

## GROUP 11B

# ENGINE OVERHAUL

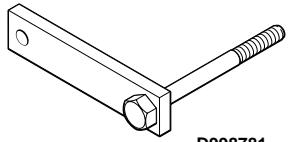
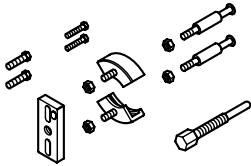
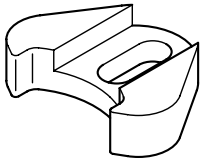
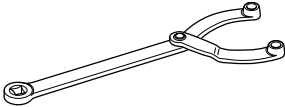
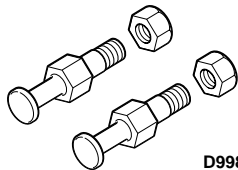
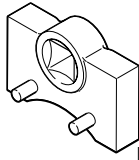
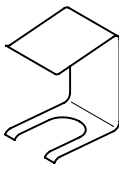
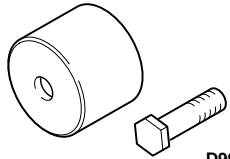
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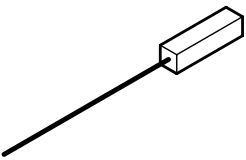
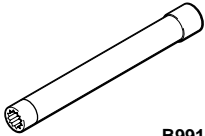
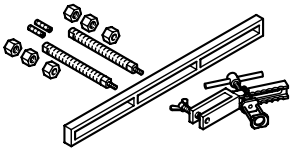
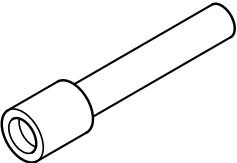
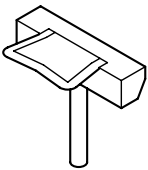
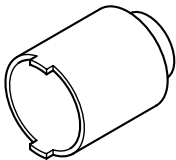
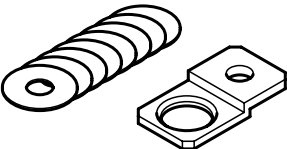
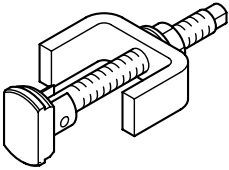
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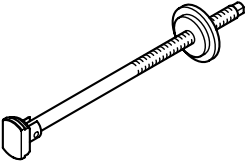
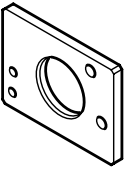
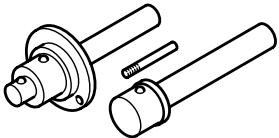
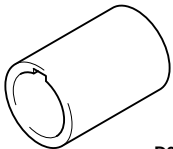
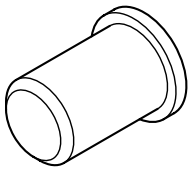
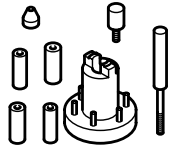
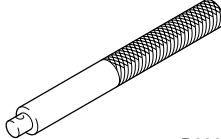

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## SPECIAL TOOLS

M1113000600056

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
 D998781	MD998781 Flywheel stopper	General service tool	Supporting flywheel and drive plate
	MD998778 Crankshaft sprocket puller	General service tool	Removal of crankshaft sprocket
	MD998785 Sprocket stopper	MD998785	Supporting counterbalance shaft sprocket
 B990767	MB990767 End yoke holder	MB990767-01	Holding camshaft sprocket when loosening or torquing bolt
 D998719	MD998719 Pins	MIT308239	
 D998767	MD998767 Timing pulley wrench	MD998752-01	Adjustment of timing belt tension
 D998443	MD998443 Lash adjuster holder (8)	MD998443-01	Supporting of the lash adjuster to prevent it from falling when rocker shaft assembly is removed or installed
 D998713	MD998713 CAMSHAFT OIL SEAL INSTALLER	MD998713-01	Installation of camshaft oil seal

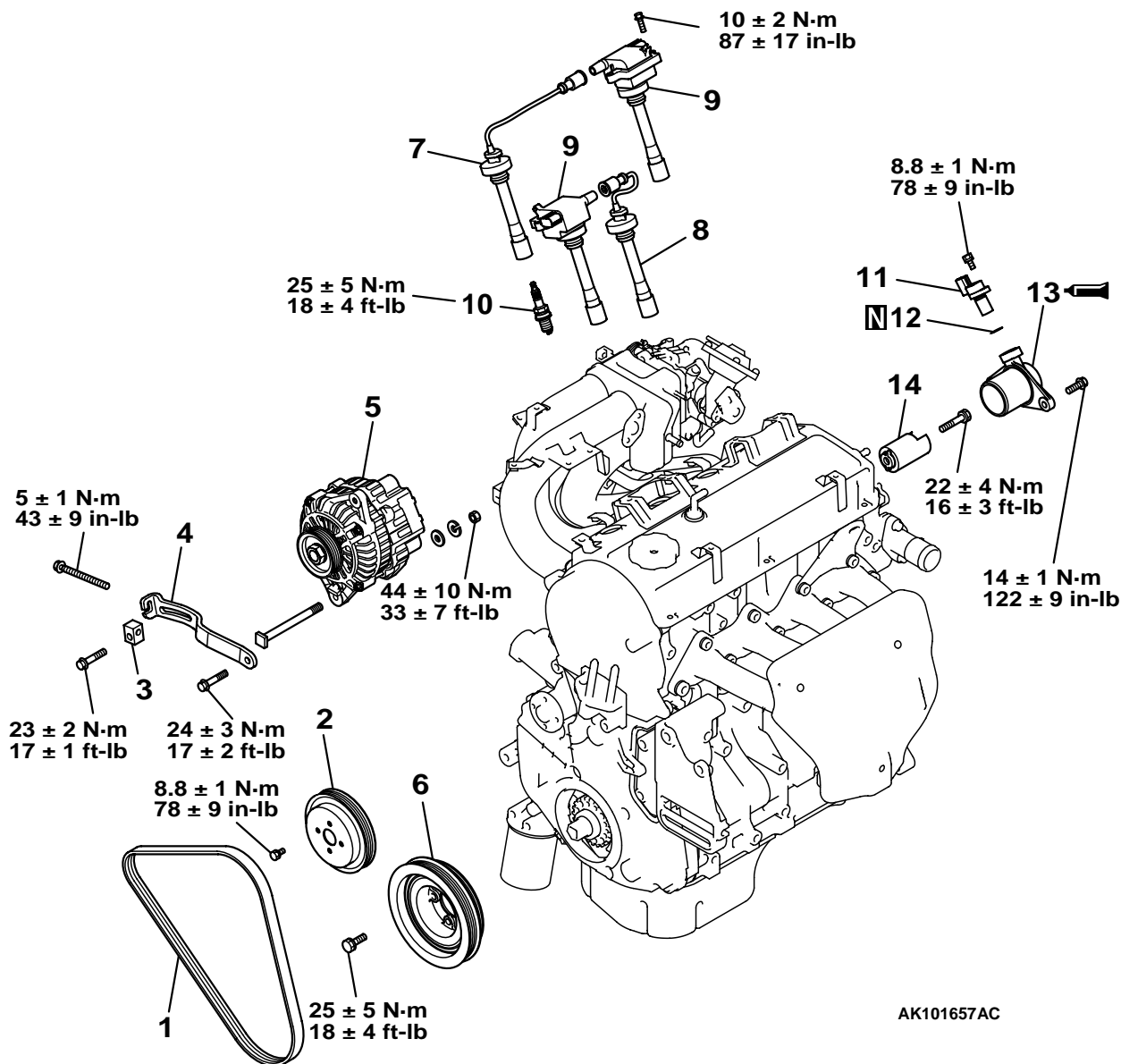
TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
	MD998442 Air bleed wire	General service tool	Air bleed of lash adjuster
 B991654	MB991654 Cylinder head bolt wrench (12)	General service tool	Removal and installation of cylinder head bolt
	MD998772 Valve spring compressor	General service tool	Compression of valve spring
	MD998774 Valve steam seal installer	MD998774-01	Installation of valve steam seal
 D998727	MD998727 Oil pan remover	MD998727-01	Removal of oil pan
	MD998162 Plug wrench Use with MD998783	MD998162-01	Removal and installation of front case cap plug
	MD998783 Plug wrench retainer	General service tool	
	MD998371 Silent shaft bearing puller	MD998371-01	Removal of counterbalance shaft front bearing

TOOL	TOOL NUMBER AND NAME	SUPERSESION	APPLICATION
	MD998372 Silent shaft bearing puller	MD998372-01	Removal of counterbalance shaft rear bearing
	MB991603 Bearing installer stopper	—	Removal and installation of rear bearing
	MD998705 Silent shaft bearing installer	MD998373-01 Use with MB990938-01	Installation of counterbalance shaft bearing
 D998285	MD998285 Crankshaft front oil seal guide	MD998285-01	Installation of crankshaft front oil seal
	MD998375 Crankshaft front oil seal installer	MD998375-01	
	MD998780 Piston pin setting tool	MIT216941	Removal and installation of piston pin
 B990938	MB990938 Handle	MB990938-01	Installation of crankshaft rear oil seal
 D998776	MD998776 Crankshaft rear oil seal installer	MD998376-01	

# GENERATOR AND IGNITION SYSTEM

## REMOVAL AND INSTALLATION

M1113001000176



AK101657AC

### REMOVAL STEPS

1. DRIVE BELT
2. WATER PUMP PULLEY
3. ADJUSTING NUT
4. GENERATOR BRACE
5. GENERATOR
6. CRANKSHAFT PULLEY
7. SPARK PLUG CABLE NO.1
8. SPARK PLUG CABLE NO.3

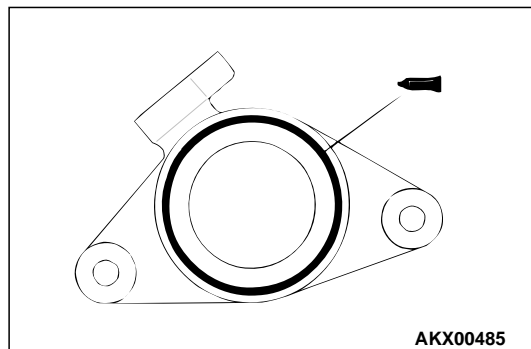
### REMOVAL STEPS (Continued)

9. IGNITION COIL ASSEMBLY
10. SPARK PLUG
11. CAMSHAFT POSITION SENSOR
12. O-RING
13. CAMSHAFT POSITION SENSOR SUPPORT
14. CAMSHAFT POSITION SENSING CYLINDER

>>A<<

**INSTALLATION SERVICE POINT****>>A<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION**

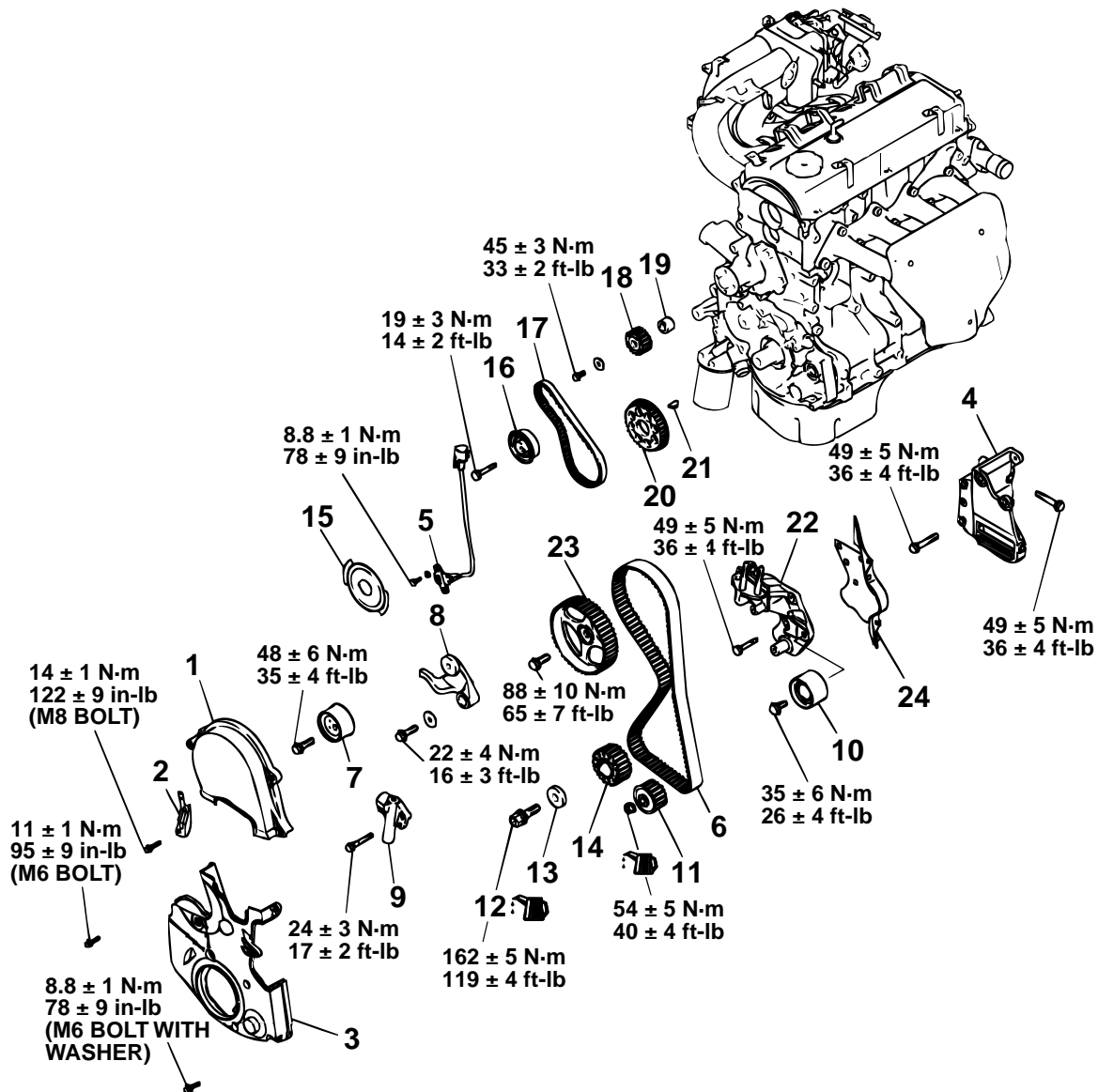
Apply a 3 mm (0.12 inch) bead of sealant (MITSUBISHI Genuine Part number MD970389) in the groove shown.



# TIMING BELT

## REMOVAL AND INSTALLATION

M1113001900243



AK101649AC

### REMOVAL STEPS

1. TIMING BELT FRONT UPPER COVER
2. CONNECTOR BRACKET
3. TIMING BELT FRONT LOWER COVER
4. POWER STEERING PUMP BRACKET
5. CRANKSHAFT POSITION SENSOR
- <<A>> >>J<< 6. TIMING BELT
7. TENSIONER PULLEY
8. TENSIONER ARM
- >>I<< 9. AUTO-TENSIONER
10. IDLER PULLEY
- <<B>> >>H<< 11. OIL PUMP SPROCKET

### REMOVAL STEPS (Continued)

- <<C>> >>G<< 12. CRANKSHAFT BOLT
- >>G<< 13. CRANKSHAFT PULLEY WASHER
- <<D>> >>G<< 14. CRANKSHAFT SPROCKET
- >>G<< 15. CRANKSHAFT SENSING BLADE
16. TENSIONER "B"
- <<E>> >>F<< 17. TIMING BELT "B"
- <<F>> >>E<< 18. COUNTERBALANCE SHAFT SPROCKET
- >>D<< 19. SPACER
- <<G>> >>C<< 20. CRANKSHAFT SPROCKET "B"
21. KEY
- >>B<< 22. ENGINE SUPPORT BRACKET
- <<H>> >>A<< 23. CAMSHAFT SPROCKET
24. TIMING BELT REAR COVER

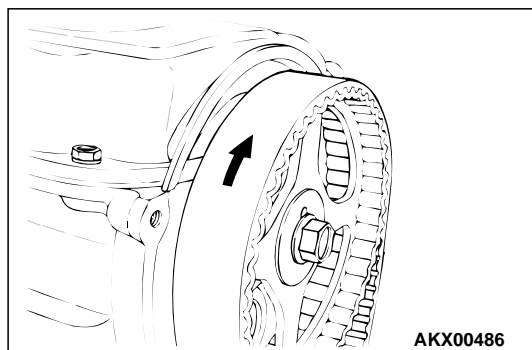
**Required Special Tools:**

- MB990767: End Yoke Holder
- MD998719: Pins
- MD998767: Tensioner Pulley Wrench
- MD998778: Crankshaft Sprocket Puller
- MD998781: Flywheel Stopper
- MD998785: Sprocket Stopper

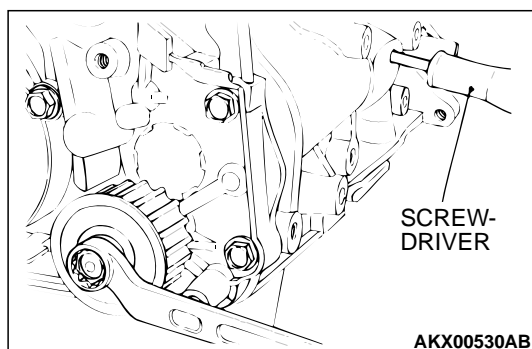
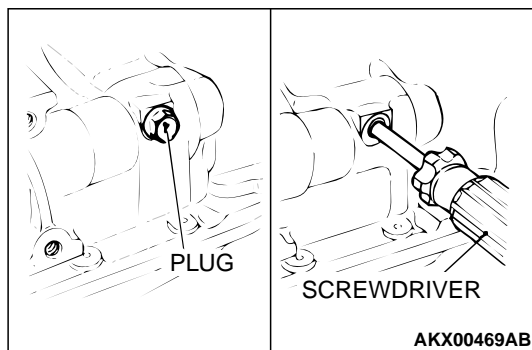
**REMOVAL SERVICE POINTS****<<A>> TIMING BELT REMOVAL****⚠ CAUTION**

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**

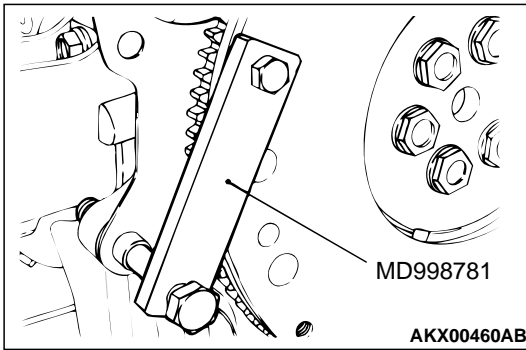
1. Remove the plug on the left side of the cylinder block.
2. Insert a Phillips screwdriver [shank diameter 8 mm (0.3 inch)] through the plug hole to block the left counterbalance shaft.
3. Loosen the nut, and then remove the oil pump sprocket.





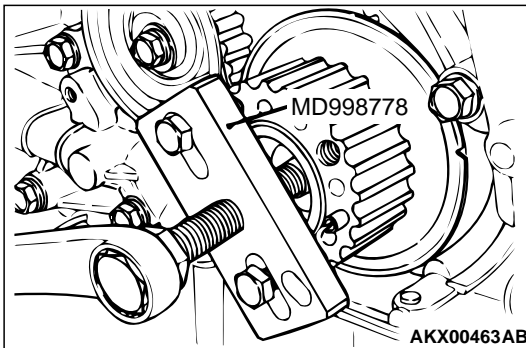
**<<C>> CRANKSHAFT BOLT LOOSENING**

1. Install special tool MD998781 to hold the flywheel or drive plate.
2. Loosen and remove the crankshaft bolt and washer.



**<<D>> CRANKSHAFT SPROCKET REMOVAL**

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

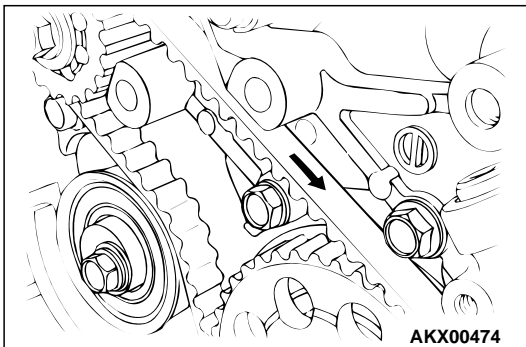


**<<E>> TIMING BELT "B" REMOVAL**

**⚠ CAUTION**

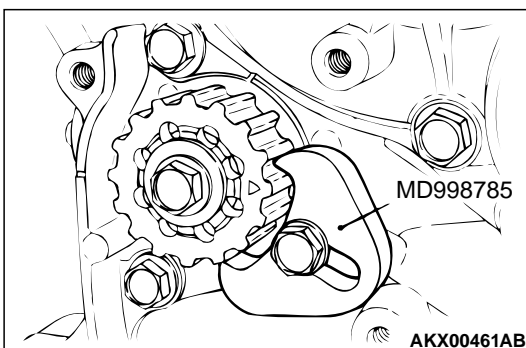
Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. These parts should not be washed or immersed in solvent. Replace parts if contaminated. If there is oil or water on each part, check the front case oil seals, camshaft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

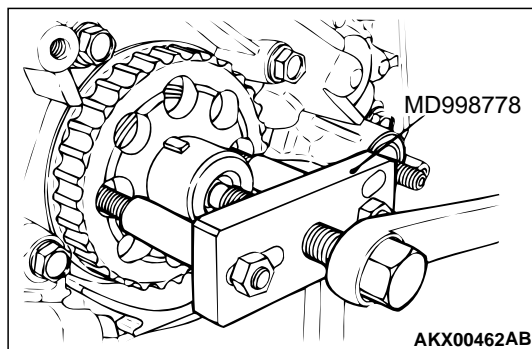
1. Mark the belt running direction for reinstallation.
2. Loosen the tensioner "B" bolt, and then remove the timing belt "B."



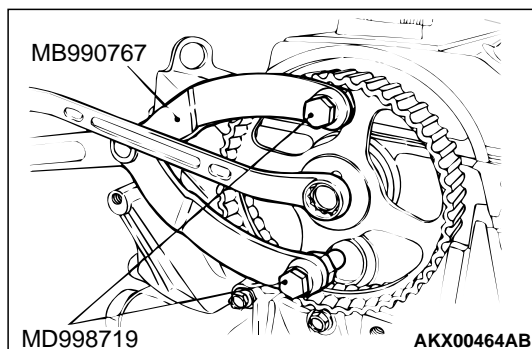
**<<F>> COUNTERBALANCE SHAFT SPROCKET REMOVAL**

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



**<<G>> CRANKSHAFT SPROCKET "B" REMOVAL**

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

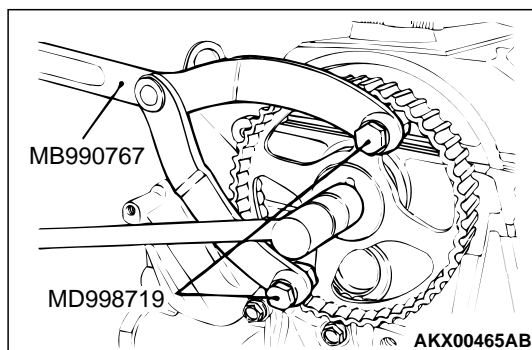
**<<H>> CAMSHAFT SPROCKET REMOVAL**

1. While holding the camshaft sprocket with special tools MB990767 and MD998719, loosen the camshaft sprocket bolt.
2. Remove the camshaft sprocket.

**INSTALLATION SERVICE POINTS****>>A<< CAMSHAFT SPROCKET INSTALLATION**

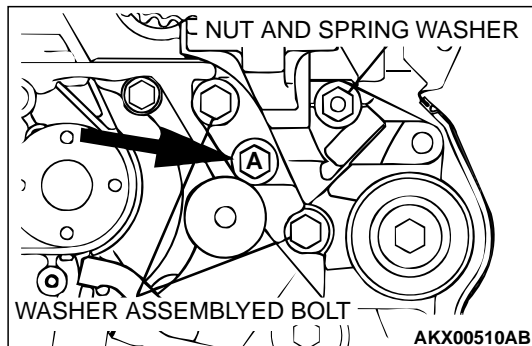
1. Fit the camshaft sprocket to the front of the camshaft.
2. While holding the camshaft sprocket with special tools MB990767 and MD998719, tighten the camshaft sprocket bolt.

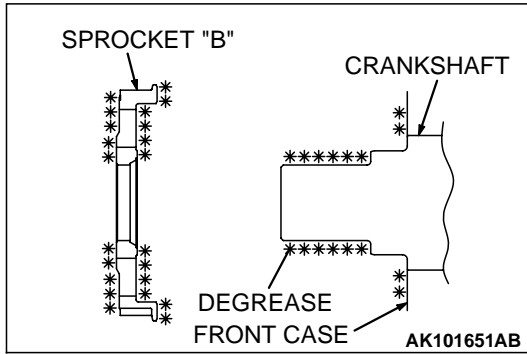
**Tightening torque:  $88 \pm 10$  N·m ( $65 \pm 7$  ft-lb)**

**>>B<< ENGINE SUPPORT BRACKET INSTALLATION**

Coat the threads of the seal bolt A in the illustration with 3M™ AAD Part number 8672 or equivalent before tightening.

**Tightening torque:  $49 \pm 5$  N·m ( $36 \pm 4$  ft-lb)**

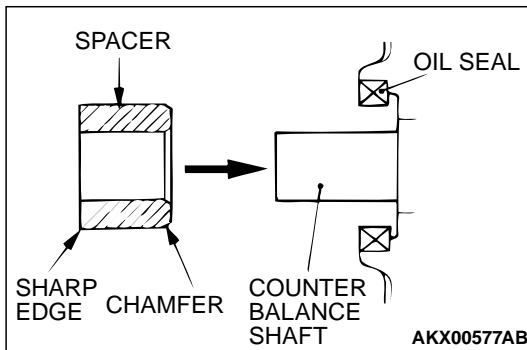




### >>C<< CRANKSHAFT SPROCKET "B" INSTALLATION

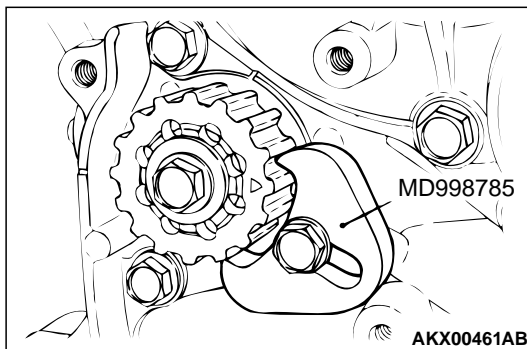
Clean and then degrease the front case of the front case, crankshaft sprocket "B" and crankshaft surface on which sprocket "B" is attached.

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



### >>D<< SPACER INSTALLATION

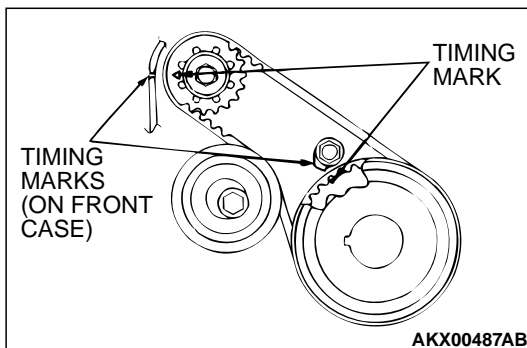
1. Apply a thin coat of clean engine oil to the lip area of the oil seal.
2. Install the spacer with the chamfered end facing toward the oil seal.



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

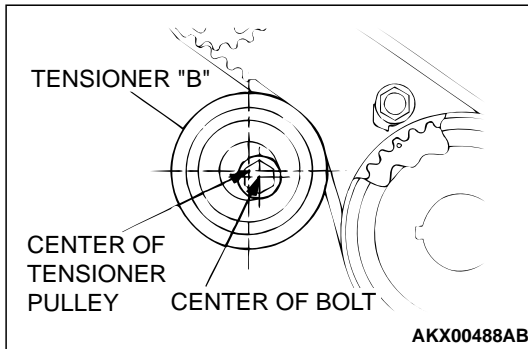
1. Install the counterbalance shaft sprocket and screw the bolt.
2. Install special tool MD998785 as shown in the illustration to lock the counterbalance shaft.
3. Tighten the bolt, and then remove the special tool.

**Tightening torque: 45 ± 3 N·m (33 ± 2 ft-lb)**

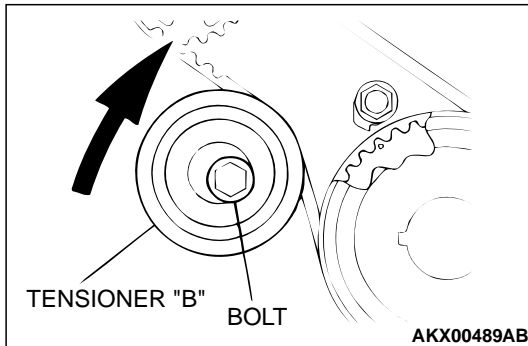


### >>F<< TIMING BELT "B" INSTALLATION

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.

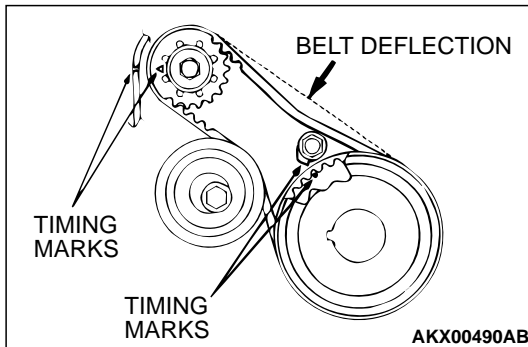


3. Make sure that the relationship between the tensioner pulley center and the bolt center is as shown in the illustration.

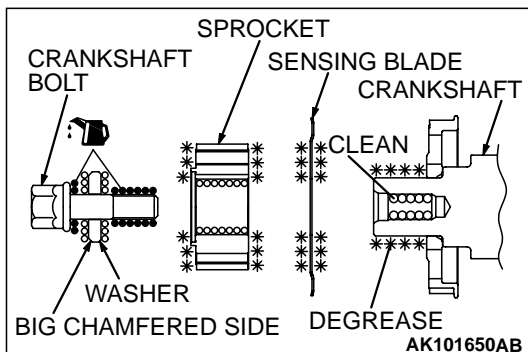


4. Move tensioner "B" in the direction of the arrow while lifting with your finger to give sufficient tension to the tension side of timing belt. In this condition, tighten the bolt to secure tensioner "B." When the bolt is tightened, use care to prevent the tensioner pulley shaft from turning with the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

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

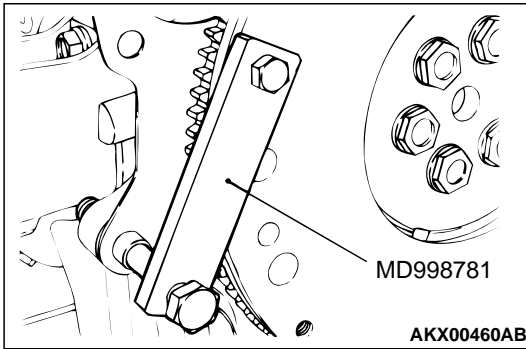


5. Check that timing marks on the sprockets are aligned with the timing marks on the front case.
6. With your index finger, press the midway of span on the tension side of timing belt "B." The bolt must deflect 5 to 7 mm (0.20 to 0.28 inch).



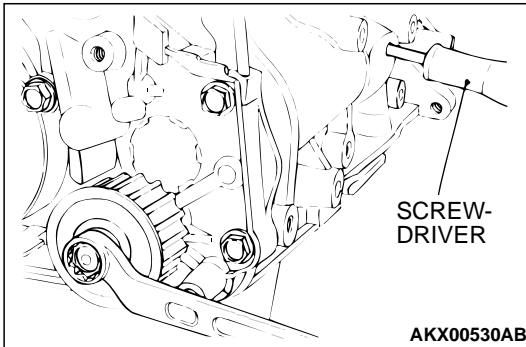
#### >>G<< CRANKSHAFT SENSING BLADE/CRANKSHAFT SPROCKET/CRANKSHAFT PULLEY WASHER/ CRANKSHAFT BOLT INSTLLATION

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 an appropriately small amount of oil to the threads and seating surface of the crankshaft bolt.
5. Install the washer to the crankshaft bolt with its largely chamfered side toward the bolt head.



6. Lock the flywheel or drive plate using the special tool.
7. Tighten the crankshaft bolt to the specified torque.

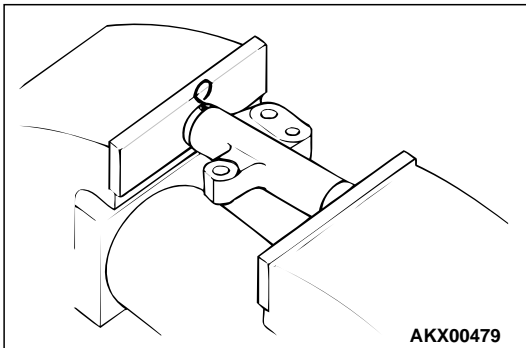
**Tightening torque:  $162 \pm 5$  N·m ( $119 \pm 4$  ft-lb)**



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

1. Insert a Phillips head screwdriver [shank diameter 8 mm (0.3 inch)] 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.

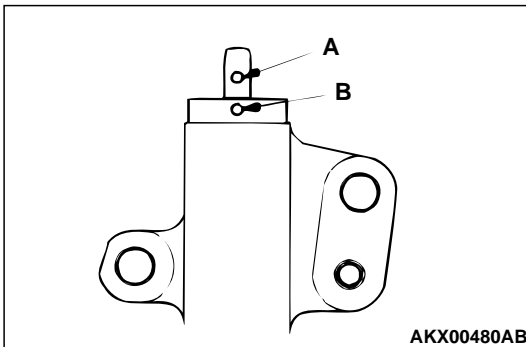
**Tightening torque:  $54 \pm 5$  N·m ( $40 \pm 4$  ft-lb)**

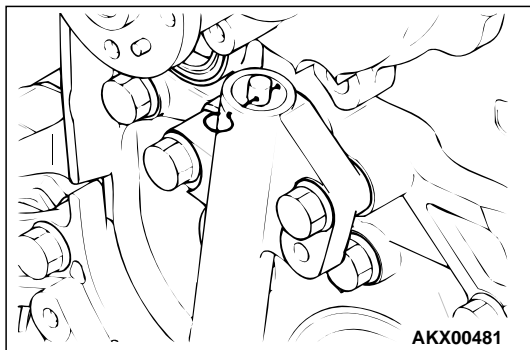


#### >>I<< AUTO-TENSIONER INSTALLATION

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 the hole B in the cylinder.
3. Insert a wire [1.4 mm (0.055 inch) 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**

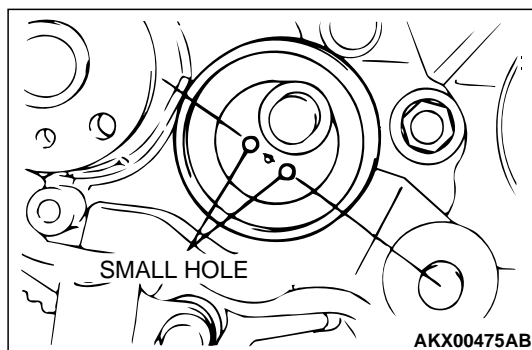
Leave the wire installed in the auto-tensioner.

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

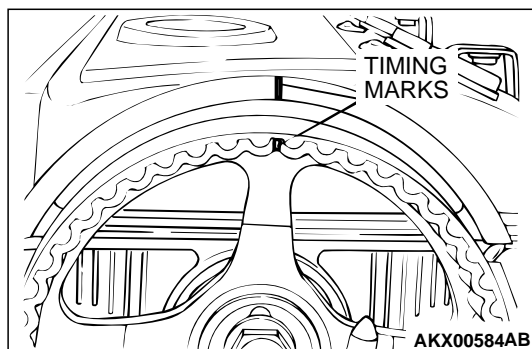
**Tightening torque:  $24 \pm 3$  N·m ( $17 \pm 2$  ft-lb)**

**>>J<< TIMING BELT INSTALLATION**

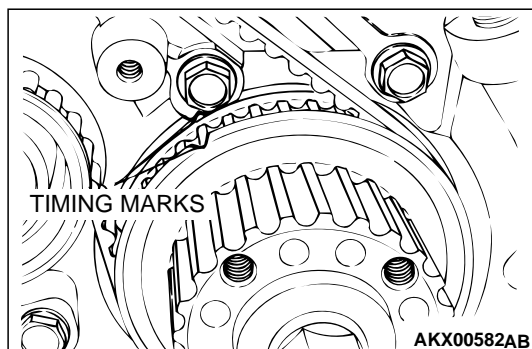
1. Set the tensioner pulley so that the holes for attaching a wrench may be positioned as shown in the illustration.

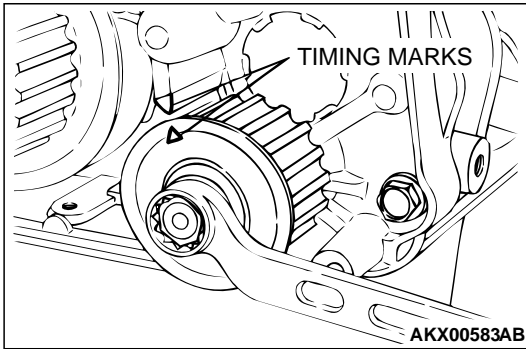


2. Align the timing mark on the camshaft sprocket with the timing mark on the rocker cover.

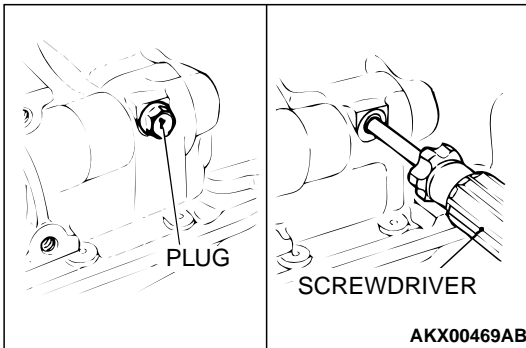


3. Align the timing mark on the crankshaft sprocket with the timing mark on the front case.





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



5. Remove the plug on the cylinder block and insert a Phillips head screwdriver [shank diameter 8 mm (0.3 inch)] through the hole.

If it can be inserted as deep as 60 mm (2.4 inches) or more, the timing marks are correctly aligned.

If the inserted depth is only 20 to 25 mm (0.8 to 0.9 inch), turn the oil pump sprocket one turn and realign the timing marks. Then check to ensure that the screwdriver can be inserted 60 mm (2.4 inches) or more. Keep the screwdriver inserted until the timing belt is completely installed.

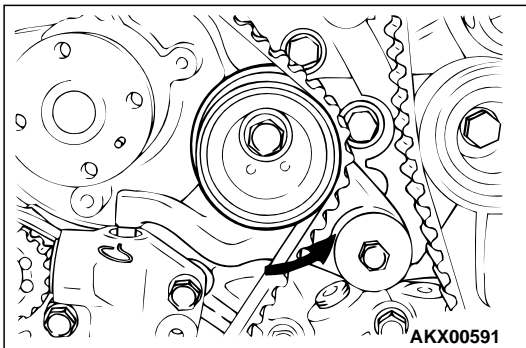
6. Install the timing belt on the crankshaft sprocket, oil pump sprocket, idler pulley, camshaft sprocket, and tensioner pulley in that order.

7. Lift up the tensioner pulley in the direction of 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.



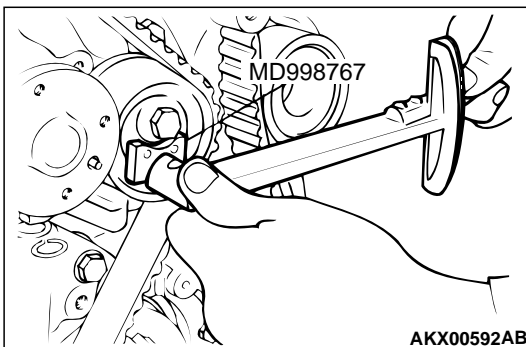
11. Install special tool, MD998767 Socket Wrench and Torque Wrench, onto the tensioner pulley, and loosen the tensioner pulley center bolt.

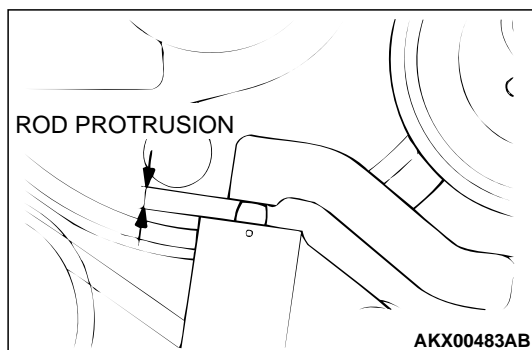
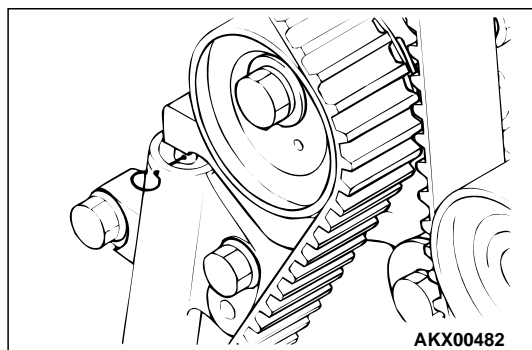
*NOTE: Use a torque wrench that can measure 0 to 5.0 N·m (0 – 50 in-lb).*

12. Torque to 3.5 N·m (30 in-lb) with the torque wrench.

13. Holding the tensioner pulley with special tool MD998767 and torque wrench, tighten the center bolt to specification.

**Tightening torque: 48 ± 6 N·m (35 ± 4 ft-lb)**





14. Give two clockwise turns to the crankshaft. Wait for 15 minutes, then proceed with the following inspection steps.

15. 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 (0.15 – 0.17 inch)**

16. 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

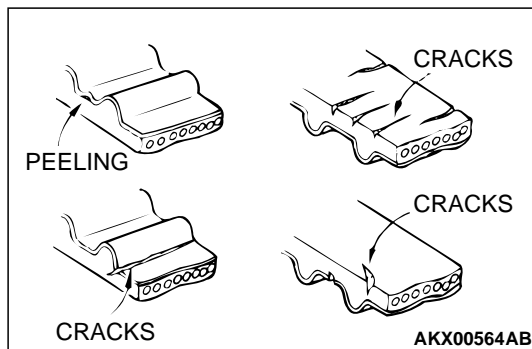
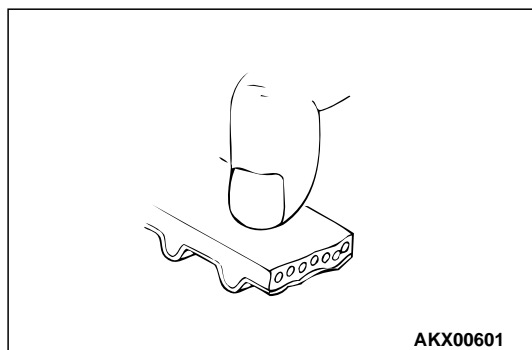
M1113002000050

### TIMING BELT

Replace the belt if any of the following conditions exist:

1. Hardening of rubber backing.

Back side is glossy without resilience and leaves no indent when pressed with fingernail.



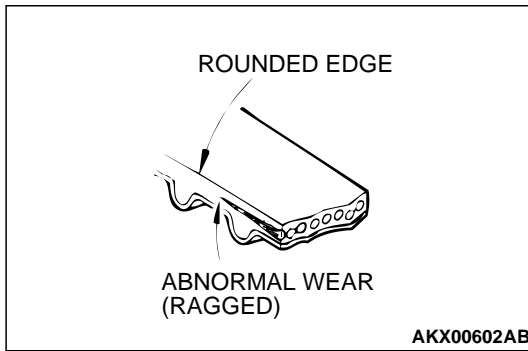
2. Cracks on rubber back.

3. Cracks or peeling of canvas.

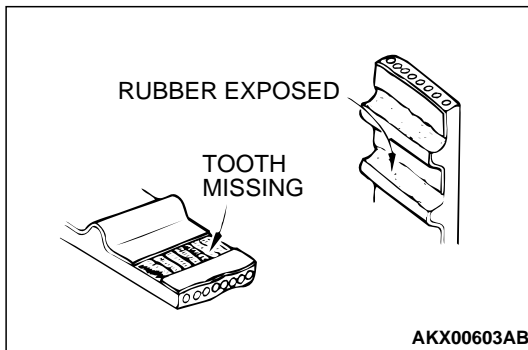
4. Cracks on rib root.

5. Cracks on belt sides.

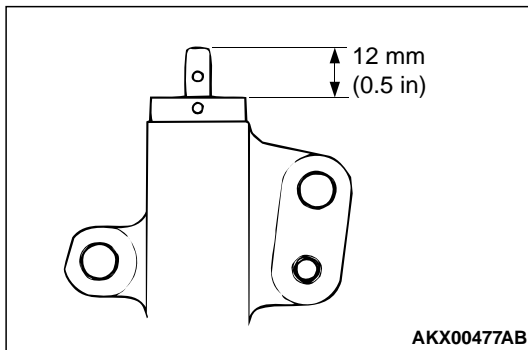




6. Abnormal wear of belt sides. Normal wear is indicated if the sides are sharp as if cut by a knife. Abnormal wear is indicated if the sides are ragged.



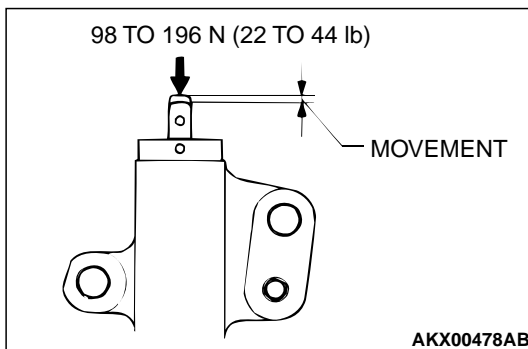
7. Abnormal wear on teeth.  
8. Missing tooth.



#### 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 (0.5 inch)**



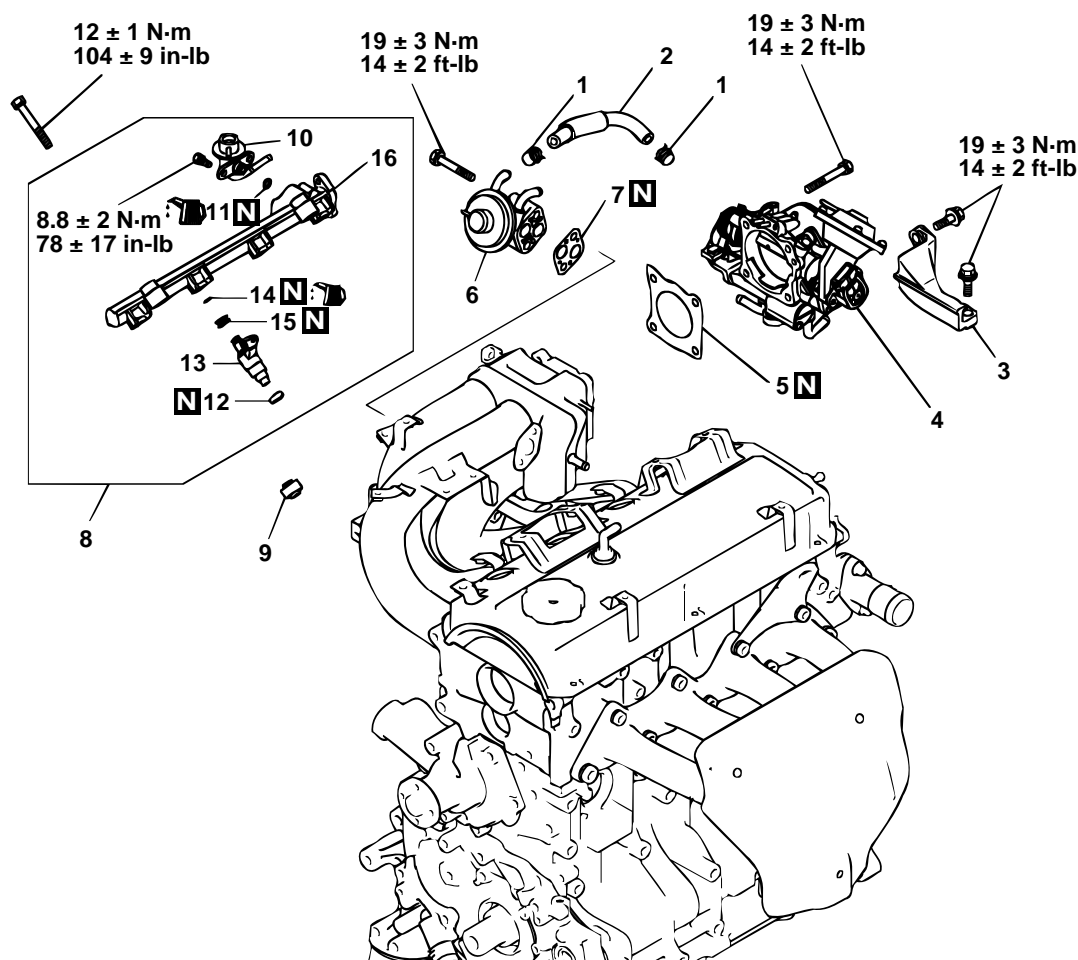
4. Press the rod with a force of 98 to 196 N (22 to 44 pound) and measure the movement of the rod.  
If the measured value is out of the standard value, replace the auto-tensioner.

**Standard value: 1.0 mm (0.03 inch) or less**

## FUEL AND EMISSION PARTS

## REMOVAL AND INSTALLATION

M1113002200032



AKX00513AB

## REMOVAL STEPS

- >>C<<
1. HOSE CLIP
  2. WATER HOSE
  3. THROTTLE BODY STAY
  4. THROTTLE BODY
  5. THROTTLE BODY GASKET
  6. EGR VALVE
  7. GASKET
  8. INJECTOR AND FUEL RAIL

## REMOVAL STEPS (Continued)

- >>B<<
9. INSULATOR
  10. FUEL PRESSURE REGULATOR
- >>A<<
11. O-RING
  12. INSULATOR
  13. INJECTOR
  14. O-RING
  15. GROMMET
  16. FUEL RAIL

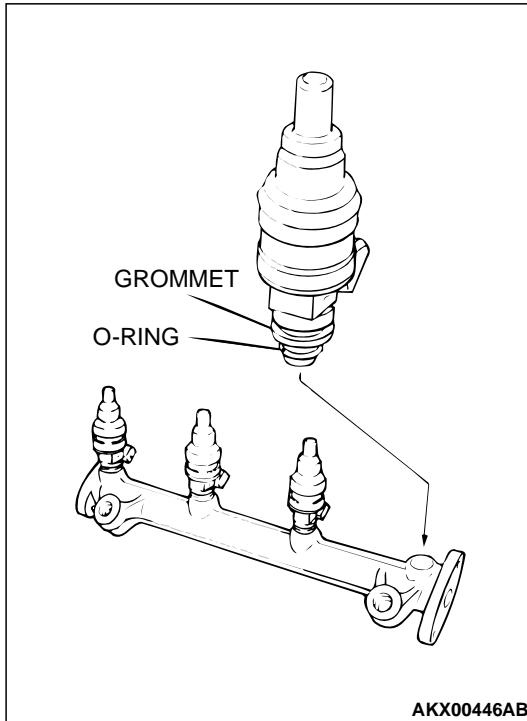
## INSTALLATION SERVICE POINTS

### >>A<< INJECTORS INSTALLATION

#### CAUTION

Use care not to let engine oil enter the fuel rail.

1. Apply clean engine oil to the O-ring.
2. Insert the injector into the fuel rail.
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.



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

#### CAUTION

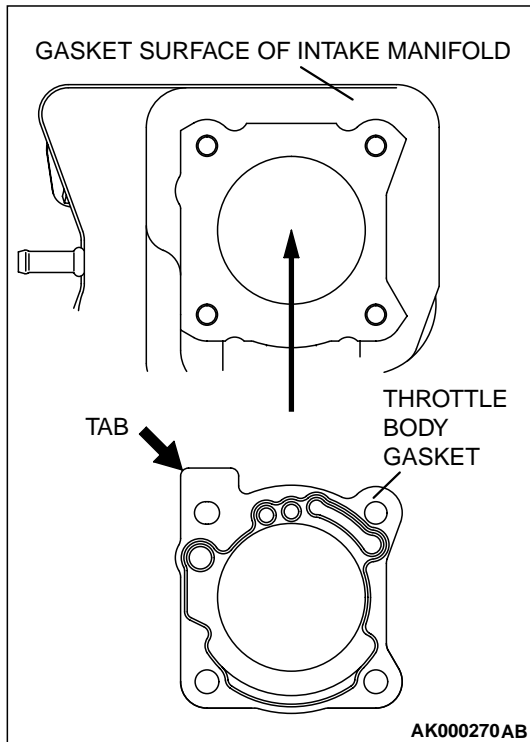
Do not let engine oil enter the fuel rail.

1. Apply clean engine oil to the O-ring.
2. Insert the fuel pressure regulator into the fuel rail.
3. Make sure the pressure regulator rotates smoothly.  
If not, remove the fuel pressure regulator to check the O-ring for damage, and replace the O-ring if necessary. Then, reinstall the fuel pressure regulator and check that it rotates smoothly.
4. Tighten the two bolts to the specified torque.

**Tightening torque:  $8.8 \pm 2$  N·m (78  $\pm$  17 in-lb)**

## &gt;&gt;C&lt;&lt; THROTTLE BODY GASKET INSTALLATION

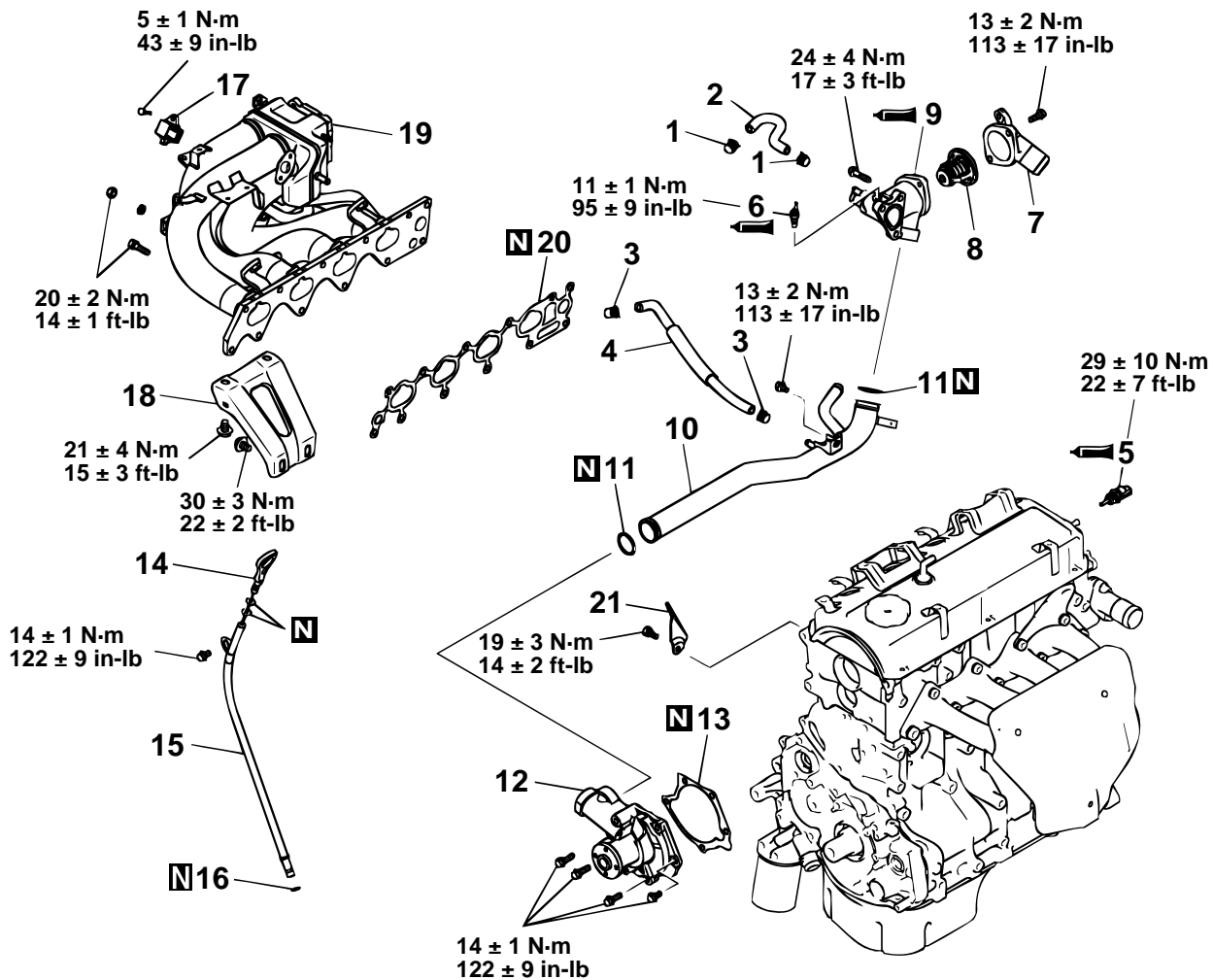
Install a new gasket so that the tab is positioned as shown in the illustration.



# INTAKE MANIFOLD

## REMOVAL AND INSTALLATION

M1113002700059



AKX00511AB

### REMOVAL STEPS

1. HOSE CLIP
2. WATER HOSE
3. HOSE CLIP
4. WATER HOSE
- >>F<< 5. ENGINE COOLANT TEMPERATURE SENSOR
- >>E<< 6. ENGINE COOLANT TEMPERATURE GAUGE UNIT
7. WATER INLET FITTING
- >>D<< 8. THERMOSTAT
- >>C<< 9. THERMOSTAT HOUSING
- >>B<< 10. WATER INLET PIPE

### REMOVAL STEPS (Continued)

- >>B<< 11. O-RING
12. WATER PUMP
13. WATER PUMP GASKET
14. OIL DIPSTICK
15. OIL DIPSTICK GUIDE
16. O-RING
17. MANIFOLD DIFFERENTIAL PRESSURE SENSOR
- >>A<< 18. INTAKE MANIFOLD STAY
19. INTAKE MANIFOLD
20. INTAKE MANIFOLD GASKET
21. ENGINE HANGER

## INSTALLATION SERVICE POINTS

## &gt;&gt;A&lt;&lt; INTAKE MANIFOLD STAY INSTALLATION

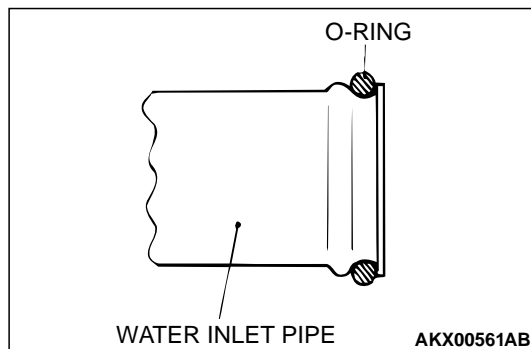
1. Install the intake manifold stay and tighten the bolts just finger tight.
2. Check to ensure that the stay is in close contact with the bosses of the intake manifold and cylinder block.
3. Tighten first the intake manifold side bolts to the specified torque, then the cylinder block side bolts to the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

**Tightening torque:** **$21 \pm 4 \text{ N}\cdot\text{m}$  ( $15 \pm 3 \text{ ft}\cdot\text{lb}$ ) for intake manifold side bolts** **$30 \pm 3 \text{ N}\cdot\text{m}$  ( $22 \pm 2 \text{ ft}\cdot\text{lb}$ ) for cylinder block side bolts**

## &gt;&gt;B&lt;&lt; WATER INLET PIPE/O-RING INSTALLATION

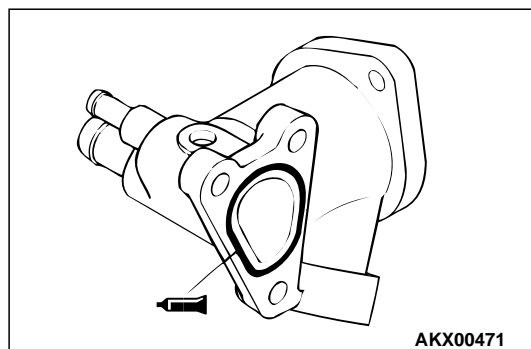
**⚠ CAUTION****Keep the O-ring free of oil or grease.**

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



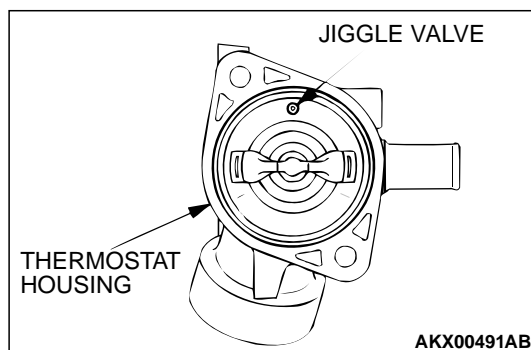
## &gt;&gt;C&lt;&lt; THERMOSTAT HOUSING INSTALLATION

1. Apply a 3 mm (0.1 inch) diameter bead of sealant MITSUBISHI Genuine Part number MD970389 or equivalent to the groove as shown in the illustration.
2. Install the housing quickly (within 15 minutes) while the sealant is wet and tighten the bolts to the specified torque.

**Tightening torque:  $24 \pm 4 \text{ N}\cdot\text{m}$  ( $17 \pm 3 \text{ ft}\cdot\text{lb}$ )***NOTE: After installation, keep the sealed area away from the coolant for approximately one hour.*

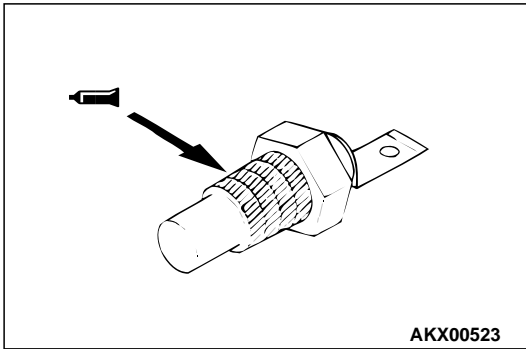
## &gt;&gt;D&lt;&lt; THERMOSTAT INSTALLATION

1. Check that the rubber ring is free from damage 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.



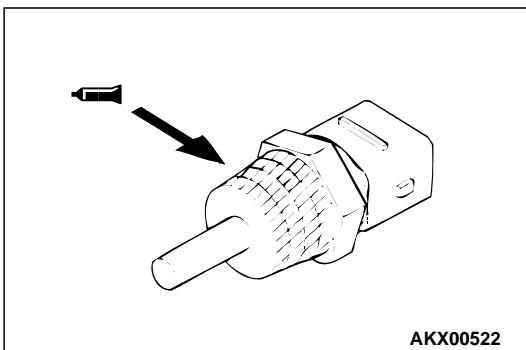
**>>E<< SEALANT APPLICATION TO ENGINE COOLANT  
TEMPERATURE GAUGE UNIT**

Apply 3M™ AAD Part number 8672 or equivalent to the engine coolant temperature gauge unit.



**>>F<< SEALANT APPLICATION TO ENGINE COOLANT  
TEMPERATURE SENSOR**

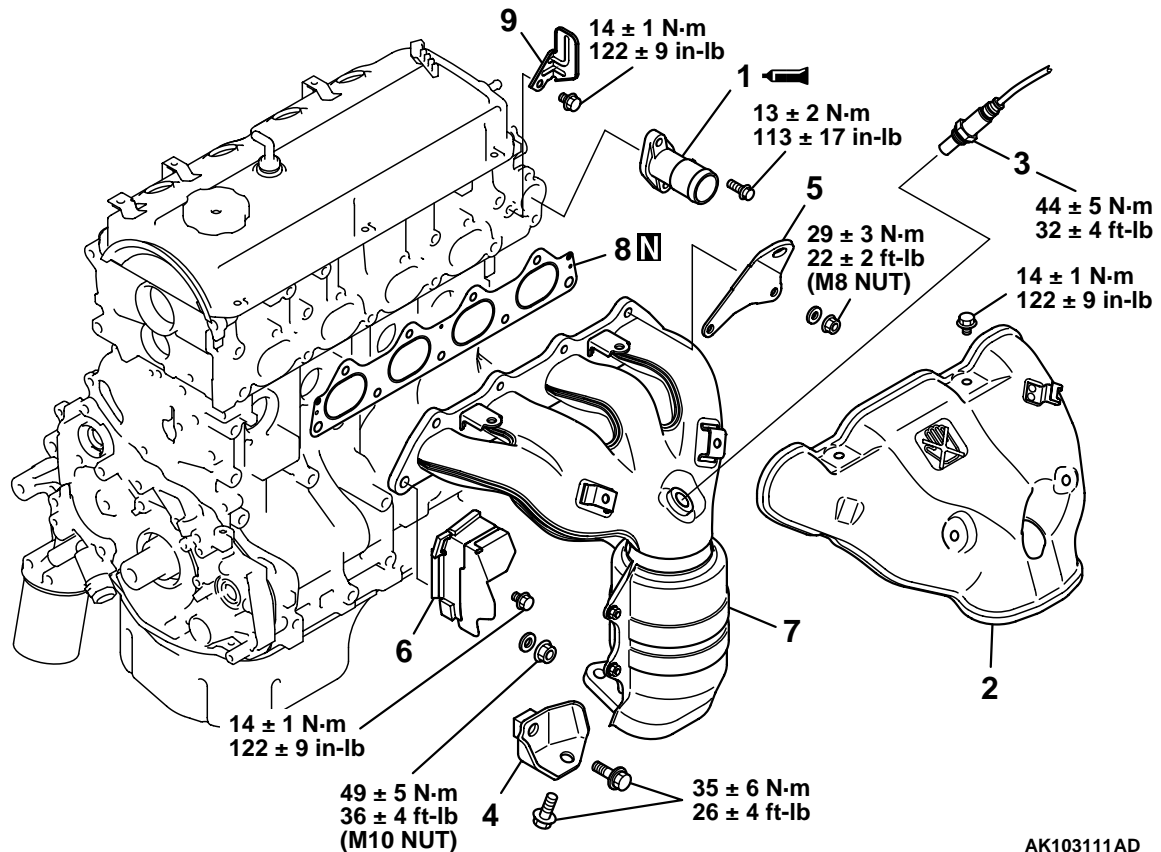
Apply 3M™ AAD Part number 8731 or equivalent to the engine coolant temperature sensor.



## EXHAUST MANIFOLD

## REMOVAL AND INSTALLATION

M1113004900208



AK103111AD

## REMOVAL STEPS

- >>A<<
1. WATER OUTLET FITTING
  2. EXHAUST MANIFOLD COVER
  3. OXYGEN SENSOR
  4. EXHAUST MANIFOLD BRACKET
  5. ENGINE HANGER

## REMOVAL STEPS (Continued)

6. HEAT PROTECTOR
7. EXHAUST MANIFOLD
8. EXHAUST MANIFOLD GASKET
9. HEAT PROTECTOR

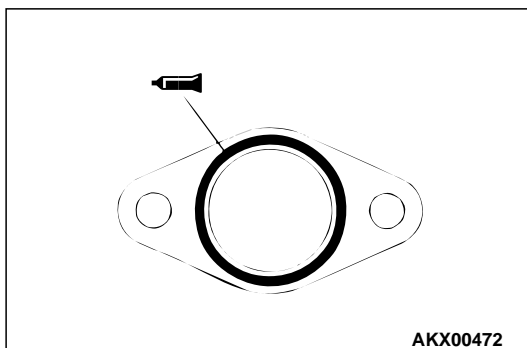
## INSTALLATION SERVICE POINT

## &gt;&gt;A&lt;&lt; WATER OUTLET FITTING INSTALLATION

1. Apply a 3 mm (0.1 inch) diameter bead of sealant. (MITSUBISHI Genuine Part number MD970389) to the groove as shown in the illustration.
2. Install the housing quickly (within 15 minutes) while the sealant is wet and tighten the bolts to the specified torque.

**Tightening torque:  $13 \pm 2 \text{ N}\cdot\text{m}$  ( $113 \pm 17 \text{ in}\cdot\text{lb}$ )**

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



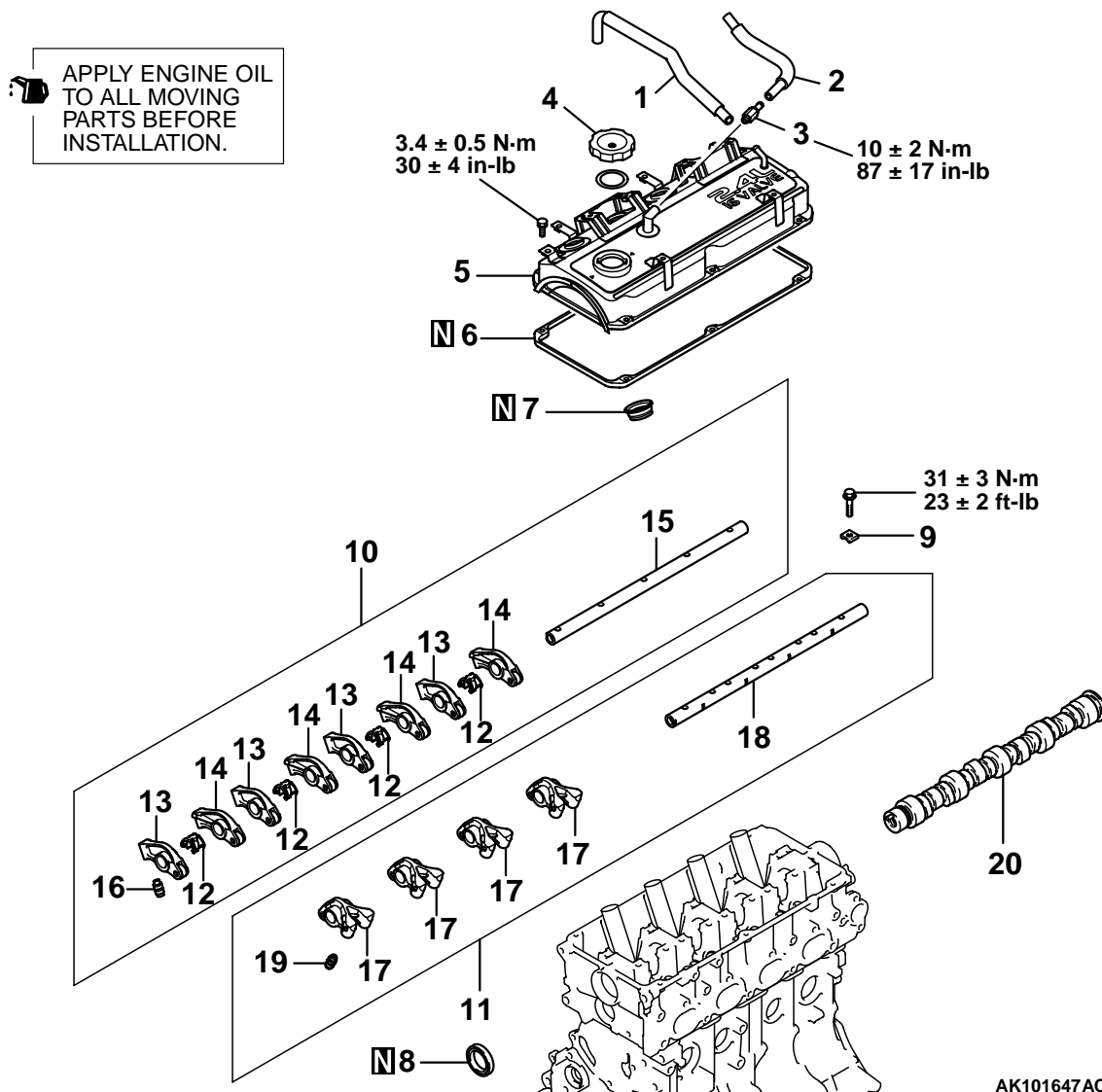
AKX00472



# ROCKER ARMS AND CAMSHAFT

## REMOVAL AND INSTALLATION

M1113005400198



### REMOVAL STEPS

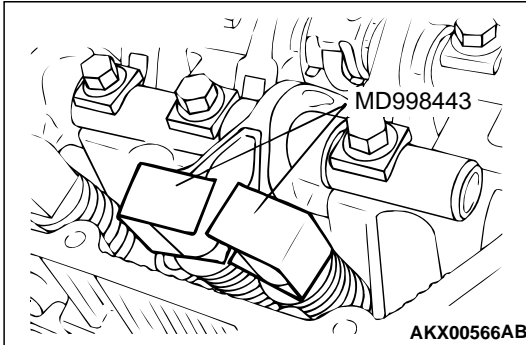
1. BREATHER HOSE
2. PCV HOSE
3. PCV VALVE
4. OIL FILLER CAP
5. ROCKER COVER
6. ROCKER COVER GASKET
7. OIL SEAL
8. OIL SEAL
9. ROCKER SHAFT CAP
10. ROCKER ARMS AND ROCKER ARM SHAFT
11. ROCKER ARMS AND ROCKER ARM SHAFT

### REMOVAL STEPS (Continued)

12. ROCKER SHAFT SPRING
13. ROCKER ARM "B"
14. ROCKER ARM "A"
15. ROCKER ARM SHAFT (INTAKE SIDE)
16. LASH ADJUSTER
17. ROCKER ARM "C"
18. ROCKER ARM SHAFT (EXHAUST SIDE)
19. LASH ADJUSTER
20. CAMSHAFT

**Required Special Tools:**

- MD998442: Air Bleed Wire
- MD998443: Lash Adjuster Holder (8)
- MD998713: Camshaft Oil Seal Installer

**REMOVAL SERVICE POINT****<<A>> ROCKER ARMS AND ROCKER ARM SHAFT REMOVAL****⚠ CAUTION**

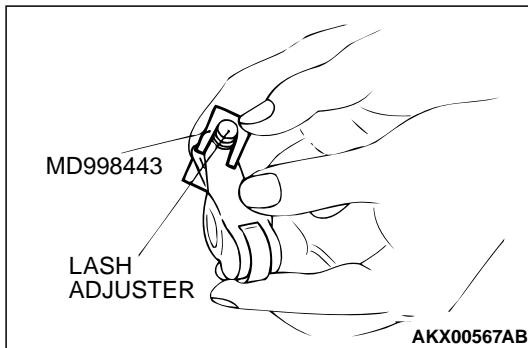
If the lash adjuster is re-used, clean the lash adjuster.  
(Refer to [P.11B-27](#))

Set special tool MD998443 to prevent the lash adjuster coming free and falling to the floor.

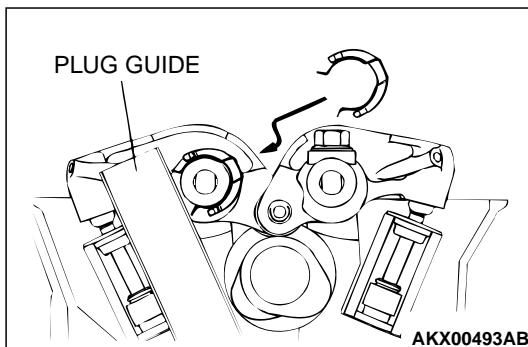
**INSTALLATION SERVICE POINTS****>>A<< LASH ADJUSTER INSTALLATION****⚠ CAUTION**

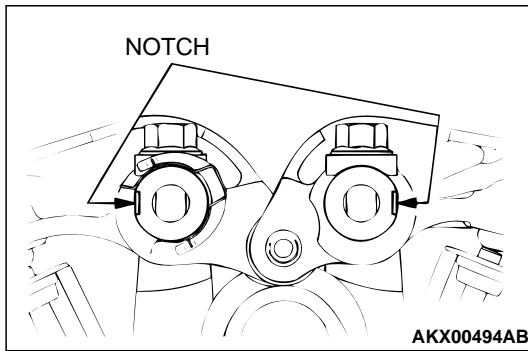
If the lash adjuster is re-used, clean the lash adjuster.  
(Refer to [P.11B-27](#))

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

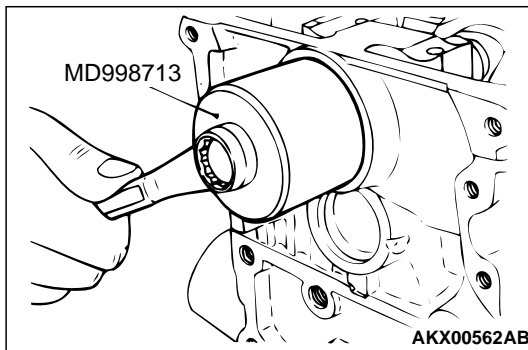
**>>B<< ROCKER SHAFT SPRING/ROCKER ARMS AND ROCKER ARM SHAFT INSTALLATION**

1. Install the exhaust side rocker arm "C"/shaft assembly to the cylinder head.
2. Install the inlet side rocker arm "A" and "B"/shaft assembly to the cylinder head.
3. Install the rocker shaft spring to the intake side rocker arm shaft as illustrated.





4. Make sure that the notch in the end of the rocker arm shaft is facing the direction as shown.



### >>C<< 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 MD998713, install the camshaft oil seal.

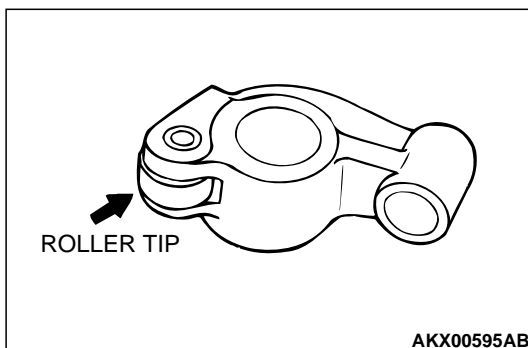
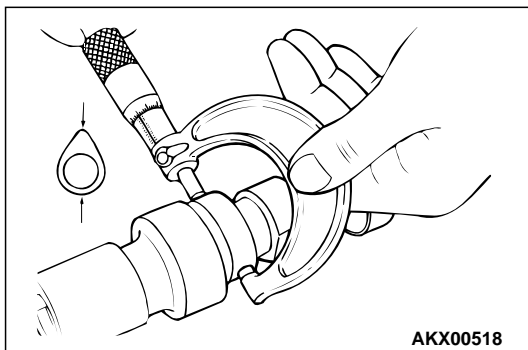
## INSPECTION

M1113005500203

### CAMSHAFT

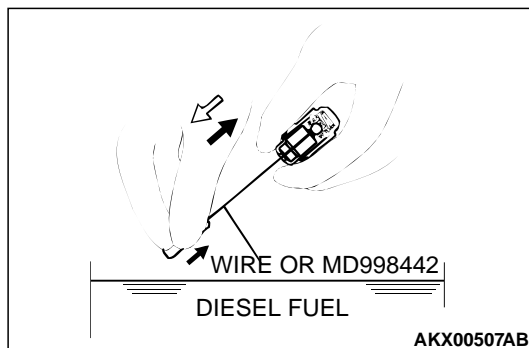
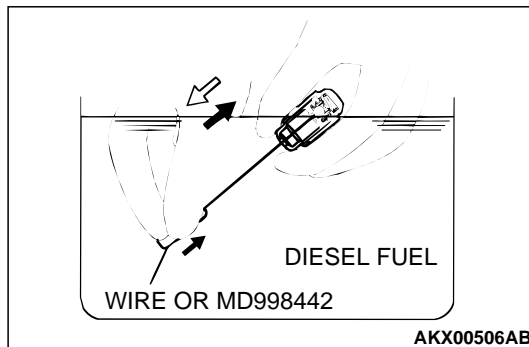
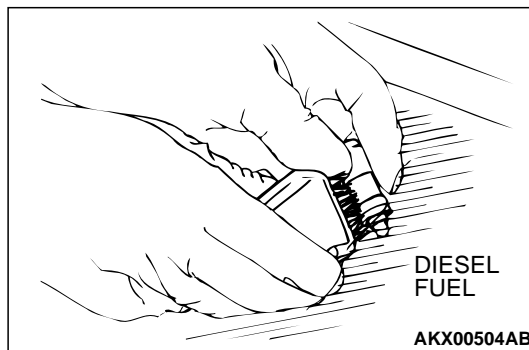
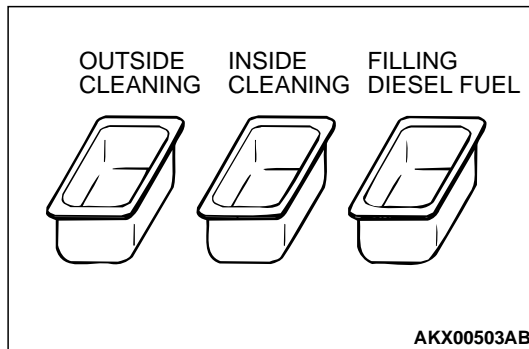
Measure the cam height. If it is below the limit, replace the camshaft.

		STANDARD VALUE	MINIMUM LIMIT
Intake		37.39 mm (1.472 in)	36.89 mm (1.452 in)
Exhaust	M/T	37.14 mm (1.462 in)	36.64 mm (1.443 in)
	A/T	36.83 mm (1.450 in)	36.33 mm (1.430 in)



### ROCKER ARM

1. Check the roller surface. If any dents, damage or seizure are evident, replace the rocker arm.
2. Check rotation of the roller. If it does not rotate smoothly or if looseness is evident, replace the rocker arm.
3. Check the inside diameter. If damage or seizure is evident, replace the rocker arm.



## 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.

1. Prepare three containers and approximately 5 dm<sup>3</sup> (30.5 quart) 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.
2. 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.

3. While gently pushing down the internal steel ball using wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442, move the plunger through five to ten strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will remove dirty oil.

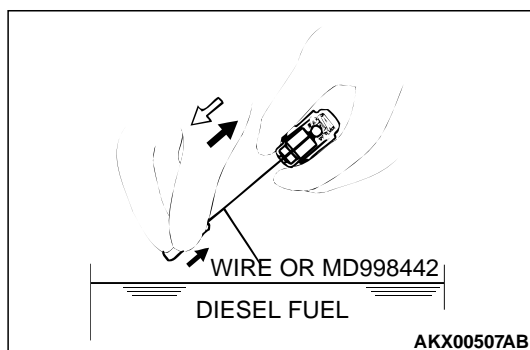
*NOTE: If the plunger remains stiff or the mechanism appears otherwise abnormal, replace the lash adjuster.*

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

**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.

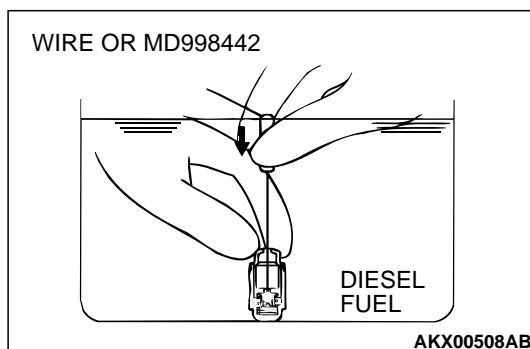
5. Place the lash adjuster in container B. Then, gently push down the internal steel ball using wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442 and move the plunger through five to ten strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.



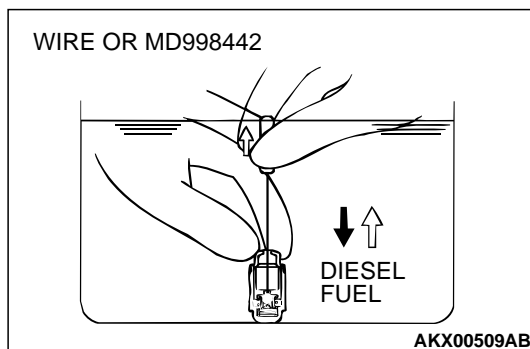
6. Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

**⚠ CAUTION**

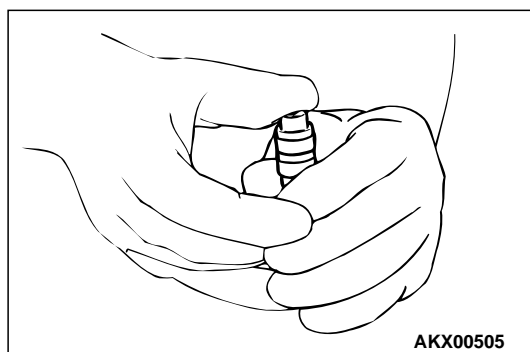
**Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when the chamber is filled with diesel fuel.**



7. Place the lash adjuster in container C. Then, gently push down the internal steel ball using wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442.



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.

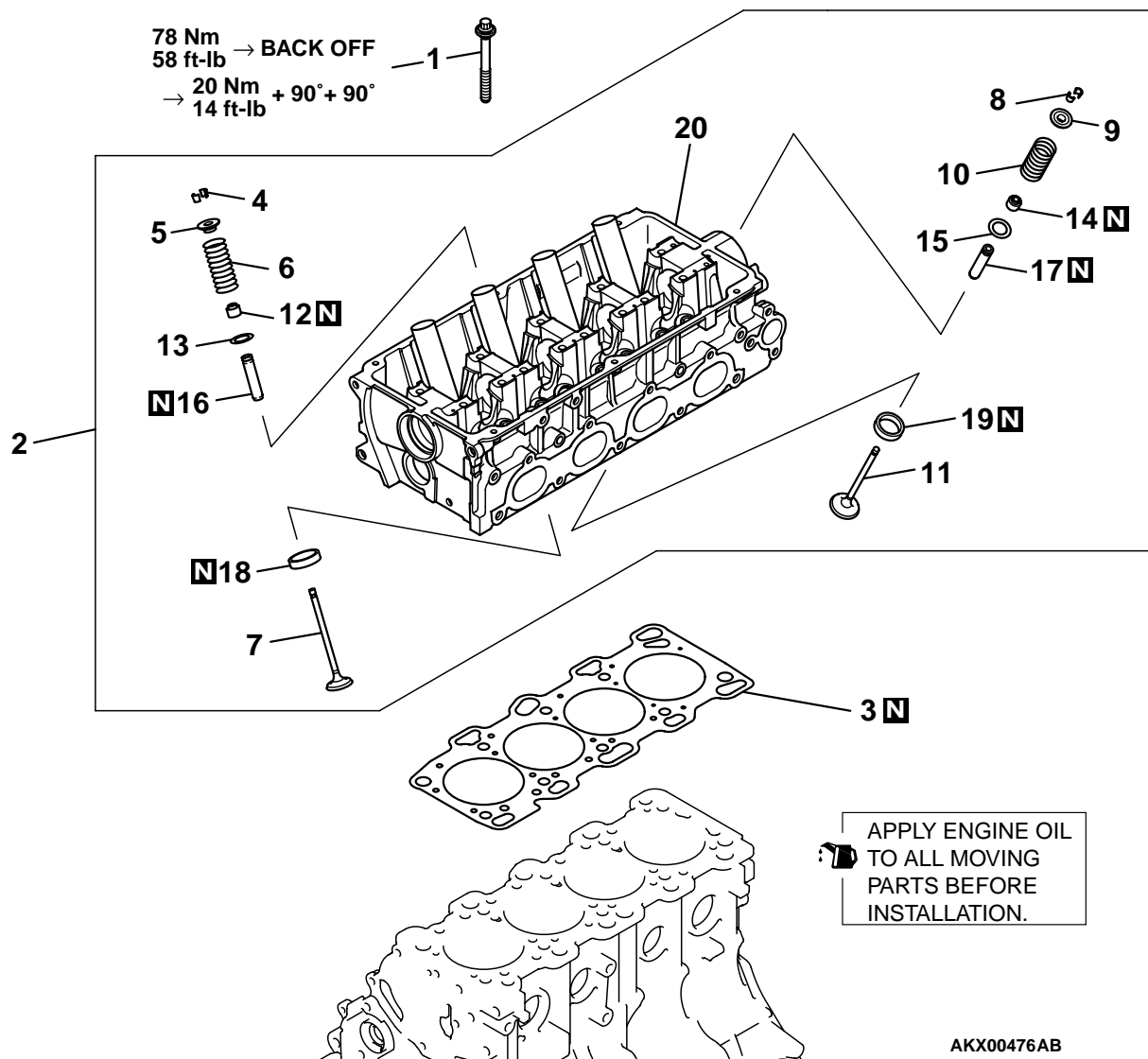
*NOTE: If the lash adjuster contracts or moves, perform the operations (7) through (9) again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts or moves after performing these steps.*

10. Stand the lash adjuster upright to prevent diesel fuel from 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

M1113006900055



## REMOVAL STEPS

- <<A>> >>D<< 1. CYLINDER HEAD BOLT  
2. CYLINDER HEAD ASSEMBLY  
>>D<< 3. CYLINDER HEAD GASKET  
<<B>> >>C<< 4. RETAINER LOCK  
5. VALVE SPRING RETAINER  
>>B<< 6. VALVE SPRING  
7. INTAKE VALVE  
<<B>> >>C<< 8. RETAINER LOCK  
9. VALVE SPRING RETAINER  
>>B<< 10. VALVE SPRING

## REMOVAL STEPS (Continued)

- >>A<< 11. EXHAUST VALVE  
>>A<< 12. VALVE STEM SEAL  
13. VALVE SPRING SEAT  
>>A<< 14. VALVE STEM SEAL  
15. VALVE SPRING SEAT  
16. INTAKE VALVE GUIDE  
17. EXHAUST VALVE GUIDE  
18. INTAKE VALVE SEAT  
19. EXHAUST VALVE SEAT  
20. CYLINDER HEAD

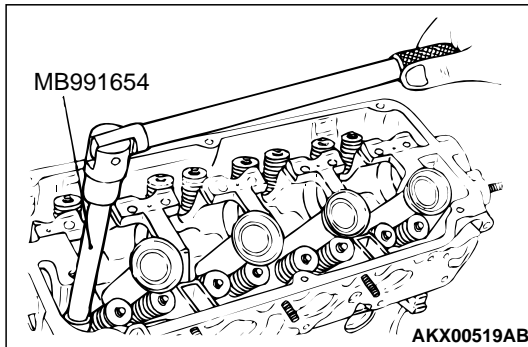
## Required Special Tools:

- MB991654: Cylinder Head Bolt Wrench (12)
- MD998772: Valve Spring Compressor
- MD998774: Valve Stem Seal Installer

## REMOVAL SERVICE POINTS

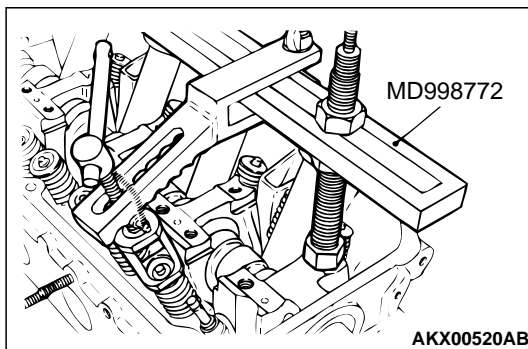
### <<A>> CYLINDER HEAD BOLTS REMOVAL

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



### <<B>> RETAINER LOCK REMOVAL

1. Set special tool MD998772 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 indicated their cylinder number and location for assembly.



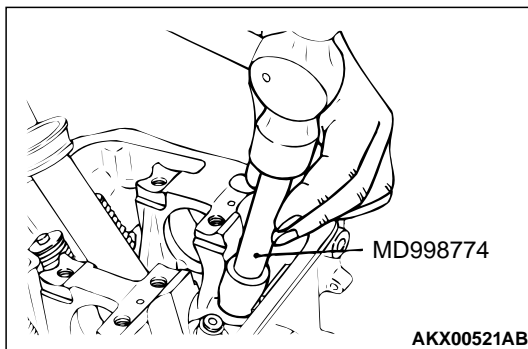
## INSTALLATION SERVICE POINTS

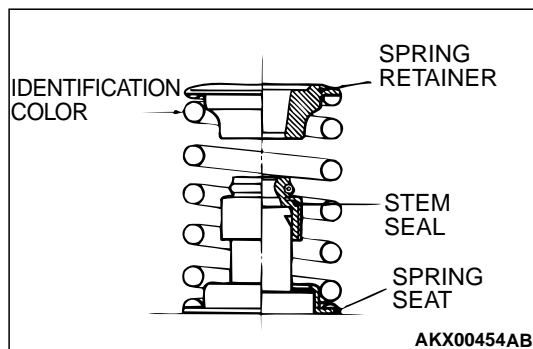
### >>A<< VALVE STEM SEAL INSTALLATION

#### 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 MD998774, install a new valve stem seal.



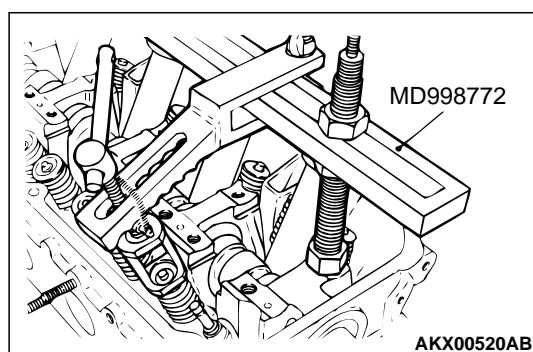
**>>B<< VALVE SPRING INSTALLATION**

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

**>>C<< RETAINER LOCK INSTALLATION****⚠ CAUTION**

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

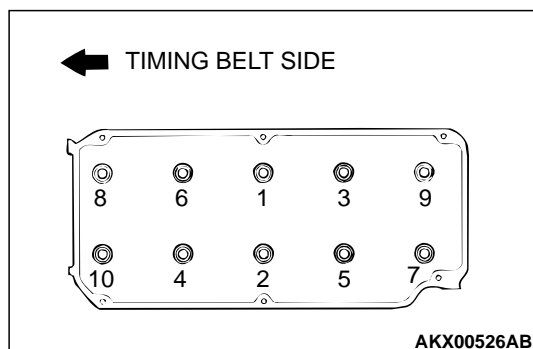
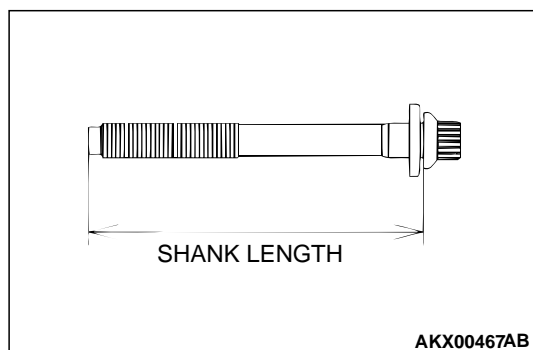
1. Set special tool MD998772 as illustrated to compress the valve spring. Install the retainer locks.
2. Relieve the spring tension. Check that the retainer locks are seated correctly.

**>>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.

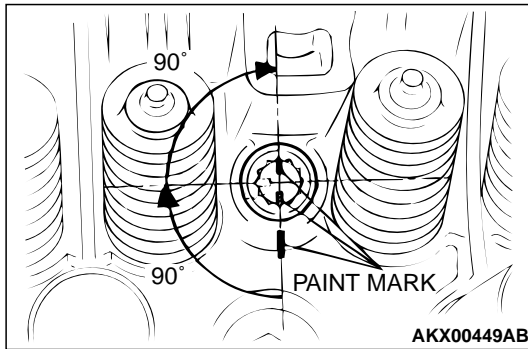
**Limit: 99.4 mm (3.91 inches)**

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



3. Using special tool MB991654 tighten the bolts to the specified torque 78 N·m (58 ft-lb), using the tightening sequence shown.
4. Loosen all bolts fully in the reverse order of tightening.
5. Retighten the loosened bolts to 20 N·m (14 ft-lb) in the tightening sequence shown.





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

**CAUTION**

- If the bolt is turned less than 90 degree angle, proper fastening performance may not be achieved. Be careful to turn each bolt exactly 90 degree angle.
  - 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 degree angle 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

M1113007000055

### CYLINDER HEAD

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

**Standard value: 0.05 mm (0.002 inch)**

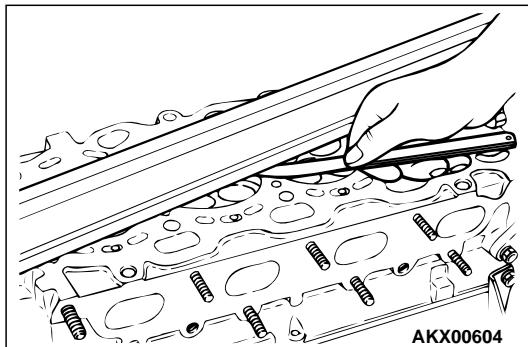
**Limit: 0.2 mm (0.007 inch)**

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

**Grinding limit: \*0.2 mm (0.007 inch)**

**\* Includes combined with cylinder block grinding.**

**Cylinder head height (Specification when new):  
120 mm (4.7 inches)**



### 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 (0.03 inch)**

**<Exhaust> 1.2 mm (0.04 inch)**

**Minimum limit:**

**<Intake> 0.5 mm (0.02 inch)**

**<Exhaust> 0.7 mm (0.03 inch)**

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

**Standard value:**

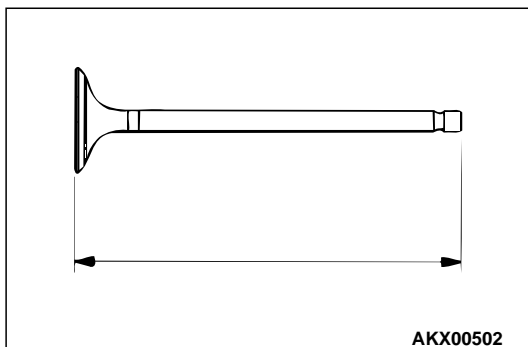
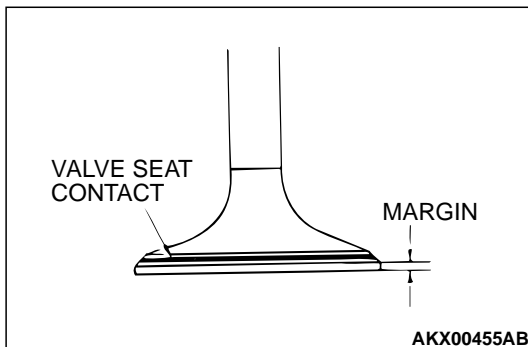
**<Intake> 112.30 mm (4.421 inches)**

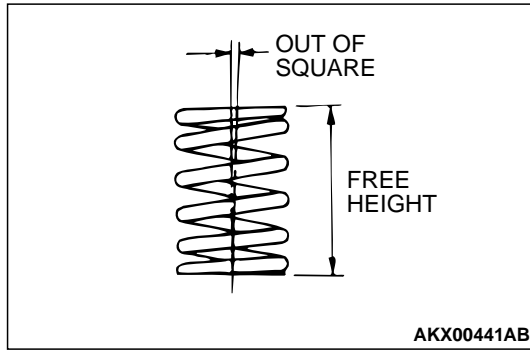
**<Exhaust> 114.11 mm (4.493 inches)**

**Minimum limit:**

**<Intake> 111.80 mm (4.402 inches)**

**<Exhaust> 113.61 mm (4.473 inches)**



**VALVE SPRING**

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

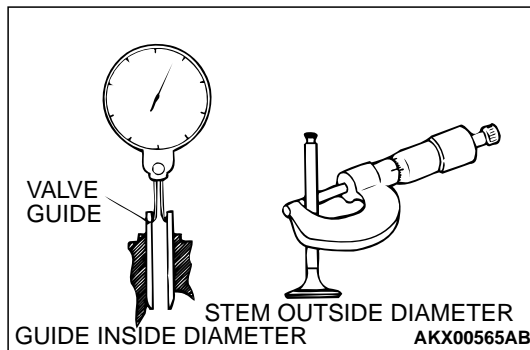
**Standard value: 51.0 mm (2.00 inches)**

**Minimum limit: 50.0 mm (1.97 inches)**

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

**Standard value: 2 degree angle or less**

**Limit: 4 degree angle**

**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:**

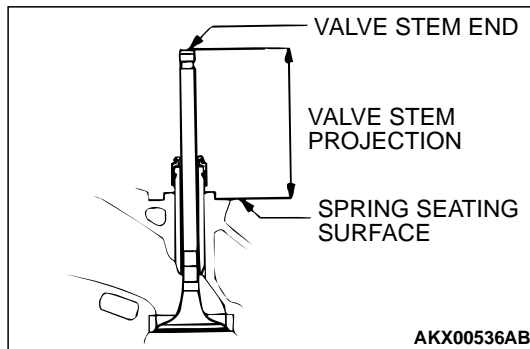
**<Intake> 0.02 – 0.05 mm (0.0008 – 0.0019 inch)**

**<Exhaust> 0.03 – 0.07 mm (0.0012 – 0.0027 inch)**

**Limit:**

**<Intake> 0.10 mm (0.003 inch)**

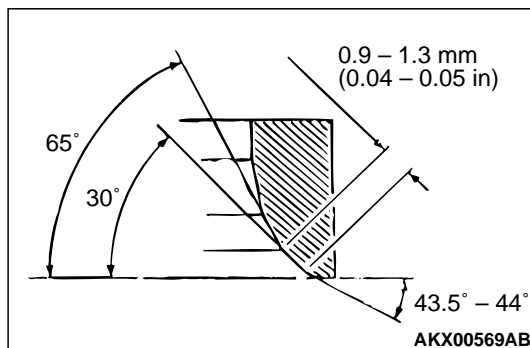
**<Exhaust> 0.15 mm (0.005 inch)**

**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.

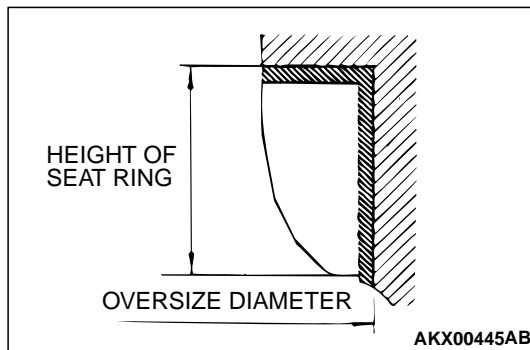
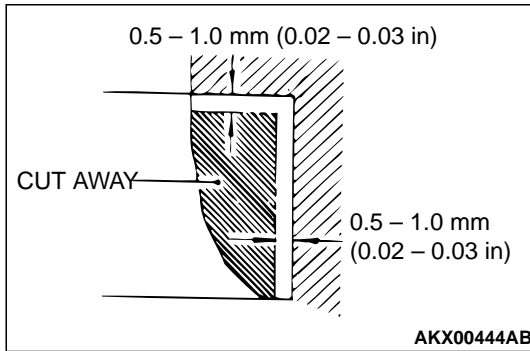
**Standard value: 49.30 mm (1.941 inches)**

**Limit: 49.80 mm (1.960 inches)**

**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 oversize valve seat diameter.

### Intake seat ring hole diameters

#### 0.3 oversize

34.30 - 34.33 mm (1.3504 - 1.3515 inches)

#### 0.6 oversize

34.60 - 34.63 mm (1.3622 - 1.3633 inches)

### Exhaust seat ring hole diameters

#### 0.3 oversize

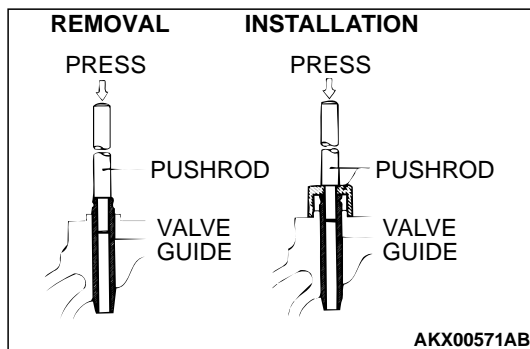
31.80 - 31.83 mm (1.2520 - 1.2531 inches)

#### 0.6 oversize

32.10 - 32.13 mm (1.2638 - 1.2649 inches)

3. Before fitting the valve seat, either heat the cylinder head up to approximately 250°C (482°F) 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.

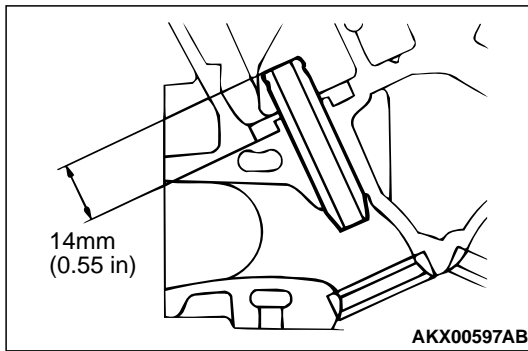
2. Rebore the valve guide hole of the cylinder head so that it fits the press-fitted oversize valve guide.

### Valve guide hole diameters

0.05 oversize 11.05 - 11.07 mm (0.4350 - 0.4358 inch)

0.25 oversize 11.25 - 11.27 mm (0.4430 - 0.4436 inch)

0.50 oversize 11.50 - 11.52 mm (0.4528 - 0.4535 inch)



3. Press-fit the valve guide until it protrudes 14.0 mm (0.55 inch) 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.*

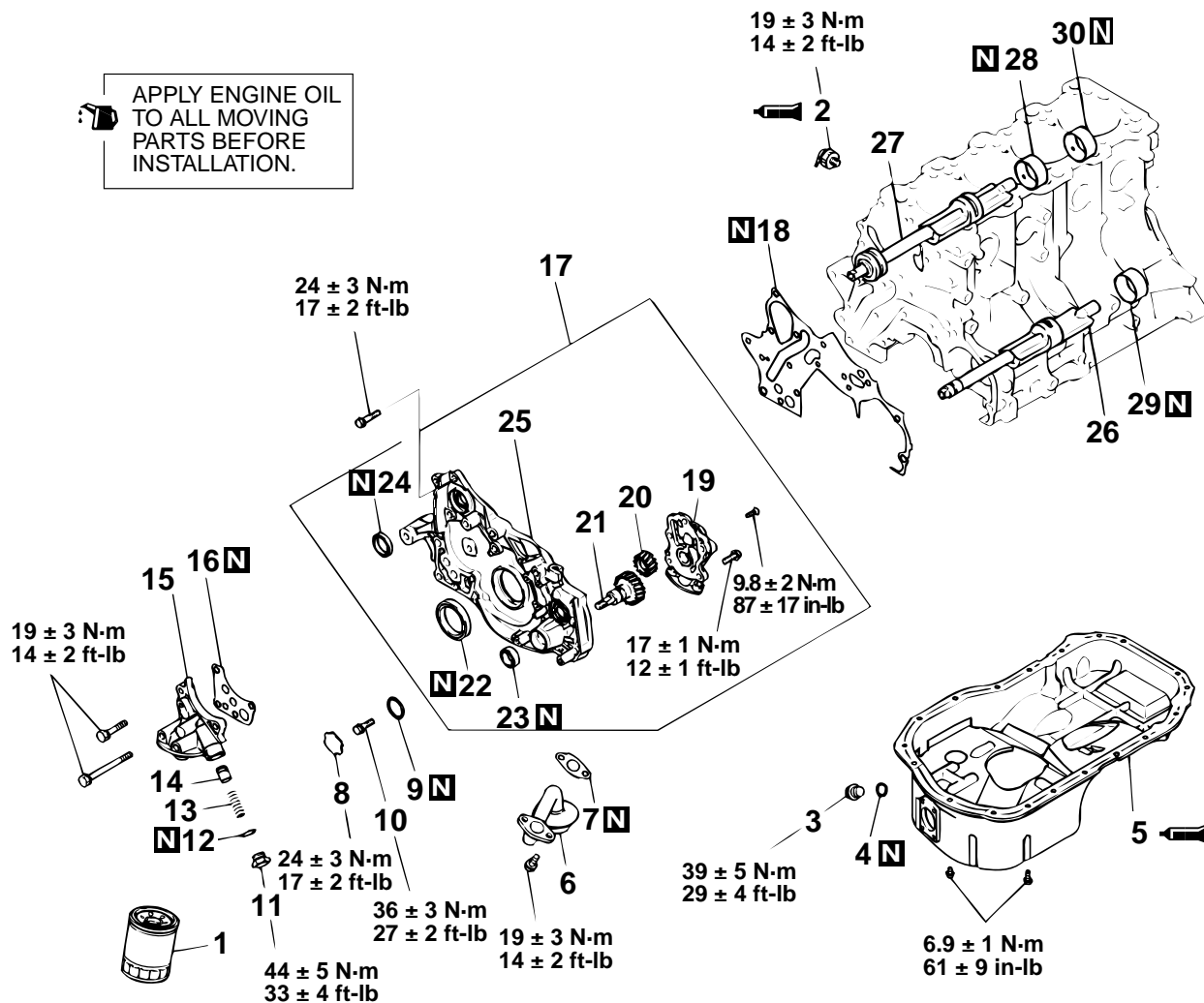
*NOTE: Pay attention to the difference in length of the valve guides. [Intake side: 45.5 mm (1.79 inches); exhaust side: 50.5 mm (1.99 inches)]*

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

## FRONT CASE AND OIL PUMP

### REMOVAL AND INSTALLATION

M1113007200037



AKX00495AB

#### REMOVAL STEPS

- >>M<< 1. OIL FILTER  
>>N<< 2. OIL PRESSURE SWITCH  
3. DRAIN PLUG  
>>L<< 4. DRAIN PLUG GASKET

#### REMOVAL STEPS (Continued)

- <<A>> >>K<< 5. OIL PAN  
6. OIL SCREEN  
7. OIL SCREEN GASKET  
<<B>> >>J<< 8. PLUG

**REMOVAL STEPS (Continued)**

- <<C>> >>I<< 9. O-RING  
10. FLANGE BOLT  
11. RELIEF PLUG  
12. GASKET  
13. RELIEF SPRING  
14. RELIEF PLUNGER  
>>H<< 15. OIL FILTER BRACKET  
16. OIL FILTER BRACKET GASKET  
>>H<< 17. OIL PUMP CASE ASSEMBLY  
18. FRONT CASE GASKET  
19. OIL PUMP COVER  
>>G<< 20. OIL PUMP DRIVEN GEAR  
>>G<< 21. OIL PUMP DRIVE GEAR  
>>F<< 22. CRANKSHAFT FRONT OIL SEAL

**REMOVAL STEPS (Continued)**

- >>E<< 23. OIL PUMP OIL SEAL  
>>D<< 24. COUNTERBALANCE SHAFT OIL SEAL  
25. FRONT CASE  
26. COUNTERBALANCE SHAFT, LEFT  
27. COUNTERBALANCE SHAFT, RIGHT  
<<D>> >>C<< 28. COUNTERBALANCE SHAFT, FRONT BEARING  
<<E>> >>B<< 29. COUNTERBALANCE SHAFT, REAR BEARING, LEFT  
<<E>> >>A<< 30. COUNTERBALANCE SHAFT, REAR BEARING, RIGHT

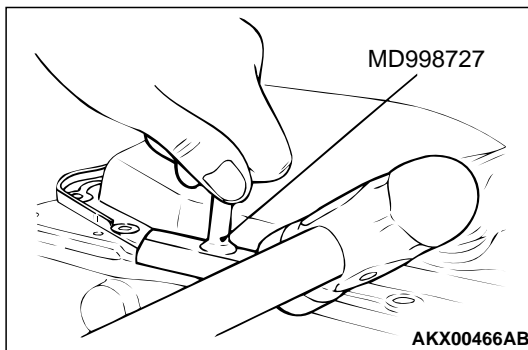
**Required Special Tools:**

- MB991603: Bearing Installer Stopper
- MD998162: Plug Wrench
- MD998285: Crankshaft Front Oil Seal Guide
- MD998371: Silent Shaft Bearing Puller
- MD998372: Silent Shaft Bearing Puller
- MD998375: Crankshaft Front Oil Seal Installer
- MD998705: Silent Shaft Bearing Installer
- MD998727: Oil Pan Remover
- MD998783: Plug Wrench Retainer

**REMOVAL SERVICE POINTS**

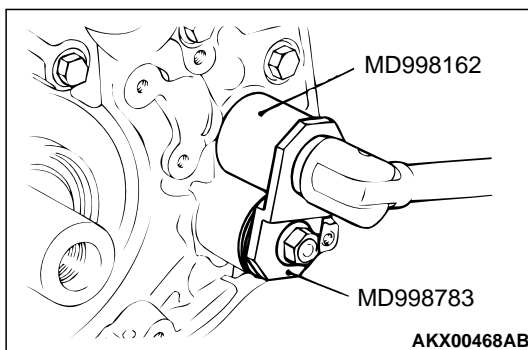
**<<A>> OIL PAN REMOVAL**

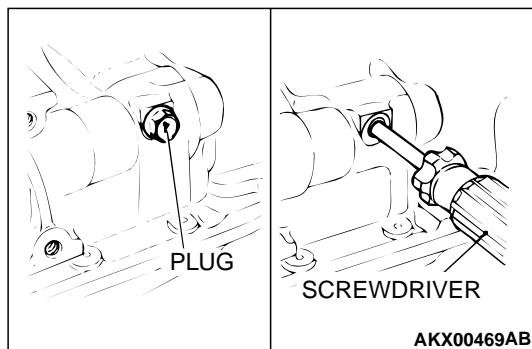
1. Remove all oil pan bolts.
2. Drive in special tool MD998727 between the cylinder block and oil pan.  
*NOTE: Never use a screwdriver or chisel to remove the oil pan. It will deform the oil pan flange and result in oil leakage.*
3. Gently hit the special tool on its corner (shoulder), then slide it along the oil pan to remove it.



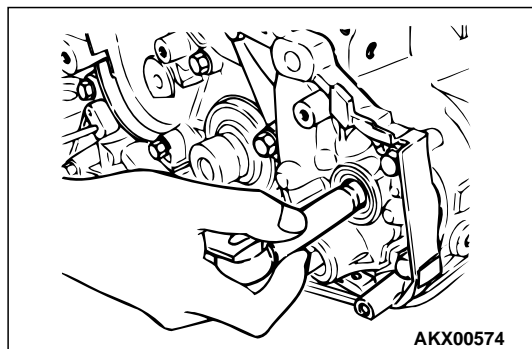
**<<B>> PLUG REMOVAL**

1. Fit special tool MD998162 on the plug, and then hold it in position with special tool MD998783.
2. Loosen the plug.
3. Remove special tools MD998783 and MD998162 and then the plug.

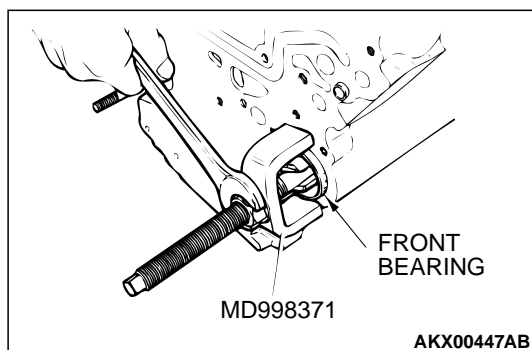


**<<C>> FLANGE BOLT REMOVAL**

1. Remove the plug on the side of the cylinder block.
2. Insert a Phillips screwdriver [shank diameter 8 mm (0.3 inch)] into the plug hole to lock the counterbalance shaft.

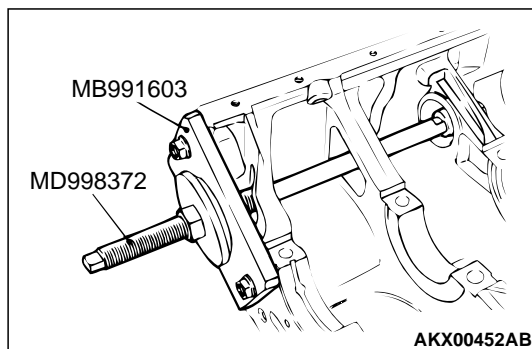


3. Loosen the flange bolt.

**<<D>> COUNTERBALANCE SHAFT FRONT BEARING REMOVAL**

Using special tool MD998371, remove the counterbalance shaft front bearing from the cylinder block.

*NOTE: Be sure to remove the front bearing first. If it has not been removed, special tool MD998372 cannot be used for rear balance shaft bearing removal.*

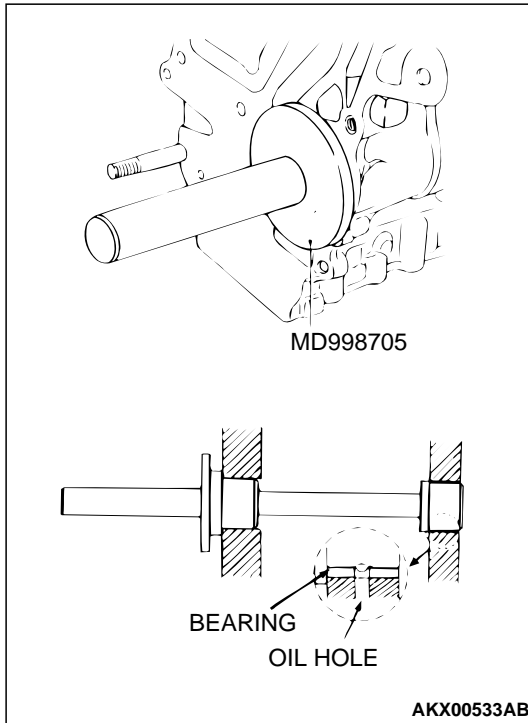
**<<E>> COUNTERBALANCE SHAFT REAR BEARING REMOVAL**

1. Install special tools MB991603 and MD998372 in front of the cylinder block when removing the left counterbalance shaft rear bearing.
2. Using special tool MD998372, remove the right counterbalance shaft rear bearing from the cylinder block.

## INSTALLATION SERVICE POINTS

### >>A<< RIGHT COUNTERBALANCE SHAFT REAR BEARING INSTALLATION

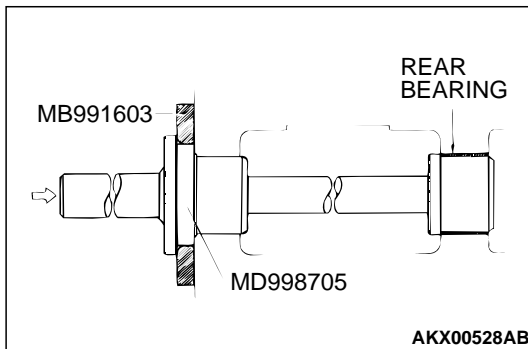
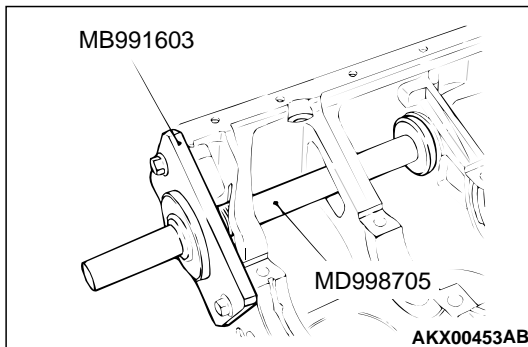
1. Apply engine oil to the bearing outer surface and bearing hole in the cylinder block.
2. Using special tool MD998705, install the rear bearing. Make sure that the oil hole of the bearing is aligned with that of the cylinder block.

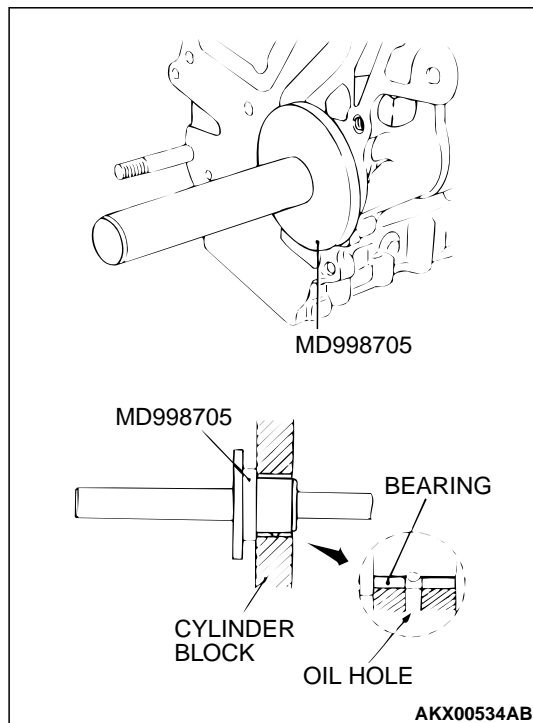


### >>B<< LEFT COUNTERBALANCE SHAFT REAR BEARING INSTALLATION

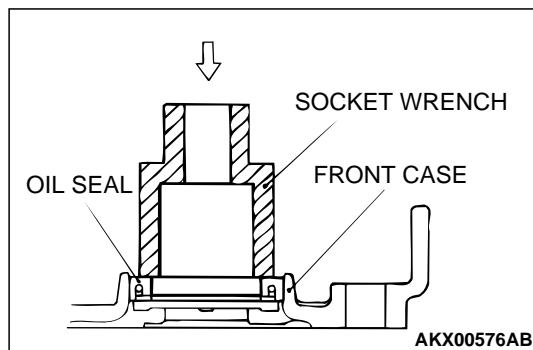
1. Install special tool MB991603 to the cylinder block.
2. Apply engine oil to the rear bearing outer surface and bearing hole in the cylinder block.
3. Using special tool MD998705, install the rear bearing.

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

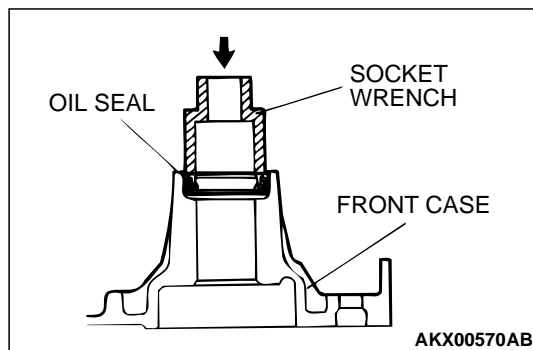


**>>C<< COUNTERBALANCE SHAFT FRONT BEARING INSTALLATION**

1. Apply engine oil to the front bearing outer surface and bearing hole in the cylinder.
2. Using special tool MD998705, install the front bearing. Make sure that the oil hole of the bearing is aligned with that 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.

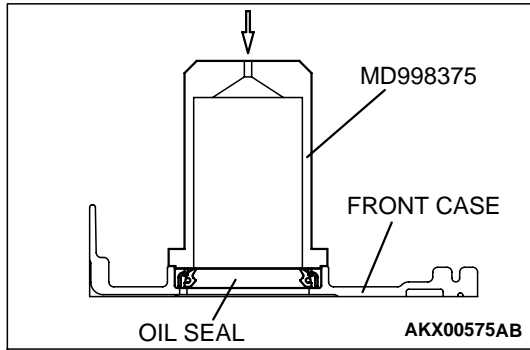
**>>E<< OIL PUMP OIL SEAL INSTALLATION**

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



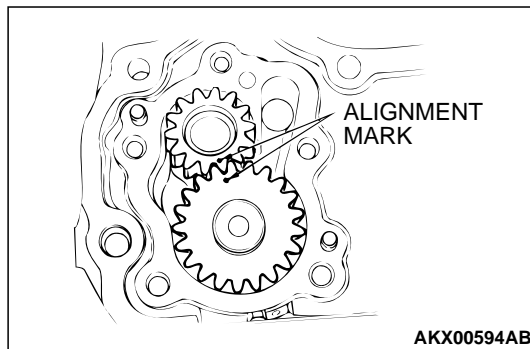
**>>F<< CRANKSHAFT FRONT OIL SEAL INSTALLATION**

Using special tool MD998375, install the crankshaft front oil seal into the front case.



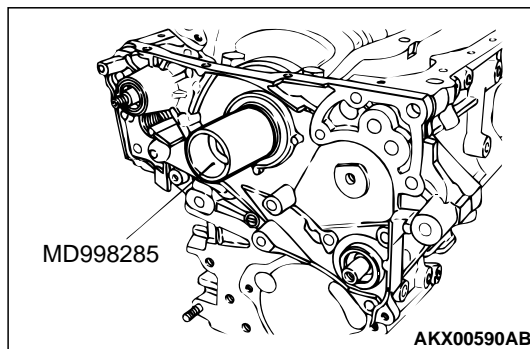
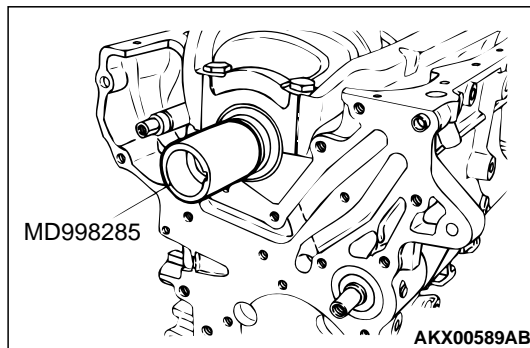
**>>G<< OIL PUMP DRIVEN GEAR/OIL PUMP DRIVE GEAR INSTALLATION**

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

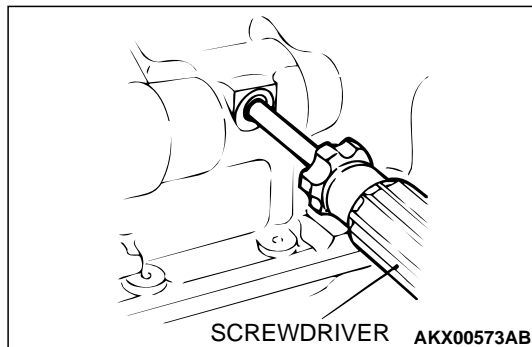


**>>H<< OIL PUMP CASE ASSEMBLY/OIL FILTER BRACKET INSTALLATION**

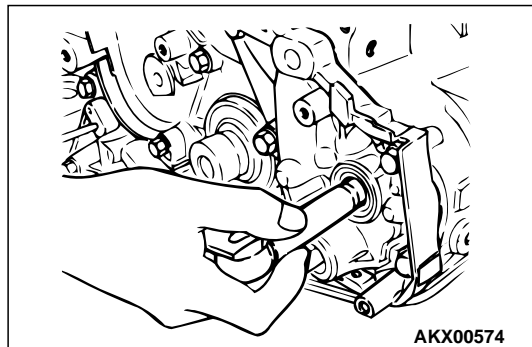
1. Set special tool MD998285 on the front end of crankshaft and apply a thin coat of engine oil to the outer surface of special tool MD998285.
2. Apply engine oil to the lip of the crankshaft front oil seal.



3. Install the oil pump case assembly together with the new front case gasket.
4. Install the oil filter bracket together with the new gasket.
5. Tighten the all flange bolts to  $24 \pm 3$  N·m ( $17 \pm 2$  ft-lb).

**>>I<< FLANGE BOLT INSTALLATION**

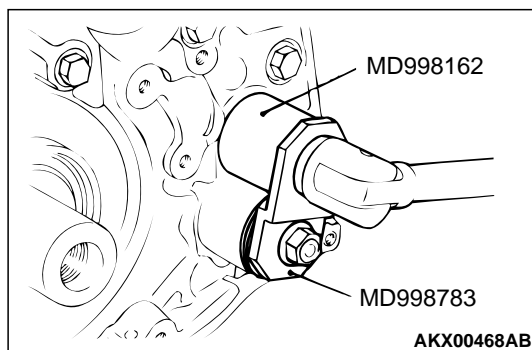
1. Insert a Phillips head screwdriver [shank diameter 8 mm (0.3 inch)] into the hole in the left side of the cylinder block to lock the counterbalance shaft.



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 ( $27 \pm 2$  ft-lb)**

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. Fit special tool MD998162 on the plug, and then hold it in position with special tool MD998783.
4. Tighten the plug to the specified torque.

**Tightening torque:  $24 \pm 3$  N·m ( $17 \pm 2$  ft-lb)**

5. Remove special tools MD998783 and MD998162.

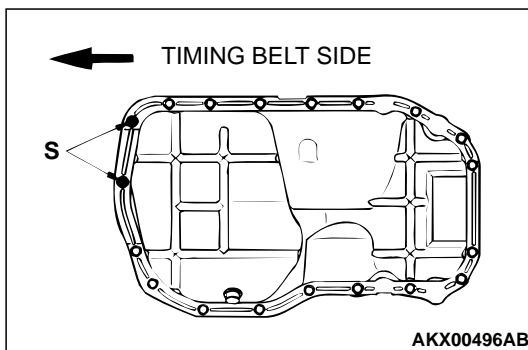
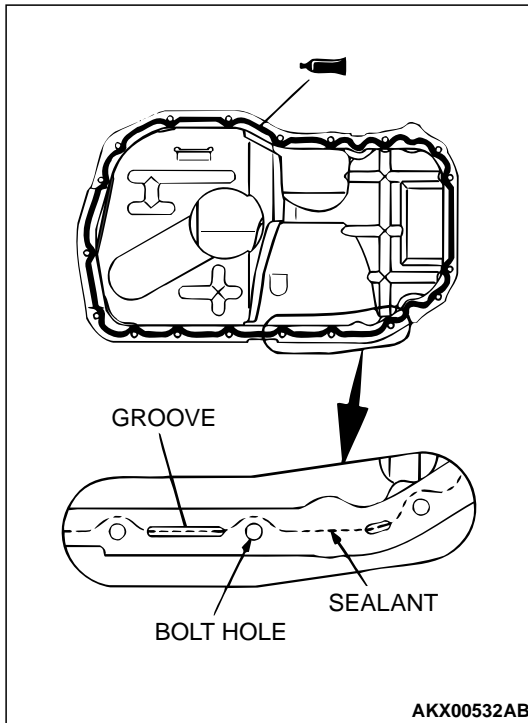
>>K<< OIL PAN INSTALLATION

1. Clean both gasket surfaces of oil pan and cylinder block.
2. Apply a 4 mm (0.15 inch) diameter bead of sealant (MITSUBISHI Genuine Part number MD970389 or equivalent) to the flange of the oil pan.

Apply sealant as indicated by the broken line in the illustration; the grooves must be traced and the bolt holes must be surrounded with a bead of sealant.

3. Install the oil pump case assembly to the front side of the cylinder block.

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



4. Fit an 8 mm (0.30 inch) long bolt in each of the two holes identified by the letter "S" in the illustration and a 10 mm (0.39 inch) long bolt in each of the remaining 17 holes. Tighten all bolts to the specified torque.

**Tightening torque:  $6.9 \pm 1$  N·m ( $61 \pm 9$  in-lb)**

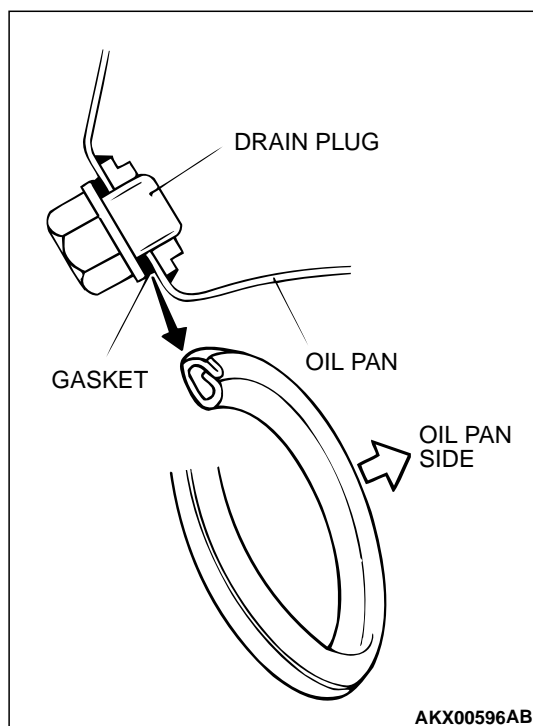
*NOTE: After installation, keep the sealed area away from the oil for approximately one hour.*

## &gt;&gt;L&lt;&lt; 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.



## &gt;&gt;M&lt;&lt; OIL FILTER INSTALLATION

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

**Tightening torque:**

**Part number MD360935 filter:**

**$14 \pm 2 \text{ N}\cdot\text{m}$  ( $122 \pm 17 \text{ in}\cdot\text{lb}$ )**

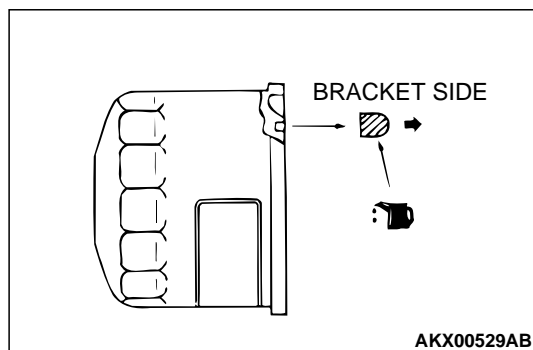
**Other Mitsubishi Genuine filter:**

**$17 \pm 3 \text{ N}\cdot\text{m}$  ( $12 \pm 2 \text{ ft}\cdot\text{lb}$ )**

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

**Part number MD360935 filter: one turn**

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



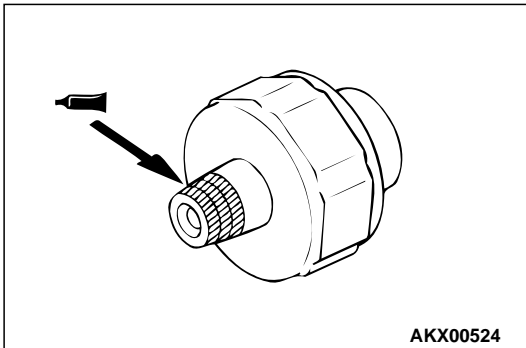
## >>N<< SEALANT APPLICATION TO OIL PRESSURE SWITCH

### CAUTION

**Be careful not to block the oil passage with sealant.**

1. Apply 3M™ AAD Part number 8672 or equivalent to the threads of the oil pressure switch.
2. Tighten the switch to the specified torque.

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



## INSPECTION

M1113007300034

### FRONT CASE

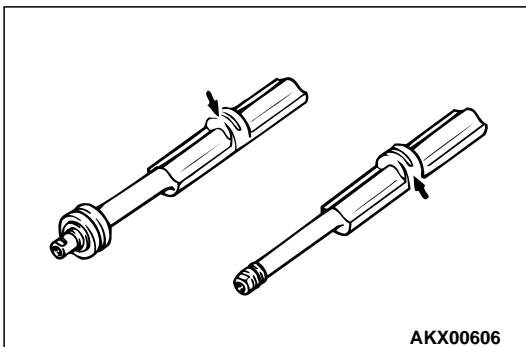
1. Check the oil passage for clogging and clean if necessary.
2. Check the left counterbalance shaft front bearing for wear, damage and seizure. If the bearing is damaged, replace the front case.
3. Check the front case for cracks and other damage.  
Replace cracked or damaged front case.

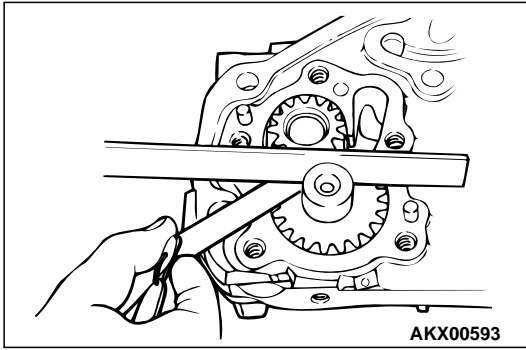
### OIL SEAL

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 (0.004 – 0.006 inch)****Driven gear 0.06 – 0.12 mm (0.003 – 0.004 inch)**

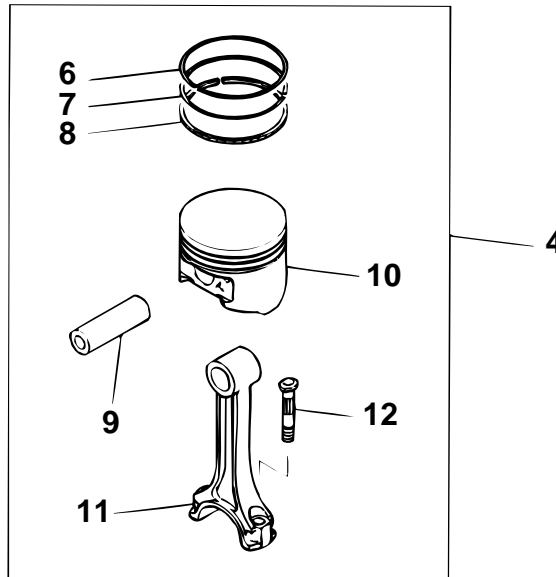
# PISTON AND CONNECTING ROD

## REMOVAL AND INSTALLATION

M1113008400238



APPLY ENGINE OIL  
TO ALL MOVING  
PARTS BEFORE  
INSTALLATION.



$20 \pm 2 \text{ N}\cdot\text{m}$   
 $14 \pm 1 \text{ ft}\cdot\text{lb}$  + 90° to 94°

AKX00501AB

### REMOVAL STEPS

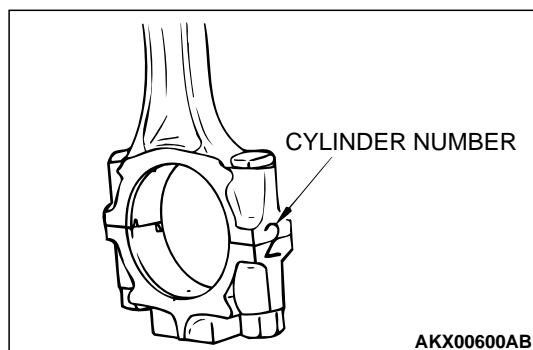
- <<A>> >>G<< 1. NUT  
>>F<< 2. CONNECTING ROD CAP  
>>D<< 3. CONNECTING ROD BEARING  
>>E<< 4. PISTON AND CONNECTING ROD ASSEMBLY  
>>D<< 5. CONNECTING ROD BEARING  
>>C<< 6. PISTON RING No. 1

### REMOVAL STEPS (Continued)

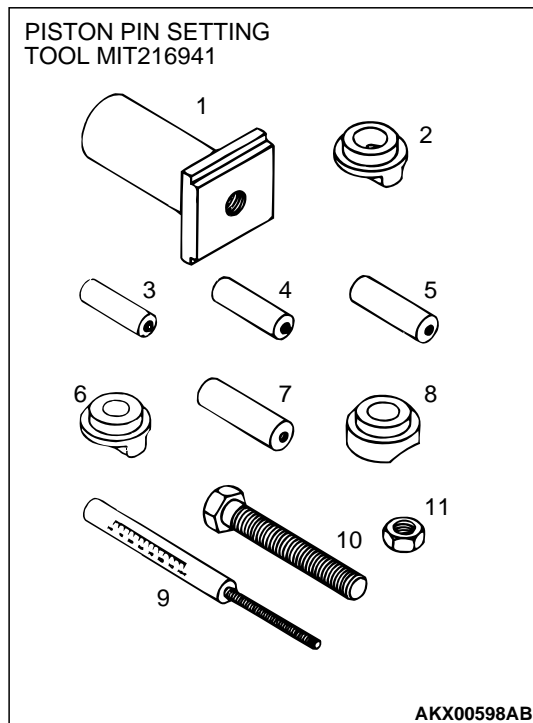
- >>C<< 7. PISTON RING No. 2  
>>B<< 8. OIL RING  
<<B>> >>A<< 9. PISTON PIN  
10. PISTON  
11. CONNECTING ROD  
12. BOLT

**Required Special Tool:**

- MIT216941: Piston Pin Setting Tool

**REMOVAL SERVICE POINTS****<<A>> CONNECTING ROD CAP REMOVAL**

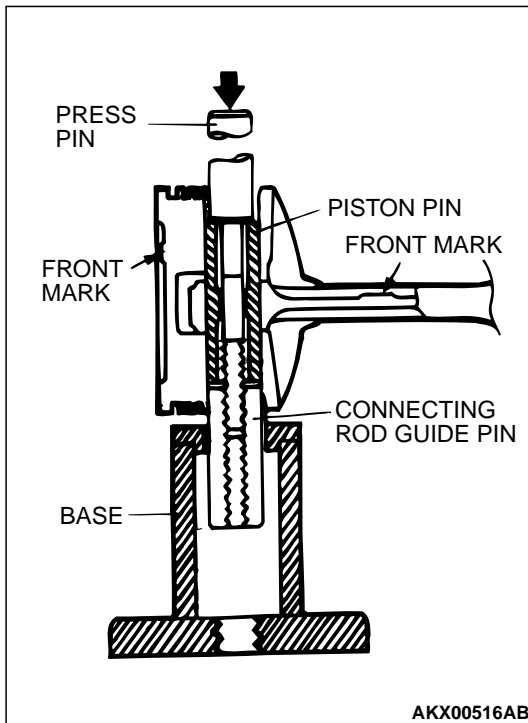
1. Mark the cylinder number on the side of the connecting rod big end for correct reassembly.
2. Keep the removed connecting rods, caps, and bearings in that order according to the cylinder number.

**<<B>> PISTON PIN REMOVAL**

ITEM NO.	PART NO.	DESCRIPTION
1.	MIT310134	Base
2.	MIT310136	Piston support
3.	MIT310137	Connecting rod guide pin
4.	MIT310138	Connecting rod guide pin
5.	MIT310139	Connecting rod guide pin
6.	MIT310140	Piston support
7.	MIT310141	Connecting rod guide pin
8.	MIT310142	Piston support
9.	MIT48143	Press pin
10.	216943	Stop screw
11.	10396	Nut

1. Remove the stop screw from the base.
2. Select the correct piston support for your application (See above). Fit the piston support onto the base. Place the base on press support blocks.





3. Insert the press pin through the piston pin hole. Select the correct connecting rod guide pin (See above). Thread the guide pin onto the threaded portion of the press pin.
4. Position the piston assembly on the piston support in the press. With the press pin up as shown, insert the guide pin through the hole in the piston and through the hole in the piston support.

**CAUTION**

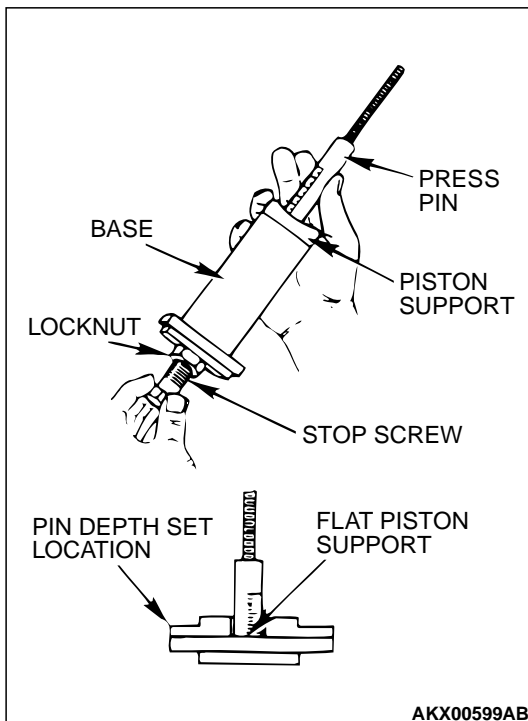
To avoid piston damage, the piston support must seat squarely against the piston. Verify that the piston pin will slide through the hole in the piston support.

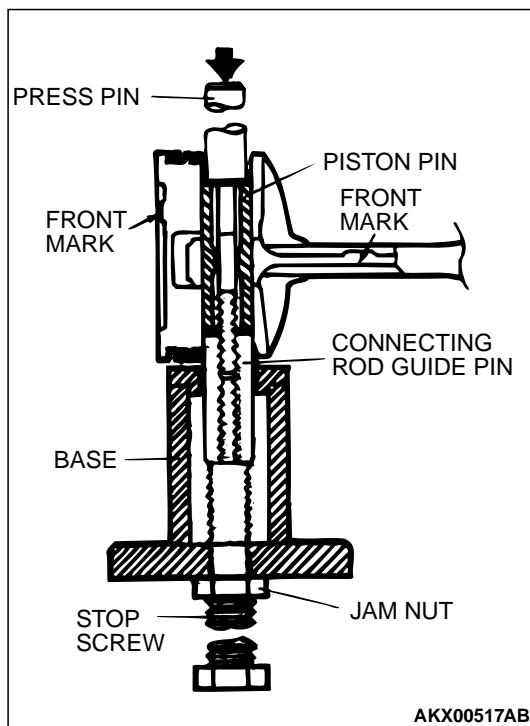
5. Press the piston pin out of the assembly.
6. Remove the piston pin from the press pin.

## INSTALLATION SERVICE POINTS

### >>A<< PISTON PIN INSTALLATION

1. Thread the stop screw and lock nut assembly into the base. Fit the correct piston support on top of the base. Insert the press pin, threaded end up, into the hole in the piston support until the press pin touches the stop screw.
2. Using the markings on the press pin, adjust the stop screw to the depth shown on the instruction for special tool MIT216941.



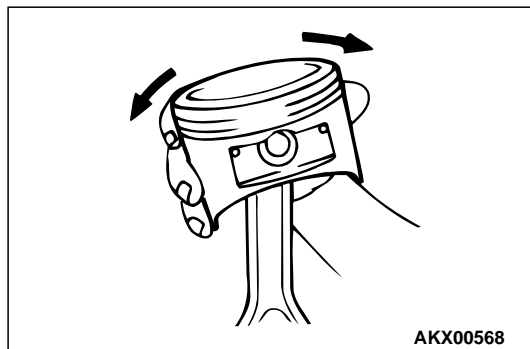


3. Place the base on press support blocks.
4. Slide the piston pin over the threaded end of the press pin, and thread the correct guide pin up against it.
5. Coat the piston pin with engine oil. With the connecting rod held in position, slide the guide pin through the piston and connecting rod.
6. Press the piston pin through the connecting rod until the guide pin contacts the stop screw.

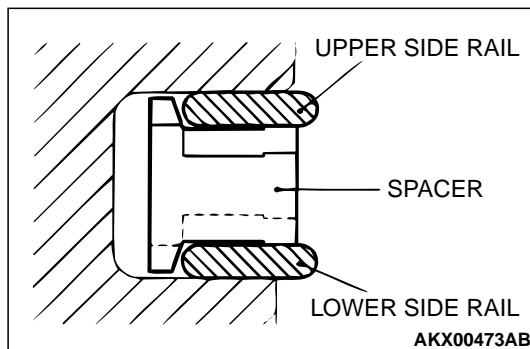
**⚠ CAUTION**

**Due to production tolerance variations, it is necessary to visually inspect the piston pin depth after installation to verify that the piston pin is centered. Adjust if necessary.**

7. Remove the piston assembly from the base. Remove the guide pin and press pin from the assembly.



8. Check that the piston moves smoothly.



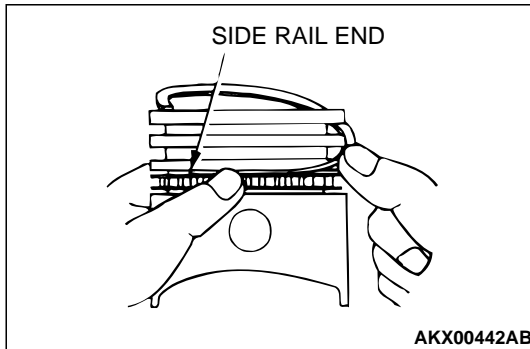
**>>B<< OIL RING INSTALLATION**

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

*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 (0.020 in) oversize diameter	Red
1.00 mm (0.040 in) oversize diameter	Yellow



**⚠ CAUTION**

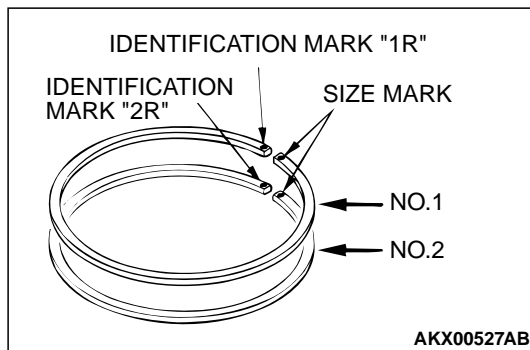
**Do not use a piston ring expander when installing side rail.**

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 finger. See illustration.

3. Install the lower side rail in the same procedure 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. To prevent wrong installation, check the identification mark of each piston ring. The identification mark is stamped near the ring gap:

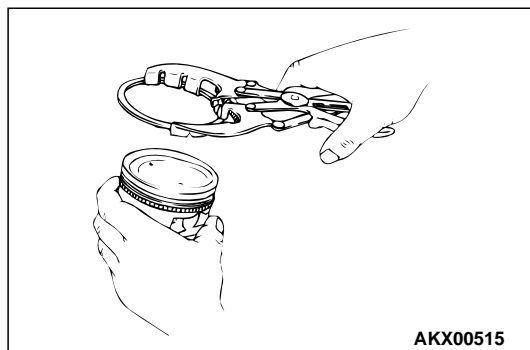
**Identification mark:**

**Number 1 ring: 1R**

**Number 2 ring: 2R**

*NOTE: Size marks on piston rings are as follows.*

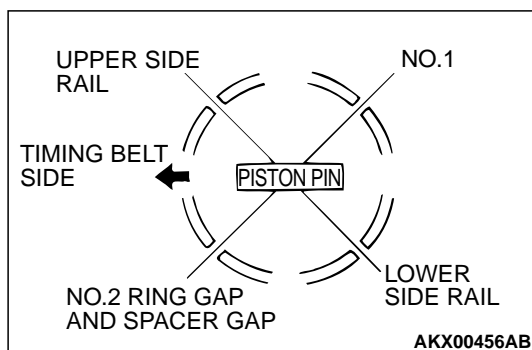
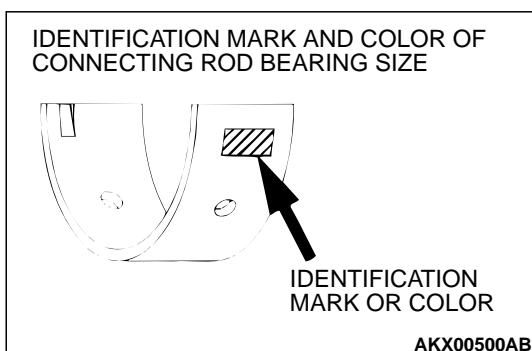
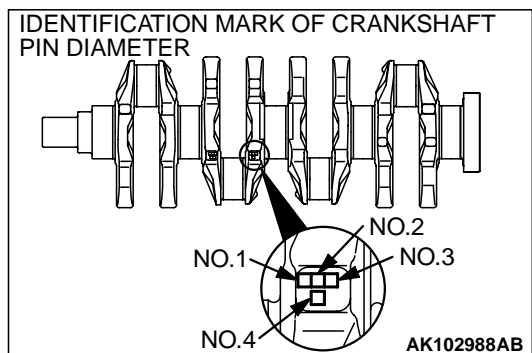
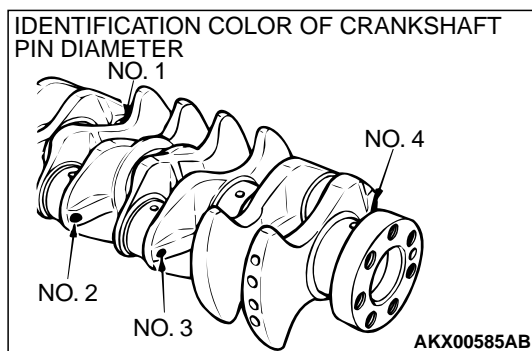
SIZE		SIZE MARK
Standard	No.1 ring	(None) Yellow paint to the ring periphery
	No.2 ring	(None) Red paint to the ring periphery
0.50 mm (0.020 in) oversize diameter		50
1.00 mm (0.040 in) oversize diameter		100



2. 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.*

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

**>>D<< CONNECTING ROD BEARING INSTALLATION**

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

CRANKSHAFT PIN OUTSIDE DIAMETER		CONNECTING ROD BEARING
IDENTIFICATION MARK OR COLOR	SIZE mm (in)	IDENTIFICATION MARK OR COLOR
I or Yellow	44.995 – 45.005 (1.7715 – 1.7719)	1 or Yellow
II or None	44.985 – 44.995 (1.7711 – 1.7715)	2 or None
III or White	44.980 – 44.985 (1.7709 – 1.7711)	3 or Blue

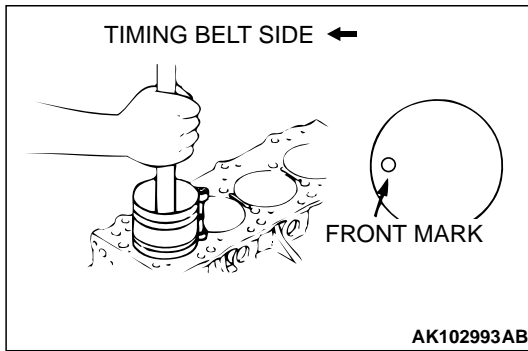
2. If the crankshaft pin outside diameter identification mark is "I" or identification color is "Yellow", for example, select a bearing whose identification mark is "1" or identification color is "Yellow".

If there is no identification mark or 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**

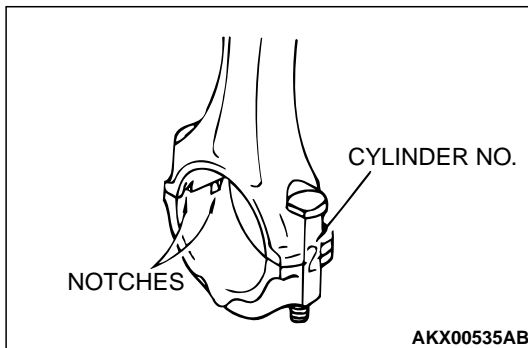
1. Apply engine oil on the circumference of the piston, piston rings, and oil ring.
2. Arrange the piston ring and oil ring gaps (side rail and spacer) as shown in the illustration.
3. Rotate the crankshaft so that crank pin is on the center of the cylinder bore.



4. 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.
5. Insert the piston and connecting rod assembly into the cylinder with front mark on the piston crown pointing to the timing belt side.
6. Using a suitable piston ring compressor tool, install the piston and connecting rod assembly into the cylinder block.

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

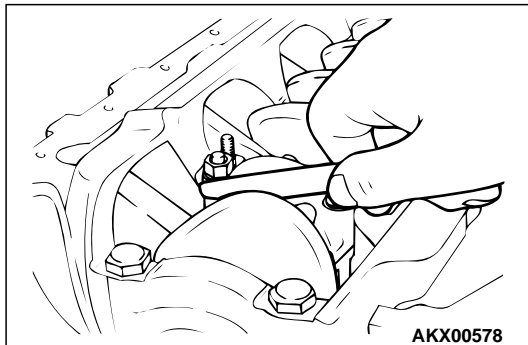
1. Verifying the mark made during disassembly, install the bearing cap to the connecting rod. If the connecting rod is new with no index mark, make sure that the bearing locking notches are on the same side as shown.



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

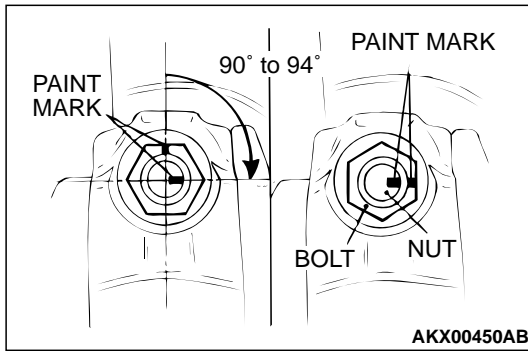
**Standard value: 0.10 – 0.25 mm (0.004 – 0.009 inch)**

**Limit: 0.4 mm (0.015 inch)**



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

1. 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.
2. Before installation of each nut, apply engine oil to the threaded portion and bearing surface of the nut.
3. Loosely tighten each nut to the bolt.
4. Then tighten the nuts alternately to a torque of  $20 \pm 2$  N·m ( $14 \pm 1$  ft-lb) to install the cap properly.



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

#### ⚠ CAUTION

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

## INSPECTION

M1113008500138

### PISTON

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

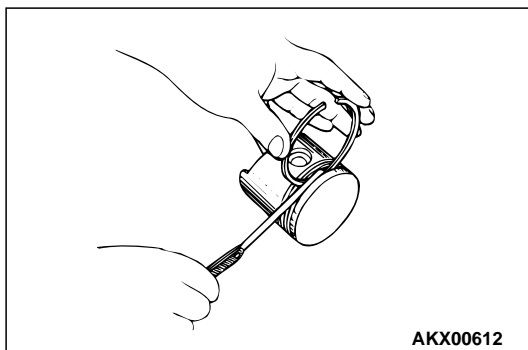
### PISTON PIN

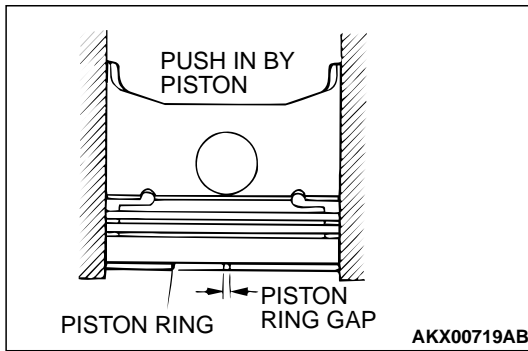
1. Insert the piston pin into the piston pin hole with your thumb. You should feel a slight resistance. Replace the piston pin if it can be easily inserted or there is an excessive play.
2. The piston and piston pin must be replaced as an assembly.

### 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: 0.02 – 0.06 mm (0.0008 – 0.0023 inch)**  
**Limit: 0.1 mm (0.003 inch)**





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: 0.30 – 0.45 mm (0.012 – 0.017 inch)**

**Number 2: 0.45 – 0.60 mm (0.018 – 0.023 inch)**

**Oil: 0.20 – 0.60 mm (0.008 – 0.023 inch)**

**Limit:**

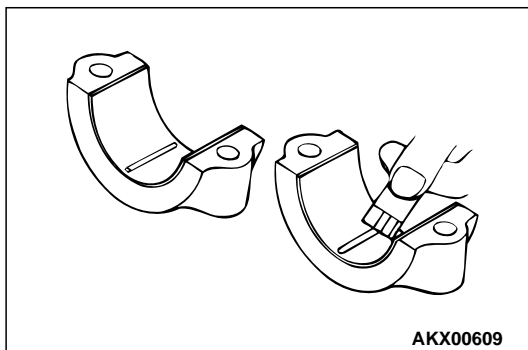
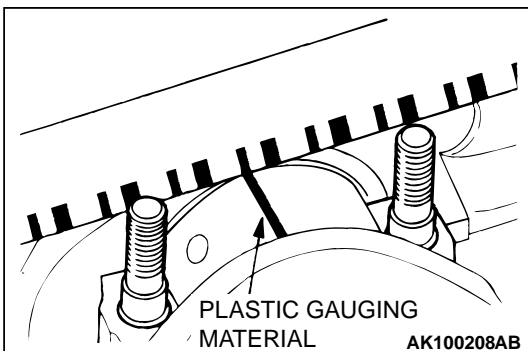
**Number 1, Number 2: 0.8 mm (0.03 inch)**

**Oil: 1.0 mm (0.03 inch)**

**CRANKSHAFT PIN OIL CLEARANCE**

**<PLASTIC GAUGING MATERIAL METHOD>**

1. Remove oil from the crankshaft pin and the connecting rod bearing.
2. Cut plastic gauging material to the same length as the width of the bearing and place it on the pin in 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 plastic gauging material at its widest part by using a scale printed on the plastic gauging material package.

**Standard value: 0.02 – 0.05 mm (0.0008 – 0.0019 inch)**

**Limit: 0.1 mm (0.003 inch)**

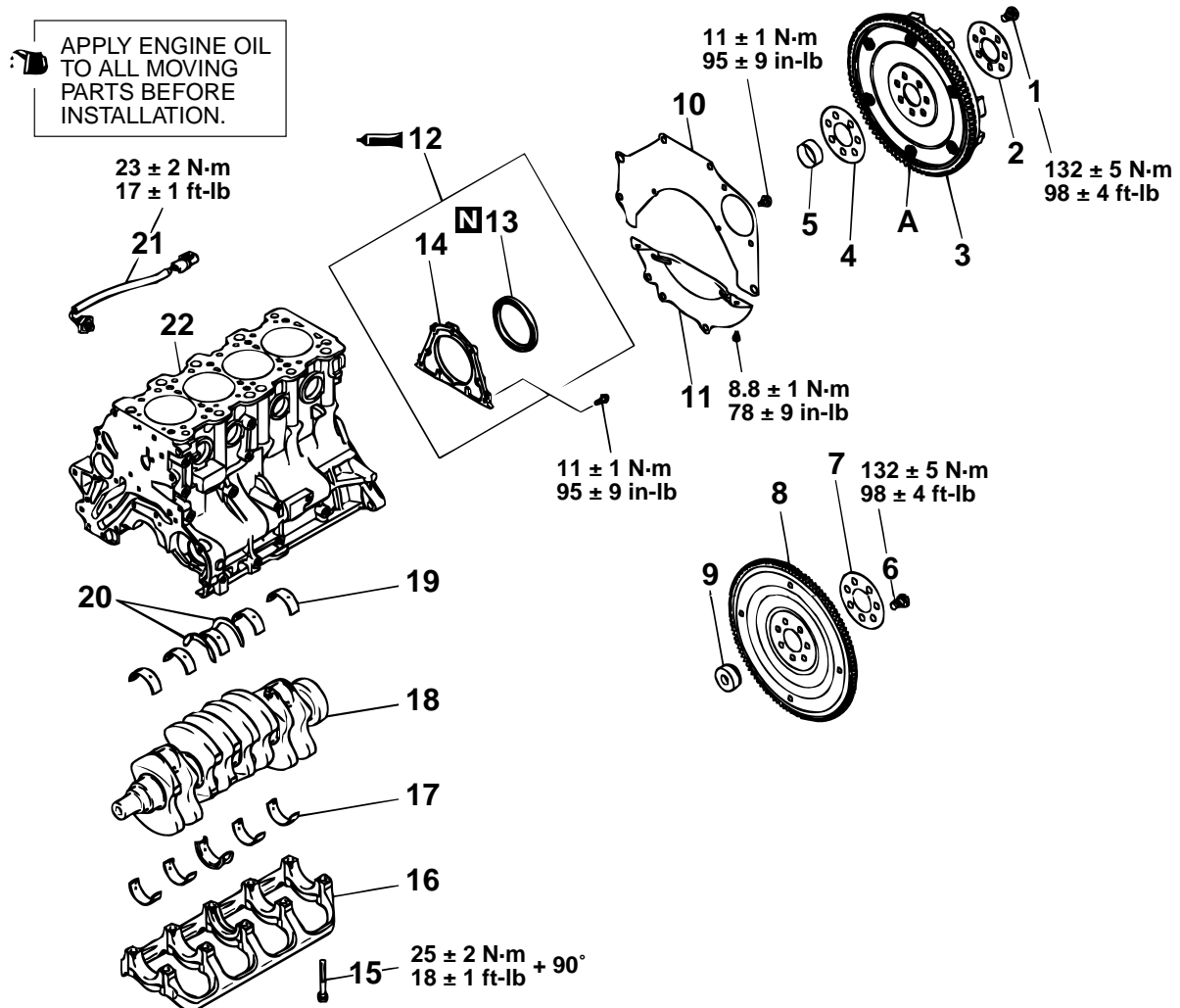
## CRANKSHAFT AND CYLINDER BLOCK

## REMOVAL AND INSTALLATION

M1113008700284

**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.



AKX00512AB

**REMOVAL STEPS**

1. FLYWHEEL BOLT <M/T>
2. ADAPTER PLATE <M/T>
3. FLYWHEEL <M/T>
4. ADAPTER PLATE <M/T>
5. CRANKSHAFT BUSHING <M/T>
6. DRIVE PLATE BOLT <A/T>
7. ADAPTER PLATE <A/T>
8. DRIVE PLATE <A/T>
9. CRANKSHAFT BUSHING <A/T>
10. REAR PLATE
11. BELL HOUSING COVER

**REMOVAL STEPS (Continued)**

- >>E<< 12. OIL SEAL CASE ASSEMBLY
- >>D<< 13. OIL SEAL
- >>C<< 14. OIL SEAL CASE
- >>C<< 15. BEARING CAP BOLT
- >>B<< 16. BEARING CAP
- >>B<< 17. CRANKSHAFT BEARING (LOWER)
- >>B<< 18. CRANKSHAFT
- >>B<< 19. CRANKSHAFT BEARING (UPPER)
- >>A<< 20. CRANKSHAFT THRUST BEARING
- >>A<< 21. KNOCK SENSOR
- >>A<< 22. CYLINDER BLOCK



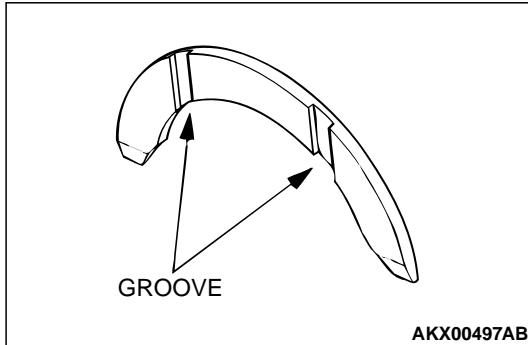
**Required Special Tools:**

- MB990938: Handle
- MD998776: Crankshaft Rear Oil Seal Installer

**INSTALLATION SERVICE POINTS**

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

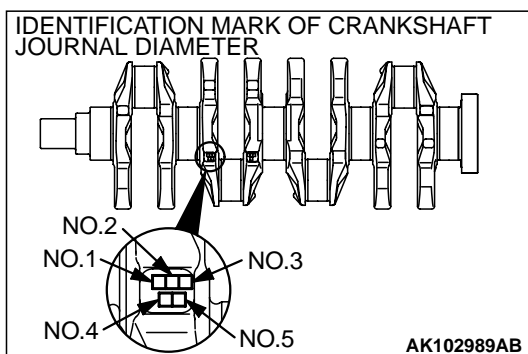
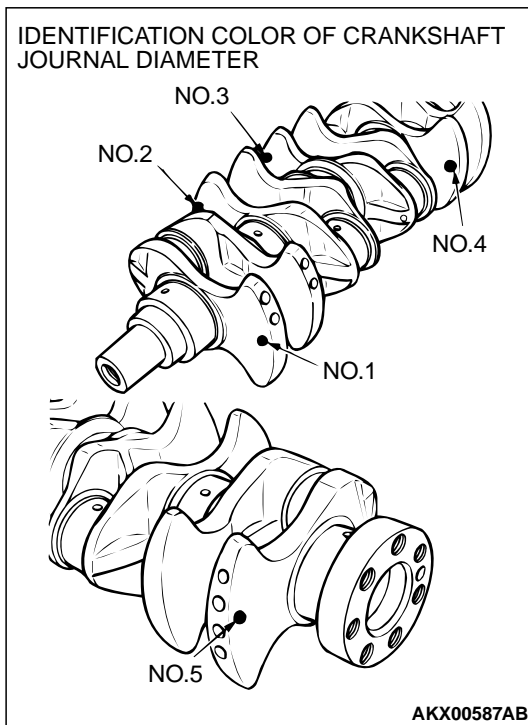
1. Install the two thrust bearings in the number 3 bearing bore in the cylinder block. For easier installation, apply engine oil to the bearings; this will help hold them in position.
2. The thrust bearings must be installed with their groove side toward the crankshaft web.

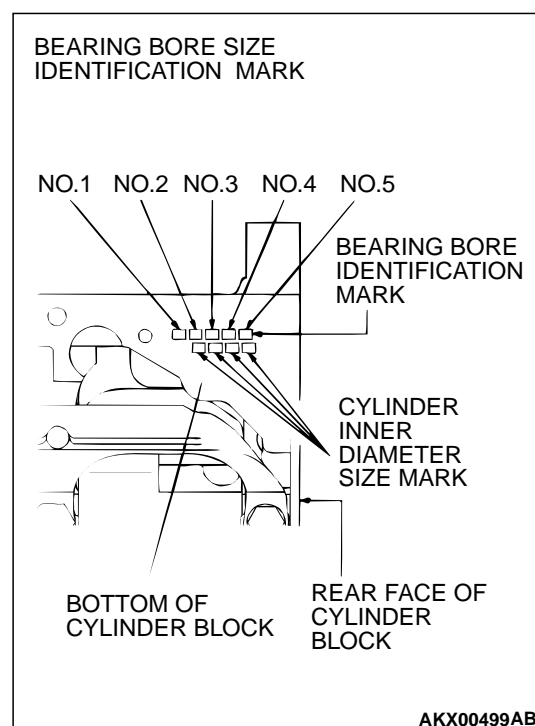


**>>B<< CRANKSHAFT BEARING INSTALLATION**

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

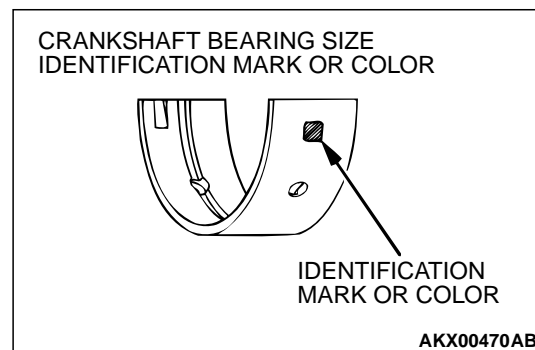
1. Measure the crankshaft journal diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification colors/ marks of its journals are painted/stamped at the positions shown in the illustration.



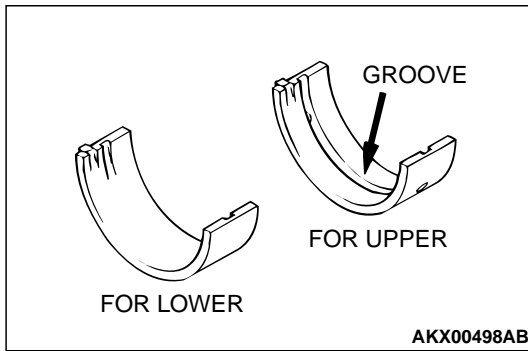


2. The cylinder block bearing bore diameter identification marks are stamped at the position shown in the illustration from left to right, beginning at No.1.

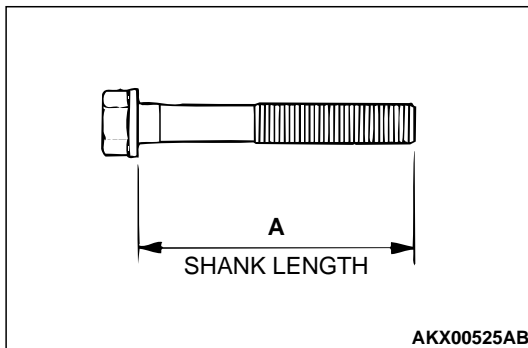
CRANKSHAFT JOURNAL OUTSIDE DIAMETER		CYLINDER BLOCK BEARING BORE	CRANKSHAFT BEARING	CRANKSHAFT BEARING FOR NO.3
IDENTIFICATION MARK OR COLOR	SIZE mm (in)	IDENTIFICATION MARK	IDENTIFICATION MARK OR COLOR	IDENTIFICATION MARK OR COLOR
0 or Yellow	56.994 – 57.000 (2.2439 – 2.2441)	0	1 or Green	0 or Black
		1	2 or Yellow	1 or Green
		2	3 or None	2 or Yellow
1 or None	56.988 – 56.994 (2.2436 – 2.2439)	0	2 or Yellow	1 or Green
		1	3 or None	2 or Yellow
		2	4 or Blue	3 or None
2 or White	56.982 – 56.988 (2.2438 – 2.2436)	0	3 or None	2 or Yellow
		1	4 or Blue	3 or None
		2	5 or Red	4 or Blue



For example, if the crankshaft journal outside diameter identification mark is "0" or identification color is "Yellow" and cylinder block bearing bore identification mark is "1," select a bearing whose identification mark is "2" or identification color is "Yellow" for number 1, 2, 4 and 5, and a bearing whose identification mark is "1" or identification color is "Green" for number 3. If there is no identification color paint or 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.

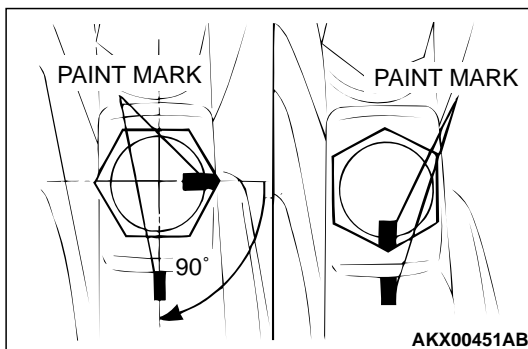
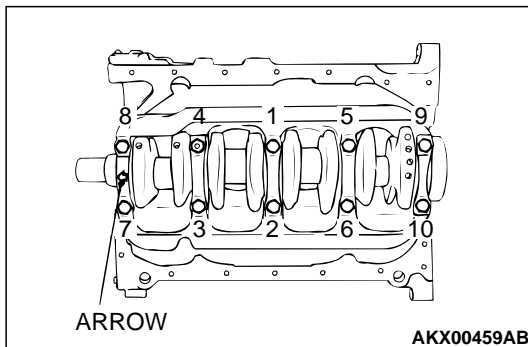


### >>C<< BEARING CAP/BEARING CAP BOLT INSTALLATION

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 (A): 71.1 mm (2.79 inches)**

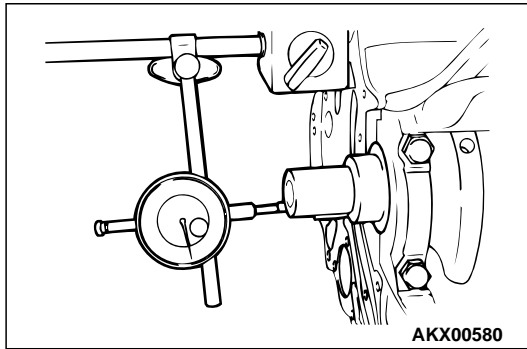
3. Apply engine oil to the threaded portion and bearing surface of the bolt.
4. Tighten the bolts to  $25 \pm 2$  N·m ( $18 \pm 1$  ft-lb) in the tightening sequence shown.



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

#### **CAUTION**

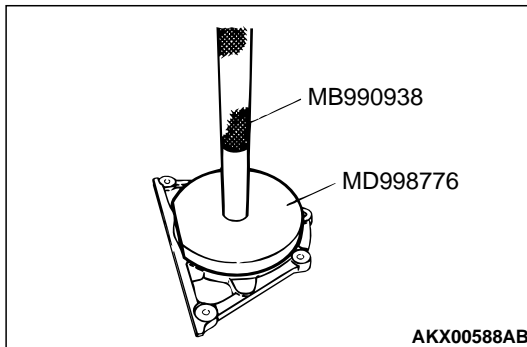
- If the bolt is overtightened, loosen the bolt completely and then retighten it by repeating the tightening procedure from step 4.
  - If the bolt is turned less than 90 degree angle, proper fastening performance may not be achieved. Be sure to turn the bolt exactly 90 degree angle.
7. Turn each bolt 90 degree angle 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.

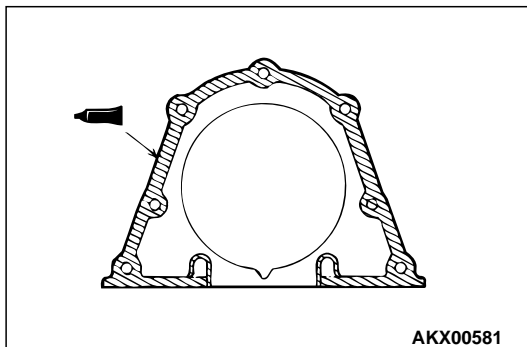
**Standard value: 0.05 – 0.25 mm (0.002 – 0.009 inch)**

**Limit: 0.40 mm (0.0015 inch)**



### >>D<< OIL SEAL INSTALLATION

Using special tools MD998776 and MB990938, press-fit the oil seal in the case.



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

1. Apply sealant MITSUBISHI Genuine Part number MD970389 or equivalent to the gasket surface of oil seal case.

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

2. Apply engine oil to the oil seal lip, and then install the oil seal case onto the cylinder block.

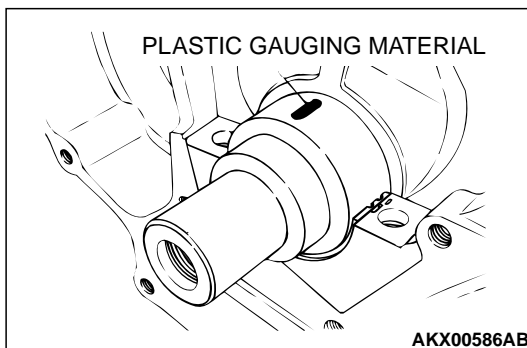
*NOTE: After installation, keep the sealed area away from the oil for approximately one hour.*

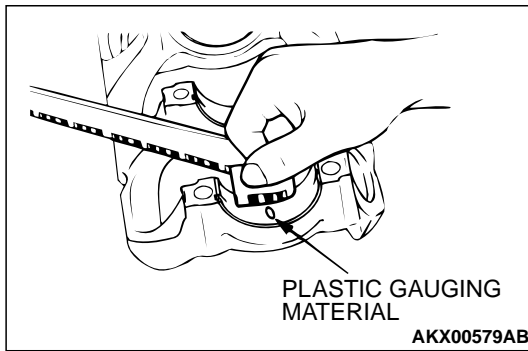
## INSPECTION

M1113008800054

### CRANKSHAFT JOURNAL OIL CLEARANCE <PLASTIC GAUGING MATERIAL METHOD>

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

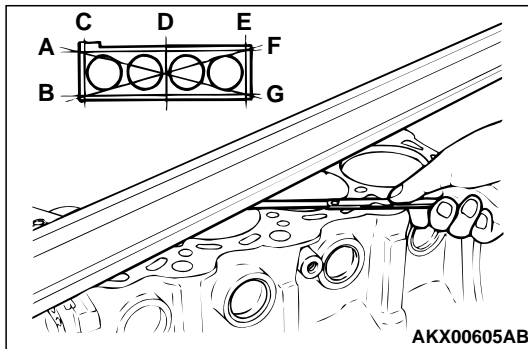




4. Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
5. Carefully remove the crankshaft bearing cap.
6. Measure the width of the plastic gauging material at its widest part by using a scale printed on the plastic gauging material package.

**Standard value: 0.02 – 0.04 mm (0.0008 – 0.0015 inch)**

**Limit: 0.1 mm (0.003 inch)**



### 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 war page. Make sure that the surface is free from gasket chips and other foreign matter.

**Standard value: 0.05 mm (0.0020 inch)**

**Limit: 0.1 mm (0.003 inch)**

3. If the distortion is excessive, correct within the allowable limit or replace.

**Grinding limit: 0.2 mm (0.007 inch)**

**\*Includes/combined with cylinder head grinding**

**Cylinder block height (when new):**

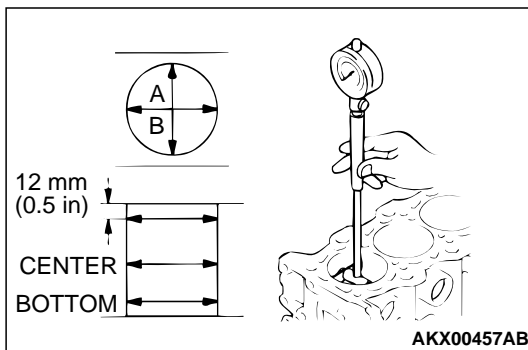
**290 mm (11.4 inches)**

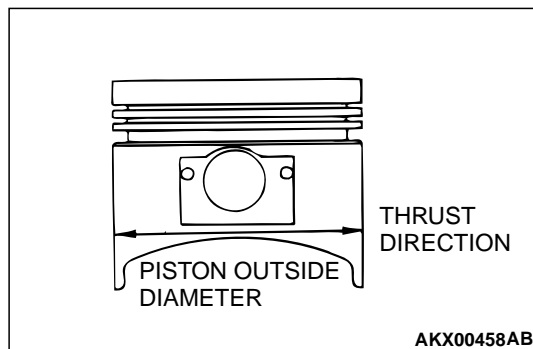
4. Check cylinder walls for scratches and seizure. If defects are evident, replace or bore to oversize and replace pistons and piston rings.
5. Using a cylinder gauge, measure the cylinder bore and cylindrically. If worn badly, correct the cylinder to an oversize and replace the piston and piston rings. Measure at the points shown in the illustration.

**Standard value:**

**Cylinder inner diameter 86.50 mm (3.41 inches)**

**Cylindrically 0.01 mm (0.0003 inch) 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 (0.020 in) oversize diameter	50
1.00 mm (0.040 in) oversize diameter	100

*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 (0.0008 inch) (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 (0.0008 – 0.0015 inch)**

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

## SPECIFICATIONS

## FASTENER TIGHTENING SPECIFICATIONS

M1113023400279

ITEMS	SPECIFICATIONS
<b>Generator and drive belt</b>	
Adjusting bolt	$5 \pm 1$ N·m ( $43 \pm 9$ in-lb)
Adjusting nut lock bolt	$23 \pm 2$ N·m ( $17 \pm 1$ ft-lb)
Camshaft position sensing cylinder bolt	$22 \pm 4$ N·m ( $16 \pm 3$ ft-lb)
Camshaft position sensor bolt	$8.8 \pm 1$ N·m ( $78 \pm 9$ in-lb)
Camshaft position sensor support bolt	$14 \pm 1$ N·m ( $122 \pm 9$ in-lb)
Crankshaft pulley bolt	$25 \pm 5$ N·m ( $18 \pm 4$ ft-lb)
Generator brace bolt	$24 \pm 3$ N·m ( $17 \pm 2$ ft-lb)
Generator pivot bolt nut	$44 \pm 10$ N·m ( $33 \pm 7$ ft-lb)
Ignition coil bolt	$10 \pm 2$ N·m ( $87 \pm 17$ in-lb)
Spark plugs	$25 \pm 5$ N·m ( $18 \pm 4$ ft-lb)
Water pump pulley bolt	$8.8 \pm 1$ N·m ( $78 \pm 9$ in-lb)
<b>Timing belt</b>	
Auto-tensioner bolt	$24 \pm 3$ N·m ( $17 \pm 2$ ft-lb)
Camshaft sprocket bolt	$88 \pm 10$ N·m ( $65 \pm 7$ ft-lb)
Counterbalance shaft sprocket bolt	$45 \pm 3$ N·m ( $33 \pm 2$ ft-lb)
Crankshaft bolt	$162 \pm 5$ N·m ( $119 \pm 4$ ft-lb)
Crankshaft position sensor bolt	$8.8 \pm 1$ N·m ( $78 \pm 9$ in-lb)
Engine support bracket bolt and nut	$49 \pm 5$ N·m ( $36 \pm 4$ ft-lb)
Idler pulley bolt	$44 \pm 5$ N·m ( $33 \pm 4$ ft-lb)
Oil pump sprocket nut	$35 \pm 6$ N·m ( $26 \pm 4$ ft-lb)
Power steering pump bolt	$49 \pm 5$ N·m ( $36 \pm 4$ ft-lb)
Tensioner arm bolt	$22 \pm 4$ N·m ( $16 \pm 3$ ft-lb)
Tensioner B bolt	$19 \pm 3$ N·m ( $14 \pm 2$ ft-lb)
Tensioner pulley bolt	$48 \pm 6$ N·m ( $35 \pm 4$ ft-lb)
Timing belt cover flange bolt M6	$11 \pm 1$ N·m ( $95 \pm 9$ in-lb)
Timing belt cover flange bolt M8	$14 \pm 1$ N·m ( $122 \pm 9$ in-lb)
Timing belt cover washer assembled bolt	$8.8 \pm 1$ N·m ( $78 \pm 9$ in-lb)
<b>Fuel and emission control parts</b>	
EGR valve bolt	$19 \pm 3$ N·m ( $14 \pm 2$ ft-lb)
Fuel pressure regulator bolt	$8.8 \pm 2$ N·m ( $78 \pm 17$ in-lb)
Injectors and fuel rail bolt	$12 \pm 1$ N·m ( $104 \pm 9$ in-lb)
Throttle body bolt	$19 \pm 3$ N·m ( $14 \pm 2$ ft-lb)
Throttle body stay bolt	$19 \pm 3$ N·m ( $14 \pm 2$ ft-lb)
<b>Water pump and intake manifold</b>	
Engine coolant temperature gauge unit	$11 \pm 1$ N·m ( $95 \pm 9$ in-lb)
Engine coolant temperature sensor	$29 \pm 10$ N·m ( $22 \pm 7$ ft-lb)
Engine hanger bolt	$19 \pm 3$ N·m ( $14 \pm 2$ ft-lb)

ITEMS	SPECIFICATIONS
Intake manifold plenum bolt and nut	20 ± 2 N·m (14 ± 1 ft-lb)
Intake manifold plenum stay M8	21 ± 4 N·m (15 ± 3 ft-lb)
Intake manifold plenum stay M10	30 ± 3 N·m (22 ± 2 ft-lb)
Manifold differential pressure sensor bolt	4.9 ± 1 N·m (43 ± 9 in-lb)
Oil dipstick guide bolt	14 ± 1 N·m (122 ± 9 in-lb)
Thermostat housing bolt	24 ± 4 N·m (17 ± 3 ft-lb)
Water inlet fitting bolt	13 ± 2 N·m (113 ± 17 in-lb)
Water inlet pipe bolt	13 ± 2 N·m (113 ± 17 in-lb)
Water pump bolt	14 ± 1 N·m (122 ± 9 in-lb)
<b>Exhaust manifold</b>	
Exhaust manifold bracket bolt	35 ± 6 N·m (26 ± 4 ft-lb)
Exhaust manifold cover bolt	14 ± 1 N·m (122 ± 9 in-lb)
Exhaust manifold nut M8	29 ± 3 N·m (22 ± 2 ft-lb)
Exhaust manifold nut M10	49 ± 5 N·m (36 ± 4 ft-lb)
Heat protector bolt	14 ± 1 N·m (122 ± 9 in-lb)
Oxygen sensor	44 ± 5 N·m (32 ± 4 ft-lb)
Water outlet fitting bolt	13 ± 2 N·m (113 ± 17 in-lb)
<b>Rocker arms and camshaft</b>	
PCV valve	10 ± 2 N·m (87 ± 17 in-lb)
Rocker cover bolt	3.5 ± 0.5 N·m (30 ± 4 in-lb)
Rocker arm shaft bolt	31 ± 3 N·m (23 ± 2 ft-lb)
<b>Cylinder head and valve</b>	
Cylinder head bolt [Tighten to 78 N·m (58 ft-lb) and then completely before tightening to final torque specification]	25 N·m (14 ft-lb) + 90° + 90°
<b>Front case, counterbalance shaft and oil pan</b>	
Drain plug	39 ± 5 N·m (29 ± 4 ft-lb)
Flange bolt	36 ± 3 N·m (27 ± 2 ft-lb)
Front case bolt	24 ± 3 N·m (17 ± 2 ft-lb)
Oil filter part number MD360935	14 ± 2 N·m (122 ± 17 in-lb)
Oil filter other than MITSUBISHI genuine filter	17 ± 2 N·m (13 ± 1 ft-lb)
Oil filter bracket bolt	19 ± 3 N·m (14 ± 2 ft-lb)
Oil pan bolt	6.9 ± 1 N·m (61 ± 9 in-lb)
Oil pressure switch	11 ± 1 N·m (95 ± 9 in-lb)
Oil pump cover bolt	17 ± 1 N·m (12 ± 1 ft-lb)
Oil pump cover screw	9.8 ± 2 N·m (87 ± 17 in-lb)
Oil screen bolt	19 ± 3 N·m (14 ± 3 ft-lb)
Plug	24 ± 3 N·m (17 ± 3 ft-lb)
Relief plug	44 ± 5 N·m (33 ± 4 ft-lb)
<b>Piston and connecting rod</b>	
Connecting rod cap nut	20 ± 2 N·m (14 ± 1 ft-lb) + 90° to 94°



ITEMS	SPECIFICATIONS
<b>Crankshaft and cylinder block</b>	
Bearing cap bolt	25 ± 2 N·m (18 ± 1 ft-lb) + 90°
Bell housing cover bolt	8.8 ± 1 N·m (78 ± 9 in-lb)
Drive plate bolt	132 ± 5 N·m (98 ± 4 ft-lb)
Flywheel bolt	132 ± 5 N·m (98 ± 4 ft-lb)
Knock sensor	23 ± 2 N·m (17 ± 1 ft-lb)
Oil seal case bolt	11 ± 1 N·m (95 ± 9 in-lb)
Rear plate bolt	11 ± 1 N·m (95 ± 9 in-lb)

## GENERAL SPECIFICATIONS

M1113000200058

DESCRIPTIONS			SPECIFICATIONS
Type			In-line OHV, SOHC
Number of cylinders			4
Combustion chamber			Pent roof type
Total displacement cm <sup>3</sup> (cu. in)			2,350 (143.4)
Cylinder bore (in)			86.5 (3.41)
Piston stroke mm (in)			100.0 (3.94)
Compression ratio			9.5
Valve timing	Intake valve	Opens (BTDC)	16°
		Closes (ABDC)	60° <M/T>, 53° <A/T>
	Exhaust valve	Opens (BBDC)	60° <M/T>, 50° <A/T>
		Closes (ATDC)	16°
Lubrication system			Pressure feed, full-flow filtration
Oil pump type			Involute gear type

## SERVICE SPECIFICATIONS

M1113000300055

ITEM			STANDARD VALUE	LIMIT
Timing belt				
Auto-tensioner rod projection length mm (in)			12 (0.5)	—
Auto-tensioner rod pushed-in amount [When pushed with a force of 98 – 196 N (22 – 44 lb)] mm (in)			1.0 (0.03) or less	—
Rocker arms and camshaft				
Camshaft cam height mm (in)	Intake		37.39 (1.472)	Minimum 36.89 (1.452)
	Exhaust	M/T	37.14 (1.462)	Minimum 36.64 (1.443)
		A/T	36.83 (1.450)	Minimum 36.33 (1.430)
Camshaft journal outside diameter mm (in)			45 (1.8)	—
Cylinder head and valves				
Cylinder head flatness of gasket surface mm (in)			Less than 0.05 (0.002)	0.2 (0.007)

ITEM		STANDARD VALUE	LIMIT
Cylinder head grinding limit of gasket surface mm (in) (Total resurfacing depth of cylinder head and cylinder block)		—	0.2 (0.007)
Cylinder head overall height mm (in)		120 (4.7)	—
Cylinder head bolt shank length mm (in)		—	99.4 (3.91)
Valve thickness of valve head (margin)	Intake	1.0 (0.03)	Minimum 0.5 (0.02)
	Exhaust	1.2 (0.04)	Minimum 0.7 (0.03)
Valve overall height mm (in)	Intake	112.30 (4.421)	Minimum 111.80 (4.402)
	Exhaust	114.11 (4.493)	Minimum 113.61 (4.473)
Valve stem outside diameter mm (in)	Intake	6.0 (0.24)	—
	Exhaust	5.9 (0.23)	—
Valve thickness to valve guide clearance mm (in)	Intake	0.02 – 0.05 (0.0008 – 0.0019)	0.10 (0.003)
	Exhaust	0.03 – 0.07 (0.0012 – 0.0027)	0.15 (0.005)
Valve face angle mm (in)		45° – 45.5°	—
Valve spring free length mm (in)		51.0 (2.00)	Minimum 50.0 (1.97)
Valve spring load/installed height N (lb)/mm (in)		267 (60)/44.2 (1.74)	—
Valve spring out-of-squareness		2° or less	4°
Valve seat valve contact width mm (in)		0.9 – 1.3 (0.04 – 0.05)	—
Valve guide inside diameter mm (in)		6.0 (0.24)	—
Valve guide projection from cylinder head upper surface mm (in)		14.0 (0.55)	—
Valve stem projection mm (in)		49.30 (1.941)	49.80 (1.960)
Oversize rework dimensions of valve guide hole mm (in)	0.05 oversize diameter	11.05 – 11.07 (0.4429 – 0.4437)	—
	0.25 oversize diameter	11.25 – 11.27 (0.4429 – 0.4437)	—
	0.50 oversize diameter	11.50 – 11.52 (0.4528 – 0.4535)	—
Intake oversize rework dimensions of valve seat hole mm (in)	0.3 oversize diameter	34.30 – 34.33 (1.3504 – 1.3515)	—
	0.6 oversize diameter	34.60 – 34.63 (1.3623 – 1.3633)	—
Exhaust oversize rework dimensions of valve seat hole mm (in)	0.3 oversize diameter	31.80 – 31.83 (1.2520 – 1.2531)	—
	0.6 oversize diameter	32.10 – 32.13 (1.2638 – 1.2650)	—

ITEM		STANDARD VALUE	LIMIT
<b>Front case, counterbalance shaft and oil pan</b>			
Oil pump side clearance mm (in)	Drive gear	0.08 – 0.14 (0.004 – 0.005)	–
	Driven gear	0.06 – 0.12 (0.003 – 0.004)	–
Oil pressure at curb idle speed kPa (psi) [Oil temperature is 75 to 90°C (167 to 194°F)]		78 (11.4) or more	–
<b>Piston and connecting rod</b>			
Piston outside diameter mm (in)		86.5 (3.40)	–
Piston ring side clearance mm (in)	No.1	0.02 – 0.06 (0.0008 – 0.0023)	0.1 (0.003)
	No.2	0.02 – 0.06 (0.0012 – 0.0023)	0.1 (0.003)
Piston ring end gap mm (in)	No.1	0.25 – 0.35 (0.010 – 0.013)	0.8 (0.03)
	No.2	0.40 – 0.55 (0.016 – 0.021)	0.8 (0.03)
	Oil ring side rail	0.10 – 0.40 (0.004 – 0.015)	1.0 (0.03)
Piston pin outside diameter mm (in)		22.0 (0.87)	–
Piston pin press-in load N (lb) (Room temperature)		7,350 – 17,200 (1,653 – 3,866)	–
Crankshaft pin oil clearance mm (in)		0.02 – 0.05 (0.0008 – 0.0019)	0.1 (0.003)
Connecting rod big end side clearance mm (in)		0.10 – 0.25 (0.004 – 0.009)	0.4 (0.015)
<b>Crankshaft and cylinder block</b>			
Crankshaft end play mm (in)		0.05 – 0.25 (0.002 – 0.009)	0.40 (0.015)
Crankshaft journal outside diameter mm (in)		57.0 (2.24)	–
Crankshaft pin outside diameter mm (in)		45.0 (1.77)	–
Crankshaft journal oil clearance mm (in)		0.02 – 0.04 (0.0008 – 0.0015)	0.1 (0.003)
Bearing cap bolt shank length mm (in)		–	71.1 (2.79)
Piston to cylinder clearance mm (in)		0.02 – 0.04 (0.0008 – 0.0015)	–
Cylinder block flatness of gasket surface mm (in)		0.05 (0.02)	0.1 (0.03)
Cylinder block grinding limit of gasket surface mm (in) [Total resurfacing depth of both cylinder head and cylinder block]		–	0.2 (0.007)
Cylinder block overall height mm (in)		290 (11.4)	–
Cylinder block inside diameter mm (in)		86.5 (3.41)	–
Cylindricity mm (in)		0.01 (0.0003)	–

## SEALANTS

M1113000500059

ITEM	SPECIFIED SEALANT	QUANTITY
Engine support bracket seal bolt	3M™ AAD Part No. 8672 or equivalent	As required
Thermostat housing	MAZDA genuine part No. MD970389 or equivalent	As required
Water outlet fitting	MAZDA genuine part No. MD970389 or equivalent	As required
Engine coolant temperature sensor	3M™ AAD part No. 8731 or equivalent	As required
Engine coolant temperature gauge unit	3M™ AAD Part No. 8672 or equivalent	As required
Oil pressure switch	3M™ AAD Part No. 8672 or equivalent	As required
Oil pan	MAZDA genuine part No. MD970389 or equivalent	As required
Oil seal case	MAZDA genuine part No. MD970389 or equivalent	As required