

GROUP 11B

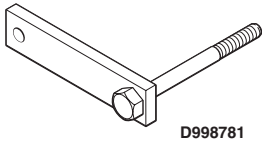
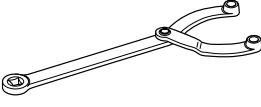
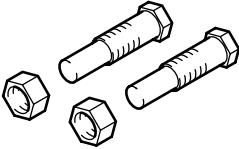
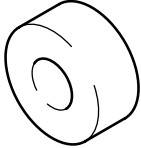
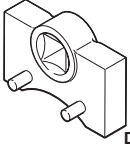
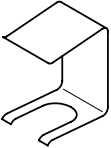
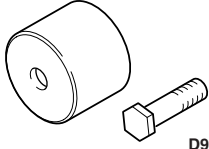

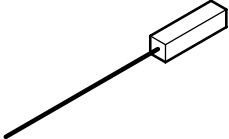
ENGINE OVERHAUL

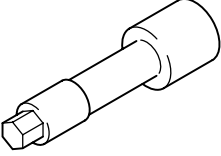
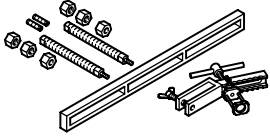
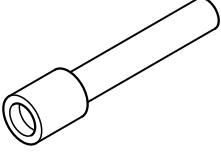
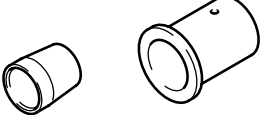
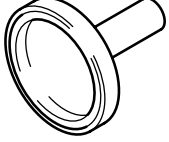
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SPECIAL TOOLS

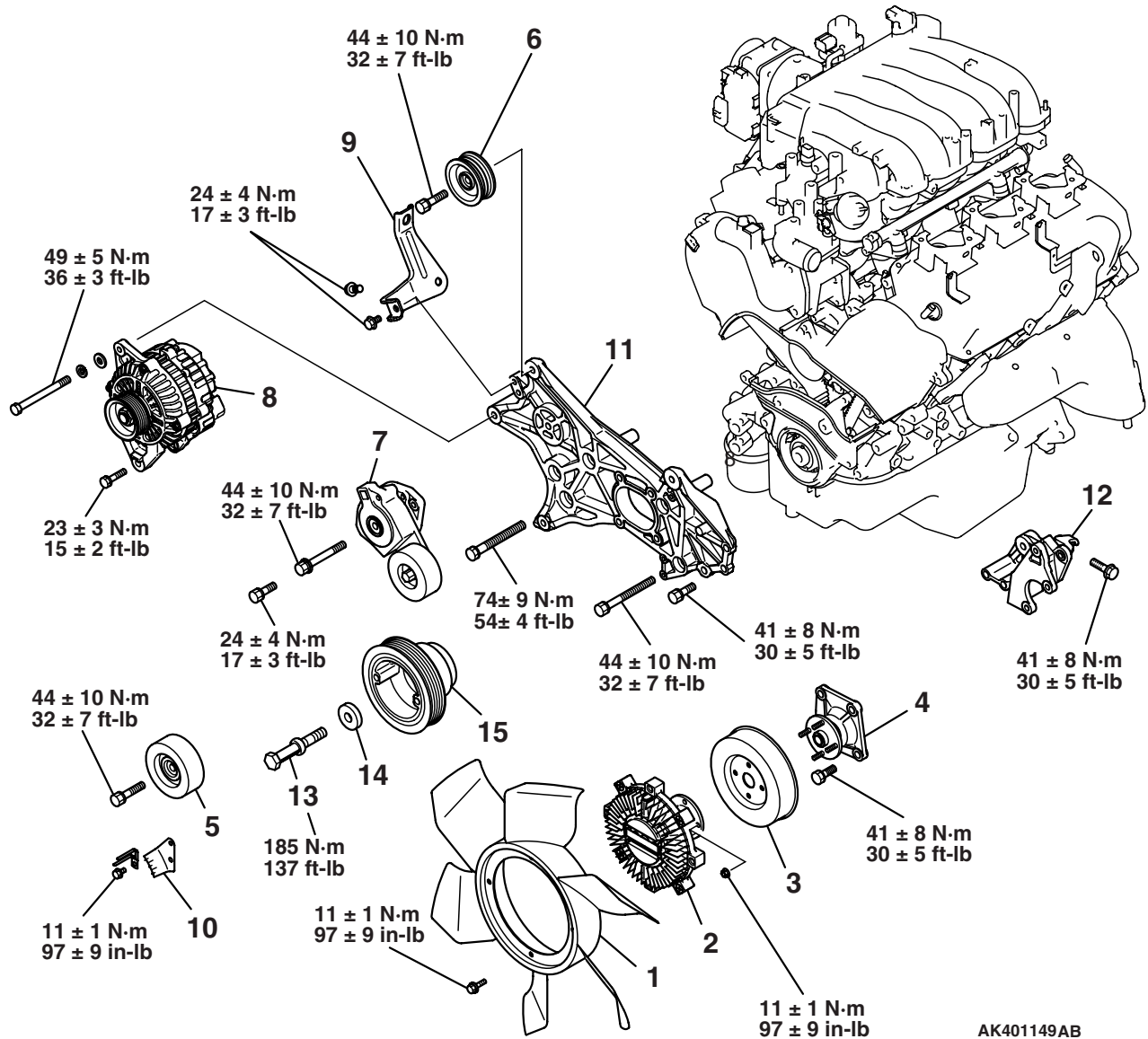
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TOOL	TOOL NUMBER AND NAME	SUPERSESSON	APPLICATION
 D998781	MD998781 Flywheel stopper	General service tool	Loosening and tightening crankshaft bolts
 B990767	MB990767 End yoke holder Use with MD998715	MB990767-01	Holding camshaft sprocket when loosening or torquing bolt.
	MD998715 Pin	MIT308239	
	MD998769 Crankshaft spacer	General service tool	Rotation of crankshaft when installing piston and timing belt
 D998767	MD998767 Tensioner 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
 B991559	MB991559 Camshaft oil seal installer adaptor	—	Installation of camshaft oil seal (left bank) (use with MD998713)
	MD998442 Air bleed wire	General service tool	Air bleeding of auto lash adjuster

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
	MD998051 Cylinder head bolt wrench	General service tool	Loosening and tightening cylinder head bolts
	MD998772 Valve spring compressor	MD998772-01 or General service tool	Compression of valve spring
	MB991999 Valve stem seal installer	–	Installation of valve stem seal
	MD998717 Crankshaft front oil seal installer	MD998717-01	Installation of crankshaft front oil seal
	MD998718 Crankshaft rear oil seal installer	MD998718-01	Installation of crankshaft rear oil seal

GENERATOR AND DRIVE BELT**REMOVAL AND INSTALLATION**

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**REMOVAL STEPS**

1. COOLING FAN
2. FAN CLUTCH
3. COOLING FAN BRACKET
4. COOLING FAN PULLEY
5. IDLER PULLEY
6. IDLER PULLEY
7. AUTO TENSIONER
8. GENERATOR

REMOVAL STEPS (Continued)

9. ACCESSORY MOUNT STAY
 10. TIMING INDICATOR BRACKET
 11. ACCESSORY MOUNT
 12. POWER STEERING PUMP BRACKET
 13. CRANKSHAFT BOLT
 14. CRANKSHAFT PULLEY WASHER
 15. DAMPER PULLEY
- <<A>> >>A<<

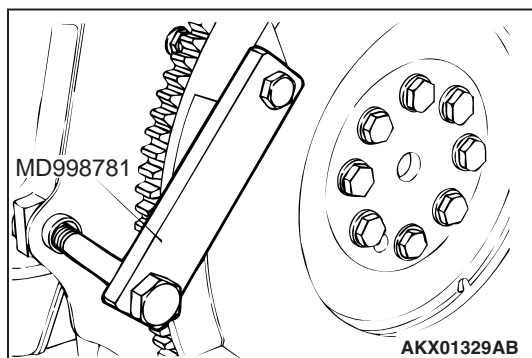
Required Special Tool:

- MD998781: Flywheel Stopper

REMOVAL SERVICE POINT

<<A>> CRANKSHAFT BOLT LOOSENING

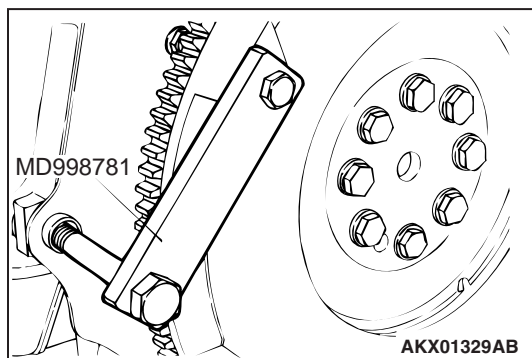
1. Using special tool MD998781, hold the drive plate or flywheel.
2. Remove the crankshaft bolt.



INSTALLATION SERVICE POINT

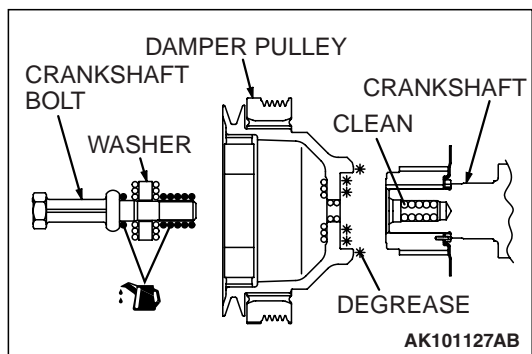
>>A<< CRANKSHAFT BOLT TIGHTENING

1. Using special tool MD998781, hold the drive plate or flywheel.



2. Clean the bolt hole in crankshaft bolt and damper pulley's seating surface.
3. Degrease the cleaned seating surface of the damper pulley.
4. Install the damper pulley.
5. Apply oil to the threads of crankshaft bolt and the outer surface of washer.
6. Tighten the crankshaft bolt to the specified torque.

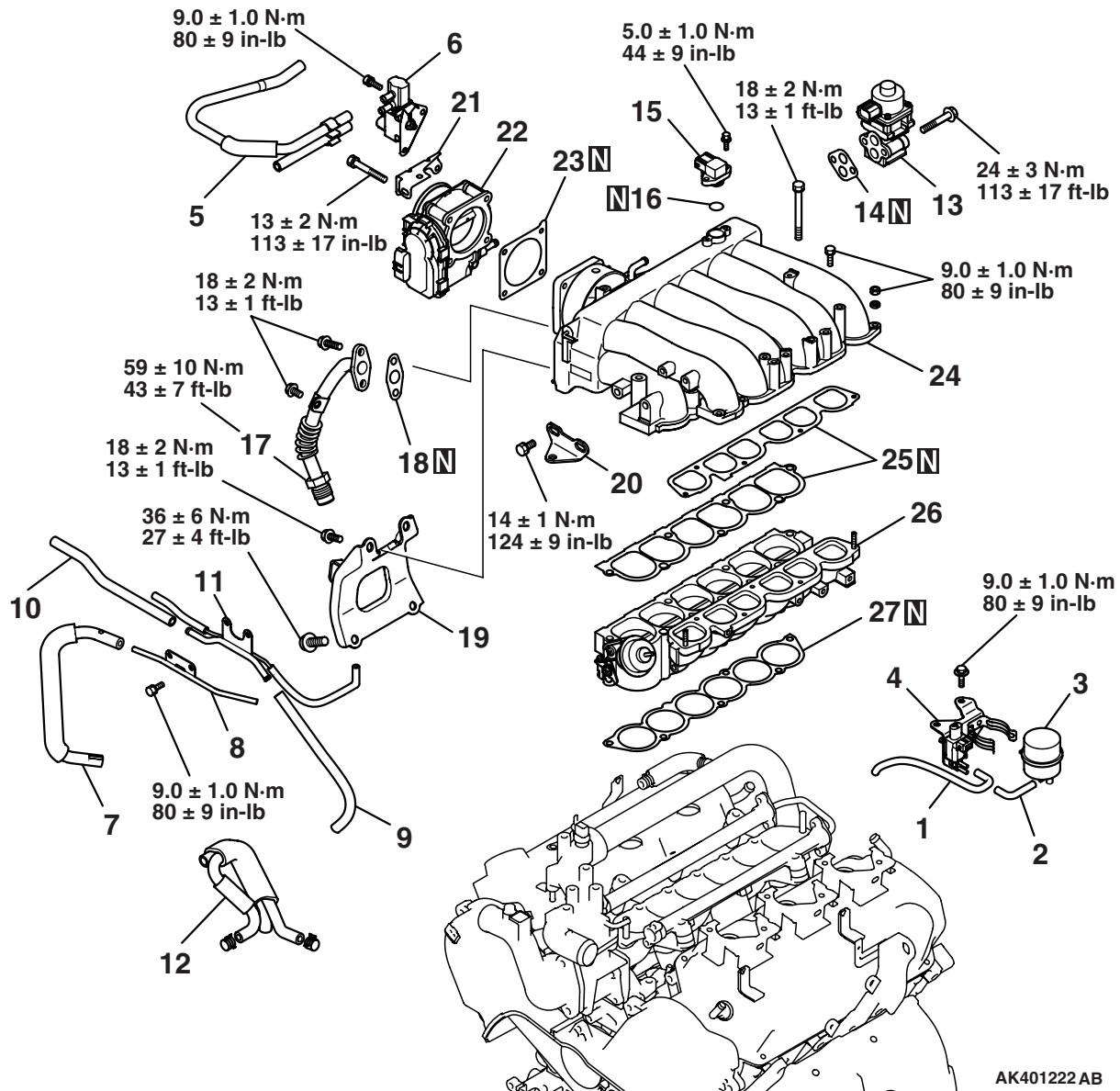
Tightening torque: 185 N·m (137 ft·lb)



INTAKE MANIFOLD PLENUM AND THROTTLE BODY ASSEMBLY

REMOVAL AND INSTALLATION

M1113003300203



REMOVAL STEPS

1. VACUUM HOSE
2. VACUUM HOSE
3. VACUUM TANK
4. SOLENOID VALVE
5. PURGE HOSE
6. SOLENOID VALVE
7. FUEL HOSE
8. FUEL RETURN PIPE
9. BREATHER HOSE
10. BREATHER HOSE
11. VACUUM PIPE AND HOSE
12. BREATHER AND WATER HOSE

REMOVAL STEPS (Continued)

13. EXHAUST GAS RECIRCULATION VALVE
14. EXHAUST GAS RECIRCULATION VALVE GASKET
15. MANIFOLD ABSOLUTE PRESSURE SENSOR
16. O-RING
17. EXHAUST GAS RECIRCULATION PIPE
18. EXHAUST GAS RECIRCULATION PIPE GASKET
19. INTAKE MANIFOLD PLENUM STAY
20. WATER OUTLET FITTING BRACKET

REMOVAL STEPS (Continued)

- 21. PURGE HOSE BRACKET
- 22. THROTTLE BODY
- >>A<< 23. THROTTLE BODY GASKET
- 24. INTAKE MANIFOLD PLENUM

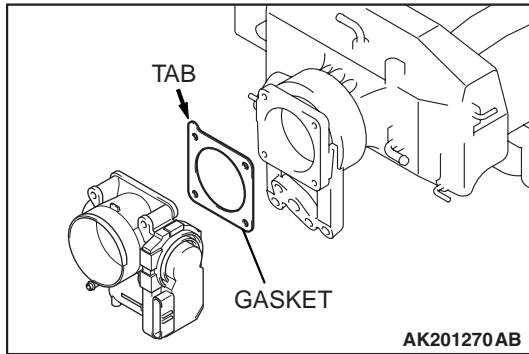
REMOVAL STEPS (Continued)

- 25. INTAKE MANIFOLD PLENUM VALVE GASKET
- 26. INTAKE MANIFOLD PLENUM VALVE ASSEMBLY
- 27. INTAKE MANIFOLD PLENUM GASKET

INSTALLATION SERVICE POINT

>>A<< THROTTLE BODY GASKET INSTALLATION

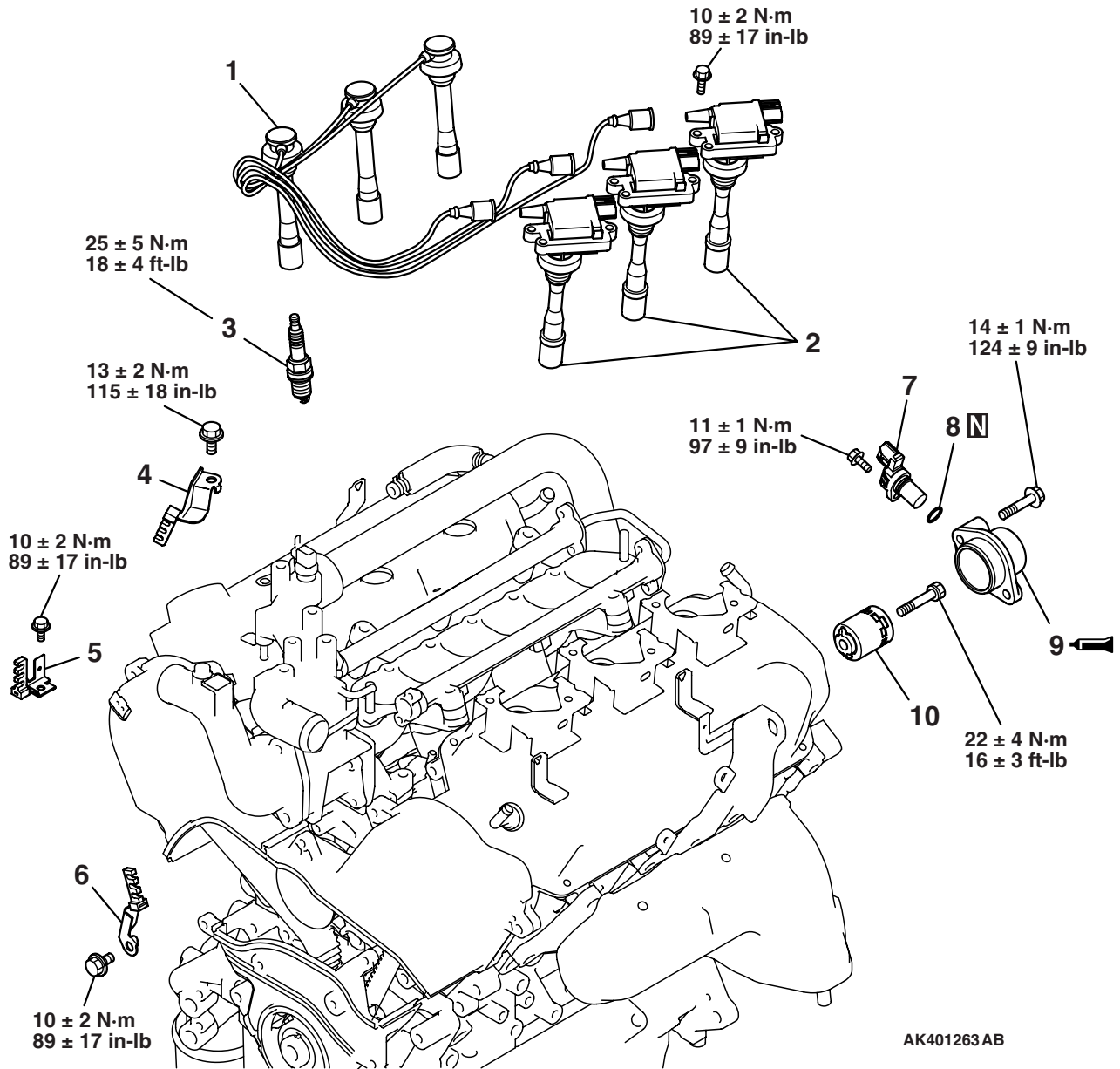
Install the gasket so that the tab is positioned as shown in the illustration.



IGNITION SYSTEM

REMOVAL AND INSTALLATION

M1113001600178



AK401263 AB

REMOVAL STEPS

1. SPARK PLUG CABLES
2. IGNITION COIL
3. SPARK PLUGS
4. SPARK PLUG CABLE SUPPORT
5. SPARK PLUG CABLE SUPPORT
6. SPARK PLUG CABLE SUPPORT

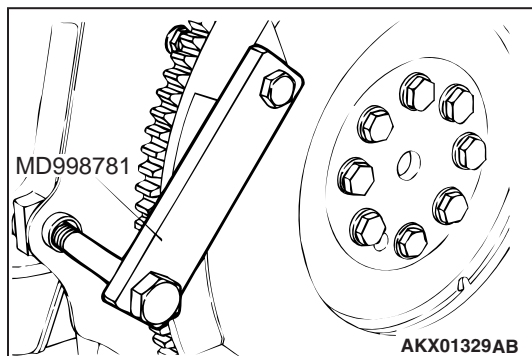
REMOVAL STEPS (Continued)

7. CAMSHAFT POSITION SENSOR
8. O-RING
- >>B<< 9. CAMSHAFT POSITION SENSOR SUPPORT
- <<A>> >>A<< 10. CAMSHAFT POSITION SENSING CYLINDER

REMOVAL SERVICE POINT

<<A>> CAMSHAFT POSITION SENSING CYLINDER REMOVAL

1. Using special tool MD998781, hold the drive plate or flywheel.
2. Loosen the camshaft position sensing cylinder bolt.

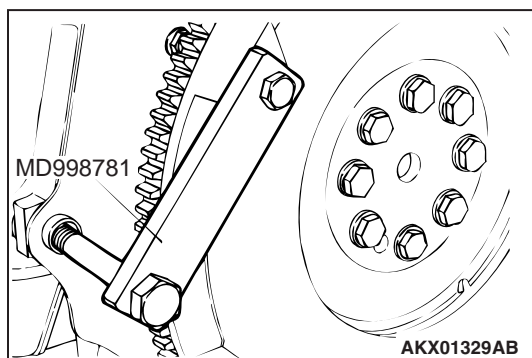


INSTALLATION SERVICE POINT

>>A<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION

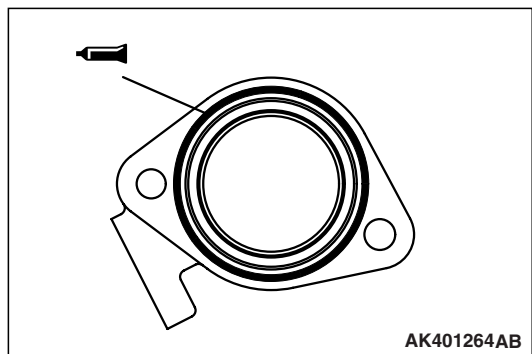
1. Using special tool MD998781, hold the drive plate or flywheel.
2. Tighten the camshaft position sensing cylinder bolt to the specified torque.

Tightening torque: 22 ± 4 N·m (16 ± 3 ft·lb)



>>B<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION

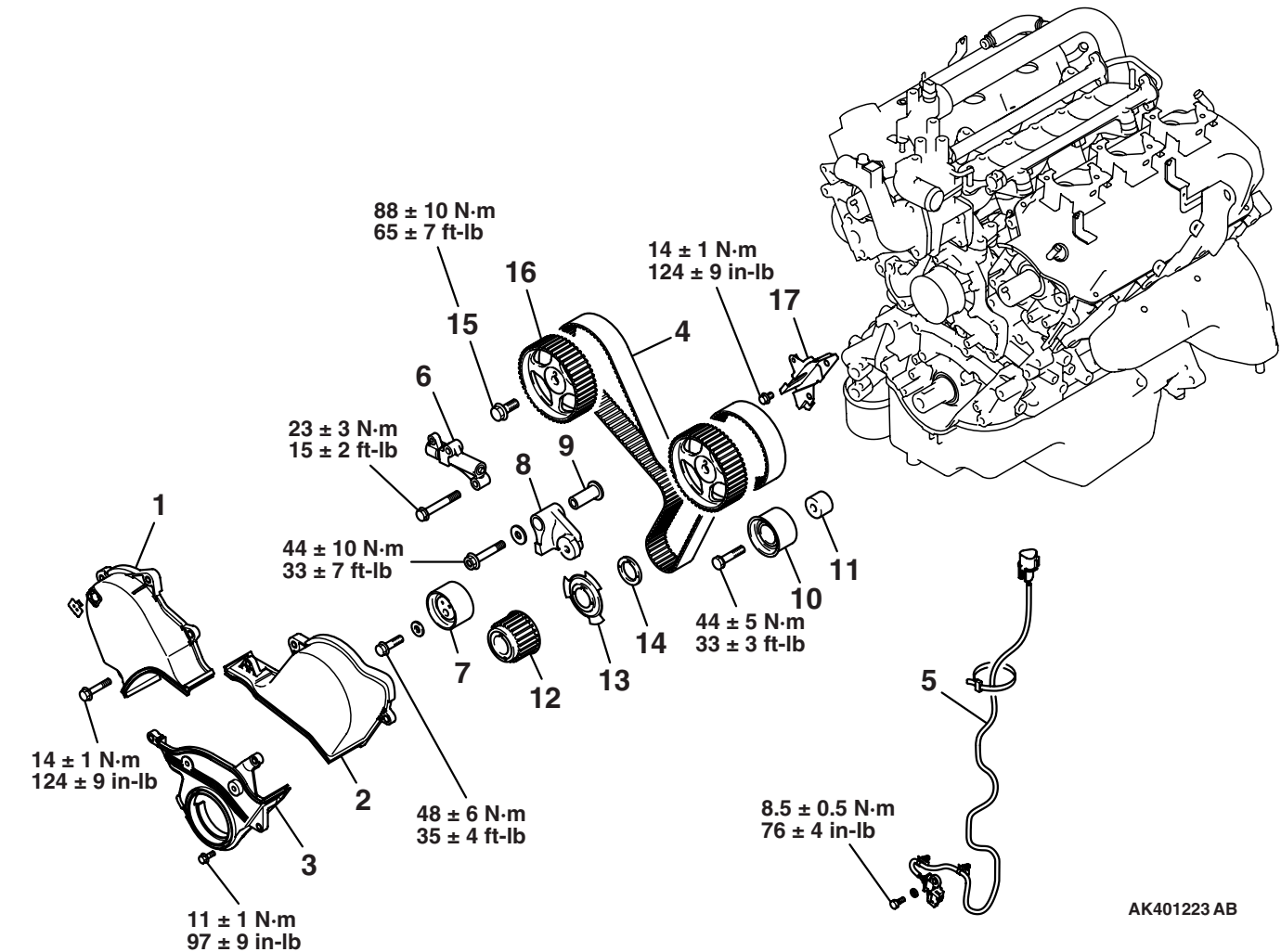
Apply a 3 mm (0.12 inch) diameter bead of sealant Mitsubishi Genuine Parts number MD970389, or equivalent to the camshaft position sensor support.



TIMING BELT

REMOVAL AND INSTALLATION

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REMOVAL STEPS

1. TIMING BELT FRONT UPPER COVER, RIGHT
2. TIMING BELT FRONT UPPER COVER, LEFT
3. TIMING BELT FRONT LOWER COVER
- <<A>> >>D<< 4. TIMING BELT
5. CRANKSHAFT POSITION SENSOR
- >>C<< 6. AUTO-TENSIONER
7. TENSIONER PULLEY

REMOVAL STEPS (Continued)

8. TENSIONER ARM
9. SHAFT
10. IDLER PULLEY
11. IDLER PULLEY SPACER
- >>B<< 12. CRANKSHAFT SPROCKET
13. CRANKSHAFT SENSING BLADE
- >>B<< 14. CRANKSHAFT SPACER
- <> >>A<< 15. CAMSHAFT SPROCKET BOLT
16. CAMSHAFT SPROCKET
17. TIMING BELT REAR COVER

Required Special Tool:

- MB990767: End Yoke Holder
- MD998715: Pins
- MD998767: Tensioner Pulley Wrench
- MD998769: Crankshaft Spacer

REMOVAL SERVICE POINTS

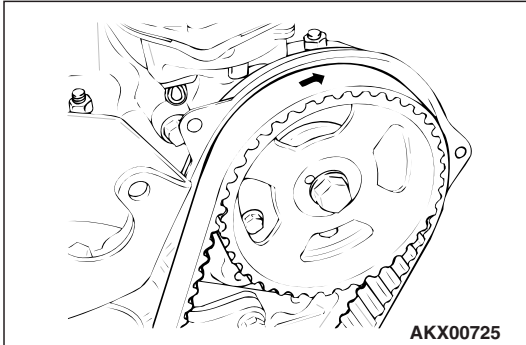
<<A>> TIMING BELT REMOVAL

CAUTION

Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be kept free from oil and water. Do not immerse parts in cleaning solvent.

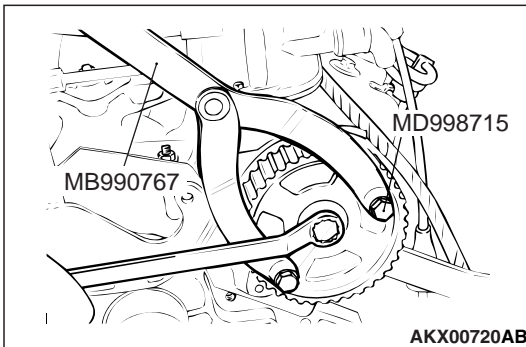
Mark the belt running direction for reference in reinstallation.

NOTE: If there is oil or water on any part, check the front case oil seal, camshaft oil seal, and water pump for leaks.



<> CAMSHAFT SPROCKET BOLT REMOVAL

Use special tools MB990767 and MD998715 to prevent the camshaft sprocket from turning, and then loosen the camshaft sprocket bolt.

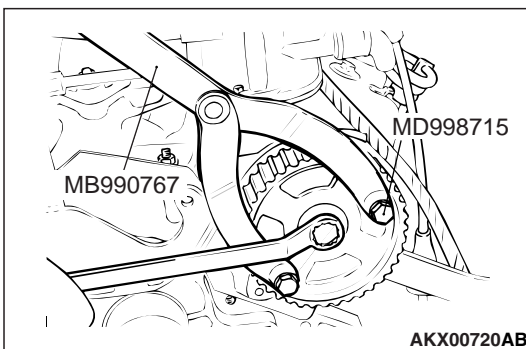


INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT SPROCKET BOLT INSTALLATION

Use special tools MB990767 and MD998715 to prevent the camshaft sprocket from turning, and then tighten the camshaft sprocket bolt.

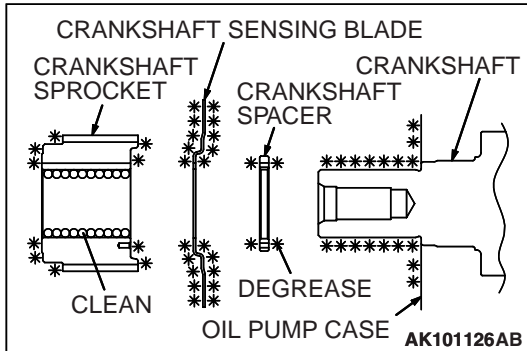
Tightening torque: 88 ± 10 N·m (65 ± 7 ft-lb)



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

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

NOTE: Degreasing is necessary to prevent decrease in friction on the mating surfaces.

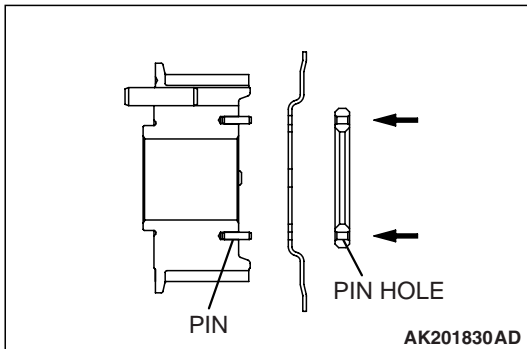


3. Align the location of pin and pin hole, and then apply equal force in the direction of the arrow.

⚠ CAUTION

Do not bend the sensing blade when installing sprocket.

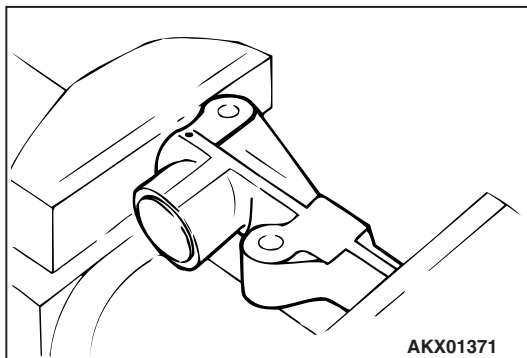
4. Install the crankshaft sprocket to the crankshaft.



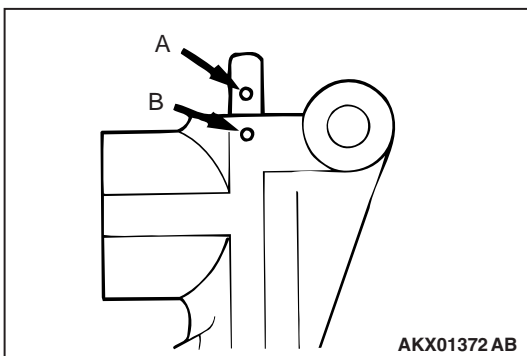
>>C<< AUTO-TENSIONER INSTALLATION

If the auto-tensioner rod is fully extended, set it in the retracted position with the following procedure.

1. Set the auto-tensioner in a vice.



2. Slowly close the vice to force the rod in until the hole (A) of the rod is lined up with set hole (B) of the cylinder.
3. Insert a wire [1.4 mm (0.06 inch) in diameter] into the set holes.
4. Remove the auto-tensioner from the vice.

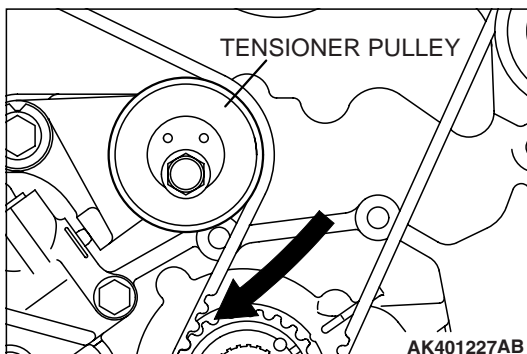
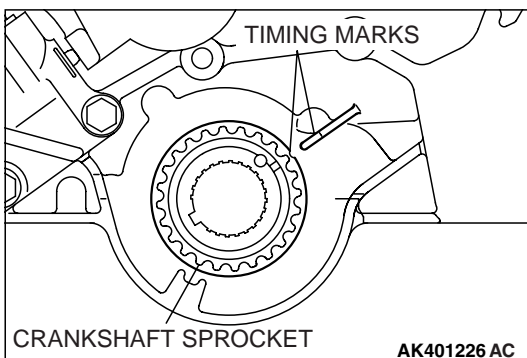
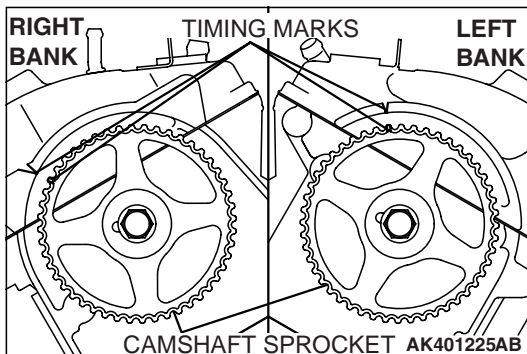
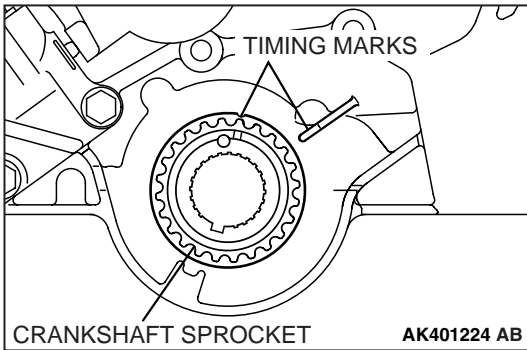


>>D<< TIMING BELT INSTALLATION

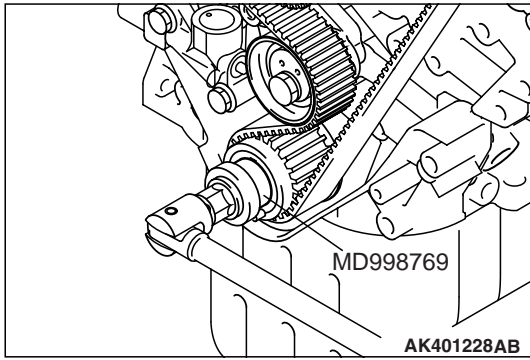
CAUTION

If the camshaft sprocket is rotated with the piston at the top dead center on the compression stroke of the number 1 cylinder, the valve and piston might interfere.

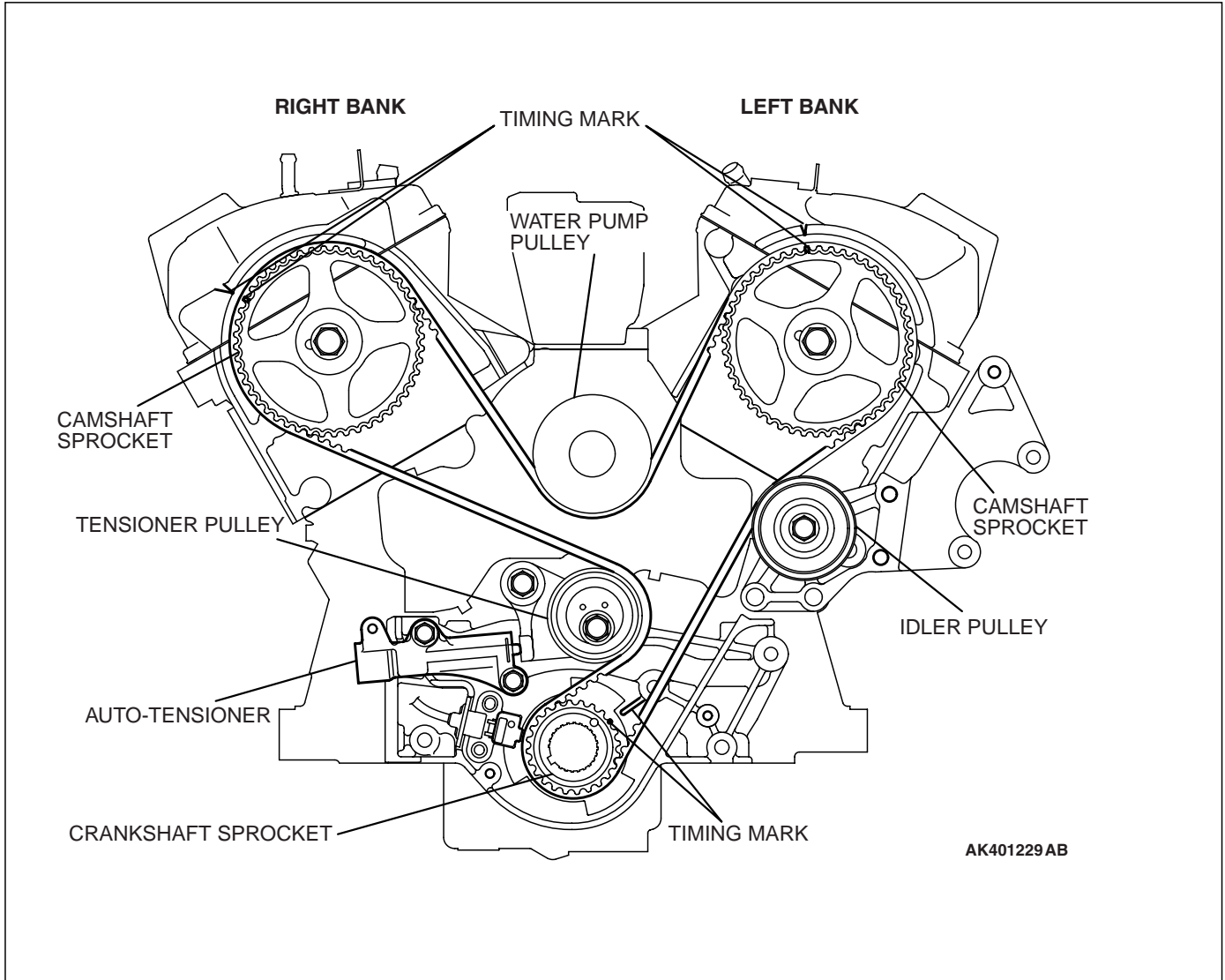
1. Move the timing mark of the crankshaft sprocket three teeth to slightly lower the piston below the top dead center on the compression stroke of the number 1 cylinder.

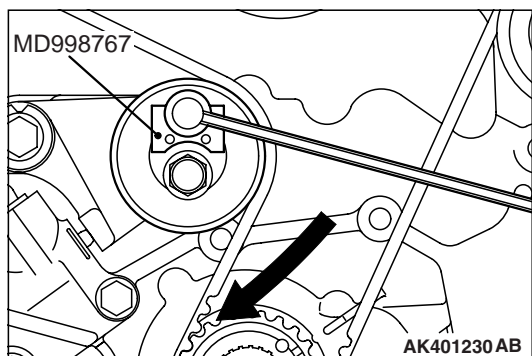


2. Line up the timing marks of the left bank camshaft sprockets.
3. Line up the timing marks of the right bank camshaft sprockets.
4. Line up the timing marks of the crankshaft sprockets.
5. Install the timing belt on each sprocket in the following sequence.
 - (1) Install the timing belt on the crankshaft sprocket and then on the idler pulley, while tightening it to prevent slackness.
 - (2) Line up the timing marks of the left bank camshaft sprockets.
 - (3) Install the timing belt on the water pump pulley, while taking up the slack.
 - (4) Install the timing belt on the right bank camshaft sprocket.
 - (5) Install the timing belt on the tensioner pulley.
6. Lightly press the tensioner pulley against the belt and temporarily tighten the center bolt.
7. Check to see that the timing marks of all the sprockets are in a alignment.



8. Using special tool MD998769, rotate the crankshaft a quarter of a turn counterclockwise. Then rotate it back clockwise to verify that all the timing marks are in alignment.

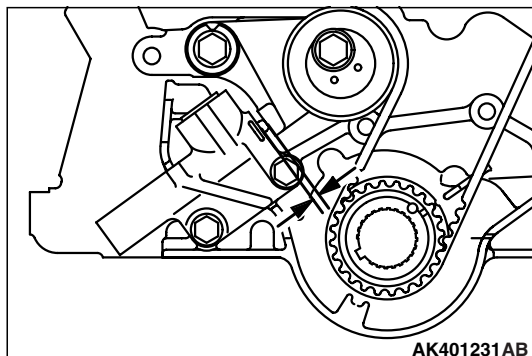




9. Mount special tool MD998767 and torque wrench on the tensioner pulley.
10. Torque it to 4.4 N·m (39 in-lb) with the torque wrench.
11. While holding the tensioner pulley in position, tighten the center bolt to the specified torque.

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

12. Rotate the crankshaft two turns clockwise and leave it alone for approximately five minutes.



13. 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 projection of the rod of the auto-tensioner is within the standard value.

Standard value: 4.8 – 5.5 mm (0.19 – 0.21 inch)

14. If the metal wire offers resistance when removed, repeat the previous steps (9) through (12) until a proper belt tension is obtained.

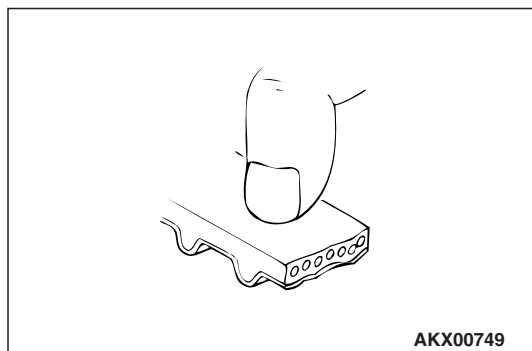
INSPECTION

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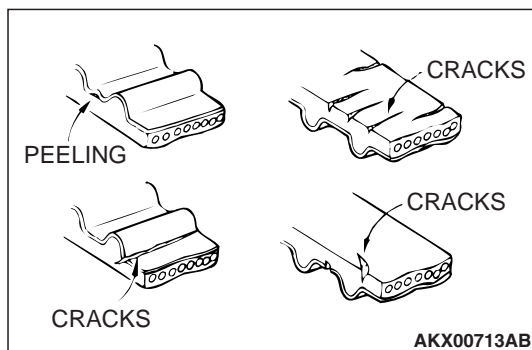
TIMING BELT

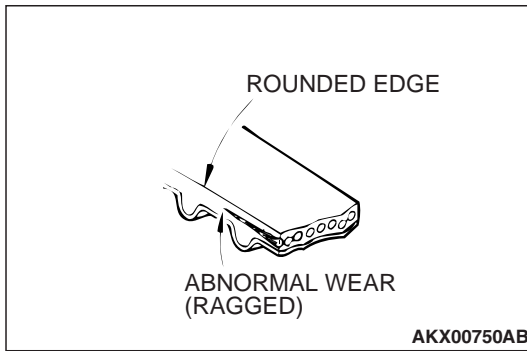
Replace the belt if any of the following conditions exist.

1. Hardening of rubber backing.
Back side is glossy without resilience and leaves no indent when pressed with fingernail.

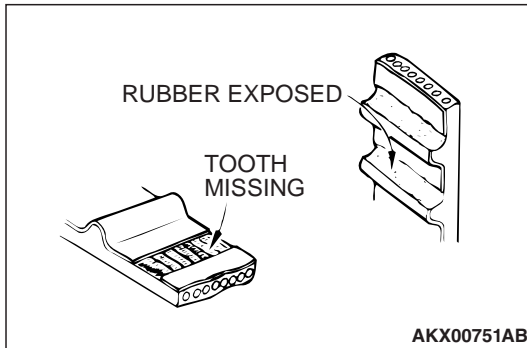


2. Cracks on rubber back.
3. Cracks or peeling of canvas.
4. Cracks on tooth bottom.
5. Cracks on belt.

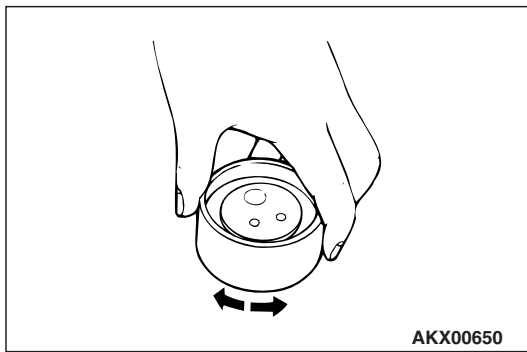




6. Abnormal wear of belt sides. Normal wear is indicated if the sides are sharp as if cut by a knife. Abnormal wear is indicated if the sides are ragged.

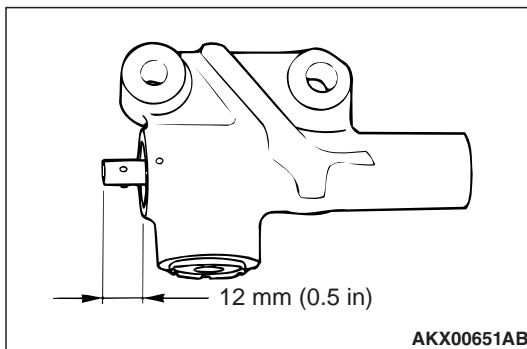


7. Abnormal wear on teeth.
8. Missing tooth.



TENSIONER PULLEY AND IDLER PULLEY

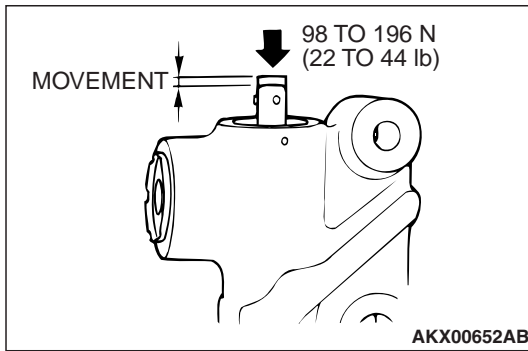
Turn the pulley. If it does not rotate smoothly, or develops noise or excessive play, replace the pulley.



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)



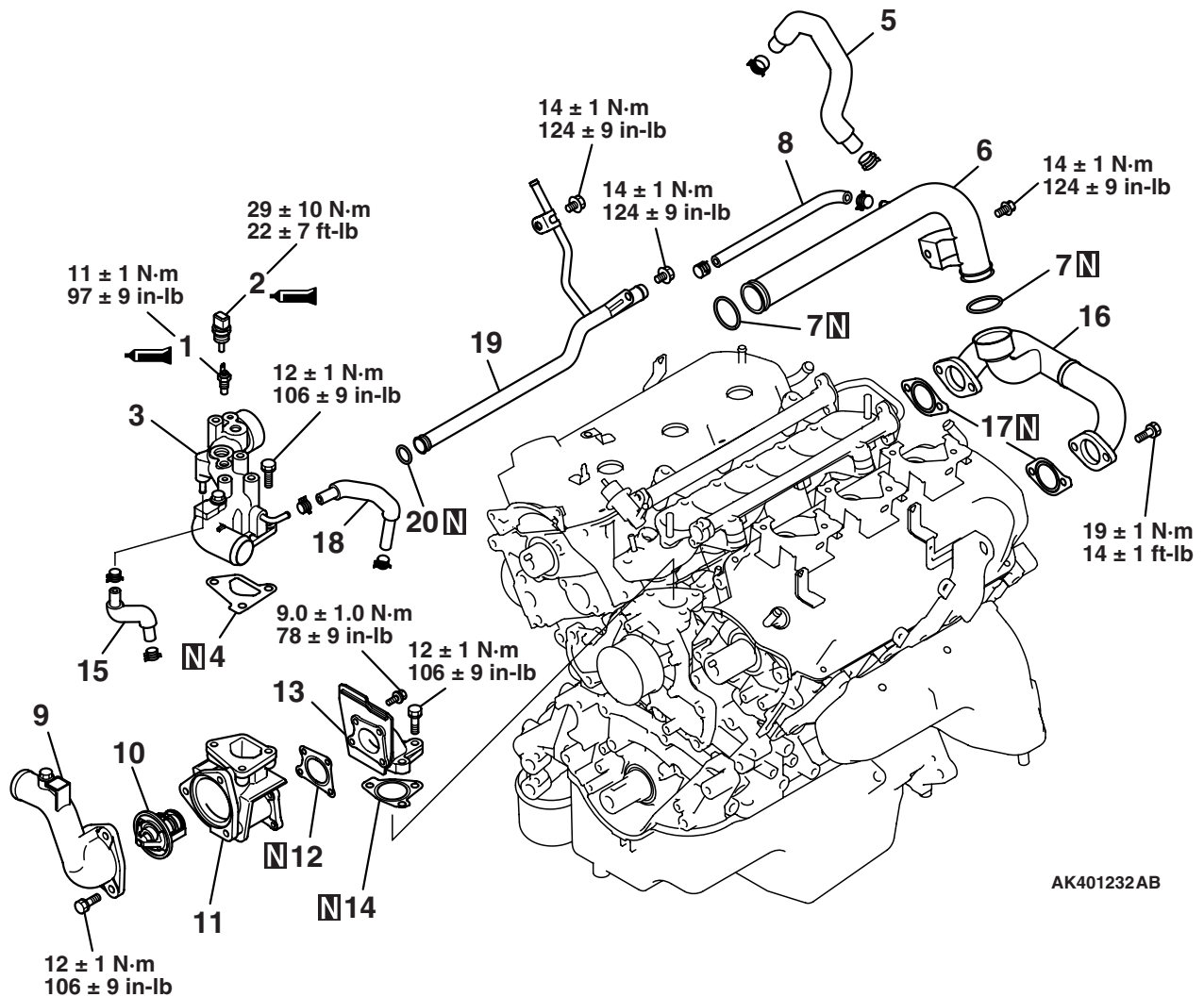
- Press the rod with a force of 98 to 196 N (22 to 44 pounds) and measure the movement of the rod.
If the measured value is out of the standard value, replace the auto-tensioner.

Standard value: 1.0 mm (0.03 inch) or less

INTAKE MANIFOLD AND FUEL PARTS

REMOVAL AND INSTALLATION

M1113004300240



REMOVAL STEPS

- >>G<< 1. ENGINE COOLANT TEMPERATURE GAUGE UNIT
- >>F<< 2. ENGINE COOLANT TEMPERATURE SENSOR

REMOVAL STEPS (Continued)

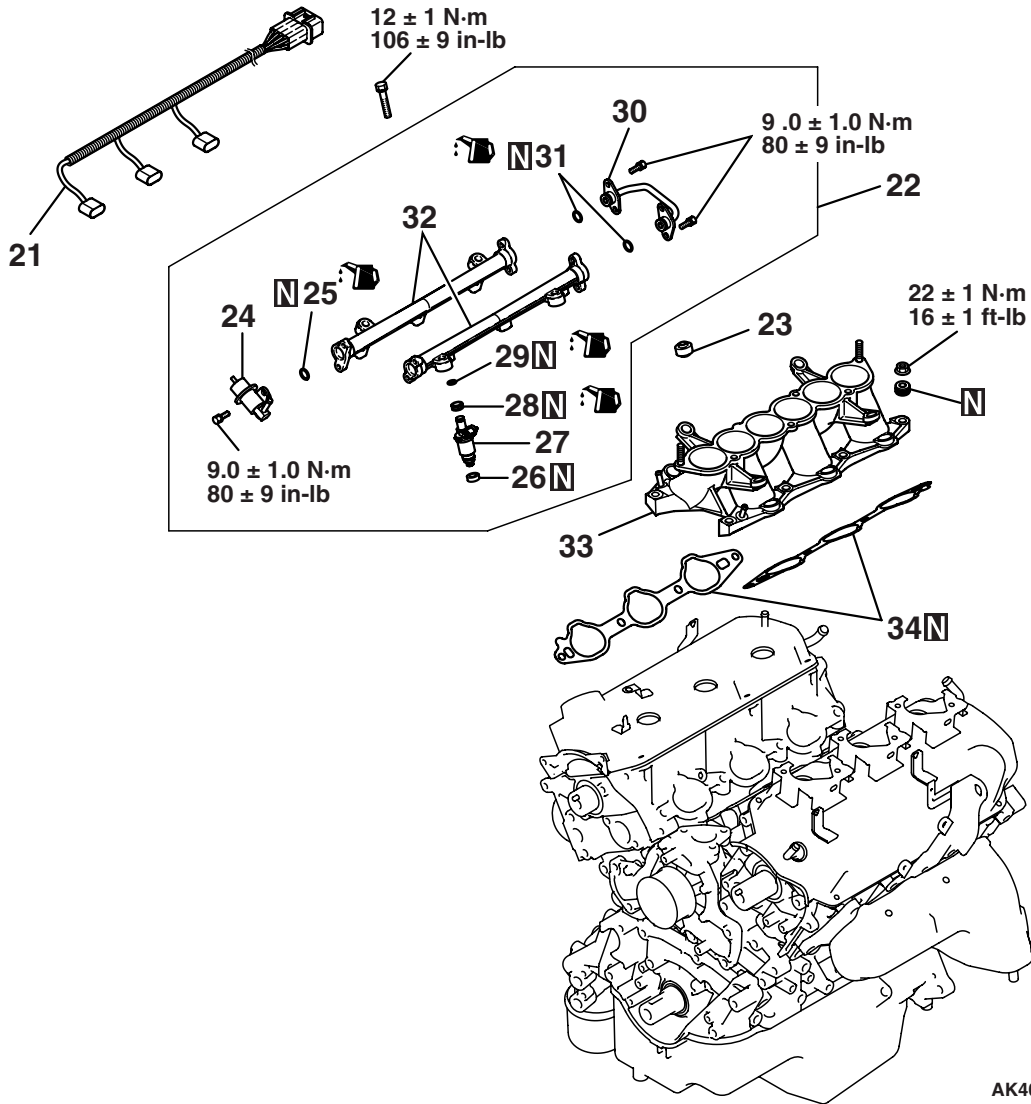
3. WATER OUTLET FITTING
4. WATER OUTLET FITTING GASKET
5. BLOW-BY HOSE
- >>D<< 6. WATER OUTLET PIPE

REMOVAL STEPS (Continued)

- >>D<< 7. O-RING
- 8. WATER HOSE
- 9. WATER INLET FITTING
- >>E<< 10. THERMOSTAT
- 11. THERMOSTAT CASE
- 12. THERMOSTAT CASE GASKET
- 13. FITTING

REMOVAL STEPS (Continued)

- 14. FITTING GASKET
- 15. WATER HOSE
- 16. WATER PASSAGE
- 17. WATER PASSAGE GASKET
- 18. WATER HOSE
- >>D<< 19. WATER PIPE
- >>D<< 20. O-RING



AK401233AB

REMOVAL STEPS

- 21. INJECTOR HARNESS
- 22. INJECTOR AND FUEL RAIL
- 23. INSULATOR
- >>C<< 24. FUEL PRESSURE REGULATOR
- 25. O-RING
- 26. INSULATOR
- >>B<< 27. INJECTOR

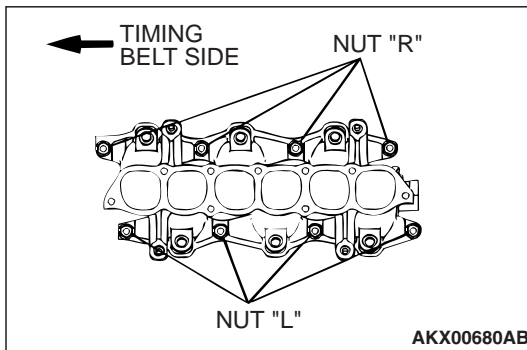
REMOVAL STEPS (Continued)

- 28. O-RING
- 29. GROMMET
- 30. FUEL PIPE
- 31. O-RING
- 32. FUEL RAIL
- >>A<< 33. INTAKE MANIFOLD
- 34. INTAKE MANIFOLD GASKET

INSTALLATION SERVICE POINTS

>>A<< INTAKE MANIFOLD INSTALLATION

1. Tighten the nuts on the right bank to 6.4 N·m (56 in-lb).
2. Tighten the nuts on the left bank to the specified torque.
Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)
3. Tighten the nuts on the right bank to the specified torque.
Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)
4. Tighten the nuts on the left bank and those on the right bank again in that order.
Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)

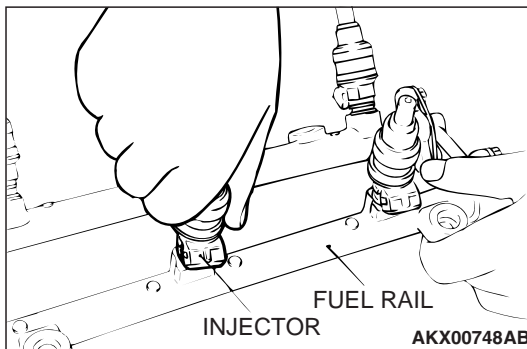


>>B<< INJECTOR INSTALLATION

⚠ CAUTION

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

1. Before installing the pressure regulator, lubricate the O-ring with a drop of new engine oil for easy installation.
2. Insert the injector top end into the fuel rail. Be careful not to damage the O-ring during installation.



>>C<< FUEL PRESSURE REGULATOR INSTALLATION

⚠ CAUTION

Do not let engine oil enter the fuel rail.

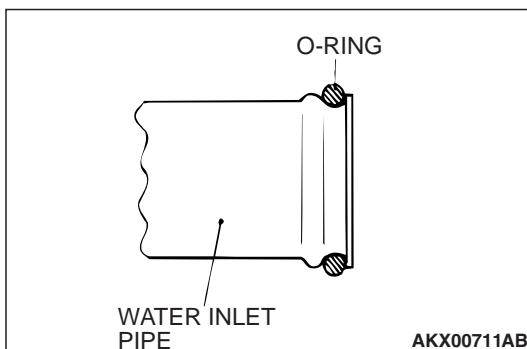
Before installing the pressure regulator, lubricate the O-ring with a drop of new engine oil for easy installation.

>>D<< O-RING AND WATER PIPE INSTALLATION

⚠ CAUTION

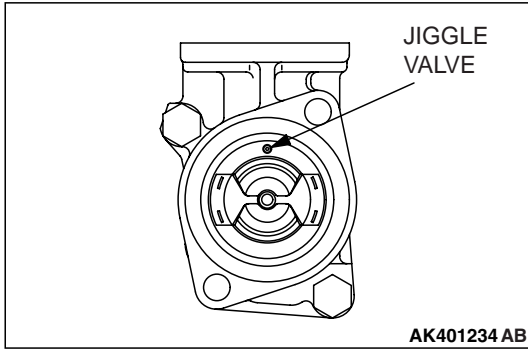
Keep the O-ring free of oil or grease.

Wet the O-ring (with water) to ease assembly.

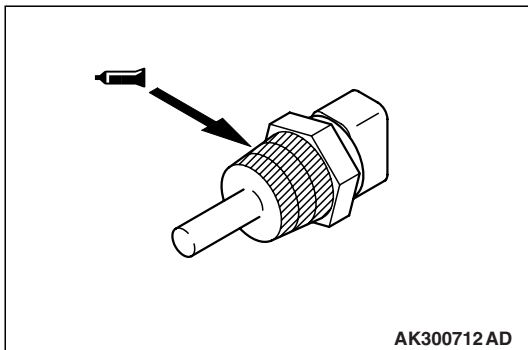


>>E<< THERMOSTAT INSTALLATION

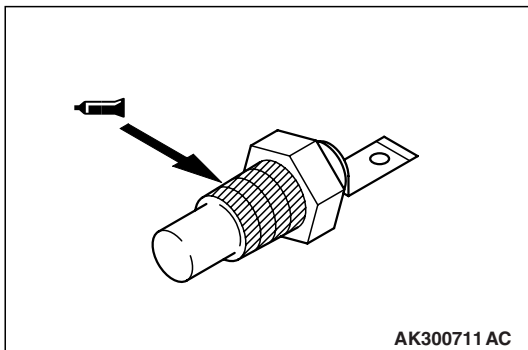
Install the thermostat in the thermostat case with its jiggle valve located at the top position.

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

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

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

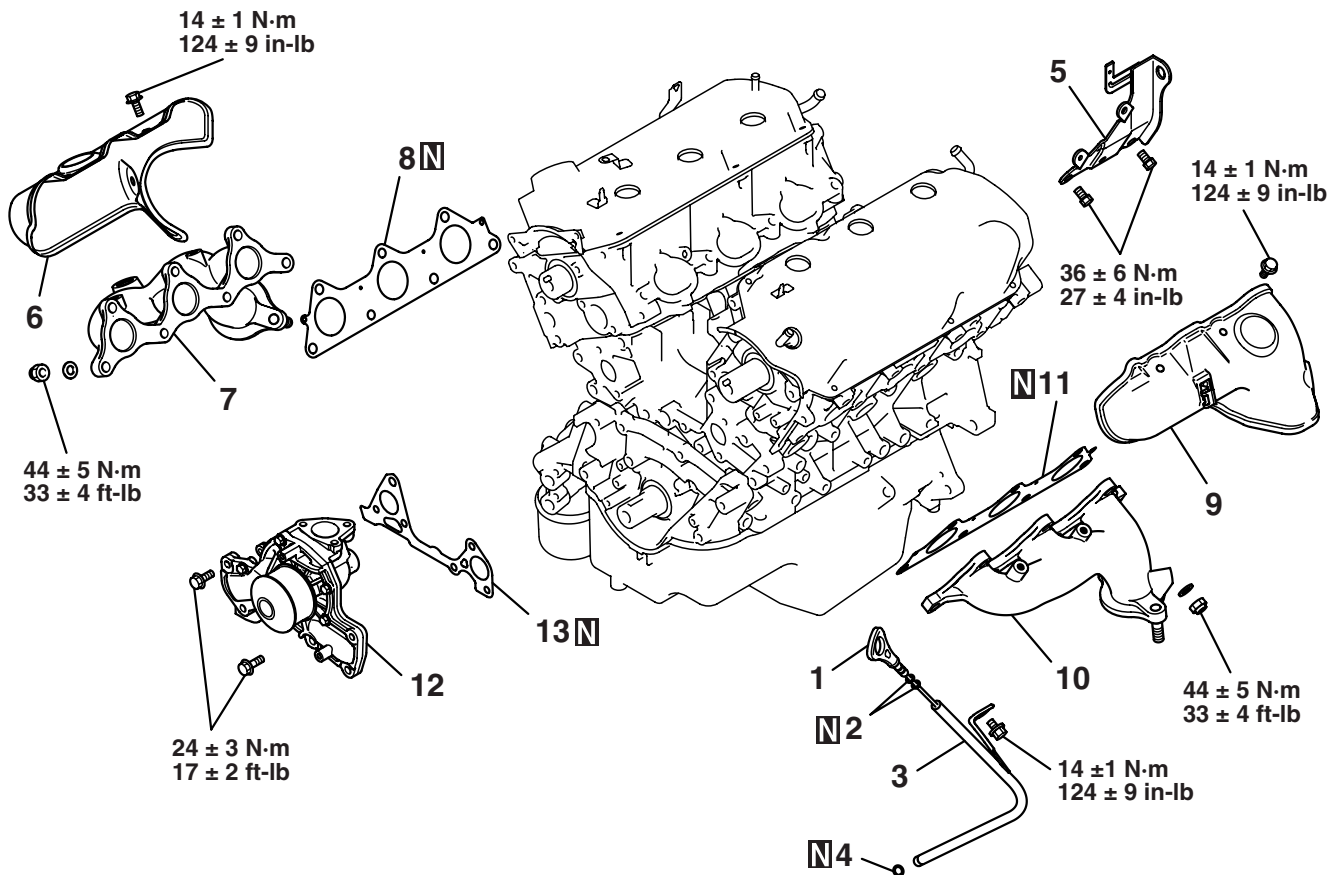
Apply 3M™ AAD Part number 8672 or equivalent to the engine coolant temperature gauge unit.



EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004900792



AK401265 AB

REMOVAL STEPS

1. OIL DIPSTICK
2. O-RING
3. OIL DIPSTICK GUIDE
4. O-RING
5. ENGINE HANGER
6. HEAT PROTECTOR, RIGHT
7. EXHAUST MANIFOLD, RIGHT

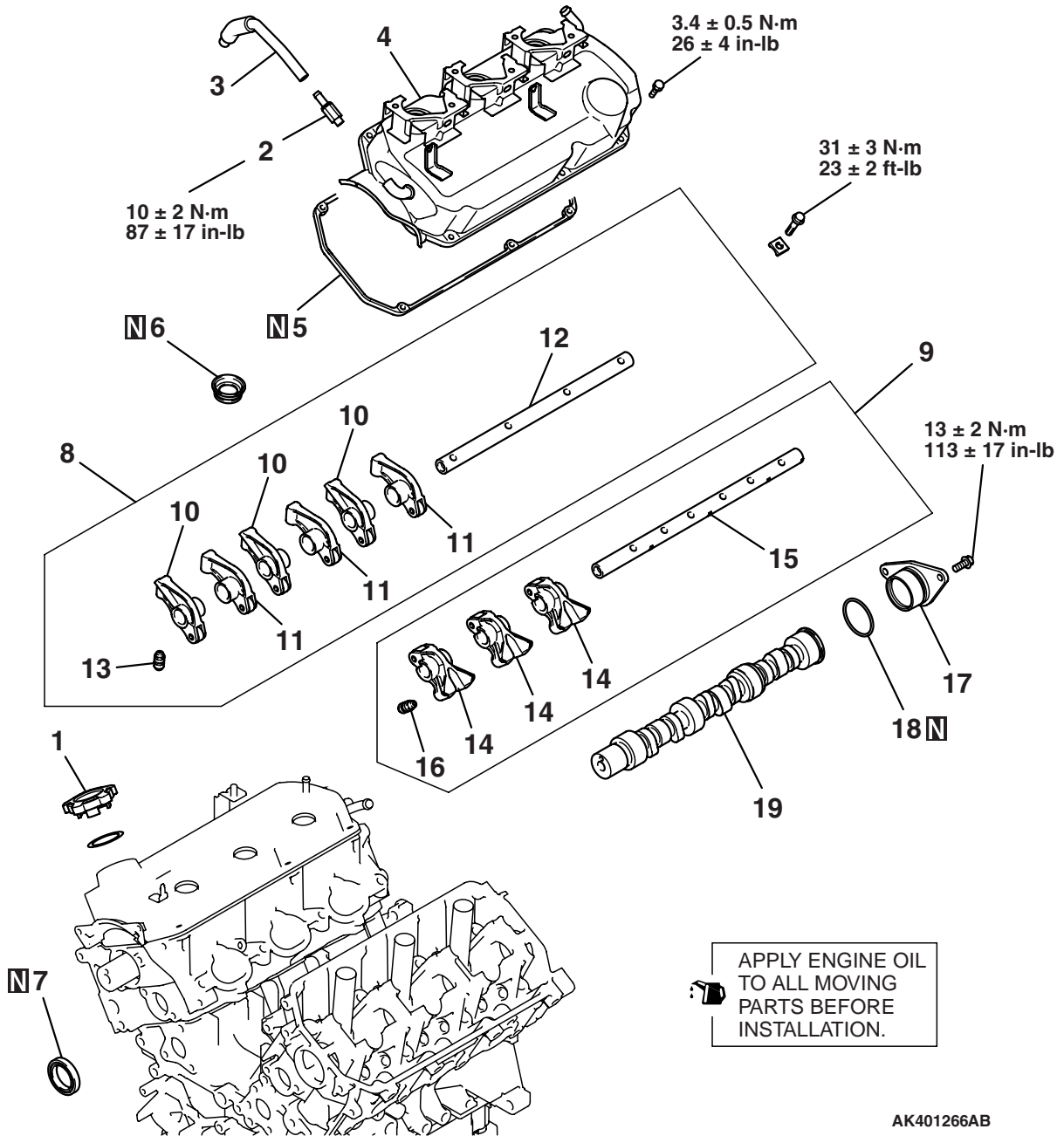
REMOVAL STEPS (Continued)

8. EXHAUST MANIFOLD GASKET
9. HEAT PROTECTOR, LEFT
10. EXHAUST MANIFOLD, LEFT
11. EXHAUST MANIFOLD GASKET
12. WATER PUMP
13. WATER PUMP GASKET

ROCKER ARMS AND CAMSHAFT

REMOVAL AND INSTALLATION

M1113005400938



APPLY ENGINE OIL TO ALL MOVING PARTS BEFORE INSTALLATION.

AK401266AB

REMOVAL STEPS

1. OIL FILLER CAP
2. PCV VALVE
3. PCV VALVE HOSE
4. ROCKER COVER
5. ROCKER COVER GASKET
6. OIL SEAL
- >>C<< 7. CAMSHAFT OIL SEAL
- <<A>> 8. ROCKER ARMS AND SHAFT
- <<A>> 9. ROCKER ARMS AND SHAFT
10. ROCKER ARM A

REMOVAL STEPS (Continued)

11. ROCKER ARM B
12. ROCKER ARM SHAFT
- >>B<< 13. LASH ADJUSTER
14. ROCKER ARM C
15. ROCKER ARM SHAFT
- >>B<< 16. LASH ADJUSTER
17. THRUST CASE
- (RIGHT BANK ONLY)
18. O-RING (RIGHT BANK ONLY)
- >>A<< 19. CAMSHAFT

Required Special Tools:

- MB991559: Camshaft Oil Seal Installer Adapter
- MD998442: Air Bleed Wire
- MD998443: Lash Adjuster Holder
- MD998713: Camshaft Oil Seal Installer

REMOVAL SERVICE POINT

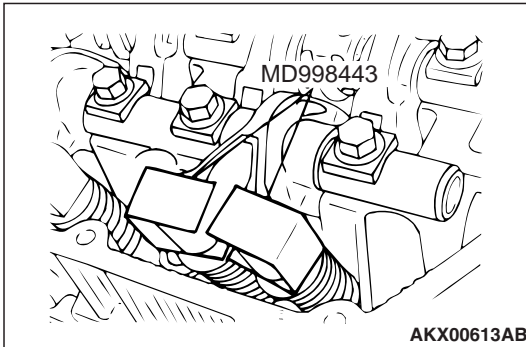
<<A>> ROCKER ARMS AND SHAFT REMOVAL

⚠ CAUTION

If the lash adjuster is re-used, clean the lash adjuster.

(Refer to lash adjuster inspection [P.11B-24.](#))

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



INSTALLATION SERVICE POINTS

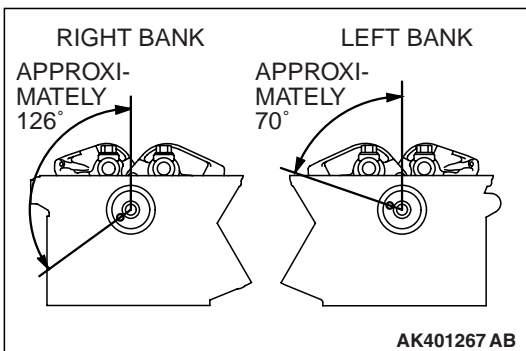
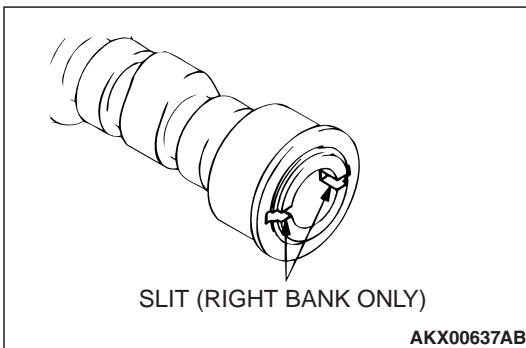
>>A<< CAMSHAFT INSTALLATION

⚠ CAUTION

Use care to prevent confusion of the right and left bank camshafts.

1. Apply engine oil to the camshaft journals and cams and then install the camshafts.

NOTE: The right bank camshaft is identified by a slit 4 mm (0.16 inch) wide at the rear end of the camshaft.



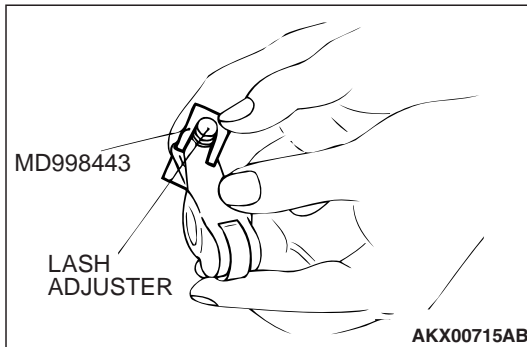
2. Check to see that the dowel pin of the camshaft is located at the position shown.

>>B<< LASH ADJUSTER INSTALLATION

CAUTION

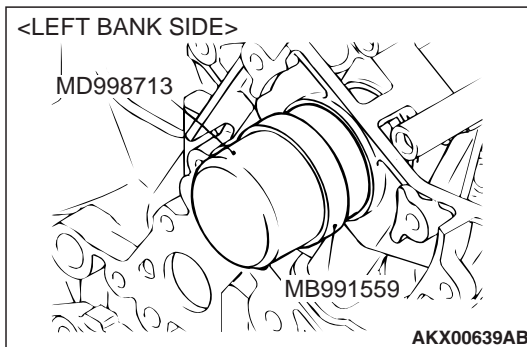
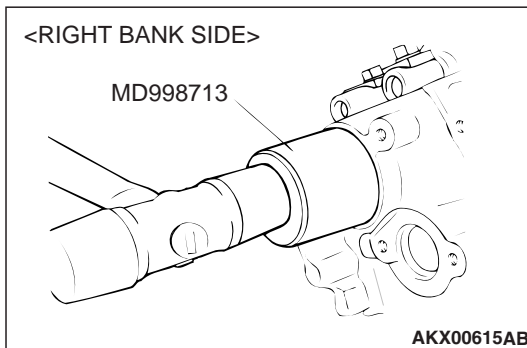
If the lash adjuster is re-used, clean the lash adjuster.
(Refer to lash adjuster inspection P.11B-24.)

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 from free and falling to the floor.



>>C<< CAMSHAFT OIL SEAL INSTALLATION

Use special tools MD998713 and MB991559 to install the camshaft oil seal.



INSPECTION

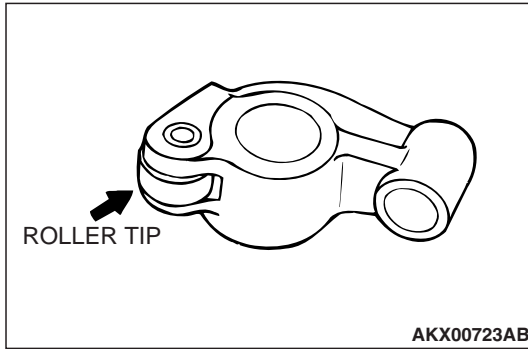
M1113005500300

ROCKER ARM SHAFT

Check the rocker arm mounting areas of the rocker arm shafts for wear or damage. Replace as necessary.

ROCKER ARM

1. Check the roller surface and replace the rocker arm if recesses, damage or heat seizure is observed.
2. Check roller rotation and replace the rocker arm if uneven rotation or roller backlash of the roller is observed.
3. Check the inside diameter and replace the rocker arm if damage or seizure is observed.



CAMSHAFT

1. Check the camshaft bearing journals for damage and binding. If the journals are binding, check the cylinder head for damage. Also check the cylinder head for clogged oil holes.
2. Check the tooth surface of the distributor drive gear teeth of the camshaft and replace if abnormal wear is evident.
3. Check the cam surface for abnormal wear and damage and replace if necessary. Also measure the cam height and replace if out of minimum limit.

Standard value:

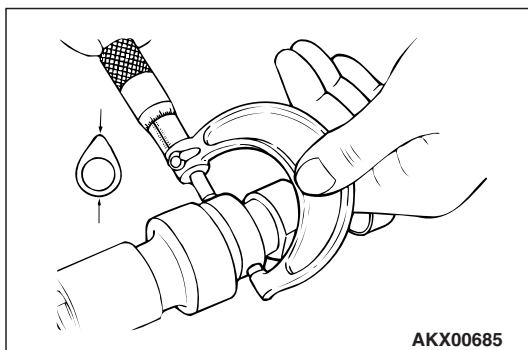
Intake 37.39 mm (1.472 inches)

Exhaust 37.14 mm (1.462 inches)

Minimum limit:

Intake 36.89 mm (1.452 inches)

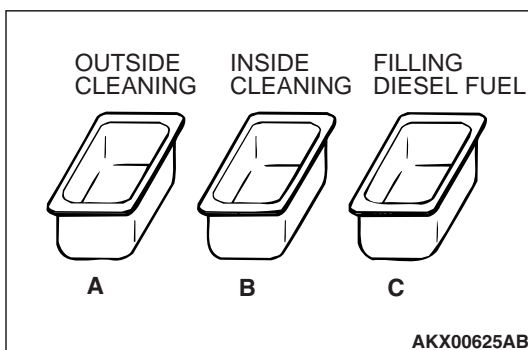
Exhaust 36.64 mm (1.443 inches)

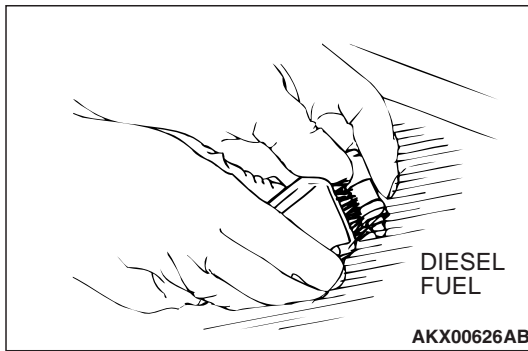


LASH ADJUSTERS

⚠ 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 dm³ (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.



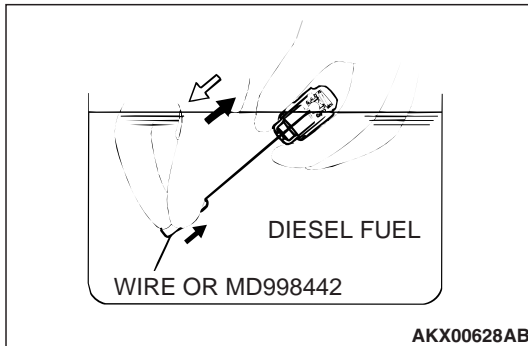


- Place the lash adjuster in container A and clean its outside surface.

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

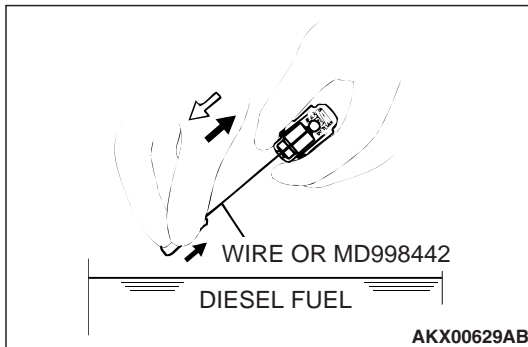
CAUTION

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



- While gently pushing down the internal steel ball using wire [0.5 mm (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.

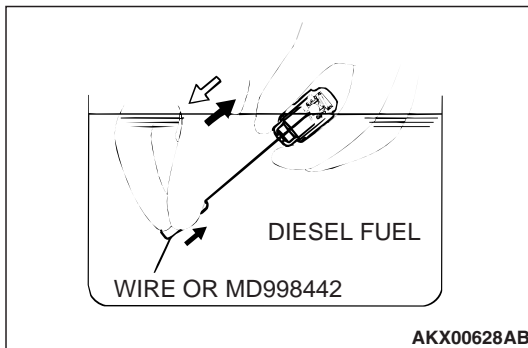
NOTE: If the plunger remains stiff or the mechanism appears otherwise abnormal, replace the lash adjuster.



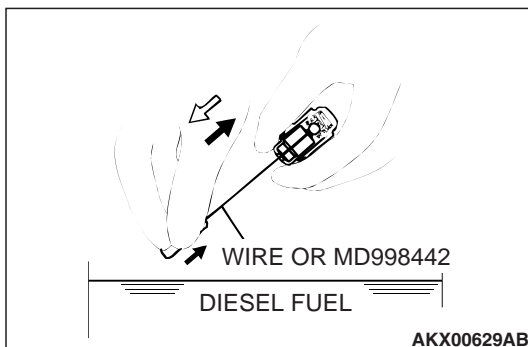
- Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

CAUTION

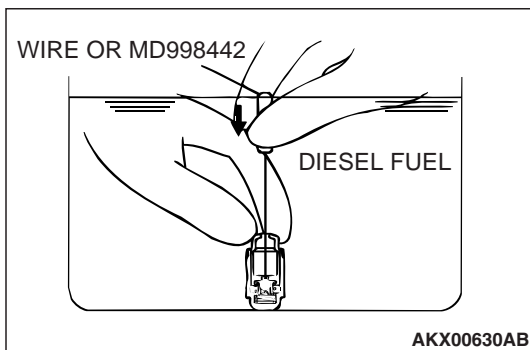
The steel ball spring is extremely weak, so the lash adjuster's functionality may be lost if the air bleed wire is pushed in hard.



- Place the lash adjuster in container B. Then, gently push down the internal steel ball using a 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.



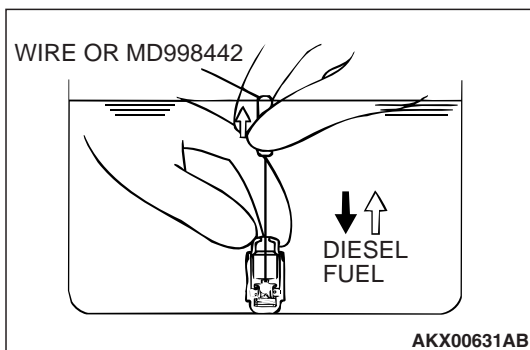
- Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.



⚠ 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.

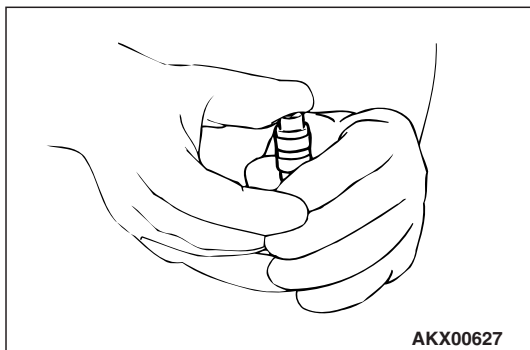
7. Place the lash adjuster in container C. Then, gently push down the internal steel ball using a wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442.
8. Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible 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.

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.

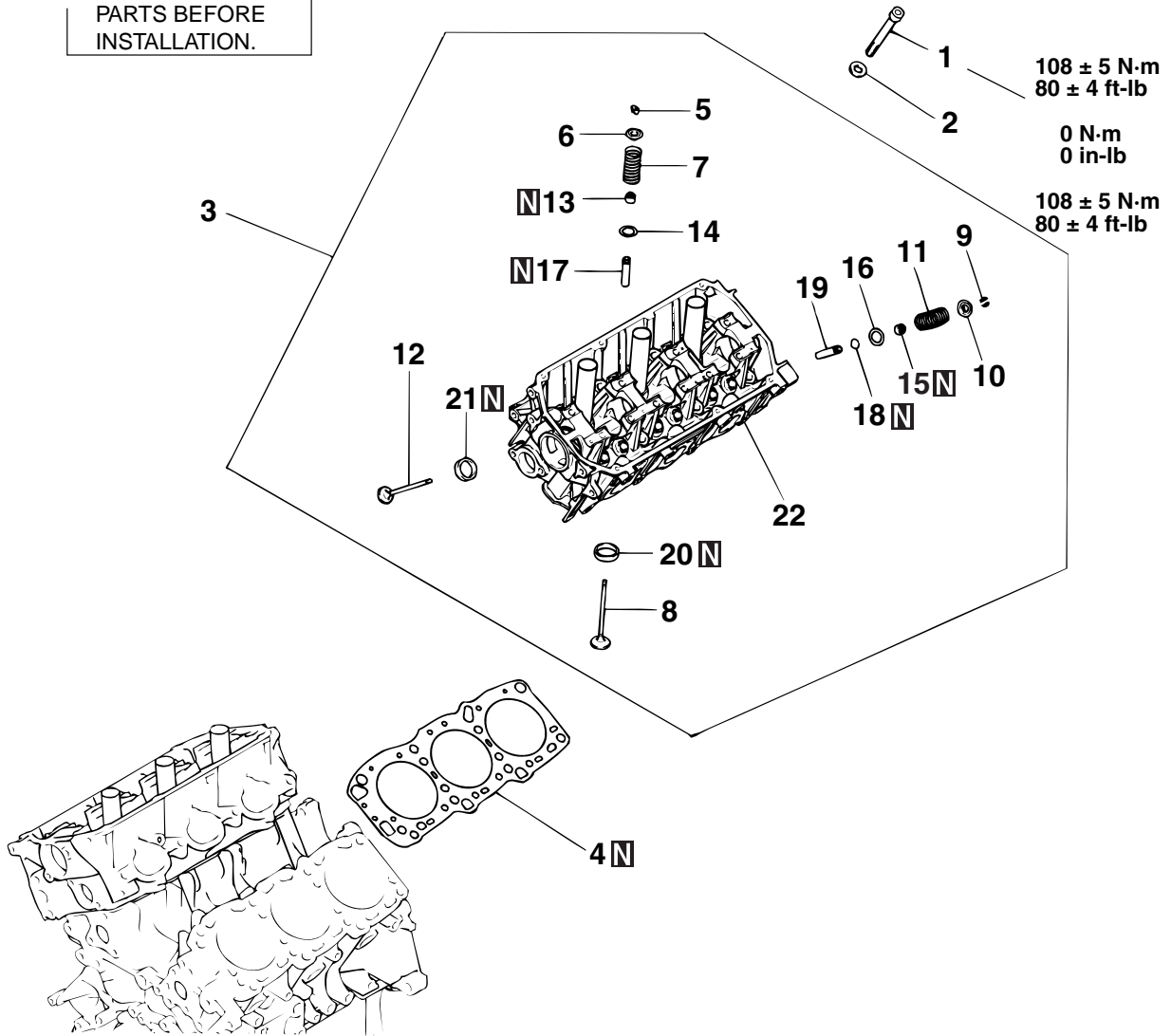


CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006900851

APPLY ENGINE OIL
TO ALL MOVING
PARTS BEFORE
INSTALLATION.



AKX00644AE

REMOVAL STEPS

- <<A>> >>D<< 1. CYLINDER HEAD BOLT
- 2. WASHER
- 3. CYLINDER HEAD ASSEMBLY
- 4. CYLINDER HEAD GASKET
- <> >>C<< 5. RETAINER LOCK
- 6. VALVE SPRING RETAINER
- >>B<< 7. VALVE SPRING
- 8. INLET VALVE
- <> >>C<< 9. RETAINER LOCK
- 10. VALVE SPRING RETAINER
- >>B<< 11. VALVE SPRING

REMOVAL STEPS (Continued)

- 12. EXHAUST VALVE
- >>A<< 13. VALVE STEM SEAL
- 14. VALVE SPRING SEAT
- >>A<< 15. VALVE STEM SEAL
- 16. VALVE SPRING SEAT
- 17. INLET VALVE GUIDE
- 18. SNAP RING
- 19. EXHAUST VALVE GUIDE
- 20. INLET VALVE SEAT
- 21. EXHAUST VALVE SEAT
- 22. CYLINDER HEAD

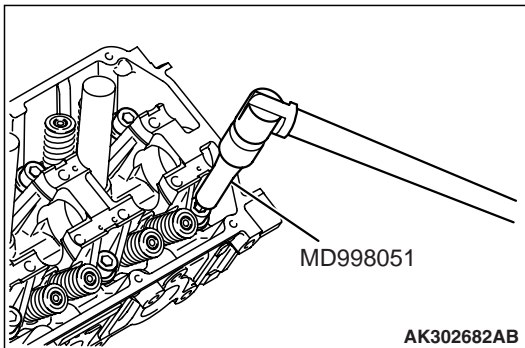
Required Special Tools:

- MD998051: Cylinder Head Bolt Wrench
- MD998772: Valve Spring Compressor
- MB991999: Valve Stem Seal Installer

REMOVAL SERVICE POINTS

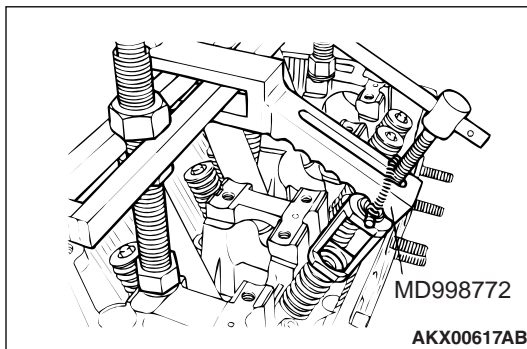
<<A>> CYLINDER HEAD BOLT REMOVAL

Use special tool MD998051 to loosen the cylinder head bolt.



<> RETAINER LOCK REMOVAL

1. Using special tool MD998772, compress the spring.
2. Remove the retainer locks.



INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION

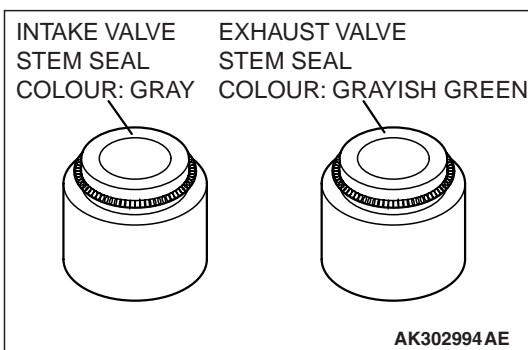
1. Install the valve spring seat.

⚠ CAUTION

- Valve stem seals for intake valves and for exhaust valves are different. Be sure to install the correct ones.
- Valve stem seal identification color.

Intake: GRAY

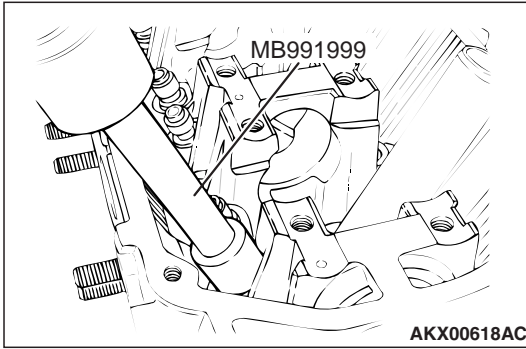
Exhaust: GRAY GREEN



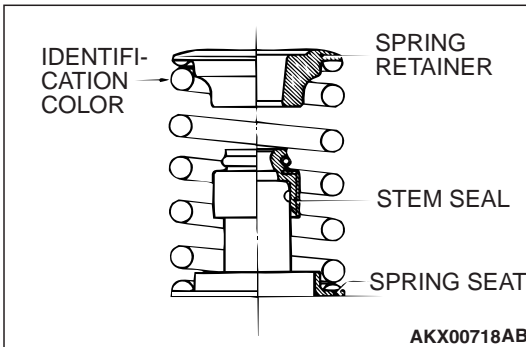
⚠ CAUTION

Always use the special tool to install the valve stem seal. Improperly installed valve stem seals may leak oil.

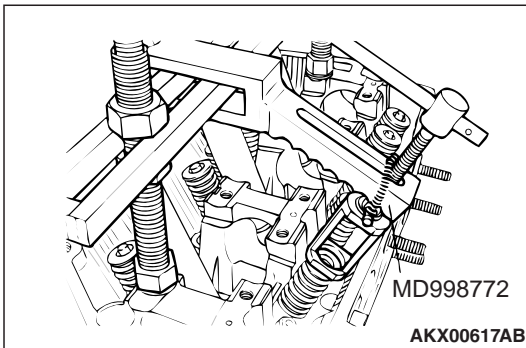
- Using special tool MB991999, install a new stem seal to the valve guide.

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

Install the valve spring end with its identification color toward the spring retainer.

**>>C<< RETAINER LOCK INSTALLATION**

Using special tool MD998772, compress the valve spring and insert the retainer lock into position.



>>D<< CYLINDER HEAD BOLT INSTALLATION

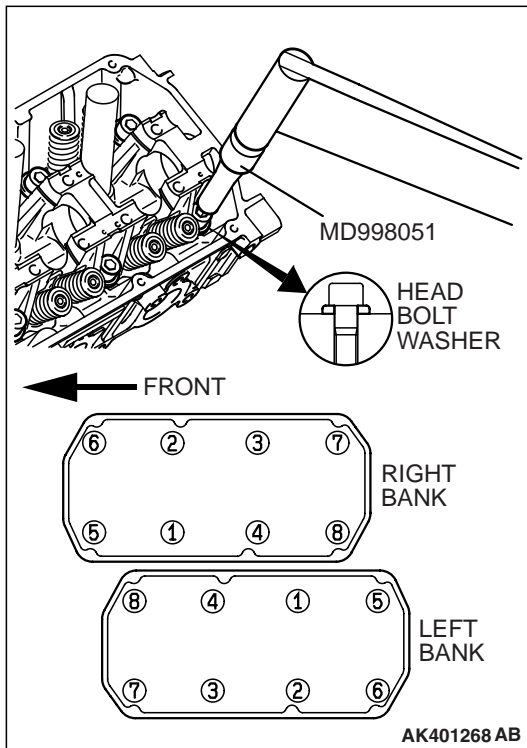
CAUTION

Attach the head bolt washer in the direction shown in the figure.

1. Tighten the bolts in the illustrated sequence two or three rounds.

Tightening torque: 108 ± 5 N·m (80 ± 4 ft-lb)

2. Back off the bolts once and tighten them to the specified torque in the same procedure as shown in step (1).



INSPECTION

M1113007000442

CYLINDER HEAD

1. Check the cylinder head gasket surface for flatness by using a straightedge in the directions of A through G shown in the illustration.

Standard value: 0.03 mm (0.0012 inch)

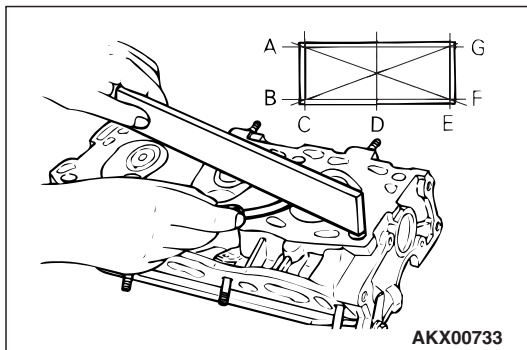
Limit: 0.2 mm (0.007 inch)

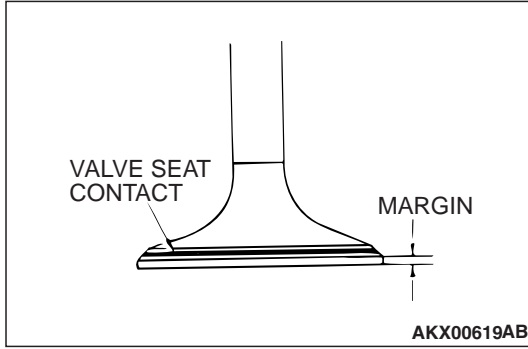
2. If the service limit is exceeded, correct to meet the specification.

Grinding limit: *0.2 mm (0.007 inch)

3. *If the service limit is exceeded, correct to meet the specification.

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



**VALVE**

1. Check the valve face for correct contact. If incorrect, reface using a valve refacer. The valve should make a uniform contact with the seat at the center of the valve face.
2. If the margin exceeds the service minimum limit, replace the valve.

Standard value:

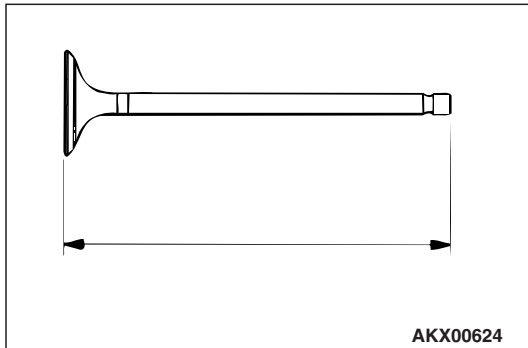
<Intake> 1.0 mm (0.04 inch)

<Exhaust> 1.2 mm (0.05 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 specified, replace the valve.

Standard value:

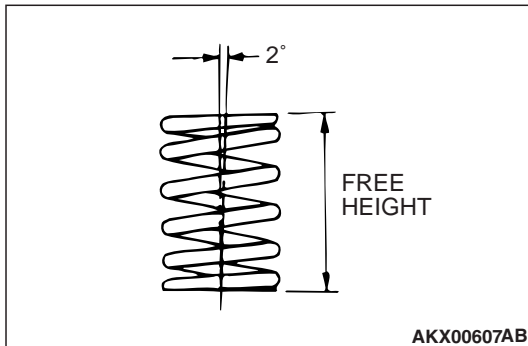
<Intake> 110.30 mm (4.343 inches)

<Exhaust> 112.11 mm (4.414 inches)

Minimum limit:

<Intake> 109.80 mm (4.323 inches)

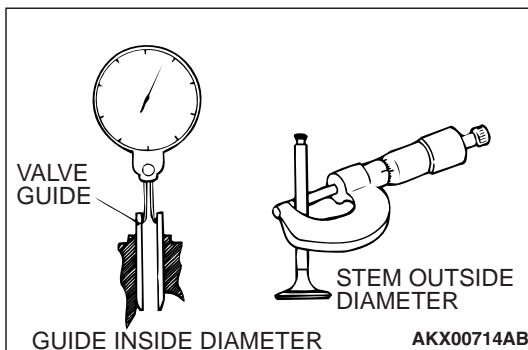
<Exhaust> 111.61 mm (4.394 inches)

**VALVE SPRINGS**

1. Measure the free height of the spring and, if it is smaller than the minimum limit, replace the spring.

Standard value: 51.0 mm (2.01 inches)**Minimum limit: 50.0 mm (1.97 inches)**

2. Measure the squareness of the spring and, if the limit is exceeded, replace the spring.

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

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

Standard value:

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

<Exhaust> 0.04 – 0.07 mm (0.0016 – 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:

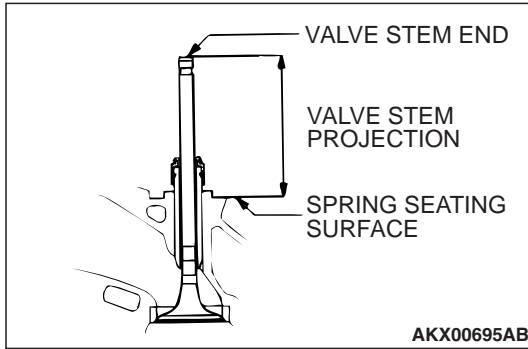
<Intake> 48.30 mm (1.9021 inches)

<Exhaust> 51.71 mm (2.039 inches)

Limit:

<Intake> 48.80 mm (1.921 inches)

<Exhaust> 52.01 mm (2.048 inches)

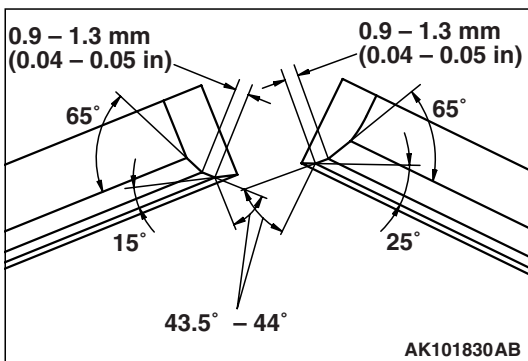


VALVE SEAT RECONDITIONING PROCEDURE

CAUTION

Before correcting the valve seat, check the clearance between the valve guide and valve and, if necessary, replace the valve guide.

1. Using the special tool or a seat grinder, correct to obtain the specified seat width and angle.
2. After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection.



VALVE SEAT REPLACEMENT PROCEDURE

CAUTION

Before replacing the valve seat, check the valve guide and, if necessary, replace the valve guide.

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.

Seat ring hole diameter:

Intake valve

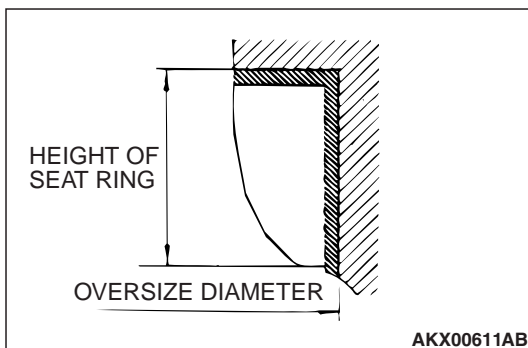
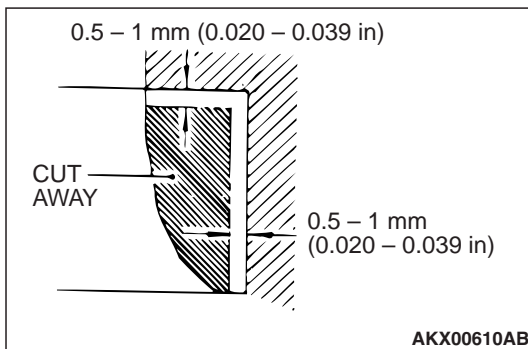
0.3 oversize 37.80 - 37.83 mm (1.4882 - 1.4894 inches)

0.6 oversize 38.10 - 38.13 mm (1.5000 - 1.5012 inches)

Exhaust valve

0.3 oversize 34.80 - 34.83 mm (1.3701 - 1.3713 inches)

0.6 oversize 35.10 - 35.13 mm (1.3819 - 1.3831 inches)



- 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.
- Using a valve seat cutter, correct the valve seat to the specified width and angle. 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

- Remove the snap ring from the exhaust valve guide.
- Using a press, remove the valve guide toward the cylinder head gasket surface.

CAUTION

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

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

Valve guide hole diameter:

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

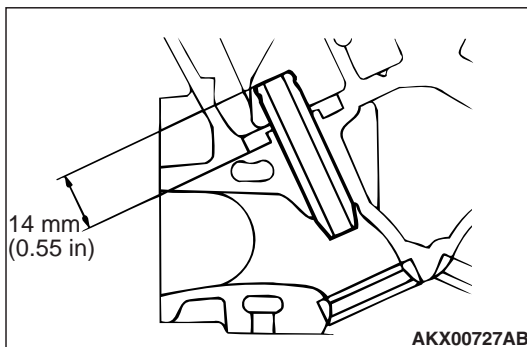
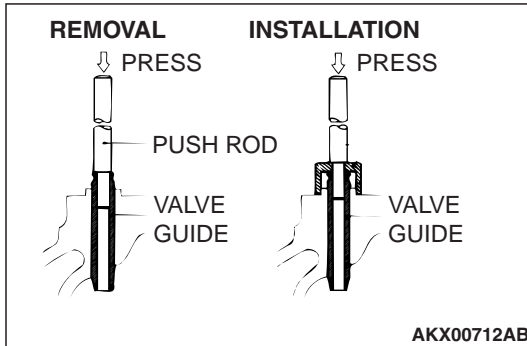
0.25 oversize 11.25 – 11.27 mm (0.4429 – 0.4457 inch)

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

- Install the new snap ring into the groove of exhaust valve guide.
- Press-fit the valve guide until it protrudes 14 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.

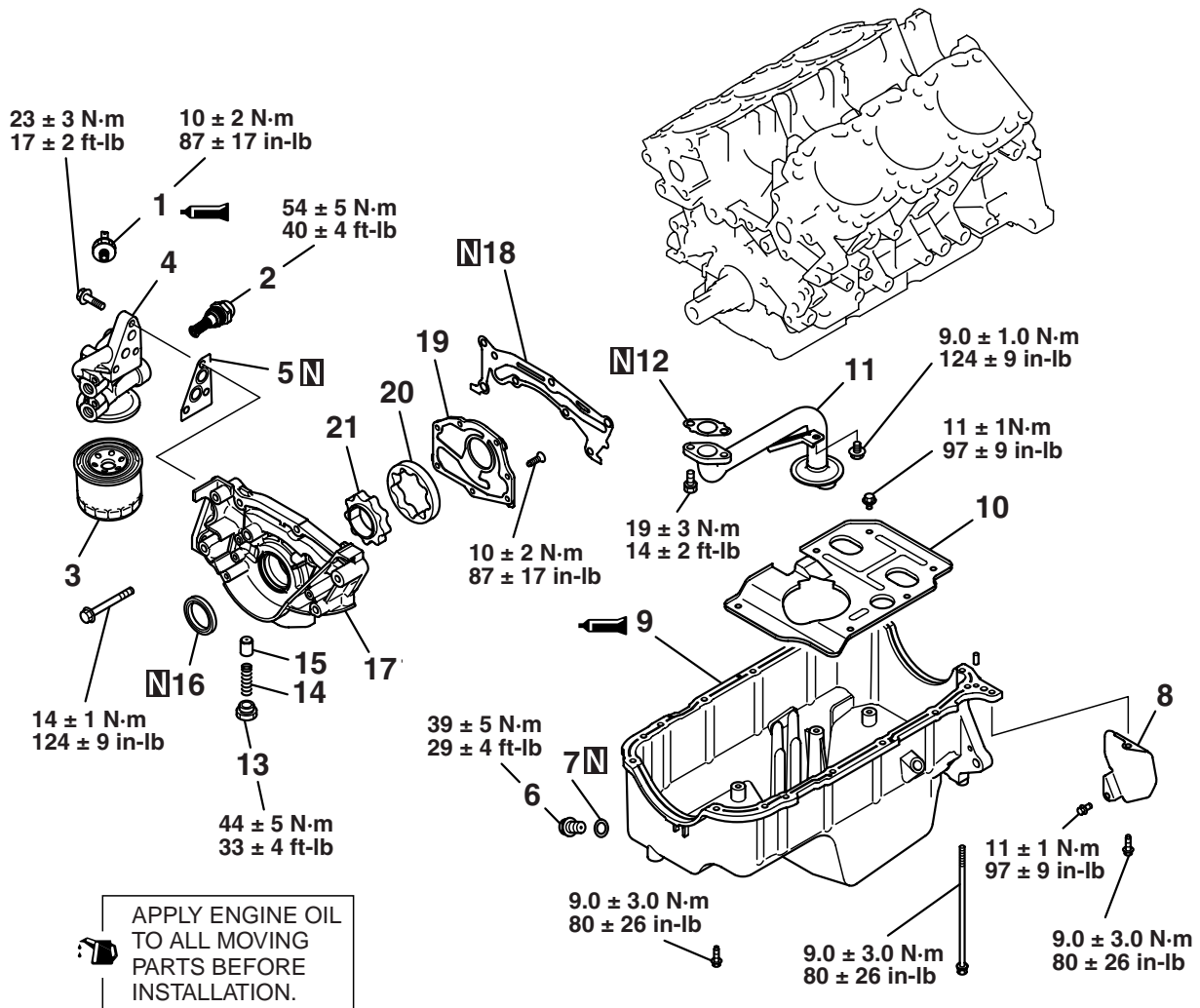
NOTE: After installing the valve guides, insert new valves in them to check for sliding condition.



OIL PAN AND OIL PUMP

REMOVAL AND INSTALLATION

M1113008100721



AK401235AB

REMOVAL STEPS

- >>F<< 1. ENGINE OIL PRESSURE SWITCH
- 2. OIL COOLER BY-PASS VALVE
- >>E<< 3. OIL FILTER
- 4. OIL FILTER BRACKET
- 5. OIL FILTER BRACKET GASKET
- 6. DRAIN PLUG
- >>D<< 7. DRAIN PLUG GASKET
- 8. COVER
- <<A>> >>C<< 9. OIL PAN
- 10. BAFFLE PLATE
- 11. OIL SCREEN

REMOVAL STEPS (Continued)

- 12. OIL SCREEN GASKET
- 13. RELIEF PLUG
- 14. RELIEF SPRING
- 15. RELIEF PLUNGER
- >>B<< 16. CRANKSHAFT OIL SEAL
- 17. OIL PUMP CASE
- 18. OIL PUMP CASE GASKET
- 19. OIL PUMP COVER
- <> >>A<< 20. OIL PUMP OUTER ROTOR
- <> >>A<< 21. OIL PUMP INNER ROTOR

Required Special Tool

- MD998717: Crankshaft Front Oil Seal Installer

REMOVAL SERVICE POINTS

<<A>> OIL PAN REMOVAL

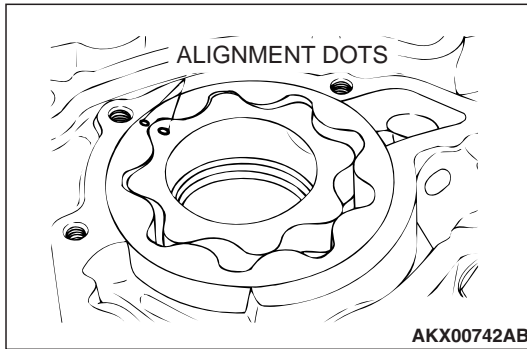
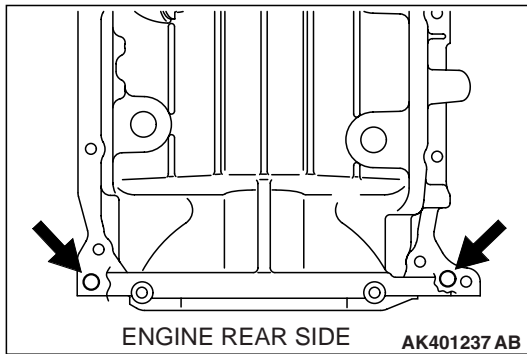
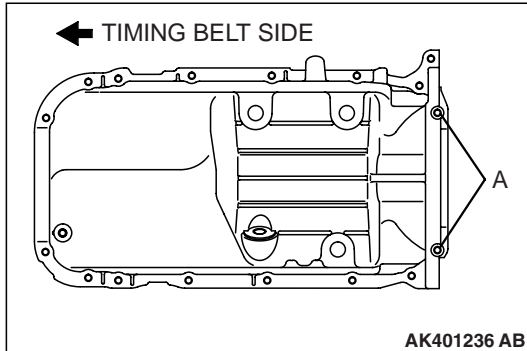
1. Remove the bolts A shown in the illustration first.
2. Remove all other bolts.

⚠ CAUTION

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

3. Remove the oil pan.

4. Thread the bolt into the illustrated bolt hole to remove the oil pan.



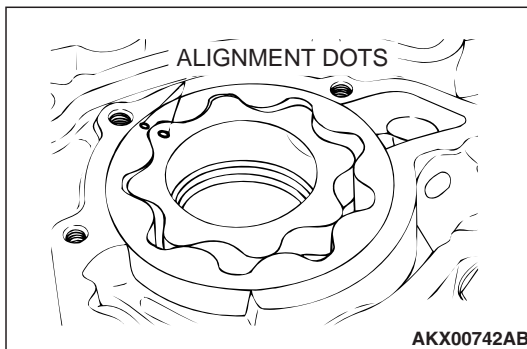
<> OUTER ROTOR/INNER ROTOR REMOVAL

Make alignment dots on the outer and inner rotors for assembly.

INSTALLATION SERVICE POINTS

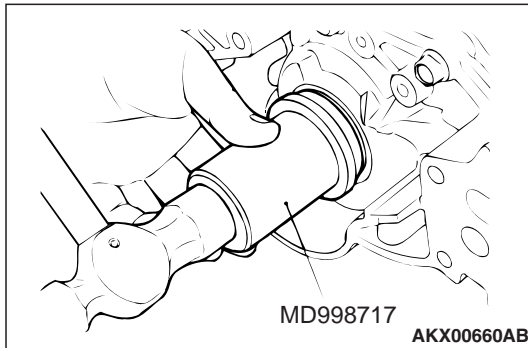
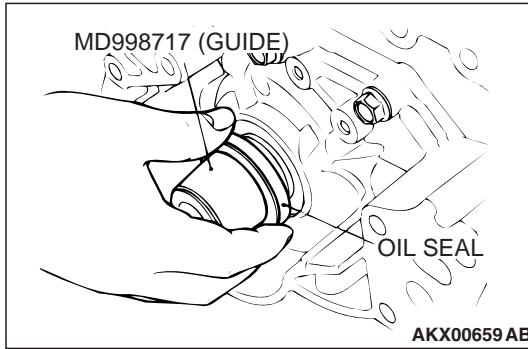
>>A<< INNER ROTOR/OUTER ROTOR INSTALLATION

Apply engine oil to the rotors. Then, install the rotors ensuring that the alignment dots made at disassembly are properly aligned.



>>B<< CRANKSHAFT OIL SEAL INSTALLATION

1. Install the guide of special tool MD998717 to the front end of the crankshaft.
2. Apply engine oil to the lip area of a new oil seal and push it in until it contacts the oil pump case.



3. Using special tool MD998717, press-fit the oil seal into the oil pump case.

>>C<< OIL PAN INSTALLATION

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

CAUTION

When installing the upper oil pan, be sure not to expel the sealant from the oil pan flange at portion A in the illustration.

2. Apply a 4 mm (0.2 inch) diameter bead of sealant Mitsubishi Genuine Parts number MD970389, or equivalent to the oil pan. Be sure to install the oil pan quickly while the sealant is wet.

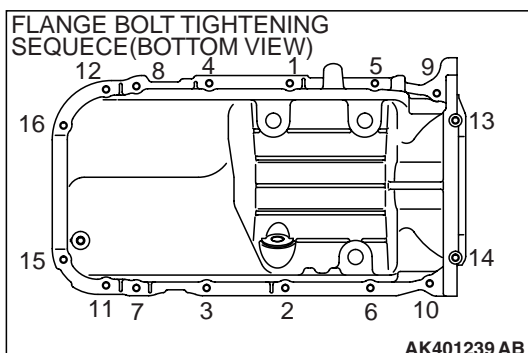
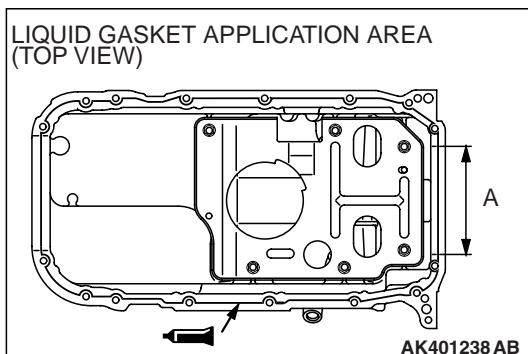
NOTE: Install the oil pan within 15 minutes after applying liquid gasket.

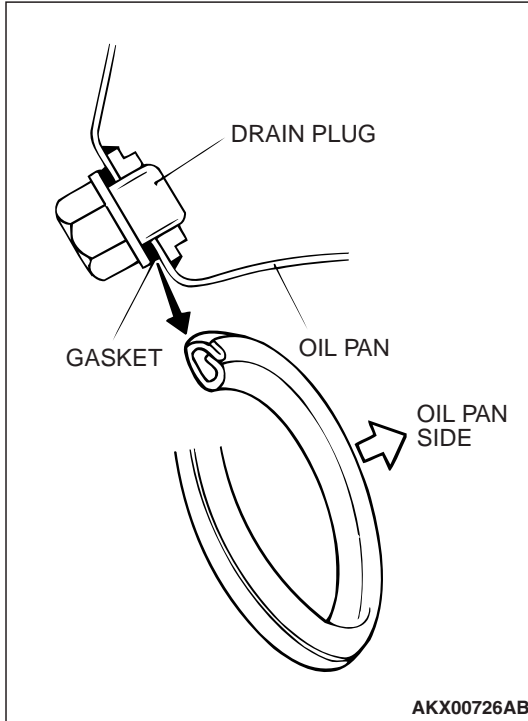
NOTE: Then wait at least one hour. Never start the engine or let engine oil or coolant touch the adhesion surface during that time.

3. Tighten the upper oil pan bolts in the sequence shown.

Tightening torque: 9.0 ± 3.0 N·m (80 ± 26 in-lb)

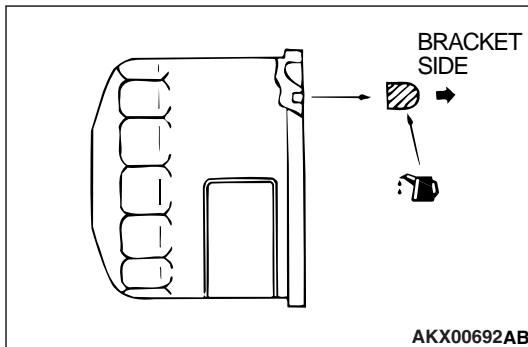
4. After installation, keep the sealed area away from the oil and coolant for approximately one hour.



**⚠ CAUTION N PLUG GASKET INSTALLATION**

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

Install the drain plug gasket as illustrated.

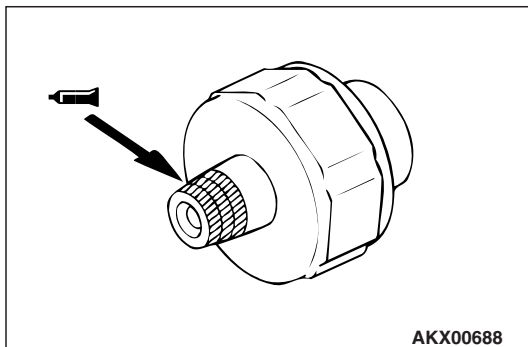
**>>E<< OIL FILTER INSTALLATION**

1. Clean the installation surface of the filter bracket.
2. Apply engine oil to the O-ring of the oil filter.
3. Screw the oil filter on until the O-ring contacts the bracket.
Then tighten $3/4$ turn [14 ± 1 N·m (124 ± 9 in-lb)]

>>F<< SEALANT APPLICATION TO ENGINE OIL**⚠ CAUTION GAUGE UNIT**

Keep the end of threaded portion clear of sealant. Avoid an overtightening.

1. Apply 3M™ ATD Part number 8672 or equivalent to the engine oil pressure switch.

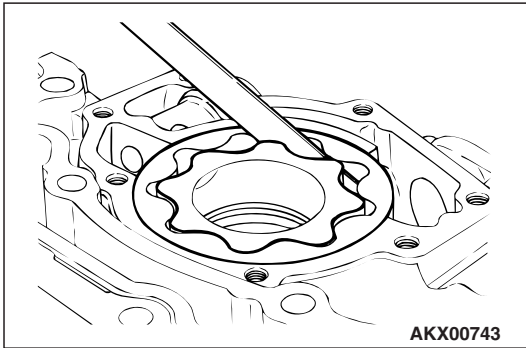


INSPECTION

OIL PUMP

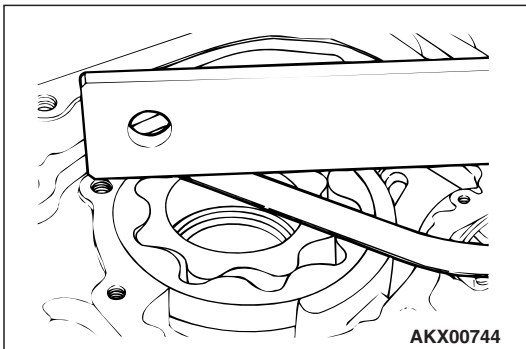
1. Check the tip clearance.

Standard value: 0.06 – 0.18 mm (0.003 – 0.007 inch)



2. Check the side clearance.

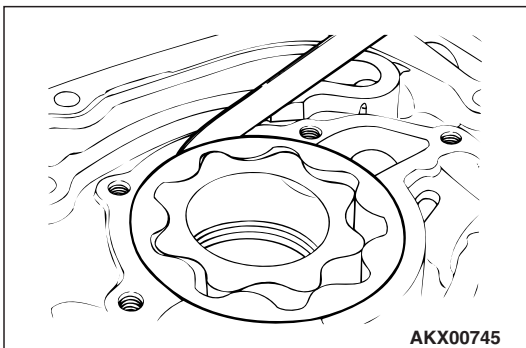
Standard value: 0.04 – 0.10 mm (0.002 – 0.003 inch)



3. Check the body clearance.

Standard value: 0.10 – 0.18 mm (0.004 – 0.007 inch)

Limit: 0.35 mm (0.013 inch)



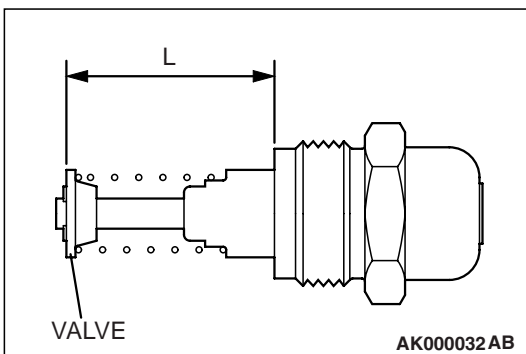
OIL COOLER BYPASS VALVE

1. Make sure that valve moves smoothly.
2. Ensure that the dimension L measures the standard value under normal temperature and humidity.

Standard value: 34.5 mm (1.358 inches)

3. The dimension must be the standard value when measured after the valve has been dipped in 97 to 103°C (207 to 217°F) oil.

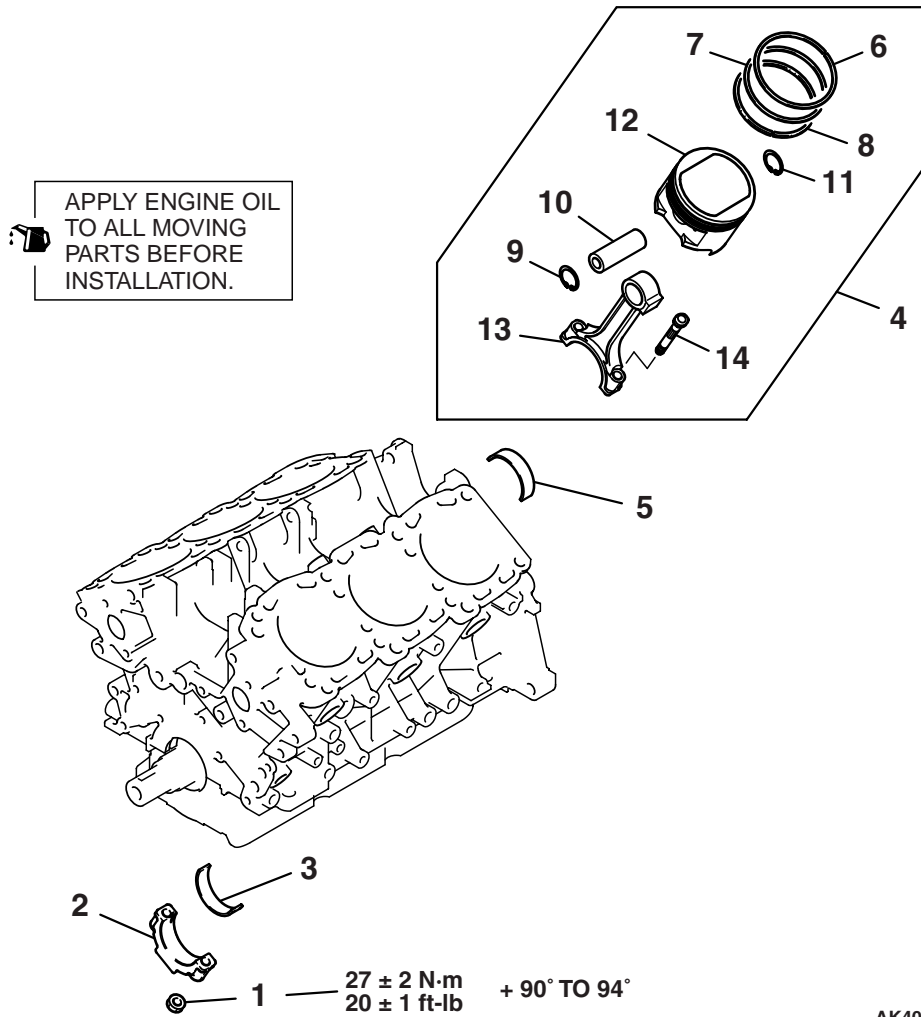
Standard value: 40.0 mm (1.575 inches)



PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008400948



AK401240AB

REMOVAL STEPS

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

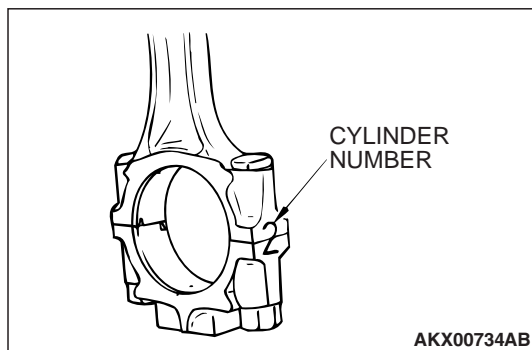
REMOVAL STEPS (Continued)

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

REMOVAL SERVICE POINTS

<<A>> CONNECTING ROD CAP REMOVAL

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



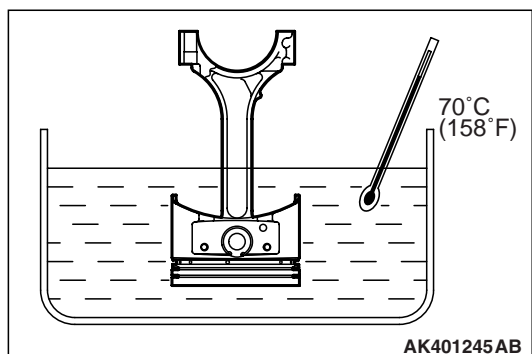
<> PISTON PIN REMOVAL

1. Remove the snap rings.

⚠ CAUTION

The clearance between the piston and the piston pin is a tight fit at room temperature. Therefore, be sure the heat the piston before pulling out the piston pin. Use care sine the piston is hot after heating.

2. Heat the piston approximately 70°C (158°F) and pull out the piston pin.



INSTALLATION SERVICE POINTS

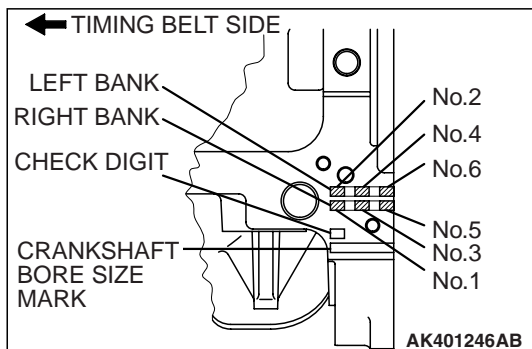
>>A<< PISTON PIN INSTALLATION

1. When replacing the piston, note the cylinder bore size mark on the cylinder block as illustrated, and select a piston according to the flowing table.

CYLINDER BORE SIZE MARK	PISTON CLASS	PISTON SIZE MARK
I	A	A
II	B	None
III	C	C

NOTE: The piston size mark shows on the top of the piston.

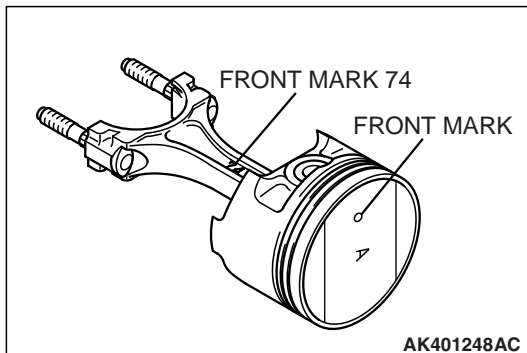
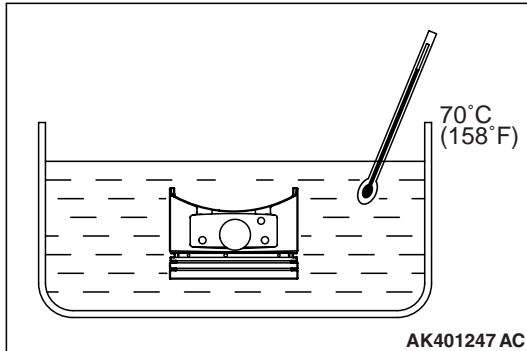
2. Set the snap ring into one side of the piston pin hole.



⚠ CAUTION

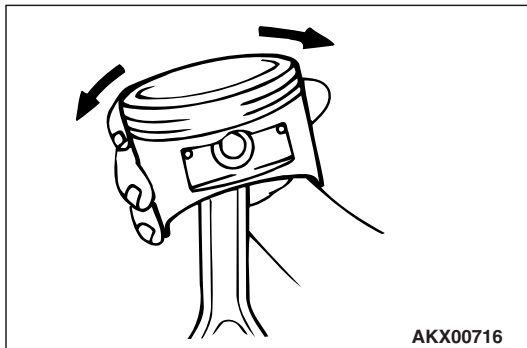
Apply ample coat of engine oil to the periphery of the piston pin and the hole of the connecting rod small end. The clearance between the piston and the piston pin is a tight fit at room temperature. Therefore, be sure to heat the piston before inserting the piston pin. Use care since the piston is hot after heating.

3. Heat the piston to approximately 70°C (158°F).

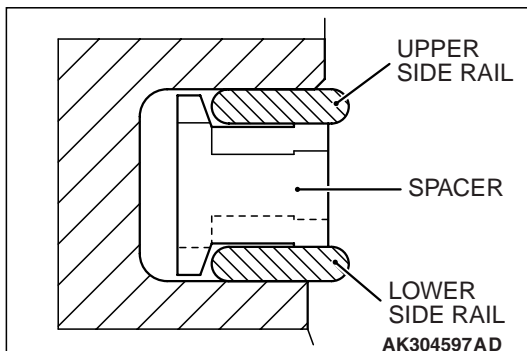


4. With the front mark of the connecting rod and that of the piston located on the same side, insert the piston pin.

5. Set the snap ring into the other side of the piston pin hole.

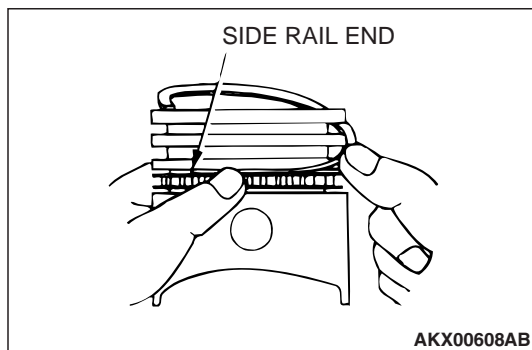


6. Check that the piston moves smoothly.

**>>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.



⚠ CAUTION

Do not use any piston ring expander when installing the side rail. It will break the 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 the 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.

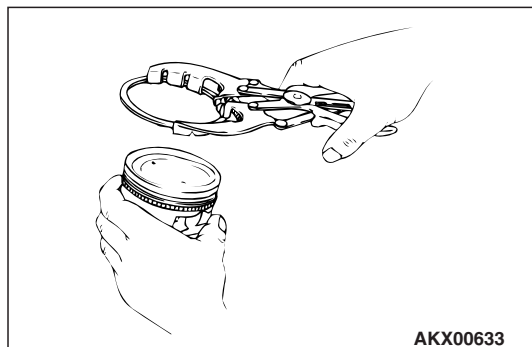
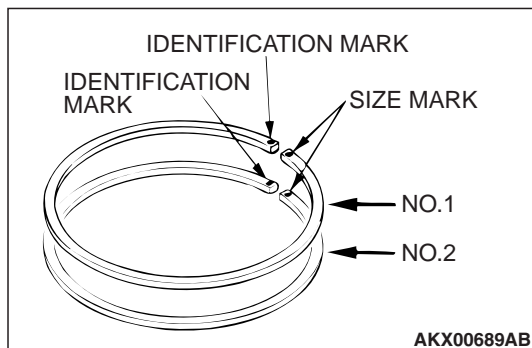
>>C<< PISTON RING NO.2/PISTON RING NO.1 INSTALLATION

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: 1T
Number 2 ring: 2T

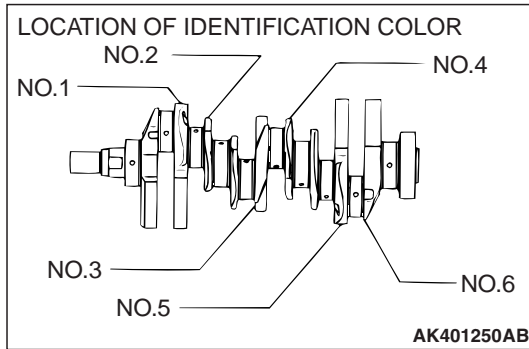
NOTE: Size marks on piston rings are as follows.

SIZE	SIZE MARK
Standard	None
0.25 mm (0.010 in) oversize diameter	25
0.50 mm (0.020 in) oversize diameter	50



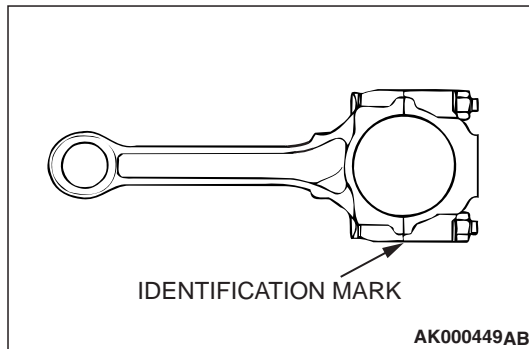
2. Using a piston ring expander, fit the number 2 piston ring into the number 2 groove of piston.
NOTE: Install the piston rings with their identification mark facing up, to the piston crown side.
3. Install the number 1 piston ring in the same manner as step 2.

**>>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.

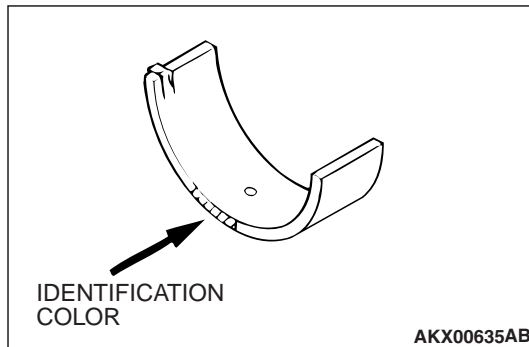
CRANKSHAFT PIN OUTSIDE DIAMETER		CONNECTING ROD	BEARING
IDENTIFICATION COLOR	SIZE mm (in)	IDENTIFICATION MARK	IDENTIFICATION COLOR
Yellow	54.994 – 55.000 (2.1651 – 2.1654)	0	Pink
		1	Red
		2	Green
None	54.988 – 54.994 (2.1649 – 2.1651)	0	Red
		1	Green
		2	Black
White	54.982 – 54.988 (2.1646 – 2.1649)	0	Green
		1	Black
		2	Brown



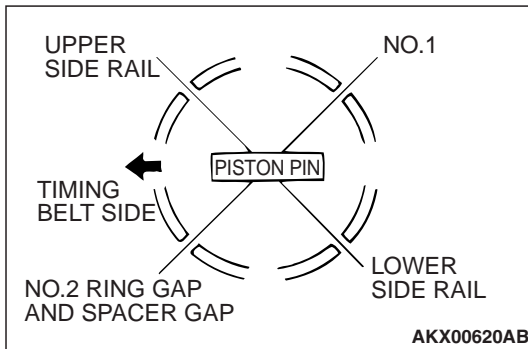
2. From the following table, select a bearing whose size is appropriate for the crankshaft pin outside the diameter. For example the crankshaft pin outside diameter identification color is "yellow" and the connecting rod identification mark is "2," for select a bearing whose identification color is "green."

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

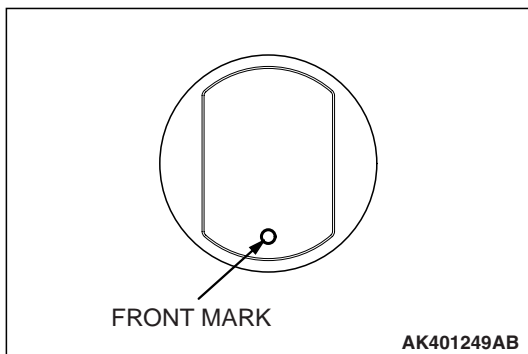
3. Install the selected bearing in the big end and in the cap of the connecting rod.



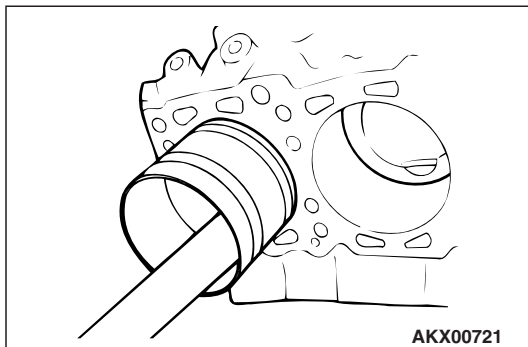
>>E<< PISTON AND CONNECTING ROD INSTALLATION



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

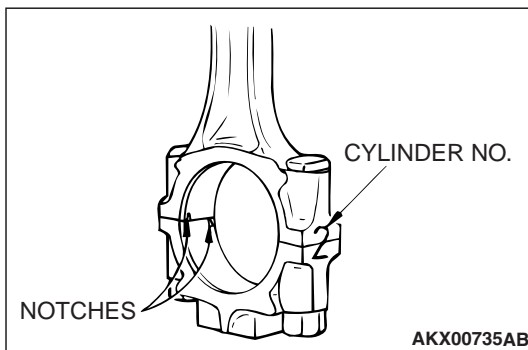


4. Insert the piston and connecting rod assembly into the cylinder with the front mark on the piston crown pointing to the timing belt side.

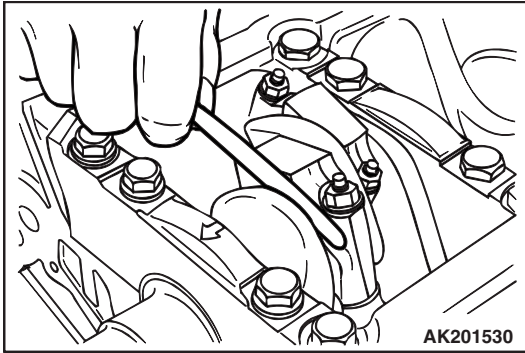


5. Using a suitable piston ring compressor tool, install the piston and connecting rod assembly into the cylinder block.

>>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)

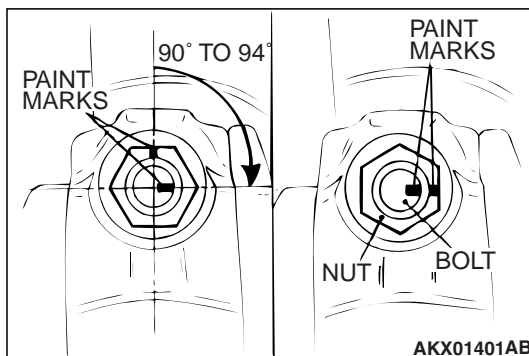
Limit: 0.4 mm (0.02 inch)

>>G<< CONNECTING ROD CAP NUT INSTALLATION

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 27 ± 2 N·m (20 ± 1 ft·lb) to install the cap properly.
5. Make a paint mark on the head of each nut.

⚠ CAUTION

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



INSPECTION

M1113008500439

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

PISTON RING

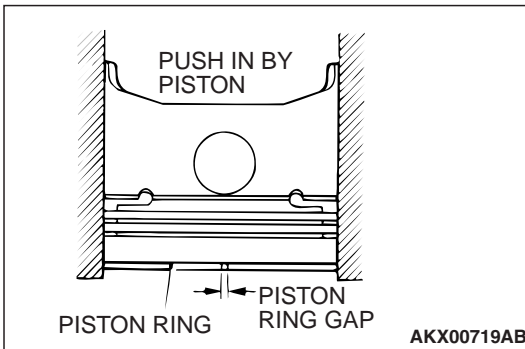
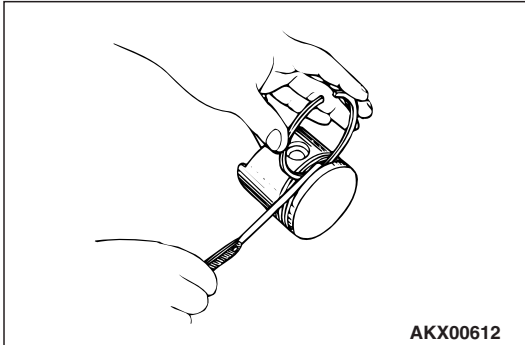
1. Check the piston ring for damage, excessive wear, and breakage and replace if defects are evident. If the piston has been replaced with a new one, the piston rings must also be replaced with new ones.
2. Check for clearance between the piston ring and ring groove. If the limit is exceeded, replace the ring or piston, or both.

Standard value:

Number 1: 0.03 – 0.07 mm (0.0012 – 0.0027 inch)

Number 2: 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: 0.25 – 0.40 mm (0.010 – 0.016 inch)

Number 2: 0.35 – 0.50 mm (0.014 – 0.020 inch)

Oil: 0.10 – 0.35 mm (0.004 – 0.014 inch)

Limit:

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

Oil: 1.0 mm (0.03 inch)

CRANKSHAFT PIN OIL CLEARANCE

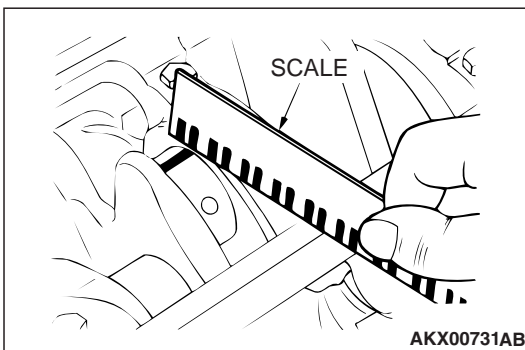
<PLASTIC GAUGING MATERIAL METHOD>

The crankshaft oil clearance can be measured easily by using plastic gauging material, as follows:

1. Remove oil from the crankshaft pin and the bearing inner surface.
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 smashed plastic gauging material at its widest section by using a scale printed on the plastic gauging material bag.

Standard value: 0.02 – 0.04 mm (0.0008 – 0.0016 inch)

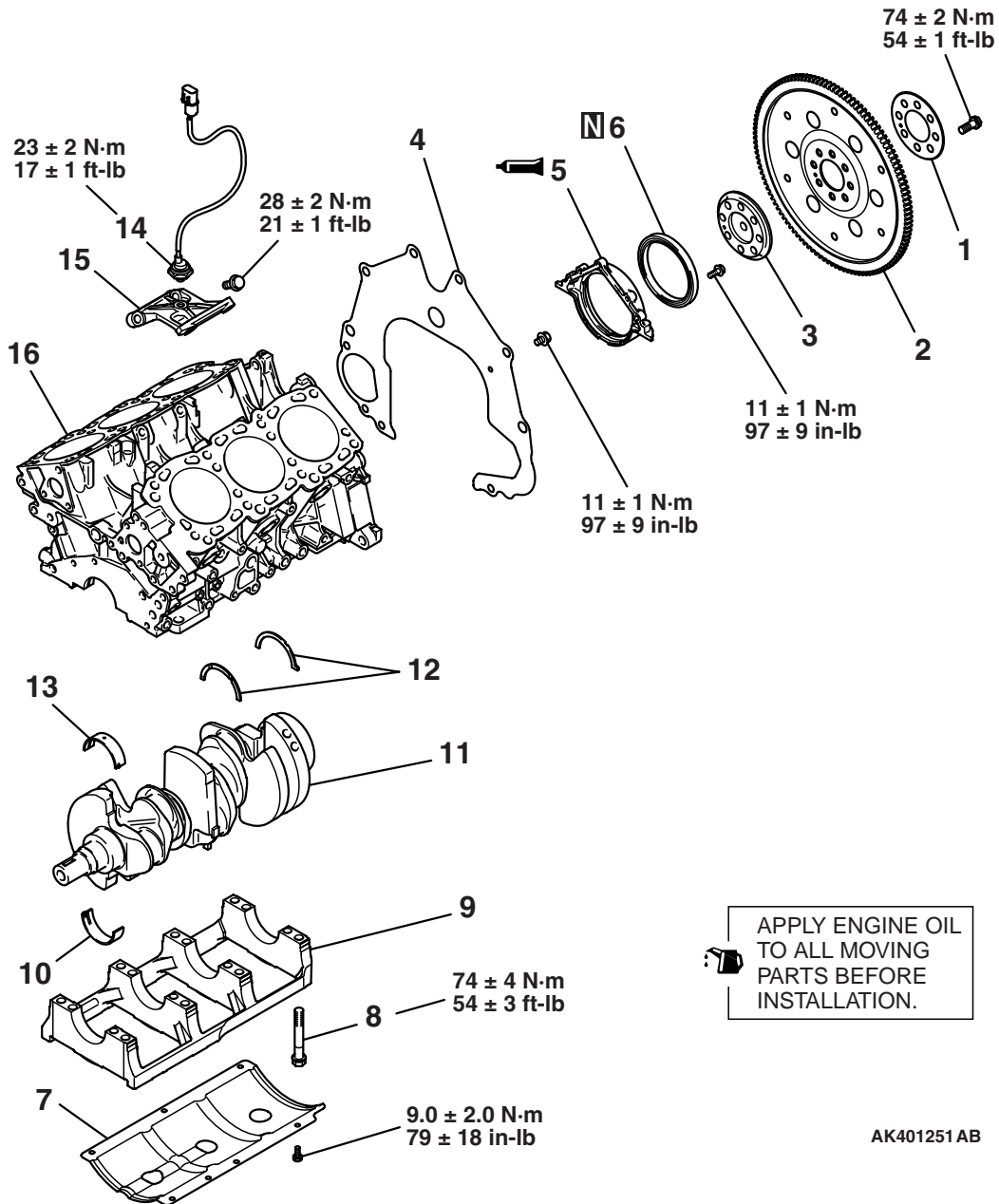
Limit: 0.1 mm (0.003 inch)



CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008700949



APPLY ENGINE OIL TO ALL MOVING PARTS BEFORE INSTALLATION.

AK401251 AB

REMOVAL STEPS

1. ADAPTER PLATE
2. DRIVE PLATE
3. CRANKSHAFT ADAPTOR
4. REAR PLATE
- >>F<< 5. OIL SEAL CASE
- >>E<< 6. CRANKSHAFT REAR OIL SEAL
7. BAFFLE PLATE
- >>D<< 8. BEARING CAP BOLT

REMOVAL STEPS (Continued)

- >>D<< 9. BEARING CAP
- >>B<< 10. CRANKSHAFT BEARING, LOWER
11. CRANKSHAFT
- >>C<< 12. THRUST BEARING
- >>B<< 13. CRANKSHAFT BEARING, UPPER
14. KNOCK SENSOR
- >>A<< 15. KNOCK SENSOR BRACKET
16. CYLINDER BLOCK

Required Special Tool:

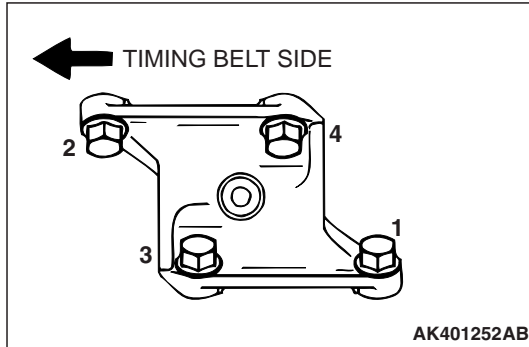
- MD998718: Crankshaft Rear Oil Seal Installer

INSTALLATION SERVICE POINTS

>>A<< KNOCK SENSOR BRACKET INSTALLATION

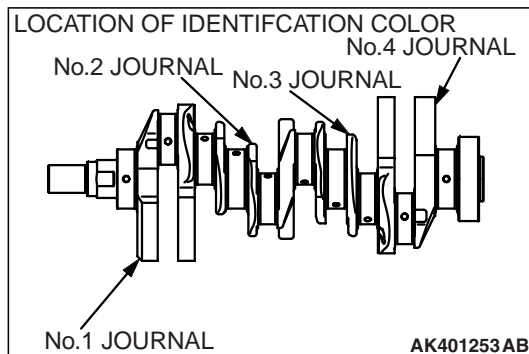
Check that the bracket is in proper contact with the cylinder block boss and tighten to the specified torque in the order shown.

Tightening torque: 28 ± 2 N·m (21 ± 1 ft-lb)

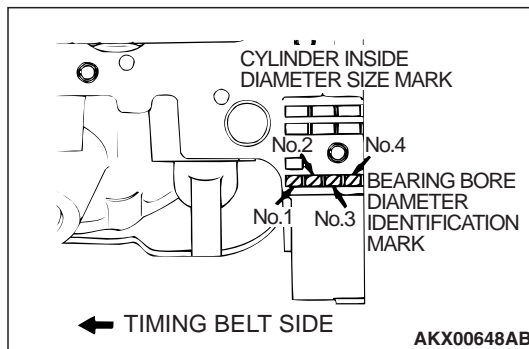


>>B<< CRANKSHAFT BEARING INSTALLATION

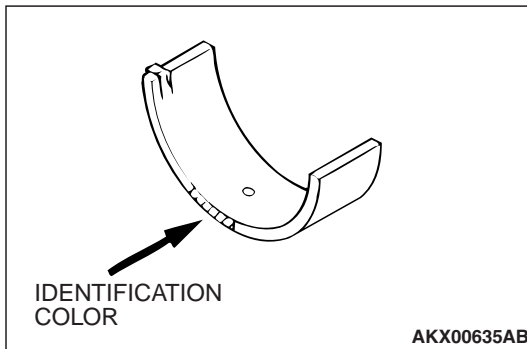
1. Measure the crankshaft journal diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification colors/marks of its journals are painted/stamped at the positions shown in the illustration.



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.

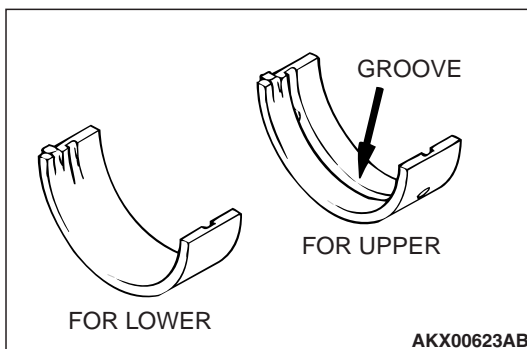


CRANKSHAFT JOURNAL OUTSIDE DIAMETER		CYLINDER BLOCK BEARING BORE	CRANKSHAFT BEARING No.1, 4	CRANKSHAFT BEARING No.2, 3
IDENTIFICATION COLOR	SIZE mm (in)	IDENTIFICATION MARK	IDENTIFICATION COLOR	IDENTIFICATION COLOR
Yellow	63.994 – 64.000 (2.5194 – 2.5197)	I	Pink	Blue
		II	Red	Pink
		III	Green	Red
None	63.988 – 63.994 (2.5192 – 2.5194)	I	Red	Pink
		II	Green	Red
		III	Black	Green
White	63.982 – 63.988 (2.5190 – 2.5192)	I	Green	Red
		II	Black	Green
		III	Brown	Black



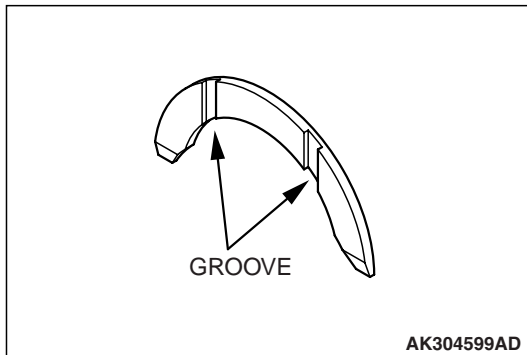
- From the above table, select a bearing whose size is appropriate for the crankshaft journal outside diameter. If the crankshaft journal outside diameter ID color is "yellow" and the cylinder block bearing bore ID mark is "III," for example, select a bearing whose ID color is "green" for number 1 and 4, and a bearing whose ID color is "Red" for number 2 and 3.

If there is no ID color paint on the crankshaft, measure the journal outside diameter and select a bearing appropriate for the measured valve.



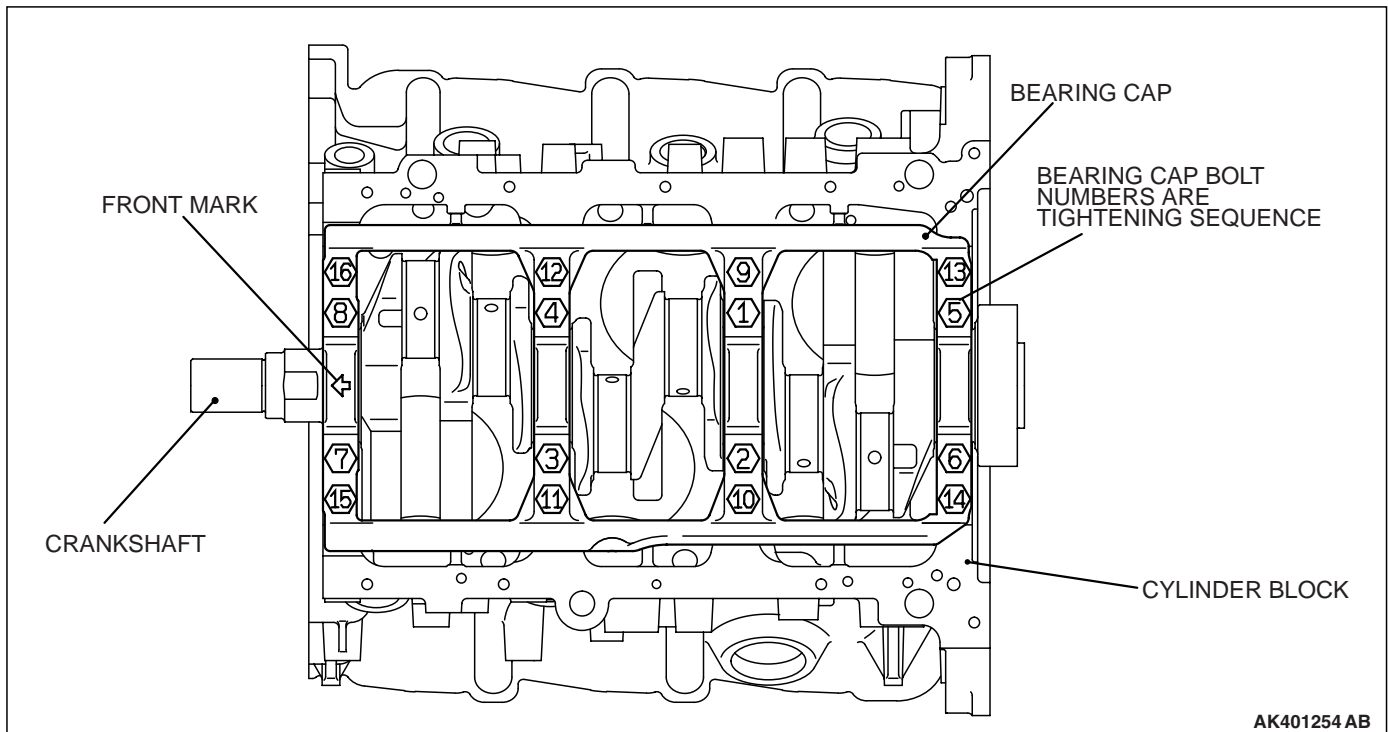
- Install bearings with the groove toward the cylinder block.
- Install the bearings having no groove to the bearing cap.

>>C<< CRANKSHAFT THRUST BEARING INSTALLATION



1. Install the thrust bearing in the No.3 bearing bore in the cylinder block and in the bearing cap. 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 toward the crankshaft web.

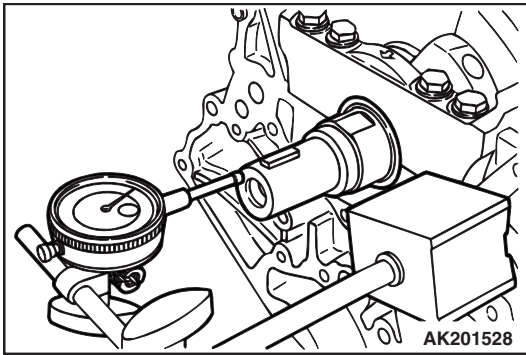
>>D<< BEARING CAP/BEARING BOLT INSTALLATION



1. Attach the bearing cap on the cylinder block as shown in the illustration.
2. Tighten the bearing cap bolts to specified torque in the sequence shown in the illustration.

Tightening torque: 74 ± 4 N·m (54 ± 3 ft-lb)

3. Check that the crankshaft rotates smoothly.

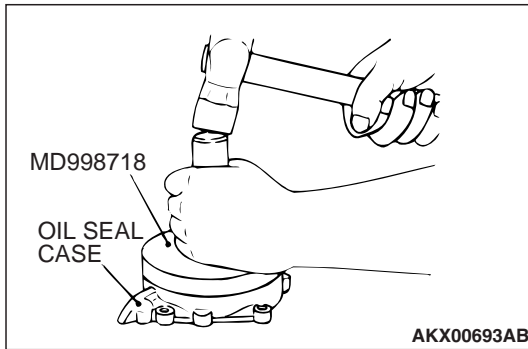


4. Check the end play. If it exceeds the limit value, replace the thrust bearing.

Standard value: 0.05 – 0.25 mm (0.002 – 0.009 inch)
Limit: 0.3 mm (0.01 inch)

>>E<< CRANKSHAFT REAR OIL SEAL INSTALLATION

Using special tool MD998718, press-fit a new crankshaft rear oil seal into the oil seal case.

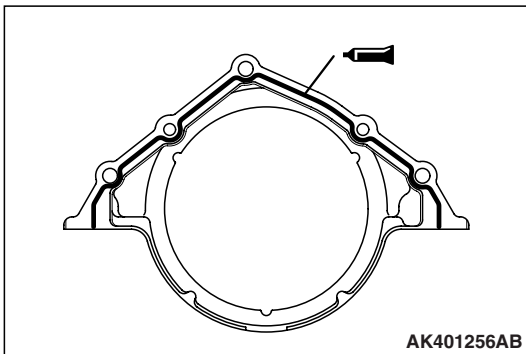


>>F<< OIL SEAL CASE INSTALLATION

1. Apply the sealant Mitsubishi Genuine Part number MD970389 or equivalent to the oil seal case.
2. Apply a small amount of engine oil to the entire circumference of the oil seal lip section, and place the oil seal case on the cylinder block.

NOTE: Install the oil seal case within 15 minutes after applying liquid gasket.

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

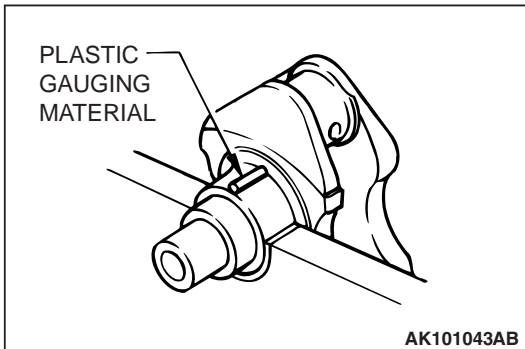


INSPECTION

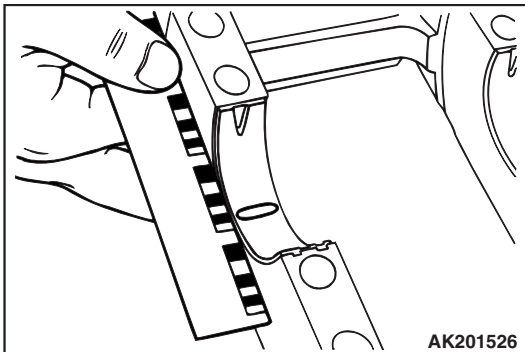
M1113008800430

CRANKSHAFT JOURNAL OIL CLEARANCE <PLASTIC GAUGING MATERIAL METHOD>

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



- Cut plastic gauging material to the same length as the width of the bearing and place it on the journal in parallel with its axis.



- Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
Tightening torque: 74 ± 4 N·m (54 ± 3 ft-lb)
- Carefully remove the crankshaft bearing cap.
- Measure the width of the smashed plastic gauging material at its widest section by using a scale printed on the plastic gauging material bag.
Standard value: 0.02 – 0.04 mm (0.0008 – 0.0016 inch)
Limit: 0.1 mm (0.003 inch)

CRANKSHAFT REAR OIL SEAL

- Check the oil seal lip for wear and damage.
- Check the rubber for deterioration or hardening.
- Check the oil seal case for cracks and damage.

CYLINDER BLOCK

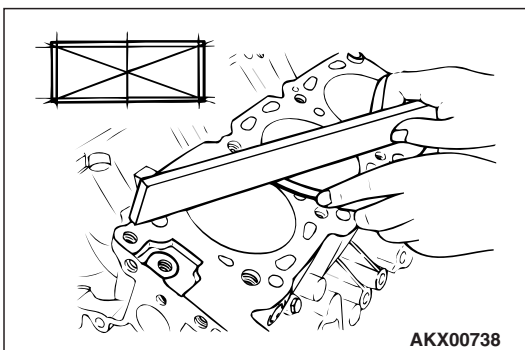
- Visually check for scratches, rust, and corrosion. Use a flaw detecting agent for the check. If defects are evident, correct, or replace.
- Using a straightedge and feeler gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other foreign matter.

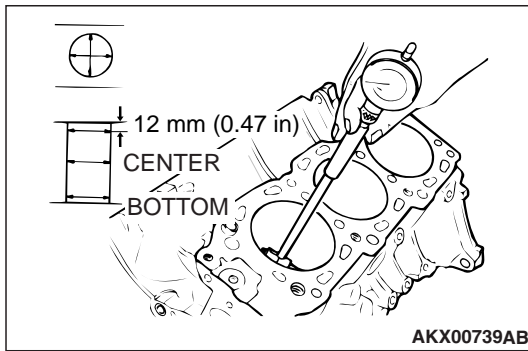
Standard value: 0.05 mm (0.002 inch)
Limit: 0.1 mm (0.003 inch)

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

Grinding limit: *0.2 mm (0.008 inch)
***Includes/combined with cylinder head grinding.**

Cylinder block height (when new):
227.9 – 228.1 mm (8.972 – 8.980 inches)





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

Standard value:

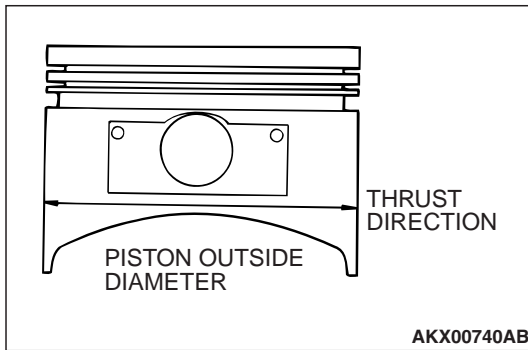
Cylinder Inside Diameter: 95.0 mm (3.740 inches)
Cylindricality: 0.01 mm (0.0003 inch)

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
0.25 mm (0.010 in) Oversize diameter	0.25
0.50 mm (0.020 in) Oversize diameter	0.50



NOTE: Size mark is stamped on the piston top.

2. Measure the outside diameter of the piston to be used. Measure it in the thrust direction as shown.
3. Based on the measured piston Outside Diameter (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 in the order of number 2, number 4, number 6, number 1, number 3 and number 5.

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.

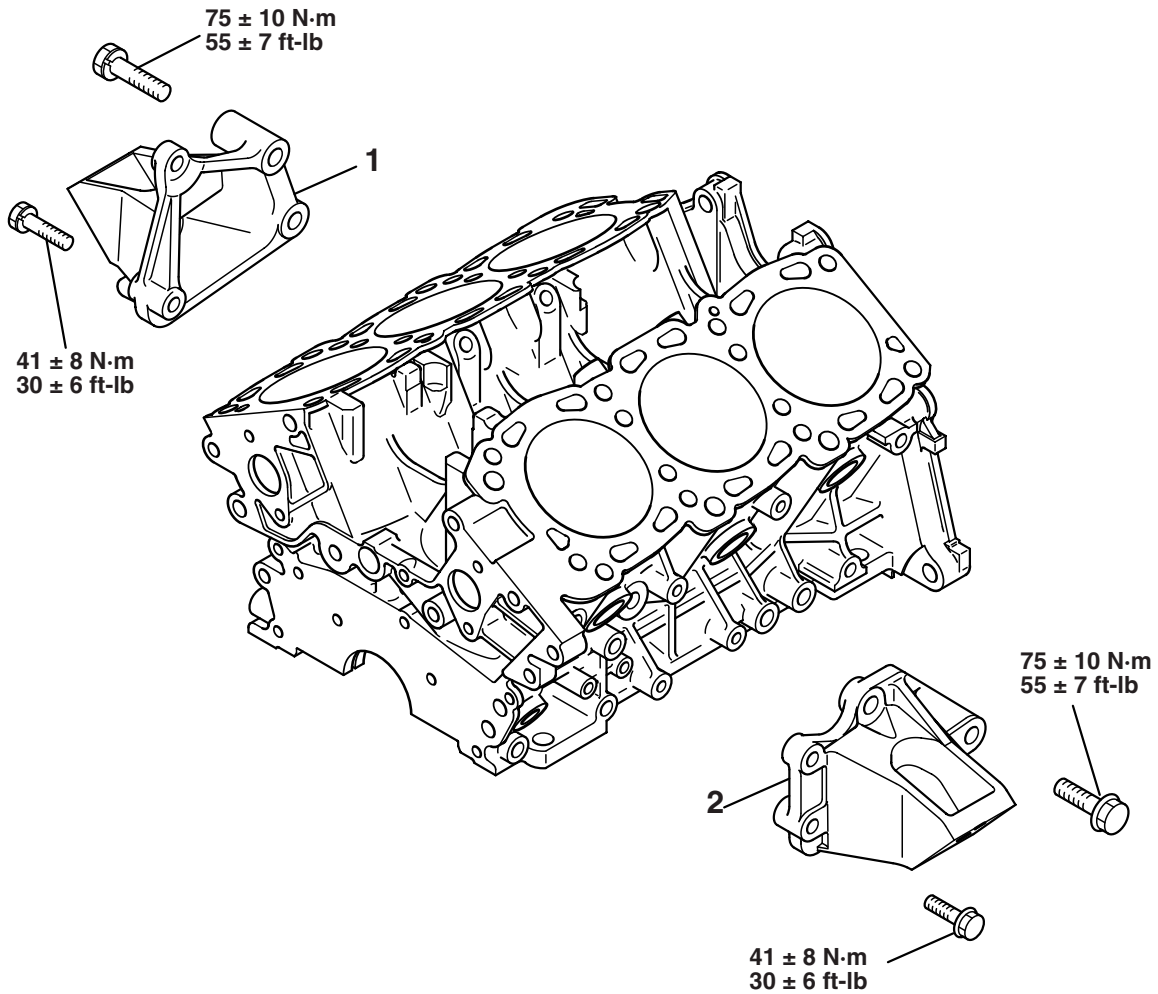
**Clearance between piston and cylinder:
0.02 – 0.04 mm (0.0008 – 0.0015 inch)**

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

BRACKET

REMOVAL AND INSTALLATION

M1113009000095



AK401257 AB

REMOVAL STEPS

1. ENGINE SUPPORT BRACKET, RIGHT
2. ENGINE SUPPORT BRACKET, LEFT

SPECIFICATIONS**FASTENER TIGHTENING SPECIFICATIONS**

M1113023401078

ITEMS	SPECIFICATIONS
Generator and drive belt	
Accessory mount bolt M10 pitch 1.25	44 ± 10 N·m (33 ± 7 ft-lb)
Accessory mount bolt M10 pitch 1.5	41 ± 8 N·m (30 ± 6 ft-lb)
Accessory mount bolt M12	74 ± 9 N·m (54 ± 7 ft-lb)
Accessory mount stay bolt	24 ± 4 N·m (17 ± 3 ft-lb)
Auto tensioner bolt M10	44 ± 10 N·m (33 ± 7 ft-lb)
Auto tensioner bolt M8	24 ± 4 N·m (17 ± 3 ft-lb)
Cooling fan bolt	11 ± 1 N·m (97 ± 9 in-lb)
Cooling fan clutch bracket bolt	41 ± 8 N·m (30 ± 6 ft-lb)
Crankshaft bolt	185 N·m (137 ft-lb)
Fan clutch nut	11 ± 1 N·m (97 ± 9 in-lb)
Generator bolt M10	49 ± 5 N·m (36 ± 3 ft-lb)
Generator bolt M8	23 ± 3 N·m (15 ± 2 ft-lb)
Idler pulley bolt	44 ± 10 N·m (33 ± 7 ft-lb)
Power steering pump bracket bolt	41 ± 8 N·m (30 ± 5 ft-lb)
Timing indicator bolt	11 ± 1 N·m (97 ± 9 in-lb)
Intake manifold plenum and throttle body	
Intake manifold plenum bolt M8	18 ± 2 N·m (13 ± 2 ft-lb)
Intake manifold plenum bolt and nut M6	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Exhaust gas recirculation pipe bolt	18 ± 2 N·m (13 ± 2 ft-lb)
Exhaust gas recirculation pipe flare nut	59 ± 10 N·m (43 ± 7 ft-lb)
Exhaust gas recirculation valve bolt	24 ± 3 N·m (18 ± 2 ft-lb)
Fuel return pipe bolt	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Intake manifold plenum stay bolt M10	36 ± 6 N·m (27 ± 4 ft-lb)
Intake manifold plenum stay bolt M8	18 ± 2 N·m (13 ± 2 ft-lb)
Intake manifold plenum valve assembly bolt	18 ± 2 N·m (13 ± 2 ft-lb)
Manifold absolute pressure sensor bolt	5.0 ± 1.0 N·m (44 ± 9 in-lb)
Throttle body bolt	13 ± 2 N·m (113 ± 17 in-lb)
Solenoid valve bolt	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Water outlet fitting bracket bolt	14 ± 1 N·m (124 ± 9 in-lb)
Ignition system	
Camshaft position sensing cylinder bolt	22 ± 4 N·m (16 ± 3 ft-lb)
Camshaft position sensor bolt	11 ± 1 N·m (97 ± 9 in-lb)
Camshaft position sensor support bolt	14 ± 1 N·m (124 ± 9 in-lb)
Ignition coil bolt	10 ± 2 N·m (89 ± 17 in-lb)
Spark plugs	25 ± 5 N·m (18 ± 4 ft-lb)
Spark plug cable support M8	13 ± 2 N·m (115 ± 18 in-lb)
Spark plug cable support M6	10 ± 2 N·m (89 ± 17 in-lb)

ITEMS	SPECIFICATIONS
Timing belt	
Auto tensioner bolt	23 ± 3 N·m (15 ± 2 ft-lb)
Camshaft sprocket bolt	88 ± 10 N·m (65 ± 8 ft-lb)
Crankshaft position sensor bolt washer assembly	8.5 ± 0.5 N·m (76 ± 4 in-lb)
Crankshaft position sensor flange bolt	11 ± 1 N·m (97 ± 9 in-lb)
Idler pulley bolt	44 ± 5 N·m (33 ± 3ft-lb)
Tensioner arm bolt	44 ± 10 N·m (33 ± 7 ft-lb)
Tensioner pulley bolt	48 ± 6 N·m (35 ± 4 ft-lb)
Timing belt front cover bolt M6	11 ± 1 N·m (97 ± 9 in-lb)
Timing belt front cover bolt M8	14 ± 1 N·m (124 ± 9 in-lb)
Timing belt rear cover bolt	14 ± 1 N·m (124 ± 9 in-lb)
Intake manifold and fuel parts	
Engine coolant temperature gauge unit	11 ± 1 N·m (97 ± 9 in-lb)
Engine coolant temperature sensor	29 ± 10 N·m (22 ± 7 ft-lb)
Fitting bolt	12 ± 1 N·m (106 ± 9 in-lb)
Fuel pipe bolt	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Fuel pressure regulator bolt	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Injector and fuel rail bolt	12 ± 1 N·m (106 ± 9 in-lb)
Intake manifold nut	22 ± 1 N·m (16 ± 1 ft-lb)
Thermostat case bolt	9.0 ± 1.0 N·m (78 ± 9 in-lb)
Water inlet fitting bolt	12 ± 1 N·m (106 ± 9 in-lb)
Water outlet fitting bolt	12 ± 1 N·m (106 ± 9 in-lb)
Water outlet pipe bolt	14 ± 1 N·m (124 ± 9 in-lb)
Water passage bolt	19 ± 1 N·m (14 ± 1 ft-lb)
Water pipe bolt	14 ± 1 N·m (124 ± 9 in-lb)
Exhaust manifold	
Oil dipstick guide bolt	14 ± 1 N·m (124 ± 9 in-lb)
Engine hanger bolt	36 ± 6 N·m (27 ± 4 in-lb)
Exhaust manifold nut	44 ± 5 N·m (33 ± 4 ft-lb)
Exhaust manifold cover bolt	14 ± 1 N·m (124 ± 9 in-lb)
Water pump bolt	24 ± 3 N·m (17 ± 2 ft-lb)
Rocker arm and camshaft	
PCV valve	10 ± 2 N·m (87 ± 17 in-lb)
Rocker cover bolt	3.4 ± 0.5 N·m (26 ± 4 in-lb)
Rocker shaft bolt	31 ± 3 N·m (23 ± 2 ft-lb)
Thrust case bolt	13 ± 2 N·m (113 ± 17 in-lb)
Cylinder head and valve	
Cylinder head bolt	108 ± 5 N·m (80 ± 4 ft-lb) → 0 N·m (0 in-lb) → 108 ± 5 N·m(80 ± 4 ft-lb)

ITEMS	SPECIFICATIONS
Oil pan and oil pump	
Baffle plate bolt	11 ± 1 N·m (97 ± 9 in-lb)
Cover bolt	11 ± 1 N·m (97 ± 9 in-lb)
Drain plug	39 ± 5 N·m (29 ± 4 ft-lb)
Engine oil pressure switch	10 ± 2 N·m (87 ± 17 in-lb)
Oil cooler by-pass valve	54 ± 5 N·m (40 ± 4 ft-lb)
Oil filter bracket bolt	23 ± 3 N·m (17 ± 2 ft-lb)
Oil pan bolt	9.0 ± 3.0 N·m (80 ± 20 in-lb)
Oil pump case bolt	14 ± 1 N·m (124 ± 9 in-lb)
Oil pump cover bolt	10 ± 2 N·m (87 ± 17 in-lb)
Oil screen bolt	19 ± 3 N·m (14 ± 2 ft-lb)
Oil screen stay bolt	9.0 ± 1.0 N·m (80 ± 9 in-lb)
Relief plug	44 ± 5 N·m (33 ± 4 ft-lb)
Piston and connecting rod	
Connecting rod cap nut	27 ± 2 N·m (20 ± 1 ft-lb) →+ 90° to 94°
Crankshaft and drive plate	
Baffle plate bolt	9.0 ± 2.0 N·m (79 ± 18 in-lb)
Bearing cap bolt	74 ± 4 N·m (54 ± 3 ft-lb)
Drive plate bolt	74 ± 2 N·m (54 ± 1 ft-lb)
Knock sensor	23 ± 2 N·m (17 ± 1 ft-lb)
Knock sensor bracket bolt	28 ± 2 N·m (21 ± 1 ft-lb)
Oil seal case bolt	11 ± 1 N·m (97 ± 9 in-lb)
Rear plate bolt	11 ± 1 N·m (97 ± 9 in-lb)
Bracket	
Engine support bracket bolt M10	41 ± 8 N·m (30 ± 6 ft-lb)
Engine support bracket bolt M12	75 ± 10 N·m (55 ± 7 ft-lb)

GENERAL SPECIFICATIONS

M1113000200382

DESCRIPTIONS		SPECIFICATIONS	
Type		60° V, OHV, SOHC	
Number of cylinders		6	
Combustion chamber		Pentroof type	
Total displacement cm ³ (cu in)		3,828 (233.6)	
Cylinder bore mm (in)		95.0 (3.74)	
Piston stroke mm (in)		90.0 (3.54)	
Compression ratio		10.0	
Valve timing	Intake valve	Opens (BTDC)	5°
		Closes (ABDC)	55°
	Exhaust valve	Opens (BBDC)	51°
		Closes (ATDC)	17°
Lubrication system		Pressure feed, full-flow filtration	
Oil pump type		Trochoid type	

SERVICE SPECIFICATIONS

M1113000300505

ITEMS		STANDARD VALUE	LIMIT
Timing belt			
Auto tensioner rod length mm (in)		4.8 – 5.5 (0.19 – 0.21)	–
Auto tensioner rod production 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 (1.462)
	Exhaust	37.14 (1.462)	Minimum 36.64 (1.443)
Camshaft journal outside diameter mm (in)		45 (1.8)	–
Cylinder head and valves			
Cylinder head flatness of gasket surface mm (in)		Less than 0.03 (0.001)	0.2 (0.007)
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)	–
Valve thickness of valve head (margin) mm (in)	Intake	1.0 (0.04)	Minimum 0.5 (0.02)
	Exhaust	1.2 (0.05)	Minimum 0.7 (0.03)
Valve overall height mm (in)	Intake	110.30 (4.343)	Minimum 109.80 (4.323)
	Exhaust	112.11 (4.414)	Minimum 111.61 (4.394)
Valve stem outside diameter mm (in)	Intake	6.0 (0.24)	–
	Exhaust	6.0 (0.24)	–

11B-60

ENGINE OVERHAUL SPECIFICATIONS

ITEMS		STANDARD VALUE	LIMIT
Valve thickness to valve guide clearance mm (in)	Intake	0.02 – 0.05 (0.0008 – 0.0019)	0.10 (0.003)
	Exhaust	0.04 – 0.07 (0.0016 – 0.0027)	0.15 (0.005)
Valve face angle mm (in)		45° – 45.5°	–
Valve spring free length mm (in)		51.0 (2.01)	50.0 (1.97)
Valve spring load/installed height N (lb) /mm (in)		267/44.2 (60.0/1.74)	–
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 (0.32)	–
Valve guide projection from cylinder head upper surface mm (in)		14 (0.6)	–
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 (0.4351 – 0.4358)	–
	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 – 31.81 (1.2520 – 1.2531)	–
	0.6 oversize diameter	32.10 – 32.13 (1.2638 – 1.2650)	–
Oil pan and oil pump			
Oil pump tip clearance mm (in)		0.06 – 0.18 (0.003 – 0.007)	–
Oil pump side clearance mm (in)		0.04 – 0.10 (0.002 – 0.003)	–
Oil pump body clearance mm (in)		0.10 – 0.18 (0.004 – 0.007)	0.35 (0.013)
Oil cooler by-pass valve mm (in)	Dimension (Normal temperature)	34.5 (1.358)	–
	By-pass hole closing temperature 97 to 103°C(207 to 217°F)	40.0 (1.575)	–
Oil pressure at curb idle speed kPa (psi) [oil temperature is 75 to 90°C(167 to 194°F)]		80 (11.6) or more	–

ITEMS	STANDARD VALUE	LIMIT
Piston and connecting rod		
Piston outside diameter mm (in)	95.0 (3.740)	–
Piston ring to ring groove clearance mm (in)	No.1 0.03 – 0.07 (0.0012 – 0.0027)	0.1 (0.003)
	No.2 0.02 – 0.06 (0.0008 – 0.0023)	0.1 (0.003)
Piston ring end gap mm (in)	No.1 0.30 – 0.45 (0.012 – 0.017)	0.8 (0.03)
	No.2 0.45 – 0.60 (0.018 – 0.023)	0.8 (0.03)
	Oil ring side rail 0.20 – 0.60 (0.008 – 0.023)	1.0 (0.03)
Piston pin outside diameter mm (in)	22.0 (0.87)	–
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 (0.003 – 0.009)	–
Crankshaft and drive plate		
Crankshaft end play mm (in)	0.05 – 0.25 (0.002 – 0.009)	0.3 (0.01)
Crankshaft journal outside diameter mm (in)	64 (2.520)	–
Crankshaft pin outside diameter mm (in)	55 (2.165)	–
Crankshaft journal oil clearance mm (in)	0.02 – 0.04 (0.0008 – 0.0015)	0.1(0.003)
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 (0.003)
Cylinder block grinding limit of gasket surface mm (in) total resurfacing depth of both cylinder head and cylinder block	–	0.2 (0.008)
Cylinder block overall height mm (in)	227.9 – 228.1 (8.972 – 8.980)	–
Cylinder bore inside diameter mm (in)	95.0 (3.740)	–
Cylindricity mm (in)	0.01 (0.0003)	–

SEALANTS AND ADHESIVES

M1113000500479

ITEMS	SPECIFIED SEALANT	QUANTITY
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
Engine Oil pressure switch	3M™ AAD Part No. 8672 or equivalent	As required
Oil pressure gauge unit	3M™ AAD Part No. 8672 or equivalent	As required
Oil seal case	MITSUBISHI genuine part No. MD970389 or equivalent	As required
Oil pan	MITSUBISHI genuine part No. MD970389 or equivalent	As required

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