# GROUP 11B

# ENGINE OVERHAUL <4A9>

## CONTENTS

# GENERAL INFORMATION

Main Index
Group TOC

M1113000100976

| Vehicle name | Vehicle model | Engine model | Displacement mL | Specification |
|---|---|---|---|---|
| Colt | Z23A | 4A91 | 1,499 | Double overhead camshaft, 16-valve |

# GENERAL SPECIFICATIONS

M1113000200962

| Item | | 4A91 |
|---|---|---|
| Total displacement mL | | 1,499 |
| Bore × stroke mm | | 75.0 × 84.8 |
| Compression ratio | | 10.0 |
| Combustion chamber | | Pentroof type |
| Camshaft arrangement | | DOHC |
| Number of valve | Intake | 2 |
| | Exhaust | 2 |
| Valve timing | Intake opening | BTDC 31° – ATDC 19° |
| | Intake closing | ABDC 21° – ABDC 71° |
| | Exhaust opening | BBDC 39° |
| | Exhaust closing | ATDC 5° |
| Fuel system | | Electronically controlled multipoint fuel injection |
| Rocker arm | | None |
| Auto-lash adjuster | | None |

# SERVICE SPECIFICATIONS

M1113000301014

| Item | | Standard value | Limit |
|---|---|---|---|
| **TIMING CHAIN** | | | |
| Valve clearance mm | Intake | 0.22 | – |
| | Exhaust | 0.30 | – |
| **CAMSHAFT** | | | |
| Cam height mm | Intake | 44.71 | 44.21 |
| | Exhaust | 44.28 | 43.78 |
| **CYLINDER HEAD AND VALVES** | | | |
| Cylinder head bottom face distortion mm | | 0.03 or less | 0.2 |
| Cylinder head bottom surface grinding limit (Total resurfacing depth of both cylinder head and cylinder block) mm | | – | 0.2 |
| Cylinder head overall height mm | | 112.9 – 113.1 | – |

Main Index
Group TOC

| Item | Standard value | Limit |
|---|---|---|
| Cylinder bore mm | 75 | – |
| Cylindrically mm | 0.007 or less | – |
| Piston to cylinder clearance mm | 0.010 – 0.035 | – |

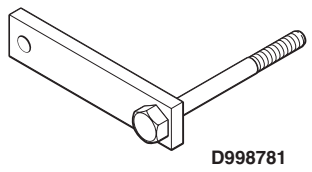
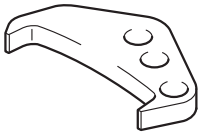
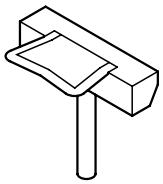
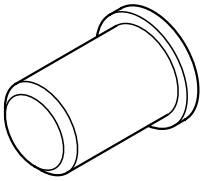
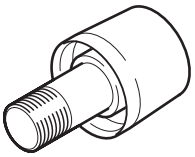
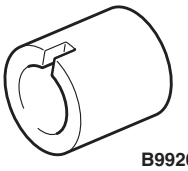
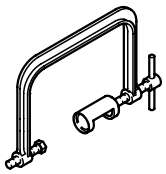
# TORQUE SPECIFICATIONS

M1113023401788

| Items | | N·m |
|---|---|---|
| **ALTERNATOR AND IGNITION SYSTEM** | | |
| Spark plugs | | 25 ± 5 |
| Ignition coil bolt | | 8.4 ± 0.6 |
| Tensioner pulley bolts | | 49 ± 9 |
| Crankshaft pulley bolts | | 190 |
| Water pump pulley bolts | | 8.4 ± 0.65 |
| Adjust bolt | | 5.0 ± 1.0 |
| Alternator brace bolt (M6) | Hexagon bolts | 11 ± 1 |
| | Torx bolts | 8.4 ± 0.6 |
| Alternator brace bolt (M10) | | 36.0 ± 3.6 |
| Alternator nut (M8) | | 22.5 ± 2.5 |
| Alternator nut (M10) | | 47 ± 5 |
| Oil level gauge guide bolt | | 7.6 ± 0.6 |
| **FUEL AND EMISSION PARTS** | | |
| Delivery pipe and injector assembly bolts | | 18.4 ± 1.4 |
| Manifold absolute pressure (MAP) sensor bolts | | 6.0 ± 0.5 |
| Throttle body bolts | | 6.0 ± 0.5 |
| Solenoid valve nut | | 7.6 ± 0.6 |
| Engine hanger bolts | | 18.4 ± 1.4 |
| **INLET MANIFOLD** | | |
| Water inlet pipe bolt | | 7.6 ± 0.6 |
| Water inlet fitting bolts | | 8.4 ± 0.65 |
| Engine coolant temperature sensor | | 29.4 ± 9.8 |
| Crank angle sensor bolts | | 8.4 ± 0.6 |
| Camshaft position bolt | | 8.4 ± 0.6 |
| Detonation sensor bolt | | 20 ± 1 |
| Oil pressure switch bolts | | 10 ± 2 |
| Inlet manifold bolts | | 13.4 ± 6.4 |
| EGR pipe nuts | | 18 ± 1 |
| EGR pipe bolts | | 7.6 ± 0.6 |
| Special bolts | | 13.4 ± 6.4 |

# SPECIAL TOOLS

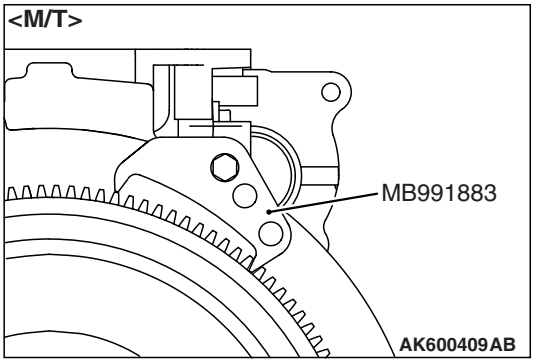
M1113000601628

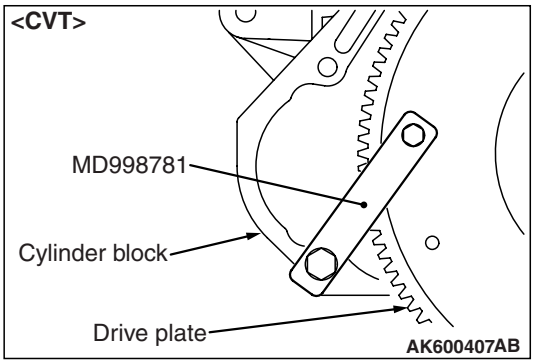
| Tool | Number | Name | Use |
|---|---|---|---|
|  D998781 | MD998781 | Flywheel stopper | Retention of flywheel |
|  MB991883 | MB991883 | Flywheel stopper | Retention of flywheel |
|  D998727 | MD998727 | Oil pan remover | Removal of oil pan |
|  | MB990699 | Differential oil seal installer | Installation of front oil seal |
|  B991993 | MB991993 | Crankshaft front oil seal guide | Installation of chain case |
|  B992000 | MB992000 | Crankshaft adapter | Turn the crankshaft |
|  D999597 | MD999597 | Valve spring compressor | Compression of valve spring |

Main Index
Group TOC

## REMOVAL SERVICE POINTS

### <<A>> CRANKSHAFT PULLEY BOLT REMOVAL

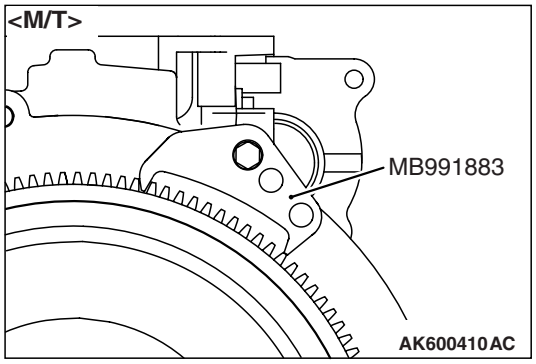


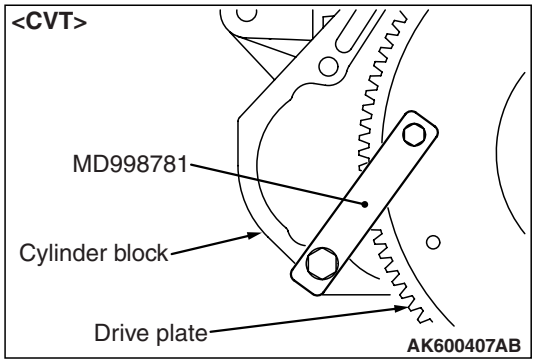




1. Lock the drive plate or the flywheel with the special tool Flywheel Stopper.
2. Remove the crankshaft bolt.
   - Flywheel Stopper (MD998781)
   - Flywheel Stopper (MB991883)

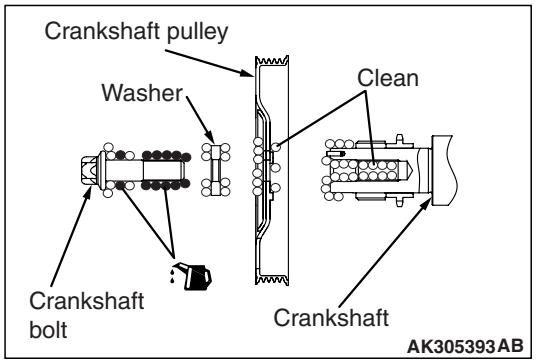
## INSTALLATION SERVICE POINTS

### >>A<< CRANKSHAFT PULLEY / WASHER / CRANKSHAFT PULLEY BOLT INSTALLATION




1. Lock the drive plate or the flywheel with the special tool Flywheel Stopper.
   - Flywheel Stopper (MD998781)
   - Flywheel Stopper (MB991883)




2. Clean the threaded holes in the crankshaft.
3. Clean and degrease the crankshaft pulley.

   *NOTE: Degreasing is required to prevent any remaining oil from compromising the friction coefficient of the pulley belt contact surface.*
4. Install the crankshaft pulley.
5. Apply an appropriate minimum amount of engine oil to the threaded portion as well as the flange bottom of the crankshaft.
6. Clean the washer.
7. Tighten the crankshaft bolt to 190 N·m.

Main Index
Group TOC

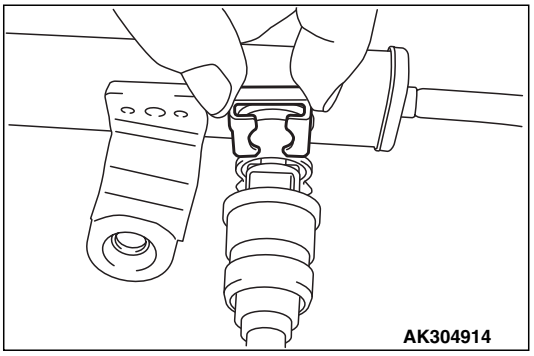
## INSTALLATION SERVICE POINTS

### >>A<< DELIVERY PIPE ASSEMBLY INSTALLATION

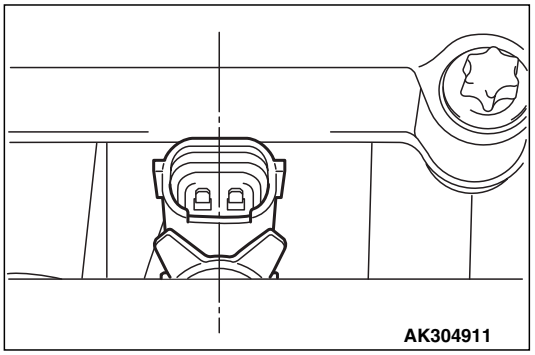
**⚠ CAUTION**

**Be sure not to allow engine oil entering into the delivery pipe.**

1. Lightly coat the injector's O-rings with new engine oil. Insert the injector squarely into the delivery pipe. Do not insert it aslant.
2. Ensure that the injector can rotate smoothly. If not, remove the injector, check the O-ring for damage, replace the O-ring as required, then try to install the injector again.




3. Install the injector support.




4. Install the delivery pipe assembly onto the cylinder head.

   Ensure that the injector can rotate smoothly. If not, remove the injector, check the O-ring for damage, replace the O-ring as required, then try to install the injector again.

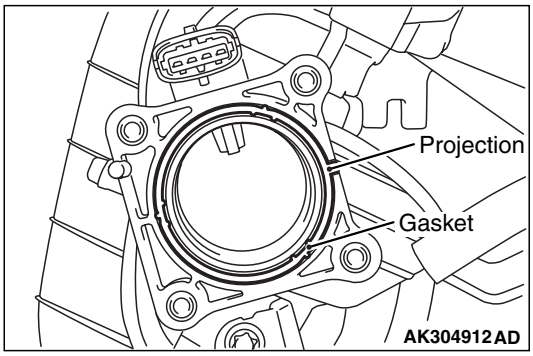
   Align the center of the injector with the center of the injector mounting hole in the delivery pipe and also aligning the protruded portions with each other.
5. The protruded portions can be aligned with each other by rotating the injector.
6. Tighten the delivery pipe assembly fittings to 18.4 ± 1.4 N·m.

### >>B<< MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INSTALLATION

**⚠ CAUTION**

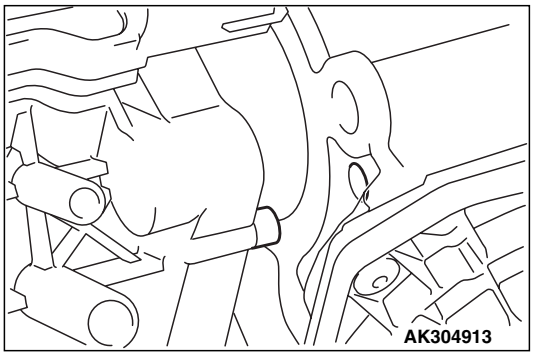
- **Be careful not to provide shock to MAP sensor when installing it.**
- **If MAP sensor is dropped to the floor when installing it, discard it and use a new one.**

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




Install the throttle body gasket, facing the gasket's protruded portion in the illustrated direction.

### >>D<< THROTTLE BODY INSTALLATION




Install the throttle body onto the inlet manifold, engaging the throttle body's recess with the manifold's protruded portion.

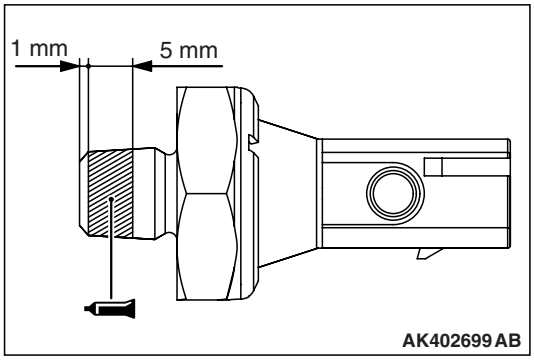
Main Index
Group TOC

3. Install the crank angle sensor onto the cylinder block by tightening it to 8.4 ± 0.6 N·m.

## >>E<< OIL PRESSURE SWITCH INSTALLATION

**⚠ CAUTION**

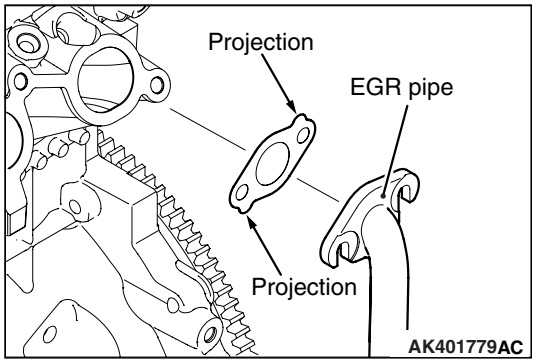
**Apply sealant correctly so that it will not be squeezed out onto the end of the threaded portion upon assembly.**



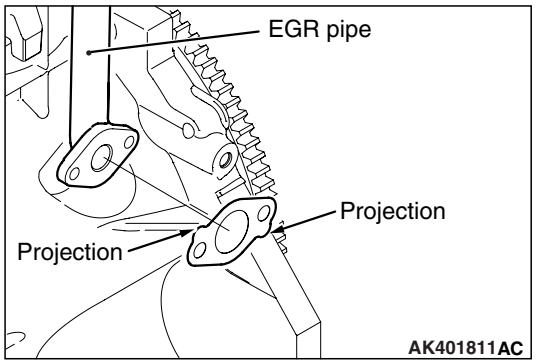

1. Remove any sealant that may be remaining on the oil pressure switch or the threaded hole in the cylinder block.
2. Apply sealant to the threaded portion of the oil pressure switch as illustrated.

   **Specified sealant:**
   **LOCTITE 565 or equivalent**
3. Install the oil pressure switch onto the cylinder block by tightening it to 10 ± 2 N·m.

## >>F<< EGR PIPE GASKET INSTALLATION

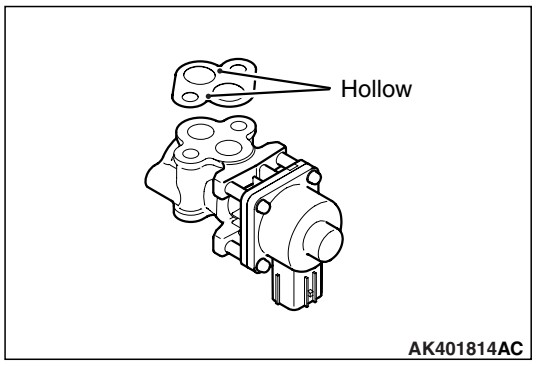



1. Install the EGR pipe gasket A, facing the gasket's protruded portion in the illudtrated direction.




2. Install the EGR pipe gasket B, facing the gasket's protruded portion in the illudtrated direction.

## >>G<< EGR VALVE GASKET INSTALLATION

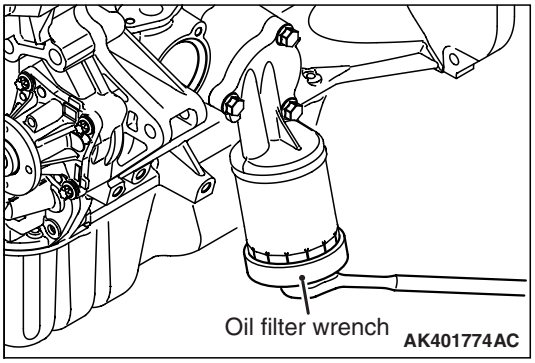



Install the EGR valve gasket, facing the gasket's hollow portion in the illudtrated direction.

Main Index
Group TOC

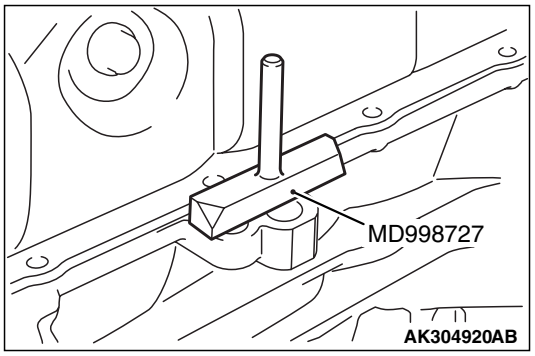
## REMOVAL SERVICE POINTS

### <<A>> OIL FILTER REMOVAL




Remove the oil filter using an oil filter wrench (commercially available).

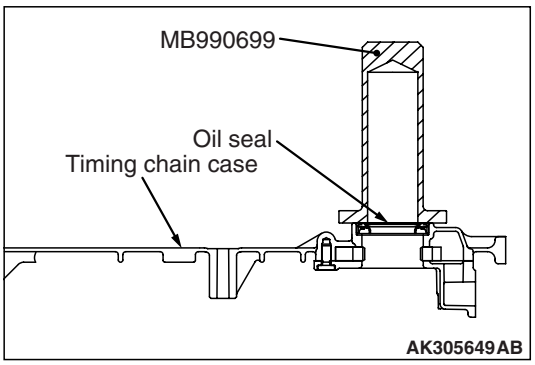
### <<B>> OIL PAN REMOVAL




1. Remove the oil pan retaining bolts.
2. Knock the special tool Oil pan cutter (MD998727) between the oil pan and the cylinder block.

## INSTALLATION SERVICE POINTS

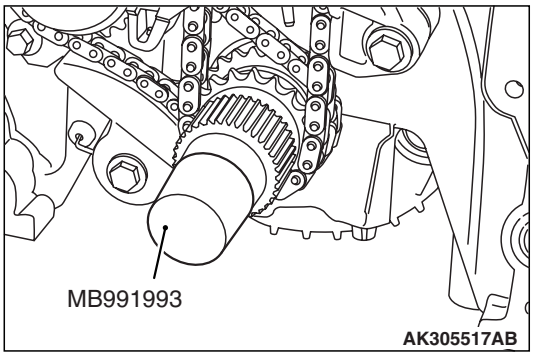
### >>A<< FRONT OIL SEAL INSTALLATION



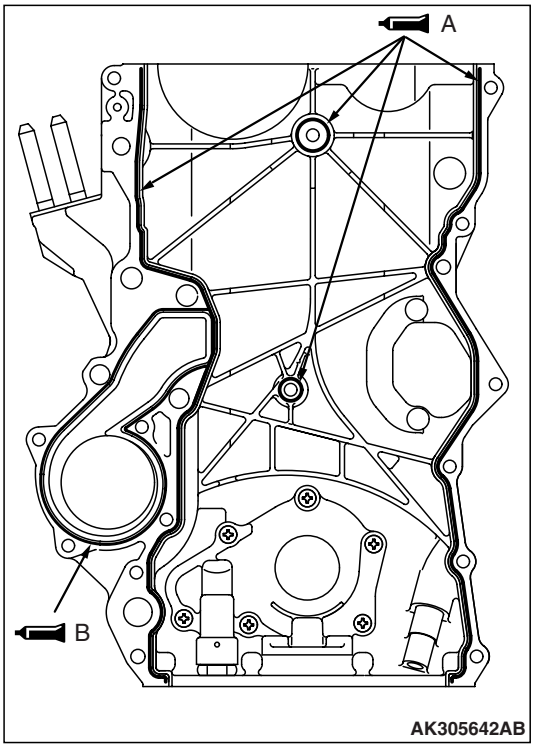

Install the front oil seal into the timing chain case using the special tool Differential oil seal installer (MB990699).

### >>B<< TIMING CHAIN CASE INSTALLATION

1. Remove any liquid gasket remaining on the timing chain case, the cylinder block, and the cylinder head.




2. Install the special tool Oil seal guide (MB991993) onto the crankshaft.




**⚠ CAUTION**
**The timing chain case should be installed within 3 minutes of applying liquid gasket.**

3. Apply a 2.0 ± 0.5 mm bead of liquid gasket to location A, and a 1.5 ± 0.5 mm bead of liquid gasket to location B on the timing chain case respectively as illustrated.

   **Specified sealant:**
   **LOCTITE 5971 or exact equivalent**

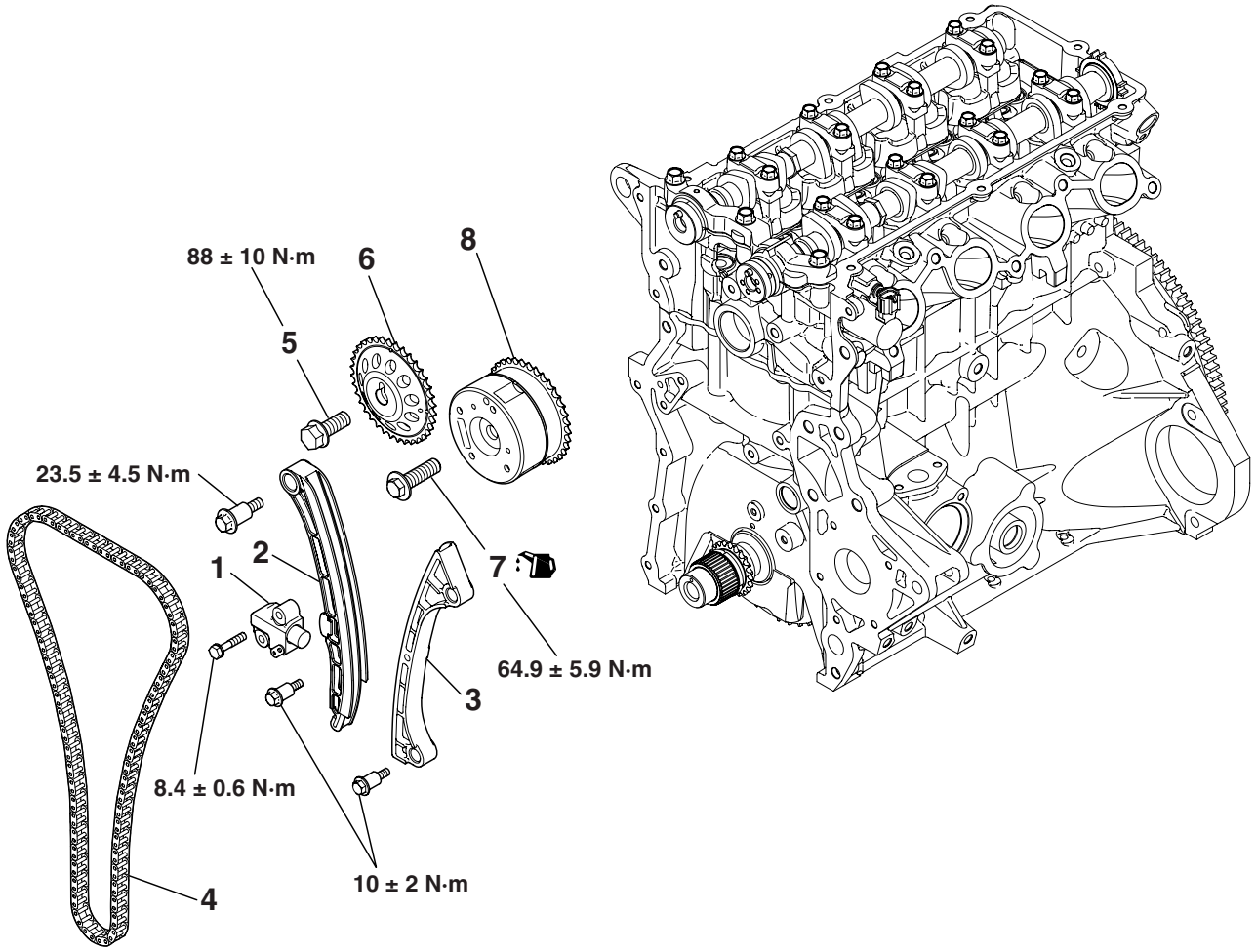
4. Install the timing chain case.

   *NOTE: The retaining bolts have different lengths. Be sure to use the correct bolt for each location.*

# TIMING CHAIN

## REMOVAL AND INSTALLATION

M1113026600216




AK402345AE

**Removal steps**

>>**D**<< 1. Timing chain tensioner assembly
2. Tensioner lever assembly
3. Chain guide assembly
>>**C**<< 4. Timing chain
<<**A**>> >>**B**<< 5. Camshaft sprocket bolt

**Removal steps (Continued)**

6. Camshaft sprocket
<<**B**>> >>**A**<< 7. V.V.T. sprocket bolt
8. V.V.T. sprocket assembly

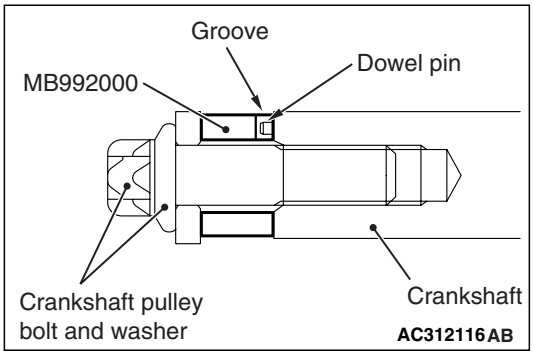
Main Index
Group TOC

## INSPECTION

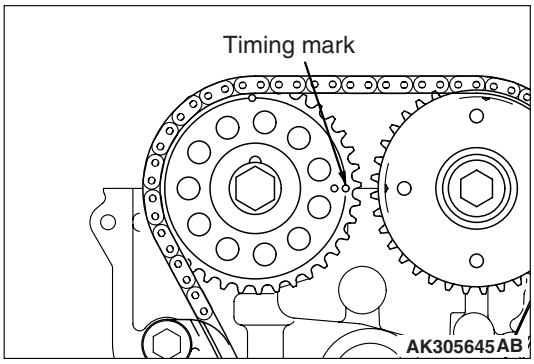
M1113026700075

## VALVE CLEARANCE MEASUREMENT

Measure the valve clearance as illustrated.



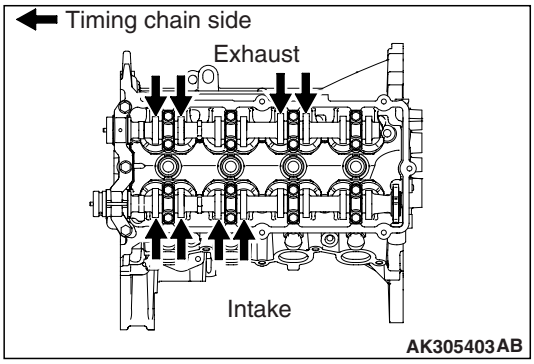

Set the special tool Crankshaft adapter (MB992000) to the crankshaft, and install the crankshaft pulley bolt and washer.



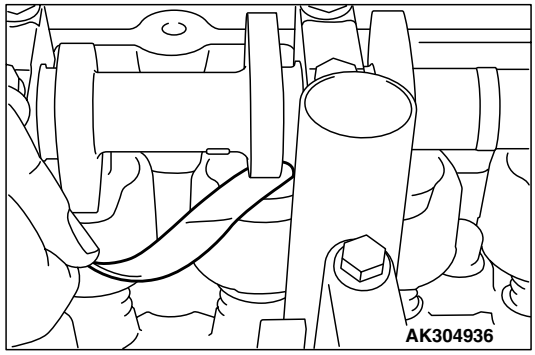

**⚠ CAUTION**

**The crankshaft should always be rotated clockwise.**

1. Rotate the crankshaft clockwise until the mark on the camshaft sprocket is aligned with the mark on the upper surface of cylinder head. (Set the No. 1 cylinder to TDC on the compression stroke.)



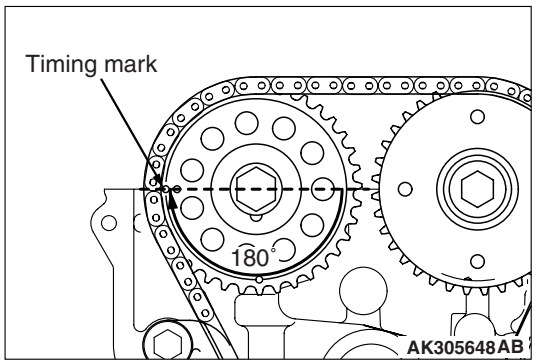

2. Now, the valve clearance (shown with an arrow) can be measured.



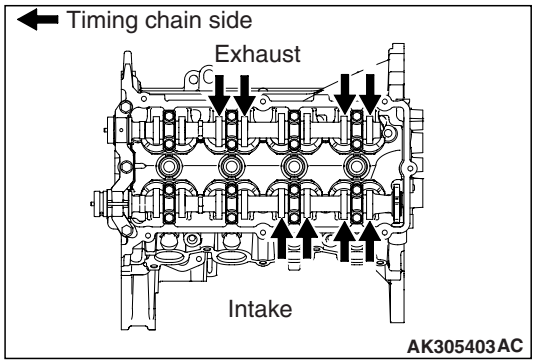

3. Using a thickness gauge, measure the clearance between the cam base circle and the valve tappet.

   **Standard value (cold engine):**
   **Intake valve 0.22 ± 0.04 mm**
   **Exhaust valve 0.30 ± 0.04 mm**

4. If the measured value does not conform to the standard value, record the measured value.




5. Rotate the crankshaft clockwise until the mating mark on the camshaft sprocket comes to the illustrated location. This will bring the No. 4 cylinder to TDC on the compression stroke.

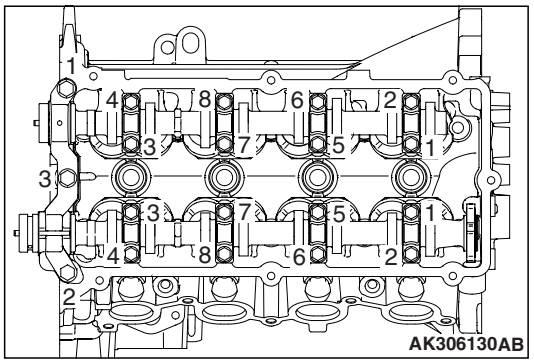



6. Measure the valve clearance at the location shown with an arrow.
7. If the measured value does not conform to the standard value, record the measured value.
8. Replace the valve tappet for the valve whose clearance is out of the standard value.

Main Index
Group TOC

## REMOVAL SERVICE POINTS

### <<A>> FRONT CAMSHAFT BEARING CAP / CAMSHAFT BEARING CAP REMOVAL




In accordance with the numerical order shown in the illustration, remove the front camshaft bearing cap first, and then remove the installation bolt of each camshaft bearing cap.

### <<B>> VALVE TAPPET REMOVAL

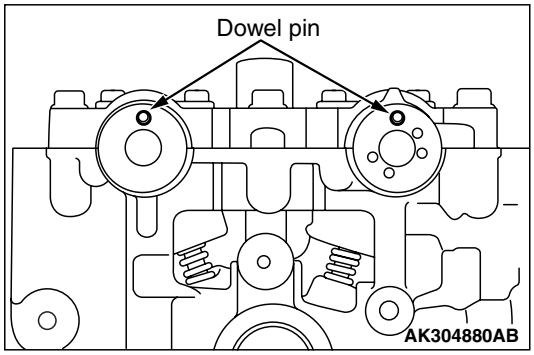
To facilitate reassembly, attach a tag to each valve tappet removed that shows where it has been assembled.

## INSTALLATION SERVICE POINTS

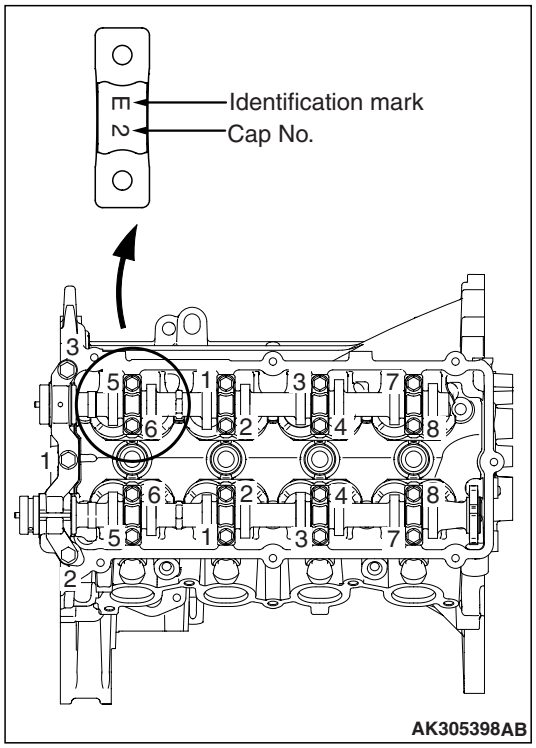
### >>A<< VALVE TAPPET INSTALLATION

Reassemble each valve tappet to the correct location shown on the tag.

### >>B<< CAMSHAFT/CAMSHAFT BEARING CAP INSTALLATION




1. Install each camshaft, ensuring that the dowel pin faces the illustrated direction.




2. The No. 2 to No. 5 bearing caps are equally shaped for both the intake and exhaust camshafts. Be sure to correctly install them by referring to the identification marks.

**Identification mark (stamped on the front and No. 2 to No. 5 bearing caps)**
**I: Intake**
**E: Exhaust**

3. In accordance with the numerical order shown in the illustration, tighten each camshaft bearing cap first and then tighten the front camshaft bearing cap in several steps.

### >>C<< OIL FEEDER CONTROL VALVE (OCV) FILTER INSTALLATION

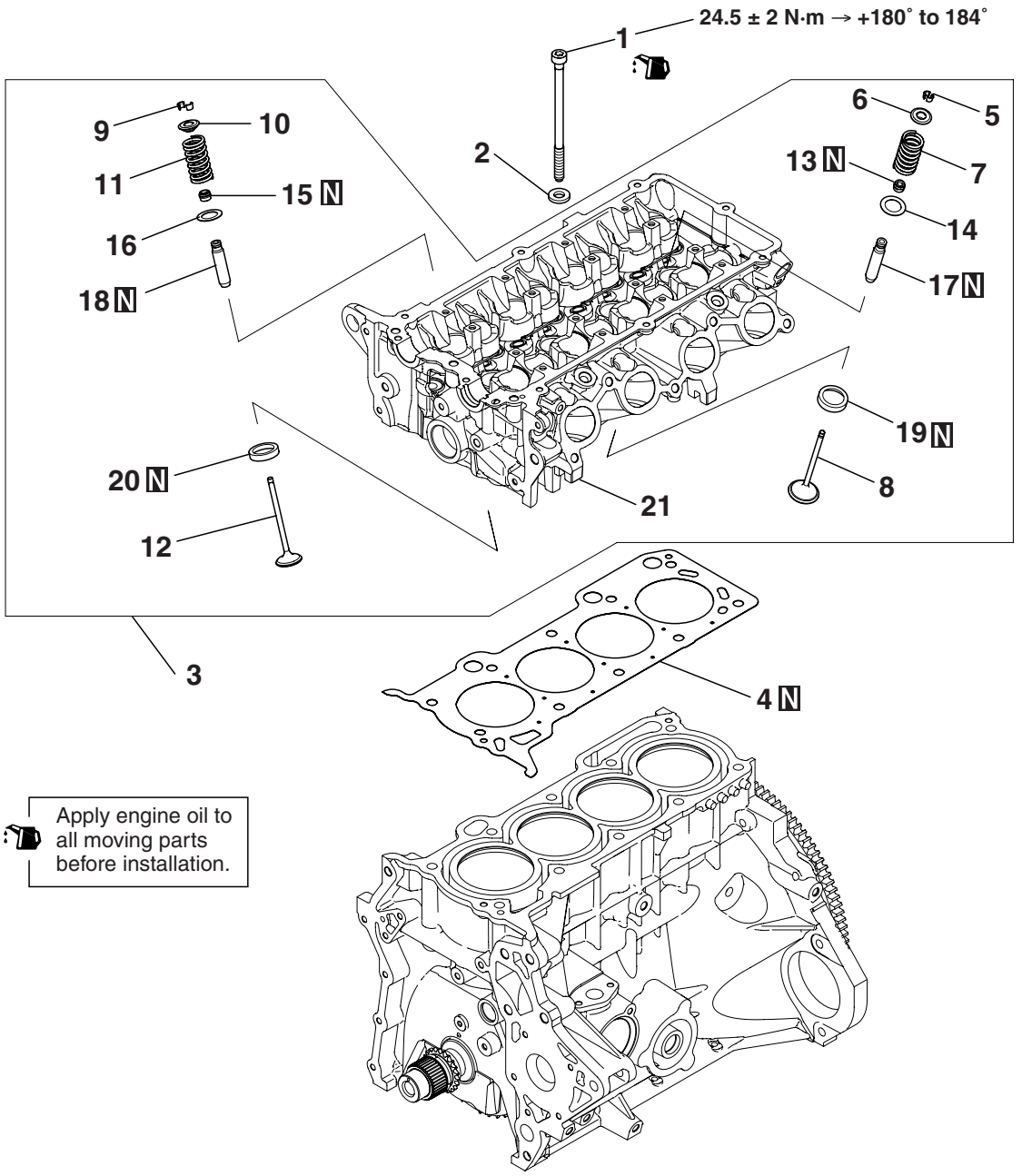
**⚠ CAUTION**
**After checking for foreign matters attached, defects and deformation, install the oil feeder control valve filter.**

Main Index
Group TOC

# CYLINDER HEAD AND VALVES

## REMOVAL AND INSTALLATION

M1113006900992



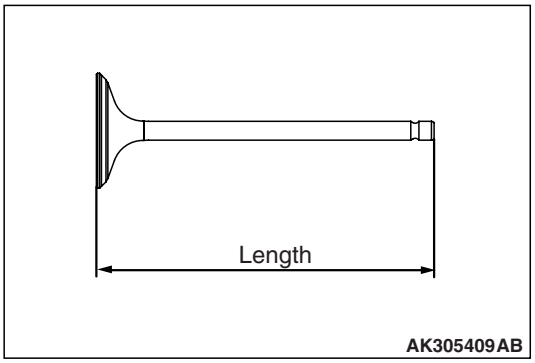

AK402342AC

**Removal steps**

>>C<< 1. Cylinder head bolt
2. Cylinder head bolt washer
3. Cylinder head assembly
4. Cylinder head gasket
<<A>> >>B<< 5. Retainer lock
6. Valve spring retainer
7. Valve spring
8. Intake valve
<<A>> >>B<< 9. Retainer lock
10. Valve spring retainer
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. Valve guide
18. Valve guide
19. Intake valve seat
20. Exhaust valve seat
21. Cylinder head

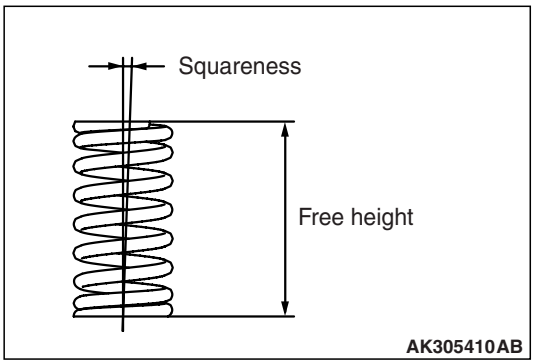



3. Measure the valve overall length. If the measured value exceeds the limit, replace with a new valve.

**Standard value:**
**Intake 89.61 mm**
**Exhaust 90.94 mm**

**Limit:**
**Intake 89.11 mm**
**Exhaust 90.44 mm**

## VALVE SPRING



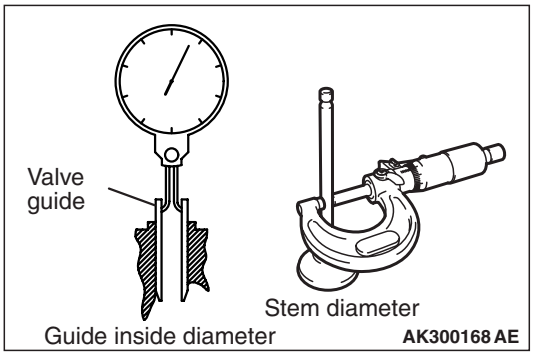

1. Measure the valve spring free height. If the measured value exceeds the limit, replace with a new spring.

**Standard value: 43.1 mm**
**Limit: 42.1 mm**

2. Measure the valve spring out-of-squareness. If the measured value exceeds the limit, replace with a new spring.

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

## VALVE GUIDE

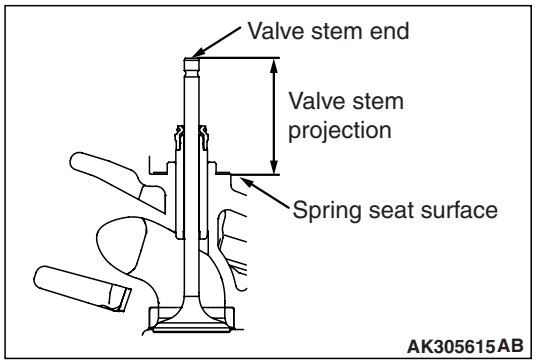



Measure the clearance between the valve guide and the valve stem. If the measured value exceeds the limit, replace the valve guide or the valve, or both.

**Standard value:**
**Intake 0.020 – 0.047 mm**
**Exhaust 0.030 – 0.057 mm**

**Limit:**
**Intake 0.10 mm**
**Exhaust 0.15 mm**

## VALVE SEAT



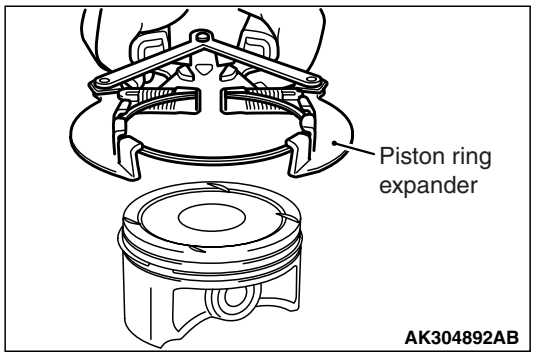

With the valve mechanism assembled and the valve face pressed against the seat, measure the valve stem end protrusion over the cylinder head face where the spring seat is located. If the measured value exceeds the limit, replace the cylinder head assembly.

**Standard value:**
**Intake 38.46 mm**
**Exhaust 38.49 mm**

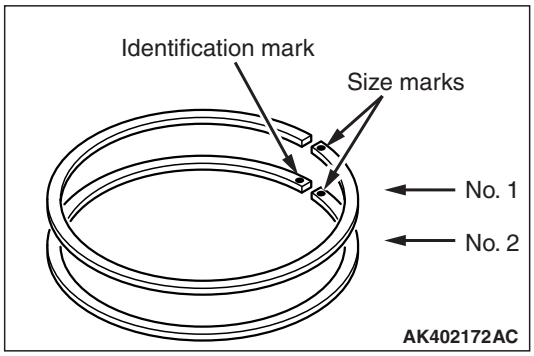
**Limit:**
**Intake 38.96 mm**
**Exhaust 38.99 mm**

Main Index
Group TOC

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




Use a piston ring expander to install the No. 1 and No. 2 piston rings. The ring identification mark should face upwards.



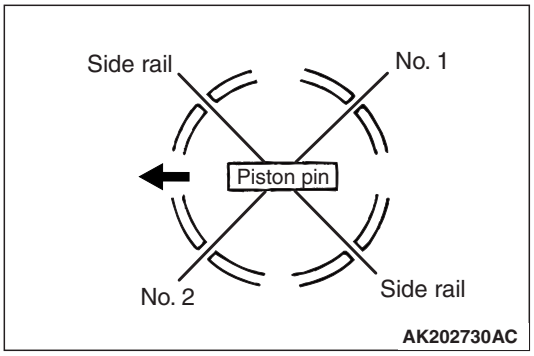

**Identification mark**
**No. 1 ring: None**
**No. 2 ring: 2R**

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

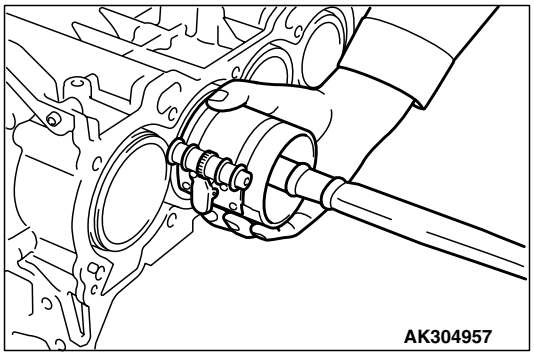
| Size | | Size mark |
|---|---|---|
| Standard | No. 1 ring | No mark (Yellow paint on periphery) |
| | No. 2 ring | No mark (Yellow paint on periphery) |
| 0.25 mm oversize | | 25 |

## >>D<< PISTON, CONNECTING ROD ASSEMBLY INSTALLATION

1. Apply engine oil sufficiently onto the piston periphery, the piston rings and the oil ring.




2. Align the gaps of the piston rings and the oil ring (side rails, spacer) as illustrated.
3. Insert the piston and connecting rod assembly from above the cylinder block and through the cylinder bore, ensuring that the front mark on the piston top faces the camshaft sprocket.

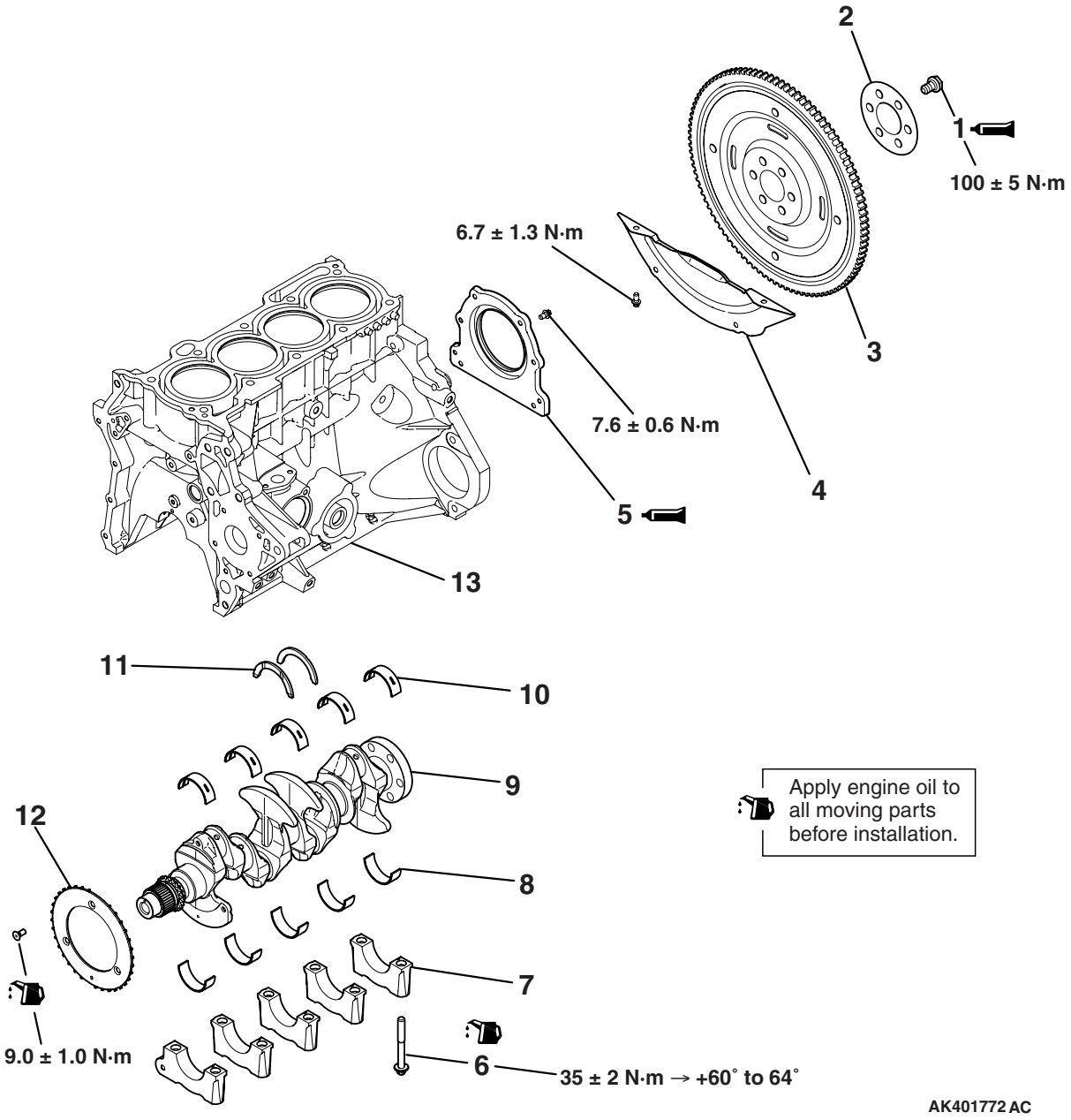



**⚠ CAUTION**
**Do not try to strike hard on the assembly to fit it in place as this will break the piston rings.**

4. While firmly holding the piston rings with a ring band, insert the piston and connecting rod assembly into place.

Main Index
Group TOC

## <CVT>




**Removal steps**

<<A>> >>G<< 1. Drive plate bolt
2. Adapter plate
3. Drive plate
4. Bell housing cover
>>F<< 5. Oil seal case
>>E<< 6. Crankshaft bearing cap bolt
>>E<< 7. Crankshaft bearing cap
>>D<< 8. Crankshaft bearing, lower

**Removal steps (Continued)**

9. Crankshaft
>>C<< 10. Crankshaft bearing, upper
>>B<< 11. Thrust bearing
>>A<< 12. Crankshaft sensing ring
13. Cylinder block