

GROUP 11B

ENGINE OVERHAUL

CONTENTS

GENERAL SPECIFICATIONS.....	11B-2	OIL PAN AND TIMING CHAIN CASE.....	11B-23
SERVICE SPECIFICATIONS.....	11B-2	REMOVAL AND INSTALLATION	11B-23
REWORK DIMENSIONS	11B-3	TIMING CHAIN	11B-30
TORQUE SPECIFICATIONS.....	11B-4	REMOVAL AND INSTALLATION	11B-30
SEALANTS AND ADHESIVES	11B-6	INSPECTION.....	11B-36
SPECIAL TOOLS.....	11B-8	CAMSHAFT	11B-40
GENERATOR AND IGNITION SYSTEM.....	11B-10	REMOVAL AND INSTALLATION	11B-40
REMOVAL AND INSTALLATION	11B-10	INSPECTION.....	11B-43
FUEL AND EMISSION PARTS	11B-13	CYLINDER HEAD AND VALVES....	11B-45
REMOVAL AND INSTALLATION	11B-13	REMOVAL AND INSTALLATION	11B-45
INTAKE MANIFOLD	11B-16	INSPECTION.....	11B-51
REMOVAL AND INSTALLATION	11B-16	PISTON AND CONNECTING ROD ..	11B-55
EXHAUST MANIFOLD.....	11B-17	REMOVAL AND INSTALLATION	11B-55
REMOVAL AND INSTALLATION	11B-17	INSPECTION.....	11B-61
WATER HOSE AND PIPE	11B-19	CRANKSHAFT AND CYLINDER BLOCK	11B-63
REMOVAL AND INSTALLATION	11B-19	REMOVAL AND INSTALLATION	11B-63
		INSPECTION.....	11B-69

GENERAL SPECIFICATIONS

M1113000203240

Item		3A92
Total displacement cm ³ (cu in)		1,193 (72.8)
Bore × stroke mm (in)		75.0 (2.95) × 90.0 (3.54)
Compression ratio		10.5
Combustion chamber		Pentroof type
Camshaft arrangement		DOHC
Valve timing	Intake opening	BTDC 41° – ATDC 9 °
	Intake closing	ABDC 19° – ABDC 69°
	Exhaust opening	BBDC 35°
	Exhaust closing	ATDC 5°
Fuel system		Electronically controlled multiport fuel injection
Ignition system		Electronic-controlled 3-coil

SERVICE SPECIFICATIONS

M1113000303742

Item		Standard value	Limit
Timing chain			
Valve clearance [cold engine] mm (in)	Intake	0.22 ± 0.04 (0.009 ± 0.001)	–
	Exhaust	0.30 ± 0.04 (0.012 ± 0.001)	–
Camshaft			
Cam height mm (in)	Intake	44.81 (1.764)	44.31 (1.744)
	Exhaust	43.98 (1.731)	43.48 (1.712)
Cylinder head and valves			
Cylinder head bottom face distortion mm (in)		0.03 (0.001) or less	–
Cylinder head overall height mm (in)		112.9 – 113.1 (4.445 – 4.452)	–
Valve margin mm (in)	Intake	0.85 (0.033)	–
	Exhaust	1.50 (0.059)	–
Valve length mm (in)	Intake	87.21 (3.433)	86.71 (3.414)
	Exhaust	88.54 (3.486)	88.04 (3.466)
Valve spring free length mm (in)		49.6 (1.95)	48.6 (1.91)
Valve spring out-of-squareness		2° or less	4°
Valve stem-to-guide clearance mm (in)	Intake	0.020 – 0.047 (0.0008 – 0.0018)	0.10 (0.004)
	Exhaust	0.030 – 0.057 (0.0012 – 0.0022)	0.15 (0.006)
Valve seat contact width mm (in)		1.1 – 1.5 (0.044 – 0.059)	–
Valve guide press-fit height mm (in)		12.7 – 13.3 (0.50 – 0.52)	–

Item		Standard value	Limit
Piston and connecting rod			
Piston pin press-fit load N (lb)		2,000 – 8,000 (449.7 – 1798.5)	–
Connecting rod big end thrust clearance mm (in)		0.10 – 0.35 (0.004 – 0.013)	0.4 (0.02)
Outside diameter difference of connecting rod bolt mm (in)		0 – 0.1 (0 – 0.003)	–
Piston ring to ring groove clearance mm (in)	No. 1	0.03 – 0.07 (0.0012 – 0.0027)	0.1 (0.004)
	No. 2	0.02 – 0.06 (0.0008 – 0.0023)	0.1 (0.004)
Piston ring end gap mm (in)	No. 1	0.15 – 0.30 (0.006 – 0.011)	0.8 (0.03)
	No. 2	0.20 – 0.40 (0.008 – 0.015)	0.8 (0.03)
	Oil ring	0.10 – 0.35 (0.004 – 0.013)	1.0 (0.04)
Crankshaft pin oil clearance mm (in)		0.026 – 0.062 (0.0011 – 0.0024)	0.1 (0.004)
Crankshaft and cylinder block			
Crankshaft bearing cap bolt shank length mm (in)		74.15 – 74.85 (2.920 – 2.946)	–
Crankshaft end play mm (in)		0.09 – 0.27 (0.004 – 0.010)	0.30 (0.012)
Crankshaft journal oil clearance mm (in)		0.023 – 0.043 (0.0010 – 0.0016)	0.1 (0.004)
Cylinder block top surface distortion mm (in)		0.05 (0.002)	0.1 (0.004)
Cylinder bore mm (in)		75.0 (2.95)	–
Cylindrically mm (in)		0.01 (0.0004) or less	–

REWORK DIMENSIONS

M1113024301814

Item			Dimension
Cylinder head and valve			
Cylinder head oversize valve seat bore diameter mm	Intake	0.30 O.S.	31.83 – 31.85 (1.2532 – 1.2539)
	Exhaust	0.30 O.S.	28.32 – 28.34 (1.1150 – 1.1157)
Cylinder head oversize valve guide bore diameter mm	Intake	0.05 O.S.	10.56 – 10.58 (0.4158 – 0.4165)
	Exhaust	0.05 O.S.	10.55 – 10.57 (0.4154 – 0.4161)

TORQUE SPECIFICATIONS

M1113023406062

Item	Specification
Generator and ignition system	
Crankshaft pulley center bolt	50 N·m (37 ft-lb), +60°, 0 N·m (0 ft-lb), 50 N·m (37 ft-lb) then +60°
Generator brace bolt (M8)	5.0 ± 1.0 N·m (44 ± 8 in-lb)
Generator brace bolt (M10)	38 ± 5 N·m (28 ± 3 ft-lb)
Generator nut (M8)	23 ± 2 N·m (17 ± 1 ft-lb)
Generator nut (M10)	47 ± 5 N·m (35 ± 3 ft-lb)
Ignition coil bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Oil dipstick guide bolt	11 ± 3 N·m (97 ± 26 in-lb)
Spark plug	25 ± 5 N·m (18 ± 3 ft-lb)
Water pump pulley bolt	11 ± 3 N·m (97 ± 26 in-lb)
Fuel and emission parts	
Engine hanger bolt	25 ± 5 N·m (18 ± 3 ft-lb)
Evaporative emission purge solenoid nut	5.5 ± 1.5 N·m (49 ± 13 in-lb)
Fuel rail and fuel injector assembly bolt	14 ± 3 N·m (124 ± 26 in-lb)
Throttle body bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Intake manifold	
Intake manifold bolt	28 ± 2 N·m (21 ± 1 ft-lb)
Intake manifold stay bolt	19 ± 1 N·m (14.0 ± 0.7 ft-lb)
Manifold absolute pressure sensor bolt	5.5 ± 1.5 N·m (49 ± 13 in-lb)
Exhaust manifold	
Exhaust manifold bolt and nut	34 ± 3 N·m (25 ± 2 ft-lb)
Exhaust manifold cover bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Linear air-fuel ratio sensor	44 ± 5 N·m (32 ± 3 ft-lb)
Water hose and pipe	
Engine coolant temperature sensor	30 ± 9 N·m (22 ± 6 ft-lb)
Engine oil pressure switch	10 ± 2 N·m (89 ± 17 in-lb)
Camshaft position sensor bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Crankshaft position sensor bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Knock sensor bolt	20 ± 2 N·m (15 ± 1 ft-lb)
Water inlet fitting bolt	11 ± 3 N·m (97 ± 26 in-lb)
Water pipe bolt	11 ± 3 N·m (97 ± 26 in-lb)

Item	Specification
Oil pan and timing chain case	
Cylinder head cover bolt	2.0 ± 0.5 N·m then 7.0 ± 0.5 N·m (18 ± 4 in-lb then 62 ± 4 in-lb)
Oil drain plug	39 ± 5 N·m (29 ± 3 ft-lb)
Oil filter cover bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Oil filter stud	27 ± 2 N·m (20 ± 1 ft-lb)
Oil pan bolt	11 ± 3 N·m (97 ± 26 in-lb)
Oil strainer bolt	10 ± 2 N·m (89 ± 17 in-lb)
PCV valve	2.5 ± 0.4 N·m (22 ± 3 in-lb)
Service hole bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Stud (M10 × 80.5)	11 ± 2 (97 ± 17 in-lb)
Stud (M10 × 90.8)	10 ± 1 (89 ± 8 in-lb)
Timing chain case bolt (M6)	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Timing chain case bolt (M10)	42 ± 16 N·m (31 ± 11 ft-lb)
Transaxle stay	26 ± 6 N·m (19 ± 4 ft-lb)
Water pump bolt	11 ± 3 N·m (97 ± 26 in-lb)
Timing chain	
Camshaft sprocket bolt	92 ± 13 N·m (68 ± 9 ft-lb)
Chain guide bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Tensioner lever bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Timing chain tensioner bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
V.V.T. sprocket bolt	65 ± 5 N·m (48 ± 3 ft-lb)
Camshaft	
Camshaft bearing cap bolt	11 ± 1 N·m (97 ± 8 in-lb)
Front camshaft bearing cap bolt	20 ± 1 N·m (14.8 ± 0.7 ft-lb)
Oil feeder control valve bolt	10 ± 2 N·m (89 ± 17 in-lb)
Oil feeder control valve filter bolt	44 ± 5 N·m (32 ± 3 ft-lb)
Cylinder head and valves	
Cylinder head bolt	24.5 ± 2.0 N·m (18.4 ± 0.7 ft-lb) then +180° to 184°
Piston and connecting rod	
Connecting rod cap bolt	14.7 ± 2.0 N·m (11.1 ± 0.7 ft-lb) then +90° to 94°
Crankshaft and cylinder block	
Bell housing cover bolt (M6)	11 ± 3 N·m (97 ± 26 in-lb)
Bell housing cover bolt (M8)	26 ± 6 N·m (19 ± 4 ft-lb)
Crankshaft bearing cap bolt	35 ± 2 N·m (26 ± 1 ft-lb) then +60° to 64°
Crankshaft sensing ring bolt	10 ± 2 N·m (89 ± 17 in-lb)
Drive plate bolt	100 ± 5 N·m (74 ± 3 ft-lb)
Flywheel bolt	100 ± 5 N·m (74 ± 3 ft-lb)
Oil seal case bolt	11 ± 3 N·m (97 ± 26 in-lb)
Stiffener plate bolt	26 ± 6 N·m (19 ± 4 ft-lb)

SEALANTS AND ADHESIVES

M1113000503940

Item	Specified sealant and adhesive	Remark
Engine coolant temperature sensor	LOCTITE 262, ThreeBond 1324N or equivalent	Anaerobic adhesive
Cylinder block crank angle sensor mounting face	ThreeBond 1207F (MITSUBISHI MOTORS GENUINE Part No.1000A992) or equivalent	Semi-drying sealant
Engine oil pressure switch	ThreeBond 1215, ThreeBond 1141J, ThreeBond 1212D or equivalent	
Timing chain case (matching area of the cylinder block, the cylinder head gasket and the cylinder head)	ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), LOCTITE 5900, LOCTITE 5970 or equivalent	
Cylinder head cover (matching area of the cylinder head and timing chain case)		
Cylinder head gasket (matching area of the cylinder block, the cylinder head gasket and the cylinder head)		
Timing chain case (Area of the water pump)	ThreeBond 1227D, ThreeBond 1207F (MITSUBISHI MOTORS GENUINE Part No.1000A992) or equivalent	
Oil pan	ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), ThreeBond 1227D, LOCTITE 5900, LOCTITE 5970 or equivalent	
Oil seal case		
Flywheel bolt <M/T>	LOCTITE 2701 or equivalent	
Drive plate bolt <CVT>	LOCTITE 2701, ThreeBond 1324 or equivalent	

NOTE: The number in brackets shows the genuine part number.

LIQUID GASKET (FIPG)

FIPG is used for some parts in the engine. It is necessary to pay attention to an application amount, application procedure and applied surface condition for this gasket to fully achieve its purpose.

Too small application amount of FIPG or the dirty surface where the FIPG is applied might cause the water or oil leakage. Too large application amount of FIPG overflows and might clog or narrow the passage of water or oil. It is absolutely essential that the surface where the FIPG is applied must be cleaned and the appropriate amount of FIPG must be evenly applied to prevent the leakage from the connected area.

FIPG used for engine parts hardens reacting with moisture in the air, and is usually used for metal flanges.

 CAUTION

Reapply the FIPG with care to the followings.

- Completely remove the old FIPG including the residue in gaps of parts.
- Using MITSUBISHI MOTORS GENUINE parts cleaner (MZ100387) or equivalent, degrease the FIPG application surface carefully.
- According to the FIPG application procedures, apply it accurately.

DISASSEMBLY

 CAUTION

Sufficiently check that there is no residual oil on the place where degreasing is performed. If fingerprints are left, do not touch it with bare hands after the degreasing, since the oils from your fingers will harm the seal ability.

Parts assembled with FIPG can be easily disassembled without using a special method. In some cases, however, it is necessary to lightly tap parts with a wooden hammer or similar tool to break sealant between mating surfaces. Or lightly driving a smooth and thin gasket scraper in mating surfaces is useful, but full care must be exercised not to damage mating surfaces. As special tool oil pan FIPG cutter (MD998727) is set, use this tool.

CLEANING OF GASKET SURFACE

Completely remove all deposits from the gasket surface with a gasket scraper or wire brush. Make sure that the surface to which FIPG is applied is smooth.

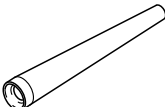
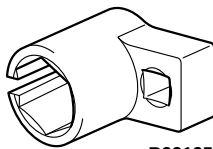
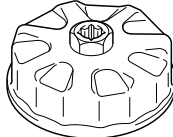
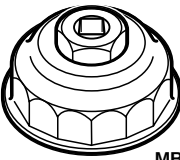
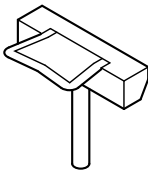
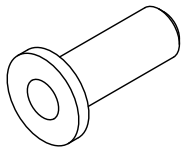
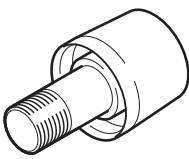
Completely remove all the old FIPG, which might be remaining in the installation hole, the thread hole or among the components.

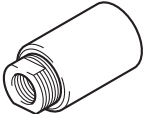
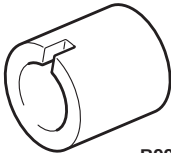
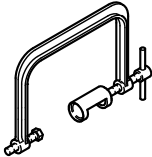
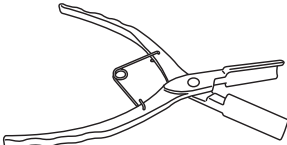
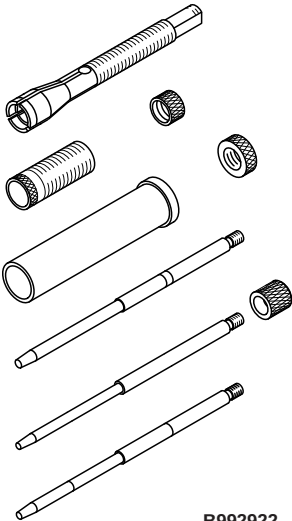
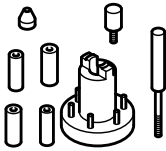
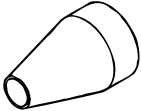
APPLICATION PROCEDURE

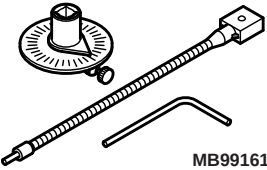
Apply FIPG in a determined diameter and continuously without break. Completely enclose the periphery of mounting holes. FIPG can be wiped off if it is not hardened. Install parts in place while FIPG is still wet. Take care not to allow FIPG to adhere to other locations than necessary locations during installation. Do not pour oil or water on applied locations or do not start the engine until sufficient time (approximately one hour) passes. The application procedure of FIPG may differ depending on areas. Follow the procedure in the body of the manual to apply FIPG.

SPECIAL TOOLS

M1113000603538

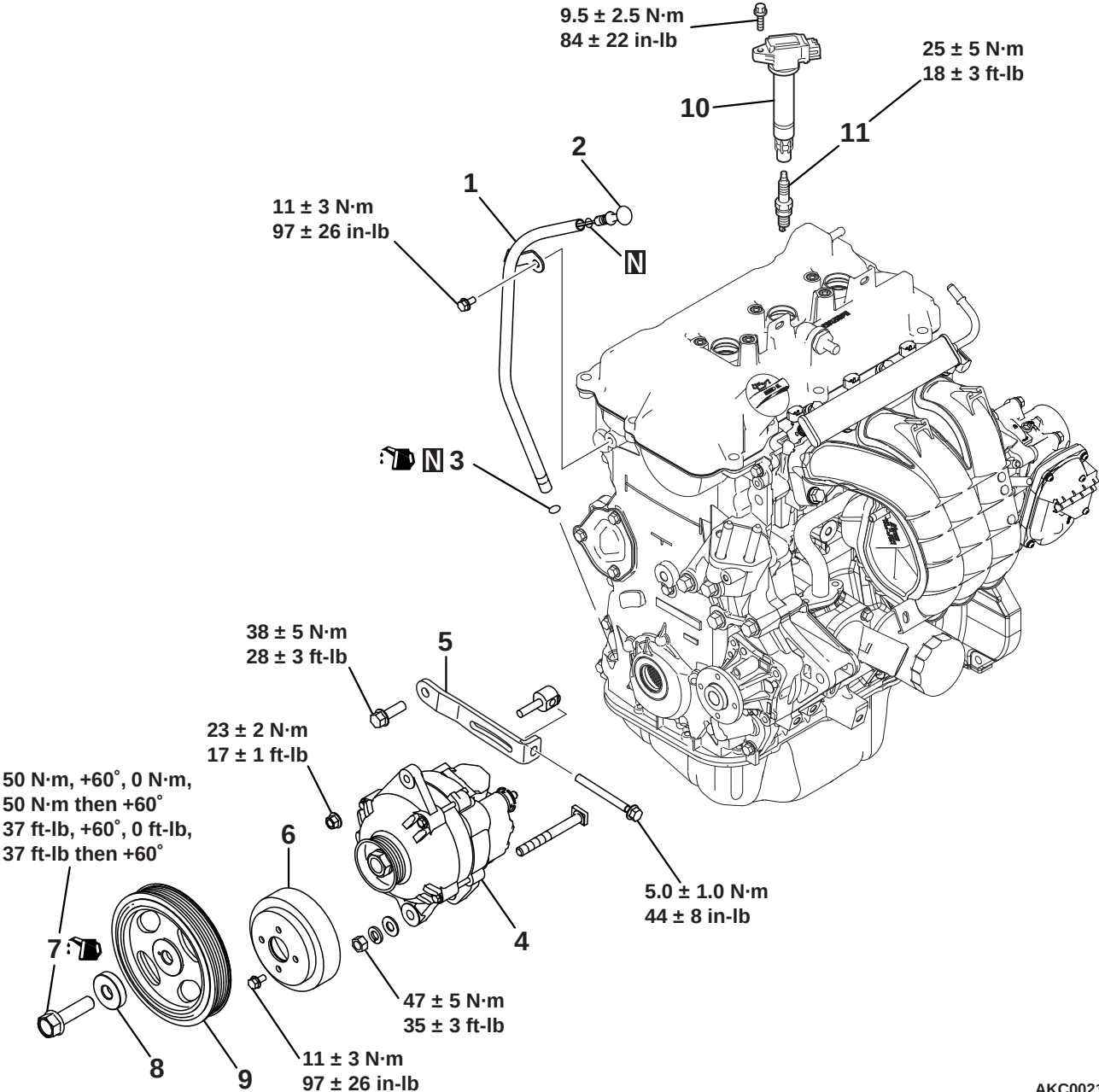
Tool	Tool number and name	Supersession	Application
 MB991883	MB991883 Flywheel stopper	General service tool	Supporting the flywheel <M/T> or drive plate <CVT>
 B992106	MB992106 O-ring installer	—	Installation of O-ring on fuel injector injection nozzle side
 B991953	MB991953 Oxygen sensor wrench	MB991953-01	Removal and installation of linear air-fuel ratio sensor
 B991396	MB991396 Oil filter wrench	General service tool or MB991396-01	Removal and installation of oil filter
 MB991828	MB991828 Oil filter wrench	General service tool	
 D998727	MD998727 Oil pan FIPG cutter	MD998727-01	Removal of oil pan
	MB990699 Differential oil seal installer	—	Installation of front oil seal
 B991993	MB991993 Crankshaft front oil seal guide	—	Installation of timing chain case

Tool	Tool number and name	Supersession	Application
 MB992676	MB992676 Oil filter stud setter	—	Installation of oil filter stud
 B992000	MB992000 Crankshaft adapter	—	Turn the crankshaft
 D999597	MD999597 Valve spring compressor	—	Compression of valve spring
	MB992085 Valve stem seal pliers	—	Valve stem seal removal
 B992922	MB992922 Valve stem seal installer adjustable	—	Valve stem seal press-fitting
	MD998780 Piston pin setting tool	MIT216941	Removal and press-fitting of piston pin
	MB991659 Guide D	—	

Tool	Tool number and name	Supersession	Application
 MB991614	MB991614 Angle gauge	General service tool	Tightening crankshaft bearing cap bolt

GENERATOR AND IGNITION SYSTEM
REMOVAL AND INSTALLATION

M1113001002837



AKC00219AB

Removal steps

1. Oil dipstick guide
2. Oil dipstick
3. O-ring
4. Generator
5. Generator brace
6. Water pump pulley

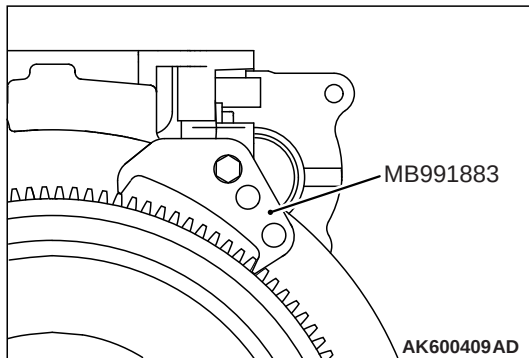
Removal steps (Continued)

- | | | |
|-------|-------|----------------------------------|
| <<A>> | >>A<< | 7. Crankshaft pulley center bolt |
| | >>A<< | 8. Crankshaft pulley washer |
| | >>A<< | 9. Crankshaft pulley |
| | | 10. Ignition coil |
| | | 11. Spark plug |

REMOVAL SERVICE POINT

**<<A>> CRANKSHAFT PULLEY CENTER BOLT
REMOVAL**

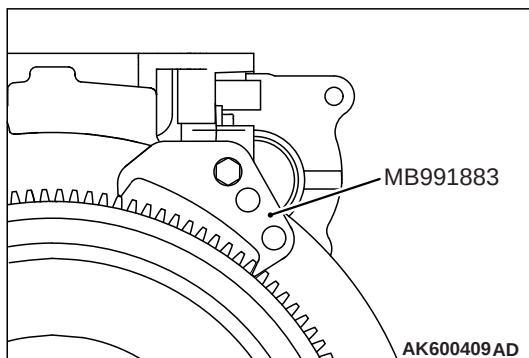
1. Lock the flywheel or drive plate with special tool flywheel stopper (MB991883).
2. Remove the crankshaft pulley center bolt.



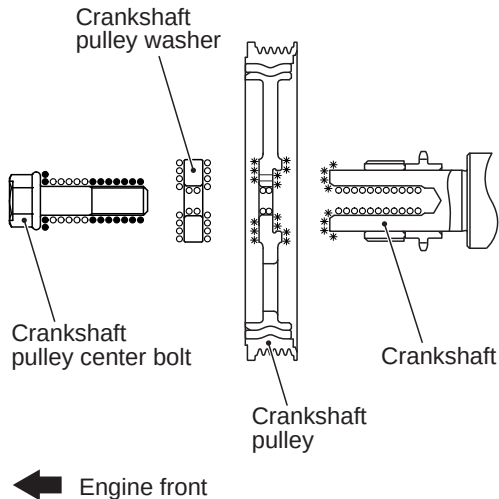
INSTALLATION SERVICE POINTS

**>>A<< CRANKSHAFT PULLEY / CRANKSHAFT
PULLEY WASHER / CRANKSHAFT PULLEY CEN-
TER BOLT INSTALLATION**

1. Lock the flywheel or drive plate with special tool flywheel stopper (MB991883).



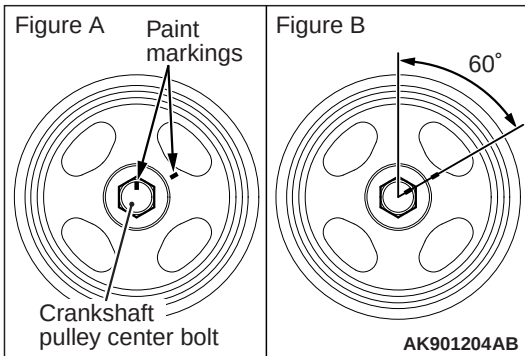
- : Wipe clean with a rag.
- * : Wipe clean with a rag and degrease.
- : Wipe clean with a rag, degrease and apply a small amount of engine oil.



2. Using a rag, wipe dirt on the crankshaft thread hole and the crankshaft pulley washer.
3. Using a rag, wipe dirt on the crankshaft pulley and then degrease the place specified in the illustration.

NOTE: Perform degreasing to prevent the friction resistance from decreasing in the compressed area due to the residual oil.

4. Install the crankshaft pulley.
5. Apply the minimum amount of engine oil to the crankshaft pulley center bolt threads and the seating surface.
6. Tighten the crankshaft pulley center bolt to the specified torque of 50 N·m (37 ft-lb).



7. As shown in figure A, put a paint mark on one angle of the crankshaft pulley center bolt. Then, put a paint mark on the crankshaft pulley on the extended line of the angle next to the marked angle.

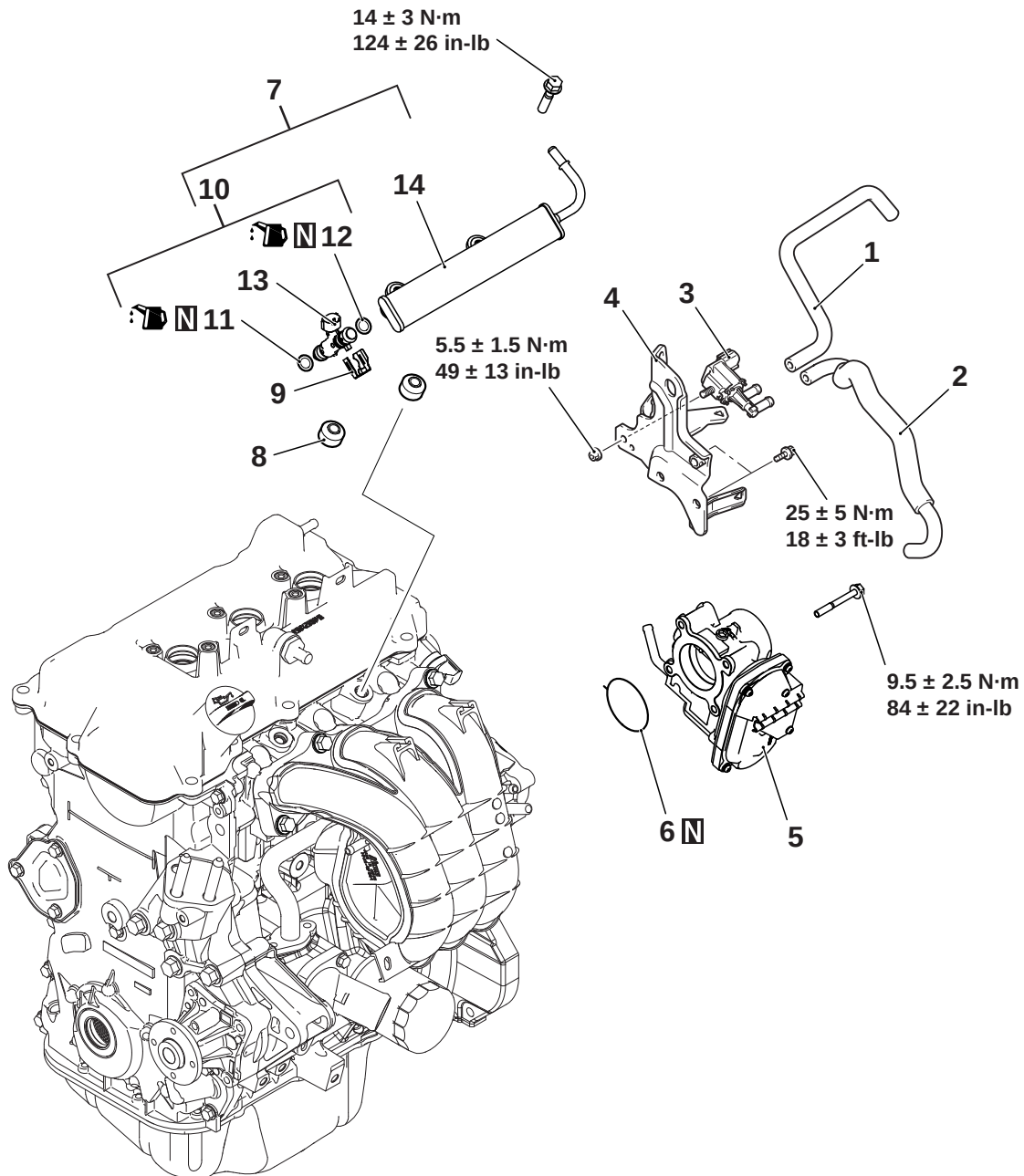
⚠ CAUTION

- When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.
 - When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.
8. Tighten the crankshaft pulley center bolt in a 60°, and check that the paint mark on the crankshaft pulley center bolt aligns with the paint mark on the crankshaft pulley as shown in figure B.
 9. Loosen the crankshaft pulley center bolt completely after steps 6 to 8, and then repeat steps 6 to 8.

FUEL AND EMISSION PARTS

REMOVAL AND INSTALLATION

M1113002201615



ACC06804 AB

Removal steps

1. Purge hose
2. Purge hose
3. Evaporative emission purge solenoid
4. Engine hanger
5. Throttle body
- >>F<< 6. Throttle body gasket
- <<A>> >>E<< 7. Fuel rail and fuel injector assembly

Removal steps (Continued)

8. Insulator
- >>D<< 9. Injector support
- >>C<< 10. Fuel injector assembly
- >>B<< 11. O-ring
- >>A<< 12. O-ring
13. Fuel injector
14. Fuel rail

REMOVAL SERVICE POINT

<<A>> FUEL RAIL AND FUEL INJECTOR ASSEMBLY REMOVAL

 CAUTION

Do not drop the fuel injector.

Remove the fuel rail with the fuel injectors attached to it.

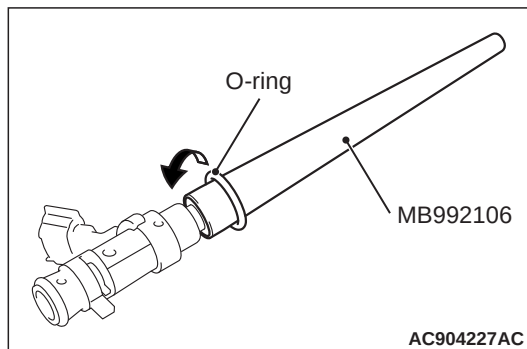
INSTALLATION SERVICE POINTS

>>A<< O-RING INSTALLATION

1. Apply a small amount of new engine oil to the O-ring.
2. While turning the fuel injector to the right and left, install the O-ring to the fuel injector with care not to damage the O-ring.

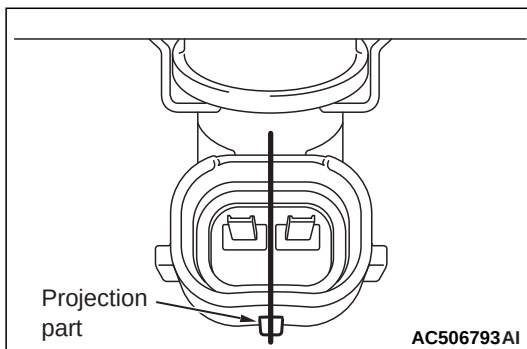
>>B<< O-RING INSTALLATION

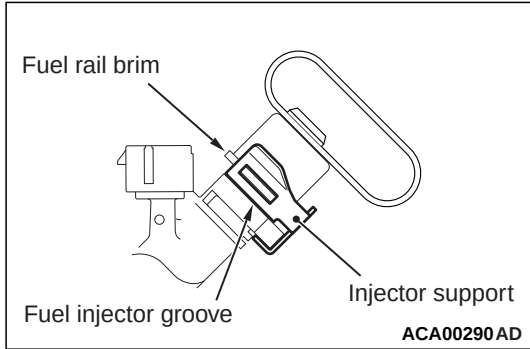
1. Apply a small amount of new engine oil to the O-ring.
2. Using special tool O-ring installer (MB992106), install the fuel injector paying attention to avoid damage to the O-ring.



>>C<< FUEL INJECTOR ASSEMBLY INSTALLATION

1. Apply a small amount of new engine oil to the O-ring.
2. Turning the fuel injector assembly to right and left, install it to the fuel rail with care not to damage the O-ring. After the installation, check for its smooth rotation. At this time, check that the projection part of the fuel injector assembly is in the center.
3. If the rotation is not smooth, the O-ring may be caught. Remove the fuel injector assembly and check the O-ring for damage. After this, re-insert it to the fuel rail and check for its smooth rotation.





>>D<< INJECTOR SUPPORT INSTALLATION

Install the injector support to the fuel injector groove and fuel rail brim, and fix the fuel injector assembly and fuel rail.

>>E<< FUEL RAIL AND FUEL INJECTOR ASSEMBLY INSTALLATION

1. Apply a small amount of new engine oil to the O-ring at the end of the fuel injector assembly.

⚠ CAUTION

When installing the fuel rail and fuel injector assembly to the cylinder head, take care not to damage the O-ring at the tip of the fuel injector assembly.

2. Install the fuel rail and fuel injector assembly to the cylinder head. Be careful not to damage the O-ring.
3. Tighten the fuel rail mounting bolts to the specified torque.

Tightening torque: 14 ± 3 N·m (124 ± 26 in-lb)

>>F<< THROTTLE BODY GASKET INSTALLATION

Securely insert the gasket in the groove of the inlet manifold without causing any torsion or damage to the gasket.

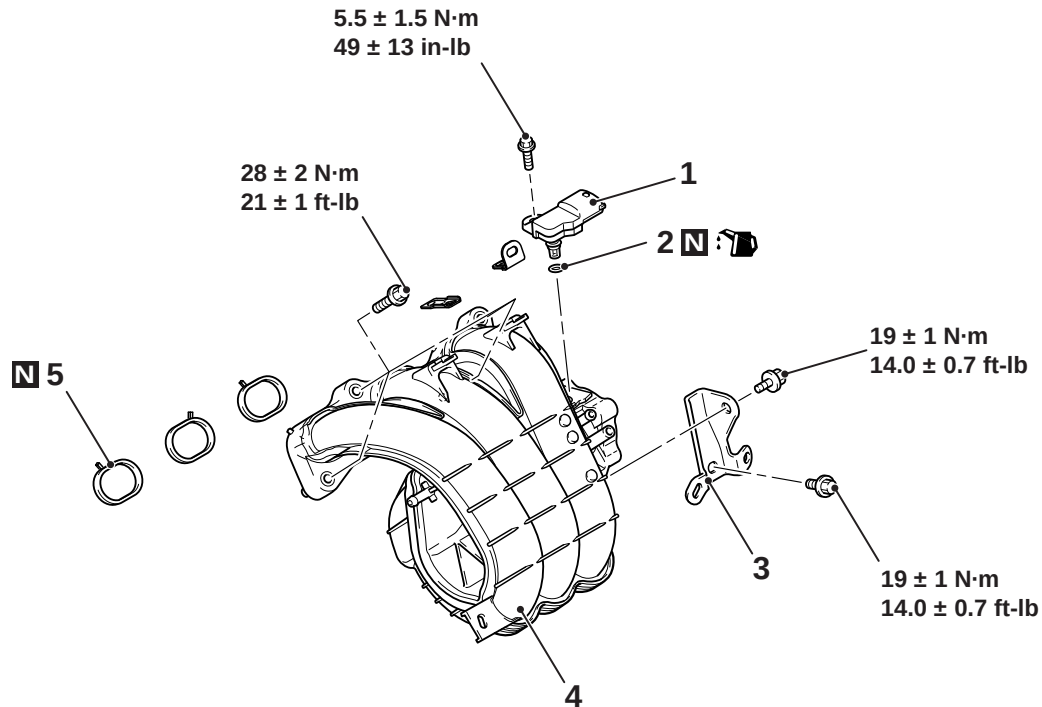
INTAKE MANIFOLD

REMOVAL AND INSTALLATION

M1113026101281

CAUTION

- When removing or installing the manifold absolute pressure sensor, be careful not to apply impact to the sensor.
- Do not reuse the manifold absolute pressure sensor that has been dropped.



ACB03397AC

Removal steps

1. Manifold absolute pressure sensor
2. O-ring

Removal steps (Continued)

- | | |
|-------|---------------------------|
| >>B<< | 3. Intake manifold stay |
| >>B<< | 4. Intake manifold |
| >>A<< | 5. Intake manifold gasket |

INSTALLATION SERVICE POINTS

>>A<< INTAKE MANIFOLD GASKET INSTALLATION

Securely insert the gasket in the groove of the intake manifold without causing any torsion or damage to the gasket.

>>B<<INTAKE MANIFOLD/INTAKE MANIFOLD STAY INSTALLATION

1. Install the intake manifold and intake manifold stay temporarily tighten the mounting bolts.

CAUTION

Check that the sealing surfaces of the intake manifold and intake manifold stay contact securely after temporary tightening.

2. Tighten the intake manifold and intake manifold stay bolts to the specified torque.

Tightening torque:

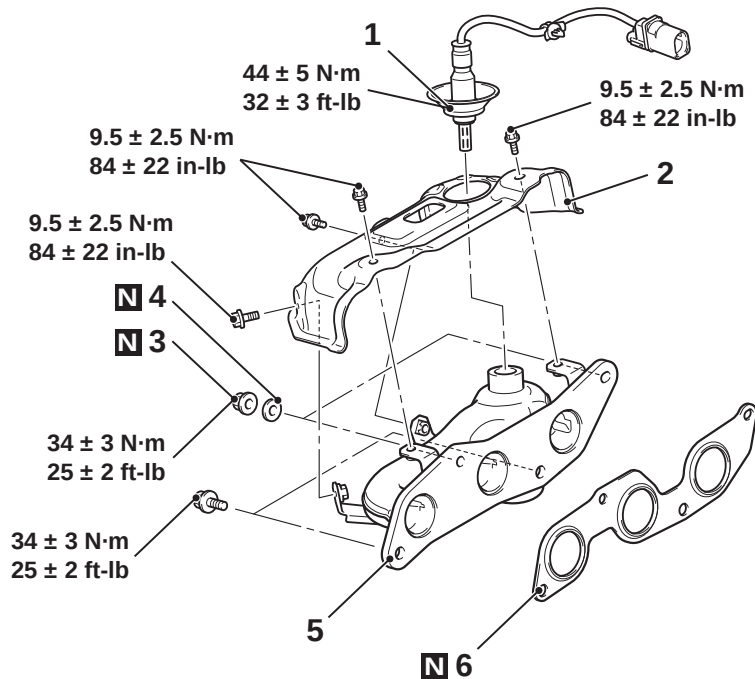
Intake manifold: 28 ± 2 N·m (21 ± 1 ft-lb)

Intake manifold stay: 19 ± 1 N·m (14.0 ± 0.7 ft-lb)

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004902152



ACC06805AB

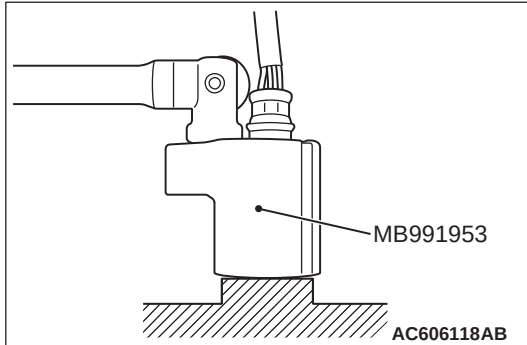
- <<A>> >>A<<
- Removal steps**
1. Linear air-fuel ratio sensor
 2. Exhaust manifold cover
 3. Nut

- Removal steps (Continued)**
4. Washer
 5. Exhaust manifold
 6. Exhaust manifold gasket

REMOVAL SERVICE POINT

<<A>> LINEAR AIR-FUEL RATIO SENSOR
REMOVAL

1. Remove the linear air-fuel ratio sensor connector connection and harness clip.
2. Use special tool heated oxygen sensor wrench (MB991953) to remove the linear air-fuel ratio sensor.



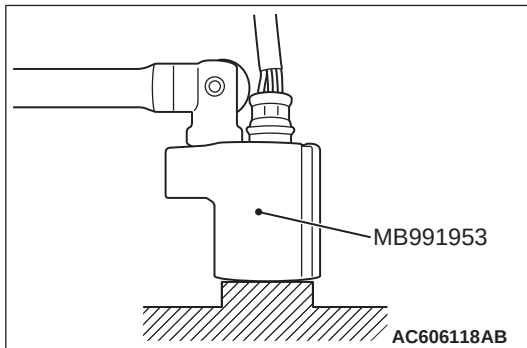
INSTALLATION SERVICE POINT

>>A<< LINEAR AIR-FUEL RATIO SENSOR
INSTALLATION

1. In the same manner as removal, use special tool heated oxygen sensor wrench (MB991953) to tighten the linear air-fuel ratio sensor to the specified torque.

Tightening torque: 44 ± 5 N·m (32 ± 3 ft-lb)

2. Install the linear air-fuel ratio sensor connector connection and harness clip.



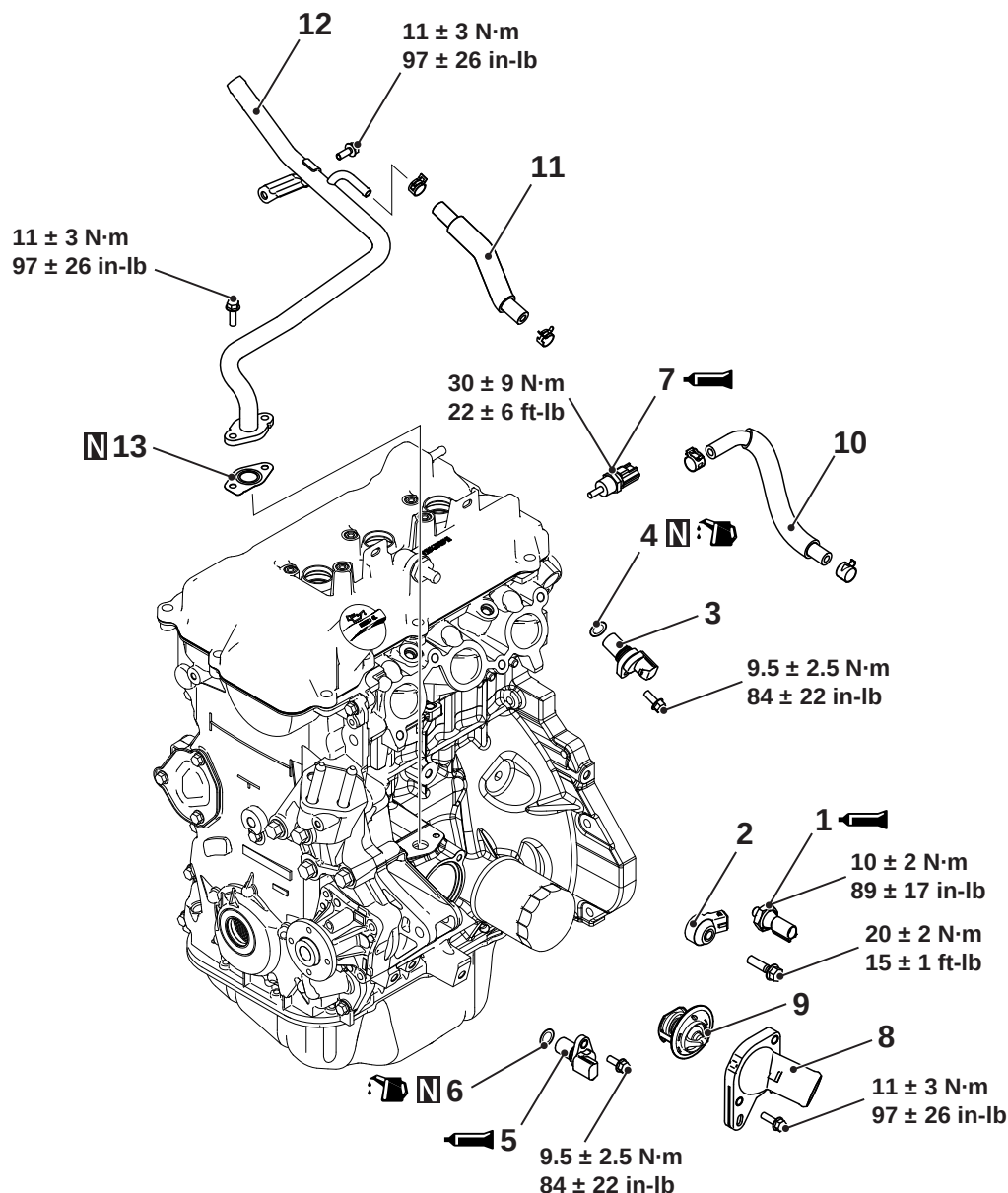
WATER HOSE AND PIPE

REMOVAL AND INSTALLATION

M1113010201018

CAUTION

- When removing or installing the camshaft position sensor or crankshaft position sensor, be careful not to apply impact to the sensor.
- Do not reuse the camshaft position sensor or crankshaft position sensor that has been dropped.



ACC06785AB

Removal steps

- >>G<< 1. Engine oil pressure switch
>>F<< 2. Knock sensor
3. Camshaft position sensor
4. O-ring
>>E<< 5. Crankshaft position sensor
6. O-ring
>>D<< 7. Engine coolant temperature sensor

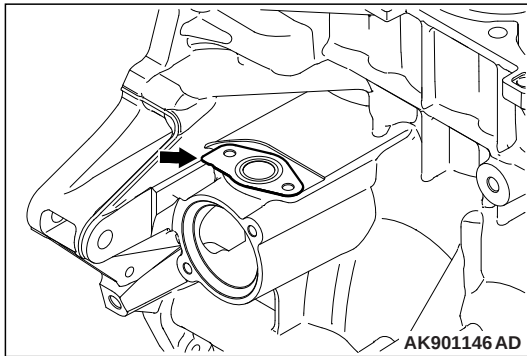
Removal steps (Continued)

8. Water inlet fitting
>>C<< 9. Thermostat
>>B<< 10. Water hose A
11. Water hose B
12. Water pipe
>>A<< 13. Water pipe gasket

INSTALLATION SERVICE POINTS

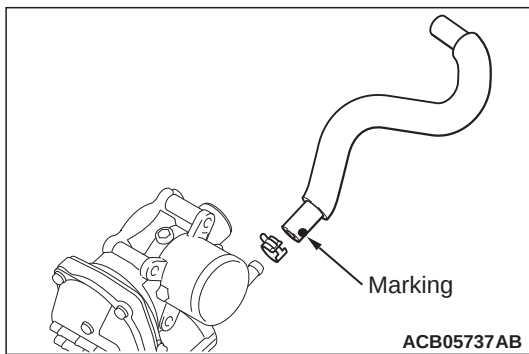
>>A<< WATER PIPE GASKET INSTALLATION

Install the water pipe gasket as its protrusion is in the direction shown.



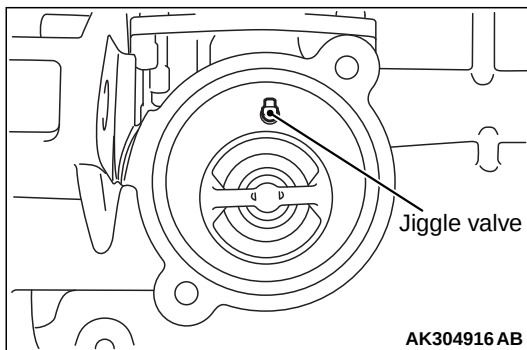
>>B<< WATER HOSE A INSTALLATION

Make sure that the marking on the hose should face towards the transaxle.



>>C<< THERMOSTAT INSTALLATION

Install the thermostat onto the cylinder block such that the jiggle valve is positioned on top of the thermostat housing.



>>D<< ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION

CAUTION

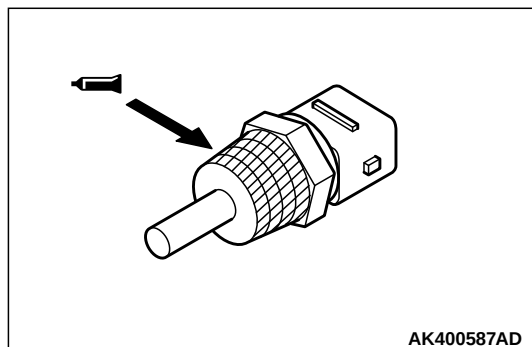
Be careful not to damage the connector portion (made of resin) of the sensor with the tool.

1. Remove any sealant that may be remaining on the engine coolant temperature sensor or the threaded hole in the cylinder head.
2. Apply sealant onto the threaded portion (illustrated) of the sensor.

Specified sealant:

LOCTITE 262 or equivalent

3. Install the engine coolant temperature sensor onto the cylinder block by tightening it to 30 ± 9 N·m (22 ± 6 ft-lb).



>>E<< CRANKSHAFT POSITION SENSOR INSTALLATION

CAUTION

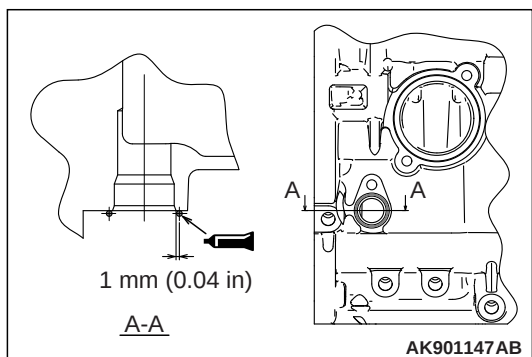
Apply sealant correctly so that it will not be squeezed out onto the end of the threaded portion upon assembly.

1. Remove any sealant that may be remaining on the angle sensor or the mounting face on the cylinder block.
2. Apply a bead of sealant with a diameter of 1.7 ± 0.5 mm (0.07 ± 0.01 inch) on the cylinder block as illustrated.

Specified sealant:

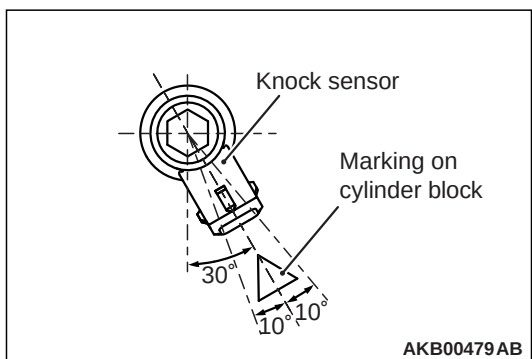
ThreeBond 1207F or equivalent

3. Install the crankshaft position sensor onto the cylinder block by tightening it to 9.5 ± 2.5 N·m (84 ± 22 in-lb).



>>F<< KNOCK SENSOR INSTALLATION

Align the knock sensor connector with the position shown in the illustration, and then tighten it to the specified torque of 20 ± 2 N·m (15 ± 1 ft-lb).



>>G<< ENGINE OIL PRESSURE SWITCH
INSTALLATION CAUTION

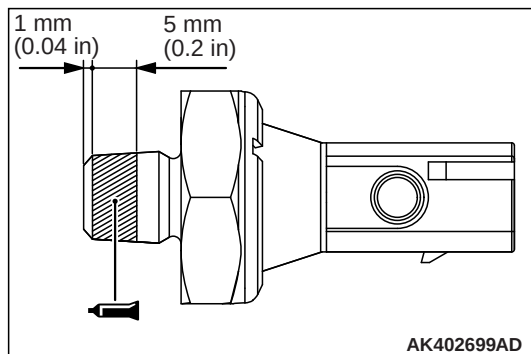
Apply sealant correctly so that it will not be squeezed out onto the end of the threaded portion upon assembly.

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

Specified sealant:

ThreeBond 1215 or equivalent

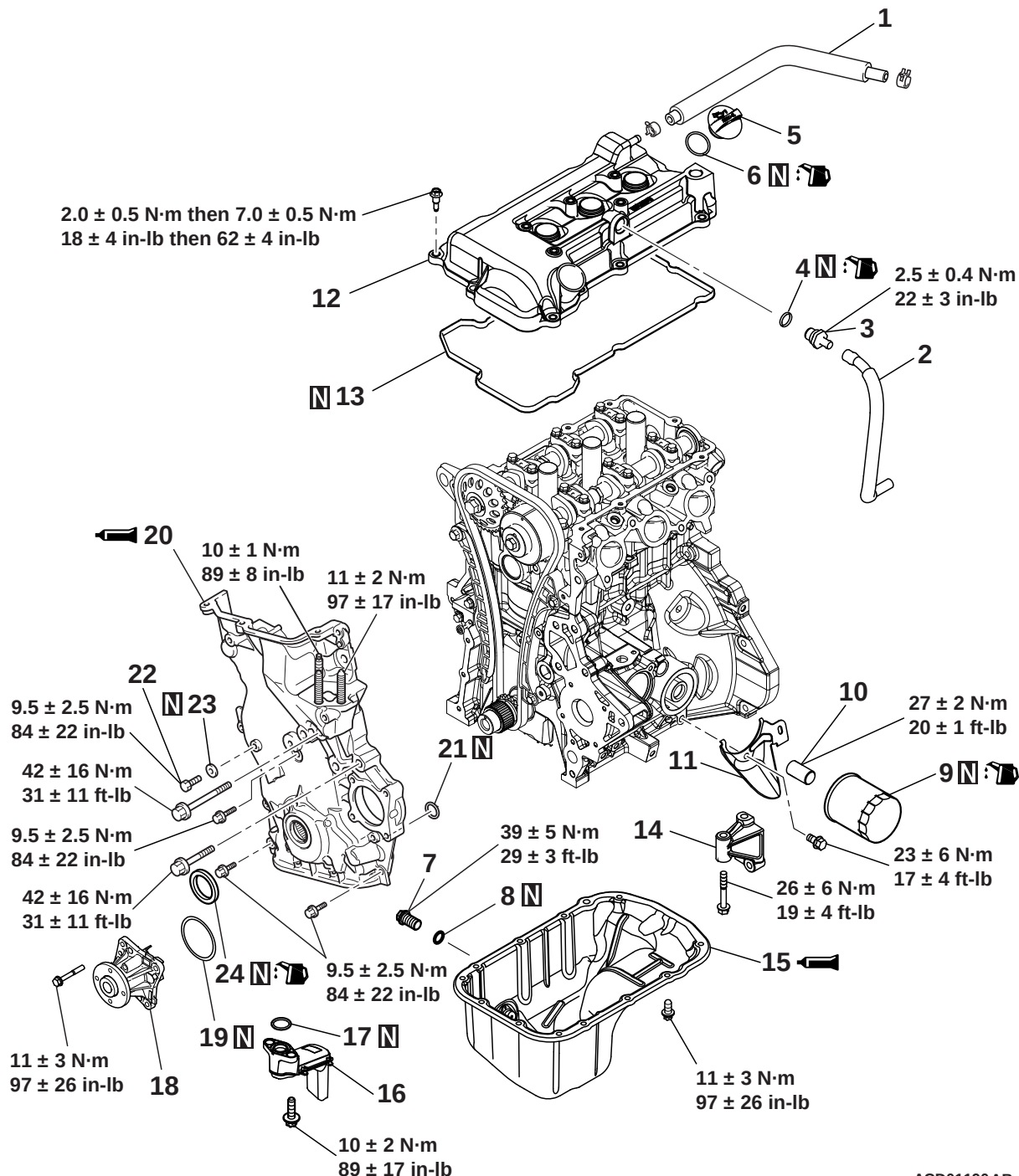
3. Install the engine oil pressure switch onto the cylinder block by tightening it to 10 ± 2 N·m (89 ± 17 in-lb).



OIL PAN AND TIMING CHAIN CASE

REMOVAL AND INSTALLATION

M1113026301735



ACD01190 AB

Removal steps

1. Breather hose
2. PCV hose
3. PCV valve
4. PCV valve gasket
5. Oil filler cap
6. O-ring
7. Oil drain plug
8. Oil drain plug gasket

Removal steps (Continued)

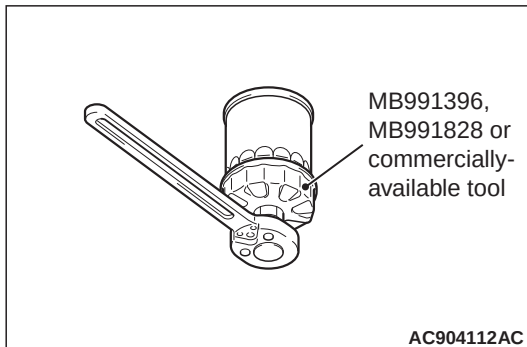
- <<A>> >>G<< 9. Oil filter
- <> >>F<< 10. Oil filter stud
- >>E<< 11. Oil filter cover
- >>E<< 12. Cylinder head cover
- >>E<< 13. Cylinder head cover gasket
- <<C>> >>D<< 14. Transaxle stay
- <<C>> >>D<< 15. Oil pan
- <<C>> >>D<< 16. Oil strainer

Removal steps (Continued)

- 17. Oil strainer gasket
- >>C<< 18. Water pump
- >>C<< 19. O-ring
- >>B<< 20. Timing chain case
- 21. O-ring
- >>B<< 22. Service hole bolt
- 23. Gasket
- >>A<< 24. Front oil seal

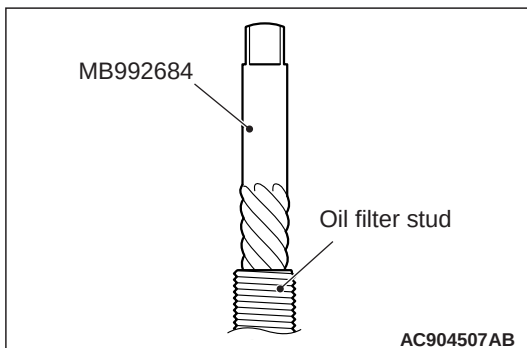
REMOVAL SERVICE POINTS**<<A>> OIL FILTER REMOVAL**

Use special tool oil filter wrench (MB991396, MB991828) or commercially-available tool to remove the oil filter.

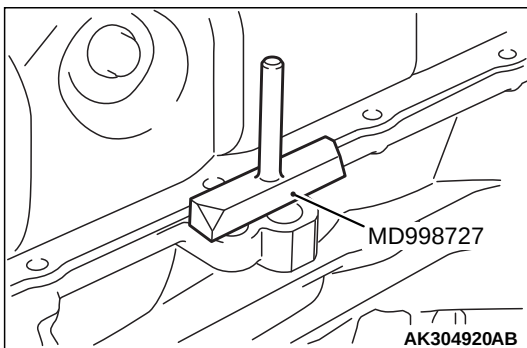
**<> OIL FILTER STUD REMOVAL**

Remove the oil filter stud using recommended tool screw extractor (MB992684) or equivalent.

NOTE: This recommended tool is a component of screw extractor set (MB992678).

**<<C>> OIL PAN REMOVAL**

1. Remove the oil pan mounting bolts.
2. Lightly tap special tool oil pan FIPG cutter (MD998727) between the oil pan and the cylinder block.
3. Lightly tap and slide special tool to remove the oil pan.



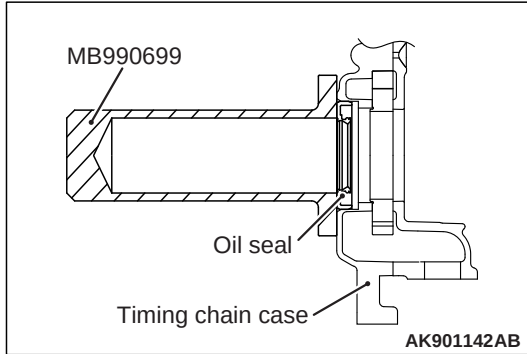
INSTALLATION SERVICE POINTS

>>A<< FRONT OIL SEAL INSTALLATION

CAUTION

When installing the front oil seal, be careful to avoid damage to the front oil seal.

1. Using special tool differential oil seal installer (MB990699), drive the oil seal so that it is flush with the timing chain case.
2. Apply a small amount of engine oil to the entire inner circumference of the oil seal lip.

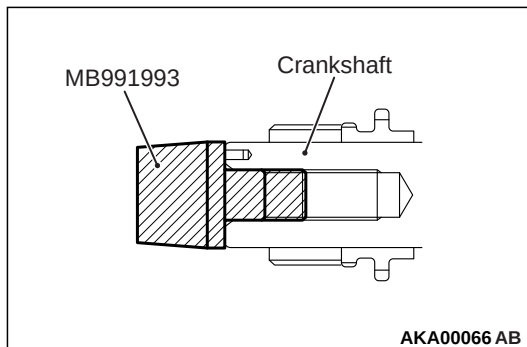


>>B<< SERVICE HOLE BOLT / TIMING CHAIN CASE INSTALLATION

CAUTION

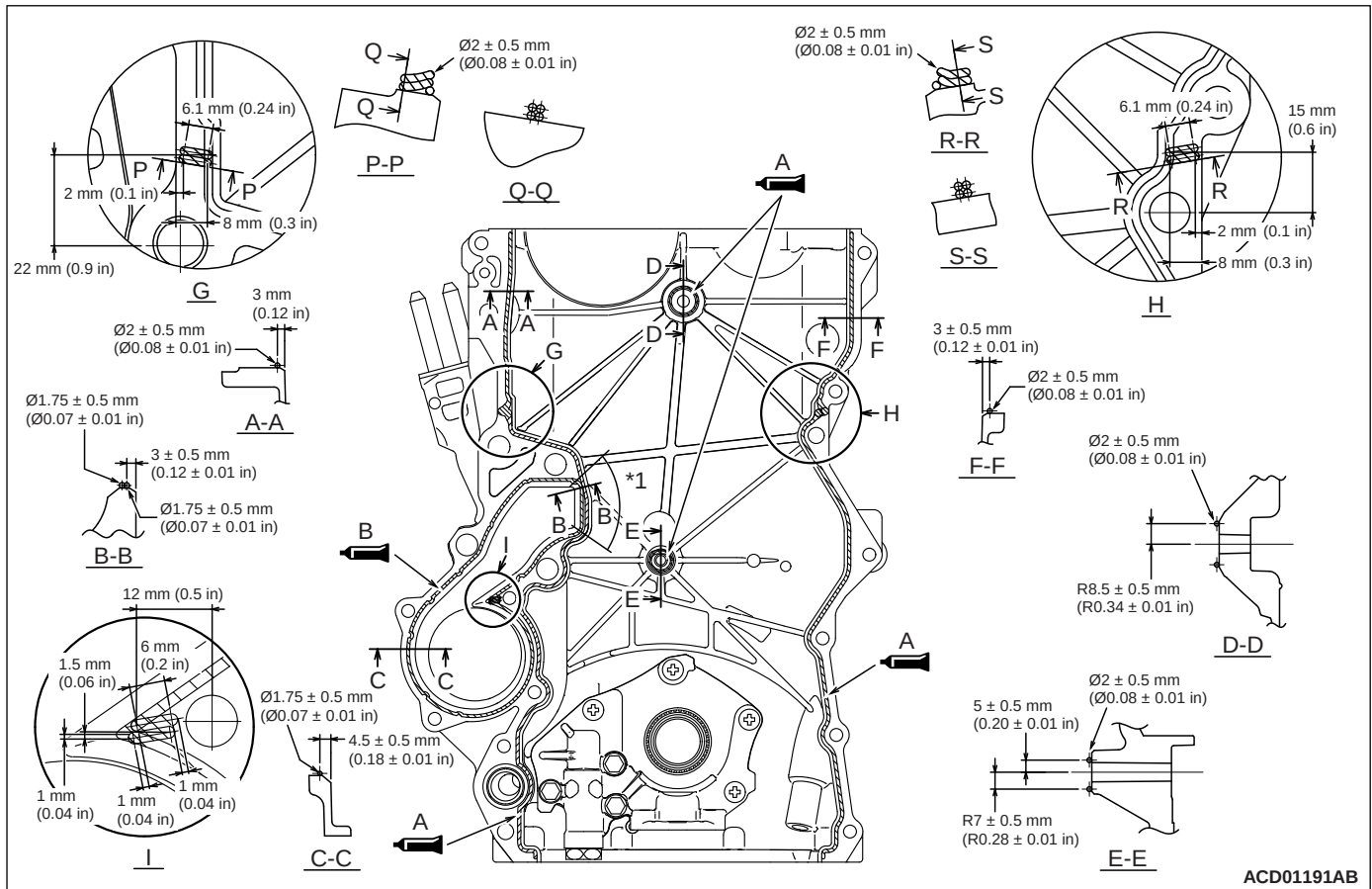
Sufficiently check that there is no residual oil on the place where degreasing is performed. If fingerprints are left, do not touch it with bare hands after the degreasing, since the oils from your fingers will harm the seal ability.

1. Remove any liquid gasket remaining on the timing chain case, the cylinder block, and the cylinder head.
2. Install special tool crankshaft front oil seal guide (MB991993) onto the crankshaft.



CAUTION

The timing chain case should be installed within 10 minutes of applying liquid gasket.

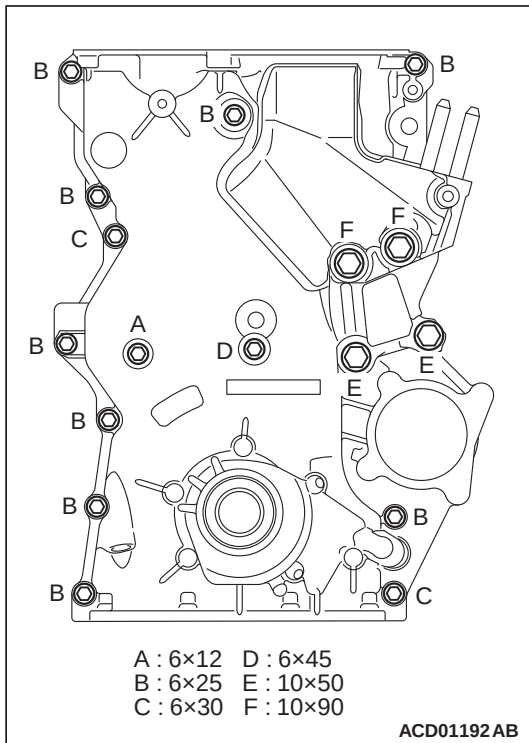


3. Apply a 2 ± 0.5 mm (0.08 ± 0.01 inch) bead of liquid gasket to location A on the timing chain case respectively as illustrated. [Apply a 1.75 ± 0.5 mm (0.07 ± 0.01 inch) wide bead in the area indicated by *1].
Apply a 1.75 ± 0.5 mm (0.07 ± 0.01 inch) bead of liquid gasket to location B on the timing chain case respectively as illustrated.

Specified sealant:

A: ThreeBond 1217G or equivalent

B: ThreeBond 1227D or equivalent



4. Install the timing chain case.

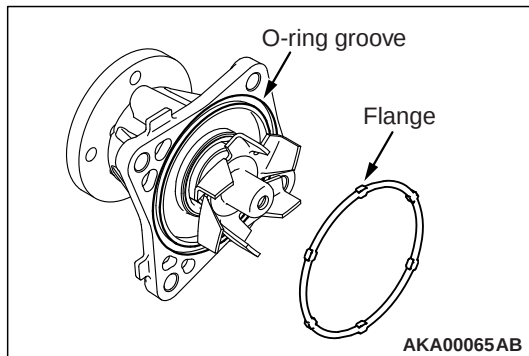
NOTE: The service hole bolt and timing chain case mounting bolts have different lengths. Be sure to use the correct bolt for each location.

5. Tighten the service hole bolt and timing chain case mounting bolts to the specified torque.

Tightening torque

M6: 9.5 ± 2.5 N·m (84 ± 22 in-lb)

M10: 42 ± 16 N·m (31 ± 11 ft-lb)



>>C<< O-RING / WATER PUMP INSTALLATION

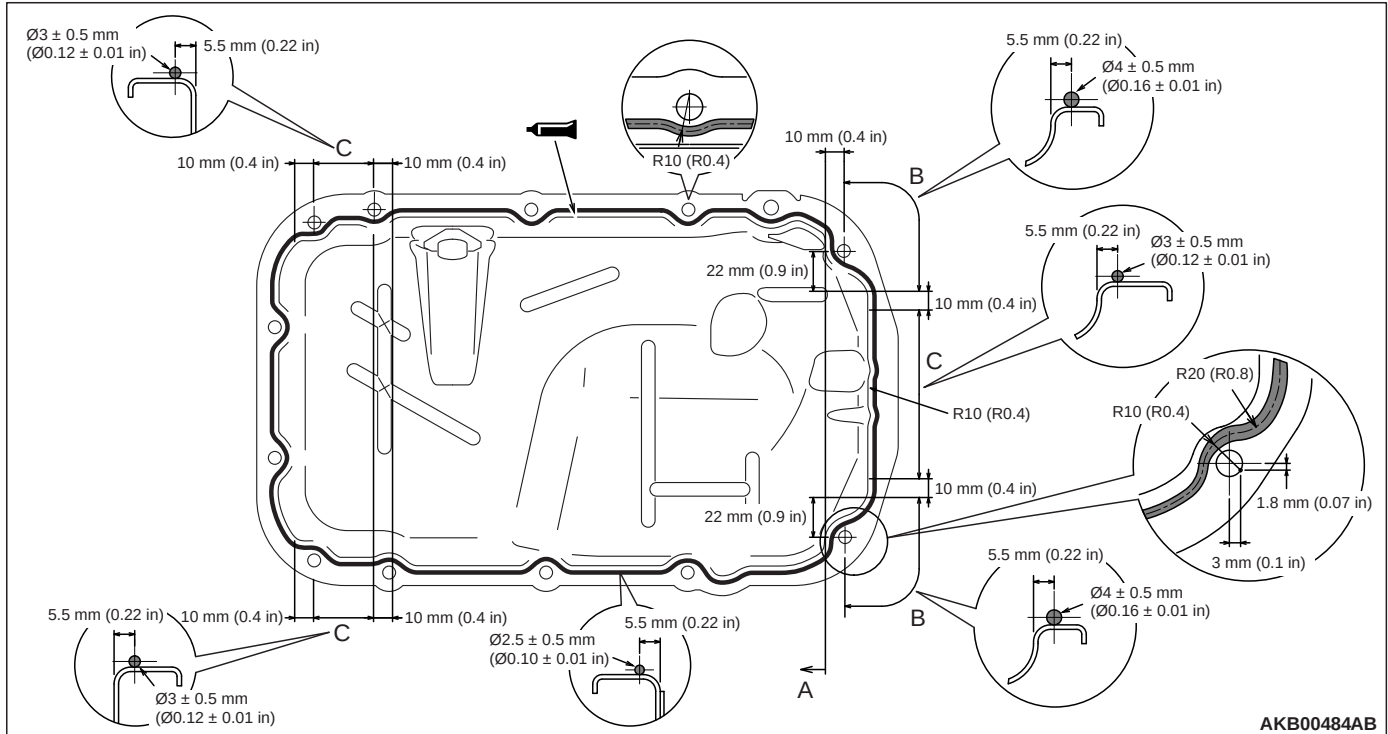
1. Carefully remove the coolant dry matters and the other foreign materials from the O-ring groove of the water pump. In the same way, clean the timing chain case side.
2. Push the flange of the new O-ring into the O-ring groove of the water pump to securely install the O-ring. Sufficiently apply water or the coolant to the O-ring with a brush so that the O-ring does not fall.
3. Gently inverting the water pump, check whether the O-ring does not fall.
4. Install the water pump to the timing chain case. At that time, be careful that the O-ring does not fall or the O-ring is not jammed.

>>D<< OIL PAN INSTALLATION

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

⚠ CAUTION

The oil pan should be installed within 10 minutes of applying liquid gasket.



2. Apply a $2.5 \pm 0.5 \text{ mm}$ ($0.10 \pm 0.01 \text{ inch}$) bead of liquid gasket to location A, and a $4 \pm 0.5 \text{ mm}$ ($0.16 \pm 0.01 \text{ inch}$) bead of liquid gasket to location B, and a $3 \pm 0.5 \text{ mm}$ ($0.12 \pm 0.01 \text{ inch}$) bead of liquid gasket to location C on the oil pan respectively as illustrated.

Specified sealant:

ThreeBond 1217G or equivalent

3. Install the oil pan by tightening the fittings to the specified torque of $11 \pm 3 \text{ N}\cdot\text{m}$ ($97 \pm 26 \text{ in}\cdot\text{lb}$).

>>E<< CYLINDER HEAD COVER INSTALLATION

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

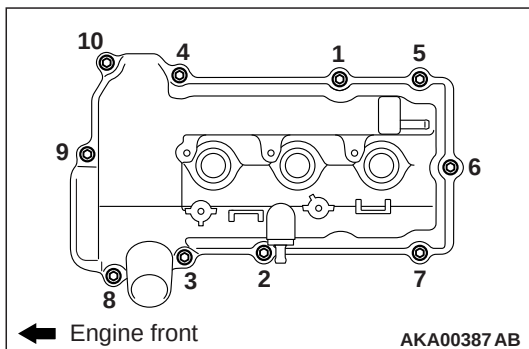
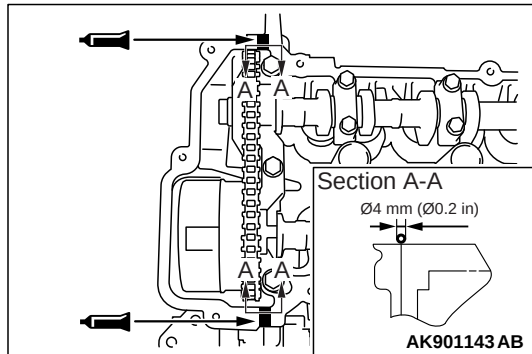
CAUTION

The timing chain should be installed within 3 minutes of applying liquid gasket.

2. Apply a 4 mm (0.2 in) bead of liquid gasket as illustrated.

Specified sealant:

ThreeBond 1217G or equivalent



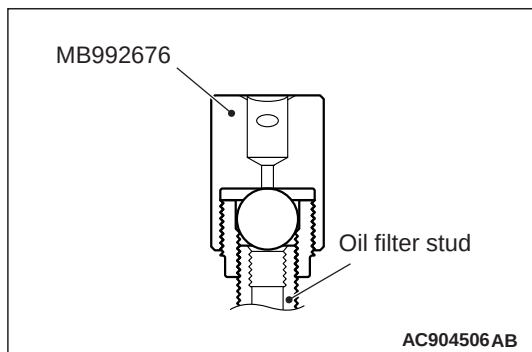
3. Tighten the bolts to the tightening torque of 2.0 ± 0.5 N·m (18 ± 4 in-lb) in the order shown in the illustration.

4. Next, tighten the bolts to the specified torque of 7.0 ± 0.5 N·m (62 ± 4 in-lb) in the same order.

>>F<< OIL FILTER STUD INSTALLATION

Using special tool oil filter stud setter (MB992676), install the new oil filter stud and tighten it to the specified torque.

Specified torque: 27 ± 2 N·m (20 ± 1 ft-lb)



>>G<< OIL FILTER INSTALLATION

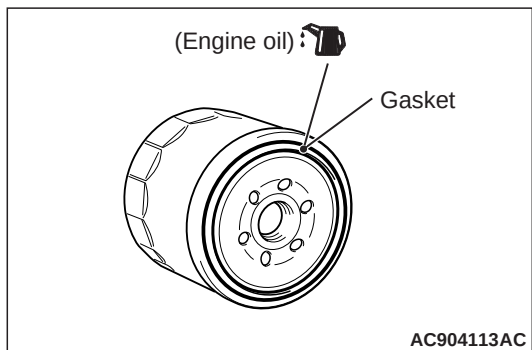
1. Clean the oil filter installing surface on the cylinder block side.

2. Apply a small amount of engine oil to the new oil filter gasket.

3. For the specified tightening torque, refer to the caution label attached on the oil filter.

4. Tighten the oil filter until the gasket contacts with the installation surface.

5. In the same manner as removal, use special tool oil filter wrench (MB991396, MB991828) or commercially-available tool to tighten the oil filter to the specified torque.



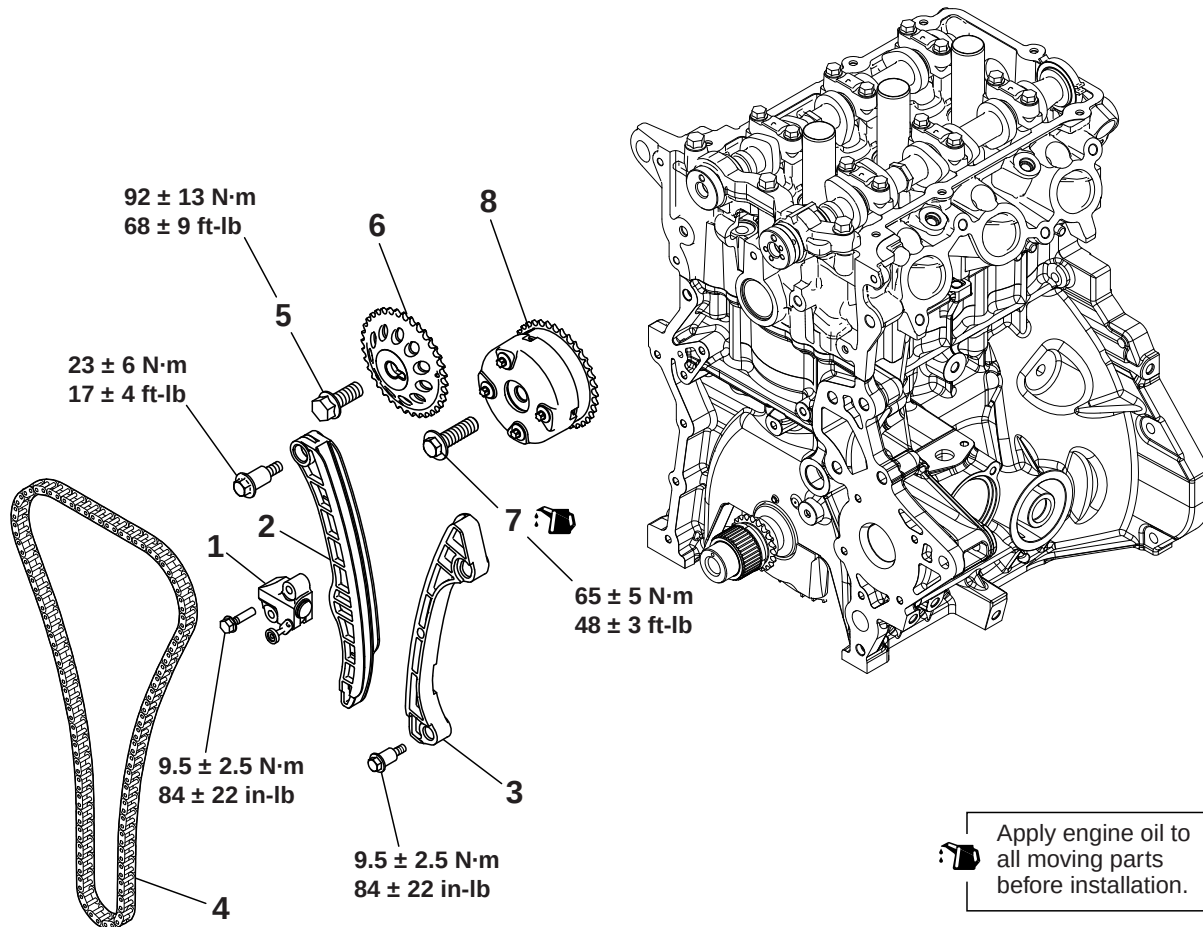
TIMING CHAIN

REMOVAL AND INSTALLATION

M1113026601286

CAUTION

Never overhaul the V.V.T. sprocket assembly.



AKB00485AC

Removal steps

- <<A>> >>D<< 1. Timing chain tensioner
 2. Tensioner lever
 3. Chain guide
 >>C<< 4. Timing chain

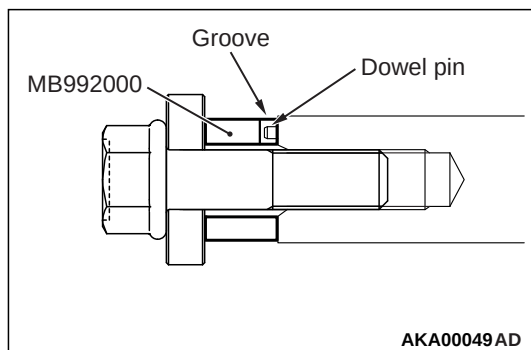
Removal steps (Continued)

- <> >>B<< 5. Camshaft sprocket bolt
 6. Camshaft sprocket
 <<C>> >>A<< 7. V.V.T. sprocket bolt
 8. V.V.T. sprocket assembly

REMOVAL SERVICE POINTS

<<A>> TIMING CHAIN TENSIONER REMOVAL

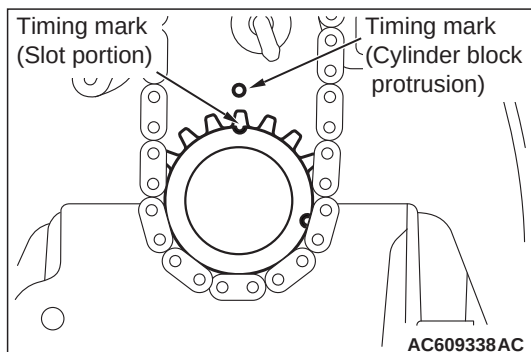
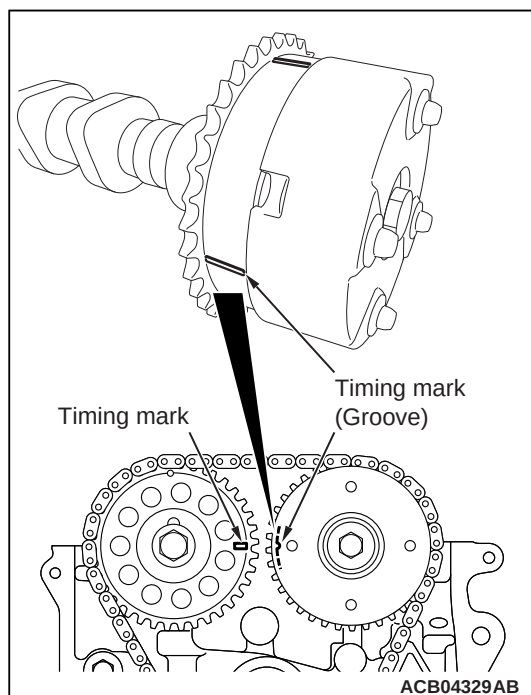
1. Set special tool crankshaft adapter (MB992000) to the crankshaft, and install the crankshaft pulley center bolt and washer.

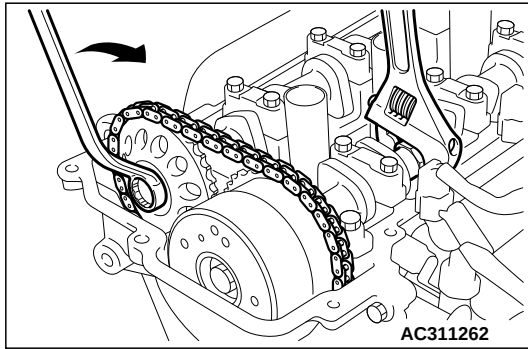


CAUTION

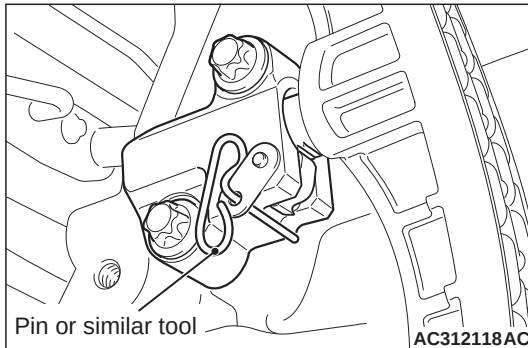
Never turn the crankshaft counterclockwise.

2. Turn the crankshaft clockwise, and align the timing marks of the sprocket. Then set No.1 cylinder to the TDC.





3. While holding the inlet camshaft hexagonal area with a wrench or a similar tool, slightly turn the exhaust camshaft clockwise to tighten the timing chain at the timing chain tensioner side and shorten the plunger of the timing chain tensioner.



4. With the plunger of the tensioner shortened, insert a pin [3 mm (0.1 inch) in diameter] or a similar tool to the hole shown in the illustration of the timing chain tensioner.

NOTE: Pull out the pin or a similar tool after installing the timing chain tensioner.

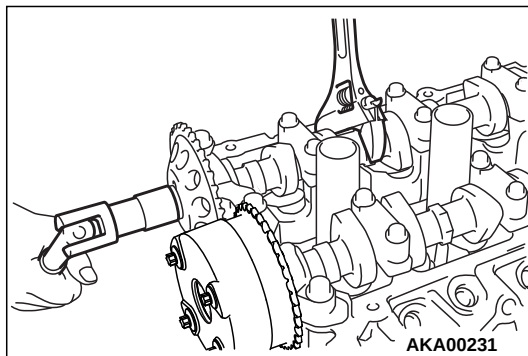
⚠ CAUTION

Do not turn the crankshaft after removing the timing chain tensioner.

5. Remove the timing chain tensioner.

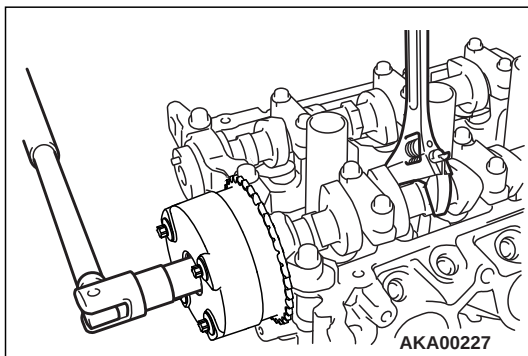
<> CAMSHAFT SPROCKET BOLT REMOVAL

While holding the hexagonal portion of the camshaft with a wrench, remove the camshaft sprocket bolt.



<<C>> V.V.T. SPROCKET BOLT REMOVAL

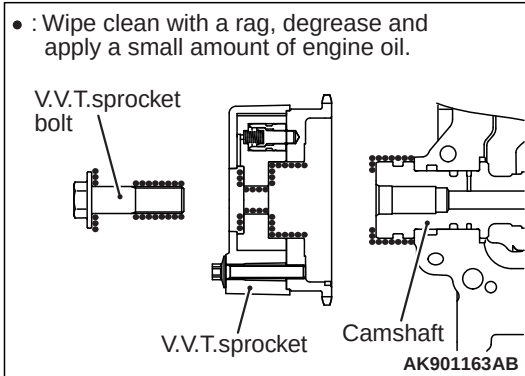
While holding the hexagonal portion of the camshaft with a wrench, remove the V.V.T. sprocket bolt.



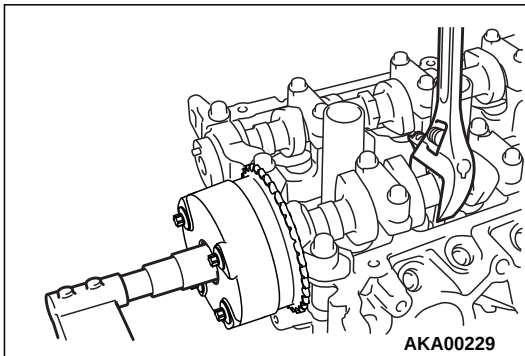
INSTALLATION SERVICE POINTS

>>A<< V.V.T. SPROCKET BOLT INSTALLATION

- : Wipe clean with a rag, degrease and apply a small amount of engine oil.

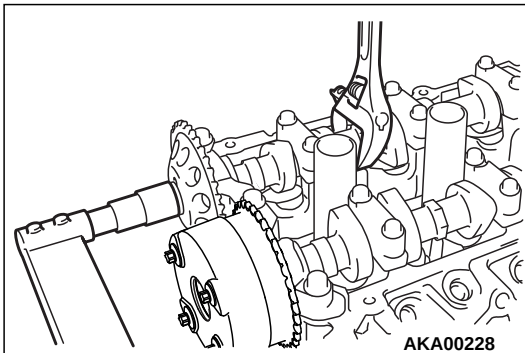


1. Apply a proper minimum quantity of engine oil to the following points.
 - Camshaft end
 - Insertion hole in V.V.T. sprocket (all over inside and outside surfaces)
 - Threads and head of V.V.T. sprocket bolt
 - Bearing surface of V.V.T. sprocket bolt
2. Install the V.V.T. sprocket onto the camshaft.
3. Make sure that the V.V.T. sprocket is installed all the way onto the camshaft. Holding the hexagonal portion of the camshaft with a wrench, check that the V.V.T. sprocket does not turn.
4. While holding the hexagonal portion of the camshaft with a wrench, tighten the V.V.T. sprocket bolt to 65 ± 5 N·m (48 ± 3 ft-lb).



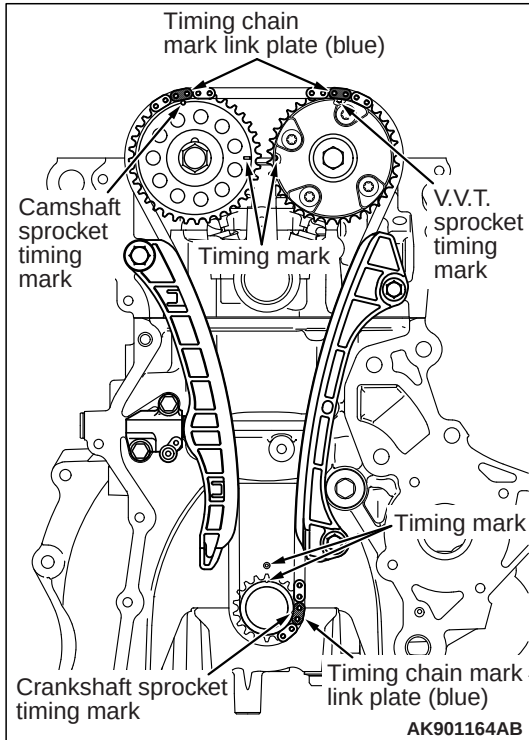
>>B<< CAMSHAFT SPROCKET BOLT INSTALLATION

While holding the hexagonal portion of the camshaft with a wrench, tighten the camshaft sprocket bolt to 92 ± 13 N·m (68 ± 9 ft-lb).

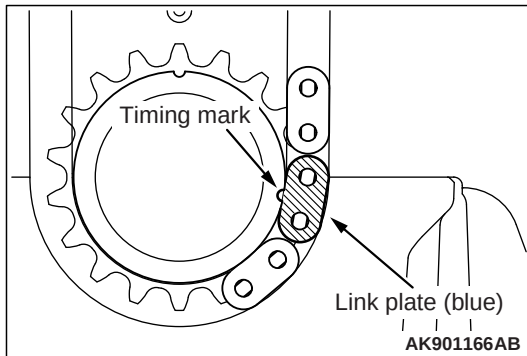


>>C<< TIMING CHAIN INSTALLATION

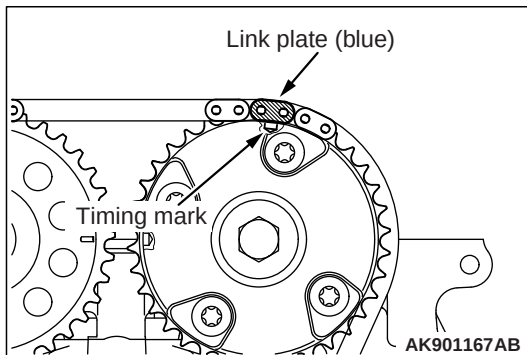
1. Place the timing chain such that the blue link that is away from the other two blue links of the chain is on the crankshaft side.

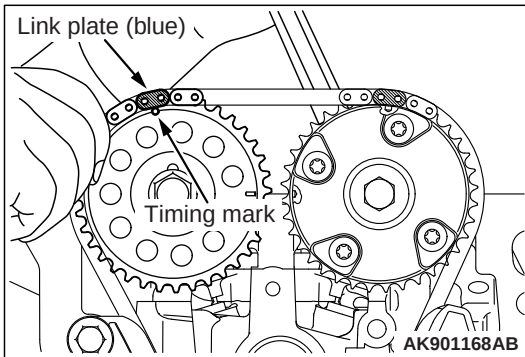


2. Install the timing chain onto the crankshaft sprocket, aligning the blue link with the mark on the sprocket.



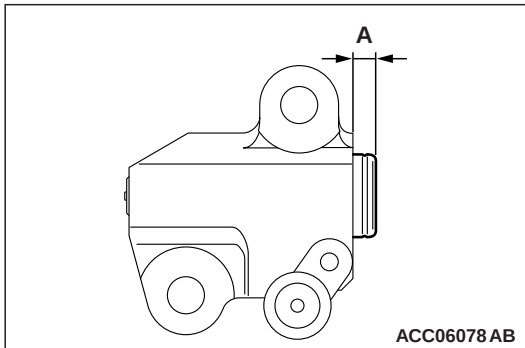
3. Install the chain onto the V.V.T. sprocket, aligning the blue link with the mark on the sprocket.



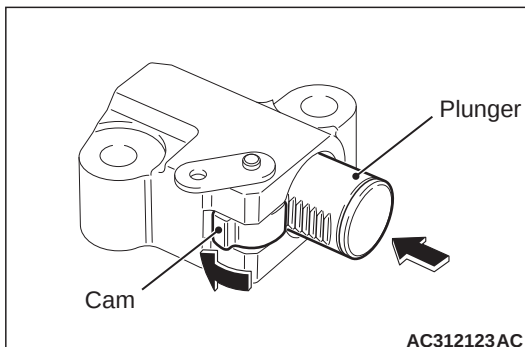


4. Install the chain onto the camshaft sprocket, aligning the blue link with the mark on the sprocket.
When doing this, rotate the V.V.T. sprocket or the camshaft sprocket by a tooth or two and then align the blue link and the mark.
5. Ensure that all of the 3 pairs of the timing marks are aligned.
6. Install the chain guide and the tensioner lever.

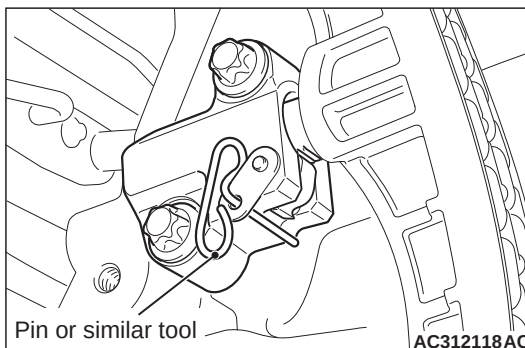
>>D<< TIMING CHAIN TENSIONER INSTALLATION



1. Check the projection (A) of the timing chain tensioner plunger.
2. If the plunger projection does not satisfy the standard value [approximately 4 mm (0.2 inch)], observe the following procedure to adjust it.
 - (1) Pull the pin or the similar tool out of the tensioner.



- (2) Rotate the tensioner cam in the arrow direction to push the plunger slowly.
- (3) Insert the pin or the similar tool again when the plunger projection reaches approximately 4 mm (0.2 inch).
- (4) Check that the projection of the locked plunger is approximately 4 mm (0.2 inch).



3. Install the timing chain tensioner with the pin or the similar tool to the cylinder block, and tighten the timing chain tensioner mounting bolts to the specified torque.

Tightening torque: 9.5 ± 2.5 N·m (84 ± 22 in-lb)

4. After installing the timing chain tensioner, confirm that the timing marks of each sprocket are aligned with the TDC of No.1 cylinder, and the marked link plate (blue-colored area) of the timing chain is aligned with the specified position of each sprocket. Then pull out the pin or a similar tool of the timing chain tensioner, and apply tension to the timing chain.
5. Remove special tool crankshaft adapter (MB992000).

INSPECTION

M1113026701249

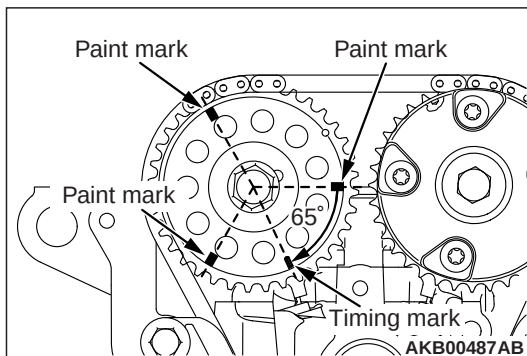
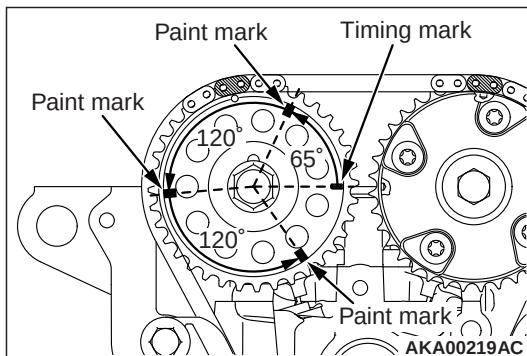
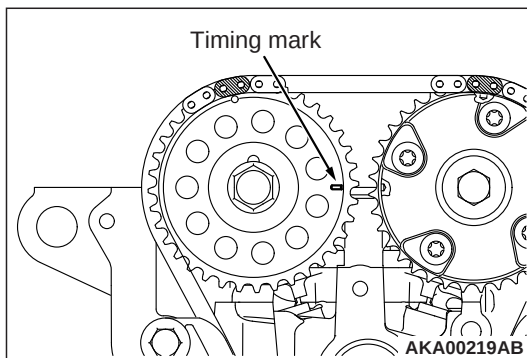
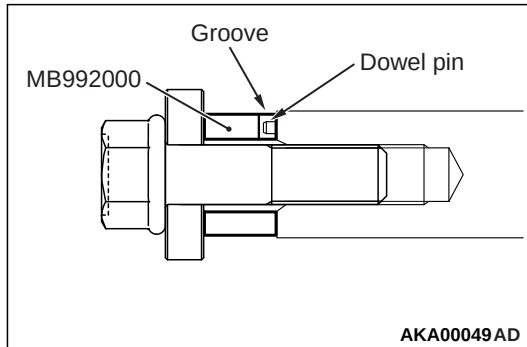
VALVE CLEARANCE MEASUREMENT

Measure the valve clearance as illustrated.

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

CAUTION

The crankshaft should always be rotated clockwise.



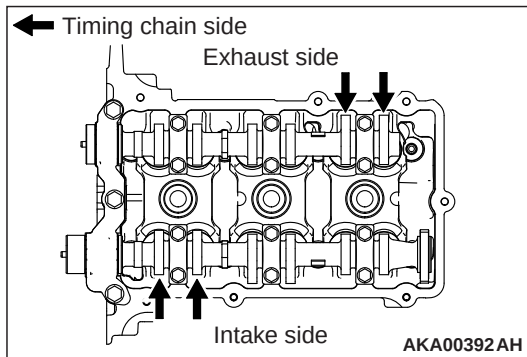
2. Rotate the crankshaft clockwise until the mark on the camshaft sprocket exhaust is aligned with the mark on the upper surface of cylinder head. (Set the No. 1 cylinder to TDC on the compression stroke.)

3. Make paint marks on 3 places at the camshaft sprocket exhaust by means of the following procedure as shown in Figure.

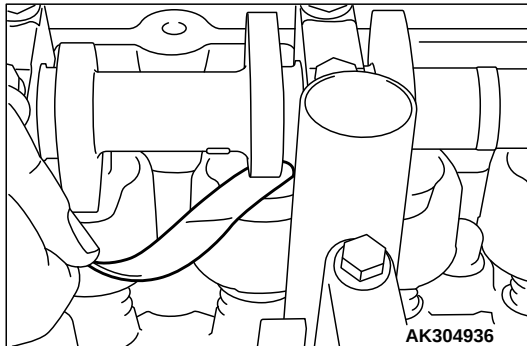
- (1) Make a paint mark on the place of 65 degree angle (6.5th tooth) in the counterclockwise direction of the timing mark.
- (2) Moreover, make a paint mark on the place of 120 degree angle (12th tooth).
- (3) Also, make a paint mark on the place of 120 degree angle (12th tooth).

NOTE: The space between the teeth of the camshaft sprocket exhaust is 10 degree angle.

4. Turn the crankshaft clockwise and locate the paint mark of the camshaft sprocket exhaust on the upper surface of the cylinder head as shown in figure.



5. The valve clearances (arrows) shown in figure are measured.

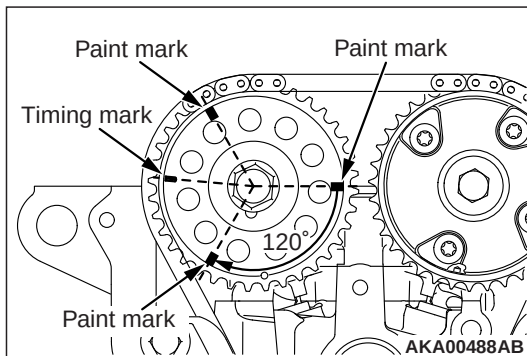


6. Using a thickness gauge, measure the clearance between the cam base circle and the valve tappet.
If the measured value does not conform to the standard value, record the measured value.

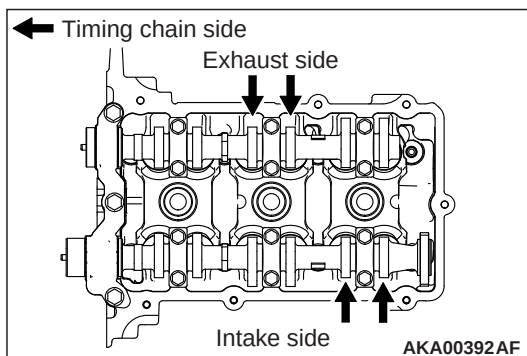
Standard value (cold engine):

Intake valve 0.22 ± 0.04 mm (0.009 ± 0.001 inch)

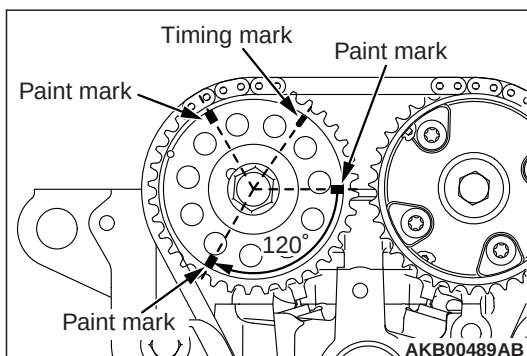
Exhaust valve 0.30 ± 0.04 mm (0.012 ± 0.001 inch)



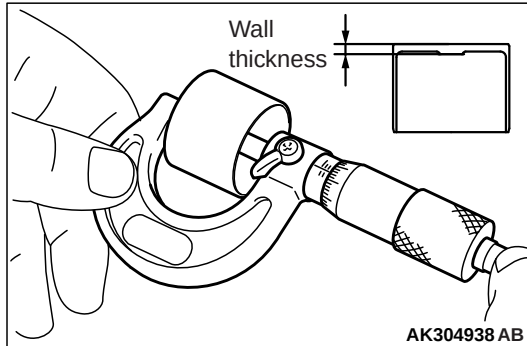
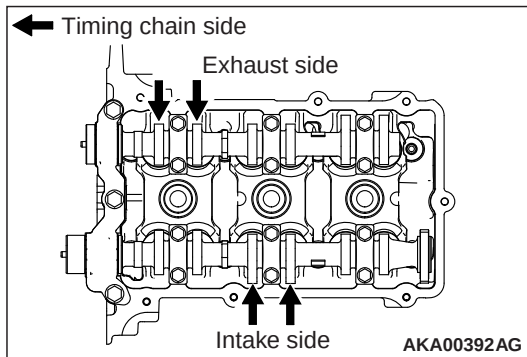
7. Turn the crankshaft clockwise and locate the paint mark of the camshaft sprocket exhaust on the upper surface of the cylinder head as shown in figure.



8. Measure the valve clearance at the location shown with an arrow.
If the measured value does not conform to the standard value, record the measured value.



9. Turn the crankshaft clockwise and locate the paint mark of the camshaft sprocket exhaust on the upper surface of the cylinder head as shown in figure.



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

NOTE: Valve tappets are available in 31 sizes, at 0.02 mm (0.0008 inch) intervals in the 5.10 – 5.70 mm (0.2008 – 0.2244 inch) range.

13. Valve tappets should be selected in the following manner.
 - (1) Remove the valve tappet and measure its thickness.
 - (2) Calculate the correct thickness for a new valve tappet as follows that achieves the standard valve clearance.

A: Thickness of new valve tappet

B: Thickness of old valve tappet

C: Measured valve clearance

Equation:

Intake valve: $A = B + [C - 0.22 \text{ mm (0.009 in)}]$

Exhaust valve: $A = B + [C - 0.30 \text{ mm (0.012 in)}]$

For removal and installation procedures for the valve tappet, refer to [P.11B-40](#).

V.V.T. SPROCKET

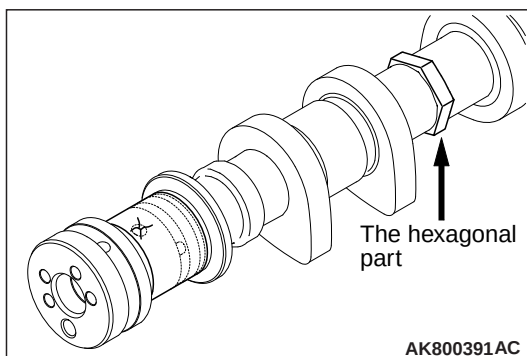
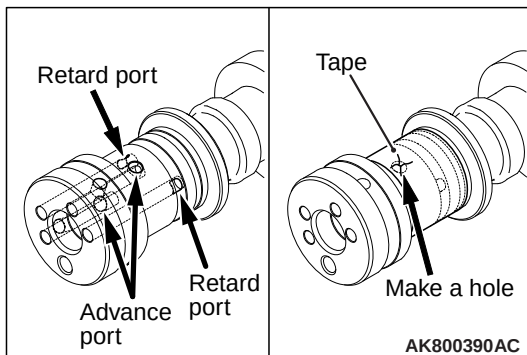
⚠ CAUTION

Never overhaul the V.V.T. sprocket.

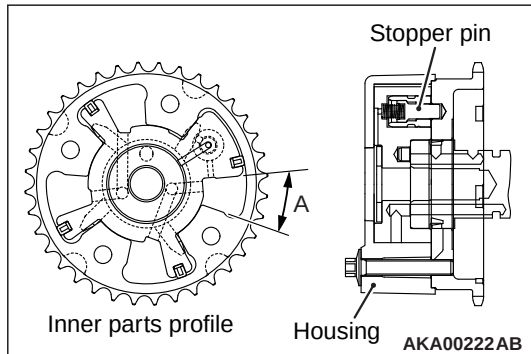
1. Seal with a tape all the inlet camshaft ports for the advanced angle and the retarded angle.
2. Make a hole on the port for the advanced angle.

⚠ CAUTION

Fix the camshaft on a vise not to damage it.



3. Fixing the hexagonal area of the inlet camshaft on a vise, install the V.V.T. sprocket.



⚠ CAUTION

When applying air pressure, keep in mind that oil could splash.

4. By applying air pressure slowly to the holed port for the advanced angle, remove the stopper pin.

5. Turn the V.V.T. sprocket housing in the right and left directions. Check it smoothly moves in the range of A (approximately 25°)

NOTE: The stopper pin is locked in the most retarded angle position.

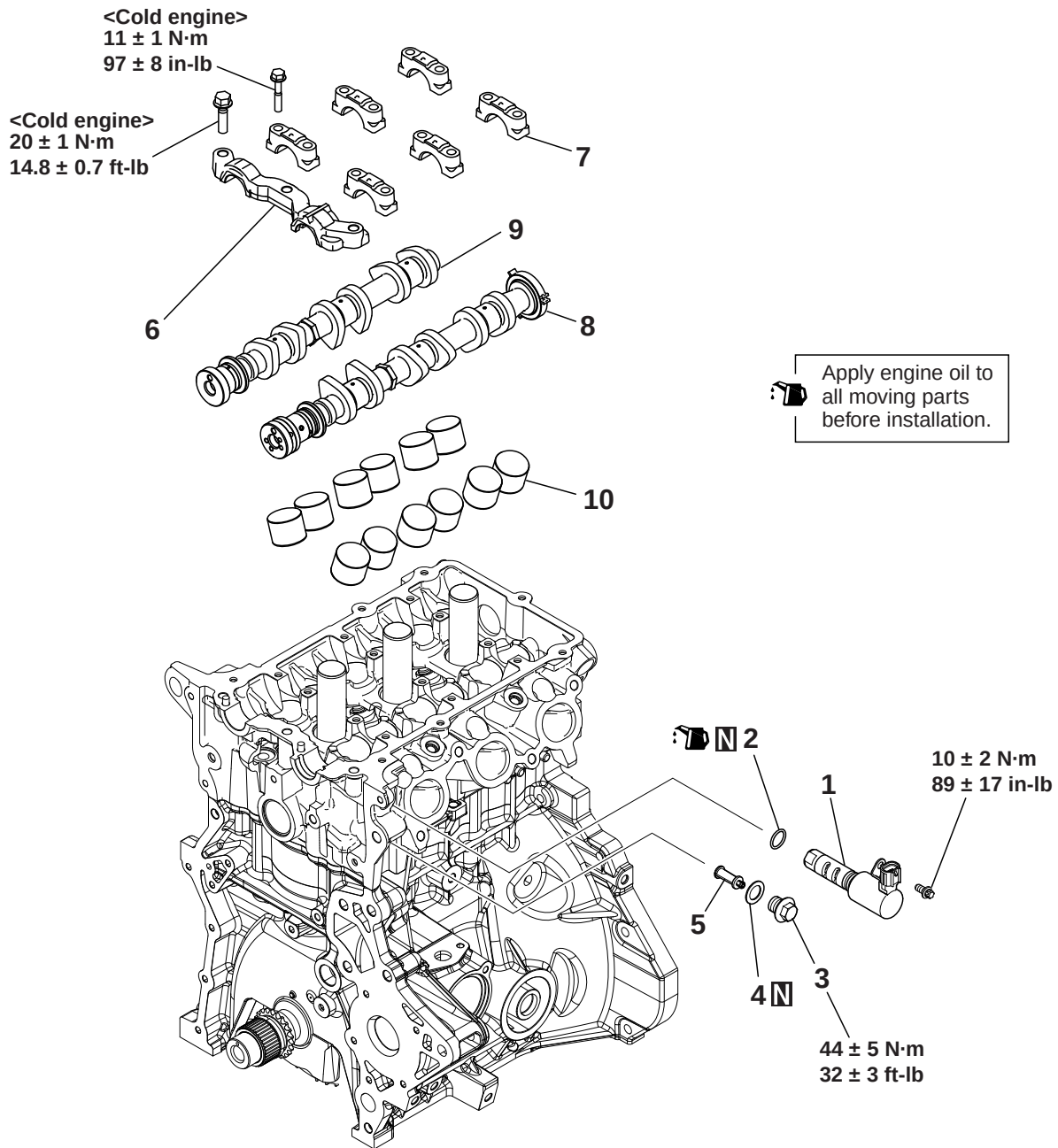
6. After the check, remove the V.V.T. sprocket from the inlet camshaft

7. Completely remove the tape sealing the inlet camshaft ports for the advanced angle and for the retarded angle.

CAMSHAFT

REMOVAL AND INSTALLATION

M1113026900983



AKB00563AC

Removal steps

- >>D<< 1. Oil feeder control valve (OCV)
 >>D<< 2. O-ring
 3. Oil feeder control valve filter bolt
 4. Gasket
 >>C<< 5. Oil feeder control valve filter

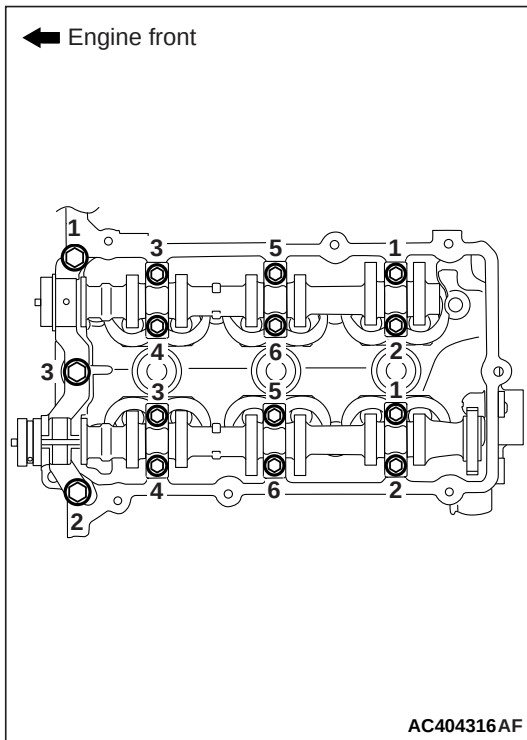
Removal steps (Continued)

- <<A>> >>B<< 6. Front camshaft bearing cap
 <<A>> >>B<< 7. Camshaft bearing cap
 >>B<< 8. Intake camshaft
 >>B<< 9. Exhaust camshaft
 <> >>A<< 10. Valve tappet

REMOVAL SERVICE POINTS

<<A>> CAMSHAFT BEARING CAP REMOVAL

Loosen the front camshaft bearing cap mounting bolts, and then loosen each camshaft bearing cap mounting bolts in the order shown. Remove the front camshaft bearing cap and each camshaft bearing cap.



<> VALVE TAPPET REMOVAL

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

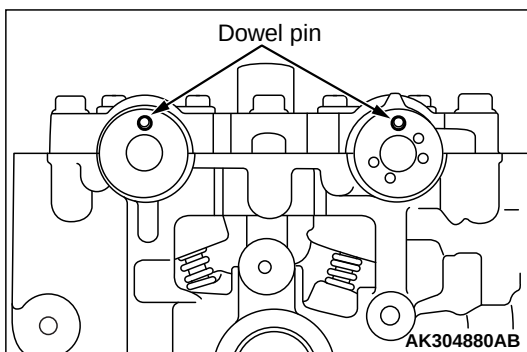
INSTALLATION SERVICE POINTS

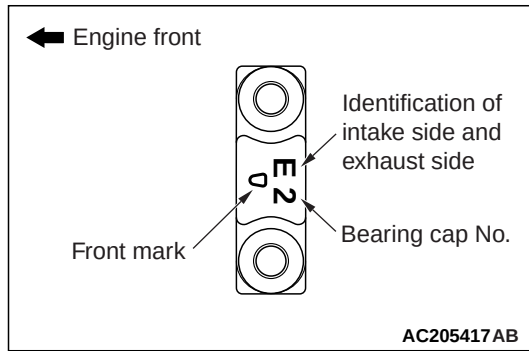
>>A<< VALVE TAPPET INSTALLATION

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.



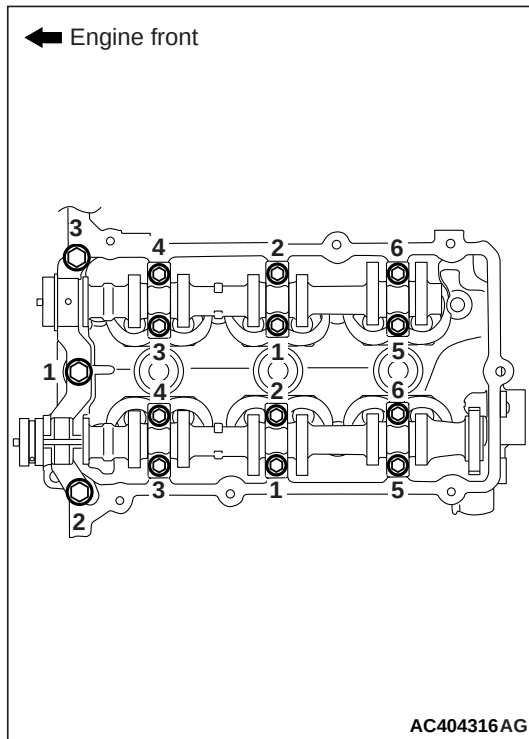


2. Camshaft bearing caps (No.2 to 4) are identical. To avoid confusion (bearing cap No. and intake/exhaust side), confirm each identification mark and face the front mark towards the direction shown before installing them.

Identification mark (engraved on the front and bearing caps No.2 – 4)

I: Intake side

E: Exhaust side



3. Tighten each camshaft bearing cap mounting bolts to the specified torque in the order shown, and then tighten the front camshaft bearing cap mounting bolts as well.

Tightening torque:

Camshaft bearing cap mounting bolts: 11 ± 1 N·m (97 $\pm$ 8 in-lb)

Front camshaft bearing cap mounting bolts: 20 ± 1 N·m (14.8 ± 0.7 ft-lb)

>>C<< OIL FEEDER CONTROL VALVE FILTER INSTALLATION

CAUTION

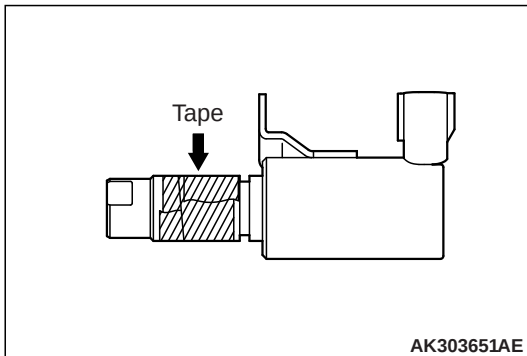
After checking for foreign matters attached, defects and deformation, install the oil feeder control valve filter.

>>D<< O-RING/OIL FEEDER CONTROL VALVE INSTALLATION

⚠ CAUTION

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

1. Apply a little amount of engine oil to the O-ring of oil feeder control valve.
2. Install the oil feeder control valve to the cylinder head.
3. Tighten the oil feeder control valve to the specified torque of $10 \pm 2 \text{ N}\cdot\text{m}$ ($89 \pm 17 \text{ in}\cdot\text{lb}$).



INSPECTION

M1113027000983

CAMSHAFT

Measure the cam height. If the measured value exceeds the limit, replace the camshaft.

Standard value:

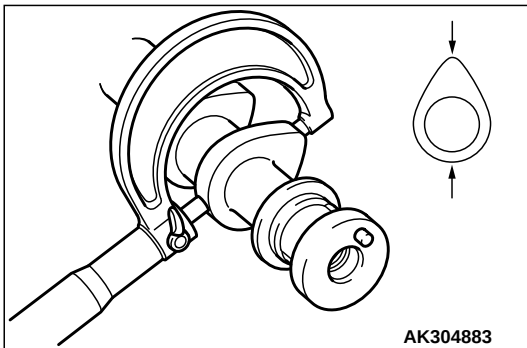
Intake: 44.81 mm (1.764 inches)

Exhaust: 43.98 mm (1.731 inches)

Limit:

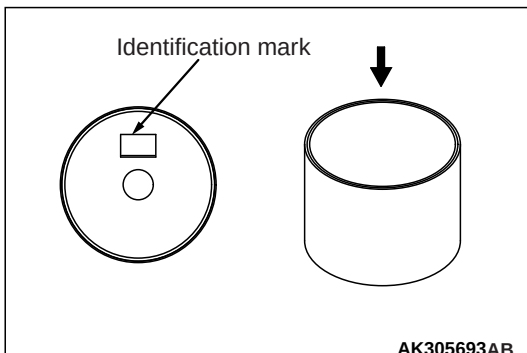
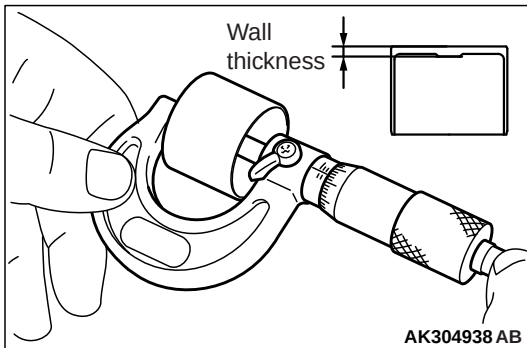
Intake: 44.31 mm (1.744 inches)

Exhaust: 43.48 mm (1.712 inches)



VALVE TAPPET

1. Measure the valve tappet at the illustrated location. If the measured valve is discord to instruction valve by identification mark and following table, replace the tappet.



2. Every valve tappet has an identification mark stamped at the illustrated location.

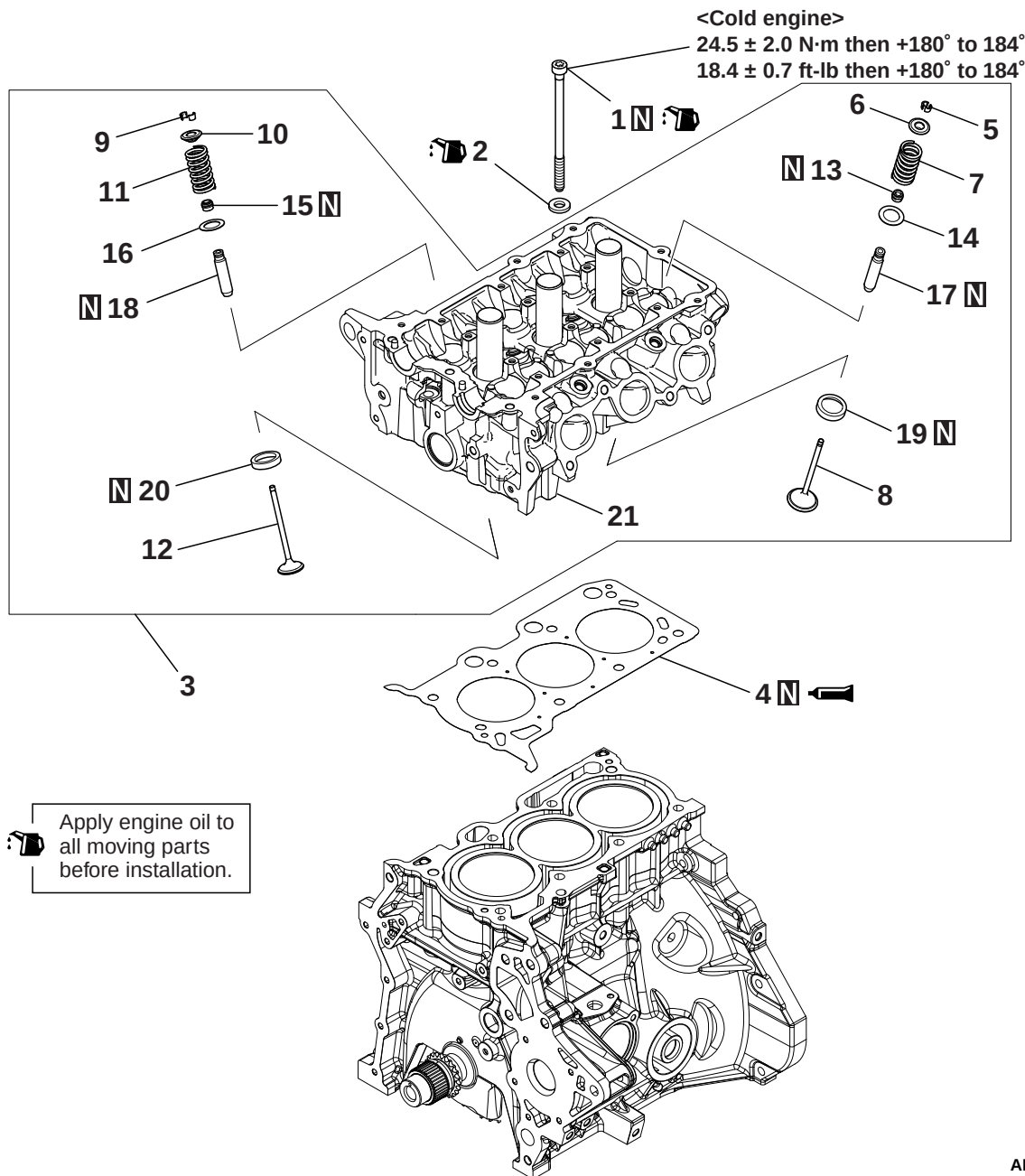
Valve tappets are available in 31 sizes, at 0.02 mm (0.0008 inch) intervals in the 5.10 – 5.70 mm (0.2008 – 0.2244 inch) range, as shown in the following table.

Thickness mm (in)	Identification mark	Thickness mm (in)	Identification mark	Thickness mm (in)	Identification mark
5.10 (0.2008)	10	5.32 (0.2094)	32	5.54 (0.2181)	54
5.12 (0.2016)	12	5.34 (0.2102)	34	5.56 (0.2189)	56
5.14 (0.2024)	14	5.36 (0.2110)	36	5.58 (0.2197)	58
5.16 (0.2031)	16	5.38 (0.2118)	38	5.60 (0.2205)	60
5.18 (0.2039)	18	5.40 (0.2126)	40	5.62 (0.2213)	62
5.20 (0.2047)	20	5.42 (0.2134)	42	5.64 (0.2220)	64
5.22 (0.2055)	22	5.44 (0.2142)	44	5.66 (0.2228)	66
5.24 (0.2063)	24	5.46 (0.2150)	46	5.68 (0.2236)	68
5.26 (0.2071)	26	5.48 (0.2157)	48	5.70 (0.2244)	70
5.28 (0.2079)	28	5.50 (0.2165)	50		
5.30 (0.2087)	30	5.52 (0.2173)	52		

CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006903515



AKA00368AD

Removal steps

- >>D<< 1. Cylinder head bolt
2. Cylinder head bolt washer
3. Cylinder head assembly
>>C<< 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)

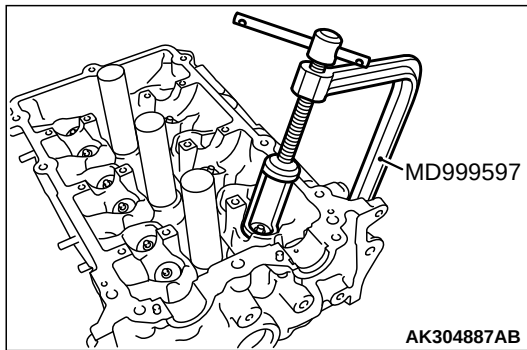
12. Exhaust valve
<> >>A<< 13. Valve stem seal
>>A<< 14. Valve spring seat
<> >>A<< 15. Valve stem seal
>>A<< 16. Valve spring seat
17. Valve guide
18. Valve guide
19. Intake valve seat
20. Exhaust valve seat
21. Cylinder head

REMOVAL SERVICE POINTS

<<A>> RETAINER LOCK REMOVAL

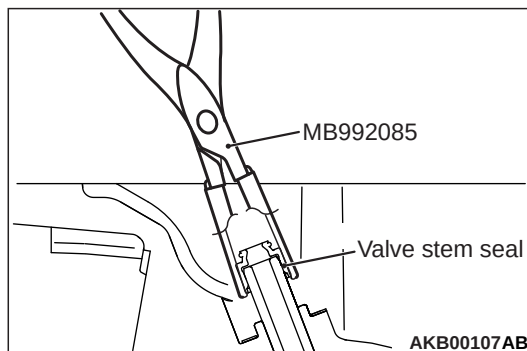
While compressing the valve spring using special tool valve spring compressor (MD999597), remove the retainer lock.

NOTE: To facilitate reassembly, the valve, spring and other parts removed should be kept together and attached with a tag showing where it has been assembled including the cylinder number.



<> VALVE STEM SEAL REMOVAL

Use special tool valve stem seal pliers (MB992085) to nip the base of the stem seal (where the outside diameter is larger) securely, and remove it by twisting it to the left and right.



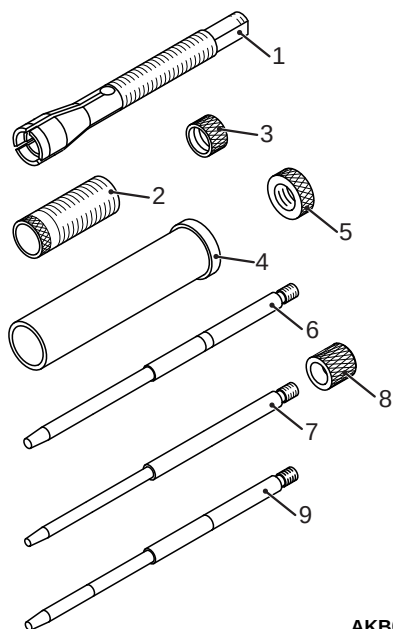
INSTALLATION SERVICE POINTS

>>A<< VALVE SPRING SEAT / VALVE STEM SEAL
INSTALLATION**⚠ CAUTION**

- The valve stem seal must not be reused.
- Do not damage the tappet wall during assembly.
- Be sure to use a special tool to install the valve stem seal. Poor installation causes oil loss via valve guides.
- If oil is not applied, the valve stem seal may rise to the surface after it is press fitted.

1. Apply a small amount of engine oil to the press-fit part and lip part of the new valve stem seal.
2. Use a special tool to install the valve stem seal, obeying the following procedures.

Valve stem seal installer adjustable
(MB992922)

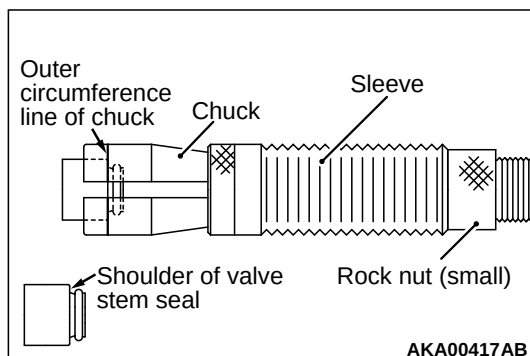


AKB00106AE

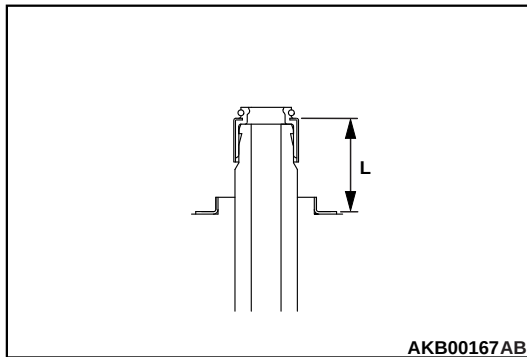
3. Special tool valve stem seal installer adjustable (MB992922) is composed of the components shown in the illustration.
 - 1: Chuck
 - 2: Sleeve
 - 3: Rock nut (small)
 - 4: Outer pipe
 - 5: Rock nut (large)
 - 6: Guide pin (5.9)
 - 7: Guide pin (4.9)
 - 8: Cap
 - 9: Guide pin (5.4)

4. Adjust the inside chuck diameter, obeying the following procedures.

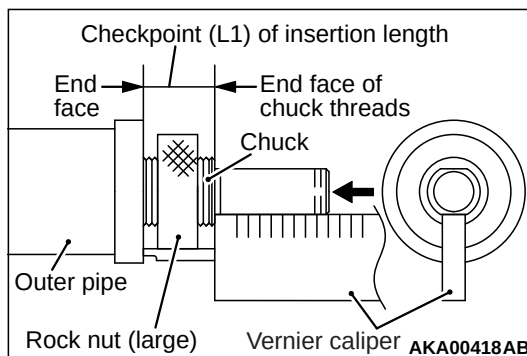
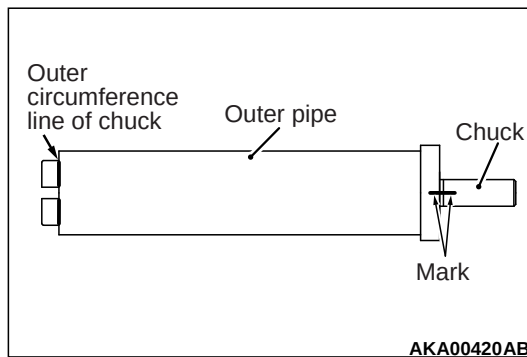
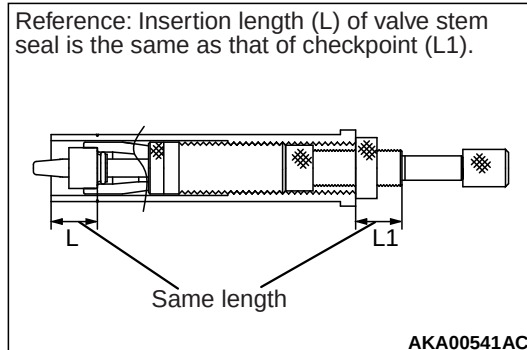
- (1) Install the sleeve to the chuck as shown in the illustration.
- (2) Install the shoulder of the valve stem seal to the chuck, aligning with the outer circumference line of the chuck as shown in the illustration.
- (3) Turn the sleeve to wring the chuck.
- (4) Stop the sleeve at the position where you can easily remove the valve stem seal by hand.
- (5) Use the (small) rock nut to fix the sleeve.



AKA00417AB



Reference: Insertion length (L) of valve stem seal is the same as that of checkpoint (L1).



5. Adjust the stem seal insertion length [L (L1)], obeying the following procedures.

- (1) The position, in which the end face of the outer pipe is aligned with the outer circumference line of the chuck, is 0 mm of the insertion length. Insert the chuck and the sleeve into the outer pipe to fit the nut as shown in the illustration.
- (2) Turn the chuck to adjust the valve stem seal insertion length.

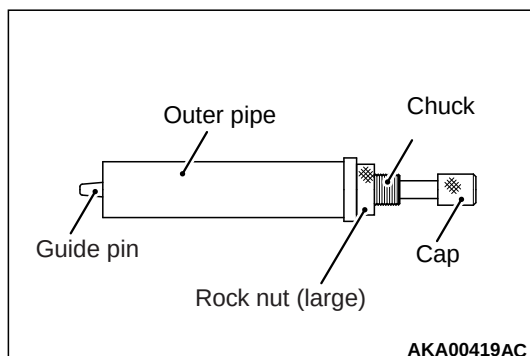
NOTE: The insertion length can change by 1 mm (0.04 inch) per the chuck turn.

To easily know how many times the chuck is turned, put the mark at the position shown in the illustration.

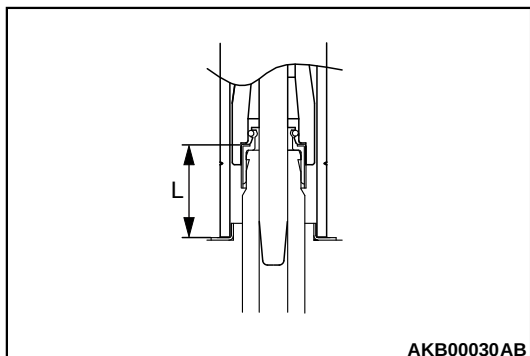
- (3) Use a vernier caliper to measure the checkpoint (L1) of the insertion length shown in the illustration. Check the insertion length.

L1: 14.4 mm (0.57 inch)

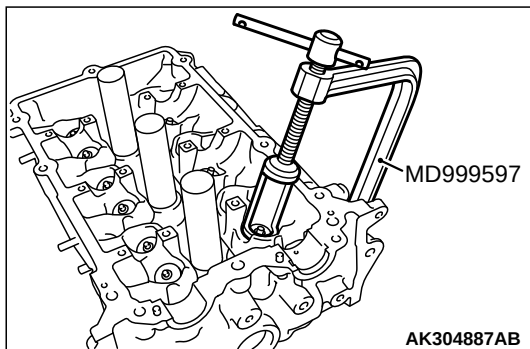
- (4) Use the (large) rock nut to fix the sleeve.



6. Install the cap to the guide pin (4.9).
7. Install the guide pin (4.9) as shown in the illustration.
8. Apply the engine oil to the valve stem seal to set the chuck.
9. Install the valve spring seat.

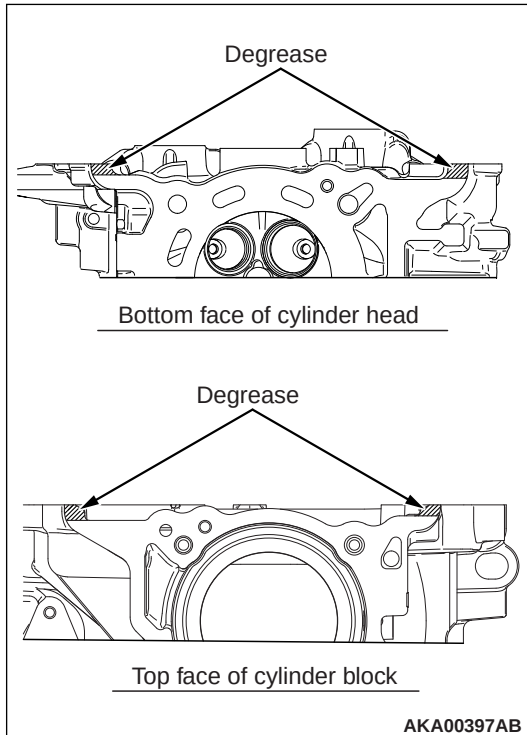


10. Use the plastic hammer to insert the valve stem seal.



>>B<< RETAINER LOCK INSTALLATION

While compressing the valve spring using special tool valve spring compressor (MD999597), install the retainer lock.



>>C<< CYLINDER HEAD GASKET INSTALLATION

1. Completely remove the liquid gasket on the upper plane of the cylinder block and the lower plane of the cylinder head.

⚠ CAUTION

Sufficiently check that there is no residual oil on the place where degreasing is performed. If fingerprints are left, do not touch it with bare hands after the degreasing, since the oils from your fingers will harm the seal ability.

2. Degrease the place specified in the illustration.

3. As shown in the illustration, apply a 2 to 3 mm (0.08 to 0.11 inch) of sealant to the top face of cylinder block.

Specified sealant:

Three bond 1217G or equivalent

4. Install the cylinder head gasket.

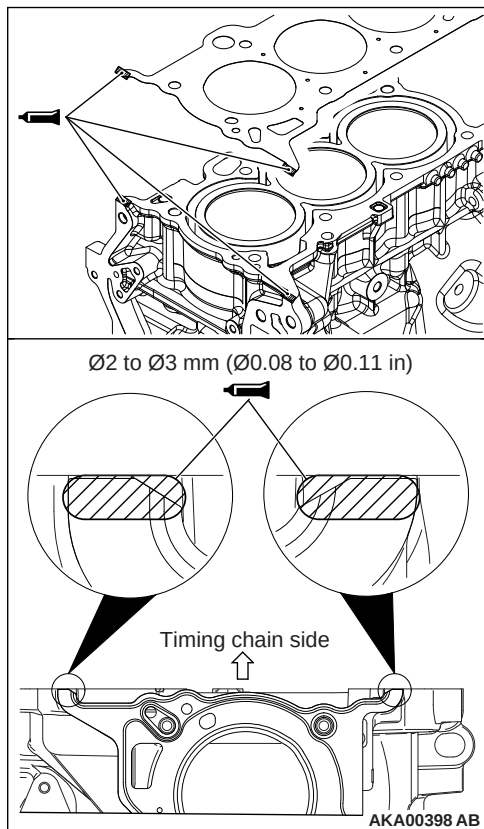
NOTE: Check that the center of the liquid gasket is located toward the cylinder gasket in the position specified in the illustration.

5. As shown in the illustration, apply a 2 to 3 mm (0.08 to 0.11 inch) of sealant to the top face of cylinder head gasket.

Specified sealant:

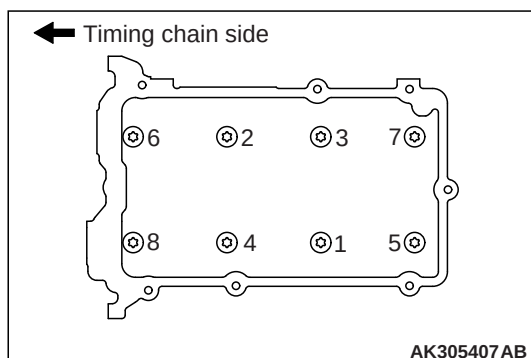
Three bond 1217G or equivalent

6. Install the cylinder head assembly.

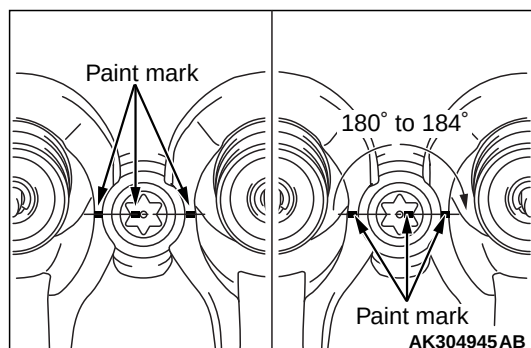


>>D<< CYLINDER HEAD BOLT INSTALLATION

1. Install the cylinder head bolt and washer assembly onto the cylinder head.



2. In accordance with the installation order, tighten them to the specified torque of 24.5 ± 2.0 N·m (18.4 ± 0.7 ft·lb) in several steps.
3. Make sure all bolts reach the specified torque.



4. Put paint marks on the bolt heads and the cylinder as illustrated.

⚠ CAUTION

- When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.
- When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.

5. Tighten the bolts in the correct sequence by 180 to 184 degree angle.

Ensure that the paint marks on the bolt heads and the cylinder are aligned in a straight line.

INSPECTION

M1113007003139

CYLINDER HEAD

1. Before cleaning, check the cylinder head for leakage of coolant or exhaust gas as well as cracks or other damage.
2. Remove oil, scale, sealant, carbon and other residues completely. Clean the oil passages and blow compressed air through them to verify that they are free of restriction.

⚠ CAUTION

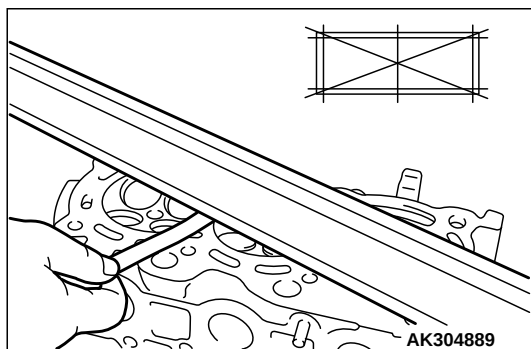
The grinding limit for the cylinder head and block combined is 0.2 mm (0.01 inch).

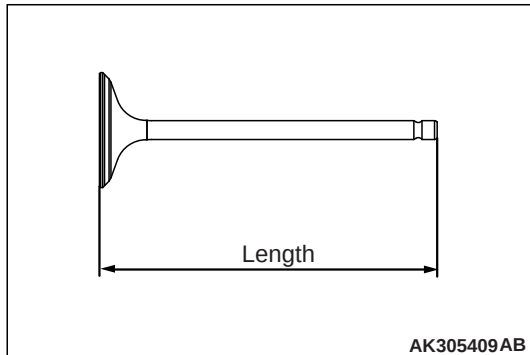
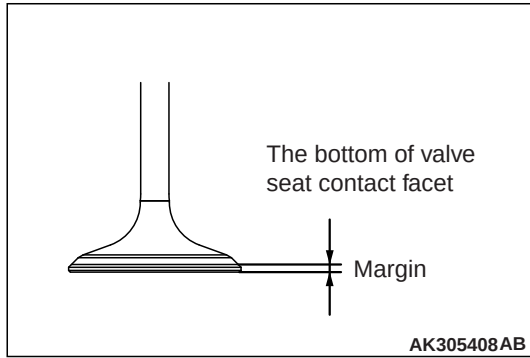
3. Using a straight edge and a thickness gauge, measure the flatness of the cylinder head bottom surface.

Bottom face distortion

Standard value: 0.03 mm (0.001 inch) or less

Cylinder head height (standard value for new part):
112.9 – 113.1 mm (4.445 – 4.452 inches)

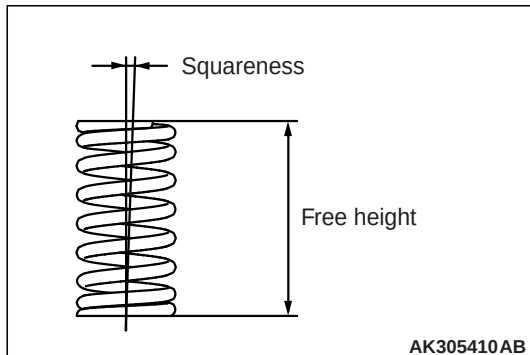


**VALVE**

1. If the valve face-to-seat contact is uneven or interrupted, correct the valve seat.
2. Measure the valve head margin. If the measured value exceeds the limit, replace with a new valve.

Standard value:**Intake 0.85 mm (0.033 inch)****Exhaust 1.50 mm (0.059 inch)**

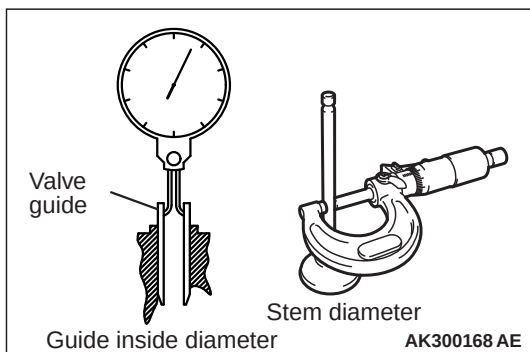
3. Measure the valve overall length. If the measured value exceeds the limit, replace with a new valve.

Standard value:**Intake 87.21 mm (3.433 inches)****Exhaust 88.54 mm (3.486 inches)****Limit:****Intake 86.71 mm (3.414 inches)****Exhaust 88.04 mm (3.466 inches)****VALVE SPRING**

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

Standard value: 49.6 mm (1.95 inches)**Limit: 48.6 mm (1.91 inches)**

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 (0.0008 – 0.0018 inch)****Exhaust 0.030 – 0.057 mm (0.0012 – 0.0022 inch)****Limit:****Intake 0.10 mm (0.004 inch)****Exhaust 0.15 mm (0.006 inch)**

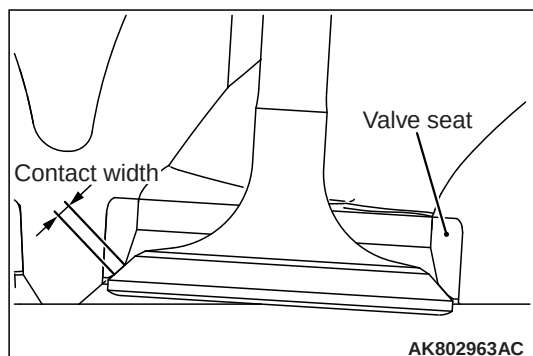
VALVE SEAT

⚠ CAUTION

If the variation in the width exceeds 0.2 mm (0.01 inch) even if the contact width is within the standard value, replace or correct the valve sheet.

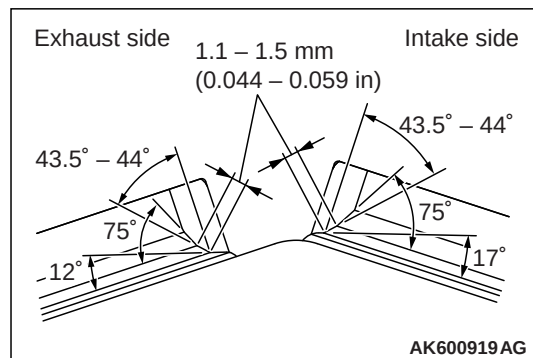
Assemble the valve, then measure the contact width. If the measurement exceeds the specified limit, replace or correct the valve seat.

Standard value: 1.1 – 1.5 mm (0.044 – 0.059 inch)



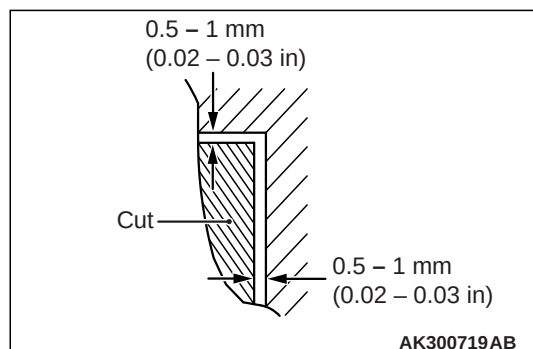
REPAIR PROCEDURE OF VALVE SEAT

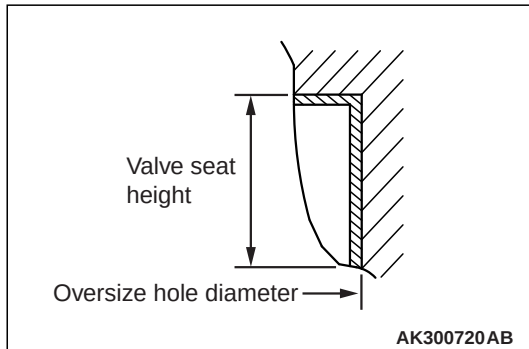
1. Check clearance between valve guide and valve and replace the valve guide if necessary before repairing the valve seat.
2. Repair the valve seat so that seat width and seat angle can become the specified shape.
3. Smear a lapping compound on the valve and valve seat after the repair. Fit the valve into the valve seat.



REPLACEMENT PROCEDURE OF VALVE SEAT

1. Scrape the valve seat to be replaced from inside. Make its wall thickness thin before pulling out.





2. Repair the valve seat hole of the cylinder head to match it with the diameter of the press fit oversize valve seat.

Intake valve seat bore diameter

0.30 O.S.: 31.83 – 31.85 mm (1.2532 – 1.2539 inches)

Exhaust valve seat bore diameter

0.30 O.S.: 28.32 – 28.34 mm (1.1150 – 1.1157 inches)

3. Press fit the valve seat, paying attention not to score the cylinder head inner diameter at room temperature.
4. Ream the valve seat.
Refer to "Repair procedures of valve seat."

REPLACEMENT PROCEDURE OF VALVE GUIDE

1. Pull out the valve guide with a press toward the cylinder block side.

⚠ CAUTION

Do not use a valve guide with the same size as the pulled out valve guide because it cannot be press fitted.

2. Ream the valve guide hole of the cylinder head to match it with the press fit oversize valve guide.

Intake valve guide bore diameter

0.05 O.S.: 10.56 – 10.58 mm (0.4158 – 0.4165 inch)

Exhaust valve guide bore diameter

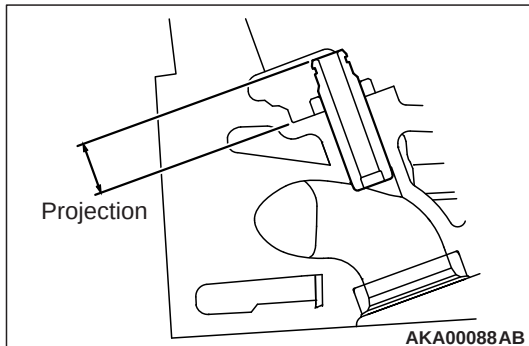
0.05 O.S.: 10.55 – 10.57 mm (0.4154 – 0.4161 inch)

3. Press fit the valve guide to the illustrated dimension.

Standard value: 12.7 – 13.3 mm (0.50 – 0.52 inch)

NOTE: Press fit the valve guide from the cylinder head top surface.

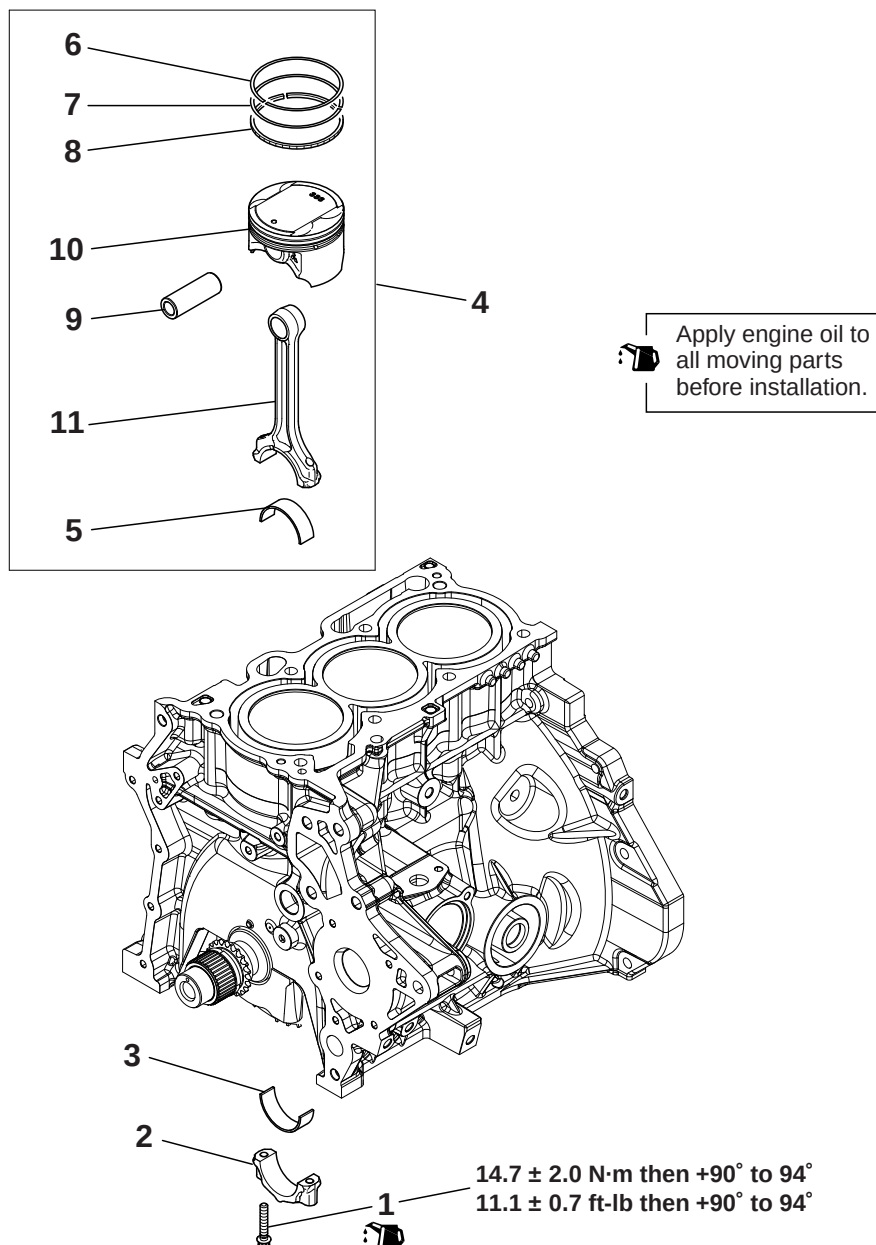
4. After pressing fit the valve guide, insert a new valve to check for sliding.



PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008403992



AKA00369AE

Removal steps

- >>G<< 1. Connecting rod cap bolt
- <<A>> >>F<< 2. Connecting rod cap
- >>E<< 3. Connecting rod bearing
- >>D<< 4. Piston, connecting rod assembly
- >>E<< 5. Connecting rod bearing
- >>C<< 6. Piston ring, No. 1

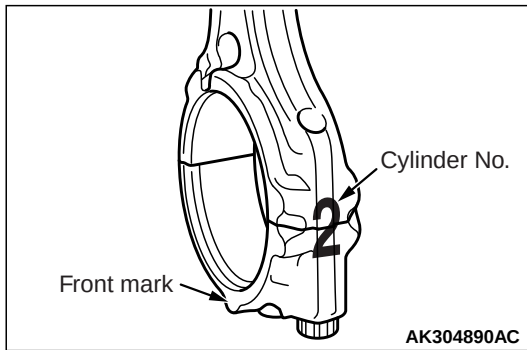
Removal steps (Continued)

- >>C<< 7. Piston ring, No. 2
- >>B<< 8. Oil ring
- <> >>A<< 9. Piston pin
- 10. Piston
- 11. Connecting rod

REMOVAL SERVICE POINTS

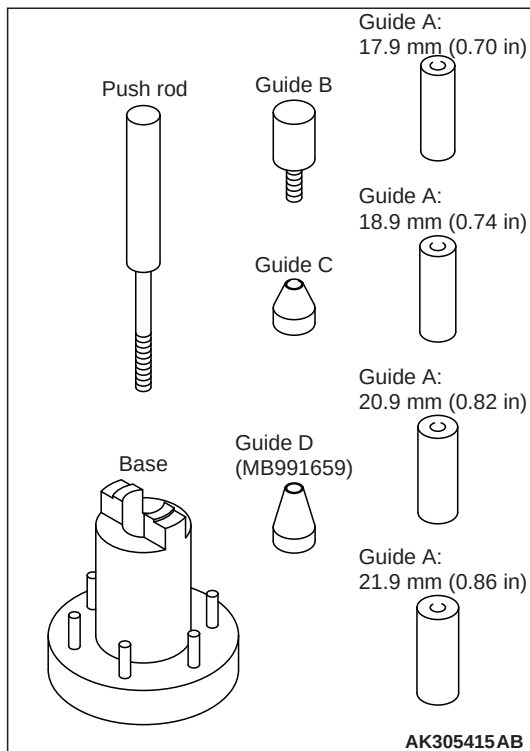
<<A>> CONNECTING ROD CAP REMOVAL

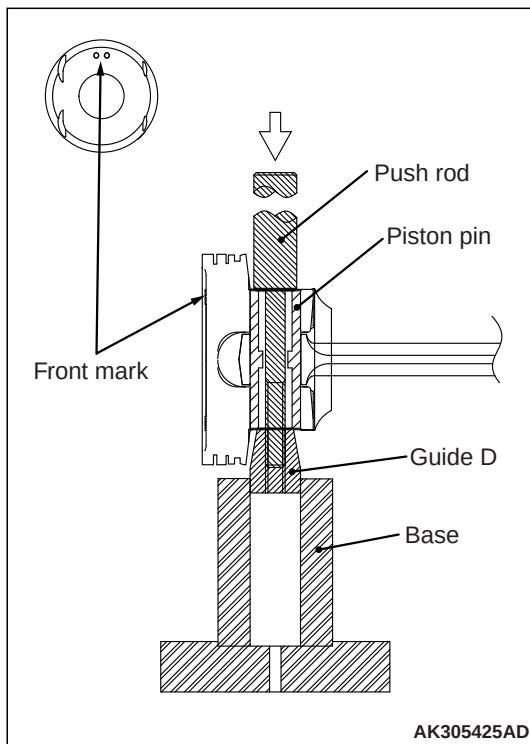
To facilitate reassembly, mark the side face of the connecting rod big end with the corresponding cylinder number.



<> PISTON PIN REMOVAL

The special tool Piston pin setting tool (MD998780) consists of the parts illustrated. The special tool Guide D (MB991659) is also used for removal.





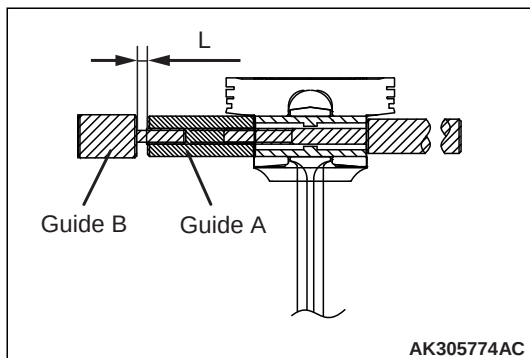
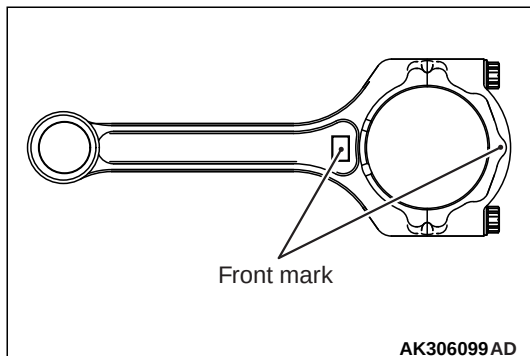
1. Insert the Push rod (special tool) into the piston, from the piston side with the front mark on the piston top face. Install the Guide D on the other side.
2. Install the piston and connecting rod assembly with the tools onto the Piston pin setting base (special tool), ensuring that the piston front mark faces upwards.
3. Using a press, remove the piston pin.

NOTE: With the piston pin removed, keep the pin, piston and connecting rod of the same cylinder together.

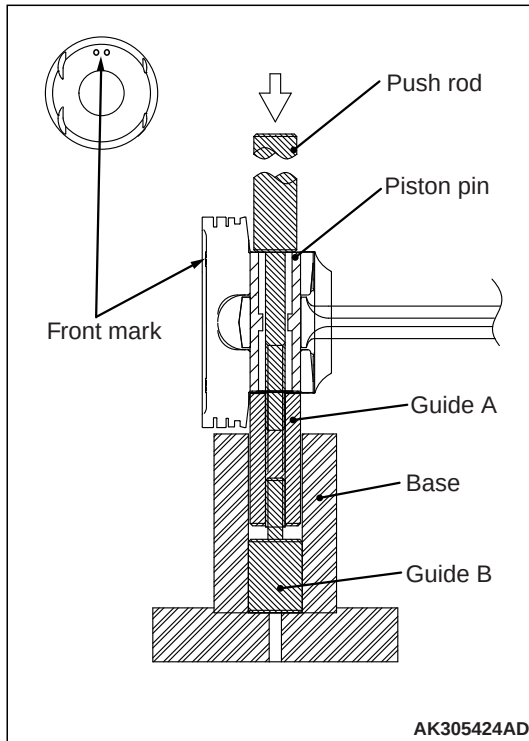
INSTALLATION SERVICE POINTS

>>A<< PISTON PIN INSTALLATION

1. Insert the special tool Push rod into the piston pin, and install Guide A.
2. Assemble the piston and the connecting rod together, ensuring that their front marks are aligned with each other.
3. Apply engine oil onto the periphery of the piston pin.
4. Insert the piston pin assembled in step 1 above into the piston pin boss. Guide A end of the piston pin should be inserted first into the front mark end of the boss.



5. Insert Guide B into Guide A with having 2.25 mm (0.089 inch) of the clearance "L" between Guide A and B.



6. Install the piston and connecting rod assembly with the tools onto the Piston setting base (special tool), ensuring that the piston front mark faces upwards.
7. Using a press, press fit the piston pin. If the force required to press fit the piston pin is less than the standard value, replace the piston pin (piston assembly) or the connecting rod, or both.

Standard value: 2,000 – 8,000 N (449.7 – 1798.5 pounds)

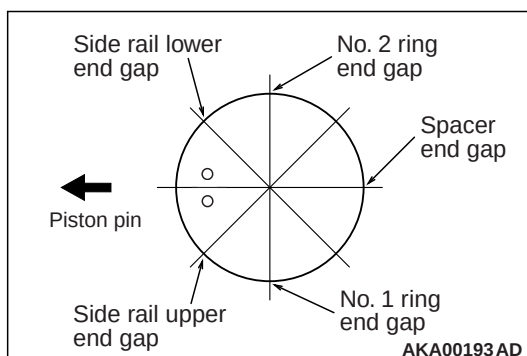
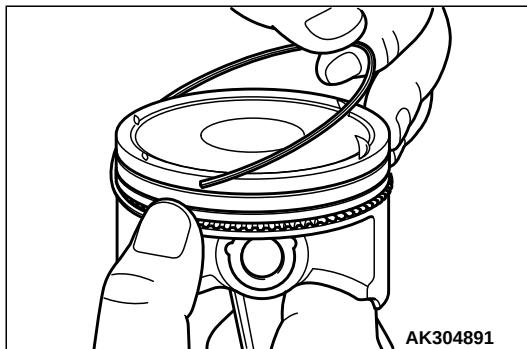
>>B<< OIL RING INSTALLATION

1. Install the oil ring spacer first into the piston ring groove, followed by the upper side rail and then the lower side rail.

CAUTION

Do not use a ring expander on side rails as they may break when the gap is opened.

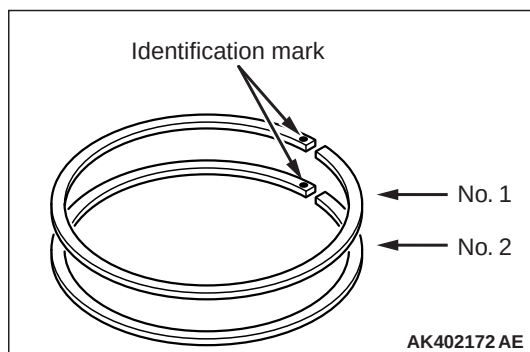
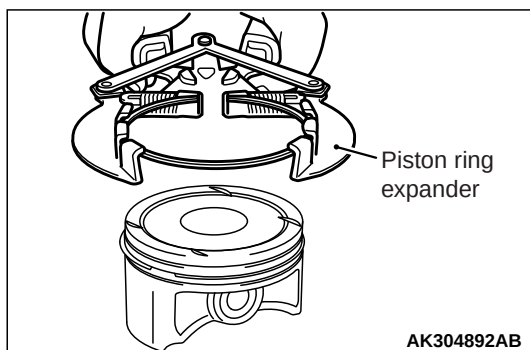
2. Side rails can be installed easily by first inserting one end of the rail into the piston groove, then pressing the rail into place with finger.
3. With the side rails installed onto the piston, check that they can be rotated smoothly in both directions.



4. The gaps of the side rails and spacer should be located as illustrated.

>>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: T

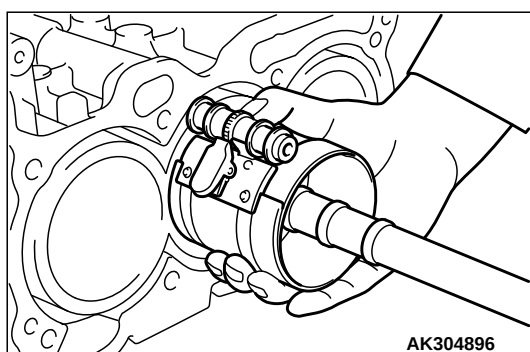
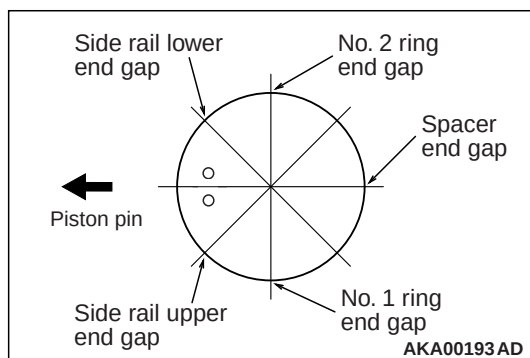
No. 2 ring: TT

>>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

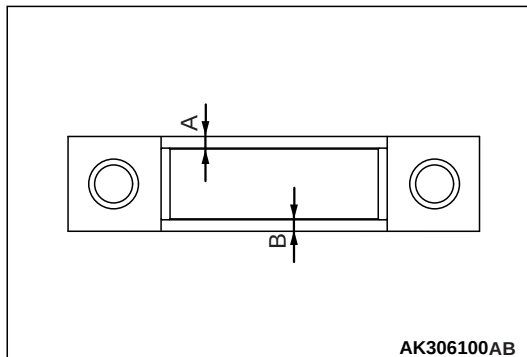
Do not try to strike hard on the assembly to fit it in place as this will break the piston rings.



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

>>E<< CONNECTING ROD BEARING
INSTALLATION

Measure the illustrated location. (A – B) should be within 0.5 mm (0.02 inch).



>>F<< CONNECTING ROD CAP INSTALLATION

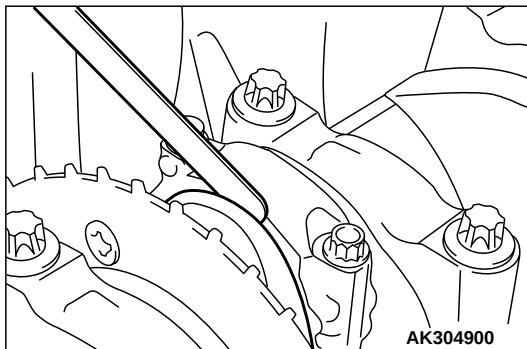
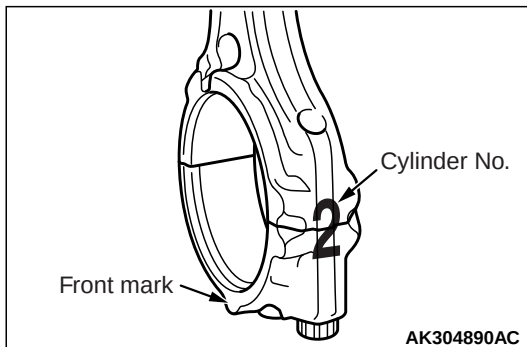
NOTE: The connecting rod resulting from the breaking process has the high insertion force. The new connecting rod assembly may possibly be difficult to remove the connecting rod.

If difficult to remove it, alternately strike the two bolt heads with a plastic hammer while the connecting rod bolt is slightly loosened, or strike the center of the cap shaft's inside diameter slightly and outward.

If the outside of the cap is directly struck, the lateral force is added to the broken-out section. Thus, pay attention to the broken-out section that might be difficult to be separated or might fall.

Clean the broken-out section before the installation to the engine, using compression air.

1. Install the correct bearing cap onto the corresponding connecting rod, based on the marking placed during disassembly.

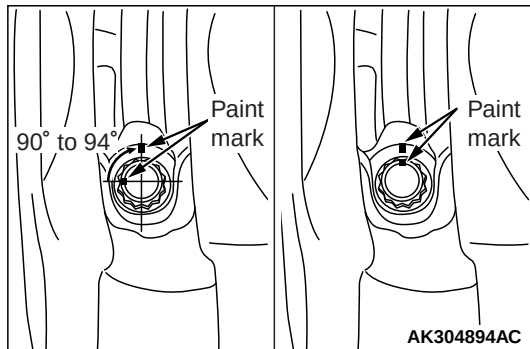
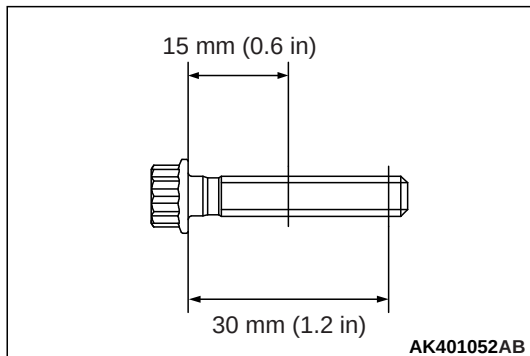


2. Ensure that the thrust clearance of the connecting rod big end is to specification.

Standard value: 0.10 – 0.35 mm (0.004 – 0.013 inch)

Limit: 0.4 mm (0.02 inch)

>>G<< CONNECTING ROD CAP BOLT INSTALLATION



1. Inspect all reused connecting rod bolts according to the following procedure.
 - (1) Measure the outside diameter at 15 mm (0.6 inch) and 30 mm (1.2 inches) from the head of the connecting rod bolts shown in Figure respectively.
 - (2) When the difference between the outside diameters [measured at 15 mm (0.6 inch) and 30 mm (1.2 inches)] exceeds the standard value, replace the connecting rod bolts.

Standard value: 0 – 0.1 mm (0 – 0.003 inch)

2. Apply engine oil to the threaded portion and seating face of the bolt.
3. To correctly install the cap, loosely install the bolts with fingers.
4. Alternately, tighten the bolts in several steps to the specified torque of 14.7 ± 2.0 N·m (11.1 ± 0.7 ft·lb).
5. Put a paint mark on the bolt head as illustrated.
6. Put another paint mark on the bolt head at 90 to 94° in the tightening direction from the first paint mark.

⚠ CAUTION

- When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.
 - When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.
7. Tighten the bolt 90° to 94°. The paint mark on the connecting rod should be aligned with the paint mark on the bolt.

INSPECTION

M1113008502725

PISTON RING

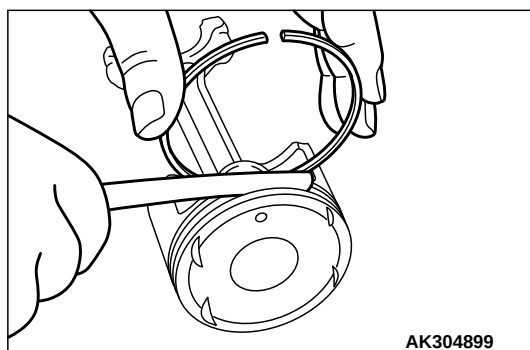
1. Measure the clearance between the piston ring and the ring groove. If the measured value exceeds the limit, replace the piston ring, or both the piston and the piston ring.

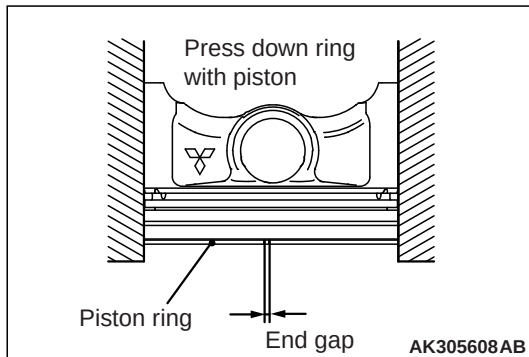
Standard value:

No. 1 ring: 0.03 – 0.07 mm (0.0012 – 0.0027 inch)

No. 2 ring: 0.02 – 0.06 mm (0.0008 – 0.0023 inch)

Limit: 0.1 mm (0.004 inch)





2. Insert the piston ring into the cylinder bore. Insert the piston with the top face end first into the cylinder bore, pushing the piston ring and positioning it squarely with the cylinder bore. Then, measure the piston ring end gap using a feeler gauge. If the measured value exceeds the limit, replace the piston ring.

Standard value:

No. 1 ring: 0.15 – 0.30 mm (0.006 – 0.011 inch)

No. 2 ring: 0.20 – 0.40 mm (0.008 – 0.015 inch)

Oil ring: 0.10 – 0.35 mm (0.004 – 0.013 inch)

Limit:

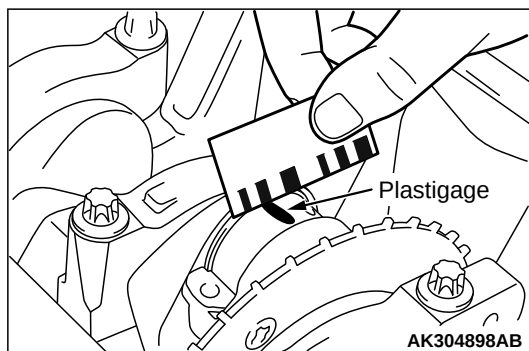
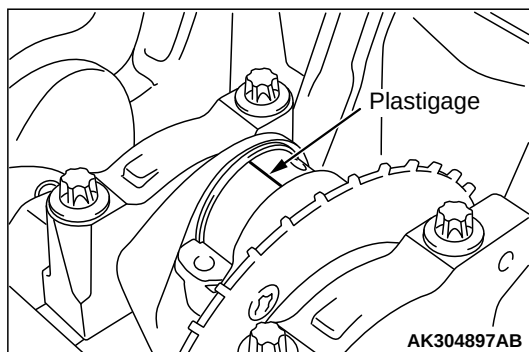
No. 1 ring: 0.8 mm (0.03 inch)

No. 2 ring: 0.8 mm (0.03 inch)

Oil ring: 1.0 mm (0.04 inch)

**CRANKSHAFT PIN OIL CLEARANCE
(PLASTIGAGE METHOD)**

1. Wipe off oil from the crankshaft pin and the connecting rod bearings.
2. Place a plastigage, with a length equal to the bearing width, onto the crank pin in the axial direction.
3. Carefully install the connecting rod cap over the plastigage, and tighten the bolts to the specified torque of 14.7 ± 2.0 N·m (11.1 ± 0.7 ft-lb).
4. Next, tighten the bolts 90° to 94° .
5. Remove the bolts. Slowly remove the connecting rod cap.



6. Using the measure printed on the plastigage package, measure the width (widest portion) of the crushed plastigage.

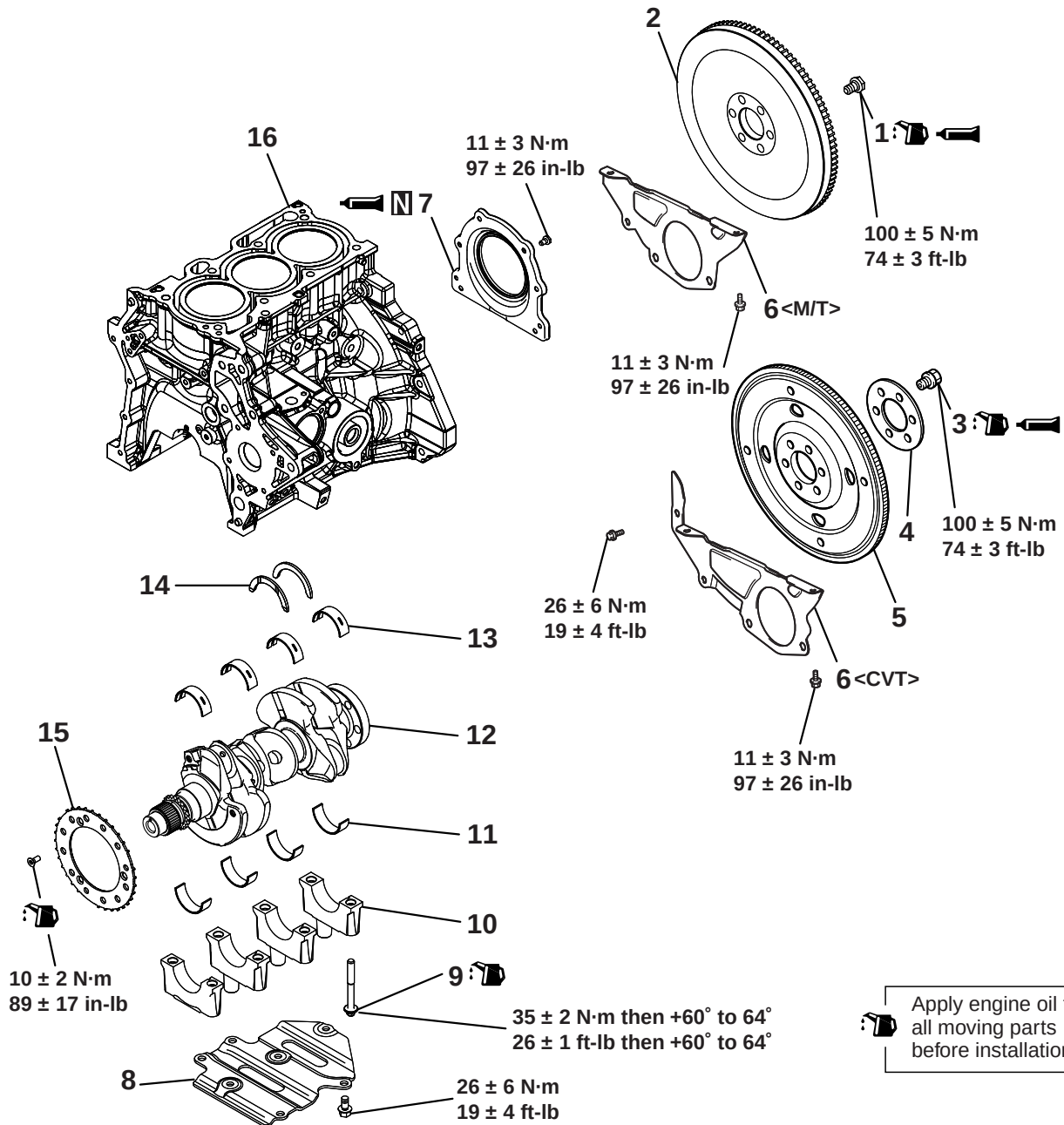
Standard value: 0.026 – 0.062 mm (0.0011 – 0.0024 inch)

Limit: 0.1 mm (0.004 inch)

CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008704372



AKB00490 AB

Removal steps

- <<A>> >>H<< 1. Flywheel bolt <M/T>
2. Flywheel <M/T>
>>H<< 3. Drive plate bolt <CVT>
>>G<< 4. Adapter plate <CVT>
5. Drive plate <CVT>
6. Bell housing cover
>>G<< 7. Oil seal case
>>F<< 8. Stiffener plate

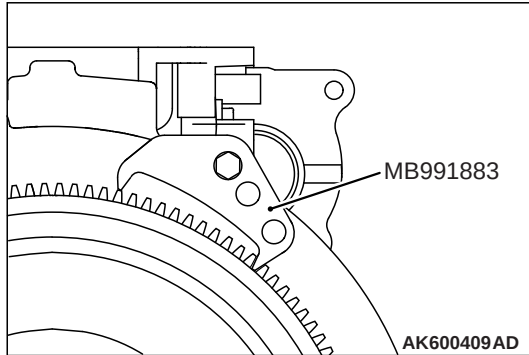
Removal steps (Continued)

- >>E<< 9. Crankshaft bearing cap bolt
>>E<< 10. Crankshaft bearing cap
>>D<< 11. Crankshaft bearing, lower
12. Crankshaft
>>C<< 13. Crankshaft bearing, upper
>>B<< 14. Thrust bearing
>>A<< 15. Crankshaft sensing ring
16. Cylinder block

REMOVAL SERVICE POINT

<<A>> FLYWHEEL BOLT / DRIVE PLATE BOLT
REMOVAL

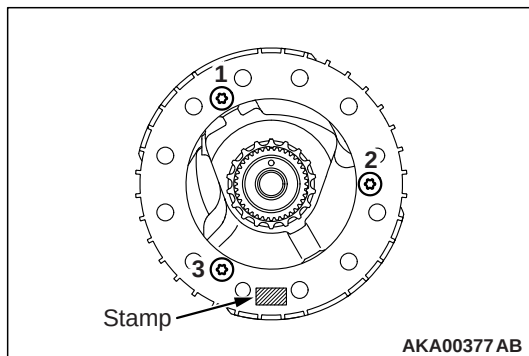
1. Lock the flywheel or drive plate using special tool flywheel stopper (MB991883).
2. Remove the flywheel bolt or drive plate bolt.



INSTALLATION SERVICE POINTS

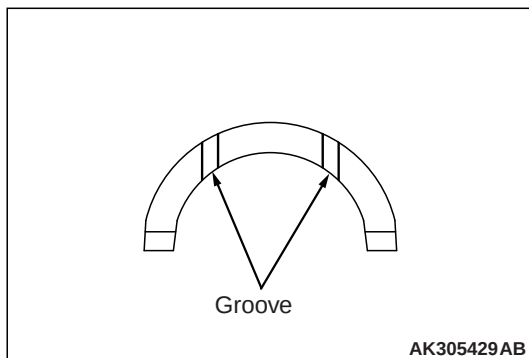
>>A<< CRANKSHAFT SENSING RING INSTALLATION

1. Install the crankshaft sensing ring to the crankshaft after aligning a stamp to the position as shown in the illustration when the crankshaft is at No.1 TOP.
2. Apply engine oil to the crankshaft sensing ring bolt.
3. Tighten the crankshaft sensing ring bolts to 10 ± 2 N·m (89 ± 17 in-lb) in the steps given in the illustrated.



>>B<< THRUST BEARING INSTALLATION

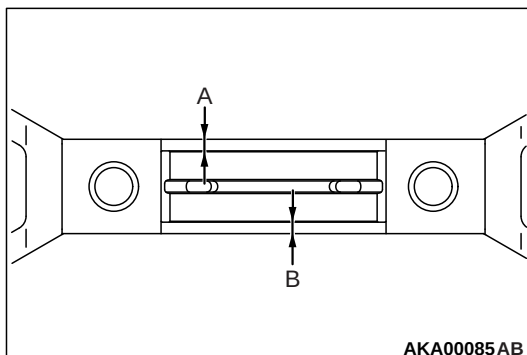
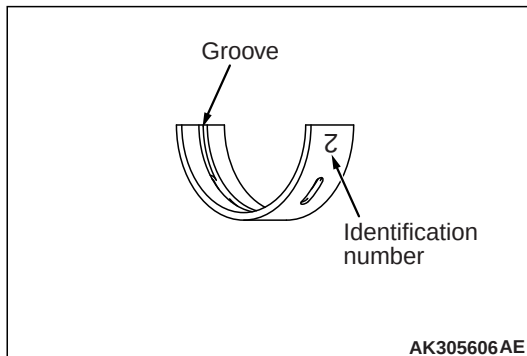
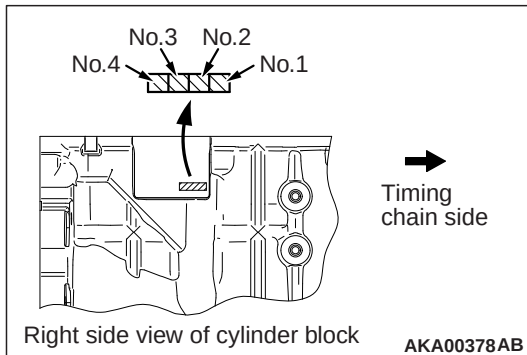
1. Install the thrust bearing onto the cylinder block side of the No. 3 bearing. Apply engine oil to the thrust bearing to facilitate installation.
2. The thrust bearing should be installed such that its groove faces the crankshaft weight.



>>C<< CRANKSHAFT BEARING UPPER INSTALLATION

1. The crankshaft bearing upper should be selected based on the identification mark on the right side face of the cylinder block (illustrated) and the table shown below.

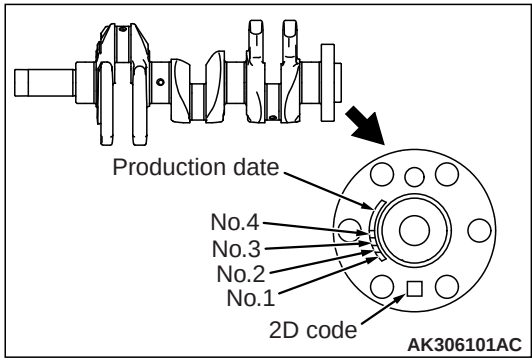
The crankshaft bearing upper has the identification mark at the illustrated position.



Cylinder block		Crankshaft bearing identification mark
Identification mark	Journal diameter mm (in)	
1	50.000 – 50.005 (1.9685 – 1.9687)	1
2	50.005 – 50.010 (1.9687 – 1.9689)	2
3	50.010 – 50.015 (1.9689 – 1.9691)	3

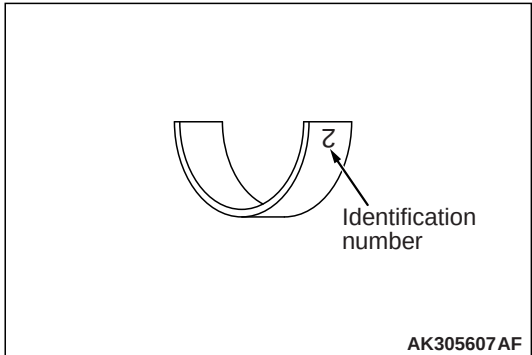
2. Select and install the crankshaft bearing upper.
3. Measure the illustrated location. (A – B) be within 0.5 mm (0.02 inch).

>>D<< CRANKSHAFT BEARING LOWER
INSTALLATION

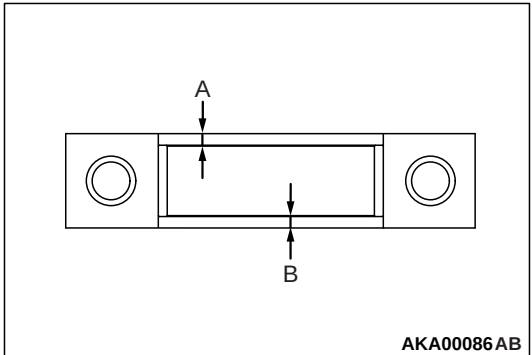


1. The crankshaft bearing lower should be selected based on the identification mark on the crankshaft rear flange (illustrated) and the table shown below.
The crankshaft bearing lower has the identification mark at illustrated position.

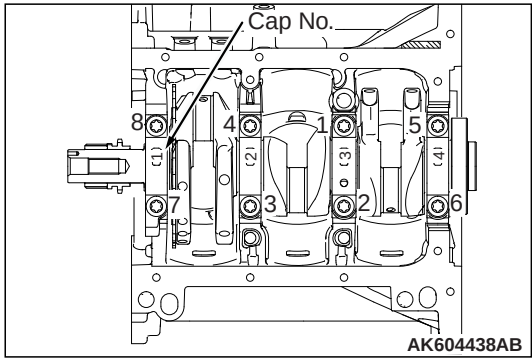
Crankshaft		Crankshaft bearing identification mark
Identification mark	Journal diameter mm (in)	
2	46.019 – 46.024 (1.8118 – 1.8120)	2
3	46.014 – 46.019 (1.8116 – 1.8118)	3
4	46.009 – 46.014 (1.8114 – 1.8116)	4
5	46.004 – 46.009 (1.8112 – 1.8114)	5



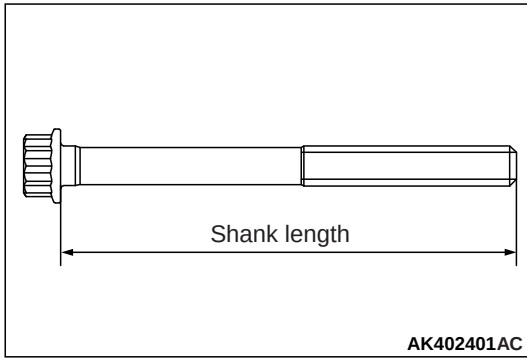
2. Select and install the crankshaft bearing lower.
3. Measure the illustrated location. (A – B) should be within 0.5 mm (0.02 inch).



>>E<< BEARING CAP / BEARING CAP BOLT
INSTALLATION



1. Install the bearing cap, based on the identification mark at the illustrated location.



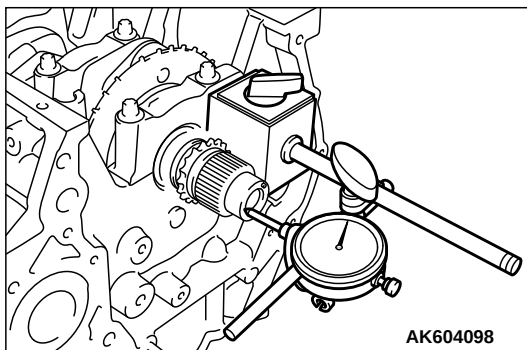
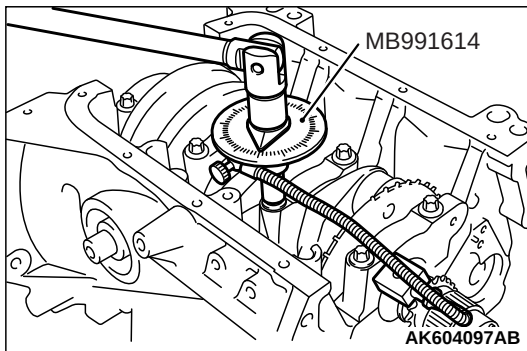
- Before the bearing cap bolt is installed, make sure the nominal length of the bolt is below the limit. If above the limit, replace the bolt with the new one.

Standard value: 74.15 – 74.85 mm (2.920 – 2.946 inches)

- Apply engine oil to the threaded portion and seating face of the bolt.
- Tighten the bearing cap bolts in the illustrated sequence to 35 ± 2 N·m (26 ± 1 ft-lb).

CAUTION

- When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.
 - When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.
- Using special tool angle gauge (MB991614), tighten the bearing cap bolts in the illustrated sequence by a further 60° to 64° .

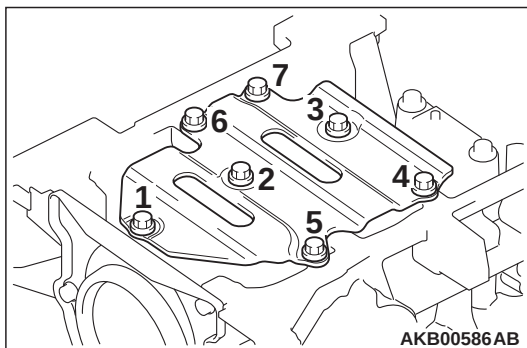


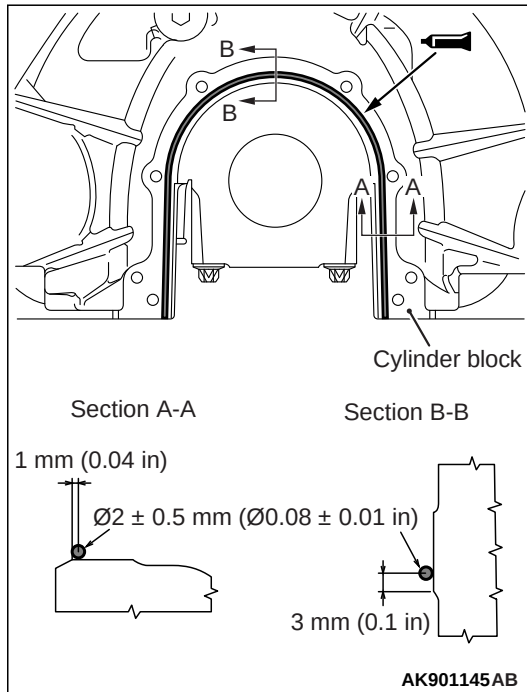
- With the bearing caps installed, check the crankshaft end play. If the measured value exceeds the limit, replace the crankshaft bearings.

Standard value: 0.09 – 0.27 mm (0.004 – 0.010 inch)
Limit: 0.30 mm (0.012 inch)

>>F<< STIFFENER INSTALLATION

In accordance with the installation order, tighten them to the specified torque of 26 ± 6 N·m (19 ± 4 ft-lb).





>>G<< OIL SEAL CASE INSTALLATION

1. Remove sealant from the oil seal case mounting surface of the cylinder block.
2. Apply a bead of specified sealant to the oil seal case mating surface of the cylinder block as shown.

Specified sealant:

Three bond 1217G or equivalent

⚠ CAUTION

Install the oil seal case not to damage the oil seal.

3. Within 10 minutes after applying the specified sealant, install the oil seal case to the cylinder block.
4. Tighten the oil seal case mounting bolts to the specified torque.

Tightening torque: $11 \pm 3 \text{ N}\cdot\text{m}$ ($97 \pm 26 \text{ in}\cdot\text{lb}$)

>>H<< FLYWHEEL BOLT / DRIVE PLATE BOLT INSTALLATION

1. Remove any sealant remaining on the threaded hole in the crankshaft.
2. Apply a small amount of engine oil the installation face of the flywheel bolt or drive plate bolt and the thread portion of the crankshaft.

⚠ CAUTION

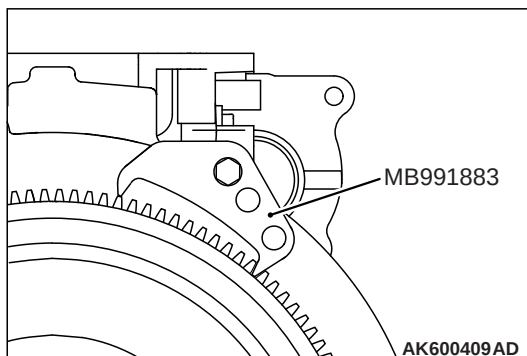
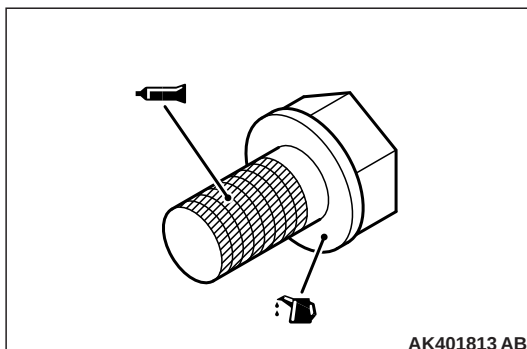
Apply sealant correctly so that it will not be squeezed out onto the end of the threaded portion upon assembly.

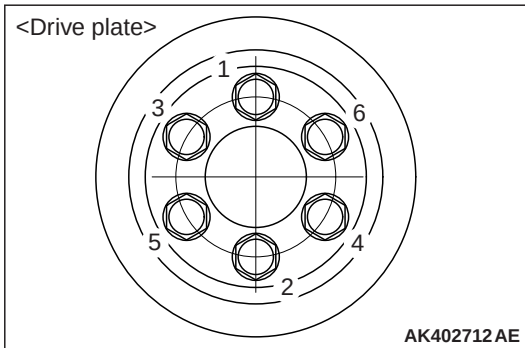
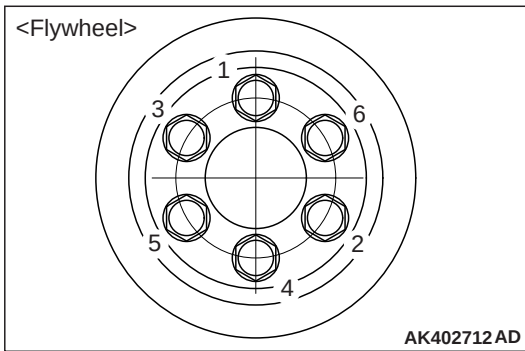
3. Apply sealant to the threaded portion of the flywheel bolt or drive plate bolt as illustrated.

Specified sealant:

LOCTITE 2701 or equivalent

4. Fix the flywheel or drive plate in place using special tool flywheel stopper (MB991883).





- In accordance with the numerical order shown in the illustration, tighten the flywheel bolt or drive plate bolt to the specified torque of $100 \pm 5 \text{ N}\cdot\text{m}$ ($74 \pm 3 \text{ ft}\cdot\text{lb}$) in several steps.

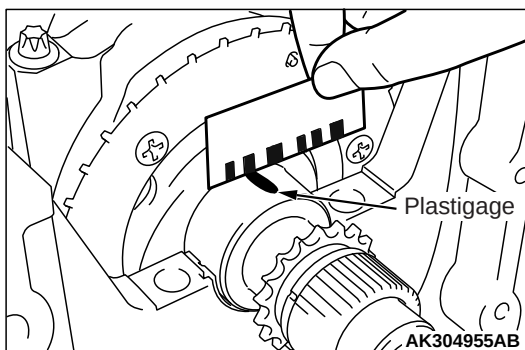
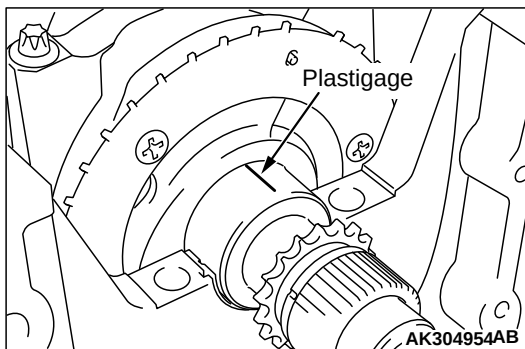
INSPECTION

M1113008802801

CRANKSHAFT OIL CLEARANCE (USING PLASTIGAGE)

Oil clearance can be measured easily by using "plastigage." Use the "plastigage" in the following manner.

- Wipe off oil from the surfaces of the crankshaft journals as well as the inner surfaces of the bearings.
- Assemble the crankshaft.
- Place a plastigage, with a length equal to the width of the bearing, onto the journals in the axial direction.
- Carefully place the main bearing caps, and tighten the bolts to the specified torque.
- Remove the bolts. Carefully remove the main bearing caps.



- Using the measure printed on the plastigage package, measure the width (widest portion) of the crushed plastigage.

Standard value: 0.023 – 0.043 mm (0.0010 – 0.0016 inch)

Limit: 0.1 mm (0.004 inch)

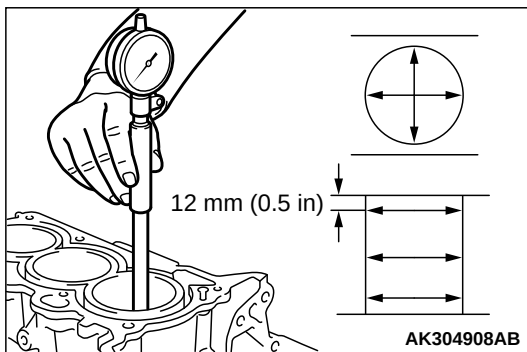
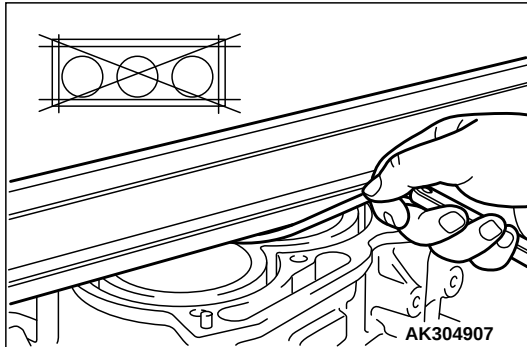
CYLINDER BLOCK

1. Check visually for scoring, rust, or corrosion. Perform liquid penetrant test etc. to check for cracks. If faulty, replace.
2. Using a straight edge or a thickness gauge, measure the flatness of the cylinder block top surface. Ensure that no gasket or other foreign matter is attached to the top face.

Standard value: 0.05 mm (0.002 inch)

Limit: 0.1 mm (0.004 inch)

3. Check the cylinder bore for scoring or seizure. If faulty, replace.



4. Using a cylinder gauge, measure the cylinder bore and centricity. If excessively worn, replace the cylinder block.

Standard value:

Inner diameter 75.0 mm (2.95 inches)

Cylindrically 0.01 mm (0.0004 inch) or less