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# GROUP 11B

# ENGINE OVERHAUL

## <4G64>

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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.



## GENERAL INFORMATION

M1113000100879

Vehicle name	Vehicle model	Engine model	Displacement cc	Specification
Outlander	CU4W	4G64-2	2,351	Single overhead camshaft, 16-valve

## GENERAL SEPCIFICATIONS

M1113000201147

Item		4G64-SOHC
Bore × stroke mm		86.5 × 100
Displacement mL		2,351
Number of cylinders		4
Valve mechanism	Type	Single overhead camshaft
	Number of intake valves	2
	Number of exhaust valves	2
	Lash adjusters	Hydraulic
	Rocker arms	Roller rocker arms
Compression ratio		9.0
Fuel injection system		Electronically controlled multi-point injection system
Ignition system		Electronically controlled distributor (with built-in coil)
Generator		Alternator (with built-in IC regulator)
Starter motor		Gear reduction drive type

## SERVICE SPECIFICATIONS

M1113000301166

Item			Standard value	Limit
<b>TIMING BELT</b>				
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 – 196N) mm			Less than 1	–
<b>ROCKER ARMS AND CAMSHAFT</b>				
Cam height mm	Intake		37.39	36.89
	Exhaust		36.83	36.33
<b>CYLINDER HEAD AND VALVES</b>				
Cylinder head bolt nominal length mm			–	99.4
Cylinder head gasket surface warp mm			Less than 0.03	0.2

Item		Standard value	Limit
Cylinder head gasket surface grinding limit (including cylinder block grinding amount) mm		–	0.2
Cylinder head overall height mm		119.1 – 120.1	–
Valve margin mm	Intake	1.0	0.5
	Exhaust	1.2	0.7
Valve stem diameter mm		6.0	–
Valve face angle		45.5°	–
Valve height mm	Intake	112.30	111.80
	Exhaust	114.11	113.61
Valve spring free height mm		50.8	49.8
Valve spring squareness		2° or less	4°
Valve stem-to-guide clearance mm	Intake	0.02 – 0.05	0.10
	Exhaust	0.04 – 0.07	0.15
Valve stem projection mm		49.30	48.90
Valve spring load/height N/mm		267/44.2	–
Valve face-to-seat contact width mm		0.9 – 1.3	–
Valve guide inside diameter mm		6.0	–
Valve guide press-in height mm		14.0	–
<b>FRONT CASE AND OIL PAN</b>			
Oil pump gear side clearance mm	Drive gear	0.08 – 0.14	–
	Driven gear	0.06 – 0.12	–
<b>PISTONS AND CONNECTING RODS</b>			
Piston outside diameter mm		86.5	–
Piston pin press-in load (at ambient temperature) N		7350 – 17200	–
Connecting rod big end thrust clearance mm		0.10 – 0.25	0.4
Piston ring side clearance in ring groove mm	No. 1	0.03 – 0.07	0.1
	No. 2	0.02 – 0.06	0.1
Piston ring end gap mm	No. 1	0.25 – 0.35	0.8
	No. 2	0.40 – 0.55	0.8
	Oil ring	0.10 – 0.40	1.0
Piston pin outside diameter mm		22.0	–
Oil clearance at crankshaft pins mm		0.02 – 0.05	0.1
<b>CRANKSHAFT AND CYLINDER BLOCK</b>			
Crankshaft bearing cap bolt nominal length mm		–	71.1
Crankshaft end play mm		0.05 – 0.25	0.40
Crankshaft journal diameter mm		57.0	–
Crankshaft pin diameter mm		45.0	–
Oil clearance at crankshaft journals mm		0.02 – 0.04	0.1
Cylinder block gasket surface warp mm		0.05	0.1

Item	Standard value	Limit
Cylinder block gasket surface grinding limit (including cylinder head grinding amount) mm	–	0.2
Cylinder block overall height mm	290	–
Cylinder bore diameter mm	86.5	–
Taper of cylinder mm	0.1 or less	–
Cylinder-to-piston clearance mm	0.02 – 0.04	–

## REWORK DIMENSIONS

M1113024300435

Items			Standard value
<b>CYLINDER HEAD AND VALVES</b>			
Diameter of oversize valve seat ring hole in cylinder head mm	Intake	0.03 oversize	34.30 – 34.33
		0.06 oversize	34.60 – 34.63
	Exhaust	0.03 oversize	31.80 – 31.83
		0.06 oversize	32.10 – 34.13
Diameter of oversize valve guide hole in cylinder head mm		0.05 oversize	11.05 – 11.07
		0.25 oversize	11.25 – 11.27
		0.50 oversize	11.50 – 11.52

## TORQUE SPECIFICATIONS

M1113023401432

Item	N·m
<b>ALTERNATOR AND IGNITION COIL</b>	
Auto-tensioner bolt (M10)	44 ± 10
Auto-tensioner bolt (M8)	24 ± 4
Water pump pulley bolt	8.8 ± 1.0
Alternator brace bolt (water pump end)	23 ± 3
Alternator brace bolt (alternator end)	22 ± 4
Alternator nut	44 ± 10
Crankshaft pulley bolt	25 ± 4
Ignition coil bolt	10 ± 2
Spark plug	25 ± 5
Camshaft position sensor bolt	8.8 ± 1.0
Camshaft position sensor support bolt	14 ± 1
Camshaft position sensing cylinder bolt	22 ± 4
<b>TIMING BELT</b>	
Timing belt front cover flange bolt (M6)	11 ± 1

<b>Item</b>	<b>N·m</b>
Timing belt front cover flange bolt (M8)	14 ± 1
Timing belt front cover washer assembled bolt	9.0 ± 1.0
Power steering pump bracket bolt	49 ± 9
Crank angle sensor bolt	8.8 ± 1.0
Tensioner pulley bolt	48 ± 5
Tensioner arm bolt	21 ± 4
Auto-tensioner bolt	23 ± 3
Idler pulley bolt	35 ± 6
Oil pump sprocket bolt	54 ± 4
Crankshaft bolt	167
Tensioner B bolt	19 ± 3
Counterbalance shaft sprocket bolt	45 ± 3
Engine support bracket bolt	49 ± 5
Camshaft sprocket bolt	89 ± 9
<b>FUEL SYSTEM</b>	
Throttle body bolt	19 ± 3
EGR valve bolt	20 ± 2
Delivery pipe and injector assembly bolt	11 ± 1
Fuel pressure regulator bolt	9.0 ± 1.0
Vacuum pipe and hose bolt	9.0 ± 1.0
Solenoid valve bolt	9.0 ± 1.0
<b>INTAKE MANIFOLD</b>	
Engine coolant temperature sensor	29 ± 10
Engine coolant temperature gauge unit	11 ± 1
Water inlet fitting bolt	13 ± 2
Thermostat housing bolts	23 ± 4
Water inlet pipe bolt	13 ± 2
Water pump bolts	14 ± 1
Oil level gauge guide bolt	13 ± 1
Intake manifold stay bolts	31 ± 3
Intake manifold bolts and nuts	20 ± 2
Detonation sensor	23 ± 2
<b>EXHAUST MANIFOLD</b>	
Water outlet fitting bolts	13 ± 2
Exhaust manifold cover bolts	14 ± 1
Engine hanger bolt	19 ± 3
Exhaust manifold nuts (M8)	29 ± 3
Exhaust manifold nuts (M10)	49 ± 5
<b>ROCKER ARMS AND CAMSHAFT</b>	
Rocker cover bolts	3.4 ± 0.5

Item	N·m
Rocker arm shaft bolts	31 ± 3
<b>CYLINDER HEAD AND VALVES</b>	
Cylinder head bolts	78 ± 2 → loosen completely → 20 ± 2 → 90° + 90°
<b>FRONT CASE AND OIL PAN</b>	
Drain plug	39 ± 5
Transmission stay bolts	22 ± 4
Oil pan bolts	9.0 ± 3.0
Oil pan lower section bolts	9.0 ± 3.0
Oil pan upper section bolts	9.0 ± 3.0
Oil screen bolts	19 ± 3
Engine oil pressure switch	19 ± 3
Relief plug	44 ± 5
Oil filter bracket bolts	19 ± 3
Plug	23 ± 3
Flange bolt	36 ± 6
Front case bolts	23 ± 3
Oil pump cover bolts	17 ± 1
Oil pump cover screw	10 ± 2
<b>PISTONS AND CONNECTING RODS</b>	
Connecting rod cap nuts	20 ± 2 → 90° to 94°
<b>CRANKSHAFT AND CYLINDER BLOCK</b>	
Drive plate bolts	132 ± 5
Rear plate bolt	11 ± 1
Bell housing cover bolts	9.0 ± 1.0
Rear oil seal case bolts	11 ± 1
Bearing cap bolts	25 ± 2 → 90° to 100°



## SEALANTS

M1113000501018

Items	Specified sealant
Engine coolant temperature sensor	3M Nut Locking Part No.4171 or equivalent
Engine coolant temperature gauge unit	3M ATD No.8660 or equivalent
Engine support bracket bolt*	Mitsubishi Genuine Part No. MD970389 or equivalent
Water outlet fitting*	
Thermostat housing*	
Oil pan*	
Camshaft position sensor support*	
Rear oil seal case*	
Engine oil pressure switch	3M ATD No.8660 or equivalent

**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 used with an aluminum oil pan as it could damage the mating surfaces.

**CLEANING FIPG APPLICATION SURFACE**

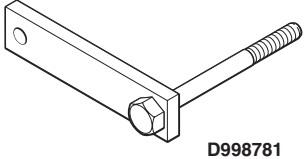
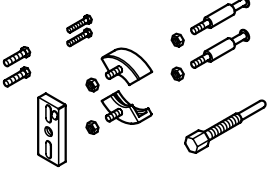
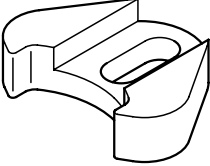
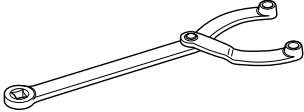
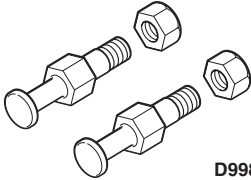
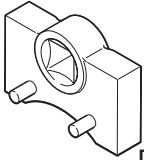
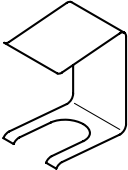
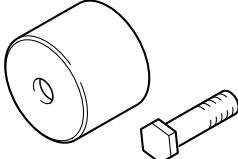
Thoroughly remove all substances deposited on the FIPG application surface, using a gasket scraper or wire brush. Make sure that the FIPG application surface is flat and smooth. Also make sure that the surface is free from oils, greases and foreign substances. Do not fail to remove old FIPG that may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

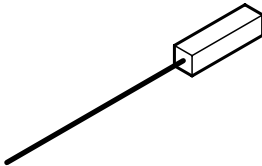
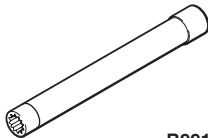
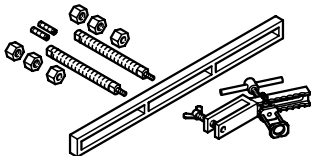
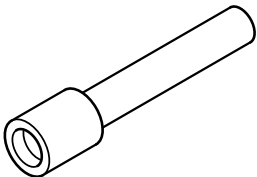
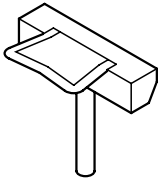
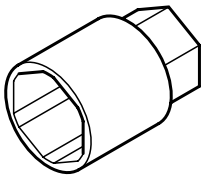
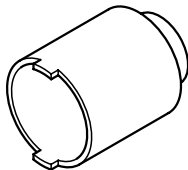
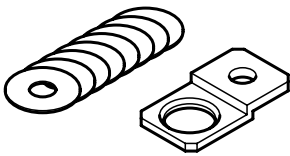
**APPLICATION OF FIPG**

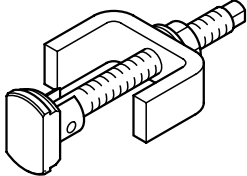
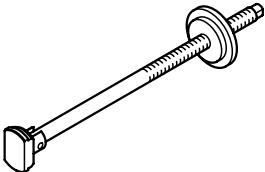
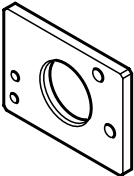
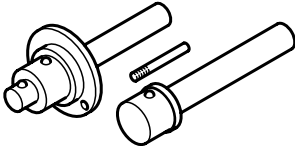
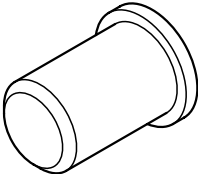
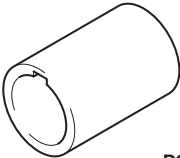
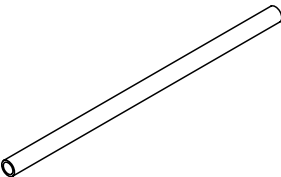
Applied FIPG bead should be of the specified size and free of any break. FIPG can be wiped away unless it has completely hardened. Install the mating parts in position while the FIPG is still wet (in less than 15 minutes after application). Do not allow FIPG to spread beyond the sealing areas during 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.

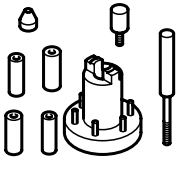
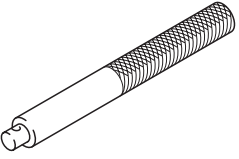

## SPECIAL TOOLS

M1113000601316

Tool	Number	Name	Use
 D998781	MD998781	Flywheel stopper	Retention of drive plate
	MD998778	Crankshaft sprocket puller	Removal of crankshaft sprocket and crankshaft sprocket B
	MD998785	Sprocket stopper	Retention of counterbalance shaft sprocket
 B990767	MB990767	End yoke holder	Retention of camshaft sprocket (Use with MD998719.)
 D998719	MD998719	Pulley holder pin	Retention of camshaft sprocket (Use with MD990767)
 D998767	MD998767	Tension pulley socket wrench	Manipulation of tensioner pulley during adjustment of timing belt tension
 D998443	MD998443	Lash adjuster holder	Retention of lash adjuster inside rocker arm when removing and installing rocker arm shaft assembly
 D998713	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal

Tool	Number	Name	Use
	MD998442	Air bleed wire	Air bleeding of lash adjuster
 B991654	MB991654	Cylinder head bolt wrench	Removal and installation of cylinder head bolts
	MD998772	Valve spring compressor	Compression of valve spring
	MD998774	Valve stem seal installer	Installation of valve stem seal
 D998727	MD998727	Oil pan remover	Removal of oil pan
	MD998012	Oil pressure switch socket wrench	Removal and installation of engine oil pressure switch <to cylinder block>
	MD998162	Plug wrench	Removal and installation of front case cap plug
	MD998783	Plug wrench retainer	Removal and installation of front case cap plug (Use with MD998162)

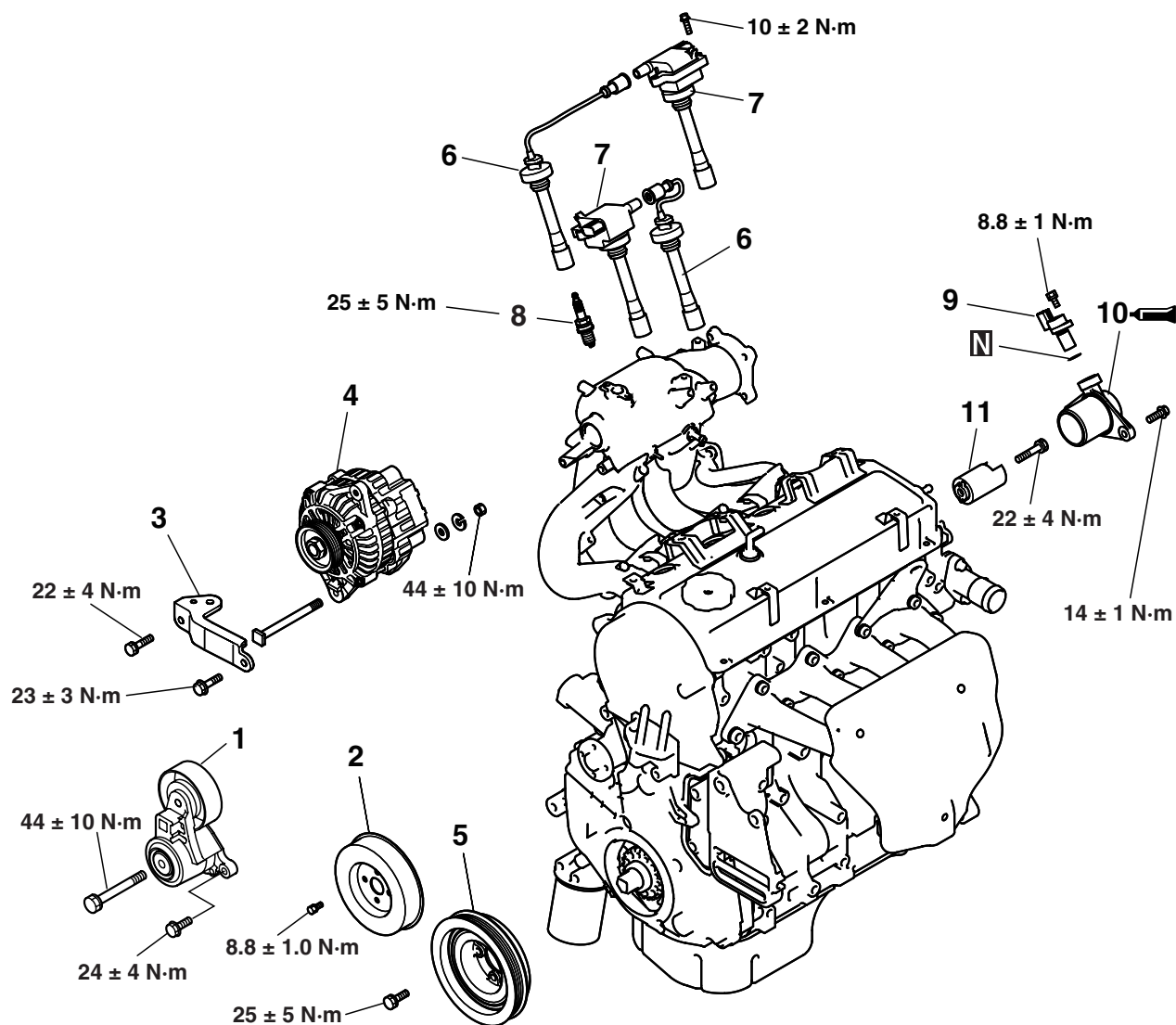
Tool	Number	Name	Use
	MD998371	Silent shaft bearing puller	Removal of counterbalance shaft front bearing
	MD998372	Silent shaft bearing puller	Removal of counterbalance shaft rear bearing
	MB991603	Silent shaft bearing installer stopper	Guide and stopper for removal and press-fitting of counterbalance rear bearing
	MD998705	Silent shaft bearing installer	Press-fitting of counterbalance 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
	MB992010	Bolt guide	Removal and installation of piston and connecting rod assembly

Tool	Number	Name	Use
	MD998780	Piston pin setting tool	Removal and press-fitting of piston pin
	MB990938	Handle	Installation of crankshaft rear oil seal (Use with MD998776.)
 D998776	MD998776	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal

## ALTERNATOR AND IGNITION SYSTEM

## REMOVAL AND INSTALLATION

M1113001000745



AK401134 AB

**Removal steps**

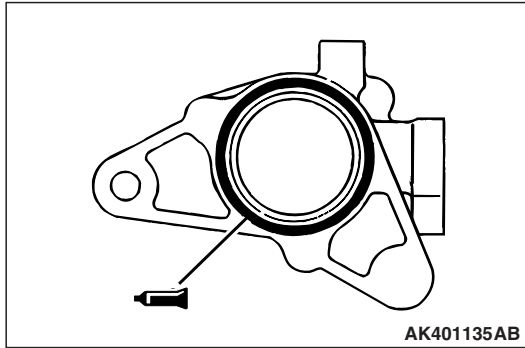
1. Auto tensioner
2. Water pump pulley
3. Alternator brace
4. Alternator
5. Crankshaft pulley
6. Spark plug cable

**Removal steps (Continued)**

7. Ignition coil
  8. Spark plug
  9. Camshaft position sensor
  10. Camshaft position sensor support
  11. Camshaft position sensing cylinder
- >>A<<

## INSTALLATION SERVICE POINTS

### >>A<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION



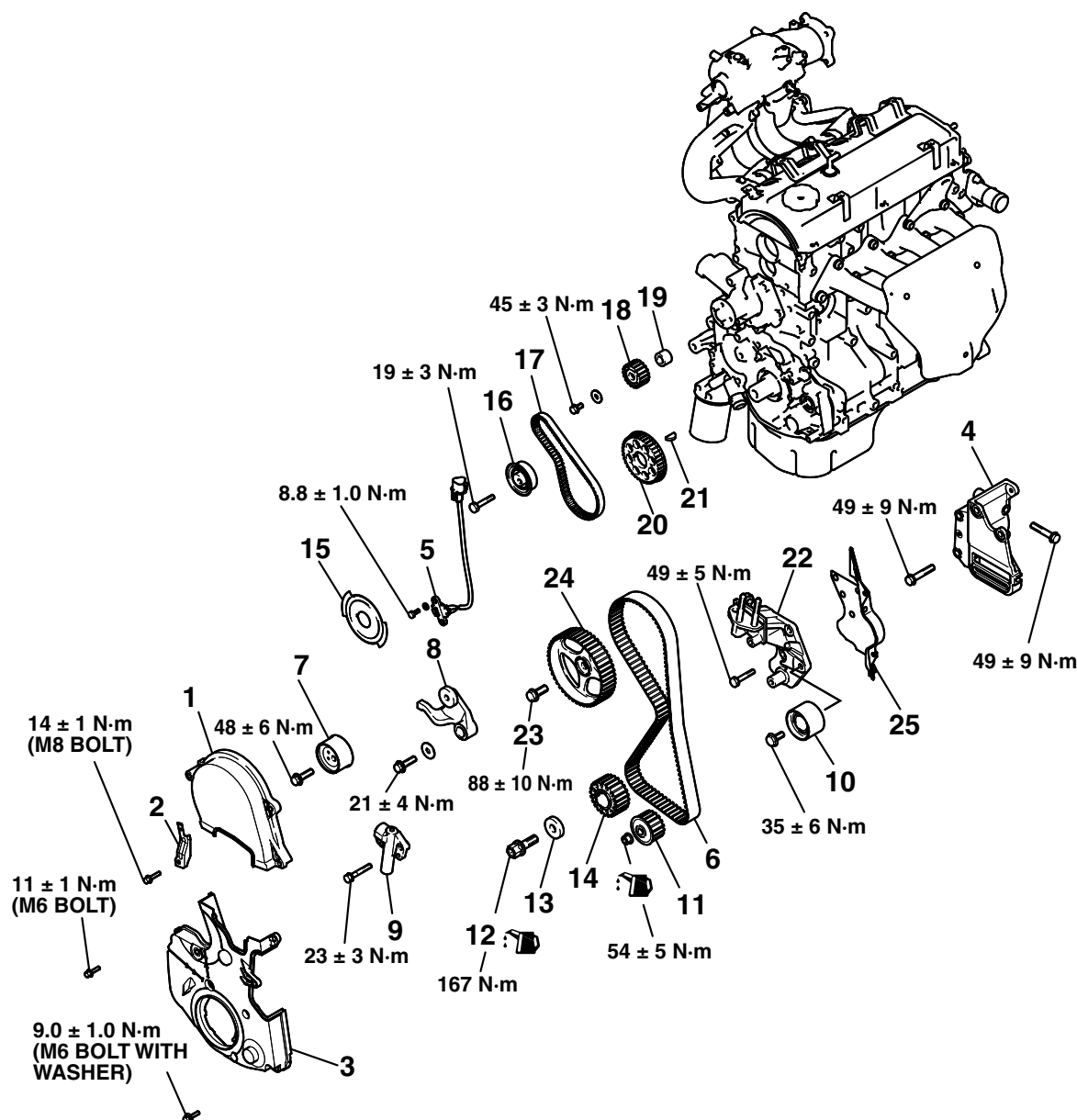
Apply a 3mm diameter bead of form-in-place gasket (FIPG) to the gasket surface as shown in the drawing.

#### **Specified sealant:**

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

## REMOVAL AND INSTALLATION

M1113001900908



AK401136AB

## Removal steps

- |       |       |                                  |
|-------|-------|----------------------------------|
|       |       | 1. Timing belt front upper cover |
|       |       | 2. Connector bracket             |
|       |       | 3. Timing belt front lower cover |
|       |       | 4. Power steering pump bracket   |
| <<A>> | >>K<< | 5. Crankshaft angle sensor       |
|       | >>J<< | 6. Timing belt                   |
|       |       | 7. Tensioner pulley              |
|       | >>I<< | 8. Tensioner arm                 |
|       |       | 9. Auto-tensioner                |
|       |       | 10. Idler pulley                 |
| <<B>> | >>H<< | 11. Oil pump sprocket            |
| <<C>> | >>G<< | 12. Crankshaft bolt              |
|       |       | 13. Crankshaft sprocket washer   |

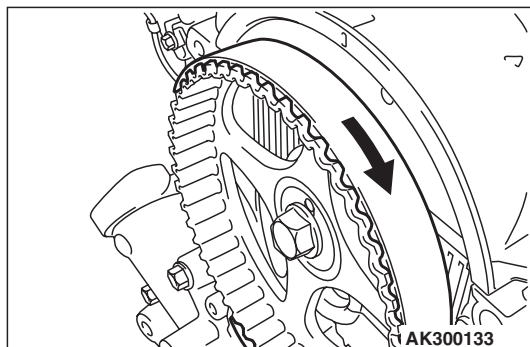
### Removal steps (Continued)

- <<D>> >>G<< 14.Crankshaft sprocket  
>>G<< 15.Crankshaft sensing blade  
16.Tensioner B  
<<E>> >>F<< 17.Timing belt B  
<<F>> >>E<< 18.Counterbalancer shaft sprocket  
>>D<< 19.Spacer  
<<G>> >>C<< 20.Crankshaft sprocket B  
21.Crankshaft key  
>>B<< 22.Engine support bracket  
<<H>> >>A<< 23.Camshaft sprocket bolt  
24.Camshaft sprocket  
25.Timing belt rear cover



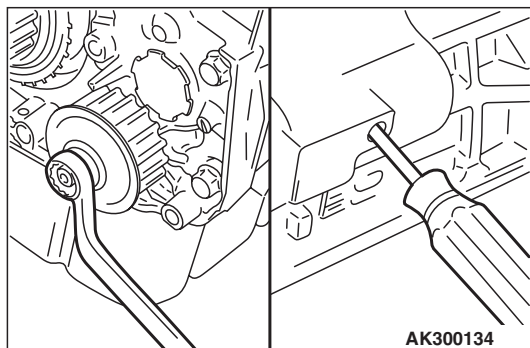
## REMOVAL SERVICE POINTS

### <<A>> TIMING BELT REMOVAL



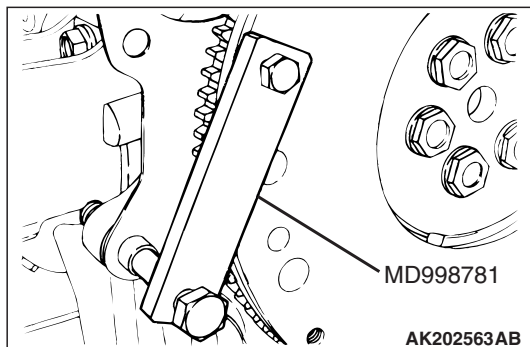
If the timing belt is to be reused, make an arrow mark with something like chalk on the back of the belt indicating the direction of rotation so it may be reinstalled in the same direction.

### <<B>> OIL PUMP SPROCKET REMOVAL



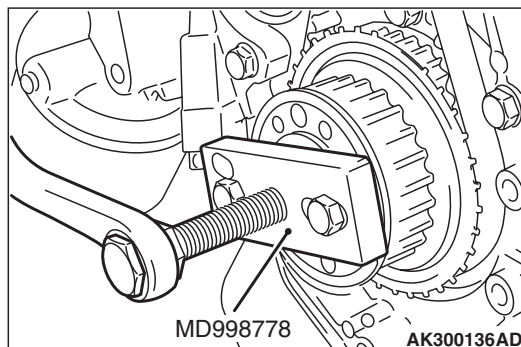
1. Remove the plug on the left side of cylinder block.
2. Insert a crosspoint screwdriver (shank diameter: 8 mm) to prevent the counterbalancer shaft from rotating.
3. Remove the flange nut.
4. Remove the oil pump sprocket.

### <<C>> CRANKSHAFT BOLT REMOVAL



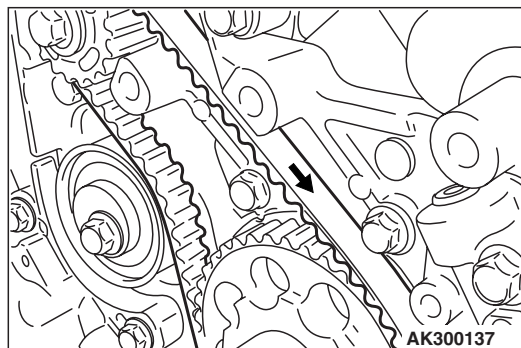
1. Hold the drive plate with the special tool Flywheel stopper (MD998781).
2. Remove the crankshaft bolt.

### <<D>> CRANKSHAFT SPROCKET REMOVAL



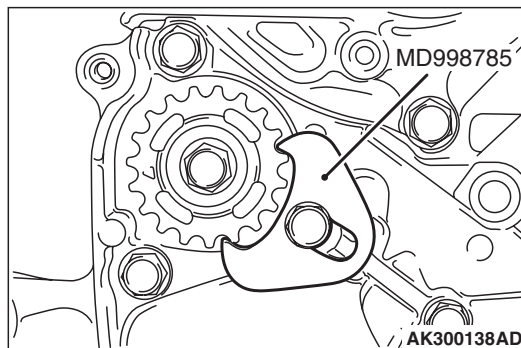
Use the special tool Crankshaft sprocket puller (MD998778) if the sprocket is stuck and hard to remove.

### <<E>> TIMING BELT B REMOVAL

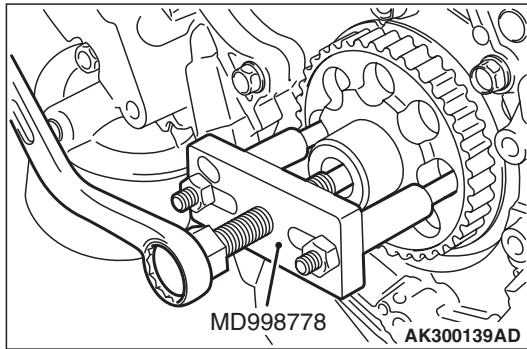


If the timing belt is to be used, make an arrow mark with something like chalk on the back of the timing belt indicating the direction of rotation so it may be reinstalled in the same direction.

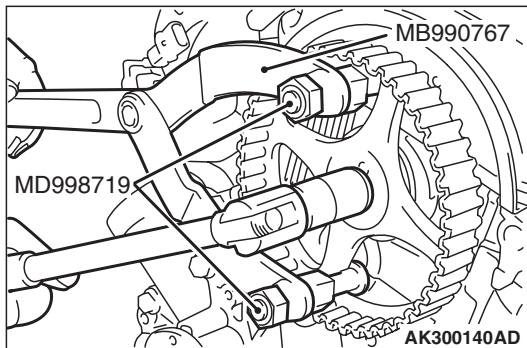
### <<F>> COUNTERBALANCER SHAFT SPROCKET REMOVAL



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

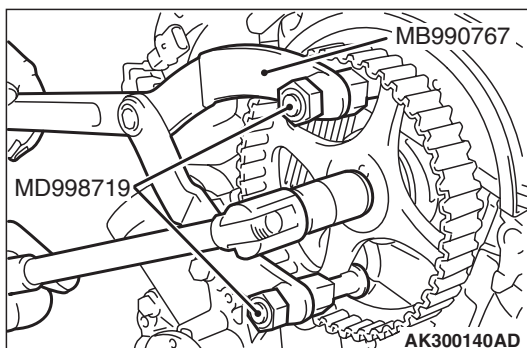
<<G>> CRANKSHAFT SPROCKET B  
REMOVAL

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

<<H>> CAMSHAFT SPROCKET BOLT  
REMOVAL

1. Use the special tools to prevent the camshaft sprocket from rotating.
  - End yoke holder (MB990767)
  - Pulley holder pin (MD998719)
2. Remove the camshaft sprocket bolt.

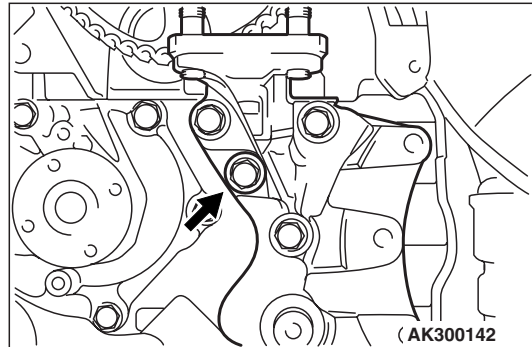
## INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT SPROCKET BOLT  
INSTALLATION

1. Use the special tools to prevent the camshaft sprocket from rotating.

- End yoke holder (MB990767)
- Pulley holder pin (MD998719)

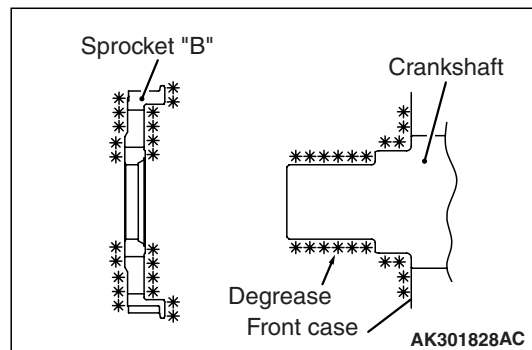
2. Tighten the camshaft sprocket bolt to the specified torque.

>>B<< ENGINE SUPPORT BRACKET  
INSTALLATION

Coat the bolt indicated in the drawing with sealant before it is installed.

**Specified sealant:**

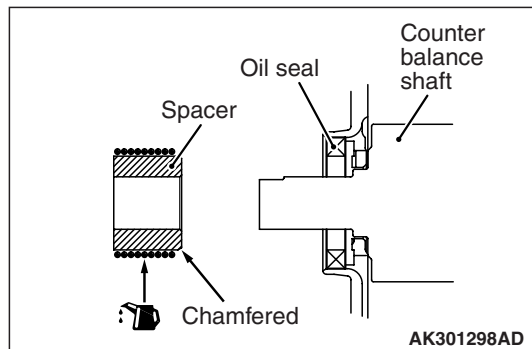
**Mitsubishi Genuine Part No. MD970389 or equivalent**

>>C<< CRANKSHAFT SPROCKET B  
INSTALLATION

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

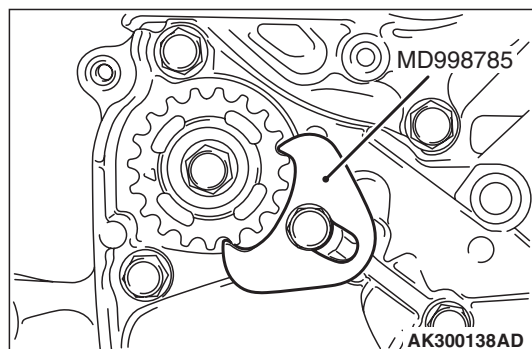
**NOTE:** Degreasing is necessary to prevent lack of frictional coefficient between the mating surfaces.

## >>D<< SPACER INSTALLATION



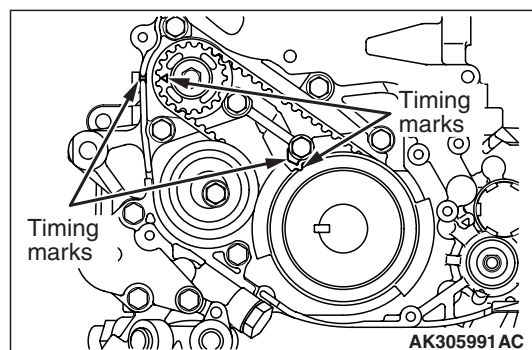
1. Smear slightly oil on the outer surface of the spacer that comes into contact with the oil seal.
2. Install the spacer with the chamfered end toward the oil seal. Reversing the direction will cause damage to the oil seal lip.

## >>E<< COUNTERBALANCER SHAFT SPROCKET INSTALLATION



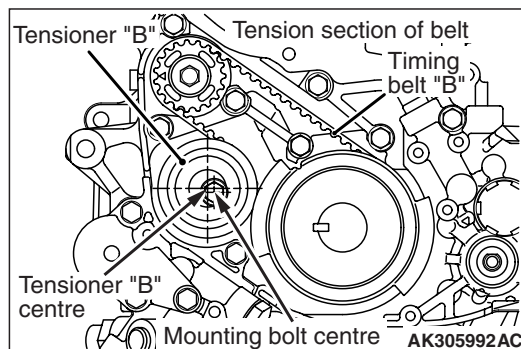
Use the special tool Sprocket stopper (MD998785) as shown in the drawing to prevent the counterbalancer shaft sprocket from rotating, then tighten the sprocket mounting bolt to the specified torque.

## >>F<< TIMING BELT B INSTALLATION

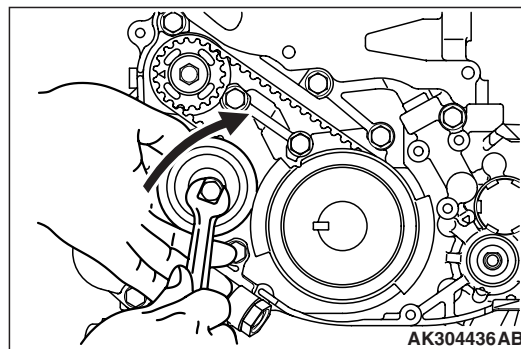


1. Align the timing marks on the crankshaft sprocket B and counterbalancer shaft sprocket with the corresponding timing marks on the oil pump case.

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.



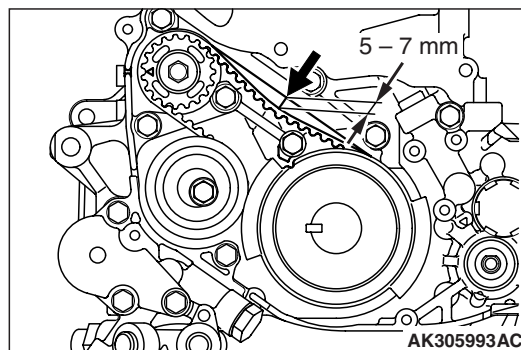
3. Make sure that the tensioner B center is positioned as shown in the drawing relative to the mounting bolt center.



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.

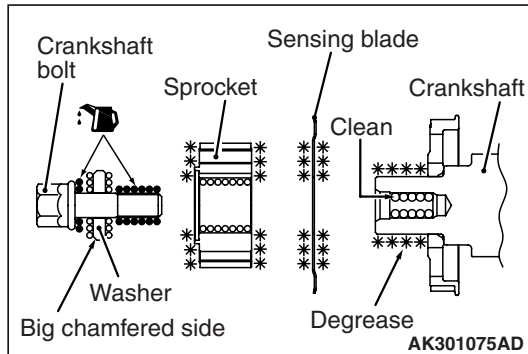
*NOTE: When the bolt is tightened, prevent the tensioner B shaft from turning. If the shaft turns, the belt will be overtightened.*

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

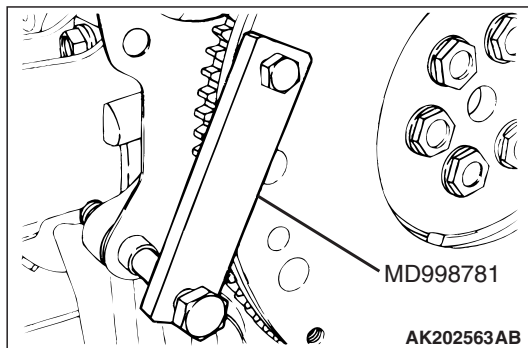


6. Push a central point of the timing belt B tension section lightly with an index to see if it deflects 5 – 7 mm.

## >>G<< CRANKSHAFT BOLT /CRANKSHAFT SPROCKET /CRANKSHAFT SENSING BLADE INSTALLATION

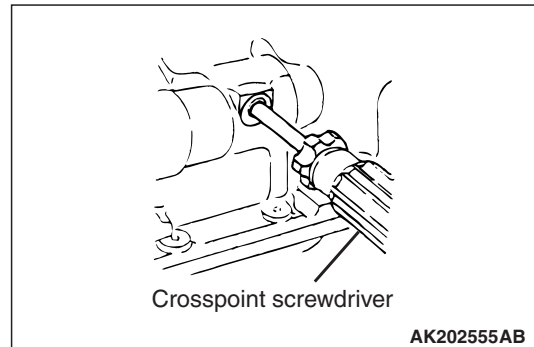


1. Clean and then degrease the crankshaft sprocket, sprocket fitting surface of the crankshaft, and crankshaft sensing blade. Install the crankshaft sprocket and crankshaft sensing blade on the crankshaft.
2. Clean the bolt hole in the crankshaft, and the washer.
3. Apply a necessary minimum amount of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



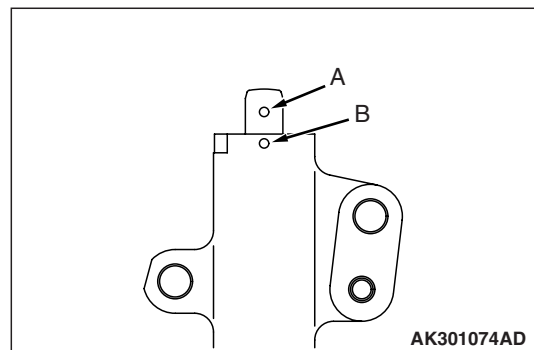
4. Hold the drive plate using the special tool Flywheel stopper (MD998781).
5. Tighten the crankshaft bolt to a torque of  $162 \pm 5$  N·m.

## >>H<< OIL PUMP SPROCKET INSTALLATION



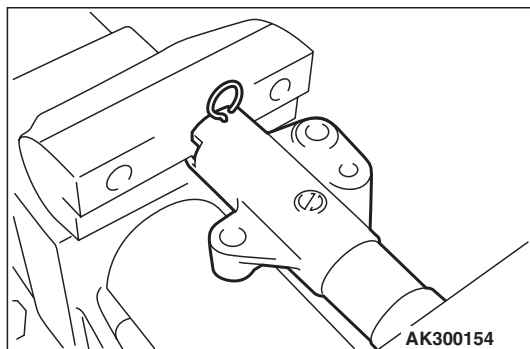
1. Prevent the counterbalancer shaft from rotating in the same method as in the removal procedure.
2. Install the oil pump sprocket.
3. Apply a necessary minimum amount of engine oil to the seating surface of the flange nut.
4. Tighten the flange nut to the specified torque.

## >>I<< AUTO-TENSIONER INSTALLATION



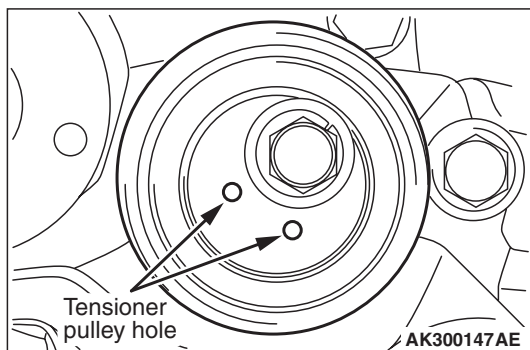
1. If the auto-tensioner rod remains in its fully extended position, reset it to the retracted position as follows:
  - (1) Clamp the auto-tensioner in a vise at right angles to the jaws.
  - (2) Push in the rod little by little with the vise until the set hole A in the rod is aligned with the set hole "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.





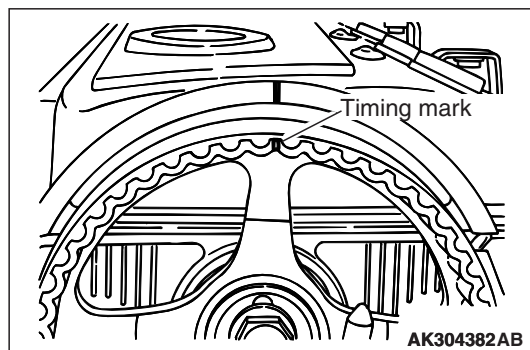
2. Install the auto-tensioner in position. Leave the wire installed until the auto-tensioner is completely installed.

### >>J<< TENSIONER PULLEY INSTALLATION

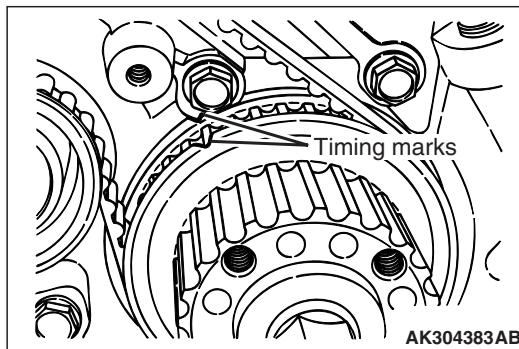


Install the tensioner pulley with its holes aligned as shown in the drawing.

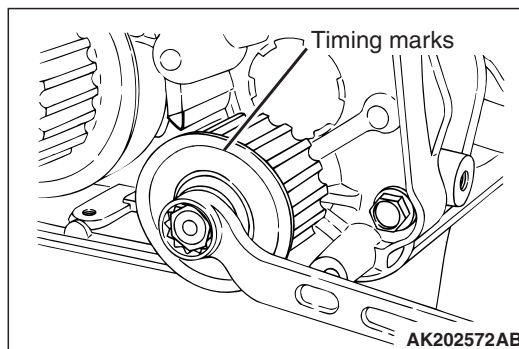
### >>K<< TIMING BELT INSTALLATION



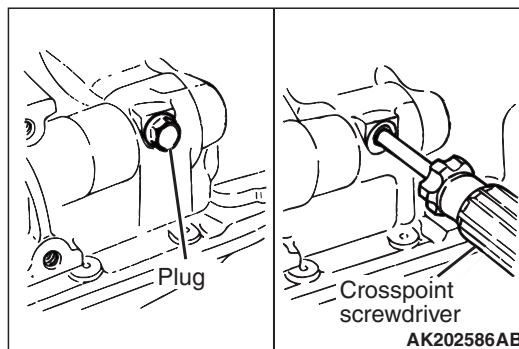
1. Check that the tensioner pulley is installed with its holes correctly aligned. (See >>J<< )
2. Align the timing mark on the camshaft sprocket with that on the cylinder head.



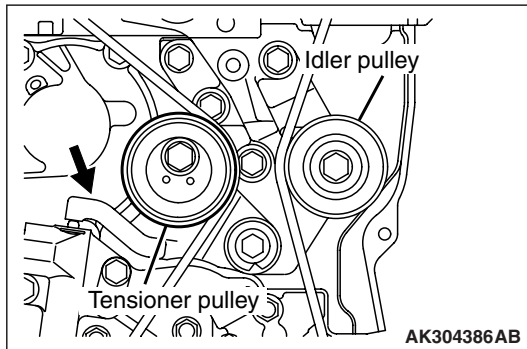
3. Align the timing mark on the crankshaft sprocket with that on the front case.



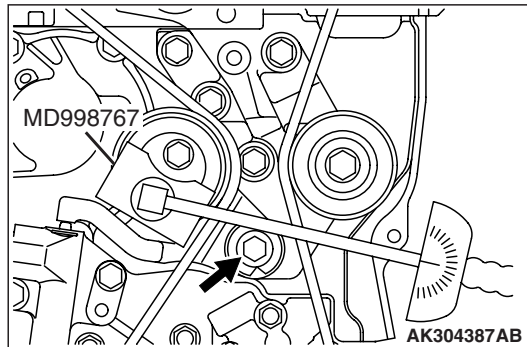
4. Align the timing mark on the oil pump sprocket with that on the front case.



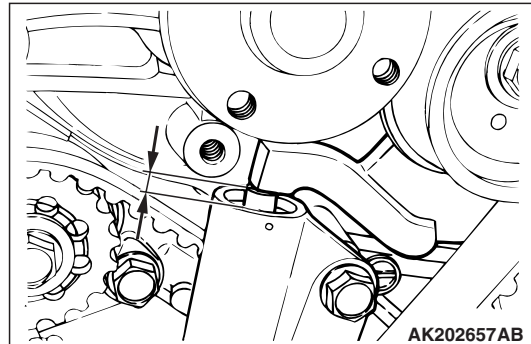
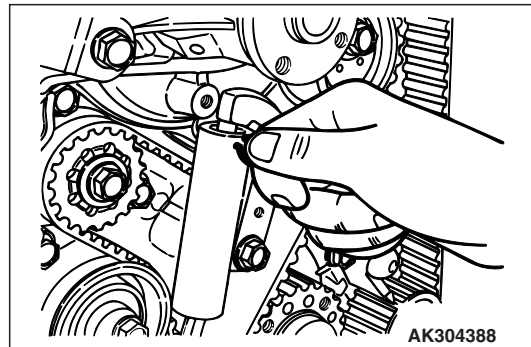
5. Check that the oil pump sprocket is in the correct phase as follows: Remove the plug from the cylinder block and insert a crosspoint screwdriver with a shank diameter of 8 mm through the hole. If it can be inserted 60 mm or more, the sprocket is in the correct phase. If the insertion depth is up to 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.



6. Install the timing belt on the crankshaft sprocket, idler pulley, camshaft sprocket, and tensioner pulley in that order.
7. Lift the tensioner pulley in the direction of the arrow and tighten the tensioner pulley bolt.
8. Check that all the timing marks are aligned.
9. Rotate the crankshaft counterclockwise a quarter (1/4) turn.



10. Install the special tool Tension pulley socket wrench (MD998767) on the tensioner pulley and attach a torque wrench to the tool.
11. Apply a torque of 3.5 N·m to the tensioner pulley using the torque wrench.
12. While holding the tensioner pulley to prevent it from rotating, tighten the center bolt to the specified torque.
13. Turn the crankshaft clockwise two turns, then let it alone for approx. 15 minutes.



14. Check that the wire that was inserted in the auto-tensioner when it was installed can be moved freely.

If the wire can be pulled freely, the belt tensioner is adjusted properly. Remove the wire. At that time, check that the auto-tensioner rod extends by the specified amount.

**Standard value: 3.8 – 4.5 mm**

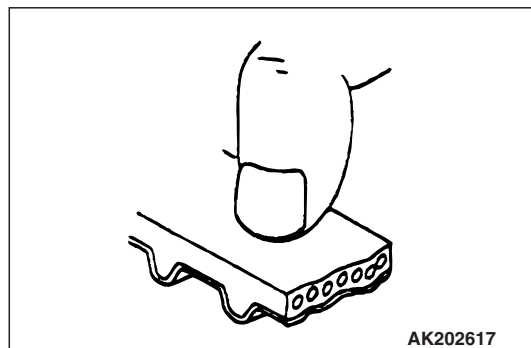
15. If the wire cannot be pulled out freely, perform the steps 10. through 13. again to make the belt tension proper.

## INSPECTION

M1113002000704

## TIMING BELT

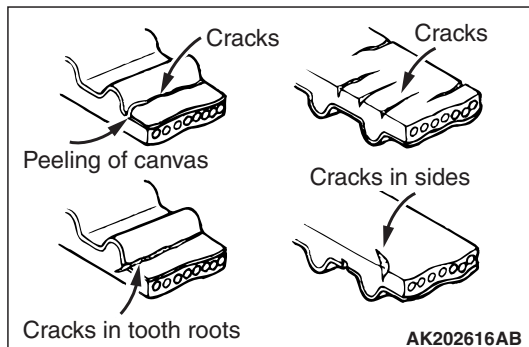
Check closely the entire timing belt and replace it if any of the following conditions is found.



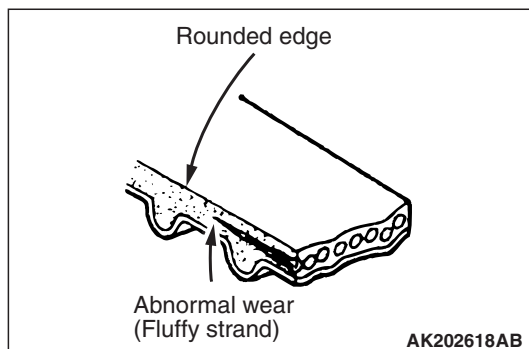
1. Hardened back side rubber

Back side surface is glossy, lacking in elasticity, and so hard that no impression is left when pressed with fingernail.

2. Cracks in back rubber surface.
3. Cracks in canvas.
4. Cracks in tooth roots.



5. Cracks in belt sides.



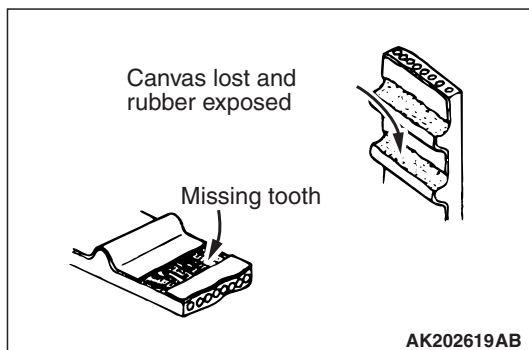
6. Abnormally worn belt sides;

*NOTE: belt sides are normal if they have "knife-cut" surfaces.*

7. Badly worn teeth

Initial stage: Canvas is worn (canvas fiber is fluffy; teeth look whitish due to worn-out rubber; canvas texture is unclear)

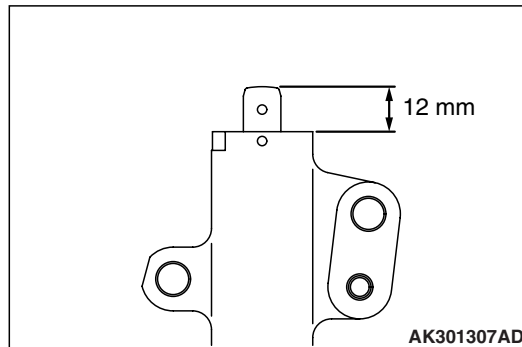
Second stage: Canvas is lost and rubber is exposed (tooth width narrows down)



8. Missing tooth.

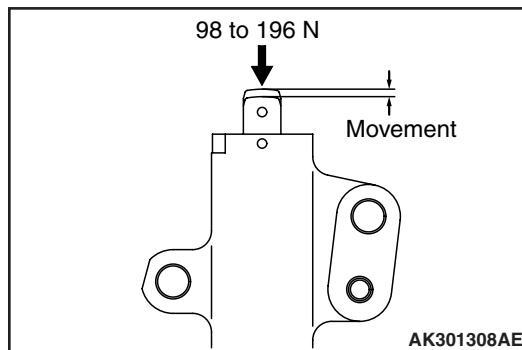
## AUTO-TENSIONER

1. Check the auto-tensioner for leaks; replace it if leaky.
2. Check the rod end for wear and other damage; replace the auto-tensioner if the rod is badly worn or damaged.



3. Measure the extension length of the rod. If it is not within the standard value range, replace the auto-tensioner.

**Standard value: 12.0 mm**



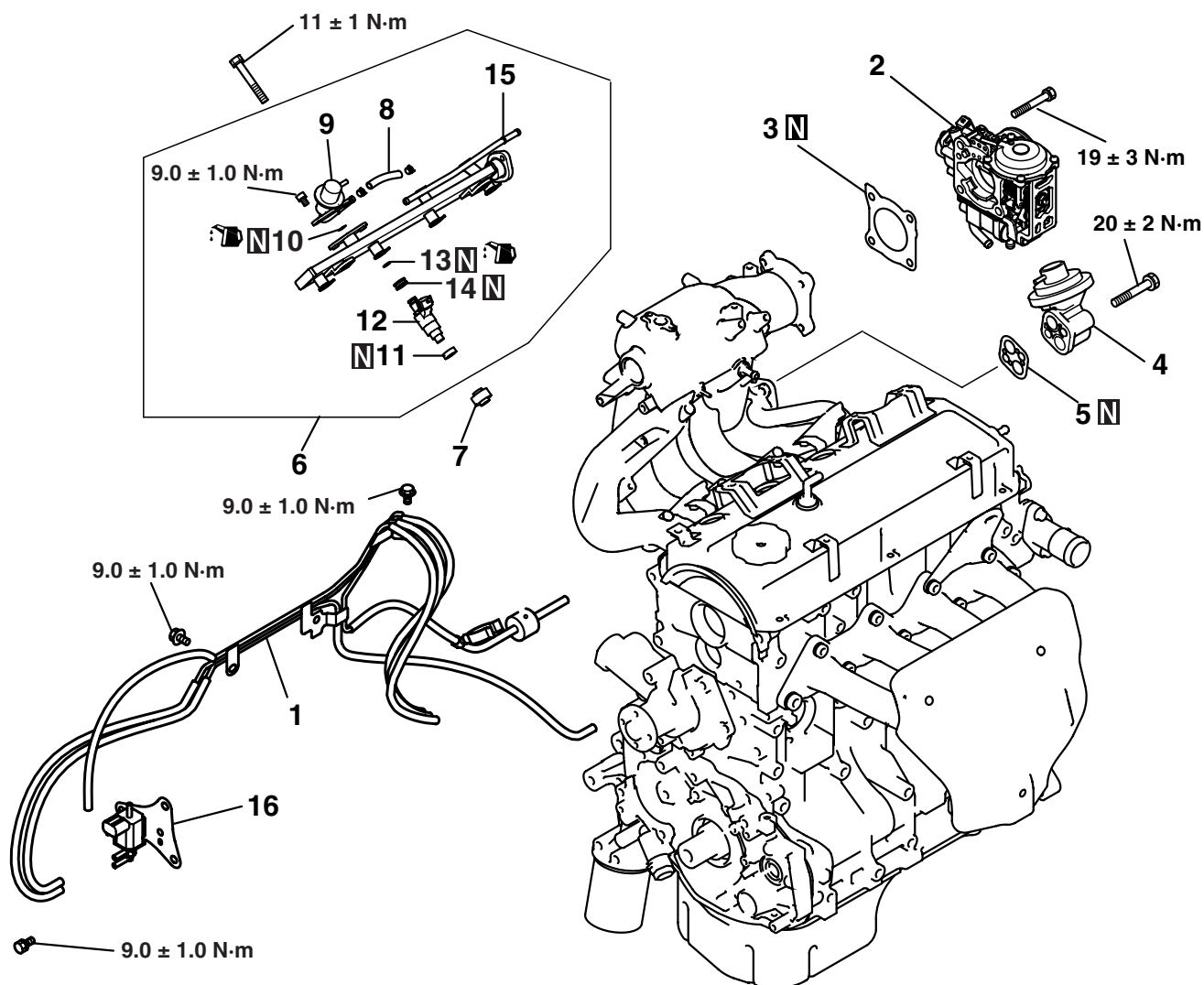
4. Press the rod with a force of 98 to 196 N and measure the amount of retraction. If the measurement exceeds the standard value, replace the auto-tensioner.

**Standard value: 1 mm maximum**

## FUEL AND EMISSION PARTS

## REMOVAL AND INSTALLATION

M1113002200991



AK401137AB

**Removal steps**

- >>C<<
1. Vacuum pipe and hose
  2. Throttle body
  3. Throttle body gasket
  4. EGR valve
  5. EGR gasket
  6. Delivery pipe and injector assembly
  7. Insulator
  8. Fuel hose

**Removal steps (Continued)**

- >>B<<
9. Fuel pressure regulator
  10. O-ring
  11. Insulator
- >>A<<
12. Injector
  13. O-ring
  14. Grommet
  15. Delivery pipe
  16. Solenoid valve



## INSTALLATION SERVICE POINTS

### >>A<< INJECTOR INSTALLATION

1. Apply a thin coat of fresh engine oil to the O-ring.
2. Insert the injector into the delivery pipe while turning it in both directions carefully not to damage the O-ring.

#### **⚠ CAUTION**

**Prevent engine oil from getting into the delivery pipe.**

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

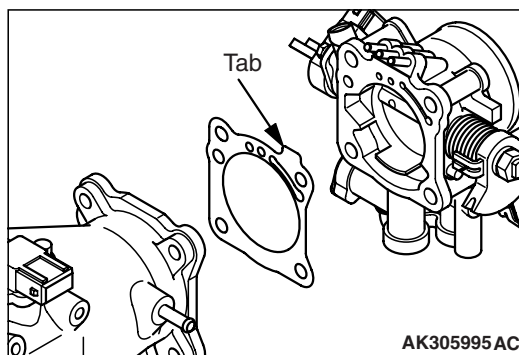
1. Apply a thin coat of fresh engine oil to the O-ring. Insert the fuel pressure regulator carefully not to damage the O-ring.
2. Insert the fuel pressure regulator into the delivery pipe while turning it in both directions carefully not to damage the O-ring.

#### **⚠ CAUTION**

**Prevent engine oil from getting into the delivery pipe.**

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

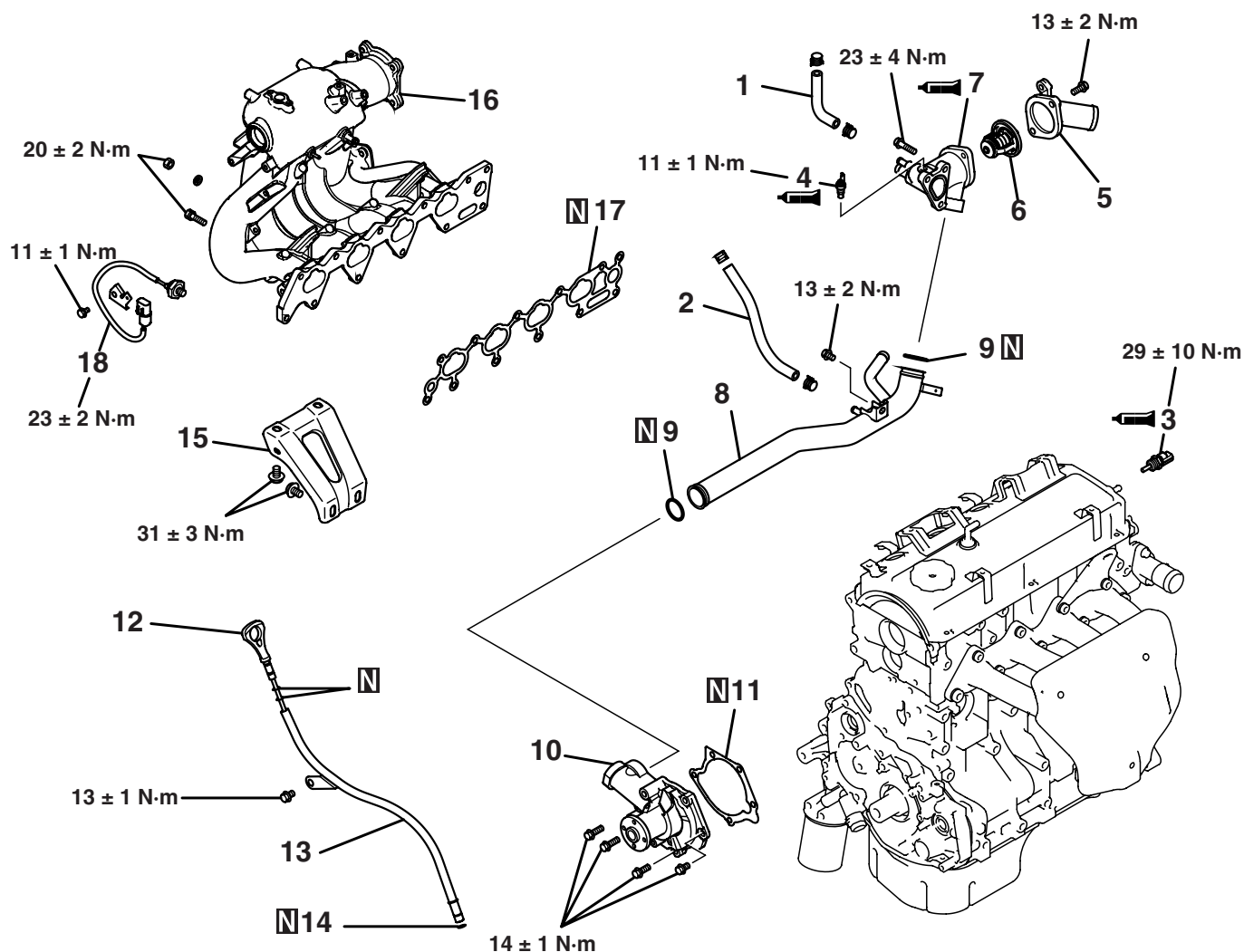


Install the throttle body gasket with its tab located as shown in the drawing.

## INTAKE MANIFOLD

## REMOVAL AND INSTALLATION

M1113002700479



AK401139AB

## Removal steps

1. Water hose
2. Water hose
- >>D<< 3. Engine coolant temperature sensor
- >>C<< 4. Engine coolant temperature gauge unit
5. Water inlet fitting
6. Thermostat
- >>B<< 7. Thermostat housing
- >>A<< 8. Water inlet pipe
- >>A<< 9. O-ring

## Removal steps (Continued)

10. Water pump
11. Gasket
12. Oil level gauge
13. Oil level gauge guide
14. O-ring
15. Intake manifold stay
16. Intake manifold
17. Intake manifold gasket
18. Detonation sensor

## INSTALLATION SERVICE POINTS

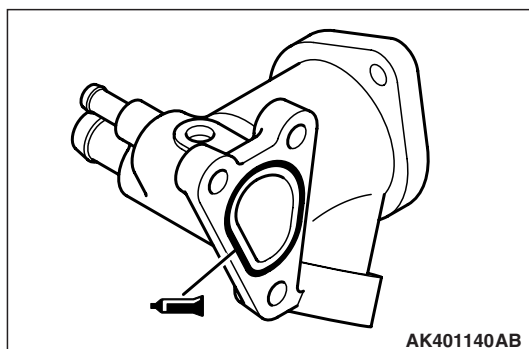
### >>A<< O-RING /WATER INLET PIPE INSTALLATION

Replace the O-rings of the water inlet pipe with new ones and wet the peripheries with water for easy insertion into the water pump and thermostat case.

#### CAUTION

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

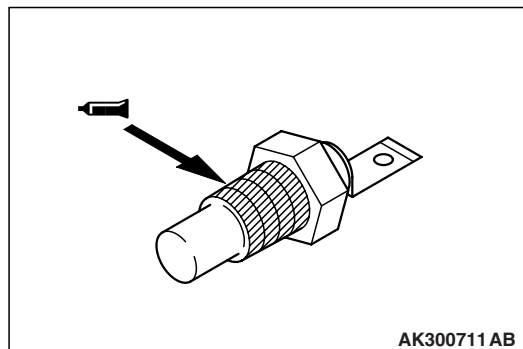
### >>B<< THERMOSTAT HOUSING INSTALLATION



Apply a 3 mm diameter bead of FIPG to the surface indicated in the drawing.

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

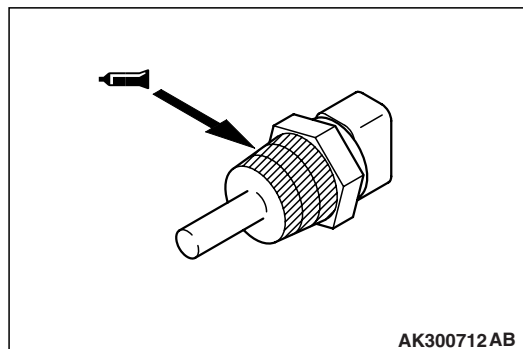
### >>C<< ENGINE COOLANT TEMPERATURE GAUGE UNIT INSTALLATION



If the engine coolant temperature gauge unit is to be reused, apply the specified sealant to its threads.

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

### >>D<< ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION



#### CAUTION

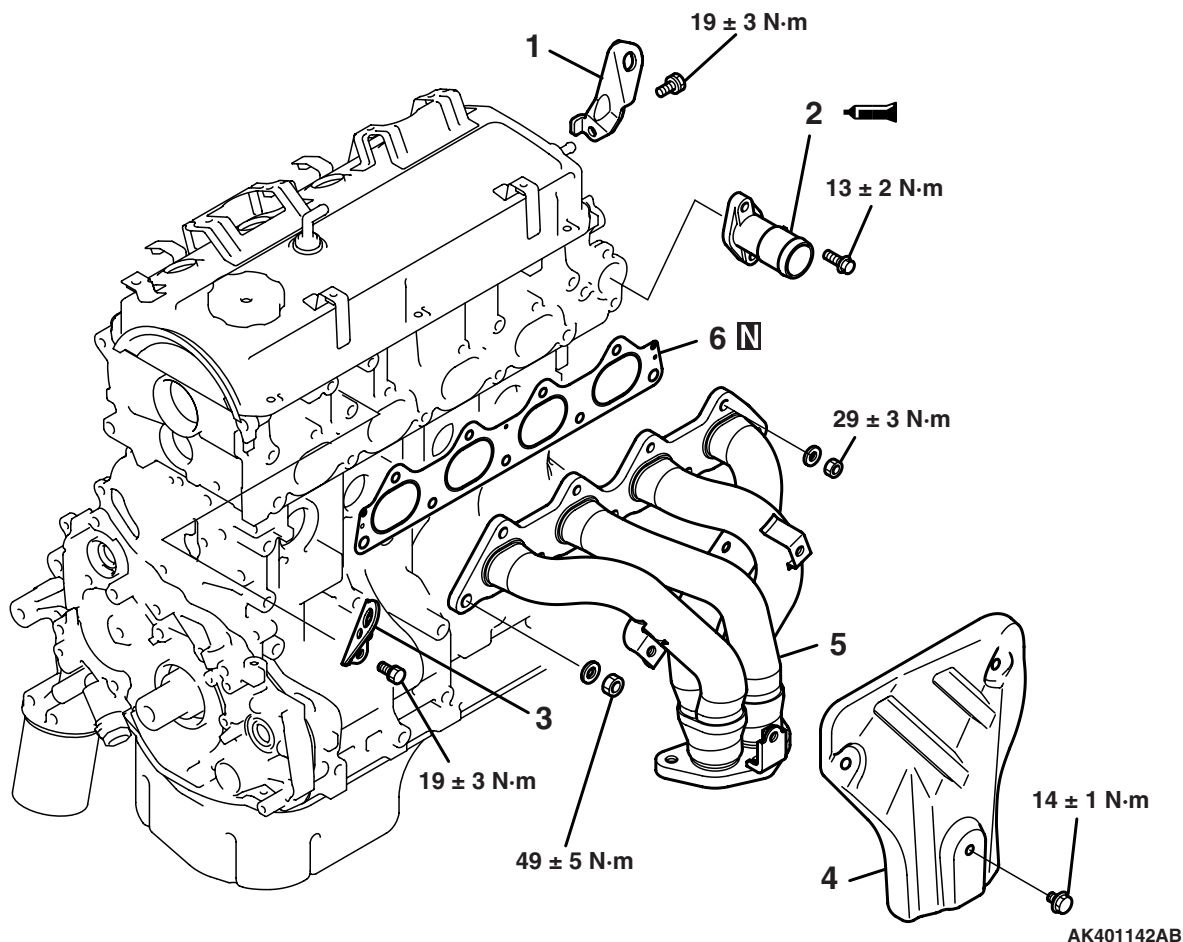
When using a tool, avoid letting it touch the connector which is made of plastic.

Apply the specified sealant to the threads of the sensor.

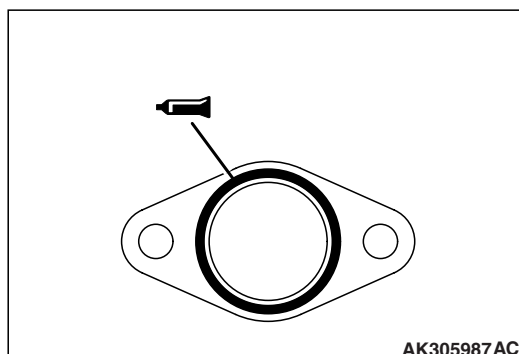
**Specified sealant:**  
**3M ATD Part No.8660 or equivalent**

**EXHAUST MANIFOLD****REMOVAL AND INSTALLATION**

M1113004900996

**Removal steps**

- >>A<<
1. Engine hanger
  2. Water outlet fitting
  3. Engine hanger
  4. Exhaust manifold cover
  5. Exhaust manifold
  6. Exhaust manifold gasket

**INSTALLATION SERVICE POINTS****>>A<< EXHAUST MANIFOLD BRACKET  
INSTALLATION**

Apply a 3 mm diameter bead of FIPG to the surface shown in the drawing.

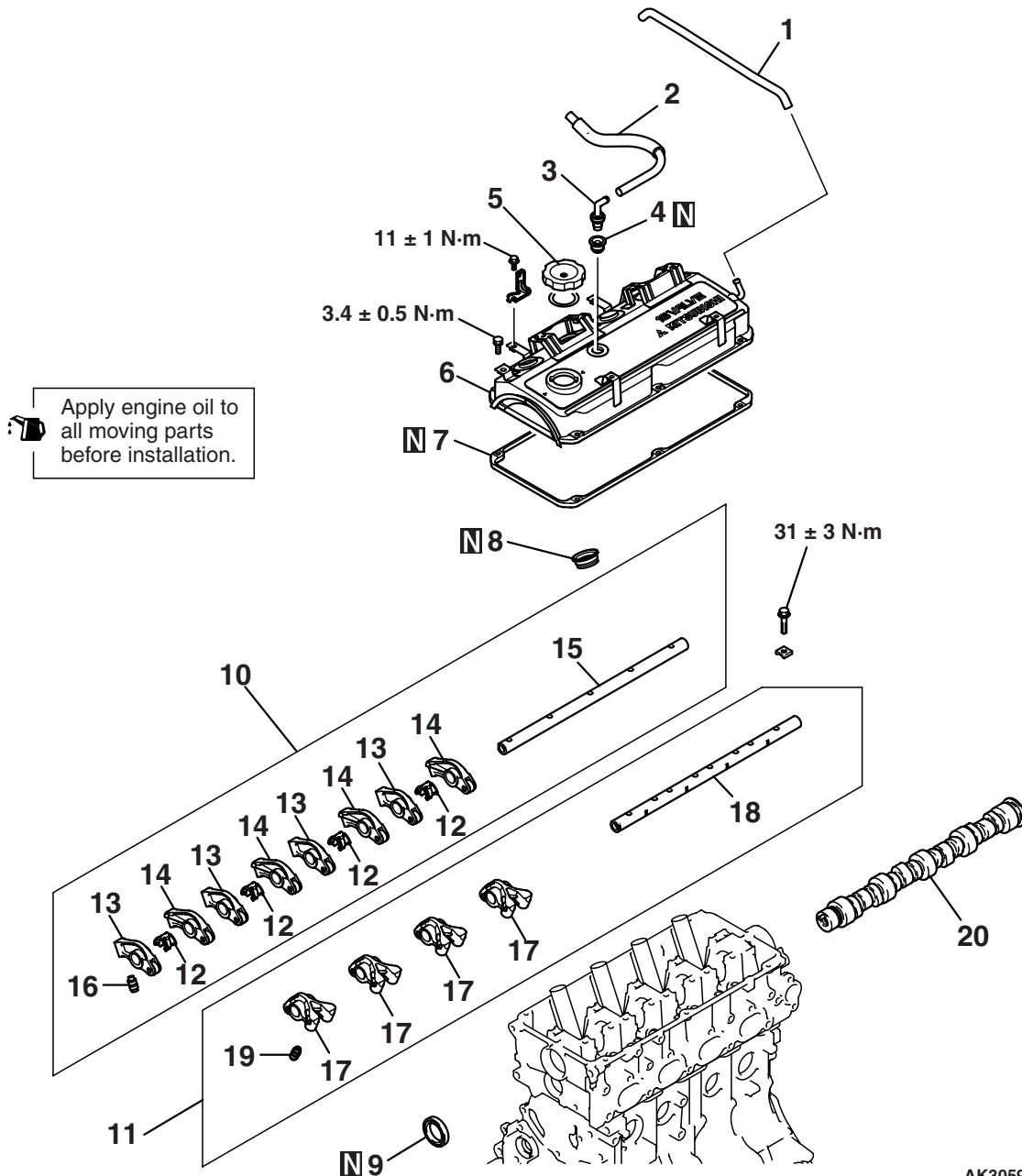
**Specified sealant:**

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

# ROCKER ARMS AND CAMSHAFT

## REMOVAL AND INSTALLATION

M1113005400905



AK305923AB

### Removal steps

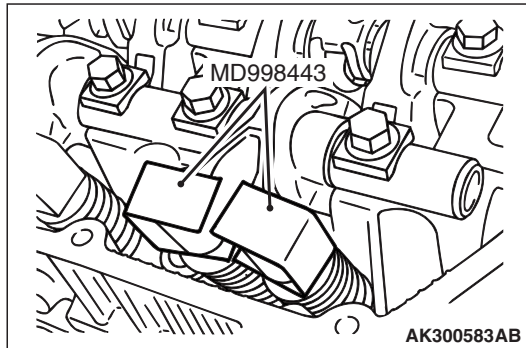
1. Breather hose
2. Positive crankcase ventilation (PCV) hose
3. Positive crankcase ventilation (PCV) valve
4. Positive crankcase ventilation (PCV) valve gasket
5. Oil filler cap
6. Rocker cover
7. Rocker cover gasket
8. Oil seal
9. Oil seal

### Removal steps (Continued)

- |       |       |                                      |
|-------|-------|--------------------------------------|
| <<A>> | >>B<< | 10. Rocker arms and rocker arm shaft |
| <<A>> | >>B<< | 11. Rocker arms and rocker arm shaft |
|       | >>B<< | 12. Rocker shaft spring              |
|       |       | 13. Rocker arm A                     |
|       |       | 14. Rocker arm B                     |
|       |       | 15. Rocker arm shaft                 |
|       | >>A<< | 16. Lash adjuster                    |
|       |       | 17. Rocker arm C                     |
|       |       | 18. Rocker arm shaft                 |
|       | >>A<< | 19. Lash adjuster                    |
|       |       | 20. Camshaft                         |

>>C<<

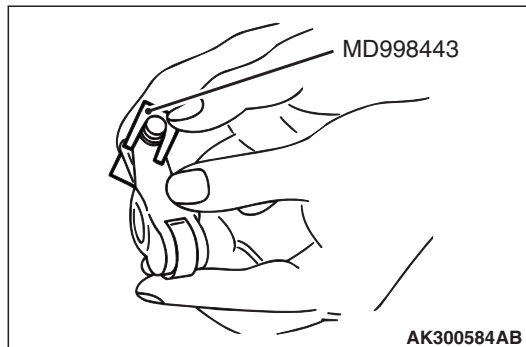
## REMOVAL SERVICE POINTS

<<A>> ROCKER ARMS AND ROCKER  
ARM SHAFT REMOVAL

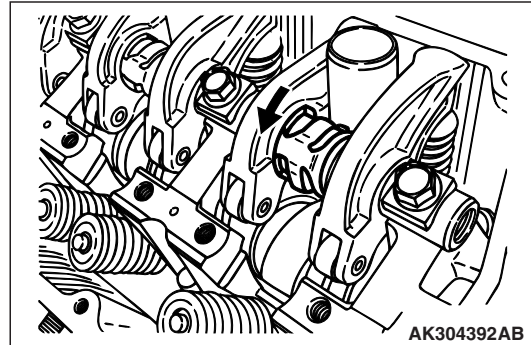
Attach the special tool Lash adjuster holder (MD998443) to retain the lash adjusters during removal operation.

## INSTALLATION SERVICE POINTS

## &gt;&gt;A&lt;&lt; LASH ADJUSTER INSTALLATION

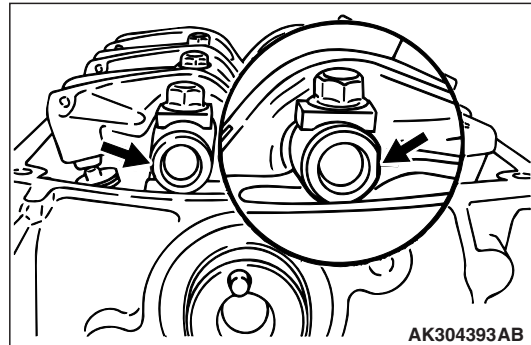


Install the lash adjuster into the rocker arm, being careful not to spill the diesel fuel it contains. Retain the installed lash adjuster with the special tool Lash adjuster holder (MD998443).

>>B<< ROCKER ARMS AND ROCKER  
ARM SHAFT/ROCKER SHAFT SPRING  
INSTALLATION

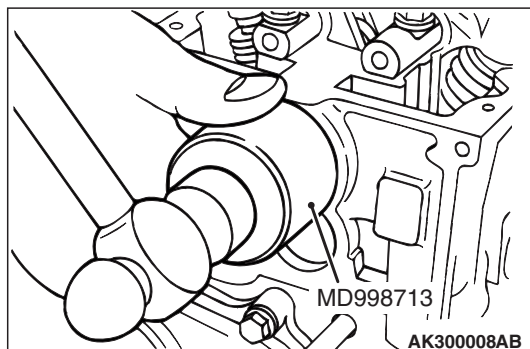
1. Install the rocker arm shaft by loosely fastening the bolts such that any of the intake valve rocker arms does not push the valve.
2. Fit each rocker shaft spring from above and make it at right angles to the plug guide.

*NOTE: Install the rocker shaft springs before installing the exhaust valve rocker arms and rocker arm shaft.*



3. Remove the special tool Camshaft lash adjuster holder (MD998443) retaining each lash adjuster.
4. Make sure that the flat portion on the rocker arm shaft faces in the direction shown in the drawing.

## >>C<< CAMSHAFT OIL SEAL INSTALLATION

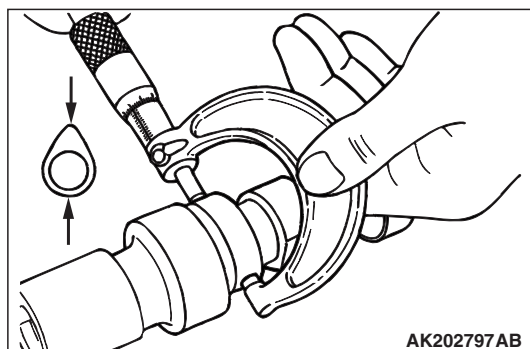


Use the special tool camshaft oil seal installer (MD998713) to drive each oil seal into position in the cylinder head.

## INSPECTION

M1113005500968

### CAMSHAFT



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

#### Standard values:

Intake : 37.39 mm

Exhaust : 36.83 mm

#### Limits:

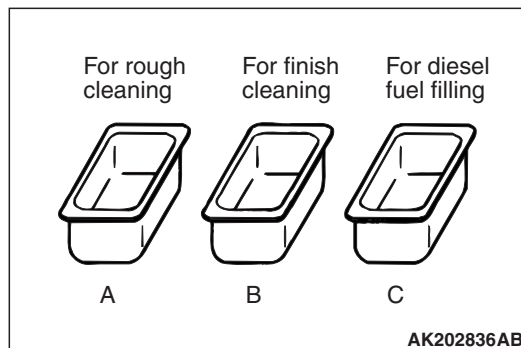
Intake : 36.89 mm

Exhaust : 36.33 mm

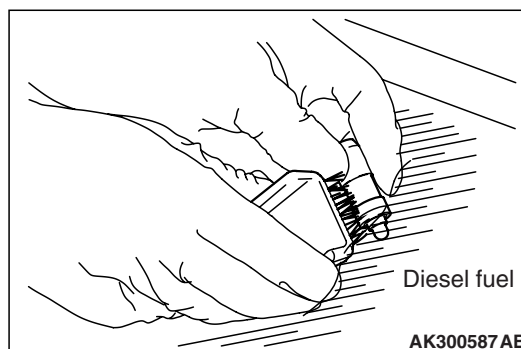
## LASH ADJUSTERS

### ⚠ CAUTION

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

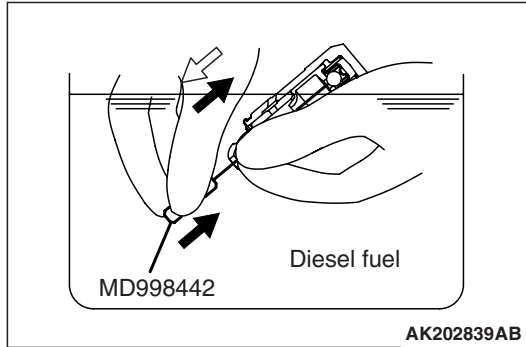


1. Prepare three containers and approximately five liters of diesel fuel. Pour into each container the diesel fuel in an amount enough for a lash adjuster placed in the container in its upright position to completely submerge.



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

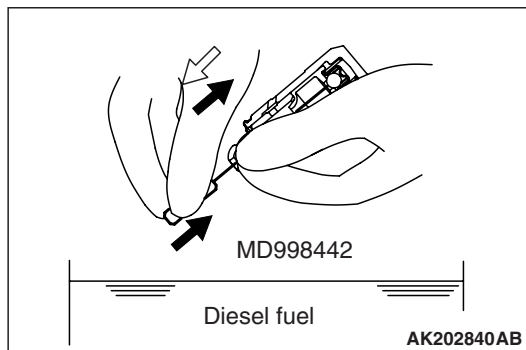
*NOTE: Use a nylon brush if there are hard-to-remove deposits.*

**⚠ CAUTION**

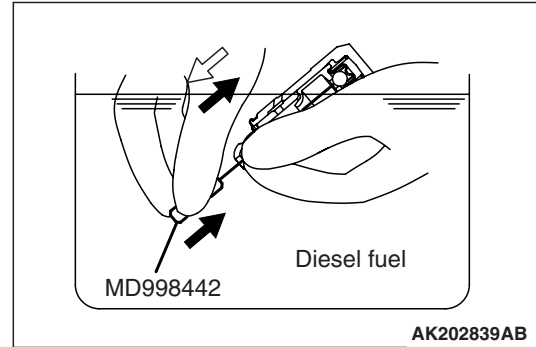
The steel ball spring of the lash adjuster is extremely weak. The lash adjuster's functionality may be badly affected if the special tool is inserted too strongly.

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.*

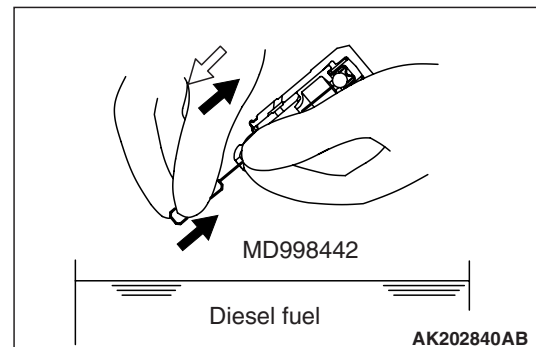


4. Take the lash adjuster out of the container, then move the plunger by pushing the steel ball gently to discharge the diesel fuel from the pressure chamber.

**⚠ 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.

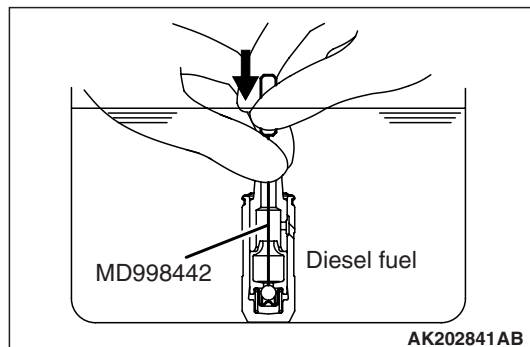
5. Soak the lash adjuster in the diesel fuel in container B. Move the plunger in and out 5 – 10 times by gently pushing the internal steel ball using the special tool Air bleed wire (MD998442) until the plunger moves smoothly to wash the lash adjuster's pressure chamber.



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.

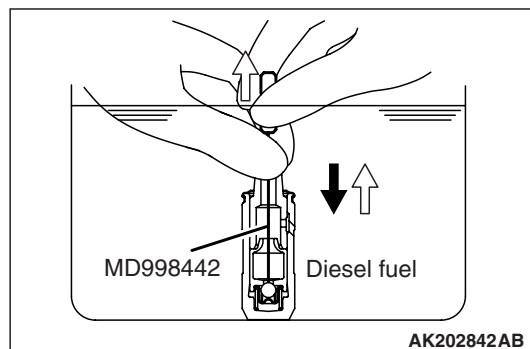


**CAUTION**

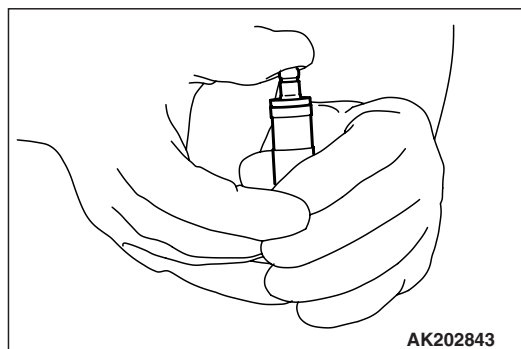


**Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when the chamber is filled with diesel fuel.**

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.



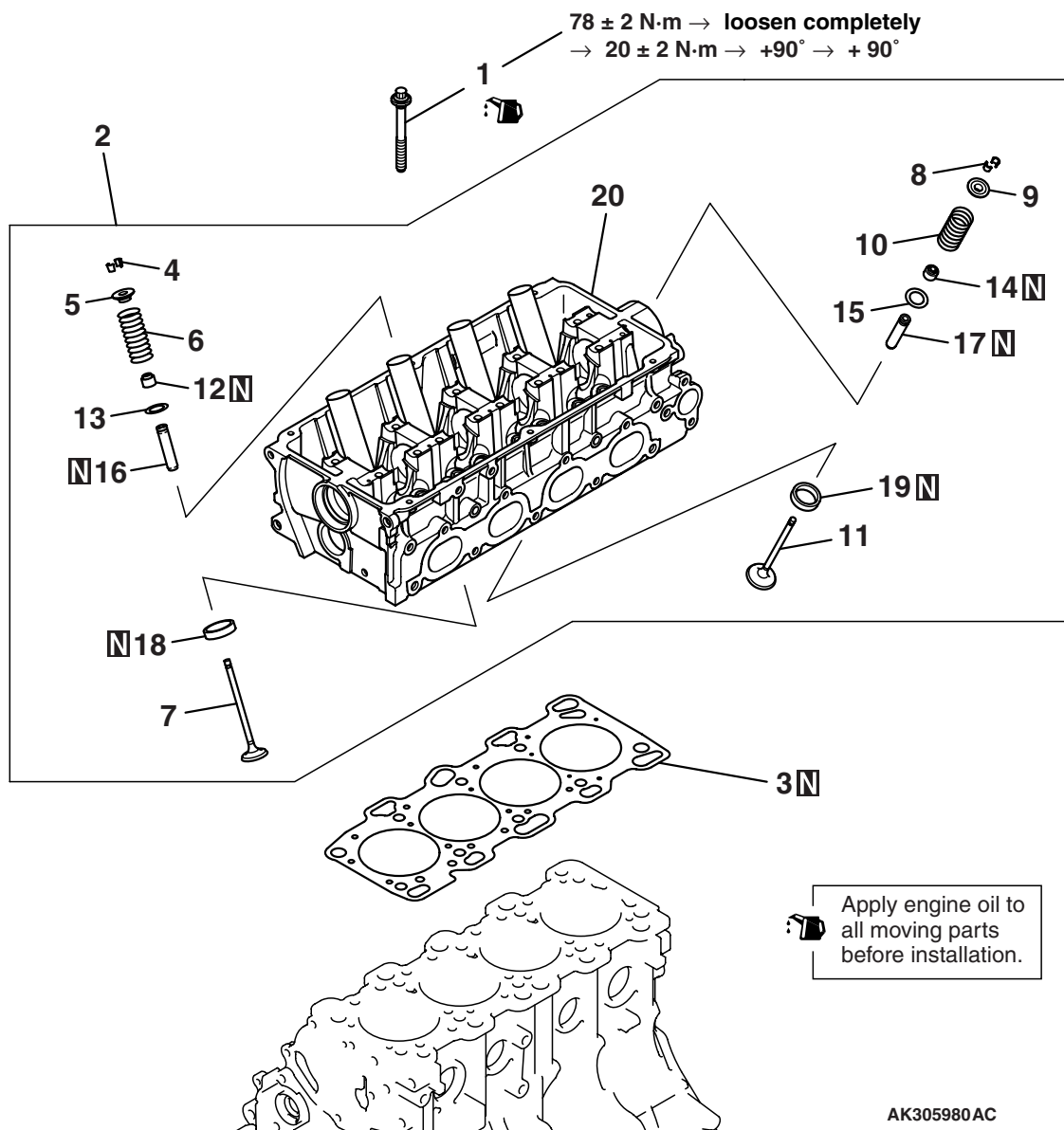
*NOTE: If the lash adjuster contracts, perform the operations 7. through 9. again. Replace the lash adjuster if it still contracts even after the pressure chamber has completely been filled with diesel fuel (air has been bled).*

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.
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

M1113006900828



AK305980AC

## Removal steps

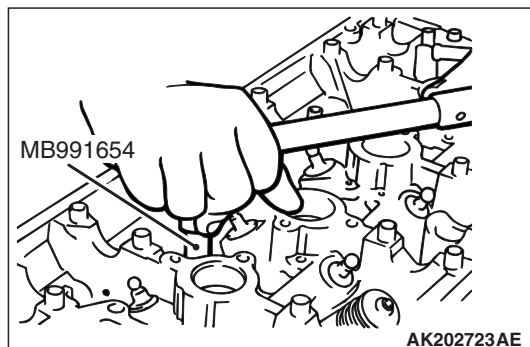
- <<A>> >>D<< 1. Cylinder head bolt  
2. Cylinder head assembly  
3. Cylinder head gasket  
<<B>> >>C<< 4. Retainer lock  
5. Valve spring retainer  
    >>B<< 6. Valve spring  
7. Intake valve  
<<B>> >>C<< 8. Retainer lock  
9. Valve spring retainer  
    >>B<< 10. Valve spring

## Removal steps (Continued)

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

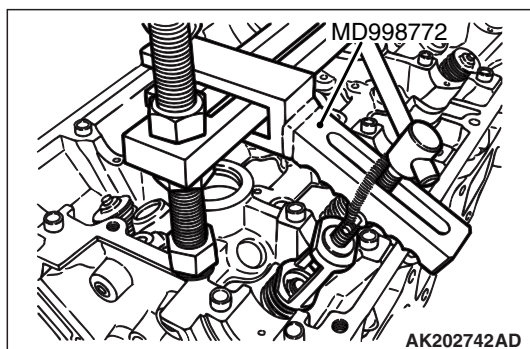
## REMOVAL SERVICE POINTS

### <<A>> CYLINDER HEAD BOLT REMOVAL



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

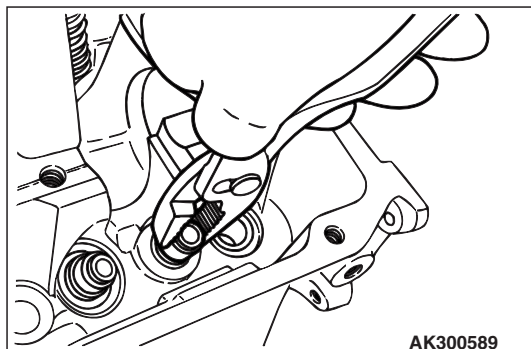
### <<B>> RETAINER LOCK REMOVAL



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.*

### <<C>> VALVE STEM SEAL REMOVAL

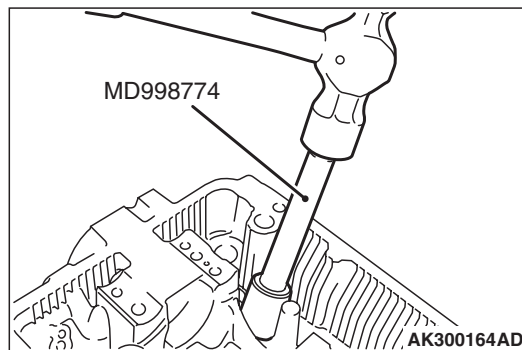


#### ⚠ CAUTION

Do not reuse any removed stem seal.

## INSTALLATION SERVICE POINTS

### >>A<< VALVE STEM SEAL INSTALLATION

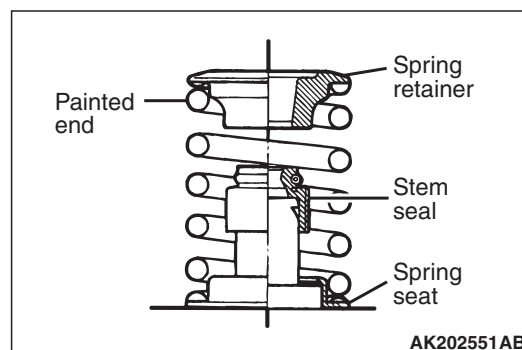


1. Install the valve spring seat.

#### ⚠ CAUTION

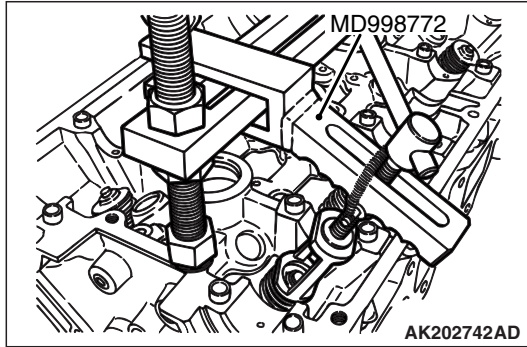
- Do not reuse any removed valve stem seal.
  - The special tool must always be used when installing the valve stem seal. Improper installation could result in oil leaks past the valve guide.
2. Use the special tool Valve stem seal installer (MD998774) to install a new stem seal on the valve guide.

### >>B<< VALVE SPRING INSTALLATION



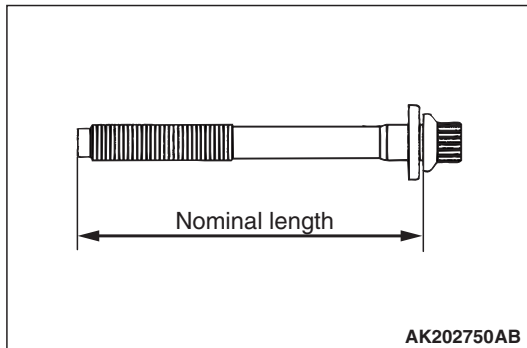
Install each valve spring with the painted end toward the rocker arm.

## &gt;&gt;C&lt;&lt; RETAINER LOCK INSTALLATION

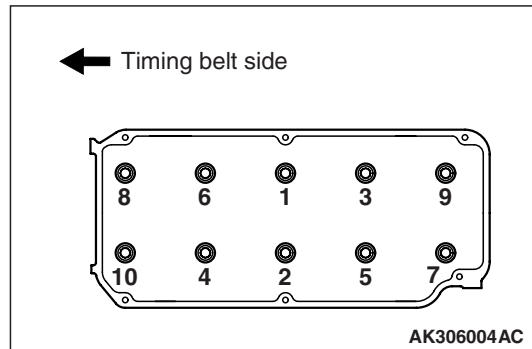


Compress the the valve spring using the special tool Valve spring compressor (MD998772), then install the retainer lock.

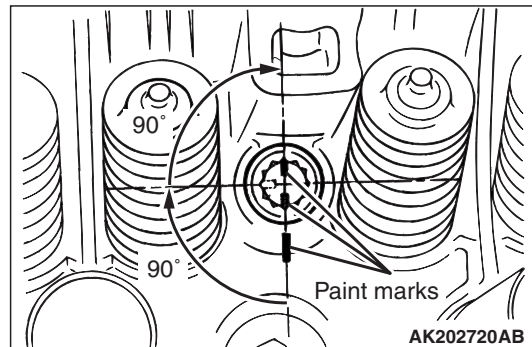
## &gt;&gt;D&lt;&lt; CYLINDER HEAD BOLT INSTALLATION



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.



3. Use the special tool Cylinder head bolt wrench (MB991654) to tighten the bolts to the specified torque in the indicated sequence.  
**Tightening torque:  $78 \pm 2$  N·m**
4. Loosen all the bolts completely.
5. Tighten the bolts again to a torque of  $20 \pm 2$  N·m in the indicated sequence.
6. Make paint marks on each bolt's head and on the cylinder head.



7. Turn the bolts  $90^\circ$  in the tightening direction and in the indicated sequence.
8. Give another  $90^\circ$  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.

**CAUTION**

- If the tightening angle is smaller than the specified angle, proper fastening performance could not be assured. Be sure to respect the angle indicated above.
- 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.

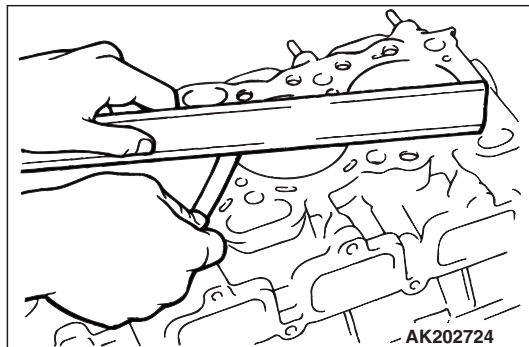
## INSPECTION

M1113007000732

### 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 0.03 mm

**Limit:** 0.2 mm

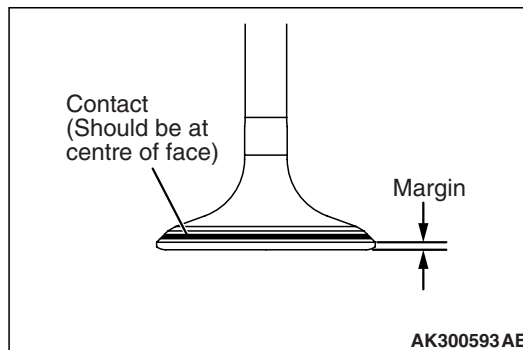
**Grinding limit:** 0.2 mm

**Cylinder head height (standard value for new part):**

119.1 – 120.1 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. Replace the valve if its margin is smaller than the limit.

#### Standard values:

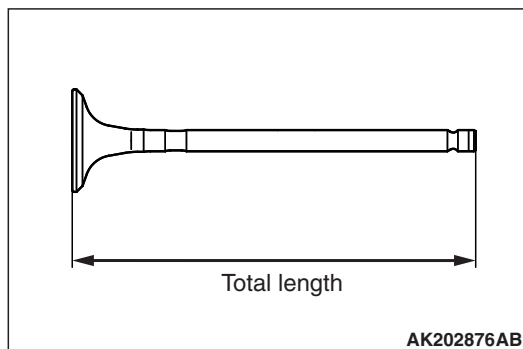
**Intake** 1.0 mm

**Exhaust** 1.2 mm

#### Limits:

**Intake** 0.5 mm

**Exhaust** 0.7 mm



3. Measure the total length of the valve. Replace the valve if the length is less than the limit.

#### Standard values:

**Intake** 112.30 mm

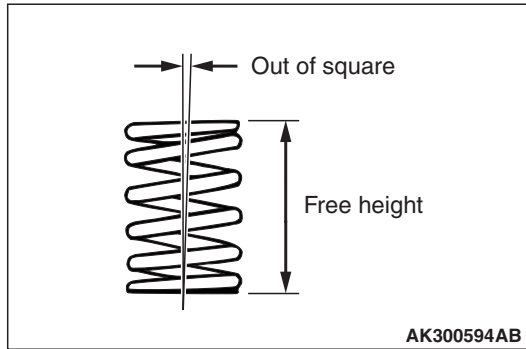
**Exhaust** 114.11 mm

#### Limits:

**Intake** 111.80 mm

**Exhaust** 113.61 mm

## VALVE SPRINGS



1. Measure the free height of the spring. Replace the spring if its height is smaller than the limit.

**Standard value: 50.8 mm**

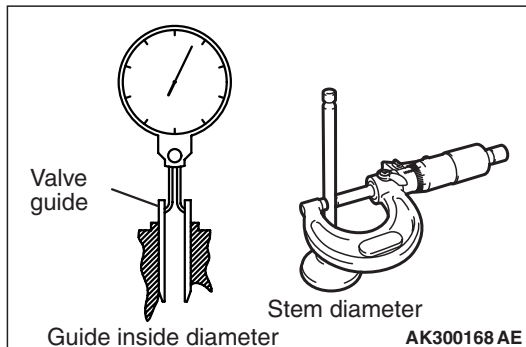
**Limit: 49.8 mm**

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

**Standard value: 2° or smaller**

**Limit: 4°**

## VALVE GUIDE



Measure the valve guide de 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**

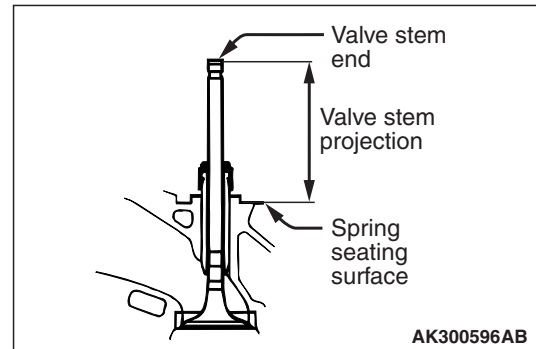
**Exhaust 0.04 – 0.07 mm**

**Limits:**

**Intake 0.10 mm**

**Exhaust 0.15 mm**

## VALVE SEATS



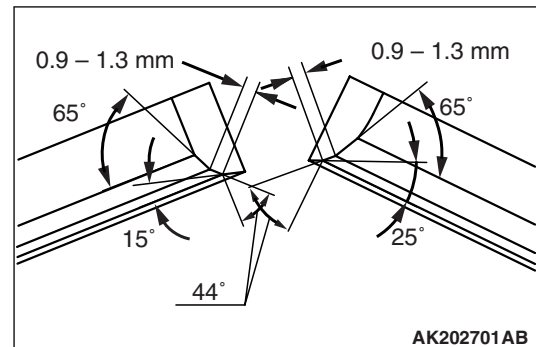
With the valve installed in position and its face pressed against the valve seat, measure the valve stem projection (distance between the valve stem end and spring seating surface). If the measurement exceeds the limit, replace the valve seat.

**Standard value: 49.30 mm**

**Limit: 48.90 mm**

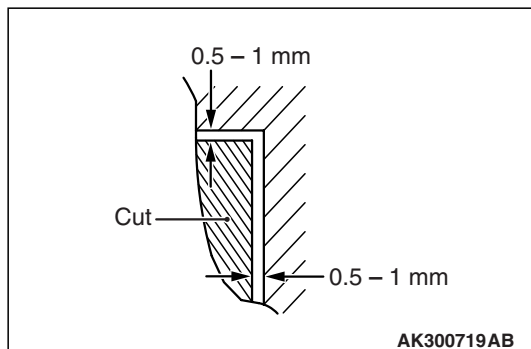
## VALVE SEAT RECONDITIONING

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

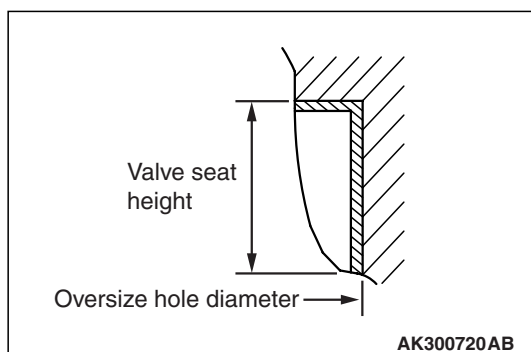


2. Resurface the valve seat to the indicated width and angles.
3. After resurfacing, lap the valve and valve seat using lapping compound. Then, check the valve stem projection (refer to 5. VALVE SEATS in the INSPECTION section).

## 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 diameter:

**0.3 oversize: 34.30 – 34.33 mm**

**0.6 oversize: 34.60 – 34.63 mm**

### Exhaust valve seat hole diameter:

**0.3 oversize: 31.80 – 31.83 mm**

**0.6 oversize: 32.10 – 34.13 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. Refer to, the VALVE SEAT RECONDITIONING section.

## VALVE GUIDE REPLACEMENT

1. Force out the valve guide toward the cylinder block using a press.
2. Machine the valve guide hole in the cylinder head to the size matched to the selected oversize valve guide.

### ⚠ CAUTION

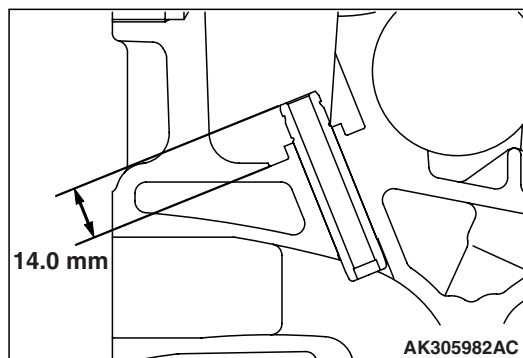
**Do not use a replacement valve guide of the same size as the removed one.**

### Valve guide hole diameters

**0.05 oversize: 11.05 – 11.07 mm**

**0.25 oversize: 11.25 – 11.27 mm**

**0.50 oversize: 11.50 – 11.52 mm**



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

**Standard value: 14.0 mm**

### 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.

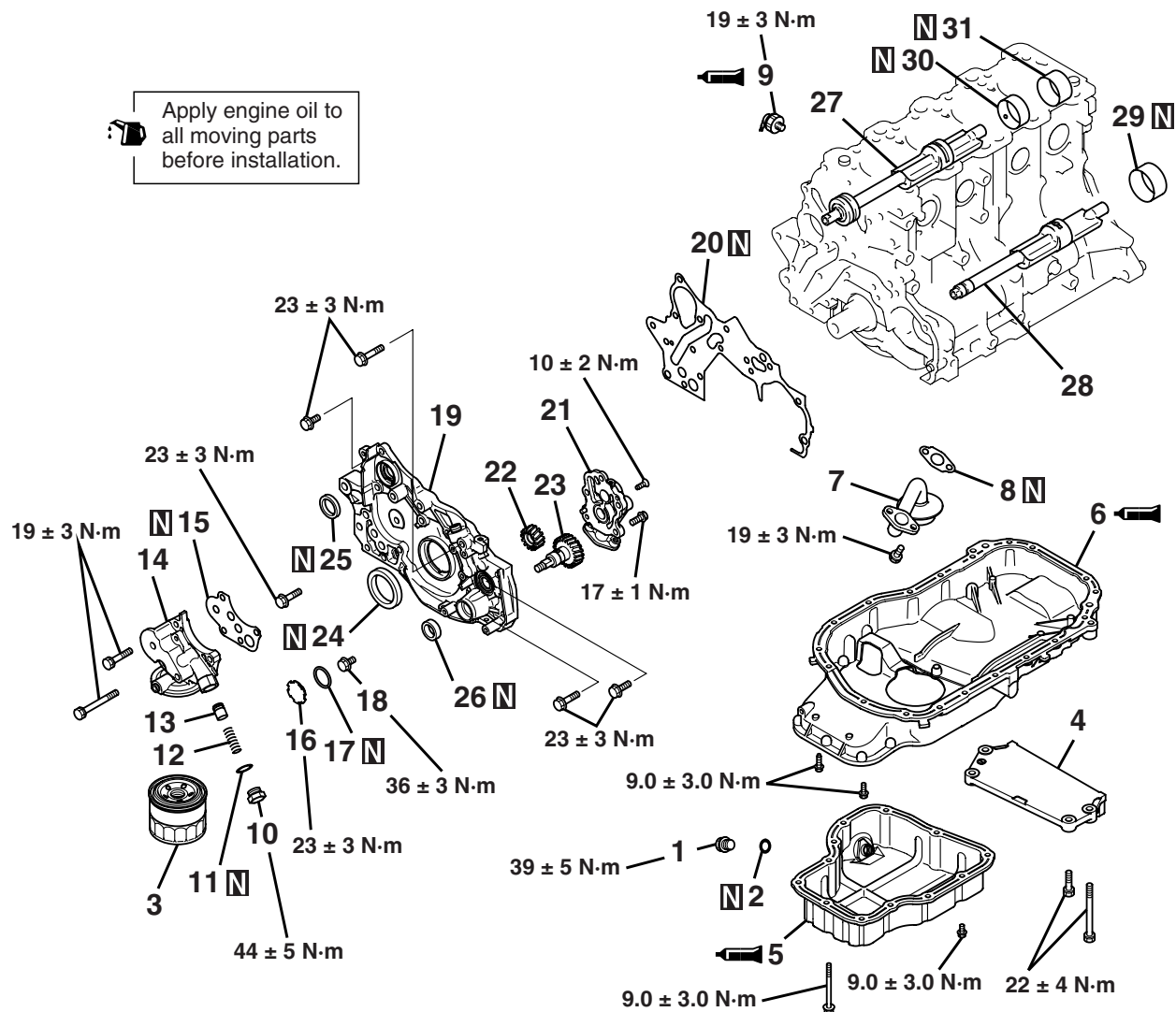


## OIL PAN AND OIL PUMP

## REMOVAL AND INSTALLATION

M1113008100925

Apply engine oil to  
all moving parts  
before installation.



AK501651AB

## Removal steps

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

## Removal steps (Continued)

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



Removal steps (Continued)

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

## REMOVAL SERVICE POINTS

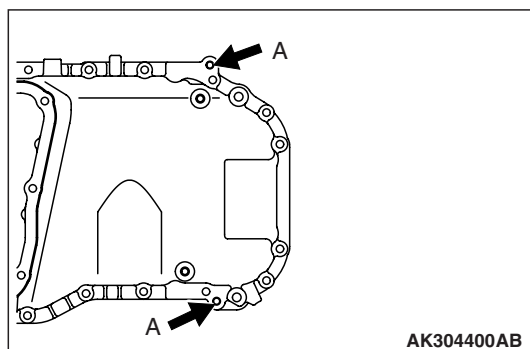
### <<A>> OIL PAN LOWER SECTION REMOVAL

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.

### <<B>> OIL PAN UPPER SECTION REMOVAL

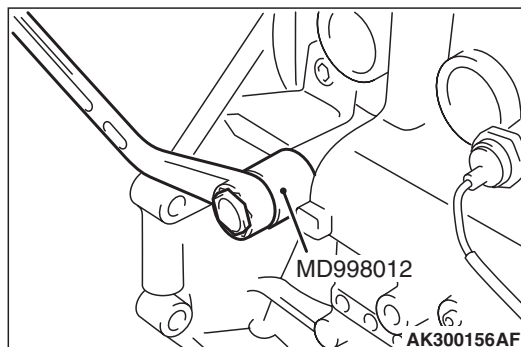


Screw bolts into the bolt holes A shown in the drawing (holes at both ends) to remove the oil pan.

**CAUTION**

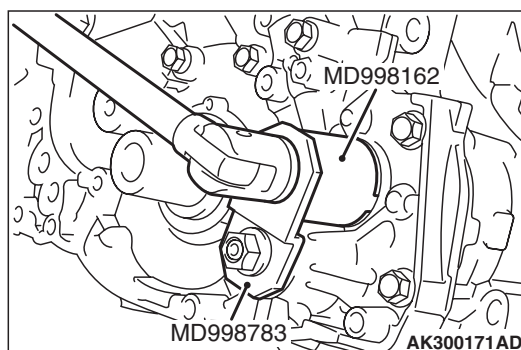
Do not use a scraper or the special tool to remove the oil pan.

### <<C>> ENGINE OIL PRESSURE SWITCH REMOVAL



Using special tool Oil pressure switch socket wrench (MD998012), removal the engine oil pressure switch.

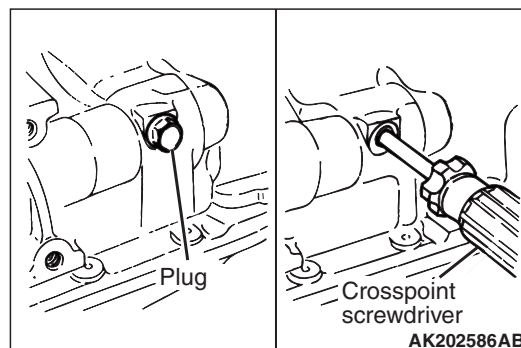
### <<D>> PLUG REMOVAL



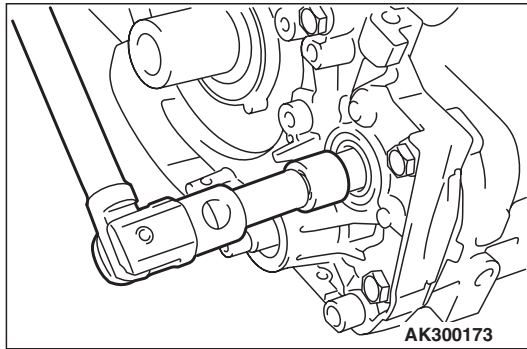
Fit the teeth of the special tool in notches of the plug as shown in the drawing and support the tool with the special tool to loosen the plug.

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

### <<E>> FLANGE BOLT REMOVAL



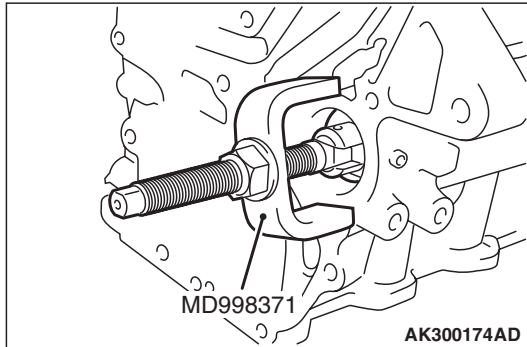
1. Remove the plug on the left side of the cylinder block. Insert a cross point screwdriver (shank diameter 8 mm) into the plug hole more than 60 mm to prevent the left counterbalancer shaft from rotating.



- Loosen and remove the flange bolt.

## <<F>> COUNTERBALANCER SHAFT FRONT BEARING REMOVAL

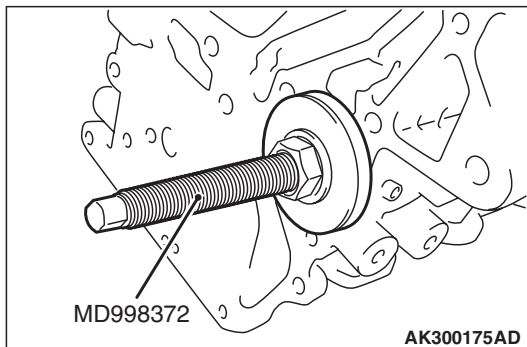
**CAUTION**



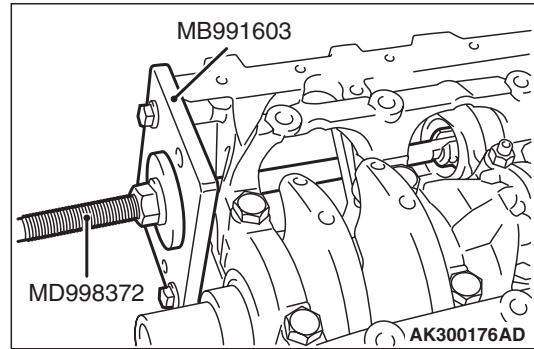
**Remove the front bearing first. Otherwise, the special tool cannot be used.**

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



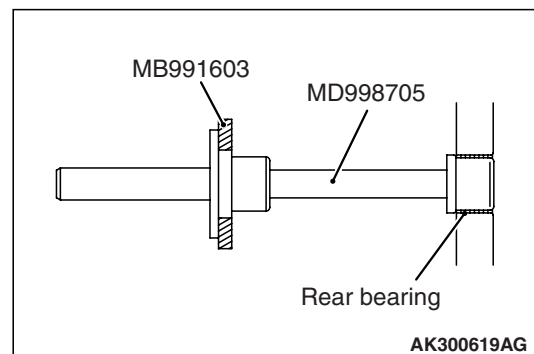
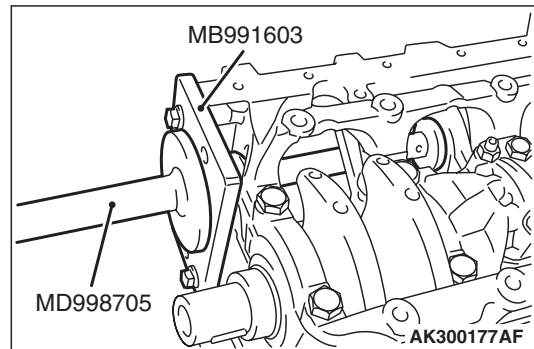
- Use the special tool Silent shaft bearing puller (MD998372) to remove the counterbalancer shaft rear bearings from the cylinder block.



- 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

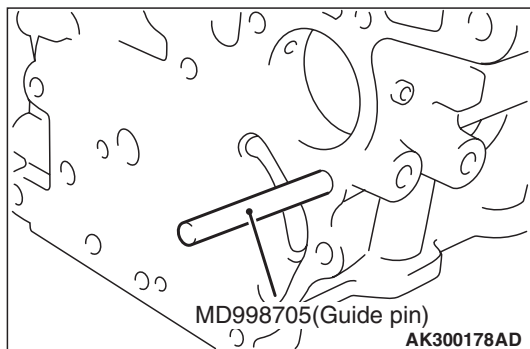
### >>A<< LEFT COUNTERBALANCER SHAFT REAR BEARING INSTALLATION



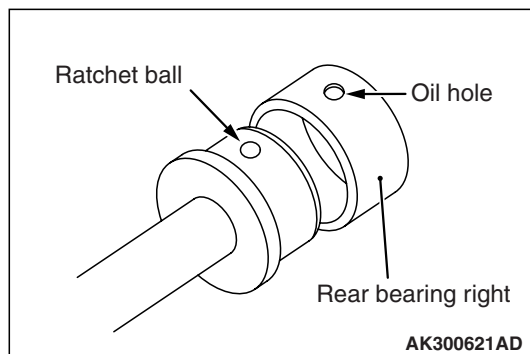
- Install special tool Silent shaft bearing installer stopper (MB991603) to the cylinder block.
- Apply engine oil to the rear bearing outer surface and bearing hole in the cylinder block.
- Using special tool Silent shaft bearing installer (MD998705), install the rear bearing.

**NOTE:** The left rear bearing has no oil holes.

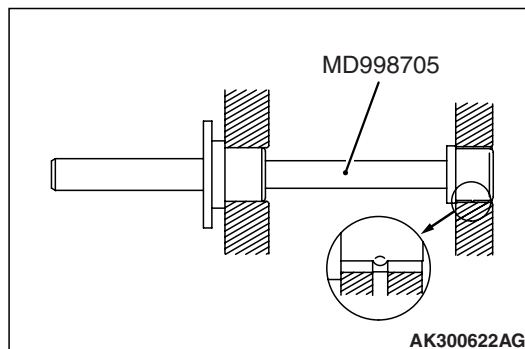
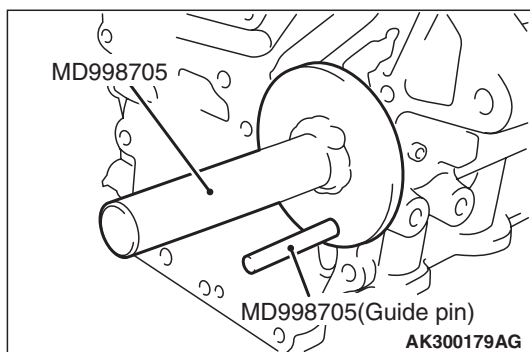
## >>B<< RIGHT COUNTERBALANCER SHAFT REAR BEARING INSTALLATION



1. Install the guide pin of the Silent shaft bearing installer (MD998705) in the threaded hole of the cylinder block as shown.

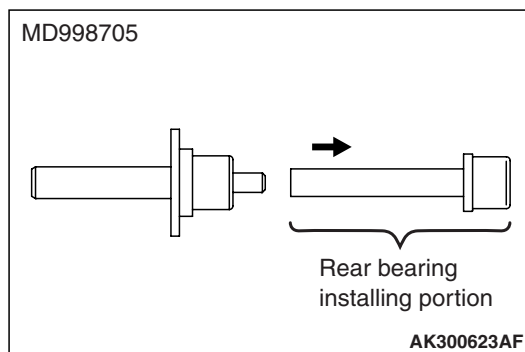


2. Align the ratchet ball of the special tool with the oil hole in the rear bearing to install the bearing of the special tool.
3. Apply engine oil to the bearing outer surface and bearing hole in the cylinder block.

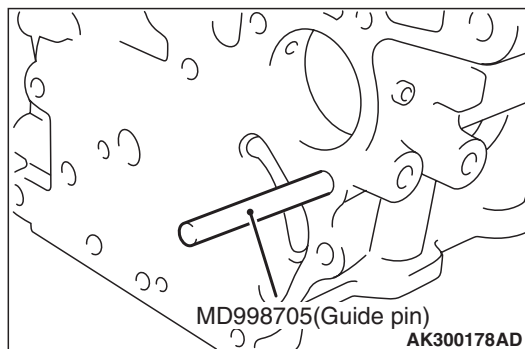


4. Using special tool Silent shaft bearing installer (MD998705), install the rear bearing. Make sure that the oil hole of the bearing is aligned with the oil hole of the cylinder block.

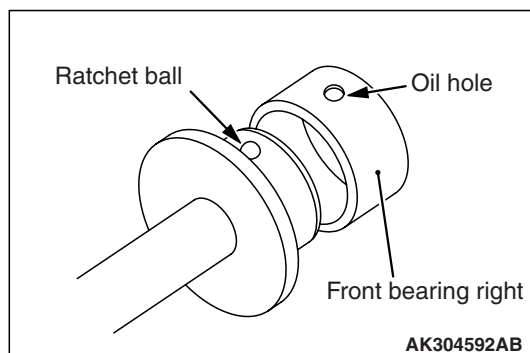
## >>C<< COUNTERBALANCE SHAFT FRONT BEARING INSTALLATION



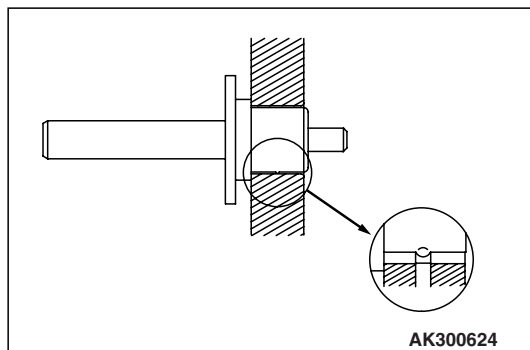
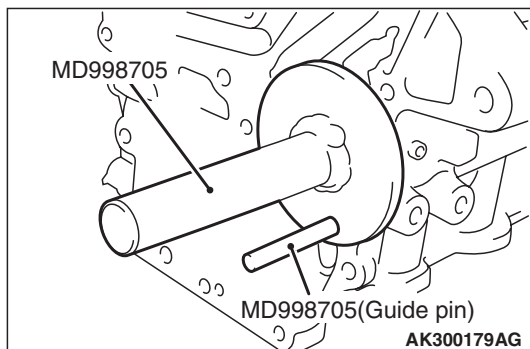
1. Remove the rear bearing installing portion from the special tool Silent shaft bearing installer (MD998705).



2. Install the guide pin of the Silent shaft bearing installer (MD998705) in the threaded hole of the cylinder block as shown.

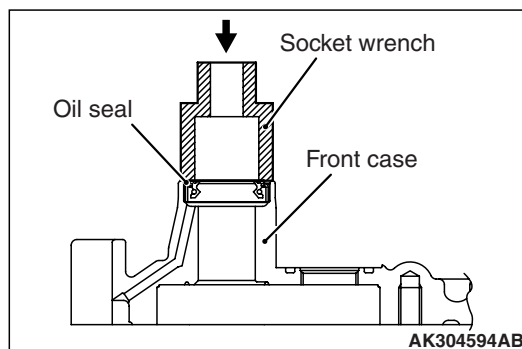


3. Align the ratchet ball of the special tool with the oil hole in the rear bearing to install the bearing of the special tool.
4. Apply engine oil to the front bearing outer surface and bearing hole in the cylinder.



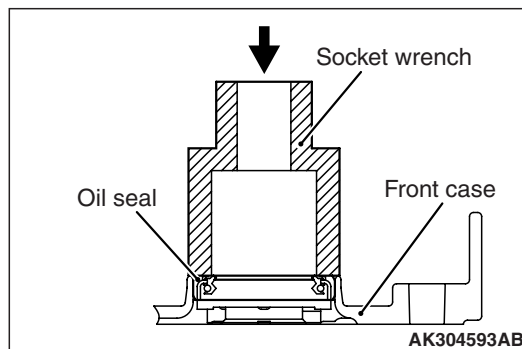
5. Using special tool Silent shaft bearing installer (MD998705), install the rear bearing. Make sure that the oil hole of the bearing is aligned with the oil hole of the cylinder block.

### >>D<< OIL PUMP OIL SEAL INSTALLATION



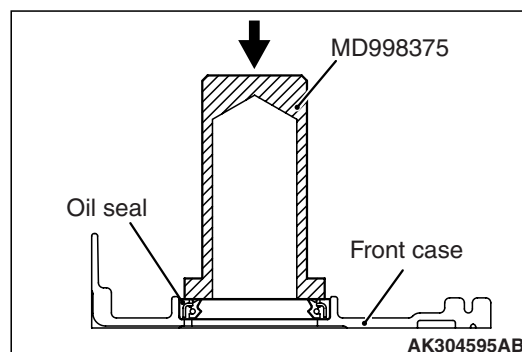
Use an appropriate socket wrench to install the oil pump oil seal.

### >>E<< COUNTERBALANCER SHAFT OIL SEAL INSTALLATION



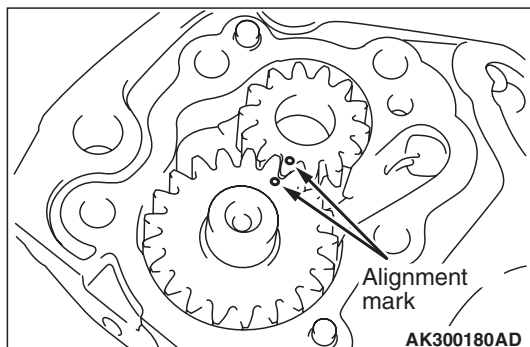
Use an appropriate socket wrench to install the counterbalancer shaft oil seal.

### >>F<< CRANKSHAFT OIL SEAL INSTALLATION



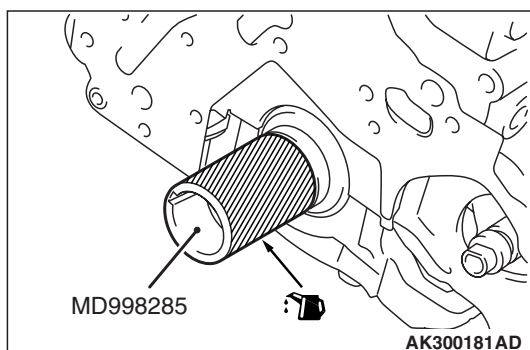
Use the special tool Crankshaft front oil seal installer (MD998375) to install the crankshaft oil seal.

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

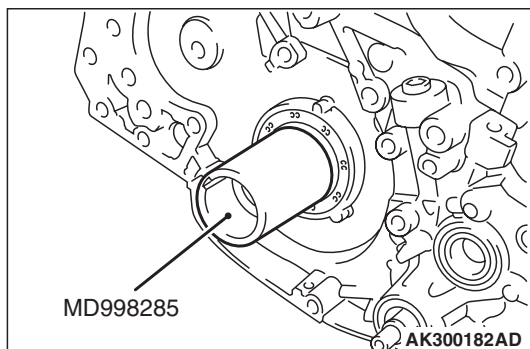


Apply engine oil generously to the gears and line up the alignment marks.

## >>H<< FRONT CASE INSTALLATION

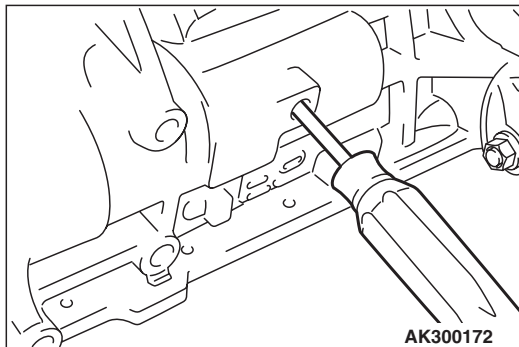


1. Install the special tool Crankshaft front oil seal guide (MD998285) on the front end of crankshaft and apply a thin coat of engine oil to the outer surface of the special tool. Be sure to use the special tool when the front case is fitted with an oil seal.
2. Install the front case on the cylinder 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.

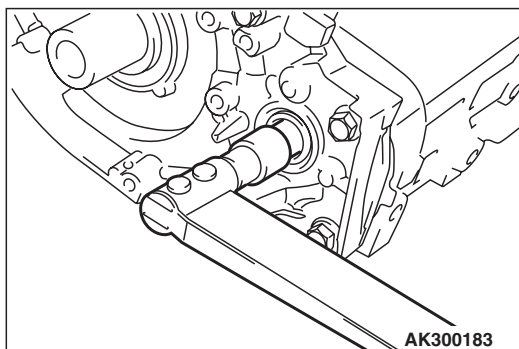


3. Install the oil filter bracket on the front case with the oil filter bracket gasket in between and temporarily tighten the washer-assembled bolts.
4. Tighten all the bolts to the specified torques.

## >>I<< FLANGE BOLT INSTALLATION



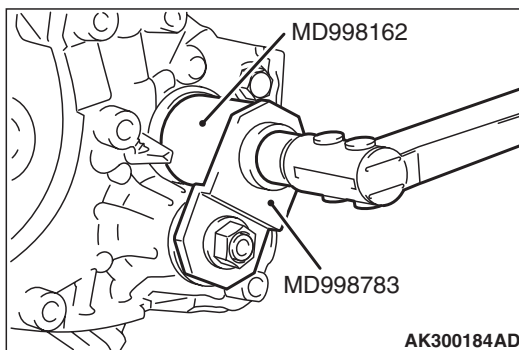
1. Insert a correspond screwdriver (shank diameter 8 mm) into the hole in the left side of the cylinder block to prevent the counterbalancer shaft from rotating.



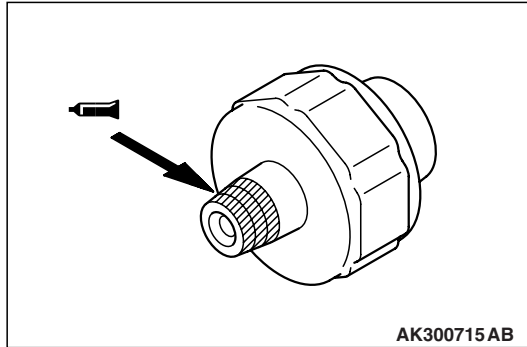
2. Tighten the flange bolts.

## >>J<< PLUG INSTALLATION

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



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

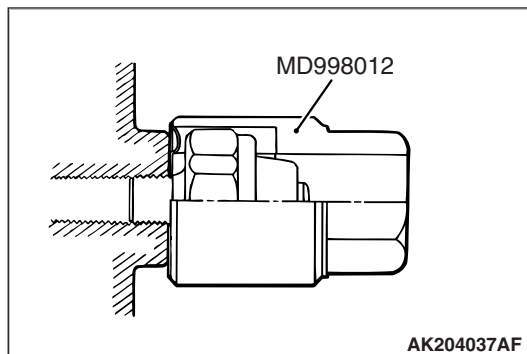
>>K<< ENGINE OIL PRESSURE SWITCH  
INSTALLATION**⚠ CAUTION**

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**



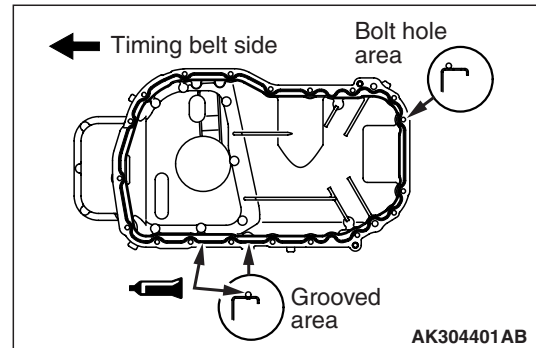
2. Tighten the engine oil pressure switch together with the oil filter bracket by the specified torque using of the special tool MD998012.

**Tightening torque:  $19 \pm 3$  N·m ( $14 \pm 2$  ft-lb)**

>>L<< OIL PAN UPPER SECTION/OIL  
PAN LOWER SECTION INSTALLATION**⚠ 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**

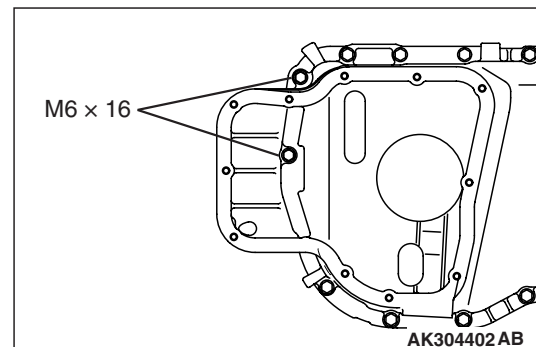
Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

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.

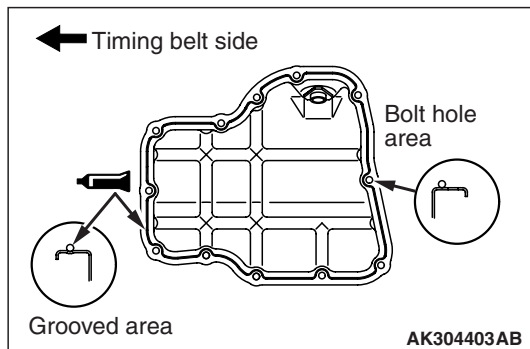
**⚠ CAUTION**

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**



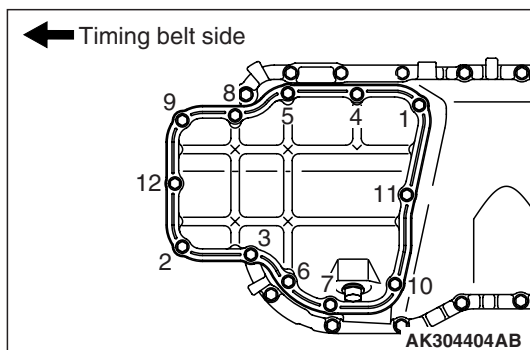
Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

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

**Specified sealant:**

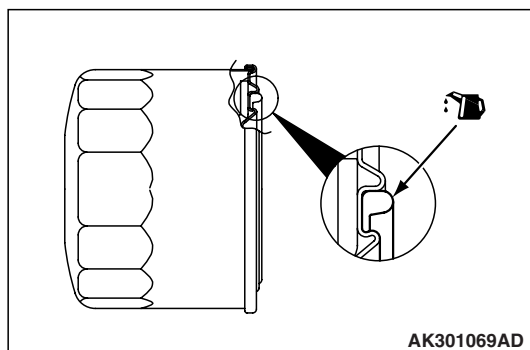
**Mitsubishi Genuine Part No.MD970389 or equivalent**

*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 FILTER INSTALLATION**



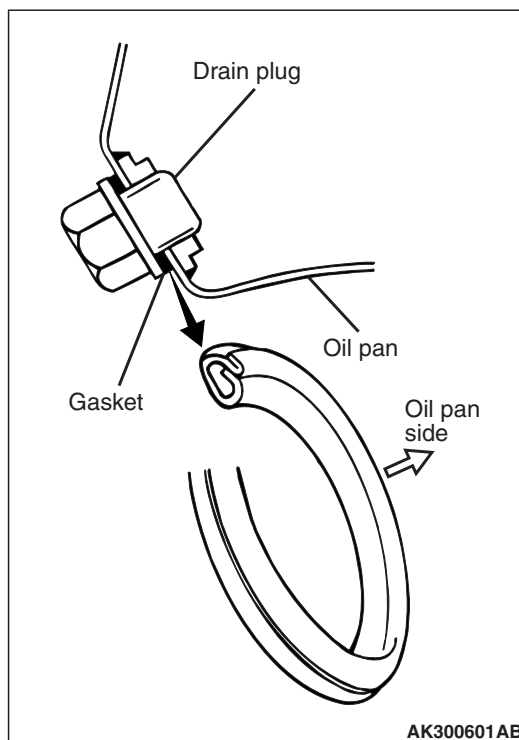
1. Clean the installation surface of the filter bracket.

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:  $14 \pm 2$  N·m ( $124 \pm 17$  in-lb)**

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.

**>>N<< DRAIN PLUG GASKET INSTALLATION**



**CAUTION**

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

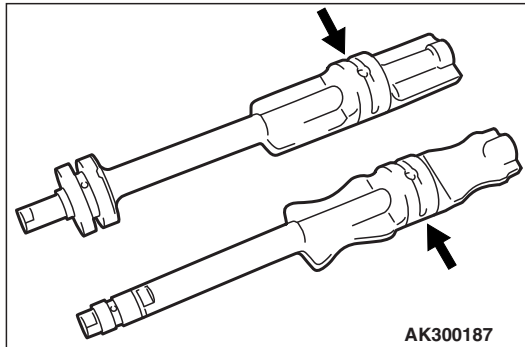
Replace the drain plug gasket with a new one. Install it with the side indicated in the drawing toward the oil pan.

## INSPECTION

## COUNTERBALANCE SHAFTS

M1113008200405

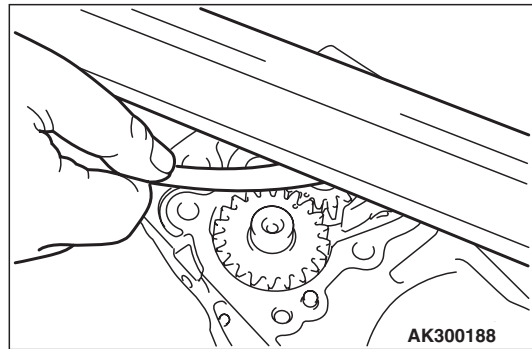
1. Check that the oil holes are not blocked.



2. Check the journals for seizure, damage and defective contact with bearing. If any of these faults is found, replace the Counterbalance shaft, bearing and/or front case assembly.

## OIL PUMP

1. Install the drive and driven gears in the front case.



2. Measure the gear side clearance using a straight edge and thickness gauge.

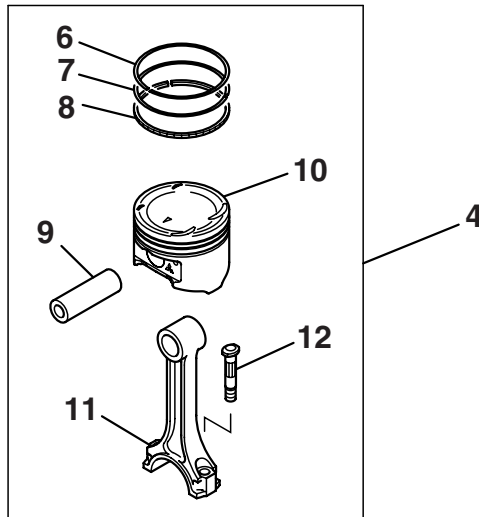
**Standard values:****Drive gear 0.08 – 0.14 mm****Driven gear 0.06 – 0.12 mm**



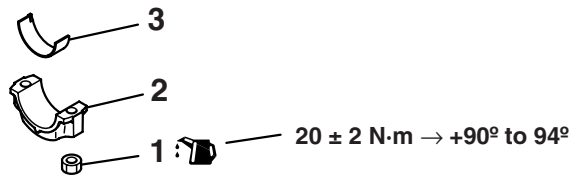
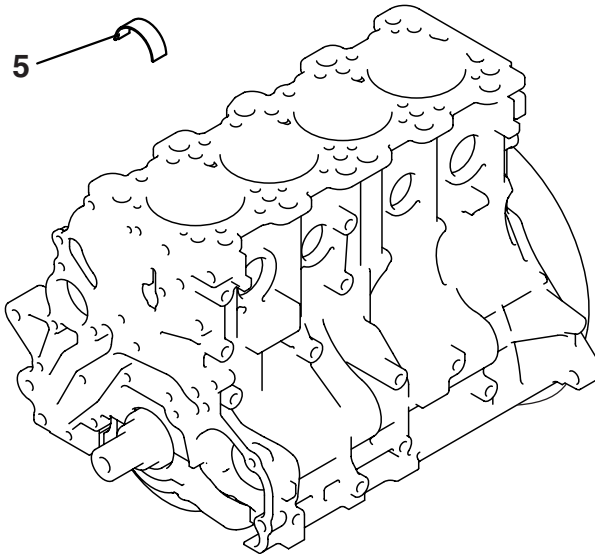
# PISTON AND CONNECTING ROD

## REMOVAL AND INSTALLATION

M1113008401275



Apply engine oil to  
all moving parts  
before installation.



AK306012 AC

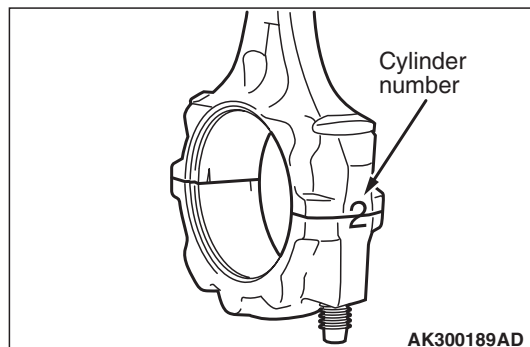
### Removal steps

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

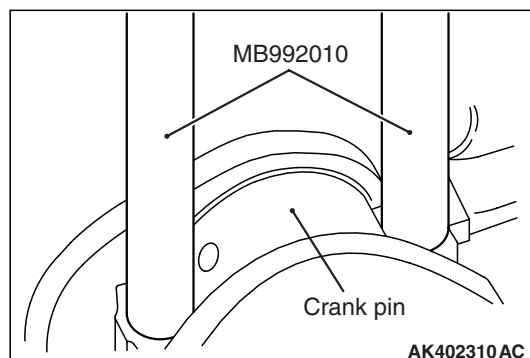
### Removal steps (Continued)

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

## REMOVAL SERVICE POINTS

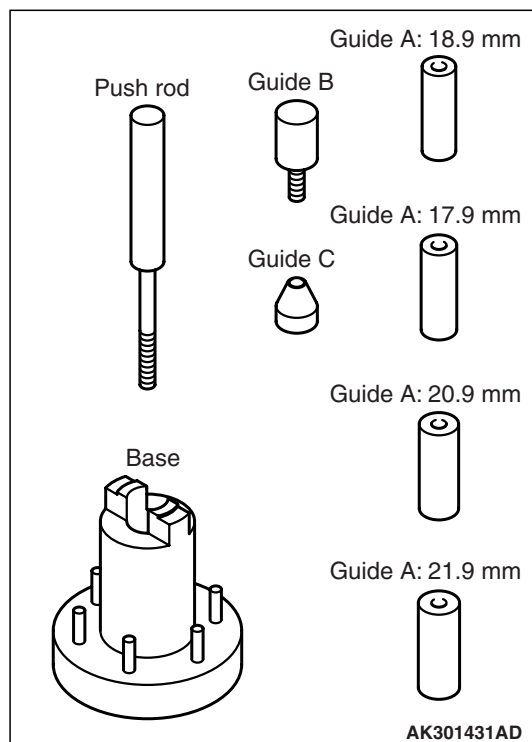
<<A>> CONNECTING ROD CAP  
REMOVAL

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

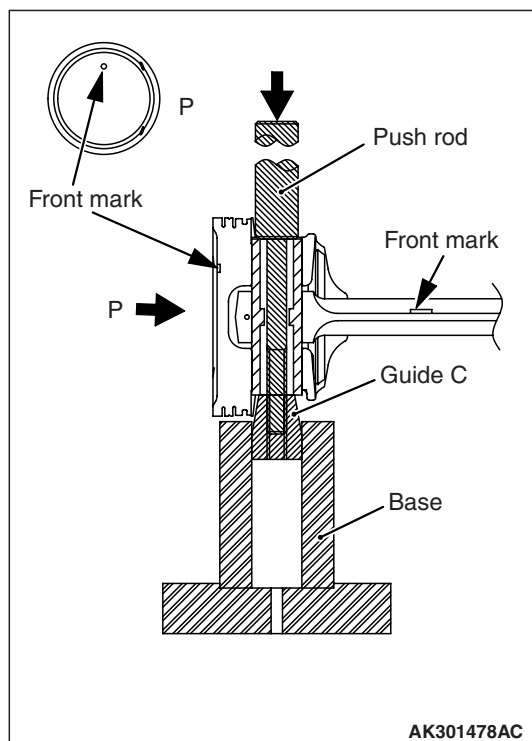
<<B>> PISTON AND CONNECTING ROD  
ASSEMBLY REMOVAL

1. Not to damage the crank pin, attach a special tool Bolt guide (MB992010), to the connecting rod bolt.
2. Remove the piston and connecting rod assembly from the cylinder block.

## &lt;&lt;C&gt;&gt; PISTON PIN REMOVAL



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



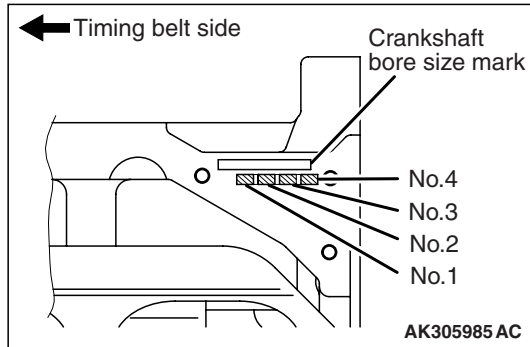
1. Insert the tool element, Push rod, into the piston from the front mark side (notched side), then attach the tool element, Guide C, to the push rod.
2. Place the piston and connecting rod assembly on the tool element, Base, with the front mark facing up.

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

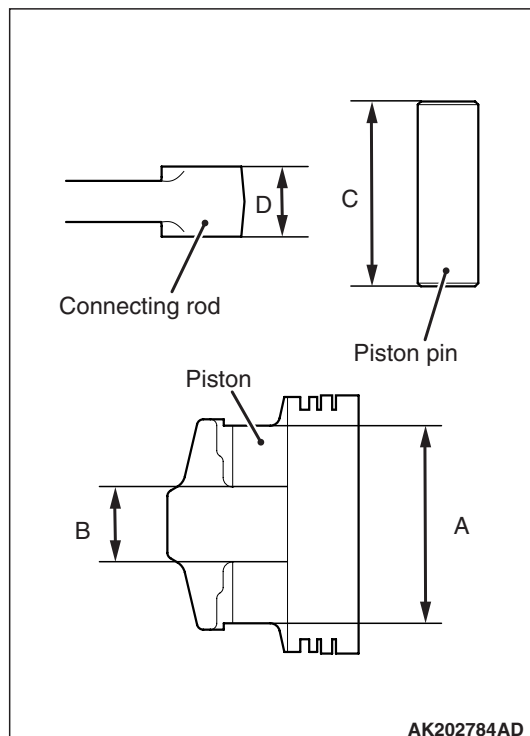
### >>A<< PISTON PIN INSTALLATION



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.*



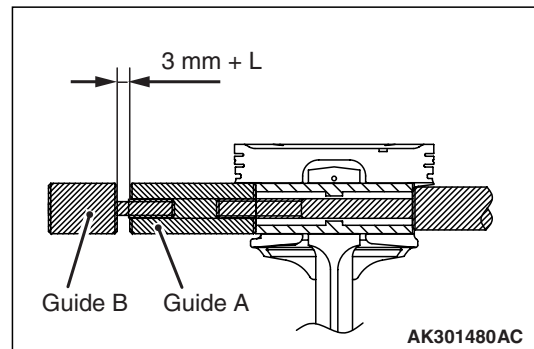
2. Measure the following dimensions:

- A: Piston pin insertion hole length  
B: Distance between piston bosses  
C: Piston pin length  
D: Connecting rod small end width

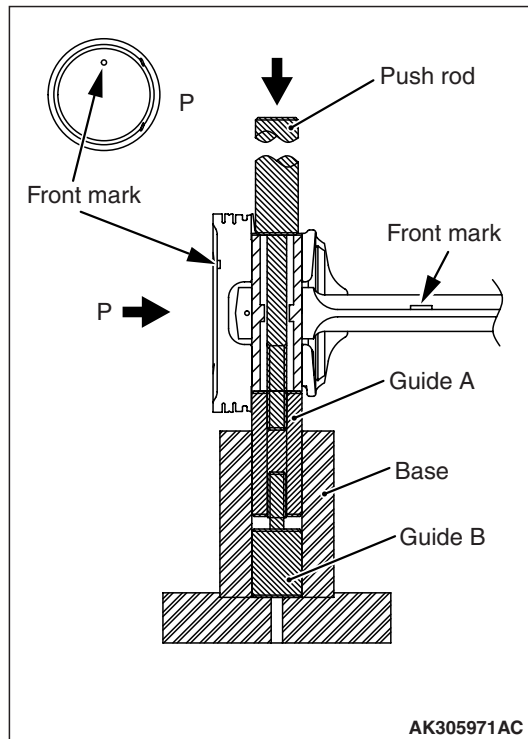
3. Obtain dimension L from the measurements using the following formula.

$$L = [(A - C) - (B - D)] \div 2$$

4. Insert the tool element, Push rod, into the piston pin and attach the tool element, Guide A (21.9 mm) 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 3.) into the piston pin holes from the front marked side of the piston.



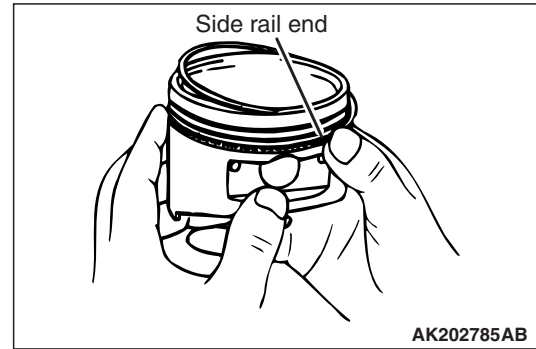
8. Screw the guide B into the guide A until the gap between both guides amounts the value L obtained in step 2 plus 3 mm.



9. Place the piston and connecting rod assembly onto the tool 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.

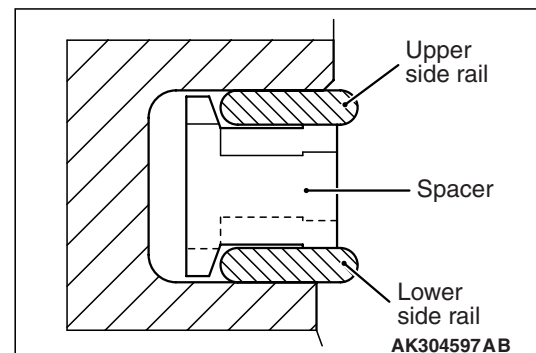
**Standard value: 7,350 – 17,100 N**

## >>B<< OIL RING INSTALLATION



1. Fit the oil ring spacer into the piston ring groove.

### **CAUTION**



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

2. Install the upper side rail, then the lower side rail.

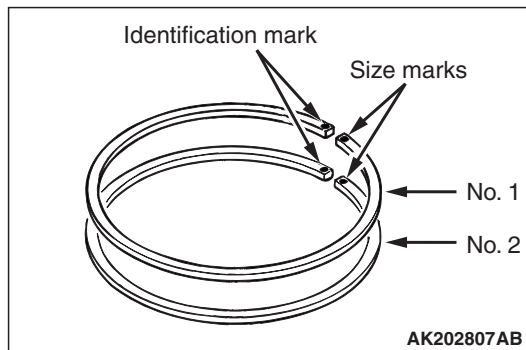
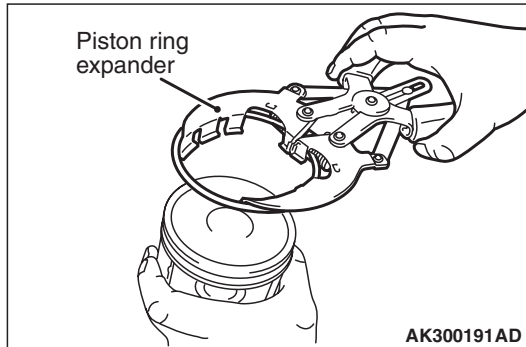
To install each side rail, first fit one end of the rail into the piston groove, then press the remaining portion progressively into position by finger as shown in the drawing.

*NOTE: Each of the spacers and the side rails (new) has an identification color as follows:*

Size	Color mark
Standard	No mark
0.50 mm oversize	Red
1.00 mm oversize	Yellow

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 head).

### Identification marks:

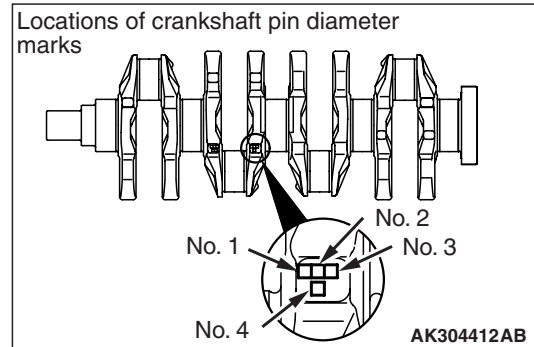
**No.1 ring: 1R**

**No.2 ring: 2R**

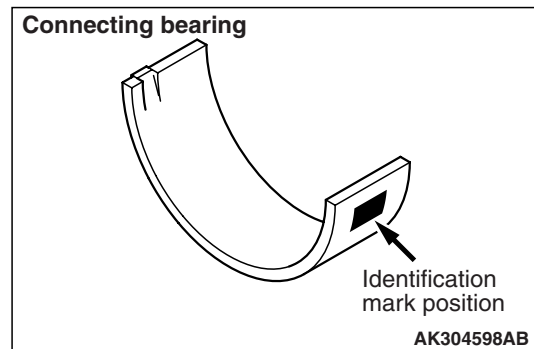
*NOTE: Each of the available piston rings has a size mark as follows:*

Size	Size mark
Standard	No mark
0.50 mm oversize	50
1.00 mm oversize	100

## >>D<< CONNECTING ROD BEARINGS 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>

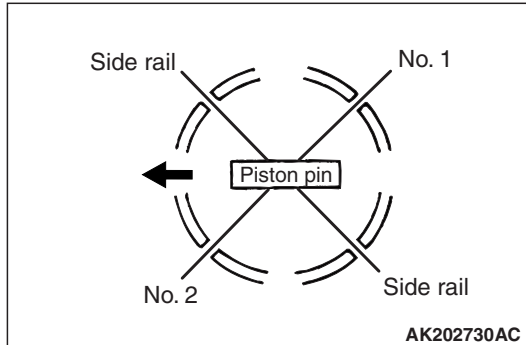
If the crankshaft pin diameter mark is "I," select a bearing marked "1."

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

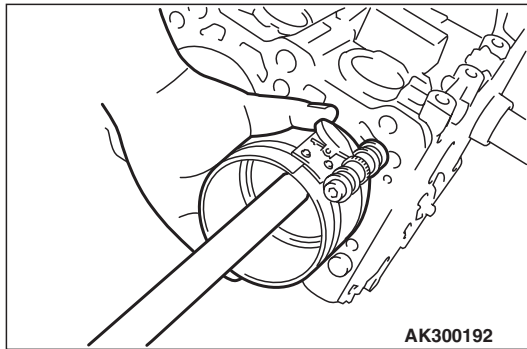
4. Install the upper and lower halves of the selected bearing on the connecting rod big end and cap, respectively.

>>E<< PISTON AND CONNECTING ROD  
ASSEMBLY INSTALLATION

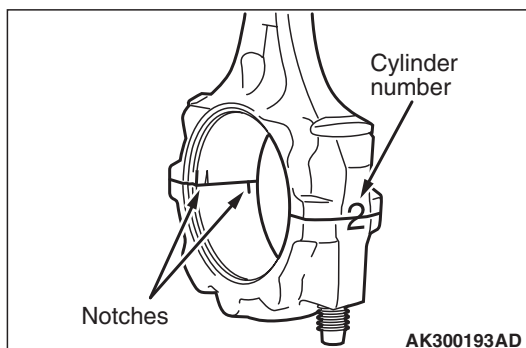
1. Apply engine oil generously to the piston's outside surface, piston rings, and oil ring.



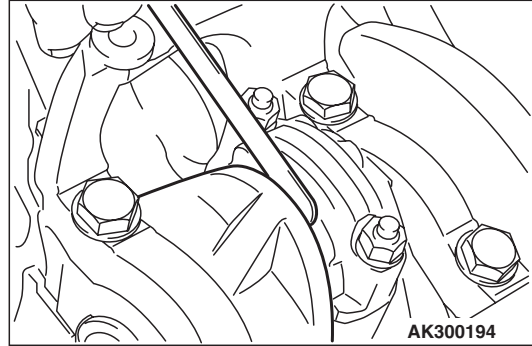
2. Align the end gaps of the piston rings and oil ring (side rail and spacer) as shown in the drawing.
3. Insert the piston and connecting rod assembly from the top of cylinder with the front mark notch on the head toward the camshaft sprocket.



4. Use a piston ring band to hold the piston rings compressed when inserting the piston and connecting rod assembly into the cylinder. Do not strike the assembly with a large force. Doing so could break the piston rings and crank pin.

>>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 both bearing locating notches are on the same side as shown in the drawing.



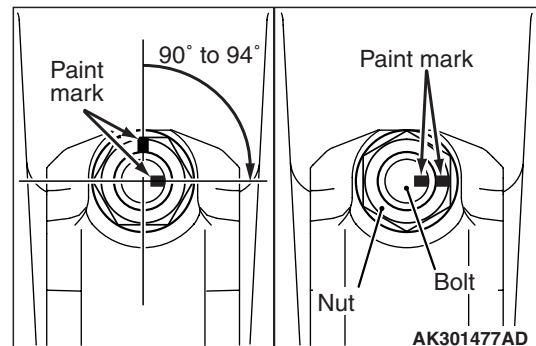
2. Make sure that the thrust clearance of the connecting rod big end is proper.

**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  $20 \pm 2$  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 in the tightening direction from the paint mark made on the nut.
7. Turn the nut 90° to 94° to bring the mark on the nut into alignment with that on the bolt.

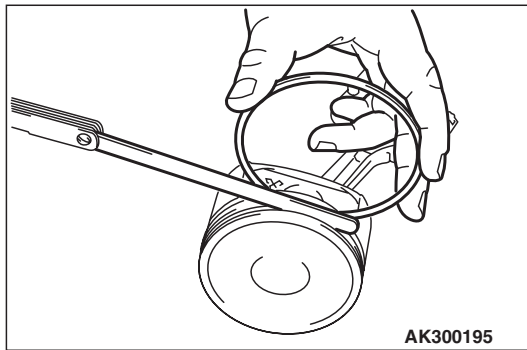
**⚠ CAUTION**

- 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.

**INSPECTION**

**PISTON RING**

M1113008500989



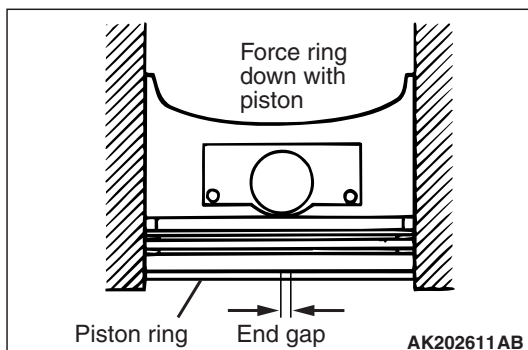
1. Measure the clearance between each piston ring and its groove in the piston. If the limit is exceeded, replace the ring or piston, or both.

**Standard value:**

**No. 1 ring : 0.03 – 0.07 mm**

**No. 2 ring : 0.02 – 0.06 mm**

**Limit: 0.1 mm**



2. Install a piston ring 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. If the end gap is excessive, replace the piston ring.

**Standard value:**

**No. 1 ring : 0.25 – 0.35 mm**

**No. 2 ring : 0.40 – 0.55 mm**

**Oil ring: 0.10 – 0.40 mm**

**Limit:**

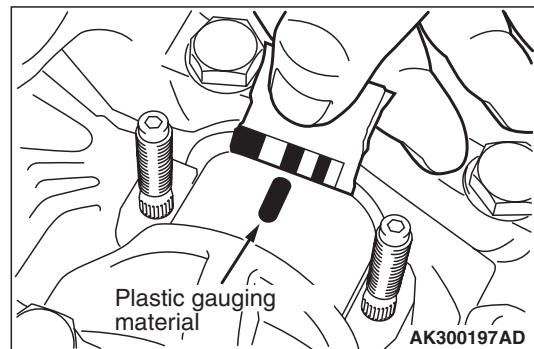
**No. 1 ring: 0.8 mm**

**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 torque.
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: 0.02 – 0.05 mm**

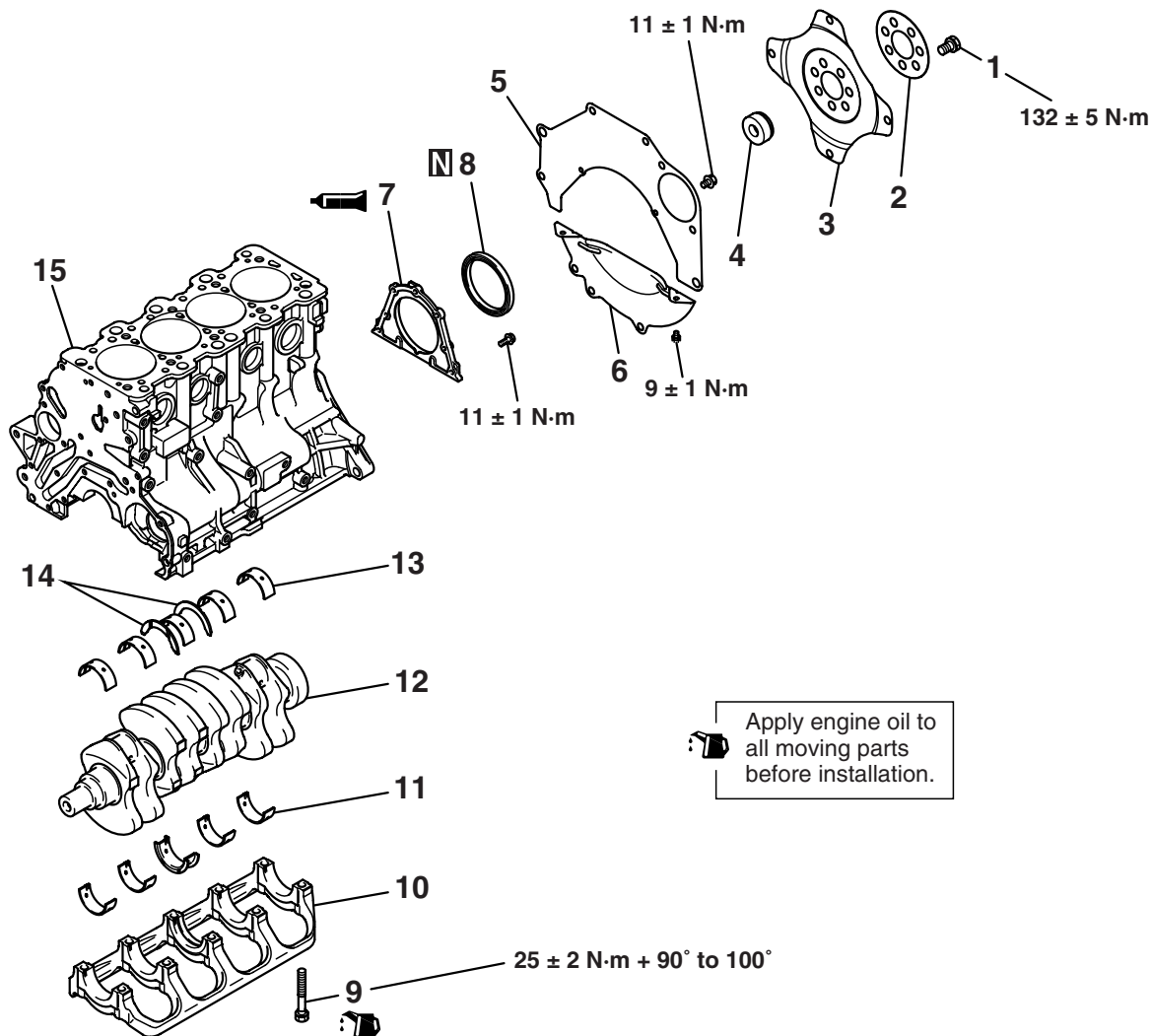
**Limit: 0.1 mm**



## CRANKSHAFT AND CYLINDER BLOCK

## REMOVAL AND INSTALLATION

M1113008701351



AK501641 AB

## Removal steps

- 1. Drive plate bolt
- 2. Adapter plate
- 3. Drive plate
- 4. Crankshaft bushing
- 5. Rear plate
- 6. Bell housing cover
- >>E<< 7. Oil seal case
- >>D<< 8. Oil seal

## Removal steps (Continued)

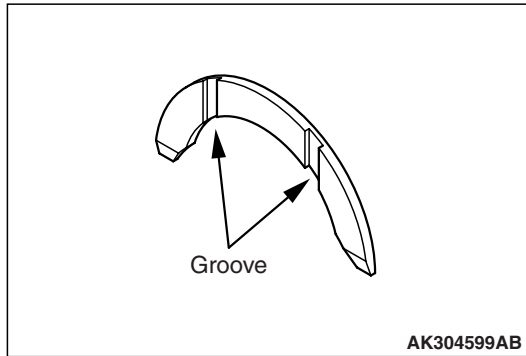
- >>C<< 9. Bearing cap bolt
- 10. Bearing cap
- >>B<< 11. Crankshaft bearing, lower
- >>A<< 12. Crankshaft
- 13. Crankshaft bearing, upper
- 14. Thrust bearing
- 15. Cylinder block



## INSTALLATION SERVICE POINTS

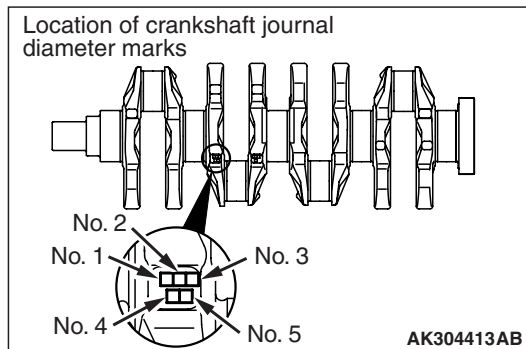
### >>A<< THRUST BEARING INSTALLATION

1. Install the two thrust bearings in the No. 3 bearing bore in the cylinder block. Applying engine oil to the bearings will help facilitate holding them in position.



2. Each thrust bearing must be installed with the grooved side toward the crankshaft web.

### >>B<< CRANKSHAFT BEARING INSTALLATION

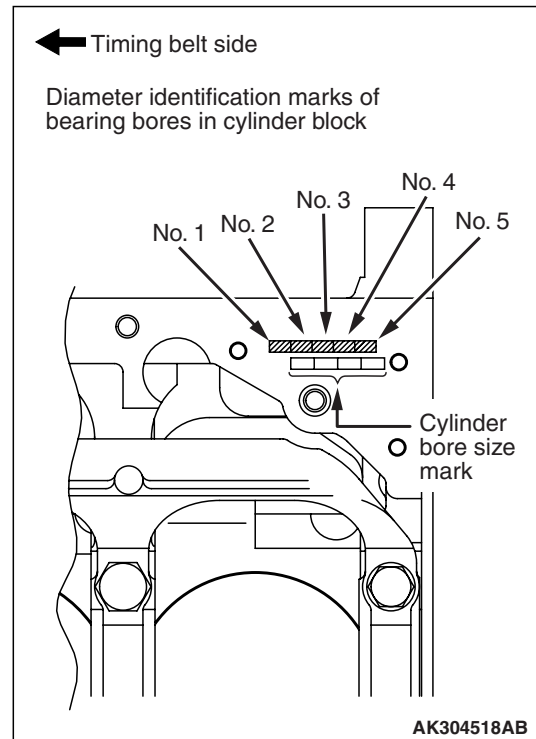


1. Location of crankshaft journal diameter marks.

#### <Bearing selection example>

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.

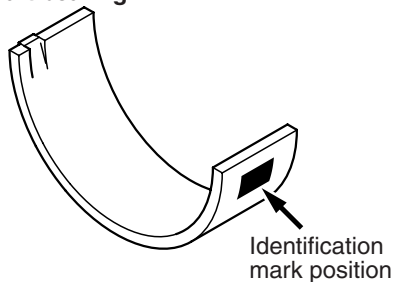


2. The diameter identification marks of the bearing bores in the cylinder block are stamped in the location shown in the drawing.

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

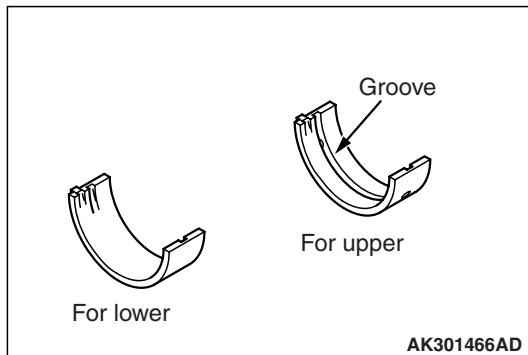
No. 3 bearing			
Crankshaft journal diameter		Cylinder block bearing bore marking	Crankshaft bearing marking
Identification mark	Journal diameter measurement mm		
1	56.988 – 56.994	0	1
		1	2
		2	3
2	56.982 – 56.988	0	2
		1	3
		2	4

Crankshaft bearing



AK304598AC

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

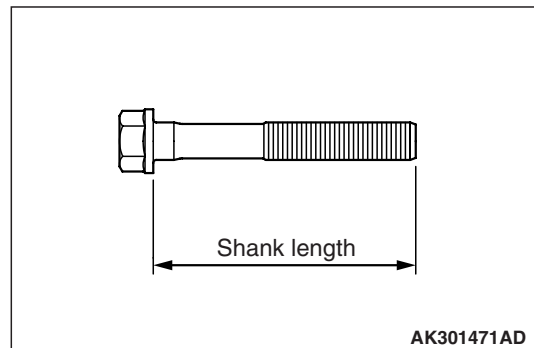


AK301466AD

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<< BEARING CAP/BEARING CAP BOLT INSTALLATION

1. Install the bearing cap with the arrow pointing to the timing belt.

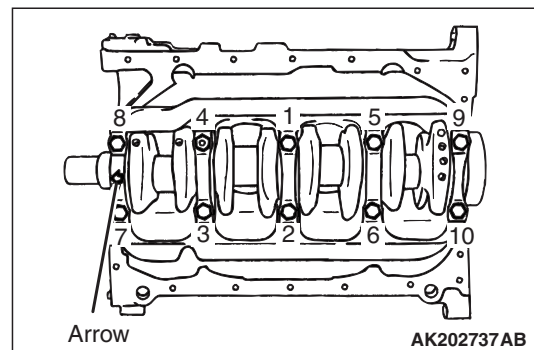


AK301471AD

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

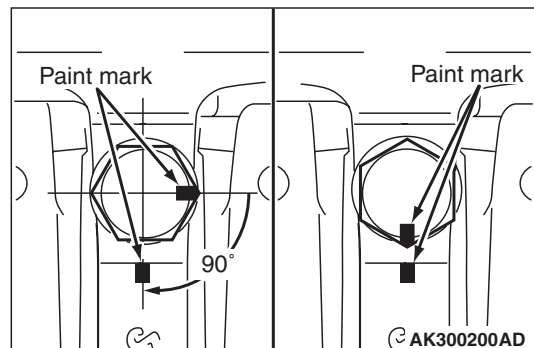
**Limit: 71.1 mm**

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



AK202737AB

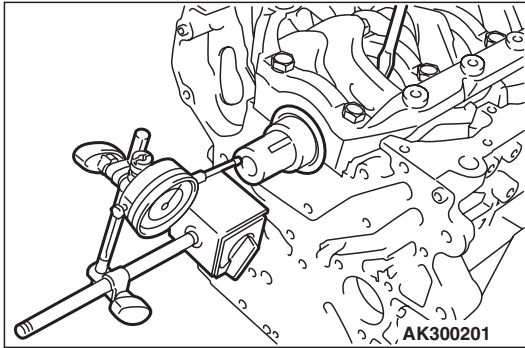
4. Tighten the bolts to  $25 \pm 2$  N·m in the indicated sequence.  
5. Make a paint mark on the head of each bolt.  
6. Make a paint mark on the bearing cap at a point  $90^\circ$  to  $100^\circ$  away in the tightening direction from the paint mark made on the bolt head.



AK300200AD

**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 procedure 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.

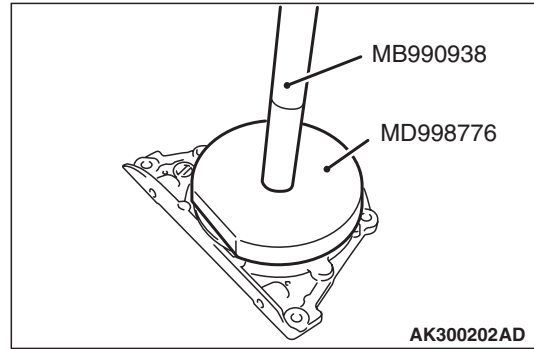


8. After installing the bearing caps, measure the end play of the crankshaft. If the end play exceeds the limit, replace the crankshaft bearings.

**Standard value: 0.05 – 0.25 mm**

**Limit: 0.40 mm**

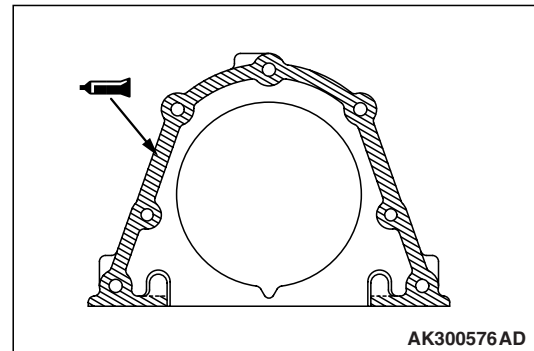
**>>D<< REAR OIL SEAL INSTALLATION**



Use the special tools to install the rear oil seal.

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

**>>E<< REAR OIL SEAL CASE INSTALLATION**



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

**Specified sealant:**

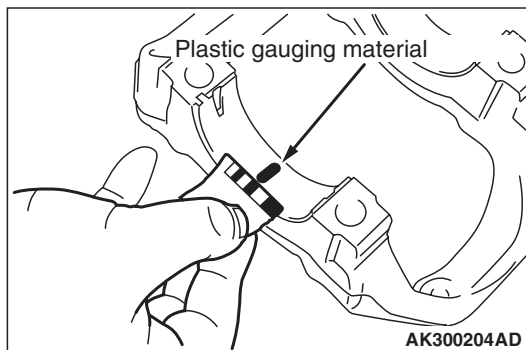
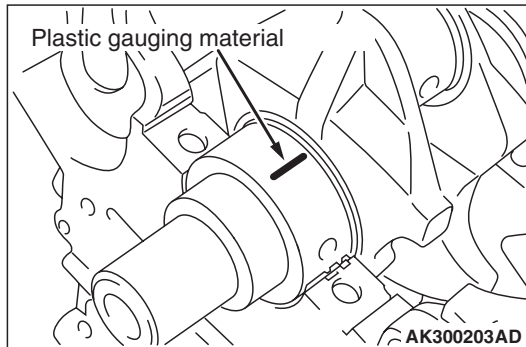
**Mitsubishi Genuine Part No.MD970389 or equivalent**

2. Install the oil seal into the cylinder block after applying an appropriate amount of engine oil to the entire circumference of its lip portion.

## INSPECTION

CRANKSHAFT OIL CLEARANCE  
(PLASTIC GAUGE METHOD)

M1113008800979



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:

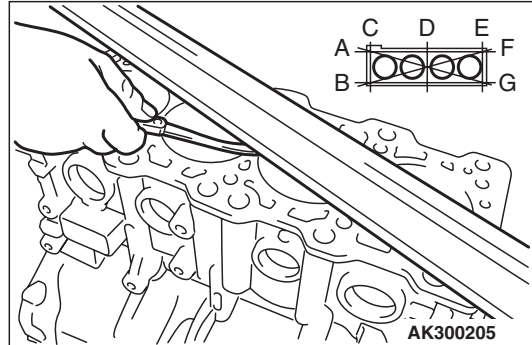
1. Wipe off oil from the crankshaft journal surface and the crankshaft bearing inner surface.
2. Install the crankshaft.
3. Cut a piece of plastic gauge whose length is equivalent to the width of the bearing and place it on the crankshaft journal in parallel with its axis.
4. Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
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.

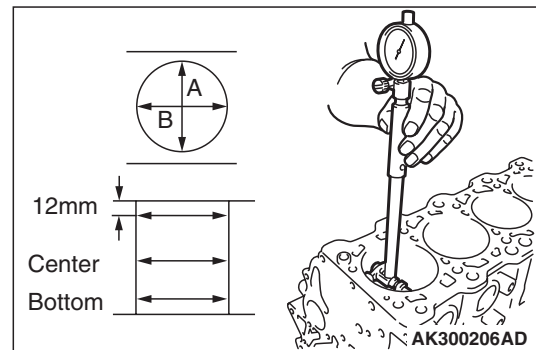


2. Use a straightedge and thickness gauge to check the cylinder block top surface for warp. Make sure that the surface is free from remaining gasket material and other foreign matter.

**Standard value: 0.05 mm**

**Limit: 0.1 mm**

3. Check cylinder walls for scratches and seizure. If defects are evident, rebore to an oversize or replace the cylinder block.



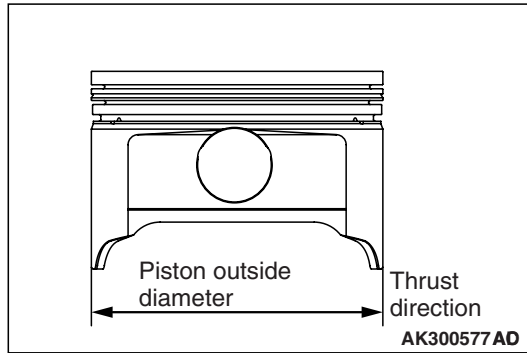
4. Use a cylinder gauge to measure the cylinder bore diameter and taper. If the cylinder is worn badly, rebore it to an oversize and replace the piston and piston rings with ones that match with the new bore size.

**Standard value: 86.5 mm**

**Cylindricity 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 (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**

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## NOTES