

GROUP 11B

ENGINE OVERHAUL

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GENERAL SPECIFICATIONS

M1113000201501

Descriptions		Specifications	
Engine type		4B11	
Bore × stroke mm (in)		86 (3.39) × 86 (3.39)	
Total displacement cm ³ (cu in)		1,998 (121.9)	
Combustion chamber		Pent-roof type	
Number of cylinders		4	
Valve mechanism		Type	DOHC
		Intake valve	8
		Exhaust valve	8
Compression ratio		10.0	
Valve timing	Intake valve	Opens (BTDC)	25° -0° <CALIFORNIA>, 28° -3° <Except CALIFORNIA>
		Closes (ABDC)	48° -23° <CALIFORNIA>, 45° -20° <Except CALIFORNIA>
	Exhaust valve	Opens (BBDC)	24° -44° <CALIFORNIA>, 21° -41° <Except CALIFORNIA>
		Closes (ATDC)	0° -20° <CALIFORNIA>, 3° -23° <Except CALIFORNIA>
Fuel injection system type		Electronic control MPI	
Ignition system type		Electronic spark-advance control type (4-coil type)	
Generator type		Alternating current system (with built-in IC regulator)	
Starter motor type		Reduction drive type	

SERVICE SPECIFICATIONS

M1113000301627

Item	Standard value		Limit
Timing chain			
Valve clearance mm (in)	Intake	0.20 (0.008)	—
	Exhaust	0.30 (0.012)	—
Camshaft			
Cam height of camshaft mm (in)	Intake	43.25 (1.703)	42.75 (1.683)
	Exhaust	45.00 (1.772)	44.50 (1.752)
Camshaft oil clearance mm (in)	0.035 -0.072 (0.0014 -0.0028)		—
Cylinder head and valves			
Distortion of cylinder head bottom mm (in)	Within 0.05 (0.002)		0.02 (0.0008)
Grinding limit of cylinder head bottom mm (in)	—		0.2 (0.008)
Overall height of cylinder head mm (in)	128.5 (5.06)		—

**ENGINE OVERHAUL
SERVICE SPECIFICATIONS**

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Item		Standard value	Limit
Overall length of valve mm (in)	Intake	113.18 (4.456)	112.68 (4.436)
	Exhaust	105.89 (4.169)	105.39 (4.149)
Valve margin mm (in)	Intake	1.022 (0.0402)	0.522 (0.0206)
	Exhaust	1.094 (0.0431)	0.594 (0.0234)
Free height of valve spring mm (in)		47.44 (1.868)	46.44 (1.828)
Squareness of valve spring		2° or less	4°
Clearance between valve guide and valve stem mm (in)	Intake	0.020 –0.047 (0.0008 –0.0019)	0.10 (0.004)
	Exhaust	0.030 –0.054 (0.0012 –0.0021)	0.15 (0.006)
Valve seat contact width mm (in)	Intake	1.16 –1.46 (0.046 –0.058)	–
	Exhaust	1.35 –1.65 (0.053 –0.065)	–
Oversize rework dimensions of valve guide hole mm (in)	0.25 oversize diameter	11.23 –11.25 (0.442 –0.443)	–
Intake oversize rework dimensions of valve seat hole mm (in)	0.3 oversize diameter	36.22 –36.24 (1.426 –1.427)	–
Exhaust oversize rework dimensions of valve seat hole mm (in)	0.3 oversize diameter	30.22 –30.24 (1.190 –1.191)	–
Piston and connecting rod			
Piston pin press-fit load N (pound)		7,500 –17,500 (1,686 –3,934)	–
Clearance between piston ring and ring groove mm (in)	No.1	0.03 –0.07 (0.001 –0.003)	0.1 (0.004)
	No.2	0.03 –0.07 (0.001 –0.003)	0.1 (0.004)
Piston ring end gap mm (in)	No.1	0.15 –0.28 (0.006 –0.011)	0.8 (0.03)
	No.2	0.30 –0.45 (0.012 –0.018)	0.8 (0.03)
	Oil	0.10 –0.35 (0.004 –0.014)	1.0 (0.004)
Clearance of connecting rod big end thrust mm (in)		0.10 –0.25 (0.004 –0.010)	0.4 (0.016)
Outside diameter of connecting rod bolt mm (in)		–	0.1 (0.004)
Connecting rod bearing oil clearance mm (in)		0.018 –0.045 (0.0007 –0.0018)	0.1 (0.004)
Crankshaft and cylinder block			
Underhead length of bearing cap bolt mm (in)		75.3 (2.96)	–
Crankshaft end play mm (in)		0.05 –0.25 (0.002 –0.010)	0.4 (0.016)
Crankshaft journal oil clearance mm (in)		0.012 –0.030 (0.0005 –0.0012)	0.1 (0.004)
Distortion of cylinder block top surface mm (in)		0.05 (0.002)	0.02 (0.0008)
Grinding limit of cylinder block top surface mm (in)		–	0.2 (0.008)
Cylinder block cylinder bore mm (in)		86 (3.4)	–
Cylindricity of cylinder block mm (in)		0.15 (0.006)	–

FASTENER TIGHTENING SPECIFICATIONS

M1113023402071

Item	Specification
Generator and ignition system	
Idler pulley bolt	48 ± 7 N· m (36 ± 4 ft-lb)
Auto tensioner	22 ± 4 N· m (17 ± 2 ft-lb)
Crankshaft bolt	210 N· m (155 ft-lb)
Generator nut	44 ± 10 N· m (32 ± 7 ft-lb)
Generator bolt	44 ± 10 N· m (32 ± 7 ft-lb)
Ignition coil bolt	10 ± 2 N· m (89 ± 17 in-lb)
Spark plug	25 ± 5 N· m (19 ± 3 ft-lb)
Power steering pump bracket bolt (M8)	23 ± 2 N· m (17 ± 1 ft-lb)
Power steering pump bracket bolt (M10)	44 ± 8 N· m (33 ± 5 ft-lb)
Throttle body and EGR system	
Vacuum pump assembly bolt (M6)	11 ± 1 N· m (98 ± 8 in-lb)
Vacuum pump assembly bolt (M8)	24 ± 3 N· m (18 ± 1 ft-lb)
Throttle body bolt	9.5 ± 2.5 N· m (84 ± 22 in-lb)
Throttle body stay bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Exhaust gas recirculation valve support bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Exhaust gas recirculation pipe bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Exhaust gas recirculation support stay A bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Exhaust gas recirculation support stay B bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Exhaust gas recirculation valve bolt	24 ± 3 N· m (18 ± 1 ft-lb)
Manifold absolute pressure (MAP) sensor screw	4.0 ± 1.0 N· m (36 ± 8 in-lb)
Solenoid valve screw	4.0 ± 1.0 N· m (36 ± 8 in-lb)
Intake manifold and fuel system	
Oil dipstick guide bolt	10 ± 2 N· m (89 ± 17 in-lb)
Injector protector rear bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Fuel rail bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Intake manifold nut	20 ± 2 N· m (15 ± 1 ft-lb)
Intake manifold assembly bolt washer	20 ± 2 N· m (15 ± 1 ft-lb)
Intake manifold stay bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Injector protector front bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Generator bracket bolt	44 ± 8 N· m (33 ± 5 ft-lb)
Knock sensor bolt	20 ± 2 N· m (15 ± 1 ft-lb)
Engine oil pressure switch	10 ± 2 N· m (89 ± 17 in-lb)
Exhaust manifold	
Exhaust manifold upper cover bolt	14 ± 1 N· m (124 ± 8 in-lb)
Exhaust manifold lower cover bolt	14 ± 1 N· m (124 ± 8 in-lb)
Exhaust manifold nut	49 ± 5 N· m (36 ± 3 ft-lb)
Exhaust manifold bracket D bolt	20 ± 5 N· m (15 ± 3 ft-lb)

**ENGINE OVERHAUL
FASTENER TIGHTENING SPECIFICATIONS**

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Item	Specification
Exhaust manifold bracket bolt	41 ± 10 N· m (30 ± 7 ft-lb)
Exhaust manifold bracket A, B bolt	41 ± 10 N· m (30 ± 7 ft-lb)
Crankshaft position sensor bolt	11 ± 1 N· m (98 ± 8 in-lb)
Crankshaft position sensor cover bolt (M6)	11 ± 1 N· m (98 ± 8 in-lb)
Crankshaft position sensor cover bolt (M10)	49 ± 6 N· m (36 ± 4 ft-lb)
Water hose and pipe	
Water inlet fitting bolt	24 ± 3 N· m (18 ± 1 ft-lb)
Water outlet fitting bolt	24 ± 3 N· m (18 ± 1 ft-lb)
Thermostat housing bolt	24 ± 3 N· m (18 ± 1 ft-lb)
Engine hanger bolt	28 ± 8 N· m (21 ± 5 ft-lb)
Engine coolant temperature sensor	30 ± 9 N· m (22 ± 6 ft-lb)
Water pump bolt	24 ± 3 N· m (18 ± 1 ft-lb)
Water pipe nut	24 ± 3 N· m (18 ± 1 ft-lb)
Camshaft position sensor	11 ± 1 N· m (98 ± 8 in-lb)
Oil pan and timing chain case	
Cylinder head cover bolt	3.0 ± 1.0 N· m (27 ± 8 in-lb) →5.5 ± 0.5 N· m (49 ± 8 in-lb)
Timing chain case bolt (M6)	10 ± 2 N· m (89 ± 17 in-lb)
Timing chain case bolt (M8 × 10)	13 ± 1 N· m (115 ± 8 in-lb)
Timing chain case bolt (M8 × 28)	24 ± 4 N· m (18 ± 2 ft-lb)
Oil pan bolt (M6)	10 ± 2 N· m (89 ± 17 in-lb)
Oil pan bolt (M8)	29 ± 2 N· m (21 ± 1 ft-lb)
Air compressor bracket bolt	23 ± 6 N· m (17 ± 4 ft-lb)
Oil drain plug	39 ± 5 N· m (29 ± 3 ft-lb)
Oil filter	14 ± 2 N· m (124 ± 17 in-lb)
PCV valve	2.5 ± 0.4 N· m (22 ± 3 in-lb)
Engine support bracket assembly washer bolt	45 ± 5 N· m (33 ± 3 ft-lb)
Timing chain	
Chain upper guide bolt	10 ± 2 N· m (89 ± 17 in-lb)
Oil jet bolt	10 ± 2 N· m (89 ± 17 in-lb)
V.V.T. intake sprocket bolt	59 ± 5 N· m (44 ± 3 ft-lb)
V.V.T. exhaust sprocket bolt	59 ± 5 N· m (44 ± 3 ft-lb)
Timing chain tensioner bolt	10 ± 2 N· m (89 ± 17 in-lb)
Tensioner lever bolt	10 ± 2 N· m (89 ± 17 in-lb)
Timing chain guide bolt	10 ± 2 N· m (89 ± 17 in-lb)
Camshaft	
Engine oil control valve (OCV) bolt	10 ± 2 N· m (89 ± 17 in-lb)
Camshaft bearing cap bolt (M6)	12 ± 1 N· m (107 ± 8 in-lb)
Front camshaft bearing cap bolt (M8)	17 ± 3 N· m (14 ± 2 ft-lb) →30 ± 2 N· m (22 ± 1 ft-lb)

Item	Specification
Cylinder head and valves	
Cylinder head bolt	35 ± 2 N· m (26 ± 1 ft-lb) →+180°
Oil pump chain	
Drive plate bolt	40 ± 2 N· m (29 ± 1 ft-lb) →+30°
Flywheel bolt	40 N· m (30 ft-lb) →130 N· m (96 ft-lb)
Oil pump case bolt	26 ± 2 N· m (19 ± 1 ft-lb)
Oil pump sprocket bolt	23 ± 2 N· m (17 ± 1 ft-lb)
Oil pump tensioner lever bolt	10 ± 2 N· m (89 ± 17 in-lb)
Oil pump chain guide bolt	10 ± 2 N· m (89 ± 17 in-lb)
Ladder frame bolt	26 ± 1 N· m (19 ± 1 ft-lb)
Piston and connecting rod	
Connecting rod cap bolt	5.0 N· m (44 in-lb) →20 N· m (15 ft-lb) →+90°
Crankshaft and cylinder block	
Crankshaft sensing ring bolt	11 ± 1 N· m (98 ± 8 in-lb)
Bearing cap bolt	26.5 ± 2.0 N· m (20 ± 1 ft-lb) →+45°

NEW TIGHTENING METHOD BY USING PLASTIC REGION TIGHTENING BOLT

Plastic region tightening bolts are used in some parts of the engine. Install these bolts according to the method described in the body of the manual because the tightening method of these bolts are different from the conventional method. The service limit is determined for these bolts. Be sure to strictly follow the service limit described in the body of the manual.

- Parts to be used
 1. Cylinder head bolt

2. Bearing cap bolt
 3. Connecting rod cap bolt
- Tightening method
After tightening to the specified torque, further tighten 45° and 90°, or 180° (90° + 90°). Follow the tightening method described in the body of the manual because the tightening method differs from part to part.

SIZE OF TORQUE WRENCH USED

Tool size	Main parts to be used
T25	Solenoid valve
T25	Manifold absolute pressure (MAP) sensor
T30	Crankshaft sensing ring
T55	Cylinder head bolt


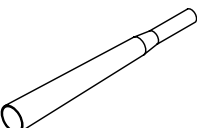
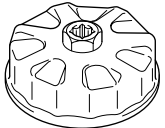
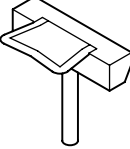
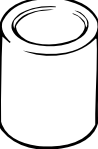
SEALANTS AND ADHESIVES

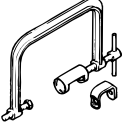
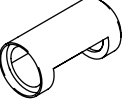
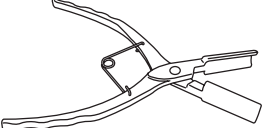
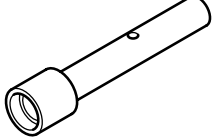
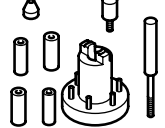
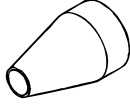
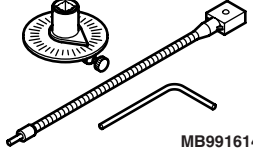
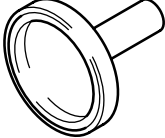
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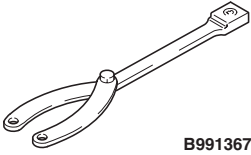
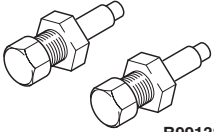
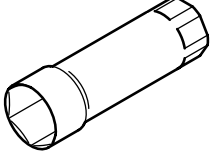
Item	Specified sealant
Flywheel bolt	LOCTITE 262 or equivalent
Ladder frame	Three bond 1217G, LOCTITE 5900, 5970, 5971 or equivalent
Cylinder block	
Cylinder head	
Cylinder head gasket	
Oil pan	
Timing chain case	
Cylinder head cover	Three bond 1217G or equivalent
Engine coolant temperature sensor	LOCTITE 262 or equivalent
Engine oil pressure switch	LOCTITE 565 or equivalent

SPECIAL TOOLS

M1113000601899

Tool	Tool number and name	Supersession	Application
 MB991883	MB991883 Flywheel stopper	-	Securing of drive plate and flywheel
	MB992106 O-ring installer	-	Installation of O-ring on injector injection nozzle side
 B991396	MB991396 Oil filter wrench	-	Removal and installation of oil filter
 D998727	MD998727 Oil pan FIPG cutter	MD998727-01	Removal of oil pan
	MB991448 Bushing remover and installer base	MB991448-01	Press fit of front oil seal

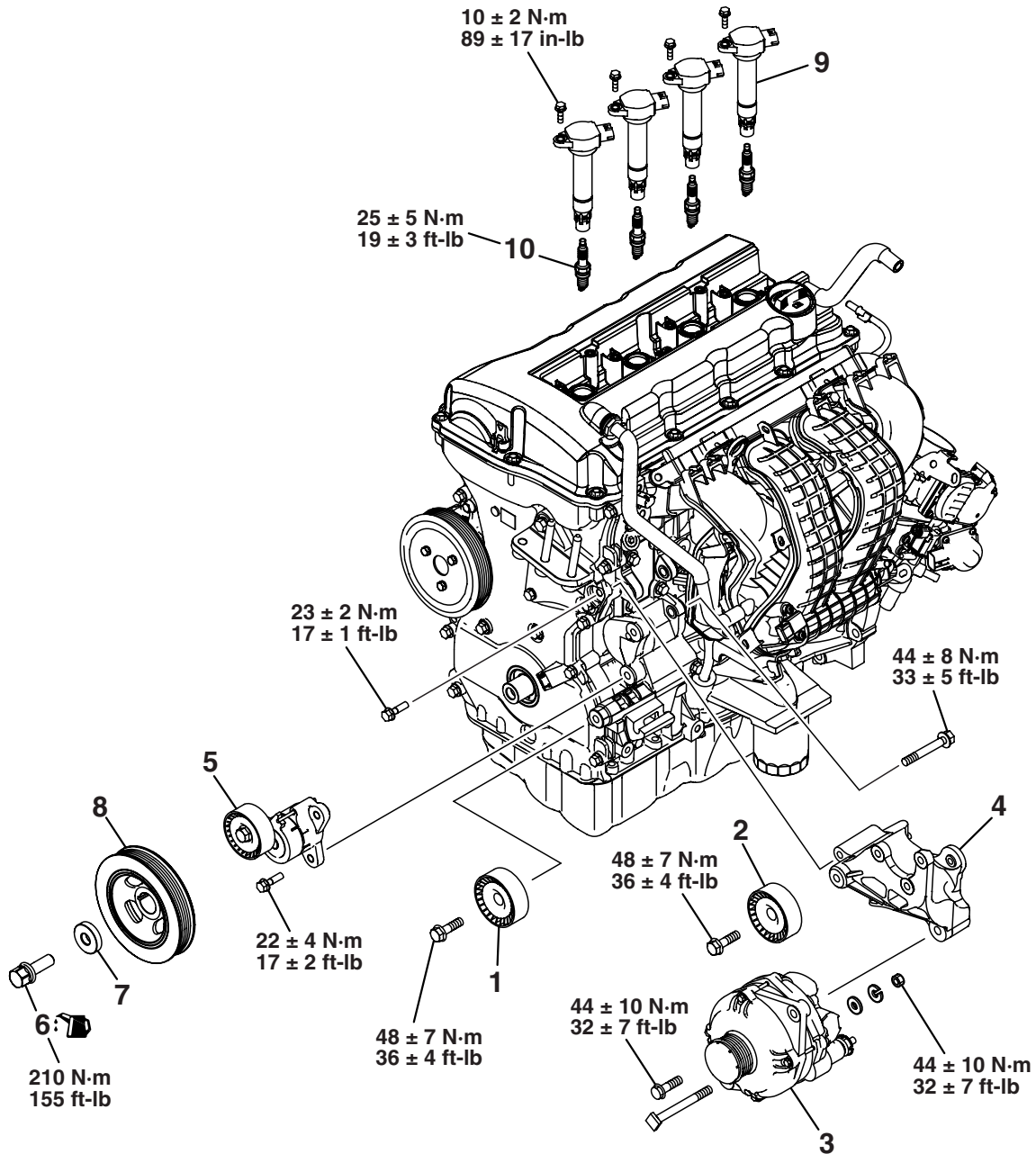
Tool	Tool number and name	Supersession	Application
	MD998735 Valve spring compressor	MD998735-01	Compression of valve spring
	MB992089 Retainer holder C	MB992089-01	
	MB992085 Valve stem seal pliers	-	Extraction of valve stem seal
	MD998737 Valve stem seal installer	MD998737-01	Installation of valve stem seal
	MD998780 Piston pin setting tool	MIT216941	Extraction and press fit of piston pin
	MB991659 Guide D	-	
	MB991614 Angle gauge	General service tool	Installation of crankshaft bearing cap bolt and installation of balancer shaft module bolt
	MD998718 Rear oil seal installer	MD998718-01	Press fit of rear oil seal

Tool	Tool number and name	Supersession	Application
 <p align="center">B991367</p>	MB991367 Special spanner	–	Removal and installation of oil pump sprocket
 <p align="center">B991385</p>	MB991385 Pin	–	
	MB991398 Spark plug wrench	–	Removal and installation of spark plug

GENERATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION

M1113001001403



AK600613AD

Removal steps

1. Idler pulley
2. Idler pulley
3. Generator
4. Power steering pump bracket
- >>C<< 5. Auto tensioner

Removal steps (Continued)

- | | | |
|-------|-------|---------------------------|
| <<A>> | >>B<< | 6. Crankshaft pulley bolt |
| | >>B<< | 7. Washer |
| | >>B<< | 8. Crankshaft pulley |
| | | 9. Ignition coil |
| <> | >>A<< | 10. Spark plug |

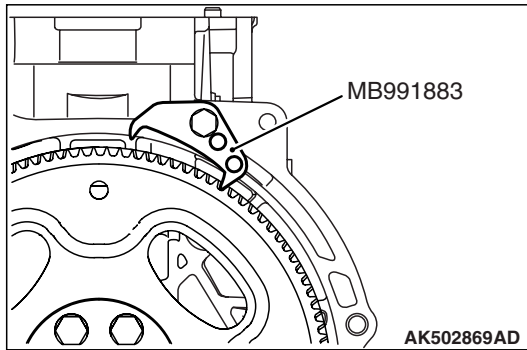
Required Special Tools:

- MB991398: Spark Plug Wrench
- MB991883: Flywheel Stopper

REMOVAL SERVICE POINT

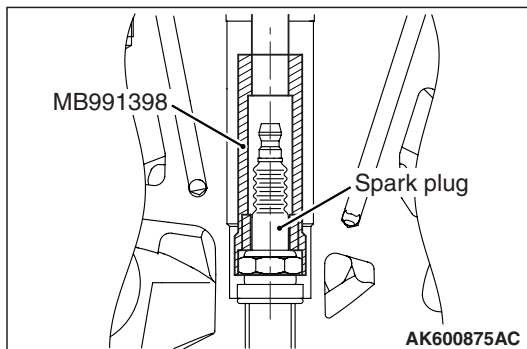
<<A>> CRANKSHAFT PULLEY BOLT REMOVAL

1. Use special tool MB991883 to secure the drive plate or flywheel.
2. Remove the crankshaft pulley bolt.



<> SPARK PLUG REMOVAL

Using special tool MB991398, removal the spark plug.

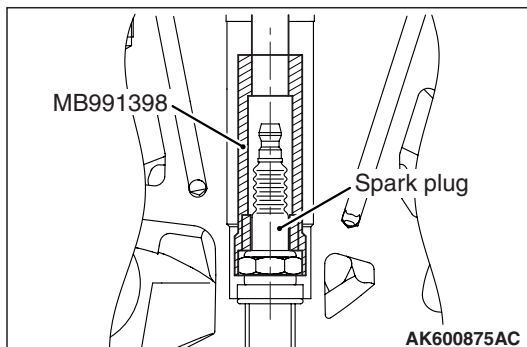


INSTALLATION SERVICE POINTS

>>A<< SPARK PLUGS INSTALLATION

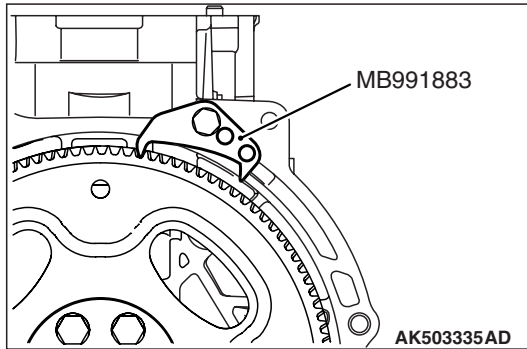
Using special tool MB991398, tighten the spark plug to the specified torque.

Specified torque: 18 ± 2 N·m (13 ± 1 ft-lb)

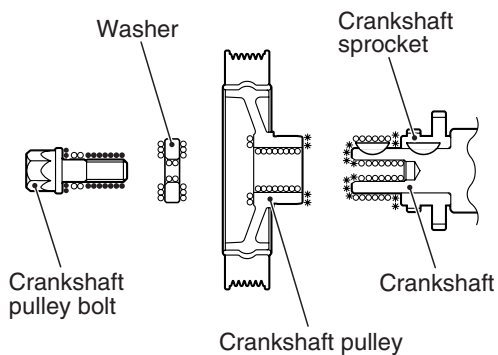


>>B<< CRANKSHAFT PULLEY / WASHER /
CRANKSHAFT PULLEY BOLT INSTALLATION

1. Use special tool MB991883 to secure the drive plate or flywheel.



- : 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.



← Engine front

AK602911AD

2. Wipe off the dirt on the washer and on the thread hole of the crankshaft using a rag.
3. Wipe off the dirt on the crankshaft pulley and the crankshaft sprocket using a rag, and then remove the grease from the portion shown in the illustration.

NOTE: Remove grease to prevent the coefficient of friction of the pressing portion from declining due to adhesion of oil.

4. Install the crankshaft pulley.
5. Apply an appropriate and minimum amount of engine oil to the threaded portion of the crankshaft and lower part of the flange.
6. With off the chamfered side on the inside of the washer facing the bolt top, install the washer to the crankshaft pulley bolt.
7. Tighten the crankshaft pulley bolt to the specified torque.

Specified torque: 210 N·m (155 ft-lb)

>>C<< GENERATOR / POWER STEERING PUMP BRACKET INSTALLATION

1. Temporarily tighten power steering pump bracket bolts.
2. Temporarily tighten generator bolts.
3. Tighten them to the specified torque according to the order as illustrated.

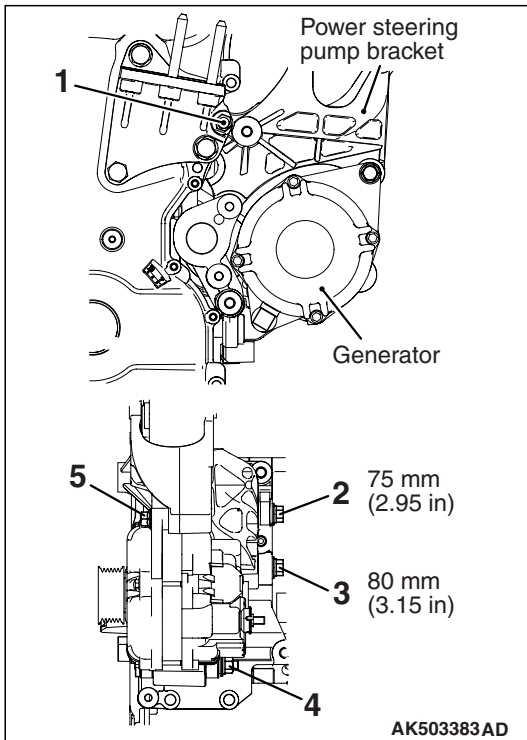
Specified torque

Power steering pump bracket:

M8 23 ± 2 N·m (17 \pm 1 ft-lb)

M10 44 ± 8 N·m (33 \pm 5 ft-lb)

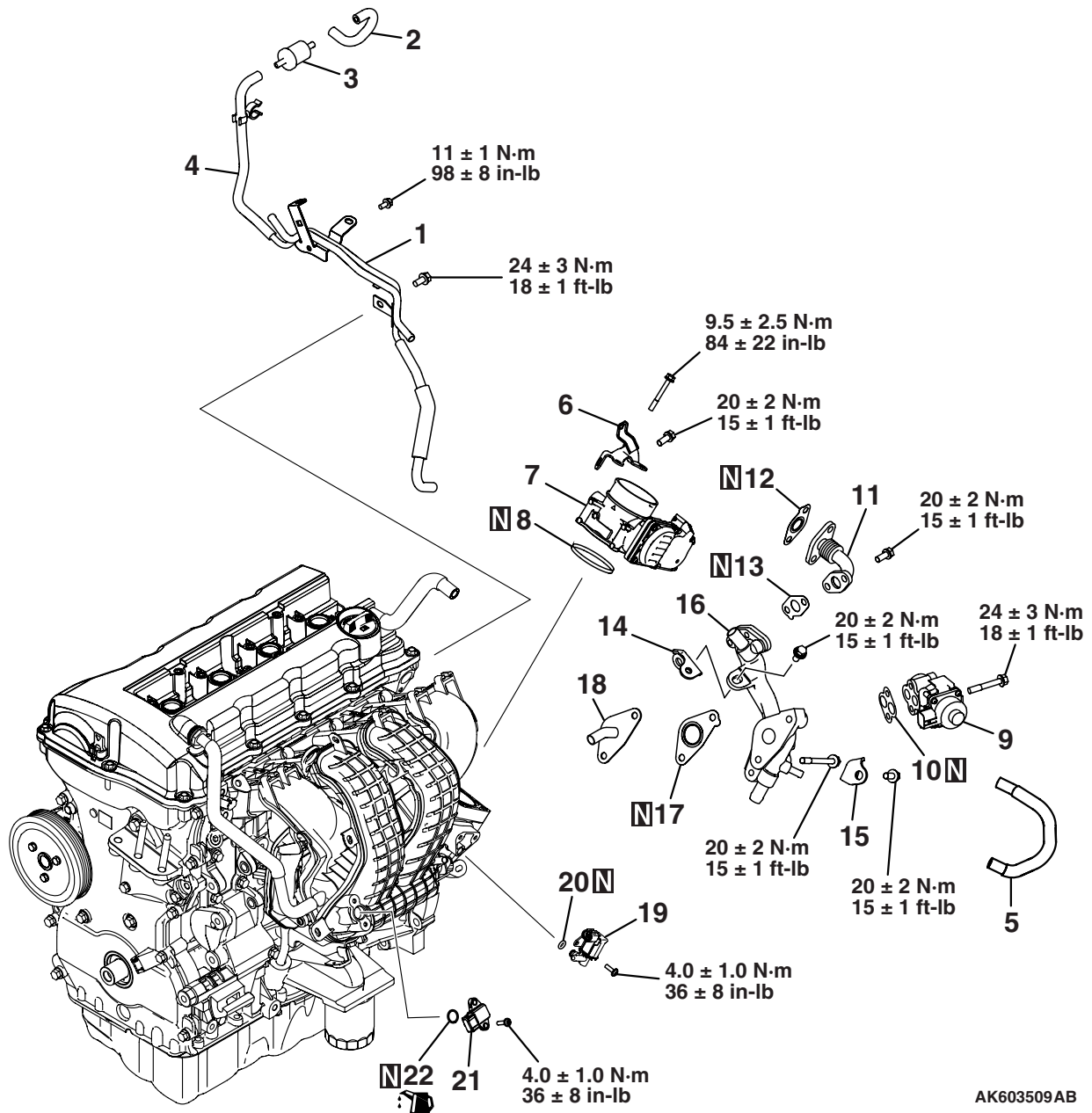
Generator: 44 ± 10 N·m (32 \pm 7 ft-lb)



THROTTLE BODY AND EGR SYSTEM

REMOVAL AND INSTALLATION

M1113032700063



AK603509AB

Removal steps

1. Vacuum pipe assembly
2. Purge hose
3. Chamber
4. Purge hose
5. Water hose
6. Throttle body stay
- >>D<< 7. Throttle body
- >>D<< 8. Throttle body gasket
- >>C<< 9. Exhaust gas recirculation valve <for California>
- >>C<< 10. Exhaust gas recirculation valve gasket <for California>

Removal steps (Continued)

- >>B<< 11. Exhaust gas recirculation pipe <for California>
- >>B<< 12. Gasket <for California>
- >>B<< 13. Gasket <for California>
- >>B<< 14. Exhaust gas recirculation support stay A <for California>
- >>B<< 15. Exhaust gas recirculation support stay B <for California>
- >>B<< 16. Exhaust gas recirculation valve support <for California>
- >>B<< 17. Gasket <for California>
- >>B<< 18. Exhaust gas recirculation inlet pipe <for California>

Removal steps (Continued)

- 19. Solenoid valve
- 20. O-ring
- >>A<< 21. Manifold absolute pressure (MAP) sensor
- 22. O-ring

INSTALLATION SERVICE POINTS

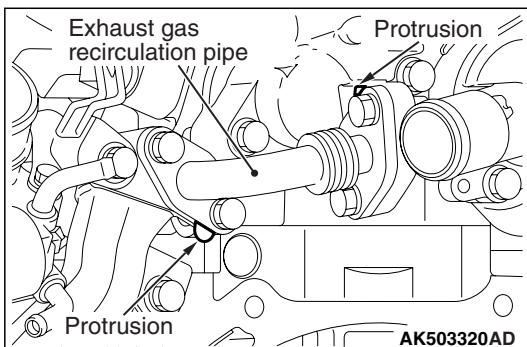
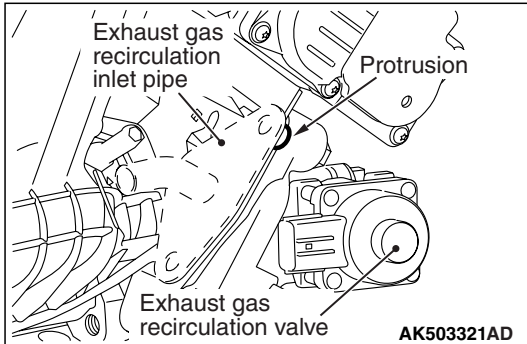
>>A<< MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR INSTALLATION

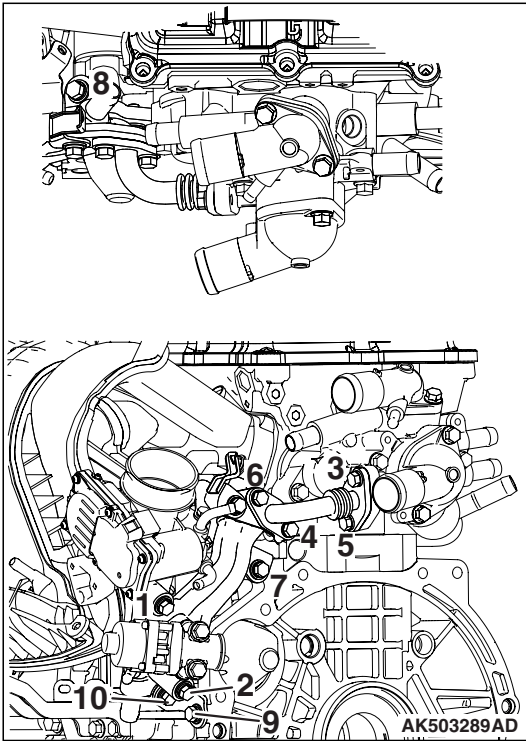
⚠ CAUTION

- Install the manifold absolute pressure (MAP) sensor, taking care not to give a shock to it.
- Do not use a manifold absolute pressure (MAP) sensor that has been dropped.

>>B<< EXHAUST GAS RECIRCULATION INLET PIPE / EXHAUST GAS RECIRCULATION VALVE SUPPORT / EXHAUST GAS RECIRCULATION SUPPORT STAY A / EXHAUST GAS RECIRCULATION SUPPORT STAY B / EXHAUST GAS RECIRCULATION PIPE / GASKET INSTALLATION

1. Temporarily tighten each part so that the protrusion of each gasket is positioned as illustrated.

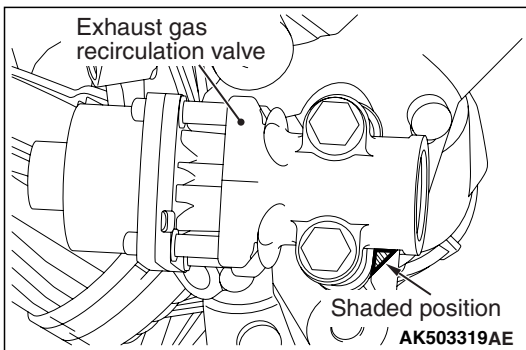




2. Tighten mounting bolts to the specified torque of 20 ± 2 N·m (15 ± 1 ft-lb) in the order shown in the illustration.

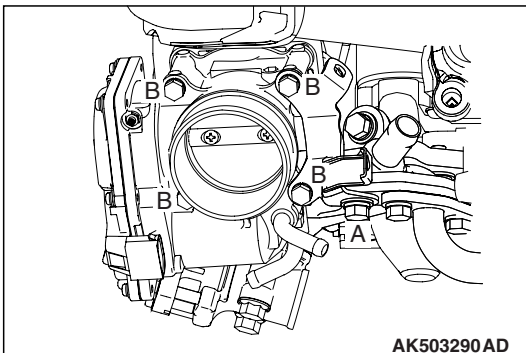
>>C<< EXHAUST GAS RECIRCULATION VALVE GASKET INSTALLATION

Install the exhaust gas recirculation valve gasket with the diagonally shaded area used as the illustrated position so as not to confuse the front with the back.



>>D<< THROTTLE BODY GASKET / THROTTLE BODY INSTALLATION

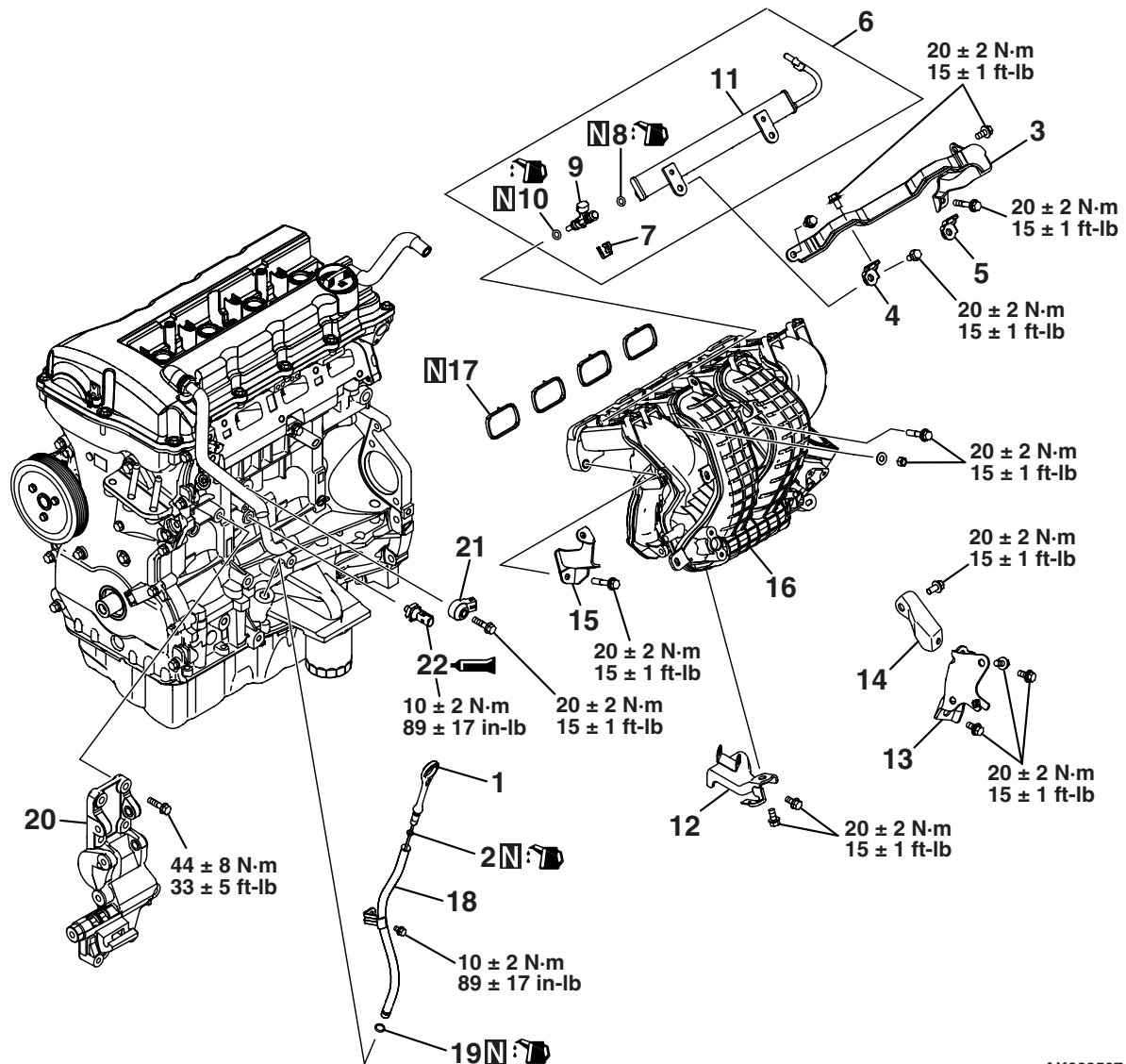
1. Make sure that the throttle body gasket is placed before installing the throttle body.
2. Temporarily tighten throttle body and throttle body stay mounting bolts at A and B in the illustration.
3. Tighten the throttle body mounting bolt at illustrated position A to the specified torque of 20 ± 2 N·m (15 ± 1 ft-lb).
4. Tighten the throttle body mounting bolts at illustrated position B to the specified torque of 9.5 ± 2.5 N·m (84 ± 22 in-lb).



INTAKE MANIFOLD AND FUEL SYSTEM

REMOVAL AND INSTALLATION

M1113032500144



AK603507AB

Removal steps

1. Oil dipstick rod
- >>G<< 3. Injector protector rear
- >>G<< 4. Bracket
- >>G<< 5. Bracket
- >>G<< 6. Fuel rail assembly
- >>F<< 7. Injection support
- >>F<< 8. O-ring
- >>F<< 9. Injector
- >>E<< 10. O-ring
- >>D<< 11. Fuel rail
- >>D<< 12. Intake manifold stay

Removal steps (Continued)

13. Intake manifold stay B <except for California>
14. Intake manifold stay C <except for California>
- >>C<< 15. Injector protector front
- >>C<< 16. Intake manifold
- >>C<< 17. Intake manifold gasket
- >>C<< 18. Oil dipstick guide
- >>C<< 19. O-ring
- >>B<< 20. Generator bracket
- >>B<< 21. Knock sensor
- >>A<< 22. Engine oil pressure switch

Required Special Tool:

- MB992106: O-ring Installer

TSB Revision

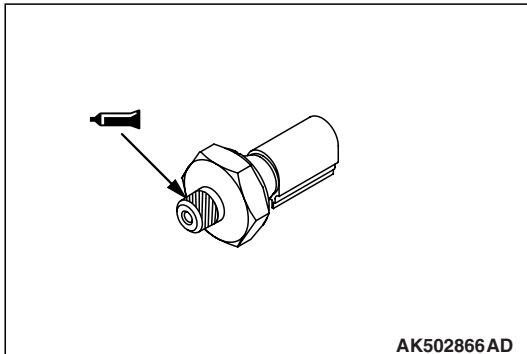
INSTALLATION SERVICE POINTS

>>A<< ENGINE OIL PRESSURE SWITCH INSTALLATION

⚠ CAUTION

- Do not allow sealant to squeeze out to the screw tip.
 - Do not exceed the specified torque.
1. Completely remove sealant adhering to the engine oil pressure switch and cylinder block threaded holes.
 2. Apply sealant (LOCTITE 565 or equivalent) of 5 mm to the threaded portion of the engine oil pressure switch shown in the illustration.
 3. Tighten the engine oil pressure switch to the cylinder block to the specified torque.

Specified torque: 10 ± 2 N·m (89 ± 17 in-lb)

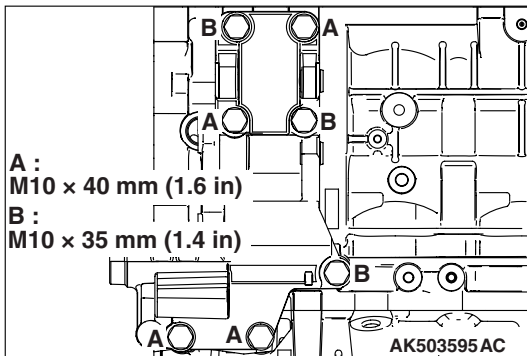


>>B<< GENERATOR BRACKET INSTALLATION

Tighten the Generator bracket to the specified torque.

Specified torque: 44 ± 8 N·m (33 ± 5 ft-lb)

NOTE: Be careful when install mounting bolts as they are different in length. See illustration for bolt locations.



>>C<< INTAKE MANIFOLD INSTALLATION

⚠ CAUTION

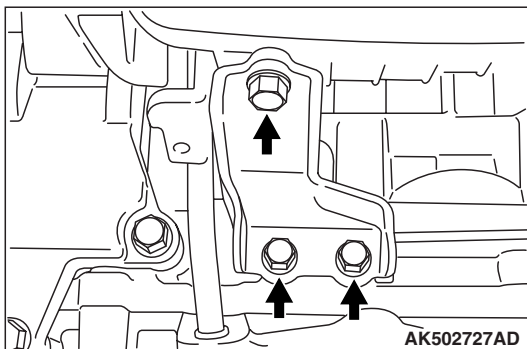
Temporarily tighten the intake manifold because there is a bolt tightening procedure for the intake manifold, fuel rail and injector protector.

Install the intake manifold and temporarily tighten bolts.

>>D<< INTAKE MANIFOLD STAY INSTALLATION

Make sure that the intake manifold stay is in intimate contact with the intake manifold and cylinder block boss before tightening it to the specified torque.

Specified torque: 20 ± 2 N·m (15 ± 1 ft-lb)

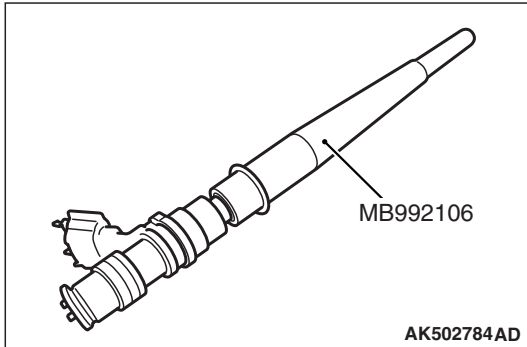


>>E<< O-RING INSTALLATION

⚠ CAUTION

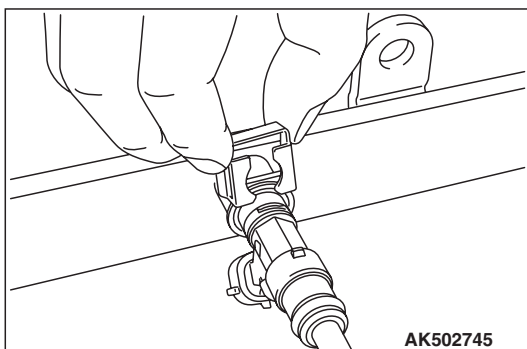
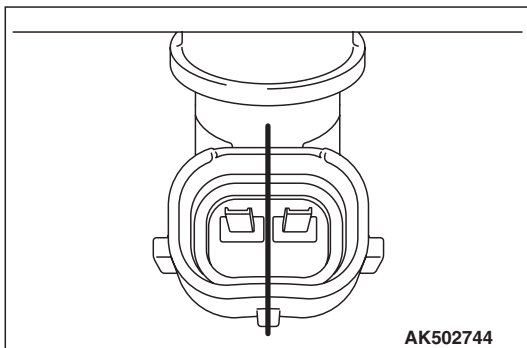
Do not allow engine oil to enter the fuel rail.

When inserting an O-ring into the injector on the injection nozzle side, use special tool MB992106 to gradually expand the O-ring, and fit it in place.



>>F<< INJECTOR AND INJECTOR SUPPORT INSTALLATION

1. Apply spindle oil or gasoline to the O-ring of the injector.
2. Insert the injector into the fuel rail while rotating the injector from side to side, taking care not to damage the O-ring.
3. Check that the injector rotates smoothly. If it does not rotate smoothly, the O-ring may be caught. Remove the injector and check the O-ring for damage. Then, insert it again into the fuel rail and check.
4. Make sure that the protrusion of the injector is at the center as shown in the illustration.

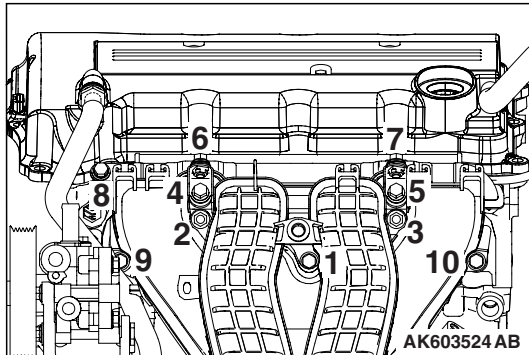


5. Securely assemble the injector to the injector groove and fuel rail collar.

**>>G<< FUEL RAIL ASSEMBLY / BRACKET /
INJECTOR PROTECTOR REAR INSTALLATION**

1. Install the fuel rail assembly, bracket and injector protector on the cylinder head.
2. Tighten mounting bolts to the specified torque together with temporarily tightened intake manifold mounting bolts in the order shown in the illustration.

Specified torque: 20 ± 2 N·m (15 ± 1 ft-lb)

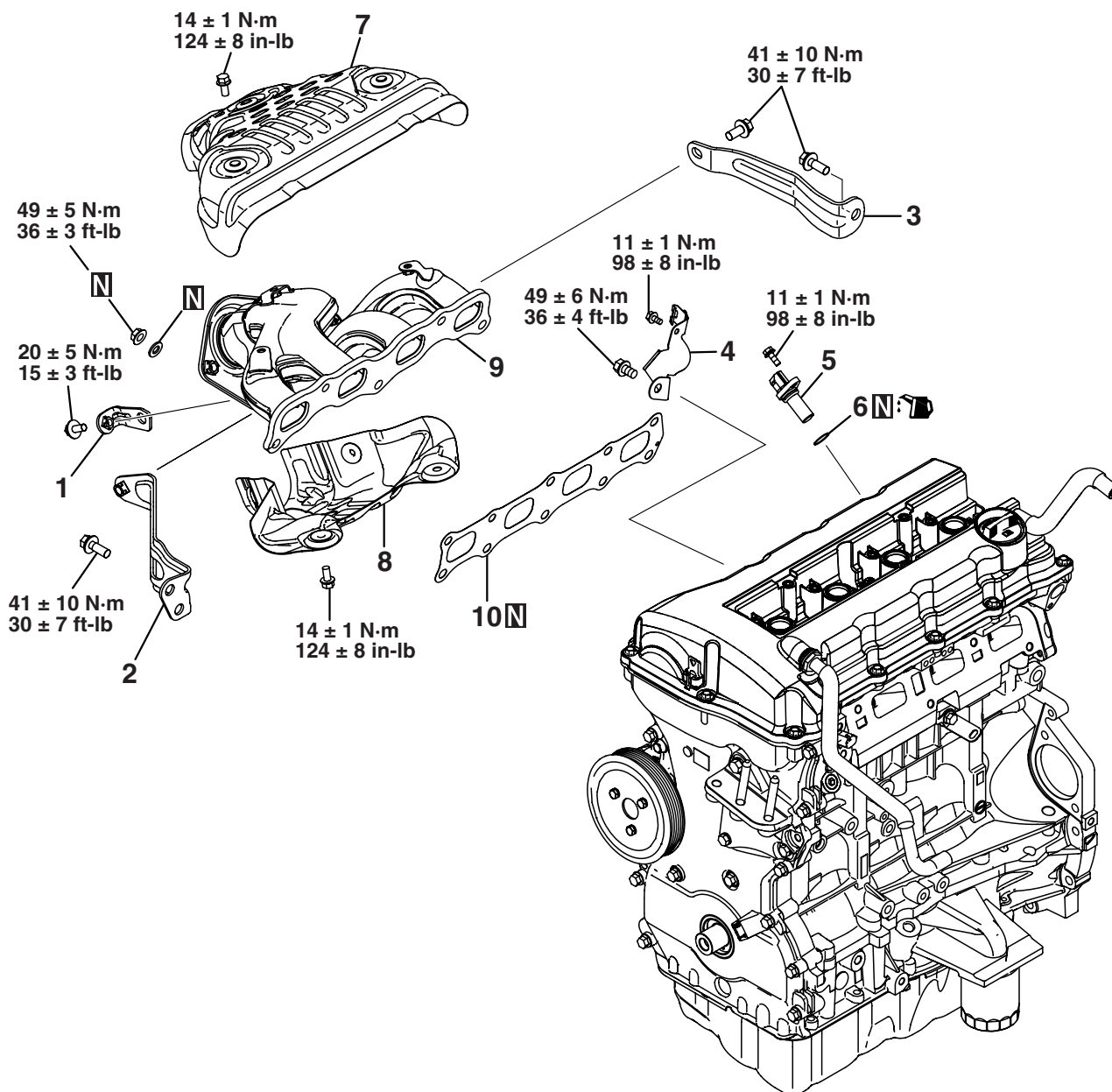


EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004901320

<For except CALIFORNIA>



AK603508AB

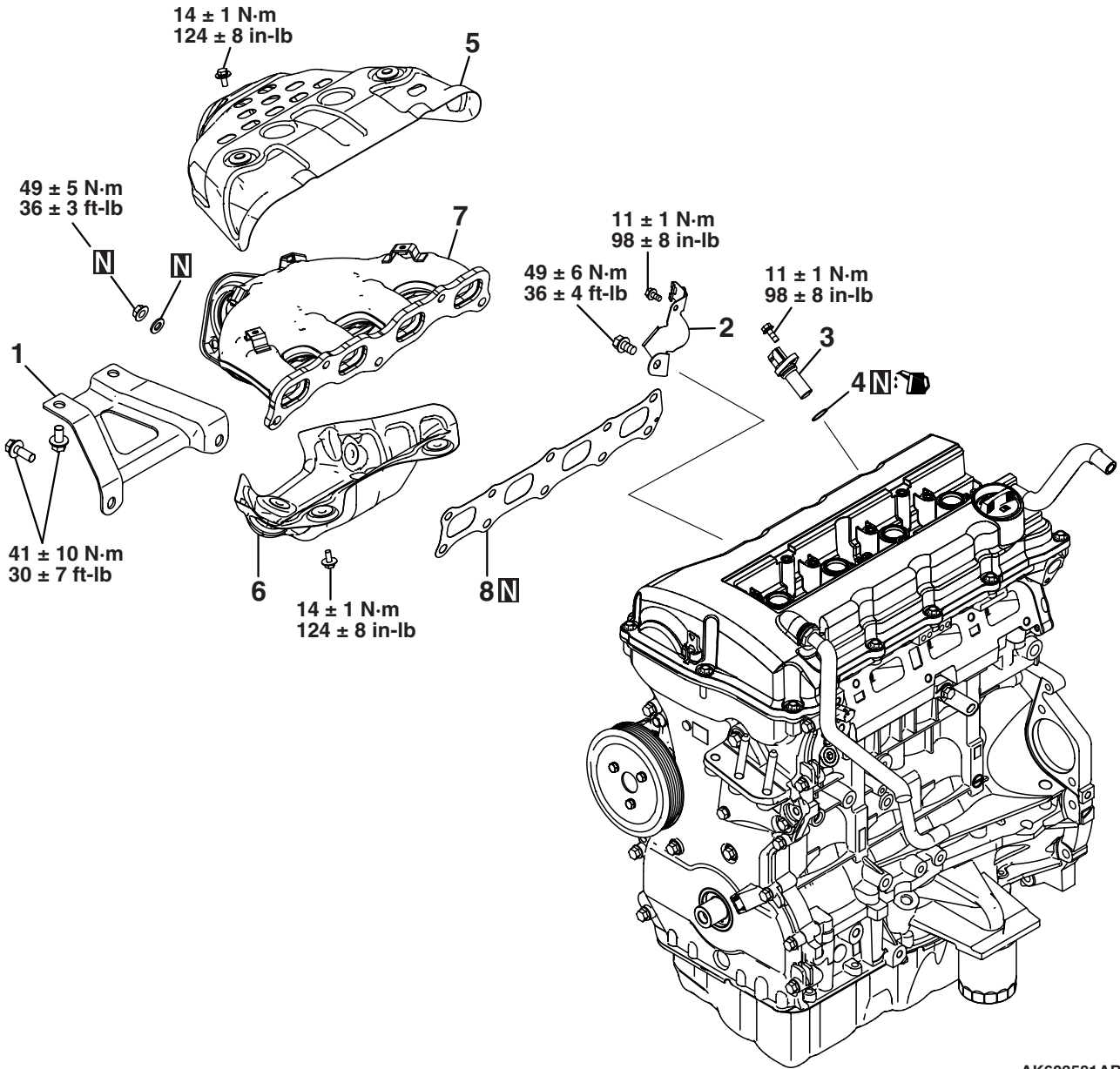
Removal steps

1. Exhaust manifold bracket D
- >>B<< 2. Exhaust manifold bracket A
- >>B<< 3. Exhaust manifold bracket B
4. Crankshaft position sensor cover
- >>A<< 5. Crankshaft position sensor

Removal steps (Continued)

6. O-ring
7. Exhaust manifold upper cover
8. Exhaust manifold lower cover
9. Exhaust manifold
10. Exhaust manifold gasket

<For CALIFORNIA>



AK603581AB

Removal steps

- >>A<<
1. Exhaust manifold bracket
 2. Crankshaft position sensor cover
 3. Crankshaft position sensor
 4. O-ring

Removal steps (Continued)

5. Exhaust manifold upper cover
6. Exhaust manifold lower cover
7. Exhaust manifold
8. Exhaust manifold gasket

INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT POSITION SENSOR INSTALLATION

⚠ CAUTION

- Do not apply a force such as torsion or twist to the O-ring during assembly of the sensor.
- Assemble the sensor, taking care not to give a shock to it.
- Do not use a sensor that has been dropped.

Tighten the crankshaft position sensor to the specified torque.

Specified torque: 11 ± 1 N·m (98 ± 8 in-lb)

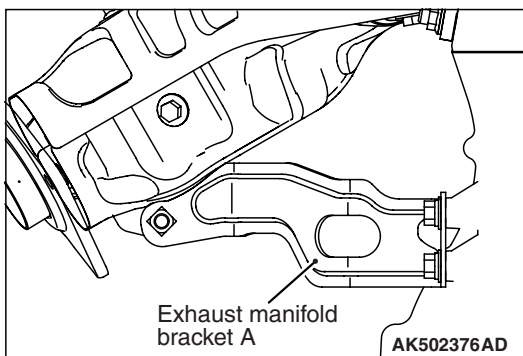
>>B<< EXHAUST MANIFOLD BRACKET A / EXHAUST MANIFOLD BRACKET B INSTALLATION

⚠ CAUTION

The exhaust manifold gasket, washers and nuts must not be reused.

Make sure that exhaust manifold bracket B is in direct contact with the exhaust manifold and exhaust manifold bracket A, and then tighten it to the specified torque.

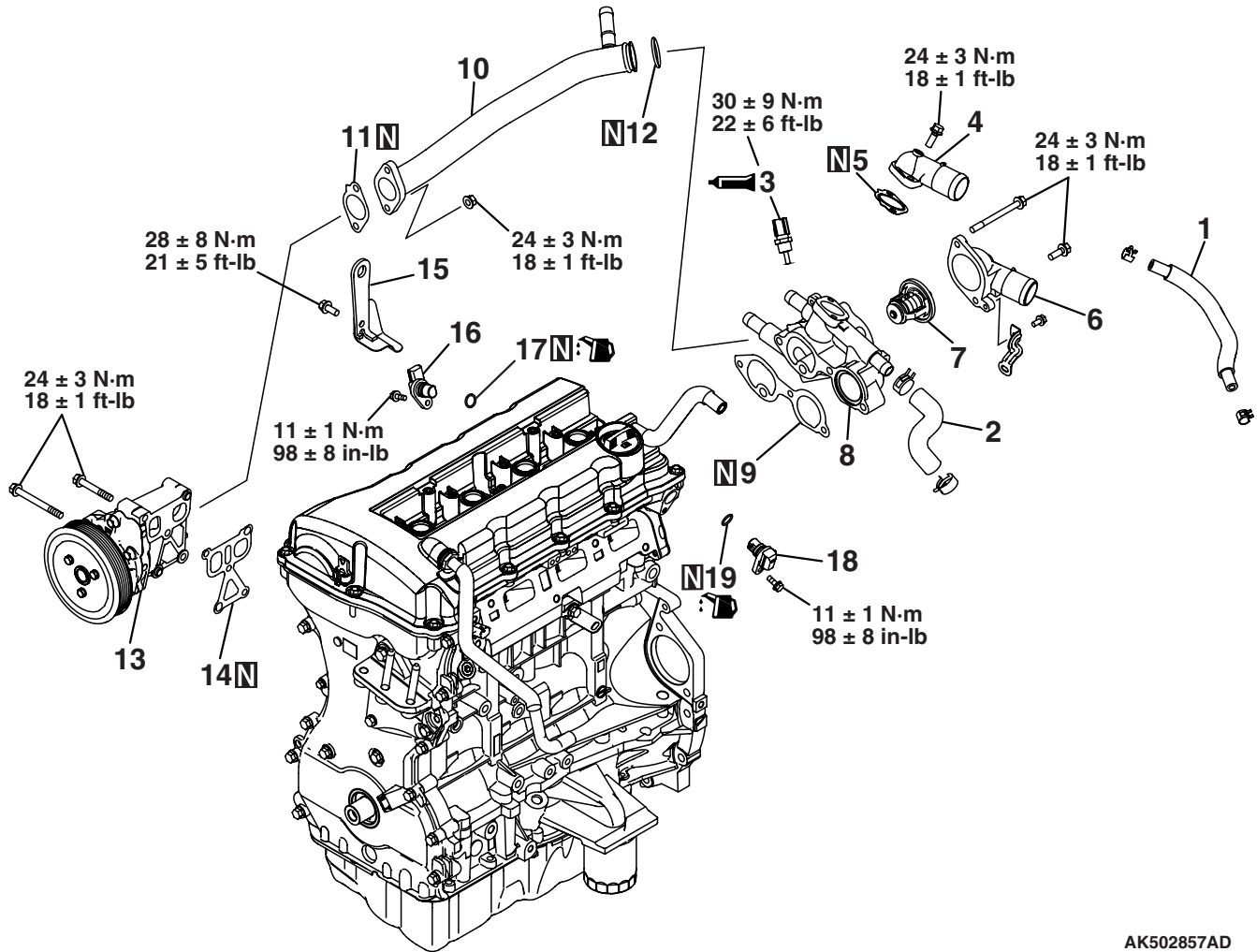
Specified torque: 41 ± 10 N·m (30 ± 7 ft-lb)



WATER HOSE AND PIPE

REMOVAL AND INSTALLATION

M1113032900078



AK502857AD

Removal steps

1. Water hose
2. Water hose <for California>
- >>C<< 3. Engine coolant temperature sensor
4. Water outlet fitting
5. Outlet fitting gasket
- >>B<< 6. Water inlet fitting
- >>A<< 7. Thermostat
- >>A<< 8. Thermostat housing
9. Thermostat housing gasket
- >>A<< 10. Water pipe assembly

Removal steps (Continued)

11. Water pipe gasket
12. O-ring
13. Water pump assembly
14. Water pump gasket
15. Engine hanger
16. Intake camshaft position sensor
17. O-ring
18. Exhaust camshaft position sensor
19. O-ring

INSTALLATION SERVICE POINTS

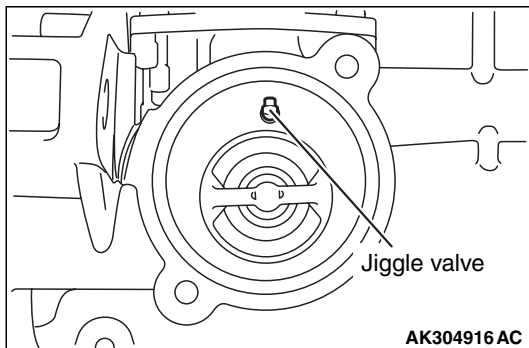
>>A<< THERMOSTAT HOUSING / WATER PIPE ASSEMBLY INSTALLATION

Assemble the thermostat housing and water pipe, and temporarily tighten them to the cylinder head and water pump. Then tighten them to the specified torque.

Specified torque: 24 ± 3 N·m (18 ± 1 ft-lb)

>>B<< THERMOSTAT INSTALLATION

Install the thermostat with the jiggle-valve facing almost straight upwards.



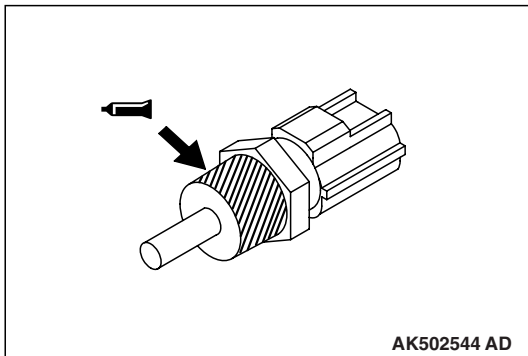
>>C<< ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION

⚠ CAUTION

Be careful not to give a shock, twist and the like to the resin mold with a tool during installation.

1. Apply an appropriate and minimum amount of sealant (LOCTITE 262 or equivalent) to the engine coolant temperature sensor, taking care not to allow sealant to squeeze out.
2. Tighten the engine coolant temperature sensor to the cylinder block to the specified torque.

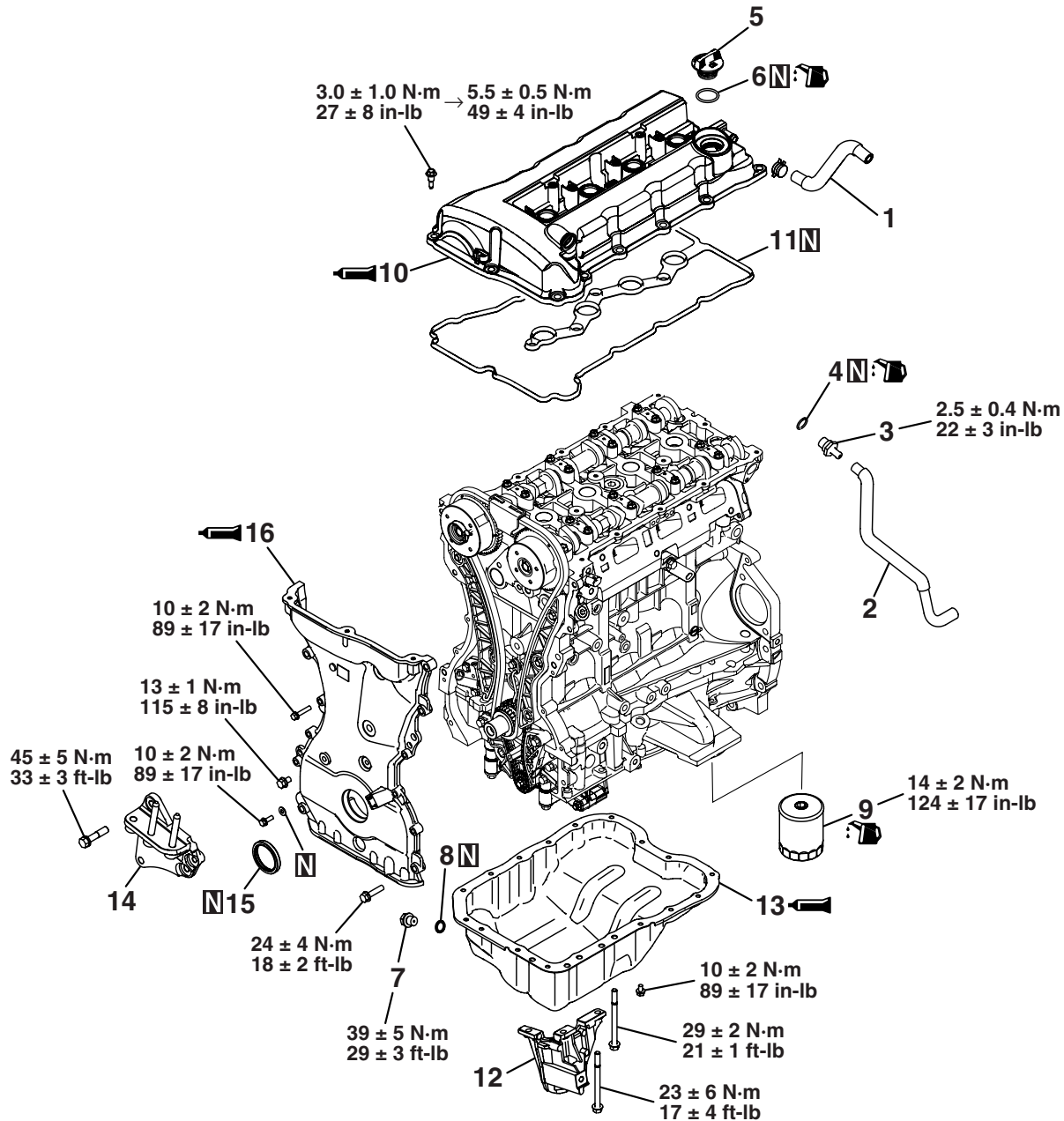
Specified torque: 30 ± 9 N·m (22 ± 6 ft-lb)



OIL PAN AND TIMING CHAIN CASE

REMOVAL AND INSTALLATION

M1113026300312



AK603510AB

Removal steps

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

Removal steps (Continued)

- | | | |
|-------|-------|--------------------------------|
| <<A>> | >>E<< | 9. Oil filter |
| | >>D<< | 10. Cylinder head cover |
| | | 11. Cylinder head cover gasket |
| | | 12. Air compressor bracket |
| <> | >>C<< | 13. Oil pan |
| | >>B<< | 14. Engine support bracket |
| <<C>> | >>A<< | 15. Front oil seal |
| | | 16. Timing chain case |

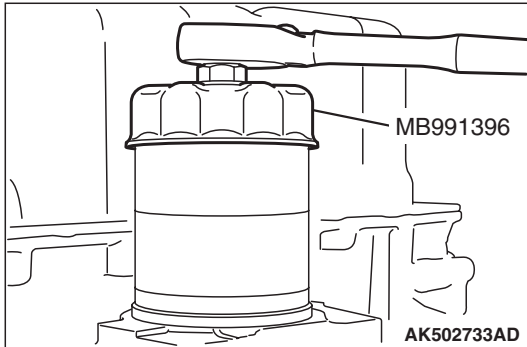
Required Special Tools:

- MB991396: Oil Filter Wrench
- MD998727: Oil Pan FIPG Cutter
- MB991448: crankshaft front oil seal installer

REMOVAL SERVICE POINTS

<<A>> OIL FILTER REMOVAL

Use special tool MB991396 to remove the oil filter.



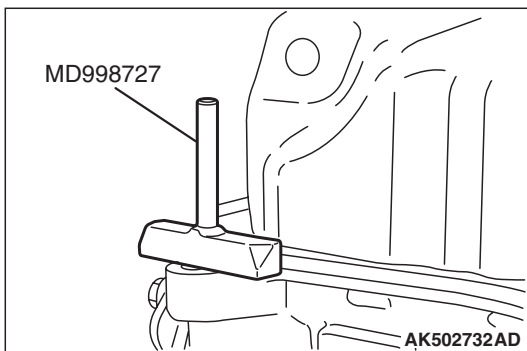
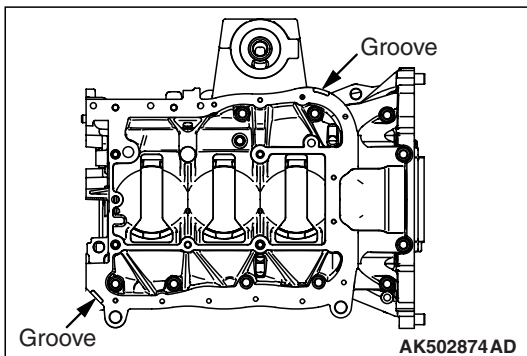
<> OIL PAN REMOVAL

1. Remove oil pan tightening bolts.

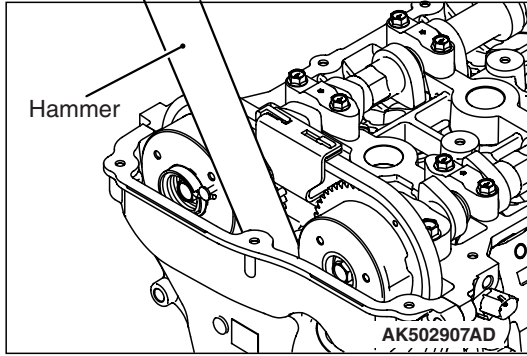
⚠ CAUTION

Lightly tap the oil pan FIPG cutter to drive in, taking care not to damage the ladder frame and oil pan sealed area.

2. Lightly tap special tool oil pan FIPG cutter (MD998727) to drive in the illustrated groove of the oil pan and ladder frame.



3. Lightly tap and slide special tool MD998727 to remove the oil pan.

**<<C>> TIMING CHAIN CASE REMOVAL**

If the timing chain case is difficult to remove, insert a hammer handle as shown in the illustration and lightly pry it.

INSTALLATION SERVICE POINTS**>>A<< TIMING CHAIN CASE INSTALLATION****⚠ CAUTION**

Be sure to remove liquid gasket that has entered mounting holes and O-ring grooves.

1. Completely remove liquid gasket adhering to the timing chain case, cylinder block and 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. Using white gasoline and so on, degrease the surface where the liquid gasket is applied and the contact surface between the cylinder block and the cylinder head.

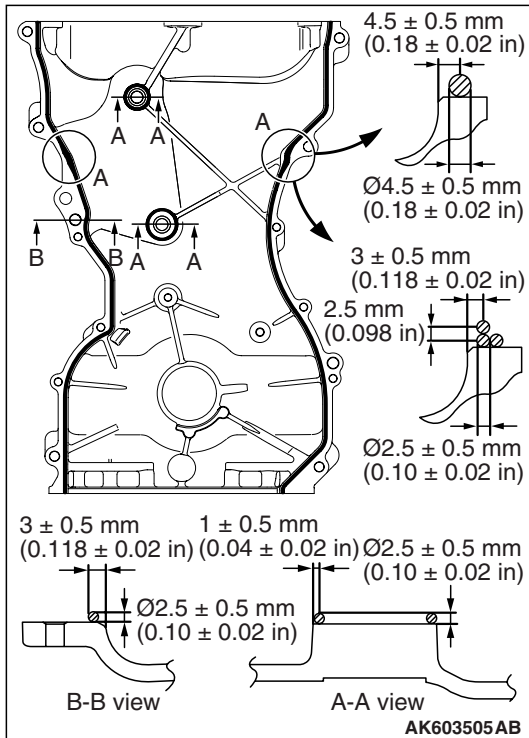
CAUTION

Install the timing chain case within three minutes after applying liquid gasket.

3. Apply liquid gasket (Three bond 1217G, LOCTITE 5900, 5970, 5971 or equivalent) of 2.5 ± 0.5 mm (0.10 ± 0.02 inch) in thickness to the timing chain case. For illustrated A locations, however, apply liquid gasket of 4.5 ± 0.5 mm (0.18 ± 0.02 inch) in diameter or liquid gasket of 2.5 ± 0.5 mm (0.10 ± 0.02 inch) by putting one on top of another as shown in the illustration.

4. Install the timing chain case.

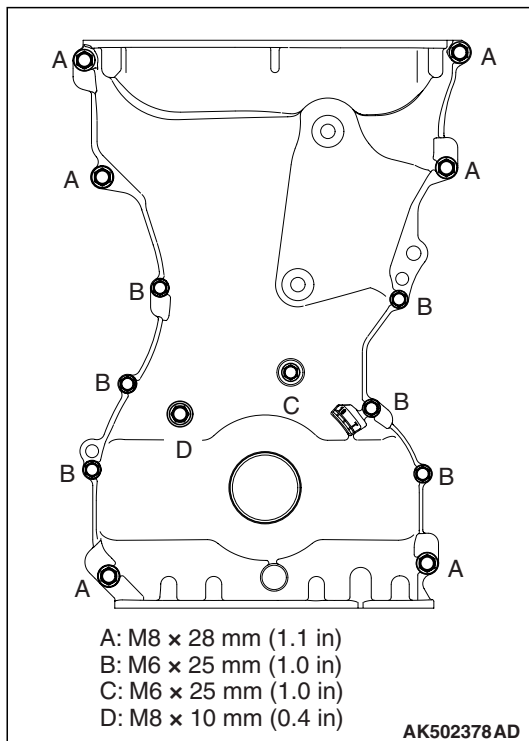
NOTE: Be careful when install mounting bolts as they are different in length.



5. Tighten timing chain case mounting bolts to the specified torque.

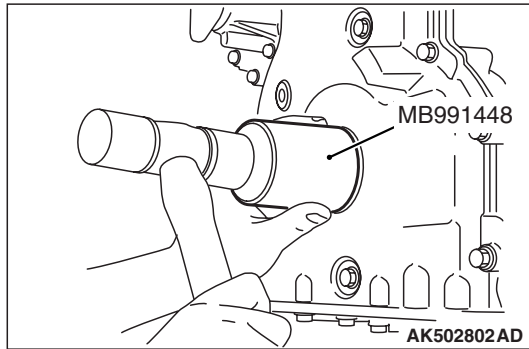
Specified torque

- A: 24 ± 4 N·m (18 ± 2 ft-lb)**
- B: 10 ± 2 N·m (89 ± 17 in-lb)**
- C: 10 ± 2 N·m (89 ± 17 in-lb)**
- D: 13 ± 1 N·m (115 ± 8 in-lb)**



>>B<< FRONT OIL SEAL INSTALLATION

1. Apply engine oil to the internal circumference of the oil seal.
2. Use special tool MB991448 to install the front oil seal on the timing chain case.

**>>C<< OIL PAN INSTALLATION**

1. Completely remove liquid gasket adhering to the cylinder block and oil pan.
2. Using white gasoline and so on, degrease the cylinder block and oil pan.

⚠ CAUTION

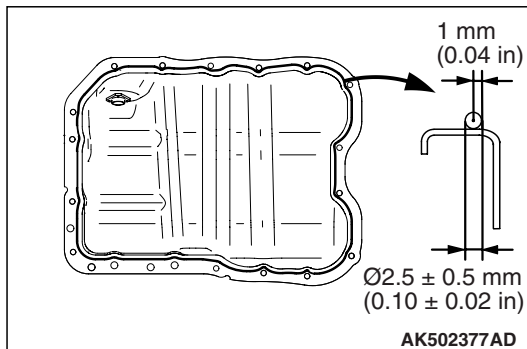
Install the oil pan within three minutes after liquid gasket is applied.

3. Apply liquid gasket (Three bond 1217G, LOCTITE 5900, 5970, 5971 or equivalent) of $\phi 2.5 \pm 0.5$ mm (0.10 ± 0.02 inch) of thickness in diameter to the illustrated area of the oil pan.
4. Tighten the oil pan to the specified torque.

Specified torque

M6: 10 ± 1 N·m (89 ± 17 in·lb)

M8: 29 ± 2 N·m (21 ± 1 ft·lb)

**>>D<< CYLINDER HEAD COVER INSTALLATION**

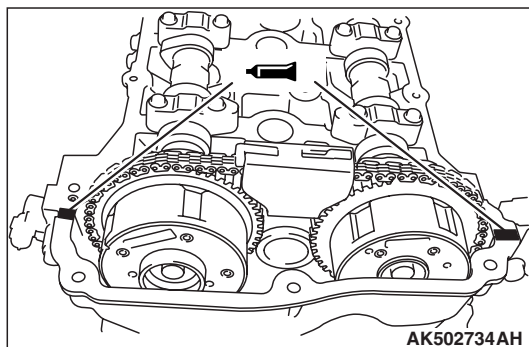
1. Completely remove liquid gasket adhering to the cylinder head cover, timing chain case and cylinder head.
2. Using white gasoline and so on, degrease the cylinder head cover, timing chain case and cylinder head.

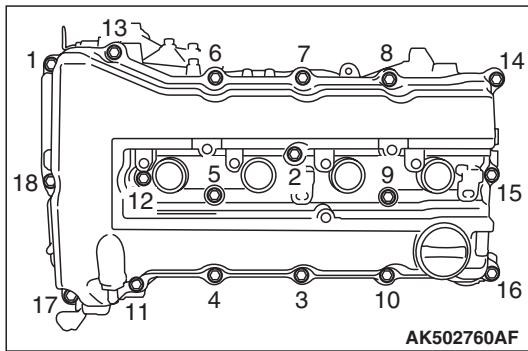
⚠ CAUTION

Install the cylinder head cover immediately after liquid gasket is applied.

3. Appropriately use a minimum amount of sealant. Be careful not to allow sealant to squeeze out from the application area.

Apply liquid gasket (Three bond 1217G or equivalent) of 4 mm of thickness in diameter.



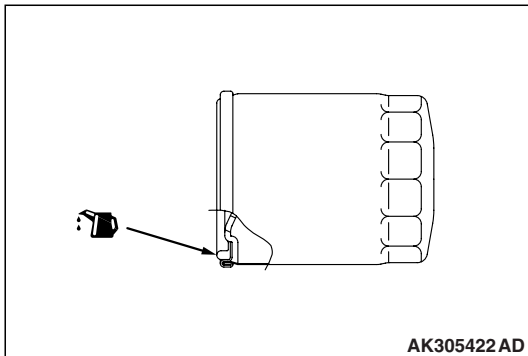


4. Tighten the cylinder head cover to the tightening torque of $3.0 \pm 1.0 \text{ N} \cdot \text{m}$ ($27 \pm 8 \text{ in-lb}$) in the order shown in the illustration.
5. Then, tighten it to the specified torque in the same order.

Specified torque: $5.5 \pm 0.5 \text{ N} \cdot \text{m}$ ($49 \pm 4 \text{ in-lb}$)

>>E<< OIL FILTER INSTALLATION

1. Clean the oil filter mounting surface of the ladder frame.
2. Apply engine oil to the O-ring of the oil filter.

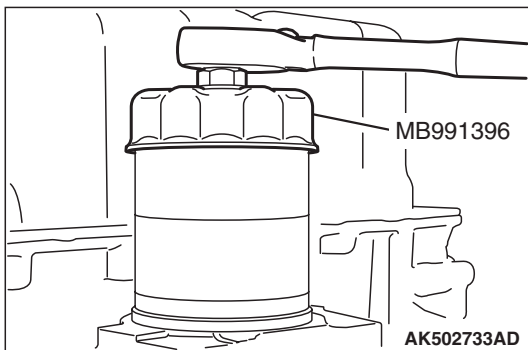


CAUTION

Use special tool MB991396 to install the oil filter. Tightening it by hand causes oil leakage due to lack of torque.

3. Screw in the oil filter. When the O-ring contacts the mounting surface, use a filter wrench to tighten it

Specified torque: $3/4 \text{ turn}$ ($14 \pm 2 \text{ N} \cdot \text{m}$ [$124 \pm 17 \text{ in-lb}$]).

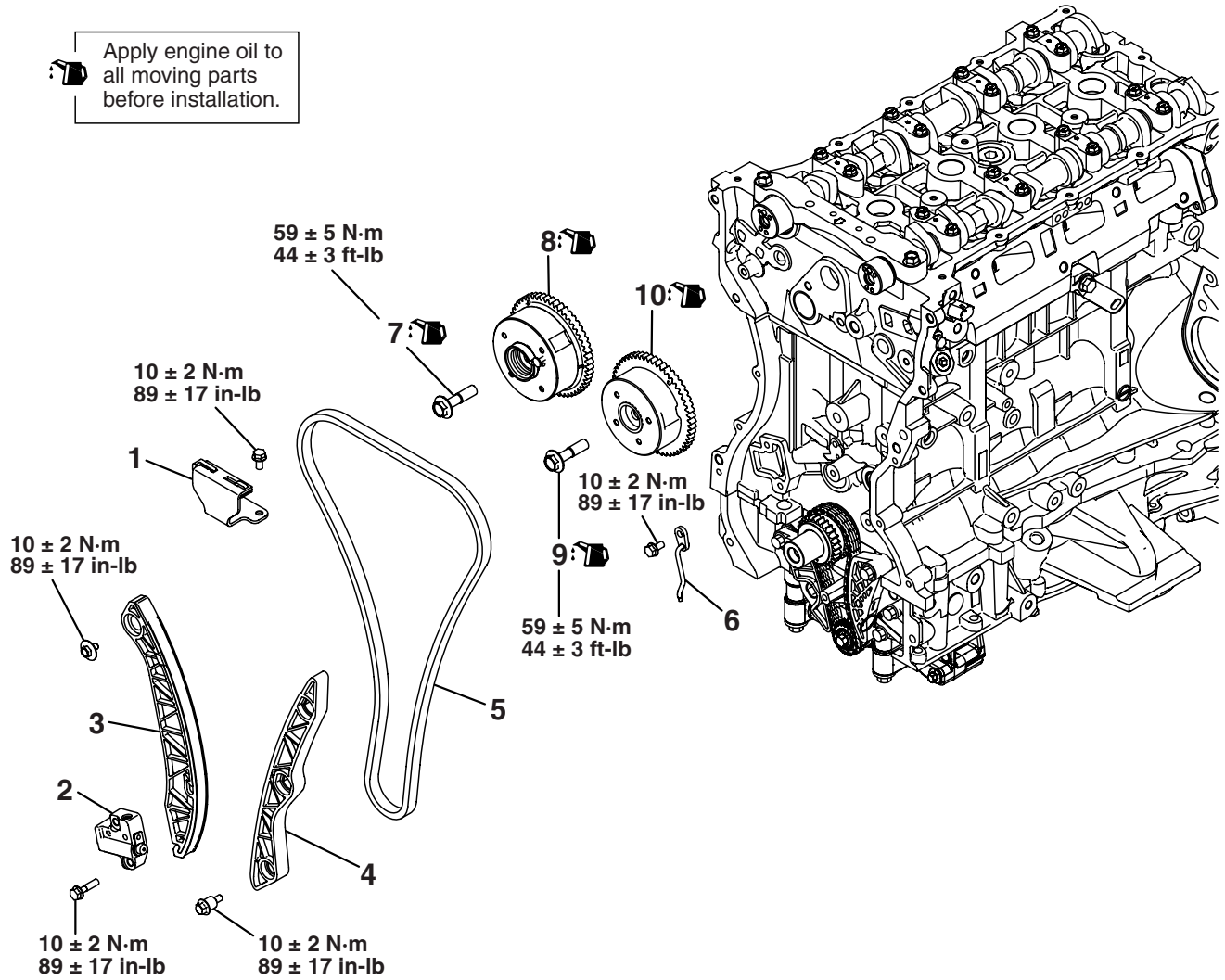


TIMING CHAIN

REMOVAL AND INSTALLATION

M1113026600261

Apply engine oil to all moving parts before installation.



AK502933AD

Removal steps

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

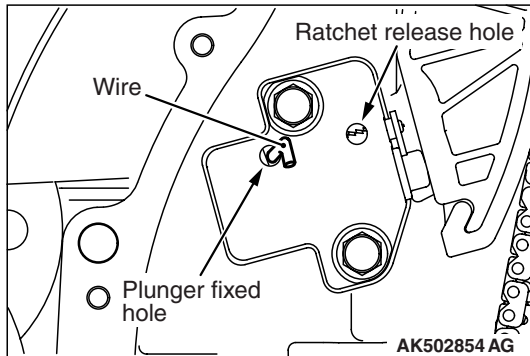
Removal steps (Continued)

- <> >>B<< 6. Oil jet
- <<C>> >>A<< 7. Exhaust V.V.T. sprocket bolt
- 8. Exhaust V.V.T. sprocket assembly
- 9. Intake V.V.T. sprocket bolt
- 10. Intake V.V.T. sprocket assembly

REMOVAL SERVICE POINTS

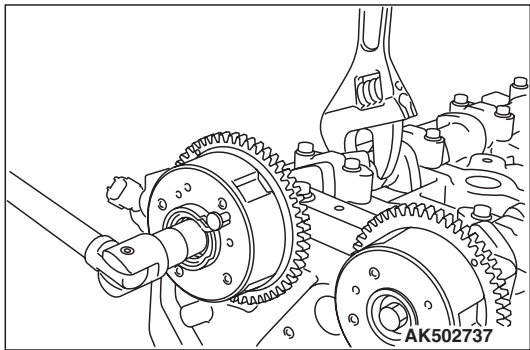
<<A>> TIMING CHAIN TENSIONER REMOVAL

1. Insert a flatblade screwdriver into the release hole of the timing chain tensioner to release the latch.
2. Push the tensioner lever by hand and push in the plunger of the timing chain tensioner until it hits the bottom. Then, insert a hard wire (piano wire or the like) of $\phi 1.5$ or hexagonal bar wrench (1.5 mm [0.05 inch]) into the fixing hole of the plunger.
3. Remove the timing chain tensioner.



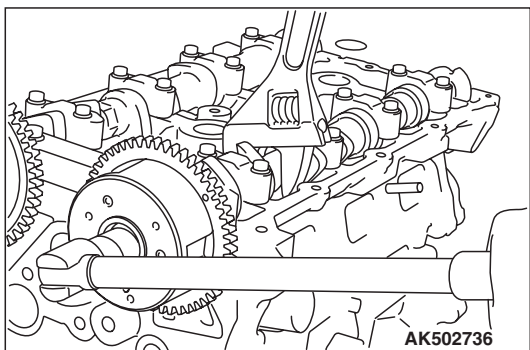
<> EXHAUST V.V.T. SPROCKET BOLT REMOVAL

Hold the hexagonal portion of the exhaust camshaft with a wrench and loosen the exhaust V.V.T. sprocket bolt.



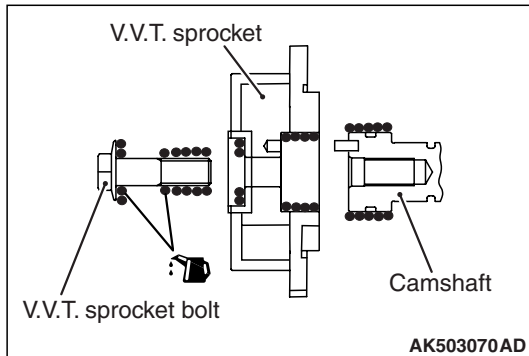
<<C>> INTAKE V.V.T. SPROCKET BOLT REMOVAL

Hold the hexagonal portion of the intake camshaft with a wrench and loosen the intake V.V.T. sprocket bolt.



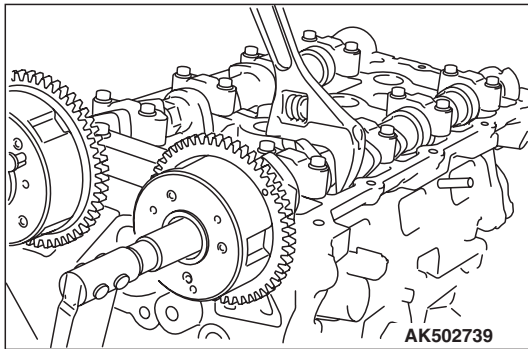
INSTALLATION SERVICE POINTS

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



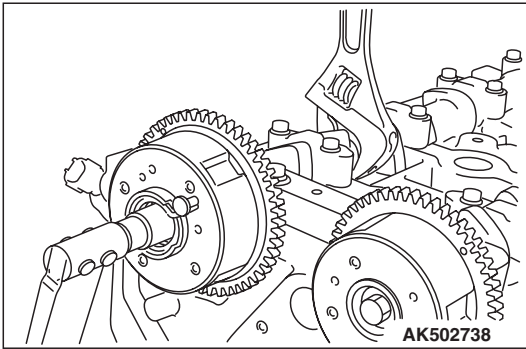
1. Assemble the intake V.V.T. sprocket assembly in the following procedure.
 - Make sure that the knock pin of the inlet camshaft assembly is positioned facing straight upward.
 - Apply an appropriate and minimum amount of engine oil to the circumference of the tip of the intake V.V.T. sprocket assembly and the entire circumference of the area into which the intake V.V.T. sprocket assembly is inserted.
 - Slowly insert the intake V.V.T. sprocket assembly into the normal position of the inlet camshaft assembly with its knock pin hole facing straight upward.
2. Install the V.V.T. sprocket.
3. Make sure that the V.V.T. sprocket is securely inserted into the bottom and that the V.V.T. sprocket does not rotate with the hexagonal portion of the camshaft secured with a wrench.
4. Hold the hexagonal portion of the camshaft with a wrench and tighten the intake V.V.T. sprocket bolt to the specified torque.

Specified torque: 59 ± 5 N·m (44 ± 3 ft-lb)



>>B<< EXHAUST V.V.T. SPROCKET BOLT INSTALLATION

1. Assemble the exhaust V.V.T. sprocket assembly in the following procedure.
 - Make sure that the knock pin of the exhaust camshaft assembly is positioned facing straight upward.
 - Apply an appropriate and minimum amount of engine oil to the circumference of the tip of the exhaust V.V.T. sprocket assembly and the entire circumference of the area into which the exhaust V.V.T. sprocket assembly is inserted.
 - Slowly insert the exhaust V.V.T. sprocket assembly into the normal position of the exhaust camshaft assembly with its knock pin hole facing straight upward.
2. Install the V.V.T. sprocket.
3. Make sure that the V.V.T. sprocket is securely inserted into the bottom and that the V.V.T. sprocket does not rotate with the hexagonal portion of the camshaft secured with a wrench.

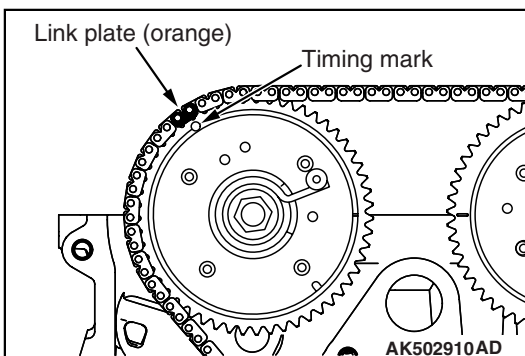
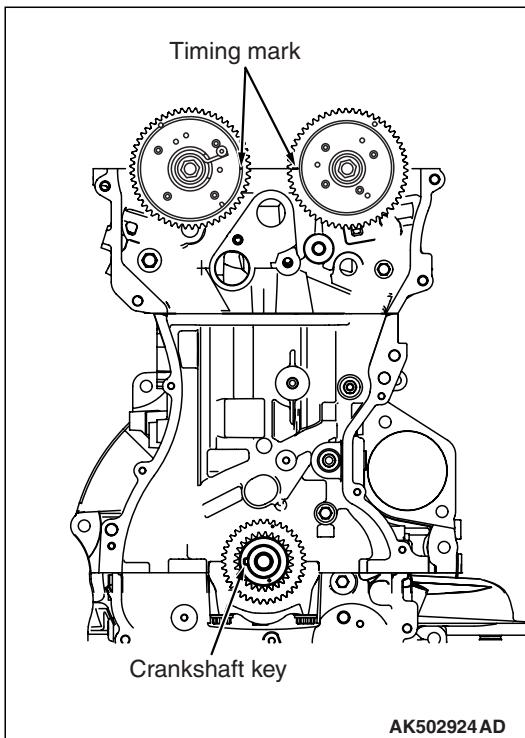


4. Hold the hexagonal portion of the camshaft with a wrench and tighten the camshaft sprocket bolt to the specified torque.

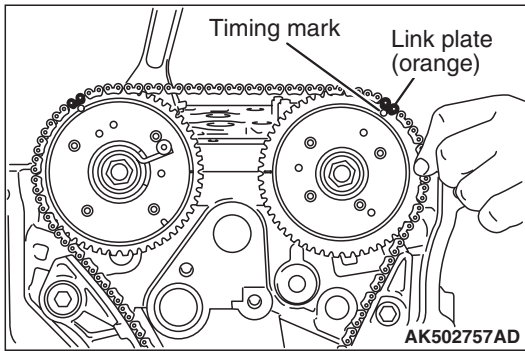
Specified torque: 59 ± 5 N· m (44 ± 3 ft-lb)

>>C<< TIMING CHAIN INSTALLATION

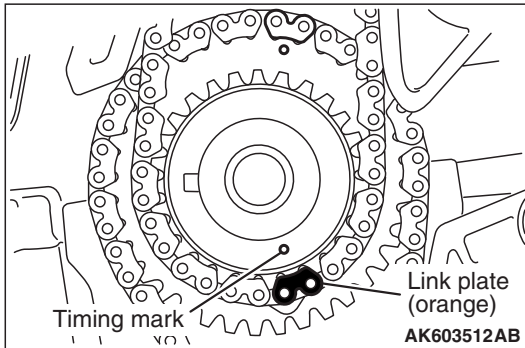
1. Align the timing mark of the V.V.T. sprocket.
2. Align the crankshaft sprocket keys with illustrated positions.



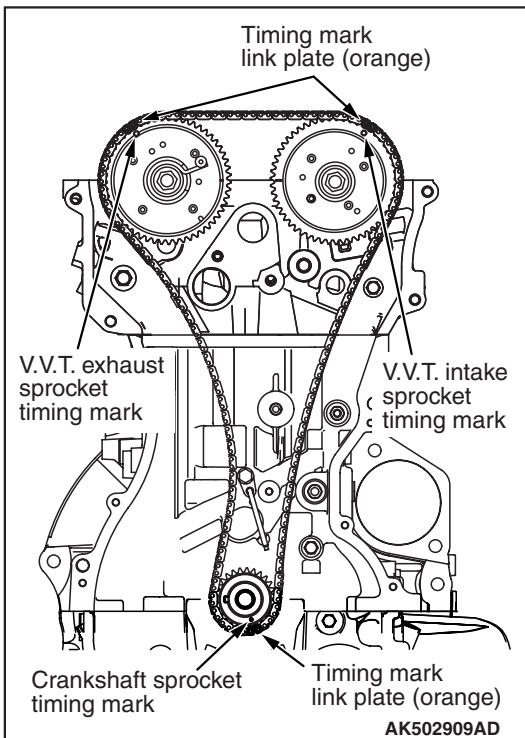
3. Align the link plate (orange) with the timing mark of the exhaust V.V.T. sprocket and loop the timing chain.



4. Align the link plate (orange) with the timing mark of the intake V.V.T. sprocket to loop the timing chain.
Rotate the intake V.V.T. sprocket by one or two teeth to align with the timing mark.

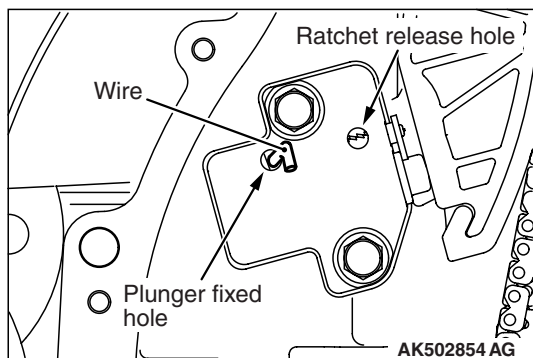


5. Align the timing mark of the crankshaft sprocket with the link plate (orange) to loop the timing chain. Because of timing chain slacks, hold it to prevent the timing mark from coming off the link plate (orange).



6. Make sure that the timing mark of each sprocket is aligned with the link plate (orange) of the timing chain at all of three locations.
7. Install the timing chain guide and tensioner lever.

>>D<< TIMING CHAIN TENSIONER INSTALLATION



1. Install the timing chain tensioner on the cylinder block and tighten it to the specified torque.

Specified torque: 11 ± 1 N·m (98 ± 8 in-lb)

2. Remove the hard wire (piano wire or the like) of $\phi 1.5$ or hexagonal bar wrench (1.5 mm [0.05 inch]) from the timing chain tensioner. This enables the plunger of the timing chain tensioner to push the tensioner lever to keep the timing chain tight.

INSPECTION

M1113026700213

VALVE CLEARANCE ADJUSTMENT

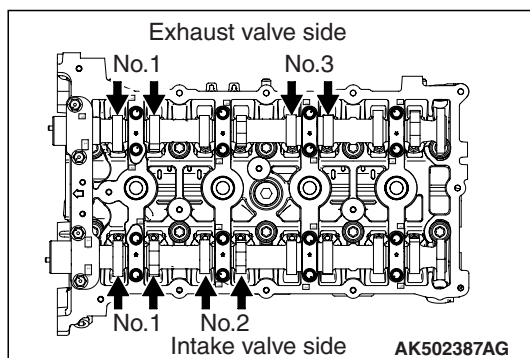
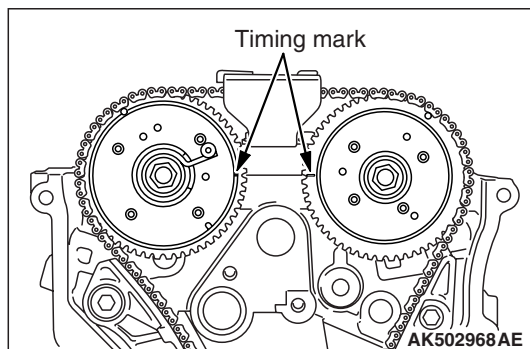
Measure valve clearance as described in the following procedure.

Check and adjust the valve clearance with the timing chain installed.

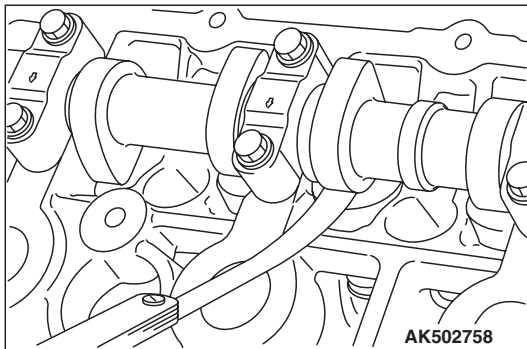
⚠ CAUTION

Always rotate the crankshaft clockwise.

1. Rotate the crankshaft clockwise to align the timing mark of the V.V.T. sprocket with the top surface of the cylinder head as illustrated. (Set the No. 1 piston at top dead center on the compression stroke.)



2. Valve clearance can be measured at the illustrated location in this condition.



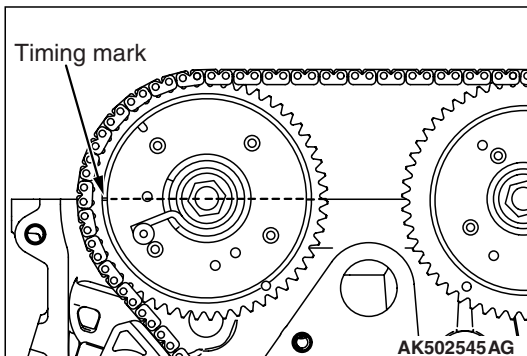
- Use a thickness gauge to measure clearance between the camshaft and valve tappet.

Standard value (when engine is cold):

Intake side: 0.20 mm (0.008 inch)

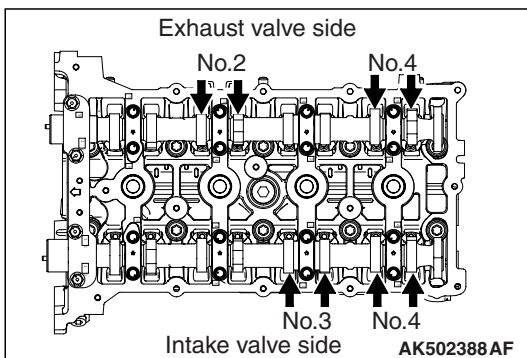
Exhaust side: 0.30 mm (0.012 inch)

- If measured values are out of the standard value, record measured values.



- Rotate the crankshaft by one turn clockwise to set the No. 4 piston at top dead center on the compression stroke.

NOTE: The timing mark of the V.V.T. exhaust sprocket must be at the illustrated position.

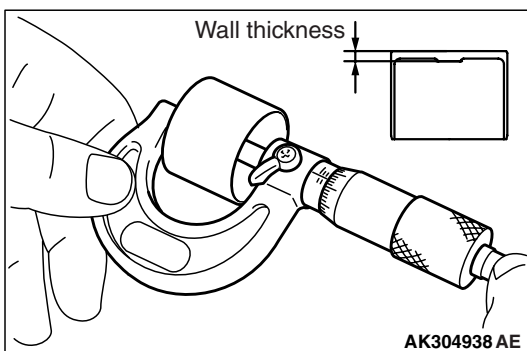


- Valve clearance can be measured at the illustrated location in this condition.

- If measured values are out of the standard value, record measured values.

- If the measured value is out of the standard value, replace the valve tappet.

NOTE: There are 47 kinds of valve tappets at intervals of 0.015 mm (0.0006 inch) in the range between 3.000 (0.1181 inch) and 3.690 mm (0.1453 inch).



- Use the following procedure select a valve tappet.

(1) Measure thickness of a removed valve tappet.

(2) Calculate thickness of a valve tappet so that valve clearance meets the standard value.

A: Thickness of valve tappet to be selected

B: Thickness of removed valve tappet

C: Measured valve clearance

Formula

Intake side: $A = B + (C - 0.20 \text{ mm [0.008 inch]})$

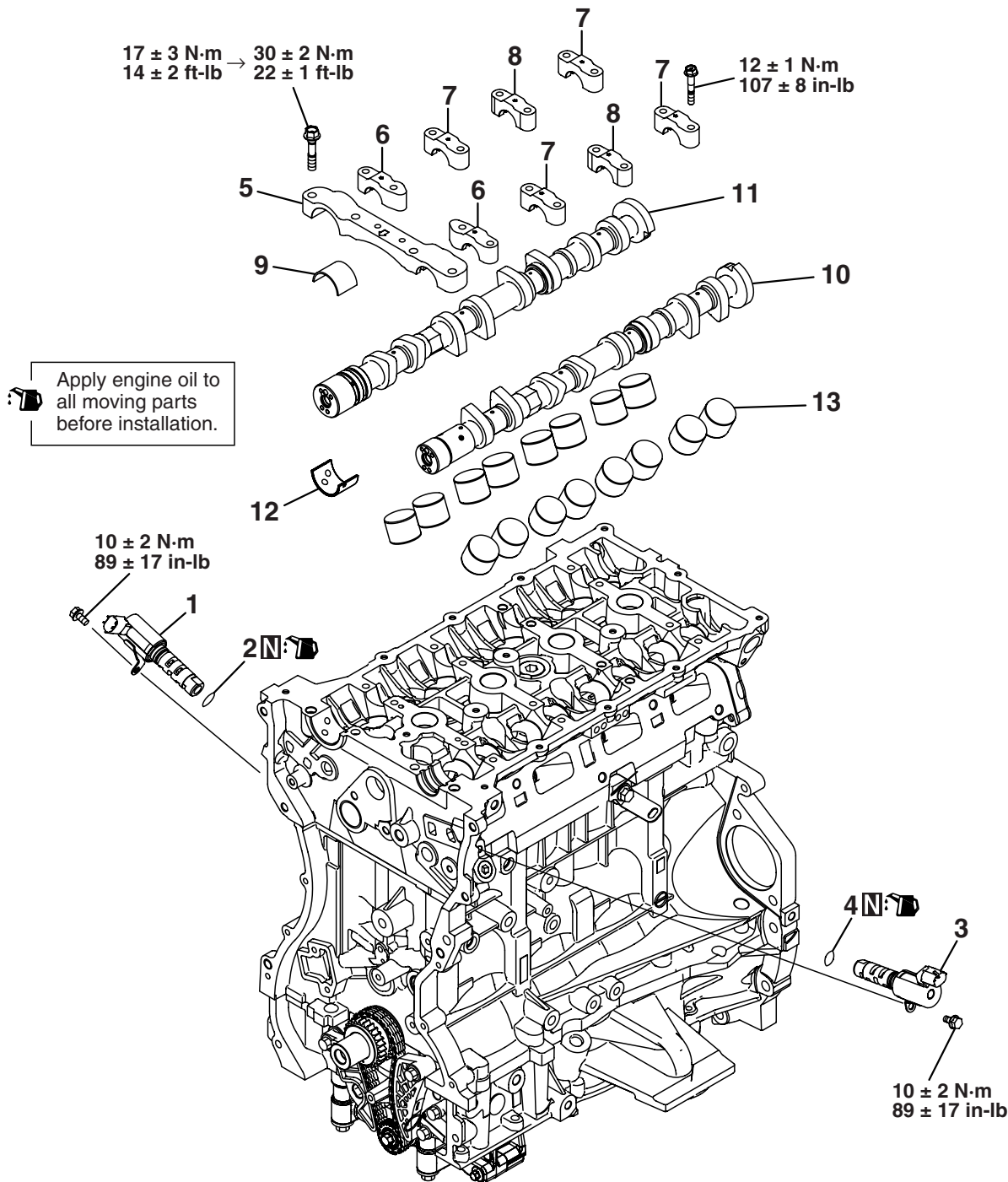
Exhaust side: $A = B + (C - 0.30 \text{ mm [0.012 inch]})$

Refer to "Removal and installation of camshaft" for removal, installation and inspection procedure of valve tappets.

CAMSHAFT

REMOVAL AND INSTALLATION

M1113026900176



AK502934AD

Removal steps

- >>C<< 1. Engine oil control valve (OCV) exhaust
- >>C<< 2. O-ring
- >>C<< 3. Engine oil control valve (OCV) intake
- >>C<< 4. O-ring
- <<A>> >>B<< 5. Front camshaft bearing cap
- <<A>> >>B<< 6. Oil feeding camshaft bearing cap

Removal steps (Continued)

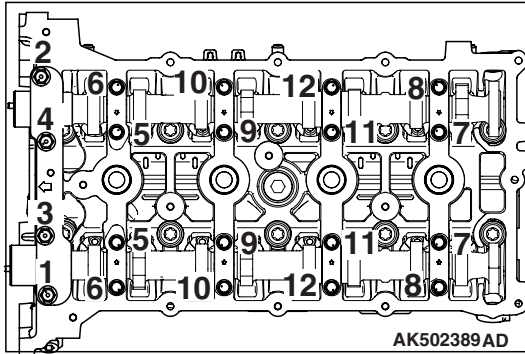
- <<A>> >>B<< 7. Camshaft bearing cap
- <<A>> >>B<< 8. Thrust camshaft bearing cap
- >>B<< 9. Bearing
- >>B<< 10. Camshaft intake
- >>B<< 11. Camshaft exhaust
- >>B<< 12. Bearing
- <> >>A<< 13. Valve tappet

REMOVAL SERVICE POINTS

<<A>> FRONT CAMSHAFT BEARING CAP / OIL FEEDING CAMSHAFT BEARING CAP / CAMSHAFT BEARING CAP / THRUST CAMSHAFT BEARING CAP REMOVAL

⚠ CAUTION

Loosing the camshaft bearing cap installation bolts in four to five steps. Do not loosen bolts in one step as this causes the valve spring force to push on the bolts and make them jump out causing damage to the threads. First remove a mounting bolt of the front camshaft bearing cap and then a mounting bolt of each camshaft bearing cap in the order shown in the illustration.



<> VALVE TAPPET REMOVAL

Pick out valve tappets with fingers and store removed valve tappets with tags describing the installed position attached for reassembly.

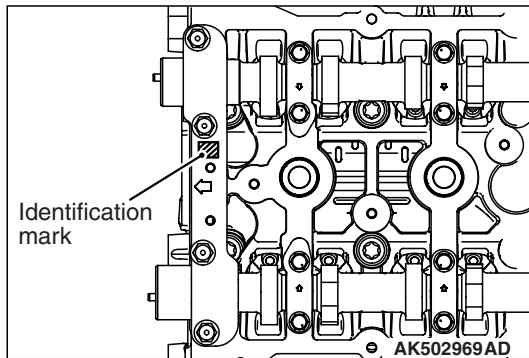
INSTALLATION SERVICE POINTS

>>A<< VALVE TAPPET INSTALLATION

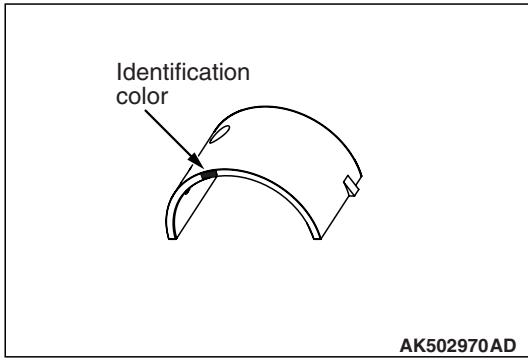
Install valve tappets at the same position based on tags describing the installed position for reassembly.

>>B<< CAMSHAFT / BEARING / THRUST CAMSHAFT BEARING CAP / CAMSHAFT BEARING CAP / OIL FEEDING CAMSHAFT BEARING CAP / FRONT CAMSHAFT BEARING CAP INSTALLATION

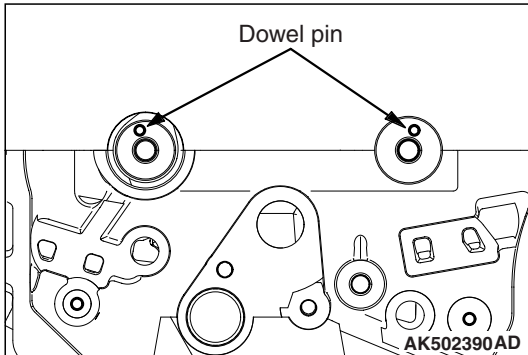
1. When replacing a camshaft bearing, select a bearing with the size corresponding to the identification mark in the table below.
2. Install camshaft bearings on the cylinder head.



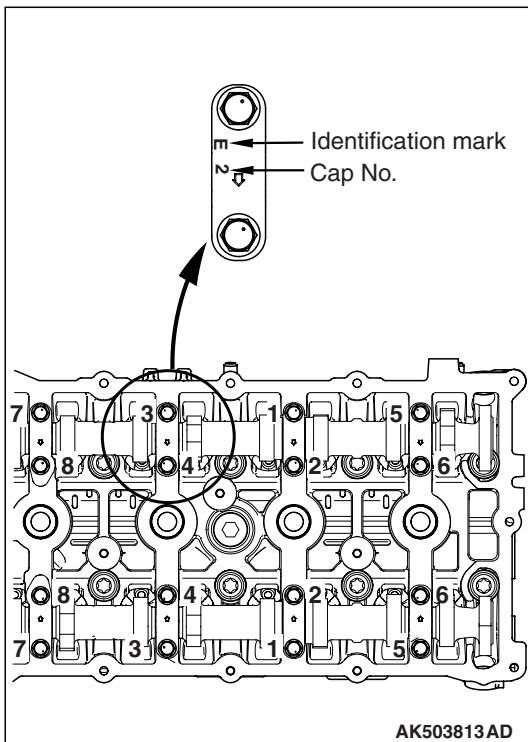
Front camshaft bearing cap		Camshaft bearing identification color
Identification mark	Inner diameter mm (in)	
1	40.000 - 40.008 (1.5748 - 1.5751)	Black
2	40.008 - 40.016 (1.5751 - 1.5754)	None
3	40.016 - 40.024 (1.5754 - 1.5757)	Green



- The identification color of the camshaft bearing is painted at the illustrated position.



- Set the dowel pins of the camshaft at the illustrated positions.

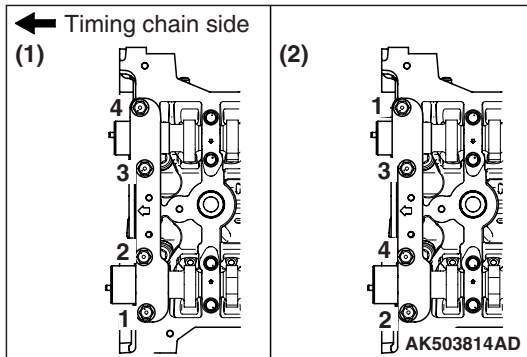


- Install them upon checking the identification mark so as not to misidentify cap No. and to confuse the intake side with the exhaust side.

Identification mark
I: Intake side
E: Exhaust side

- Tighten each camshaft bearing cap mounting bolt to the specified torque in the order of number shown in the figure in two or three steps.

Specified torque: 12 ± 1 N·m (106 ± 8 in-lb)



7. Tighten each front camshaft bearing cap mounting bolt to the temporarily torque of $17 \pm 3 \text{ N} \cdot \text{m}$ ($14 \pm 2 \text{ ft-lb}$) in the order shown (1).
8. Tighten each front camshaft bearing cap mounting bolt to the specified torque in the order shown (2).

Specified torque: $30 \pm 2 \text{ N} \cdot \text{m}$ ($22 \pm 1 \text{ ft-lb}$)

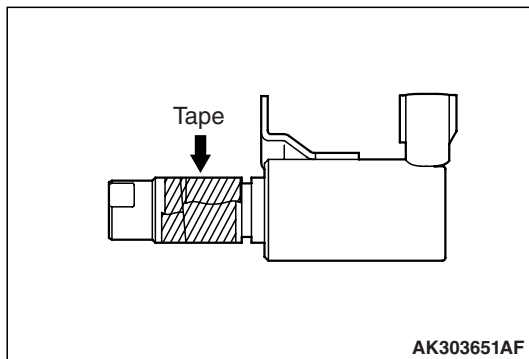
>>C<< O-RING / ENGINE OIL CONTROL VALVE INSTALLATION

CAUTION

- The O-ring must not be reused.
- Wind non-adhesive tape (seal tape, etc.) around the notch of the oil passage of the engine oil control valve before installing the O-ring to prevent damage. Damage to the O-ring causes oil leakage.

1. Apply a small amount of engine oil to the O-ring of the engine oil control valve.
2. Install the engine oil control valve on the cylinder head.
3. Tighten the engine oil control valve to the specified torque.

Specified torque: $10 \pm 2 \text{ N} \cdot \text{m}$ ($89 \pm 17 \text{ in-lb}$)



INSPECTION

M1113027000154

CAMSHAFT

Measure camshaft height (camshaft major axis). If the height is less than the limit, replace the camshaft.

Standard value:

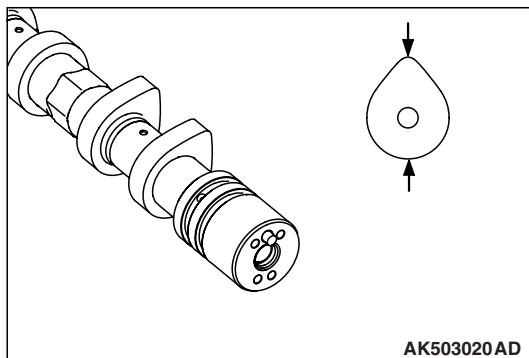
Intake: 43.25 mm (1.703 inches)

Exhaust: 45.00 mm (1.772 inches)

Limit:

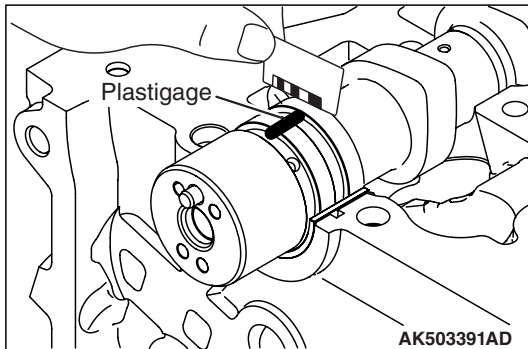
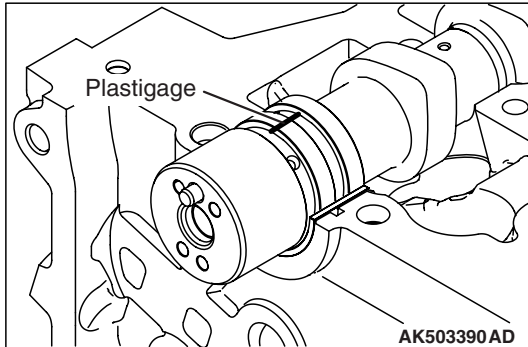
Intake: 42.75 mm (1.683 inches)

Exhaust: 44.50 mm (1.752 inches)



CAMSHAFT OIL CLEARANCE (PLASTIGAGE METHOD)

1. Thoroughly wipe oil on the outside diameter of the camshaft and the inside diameter of the bearing.
2. Install the bearing to the camshaft.
3. Put straightly the plastigage having the length of the bearing width on the journal axis, centering the axis.
4. Carefully install the bearing cap. Tighten the bolt as instructed in >>B<< Bolt Installation Point.
5. Remove the bolt and the bearing cap carefully.



6. Measure the plastigage whose width is most compressed using the scale printed on the plastigage bag. When the measured value deviates from the standard one, replace the bearing.

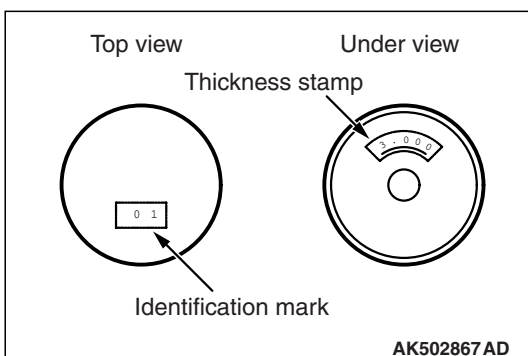
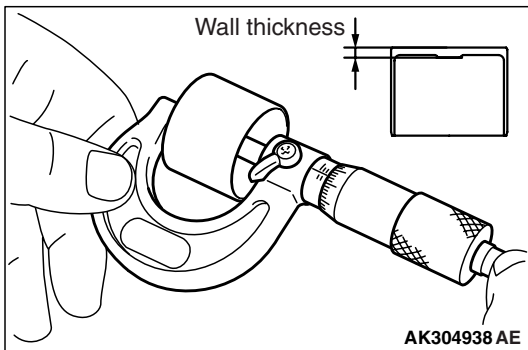
Standard value: 0.035 –0.072 mm (0.0014 –0.0028 inch)

CAUTION

When the bearing is used again, be careful not to reverse the cylinder head side and the camshaft side during installation.

VALVE TAPPET

1. Measure the valve tappet at the illustrated position. If the measured value is not in agreement with the value in the table corresponding to the identification mark, replace the valve tappet.



2. The valve tappet has an identification mark and stamping of thickness at illustrated positions.

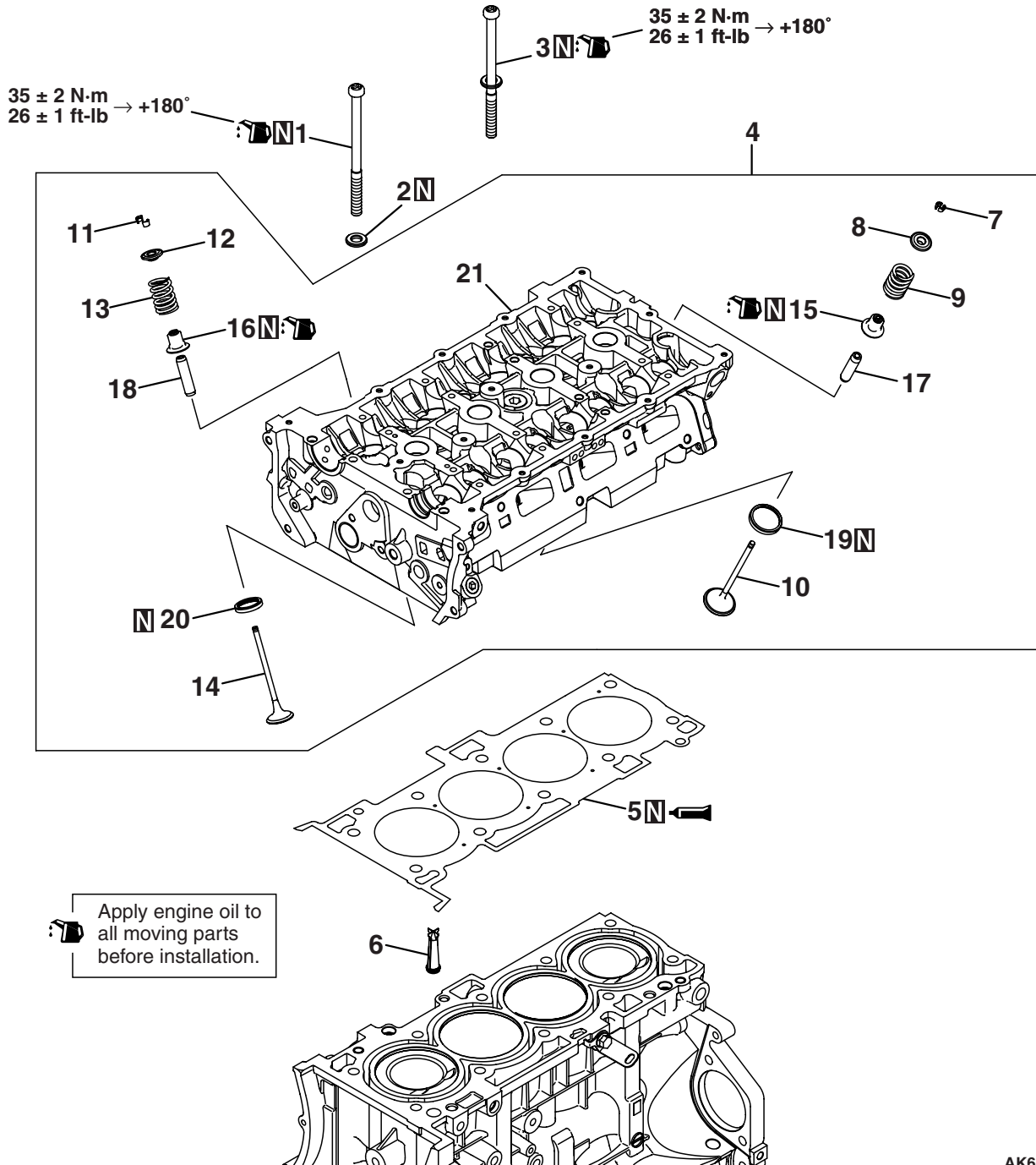
There are 47 kinds of valve tappets at intervals of 0.015 mm (0.0006 inch) in the range between 3.000 mm (0.1181 inch) and 3.690 mm (0.1453 inch).

Thickness mm (in)	Identification mark	Thickness mm (in)	Identification mark	Thickness mm (in)	Identification mark
3.000 (0.1181)	01	3.240 (0.1276)	17	3.480 (0.1370)	33
3.015 (0.1187)	02	3.255 (0.1281)	18	3.495 (0.1376)	34
3.030 (0.1193)	03	3.270 (0.1287)	19	3.510 (0.1382)	35
3.045 (0.1199)	04	3.285 (0.1293)	20	3.525 (0.1388)	36
3.060 (0.1205)	05	3.300 (0.1299)	21	3.540 (0.1394)	37
3.075 (0.1211)	06	3.315 (0.1305)	22	3.555 (0.1400)	38
3.090 (0.1217)	07	3.330 (0.1311)	23	3.570 (0.1406)	39
3.105 (0.1222)	08	3.345 (0.1317)	24	3.585 (0.1411)	40
3.120 (0.1228)	09	3.360 (0.1323)	25	3.600 (0.1417)	41
3.135 (0.1234)	10	3.375 (0.1329)	26	3.615 (0.1423)	42
3.150 (0.1240)	11	3.390 (0.1335)	27	3.630 (0.1429)	43
3.165 (0.1246)	12	3.405 (0.1341)	28	3.645 (0.1435)	44
3.180 (0.1252)	13	3.420 (0.1346)	29	3.660 (0.1441)	45
3.195 (0.1258)	14	3.435 (0.1352)	30	3.675 (0.1447)	46
3.210 (0.1264)	15	3.450 (0.1358)	31	3.690 (0.1453)	47
3.225 (0.1270)	16	3.465 (0.1364)	32		

CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006901597



Apply engine oil to all moving parts before installation.

AK604561 AB

Removal steps

- >>D<< 1. Cylinder head bolt
- >>D<< 2. Cylinder head bolt washer
- >>D<< 3. Cylinder head bolt & washer assembly
- >>C<< 4. Cylinder head assembly
- >>C<< 5. Cylinder head gasket
- <<A>> >>B<< 6. Oil feeder control valve (OCV) filter
- <<A>> >>B<< 7. Retainer lock
- <<A>> >>B<< 8. Valve spring retainer

Removal steps (Continued)

- <<A>> >>B<< 9. Valve spring
- <<A>> >>B<< 10. Intake valve
- <<A>> >>B<< 11. Retainer lock
- <<A>> >>B<< 12. Valve spring retainer
- <<A>> >>B<< 13. Valve spring
- <<A>> >>B<< 14. Exhaust valve
- <<A>> >>B<< 15. Valve stem seal
- <<A>> >>B<< 16. Valve stem seal
- <<A>> >>B<< 17. Intake valve guide

Removal steps (Continued)

18. Exhaust valve guide
19. Intake valve seat
20. Exhaust valve seat
21. Cylinder head

Required Special Tools:

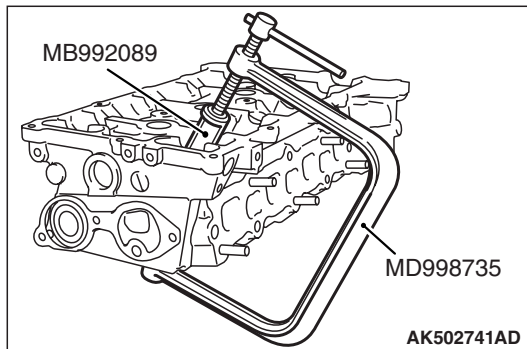
- MD998735: Valve Spring Compressor
- MB992089: Retainer Holder
- MB992085: Valve Stem Seal Pliers
- MD998737: Valve Stem Seal Installer

REMOVAL SERVICE POINTS**<<A>> RETAINER LOCK REMOVAL****⚠ CAUTION**

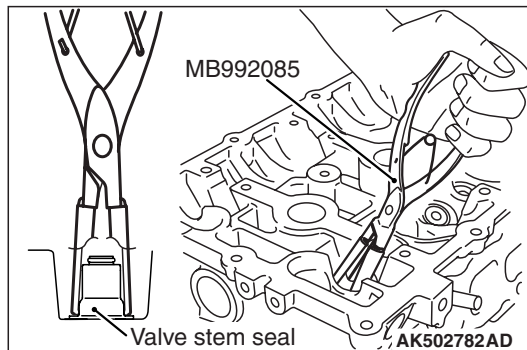
Be careful not to allow retainer holder C to interfere with the wall of the tappet hole and to damage it.

Use a special tool MD998735 and MB992089 to compress the valve spring and to remove the retainer lock.

NOTE: Store removed parts such as valves and springs with tags describing cylinder No. and installed position attached for reassembly.

**<> VALVE STEM SEAL REMOVAL**

Use special tool MB992085 to firmly pinch the base (larger external shape) of the stem seal and twist it right and left for pulling out.



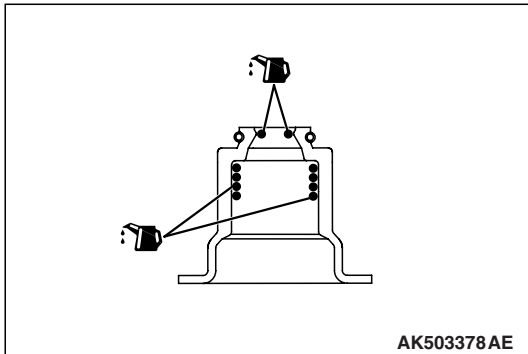
INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION

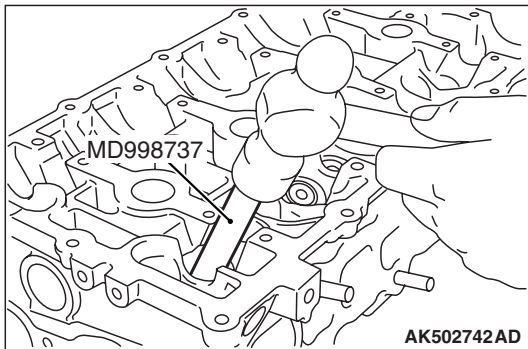
⚠ CAUTION

- 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 thin coat of engine oil to a new valve stem seal.

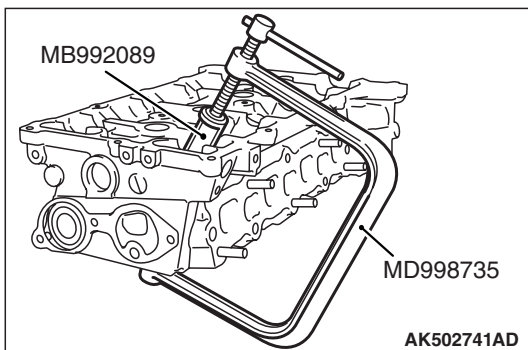


2. Use special tool MD998737 to press fit the valve stem seal into the valve guide with the valve stem used as a guide.



>>B<< RETAINER LOCK INSTALLATION

Use a special tool MD998735 and MB992089 to compress the valve spring and to install the retainer lock.



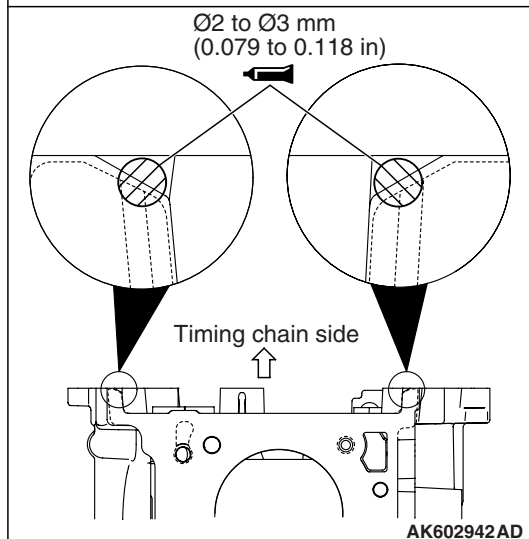
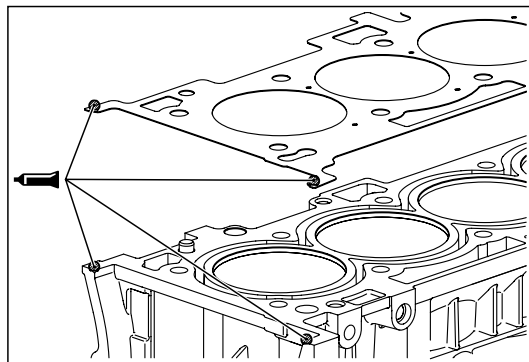
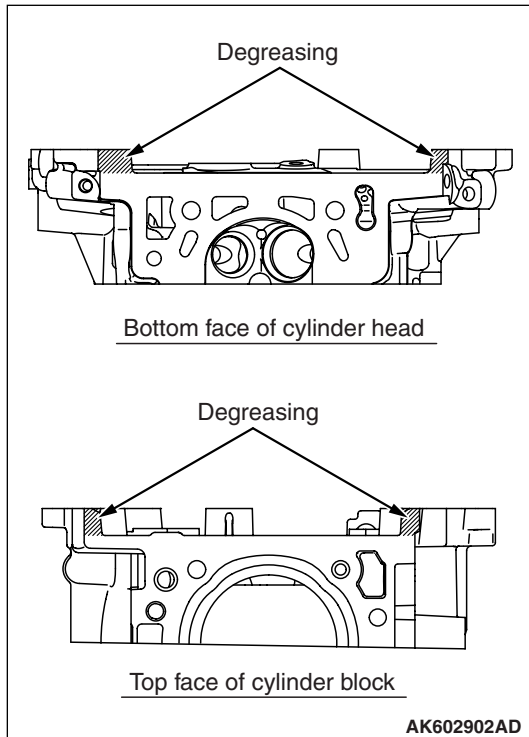
>>C<< CYLINDER HEAD GASKET / CYLINDER
HEAD ASSEMBLY INSTALLATION

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. Using white gasoline and so on, degrease the place specified in the illustration.



3. As shown in the illustration, apply a $\phi 2$ to 3 mm (0.079 to 0.118 inch) of sealant (Three bond 1217G, LOCTITE 5900, 5970, 5971 or equivalent) to the top face of cylinder block.

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 $\phi 2$ to 3 mm (0.079 to 0.118 inch) of sealant (Three bond 1217G, LOCTITE 5900, 5970, 5971 or equivalent) to the top face of cylinder head gasket.

6. Install the cylinder head assembly.

>>D<< CYLINDER HEAD BOLT INSTALLATION

1. Install new cylinder head bolts and washers in the following procedure.

NOTE: Cylinder head bolts and washers must not be reused.

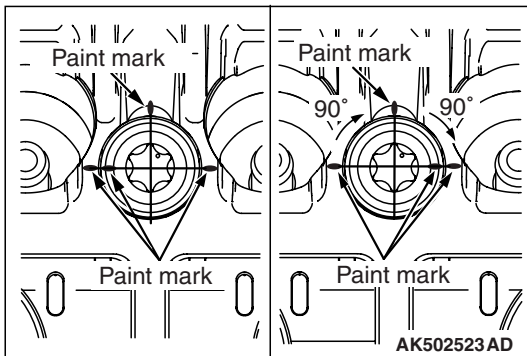
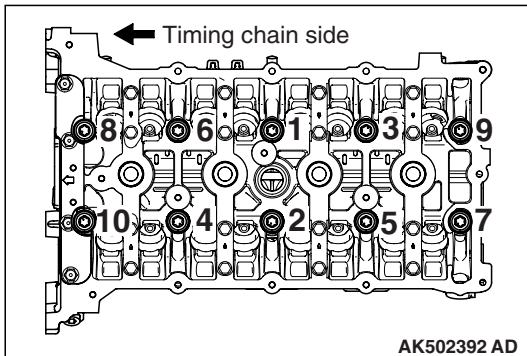
2. Apply an appropriate amount of engine oil to top and bottom surfaces of washers and threaded portion of bolts.

3. Install cylinder head bolts to the cylinder head.

NOTE: Bolts and washers are different parts for bolts on the timing chain side.

4. Tighten cylinder head bolts in several steps to the specified torque according to the assembly order shown.

Specified torque: $35 \pm 2 \text{ N} \cdot \text{m}$ ($26 \pm 1 \text{ ft-lb}$)



5. Put a paint mark on all of cylinder head bolt heads and cylinder head.

CAUTION

- If the tightening angle is 180° or less, tightening performance may not be secured. Use caution to the tightening angle during tightening.
- If the tightening angle becomes more than 180° , completely loosen bolts and start tightening over again according to the procedure.

6. Tighten the cylinder head 90° according to the tightening order.

Tighten it further 90° and make sure that the paint mark on the cylinder head bolt is in a straight line with that on the cylinder head.

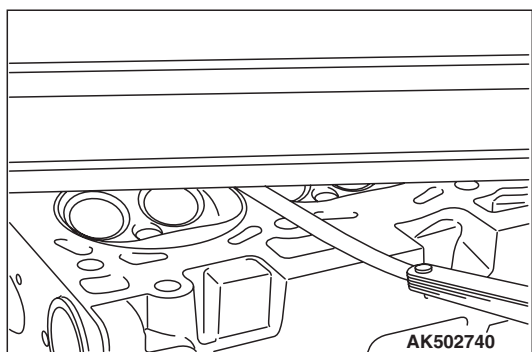
INSPECTION

M1113007001371

CYLINDER HEAD

1. Check the cylinder head for water leakage, gas leakage, damage or cracks before cleaning.
2. Completely remove oil, scale, sealant, carbon, etc. After cleaning oil passages, blow air to make sure that they are not clogged.

CAUTION



The grinding limit shall be within 0.2 mm (0.008 inch) in combination with the cylinder block to be assembled.

- For the flatness on the cylinder head bottom, measure distortion using a straight edge and thickness gauge. If the distortion exceeds the limit, grind and repair it.

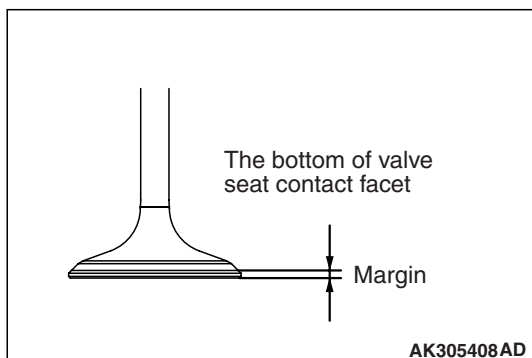
Distortion on bottom

Standard value: Within 0.05 mm (0.002 inch)

Limit: 0.02 mm (0.0008 inch)

Grinding limit: 0.2 mm (0.008 inch)

Cylinder head height: 128.5 mm (5.06 inches)



VALVE

- Repair the valve seat if contact with the valve seat is poor, uneven or broken.
- Measure the margin.
If the limit is exceeded, replace the valve.

Standard value:

Intake 1.022 mm (0.0402 inch)

Exhaust 1.094 mm (0.0431 inch)

Limit:

Intake 0.522 mm (0.0206 inch)

Exhaust 0.594 mm (0.0234 inch)

- Measure overall length of the valve.
If the limit is exceeded, replace the valve.

Standard value:

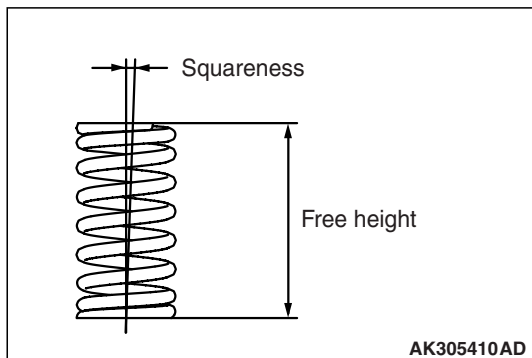
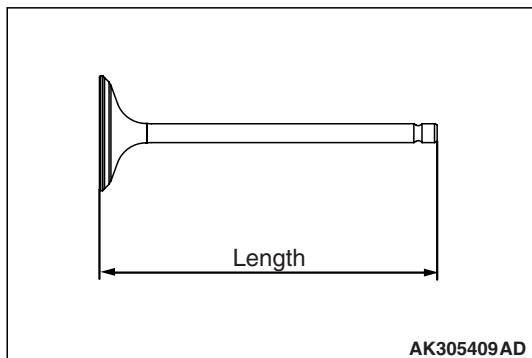
Intake 113.18 mm (4.456 inches)

Exhaust 105.89 mm (4.169 inches)

Limit:

Intake 112.68 mm (4.436 inches)

Exhaust 105.39 mm (4.149 inches)



VALVE SPRING

- Measure free height of the spring.
If the limit is exceeded, replace the spring.

Standard value: 47.44 mm (1.868 inch)

Limit: 46.44 mm (1.828 inch)

- Measure squareness of the spring.

If the inclination exceeds the limit, replace the spring.

Standard value: 2° or less

Limit: 4°

VALVE GUIDE

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

Standard value:

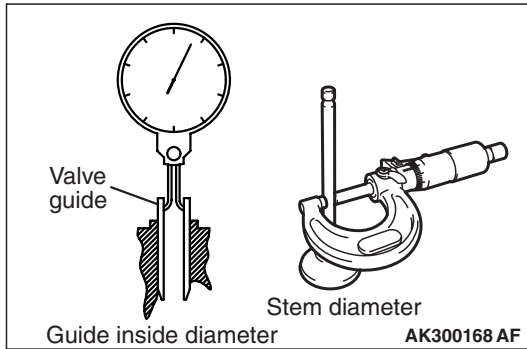
Intake 0.020 –0.047 mm (0.0008 –0.0019 inch)

Exhaust 0.030 –0.054 mm (0.0012 –0.0021 inch)

Limit:

Intake 0.10 mm (0.004 inch)

Exhaust 0.15 mm (0.006 inch)



VALVE SEAT

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

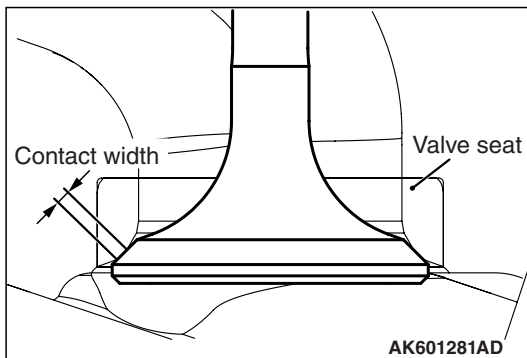
Standard value

Intake: 1.16 –1.46 mm (0.046 –0.058 inch)

Exhaust: 1.35 –1.65 mm (0.053 –0.065 inch)

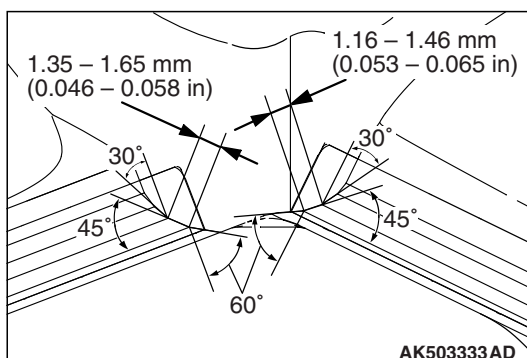
CAUTION

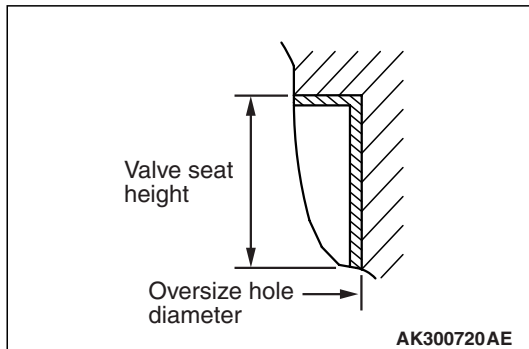
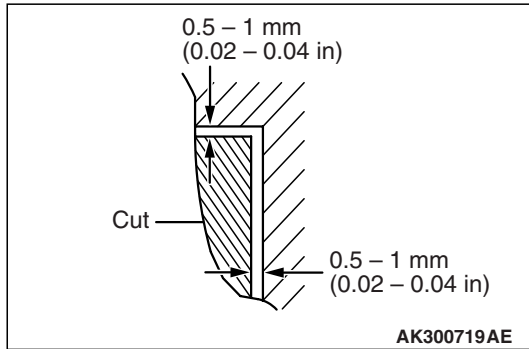
If the variation in the width exceeds 0.2 mm (0.008 inch) even if the contact width is within the standard value, replace or correct the valve seat.



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 are to the specified shape.
3. Lap valve and valve seat with lapping compound after repairing valve seat.





REPLACEMENT PROCEDURE OF VALVE SEAT

1. Scrape the valve seat to be replaced from inside to 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 oversize valve seat to be press fitted.
 - Intake valve seat bore diameter:**
0.3 O.S.: 36.22 - 36.24 mm (1.426 - 1.427 inches)
 - Exhaust valve seat bore diameter:**
0.3 O.S.: 30.22 - 30.24 mm (1.190 - 1.191 inches)
3. Press fit the valve seat, taking care not to score the cylinder head bore at room temperature.
4. Ream the valve seat.
Refer to "Repair procedure of valve seat."

REPLACEMENT PROCEDURE OF VALVE GUIDE

1. Pull out the valve guide with a press toward the cylinder block side.
2. Ream the valve guide hole of the cylinder head to match it with the diameter of the oversize valve guide to be press fitted.

CAUTION

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

Valve guide bore diameter

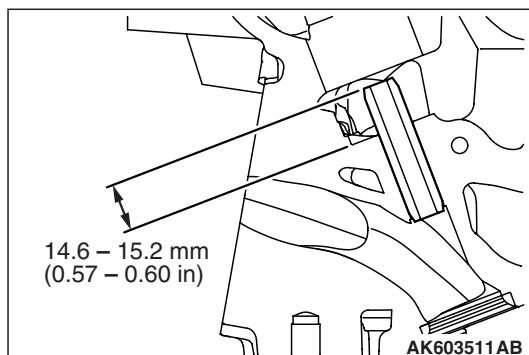
0.25 O.S.: 11.23 - 11.25 mm (0.442 - 0.443 inch)

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

Standard value: 14.6 - 15.2 mm (0.57 - 0.60 inch)

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

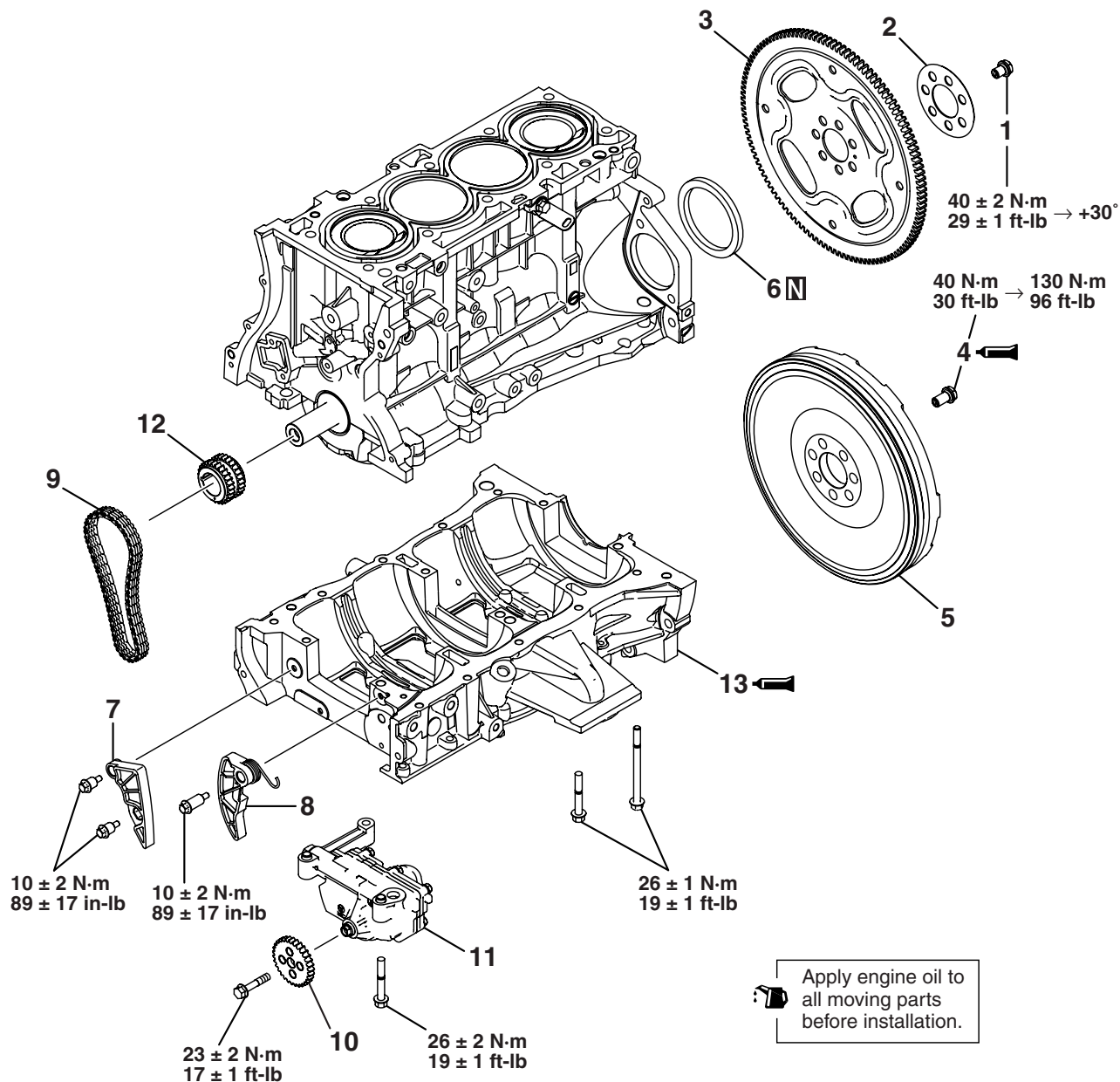
4. After pressing fit the valve guide, insert a new valve to check for sliding.



OIL PUMP CHAIN

REMOVAL AND INSTALLATION

M1113033700011



Apply engine oil to all moving parts before installation.

AK603506AB

Removal steps

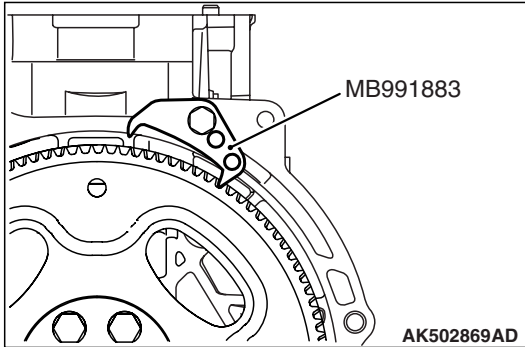
- <<A>> >>F<< 1. Drive plate bolt <CVT>
 2. Adapter plate <CVT>
 3. Drive plate <CVT>
 <<A>> >>E<< 4. Flywheel bolt <M/T>
 5. Flywheel <M/T>
 >>D<< 6. Rear oil seal
 >>C<< 7. Oil pump chain guide

Removal steps (Continued)

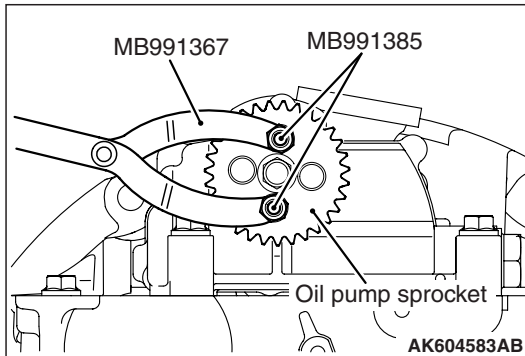
- >>C<< 8. Oil pump tensioner lever
 >>C<< 9. Oil pump chain
 <> >>C<< 10. Oil pump sprocket
 11. Oil pump case
 >>B<< 12. Crankshaft sprocket
 <<C>> >>A<< 13. Ladder frame

Required Special Tools:

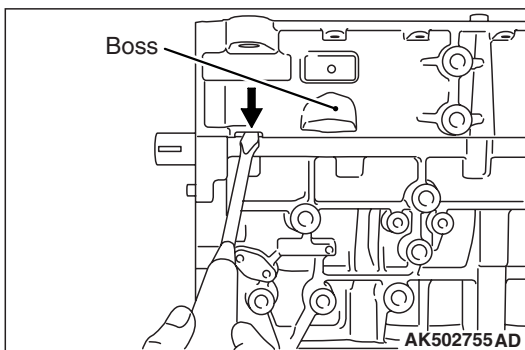
- MB991367: Special Spanner
- MB991385: Pin
- MB991614: Angle Gauge
- MB991883: Flywheel Stopper
- MD998718: Rear Oil Seal Installer

REMOVAL SERVICE POINTS**<<A>> DRIVE PLATE BOLT / FLYWHEEL BOLT
REMOVAL**

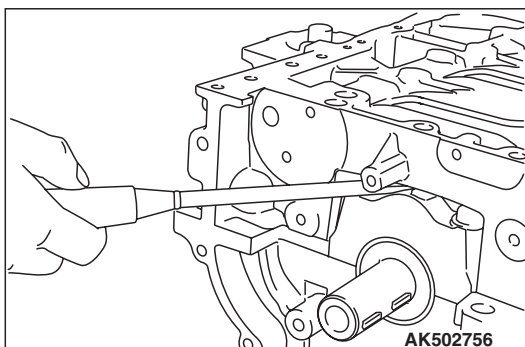
1. Use special tool MB991883 to secure the drive plate or flywheel.
2. Remove the drive plate bolts or flywheel bolts.

<> OIL PUMP SPROCKET REMOVAL

- Fix the oil pump sprocket with a special tools MB991367 and MB991385, loosen a center bolt, and remove the oil pump sprocket.

<<C>> LADDER FRAME REMOVAL

1. Pry the illustrated position with a screwdriver or tap the boss with a hammer.



2. If the ladder frame does not come off, insert a flatblade screwdriver into the gap between the ladder frame and bearing cap as shown in the illustration and lightly pry it to remove the ladder frame.

INSTALLATION SERVICE POINTS

>>A<< LADDER FRAME INSTALLATION

⚠ CAUTION

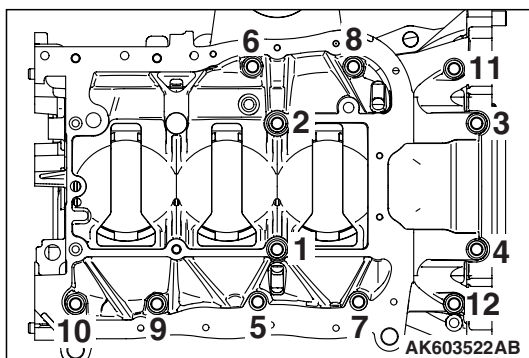
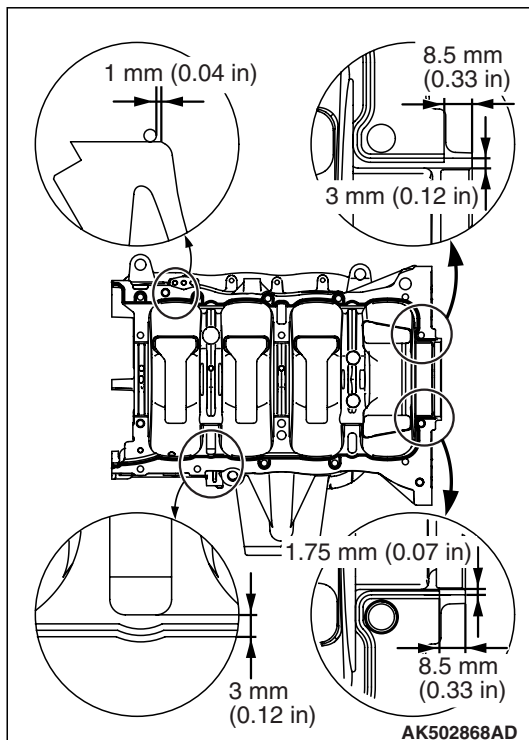
Be sure to remove liquid gasket that has entered mounting holes.

1. Completely remove liquid gasket adhering to the cylinder block and ladder frame.

⚠ 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.

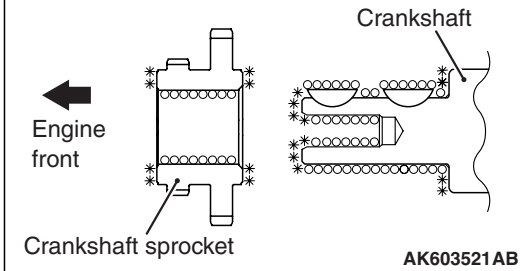
2. Using white gasoline and so on, degrease the surface where the liquid gasket is applied and the contact surface between the cylinder block and ladder frame.
3. Squeeze liquid gasket (Three bond 1217G, LOCTITE 5900, 5970, 5971 or equivalent) of $\phi 2$ to 3 mm (0.08 to 0.12 inch) in thickness and apply it to the illustrated position of the ladder frame.



4. Tighten the ladder frame to the specified torque in the order shown in the illustration.

Specified torque: 26 ± 1 N·m (19 ± 1 ft-lb)

- : Wipe clean with a rag.
* : Wipe clean with a rag and degrease.

**>>B<< CRANKSHAFT SPROCKET INSTALLATION**

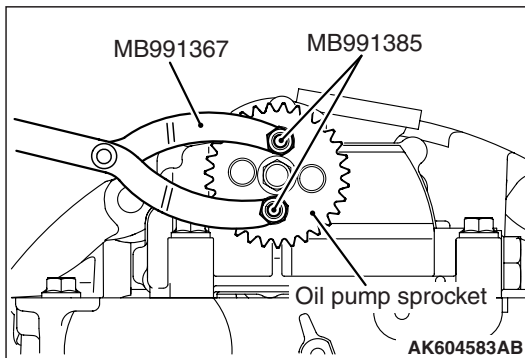
1. Wipe off the dirt on the crankshaft sprocket and the crankshaft using a rag, and then remove the grease from the portion shown in the illustration.

NOTE: Remove grease to prevent a drop in the coefficient of friction of the pressing portion caused by adhesion of oil.

2. Set the No. 1 piston at top dead center on the compression stroke.
3. Install the crankshaft sprocket to the crankshaft.

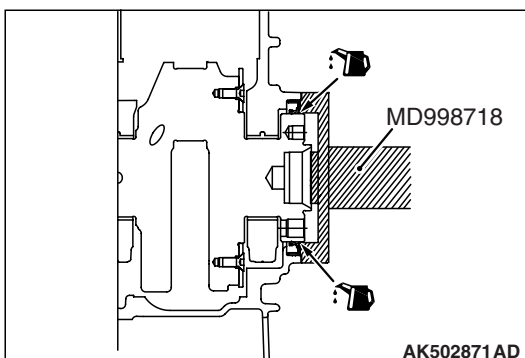
>>C<< OIL PUMP SPROCKET / OIL PUMP CHAIN / OIL PUMP CHAIN GUIDE / OIL PUMP TENSIONER LEVER INSTALLATION

1. Set the No. 1 piston at top dead center on the compression stroke.
2. Using the special tools MB991367 and MB991385, install the oil pump sprocket to the oil pump case.
3. Install the oil pump chain to the crankshaft sprocket.
4. Install the oil pump chain to the oil pump sprocket.

**>>D<< REAR OIL SEAL INSTALLATION****⚠ CAUTION**

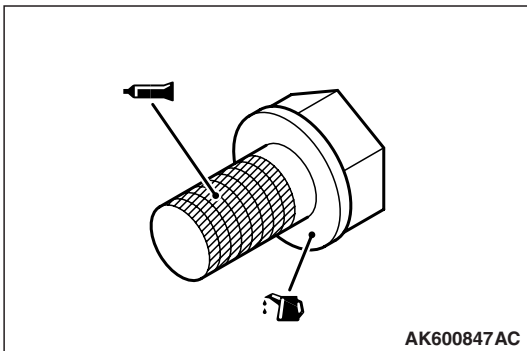
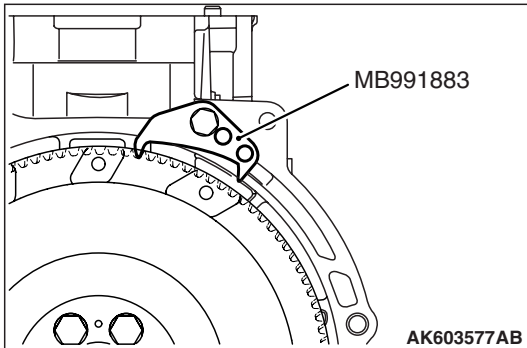
Do not apply oil to the circumference of the oil seal and oil seal pressing hole on the cylinder block side to prevent teeth from pulling out.

After applying a small amount of engine oil to the oil seal lip, use special tool MD998718 to press fit the oil seal.

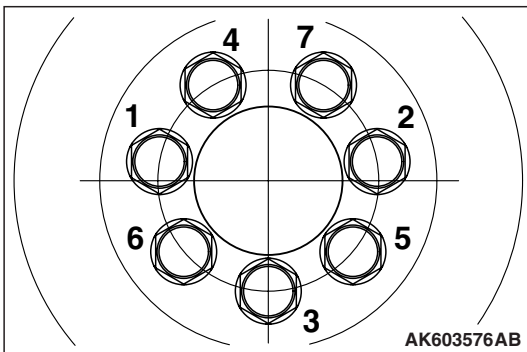


>>E<< FLYWHEEL BOLT INSTALLATION

1. Clean off sealant and oil of thread of crankshaft and flywheel bolt.
2. Use special tool MB991883 to secure the flywheel.



3. Apply engine oil to thread of crankshaft and bolt seat area of flywheel.
4. Apply the sealant (LOCTITE 262 or equivalent) to the thread of flywheel bolt.



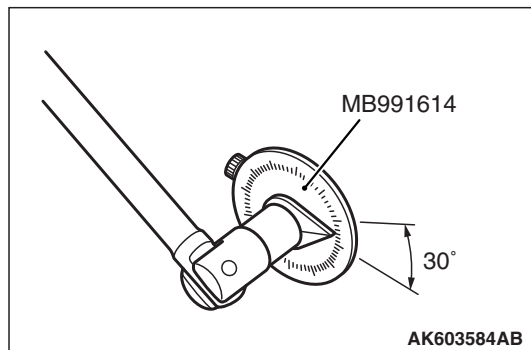
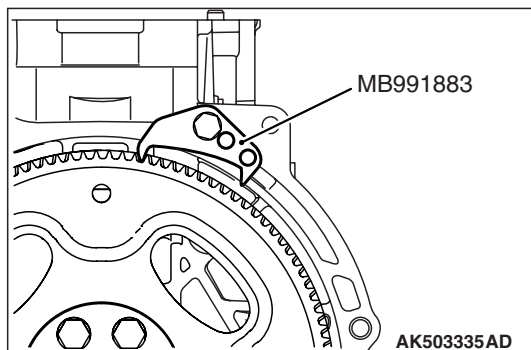
5. Tighten flywheel bolts to temporary torque 40 N· m (30 ft-lb) in the order shown to illustration.
6. Tighten flywheel bolts to specified torque in the order shown in the illustration.

Specified torque: 130 N· m (96 ft-lb)

>>F<< DRIVE PLATE BOLT INSTALLATION

1. Use special tool MB991883 to secure the drive plate.
2. Clean off sealant and oil of thread of crankshaft and drive plate bolt.
3. Tighten drive plate bolts to specified torque.

Specified torque: 40 ± 2 N·m (29 ± 1 ft-lb)

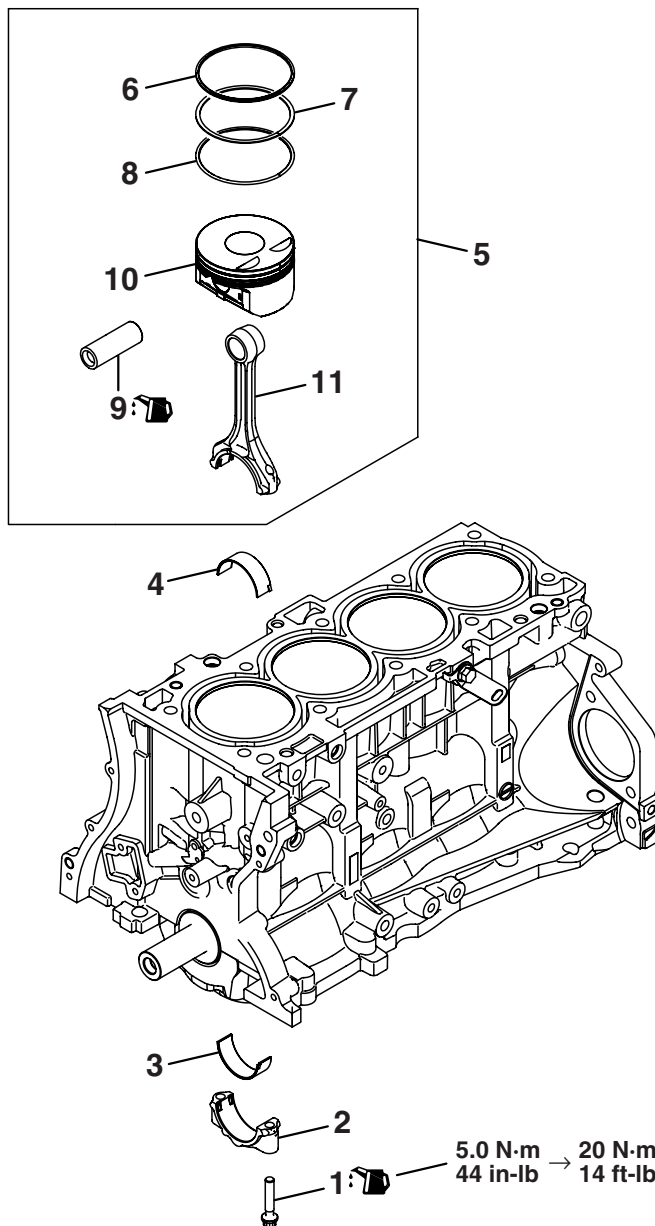
**⚠ CAUTION**


- If the tightening angle is less than 30° , tightening performance may not be secured. Use caution to the tightening angle during tightening.
 - If the tightening angle becomes more than 30° , completely loosen bolts and start tightening over again according to the procedure.
4. Use special tool MB991614 to tighten bolts 30° according to the tightening order.

PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008401811



 Apply engine oil to all moving parts before installation.

AK603501AB

- Removal steps**
- <<A>> >>G<< 1. Connecting rod cap bolt
 - >>F<< 2. Connecting rod cap
 - >>E<< 3. Connecting rod bearing
 - >>E<< 4. Connecting rod bearing
 - >>D<< 5. Piston connecting rod assembly
 - >>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

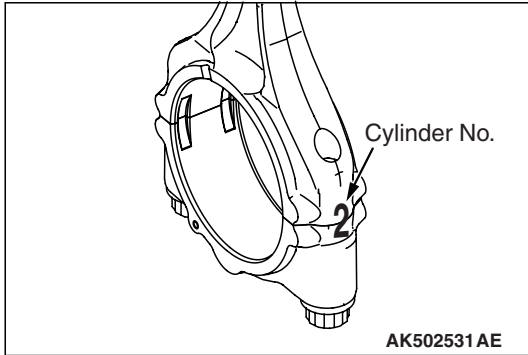
Required Special Tools:

- MD998780: Piston Setting Tool
- MB991659: Guide D

REMOVAL SERVICE POINTS

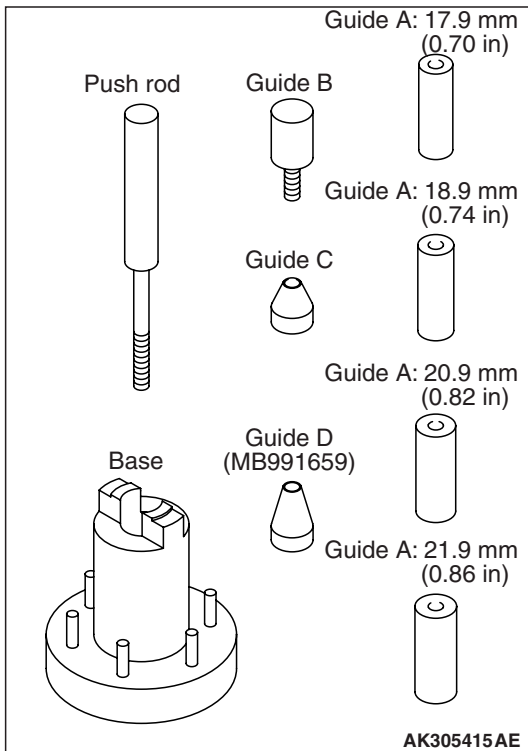
<<A>> CONNECTING ROD REMOVAL

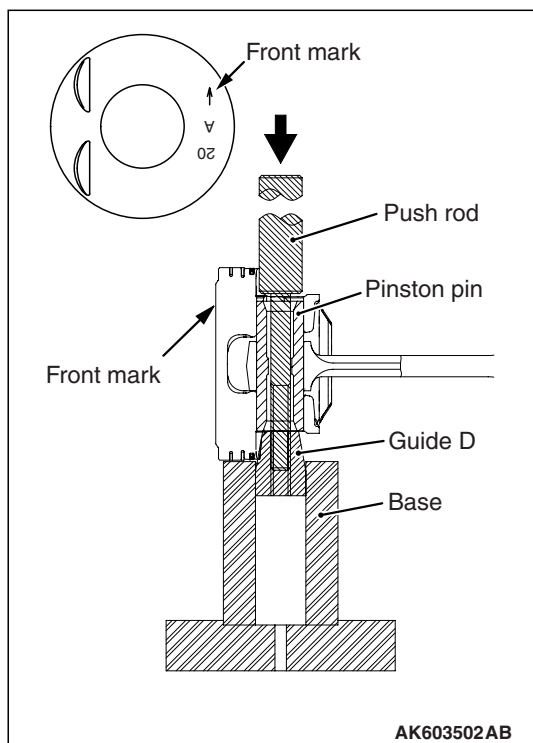
Mark the connecting rod on the big end with the cylinder number it is being removed from.



<> PISTON PIN REMOVAL

Special tool MD998780 consists of parts shown in the illustration. Also use special tool MB991659 to remove the piston pin.





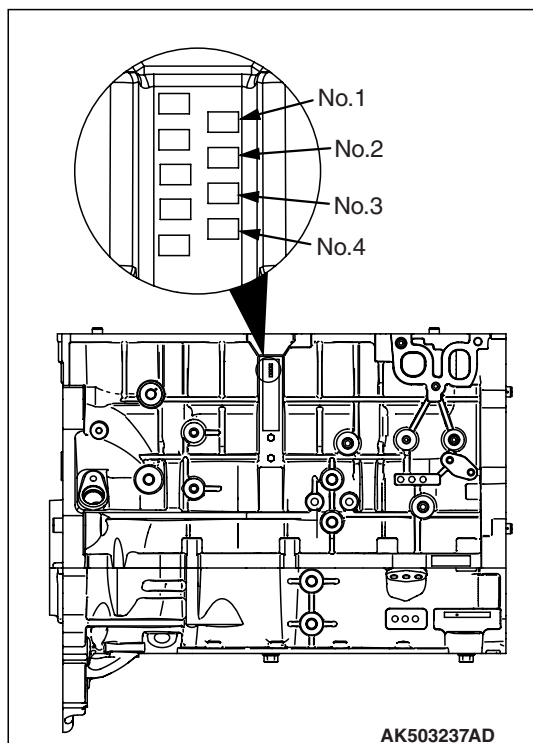
1. Insert the push rod into the piston pin from the front mark side of the piston top surface, and attach special tool MB991659.
2. Set the piston and connecting rod assembly on the base so that the front mark of the piston faces upward.
3. Use a press to push the push rod and pull out the piston pin.
NOTE: After pulling out the piston pin, organize pistons, piston pins and connecting rods by cylinder No.

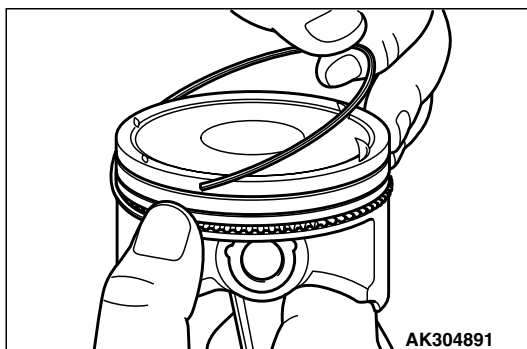
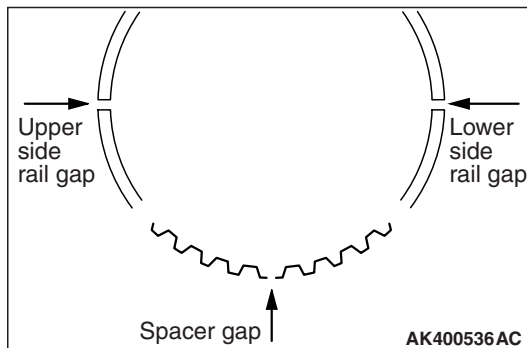
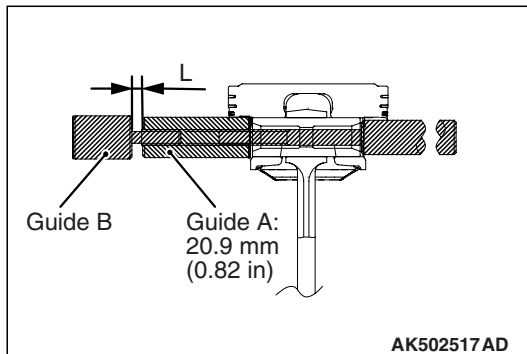
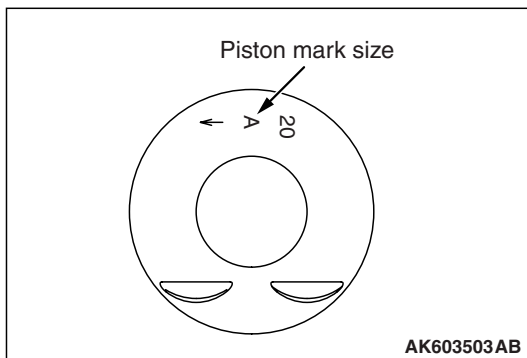
INSTALLATION SERVICE POINTS

>>A<< PISTON PIN INSTALLATION

1. When replacing a piston, check the cylinder bore size mark stamped on the illustrated position of the cylinder block and select a corresponding piston from the table below.

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





NOTE: The piston size mark is indicated on the piston top face.

2. Insert the push rod into the piston pin and attach guide A.
3. Align the front mark of the piston with that of the connecting rod to assemble.
4. Apply engine oil to the circumference of the piston pin.
5. Insert the guide A side of the piston pin assembled in section 1 into the pin hole from the front mark side of the piston.
6. Screw guide B into guide A and open clearance between guide A and guide B by 3 mm (0.12 inch) (make the base in line with flushed surface) to assemble.
7. Set the piston on special tool piston setting base so that its front mark faces upward.
8. Use a press to press fit the piston pin. If the press fit load is below the standard value, replace the piston pin (piston assembly) or connecting rod, or both.

Standard value: 7,500 –17,500 N (1,686 –3,934 pound)

>>B<< OIL RING INSTALLATION

1. Assemble the spacer of the oil ring into the piston ring groove. Then, assemble the upper side rail, and after this assemble the lower side rail.

NOTE: Install the side rail and end gap of the spacer so that they are at the position as shown in the illustration.

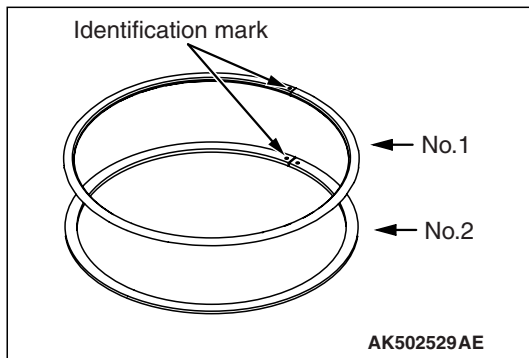
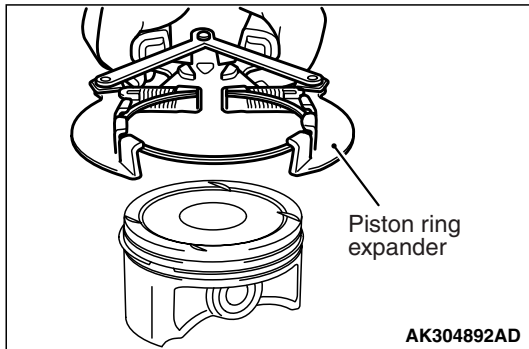
CAUTION

The side rail may be broken if its end gap is widened by a ring expander as in other piston rings.

2. When assembling the side rail, push it by fingers, after fitting one end of the side rail into the piston groove, for easy assembly.
3. After assembling the oil ring into the piston, make sure that the side rail turns smoothly to either direction.

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

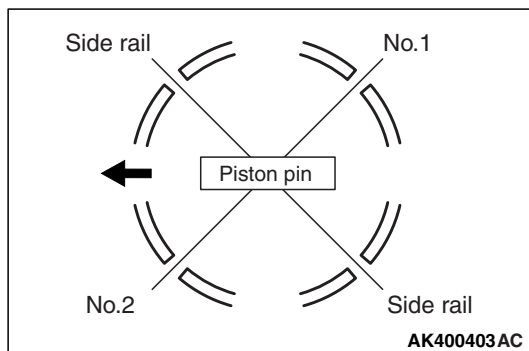
Use a piston ring expander to assemble piston rings with their identification marks facing upward. Piston rings can be assembled by hand without using the piston ring expander.



Identification mark
No. 1 ring: 1T
No. 2 ring: 2T

>>D<< PISTON CONNECTING ROD ASSEMBLY INSTALLATION

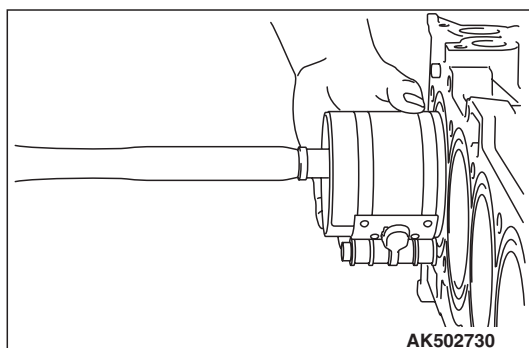
1. Apply a sufficient amount of engine oil to the circumference of the piston, piston rings and oil ring.
2. Arrange end gap positions of piston rings and oil ring (side rail and spacer) as shown in the illustration.
3. Insert the piston and connecting rod assembly from the top surface of the cylinder block with the front mark of the piston top face facing toward the timing chain side.



⚠ CAUTION

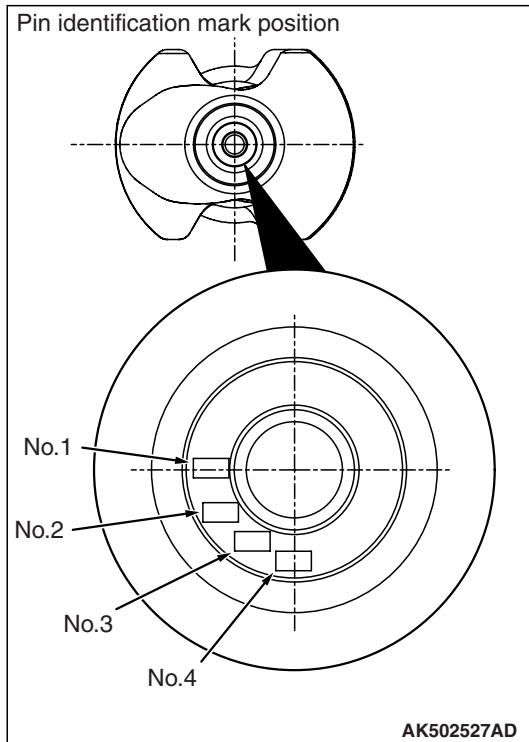
Driving it in hard causes breakage of piston rings and damage to the crank pin.

4. Firmly tighten the piston ring with a ring band and insert the piston and connecting rod assembly.



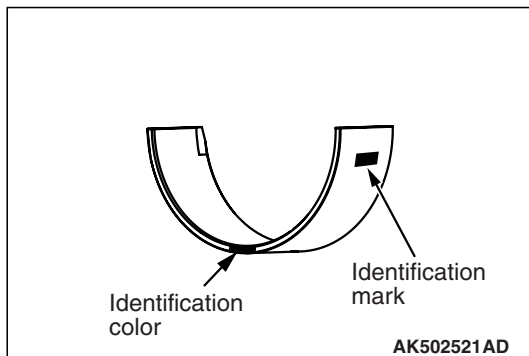
**>>E<< CONNECTING ROD BEARING
INSTALLATION**

1. When replacing a connecting rod bearing, select the bearing corresponding to the crankshaft pin outside diameter according to the crankshaft pin identification in the table below.



Crankshaft pin		Connecting rod bearing	
Identification mark	Journal diameter mm (in)	Identification color	Identification mark
1	47.966 –47.972 (1.8884 –1.8887)	Black	1
2	47.960 –47.966 (1.8882 –1.8884)	None	2
3	47.954 –47.960 (1.8880 –1.8882)	Green	3

2. An identification mark of a crankshaft is stamped at the illustrated position by No.
3. A connecting rod bearings an identification color or identification mark at the illustrated position.

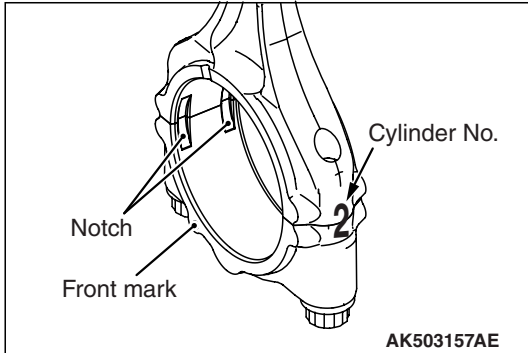


>>F<< CONNECTING ROD CAP INSTALLATION

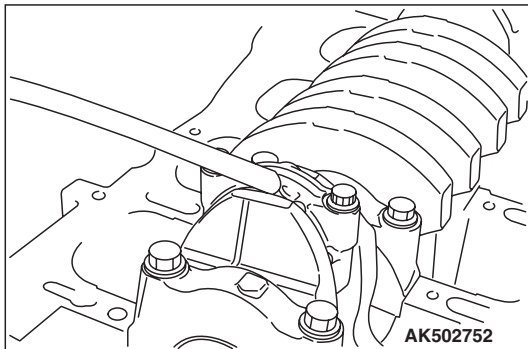
NOTE: The connecting rod resulting from the breaking process has the high insertion force. The new connecting rod assembly may possibly be difficult to remove the connecting rod. If difficult to remove it, alternately strike the two bolt heads with a plastic hammer while the connecting rod bolt is slightly 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. Assemble the bearing cap on the connecting rod by aligning it with the mark put during removal. If a new connecting rod without a mating mark is used, assemble so that the detent notch of the bearing is on the same side as illustrated.



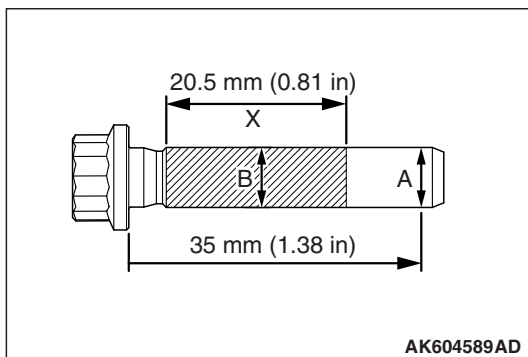
2. Make sure that clearance of the thrust of the connecting rod big end is appropriate.

Standard value: 0.10 –0.25 mm (0.004 –0.010 inch)
Limit: 0.4 mm (0.016 inch)

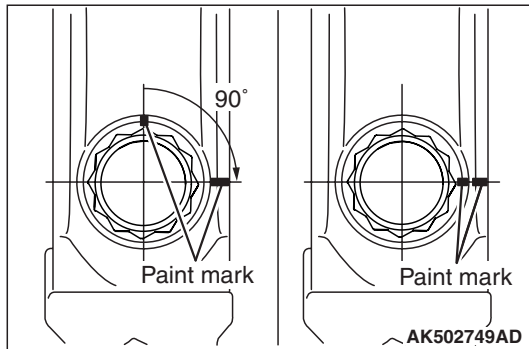
>>G<< CONNECTING ROD CAP BOLT INSTALLATION

1. Check in the following procedure before reusing the connecting rod bolt.
 - (1) Measure the outside diameter "A."
 - (2) Measure the smallest outside diameter "B" within the range "X" shown in the illustration.
 - (3) If the difference of outside diameter of thread exceeds the limit, replace the connecting rod bolt.

Limit: 0.1 mm



2. Apply engine oil to the threaded portion and seat surface of the bolt before installing it.
3. After installing each bolt and tightening it by fingers, tighten bolts alternately to properly assemble the cap.
4. Tighten the bolt in several steps until the torque reaches 5.0 N· m (44 in-lb).
5. Tighten the bolt in several steps until the torque reaches 20 N· m (15 ft-lb).



6. Put a paint mark on the bolt head as illustrated.
7. Put a paint mark on the connecting rod at 90° position in the tightening direction of the bolt with reference to the paint mark position of the bolt.

⚠ CAUTION

- If the tightening angle is less than 90°, tightening performance may not be secured. Use caution to the tightening angle during tightening.
 - If the tightening angle becomes more than 90°, completely loosen the bolt and start tightening over again according to the procedure.
8. Tighten the bolt 90°, and make sure that the paint mark of the connecting rod is aligned with that of the bolt.

INSPECTION

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PISTON RINGS

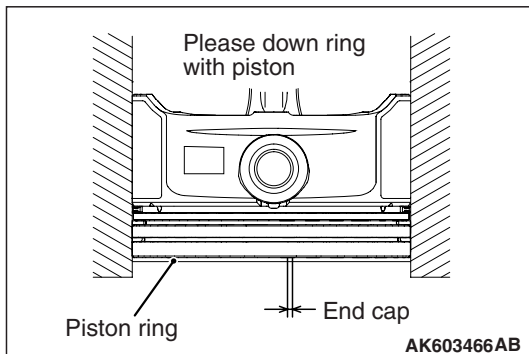
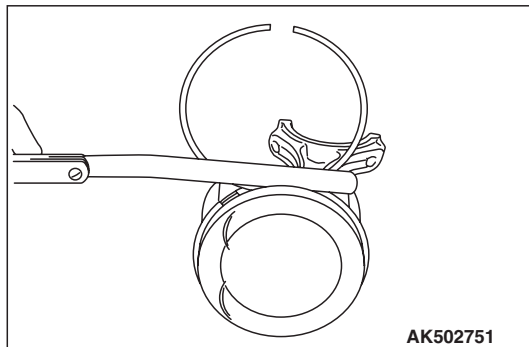
1. Check clearance between piston rings and ring grooves. If the limit is exceeded, replace piston rings or piston, or both.

Standard value:

No. 1 ring: 0.03 –0.07 mm (0.001 –0.003 inch)

No. 2 ring: 0.03 –0.07 mm (0.001 –0.003 inch)

Limit: 0.1 mm (0.004 inch)



2. Put piston rings into the cylinder bore, press them against the piston top face, and push them in. After achieving squareness, measure the end gap with a thickness gauge. If the end gap is excessive, replace piston rings.

Standard value:

No. 1 ring: 0.15 –0.28 mm (0.006 –0.011 inch)

No. 2 ring: 0.30 –0.45 mm (0.012 –0.018 inch)

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

Limit:

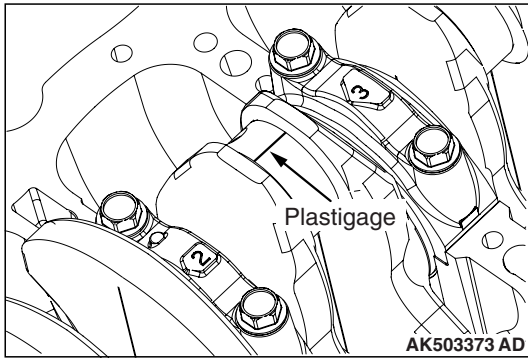
No. 1 ring: 0.8 mm (0.03 inch)

No. 2 ring: 0.8 mm (0.03 inch)

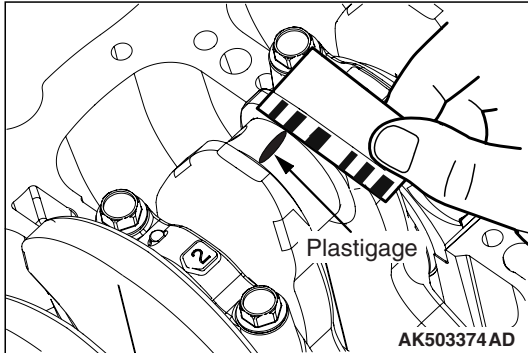
Oil ring: 1.0 mm (0.04 inch)

CRANKSHAFT PIN OIL CLEARANCE (PLASTIGAGE METHOD)

1. Wipe oil off the crankshaft pin and connecting rod bearing.
2. Place a plastigage in length equal to the bearing width on the pin shaft straight in alignment with the shaft center.



3. Carefully install the connecting rod cap and tighten bolts to the specified torque of 5.0 N·m (44 in-lb) →20 N·m (15 ft-lb) →+90°.
4. Remove bolts and gently remove the connecting rod cap.

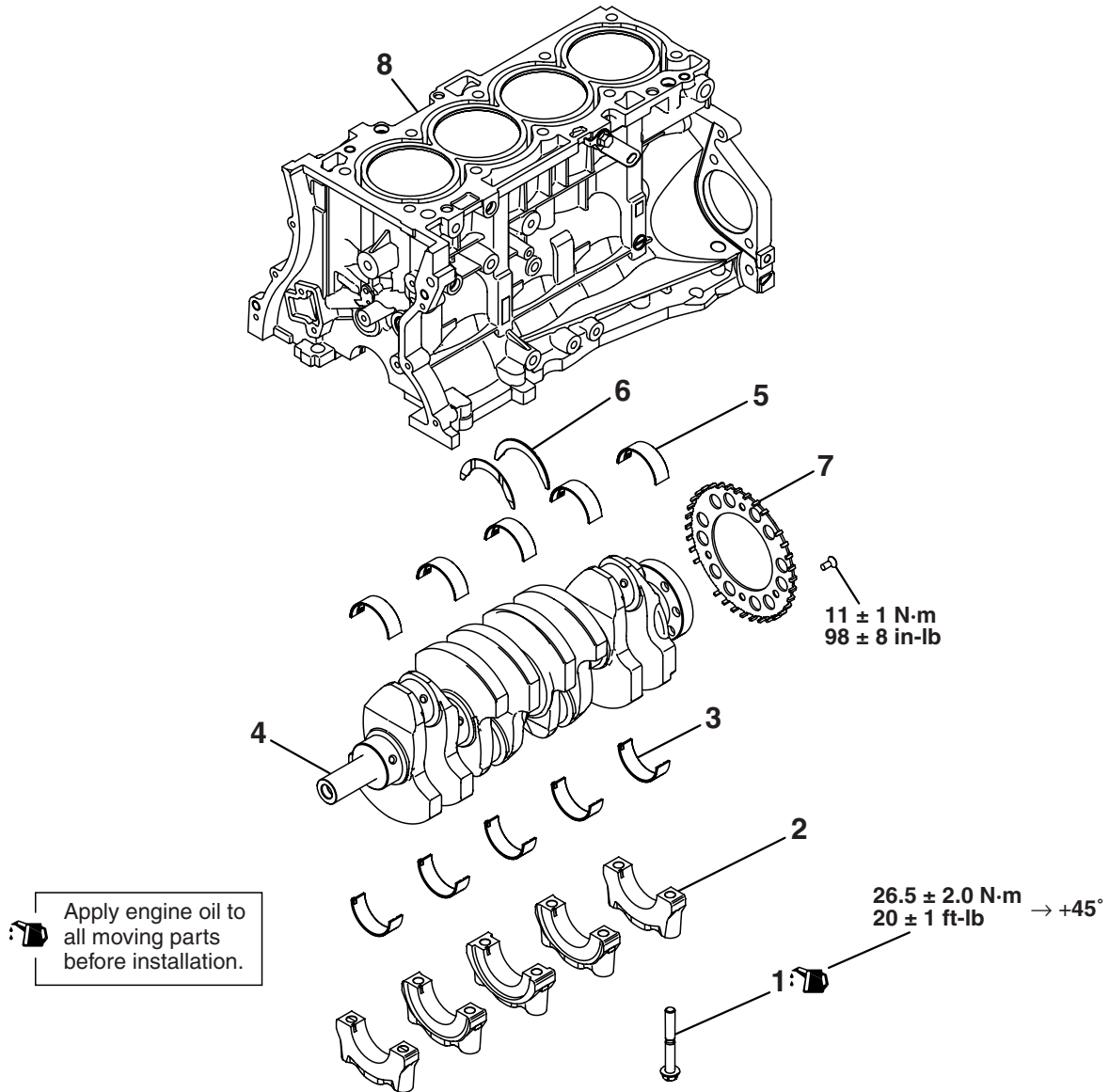


5. Measure the crushed plastigage width (area most widely crushed) using a scale printed on the plastigage bag.
Standard value: 0.018 –0.045 mm (0.0007 –0.0018 inch)
Limit: 0.1 mm (0.004 inch)

CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008702105



AK604556AB

Removal steps

- >>E<< 1. Crankshaft bearing cap bolt
- >>E<< 2. Crankshaft bearing cap
- >>D<< 3. Crankshaft bearing lower
- <<A>> 4. Crankshaft

Removal steps (Continued)

- >>C<< 5. Crankshaft bearing upper
- >>B<< 6. Thrust bearing
- >>A<< 7. Crankshaft sensing ring
- 8. Cylinder block

Required Special Tool:

- MB991614: Angle Gauge

REMOVAL SERVICE POINT

<<A>> CRANKSHAFT REMOVAL

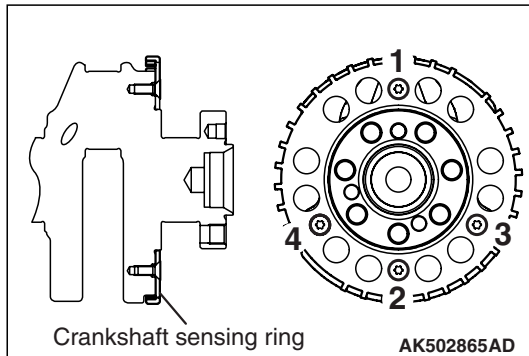
After removing the crankshaft with the crankshaft sensing ring attached, temporarily place it on a V-block to prevent teeth of the sensing ring from deforming.

NOTE: If a tooth bends, be sure to replace the crankshaft sensing ring with a new one.

INSTALLATION SERVICE POINTS

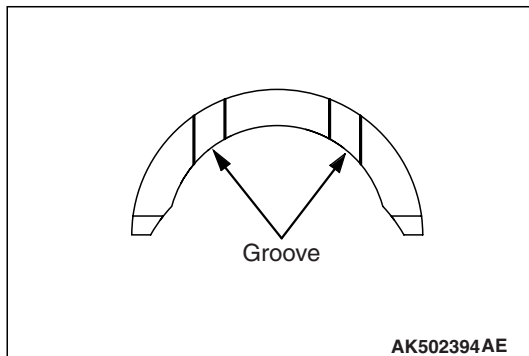
>>A<< CRANKSHAFT SENSING RING INSTALLATION

Tighten crankshaft sensing ring bolts to the torque of 11 ± 1 N·m in the tightening order shown in the illustration.



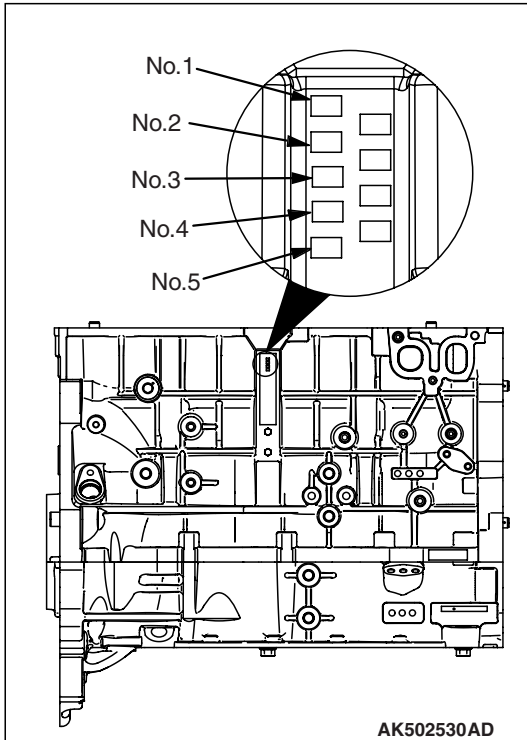
>>B<< THRUST BEARING INSTALLATION

1. Install the thrust bearing on the No. 3 bearing on the cylinder block side. Application of engine oil makes the installation easier.
2. Install the thrust bearing so that the grooved side is on the crankshaft weight side.

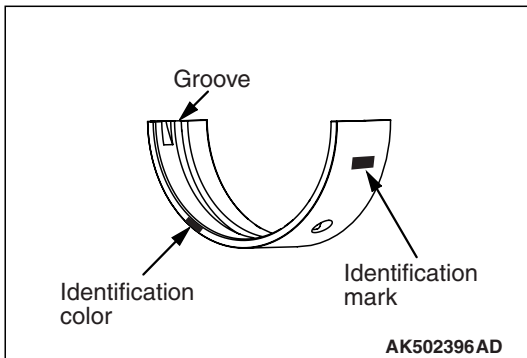


>>C<< CRANKSHAFT BEARING UPPER
INSTALLATION

1. When replacing the crankshaft bearing upper, select a bearing with the size corresponding to the crankshaft journal diameter in the table below.



2. The crankshaft bearing upper has an identification color or identification mark at the illustrated position.

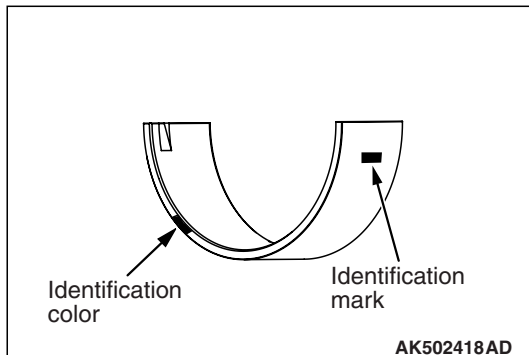
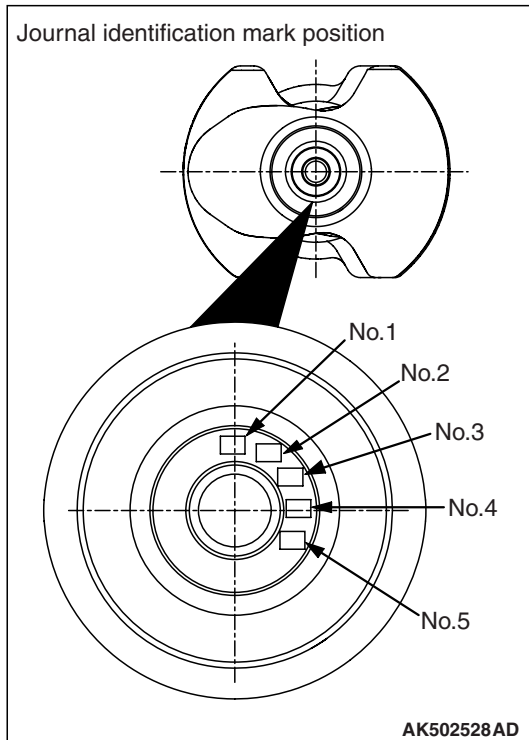


Cylinder block		Crankshaft bearing	
Identification mark	Journal diameter mm (in)	Identification color	Identification mark
1	56.000 –56.006 (2.2047 –2.2050)	Black	1
2	56.006 –56.012 (2.2050 –2.2052)	None	2
3	56.012 –56.018 (2.2052 –2.2054)	Green	3

3. Install the selected crankshaft bearing upper.

>>D<< CRANKSHAFT BEARING LOWER INSTALLATION

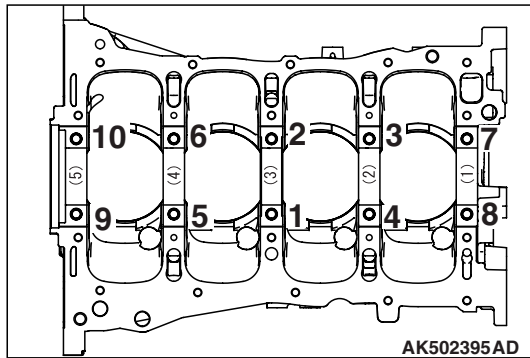
1. When replacing the crankshaft bearing lower, select a bearing with the size corresponding to the crankshaft journal diameter in the table below.



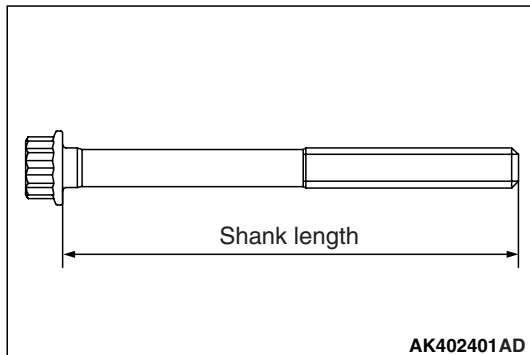
2. The crankshaft bearing lower has an identification color or identification mark at the illustrated position.

Crankshaft		Crankshaft bearing	
Identification mark	Journal diameter mm (in)	Identification color	Identification mark
0	51.985 –51.988 (2.0467 –2.0468)	Pink or red	0
1	51.982 –51.985 (2.0465 –2.0467)	Black	1
2	51.979 –51.982 (2.0464 –2.0465)	None	2
3	51.976 –51.979 (2.0463 –2.0464)	Green	3
4	51.973 –51.976 (2.0462 –2.0463)	Blue	4

3. Install the selected crankshaft bearing lower.

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

1. Install the crankshaft bearing cap with reference to the identification mark as illustrated.



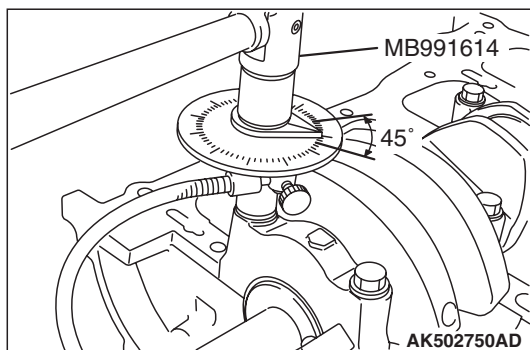
2. Make sure that the underhead length of the bolt is at or below the limit before installing the crankshaft bearing cap bolt. If the length exceeds the limit, replace the bolt with a new one.

Limit: 75.3 mm (2.96 inch)

3. Apply engine oil to the threaded portion and seat surface of the bolt.
4. Tighten crankshaft bearing cap bolts to the torque of 26.5 ± 2.0 N·m (20 ± 1 ft-lb) according to the tightening order.

⚠ CAUTION

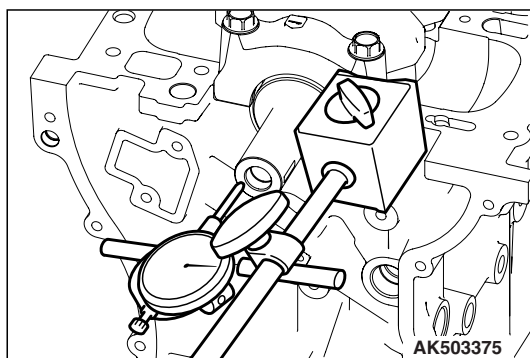
- If the tightening angle is less than 45° , tightening performance may not be secured. Use caution to the tightening angle during tightening.
 - If the tightening angle becomes more than 45° , completely loosen bolts and start tightening over again according to the procedure.
5. Use special tool MB991614 to tighten bolts 45° according to the tightening order.



6. Check end play of the crankshaft after installing the crankshaft bearing cap. If the end play exceeds the limit, replace the thrust bearing.

Standard value: 0.05 – 0.25 mm (0.002 – 0.010 inch)

Limit: 0.4 mm (0.016 inch)

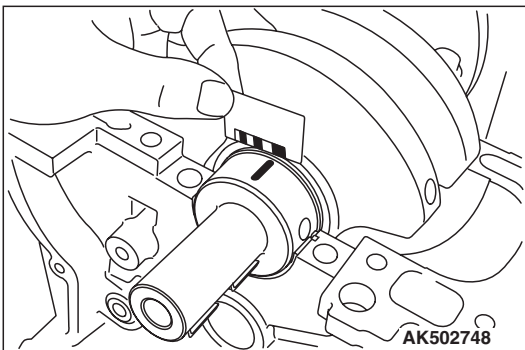
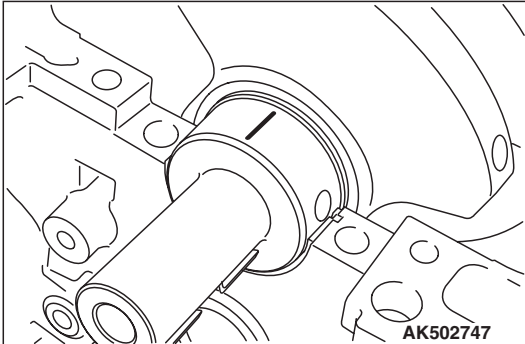


INSPECTION

CRANKSHAFT OIL CLEARANCE (PLASTIGAGE METHOD)

Oil clearance can be easily measured by using a "plastigage." When using a "plastigage," perform measurement in the following procedure.

1. Fully wipe oil off the outside diameter of the crankshaft and inside diameter of the bearing.
2. Assemble the crankshaft.
3. Place a plastigage in length equal to the bearing width on the journal shaft straight in alignment with the shaft center.
4. Carefully install the bearing cap and tighten the bolt according to the main point of installation >>B<<.
5. Remove the bolt, and then carefully remove the crankshaft bearing cap.



6. Measure the crushed plastigage width (area most widely crushed) using a scale printed on the plastigage bag.

Standard value: 0.012 –0.030 mm (0.0005 –0.0012 inch)

Limit: 0.1 mm (0.004 inch)

CYLINDER BLOCK

1. Visually check the cylinder block for scratch, rust and corrosion. Use a flaw detecting agent to check for cracks. If it is found faulty, repair or replace it.
2. Measure distortion on the top surface of the cylinder block using a straight edge and thickness gauge.
If distortion exceeds the limit, grind and repair it.
A gasket or the like must not be adhered to the top surface of the cylinder block during measurement.

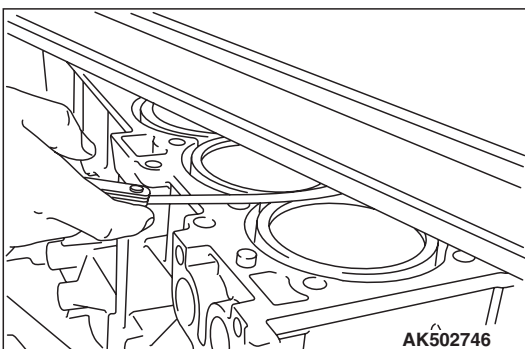
Distortion on bottom

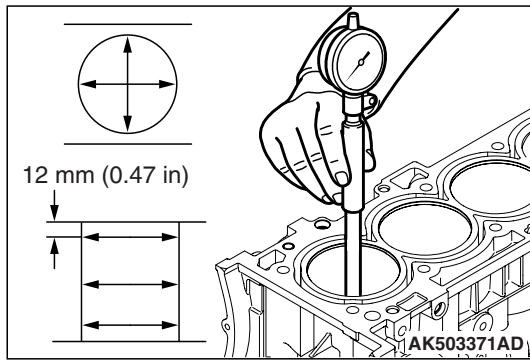
Standard value: Within 0.05 mm (0.0020 inch)

Limit: 0.02 mm (0.0008 inch)

Grinding limit: 0.2 mm (0.008 inch)

3. Check the cylinder wall for scratch or seizure. If there is any defect, replace the cylinder block.





4. Measure the bore and cylindricity of the cylinder using a cylinder gauge.
If the cylinder is excessively worn, repair the cylinder and replace the piston and piston rings.
Measuring points are as shown in the illustration.

Standard value**Cylinder bore: 86 mm (3.4 inches)****Cylindricity: 0.15 mm (0.006 inch)**