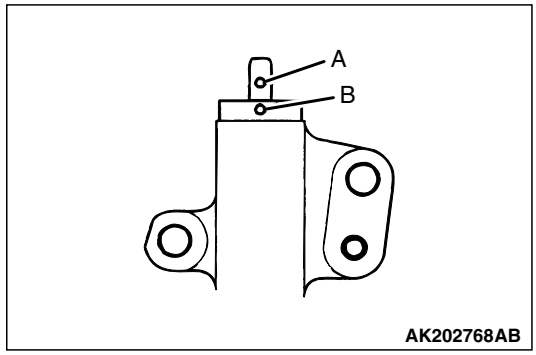
4. Hold the drive plate using the special tool Fly wheel stopper(MD998781).
5. Tighten the crankshaft bolt to a torque of 167 N·m.

>>J<< OIL PUMP SPROCKET INSTALLATION

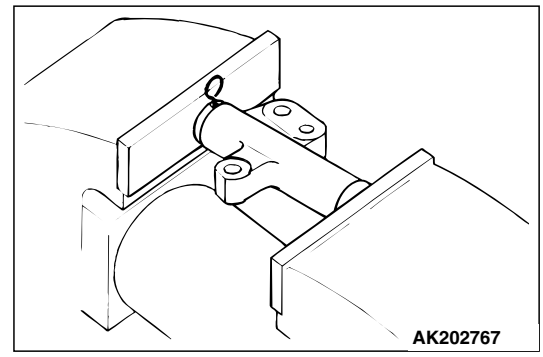


1. Prevent the counterbalancer shaft from rotating in the same method as in the removal procedure.
2. Install the oil pump sprocket.
3. Install the oil pump sprocket.
4. Tighten the flange nut to 54 ± 5 N·m.

>>K<< AUTO-TENSIONER INSTALLATION

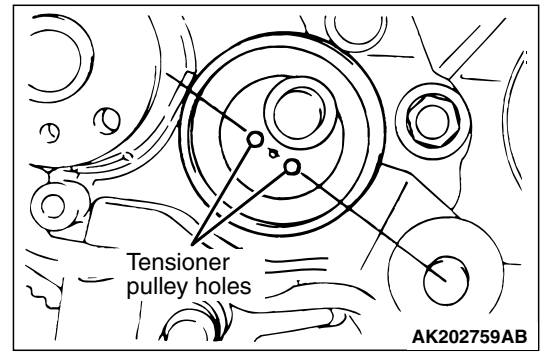


1. If the auto-tensioner rod remains in its fully extended position, reset it to the retracted position as follows:
   (1) Clamp the auto-tensioner in a vise at right angles to the jaws.
   (2) Push in the rod little by little with the vise until the set hole A in the rod is aligned with the set hole B in the cylinder.
   (3) Insert a piece of wire (1.4 mm diameter) into the set holes.
   (4) Remove the auto-tensioner from the vise.



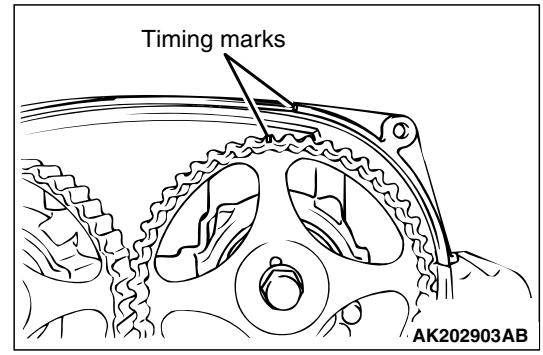
2. Install the auto-tensioner in position. Leave the wire installed until the auto-tensioner is completely installed.

>>L<< TENSIONER PULLEY INSTALLATION



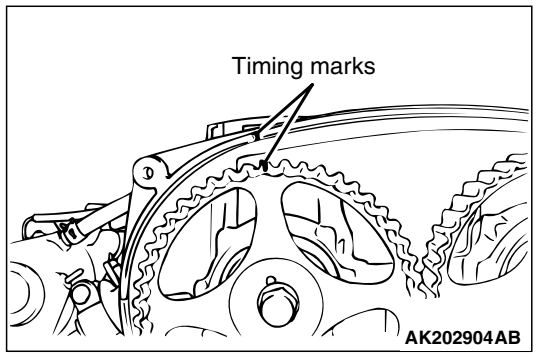
Install the tensioner pulley with its holes aligned as shown in the drawing.

>>M<< TIMING BELT INSTALLATION



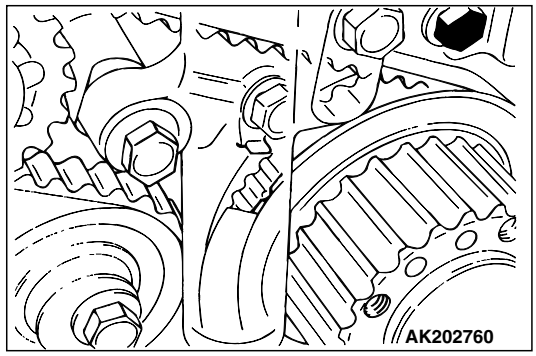
1. Bring the timing mark on the exhaust camshaft sprocket to a point one sprocket tooth away from the timing mark on the rocker cover in the counterclockwise direction.

   NOTE: If the timing marks were aligned, the exhaust camshaft would be turned counterclockwise by one sprocket tooth and stay there by the force of the valve springs.



2. Align the timing mark on the intake camshaft sprocket with that on the rocker cover.

   NOTE: The intake camshaft will be turned slightly clockwise from where the timing marks are aligned by the force of the valve springs and stay there.



3. Bring the timing mark on the crankshaft sprocket to a point one sprocket tooth away from the mating timing mark in the counterclockwise direction like in the operation with the exhaust camshaft sprocket.

4. Align the timing mark on the oil pump sprocket with that on the cylinder block.
   (1) Remove the plug from the cylinder block.
   (2) Insert a crosspoint screwdriver with a shank diameter of 8 mm through the plug hole. If it can be inserted 60 mm or more, the sprocket is in the correct phase. If the insertion depth is up to 20 – 25 mm, the screwdriver is blocked by the counterbalancer shaft. Then turn the oil pump sprocket one turn and realign the timing marks. Then check that the screwdriver can be inserted 60 mm or more. Keep the screwdriver inserted until installation of timing belt is finished.
   (3) Turn the oil pump sprocket counterclockwise by one sprocket tooth.

5. Install the timing belt on the exhaust camshaft sprocket, and hold it in place with a paper clip at the point indicated in the drawing.

INSTALLATION SERVICE POINTS

>>A<< INJECTOR INSTALLATION

1. Apply a thin coat of engine oil to a new O-ring.

⚠ CAUTION
Prevent engine oil from getting into the delivery pipe.

2. Insert the injector into the delivery pipe while turning it in both directions carefully not to damage the O-ring.
3. Check that the injector turns smoothly. If it does not, the O-ring may be jamming, so remove the injector and check the O-ring for damage. If the O-ring is intact, insert the injector into the delivery pipe and check it for smooth rotation again.

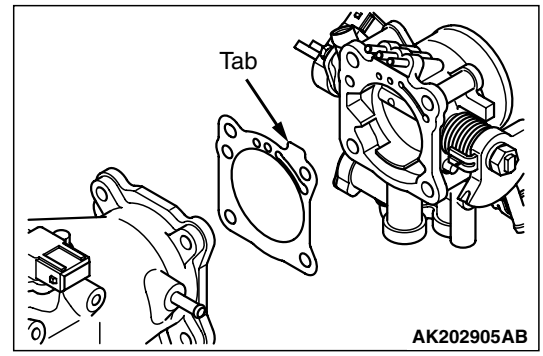
>>B<< FUEL PRESSURE REGULATOR INSTALLATION

1. Apply a thin coat of engine oil to a new O-ring.

⚠ CAUTION
Prevent engine oil from getting into the delivery pipe.

2. Insert the fuel pressure regulator into the delivery pipe while turning it in both directions carefully not to damage the O-ring.
3. Check that the fuel pressure regulator turns smoothly. If it does not, the O-ring may be jamming, so remove the fuel pressure regulator and check the O-ring for damage. If the O-ring is intact, insert it into the delivery pipe and check it for smooth rotation again.

>>C<< THROTTLE BODY GASKET INSTALLATION

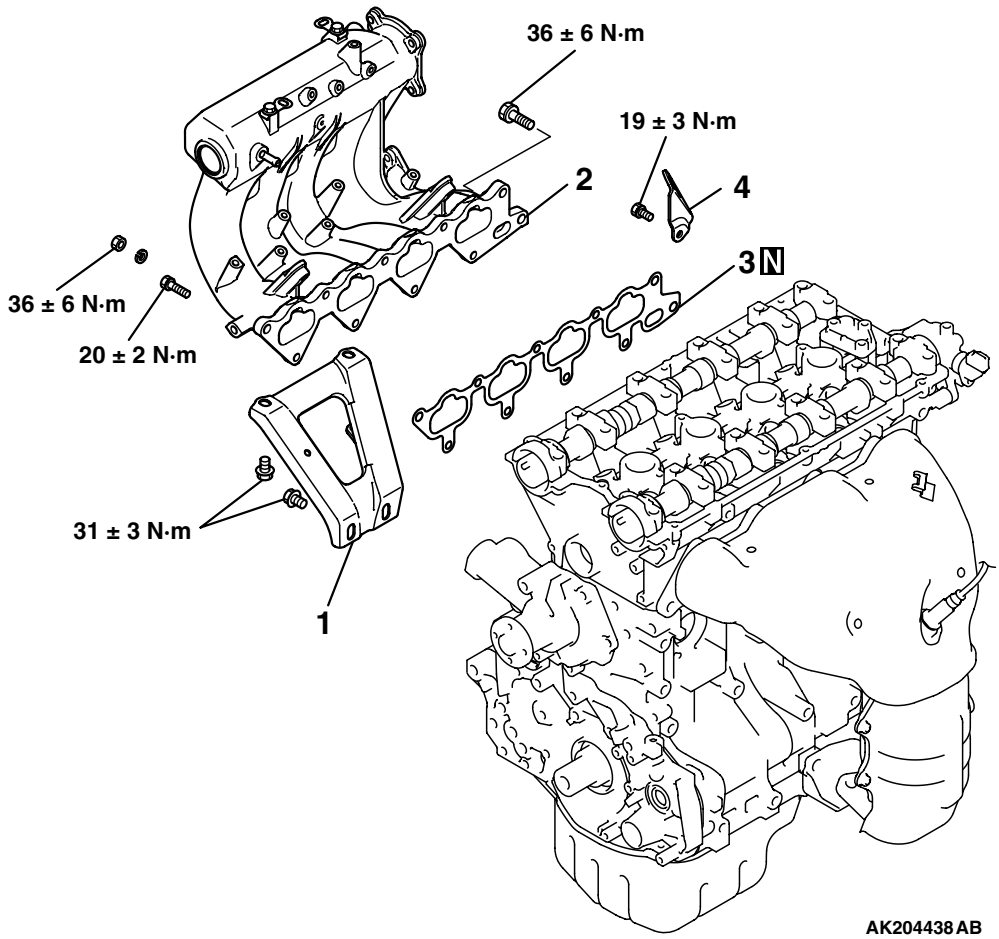


Install the throttle body gasket with its tab located as shown in the drawing.

INTAKE MANIFOLD

REMOVAL AND INSTALLATION

M1113002700286

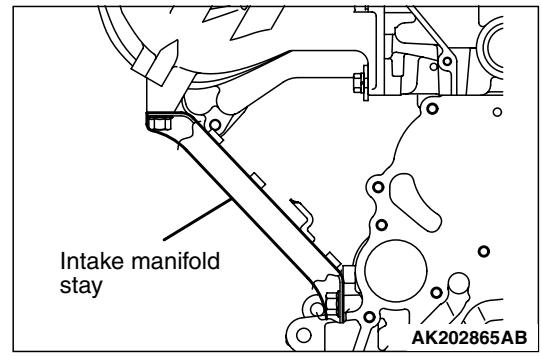


Removal steps

>>A<< 1. Intake manifold stay
2. Intake manifold
3. Intake manifold gasket
4. Engine hanger

INSTALLATION SERVICE POINTS

>>A<< INTAKE MANIFOLD STAY INSTALLATION

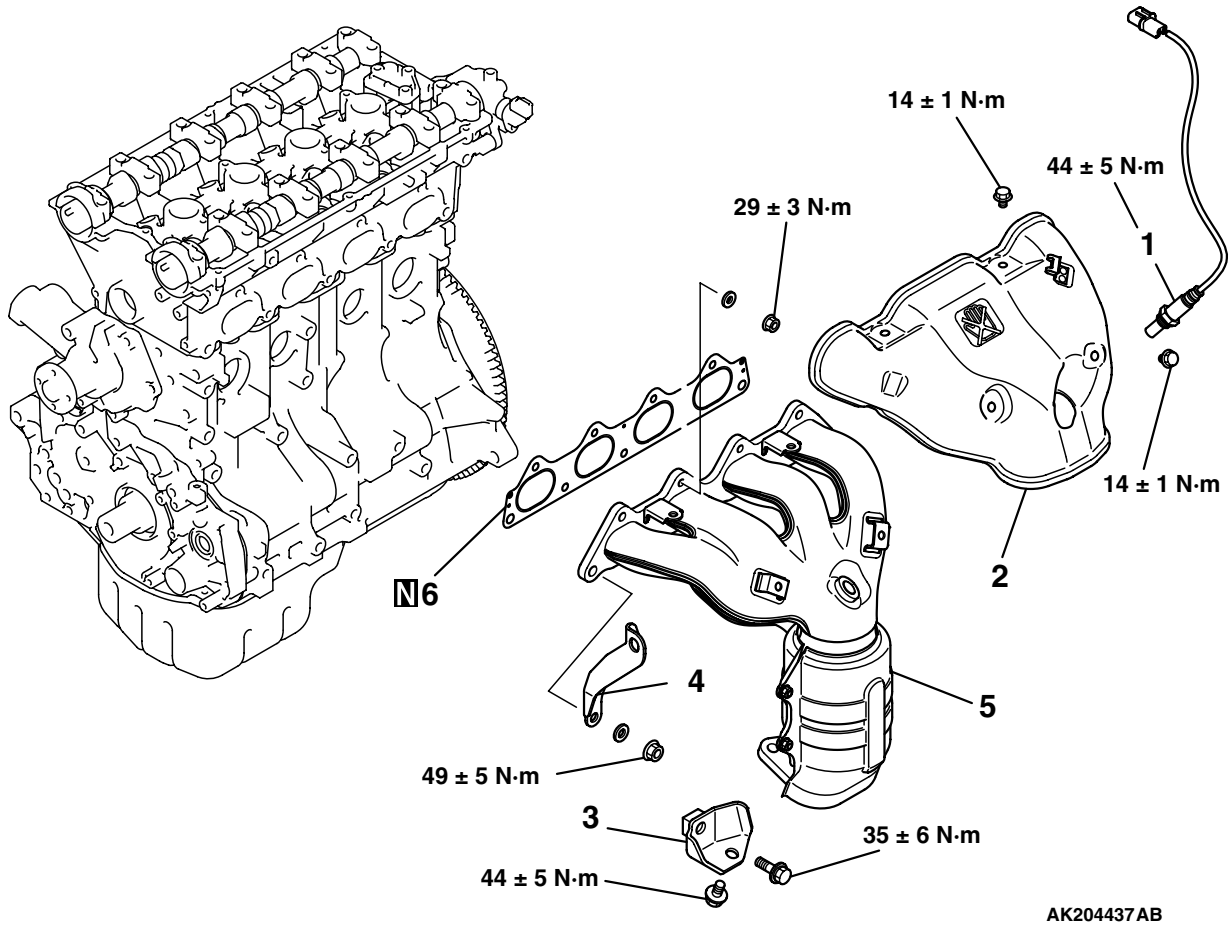


Tighten the bolts to the specified torque 31 ± 3 N·m on both ends after making sure that the stay is in close contact with the bosses on the intake manifold and cylinder block.

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004900383



Removal steps

1. Oxygen sensor
2. Exhaust manifold cover
3. Exhaust manifold bracket

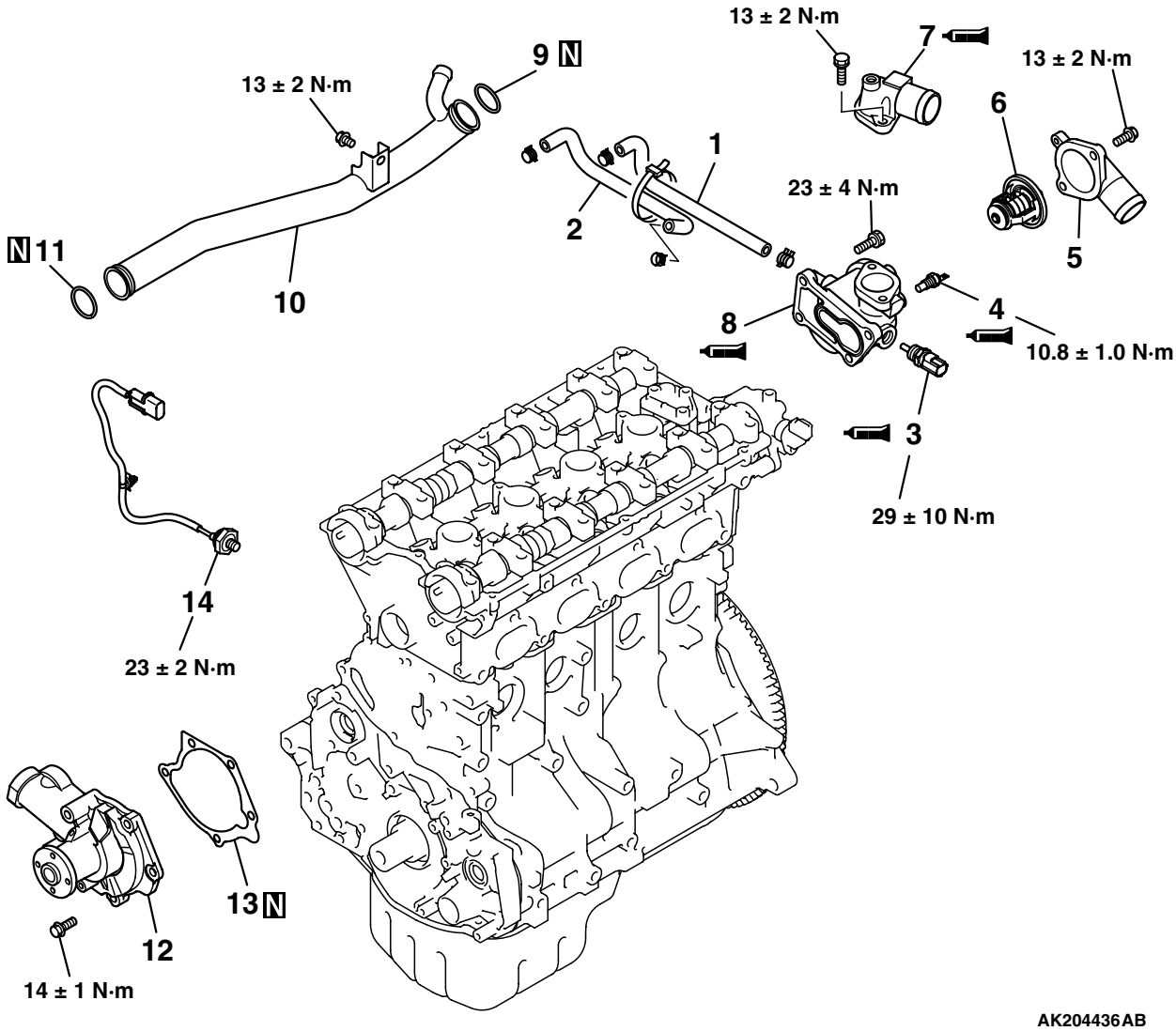
Removal steps (Continued)

4. Engine hanger
5. Exhaust manifold
6. Exhaust manifold gasket

WATER PUMP AND WATER HOSE

REMOVAL AND INSTALLATION

M1113017900220



AK204436AB

Removal sequence

1. Water hose
2. Water hose
- **>>E<<** 3. Coolant temperature sensor
- **>>D<<** 4. Coolant temperature gauge unit
5. Water inlet fitting
6. Thermostat
- **>>C<<** 7. Water outlet fitting
- **>>B<<** 8. Thermostat housing
- **>>A<<** 9. O-ring
- **>>A<<** 10. Water inlet pipe
- **>>A<<** 11. O-ring
12. Water pump
13. Water pump gasket
14. Knock sensor

INSTALLATION SERVICE POINTS

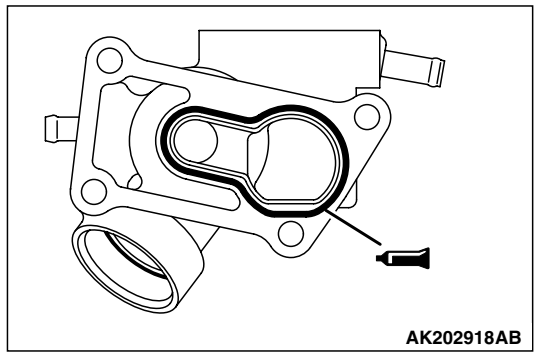
>>A<< O-RING/WATER INLET PIPE INSTALLATION

⚠ CAUTION

- **Never allow any oil or grease to touch the O-rings.**
- **Clamp the water inlet pipe only after installation of the thermostat case.**

Replace the O-rings at both ends of the water inlet pipe with new ones. Insert the O-rings into the water pump and thermostat housing after wetting their peripheries with water.

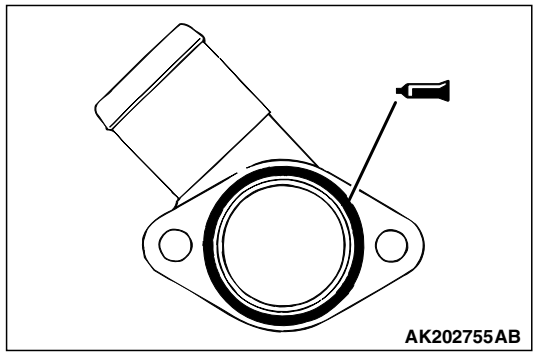
>>B<< THERMOSTAT HOUSING INSTALLATION



1. Remove all old FIPG remaining on the thermostat housing and cylinder head.
2. Apply a 2.7 ± 0.3 mm diameter bead of FIPG on the indicated surface of the thermostat housing.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

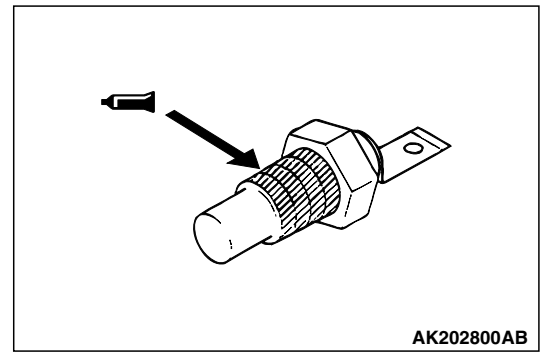
>>C<< WATER OUTLET FITTING INSTALLATION



1. Remove all old FIPG remaining on the water outlet fitting and thermostat housing.
2. Apply a 2.7 ± 0.3 mm diameter bead of FIPG to the indicated surface of the water outlet fitting.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

>>D<< COOLANT TEMPERATURE GAUGE UNIT INSTALLATION

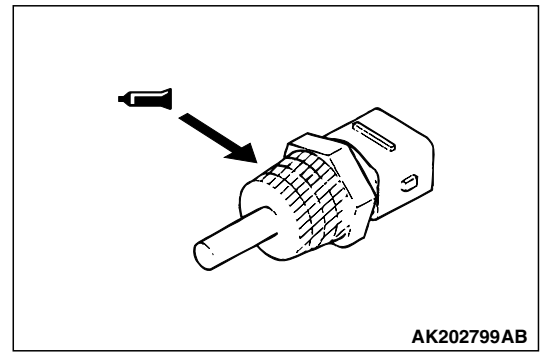


1. Remove all old sealant remaining on the threaded hole in the coolant temperature gauge unit and the thermostat housing.

   NOTE: A new coolant temperature gauge unit is coated with sealant. It does not require coating with sealant before installation.
2. Apply sealant to the indicated threads of the coolant temperature gauge unit.

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

>>E<< COOLANT TEMPERATURE SENSOR INSTALLATION



⚠ CAUTION
When using a tool, avoid letting it touch the connector portion which is made of plastic.

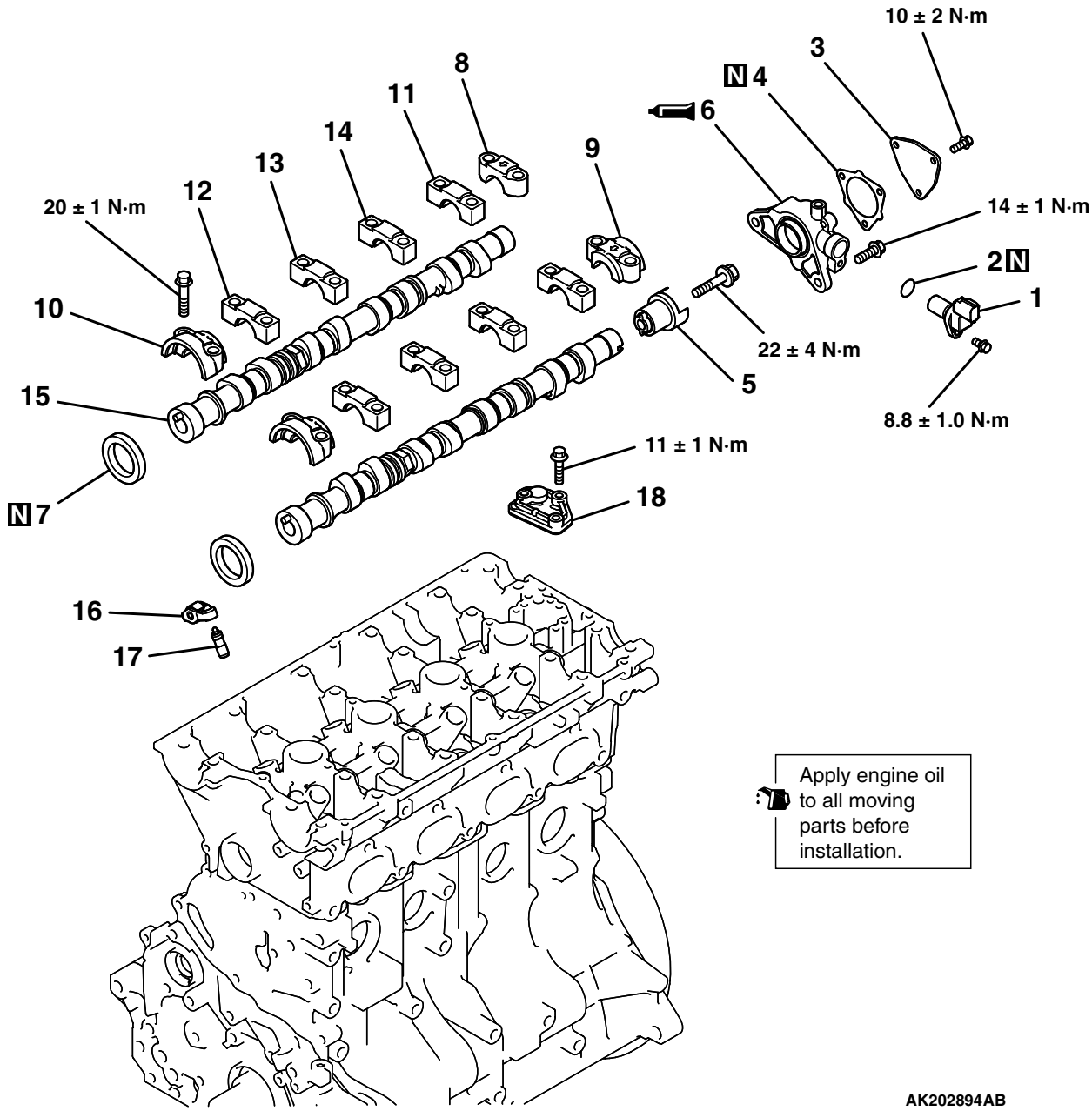
1. Remove all old sealant remaining on the threads of the coolant temperature sensor and in the threaded hole in the thermostat housing.
2. Apply sealant to the coolant temperature sensor's threads indicated in the drawing.

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

ROCKER ARMS AND CAMSHAFT

REMOVAL AND INSTALLATION

M1113005400455



Removal steps

1. Camshaft position sensor
2. O-ring
3. Cover
4. Gasket

>>F<< 5. Camshaft position sensing cylinder

>>E<< 6. Camshaft position sensor support

>>D<< 7. Camshaft oil seal

>>C<< 8. Bearing cap, rear right

>>C<< 9. Bearing cap, rear left

Removal steps (Continued)

>>C<< 10. Bearing cap, front

>>C<< 11. Bearing cap No.5

>>C<< 12. Bearing cap No.2

>>C<< 13. Bearing cap No.3

>>C<< 14. Bearing cap No.4

>>B<< 15. Camshaft

16. Rocker arm

<<A>> >>A<< 17. Lash adjuster

18. Oil delivery body

SERVICE POINTS FOR REMOVAL

<<A>> LASH ADJUSTER REMOVAL

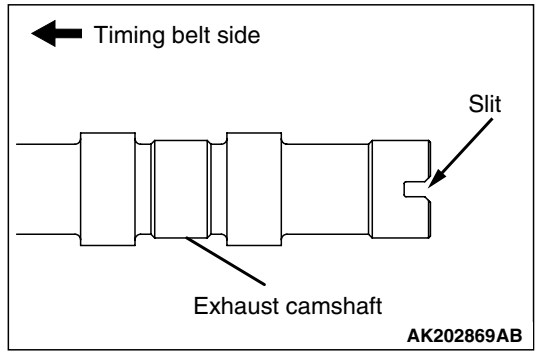
⚠ CAUTION
When reusing a lash adjuster, it must be washed and inspected before installation. (Refer to P.11B-33, the instruction under LASH ADJUSTER in the INSPECTION section.)

INSTALLATION SERVICE POINTS

>>A<< LASH ADJUSTER INSTALLATION

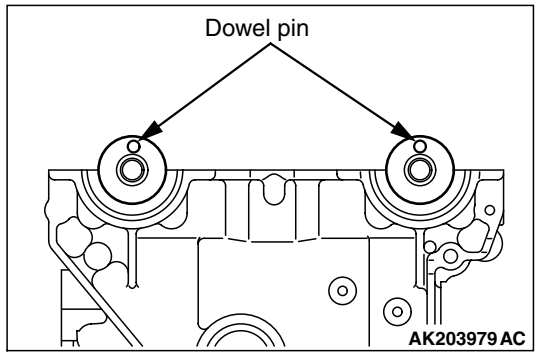
⚠ CAUTION
When reusing a lash adjuster, it must be washed and inspected before installation. (Refer to P.11B-33, the instruction under LASH ADJUSTER in the INSPECTION section.)
Install the lash adjuster into the rocker arm, being careful not to spill the diesel fuel it contains.

>>B<< CAMSHAFT INSTALLATION

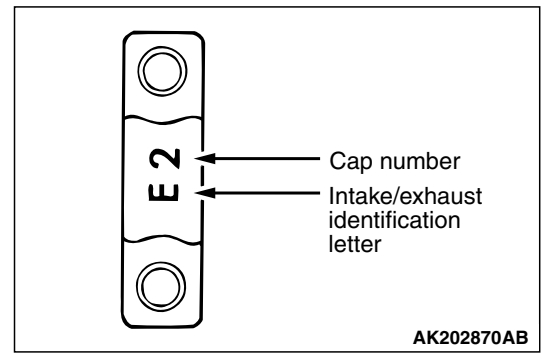


⚠ CAUTION
- **Do not confuse the intake camshaft with the exhaust camshaft.**
- **The exhaust camshaft has a 4 mm wide slit at the rear end.**

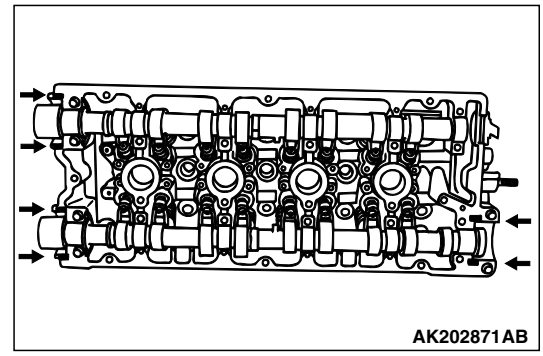
>>C<< BEARING CAP INSTALLATION



1. Set each camshaft with its dowel pin at the top.



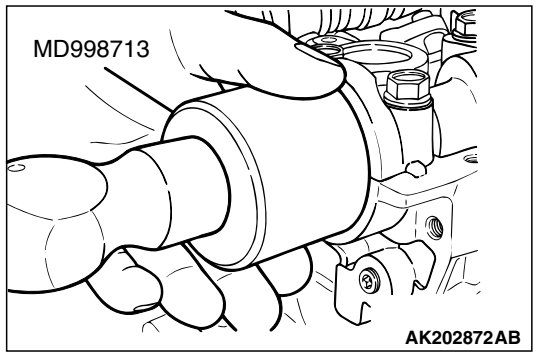
2. The bearing caps No. 2 to 5 are identical in shape for both intake and exhaust camshafts. Check the identification mark on each cap before installation.
   Identification mark (stamped on front and Nos. 2 – 5 bearing caps)
   I: intake camshaft
   E: exhaust camshaft
3. Remove completely sealant remaining on the bearing caps and cylinder head.



4. Apply sealant to the surfaces indicated in the drawing.
   Specified sealant:
   3M ATD No.8660 or equivalent
5. Install each bearing cap and tighten its bolts in two or three passes.
6. Finally tighten the bolts to 20 ± 1 N·m.
7. Check that the rocker arms are correctly installed.

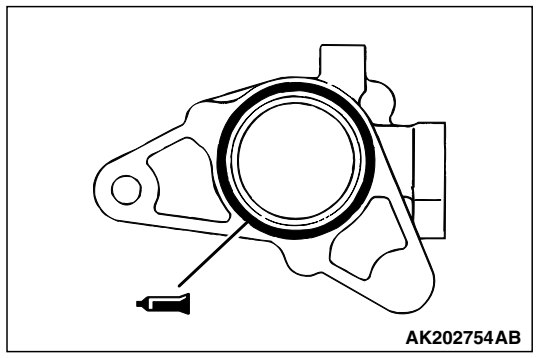
NOTE: Wipe off any squeezed out sealant completely.

>>D<< CAMSHAFT OIL SEAL INSTALLATION



Use the special tool Camshaft oil seal installer (MD998713) to drive each oil seal into position in the cylinder head.

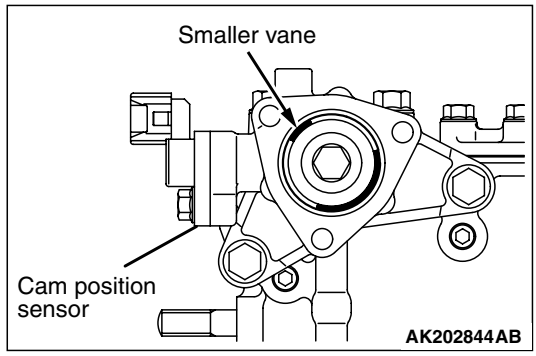
>>E<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION



1. Remove completely the FIPG remaining on the camshaft position sensor support and cylinder head.
2. Apply a 3 ± 1 mm diameter bead of FIPG to the indicated surface of the camshaft position sensor support.

Specified sealant:
Mitsubishi Genuine Part No.MD970389 or equivalent

>>F<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION



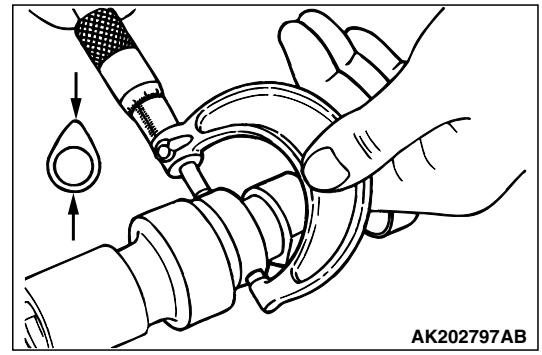
1. Turn the exhaust camshaft to the No.1 cylinder top dead center position.

   NOTE: The camshaft will slightly turn counter-clockwise by the force of the exhaust valve spring.
2. Install the camshaft position sensing cylinder with the smaller vane located as shown in the drawing.

INSPECTION

M1113005500388

CAMSHAFT



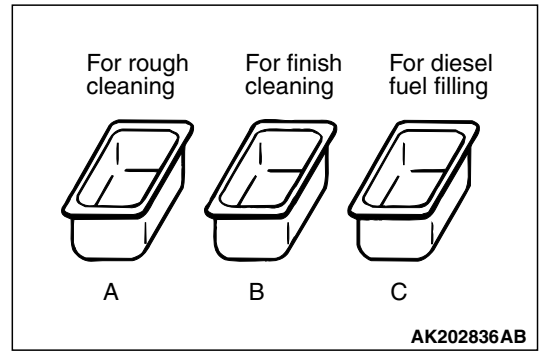
Measure the cam height (nose-to-heel diameter).
If any cam is worn beyond the limit, replace the camshaft.

Standard value: 34.91 mm
Limit: 34.41 mm

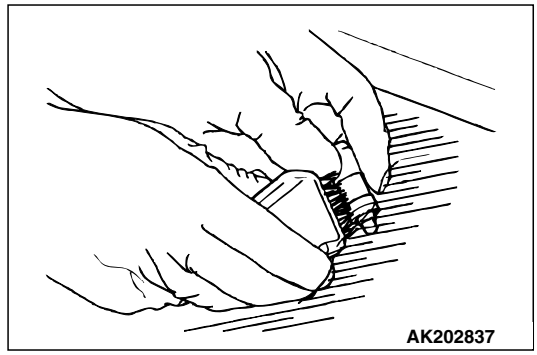
LASH ADJUSTERS

⚠ CAUTION

- **The lash adjuster is a precision-engineered component. Do not allow dust or other foreign matter to enter it.**
- **Do not disassemble lash adjusters.**
- **Use only non-contaminated diesel fuel to clean the lash adjuster.**

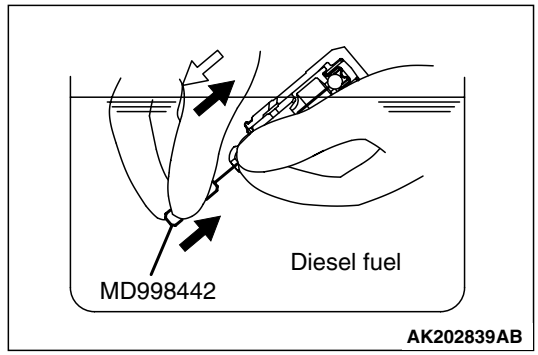


1. Prepare three containers and approximately five liters of diesel fuel. Pour into each container the diesel fuel in an amount enough for a lash adjuster placed in the container in its upright position to completely submerge.



2. Place the lash adjuster in container A and wash its outside surface.

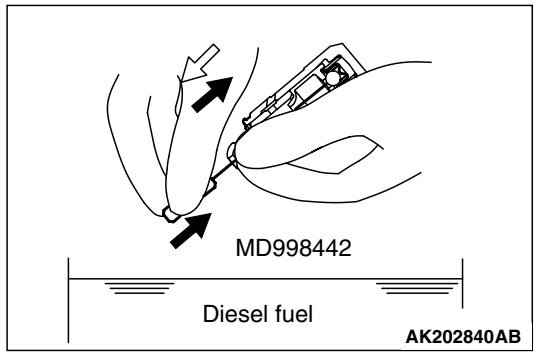
   NOTE: Use a nylon brush if there are hard-to-remove deposits.



⚠ CAUTION
The steel ball spring of the lash adjuster is extremely weak. The lash adjuster's functionality may be badly affected if the special tool is inserted too strongly.

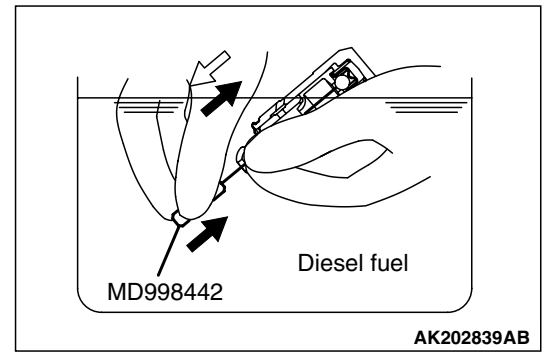
3. While gently pushing the internal steel ball using the special tool Air bleed wire (MD998442), move the plunger in and out 5 – 10 times to eliminate stiffness in the plunger and expel contaminated oil.

   NOTE: The plunger must be free from jamming and any other abnormalities. If a defect is found in plunger operation, replace the lash adjuster.



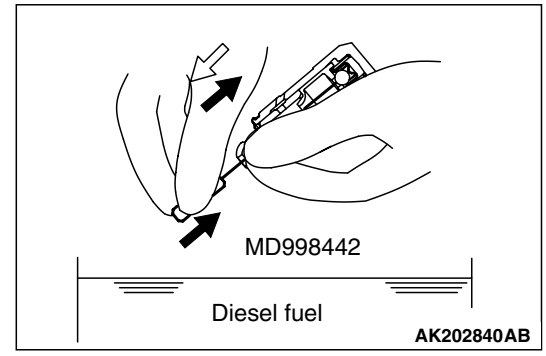
⚠ CAUTION
The hole in the side of the lash adjuster must be directed toward the inside of container A. Never direct it against any person.

4. Take the lash adjuster out of the container, then move the plunger by pushing the steel ball gently to discharge the diesel fuel from the pressure chamber.



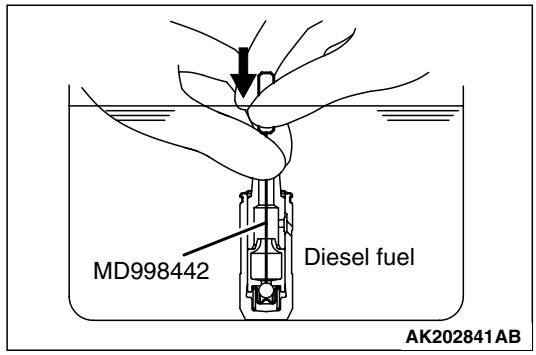
⚠ CAUTION
The steel ball spring of the lash adjuster is extremely weak. The lash adjuster's functionality may be badly affected if the special tool is inserted too strongly.

5. Soak the lash adjuster in the diesel fuel in container B. Move the plunger in and out 5 – 10 times by gently pushing the internal steel ball using the special tool Air bleed wire (MD998442) until the plunger moves smoothly to wash the lash adjuster's pressure chamber.



⚠ CAUTION
The hole in the side of the lash adjuster must be directed toward the inside of container B. Never direct it against any person.

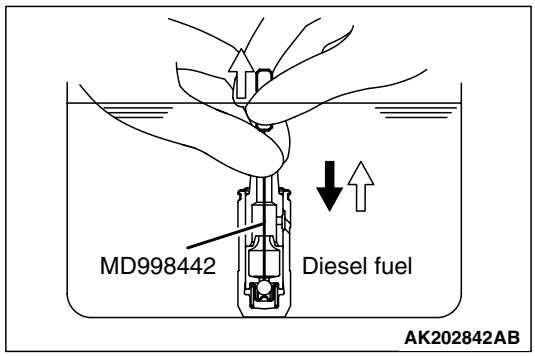
6. Take the lash adjuster out of the container, then move the plunger by pushing the steel ball gently to discharge the diesel fuel from the pressure chamber.



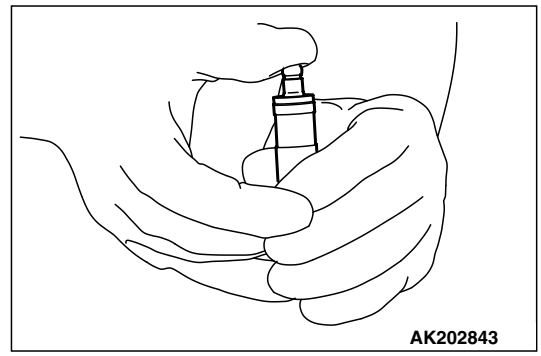
⚠ CAUTION

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

7. Soak the lash adjuster in the diesel fuel in container C. Gently push the internal steel ball using the special tool Air bleed wire (MD998442).



8. Place the lash adjuster upright with the plunger at the top. Push the plunger firmly until it makes a full stroke, then return the plunger slowly and release the hold of the steel ball to allow the pressure chamber to be filled with diesel fuel.



9. Take the lash adjuster out of the container, place it upright with the plunger at the top, and push the plunger firmly. The plunger must not move at all.

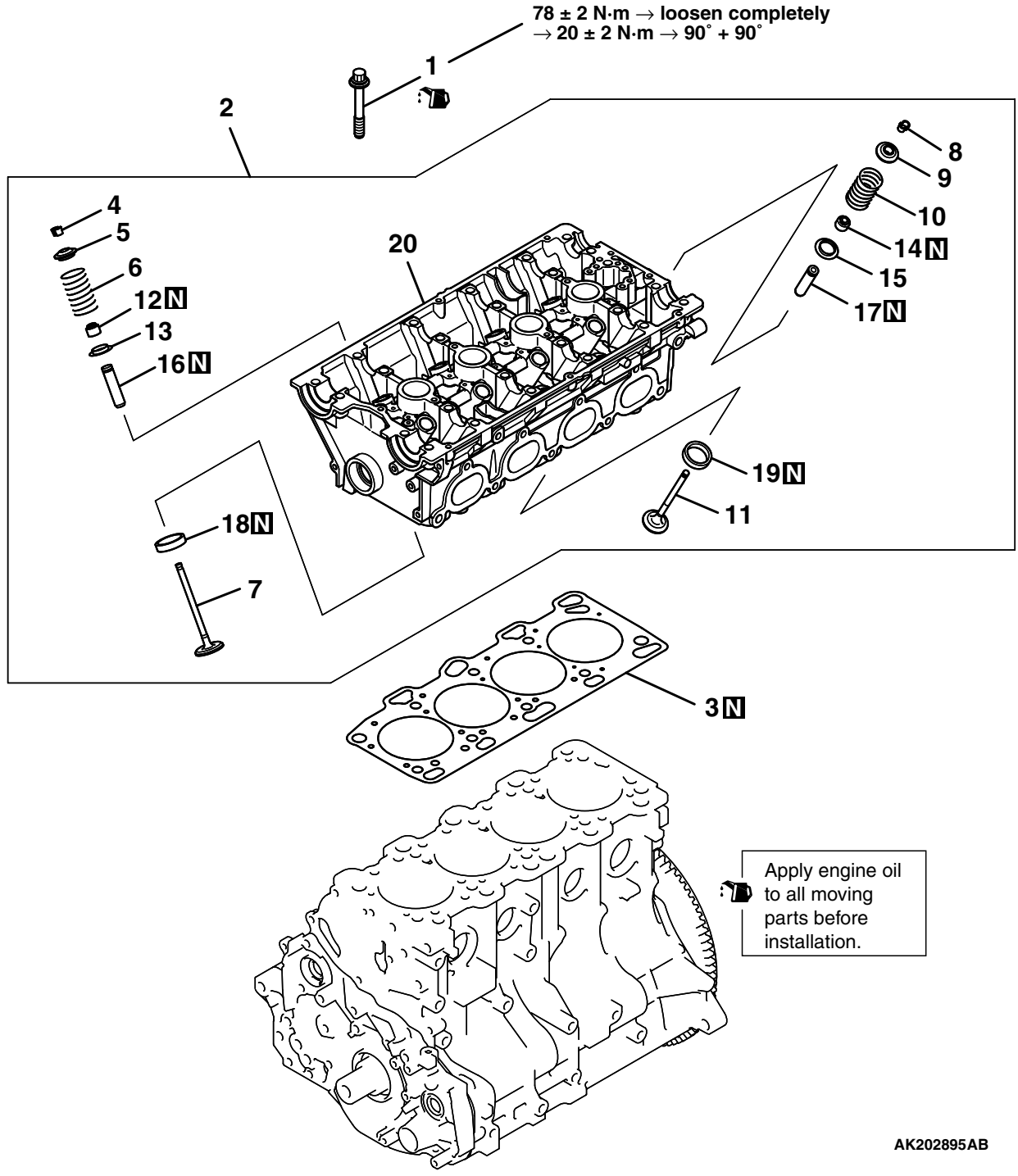
   NOTE: If the lash adjuster contracts, perform the operations 7. through 9. again. Replace the lash adjuster if it still contracts even after the pressure chamber has completely been filled with diesel fuel (air has been bled).

10. Keep the serviced lash adjusters in their upright positions to prevent diesel fuel from spilling out. Protect them from dust or other foreign matter. Install the lash adjusters onto the engine as soon as possible.

CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006900389



Removal steps

<<A>> >>D<< 1. Cylinder head bolt
2. Cylinder head assembly
3. Cylinder head gasket
<<B>> >>C<< 4. Retainer lock
5. Valve spring retainer
>>B<< 6. Valve spring

Removal steps (Continued)

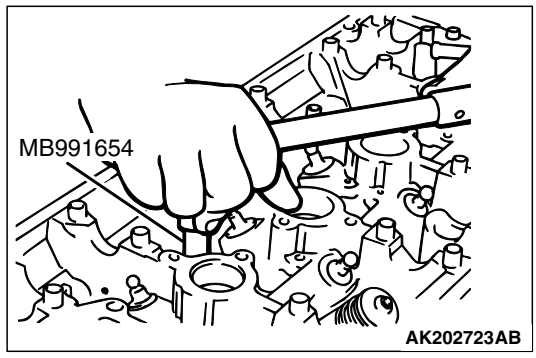
7. Intake valve
<<B>> >>C<< 8. Retainer lock
9. Valve spring retainer
>>B<< 10. Valve spring
11. Exhaust valve
>>A<< 12. Valve stem seal
13. Valve spring seat

Removal steps (Continued)

>>A<< 14. Valve stem seal
15. Valve spring seat
16. Intake valve guide
17. Exhaust valve guide
18. Intake valve seat
19. Exhaust valve seat
20. Cylinder head

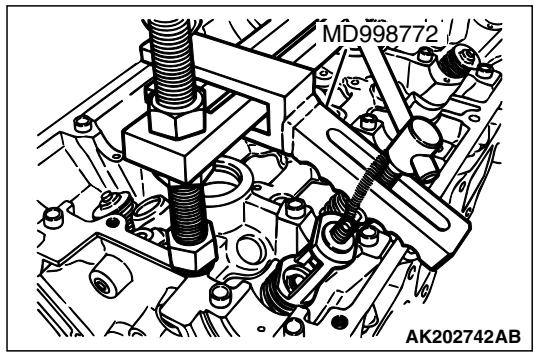
REMOVAL SERVICE POINTS

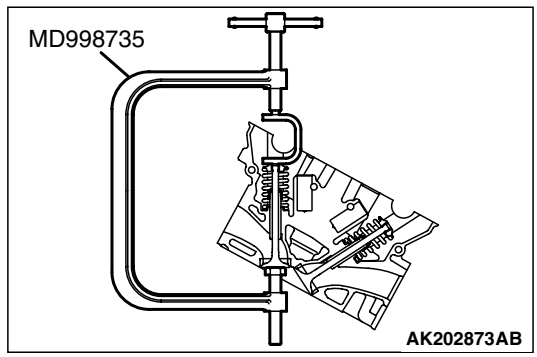
<<A>> CYLINDER HEAD BOLT REMOVAL



Use the special tool Cylinder head bolt wrench (MB991654) to loosen the cylinder head bolts.

<<B>> RETAINER LOCK REMOVAL



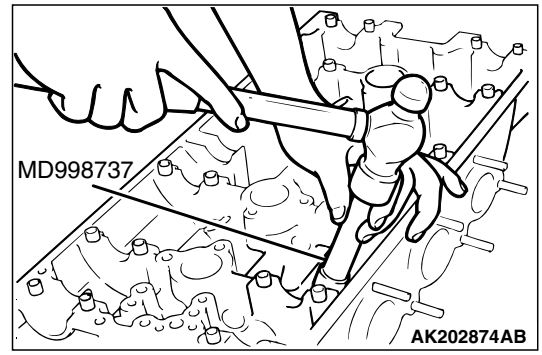


Compress the valve spring using the special tool Valve spring compressor (MD998772), then remove the retainer lock.

NOTE: Store removed valves, springs and other parts, after putting to each of them a tag that identifies its cylinder No. or installation location.

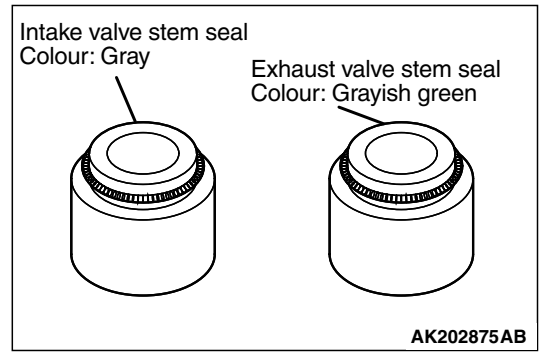
INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION



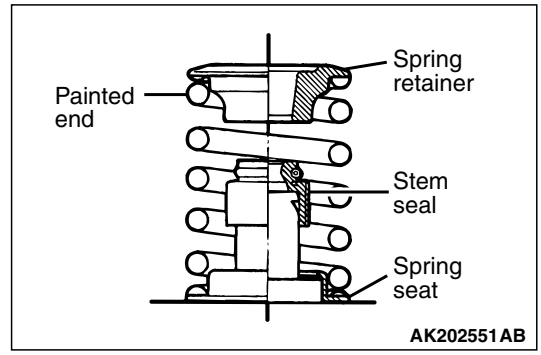
⚠ CAUTION
The special tool must always be used when installing the valve stem seal. Improper installation could result in oil leaks past the valve guide.

1. Install the valve spring seat.
2. Install the valve.
3. Apply a thin coat of engine oil to a new valve stem seal.
4. Use the special tool Valve stem seal installer (MD998737) to install the stem seal on the valve guide. Use the stem of the valve to guide the stem seal.



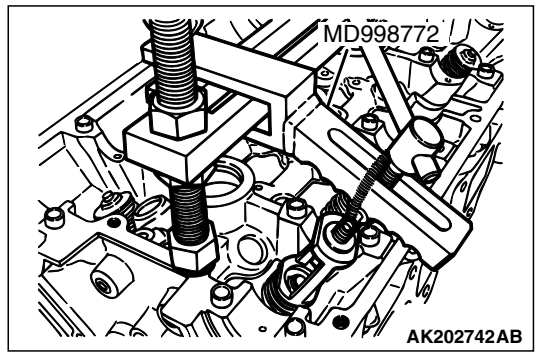
NOTE: Do not confuse the stem seals for intake valves with those for exhaust valves.

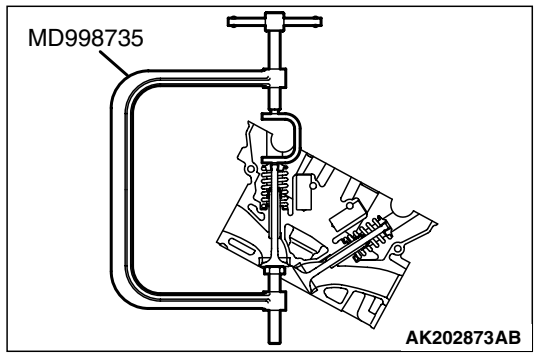
>>B<< VALVE SPRING INSTALLATION



Install each valve spring with the painted end toward the rocker arm.

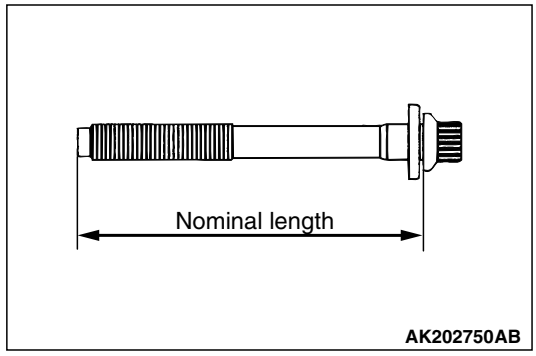
>>C<< RETAINER LOCK INSTALLATION

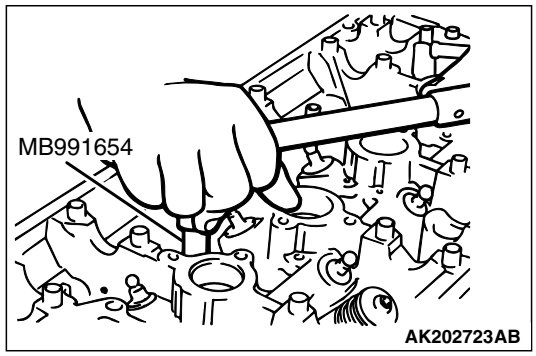




Compress the valve spring using the special tool Valve spring compressor (MD998772), then install the retainer lock.

>>D<< CYLINDER HEAD BOLT INSTALLATION



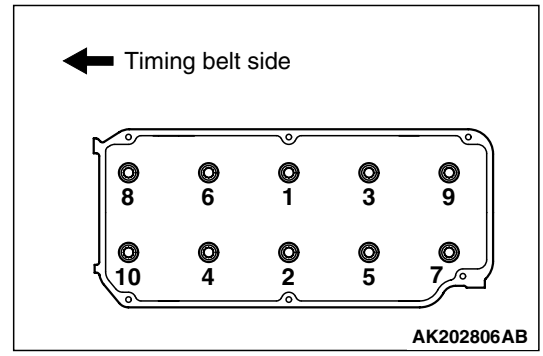


1. When reusing a cylinder head bolt, check that its nominal length (shank length) is not greater than the limit. If the limit is exceeded, replace the bolt.

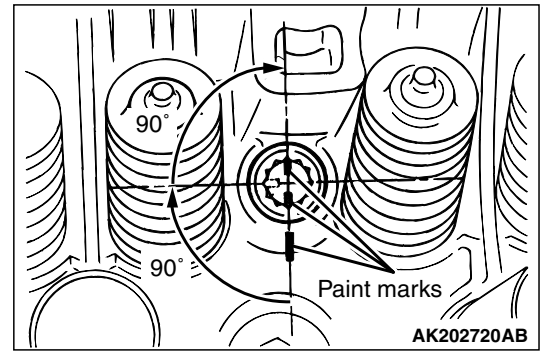
   Limit: 99.4 mm

2. Apply engine oil to the threads and washer of the bolt.

   NOTE: Use the special tool Cylinder head bolt wrench (MB991654) to tighten the bolts.



3. Tighten the bolts to 78 ± 2 N·m in the indicated sequence.
4. Loosen all the bolts completely.
5. Tighten the bolts again to a torque of 20 ± 2 N·m in the indicated sequence.



⚠ CAUTION

- **If the tightening angle is smaller than 90°, proper fastening performance could not be assured. Be sure to respect that angle.**
- **If the bolt is tightened to an angle greater than the specified angle, loosen the bolt completely and then retighten it beginning with the first step.**

6. Make paint marks on each bolt's head and on the cylinder head.
7. Turn the bolts 90° in the tightening direction and in the indicated sequence.
8. Give another 90° turn in the tightening direction to each bolt, making sure that the paint mark on the bolt head and that on the cylinder head are on the same line.

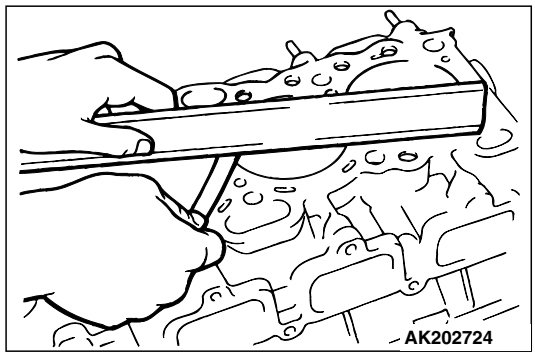
INSPECTION

M1113007000378

CYLINDER HEAD

1. Before cleaning the cylinder head, check it for traces of water and gas leakage and for cracks and any other damage.

2. Thoroughly remove oils, scale, sealants, carbon and other contamination. Clean the oil passages, then check using compressed air that they are not blocked.



⚠ CAUTION
The thickness of the metal that can be removed by grinding from both the cylinder head and the mating cylinder block is limited to 0.2 mm in total.

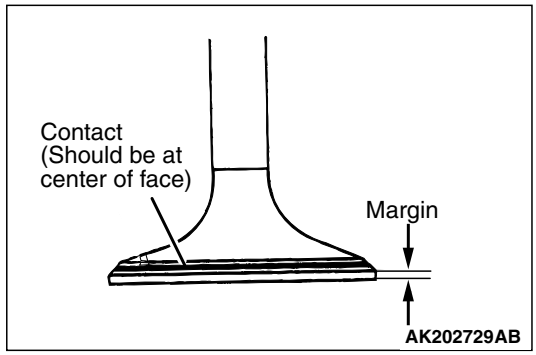
3. Check the cylinder head gasket surface for warp using a straightedge and thickness gauge.

   If the surface is warped beyond the limit, grind the surface for rectification.

   Gasket surface warp
   Standard value: Less than 0.05 mm
   Limit: 0.2 mm
   Grinding limit: 0.2 mm
   Cylinder head height (standard value for new part):
   131.9 – 132.1 mm

VALVES

1. Check the valve face for correct contact with the seat. Reface the valve if the contact is partial or one sided.

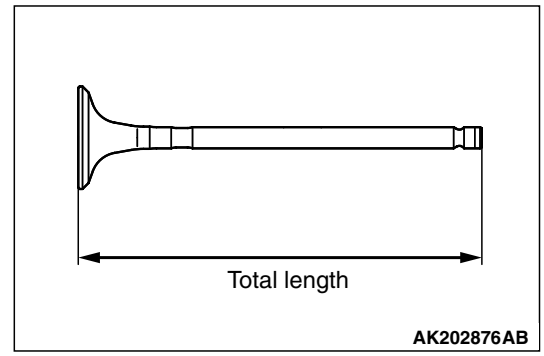


2. Measure the margin.

   Replace the valve if its margin is smaller than the limit.

   Standard values:
   Intake 1.0 mm
   Exhaust 1.5 mm

   Limits:
   Intake 0.5 mm
   Exhaust 1.0 mm



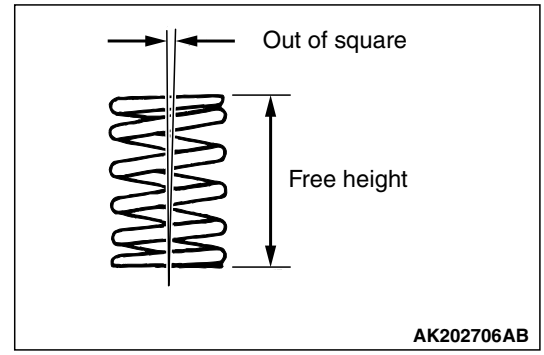
3. Measure the total length of the valve.

   Replace the valve if the length is less than the limit.

   Standard values:
   Intake 109.50 mm
   Exhaust 109.70 mm

   Limits:
   Intake 109.00 mm
   Exhaust 109.20 mm

VALVE SPRINGS



1. Measure the free height of the spring.

   Replace the spring if its height is smaller than the limit.

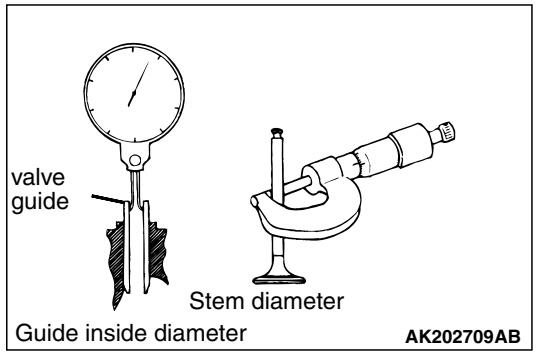
   Standard value: 47.0 mm
   Limit: 46.0 mm

2. Measure the squareness of the spring.

   Replace the spring if it is out of square beyond the limit.

   Standard value: 1.5° or smaller
   Limit: 4°

VALVE GUIDE

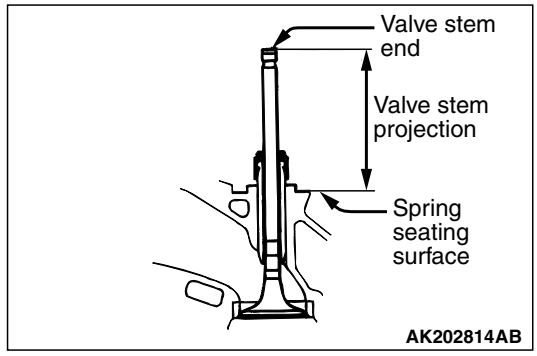


Measure the valve guide inside diameter and valve stem diameter to calculate the clearance between the valve guide and valve stem.
If the limit is exceeded, replace the valve guide or valve, or both.

Standard values:
Intake 0.02 – 0.05 mm
Exhaust 0.05 – 0.09 mm

Limits:
Intake 0.10 mm
Exhaust 0.15 mm

VALVE SEATS



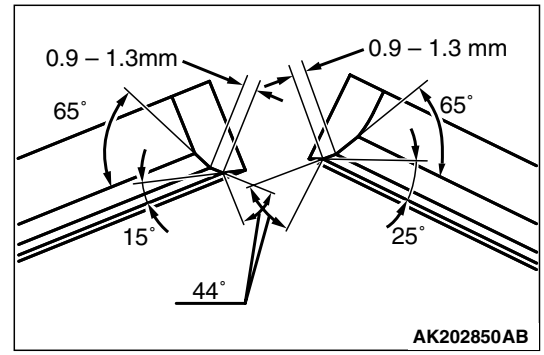
With the valve installed in position and its face pressed against the valve seat, measure the valve stem projection (distance between the the valve stem end and spring seating surface). If the measurement exceeds the limit, replace the valve seat.

Standard values:
Intake 49.20 mm
Exhaust 48.40 mm

Limits:
Intake 49.70 mm
Exhaust 48.90 mm

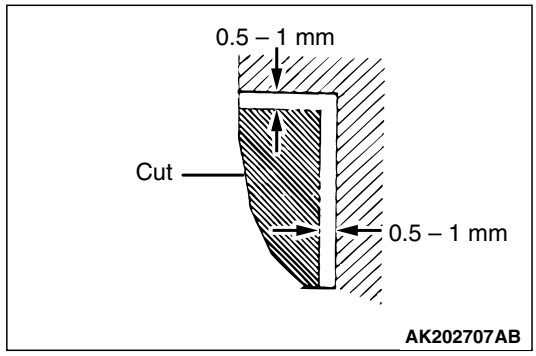
VALVE SEAT RECONDITIONING

1. Before reconditioning the valve seat, check the clearance between the valve guide and valve stem and, if necessary, replace the valve guide.

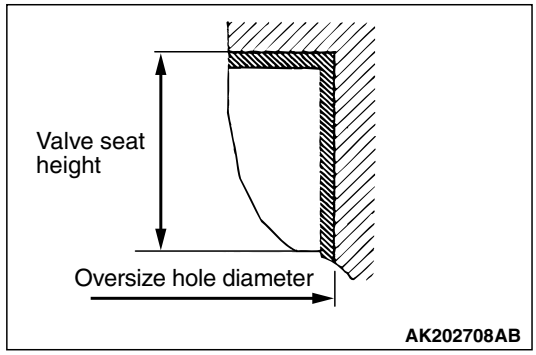


2. Resurface the valve seat to the indicated width and angles.
3. After resurfacing, lap the valve and valve seat using lapping compound.

VALVE SEAT REPLACEMENT



1. Cut inside of the valve seat to be replaced until its wall becomes thin enough for removal, then remove the valve seat.



2. Rebore the valve seat hole in the cylinder head to a diameter matched to the diameter of the selected oversize valve seat.

   Intake valve seat hole diameters:
   0.3 oversize: 35.30 – 35.33 mm
   0.6 oversize: 35.60 – 35.63 mm

   Exhaust valve seat hole diameters:
   0.3 oversize: 33.30 – 33.33 mm
   0.6 oversize: 33.60 – 33.63 mm

3. Before fitting the valve seat, cool it in liquid nitrogen to prevent damage to its hole in the cylinder head due to interference.
4. Resurface the valve seat. See the VALVE SEAT RECONDITIONING section.

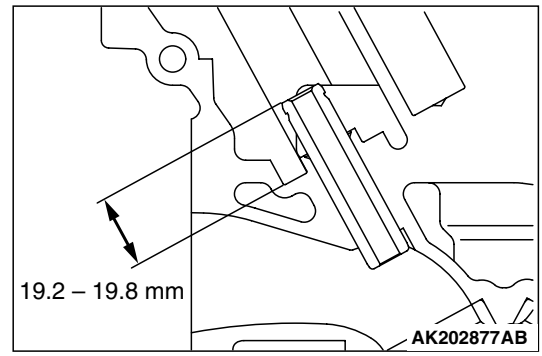
VALVE GUIDE REPLACEMENT

1. Force out the valve guide toward the cylinder block using a press.

⚠ CAUTION
Do not use a replacement valve guide of the same size as the removed one.

2. Machine the valve guide hole in the cylinder head to the size matched to the selected oversize valve guide.

   Valve guide hole diameters
   0.05 oversize: 12.05 – 12.07 mm
   0.25 oversize: 12.25 – 12.27 mm
   0.50 oversize: 12.50 – 12.52 mm



3. Press-fit the valve guide until it remains protruded above the cylinder head by the amount indicated in the drawing.

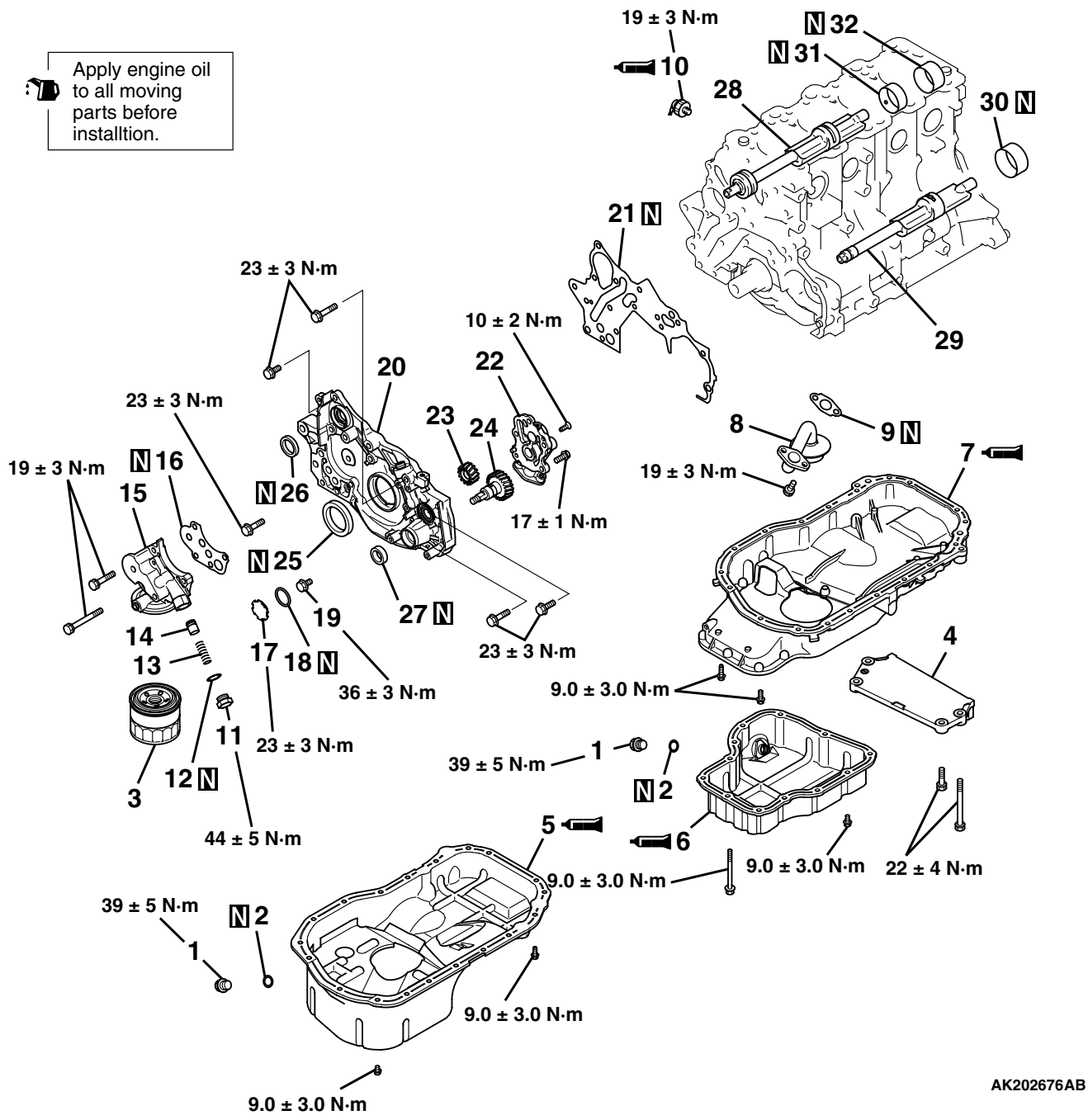
   NOTE:
   1. Press the valve guide from above the cylinder head.
   2. The valve guides for the intake valves are different in length from those for the exhaust valves (45.5 mm for intake valves; 50.5 mm for exhaust valves)

4. After installing the valve guide, insert a new valve in it to check for smooth movement.

OIL PAN AND OIL PUMP

REMOVAL AND INSTALLATION

M1113008100301



Removal steps

1. Drain plug
- >>O<< 2. Drain plug gasket
- >>N<< 3. Oil filter
4. Transmission stay <4WD>
- <<A>> >>M<< 5. Oil pan <2WD>
- <<B>> >>L<< 6. Oil pan lower section <4WD>
- <<C>> >>L<< 7. Oil pan upper section <4WD>
8. Oil screen
9. Gasket
10. Oil pressure switch

Removal steps (Continued)

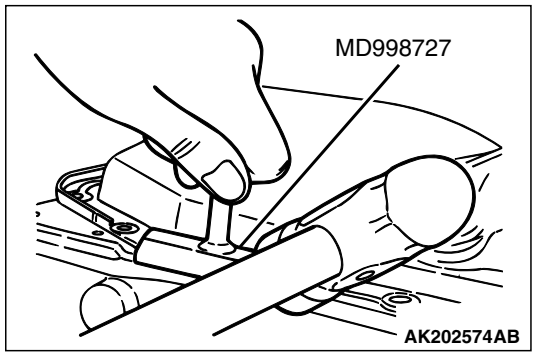
- >>K<< 11. Relief plug
12. Gasket
13. Relief spring
14. Relief plunger
15. Oil filter bracket
16. Gasket
- <<D>> >>J<< 17. Plug
18. O-ring
- <<E>> >>I<< 19. Flange bolt
- >>H<< 20. Front case

Removal steps (Continued)

21. Gasket
22. Oil pump cover
>>G<< 23. Oil pump driven gear
>>G<< 24. Oil pump drive gear
>>F<< 25. Crankshaft front oil seal
>>E<< 26. Counterbalancer shaft oil seal
>>D<< 27. Oil pump oil seal
28. Counterbalancer shaft, right
29. Counterbalancer shaft, left
<<F>> >>C<< 30. Counterbalancer shaft front bearing
<<G>> >>B<< 31. Counterbalancer shaft rear bearing, right
<<G>> >>A<< 32. Counterbalancer shaft rear bearing, left

REMOVAL SERVICE POINTS

<<A>> OIL PAN REMOVAL <2WD>



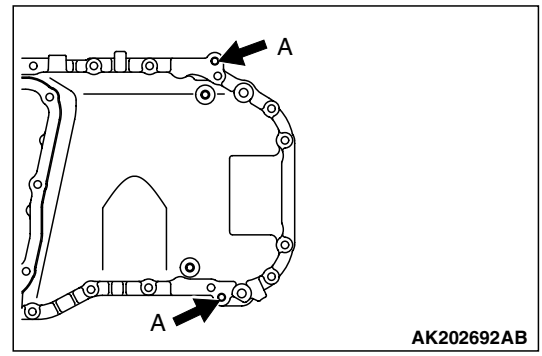
1. Remove the oil pan bolts.
2. Insert the special tool Oil pen remover (MD998727) into the joint between the cylinder block and oil pan by tapping the tool with a hammer.
3. Remove the oil pan by tapping an edge of the special tool Oil pen remover (MD998727) with a hammer to move it sideways.

<<B>> OIL PAN LOWER SECTION REMOVAL <4WD>

Remove the oil pan by tapping it through a piece of wood applied to a side with a plastic hammer.

⚠ CAUTION
Do not use a scraper or the special tool to remove the oil pan.

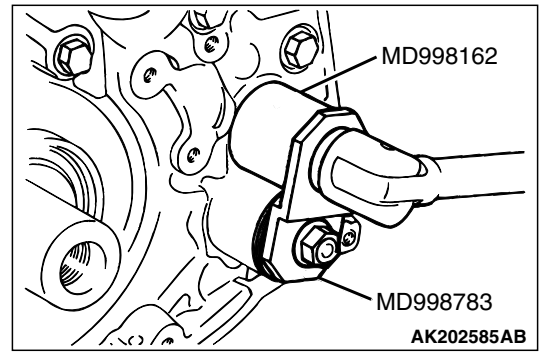
<<C>> OIL PAN UPPER SECTION REMOVAL <4WD>



Screw bolts into the bolt holes A shown in the drawing (holes at both ends) to remove the oil pan.

⚠ CAUTION
Do not use a scraper or the special tool to remove the oil pan.

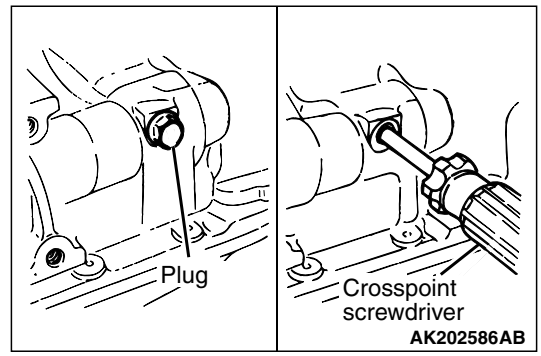
<<D>> PLUG REMOVAL



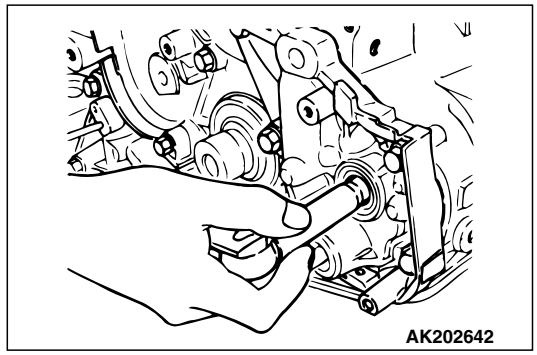
Fit the teeth of the special tool in notches of the plug as shown in the drawing and support the tool with the special tool to loosen the plug.

- Plug wrench (MD998162)
- Plug wrench retainer (MD998783)

<<E>> FLANGE BOLT REMOVAL

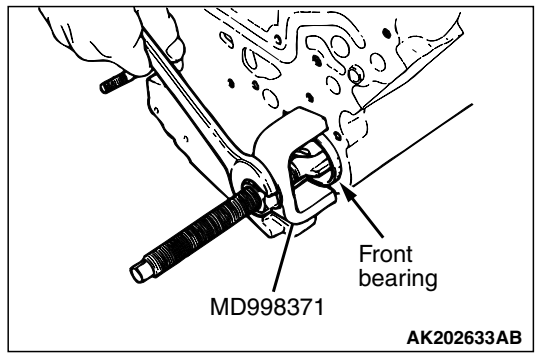


1. Remove the plug on the left side of the cylinder block. Insert a cross point screwdriver (shank diameter 8 mm) into the plug hole more than 60 mm to prevent the left counterbalancer shaft from rotating.


AK202642

2. Loosen and remove the flange bolt.

<<F>> COUNTERBALANCER SHAFT FRONT BEARING REMOVAL



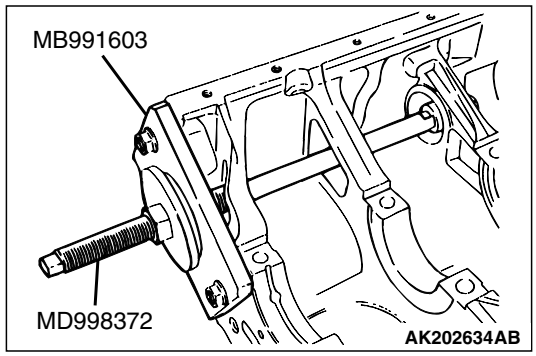
AK202633AB

⚠ CAUTION
Remove the front bearing first. Otherwise, the special tool cannot be used.

Use the special tool Silent shaft bearing puller (MD998371) to remove the counterbalancer shaft front bearing from the cylinder block.

<<G>> COUNTERBALANCER SHAFT REAR BEARING REMOVAL

1. Use the special tool Silent shaft bearing puller (MD998371) to remove the counterbalancer shaft rear bearings from the cylinder block.

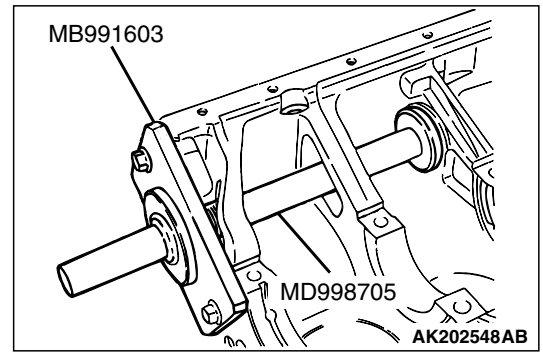


AK202634AB

2. When removing the rear bearing of the left counterbalancer shaft, install the special tool Silent shaft bearing installer stopper (MB991603) on the front of the cylinder block and use a special tool Silent shaft bearing puller (MD998372) to pull out the bearing.

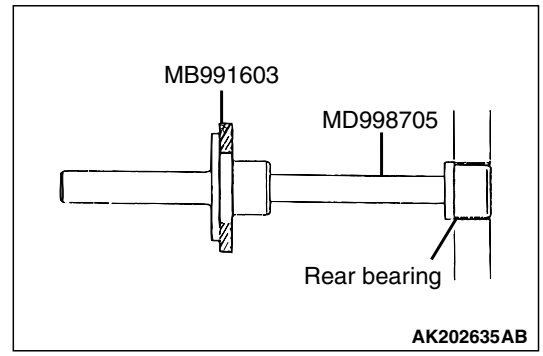
INSTALLATION SERVICE POINTS

>>A<< LEFT COUNTERBALANCER SHAFT REAR BEARING INSTALLATION



AK202548AB

1. Install the special tool Silent shaft bearing installer stopper (MB991603) on the cylinder block.



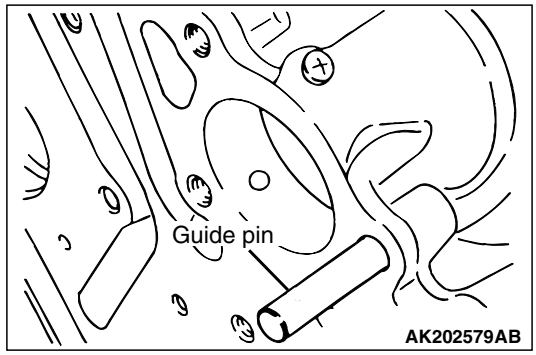
AK202635AB

2. Set the rear bearing on the special tool Silent shaft bearing installer (MD998705).

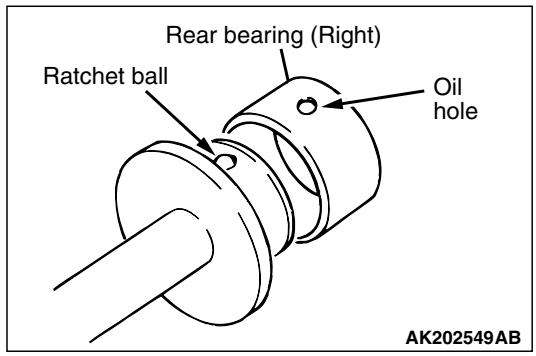
   NOTE: The left counterbalancer shaft rear bearing has no oil hole.

3. Force the rear bearing into the cylinder block by sticking the special tool.

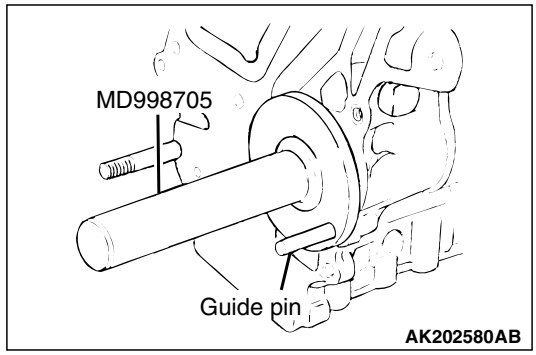
>>B<< RIGHT COUNTERBALANCER SHAFT REAR BEARING INSTALLATION



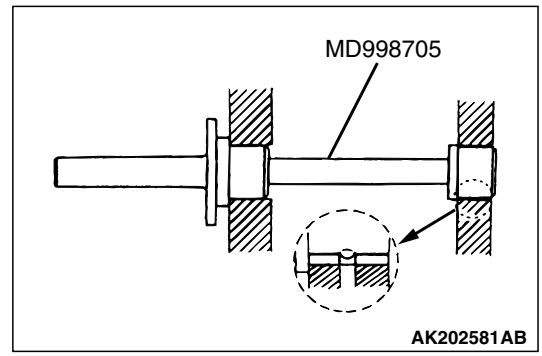
1. Install the guide pin on the cylinder block.



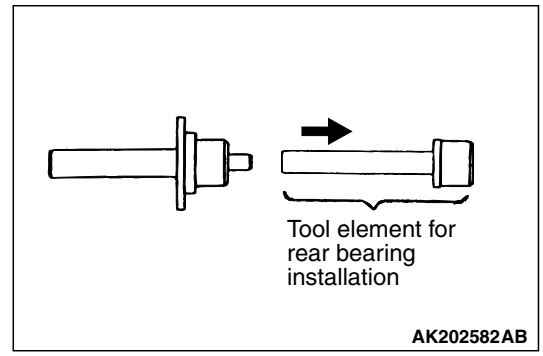
2. Set the bearing on the special tool Silent shaft bearing installer (MD998705) with its oil hole on the ratchet ball.



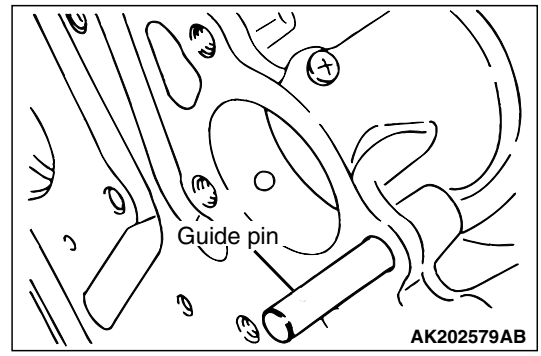
3. Insert the special tool Silent shaft bearing installer (MD998705) while passing the guide pin through its hole and force the bearing into position by striking the tool.



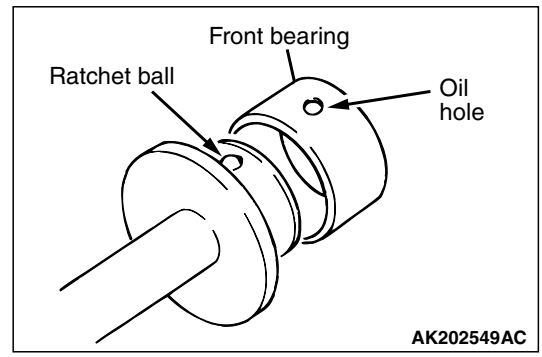
>>C<< COUNTERBALANCER SHAFT FRONT BEARING INSTALLATION



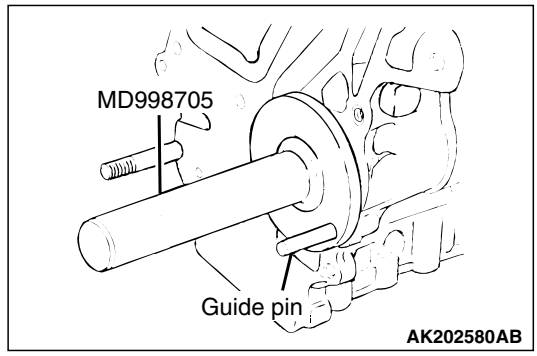
1. Detach from the special tool Silent shaft bearing installer (MD998705) its element for rear bearing installation.



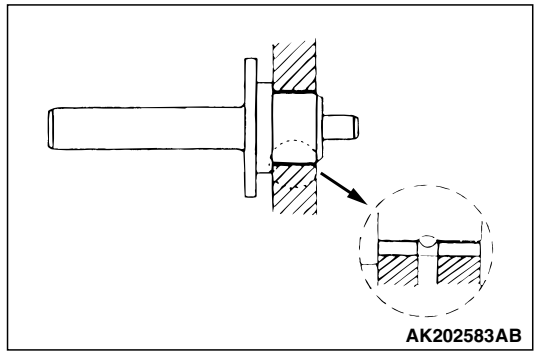
2. Install the guide pin on the cylinder block.



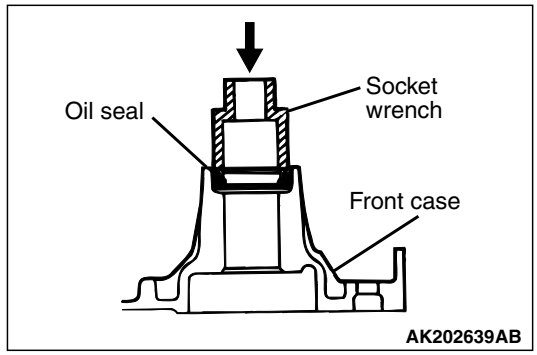
3. Set the bearing on the special tool Silent shaft bearing installer (MD998705) with its oil hole on the ratchet ball.



4. Insert the special tool Silent shaft bearing installer (MD998705) into the cylinder block while passing the guide pin through its hole and force the bearing into position by striking the tool.

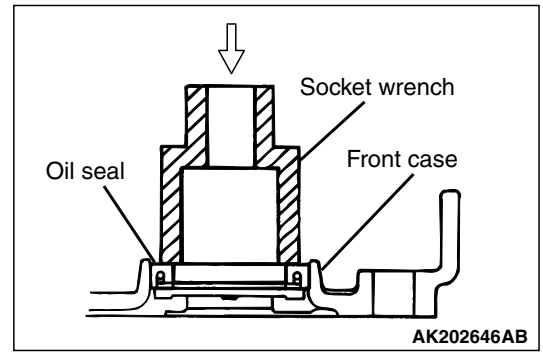


>>D<< OIL PUMP OIL SEAL INSTALLATION



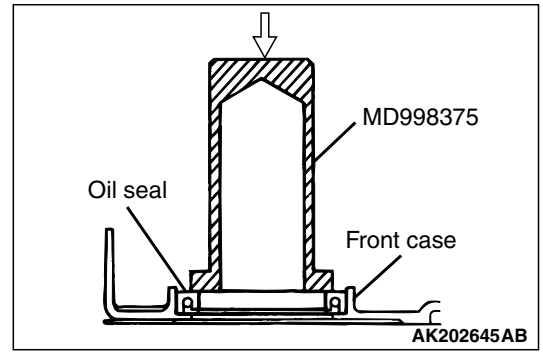
Use an appropriate socket wrench to install the oil pump oil seal.

>>E<< COUNTERBALANCER SHAFT OIL SEAL INSTALLATION



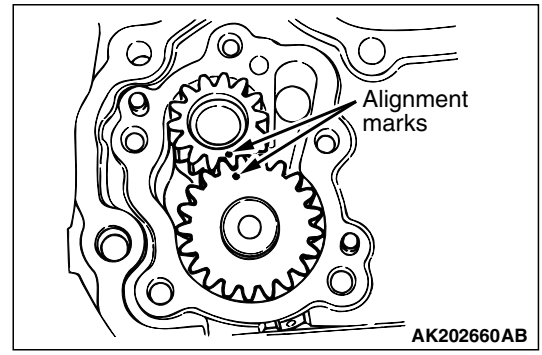
Use an appropriate socket wrench to install the counterbalancer shaft oil seal.

>>F<< CRANKSHAFT OIL SEAL INSTALLATION



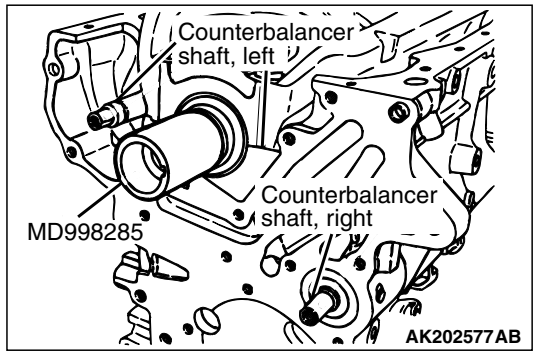
Use the special tool Crankshaft front oil seal installer (MD998375) to install the crankshaft oil seal.

>>G<< OIL PUMP DRIVEN GEAR/OIL PUMP DRIVE GEAR INSTALLATION

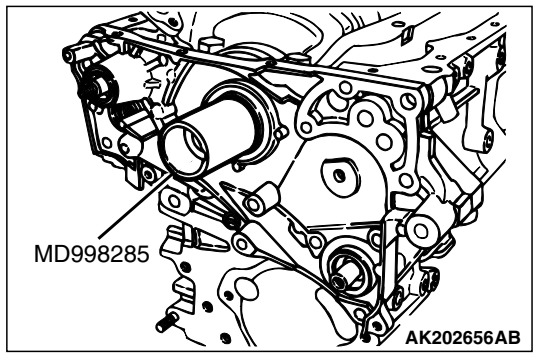


Apply engine oil generously to the gears and line up the alignment marks.

>>H<< FRONT CASE INSTALLATION

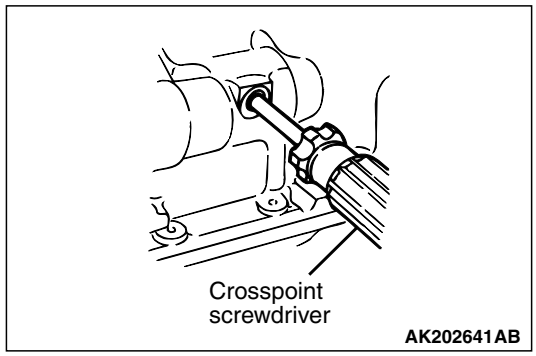


1. Install the special tool crankshaft front oil seal guide (MD998258) on the front end of crankshaft and apply a thin coat of engine oil to the outer surface of the special tool. Be sure to use the special tool when the front case is fitted with an oil seal.
2. Install the front case on the cylinder block with a new front case gasket in between and temporarily tighten all the flange bolts except those that are used for tightening the filter bracket.
3. Install the oil filter bracket on the front case with the oil filter bracket gasket in between and temporarily tighten the washer-assembled bolts.

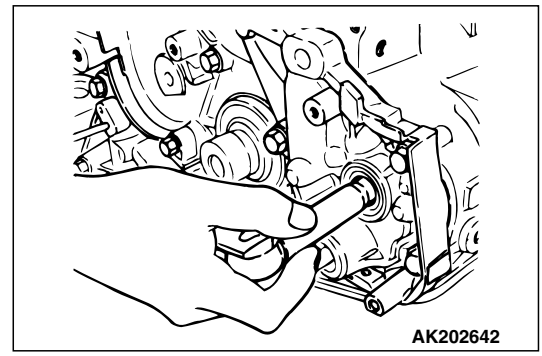


4. Tighten all the bolts to the specified torques.

>>I<< FLANGE BOLT INSTALLATION



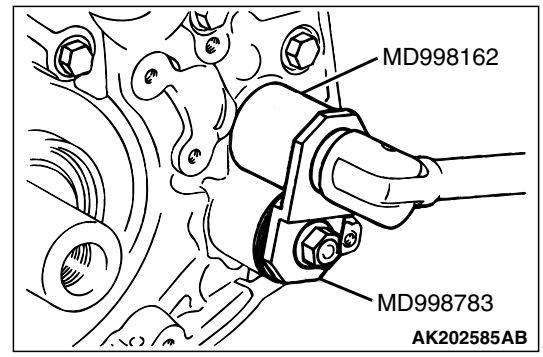
1. Insert a correspond screwdriver (shank diameter 8 mm) into the hole in the left side of the cylinder block to prevent the counterbalancer shaft from rotating.



2. Tighten the flange bolts.

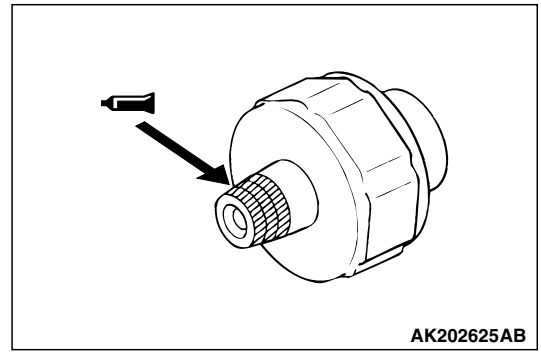
>>J<< PLUG INSTALLATION

1. Install a new O-ring on the front case.



2. Use the special tool to tighten the plug to the specified torque.
   - Plug wrench (MD998162)
   - Plug wrench retainer (MD998783)

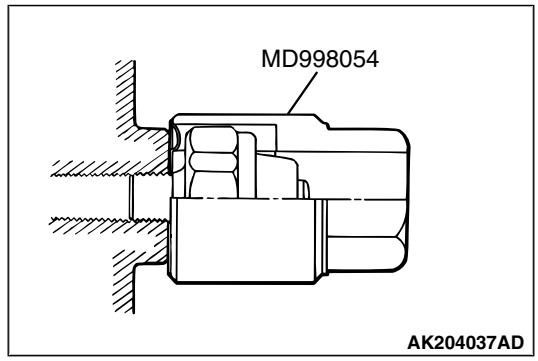
>>K<< OIL PRESSURE SWITCH INSTALLATION



⚠ CAUTION
Be careful not to block the oil passage with sealant.

1. Apply sealant to the threaded portion.

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



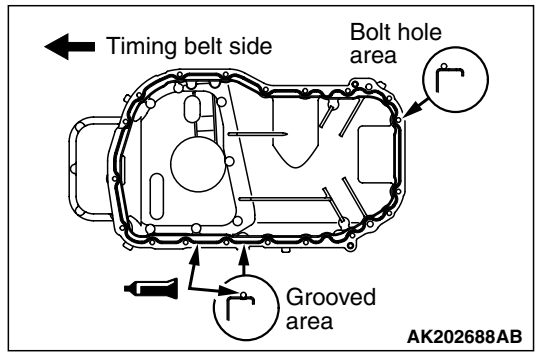
2. Tighten the oil pressure switch together with the cylinder block by the specified torque using of the special tool Oil pressure switch wrench MD998054.

   Tightening torque: 19 ± 3 N·m

>>L<< OIL PAN UPPER SECTION/OIL PAN LOWER SECTION INSTALLATION <4WD>

⚠ CAUTION
Do not apply FIPG over remaining old FIPG. Doing so could result in oil leakage.

1. Clean the gasket surfaces of the cylinder block and oil pan.

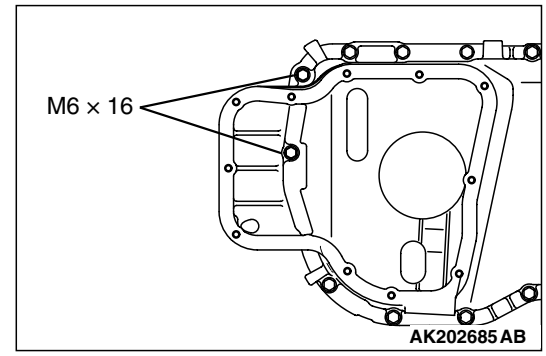


⚠ CAUTION
Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

2. Apply a 4 mm diameter bead of FIPG to the flange surface all around the oil pan.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

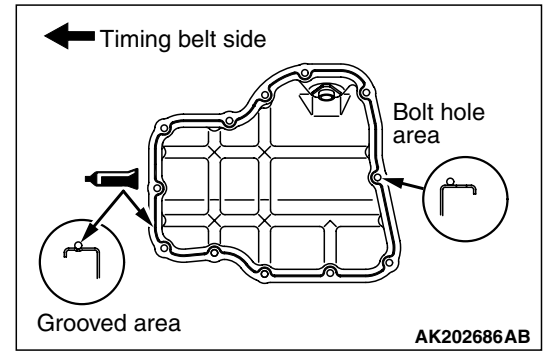
   NOTE: In the grooved areas on the oil pan flange, apply FIPG bead along the center of the groove.



3. Install the shorter bolts in the locations indicated in the drawing.

⚠ CAUTION
Do not apply FIPG over remaining old FIPG. Doing so could result in oil leakage.

4. Thoroughly remove old FIPG from the gasket surfaces of the oil pan upper and lower sections.

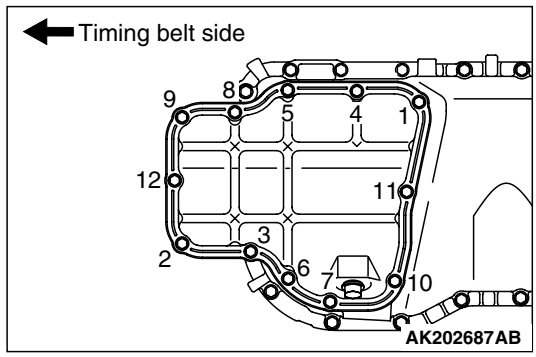


⚠ CAUTION
Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

5. Apply a 4 mm diameter bead of FIPG to the flange surface all around the oil pan.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

   NOTE: In the grooved areas on the oil pan flange, apply FIPG bead along the center of the groove.

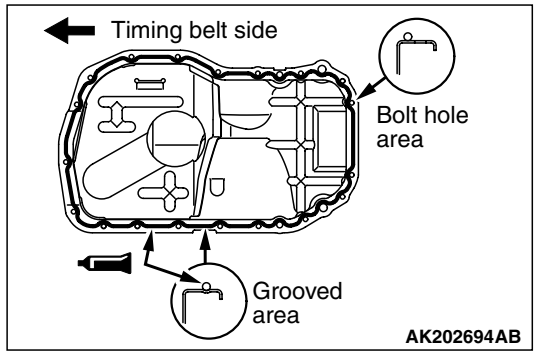


6. Install the oil pan lower section by tightening the bolts in the indicated sequence.

>>M<< OIL PAN INSTALLATION <2WD>

⚠ CAUTION
Do not apply FIPG over remaining old FIPG. Doing so could result in oil leakage.

1. Thoroughly remove old FIPG from the gasket surfaces of the cylinder block and oil pan.

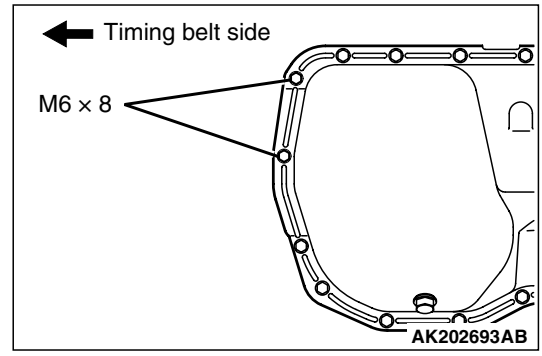


⚠ CAUTION
Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

2. Apply a 4 mm diameter bead of FIPG to the flange surface all around the oil pan.

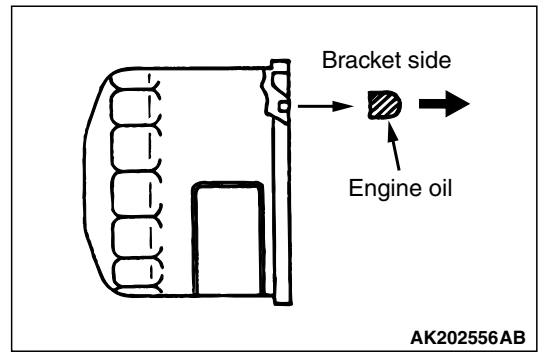
   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

   NOTE: In the grooved areas on the oil pan flange, apply FIPG bead along the center of the groove.



3. Install the shorter bolts in the locations indicated in the drawing.

>>N<< OIL FILTER INSTALLATION

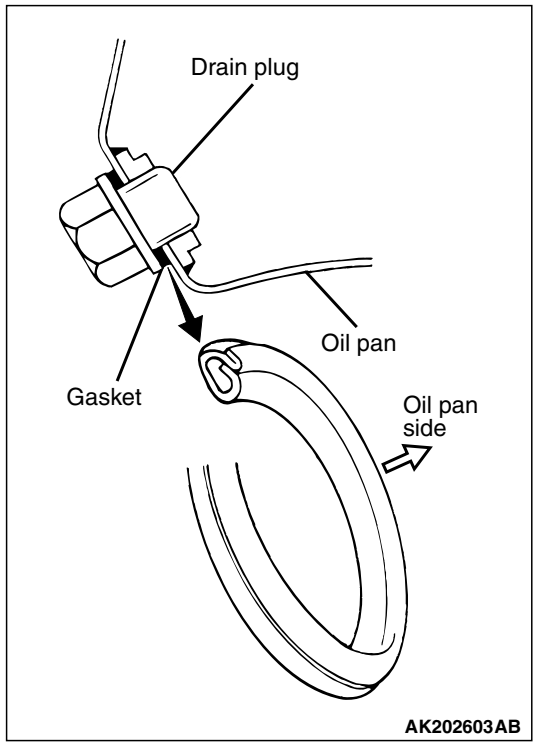


1. Clean the installation surface of the filter bracket.
2. Apply engine oil to the o-ring of the oil filter.
3. Install the oil filter to the bracket and tighten it to the specified torque.

   Tightening torque: 14 ± 2 N·m

4. If no torque wrench can be used for tightening, use the following procedure:
   (1) Screw in the oil filter until its o-ring contacts the oil filter bracket.
   (2) Tighten the oil filter 3/4 turn.

>>O<< DRAIN PLUG GASKET INSTALLATION



⚠ CAUTION

Installing the gasket with the wrong side facing the oil pan will result in oil leakage.

Replace the drain plug gasket with a new one. Install it with the side indicated in the drawing toward the oil pan.

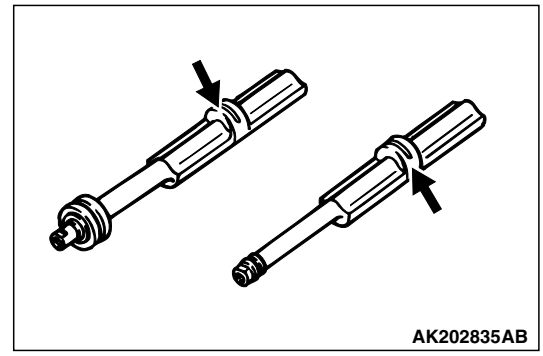
INSPECTION

M1113008200212

COUNTERBALANCE SHAFTS

1. Check that the oil holes are not blocked.

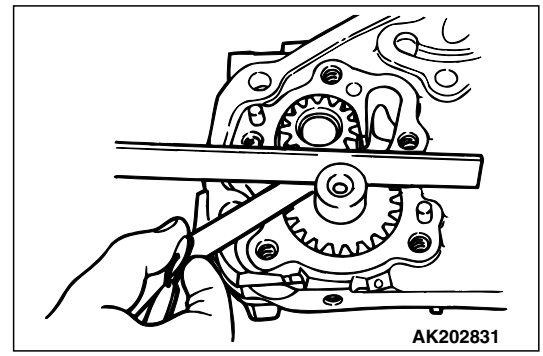
   Clean if necessary.



2. Check the journals for seizure, damage and defective contact with bearings.

   If any of these faults is found, replace the counterbalance shaft, bearings and/or oil pump case assembly.

OIL PUMP



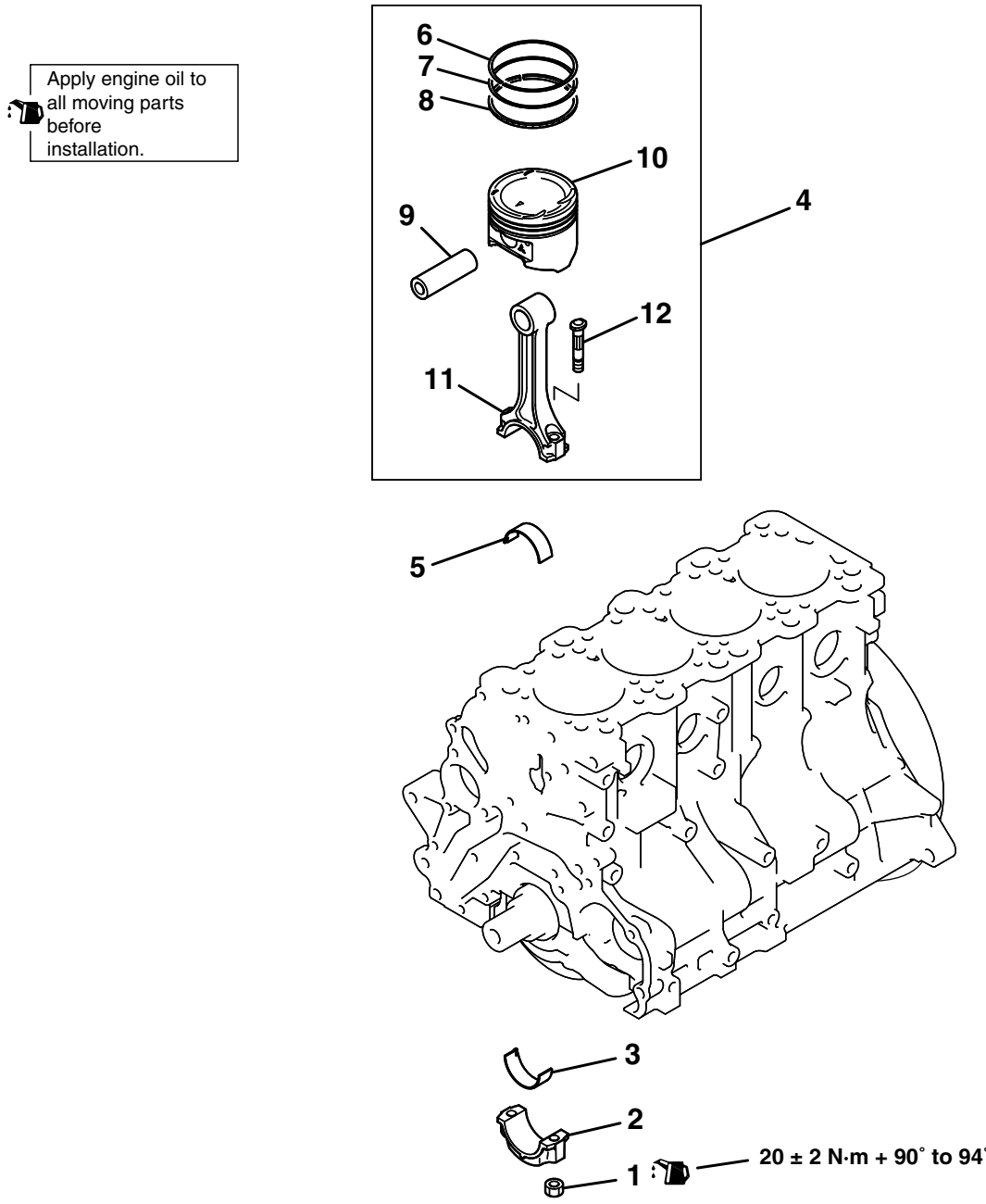
1. Install the drive and driven gears in the oil pump case.
2. Measure the gear side clearance using a straight edge and thickness gauge.

   Standard values:
   Drive gear 0.08 – 0.14 mm
   Driven gear 0.06 – 0.12 mm

PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008400528



AK202896AB

Removal steps

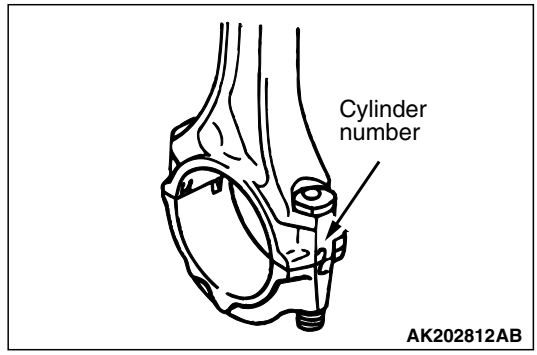
- >>G<< 1. Connecting rod cap nut
- <<A>> >>F<< 2. Connecting rod cap
- >>E<< 3. Connecting rod bearing
- >>D<< 4. Piston and connecting rod assembly
- 5. Connecting rod bearing
- >>C<< 6. Piston ring No. 1

Removal steps (Continued)

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

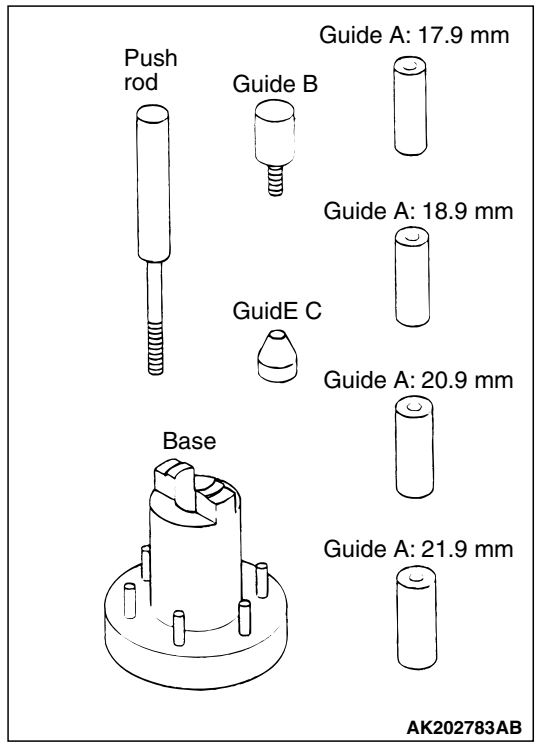
REMOVAL SERVICE POINTS

<<A>> CONNECTING ROD CAP REMOVAL

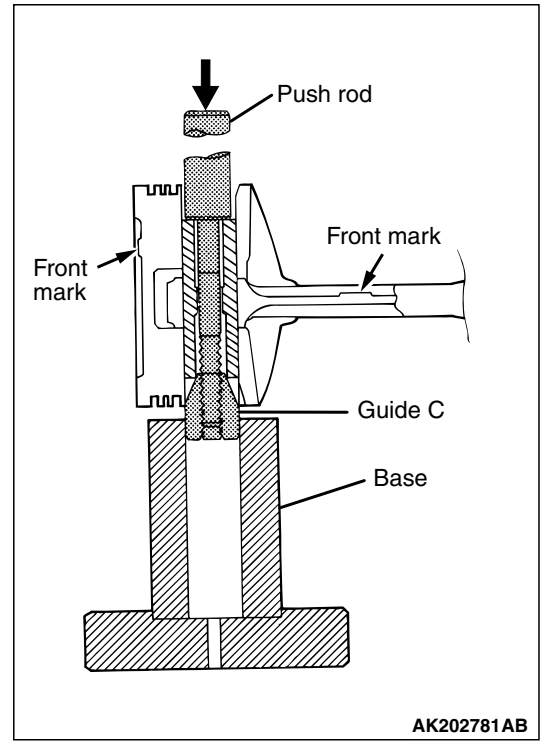


Mark the cylinder number on the side of the connecting rod big end as a guide for reassembly.

<<B>> PISTON PIN REMOVAL



The special tool Piston pin setting tool (MD998780), consists of the elements shown in the drawing.

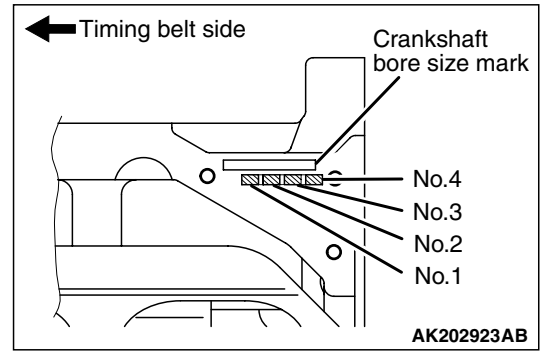


1. Insert the tool element, Push rod, into the piston from the front mark side, then attach the element, Guide C, to the push rod.
2. Place the piston and connecting rod assembly on the element, Base, with the front mark facing up.
3. Use a press to remove the piston pin.

   NOTE: Keep the disassembled pistons, piston pins and connecting rods cylinder by cylinder.

INSTALLATION SERVICE POINTS

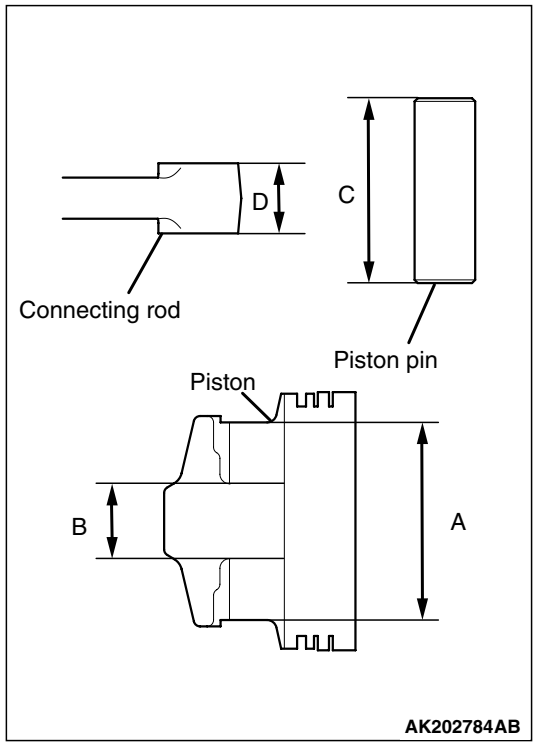
>>A<< PISTON PIN INSTALLATION



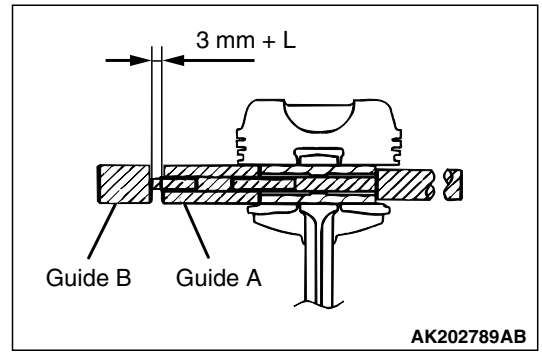
1. When replacing a piston, check the cylinder bore size mark stamped at the indicated location on the cylinder block and select an appropriate replacement piston using the following table.

Cylinder bore size mark	Piston size mark
I	A
II	No mark
III	C

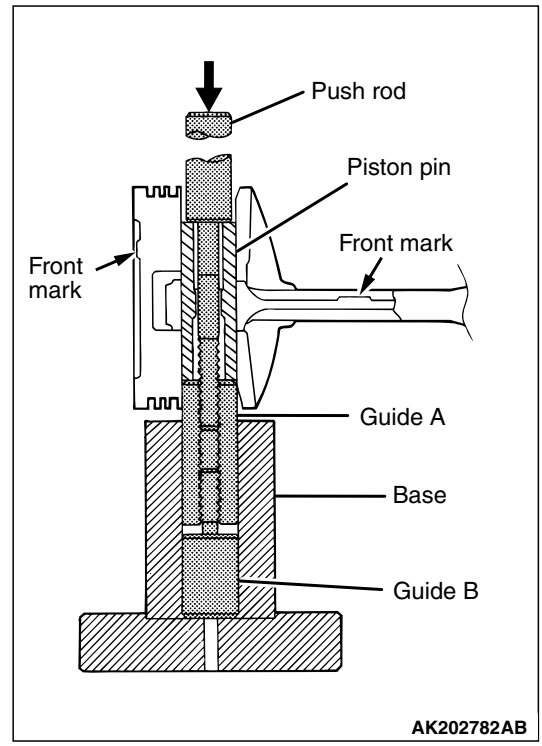
NOTE: The piston size mark is located on the piston top surface.



2. Measure the following dimensions:
   A: Piston pin insertion hole length
   B: Distance between piston bosses
   C: Piston pin length
   D: Connecting rod small end width
3. Obtain dimension L from the measurements using the following formula.
   L = [(A-C) − (B-D)] ÷ 2
4. Insert the tool element, Push rod, into the piston pin and attach the element, Guide A, to the push rod end.
5. Assemble the connecting rod with the piston with their front marks facing in the same direction.
6. Apply engine oil to the outside surface of the piston pin.
7. Insert the assembly of piston pin, Push rod, and Guide A (put together in step 4.) into the piston holes from the front mark side.



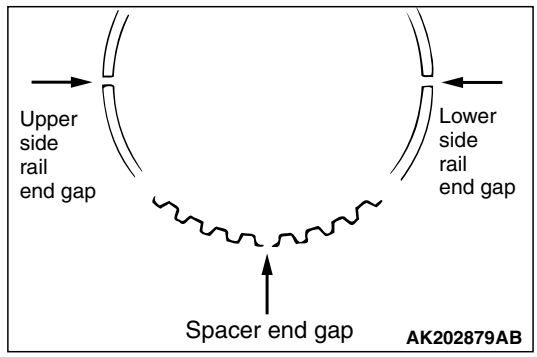
8. Screw the tool element, Guide B, into the tool element, Guide A until the gap between both the elements is equal to the dimension L (obtained in step 3.) plus 3 mm.



9. Place the piston and connecting rod assembly onto the element, Piston setting base, with the front marks facing up.
10. Install the piston pin using a press. If the required press force is less than the standard value, replace the piston and piston pin assembly or the connecting rod, or both.

Standard value: 7,350 − 17,100 N

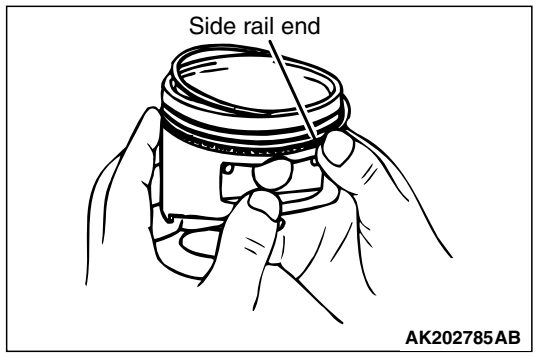
>>B<< OIL RING INSTALLATION



1. Fit the oil ring spacer into the piston ring groove. Install the upper side rail, then the lower side rail.
   NOTE:
   1. Locate the side rail and spacer end gaps as shown in the drawing.
   2. New spacers and side rails are an identified by color marks as follows:

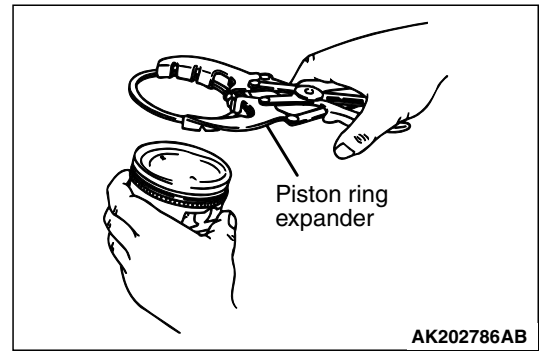
Size	Color mark
Standard	Non mark
0.50 mm oversize	Blue
1.00 mm oversize	Yellow

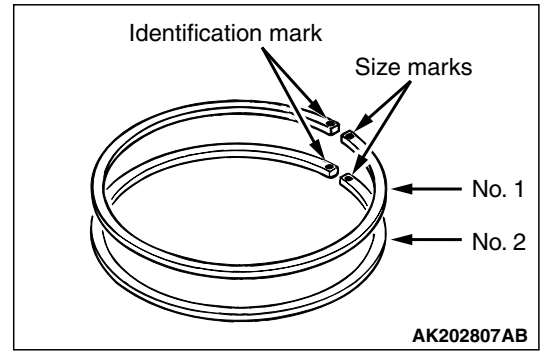
⚠ CAUTION
Use of ring expander to expand the side rail end gap can break the side rail, unlike other piston rings.



2. To install each side rail, first fit one end of the rail into the piston groove, then press the remaining portion progressively into position by finger as shown in the drawing.
3. Make sure that the installed side rails move smoothly in either direction.

>>C<< PISTON RING NO. 2/PISTON RING NO. 1 INSTALLATION





Using a piston ring expander, install the piston rings with their identification marks facing up (toward the piston crown).

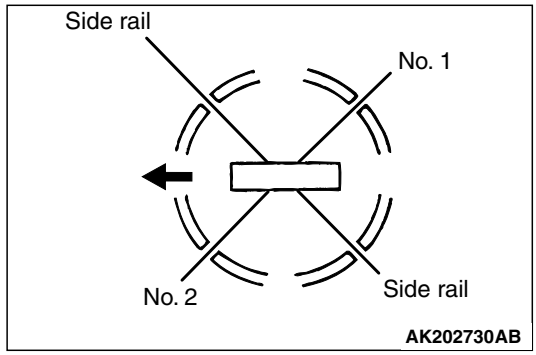
Identification marks:
No. 1 ring 1R
No. 2 ring 2R

NOTE: Each of the available piston rings has a size mark as follows:

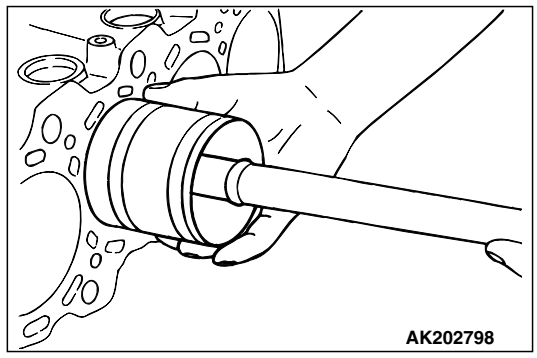
Size		Size mark
Standard	No. 1 ring	No mark (blue paint on periphery)
	No. 2 ring	No mark (green paint on periphery)
0.50 mm oversize		50
1.00 mm oversize		100

>>D<< PISTON AND CONNECTING ROD ASSEMBLY INSTALLATION

1. Apply engine oil generously to the piston's outside surface, piston rings, and oil ring.



2. Align the end gaps of the piston rings and oil ring (side rails and spacer) as shown in the drawing.
3. Insert the piston and connecting rod assembly from the top of cylinder with the front mark on the crown toward the camshaft sprocket.



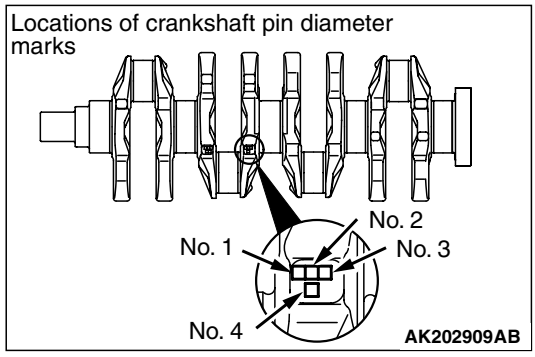
⚠ CAUTION

- **Do not strike the assembly with a large force. Doing so could break the piston rings.**
- **When striking the assembly into cylinder, do not allow it to interfere with the oil jet.**

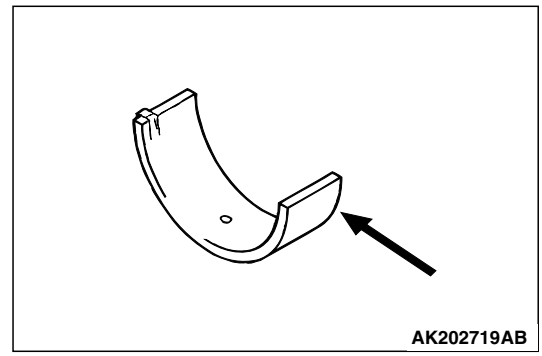
4. Use a piston ring band to hold the piston rings compressed when inserting the piston and connecting rod assembly into the cylinder.

>>E<< CONNECTING ROD BEARING INSTALLATION

1. When replacing the connecting rod bearing, select a bearing of the size appropriate for the crankshaft pin diameter in accordance with the crankshaft pin and connecting rod bearing matching table shown below.



2. Crankshaft pin diameter marks are stamped in the indicated locations.



3. Connecting rod bearing identification mark is stamped in the indicated location on each bearing.

Crankshaft pin		Connecting rod bearing
Identification mark	Diameter mm	Identification mark
I	44.995 – 45.000	1
II	44.985 – 44.995	2
III	44.980 – 44.985	3

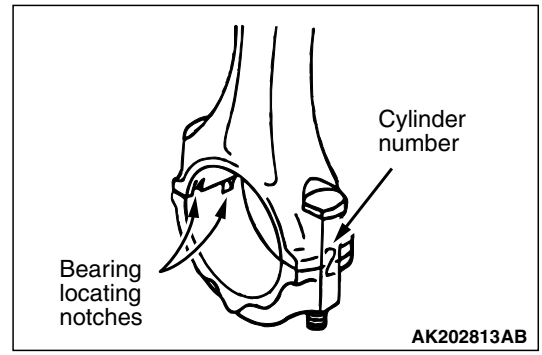
<Bearing selection example>

If the crankshaft pin diameter mark is “I”, select a bearing marked “1”.

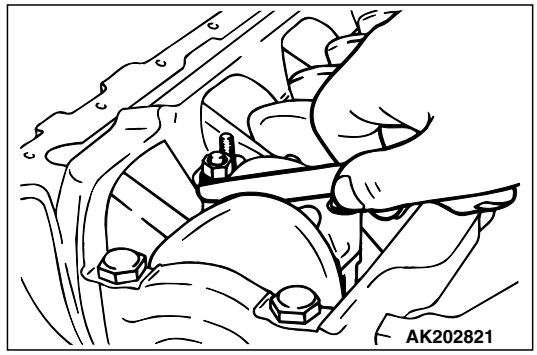
If the crankshaft pin diameter mark is illegible, measure the pin diameter and select a bearing with the mark corresponding to the measurement.

4. Install the upper and lower halves of the selected bearing on the connecting rod big end and cap, respectively.

>>F<< CONNECTING ROD CAP INSTALLATION



1. Install the bearing cap on the connecting rod while aligning the marks made during disassembly. If the connecting rod is new and has no alignment mark, assemble it with the cap such that the both bearing locating notches are on the same side as shown in the drawing.



2. Make sure that the thrust clearance of the connecting rod big end is proper.

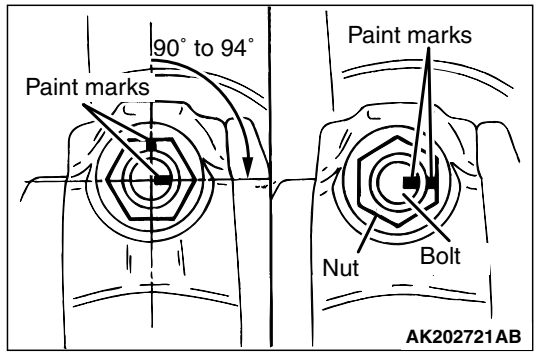
   Standard value: 0.10 – 0.25 mm

   Limit: 0.4 mm

>>G<< CONNECTING ROD CAP NUT INSTALLATION

1. The connecting rod cap bolts and nuts are tightened using the torque-to-yield method. For this reason, each bolt to be reused must be checked for elongation before installation.

   Whether or not the bolt has been elongated can be determined by running a nut with fingers through all the threads of the bolt. If the nut does not turn smoothly over all the threads, the bolt has been elongated and must be replaced.
2. Apply engine oil to the threads and bearing surface of each nut before installation.
3. Finger-tighten the nuts on the bolts, then tighten the nuts alternately and repeatedly to install the cap properly.
4. Tighten the nuts to a torque of 20 ± 2 N·m.



5. Make a paint mark on the head of each nut.
6. Make a paint mark on the bolt at a point 90°to 94° away from the paint mark made on the nut in the tightening direction.

⚠ CAUTION

- **If the tightening angle is less than 90°, adequate tightness could not be assured.**
- **If the tightening angle exceeds 94°, loosen the nut completely and then perform the tightening procedure again beginning with the first step.**

7. Turn the nut 90° to 94° to bring the mark on the nut into alignment with that on the bolt.

INSPECTION

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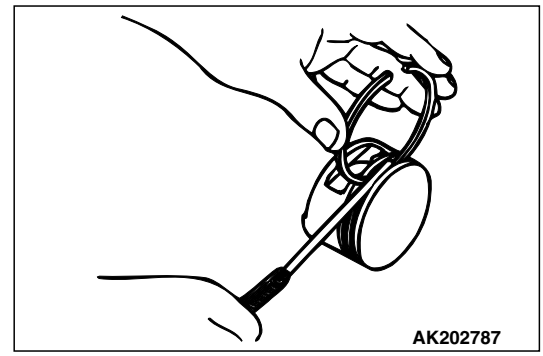
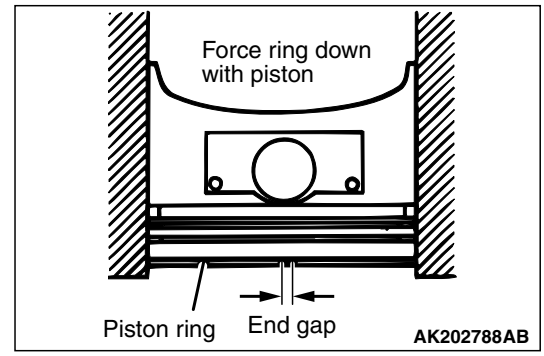
PISTON RING



1. Measure the clearance between each piston ring and its groove. If the limit is exceeded, replace the ring or piston, or both.

   Standard values:
   No. 1 ring: 0.03 – 0.07 mm
   No. 2 ring: 0.02 – 0.06 mm
   Limits: 0.1 mm



2. Install a piston ring or oil ring side rail into the cylinder bore and force it down with the head of a piston until the ring is at right angles to the cylinder wall. Measure the end gap with a thickness gauge.

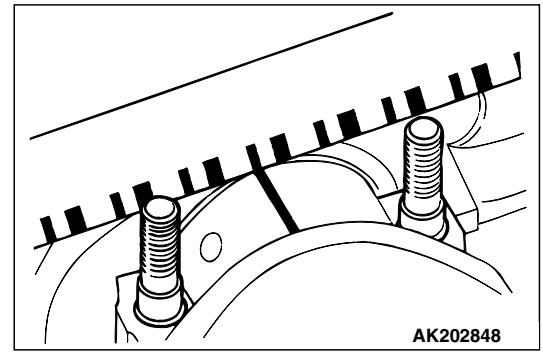
   NOTE: If the end gap is excessive, replace the piston ring.

   Standard values:
   No. 1 ring: 0.25 – 0.35 mm
   No. 2 ring: 0.40 – 0.55 mm
   Oil ring: 0.10 – 0.40 mm

Limits:
No. 1 ring: 0.8 mm
No. 2 ring: 0.8 mm
Oil ring: 1.0 mm

CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGE METHOD)

1. Wipe off oil from the crankshaft pin and connecting rod bearing.
2. Cut a piece of plastic gauge whose length is equivalent to the width of the bearing and place it on the crankshaft pin in parallel with its axis.
3. Install the connecting rod cap carefully and tighten the nuts to the specified torque20 ± 2 N·m + 90° to 94°.
4. Remove the nuts, then remove the connecting rod cap carefully.



5. Measure the largest width of the crushed plastic gauge using the ruler printed on the bag of the plastic gauge.

Standard value: 0.03 – 0.05 mm

Limit: 0.1 mm

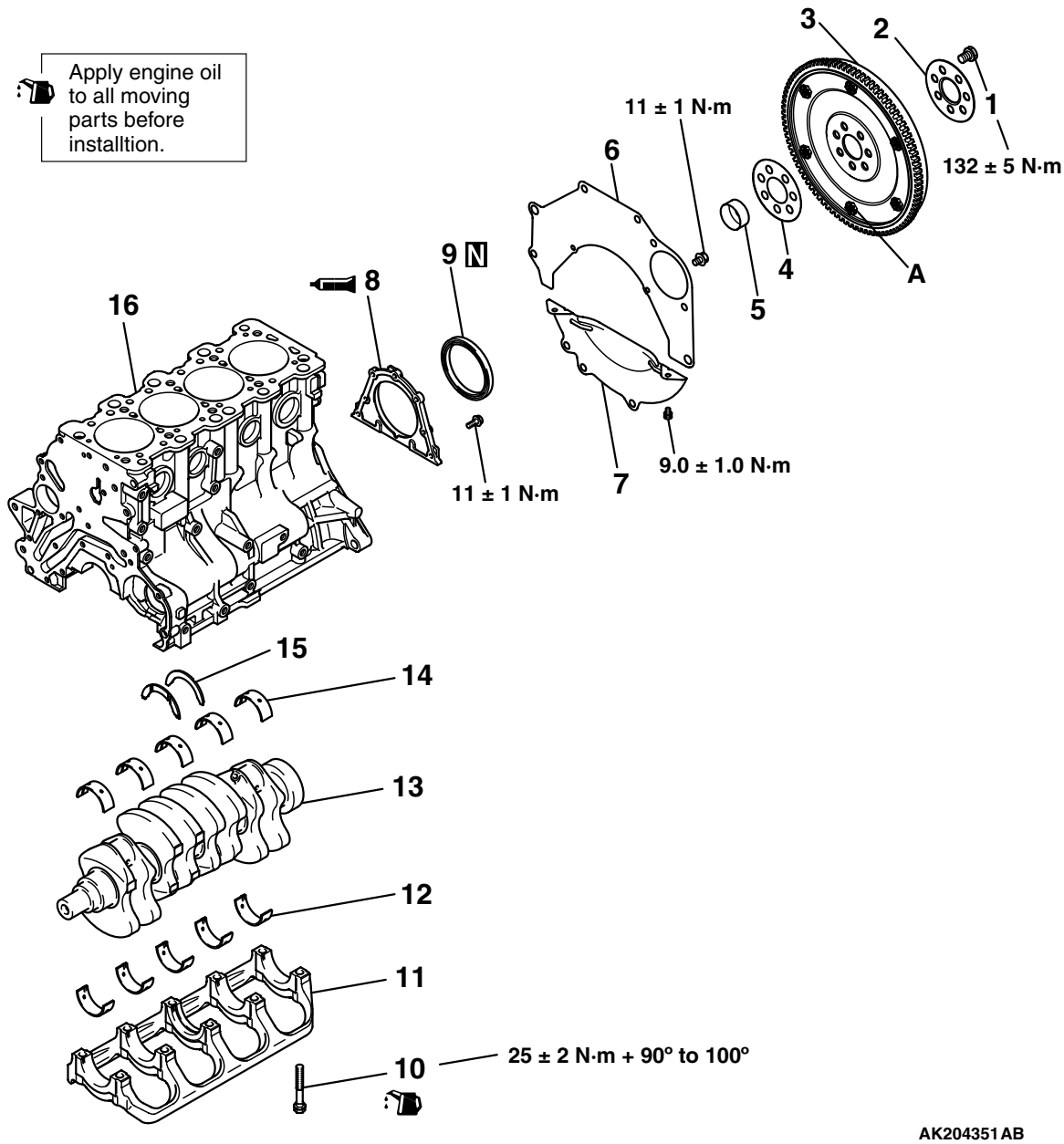
CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008700507

⚠ CAUTION

On the flexible flywheel equipped engines, do not remove any of the bolts "A" of the flywheel shown in the illustration. The balance of the flexible flywheel is adjusted in an assembled condition. Removing the bolt, therefore, can cause the flexible flywheel to be out of balance giving and resulting in damage.



AK204351AB

Removal steps

1. Flywheel bolt
2. Adapter plate
3. Flywheel
4. Adapter plate
5. Crankshaft bushing
6. Rear plate

>>E<< 7. Bell housing cover

>>D<< 8. Oil seal case

Removal steps (Continued)

>>C<< 9. Oil seal

>>C<< 10. Bearing cap bolt

>>B<< 11. Beam bearing cap

12. Crankshaft bearing, lower

>>B<< 13. Crankshaft

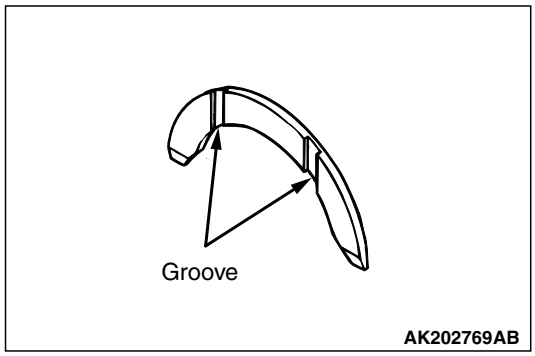
>>A<< 14. Crankshaft bearing, upper

15. Thrust bearing

16. Cylinder block

INSTALLATION SERVICE POINTS

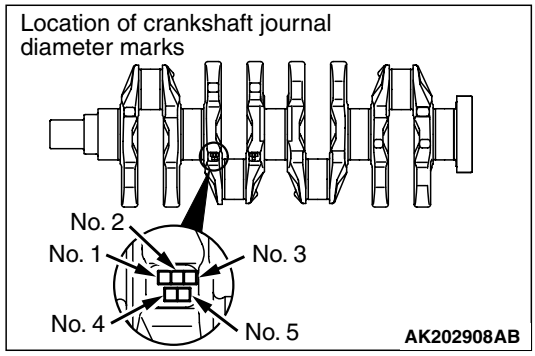
>>A<< THRUST BEARING INSTALLATION



Install the two thrust bearings in the No. 3 bearing bore in the cylinder block. Each thrust bearing must be installed with the grooved end toward the crankshaft web.

NOTE: Applying engine oil to the bearings will help facilitate holding them in position.

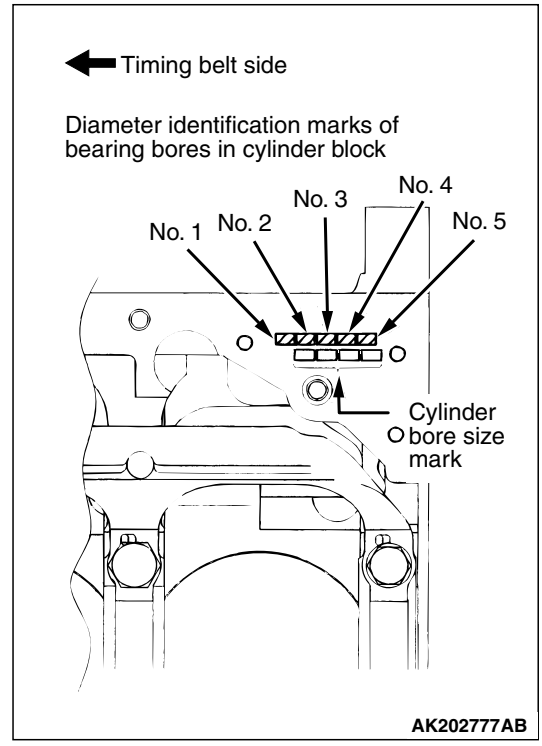
>>B<< CRANKSHAFT BEARING INSTALLATION



1. Location of crankshaft journal diameter marks

If the crankshaft journal diameter mark is "0" and the cylinder block bearing bore mark is "1", then select a bearing with a "2" mark as the No. 1, 2, 4 or 5 bearing and a bearing with a "1" mark as the No. 3 bearing.

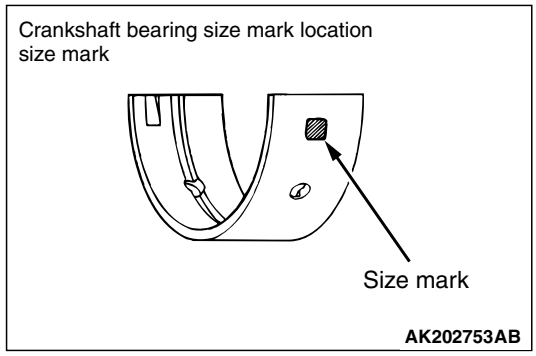
If the crankshaft journal diameter mark is illegible, measure the journal diameter and select a bearing with the mark corresponding to the measurement.



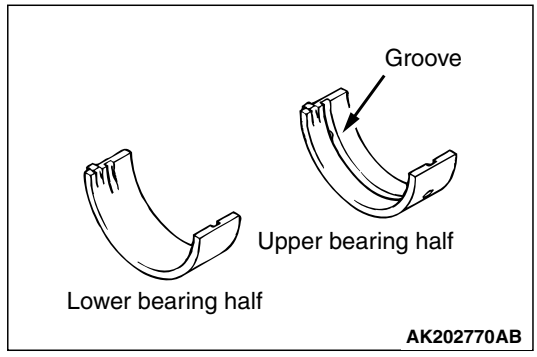
2. The diameter identification marks of the bearing bores in the cylinder block are stamped in the location shown in the drawing.

<Bearing selection example>

Crankshaft journal diameter		Cylinder block bearing bore marking	Crankshaft bearing marking	
Identification mark	Journal diameter measurement mm		No. 1, 2, 4 and 5 bearing	No. 3 bearing
0	56.994 – 57.000	0	1	0
		1	2	1
		2	3	2
1	56.988 – 56.994	0	2	1
		1	3	2
		2	4	3
2	56.982 – 56.988	0	3	2
		1	4	3
		2	5	4



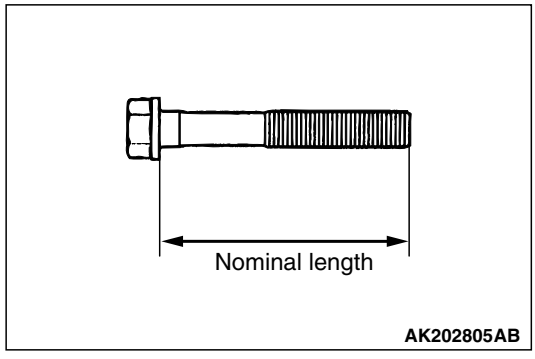
3. The size mark of each crankshaft bearing is indicated by ink in the location shown in the drawing.



4. Install bearing halves with oil grooves in the cylinder block bearing bores.
5. Install bearing halves with no oil grooves in the beam bearing cap.

>>C<< BEAM BEARING CAP/BEARING CAP BOLT INSTALLATION

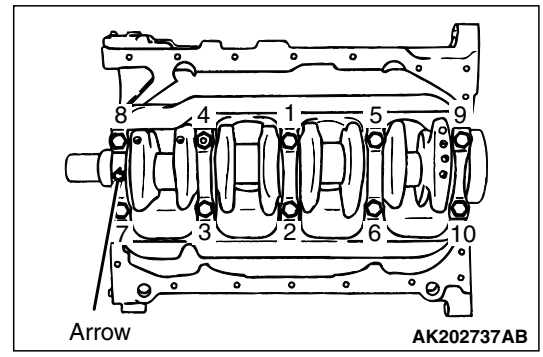
1. Install the beam bearing cap on the cylinder block with the arrow pointing to the timing belt.



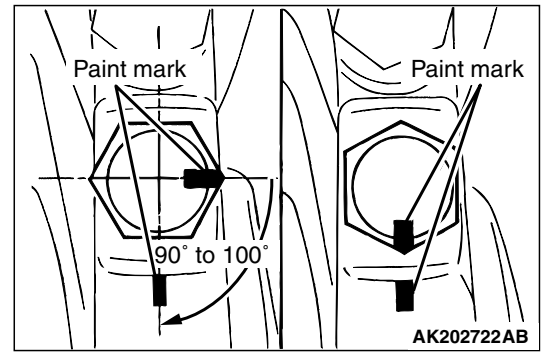
2. Measure the nominal length of each bearing cap bolt before installation. If the measurement exceeds the limit, replace the bolt.

   Limit: 71.1 mm

3. Apply engine oil to the threads and bearing surface of the bolt.



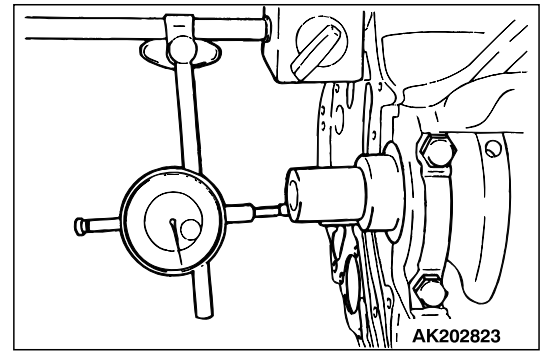
4. Tighten the bolts to 25 ± 2 N·m in the indicated sequence.
5. Make a paint mark on the head of the bolt.
6. Make a paint mark on the bearing cap at a point 90 to 100° away from the paint mark made on the bolt head in the tightening direction.



⚠ CAUTION

- **If the tightening angle is less than 90°, adequate tightness could not be assured.**
- **If the tightening angle exceeds 100°, loosen the bolt completely and then perform the tightening again beginning with the first step.**

7. Turn clockwise the bolts 90 to 100° in the indicated tightening sequence to bring the mark on each bolt head into alignment with that on the bearing cap.

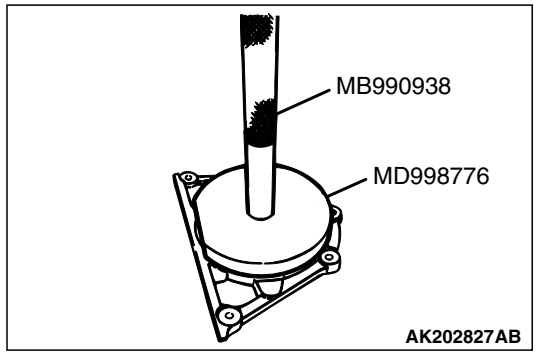


8. After installing the beam bearing cap, measure the end play of the crankshaft. If the end play exceeds the limit, replace the crankshaft bearings.

   Standard value: 0.05 – 0.25 mm

Limit: 0.4 mm

>>D<< REAR OIL SEAL INSTALLATION

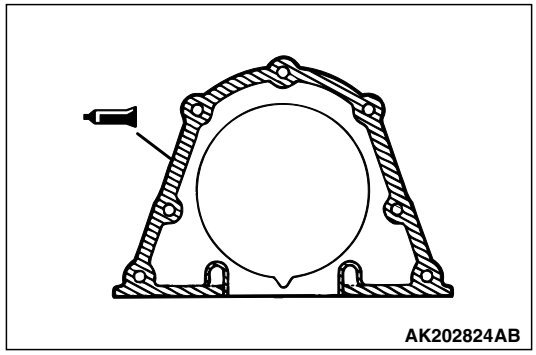


Use the special tools to press-fit the rear oil seal in the rear oil seal case.

- Handle (MB990938)
- Crankshaft rear oil seal installer (MD998776)

>>E<< REAR OIL SEAL CASE INSTALLATION

1. Remove completely old FIPG remaining on the rear oil seal case and cylinder block.



2. Apply a bead of FIPG to the surface of the rear oil seal case as shown in the drawing.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

3. Install the oil seal into the cylinder block after applying an appropriate amount of engine oil to the entire circumference of its lip portion.
4. Install the rear oil seal case by tightening its bolts to 11 ± 1 N·m.

INSPECTION

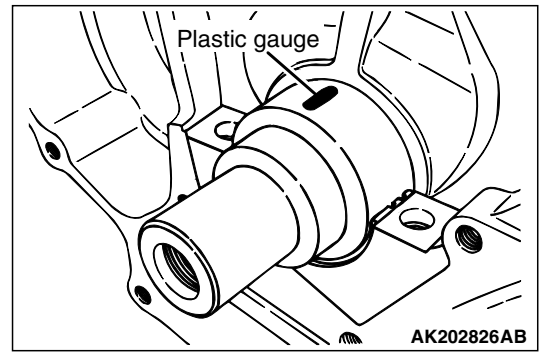
M1113008800366

CRANKSHAFT OIL CLEARANCE (PLASTIC GAUGE METHOD)

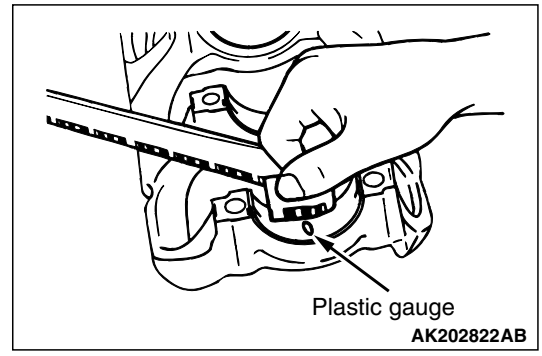
This plastic gauge method is recommended as a simplest way of measuring the crankshaft oil clearance.

Measure the crankshaft oil clearance using a plastic gauge as follows:

1. Wipe off oil from the crankshaft journal surface and the crankshaft bearing inner surface.
2. Install the crankshaft.



3. Cut a piece of plastic gauge whose length is equivalent to the width of the bearing and place it on the crankshaft journal in parallel with its axis.
4. Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque of 25 ± 2 N·m + 90° to 100°.
5. Remove the bolts, then remove the crankshaft bearing cap carefully.



6. Measure the largest width of the crushed plastic gauge using the ruler printed on the bag of the plastic gauge.

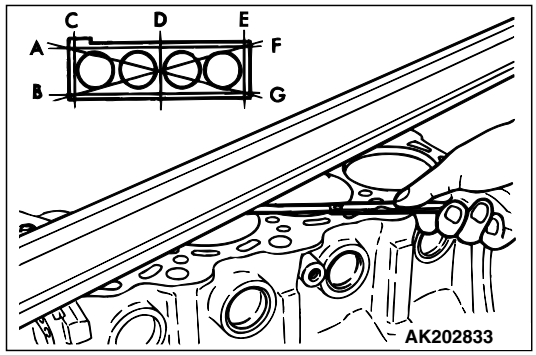
   Standard value: 0.02 – 0.04 mm

   Limit: 0.1 mm

CYLINDER BLOCK

1. Visually check the cylinder block for scratches, rust, and any other corrosion. Also check it for cracks using a flaw detecting penetrant.

   If any defect is evident, replace the cylinder block.



2. Use a straightedge and thickness gauge to check the cylinder block top surface for warp.

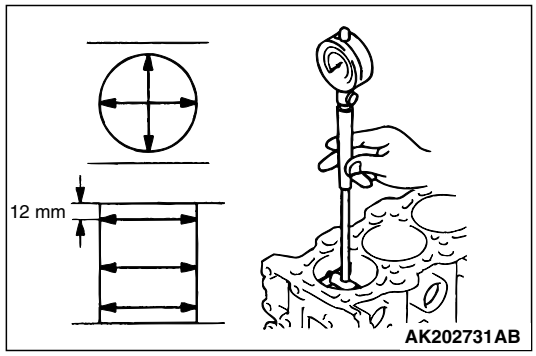
   Make sure that the surface is free from remaining gasket material and other foreign matter.

   Standard value: 0.05 mm

   Limit: 0.1 mm

3. Check cylinder walls for scratches and seizure.

   If defects are evident, rebore to oversize or replace the cylinder block.



4. Use a cylinder gauge to measure the cylinder bore diameter and taper.

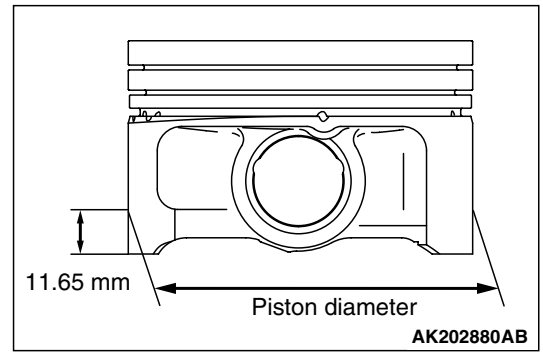
   If the cylinder is worn badly, rebore it to an oversize and replace the piston and piston rings with ones matched with the new bore size.

   Standard value: 85.00 mm

   Taper: 0.01 mm

BORING CYLINDERS

1. Select an oversize of the pistons to be used based on the largest of the cylinder bores.



2. Oversize pistons are available in two oversizes: 0.50 mm and 1.00 mm. Bore each cylinder to a size that provides the standard clearance when combined with the selected piston. The reference position for piston diameter measurement is as shown in the drawing.
3. Based on the piston diameter measurement, calculate the boring finish dimension.
   - Boring finish dimension = [Piston diameter] + [0.02 – 0.04 mm (clearance between piston and cylinder)] – [0.02 mm (honing margin)]

⚠ CAUTION

To prevent deformation of cylinder block that would result from the heat generated by boring, bore the cylinders in the following sequence: No. 2 → No. 4 → No. 1 → No. 3.

4. Bore all the cylinders to the calculated boring finish dimension.
5. Hone the bored cylinders to the final finish dimension (piston diameter + clearance between piston and cylinder).
6. Check the clearance between the piston and cylinder.

   Standard value: 0.02 – 0.04 mm