

## GROUP 11F

# ENGINE OVERHAUL

## <4G69>

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**GENERAL INFORMATION**

M1113000100534

**VEHICLE AND ENGINE MODELS**

Vehicle name	Vehicle model	Engine model	Displacement mL	Specification
Outlander	CU5W	4G69-2	2,378	Single overhead camshaft, 16-valve

**GENERAL SPECIFICATIONS**

M1113000200791

Item			Specification
Type			In-line OHV, SOHC
Number of cylinders			4
Combustion chamber			Pent roof type
Total displacement cm <sup>3</sup>			2,378
Cylinder bore mm			87
Piston stroke mm			100
Compression ratio			9.5
Valve timing	Intake valve	Opens (BTDC)	10° <Low speed cam A>
			12° <Low speed cam B>
			24° <High speed cam>
	Exhaust valve	Closes (ABDC)	42° <Low speed cam A>
			44° <Low speed cam B>
			68° <High speed cam>
	Opens (BBDC)	58°	
	Closes (ATDC)	18°	
Lubrication system			Pressure feed, full-flow filtration
Oil pump type			Involute gear type

## SERVICE SPECIFICATIONS

M1113000300806

Item	Standard value	Limit		
<b>Timing belt</b>				
Auto tensioner rod length mm	3.8 – 4.5	–		
Auto-tensioner rod projection length mm	12	–		
Auto-tensioner rod pushed-in amount [When pushed with a force of 98 – 196 N] mm	1.0 or less	–		
Valve clearance mm	Intake	0.11		
	Exhaust	0.20		
<b>Rocker arms and camshaft</b>				
Camshaft cam height mm	Intake	Low speed cam A	33.84	Minimum 33.34
		Low speed cam B	37.35	Minimum 36.85
		High speed cam	37.21	Minimum 36.71
	Exhaust	37.86	Minimum 37.36	
Camshaft journal outside diameter mm	45	–		
<b>Cylinder head and valves</b>				
Cylinder head flatness of gasket surface mm	Less than 0.03	0.2		
Cylinder head grinding limit of gasket surface mm (Total resurfacing depth of cylinder head and cylinder block)	–	0.2		
Cylinder head overall height mm	120	–		
Cylinder head bolt shank length mm	–	99.4		
Valve thickness of valve head (margin) mm	Intake	1.0	Minimum 0.5	
	Exhaust	1.2	Minimum 0.7	
Valve overall height mm	Intake	111.33	Minimum 110.83	
	Exhaust	113.54	Minimum 113.04	
Valve stem outside diameter mm	6.0	–		
Valve thickness to valve guide clearance mm	Intake	0.02 – 0.04	0.10	
	Exhaust	0.04 – 0.06	0.15	
Valve face angle mm	43.5° – 44°	–		
Valve spring free length mm	Intake	54.8	Minimum 53.8	
	Exhaust	56.1	Minimum 55.1	
Valve spring load/installed height N/mm	267/44.2	–		
Valve spring out-of-squareness	2° or less	4°		
Valve seat valve contact width mm	0.9 – 1.3	–		
Valve guide inside diameter mm	6.0	–		
Valve guide projection from cylinder head upper surface mm	14.0	–		

Item		Standard value	Limit
Valve stem projection mm	Intake	48.33	48.83
	Exhaust	48.34	48.84
<b>Oil pan and oil pump</b>			
Oil pump side clearance mm	Drive gear	0.08 – 0.14	–
	Driven gear	0.06 – 0.12	–
Oil cooler by-pass valve mm	Dimension (Normal temperature)	34.5 (1.358)	–
	By-pass hole closing temperature 97 to 103°C	40.0 (1.575)	–
Oil pressure at curb idle speed kPa [oil temperature is 75 to 90°]		78 or more	–
<b>Piston and connecting rod</b>			
Piston outside diameter mm		87	–
Piston ring side clearance mm	No. 1	0.03 – 0.07	0.1
	No. 2	0.02 – 0.06	0.1
Piston ring end gap mm	No. 1	0.15 – 0.30	0.8
	No. 2	0.28– 0.43	0.8
	Oil ring side rail	0.10 – 0.40	1.0
Piston pin outside diameter mm		22.0	–
Piston pin press-in load N (Room temperature)		7,350 – 17,200	–
Crankshaft pin oil clearance mm		0.02 – 0.05	0.1
Connecting rod big end side clearance mm		0.10 – 0.25	0.4
<b>Crankshaft and cylinder block</b>			
Crankshaft end play mm		0.05 – 0.25	0.40
Crankshaft journal outside diameter mm		57.0	–
Crankshaft pin outside diameter mm		45.0	–
Oil clearance at crankshaft journals mm	No. 1,2,4,5 journal	0.02 – 0.03	0.1
	No. 3 journal	0.03 – 0.04	0.1
Bearing cap bolt shank length mm		–	71.1
Piston to cylinder clearance mm		0.02 – 0.04	–
Cylinder block flatness of gasket surface mm		0.05	0.1
Cylinder block grinding limit of gasket surface mm (Total resurfacing depth of both cylinder head and cylinder block)		–	0.2
Cylinder block overall height mm		284	–
Cylinder block inside diameter mm		87.0	–
Cylindricity mm		0.01	–

## REWORK DIMENSIONS

M1113024300413

Item			Standard value
<b>Cylinder head And valves</b>			
Diameter of oversize valve seat ring hole in cylinder head mm	Intake	0.3 oversize	35.30 – 35.33
		0.6 oversize	35.60 – 35.63
	Exhaust	0.3 oversize	33.30 – 33.33
		0.6 oversize	33.60 – 33.63
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

M1113023401971

Item	N·m
<b>Alternator and ignition system</b>	
Auto-tensioner bracket bolt M10	44 ± 10
Auto-tensioner bracket bolt M8	22 ± 4
Camshaft position sensing cylinder bolt	22 ± 4
Camshaft position sensor bolt	11 ± 1
Camshaft position sensor support bolt	14 ± 1
Connector bracket bolt	11 ± 1
Crankshaft pulley bolt	25 ± 4
Alternator bolt	49 ± 9
Alternator pivot nut	44 ± 10
Idler pulley bolt	79 ± 5
Ignition coil bolt	10 ± 2
Oil level gauge guide bolt	13 ± 1
Spark plugs	25 ± 5
Water pump pulley bolt	8.8 ± 1.0
<b>Exhaust manifold</b>	
Oxygen sensor	44 ± 5
Engine hanger bolt	24 ± 3
Exhaust manifold cover bolt	14 ± 1
Exhaust manifold bracket B bolt	59 ± 10
Exhaust manifold nut	49 ± 5
Exhaust manifold bracket A bolt	35 ± 6
<b>Timing belt</b>	
Auto-tensioner bolt	23 ± 3
Camshaft sprocket bolt	89 ± 9

Item	N·m
Counterbalance shaft sprocket bolt	45 ± 3
Crankshaft bolt	167
Crankshaft angle sensor bolt	8.5 ± 0.5
Engine support bracket bolt	49 ± 5
Generator bracket bolt	49 ± 9
Idler pulley bolt	35 ± 6
Oil pump sprocket nut	54 ± 4
Tensioner "B" bolt	19 ± 3
Tensioner arm bolt	21 ± 4
Tensioner pulley bolt	48 ± 5
Timing belt cover bolt M6 (Bolt, washer assembly)	9.0 ± 1.0
Timing belt cover bolt M6 (Flange bolt and nut)	11 ± 1
Timing belt cover bolt M8	14 ± 1
<b>Fuel and emission parts</b>	
EGR valve bolt	24 ± 3
Injectors and delivery pipe bolt	11 ± 1
Solenoid valve bracket bolt	11 ± 1
Solenoid valve nut	9.0 ± 1.0
Throttle body bolt	19 ± 3
Vacuum pipe and hose bolt	11 ± 1
<b>Inlet manifold and water pump</b>	
Detonation sensor	23 ± 2
Engine coolant temperature gauge unit	11 ± 1
Engine coolant temperature sensor	30 ± 9
Engine hanger bolt	24 ± 3
Harness bracket bolt	11 ± 1
Inlet manifold bolt	24 ± 3
Inlet manifold nut	20 ± 2
Inlet manifold stay bolt	31 ± 3
Manifold differential pressure sensor bolt	5.0 ± 1.0
Oil pressure switch	19 ± 3
Thermostat housing bolt	24 ± 4
Water inlet fitting bolt	13 ± 2
Water inlet pipe bolt	13 ± 2
Water outlet fitting bolt	13 ± 2
Water pump bolt	14 ± 1
<b>Rocker arms and camshaft</b>	
Accumulator body bolt	44 ± 5
Oil feeder control valve bolt	11 ± 1
Rocker arms and rocker arm shaft bolt <exhaust side>	13 ± 1

**ENGINE OVERHAUL <4G69>  
TORQUE SPECIFICATIONS**

**11F-7**

<b>Item</b>	<b>N·m</b>
Rocker arms and rocker arm shaft bolt <intake side>	31 ± 3
Nut	9.0 ± 1.0
Rocker cover bolt	3.5 ± 0.5
Taper plug	47 ± 7
<b>Cylinder head and valves</b>	
Cylinder head bolt	78 ± 2 → 0 → 20 ± 2 → +90° → +90°
<b>Oil pan and oil pump</b>	
Drain plug	39 ± 5
Flange bolt	36 ± 3
Front case bolt	23 ± 3
Oil cooler by-pass valve	54 ± 5
Oil filter bracket bolt	19 ± 3
Oil pan bolt	9.0 ± 3.0
Oil pump cover bolt	17 ± 1
Oil pump cover screw	10 ± 2
Oil screen bolt	19 ± 3
Plug	23 ± 3
Relief plug	44 ± 5
Transmission stay bolt	22 ± 4
<b>Piston and connecting rod</b>	
Connecting rod cap nut	20 ± 2 → +90° to 94°
<b>Crankshaft and cylinder block</b>	
Bearing cap bolt	25 ± 2 → +90°
Bell housing cover bolt	9.0 ± 1.0
Drive plate bolt	132 ± 5
Flywheel bolt	132 ± 5
Oil seal case bolt	11 ± 1
Rear plate bolt	11 ± 1

## SEALANTS

M1113000500725

Item	Specified sealant
Camshaft position sensor support*	Mitsubishi Genuine Part No. MD970389 or equivalent
Engine support bracket seal bolt	Mitsubishi Genuine Part No. MD970389 or equivalent
Engine coolant temperature sensor	3M ATD No.8660 or equivalent
Engine coolant temperature e gauge unit	3M Nut Locking Part No.4171 or equivalent
Water outlet fitting*	Mitsubishi Genuine Part No. MD970389 or equivalent
Thermostat housing*	
Thermostat housing seal bolt	3M™ AAD Part No. 8672 or equivalent
Oil pressure switch	3M ATD No.8660 or equivalent
Oil pan*	Mitsubishi Genuine Part No. MD970389 or equivalent
Rear oil seal case*	

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

### FORM-IN-PLACE GASKET (FIPG)

This engine has several areas where the form-in-place gasket (FIPG) is used for sealing. To ensure that the FIPG fully serves its purpose, it is necessary to observe some precautions when applying it.

Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other hand, could be squeezed out of location, causing blocking or narrowing of fluid passages. To prevent leaks or blocking of passages, therefore, it is absolutely necessary to apply the FIPG evenly without a break, while observing the correct bead size.

FIPG hardens as it reacts with the moisture in the atmospheric air, and it is usually used for sealing metallic flange areas.

### REMOVAL OF FIPG SEALED PARTS

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

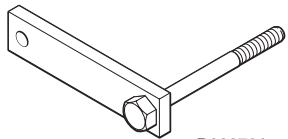

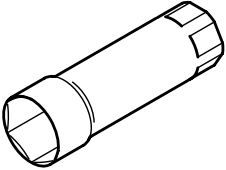
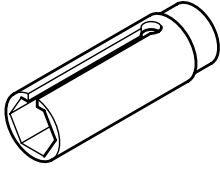
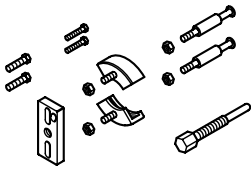
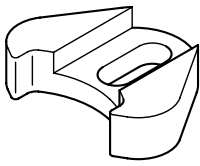
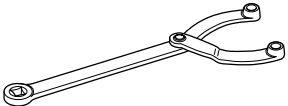
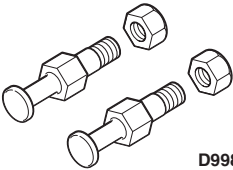
### APPLICATION OF FIPG

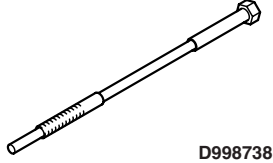
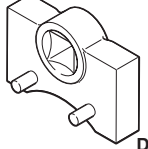
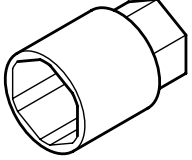
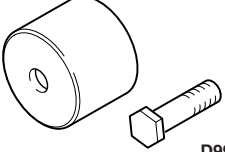
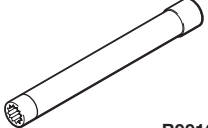
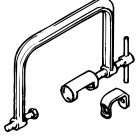
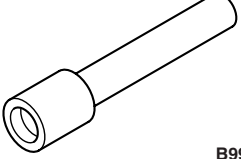
Applied FIPG bead should be of the specified size and free of any break. FIPG can be wiped away unless it has completely hardened. Install the mating parts in position while the FIPG is still wet (in less than 15 minutes after application). Do not allow FIPG to spread beyond the sealing areas during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

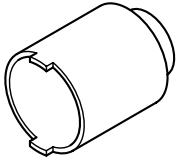
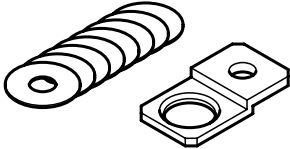
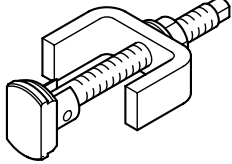
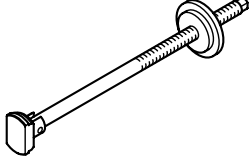
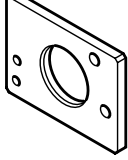
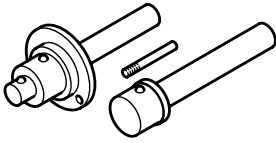
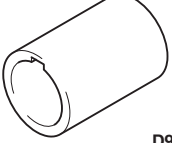
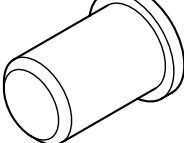


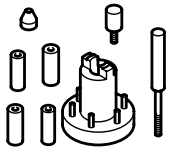
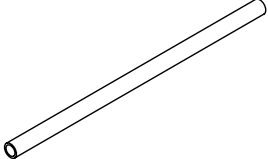
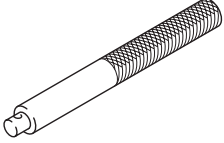
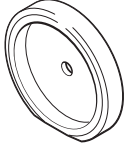
**SPECIAL TOOLS**

M1113000601769

Tool	Number	Name	Use
 <p>D998781</p>	MD998781	Flywheel stopper	Supporting drive plate
 <p>MB991883</p>	MB991883	Flywheel stopper	Supporting flywheel
	MB991398	Spark plug wrench	Removal and installation of spark plug
	MD998770	Oxygen sensor wrench	Removal and installation of oxygen sensor
	MD998778	Crankshaft sprocket puller	Removal of crankshaft sprocket
	MD998785	Sprocket stopper	Supporting counterbalance shaft sprocket
 <p>B990767</p>	MB990767	End yoke holder	Holding camshaft sprocket when loosening or torquing bolt
 <p>D998719</p>	MD998719	Pins	

Tool	Number	Name	Use
 <p>D998738</p>	MD998738	Adjusting screw	<ul style="list-style-type: none"> <li>• Holding the auto-tensioner</li> <li>• Timing belt tension adjustment</li> </ul>
 <p>D998767</p>	MD998767	Tension pulley wrench	Adjustment of timing belt tension
	MD998012	Oil pressure switch socket wrench	Removal and installation of oil pressure switch <to cylinder block>
 <p>D998713</p>	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal
 <p>B991654</p>	MB991654	Cylinder head bolt wrench (12)	Removal and installation of cylinder head bolt
	MD998735	Valve spring compressor	Compression of valve spring
 <p>B991999</p>	MB991999	Valve steam seal installer	Installation of valve steam seal

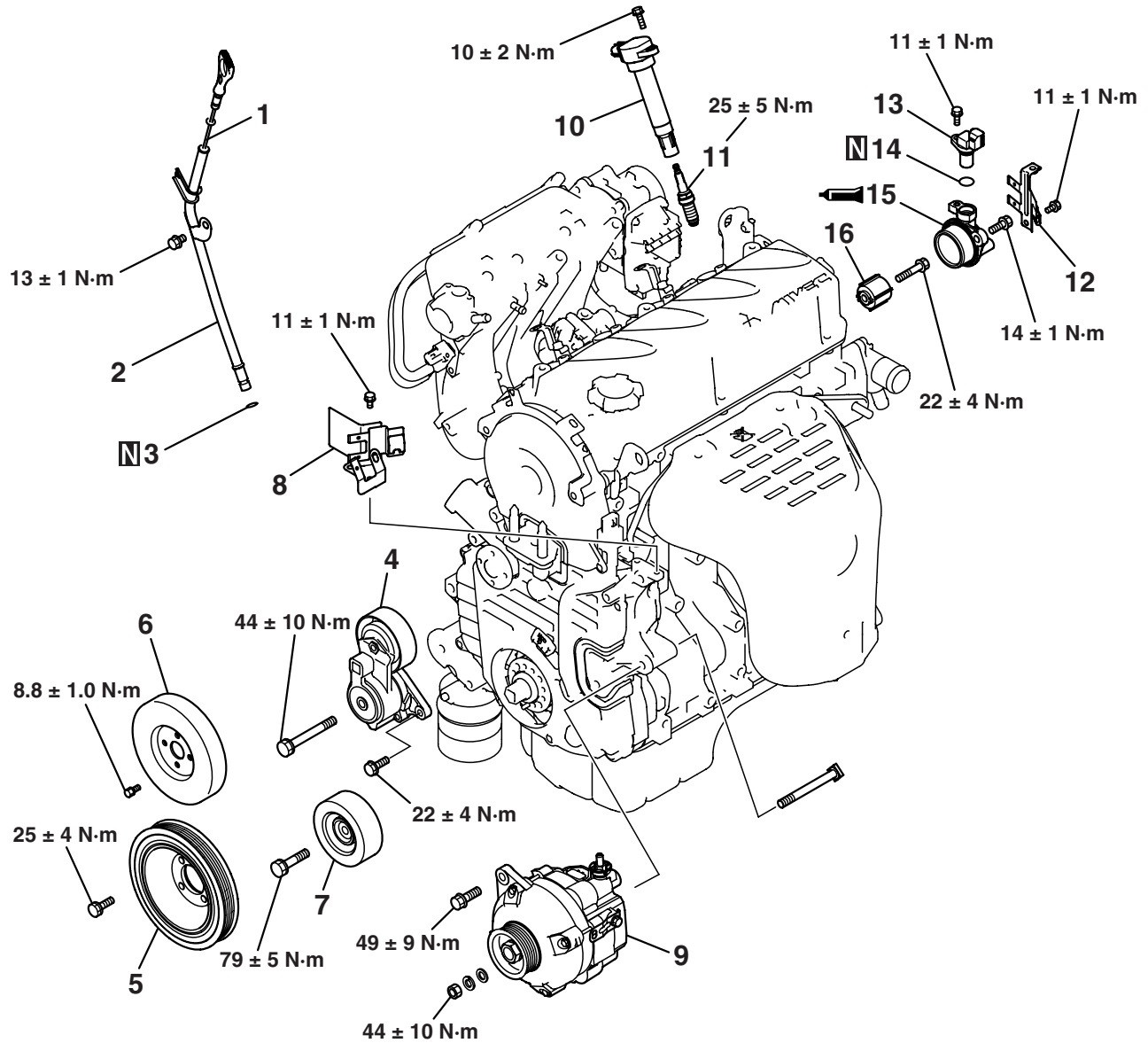
Tool	Number	Name	Use
	MD998162	Plug wrench	Removal and installation of front case cap plug
	MD998783	Plug wrench retainer	
	MD998371	Silent shaft bearing puller	Removal of counterbalance shaft front bearing
	MD998372	Silent shaft bearing puller	Removal of counterbalance shaft rear bearing
	MB991603	Bearing installer stopper	Removal and installation of rear bearing
	MD998705	Silent shaft bearing installer	Installation of counterbalance shaft bearing
 <p>D998285</p>	MD998285	Crankshaft front oil seal guide	Installation of crankshaft front oil seal
	MD998375	Crankshaft front oil seal installer	

Tool	Number	Name	Use
 A technical drawing of a piston pin setting tool, showing a central cylindrical component with a pin inserted, surrounded by several smaller cylindrical parts and a long thin rod.	MD998780	Piston pin setting tool	Removal and installation of piston pin
 A technical drawing of a long, thin cylindrical bolt guide.	MB992010	Bolt guide	Removal and installation of piston and connecting rod assembly
 A technical drawing of a handle, which is a cylindrical rod with a textured grip section.	MB990938	Handle	Installation of crankshaft rear oil seal
 A technical drawing of a circular crankshaft rear oil seal installer, showing a ring with a central hole. D998776	MD998776	Crankshaft rear oil seal installer	

# ALTERNATOR AND IGNITION SYSTEM

## REMOVAL AND INSTALLATION

M1113001001395



AK301540AD

### Removal steps

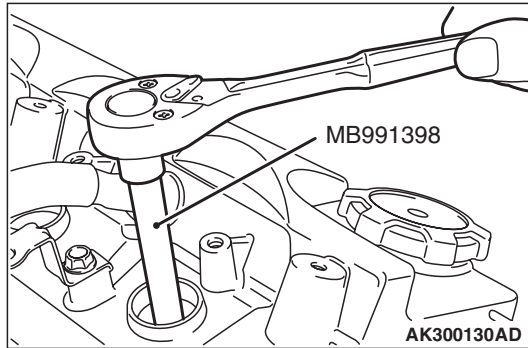
1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Auto tensioner
5. Crankshaft pulley
6. Water pump pulley
7. Idler pulley
8. Connector bracket

### Removal steps (Continued)

9. Alternator
  10. Ignition coil
  11. Spark plug
  12. Connector bracket
  13. Camshaft position sensor
  14. O-ring
  15. Camshaft position sensor support
  16. Camshaft position sensing cylinder
- <<A>> >>C<<  
>>B<<  
<<B>> >>A<<

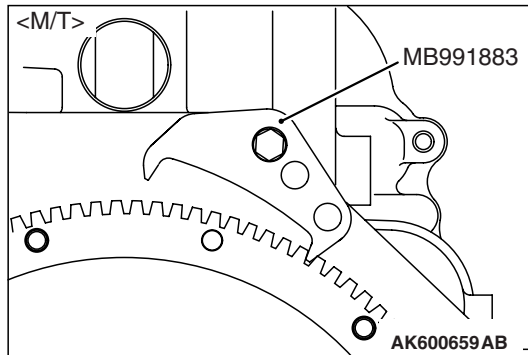
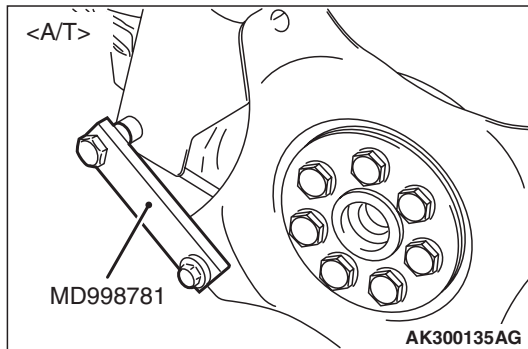
## REMOVAL SERVICE POINT

## &lt;&lt;A&gt;&gt; SPARK PLUG REMOVAL



Using special tool Spark plug wrench (MB991398), remove the spark plug.

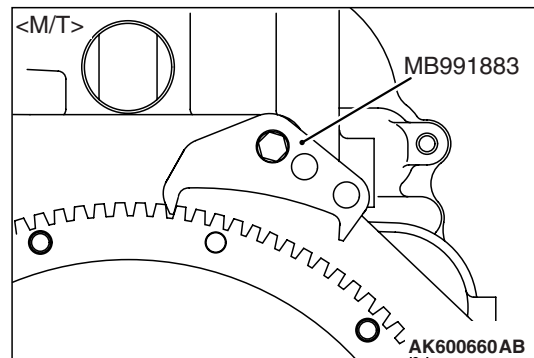
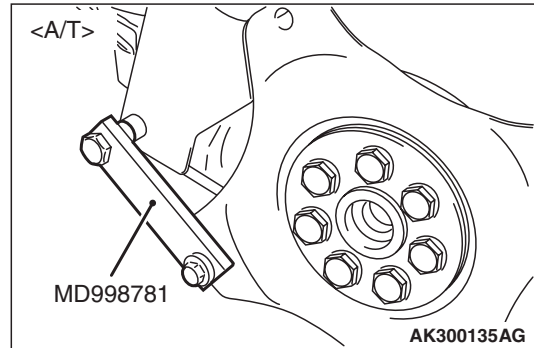
## &lt;&lt;B&gt;&gt; CAMSHAFT POSITION SENSING CYLINDER REMOVAL



1. Using special tool Flywheel stopper (MD998781), hold the drive plate.
  - Flywheel stopper (MB991883)
  - Flywheel stopper (MD998781)
2. Removal the camshaft position sensing cylinder.

## INSTALLATION SERVICE POINT

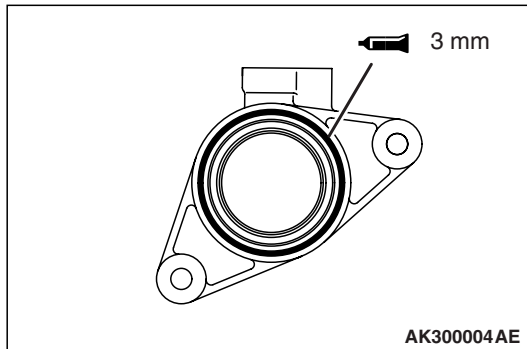
## &gt;&gt;A&lt;&lt; CAMSHAFT POSITION SENSING CYLINDER INSTALLATION



1. Using special tool Flywheel stopper (MD998781), hold the drive plate.
  - Flywheel stopper (MB991883)
  - Flywheel stopper (MD998781)
2. Tighten the camshaft position sensing cylinder to the specified torque.

**Tightening torque:  $22 \pm 4$  N·m**

>>B<< CAMSHAFT POSITION SENSOR  
SUPPORT INSTALLATION

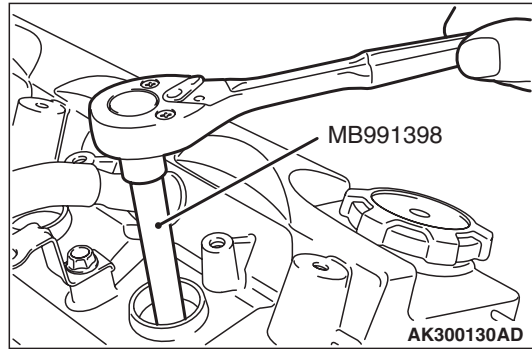


1. Remove completely the FIPG remaining on the camshaft position sensor support and cylinder head.
2. Apply a  $3 \pm 1$  mm diameter bead of FIPG to the indicated surface of the camshaft position sensor support.

**Specified sealant:**

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

>>C<< SPARK PLUG INSTALLATION



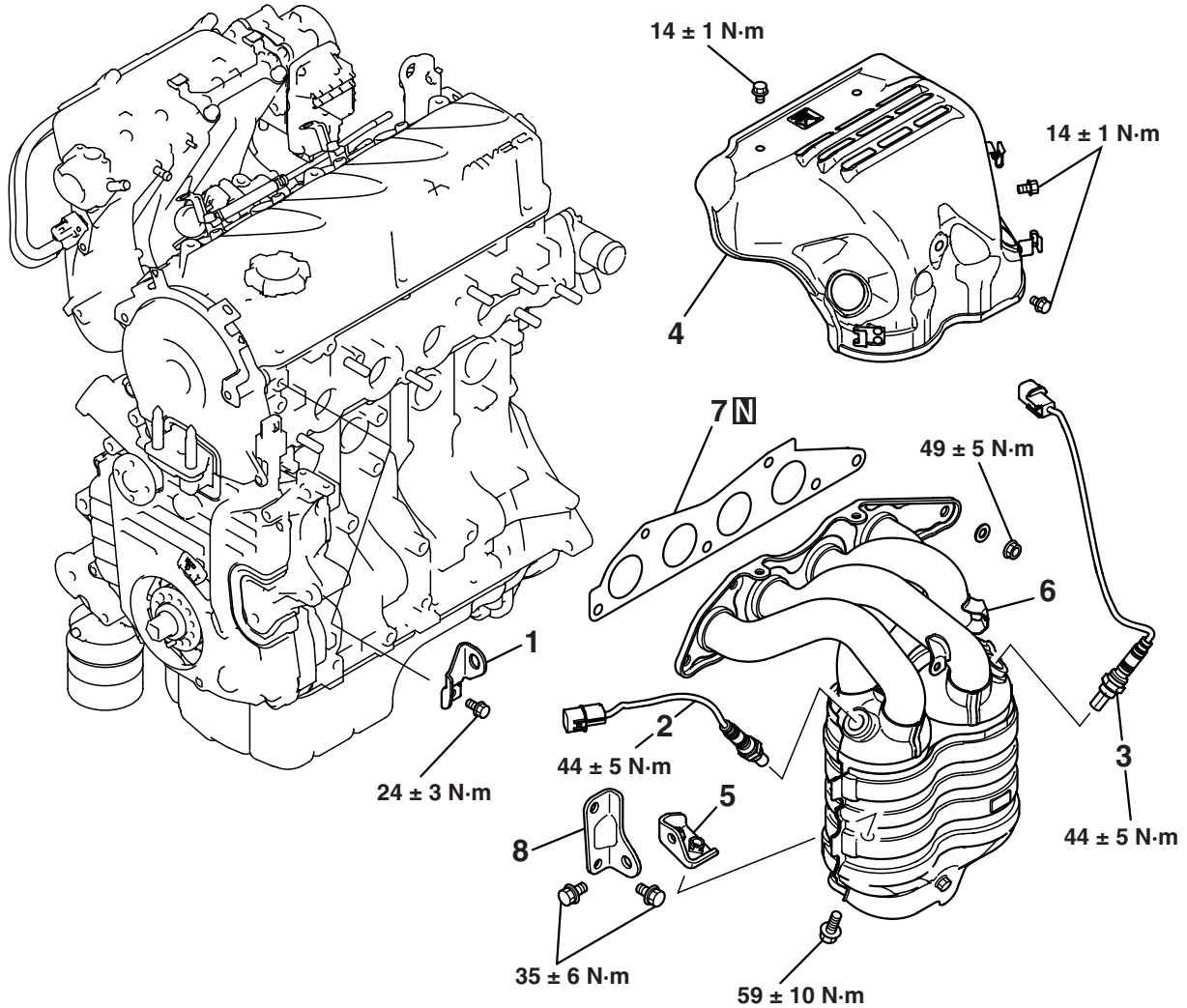
Using special tool Spark plug wrench (MB991398),  
tighten the spark plug to the specified torque.

**Tightening torque:  $25 \pm 5$  N·m**

# EXHAUST MANIFOLD

## REMOVAL AND INSTALLATION

M1113004900747



AK303751AD

### Removal steps

- <<A>> >>B<< 1. Engine hanger
- <<A>> >>B<< 2. Oxygen sensor
- <<A>> >>B<< 3. Oxygen sensor
- >>B<< 4. Exhaust manifold cover

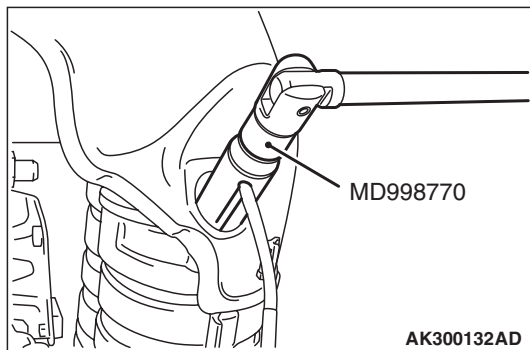
### Removal steps (Continued)

- >>A<< 5. Exhaust manifold bracket B
- 6. Exhaust manifold
- 7. Exhaust manifold gasket
- 8. Exhaust manifold bracket A



## REMOVAL SERVICE POINT

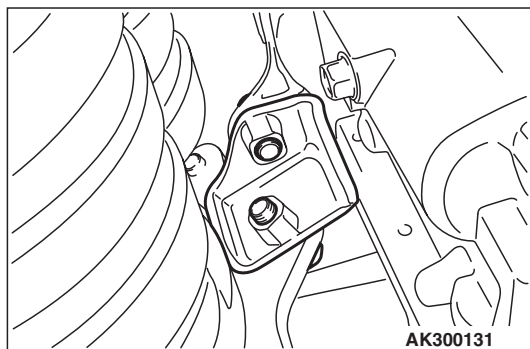
### <<A>> OXYGEN SENSOR REMOVE



Using special tool Oxygen sensor wrench (MD998770), removal the oxygen sensor.

## INSTALLATION SERVICE POINT

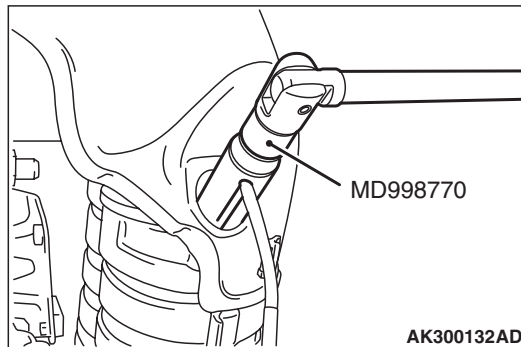
### >>A<< EXHAUST MANIFOLD BRACKET "B" INSTALLATION



Check to ensure that the exhaust manifold bracket "B" is in close contact with the exhaust manifold and the cylinder block before tightening the respective mounting bolts to the specified torque.

### >>B<< EXHAUST MANIFOLD COVER / OXYGEN SENSOR INSTALLATION

1. Install the exhaust manifold cover to the exhaust manifold.
2. Temporarily tighten the exhaust manifold cover bolt.



3. Using special tool Oxygen sensor wrench (MD998770), install both of the oxygen sensors to the exhaust manifold.

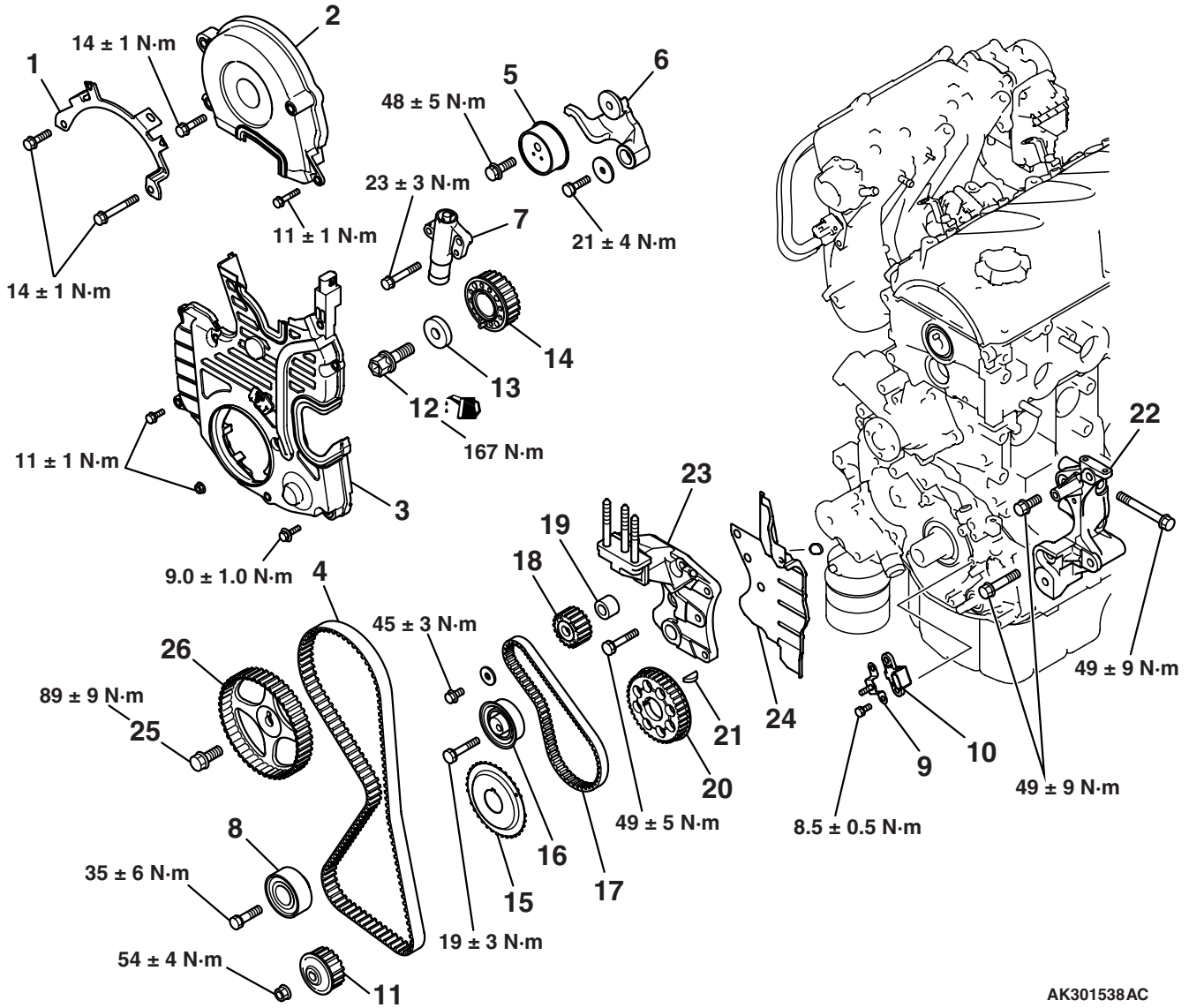
*NOTE: Do not remove the special tool after the oxygen sensor is installed.*

4. Tighten the exhaust manifold cover bolt to the specified torque of  $14 \pm 1\text{N}\cdot\text{m}$ .
5. Remove the special tool.

**TIMING BELT**

**REMOVAL AND INSTALLATION**

M1113001901525



AK301538AC

**Removal steps**

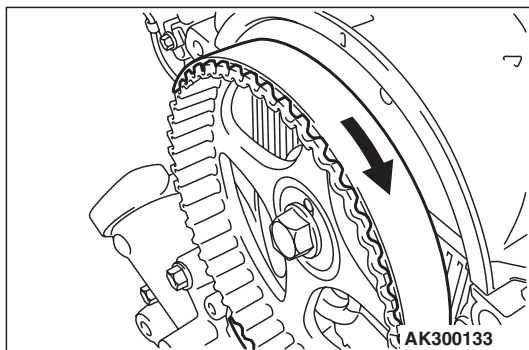
- 1. Connector bracket
- 2. Timing belt front upper cover
- 3. Timing belt front lower cover
- <<A>> >>K<< 4. Timing belt
- >>J<< 5. Tensioner pulley
- >>I<< 6. Tensioner arm
- 7. Auto-tensioner
- 8. Idler pulley
- 9. Bracket
- <<B>> >>H<< 10. Crankshaft angle sensor
- <<C>> >>G<< 11. Oil pump sprocket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

**Removal steps (Continued)**

- <<D>> >>G<< 14. Crankshaft sprocket
- >>G<< 15. Crankshaft sensing blade
- <<E>> >>F<< 16. Tensioner "B"
- <<F>> >>E<< 17. Timing belt "B"
- >>D<< 18. Counterbalance shaft sprocket
- <<G>> >>C<< 19. Spacer
- >>B<< 20. Crankshaft sprocket "B"
- >>B<< 21. Crankshaft key
- >>B<< 22. Generator bracket
- >>B<< 23. Engine support bracket
- <<H>> >>A<< 24. Timing belt rear cover
- >>A<< 25. Camshaft sprocket bolt
- >>A<< 26. Camshaft sprocket

## REMOVAL SERVICE POINTS

### <<A>> TIMING BELT REMOVAL



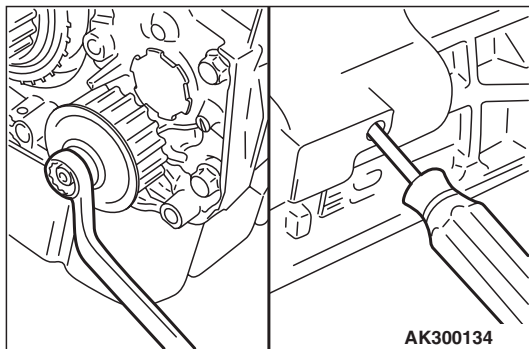
#### ⚠ CAUTION

Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be washed or immersed in solvent. Replace parts if contaminated. If there is oil or water on any part, check the front case oil seals, camshaft oil seal, and water pump for leaks.

1. Mark the belt running direction for reinstallation.
2. Loosen the tensioner pulley bolt, and then remove the timing belt.

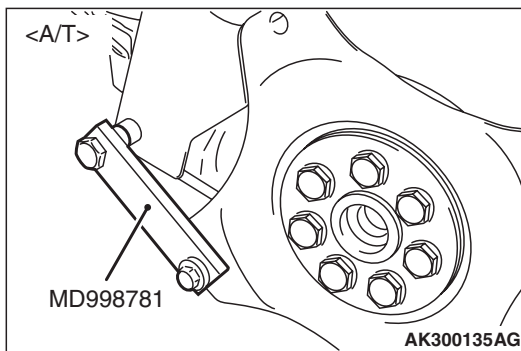
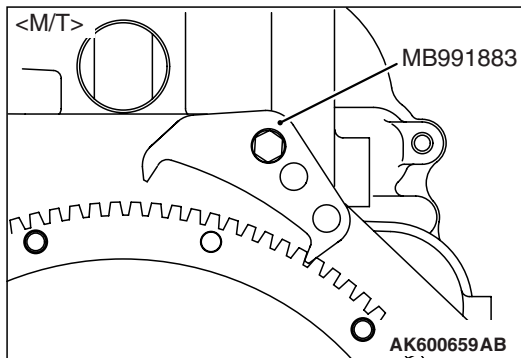
### <<B>> OIL PUMP SPROCKET REMOVAL

1. Remove the plug on the left side of the cylinder block.



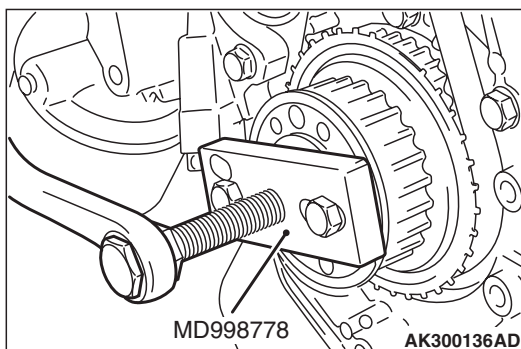
2. Insert a Phillips screwdriver (shank diameter 8 mm) through the plug hole to block the left counterbalance shaft.
3. Loosen the nut, and then remove the oil pump sprocket.

### <<C>> CRANKSHAFT BOLT LOOSENING



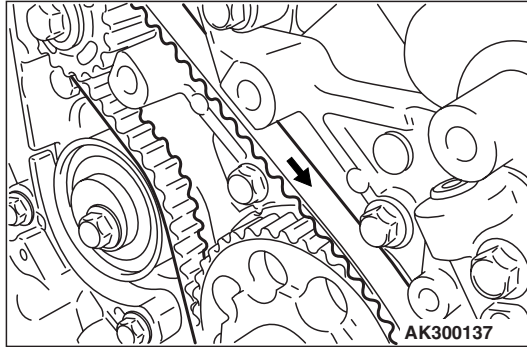
1. Install Flywheel stopper (MD998781) to hold the drive plate or the flywheel.
  - Flywheel stopper (MB991883)
  - Flywheel stopper (MD998781)
2. Loosen and remove the crankshaft bolt and washer.

### <<D>> CRANKSHAFT SPROCKET REMOVAL



1. Set special tool Crankshaft sprocket puller (MD998778) as shown in the illustration.
2. Screw in the center bolt of the special tool to remove the crankshaft sprocket.

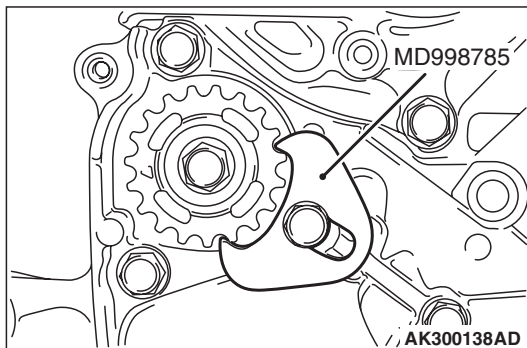
## &lt;&lt;E&gt;&gt; TIMING BELT "B" REMOVAL

**CAUTION**

Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. These parts should not be washed or immersed in solvent. Replace parts if contaminated. If there is oil or water on each part, check the front case oil seals, camshaft oil seal and water pump for leaks.

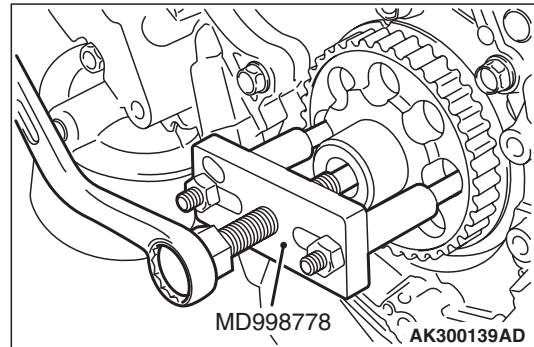
1. Mark the belt running direction for reinstallation.
2. Loosen the tensioner "B" bolt, and then remove the timing belt "B."

## &lt;&lt;F&gt;&gt; COUNTERBALANCE SHAFT SPROCKET REMOVAL



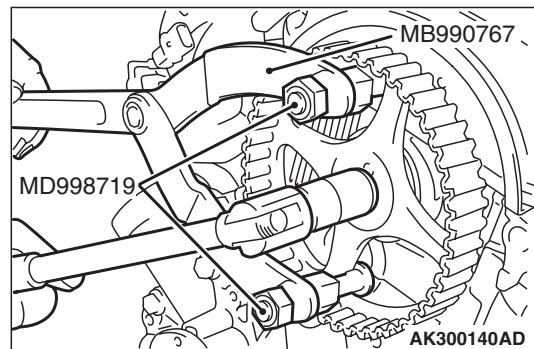
1. Set special tool Sprocket stopper (MD998785) as shown to prevent the counterbalance shaft sprocket from turning together.
2. Loosen the bolt and remove the sprocket.

## &lt;&lt;G&gt;&gt; CRANKSHAFT SPROCKET "B" REMOVAL



1. Set special tool Crankshaft sprocket puller (MD998778) as shown in the illustration.
2. Screw in the center bolt of the special tool to remove crankshaft sprocket "B."

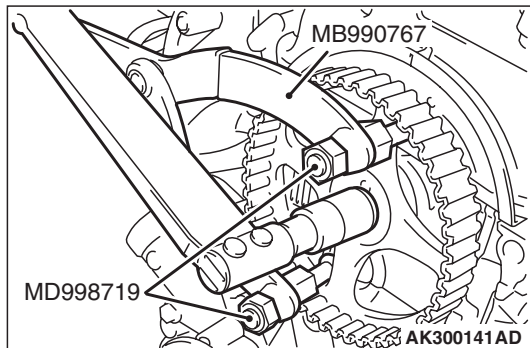
## &lt;&lt;H&gt;&gt; CAMSHAFT SPROCKET REMOVAL



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

## INSTALLATION SERVICE POINTS

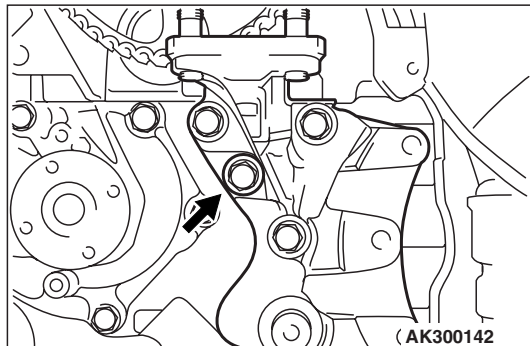
### >>A<< CAMSHAFT SPROCKET INSTALLATION



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.

**Tightening torque: 89 ± 9 N·m**

### >>B<< ENGINE SUPPORT BRACKET INSTALLATION



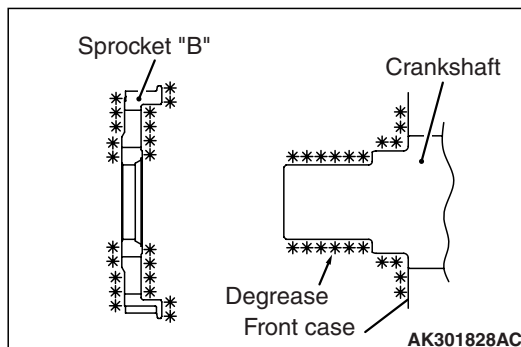
1. Remove thoroughly the old sealant remaining on the indicated bolt and in its hole.
2. Coat the bolt with sealant, then install and tighten it.

**Specified sealant:**

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

**Tightening torque: 49 ± 5 N·m**

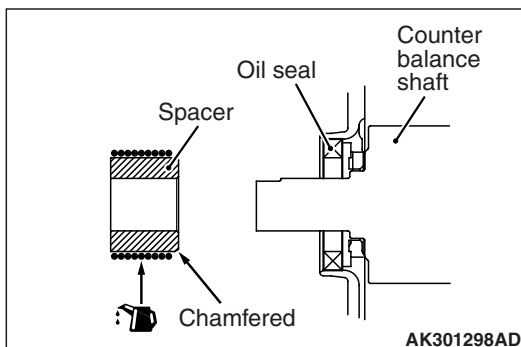
### >>C<< CRANKSHAFT SPROCKET "B" INSTALLATION



Clean and then degrease the front case of the front case, crankshaft sprocket "B" and crankshaft surface on which sprocket "B" is attached.

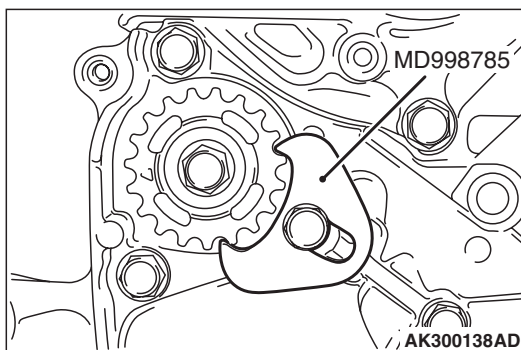
*NOTE: Degreasing is necessary to prevent decrease in the friction between contacting surfaces.*

### >>D<< SPACER INSTALLATION



1. Apply a thin coat of clean engine oil to the lip area of the oil seal.
2. Install the spacer with the chamfered end facing toward the oil seal.

### >>E<< COUNTERBALANCE SHAFT SPROCKET INSTALLATION

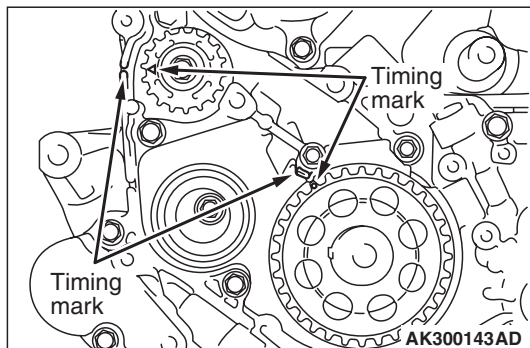


1. Install the counterbalance shaft sprocket and screw on the bolt.

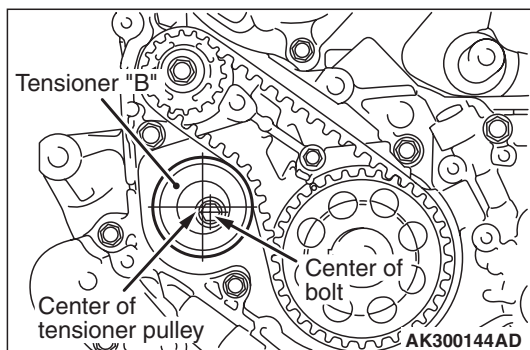
2. Install special tool Sprocket stopper (MD998785) as shown in the illustration to lock the counterbalance shaft.
3. Tighten the bolt, and then remove the special tool.

**Tightening torque:  $45 \pm 3$  N·m**

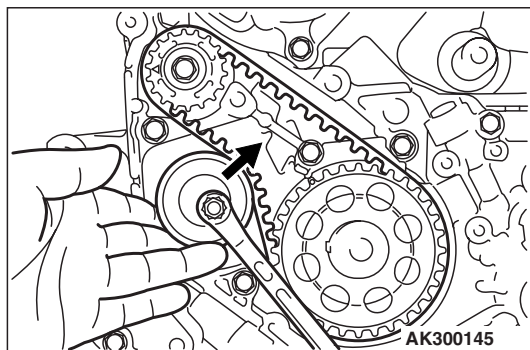
### >>F<< TIMING BELT "B" INSTALLATION



1. Align timing marks on the crankshaft sprocket "B" and counterbalance shaft sprocket with the marks on the front case.
2. Install the timing belt "B" on the crankshaft sprocket "B" and counterbalance shaft sprocket. There should be no slack on the tension side.

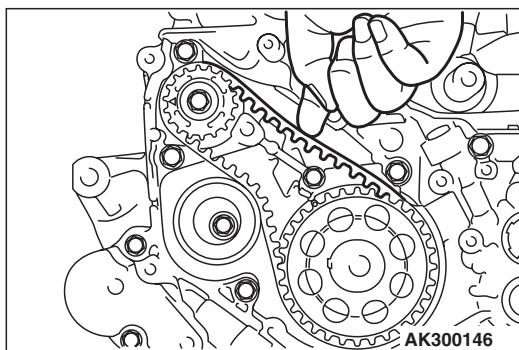


3. Make sure that the tensioner pulley center and the bolt center are positioned as shown in the illustration.



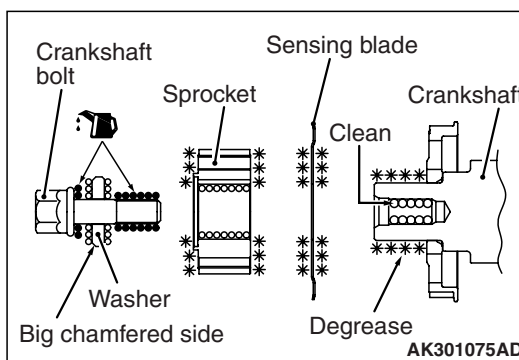
4. Move tensioner "B" in the direction of the arrow while lifting with your finger to give sufficient tension to the tension side of timing belt. In this condition, tighten the bolt to secure tensioner "B." When the bolt is tightened, use care to prevent the tensioner pulley shaft from turning with the bolt. If the shaft is turned with the bolt, the belt will be over tensioned.

**Tightening torque:  $19 \pm 3$  N·m**



5. Check that timing marks on the sprockets are aligned with the timing marks on the front case.
6. With your index finger, press the midway of span on the tension side of timing belt "B." The bolt must deflect 5 to 7 mm.

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

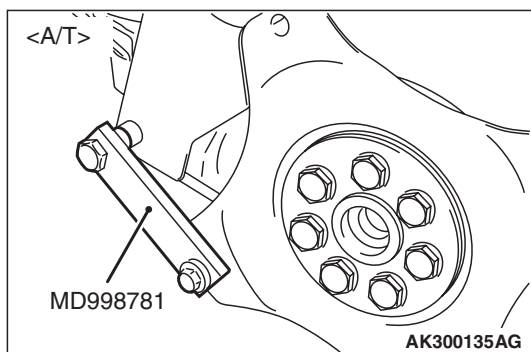
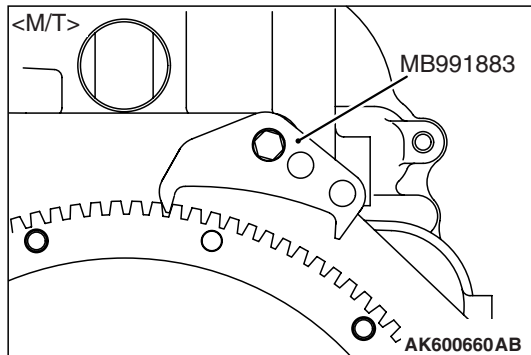


1. Clean and then degrease the contacting surfaces of the crankshaft sprocket, sensing blade and crankshaft.

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

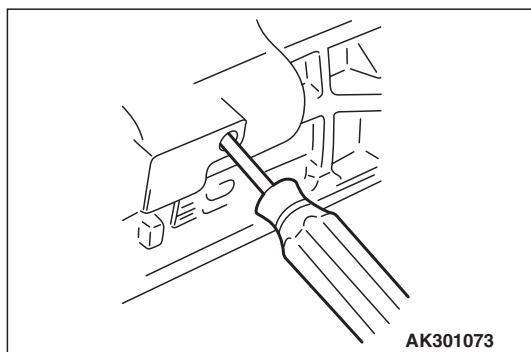
2. Clean the bolt hole in the crankshaft, the crankshaft contacting surface of the crankshaft sprocket, and the washer.

3. Install the sensing blade and the crankshaft sprocket to the crankshaft.
4. Apply a small amount of engine oil to the threads and seating surface of the crankshaft bolt.
5. Install the washer to the crankshaft bolt with the larger chamfered side toward the bolt head.



6. Lock the drive plate or the flywheel using the special tool Flywheel stopper.
  - Flywheel stopper (MB991883)
  - Flywheel stopper (MD998781)
7. Tighten the crankshaft bolt to the specified torque.  
**Tightening torque: 167 N·m**

### >>H<< OIL PUMP SPROCKET INSTALLATION



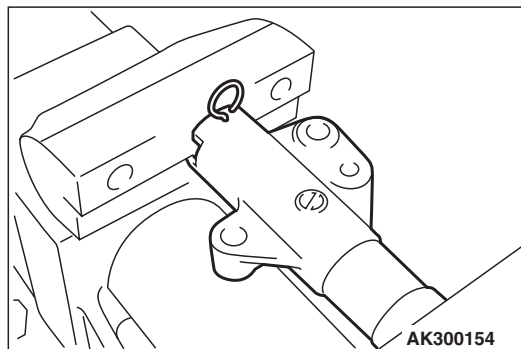
1. Insert a Phillips head screwdriver (shank diameter 8 mm) through the plug hole on the left side of the cylinder block to block the left counterbalance shaft.

2. Install the oil pump sprocket.
3. Apply a thin coat of engine oil to the seating surface of the nut.
4. Tighten the nut to the specified torque.

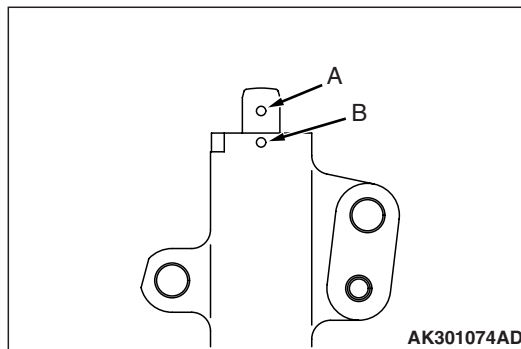
**Tightening torque: 54 ± 5 N·m**

### >>I<< AUTO-TENSIONER INSTALLATION

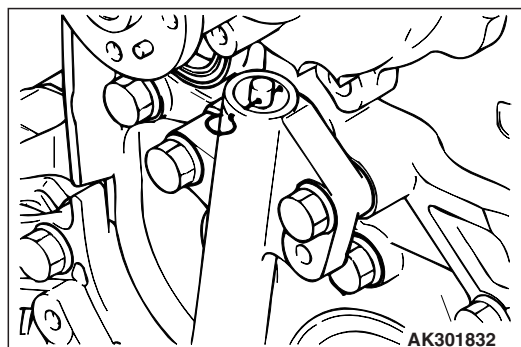
If the auto-tensioner rod is fully extended, reset it as follows:



1. Clamp the auto-tensioner in a vise with soft jaws.



2. Push in the rod little by little with the vise until the set hole A in the rod is aligned with hole B in the cylinder.
3. Insert a wire (1.4 mm in diameter) into the set holes. This auto-tensioner setting wire will be used during timing belt alignment.
4. Unclamp the auto-tensioner from the vise.

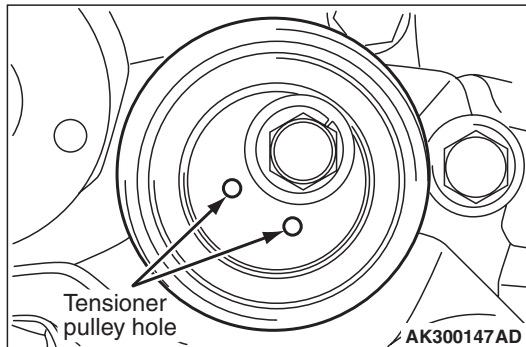


**CAUTION**

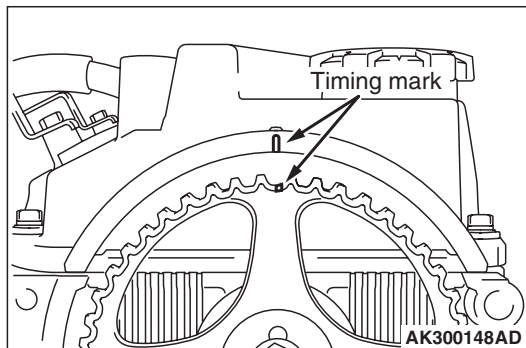
Leave the wire installed in the auto-tensioner.

5. Install the auto-tensioner onto the front case and tighten to the specified torque.

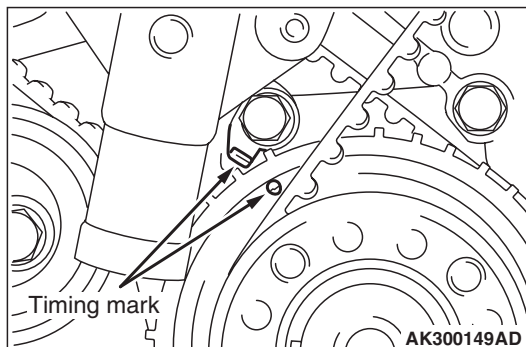
**Tightening torque:  $23 \pm 3$  N·m**

**>>J<< TENSIONER PULLEY  
INSTALLATION**

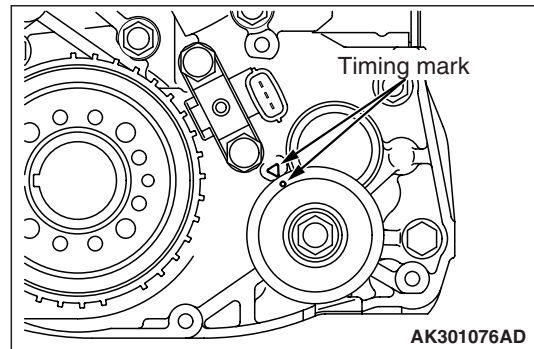
Set the tensioner pulley so that the holes for attaching a wrench may be positioned as shown in the illustration.

**>>K<< TIMING BELT INSTALLATION**

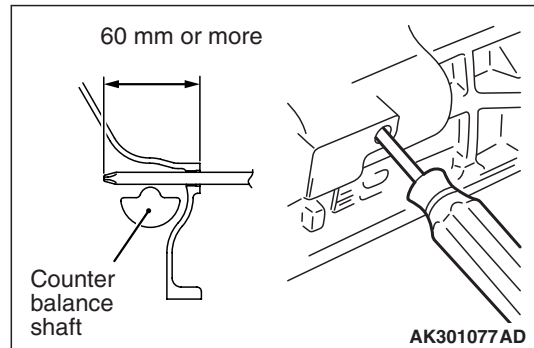
1. Align the timing mark on the camshaft sprocket with the timing mark on the rocker cover.



2. Align the timing mark on the crankshaft sprocket with the timing mark on the front case.



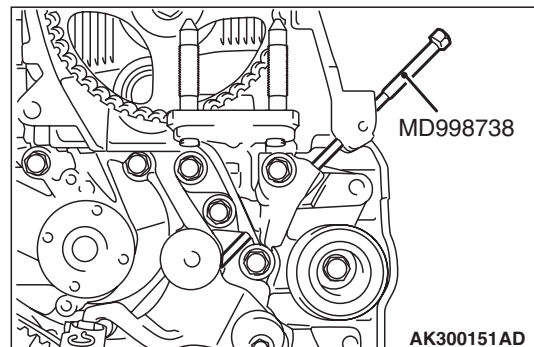
3. Align the timing mark on oil pump sprocket with its mating mark.



4. Remove the plug on the cylinder block and insert a Phillips head screwdriver (shank diameter 8 mm) through the hole.

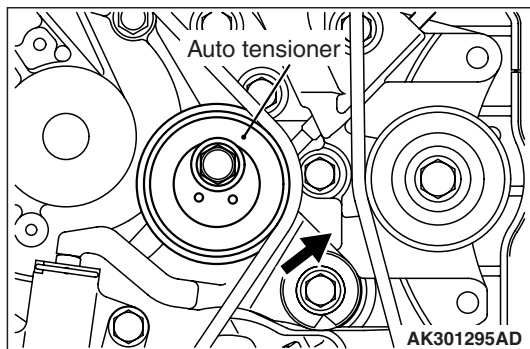
If it can be inserted as deep as 60 mm or more, the timing marks are correctly aligned.

if the inserted depth is only 20 to 25 mm, turn the oil pump sprocket one turn and realign the timing marks. then check to ensure that the screwdriver can be inserted 60 mm or more. keep the screwdriver inserted until the timing belt is completely installed.

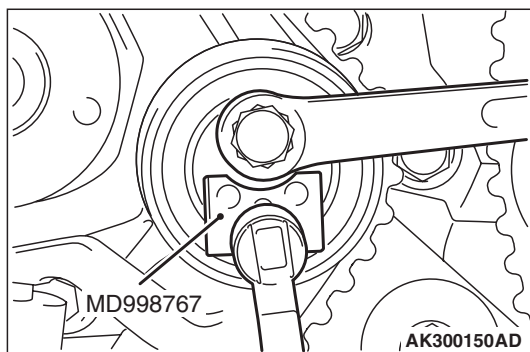


5. Set the special tool Set screw (MD998738) as shown and screw it in up to the position where the wire inserted in the auto-tensioner when installing it can be moved lightly.
6. Install the timing belt on the crankshaft sprocket, oil pump sprocket, idler pulley, camshaft sprocket, and tensioner pulley in that order.





7. Lift up the tensioner pulley in the direction of the arrow and tighten the center bolt.
8. Check that all timing marks are aligned.
9. Remove the screwdriver inserted in step 5 and install the plug.
10. Turn the crankshaft a quarter turn counterclockwise. Then, turn it clockwise until the timing marks are aligned again.

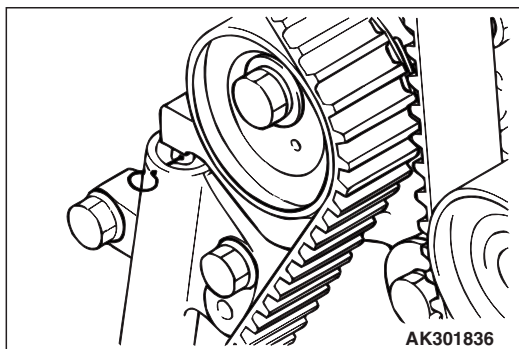


11. Install special tool Tension pulley socket wrench (MD998767), socket wrench and torque wrench, onto the tensioner pulley, and loosen the tensioner pulley center bolt.

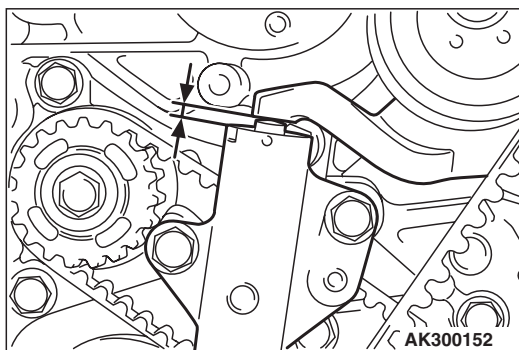
*NOTE: Use a torque wrench that can measure 0 to 5.0 N·m.*

12. Torque to 3.5 N·m with the torque wrench.
13. Holding the tensioner pulley with special tool Tension pulley socket wrench (MD998767) and torque wrench, tighten the center bolt to specification.

**Tightening torque: 48 ± 5 N·m**



14. The wire inserted at the auto-tensioner installation is pulled out and then the special tool Set screw (MD998738) is removed by hand.
15. Give two clockwise turns to the crankshaft. Wait for 15 minutes, then proceed with the following inspection steps.



16. Check to see whether the metal wire (inserted when the auto-tensioner was installed) can be removed without any resistance.

If the metal wire can be removed without any resistance, it means that the belt has a proper tension. Therefore, remove the metal wire. In this condition, check that the rod protrusion of the auto-tensioner is within the standard value.

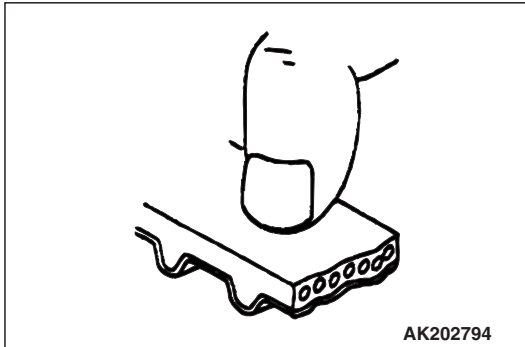
**Standard value: 3.8 – 4.5 mm**

17. If the metal wire offers resistance when removed, repeat the previous steps 10 through 15 until the standard value is obtained as measured by the rod projection of the auto-tensioner rod.

INSPECTION

TIMING BELT

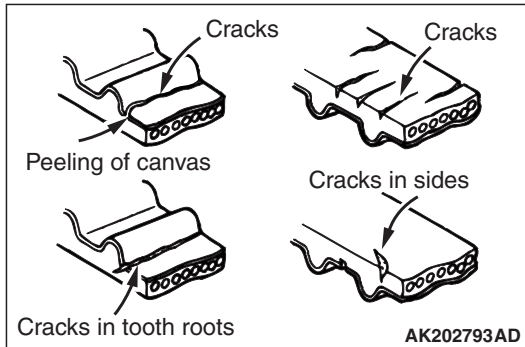
M1113002000481



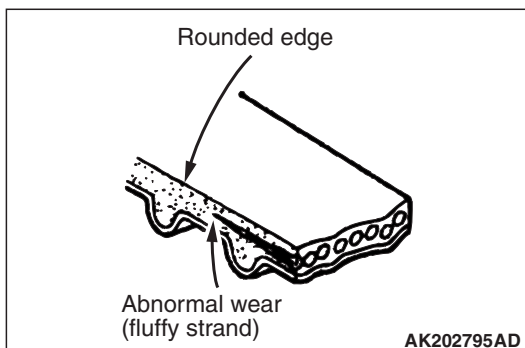
Replace the belt if any of the following conditions exist:

1. Hardening of rubber backing.

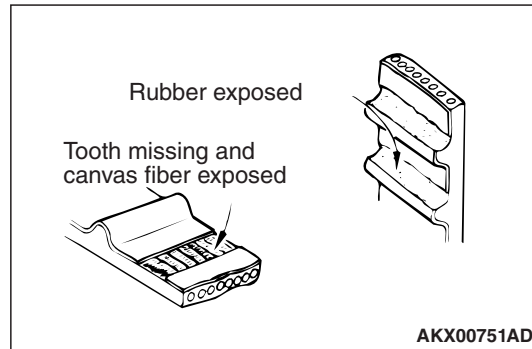
Back side should be glossy without resilience and leave no indent when pressed with fingernail.



2. Cracks on rubber back.
3. Cracks or peeling of canvas.
4. Cracks at bottom of ribs.
5. Cracks on belt sides.



6. Abnormal wear of belt sides. Normal wear is indicated if the sides are sharp as if cut by a knife. Abnormal wear is indicated if the sides are ragged.



7. Abnormal wear on teeth.

**Initial stage:**

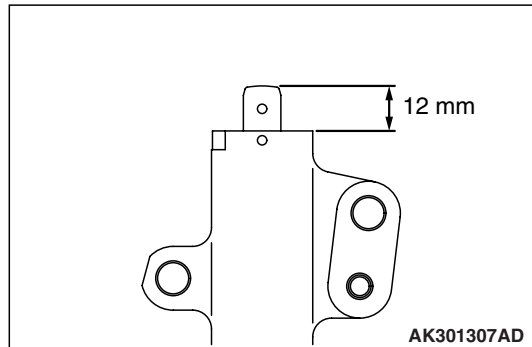
**Canvas worn (fluffy canvas fibers, rubbery texture gone, white discoloration, canvas texture indistinct)**

**Final stage:**

**Canvas worn, exposing rubber (tooth width reduced)**

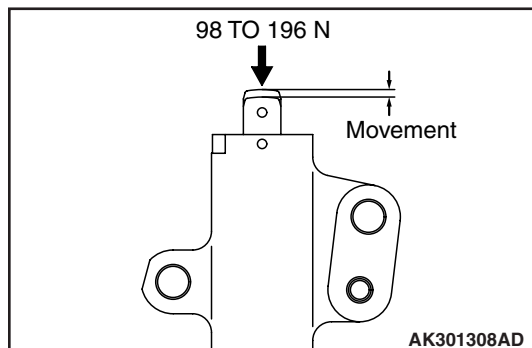
8. Missing tooth.

AUTO-TENSIONER



1. Check for oil leaks. If oil leaks are evident, replace the auto-tensioner.
2. Check the rod end for wear or damage and replace the auto-tensioner if necessary.
3. Measure the rod protrusion. If it is out of specification, replace the auto tensioner.

**Standard value: 12 mm**



- Press the rod with a force of 98 to 196 N and measure the movement of the rod.

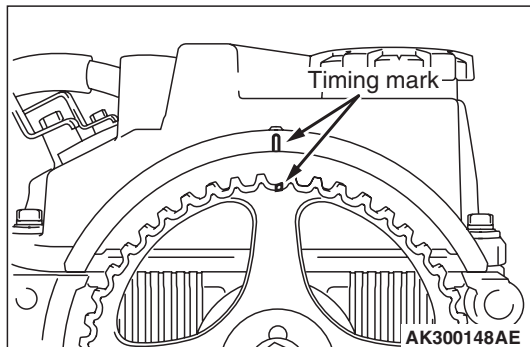
If the measured value is out of the standard value, replace the auto-tensioner.

**Standard value: 1.0 mm or less**

### VALVE CLEARANCE ADJUSTMENT

Perform the adjustment of the valve clearance in the following procedure.

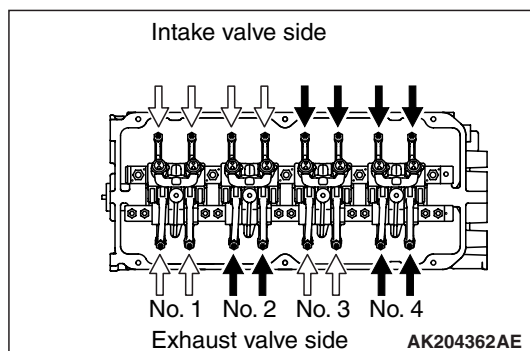
- Remove the rocker cover.



**CAUTION**

Rotate the crankshaft clockwise at any time.

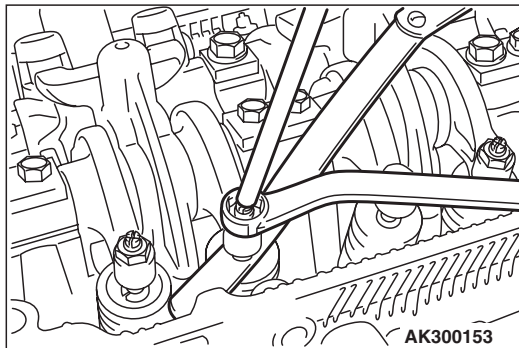
- Rotate crankshaft clockwise and then align the timing mark on the camshaft sprocket with the timing mark on the cylinder head. (Place No. 1 cylinder on the top dead center of compression stroke.)



- Measure the valve clearance marked with arrows shown in the figure.

White arrow mark: When No.1 cylinder is on the top dead center of compression stroke.

Black arrow mark: When No.4 cylinder is on the top dead center of compression stroke.



- Using a thickness gauge, adjust the clearance between the valve shaft end and the adjusting screw.

**Standard value (in cold state):**

**Intake side: 0.11 mm**

**Exhaust side: 0.20 mm**

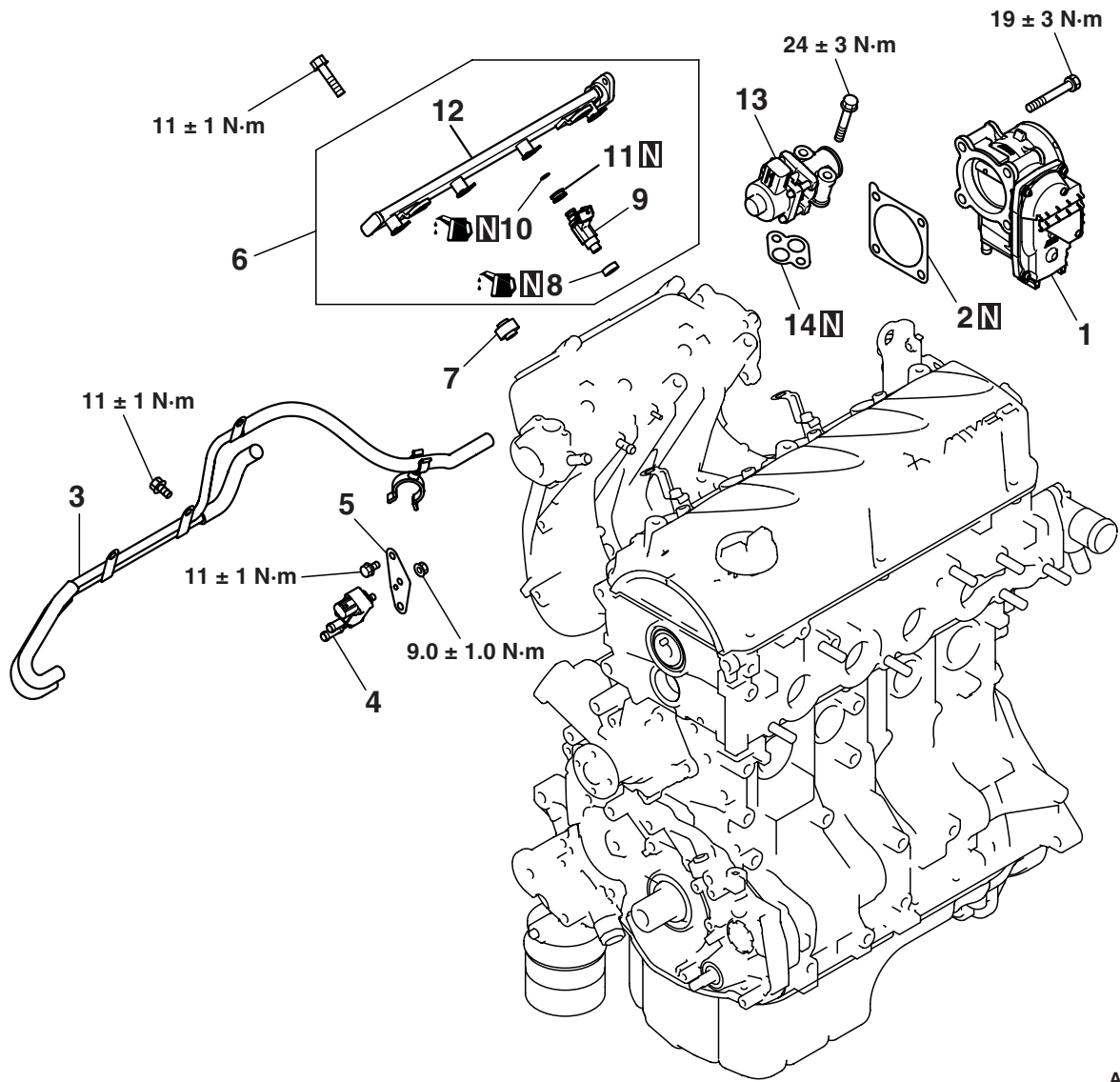
*NOTE: After the engine assembly is installed on the vehicle, check the valve clearance again in the engine warm-up state. Adjust if necessary.*

- Hold the adjusting screw not rotating through a driver and then tighten the rock nut.
- Rotate the crankshaft one time clockwise and then align the timing mark with the timing mark on the crankshaft sprocket. (Place No. 4 cylinder on the top dead center of compression stroke.)
- Adjust the valve clearance for the rest of the valves.
- Install the rocker cover.

# FUEL AND EMISSION PARTS

## REMOVAL AND INSTALLATION

M1113002200720



AK400854AB

### Removal steps

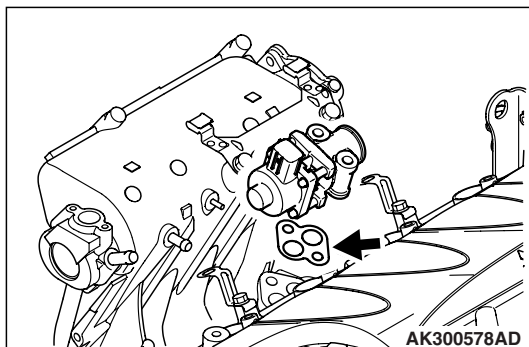
- >>C<<
1. Throttle body
  2. Throttle body gasket
  3. Vacuum pipe and hose
  4. Solenoid valve
  5. Solenoid valve bracket
  6. Injector and delivery pipe
  7. Insulator

### Removal steps (Continued)

- >>B<<
8. Insulator
  9. Injector
  10. O-ring
  11. Grommet
  12. Delivery pipe
  13. EGR valve
  14. EGR gasket
- >>A<<

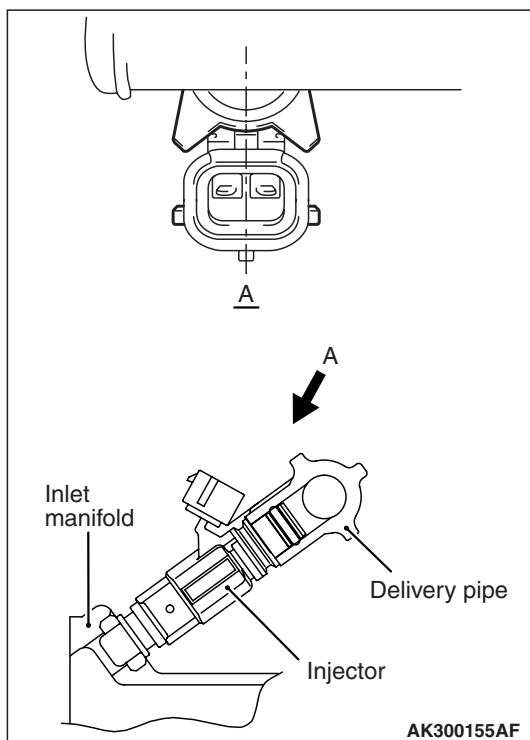
## INSTALLATION SERVICE POINTS

### >>A<< EGR VALVE INSTALLATION



Install a new gasket as positioned as shown in the illustration.

### >>B<< INJECTORS INSTALLATION



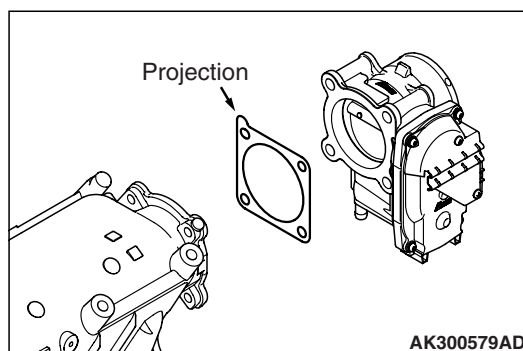
### **⚠ CAUTION**

Use care not to let engine oil enter the delivery pipe.

1. Apply clean engine oil to the O-ring.
2. Insert the injector into the delivery pipe.
3. Make sure the injector rotates smoothly.

If not, remove the injector to check the O-ring for damage, and replace the O-ring if necessary. Then, reinstall the injector and check that it rotates smoothly.

### >>C<< THROTTLE BODY GASKET INSTALLATION

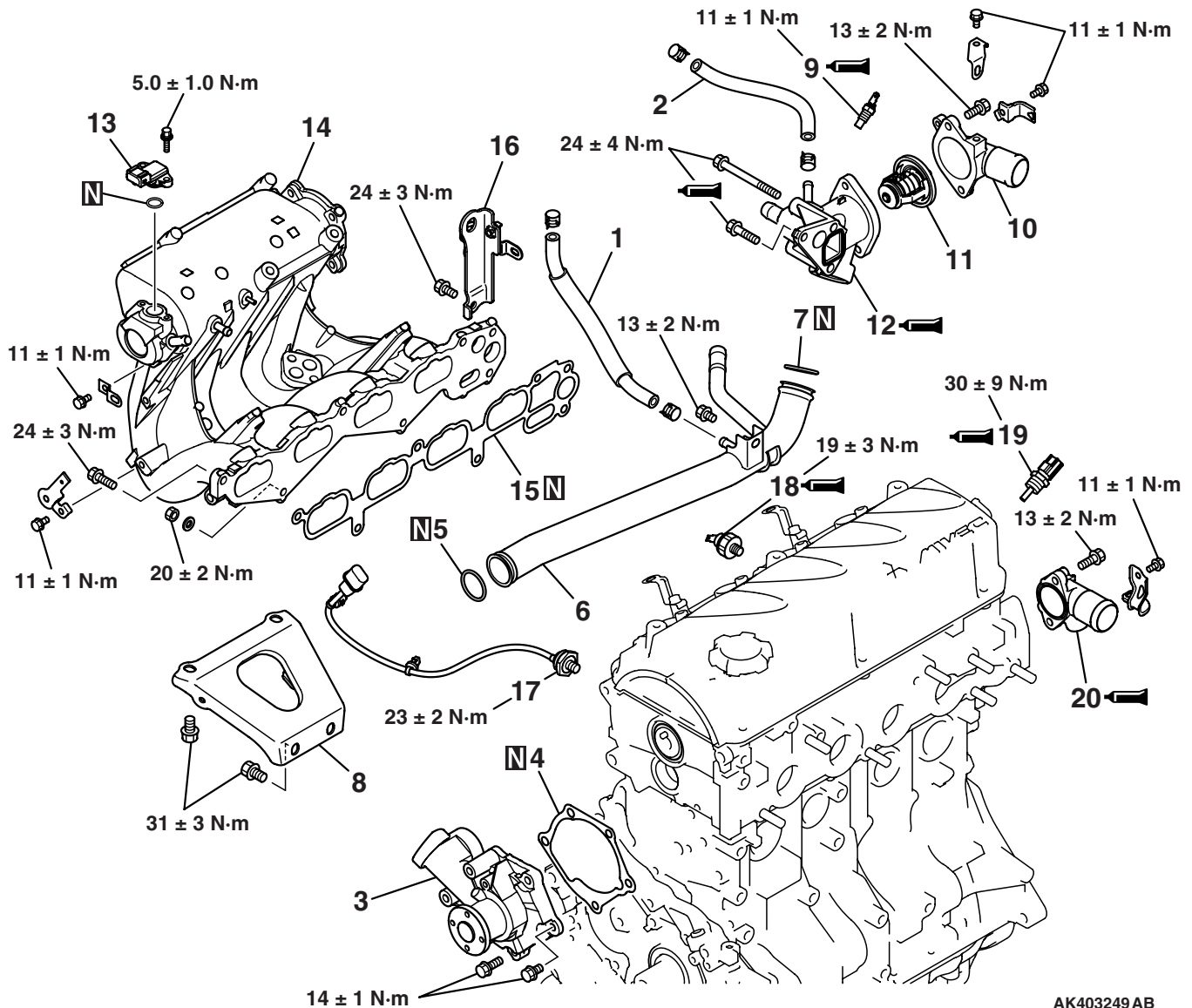


Install a new gasket so that the projection is positioned as shown in the illustration.

## INLET MANIFOLD AND WATER PUMP

## REMOVAL AND INSTALLATION

M1113025500164



AK403249 AB

## Removal steps

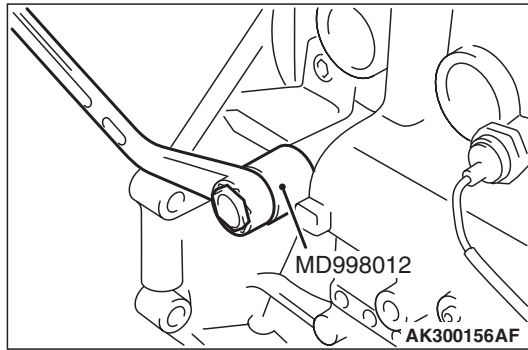
1. Water hose
2. Water hose
3. Water pump
4. Water pump gasket
- >>H<< 5. O-ring
- >>H<< 6. Water inlet pipe
- >>H<< 7. O-ring
- >>G<< 8. Inlet manifold stay
- >>F<< 9. Engine coolant temperature gauge unit
10. Water inlet fitting
- >>E<< 11. Thermostat

## Removal steps (Continued)

- >>D<< 12. Thermostat housing
13. Manifold differential pressure sensor
14. Inlet manifold
15. Inlet manifold gasket
16. Engine hanger
17. Detonation sensor
- <<A>> >>C<< 18. Oil pressure switch
- >>B<< 19. Engine coolant temperature sensor
- >>A<< 20. Water outlet fitting

## REMOVAL SERVICE POINT

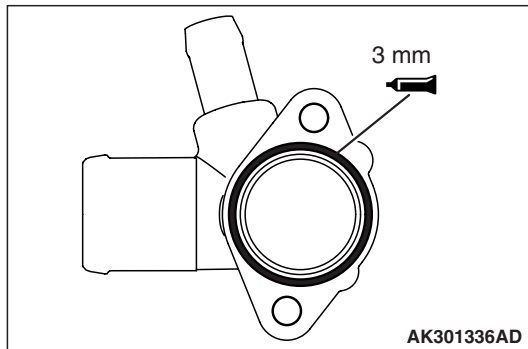
### <<A>> OIL PRESSURE SWITCH REMOVAL



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

## INSTALLATION SERVICE POINTS

### >>A<< WATER OUTLET FITTING INSTAL- LATION



1. Apply a 3 mm diameter bead of FIPG to the indicated surface of the water outlet fitting.

**Specified sealant:**

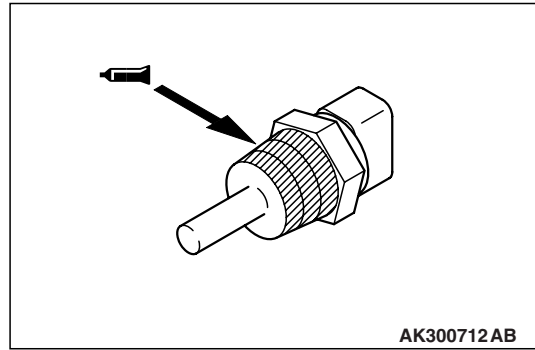
**Mitsubishi Genuine Part No.MD970389 or equivalent**

2. Install the housing quickly (within 15 minutes) while the sealant is wet and tighten the bolts to the specified torque.

**Tightening torque: 13 ± 2 N·m**

**NOTE:** . After installation, keep the sealed area away from the coolant for approximately one hour.

### >>B<< SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE SENSOR



#### **CAUTION**

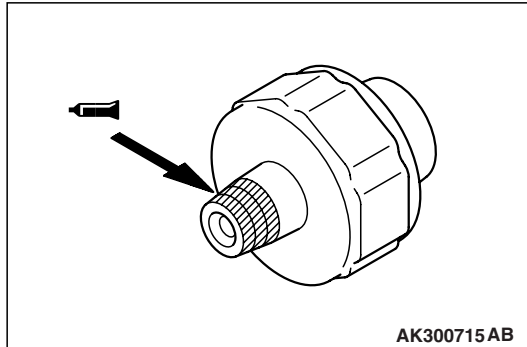
**When using a tool, avoid letting it touch the connector portion which is made of plastic.**

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

**Specified sealant:**

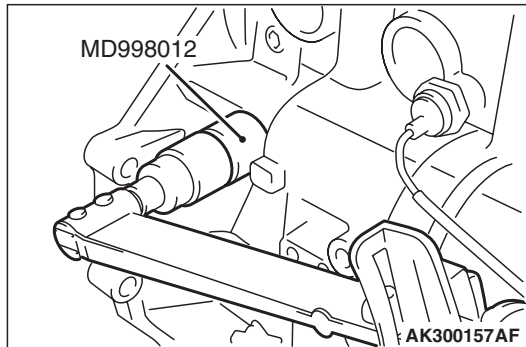
**3M ATD Part No.8660 or equivalent**

## &gt;&gt;C&lt;&lt; SEALANT APPLICATION TO OIL PRESSURE SWITCH



1. Apply sealant to the threaded portion.

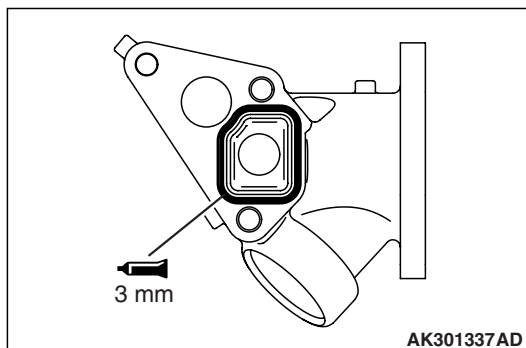
**Specified Sealant:**  
**3M ATD Part No.8660 or equivalent**



2. Using special tool Oil pressure switch wrench (MD998012), tighten the oil pressure switch to the specified torque.

**Tightening torque:  $19 \pm 3$  N·m**

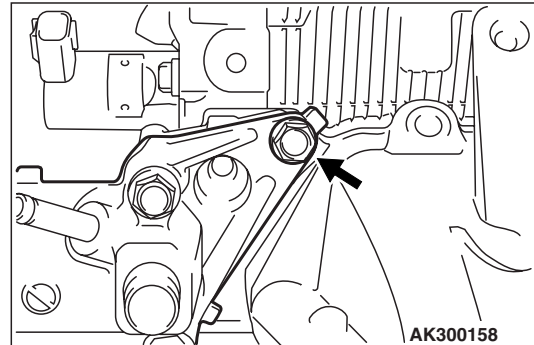
## &gt;&gt;D&lt;&lt; THERMOSTAT HOUSING INSTALLATION



1. Remove all old FIPG remaining on the thermostat housing and cylinder head.

2. Apply a 3 mm diameter bead of FIPG on the indicated surface of the thermostat housing.

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



3. Coat the bolt with sealant, then install and tighten it.

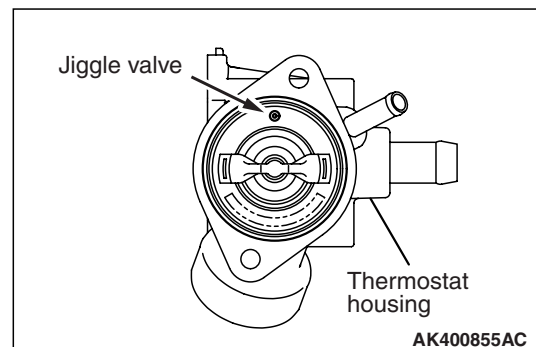
**Specified sealant:**  
**3M Nut Locking Part No.4171 or equivalent**

4. Install the housing quickly (within 15 minutes) while the sealant is wet and tighten the bolts to the specified torque.

**Tightening torque:  $24 \pm 4$  N·m**

*NOTE: After installation, keep the sealed area away from the coolant for approximately one hour.*

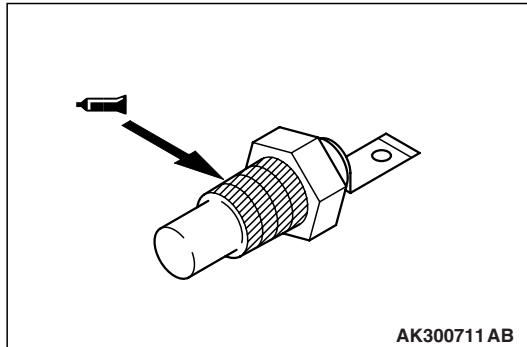
## &gt;&gt;E&lt;&lt; THERMOSTAT INSTALLATION



1. Check that the rubber ring is undamaged and seated correctly in the thermostat flange.
2. Install the thermostat as shown in the illustration. The jiggle valve must be at the uppermost position.



## >>F<< SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE GAUGE UNIT



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

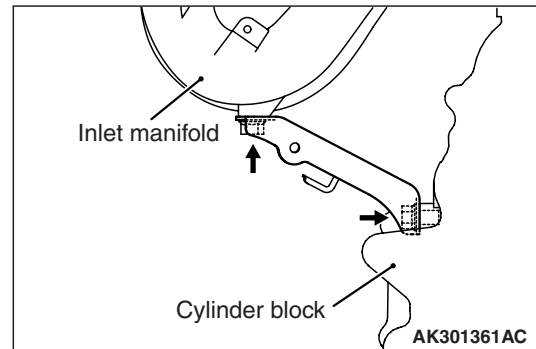
*NOTE: A new coolant temperature gauge unit is coated with sealant. It does not require coating with sealant before installation.*

2. Apply sealant to the indicated threads of the coolant temperature gauge unit.

**Specified sealant:**

**3M Nut Locking Part No.4171 or equivalent**

## >>G<< INLET MANIFOLD STAY INSTALLATION



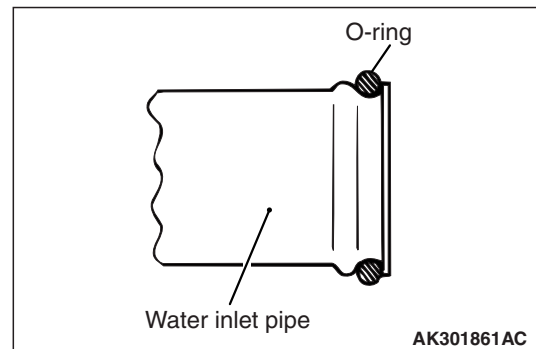
1. Install the inlet manifold stay and tighten the bolts just finger tight.
2. Check to ensure that the stay is in close contact with the bosses of the inlet manifold and cylinder block.
3. First tighten the inlet manifold side bolts to the specified torque, then the cylinder block side bolts to the specified torque.

**Tightening torque:  $31 \pm 3$  N·m**

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

### **⚠ CAUTION**

**Keep the O-ring free of oil or grease.**

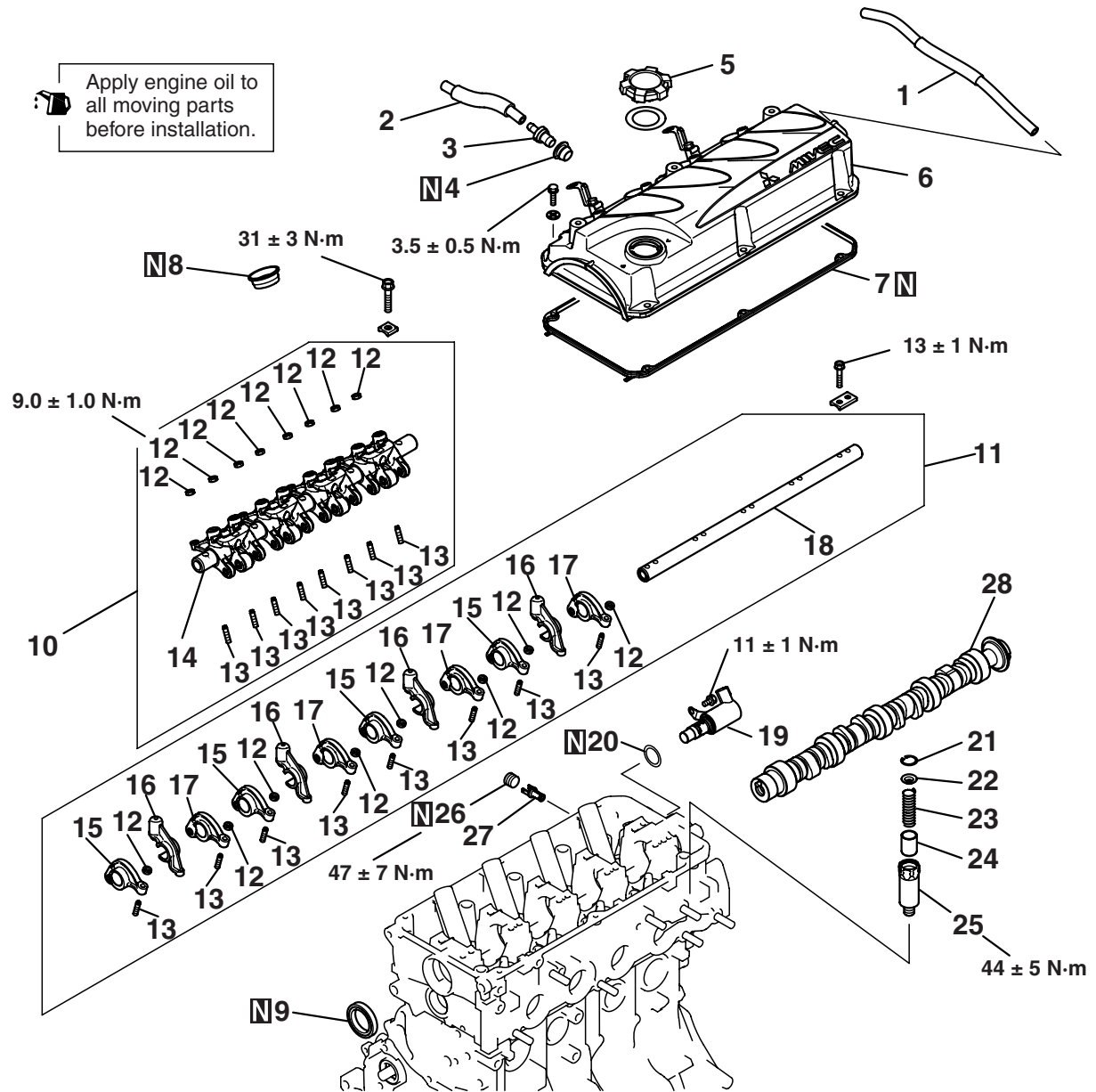


1. Attach a new O-ring to each end of the water inlet pipe.
2. Wet the O-ring with water.
3. Insert the rear end of the pipe into the thermostat housing.

# ROCKER ARMS AND CAMSHAFT

## REMOVAL AND INSTALLATION

M1113005400875



AK305650AE

### Removal steps

1. Breather hose
2. PCV hose
3. PCV valve
4. PCV valve gasket
5. Oil filler cap
6. Rocker cover
7. Rocker cover gasket
8. Oil seal
9. Oil seal
10. Rocker arms and rocker arm shaft (Intake side)

### Removal steps (Continued)

- <<A>> >>C<< 11. Rocker arms and rocker arm shaft (Exhaust side)
- >>B<< 12. Nut
- >>B<< 13. Adjusting screw
- >>B<< 14. Rocker arm shaft assembly (Intake side)
- >>B<< 15. Rocker arm "C"
- >>B<< 16. Piston arm assembly
- >>B<< 17. Rocker arm "D"
- >>B<< 18. Rocker arm shaft (Exhaust side)
- >>A<< 19. Oil feeder control valve

>>D<<  
<<A>> >>C<<

**Removal steps (Continued)**

- 20. O-ring
- 21. Snap ring
- 22. Accumulator spring seat
- 23. Plunger spring
- 24. Accumulator plunger
- 25. Accumulator body
- 26. Taper plug
- 27. Oil feeder control valve filter
- 28. Camshaft

**REMOVAL SERVICE POINT**

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

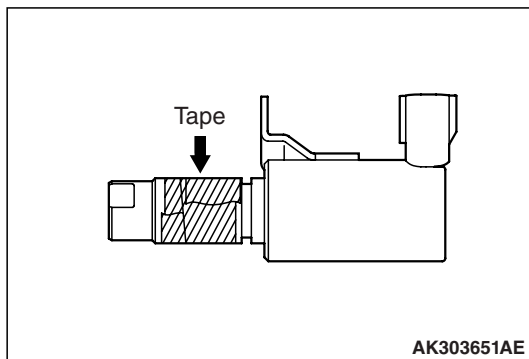
When the rocker arm is removed from the rocker shaft, keep them with the tags that show the installation location for the reinstallation of the rocker arm, the T-lever, the piston arm assembly and so on.

**INSTALLATION SERVICE POINTS**

**>>A<< OIL FEEDER CONTROL VALVE INSTALLATION**

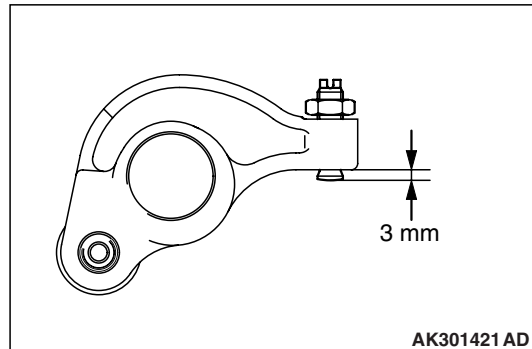
**⚠ CAUTION**

Do not reuse the O-ring. Install the O-ring after wrap a tape not having adhesion (such as a seal tape) round the notch on the oil passage of oil feeder control valve to prevent it from damage. The damaged O-ring may cause oil leakage.



1. Apply a little amount of engine oil to the O-ring of oil feeder control valve.
2. Install the oil feeder control valve to the cylinder head.
3. Tighten the oil feeder control valve to the specified torque of  $11 \pm 1$  N·m.

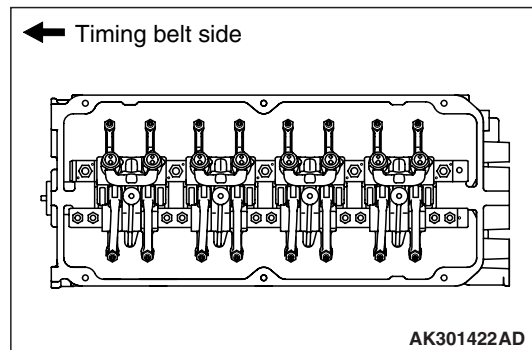
**>>B<< ADJUSTING SCREW INSTALLATION**



Install provisionally the screw to rocker arm, insert it so that end of the screw is flush with the edge of the rocker arm or projects slightly 3 mm.

**>>C<< ROCKER SHAFT SPRING/ROCKER ARMS AND ROCKER ARM SHAFT INSTALLATION**

1. In accordance with the tags for the reinstallation, install the rocker arm and so on to the rocker arm shaft.
2. Install the rocker arm shaft with oil hole to the lower (cylinder head) side.

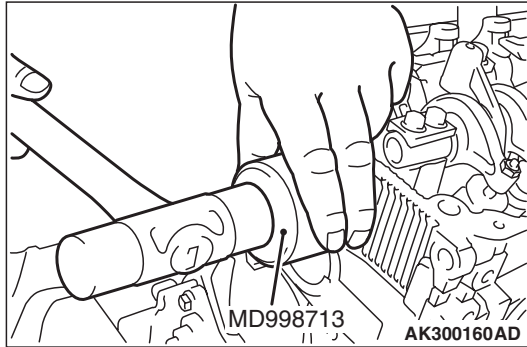


3. Install the rocker arm, rocker arm shaft assembly and intake temporarily.
4. Install the rocker arm, rocker arm shaft assembly and exhaust temporarily.
5. Confirm the each rocker arm and rocker arm shaft assembly are in position and then tighten to the specified torque.

**Tightening torque**

- M6:  $13 \pm 1$  N·m**
- M8:  $31 \pm 3$  N·m**

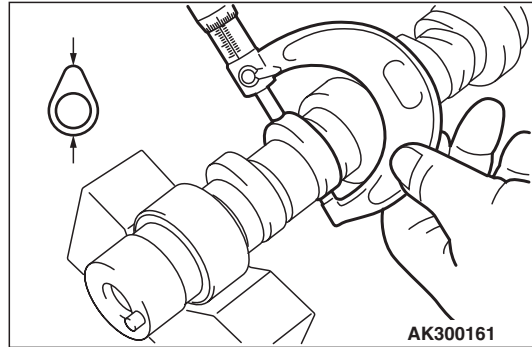
>>D<< CAMSHAFT OIL SEAL  
INSTALLATION



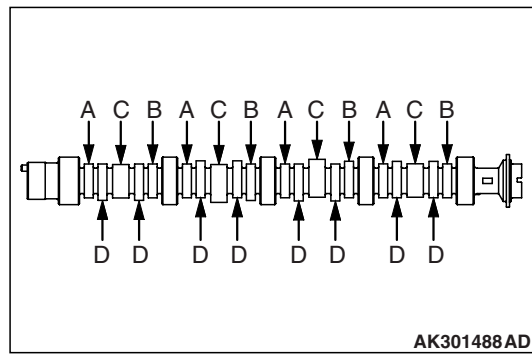
1. Apply engine oil to the lip area of the oil seal and the front end outside diameter of camshaft.
2. Using special tool Camshaft oil seal installer (MD998713), install the camshaft oil seal.

INSPECTION  
CAMSHAFT

M1113005500496



Measure the cam height. If it is below the limit, replace the camshaft.

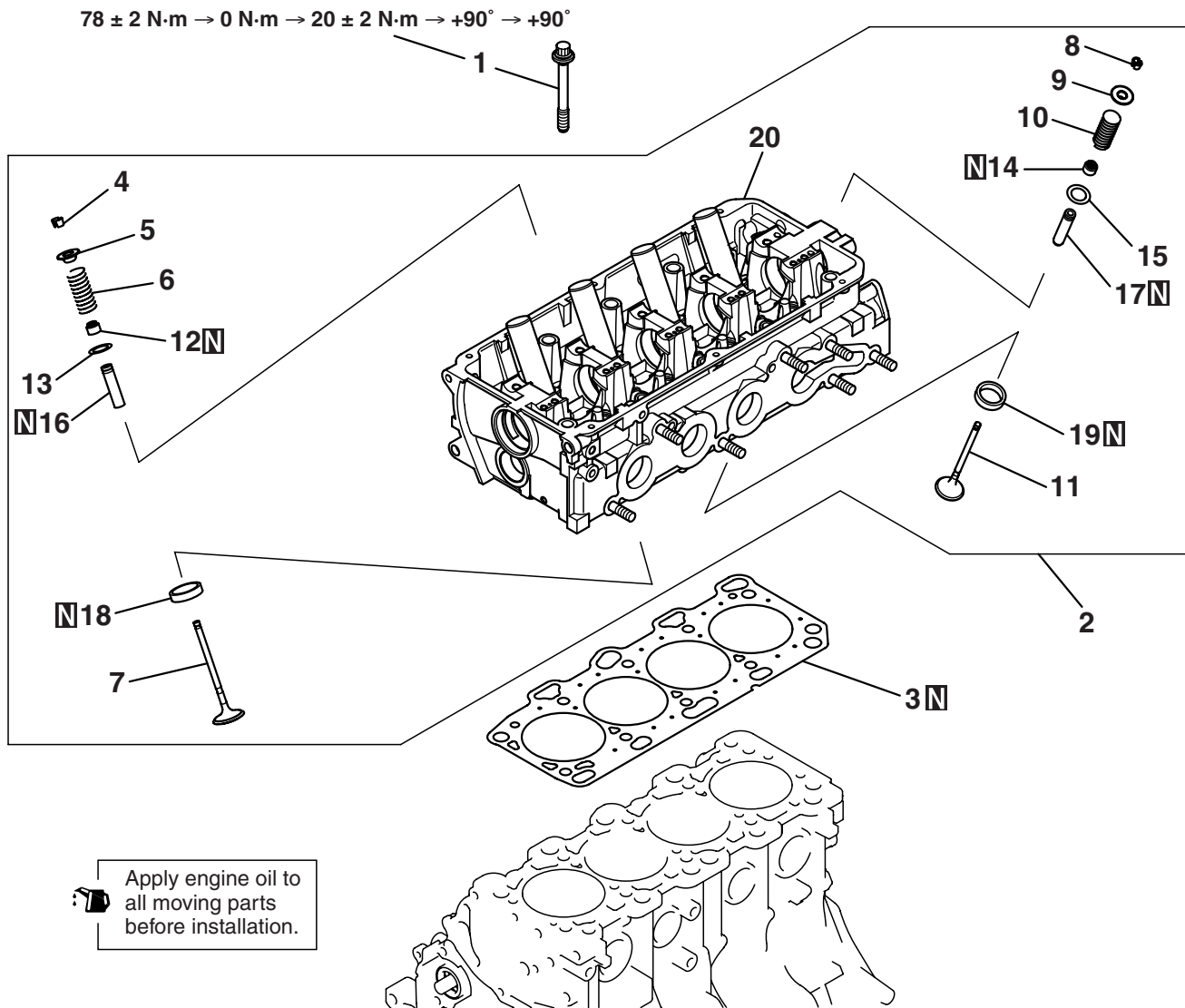


	Standard value	Minimum limit
A: Intake low speed cam A	33.84 mm	33.34 mm
B: Intake low speed cam B	37.35 mm	36.85 mm
C: Intake high speed cam	37.21 mm	36.71 mm
D: Exhaust cam	37.86 mm	37.36 mm

# CYLINDER HEAD AND VALVES

## REMOVAL AND INSTALLATION

M1113006900806



AK301262AE

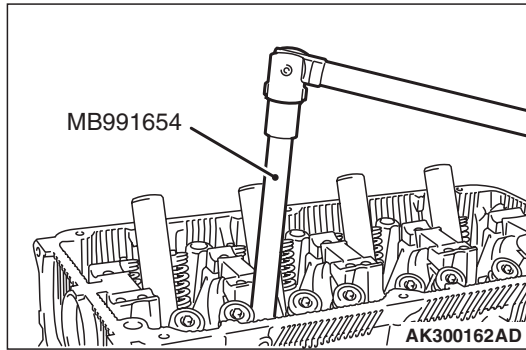
### Removal steps

- <<A>> >>D<< 1. Cylinder head bolt
- <<A>> >>D<< 2. Cylinder head assembly
- <<B>> >>C<< 3. Cylinder head gasket
- <<B>> >>C<< 4. Retainer lock
- >>B<< 5. Valve spring retainer
- >>B<< 6. Valve spring
- <<B>> >>C<< 7. Intake valve
- <<B>> >>C<< 8. Retainer lock
- >>B<< 9. Valve spring retainer
- >>B<< 10. Valve spring
- >>B<< 11. Exhaust valve

### Removal steps (Continued)

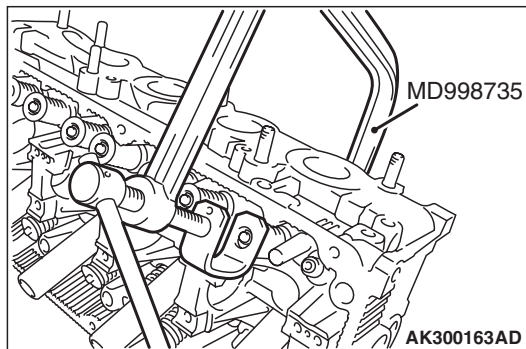
- >>A<< 12. Valve stem seal
- >>A<< 13. Valve spring seat
- >>A<< 14. Valve stem seal
- >>A<< 15. Valve spring seat
- >>A<< 16. Intake valve guide
- >>A<< 17. Exhaust valve guide
- >>A<< 18. Intake valve seat
- >>A<< 19. Exhaust valve seat
- >>A<< 20. Cylinder head

## REMOVAL SERVICE POINTS

<<A>> CYLINDER HEAD BOLTS  
REMOVAL

Using special tool Cylinder head bolt wrench (MB991654), loosen the cylinder head bolts. Loosen each bolt evenly, little by little, by two or three steps.

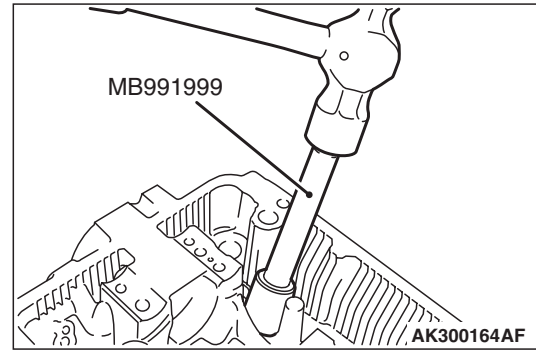
## &lt;&lt;B&gt;&gt; RETAINER LOCK REMOVAL



1. Set special tool Valve spring compressor (MD998735) as illustrated to compress the valve spring. Remove the retainer lock.
2. Relieve the spring tension and remove the valve, retainer, spring, etc. Store removed valves, springs, and other parts, tagged to indicate their cylinder number and location for assembly.

## INSTALLATION SERVICE POINTS

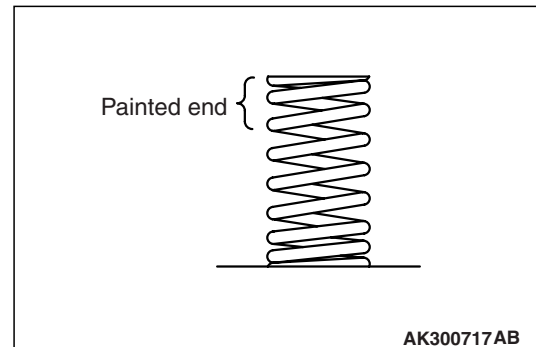
## &gt;&gt;A&lt;&lt; VALVE STEM SEAL INSTALLATION

**CAUTION**

The special tool must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.

1. Install the valve spring seat.
2. Using special tool Valve stem seal installer (MB991999), install a new valve stem seal.

## &gt;&gt;B&lt;&lt; VALVE SPRING INSTALLATION

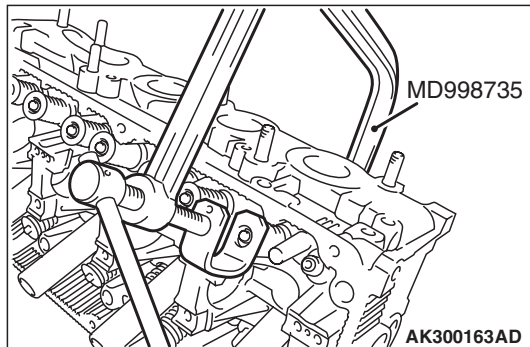


Install the valve spring with its identification color painted end (larger pitch side) upward (toward the valve spring retainer).

**Identification:**

- <Intake> Light blue
- <Exhaust> Orange

## >>C<< RETAINER LOCK INSTALLATION

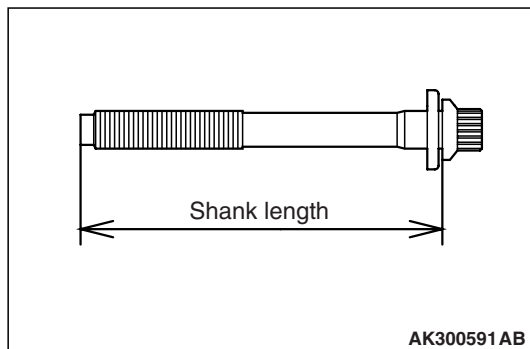


### CAUTION

Do not compress the valve spring excessively. It can damage the stem seal.

1. Set special tool Valve spring compressor (MD998735) as illustrated to compress the valve spring. Install the retainer locks.
2. Relieve the spring tension. Check that the retainer locks are seated correctly.

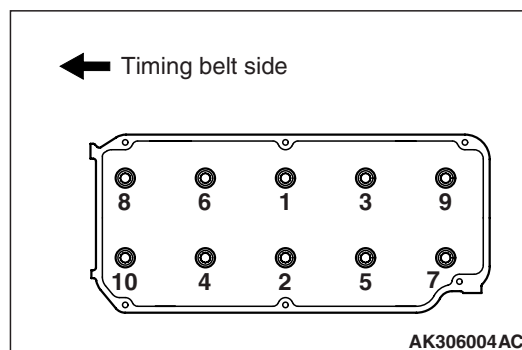
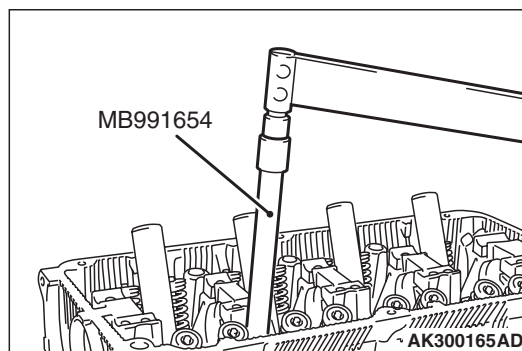
## >>D<< CYLINDER HEAD BOLT INSTALLATION



1. When the removed cylinder head bolts are to be reused, check that the shank length of each bolt meets the limit. If it exceeds the limit, replace the bolts.

**Limit: 99.4 mm**

2. Apply engine oil to the thread of the bolts and to the washers.

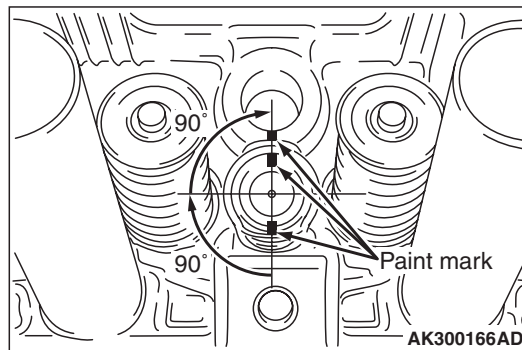


3. Using special tool Cylinder head bolt wrench (MB991654) tighten the bolts to the specified torque, using the tightening sequence shown.

**Tightening torque:  $78 \pm 2$  N·m**

4. Loosen all bolts fully in the reverse order of tightening.
5. Retighten the loosened bolts to in the tightening sequence shown.

**Tightening torque:  $20 \pm 2$  N·m**



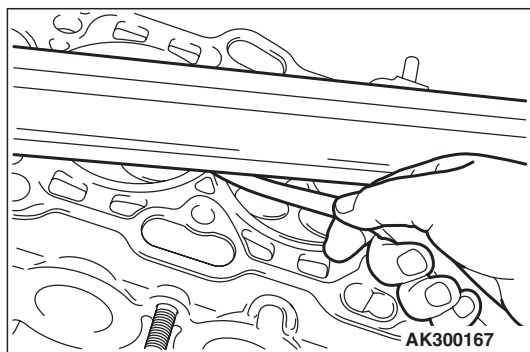
6. Make a paint mark across each bolt head and cylinder head.
7. Tighten the cylinder head bolts 90 degrees in the specified order.

**CAUTION**

- If the bolt is turned less than 90 degrees, proper fastening performance may not be achieved. Be careful to turn each bolt exactly 90 degrees.
  - If the bolt is overtightened, loosen the bolt completely and then retighten it by repeating the tightening procedure from step 1.
8. Tighten the bolts another 90 degrees in the same order as in step 7, and check that the paint marks on the cylinder head bolt are aligned with the paint marks on the cylinder head.

**INSPECTION**

M1113007000709

**CYLINDER HEAD**

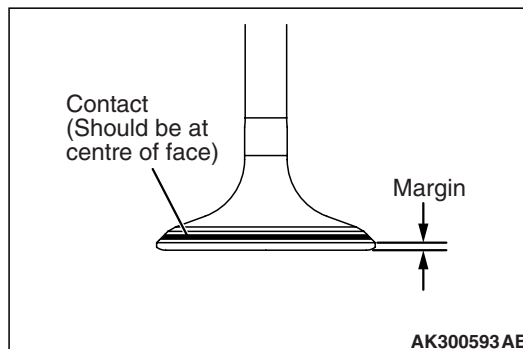
1. Check the cylinder head gasket surface for flatness by using a straight edge and feeler gauge.

**Standard value: 0.03 mm****Limit: 0.2 mm**

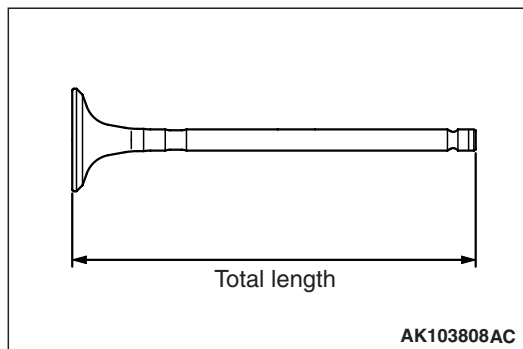
2. If it exceeds the limit, correct to meet specification.

**Grinding limit: \*0.2 mm**

\* Includes combined with cylinder block grinding.

**Cylinder head height (Specification when new): 120 mm****VALVE**

1. Check the valve seat contact. Valve seat contact should be uniform at the center of the valve face. If incorrect, reface using a valve refacer.
2. If the margin is below the limit, replace the valve.

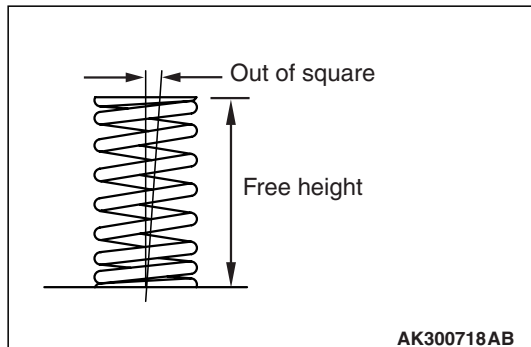
**Standard value:****<Intake> 1.0 mm****<Exhaust> 1.2 mm****Minimum limit:****<Intake> 0.5 mm****<Exhaust> 1.0 mm**

3. Measure the valve's total length. If the measurement is less than the limit, replace the valve.

**Standard value:****<Intake> 111.33 mm****<Exhaust> 113.54 mm****Minimum limit:****<Intake> 110.83 mm****<Exhaust> 113.04 mm**



## VALVE SPRING



1. Measure the free height of the spring. If it is less than the limit, replace.

**Standard value:**

<Intake> 54.8 mm

<Exhaust> 56.1 mm

**Minimum limit:**

<Intake> 53.8 mm

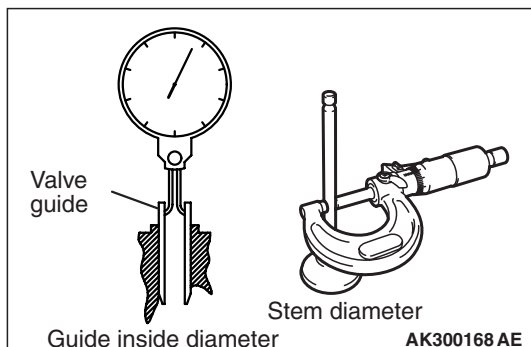
<Exhaust> 55.1 mm

2. Measure the squareness of the spring. If it exceeds the limit, replace.

**Standard value: 2 degrees or less**

**Limit: 4 degrees**

## VALVE GUIDE



Measure the clearance between the valve guide and valve stem. If it exceeds the limit, replace the valve guide or valve, or both.

**Standard value:**

<Intake> 0.02 – 0.04 mm

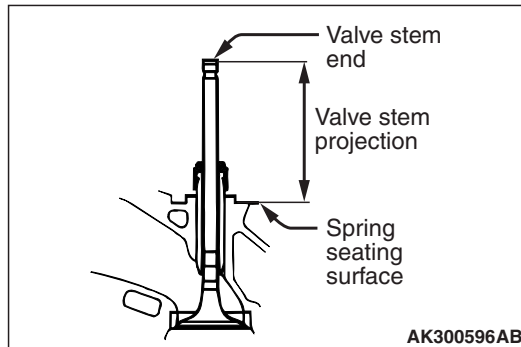
<Exhaust> 0.04 – 0.06 mm

**Limit:**

<Intake> 0.10 mm

<Exhaust> 0.15 mm

## VALVE SEAT



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

**Standard value:**

<Intake> 48.33 mm

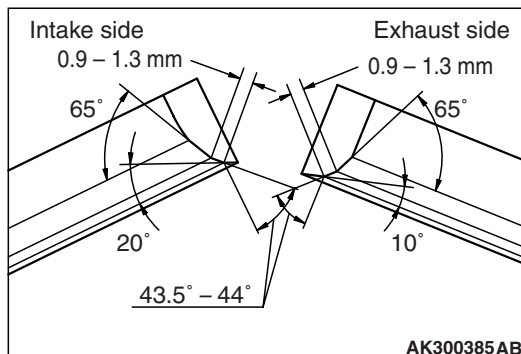
<Exhaust> 48.34 mm

**Limit:**

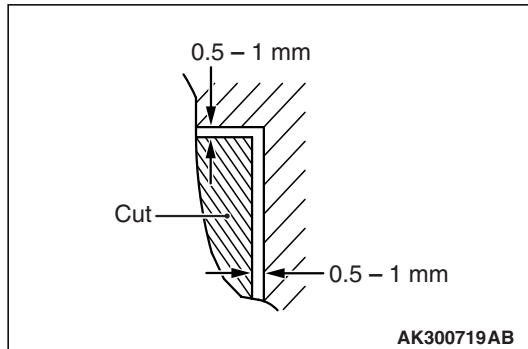
<Intake> 48.83 mm

<Exhaust> 48.84 mm

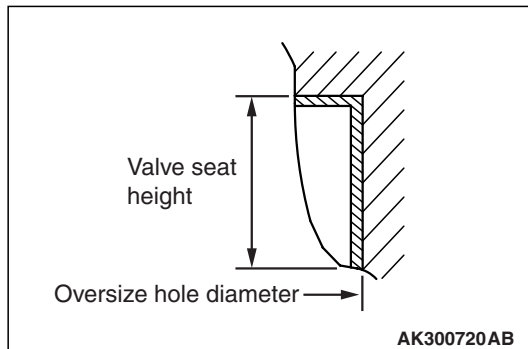
## VALVE SEAT RECONDITIONING PROCEDURE



1. Before correcting the valve seat, check for clearance between the valve guide and valve and, if necessary, replace the valve guide.
2. Using the seat grinder, correct to obtain the specified seat width and angle.
3. After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection.

**VALVE SEAT REPLACEMENT PROCEDURE**

1. Cut the valve seat from the inside to thin the wall thickness. Then, remove the valve seat.



2. Rebore the valve seat hole in the cylinder head to a selected oversized valve seat diameter.

**Intake seat ring hole diameters****0.3 oversize: 35.30 – 35.33 mm****0.6 oversize: 35.60 – 35.63 mm****Exhaust seat ring hole diameters****0.3 oversize: 33.30 – 33.33 mm****0.6 oversize: 33.60 – 33.63 mm**

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

See "VALVE SEAT RECONDITIONING PROCEDURE" on the previous page.

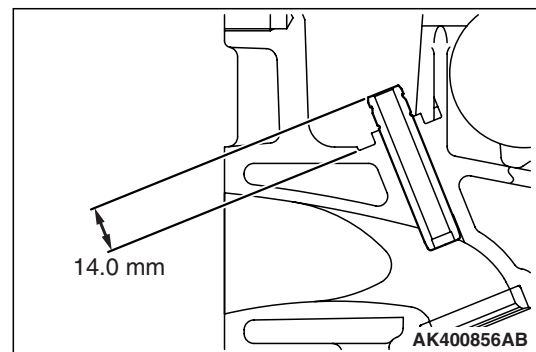
**VALVE GUIDE REPLACEMENT PROCEDURE**

1. Using a press, remove the valve guide toward the cylinder block.

**CAUTION**

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

2. Rebore the valve guide hole of the cylinder head so that it fits the press-fitted oversized valve guide.

**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 protrudes 14.0 mm from the cylinder head top surface as shown in the illustration.

*NOTE: When press-fitting the valve guide, work from the cylinder head top surface.*

*NOTE: Pay attention to the difference in length of the valve guides. (Intake side: 45.5 mm; exhaust side: 50.5 mm)*

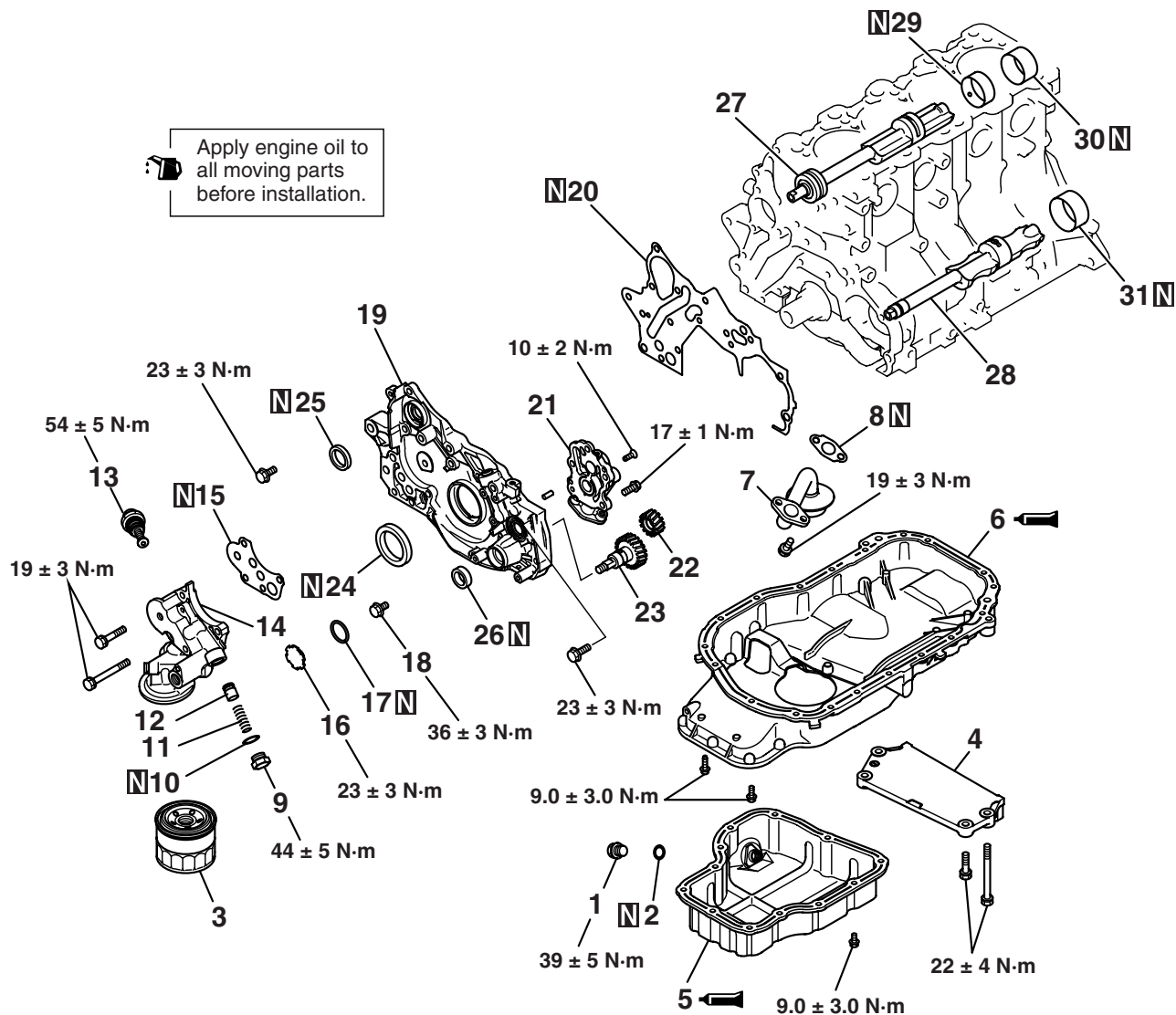
*NOTE: After installing the valve guides, insert new valves in them to check for smooth operation.*

# OIL PAN AND OIL PUMP

## REMOVAL AND INSTALLATION

M1113008101348

<<M/T>



AK400857 AB

### Removal steps

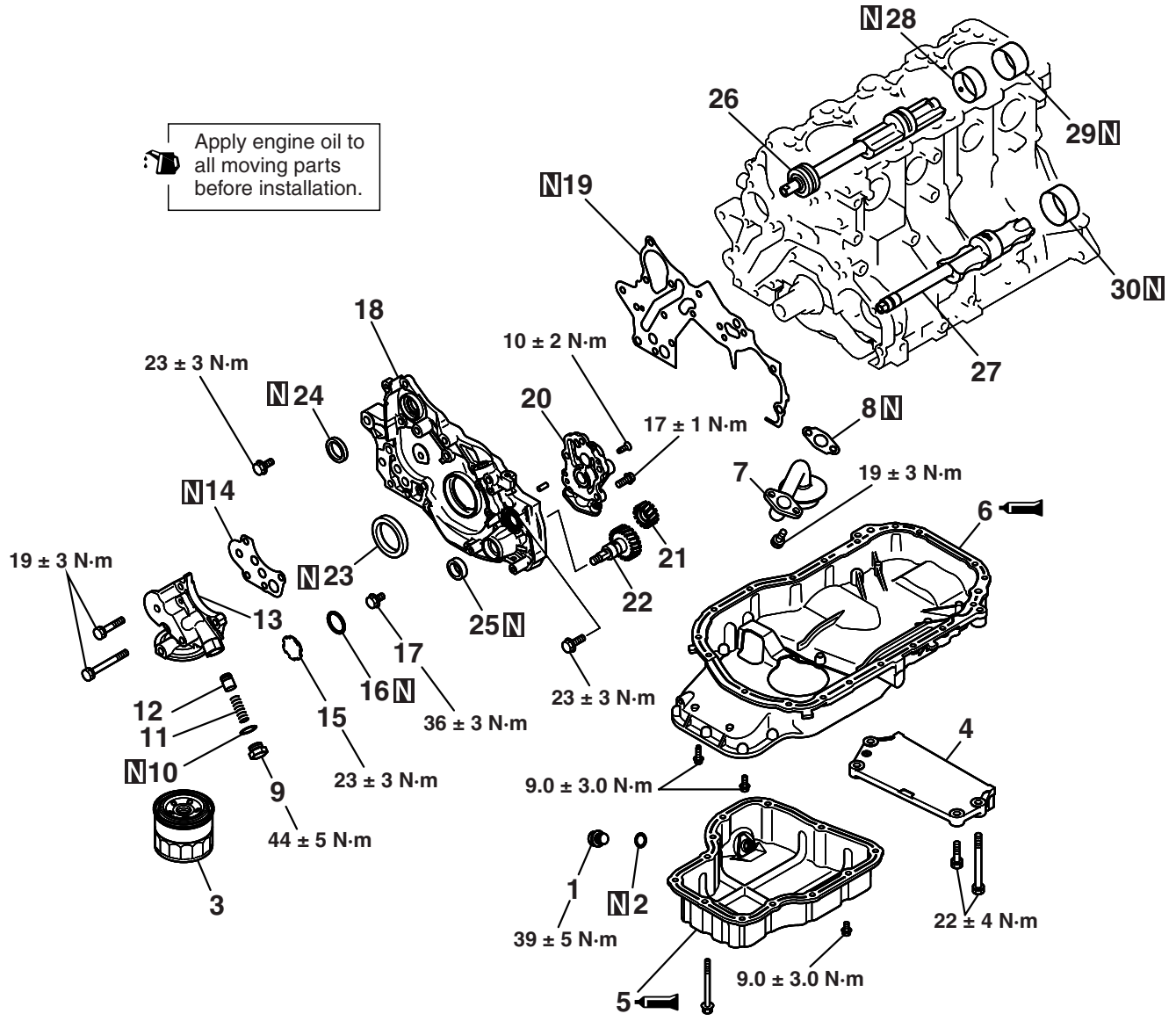
- 1. Drain plug
- >>M<< 2. Drain plug gasket
- >>L<< 3. Oil filter
- 4. Transmission stay
- <<A>> >>K<< 5. Oil pan lower
- <<B>> >>K<< 6. Oil pan upper
- 7. Oil screen
- 8. Oil screen gasket
- 9. Relief plug
- 10. Gasket
- 11. Relief spring
- 12. Relief plunger
- 13. Oil cooler by-pass valve <M/T>
- 14. Oil filter bracket
- 15. Oil filter bracket gasket
- <<C>> >>J<< 16. Plug

### Removal steps (Continued)

- 17. O-ring
- <<D>> >>I<< 18. Flange bolt
- >>H<< 19. Front case
- 20. Front case gasket
- 21. Oil pump cover
- >>G<< 22. Oil pump driven gear
- >>G<< 23. Oil pump drive gear
- >>F<< 24. Crankshaft front oil seal
- >>E<< 25. Oil pump oil seal
- >>D<< 26. Counterbalance shaft oil seal
- 27. Counterbalance shaft, left
- 28. Counterbalance shaft, right
- <<E>> >>C<< 29. Counterbalance shaft, front bearing
- <<F>> >>B<< 30. Counterbalance shaft, rear bearing, right
- <<F>> >>A<< 31. Counterbalance shaft, rear bearing, left

<A/T>

Apply engine oil to all moving parts before installation.



AK600666 AB

**Removal steps**

- 1. Drain plug
- >>M<< 2. Drain plug gasket
- >>L<< 3. Oil filter
- 4. Transmission stay
- <<A>> >>K<< 5. Oil pan lower
- <<B>> >>K<< 6. Oil pan upper
- 7. Oil screen
- 8. Oil screen gasket
- 9. Relief plug
- 10. Gasket
- 11. Relief spring
- 12. Relief plunger
- 13. Oil filter bracket
- 14. Oil filter bracket gasket
- <<C>> >>J<< 15. Plug
- <<D>> >>I<< 16. O-ring
- 17. Flange bolt

**Removal steps (Continued)**

- >>H<< 18. Front case
- 19. Front case gasket
- 20. Oil pump cover
- >>G<< 21. Oil pump driven gear
- >>G<< 22. Oil pump drive gear
- >>F<< 23. Crankshaft front oil seal
- >>E<< 24. Oil pump oil seal
- >>D<< 25. Counterbalance shaft oil seal
- 26. Counterbalance shaft, left
- 27. Counterbalance shaft, right
- <<E>> >>C<< 28. Counterbalance shaft, front bearing
- <<F>> >>B<< 29. Counterbalance shaft, rear bearing, right
- <<F>> >>A<< 30. Counterbalance shaft, rear bearing, left

## REMOVAL SERVICE POINTS

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

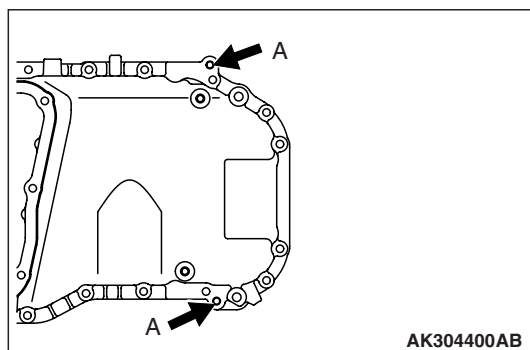
#### ⚠ CAUTION

Do not use a scraper or special tool MD998727 to remove the oil pan.

Apply a wood block to the oil pan side and remove the oil pan lower by tapping lightly on it with a plastic hammer.

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

1. Remove all bolts.

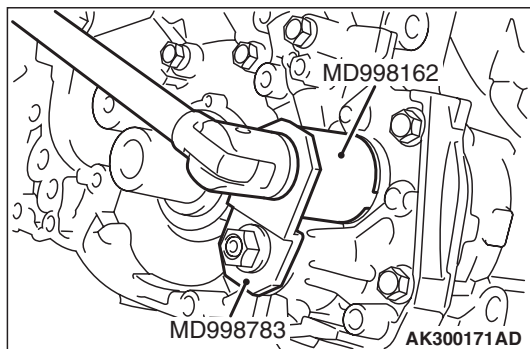


#### ⚠ CAUTION

Do not use a scraper or special tool MD998727 to remove the oil pan.

2. Screw a bolt into hole A shown to remove the oil pan.

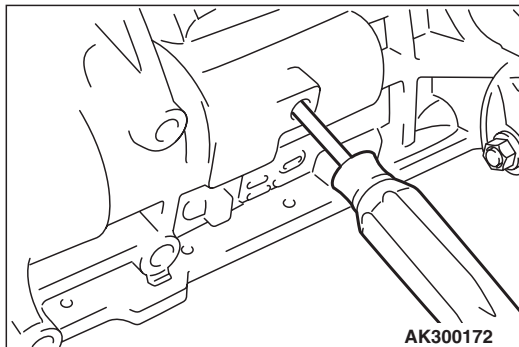
### <<C>> PLUG REMOVAL



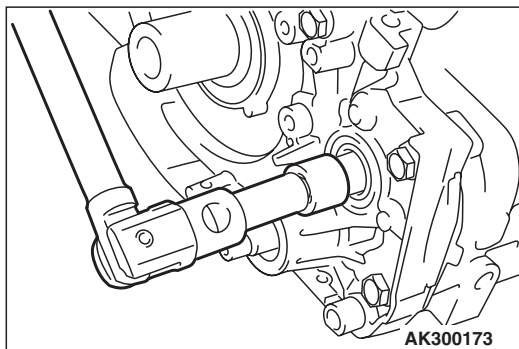
Fit the teeth of the special tools in notches of the plug as shown in the drawing and support the tool with the special tool to loosen the plug.

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

### <<D>> FLANGE BOLT REMOVAL

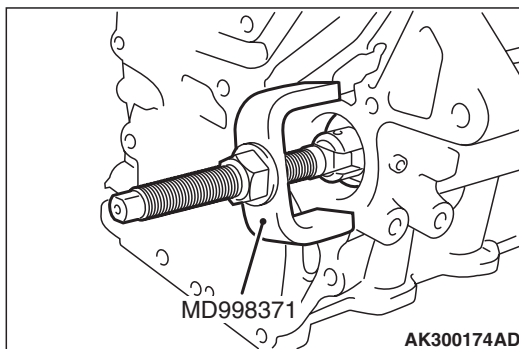


1. Remove the plug on the side of the cylinder block.
2. Insert a Phillips screwdriver (shank diameter 8 mm) into the plug hole to lock the counterbalance shaft.



3. Loosen the flange bolt.

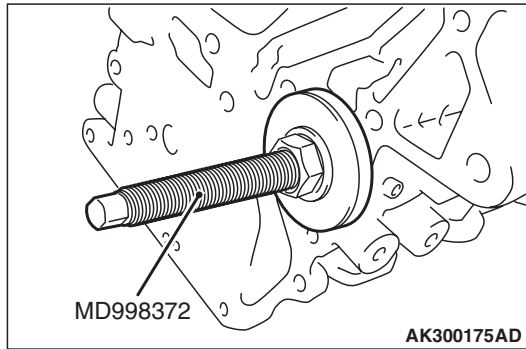
### <<E>> COUNTERBALANCE SHAFT FRONT BEARING REMOVAL



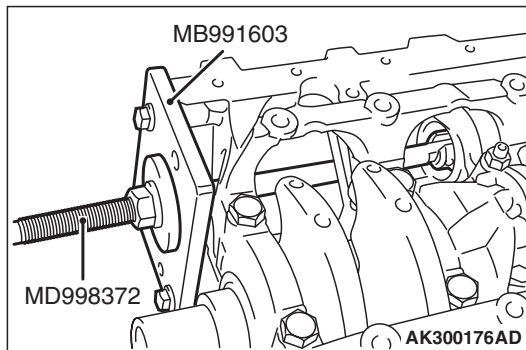
#### ⚠ CAUTION

Be sure to remove the front bearing first. If it has not been removed, special tool Silent shaft bearing puller (MD998372) cannot be used for rear balance shaft bearing removal.

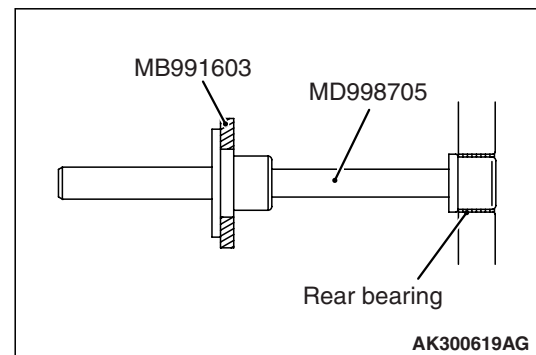
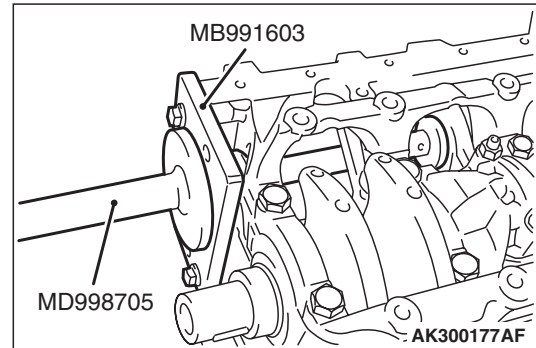
Using special tool Silent shaft bearing puller (MD998371), remove the counterbalance shaft front bearing from the cylinder block.

<<F>> COUNTERBALANCE SHAFT REAR  
BEARING REMOVAL

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

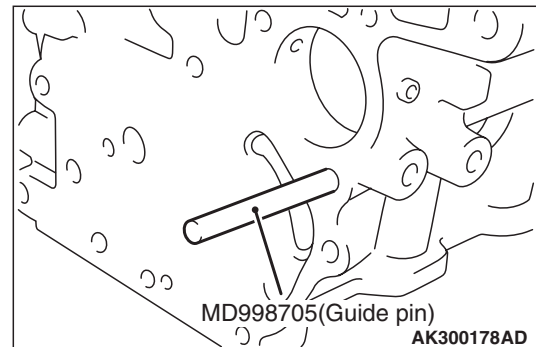


2. When removing the rear bearing of the left counterbalancer shaft, install the special tool Silent shaft bearing installer stopper (MB991603) on the front of the cylinder block and use a special tool Silent shaft bearing puller (MD998372) to pull out the bearing.

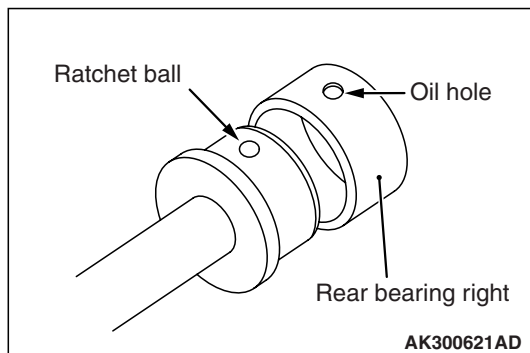
>>A<< LEFT COUNTERBALANCER  
SHAFT REAR BEARING INSTALLATION

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

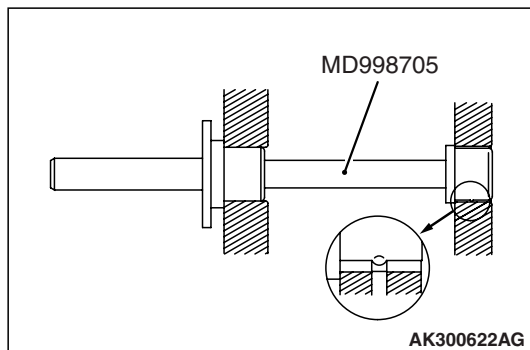
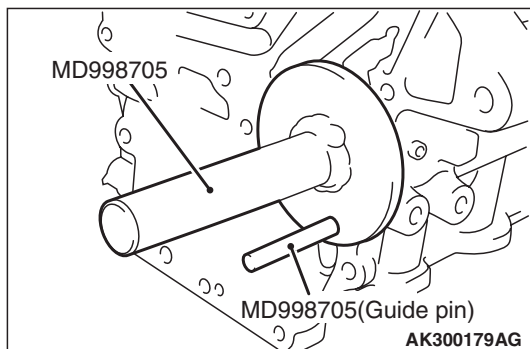
*NOTE: The left rear bearing has no oil holes.*

>>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.

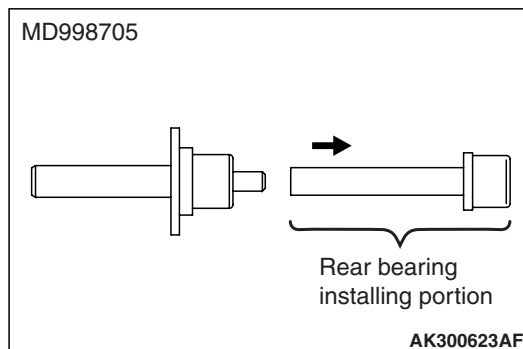


2. Align the ratchet ball of the special tool with the oil hole in the rear bearing to install the bearing of the special tool.
3. Apply engine oil to the bearing outer surface and bearing hole in the cylinder block.

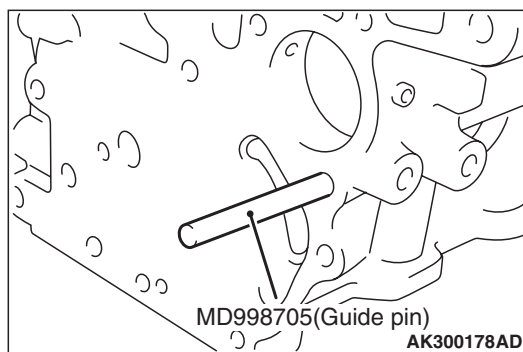


4. Using special tool Silent shaft bearing installer (MD998705), install the rear bearing. Make sure that the oil hole of the bearing is aligned with the oil hole of the cylinder block.

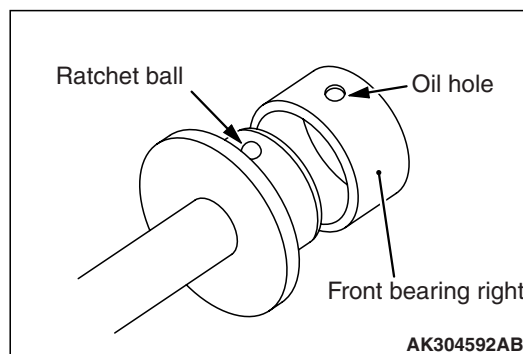
## >>C<< COUNTERBALANCE SHAFT FRONT BEARING INSTALLATION



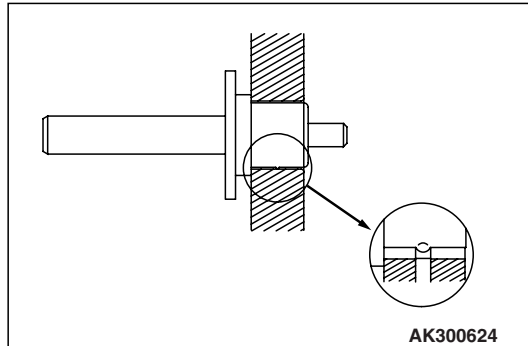
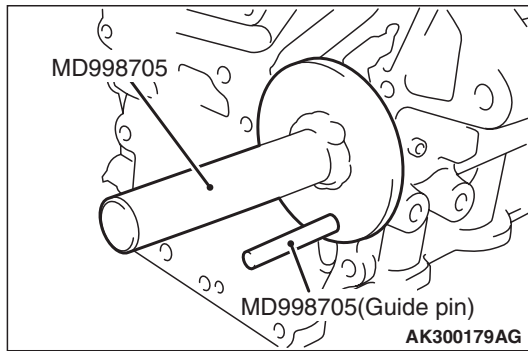
1. Remove the rear bearing installing portion from the special tool Silent shaft bearing installer (MD998705).



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

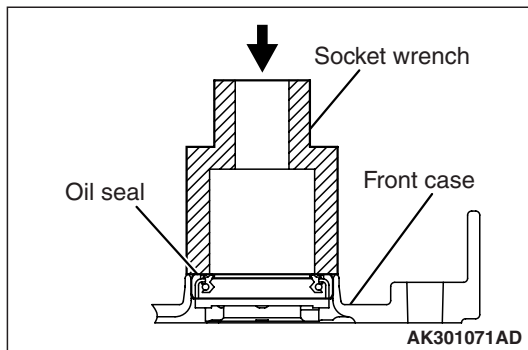


3. Align the ratchet ball of the special tool with the oil hole in the rear bearing to install the bearing of the special tool.
4. Apply engine oil to the front bearing outer surface and bearing hole in the cylinder.



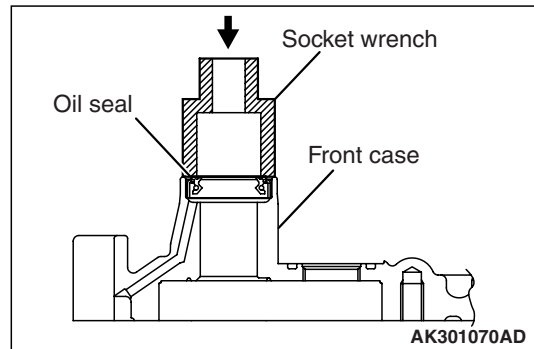
- Using special tool Silent shaft bearing installer (MD998705), install the rear bearing. Make sure that the oil hole of the bearing is aligned with the oil hole of the cylinder block.

**>>D<< COUNTERBALANCE SHAFT OIL SEAL INSTALLATION**



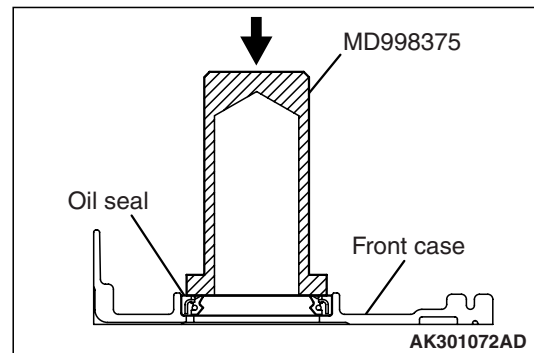
Using a suitable socket wrench, install the counterbalance shaft oil seal into the front case.

**>>E<< OIL PUMP OIL SEAL INSTALLATION**



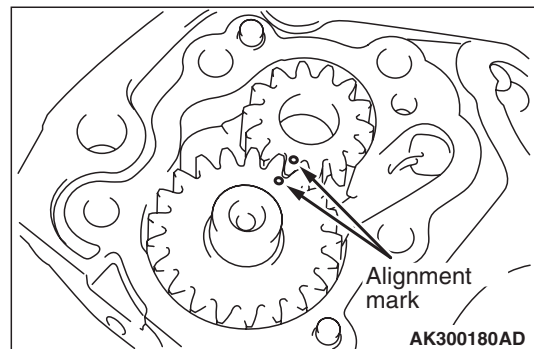
Using a suitable socket wrench, install the oil pump oil seal into the front case.

**>>F<< CRANKSHAFT FRONT OIL SEAL INSTALLATION**



Using special tool Crankshaft front oil seal installer (MD998375), install the crankshaft front oil seal into the front case.

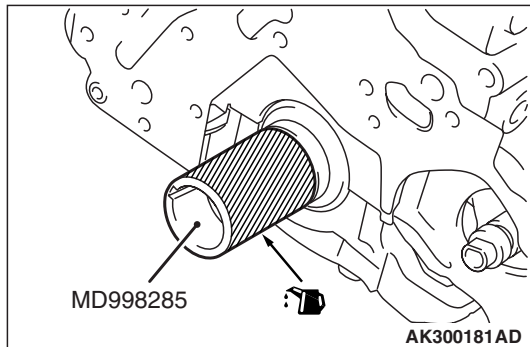
**>>G<< OIL PUMP DRIVEN GEAR/OIL PUMP DRIVE GEAR INSTALLATION**



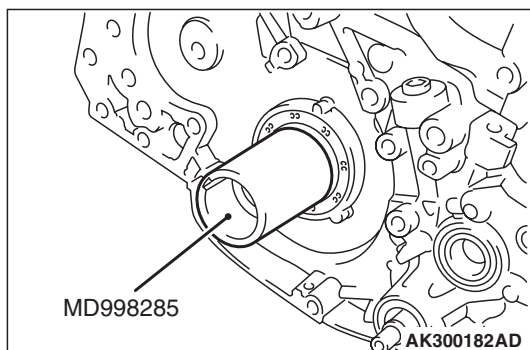
Install the oil pump gears into the front case and align the alignment marks.



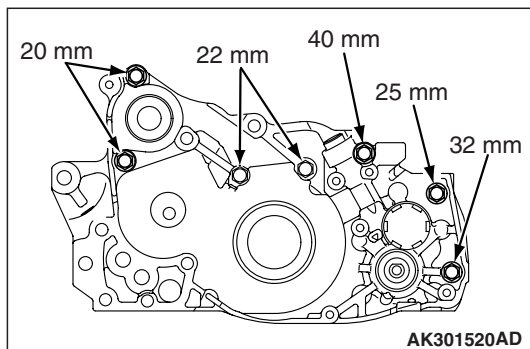
>>H<< OIL PUMP CASE INSTALLATION



1. Set special tool Crankshaft front oil seal guide (MD998258) on the front end of crankshaft and apply a thin coat of engine oil to the outer surface of special tool.
2. Apply engine oil to the lip of the crankshaft front oil seal.



3. Install the front case carefully not to damage the oil seal.

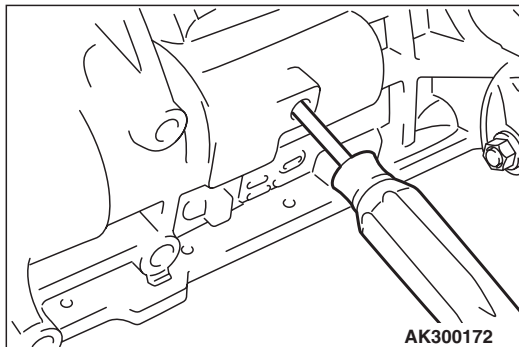


**CAUTION**

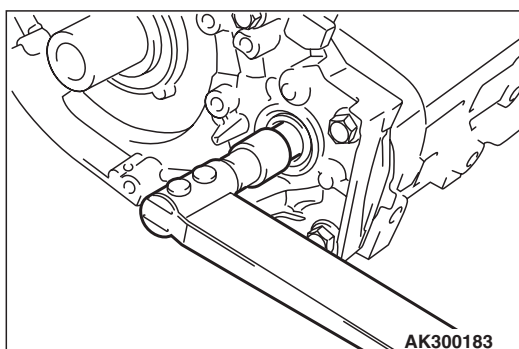
Carefully install the tightening bolts because of the different length respectively.

4. Tighten all flange bolts to the specified torque.  
**Tightening torque:  $23 \pm 3$  N·m**

>>I<< FLANGE BOLT INSTALLATION

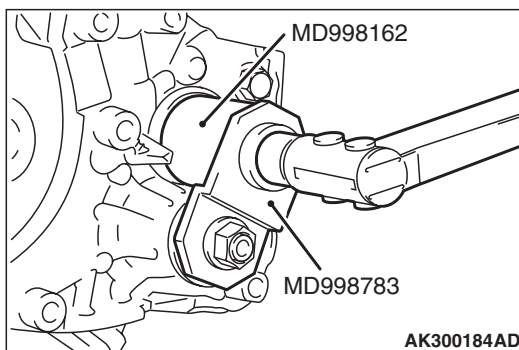


1. Insert a Phillips head screwdriver (shank diameter 8 mm) into the hole in the left side of the cylinder block to lock the counterbalance shaft.



2. Secure the oil pump driven gear onto the left counterbalance shaft by tightening the flange bolt to the specified torque.  
**Tightening torque:  $36 \pm 3$  N·m**
3. Pull out the screwdriver and screw in the plug.

>>J<< PLUG INSTALLATION



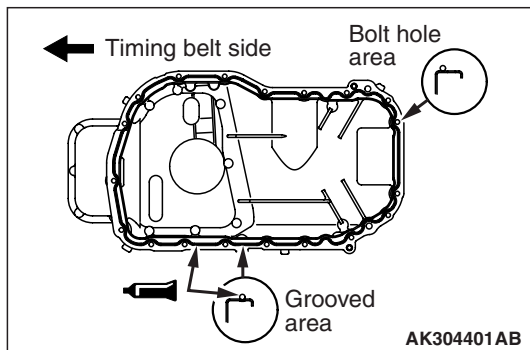
1. Install a new O-ring to the groove of the front case.
2. Install the plug to the front case.
3. Use the special tools to tighten the plug to the specified torque.
  - Plug wrench (MD998162)
  - Plug wrench retainer (MD998783)**Tightening torque:  $23 \pm 3$  N·m**

>>K<< OIL PAN UPPER/OIL PAN LOWER  
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**

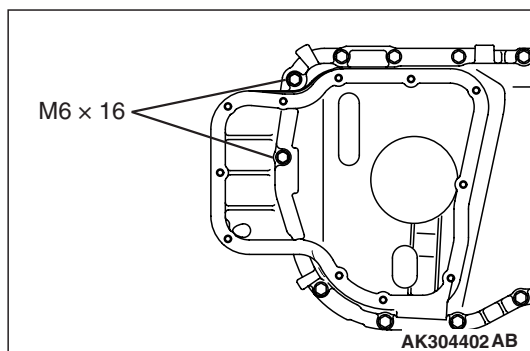
Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

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.*

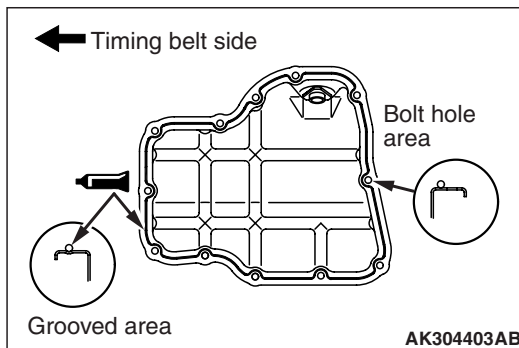


3. Install the shorter bolts in the locations indicated in the drawing.

**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**

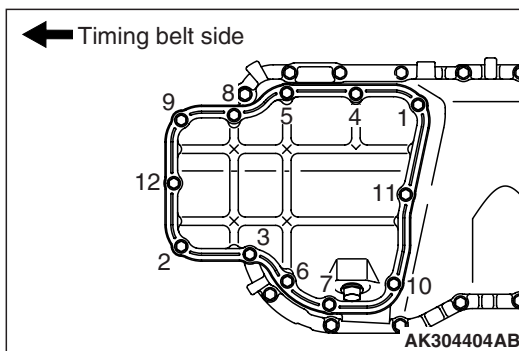
Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

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

**Specified sealant:**

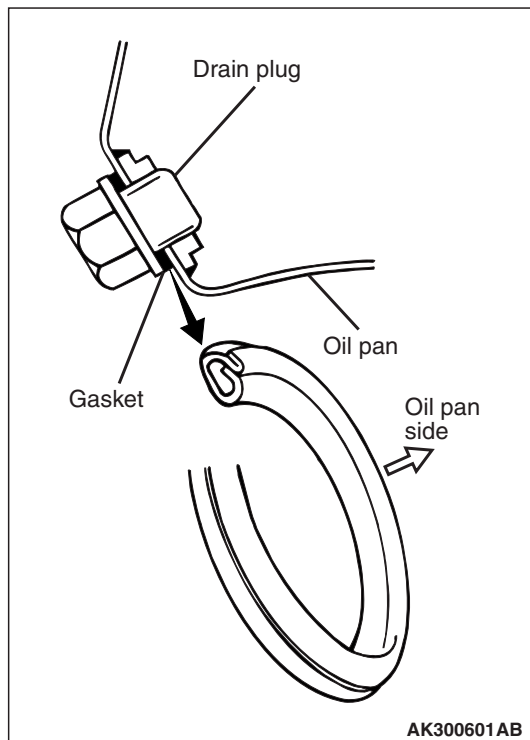
**Mitsubishi Genuine Part No.MD970389 or equivalent**

*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.

## >>L<< DRAIN PLUG GASKET INSTALLATION



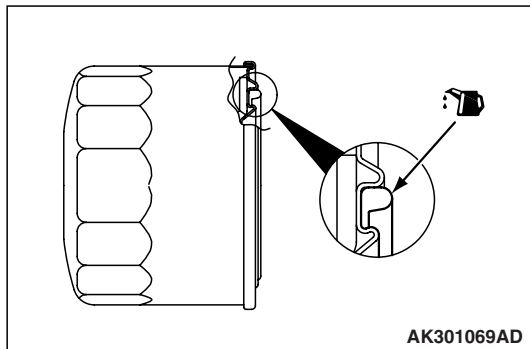
### ⚠ CAUTION

If the gasket is installed in the wrong direction, oil leaks will occur.

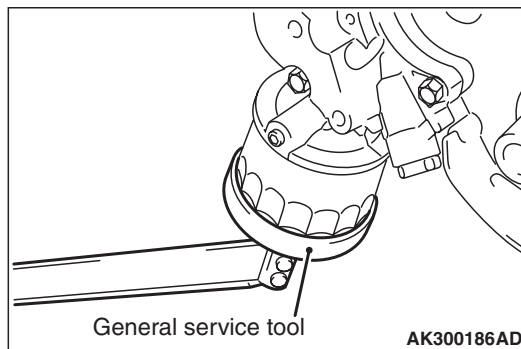
Install the drain plug gasket in the direction shown.

## >>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. Using general service tool, install the oil filter to the bracket and tighten it to the specified torque.

### Tightening torque

**Part number MD356000 filter:  $14 \pm 2$  N·m**

**Other Mitsubishi Genuine filter:  $17 \pm 3$  N·m**

4. If a torque wrench cannot be used use the following procedure:
  - (1) Screw in the oil filter until its o-ring contacts the oil filter bracket.
  - (2) Tighten the oil filter as follows:

**Part number MD356000 filter: one turn**

**Other Mitsubishi Genuine filter: 3/4 turn**

## INSPECTION

M1113008200290

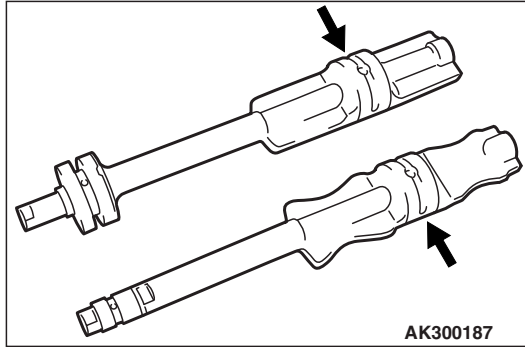
### FRONT CASE

1. Check the oil passage for clogging. Clean if necessary.
2. Check the left counterbalance shaft front bearing for wear, damage and seizure. If the bearing is damaged, replace the front case.
3. Check the front case for cracks and other damage.  
Replace cracked or damaged front case.

### OIL SEAL

1. Check the oil seal lip for wear and damage. Replace the oil seal if necessary.
2. Check the oil seal lip for deterioration. Replace the oil seal if necessary.

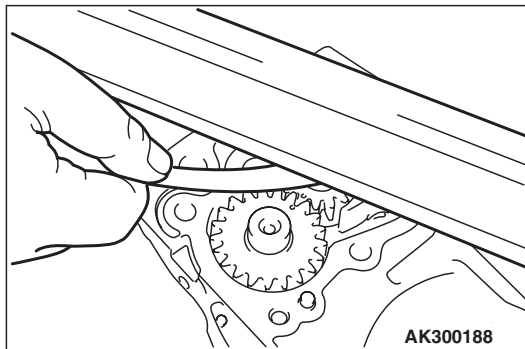
## COUNTERBALANCE SHAFT



1. Check the oil holes for clogging and clean if necessary.
2. Check the journal for seizure, damage and contact with bearing. If there is anything wrong with the journal, replace the counterbalance shaft, bearing or front case assembly if required.

## OIL PUMP

1. Assemble the oil pump gears to the front case and rotate it to ensure smooth rotation with no looseness.
2. Ensure that there is no ridge wear on the contact surface between the front case and the gear surface of the oil pump cover.



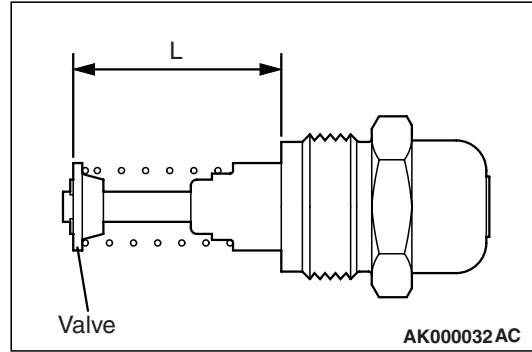
3. Check the side clearance.

**Standard value:**

**Drive gear 0.08 – 0.14 mm**

**Driven gear 0.06 – 0.12 mm**

## OIL COOLER BYPASS VALVE



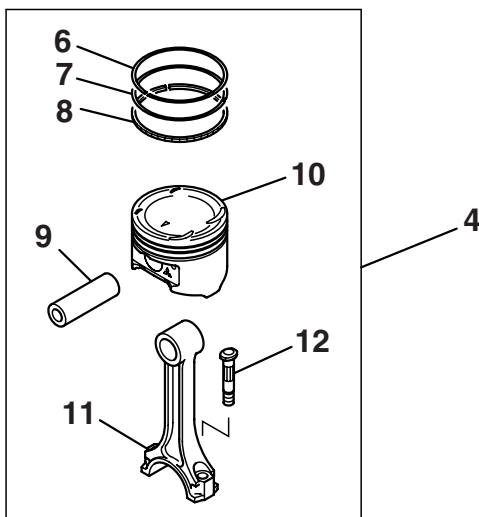
1. Make sure that valve moves smoothly.
  2. Ensure that the dimension L measures the standard value under normal temperature and humidity.
- Standard value: 34.5 mm**
3. The dimension must be the standard value when measured after the valve has been dipped in 97 to 103°C oil.


**Standard value: 40.0 mm**

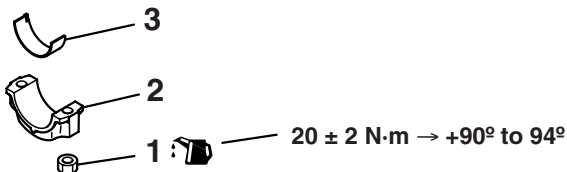
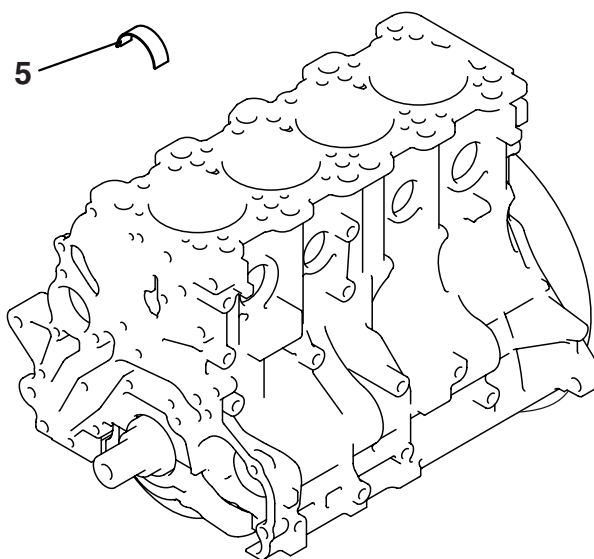
# PISTON AND CONNECTING ROD

## REMOVAL AND INSTALLATION

M1113008400885



 Apply engine oil to all moving parts before installation.



AK306012 AC

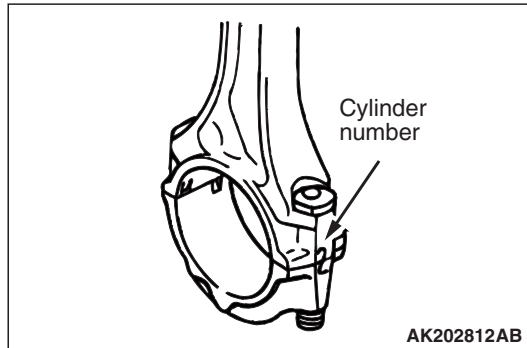
### Removal steps

- >>G<< 1. 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
- >>C<< 7. Piston ring No. 2

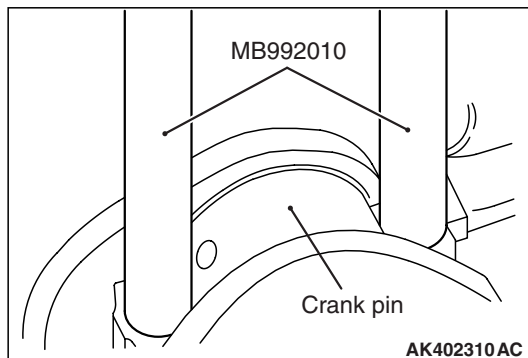
### Removal steps (Continued)

- >>B<< 8. Oil ring
- <<C>> >>A<< 9. Piston pin
- 10. Piston
- 11. Connecting rod
- 12. Bolt

## REMOVAL SERVICE POINTS

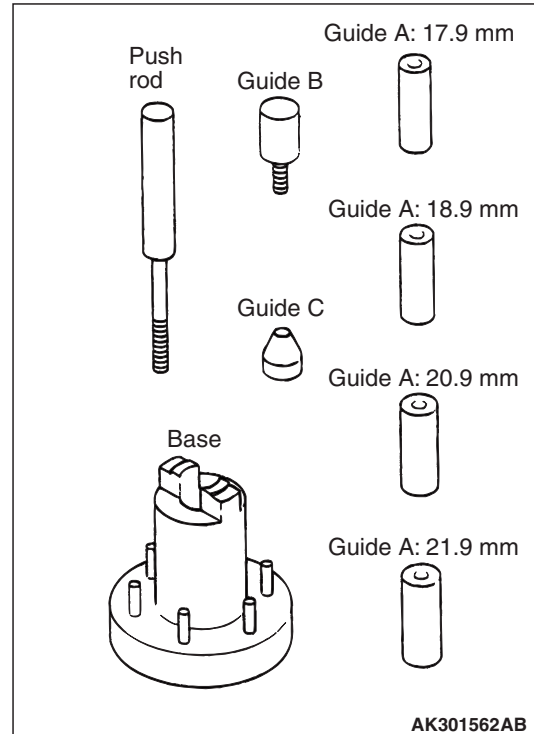
<<A>>CONNECTING ROD CAP  
REMOVAL

1. Mark the cylinder number on the side of the connecting rod big end for correct reassembly.
2. Keep the removed connecting rods, caps, and bearings in that order according to the cylinder number.

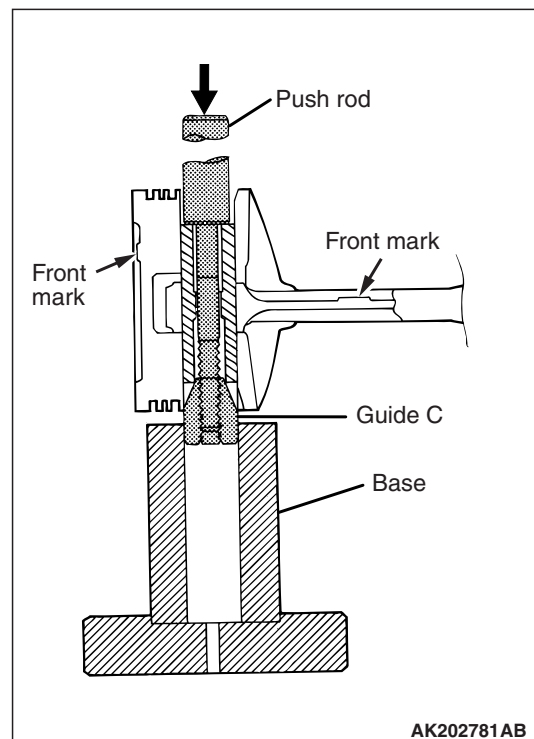
<<B>> PISTON AND CONNECTING ROD  
ASSEMBLY REMOVAL

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.

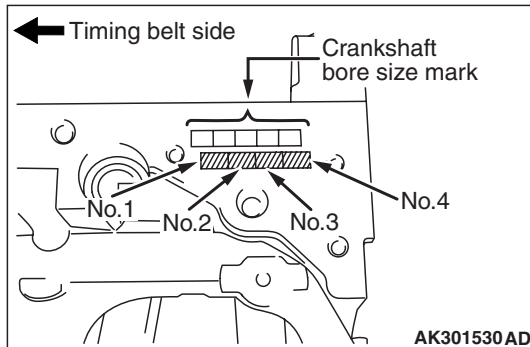


1. Insert the tool element, Push rod, into the piston from the front mark side, then attach the element, Guide C, to the push rod.
2. Place the piston and connecting rod assembly on the element, Base, with the front mark facing up.
3. Use a press to remove the piston pin.

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

## INSTALLATION SERVICE POINTS

### >>A<< PISTON PIN INSTALLATION

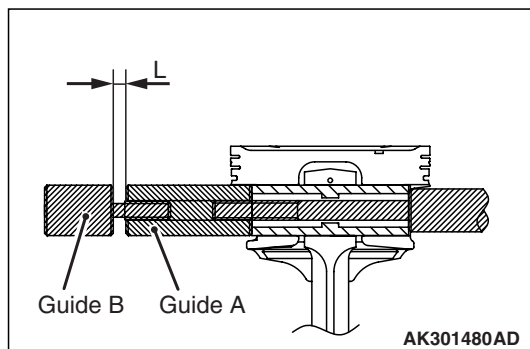


1. When replacing a piston, check the cylinder bore size mark stamped at the indicated location on the cylinder block and select an appropriate replacement piston using the following table.

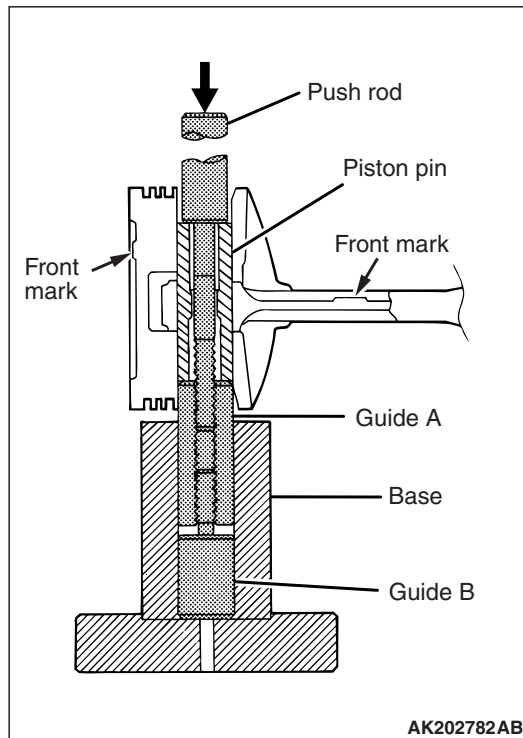
Cylinder bore size mark	Piston size mark
I	A
II	No mark
III	C

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

2. Insert the tool element, Push rod, into the piston pin and attach the element, Guide A, to the push rod end.
3. Assemble the connecting rod with the piston with their front marks facing in the same direction.
4. Apply engine oil to the outside surface of the piston pin.
5. Insert the assembly of piston pin, Push rod, and Guide A (put together in step 4.) into the piston holes from the front mark side.

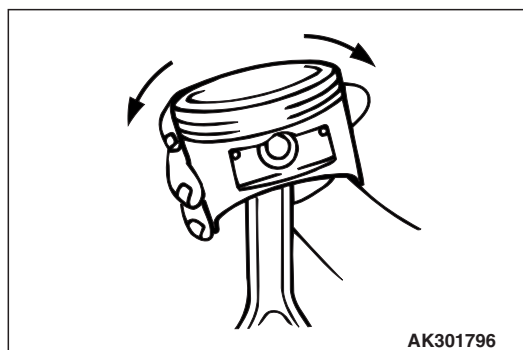


6. Insert the tool element, Guide B, into the tool element, Guide A, with having 2.75 mm of the clearance "L" between the tool element, Guide A and B.



7. Place the piston and connecting rod assembly onto the element, Piston setting base, with the front marks facing up.
8. 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.

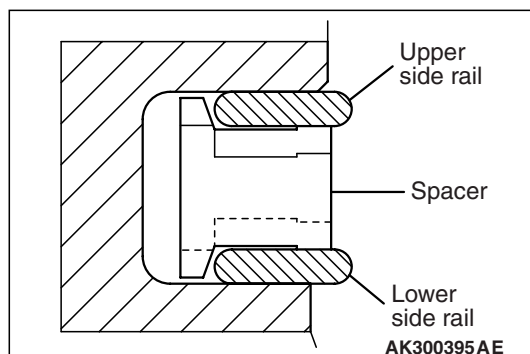
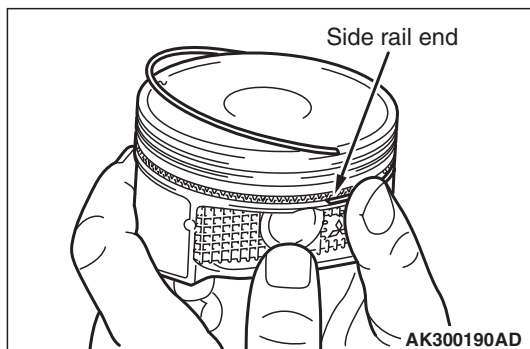
**Standard value: 7,350 – 17,100 N**



9. Check that the piston moves smoothly.

>>B<< OIL RING INSTALLATION

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



**CAUTION**

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

2. Install the upper side rail.

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

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

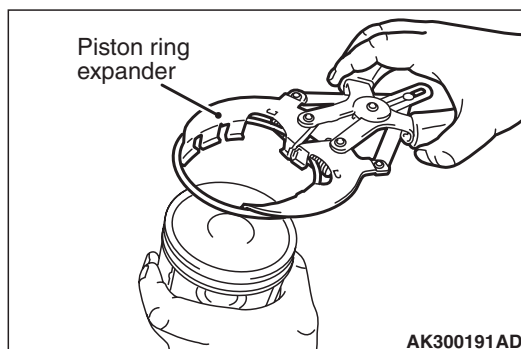
*NOTE: New spacers and side rails are colored for identification of their sizes.*

Size	Identification color
Standard	None
0.50 mm oversize diameter	Red

3. Install the lower side rail in the same manner as described in step 2.

4. Make sure that the side rails move smoothly in both directions.

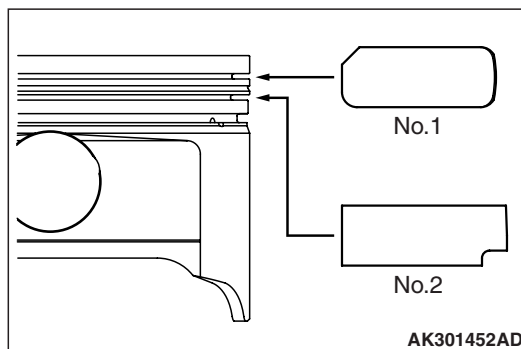
>>C<< PISTON RING NUMBER 2/PISTON RING NUMBER 1 INSTALLATION



1. Using the piston ring expander, fit number 2 into the number 2 groove of piston.

*NOTE: Install piston rings with identification mark facing up, to the piston crown side.*

2. Install the number 1 piston ring in the same manner as step 1.



**Identification mark**

<Number 1 ring> 1R

<Number 2 ring> 2R

*NOTE: Confirm the profile for No.1 and No.2 piston rings carefully. Install them correctly by careful attention to the direction of top and bottom.*

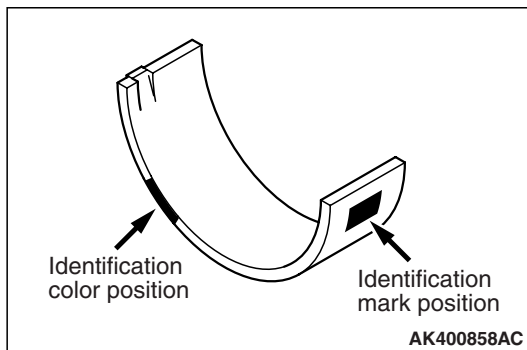
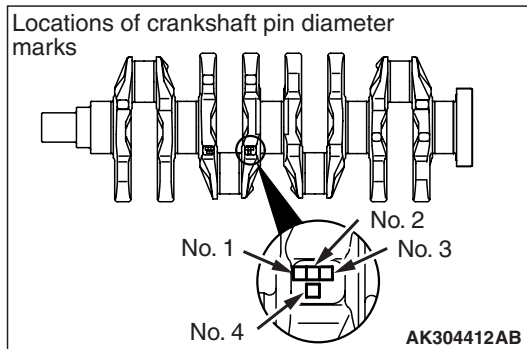
*NOTE: The identification mark and the size mark are stamped on the upper plane of the piston ring (piston top side).*

Size	Size mark
Standard	None
0.50 mm oversize diameter	50

3. To prevent wrong installation, check the identification mark of each piston ring. The identification mark is stamped near the ring gap.



## >>D<< CONNECTING ROD BEARING INSTALLATION



1. Measure the crankshaft pin diameter and confirm its classification from the following table. On a crankshaft supplied as a service part, identification marks of its pins are stamped at the positions shown in the illustration.

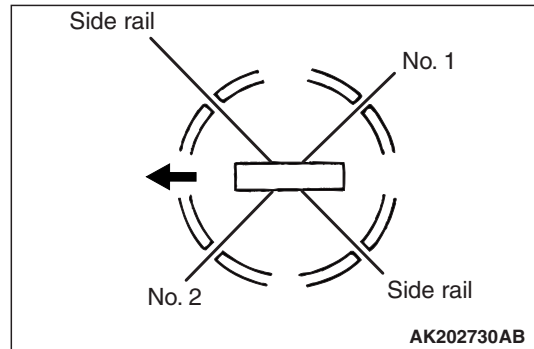
Crankshaft pin outside diameter		Connecting rod bearing
Identification mark	Size mm	Identification mark
I	44.995 – 45.000	1
II	44.985 – 44.995	2
III	44.980 – 44.985	3

2. If the crankshaft pin outside diameter identification mark is "I," for example, select a bearing whose identification mark is "1."

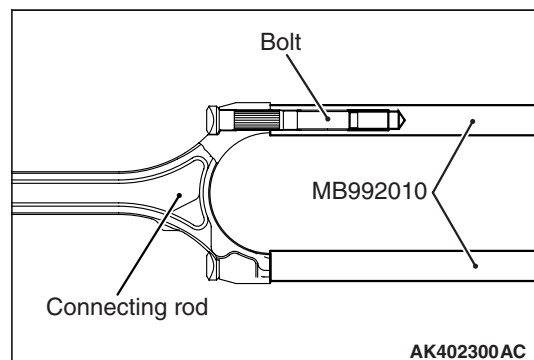
If there is no identification color paint on the crankshaft, measure the pin outside diameter and select a bearing appropriate for the measured value.

3. Install the selected bearing in the big end and in the cap of the connecting rod.

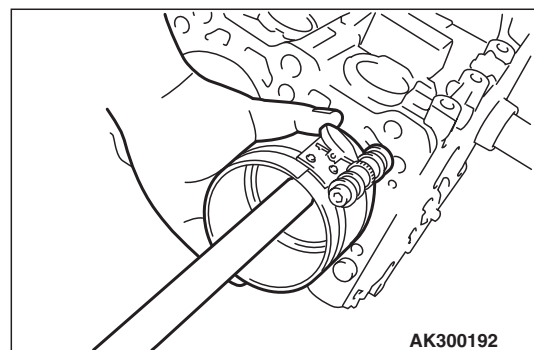
## >>E<< PISTON AND CONNECTING ROD INSTALLATION



1. Apply engine oil on the circumference of the piston, piston rings, and oil ring.
2. Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the illustration.
3. Rotate the crankshaft so that the crank pin is on the center of the cylinder bore.



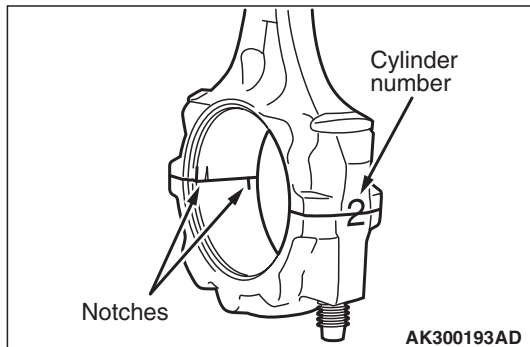
4. Not to damage the crank pin, attach a special tool Bolt guide (MB992010), to the connecting rod bolt.



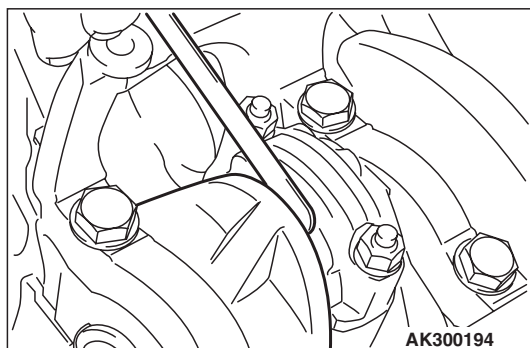
5. Use suitable thread protectors on the connecting rod bolts before inserting the piston and connecting rod assembly into the cylinder block. Care must be taken not to nick the crank pin.
6. Insert the piston and connecting rod assembly into the cylinder with the front mark on the piston crown pointing to the timing belt side.

- Using a suitable piston ring compressor tool, install the piston and connecting rod assembly into the cylinder block.

## >>F<< CONNECTING ROD CAP INSTALLATION



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



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

**Standard value: 0.10 – 0.25 mm**

**Limit: 0.4 mm**

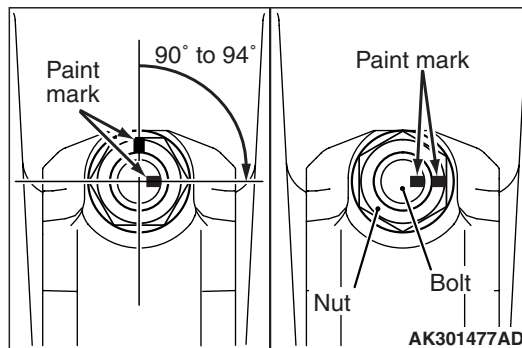
## >>G<< CONNECTING ROD CAP NUT TIGHTENING

- The connecting rod bolts should be examined before reuse. If the bolt threads are damaged, the bolt should be replaced.

Hand-thread the nut to the full length of the bolt threads. If the nut does not run down smoothly, the bolt should be replaced.

- Before installing each nut, apply engine oil to the threaded portion and bearing surface of the nut.
- Loosely tighten each nut to the bolt.
- Then tighten the nuts alternately to the specified torque to install the cap properly.

**Tightening torque:  $20 \pm 2$  N·m**



- Make a paint mark on the head of each nut.
- Make a paint mark on the bolt end at the position 90 to 94 degrees from the paint mark made on the nut in the direction of tightening the nut.

### **CAUTION**

- If the nut is turned less than 90 degrees, proper fastening performance may not be achieved. Be careful to tighten the nut exactly 90 degrees.
  - If the nut is overtightened (exceeding 94 degrees), loosen the nut completely and then retighten it by repeating the tightening procedure from step 3.
- Turn the nut 90 to 94 degrees and make sure that the paint marks on the nut and bolt are aligned.

## INSPECTION

M1113008500473

### PISTON

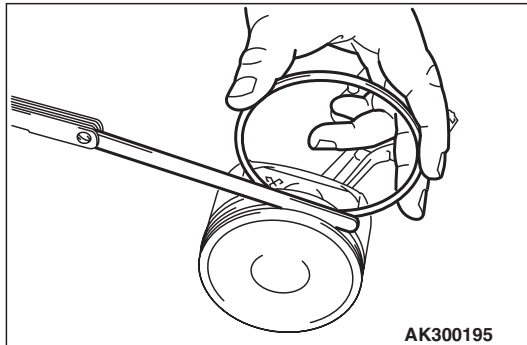
Replace the piston if scratches or seizure is evident on its surfaces (especially the thrust surface). Replace the piston if it is cracked.

### PISTON PIN

- Insert the piston pin into the piston pin hole with your thumb. You should feel a slight resistance. Replace the piston pin if it can be easily inserted or there is an excessive play.
- The piston and piston pin must be replaced as an assembly.

## PISTON RING

1. Check the piston ring for damage, excessive wear, and breakage. Replace if defects are evident. If the piston has been replaced, the piston rings must also be replaced.



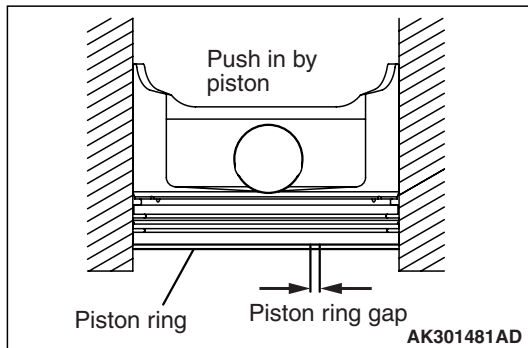
2. Check for clearance between the piston ring and ring groove. If it exceeds the limit, replace the ring or piston, or both.

**Standard value:**

<Number 1> 0.03 – 0.07 mm

<Number 2> 0.02 – 0.06 mm

**Limit: 0.1 mm**



3. Insert the piston ring into the cylinder bore. Force the ring down with a piston, the piston crown being in contact with the ring, to correctly position it at right angles to the cylinder wall. Then, measure the end gap with a feeler gauge.

If the ring gap is excessive, replace the piston ring.

**Standard value:**

<Number 1> 0.15 – 0.30 mm

<Number 2> 0.28 – 0.43 mm

<Oil> 0.10 – 0.40 mm

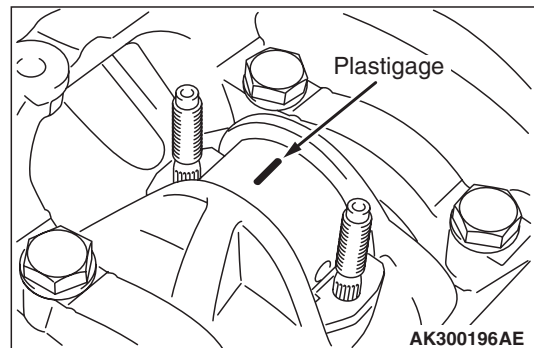
**Limit:**

<Number 1, Number 2> 0.8 mm

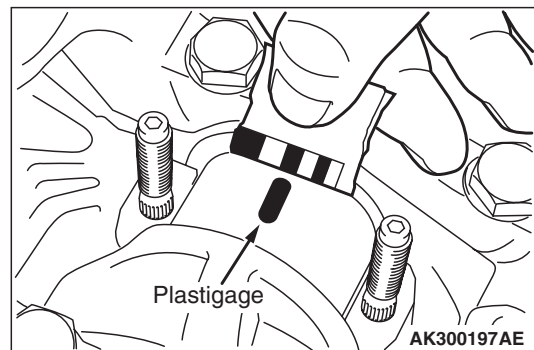
<Oil> 1.0 mm

## CRANKSHAFT PIN OIL CLEARANCE <PLASTIGAGE METHOD>

1. Remove oil from the crankshaft pin and the connecting rod bearing.



2. Cut plastigage to the same length as the width of the bearing and place it on the pin, parallel with its axis.
3. Install the connecting rod cap carefully and tighten the nuts to the specified torque.
4. Carefully remove the connecting rod cap.



5. Measure the width of the plastigage at its widest part by using a scale printed on the plastigage package.

**Standard value: 0.02 – 0.05 mm**

**Limit: 0.1 mm**

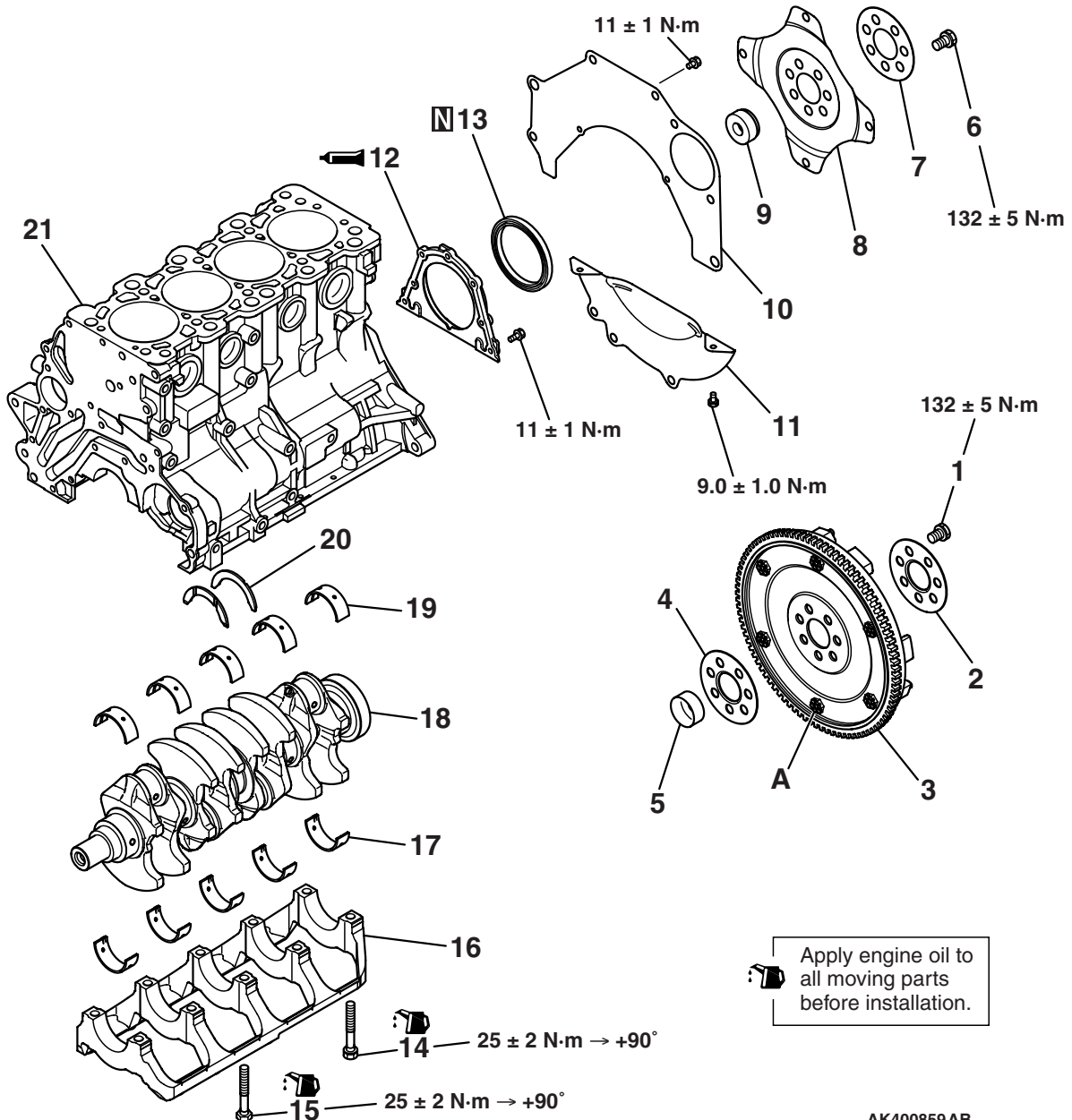
# CRANKSHAFT AND CYLINDER BLOCK

## REMOVAL AND INSTALLATION

M1113008701986

**CAUTION**

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



Apply engine oil to all moving parts before installation.

AK400859AB

**Removal steps**

- ≪A> >>F<< 1. Flywheel bolt (M/T)
- 2. Adapter plate (M/T)
- 3. Flywheel (M/T)
- 4. Adapter plate (M/T)
- 5. Crankshaft bushing (M/T)
- ≪A> >>F<< 6. Drive plate bolt (A/T)
- 7. Adapter plate (A/T)

**Removal steps (Continued)**

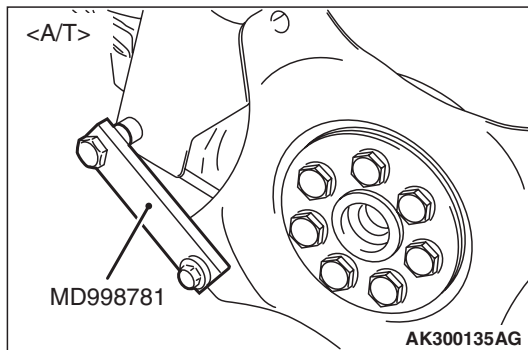
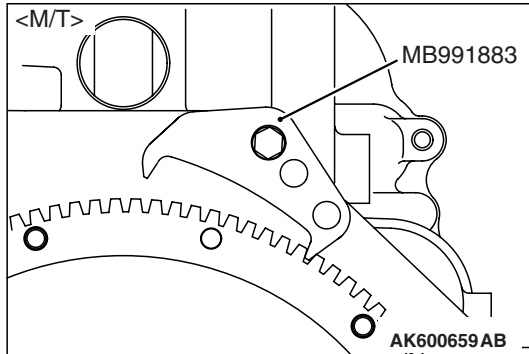
- 8. Drive plate (A/T)
- 9. Crankshaft bushing (A/T)
- 10. Rear plate
- 11. Bell housing cover
- >>E<< 12. Oil seal case
- >>D<< 13. Oil seal
- >>C<< 14. Bearing cap bolt (Head 17)
- >>C<< 15. Bearing cap bolt (Head 14)

**Removal steps (Continued)**

- >>C<< 16. Bearing cap
- >>B<< 17. Crankshaft bearing (Lower)
- 18. Crankshaft
- >>B<< 19. Crankshaft bearing (Upper)
- >>A<< 20. Crankshaft thrust bearing
- 21. Cylinder block

**REMOVE SERVICE POINTS**

**<<A>>DRIVE PLATE BOLT AND FLY-  
WHEEL BOLT REMOVE**

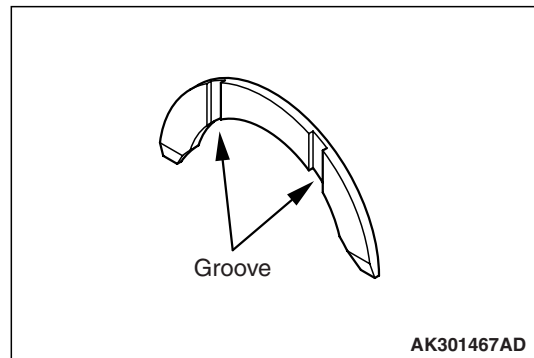


1. Lock the drive plate or the flywheel using the special tool Flywheel stopper.
  - Flywheel stopper (MB991883)
  - Flywheel stopper (MD998781)
2. Remove the drive plate bolt or the flywheel bolt.

**INSTALLATION SERVICE POINTS**

**>>A<< CRANKSHAFT THRUST BEARING  
INSTALLATION**

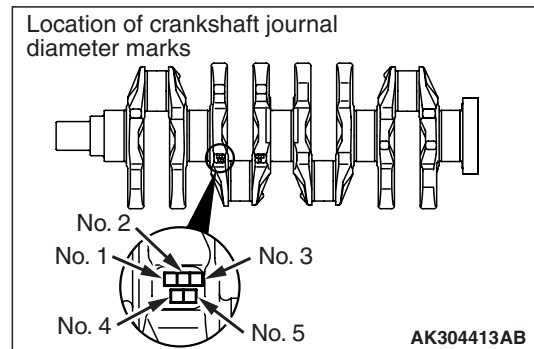
1. Install the two thrust bearings in the number 3 bearing bore in the cylinder block. For easier installation, apply engine oil to the bearings; this will help hold them in position.



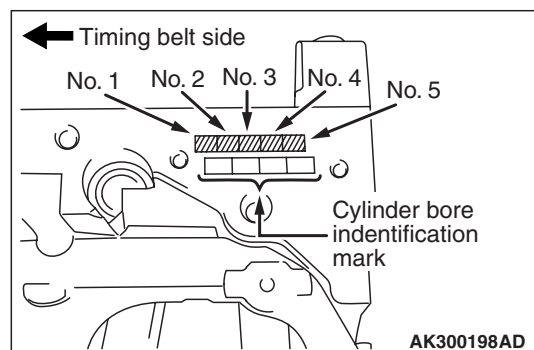
2. The thrust bearings must be installed with their groove side toward the crankshaft web.

**>>B<< CRANKSHAFT BEARING  
INSTALLATION**

When bearing replacement is required, select and install the correct bearing by the following procedure.

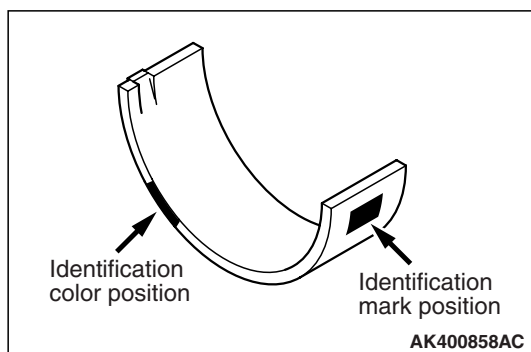


1. Measure the crankshaft journal diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification marks of its journals are stamped at the positions shown in the illustration.



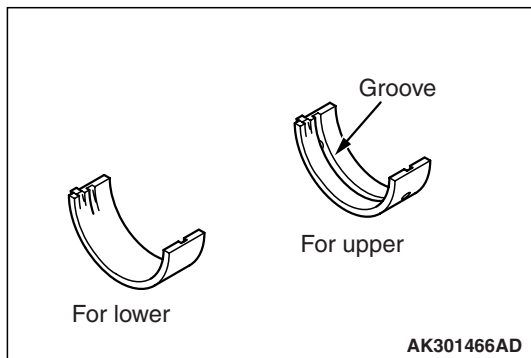
2. The cylinder block bearing bore diameter identification marks are stamped at the position shown in the illustration from left to right, beginning at No.1.

Crankshaft journal outside diameter		Cylinder block bearing bore	Crankshaft bearing	Crankshaft bearing for No.3
Identification mark	Size mm	Identification mark	Identification mark	Identification mark
0	56.994 – 57.000	0	1	0
		1	2	1
		2	3	2
1	56.988 – 56.994	0	2	1
		1	3	2
		2	4	3
2	56.982 – 56.988	0	3	2
		1	4	3
		2	5	4



For example, if the crankshaft journal outside diameter identification mark is "0" and cylinder block bearing bore identification mark is "1," select a bearing whose identification mark is "2" for number 1, 2, 4 and 5, and a bearing whose identification mark is "1" for number 3.

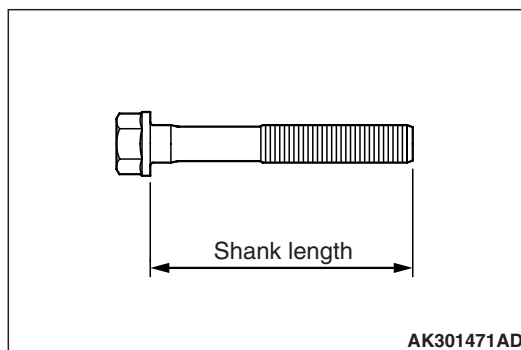
If there is no identification mark on the crankshaft, measure the journal outside diameter and select a bearing appropriate for the measured value.



3. Install the bearings having an oil groove to the cylinder block.
4. Install the bearings having no oil groove to the bearing cap.

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

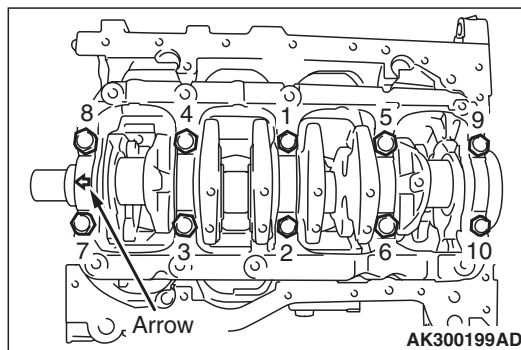
1. Install the bearing caps so that the arrow points to the timing belt side.



2. Before installing the bearing cap bolts, check that the shank length of each bolt meets the limit. If it exceeds the limit, replace the bolt.

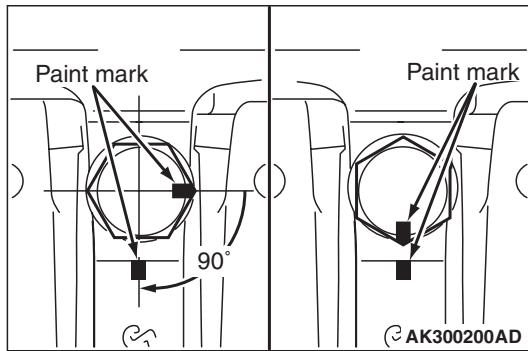
**Limit: 71.1 mm**

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



4. Tighten the bolts to the specified in the tightening sequence shown.

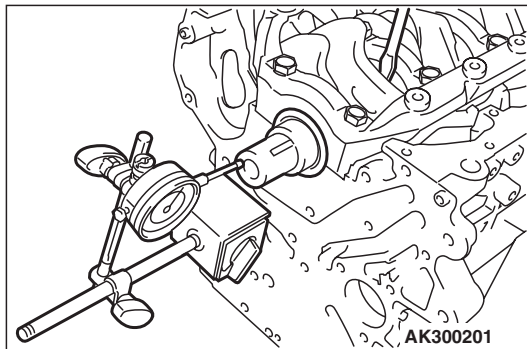
**Tightening torque: 25 ± 2 N·m**



5. Make a paint mark on the head of each bolt.
6. Make a paint mark on the bearing cap 90 degrees from the paint mark made on the bolt in the direction of tightening the bolt.

**CAUTION**

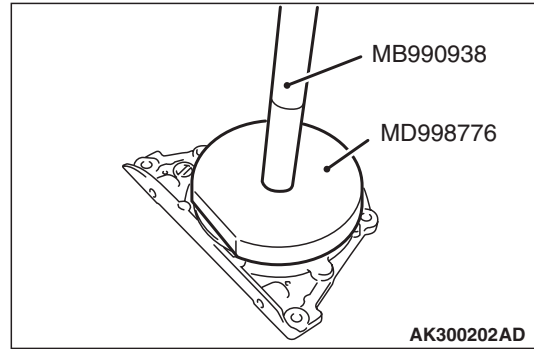
- If the bolt is overtightened, loosen the bolt completely and then retighten it by repeating the tightening procedure from step 4.
  - If the bolt is turned less than 90 degrees, proper fastening performance may not be achieved. Be sure to turn the bolt exactly 90 degrees.
7. Turn each bolt 90 degrees in the tightening sequence specified in step 4, and make sure that the paint marks on the bolt and cap are aligned.



8. Make sure that the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace the number 3 crankshaft bearings.

**Standard value: 0.05 – 0.25 mm**  
**Limit: 0.40 mm**

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

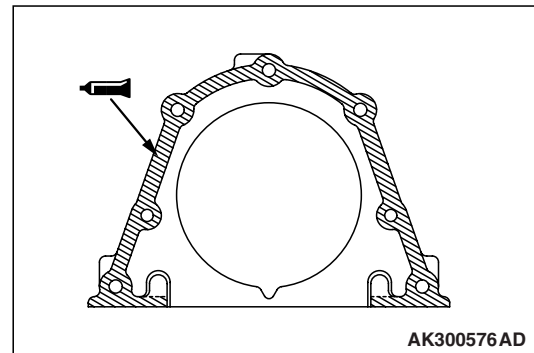


Use the special tools to press-fit the rear oil seal in the rear oil seal case.

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

**>>E<< SEALANT APPLICATION TO OIL SEAL CASE**

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



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

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

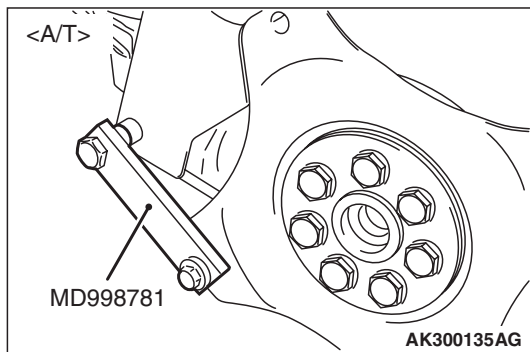
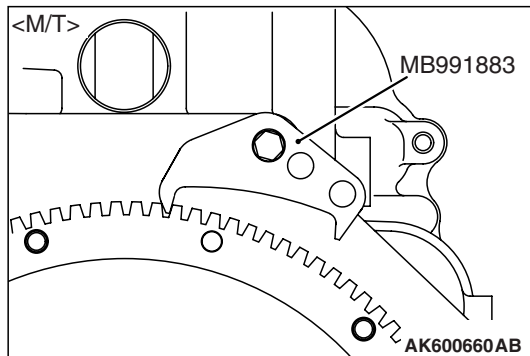
*NOTE: Be sure to install the case quickly while the sealant is wet (within 15 minutes).*

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

*NOTE: After installation, keep the sealed area away from the oil for approximately one hour.*

>>F<< DRIVE PLATE BOLT AND  
FLYWHEEL BOLT INSTALLATION

- Using the special tool Flywheel stopper secure the drive plate or the flywheel.



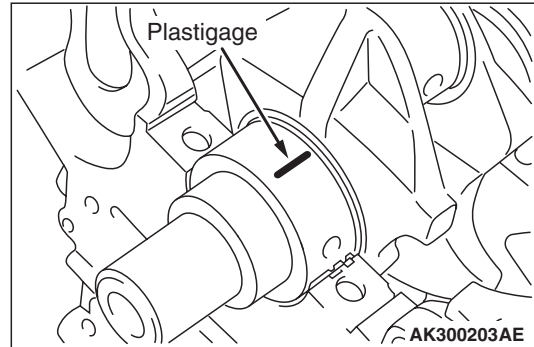
- Tighten the flywheel bolt to the specified torque of  $132 \pm 5$  N·m.

## INSPECTION

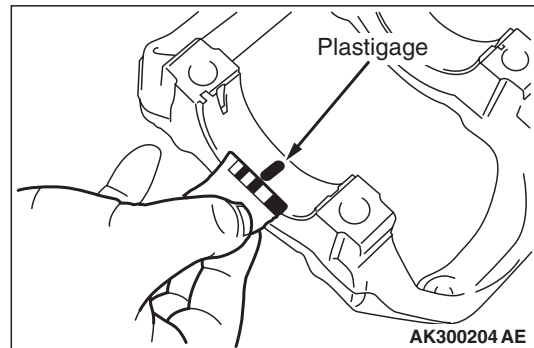
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CRANKSHAFT JOURNAL OIL  
CLEARANCE <PLASTIGAGE METHOD>

- Remove oil from the crankshaft journal and crankshaft bearing.
- Install the crankshaft.



- Cut the plastigage to the same length as the width of bearing and place it on journal in parallel with its axis.
- Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
- Carefully remove the crankshaft bearing cap.

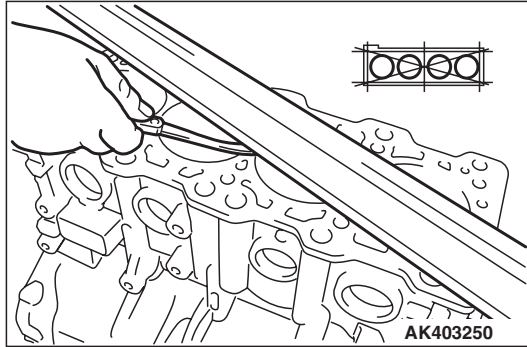


- Measure the width of the plastigage at its widest part by using a scale printed on the plastigage package.

**Standard value:****No.1,2,4,5 journal: 0.02 – 0.03 mm****No.3 journal: 0.03 – 0.04 mm****Limit: 0.1 mm**



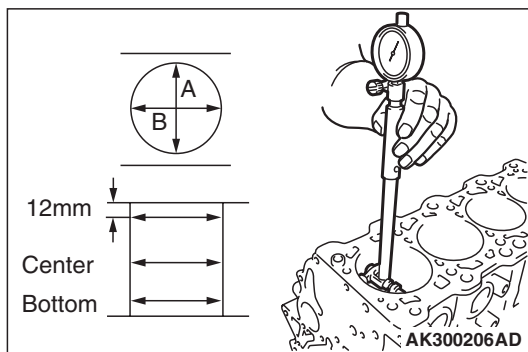
## CYLINDER BLOCK



1. Visually check for scratches, rust, and corrosion. Use also a flaw detecting agent for the check. If defects are evident, correct or replace.
2. Using a straightedge and feeler gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other foreign matter.
 

**Standard value: 0.05 mm**  
**Limit: 0.1 mm**
3. If the distortion is excessive, correct within the allowable limit or replace.
 

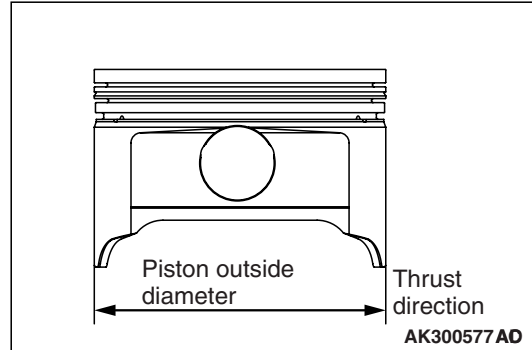
**Grinding limit: 0.2 mm**  
**\*Includes/combined with cylinder head grinding**  
**Cylinder block height (when new): 290 mm**
4. Check cylinder walls for scratches and seizure. If defects are evident, replace or bore to oversize and replace pistons and piston rings.



5. Using a cylinder gauge, measure the cylinder bore and cylindrically. If worn badly, correct the cylinder to an oversize and replace the piston and piston rings. Measure at the points shown in the illustration.
 

**Standard value:**  
**Cylinder inner diameter 87.0 mm**  
**Cylindrically 0.01 mm or less**

## BORING CYLINDER



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

### Piston size identification

Size	Identification mark
0.50 mm oversize diameter	50

*NOTE: Size mark is stamped on the piston top.*

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

**Boring finish dimension = Piston OD + (clearance between piston OD and cylinder) - 0.02 mm (honing margin)**

### ⚠ CAUTION

**To prevent distortion that may result from temperature rise during honing, bore cylinders, working from number 2 to number 4 to number 1 to number 3.**

4. Bore all cylinders to the calculated boring finish dimension.
- 5.hone to the final finish dimension (piston OD + clearance between piston OD and cylinder).
6. Check the clearance between the piston and cylinder.

**Clearance between piston and cylinder:**  
**0.02 – 0.04 mm**

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

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## NOTES