

## GROUP 11B

# ENGINE OVERHAUL

## <4G1>

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HOW TO USE THIS MANUAL

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HOW TO USE THIS MANUAL

Scope of Service Explanations

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

How to Read Explanations

Service steps

(1) A component part drawing is shown at the beginning of each section to enable the technician to ascertain the installed condition of the component parts.

(2) Service steps are indicated by means of numbers in the component part drawing. Non-reusable parts are indicated as such, and tightening torques are shown.

·Removal steps  
The numbers of the part names match the numbers in the component part drawing and indicate the removal sequence.

·Installation steps  
Installation steps are omitted wherever installation can be achieved simply by performing the removal steps in reverse.

·Disassembly steps  
The numbers of the part names match the numbers in the component part drawing and indicate the disassembly sequence.

·Reassembly steps  
Reassembly steps are omitted wherever reassembly can be achieved simply by performing the disassembly steps in reverse.

Classification of Service Points





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

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

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

Lubricant and Sealant Symbols

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

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

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

Page number

11-54

Group title

ENGINE OVERHAUL  
CRANKSHAFT AND CYLINDER BLOCK

Section title

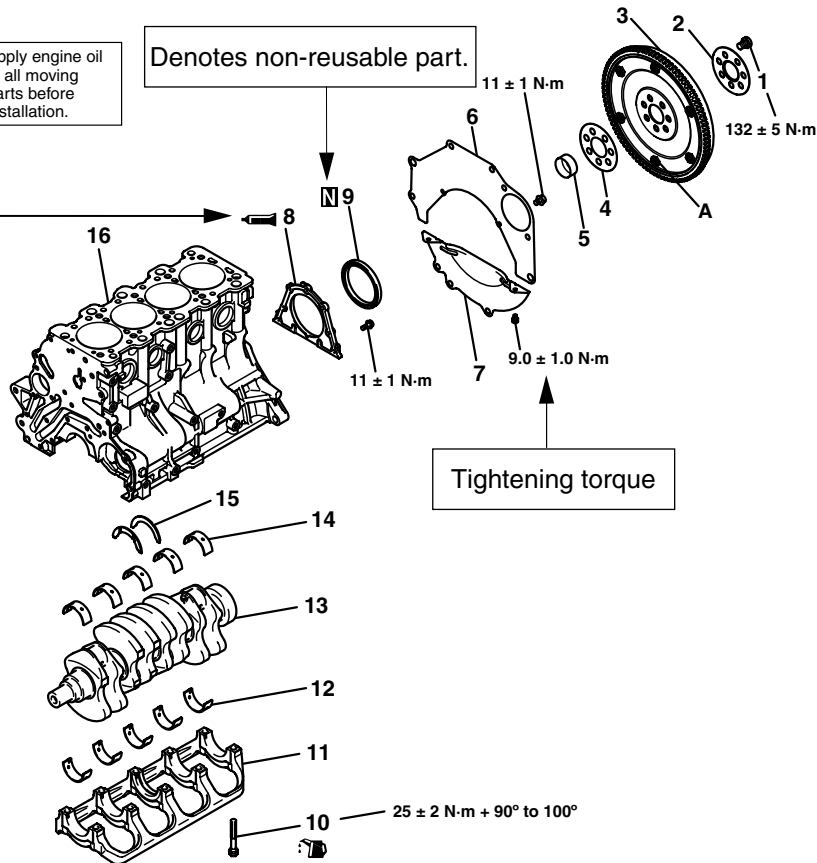
## CRANKSHAFT AND CYLINDER BLOCK

### REMOVAL AND INSTALLATION



Apply engine oil  
to all moving  
parts before  
installation.

Denotes non-reusable part.



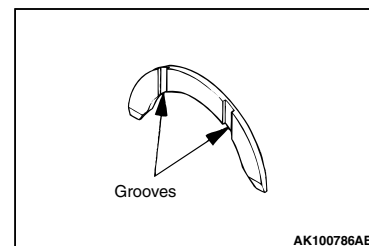
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#### Removal steps

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

#### INSTALLATION SERVICE POINTS

>>A<< THRUST BEARING INSTALLATION



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

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

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## GENERAL INFORMATION

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Vehicle name	Vehicle model	Engine model	Displacement cc	Specification
Lancer	CS1A	4G13-J	1,299	Single overhead camshaft, 16-valve
	CS3A	4G18-V, 4G18-J	1,584	Single overhead camshaft, 16-valve
Lancer wagon	CA3W	4G18-V, 4G18-J	1,584	Single overhead camshaft, 16-valve

## GENERAL SEPCIFICATIONS

M1113000200520

Items		4G13-SOHC	4G18-SOHC
Bore × stroke mm		71 × 82	76 × 87.3
Displacement cc		1,299	1,584
Number of cylinders		4	
Valve mechanism	Type	Single overhead camshaft	
	Number of intake valves	2	
	Number of exhaust valves	2	
	Lash adjusters	Hydraulic	
	Rocker arms	Roller rocker arms	
Compression ratio		10.0	
Lubrication system		Pressure feed, full-flow filtration	
Oil pump type		Trochoid type	
Cooling system		Water-cooled forced circulation	
Water pump type		Centrifugal impeller type	

## SERVICE SPECIFICATIONS

M1113000300464

Items			Standard value	Limit
Rocker arms and camshaft				
Camshaft cam height mm	4G13	Intake	36.86	36.36
		Exhaust	36.68	36.18
	4G18	Intake	37.17	36.67
		Exhaust	36.99	36.49
Cylinder head and valves				
Cylinder head gasket surface flatness mm			0.03 or less	0.2
Cylinder head gasket surface grinding limit (including grinding of cylinder block gasket surface) mm			–	0.2
Cylinder head overall height mm			119.9 – 120.1	–
Cylinder head bolt shank length mm			–	103.2

Items		Standard value	Limit
Valve margin mm	Intake	1.0	0.5
	Exhaust	1.5	1.0
Valve stem-to-guide clearance mm	Intake	0.020 – 0.047	0.10
	Exhaust	0.030 – 0.057	0.15
Valve stem projection mm	Intake	53.21	53.71
	Exhaust	54.10	54.60
Overall valve length mm	Intake	111.56	111.06
	Exhaust	114.71	114.21
Valve spring free height mm		50.87	49.87
Valve spring squareness		2° or less	4°
Valve seat valve contact width mm		0.9 – 1.3	–
Valve guide projection mm		22.7 – 23.3	–
<b>Oil pan and oil pump</b>			
Oil pump tip clearance mm		0.06 – 0.18	–
Oil pump side clearance mm		0.04 – 0.10	–
Oil pump body clearance mm		0.10 – 0.18	0.35
<b>Piston and connecting rod</b>			
Piston ring side clearance mm	No.1 ring	0.03 – 0.07	0.1
	No.2 ring	0.02 – 0.06	0.1
Piston ring end gap mm	No.1 ring	0.20 – 0.35	0.8
	No.2 ring	0.35 – 0.50	0.8
	Oil ring	0.10 – 0.40	1.0
Crankshaft pin oil clearance mm		0.02 – 0.04	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 – 0.18	0.25
Crankshaft journal oil clearance mm		0.02 – 0.04	0.1
Cylinder block gasket surface flatness mm		0.02 – 0.04	–
Cylinder block flatness of gasket surface mm		0.05 or less	0.1
Cylinder bore cylindricity mm		0.01 or less	–
Cylinder bore mm	4G13	71.0	–
	4G18	76.0	–
Piston-to-cylinder clearance mm		0.02 – 0.04	–

## REWORK DIMENSIONS

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Items			Standard value
Cylinder head and valves			
Diameter of oversize valve seat ring hole in cylinder head mm	Intake	0.03 oversize	30.30 – 30.32
		0.06 oversize	30.60 – 30.62
	Exhaust	0.03 oversize	28.30 – 28.32
		0.06 oversize	28.60 – 28.62
Diameter of oversize valve guide hole in cylinder head mm		0.05 oversize	10.55 – 10.57
		0.25 oversize	10.75 – 10.77
		0.50 oversize	11.00 – 11.02

## TORQUE SPECIFICATIONS

M1113023400558

Items	Specifications
<b>Generator and ignition system</b>	
Camshaft position sensor bolt	8.8 ± 1.0 N·m
Camshaft position sensing cylinder bolt	22 ± 4 N·m
Camshaft position sensor support bolt	14 ± 1 N·m
Crankshaft pulley bolt	181 N·m
Generator brace bolt (generator side)	23 ± 2 N·m
Generator brace bolt (tightened with water pump)	24 ± 3 N·m
Generator pivot bolt nut	44 ± 10 N·m
Ignition coil bolt	10 ± 2 N·m
Oil level guide bolt	24 ± 4 N·m
Spark plug	25 ± 4 N·m
Water pump pulley bolt	9 ± 2 N·m
<b>Timing belt</b>	
Camshaft sprocket bolt	88 ± 10 N·m
Crankshaft position sensor bolt	8.8 ± 1.0 N·m
Engine support bracket bolt M8	21 ± 4 N·m
Engine support bracket bolt, nut M10	36 ± 6 N·m
Timing belt cover bolt	11 ± 2 N·m
Timing belt tensioner bolt	23 ± 3 N·m
<b>Fuel and emission control system</b>	
Delivery pipe and injector bolt	12 ± 1 N·m
Fuel pressure regulator bolt	9.0 ± 2.0 N·m
Solenoid valve assembly bolt	9.0 ± 1.0 N·m
Throttle body bolt	19 ± 3 N·m
Vacuum pipe and hose bolt	9.0 ± 1.0 N·m

Items	Specifications
<b>Water pump and water hose</b>	
Engine coolant temperature gauge unit	10.8 ± 1.0 N·m
Engine coolant temperature sensor	29 ± 9 N·m
Thermostat case bolt	24 ± 4 N·m
Water inlet fitting bolt	22 ± 4 N·m
Water inlet pipe bolt	13 ± 2 N·m
Water pump bolt	14 ± 1 N·m
<b>Intake and exhaust manifolds</b>	
EGR valve bolt	21 ± 4 N·m
Engine hanger bolt	19 ± 3 N·m
Exhaust manifold bracket A bolt	35 ± 6 N·m
Exhaust manifold cover bolt	30 ± 3 N·m
Exhaust manifold nut M10	30 ± 3 N·m
Exhaust manifold nut M8	18 ± 2 N·m
Intake manifold bolt, nut	18 ± 2 N·m
Intake manifold stay bolt M10	31 ± 3 N·m
Intake manifold stay bolt M8	18 ± 2 N·m
Boost sensor bolt	5.0 ± 1.0 N·m
Oxygen sensor	44 ± 5 N·m
Throttle body stay bolt	18 ± 2 N·m
Power plant stay left bolt	35 ± 6 N·m
Power plant stay right bolt	49 ± 9 N·m
<b>Rocker arms and camshaft</b>	
Rocker arm shaft bolt	31 ± 3 N·m
Rocker cover bolt	3.5 ± 0.5 N·m
<b>Cylinder head and valve</b>	
Cylinder head bolt [Tighten to 49 ± 2 N·m, then completely loosen and retighten as described.]	20 ± 2 N·m + 90° + 90°
<b>Oil pan and oil pump</b>	
Drain plug	39 ± 5 N·m
Oil filter (MD348631, MD365876)	16 ± 4 N·m
Oil filter (MD360935)	14 ± 2 N·m
Oil pan bolts	7.0 ± 1.0 N·m
Oil pump case bolts	14 ± 1 N·m
Oil pump cover bolts	10 ± 2 N·m
Oil screen bolts	19 ± 3 N·m
Relief plug	44 ± 5 N·m
Transmission stay bolts	23 ± 4 N·m
<b>Piston and connecting rod</b>	
Connecting rod cap nuts	17 ± 2 N·m + 90° to 94°

Items	Specifications
<b>Crankshaft and drive plate</b>	
Bearing cap bolt	$34 \pm 2 \text{ N}\cdot\text{m} + 30^\circ$ to $34^\circ$
Bell housing cover bolt	$9.0 \pm 1.0 \text{ N}\cdot\text{m}$
Drive plate bolt	$132 \pm 5 \text{ N}\cdot\text{m}$
Flywheel bolt	$132 \pm 5 \text{ N}\cdot\text{m}$
Oil pressure switch	$19 \pm 3 \text{ N}\cdot\text{m}$
Rear oil seal case bolt	$11 \pm 1 \text{ N}\cdot\text{m}$
Rear plate bolt	$10 \pm 2 \text{ N}\cdot\text{m}$

## SEALANTS

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Items	Specified sealants
Camshaft position sensor support	Mitsubishi Genuine Part No.MD970389 or equivalent
Water pump	Mitsubishi Genuine Part No.MD970389 or equivalent
Engine coolant temperature sensor	3M Nut Locking Part No.4171 or equivalent
Engine coolant temperature e gauge unit	3M ATD No.8660 or equivalent
Oil pump case	Mitsubishi Genuine Part No. MD970389 or equivalent
Oil pan	Mitsubishi Genuine Part No. MD970389 or equivalent
Oil pressure switch	3M ATD No.8660 or equivalent
Rear oil seal case	Mitsubishi Genuine Part No. MD970389 or equivalent

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

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

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

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

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

### REMOVAL OF FIPG SEALED PARTS

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



### **CLEANING FIPG APPLICATION SURFACE**

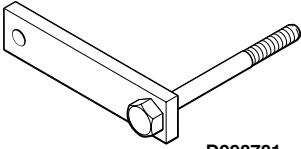
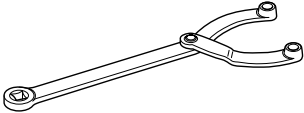
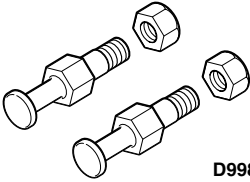
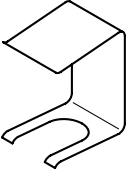
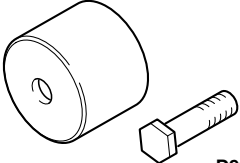
Thoroughly remove all substances deposited on the FIPG application surface, using a gasket scraper or wire brush. Make sure that the FIPG application surface is flat and smooth. Also make sure that the surface is free from oils, greases and foreign substances. Do not fail to remove old FIPG that may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

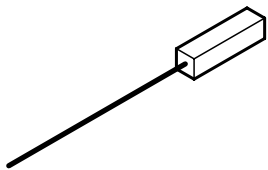
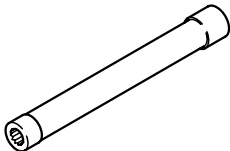
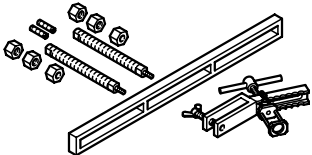
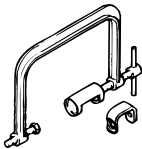
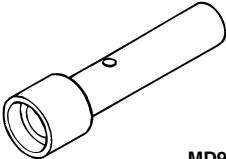
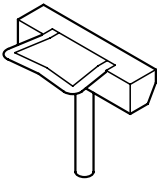
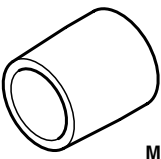
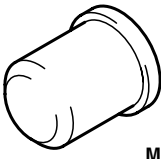
### **APPLICATION OF FIPG**

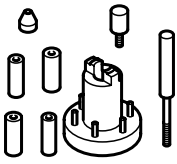
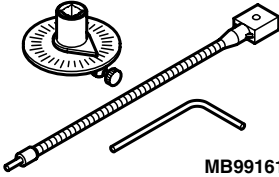
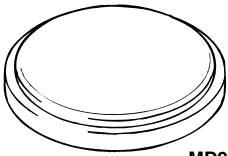
Applied FIPG bead should be of the specified size and free of any break. FIPG can be wiped away unless it has completely hardened. Install the mating parts in position while the FIPG is still wet (in less than 15 minutes after application). Do not allow FIPG to spread beyond the sealing areas during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

M1113000600517

<b>Tool</b>	<b>Number</b>	<b>Name</b>	<b>Use</b>
 D998781	MD998781	Flywheel stopper	Retention of flywheel or drive plate
 B990767	MB990767	End yoke holder	Retention of camshaft sprocket (Use with MD998719)
 D998719	MD998719	Pulley holder pin	Retention of camshaft sprocket (Use with MB990767)
 D998443	MD998443	Lash adjuster holder (8)	Supporting lash adjuster to prevent it from falling when rocker arm shaft assembly is removed or installed
 D998713	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal

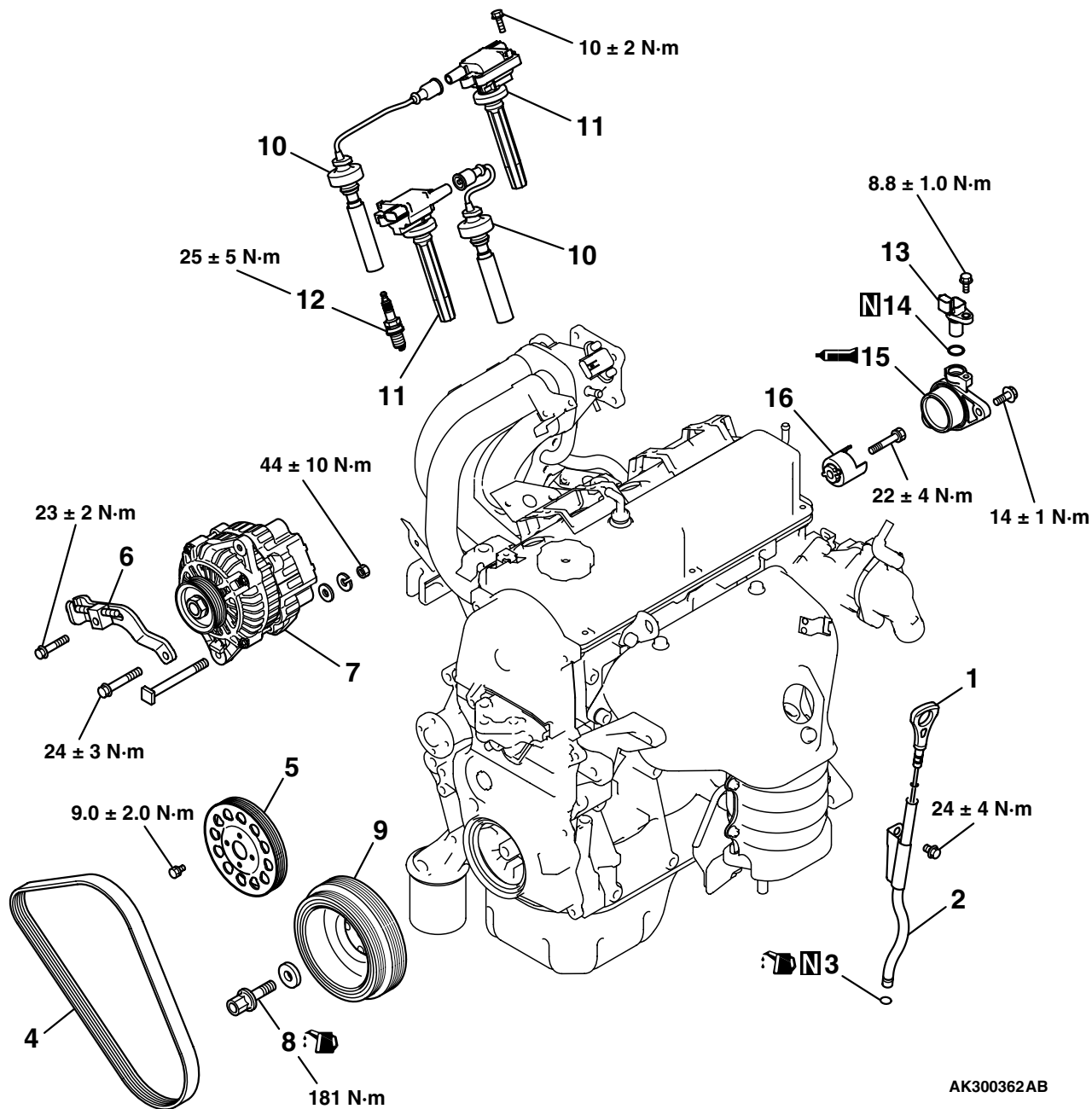
Tool	Number	Name	Use
	MD998442	Air bleed wire	Air bleeding of lash adjuster
	MB991653	Cylinder head bolt wrench	Loosening and torquing of cylinder head bolt
	MD998772	Valve spring compressor	Compression of valve spring
	MD998735	Valve spring compressor	Compression of valve spring
 MD998760	MD998760	Valve stem seal installer	Installation of valve stem seal
 D998727	MD998727	Oil pan remover	Removal of oil pan
 MB991962	MB991962	Crankshaft front oil seal guide	Installation of crankshaft front oil seal
 MD998306	MD998306	Camshaft oil seal installer	Installation of crankshaft front oil seal

Tool	Number	Name	Use
	MD998780	Piston pin setting tool	Removal and press-fitting of piston pin
 MB991614	MB991614	Angle gauge	Installation of crankshaft bearing caps
 MD998011	MD998011	Crankshaft rear oil seal installer	Installation of crankshaft rear oil seal

## ALTERNATOR AND IGNITION SYSTEM

## REMOVAL AND INSTALLATION

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## Removal steps

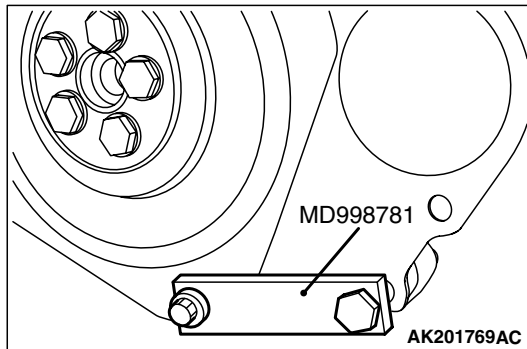
1. Oil level  
 2. Oil level guide  
 3. O-ring  
 4. Drive belt  
 5. Water pump  
 6. Alternator brace  
 7. Alternator  
 <<A>> >>C<< 8. Crankshaft pulley bolt

## Removal steps (Continued)

- >>C<< 9. Crankshaft pulley  
 10. Spark plug cables  
 11. Ignition coil  
 12. Spark plugs  
 13. Camshaft position sensor  
 >>B<< 14. Camshaft position sensor support  
 >>A<< 15. Camshaft position sensing cylinder

## REMOVAL SERVICE POINT

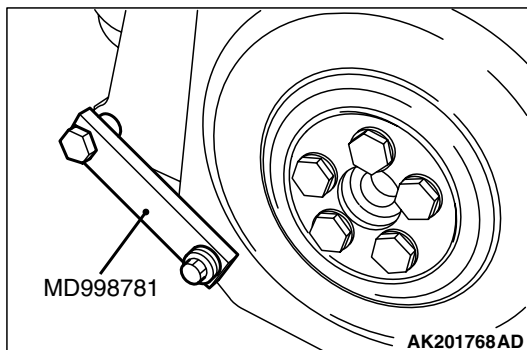
### <<A>> CRANKSHAFT BOLT REMOVAL



Lock the drive plate or flywheel in position using the special tool Flywheel stopper (MD998781) shown in the illustration, then loosen the crankshaft bolt.

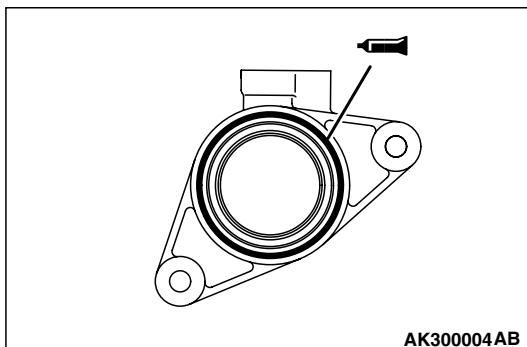
## INSTALLATION SERVICE POINTS

### >>A<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION



1. Using special tool Flywheel stopper (MD998781), hold the drive plate or flywheel.
2. Tighten the camshaft position sensing cylinder bolt to the specified torque  $22 \pm 4$  N·m.

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



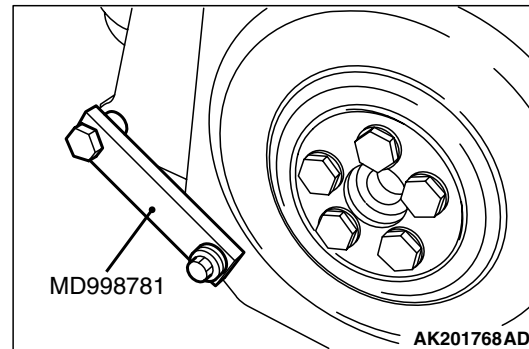
1. Clean the sealant application surfaces of cam position sensor support and cylinder head.
2. Apply a 3 mm diameter bead of sealant to the camshaft position sensor support.

### Specified sealant:

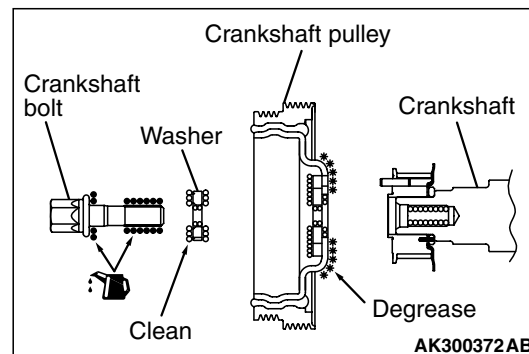
Mitsubishi Genuine Part No.MD970389 or equivalent

3. After installation, wait at least one hour. Never start the engine or let engine oil touch the adhesion surface during that time.

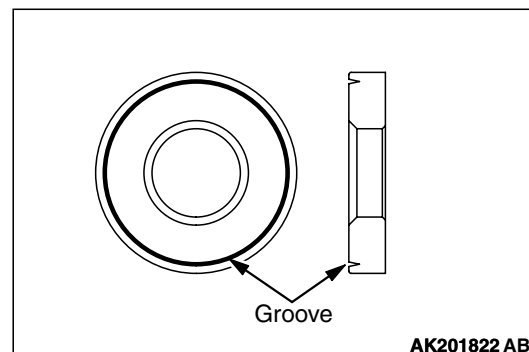
### >>C<< CRANKSHAFT BOLT INSTALLATION



1. Lock the flywheel or drive plate in position using the special tool Flywheel stopper (MD998781) shown in the illustration, then tighten the crankshaft bolt.



2. Clean the bolt hole in crankshaft bolt and the washer.
3. Degrease the cleaned seating surface of the crankshaft pulley.
4. Install the damper pulley.
5. Apply minimum appropriate oil to the threads and lower flange of the crankshaft bolt.



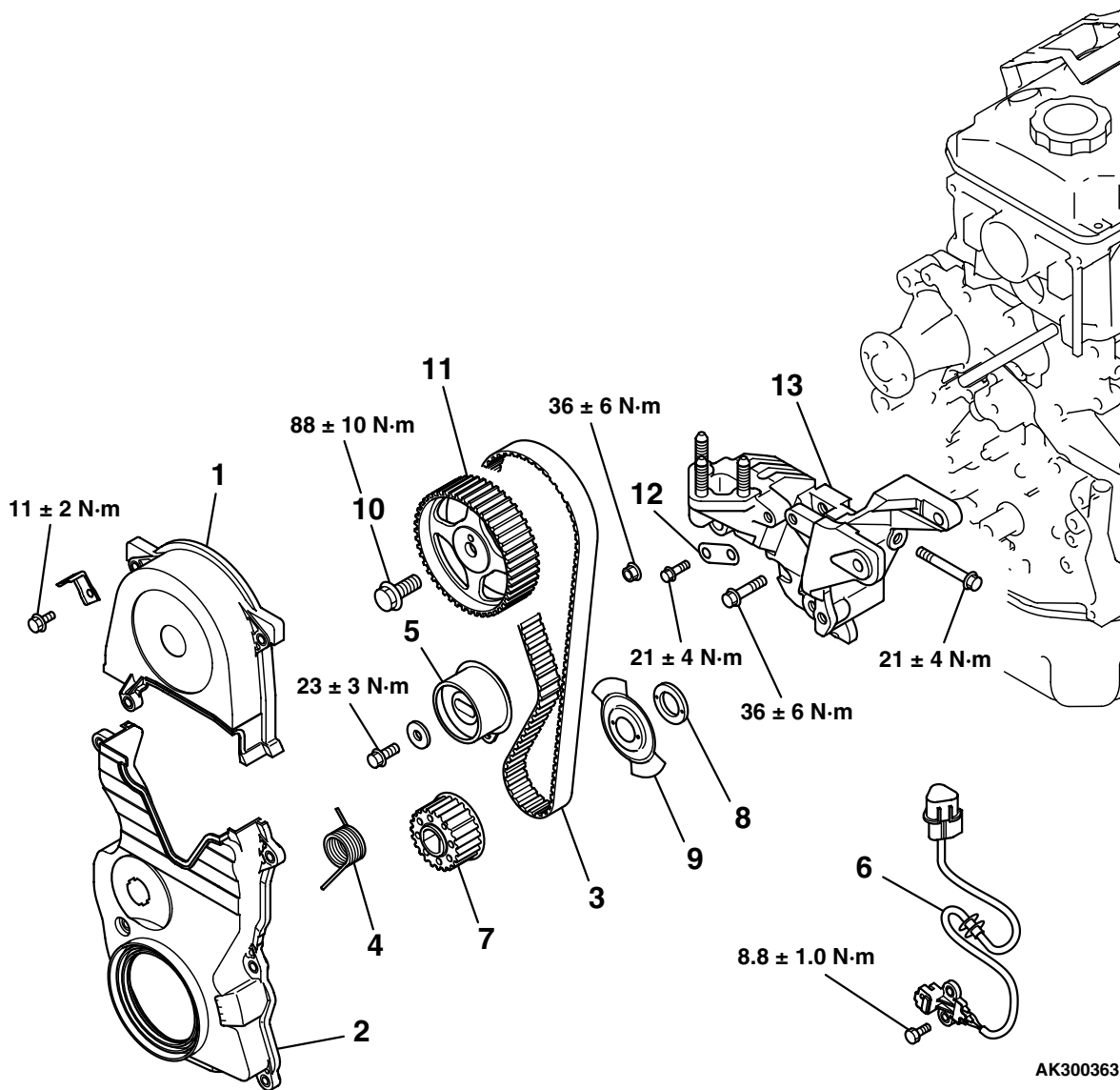
6. Install the washer facing the groove toward the bolt. **AB**

7. Tighten the crankshaft bolt to the specified torque 181 N·m.

## TIMING BELT

### REMOVAL AND INSTALLATION

M1113001900555



#### Removal steps

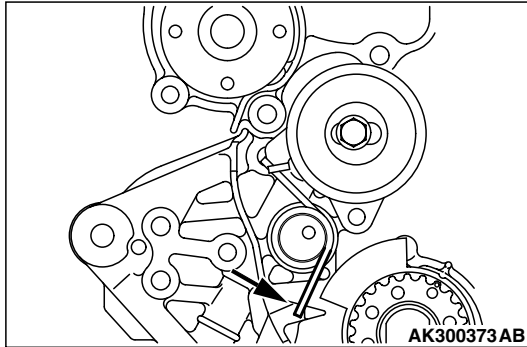
1. Timing belt upper cover  
2. Timing belt lower cover  
<<A>> >>D<< 3. Timing belt  
>>C<< 4. Tensioner spring  
>>C<< 5. Timing belt tensioner  
6. Crankshaft position sensor  
>>B<< 7. Crankshaft sprocket

#### Removal steps (Continued)

- >>B<< 8. Crankshaft spacer  
>>B<< 9. Crankshaft sensing blade  
<<B>> >>A<< 10. Camshaft sprocket bolt  
11. Camshaft sprocket  
12. Bracket  
13. Engine support bracket

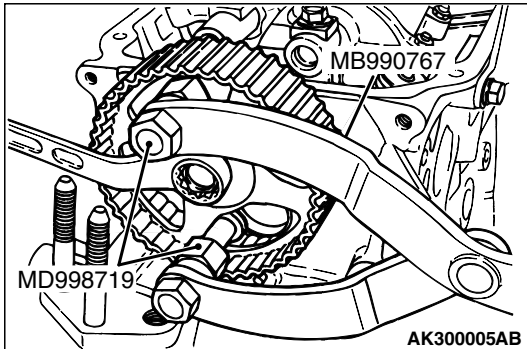
## REMOVAL SERVICE POINTS

### <<A>> TIMING BELT/TENSIONER SPRING/ TIMING BELT TENSIONER REMOVAL



1. Using pliers, grip the tensioner spring end (marked "A" in the illustration) and remove it from the front case lug. Then, remove the tensioner spring.
2. Remove the timing belt tensioner, and then remove the timing belt.
3. If the timing belt is to be reused, chalk an arrow on the belt to indicate the direction of rotation before removing it. This will ensure the timing belt is fitted correctly when reused.

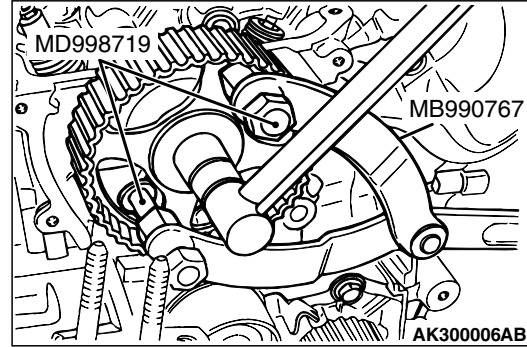
### <<B>> CAMSHAFT SPROCKET BOLT REMOVAL



1. Using the special tools shown in the illustration, lock the camshaft sprocket in position.
  - End yoke holder (MB990767)
  - Pulley holder pin (MD998719)
2. Loosen the camshaft sprocket bolt.

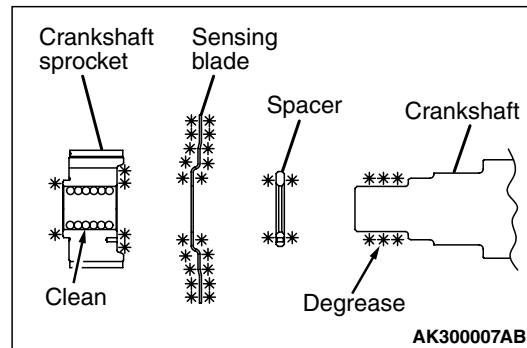
## INSTALLATION SERVICE POINTS

### >>A<< CAMSHAFT SPROCKET BOLT INSTALLATION



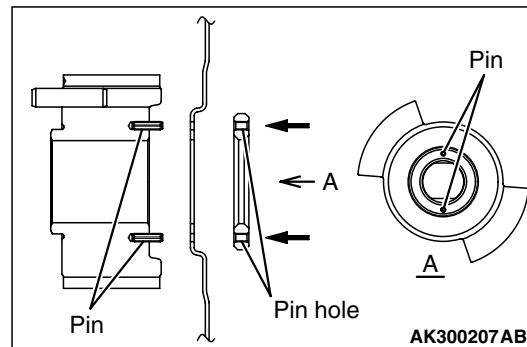
1. Using the special tools shown in the illustration, lock the camshaft sprocket in the position.
  - End yoke holder (MB990767)
  - Pulley holder pin (MD998719)
2. Tighten the camshaft sprocket bolt to the specified torque  $88 \pm 10$  N·m.

### >>B<< CRANKSHAFT SENSING BLADE/ CRANKSHAFT SPACER/CRANKSHAFT SPROCKET INSTALLATION



1. Clean the hole in the crankshaft sprocket.
2. Clean and degrease the mating surfaces of the crankshaft sprocket; sensing blade; and spacer.

**NOTE:** Degreasing is necessary to prevent decrease in friction between the mating surface due to presence of oil.



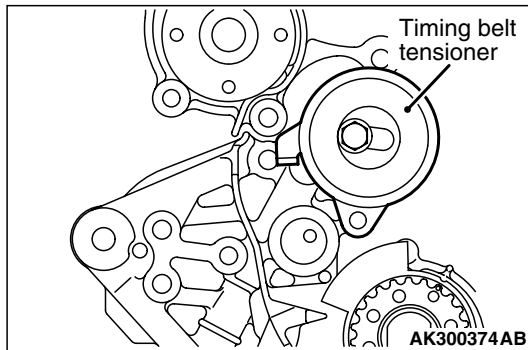
- Align the location of pin and pin hole, and then apply equal force in the direction of the arrow.

**⚠ CAUTION**

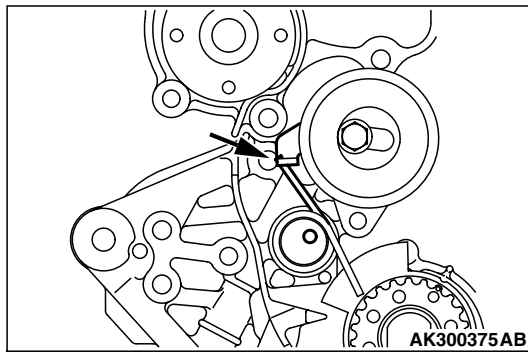
**Do not bend the sensing blade when installing sprocket**

- Install the crankshaft sprocket to the crankshaft.

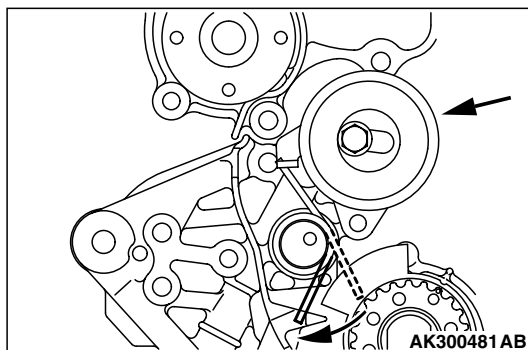
**>>C<< TIMING BELT TENSIONER/TENSIONER SPRING INSTALLATION**



- Install the timing belt tensioner in the illustrated position, and then tighten the tensioner mounting bolt.

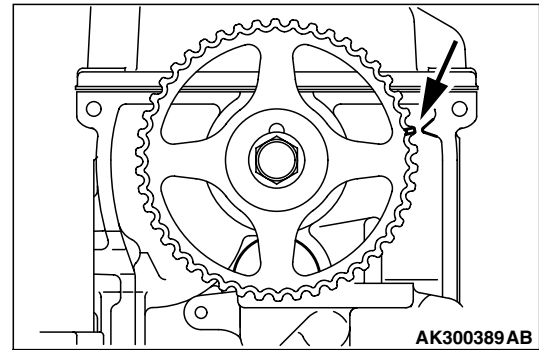


- Install the tensioner spring onto the boss of the front case, and then hook the spring end to the tensioner arm.

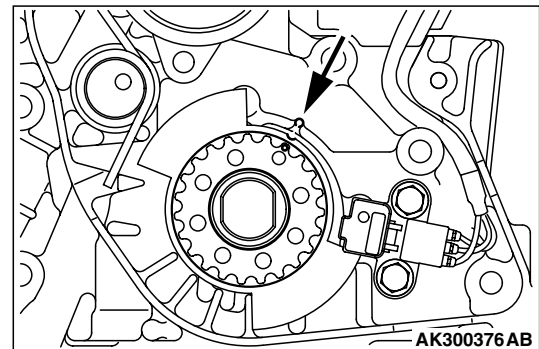


- Grip the other end of the tensioner spring projection and then hook it onto the front case lug as shown in the illustration.
- Move the timing belt tensioner in the direction shown and temporarily tighten the bolt.

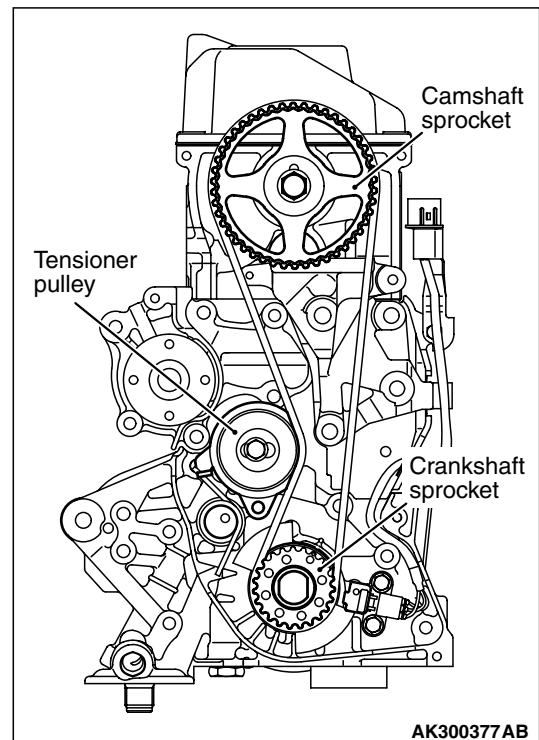
**>>D<< TIMING BELT INSTALLATION**



- Align the camshaft sprocket timing mark with the timing mark on the cylinder head.



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



- Keeping the tension side of the timing belt tight, fit the timing belt onto the crankshaft sprocket, camshaft sprocket and tensioner in that order.



4. Loosen the timing belt tensioner mounting bolt by 1/4 to 1/2 of a turn and allow the tensioner spring to apply tension to the timing belt.

**CAUTION**

This procedure utilizes the camshaft's driving torque to apply tension evenly to the timing belt. Be sure to turn the crankshaft as described above. Do not turn the crankshaft counter-clockwise.

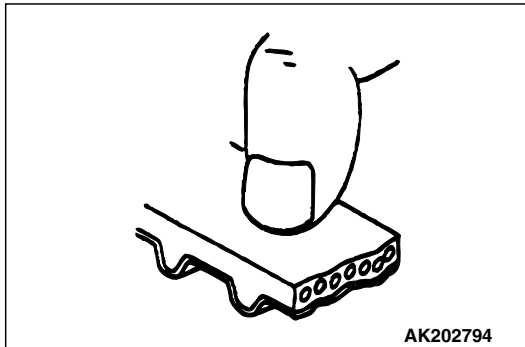
5. Turn the crankshaft twice clockwise and check that the all timing marks are correctly aligned.
6. Tighten the timing belt tensioner mounting bolt to the specified torque  $23 \pm 3$  N·m.

## INSPECTION

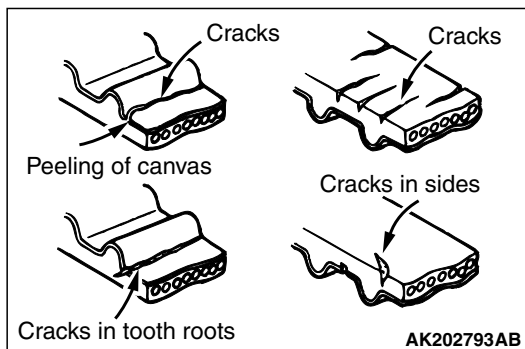
M1113002000414

### TIMING BELT

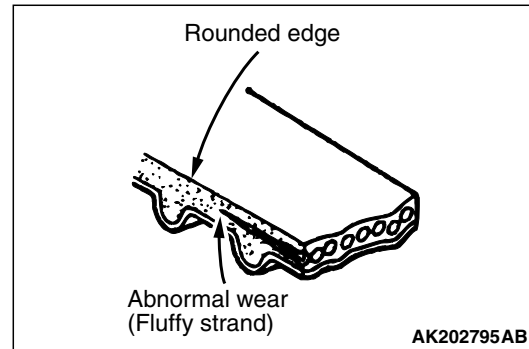
Check the timing belt closely. Replace the belt with a new one if any the following defects are evident:



1. Hardened backing rubber (the backing rubber is glossy, non-elastic, and so hard that scratching with fingernails leaves no mark).

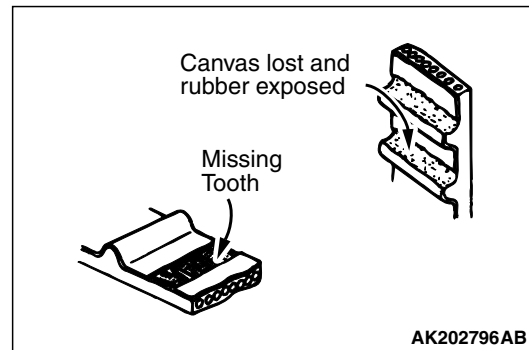


2. Surface cracks on the backing rubber.
3. Cracks or peeling of the canvas.
4. Cracks on the tooth bottom.
5. Cracks on the belt sides.



6. Abnormal wear on the belt sides.

*NOTE: The sides of the belt are normal if they are sharp as if cut by a knife.*



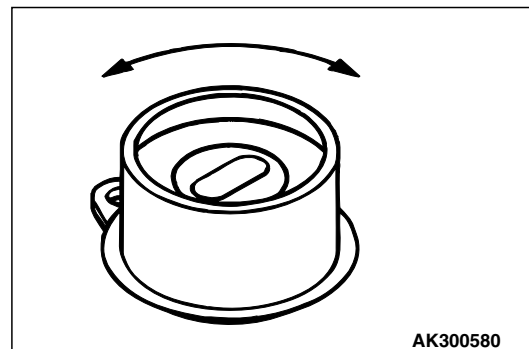
7. Abnormal wear on teeth.

**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 teeth.

### TIMING BELT TENSIONER

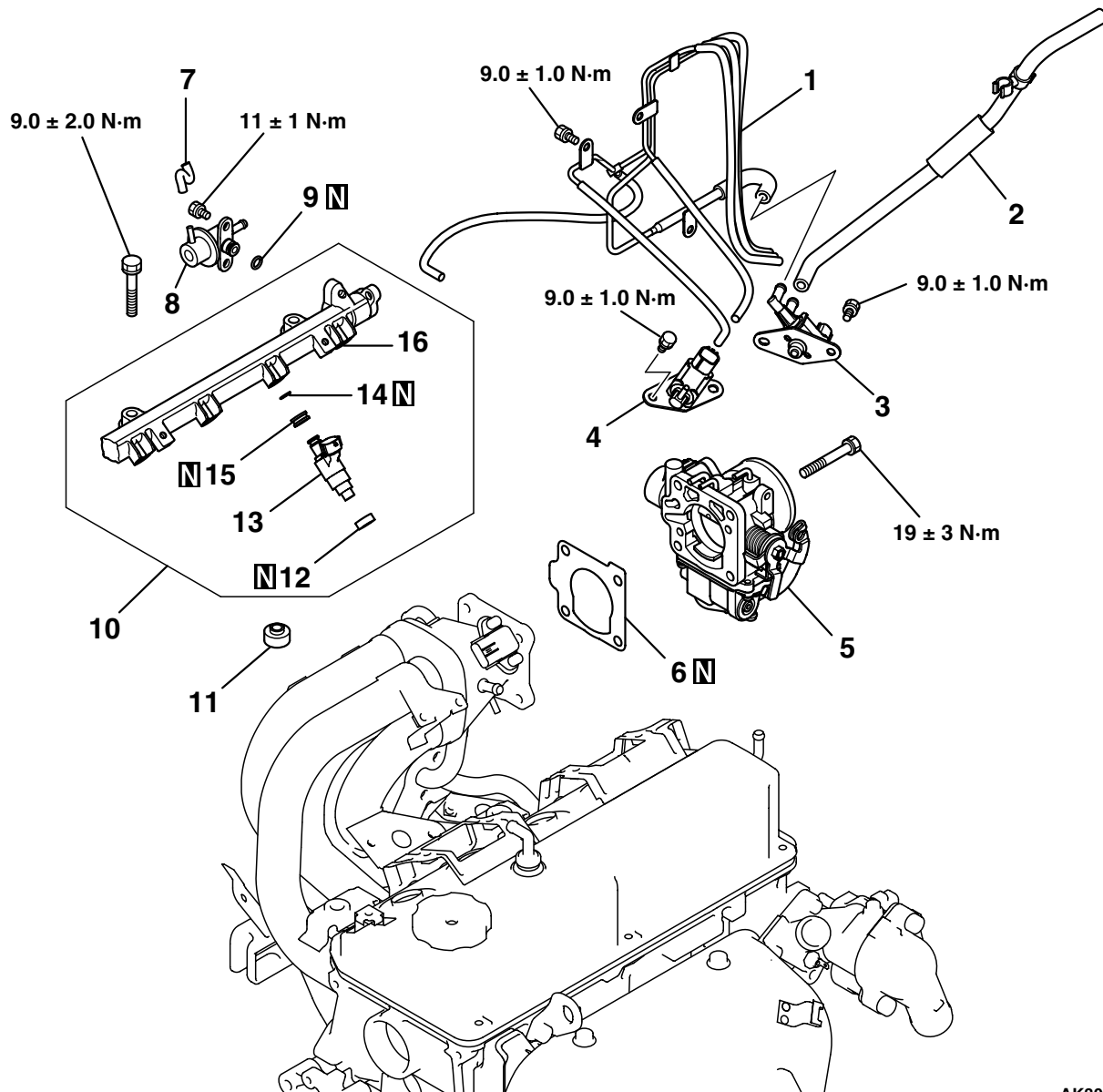


Check the pulley for smooth rotation without play and are not noisy.

## FUEL AND EMISSION PARTS

## REMOVAL AND INSTALLATION

M1113002200407



AK300364AB

## Removal steps

1. Vacuum pipe and hose
2. Purge hose
3. Solenoid valve
4. Solenoid valve
5. Throttle body assembly
- >>C<< 6. Gasket
- >>C<< 7. Vacuum hose
- >>B<< 8. Fuel pressure regulator

## Removal steps (Continued)

9. O-ring
10. Delivery pipe and injector
11. Insulator
12. Insulator
- >>A<< 13. Injector
14. O-ring
15. Grommet
16. Delivery pipe

## INSTALLATION SERVICE POINTS

### >>A<< INJECTOR INSTALLATION

1. Fit a new O-ring and grommet onto the injector.
2. Apply clean engine oil or gasoline to the injector O-ring.
3. Fit the injector onto the delivery pipe, turning it to the left and right as it goes in.

#### CAUTION

If the injector does not rotate smoothly, its O-ring may be binding. If this occurs, remove the injector from the delivery pipe, check the O-ring, and re-insert the injector.

4. Check that the injector rotates smoothly.

### >>B<< FUEL PRESSURE REGULATOR INSTALLATION

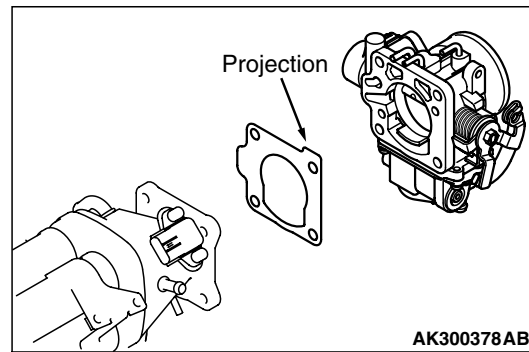
#### CAUTION

Do not let engine oil get into the delivery pipe.

1. Apply a drop of clean engine oil to the O-ring, then insert the fuel pressure regulator into the delivery pipe, being careful not to damage the O-ring.

2. Check that the fuel pressure regulator rotates smoothly. If it does not rotate smoothly, the O-ring may be binding. If this occurs, remove the fuel pressure regulator, check the O-ring for damage, then re-insert the regulator into the delivery pipe.

### >>C<< GASKET INSTALLATION

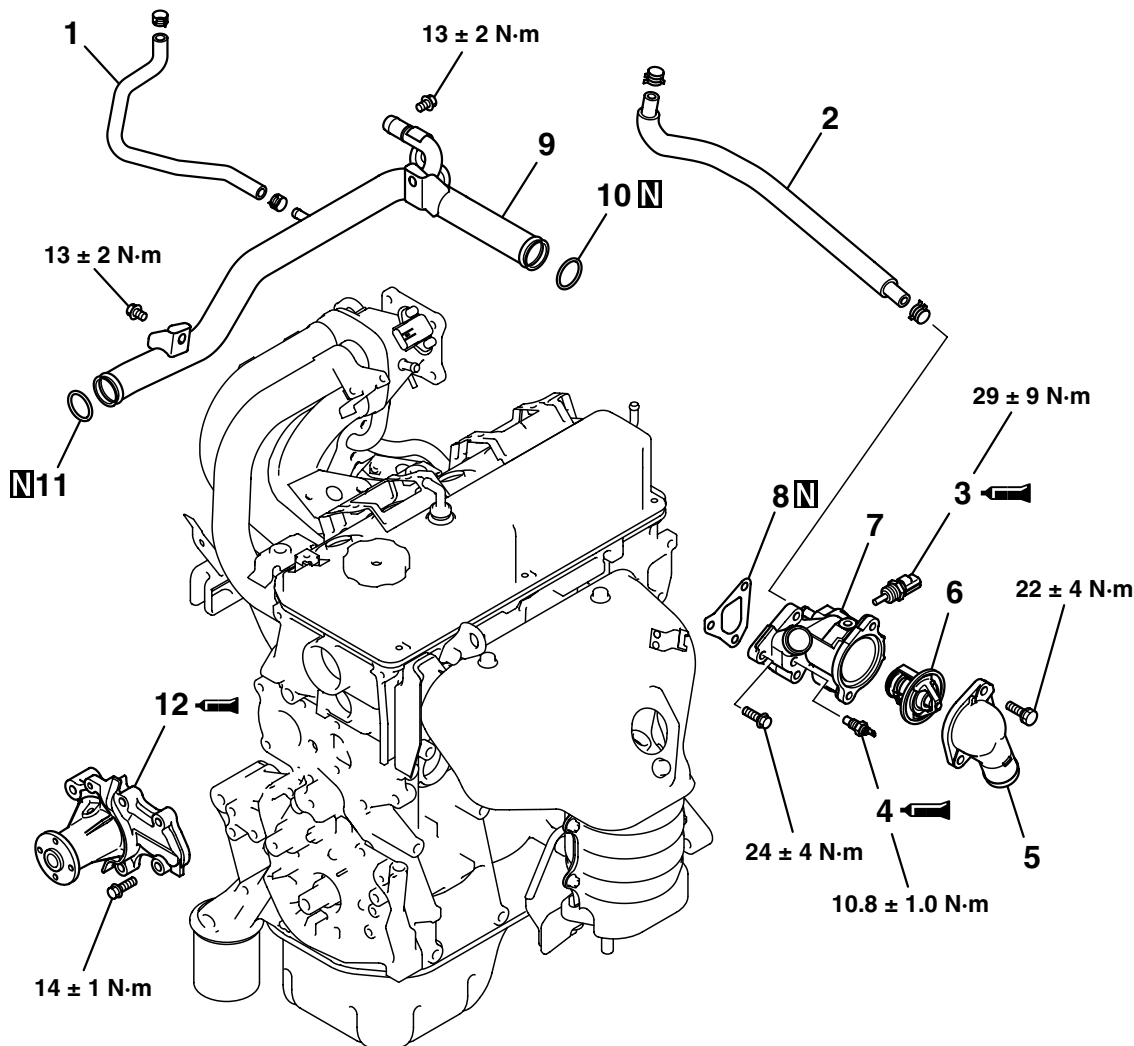


Position the projection as shown in the illustration.

# WATER PUMP AND WATER HOSE

## REMOVAL AND INSTALLATION

M1113017900275



AK300365AB

### Removal steps

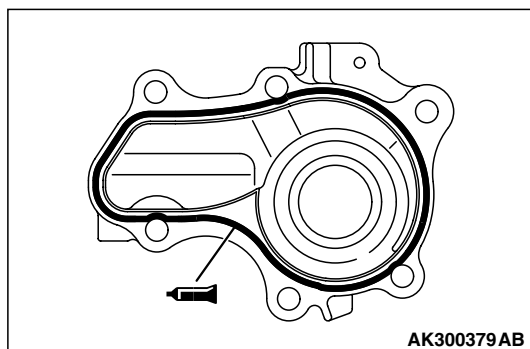
1. Water hose
2. Water hose
- >>E<< 3. Engine coolant temperature sensor
- >>D<< 4. Engine coolant temperature gauge unit
5. Water inlet fitting
- >>C<< 6. Thermostat

### Removal steps (Continued)

7. Thermostat case
8. Gasket
- >>B<< 9. Water inlet pipe
- >>B<< 10. O-ring
- >>B<< 11. O-ring
- >>A<< 12. Water pump

## INSTALLATION SERVICE POINTS

### >>A<< WATER PUMP INSTALLATION



1. Clean the sealant application surfaces of the water pump case and cylinder block.
2. Apply a 3 mmdiameter bead of sealant to the water pump.

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

3. After installation, wait at least one hour. Never start the engine or let coolant touch the adhesion surface during that time.

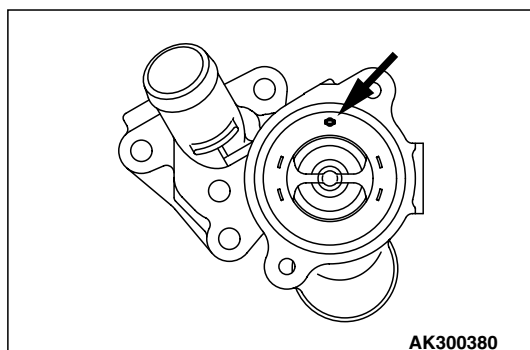
### >>B<< O-RING/WATER PIPE INSTALLATION

#### CAUTION

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

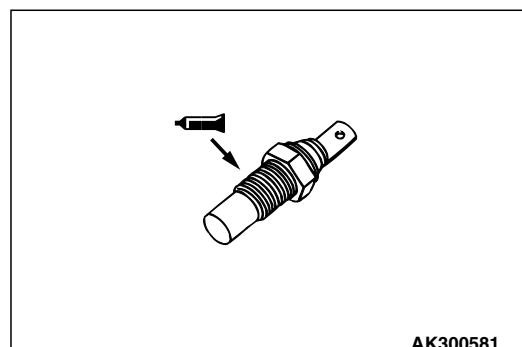
Replace the water inlet pipe O-ring with new ones, then apply water to the O-rings so that they can be inserted easily into the cylinder block and thermostat case.

### >>C<< THERMOSTAT INSTALLATION



Install the thermostat so that the jiggle valve is at the top.

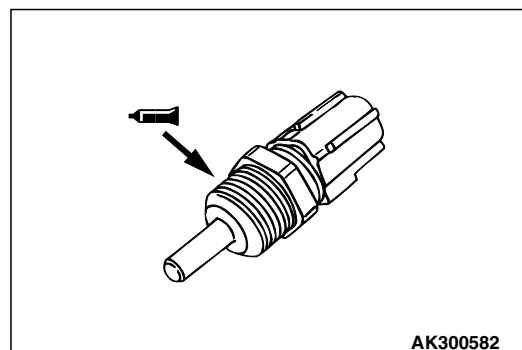
### >>D<< ENGINE COOLANT TEMPERATURE GAUGE UNIT INSTALLATION



1. When reusing the gauge unit, clean its thread.
2. Apply sealant to the indicated threads of the coolant temperature gauge unit.

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

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



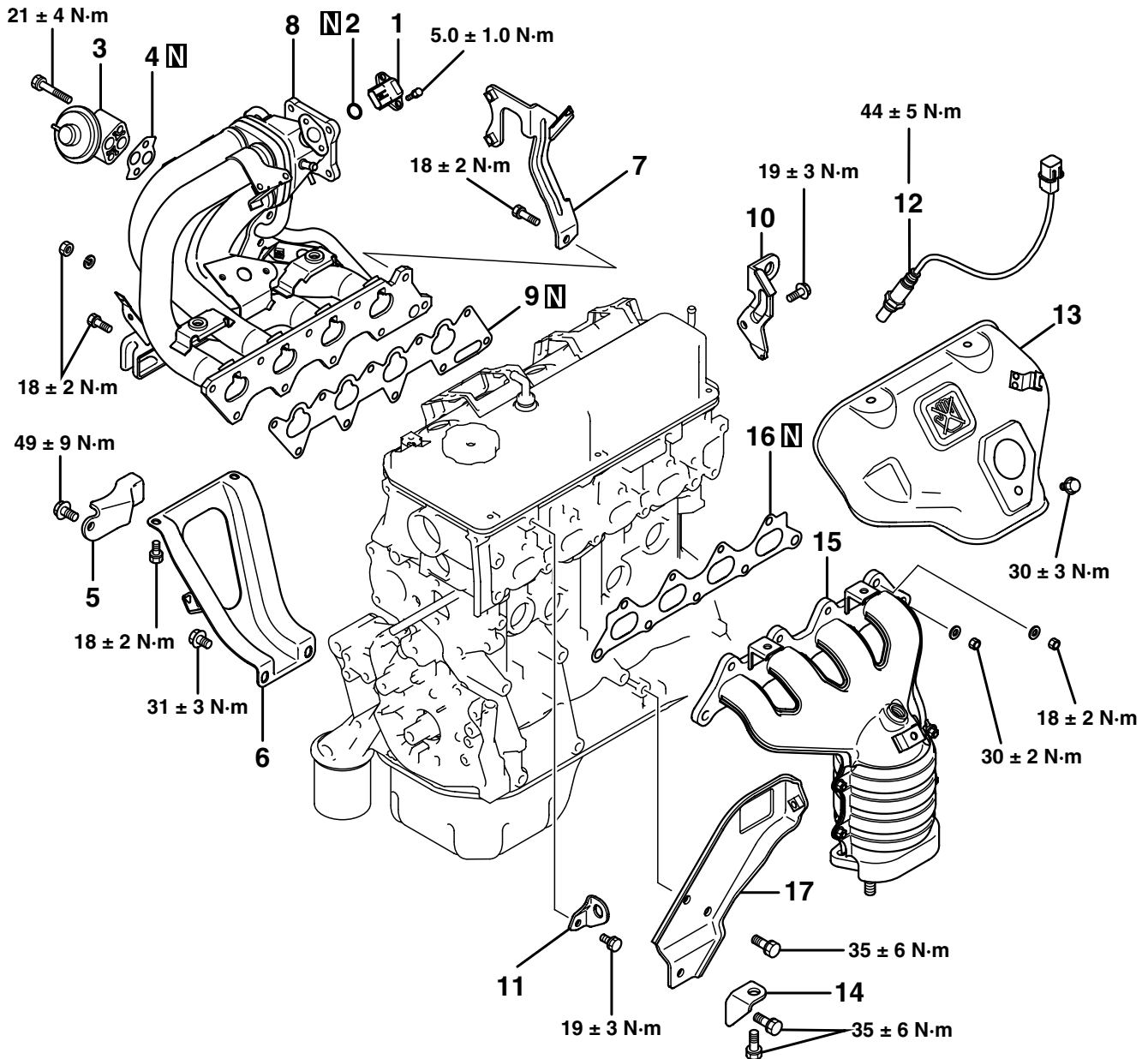
1. When reusing the sensor, clean its thread.
2. Apply sealant to the coolant temperature sensor's threads indicated in the drawing.

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

## INTAKE AND EXHAUST MANIFOLDS

## REMOVAL AND INSTALLATION

M1113017500103



AK300366 AB

**Removal steps**

1. Boost sensor
2. O-ring
3. EGR valve
4. EGR gasket
5. Power plant stay right
6. Intake manifold stay
7. Throttle body stay
8. Intake manifold
9. Intake manifold gasket

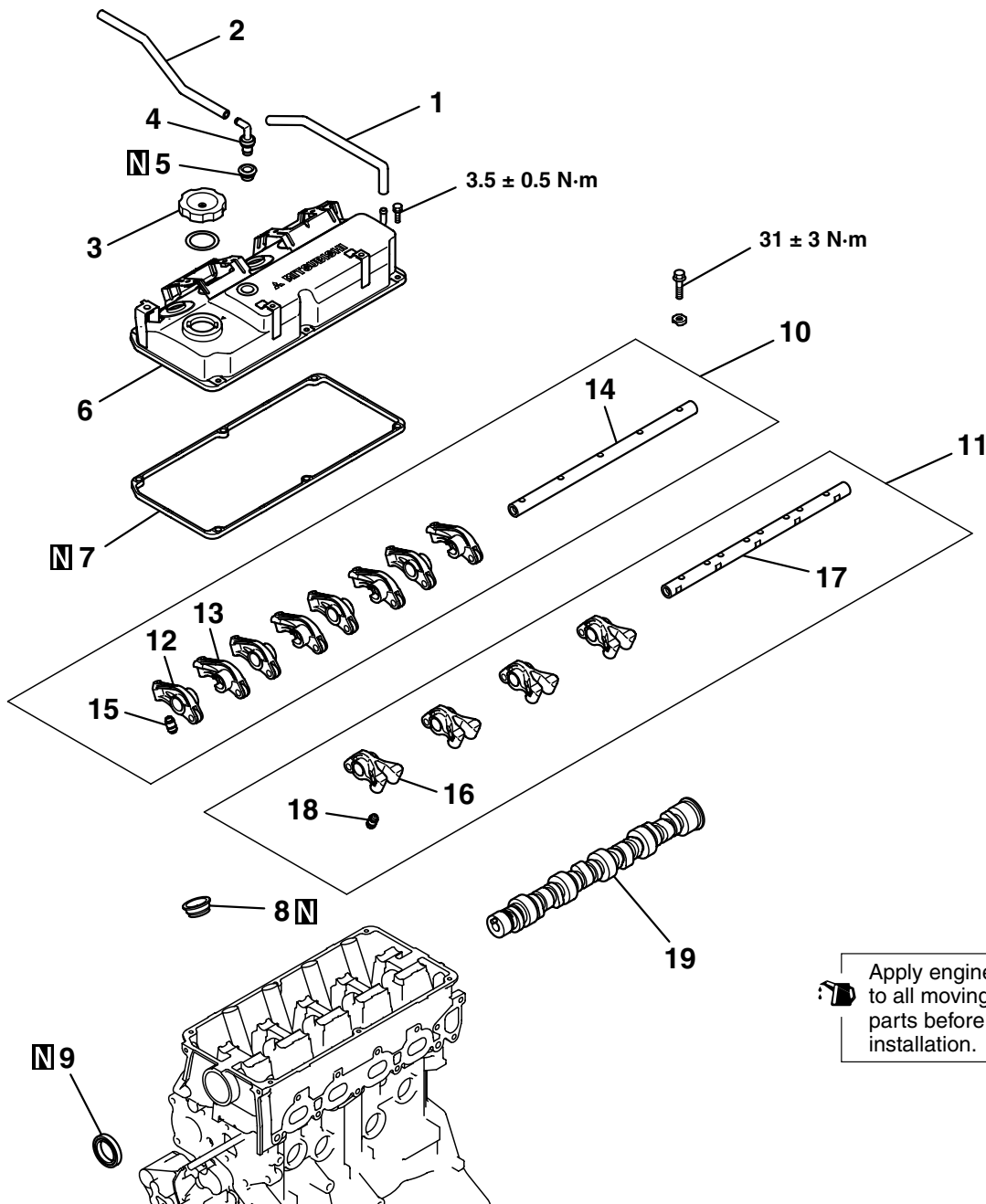
**Removal steps (Continued)**

10. Solenoid valve assembly
11. Engine hanger
12. Engine hanger
13. Oxygen sensor
14. Exhaust manifold cover
15. Exhaust manifold bracket A
16. Exhaust manifold
17. Exhaust manifold gasket
18. Power plant stay left

# ROCKER ARMS AND CAMSHAFT

## REMOVAL AND INSTALLATION

M1113005400507



Apply engine oil  
to all moving  
parts before  
installation.

AK300367AB

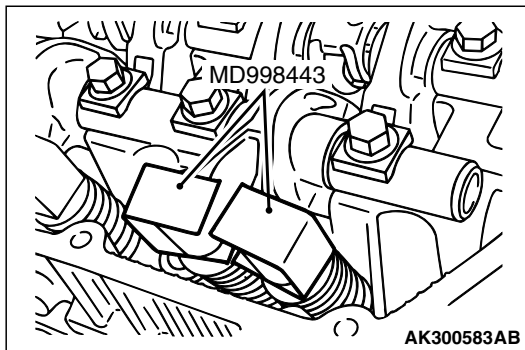
### Removal steps

1. Breather hose
2. PCV hose
3. Oil filler cap
4. PCV valve
5. PCV valve gasket
6. Rocker cover
7. Rocker cover gasket
8. Oil seal
- >>D<< 9. Camshaft oil seal
- <<A>> >>C<< 10. Rocker arms and shaft

### Removal steps (Continued)

- <<A>> >>C<< 11. Rocker arms and shaft
12. Rocker arm a
13. Rocker arm b
- >>B<< 14. Rocker arm shaft
- >>A<< 15. Lash adjuster
16. Rocker arm c
- >>B<< 17. Rocker arm shaft
- >>A<< 18. Lash adjuster
19. Camshaft

## REMOVAL SERVICE POINTS

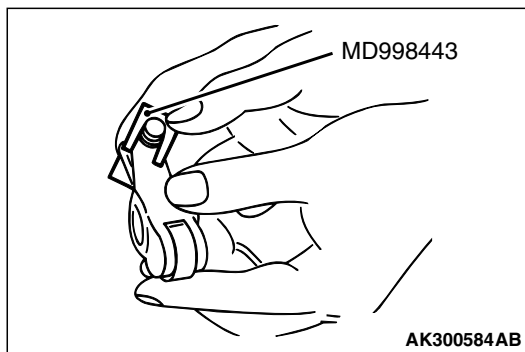
<<A>> ROCKER ARM AND ROCKER ARM SHAFT  
REMOVAL**CAUTION**

If the lash adjuster is re-used, clean the lash adjuster. (Refer to [P.11B-25](#))

Set special tool Lash adjuster holder (MD998443) to prevent the lash adjuster coming free and falling to the floor.

## INSTALLATION SERVICE POINT

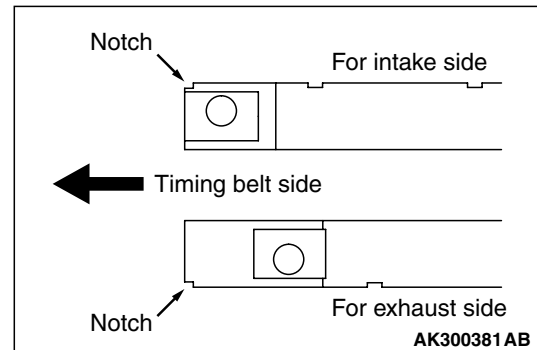
## &gt;&gt;A&lt;&lt; LASH ADJUSTER INSTALLATION

**CAUTION**

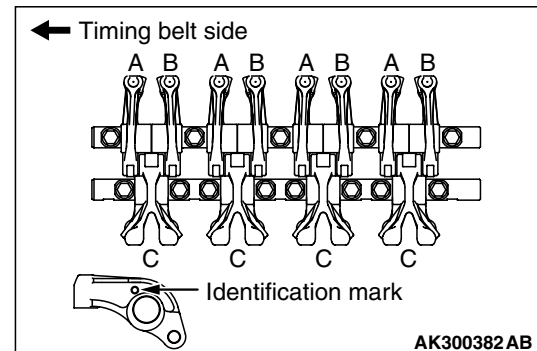
If the lash adjuster is re-used, clean the lash adjuster. (Refer to [P.11B-25](#))

Fit the lash adjuster onto the rocker arm without allowing diesel fuel to spill out. Fit special tool Lash adjuster holder (MD998443) to prevent the lash adjuster coming free and falling to the floor.

## &gt;&gt;B&lt;&lt; ROCKER ARM SHAFT INSTALLATION

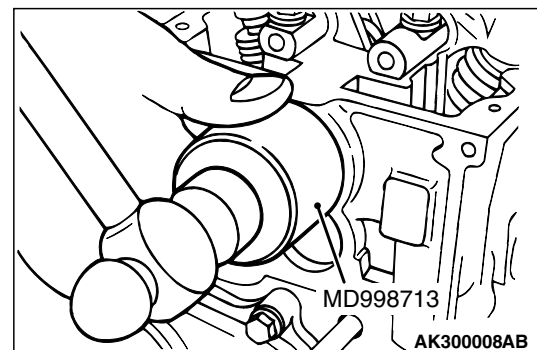


Install the rocker arm shafts, place the end with notched side toward the timing belt side as shown.

>>C<< ROCKER ARM/ROCKER SHAFT  
ASSEMBLY INSTALLATION

Assembly the rocker arms and rocker shaft, paying attention to the identification marks. Then mount the assembly on the cylinder head.

## &gt;&gt;D&lt;&lt; CAMSHAFT OIL SEAL INSTALLATION



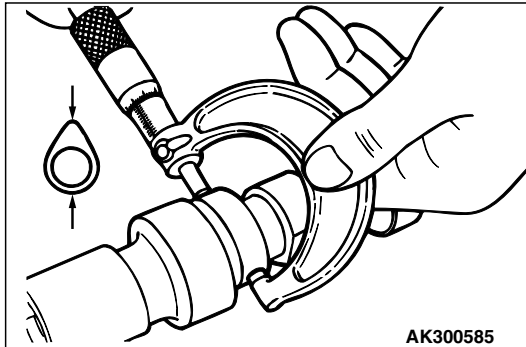
Use special tool Camshaft oil seal installer (MD998713) to install the camshaft oil seal.



## INSPECTION

### CAMSHAFT

M1113005500430



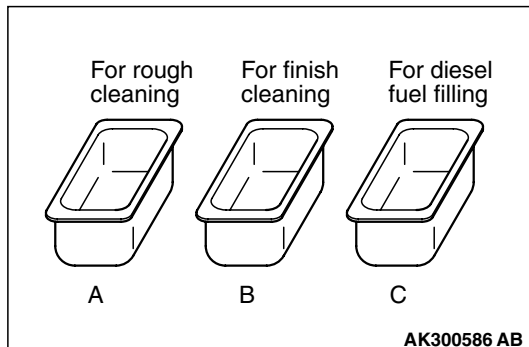
Measure the cam height and replace the camshaft if any height exceeds the specified limit.

Item		Standard value mm	Limit mm
Intake	4G13	36.86	36.36
	4G18	37.17	36.67
Exhaust	4G13	36.68	36.18
	4G18	36.99	36.49

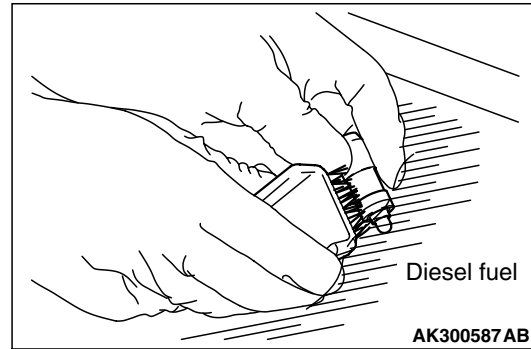
### LASH ADJUSTERS

#### ⚠ CAUTION

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

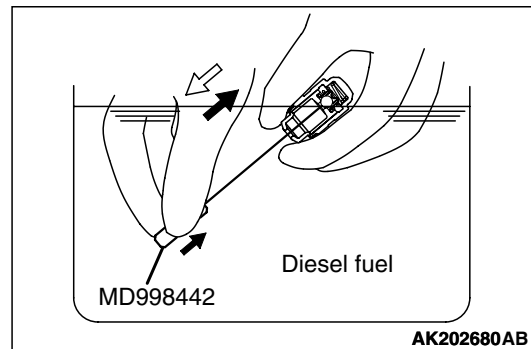


- Prepare three containers and approximately 5 dm<sup>3</sup> of diesel fuel. Into each container, pour enough diesel fuel to completely cover a lash adjuster when it is standing upright. Then, perform the following steps with each lash adjuster.



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

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

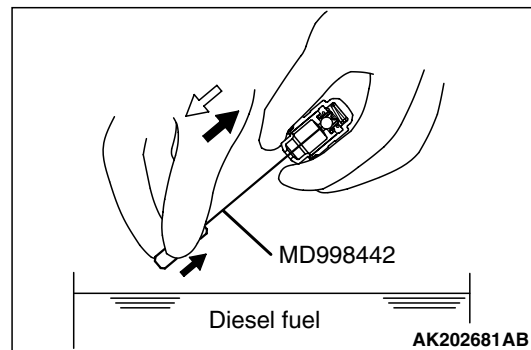


#### ⚠ CAUTION

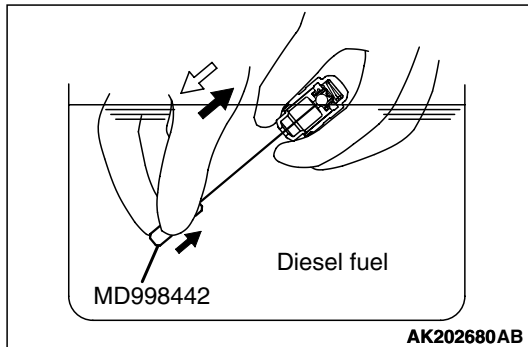
The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.

- While gently pushing down the internal steel ball using wire [0.5 mm in diameter] or special tool Air bleed wire (MD998442), move the plunger through 5 to 10 strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will remove dirty oil.

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



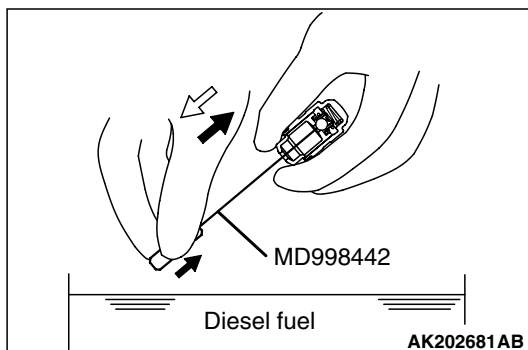
4. Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.



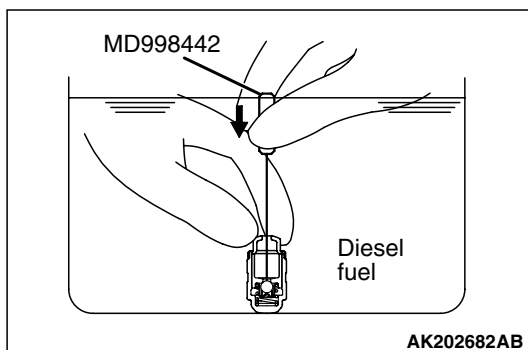
**CAUTION**

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

5. Place the lash adjuster in container B. Then, gently push down the internal steel ball using wire [0.5 mm in diameter] or special tool and move the plunger through 5 to 10 strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.



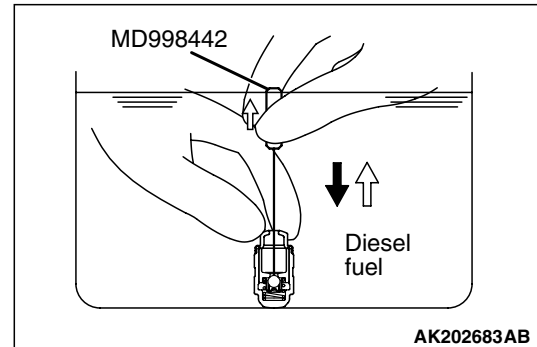
6. Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.



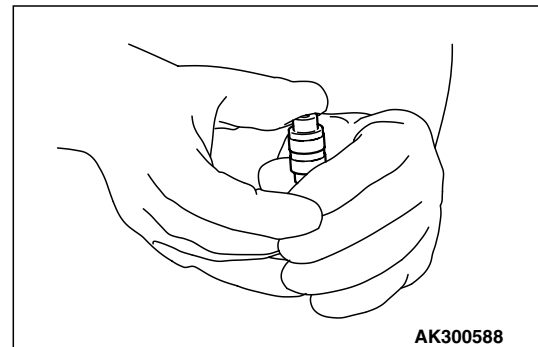
**CAUTION**

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

7. Place the lash adjuster in container C. Then, gently push down the internal steel ball using wire [0.5 mm in diameter] or special tool.



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



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

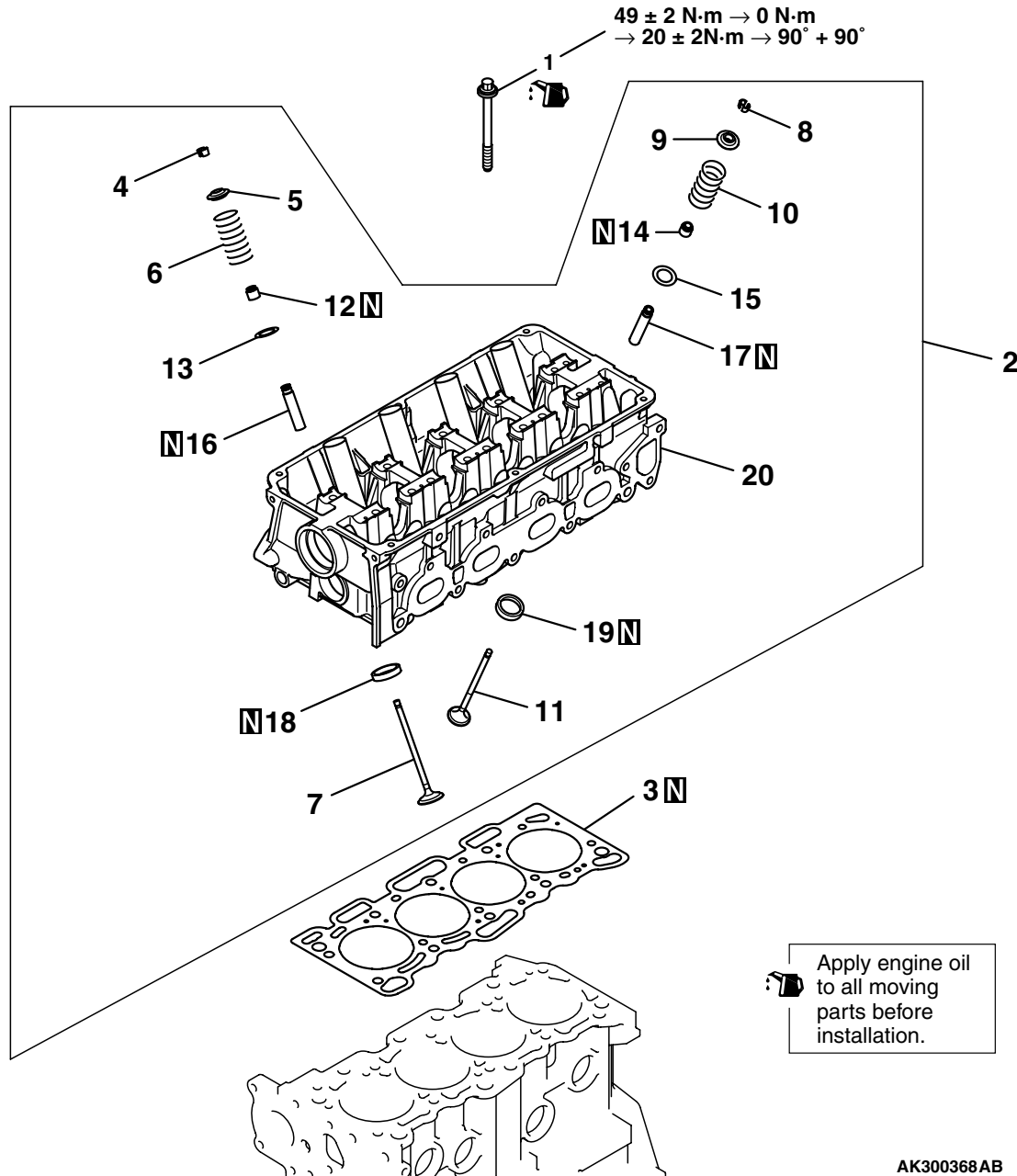
*NOTE: If lash adjuster contracts, perform the operations (7) through (9) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts after performing these steps.*

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

# CYLINDER HEAD AND VALVES

## REMOVAL AND INSTALLATION

M1113006900431



AK300368AB

### Removal steps

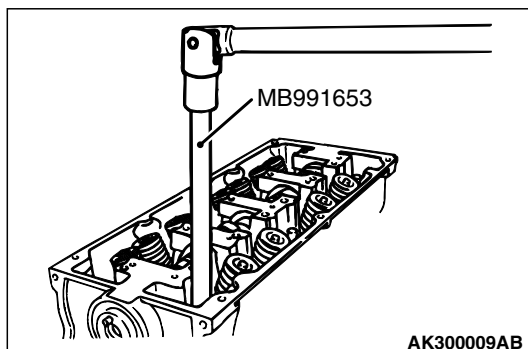
- <<A>> >>D<< 1. Cylinder head bolt  
2. Cylinder head assembly  
3. Cylinder head gasket  
<<B>> >>C<< 4. Retainer lock  
5. Valve spring retainer  
    >>B<< 6. Valve spring  
7. Exhaust valve  
<<B>> >>C<< 8. Retainer lock  
9. Valve spring retainer  
    >>B<< 10. Valve spring

### Removal steps (Continued)

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

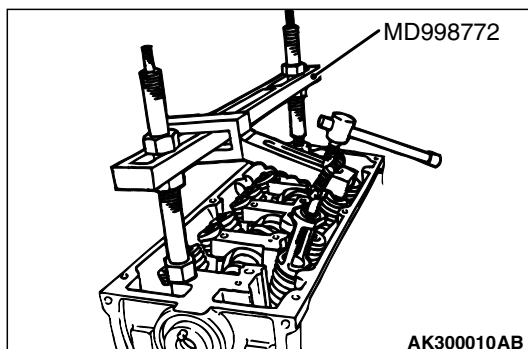
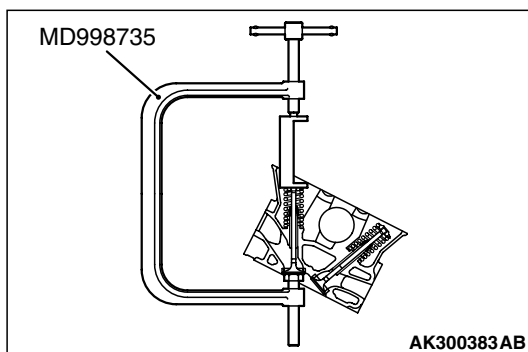
## REMOVAL SERVICE POINTS

## &lt;&lt;A&gt;&gt; CYLINDER HEAD BOLT REMOVAL



Using the special tool Cylinder head bolt wrench (MB991653) to loosen the cylinder head bolts.

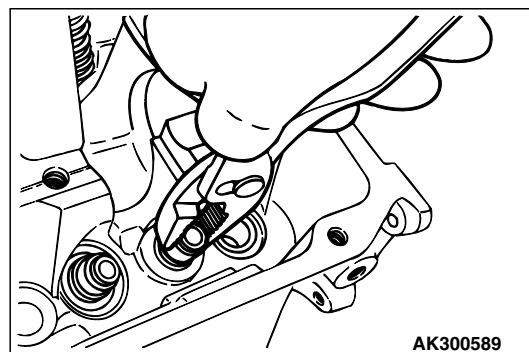
## &lt;&lt;B&gt;&gt; RETAINER LOCK REMOVAL



1. Using special tool, compress the retainer locks.
  - Valve spring compressor (MD998735)
  - Valve spring compressor (MD998772)
2. Remove the retainer locks.

*NOTE: Tag removed valves, springs and other components, noting their cylinder numbers and locations to facilitate reassembly. Store these components safely.*

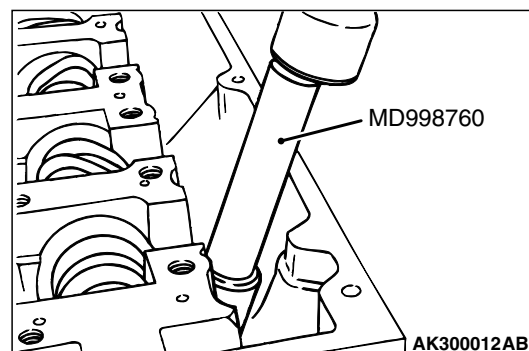
## &lt;&lt;C&gt;&gt; VALVE STEM SEAL REMOVAL



Do not reuse removed valve stem seal.

## INSTALLATION SERVICE POINTS

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

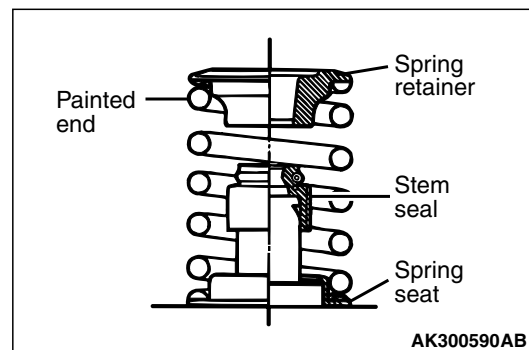


1. Install the valve spring seat.

**CAUTION**

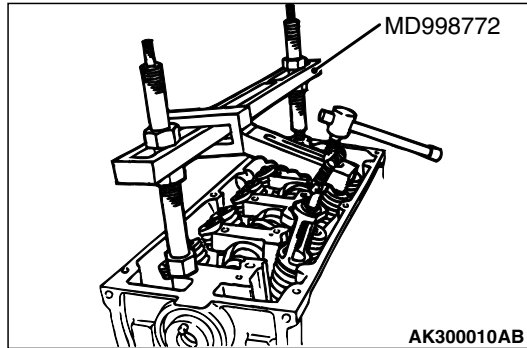
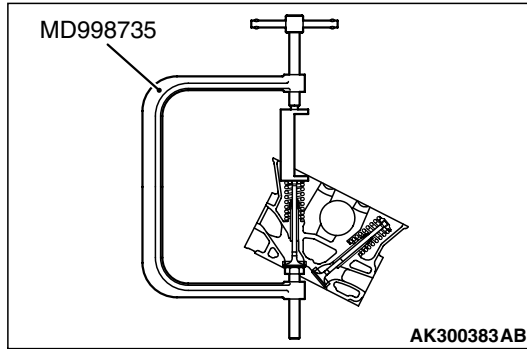
- Do not reuse the removed valve stem seals.
  - The valve stem seal must be installed using the correct special tool. Incorrect installation could result in oil leaking past the valve guide.
2. Using special tool Valve stem seal installer (MD998760), install a new stem seal to the valve guide.

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



Install the valve spring so that the painted end is on the rocker arm side.

## >>C<< RETAINER LOCK INSTALLATION

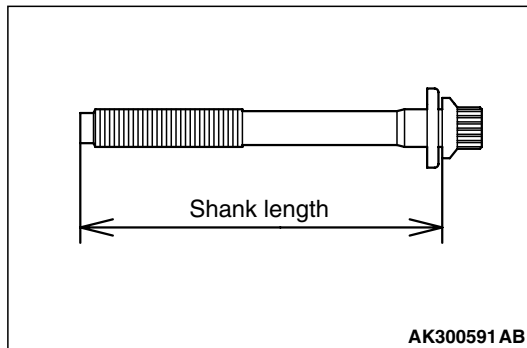


Using special tool, compress the valve spring and insert the retainer lock into position.

- Valve spring compressor (MD998735)
- Valve spring compressor (MD998772)

**NOTE:** The valve spring, if excessively compressed, causes the bottom end of retainer to be in contact with the stem seal, and damage it.

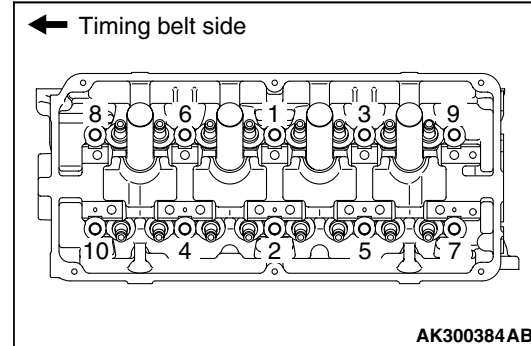
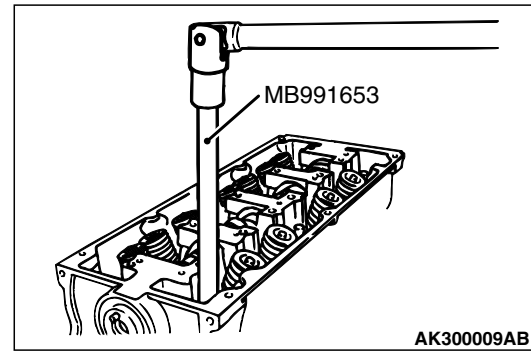
## >>D<< CYLINDER HEAD BOLT INSTALLATION



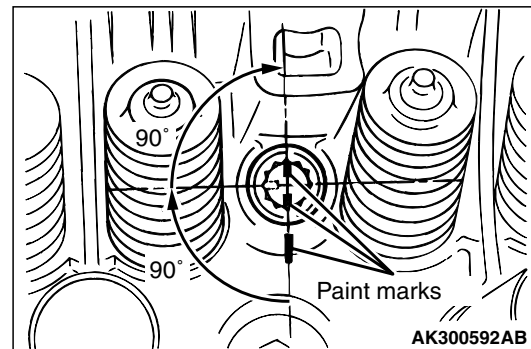
1. When reusing the cylinder head bolt, measure that its nominal length does not exceed the specified limit. Replace the bolt if this measurement exceeds the limit.

**Limit: Max. 103.2 mm**

2. Apply engine oil to the bolt thread and washer.



3. Tighten the bolts in the sequence shown until each is torqued to 49 N·m using the special tool Cylinder head bolt wrench (MB991653).
4. Loosen all bolts fully.
5. Retighten the bolts in the sequence shown until each is torqued to 20 N·m.



6. Make paint marks on the cylinder head bolt heads and cylinder head as shown.
7. In accordance with the tightening sequence, tighten each bolt by 90°.

### **CAUTION**

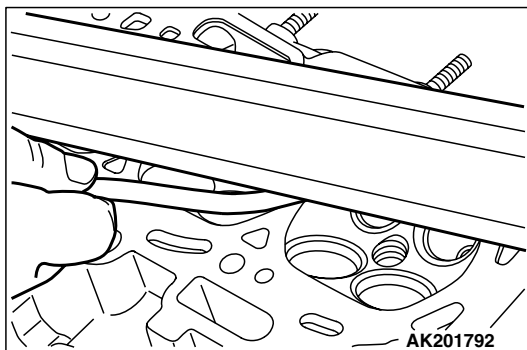
**If the bolts are tightened by an angle of less than 90°, they may not hold the cylinder head with sufficient strength. If the bolts are tightened by an angle exceeding 90°, completely remove them and carry out the installation procedure again.**

8. Tighten each bolt by a further 90° and check that the paint marks on the bolt head and cylinder head are aligned.

## INSPECTION

## CYLINDER HEAD

M1113007000420



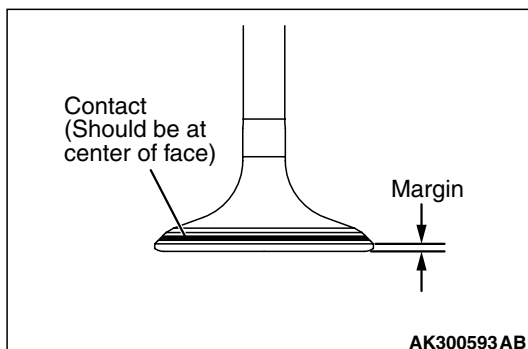
1. Before cleaning the cylinder head, check it for water leaks, gas leaks, cracks, and other damage.
2. Remove all oil, water scale, sealant, and carbon. After cleaning the oil passages, blow air through them to verify that they are not blocked.
3. Check the cylinder head gasket surface for flatness by using a straight edge and feeler gauge.

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

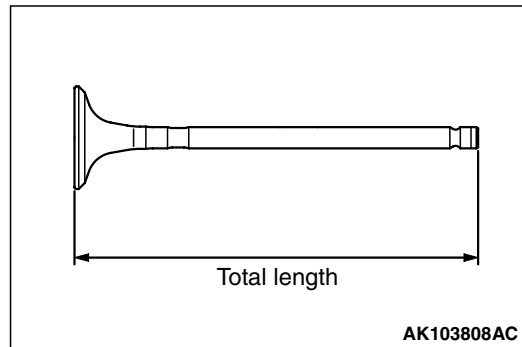
4. If flatness exceeds the specified limit, grind the gasket surface to specification.

**Grinding limit: \*0.2 mm****\*Includes/combined with cylinder block grinding.****Cylinder head height (Specification when new):****119.9 – 120.1 mm**

## VALVES



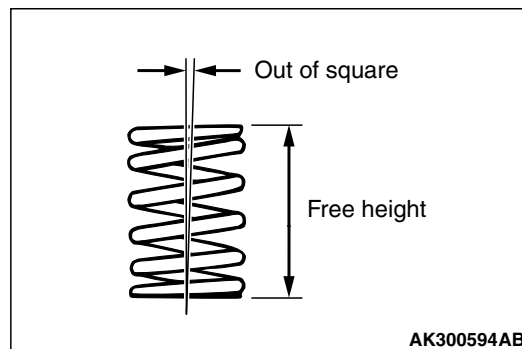
1. Check the valve face for correct contact. If contact is uneven or incomplete, reface the valve seat.
2. If the margin is less than specified, replace the valve.

**Standard value:****Intake: 1.0 mm****Exhaust: 1.5 mm****Limit:****Intake: 0.5 mm****Exhaust: 1.0 mm**

3. Measure the valve length. If the measurement is less than specified, replace the valve.

**Standard value:****Intake: 111.56 mm****Exhaust: 114.71 mm****Limit:****Intake: 111.06 mm****Exhaust: 114.21 mm**

## VALVE SPRING



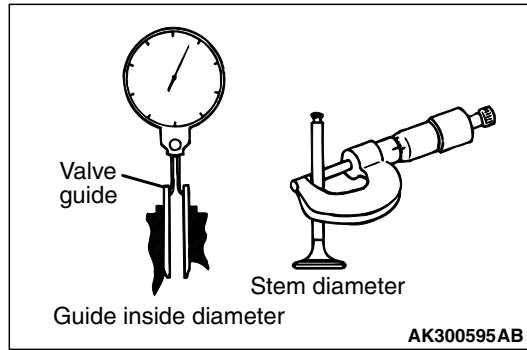
1. Measure the valve spring free height. If the measurement is less than specified, replace spring.

**Standard value: 50.87 mm****Limit: 49.87 mm**

2. Measure the squareness of the spring. If the measurement is less than specified, replace the spring.

**Standard value: 2° or less****Limit: 4°**

## VALVE GUIDES



Measure the clearance between the valve guide and valve stem. If the clearance exceeds the specified limit, replace the valve guide and/or valve.

### Standard value:

**Intake:** 0.020 – 0.047 mm

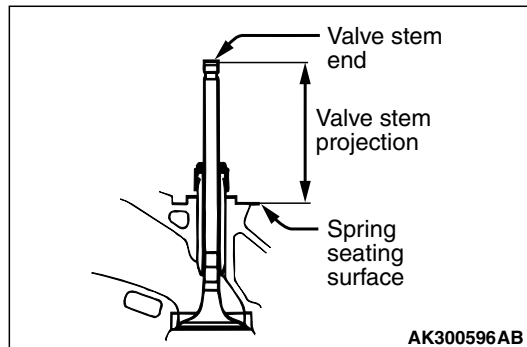
**Exhaust:** 0.030 – 0.057 mm

### Limit:

**Intake:** 0.10 mm

**Exhaust:** 0.15 mm

## VALVE SEATS



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:** 53.21 mm

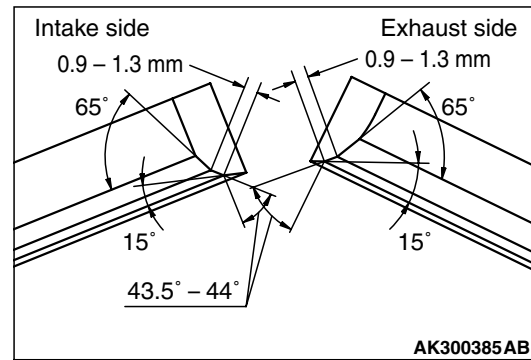
**Exhaust:** 54.10 mm

### Limit:

**Intake:** 53.71 mm

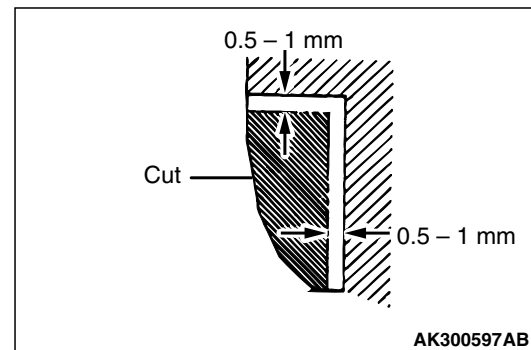
**Exhaust:** 54.60 mm

## VALVE SEAT RECONDITIONING PROCEDURE

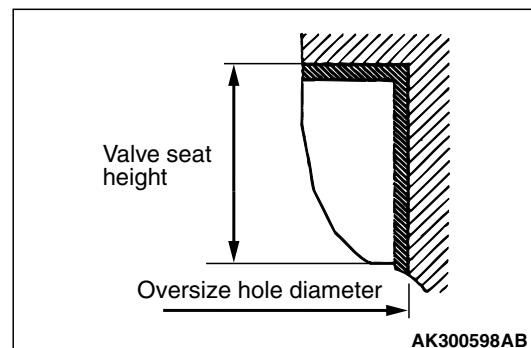


1. Before correcting the valve seat, check the clearance between the valve guide and valve. If necessary, replace the valve guide.
2. Using the appropriate special tool or seat grinder, correct the valve seat to achieve the specified seat width and angle.
3. After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection (refer to VALVE SEAT IN INSPECTION).

## VALVE SEAT REPLACEMENT PROCEDURE



1. Cut the valve seat to be replaced from the inside to reduce the wall thickness. Then, remove the valve seat.



2. Rebore the valve seat hole in the cylinder head to match the selected oversize valve seat diameter.

**Intake valve seat hole diameter**

**0.3 oversize: 30.30 – 30.32 mm**

**0.6 oversize: 30.60 – 30.62 mm**

**Exhaust valve seat hole diameter**

**0.3 oversize: 28.30 – 28.32 mm**

**0.6 oversize: 28.60 – 28.62 mm**

3. Prevent galling of the cylinder head bore by cooling the valve seat with liquid nitrogen before press-fitting it.
4. Correct the valve seat to achieve the specified width and angle (refer to VALVE SEAT RECONDITIONING PROCEDURE).

## VALVE GUIDE REPLACEMENT PROCEDURE

1. Using a press, push the valve guide out toward the cylinder block side.

### CAUTION

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

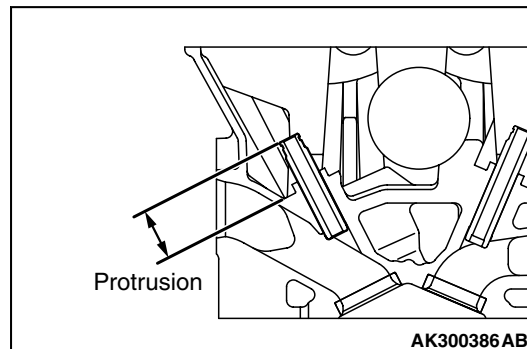
2. Rebore the valve guide hole in the cylinder head to match the oversize valve guide that is to be fitted.

**Valve guide hole diameters in cylinder head**

**0.05 oversize: 10.55 – 10.57 mm**

**0.25 oversize: 10.75 – 10.77 mm**

**0.50 oversize: 11.00 – 11.02 mm**



### CAUTION

1. The valve guide must be installed from the upper side of the cylinder head.
2. The valve guides differ in length on the intake and exhaust sides.

**Valve guide length**

**Intake: 48 mm**

**Exhaust: 55 mm**

3. Press-fit the valve guide until it projects by the specified amount.

**Standard value: 22.7 – 23.3 mm**

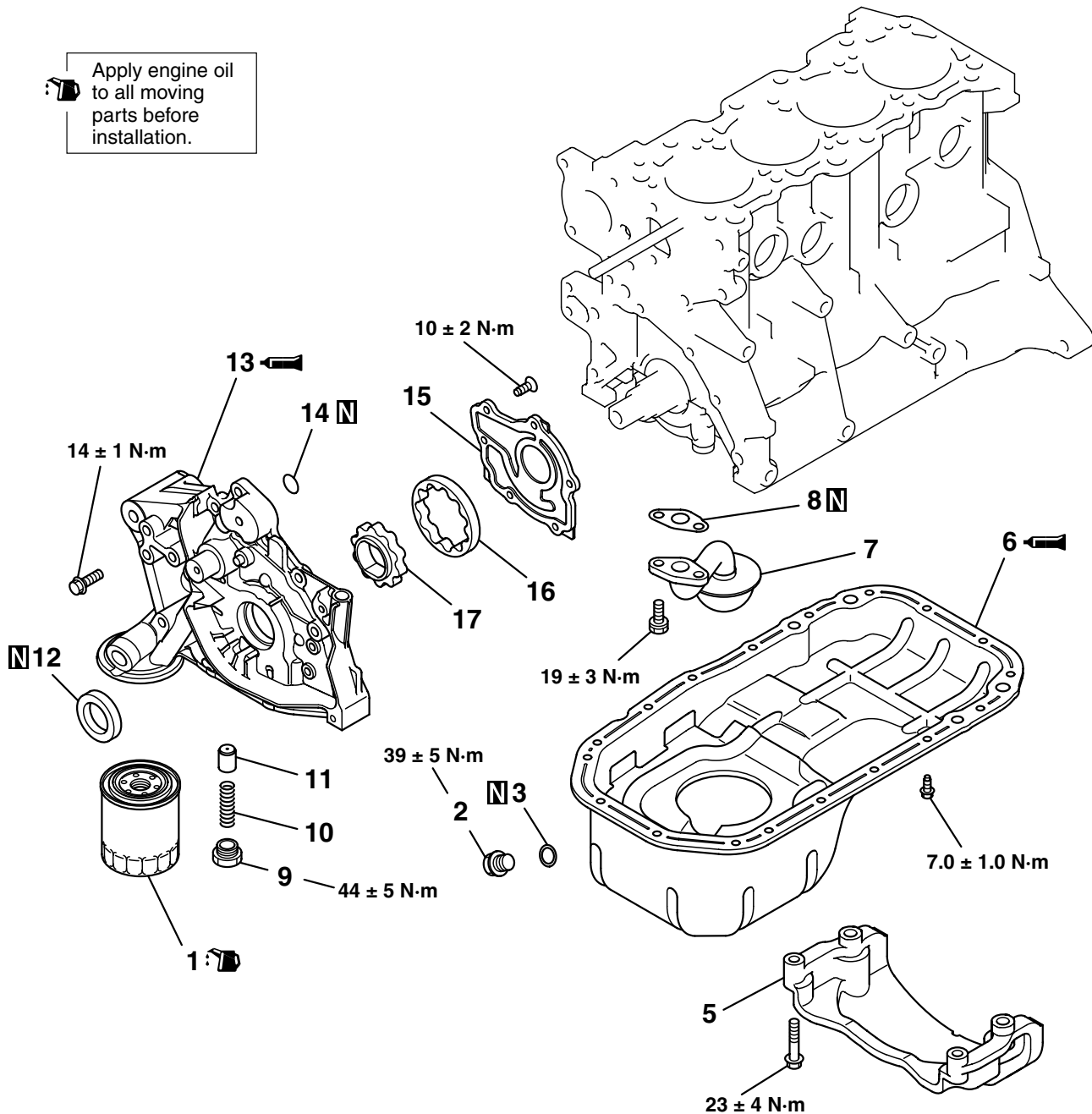
4. After press-fitting the valve guide, insert a new valve and check that it slides smoothly.



## REMOVAL AND INSTALLATION



Apply engine oil to all moving parts before installation.



## Removal steps

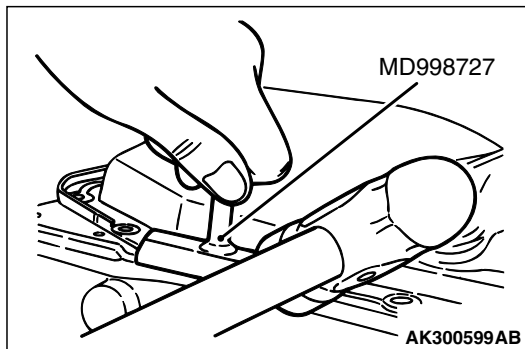
- >>E<< 1. Oil filter  
2. Drain plug  
>>D<< 3. Gasket  
4. Transmission stay  
<<A>> >>C<< 5. Oil pan  
6. Oil screen  
7. Gasket  
8. Relief plug

### Removal steps (Continued)

- 9. Relief plug spring
- 10. Relief plunger
- >>**B**<< 11. Front oil seal
- >>**A**<< 12. Oil pump case
- 13. O-ring
- 14. Oil pump cover
- 15. Oil pump cover rotor
- 16. Oil pump inner rotor

## REMOVAL SERVICE POINTS

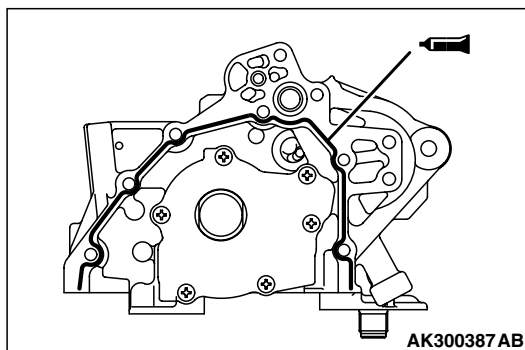
## &lt;&lt;A&gt;&gt; OIL PAN REMOVAL



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

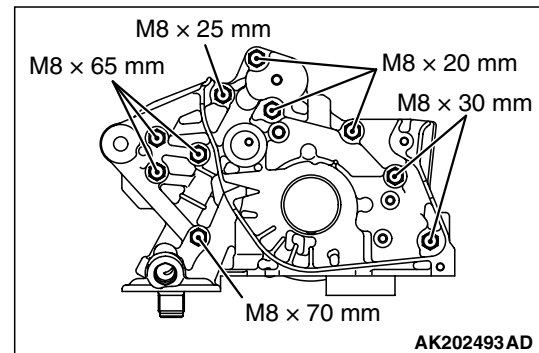
## INSTALLATION SERVICE POINTS

## &gt;&gt;A&lt;&lt; OIL PUMP CASE INSTALLATION



1. Clean the sealant application surfaces on the cylinder block and oil pump case.
2. Apply a 3 mm diameter bead of sealant to the oil pump case.

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



## ⚠ CAUTION

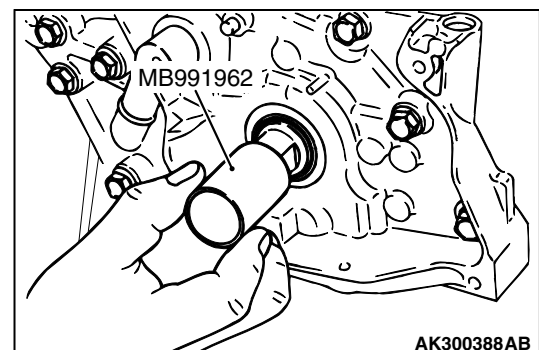
**Carefully install the tightening bolts because of the different length respectively.**

3. Tighten the oil pump case bolts to the specified torque.

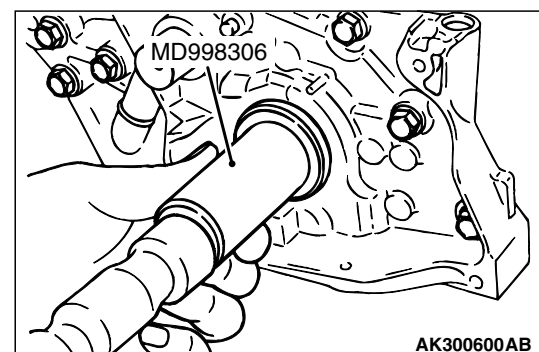
**Tightening torque:  $14 \pm 1$  N·m**

4. After installation, wait at least one hour. Never start the engine or let engine oil touch the adhesion surface during that time.

## &gt;&gt;B&lt;&lt; FRONT OIL SEAL INSTALLATION

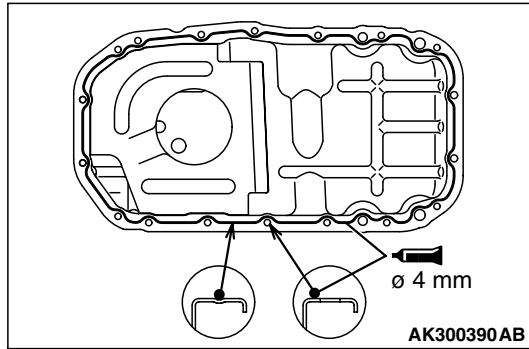


1. Place the special tool Crankshaft front oil seal guide (MB9919602) on the crankshaft front end and apply engine oil to the its outer diameter.



2. Apply engine oil to the oil seal lip, then push the oil seal along the guide by hand until it touches the front case. Tap the oil seal into place using the special tool Camshaft oil seal installer (MD998306).

## >>C<< OIL PAN INSTALLATION



1. Clean the mating surfaces of the oil pan and cylinder block.
2. Apply a 4 mm diameter bead of sealant to the oil pan.

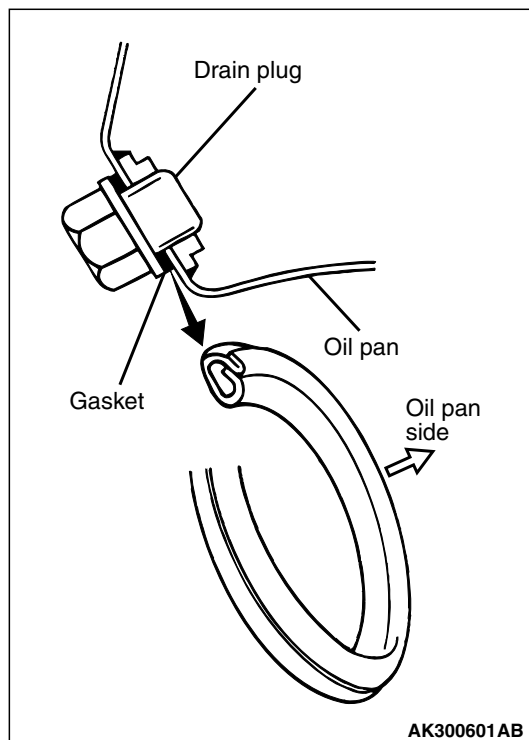
**Specified sealant:**  
**Mitsubishi Genuine Part No.MD970389 or equivalent**

3. Tighten the oil pan bolts to specified torque.

*NOTE: Install the oil pan within 15 minutes after applying liquid gasket.*

*NOTE: Then wait at least one hour. Never start the engine or let engine oil or coolant touch the adhesion surface during that time.*

## >>D<< DRAIN PLUG GASKET INSTALLATION



### ⚠ CAUTION

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

Replace the drain plug gasket with a new one. Fit the new gasket as shown.

## >>E<< OIL FILTER INSTALLATION

1. Clean the filter mounting surface on the oil pump case.
2. Apply clean engine oil to the O-ring of the oil filter.

### ⚠ CAUTION

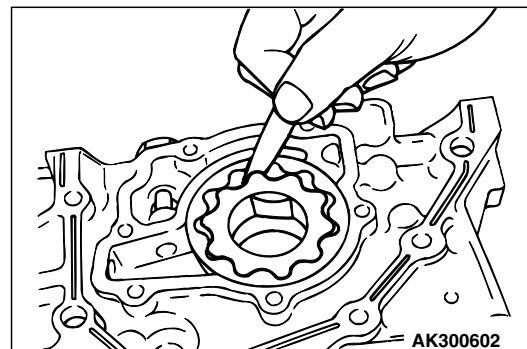
The oil filter must be tightened to the specified torque using a commercially available filter wrench. If the filter is tightened by hand only, it will be insufficiently torqued, resulting in oil leaks.

3. Screw on the oil filter until the O-ring is seated on the mounting surface.

## INSPECTION

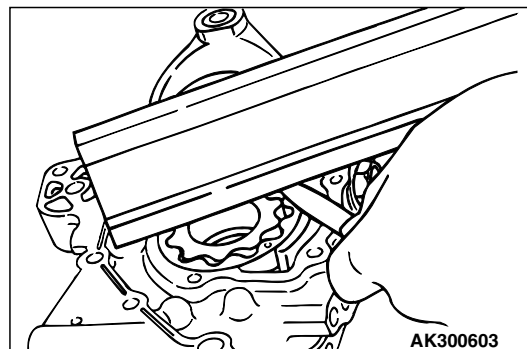
M1113008200256

### OIL PUMP



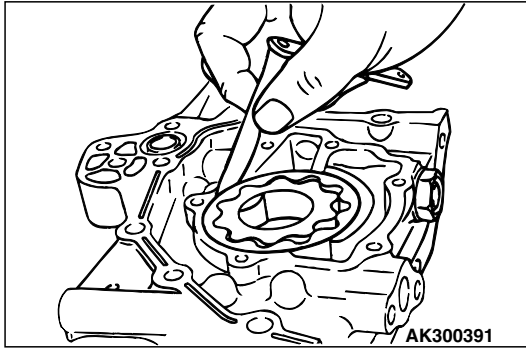
1. Fit the rotors into the front case.
2. Check the tip clearance using a feeler gauge.

**Standard value: 0.06 – 0.18 mm**



3. Check the side clearance using a straight edge and feeler gauge.

**Standard value: 0.04 – 0.10 mm**



Standard value: 0.10 – 0.18 mm  
Limit: 0.35 mm

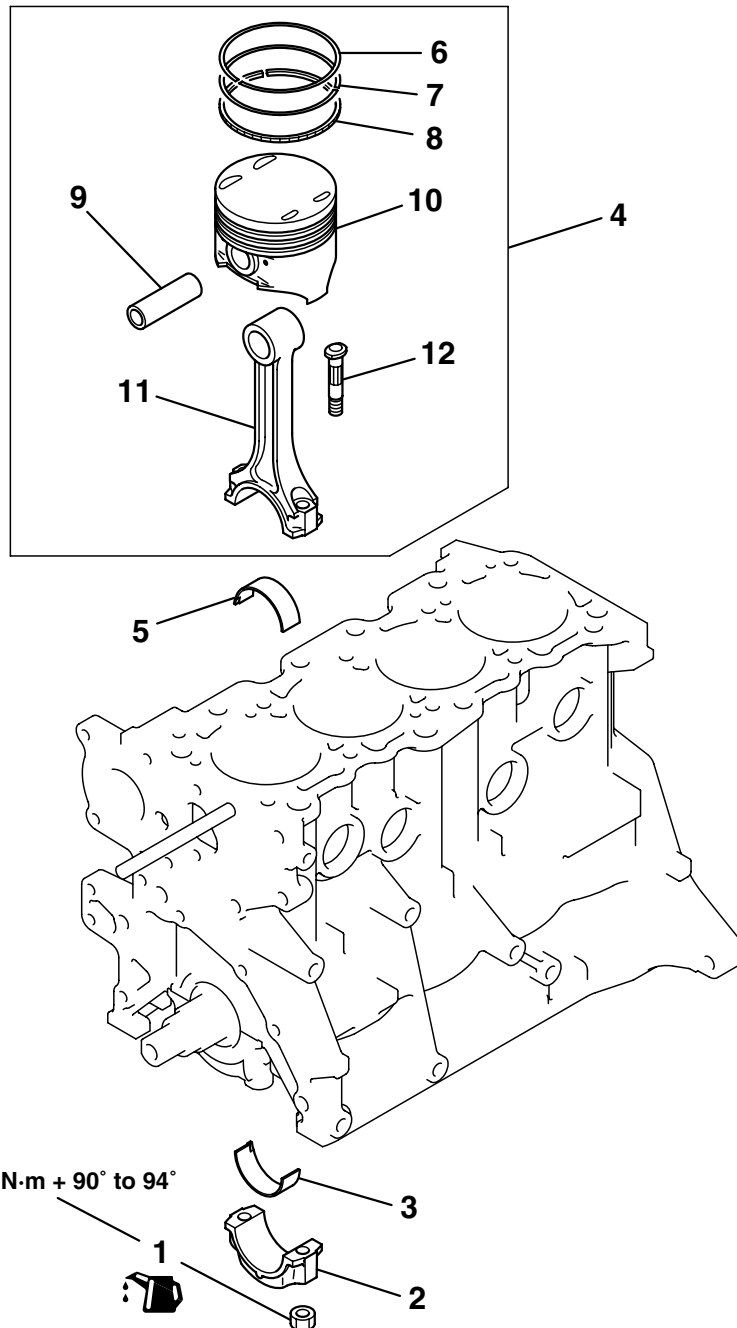
4. Check the body clearance using a feeler gauge.

# PISTON AND CONNECTING ROD

## REMOVAL AND INSTALLATION

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Apply engine oil  
to all moving  
parts before  
installation.



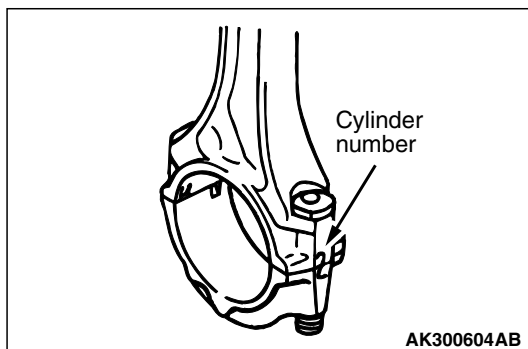
AK300370AB

- Removal steps**
- ※<A> 1. Connecting rod nut
  - >>F<<2. Connecting rod cap
  - ※<D> 3. Connecting rod bearing
  - ※<E> 4. Piston and connecting rod assembly
  - ※<D> 5. Connecting rod bearing
  - ※<C> 6. Piston ring no.1

- Removal steps (Continued)**
- ※<C> 7. Piston ring no.2
  - ※<B> 8. Oil ring
  - ※<B> 9. Piston pin
  - ※<A> 10. Piston
  - 11. Connecting rod
  - 12. Bolt

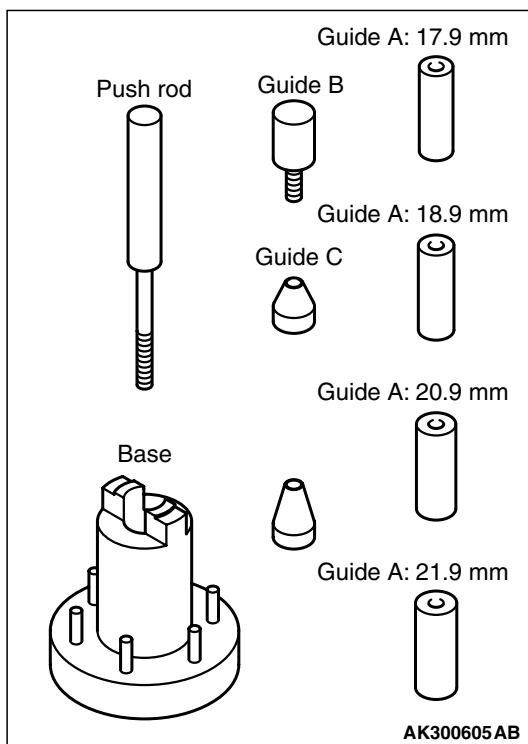
## REMOVAL SERVICE POINTS

## &lt;&lt;A&gt;&gt; CONNECTING ROD CAP REMOVAL

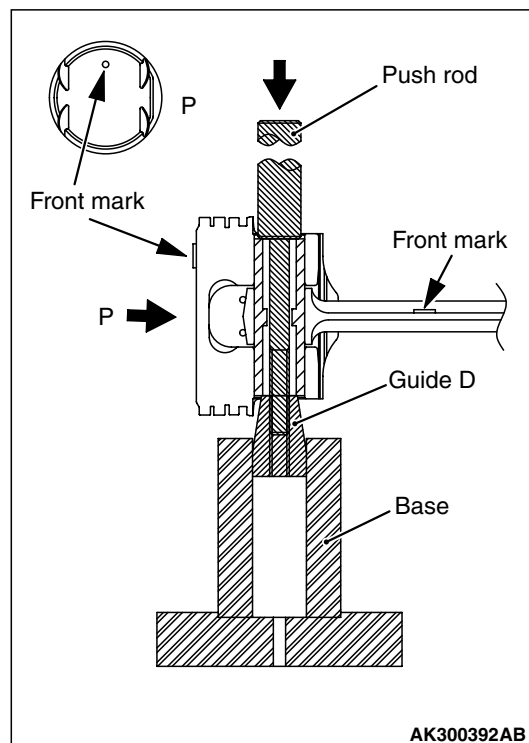


Mark the cylinder number on the side of the connecting rod big end as a guide for reassembly.

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



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

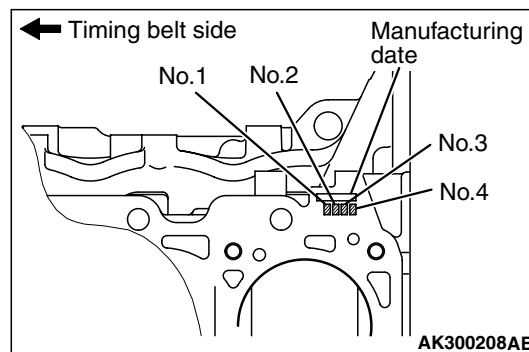


1. Insert the tool element, Push rod, into the piston from the front mark side (notched side), then attach the tool element, Guide C, to the push rod.
2. Place the piston and connecting rod assembly on the tool element, Base, with the front mark facing up.
3. Use a press to remove the piston pin.

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

## INSTALLATION SERVICE POINTS

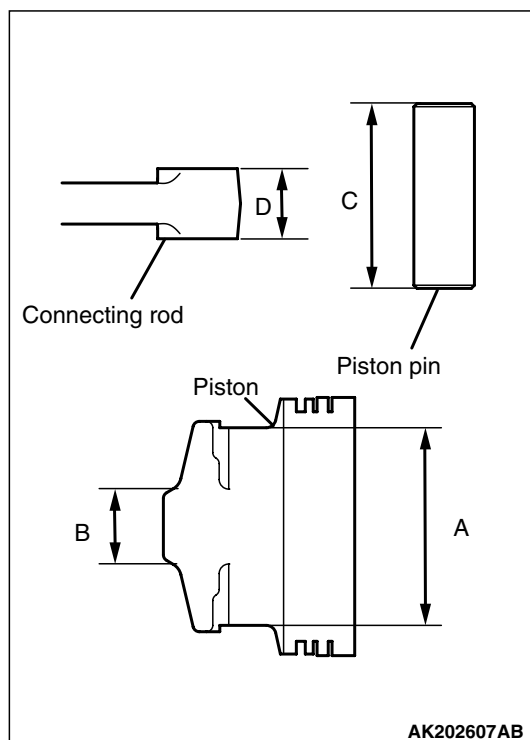
## &gt;&gt;A&lt;&lt; PISTON PIN INSTALLATION



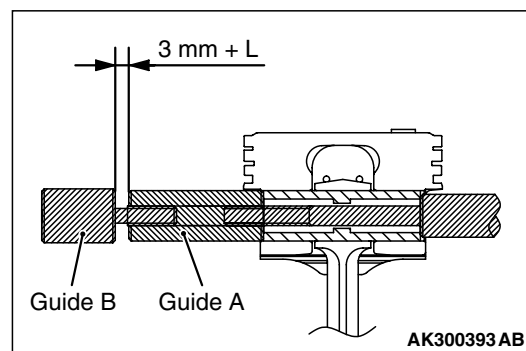
1. When replacing a piston, check the cylinder bore size mark stamped at the indicated location on the cylinder block and select an appropriate replacement piston using the following table.

Cylinder bore size mark	Piston size mark
A	A
B	B
C	C

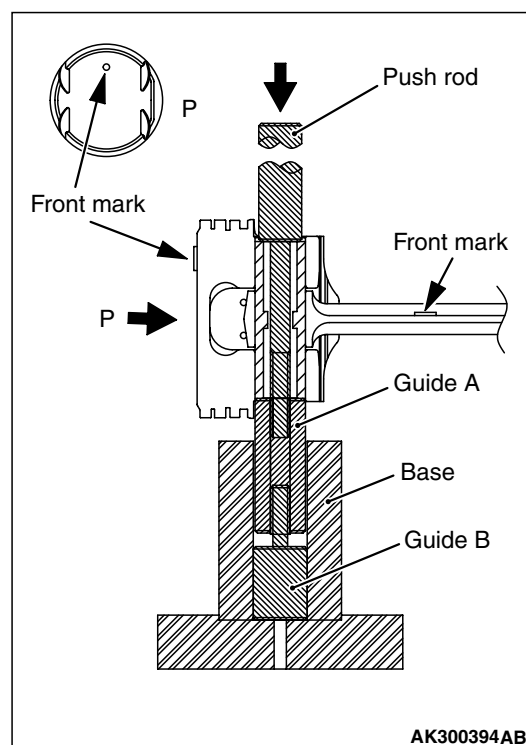
*NOTE: The piston size mark is located on the piston top surface.*



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



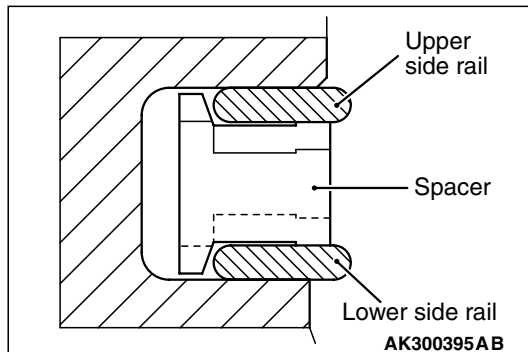
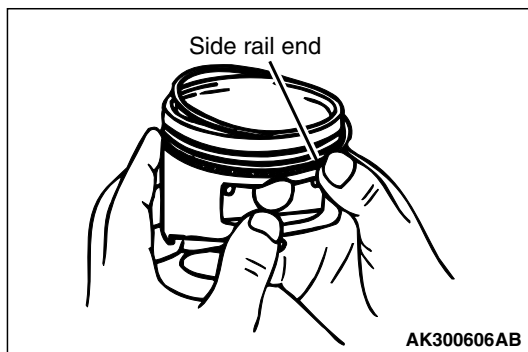
- Screw the guide B into the guide A until the gap between both guides amounts the value L obtained in step 3 plus 3 mm.



- Place the piston and connecting rod assembly onto the tool element, Piston setting base, with the front marks facing up.
- 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**

## &gt;&gt;B&lt;&lt; OIL RING INSTALLATION



1. Fit the oil ring spacer into the piston ring groove. Then, fit the upper and lower side rails.

*NOTE: The spacer and side rails may be fitted in either direction. No distinction is made between top and bottom.*

*NOTE: Spacer and side rail sizes are color-coded as follows:*

Size	Color mark	Engine model
Standard	No mark	4G13, 4G18
0.25 mm oversize	White	4G18
0.50 mm oversize	Blue	4G13, 4G18
1.00 mm oversize	Yellow	4G13

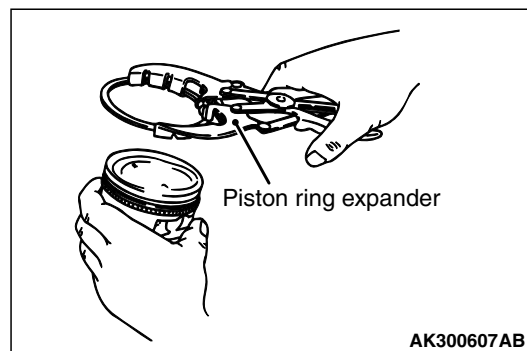
*To install a side rail, fit one end of the rail into the groove, then press the rest of the rail into position by hand as shown.*

**⚠ CAUTION**

**Do not fit side rails using a piston ring expander since they may break.**

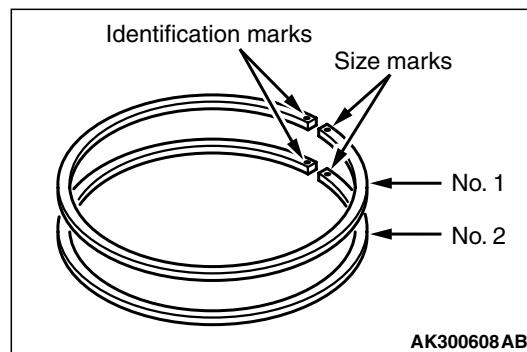
2. After installing the side rails, check that they move smoothly in both directions.

## &gt;&gt;C&lt;&lt; PISTON RING No. 2/PISTON RING No.1 INSTALLATION



Using a ring expander, fit ring No.2 and ring No.1 with their identification marks facing upward (on the piston crown side).

Item		Identification mark
No.1 ring		1T
No.2 ring	4G13	2T
	4G18	T2

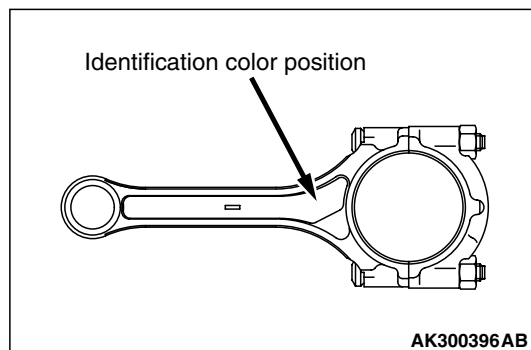
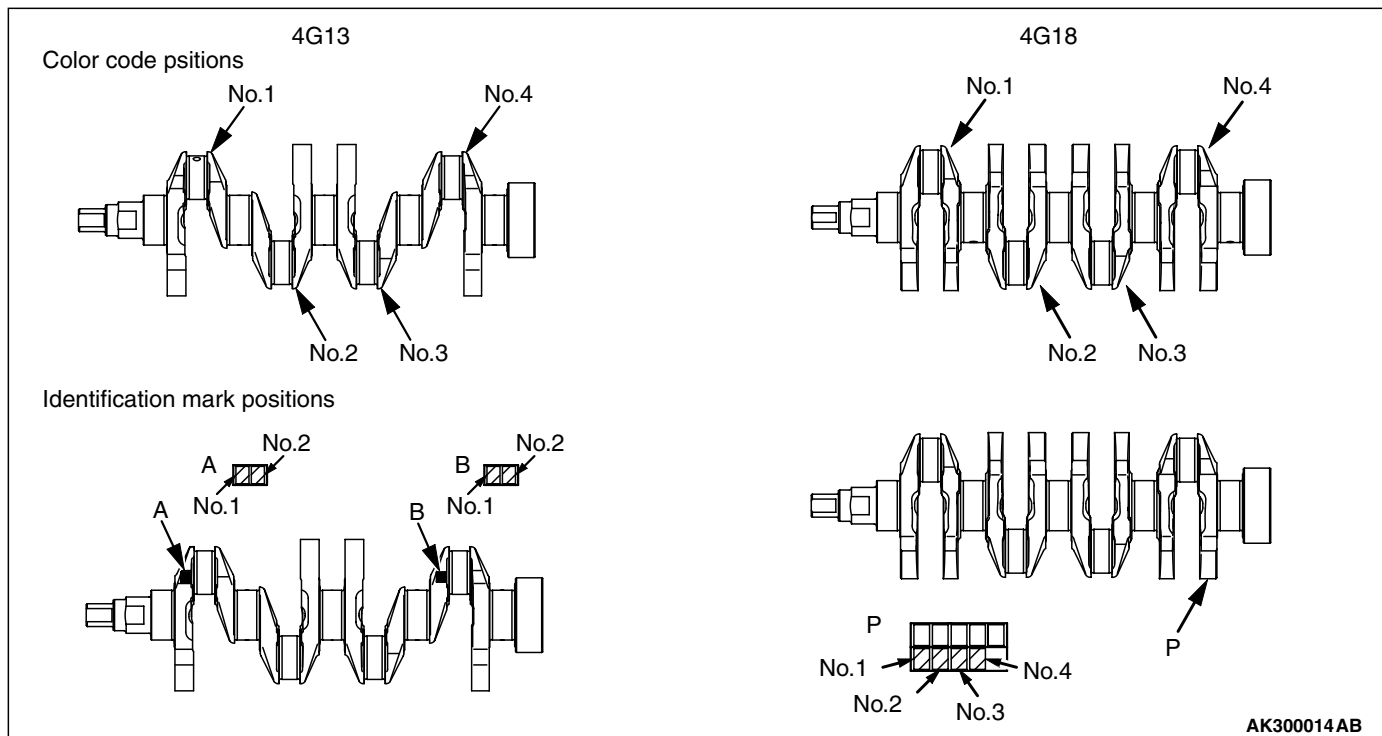


*NOTE: The piston ring is stamped the with following size mark.*

Size	Size mark	Engine model
Standard	No mark	4G13, 4G18
0.25 mm oversize	25	4G18
0.50 mm oversize	50	4G13, 4G18
1.00 mm oversize	100	4G13

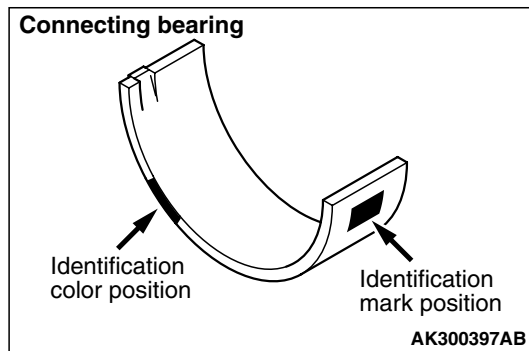


>>E<< CONNECTING ROD BEARING  
INSTALLATION

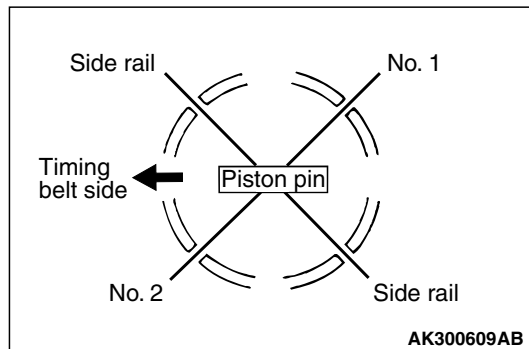


When replacing the bearings, crankshaft and/or connecting rod, read off the identification mark and color on the crankshaft and connecting rod (as illustrated), and select a bearing according to the following table.

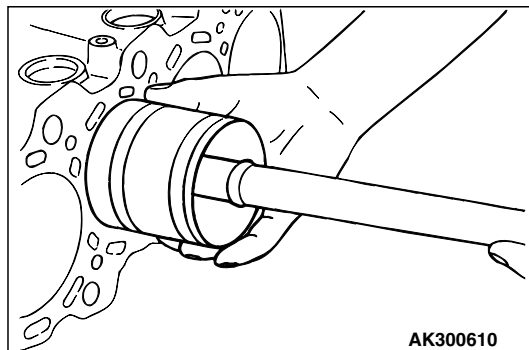
Crankshaft pin outside diameter		Connecting rod	Connecting rod bearing
Identification color or mark	Size mm	Identification color	Identification color or mark
Yellow or I	41.995 – 42.000	White	Yellow or 1
		None	Yellow or 1
		Yellow	None or 2
None or II	41.985 – 41.995	White	Yellow or 1
		None	None or 2
		Yellow	Blue or 3
White or III	41.980 – 41.985	White	None or 2
		None	Blue or 3
		Yellow	Blue or 3



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

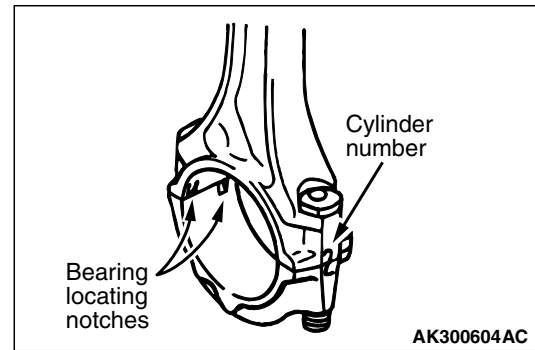


1. Apply oil to the piston, piston rings, and oil ring.
2. Align the gaps of the piston rings and oil ring (side rails and spacer) as shown.
3. With the piston crown's front arrow mark pointing toward the timing belt side, press the piston and connecting rod assembly into the cylinder from the top of the cylinder.

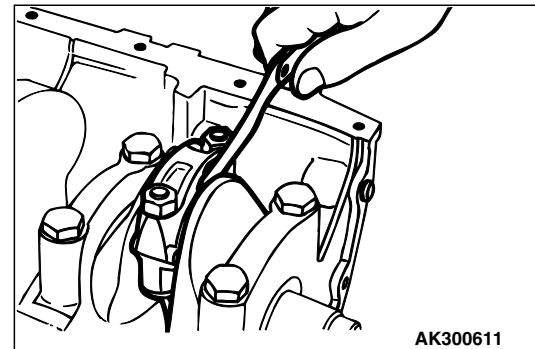


4. Compress the piston rings tightly with a suitable ring compression tool, then press the piston and connecting rod fully into the cylinder. Do not strike the piston hard since the piston rings may break and the crank pin may be nicked.

### >>F<< CONNECTING ROD CAP INSTALLATION



1. Aligning the marks made during disassembly, fit the bearing cap onto the connecting rod. If the connecting rod is new and has no index mark, ensure that the bearing locking notches are both on the same side.



2. Check that the connecting rod big end side clearance confirms with specifications.

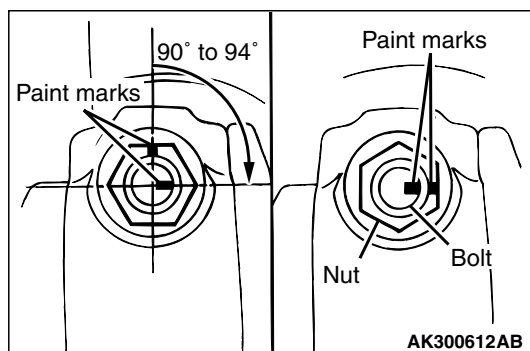
**Standard value: 0.10 – 0.25 mm**  
**Limit: 0.4 mm**

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

1. Since the connecting rod cap bolts and nuts are torqued using the plastic area tightening method, the bolts should be examined BEFORE reuse. If the bolt threads are "necked down", the bolt should be replaced.

Necking can be checked by running a nut with your fingers the full length of the bolt threads. If the nut does not run down smoothly, the bolt should be replaced.

2. Before installation of each nut, apply engine oil to the nut.
3. Install each nut to the bolt and finger-tighten it. Then tighten the nuts alternately to install the cap properly.
4. Tighten the nuts to  $17 \pm 2$  N·m



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

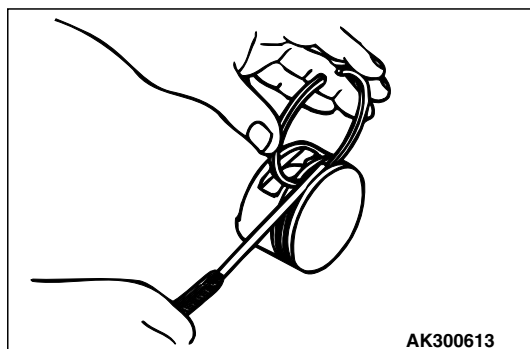
**CAUTION**

- If the nut is turned less than 90°, proper fastening performance may not be expected. When tightening the nuts, therefore, be careful to give a sufficient turn to it.
  - If the nut is overtightened (exceeding 94°), loosen the nut completely and then retighten it by repeating the tightening procedure from step (1).
7. Give a 90° to 94° turn to the nut and make sure that the paint mark on the nut and that on the bolt are in alignment.

**INSPECTION**

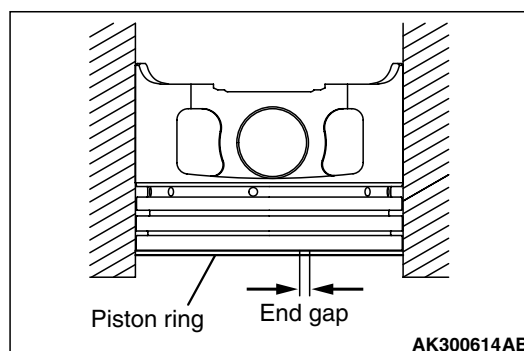
**PISTON RING**

M1113008500417



1. Check for side clearance.  
If the limit is exceeded, replace the ring or piston, or both.

**Standard value:**  
**No.1: 0.03 – 0.07 mm**  
**No.2: 0.02 – 0.06 mm**  
**Limit: 0.1 mm**



2. 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 end gap is excessive, replace the piston ring.

**Standard value:**

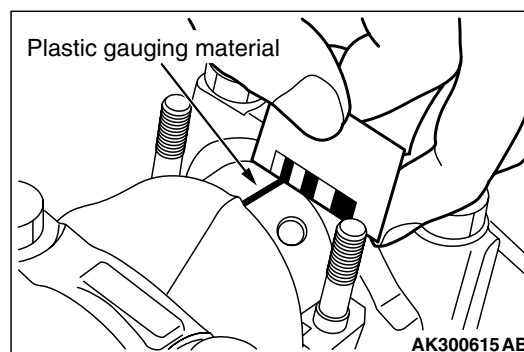
**No. 1 ring: 0.20 – 0.35 mm**  
**No. 2 ring: 0.35 – 0.50 mm**  
**Oil ring: 0.10 – 0.40 mm**

**Limit:**

**No. 1, No. 2 ring: 0.8 mm**  
**Oil ring: 1.0 mm**

**CRANKSHAFT PIN OIL CLEARANCE (PLASTIC GAUGING MATERIAL METHOD)**

1. Remove oil from the crankshaft pin and connecting rod bearing.
2. Cut the plastic gauging material to the same length as the width of bearing and place it on a crankshaft pin in parallel with its axis.



3. Install the connecting rod cap carefully and tighten the nuts to the specified torque. (See "Connecting rod cap nut tightening" procedure.)
4. Carefully remove the connecting rod cap.
5. Measure the width of the plastic gauging material at its widest part by using a scale printed on its package.

**Standard value: 0.02 – 0.04 mm**  
**Limit: 0.1 mm**

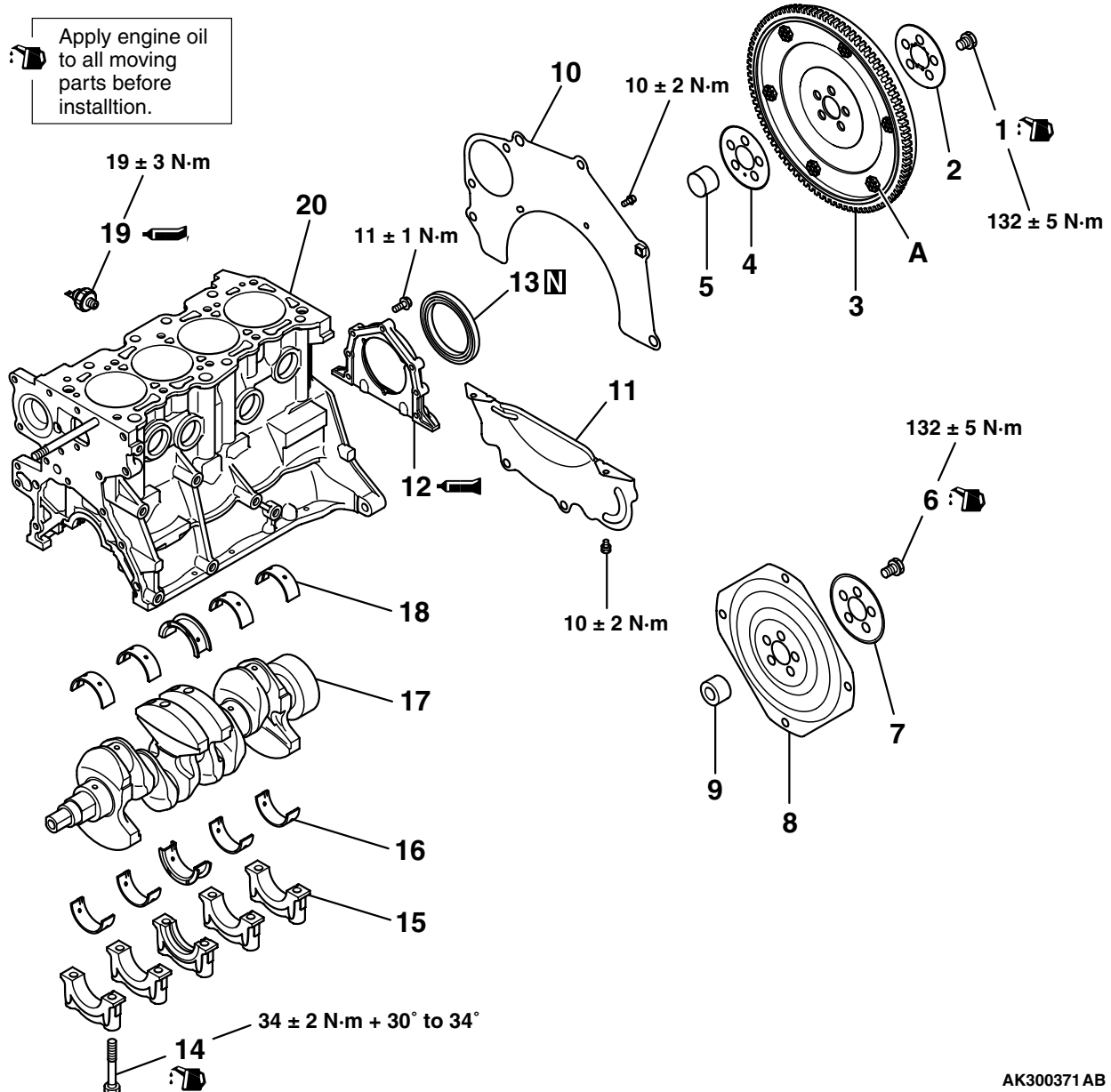
## CRANKSHAFT AND CYLINDER BLOCK

## REMOVAL AND INSTALLATION

M1113008700552

**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.



AK300371 AB

**Removal steps**

1. Flywheel bolt <M/T>
2. Flywheel <M/T>
3. Drive plate bolt <A/T>
4. Adapter plate <A/T>
5. Drive plate <A/T>
6. Crankshaft bushing <A/T>
7. Rear plate
8. Bell housing cover

**Removal steps (Continued)**

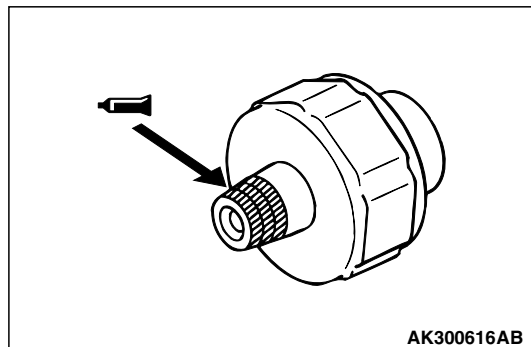
- >>E<< 9. Rear oil seal case
- >>D<< 10. Rear oil seal
- >>C<< 11. Bearing cap bolt
- >>C<< 12. Bearing cap
- >>B<< 13. Crankshaft bearing (lower)
14. Crankshaft
- >>B<< 15. Crankshaft bearing (upper)

**Removal steps (Continued)**

- >>A<< 16. Oil pressure switch  
17. Cylinder block

**INSTALLATION SERVICE POINTS**

**>>A<< OIL PRESSURE SWITCH INSTALLATION**



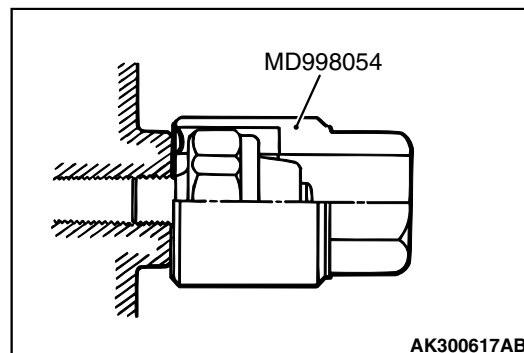
**CAUTION**

Be careful not to block the oil passage with sealant.

1. Apply sealant to the threaded portion.

**Specified Sealant:**

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

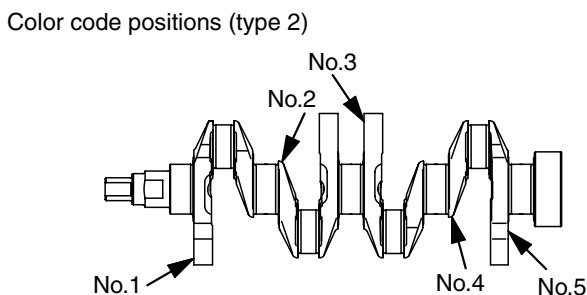
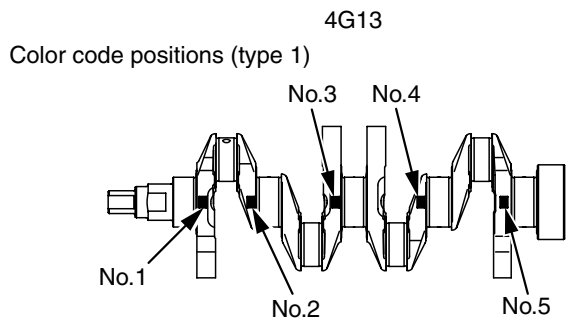


2. Tighten the oil pressure switch together with the cylinder block by the specified torque using of the special tool Oil pressure switch socket wrench (MD998054).

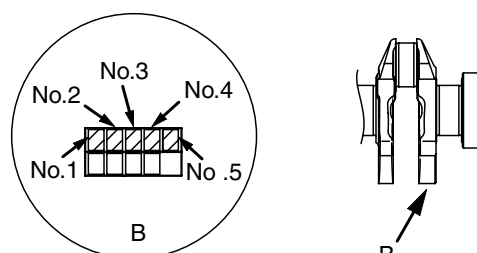
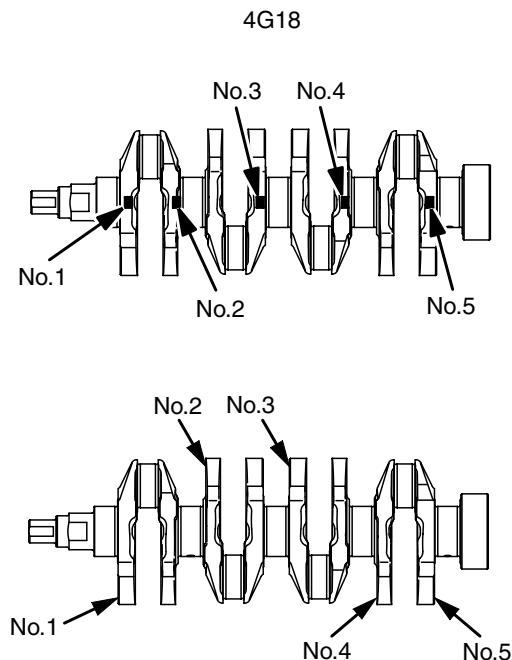
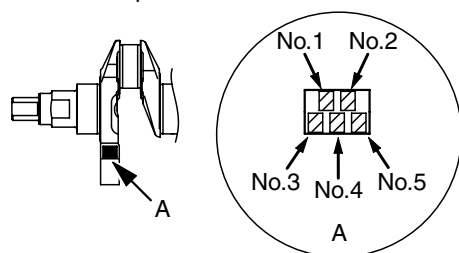
**Tightening torque:  $19 \pm 3$  N·m**

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

1. When replacing the bearings, crankshaft and/or cylinder block, read off the identification color or mark on the crankshaft and cylinder block (as illustrated), and select a bearing according to the following table.

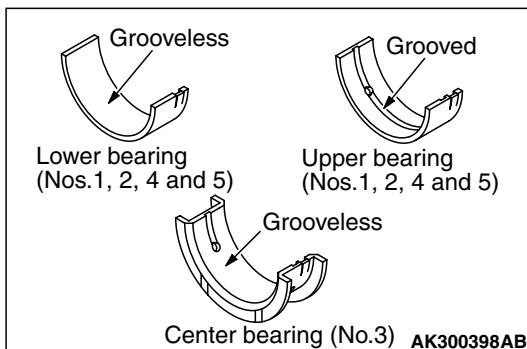
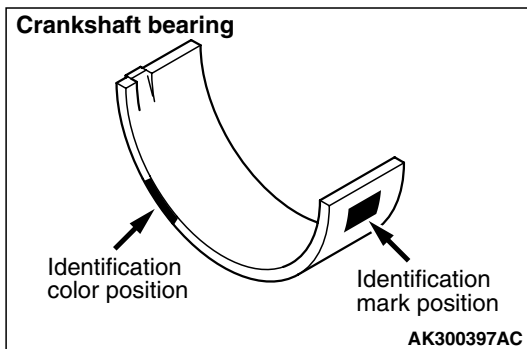
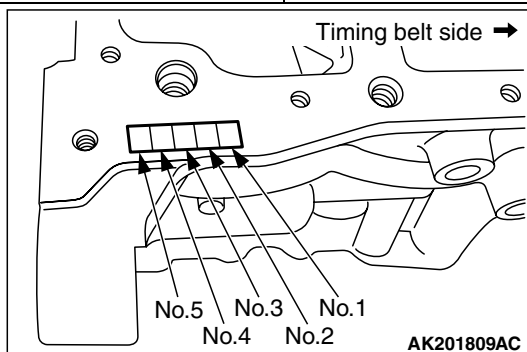


**Identification mark positions**



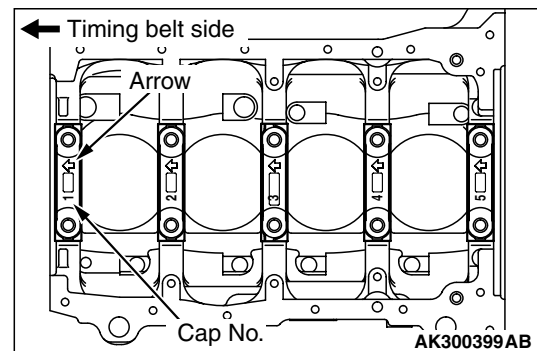
AK300015AB

Crankshaft journal outside diameter		Cylinder block bearing	Crankshaft bearing
Identification color or mark	Size mm	Identification mark	Identification color or mark
Yellow or 1	47.994 – 48.000	0	Brown or 1
		1	None or 2
		2	Blue or 3
None or 2	47.988 – 47.994	0	None or 2
		1	Blue or 3
		2	Yellow or 4
White or 3	47.982 – 47.988	0	Blue or 3
		1	Yellow or 4
		2	Green or 5

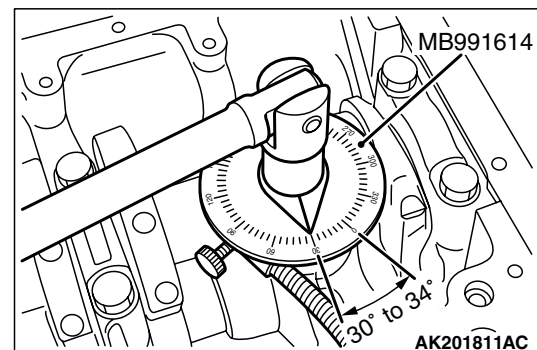


2. Install the crankshaft bearings to the cylinder block and bearing caps as shown illustration.

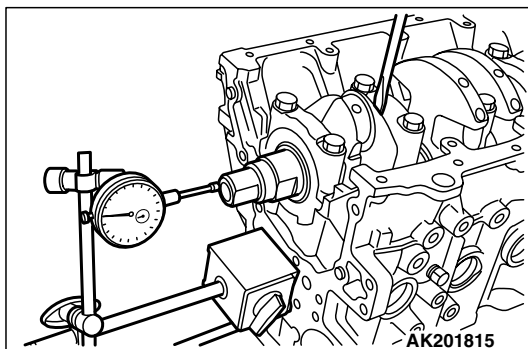
### >>C<< BEARING CAP INSTALLATION



1. On the bottom surface of each bearing cap is the cap's number and an arrow. Starting at the timing belt side, install the bearing caps in numerical order. Ensure that the arrows point toward the timing belt side.
2. Check that the crankshaft rotates smoothly.



3. Apply engine oil to the threaded portion and bearing surface of the bolt. Tighten the bolts to  $34 \pm 2$  N·m.
4. Using the special tool, tighten the bolts to a further  $30^\circ$  to  $34^\circ$ .

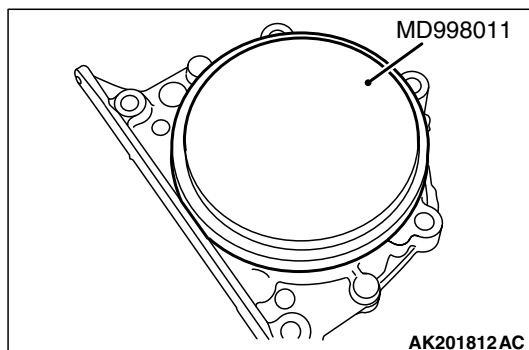


5. Measure the end play in the crankshaft. If the measurement exceeds the specified limit, replace the crankshaft bearings.

**Standard value: 0.05 – 0.18 mm**

**Limit: 0.25 mm**

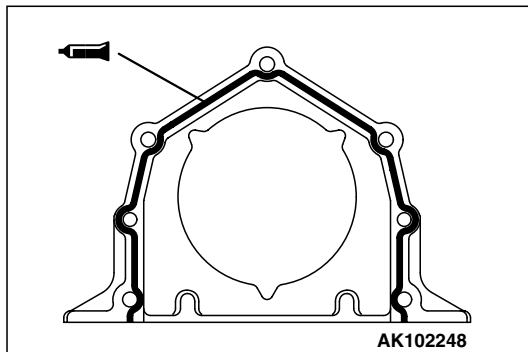
#### >>D<< REAR OIL SEAL INSTALLATION



1. Press-fit the rear oil seal using the special tool Crankshaft rear oil seal installer (MD998011) shown in the illustration.

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

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



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

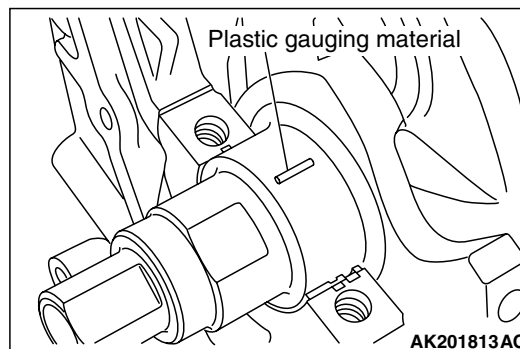
**Specified sealant:**  
**Mitsubishi Genuine Part No.MD970389 or equivalent**

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

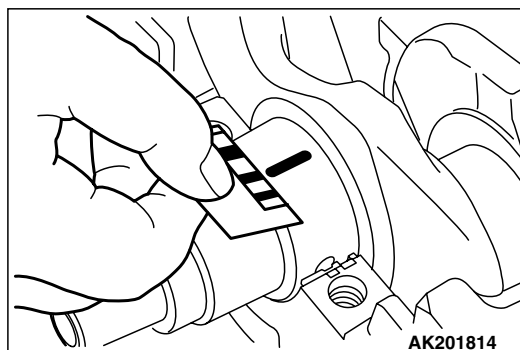
#### INSPECTION

M1113008800418

#### CRANKSHAFT JOURNAL OIL CLEARANCE (PLASTIGAGE METHOD)



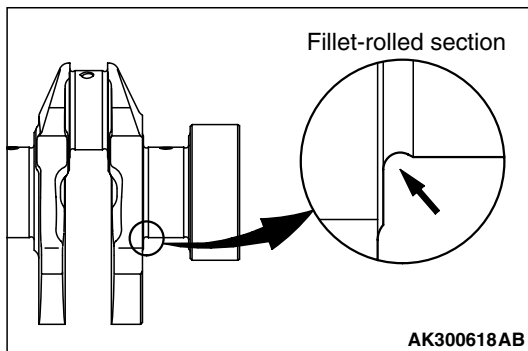
1. Remove all oil from crankshaft journal and the crankshaft bearing.
2. Install the crankshaft.
3. Cut the plastic gauging material to the same length as the width of the bearing, and place it on the journal in parallel with its axis.
4. Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
5. Carefully remove the crankshaft bearing cap.



6. Measure the width of the plastic gauging material at its widest part by using a scale printed on plastic gauging material package.

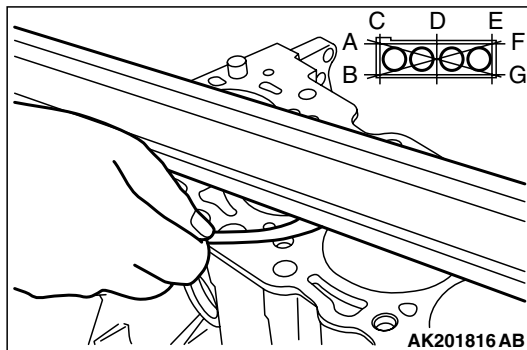
**Standard value: 0.02 – 0.04 mm**

**Limit: 0.1 mm**

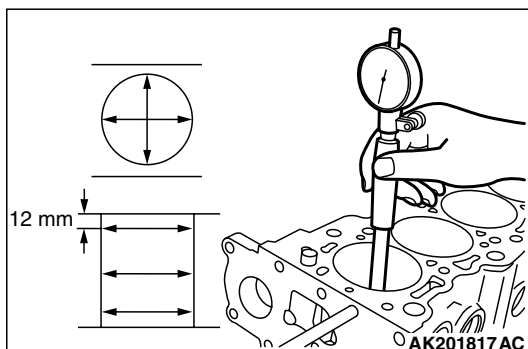


**NOTE:** The crankshaft pins and journals are fillet-rolled and must not be machined to undersize dimensions.

## CYLINDER BLOCK



1. Visually check for cracks, rust, and corrosion, and inspect the cylinder block using a flaw detecting agent. Rectify defects where possible or replace the cylinder block.
2. Ensure that the top surface is free of gasket chips and other foreign material. Check the cylinder block top surface for distortion using a straight edge and feeler gauge.  
**Standard value: 0.05 mm or less**  
**Limit: 0.1 mm**
3. Check the cylinder walls for cracks and seizure marks. If defects are evident, bore all the cylinders to oversize or replace the cylinder block.



4. Using a cylinder gauge, measure each cylinder bore and cylindricity. If any cylinder is severely worn, bore all the cylinders to oversize and replace the piston and piston rings accordingly. Take measurements at the points shown.

**Standard value:**

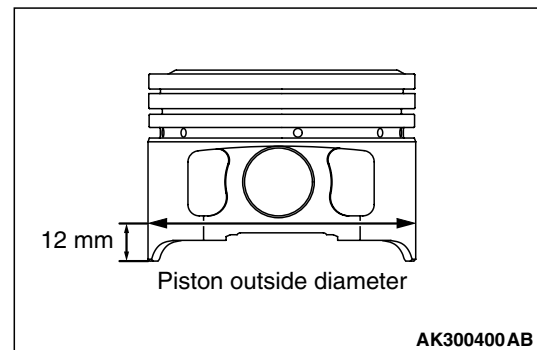
**Cylinder bore: I.D.**

**4G13 engine: 71.0 mm**

**4G18 engine: 76.0 mm**

**Cylindricity: 0.01 mm or less**

## BORING CYLINDERS



1. Oversize pistons should be based on the largest bore cylinder.

Size	Size mark	Engine model
0.25 mm oversize	25	4G18
0.50 mm oversize	50	4G13, 4G18
1.00 mm oversize	100	4G13

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

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

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

4. Bore each cylinders to the calculated boring finish dimension.

### **CAUTION**

**To prevent distortion caused by heat increased during boring, bore the cylinders in the following order: No.2, No.4, No.1, No.3.**

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

**Standard value: 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