GROUP 11B

ENGINE OVERHAUL

CONTENTS

GENERAL SPECIFICATIONS

M1113000203154

Item	Specification	
Engine model	4B11	4B12
Type	In-line DOHC	
Number of cylinders	4	
Combustion chamber	Pentroof type	
Total displacement mL	1,998	2,360
Cylinder bore mm	86	88
Piston stroke mm	86	97
Compression ratio	10	10.5
Auto lash adjuster	Non-equipped	

SERVICE SPECIFICATIONS

M1113000303645

Item		Standard value	Limit
Timing chain			
Valve clearance mm	Inlet	0.20 ± 0.03	–
	Exhaust	0.30 ± 0.03	–
Camshaft			
Cam height of camshaft mm	Inlet	43.25	42.75
	Exhaust	45.00	44.50
Camshaft bearing (metal) oil clearance mm		0 – 0.032	–
Cylinder head and valve			
Distortion of cylinder head bottom mm		Within 0.05	0.2
Grinding limit of cylinder head bottom mm		–	0.2
Overall height of cylinder head mm		128.5	–
Overall length of valve mm	Inlet	113.18	112.68
	Exhaust	105.89	105.39
Valve margin mm	Inlet	1.022	0.522
	Exhaust	1.094	0.594
Free height of valve spring mm		49.4	48.4
Squareness of valve spring		2° or less	4°
Clearance between valve guide and valve stem mm	Inlet	0.020 – 0.047	0.10
	Exhaust	0.030 – 0.057	0.15
Valve seat contact width mm	Inlet	1.16 – 1.46	–
	Exhaust	1.35 – 1.65	–
Valve guide projection from cylinder head upper surface mm		14.6 – 15.2	–
Piston and connecting rod			

Item		Standard value	Limit
Piston pin press-fit load N		7,500 – 17,500	–
Clearance between piston ring and ring groove mm	No.1	0.03 – 0.07	0.1
	No.2	0.03 – 0.07	0.1
Piston ring end gap mm	No.1<4B11>	0.15 – 0.28	0.8
	No.1<4B12>	0.15 – 0.25	0.8
Piston ring end gap mm	No.2<4B11>	0.30 – 0.45	0.8
	No.2<4B12>	0.25 – 0.40	0.8
	Oil	0.10 – 0.35	1.0
Clearance of connecting rod big end thrust mm		0.10 – 0.25	0.4
Outside diameter of connecting rod bolt mm		–	0.1
Connecting rod bearing oil clearance mm		0.018 – 0.045	0.1
Crankshaft and cylinder block			
Underhead length of crankshaft bearing cap bolt mm		75.5 – 76.5	–
Crankshaft axial play mm		0.05 – 0.25	0.4
Crankshaft journal oil clearance mm		0.012 – 0.030	0.1
Distortion of cylinder block top surface mm		0.05	0.2
Grinding limit of cylinder block top surface mm		–	0.2
Cylinder block cylinder bore mm	4B11	86	–
	4B12	88	–
Cylindricity of cylinder block mm		0.15	–

REWORK DIMENSIONS

M1113024301784

Item			Standard value
Cylinder head and valve			
Cylinder head oversize valve seat bore diameter mm	Intake	0.30 O.S.	36.22 – 36.24
	Exhaust	0.30 O.S.	30.22 – 30.24
Cylinder head oversize valve guide bore diameter mm		0.25 O.S.	11.23 – 11.25

TORQUE SPECIFICATIONS

M1113023405371

Item	N·m
Alternator and ignition system	
Idler pulley bolt	44 ± 8
Auto tensioner	22 ± 4
Crankshaft pulley centre bolt	210
Alternator nut	44 ± 10

Item	N·m
Alternator bolt	44 ± 10
Ignition coil bolt	10 ± 2
Spark plug	25 ± 5
Accessory bracket bolt	44 ± 8
Throttle body	
Vacuum pipe assembly bolt	11 ± 1
Throttle body bolt	9.5 ± 2.5
Manifold absolute pressure (MAP) sensor screw	4.0 ± 1.0
Solenoid valve screw	4.0 ± 1.0
Water pipe bolt	10 ± 2
Inlet manifold and fuel system	
Oil level gauge guide bolt	10 ± 2
Injector protector rear bolt	3.5 ± 1.5 → 20 ± 2
Delivery pipe bolt	3.5 ± 1.5 → 20 ± 2
Inlet manifold bolt and nut	3.5 ± 1.5 → 20 ± 2
Inlet manifold stay bolt	20 ± 2
Inlet manifold stay B bolt	20 ± 2
Inlet manifold stay C bolt	20 ± 2
Injector protector front bolt	3.5 ± 1.5 → 20 ± 2
Detonation sensor bolt	20 ± 2
Oil pressure switch	10 ± 2
Exhaust manifold	
Exhaust manifold cover bolt	8.0 ± 2.0
Exhaust manifold nut	49 ± 5
Exhaust manifold bracket bolt (Exhaust manifold side)	56 ± 8
Exhaust manifold bracket bolt (Cylinder block side)	41 ± 10
Crank angle sensor bolt	11 ± 1
Crank angle sensor cover bolt	11 ± 1
Oxygen sensor	44 ± 5
Water hose and pipe	
Water inlet fitting bolt	24 ± 3
Water outlet fitting bolt	24 ± 3
Thermostat housing bolt	24 ± 3
Engine hanger bolt	28 ± 8
Coolant temperature sensor	30 ± 9
Water pump bolt	24 ± 3
Water pipe nut	24 ± 3
Camshaft position sensor	11 ± 1
Oil pan and timing chain case	
Cylinder head cover bolt	3.0 ± 1.0 → 5.5 ± 0.5

Item	N·m
Timing chain case bolt <M6>	10 ± 2
Timing chain case bolt <M8 × 10>	13 ± 1
Timing chain case bolt <M8 × 30>	24 ± 4
Oil pan bolt <M6>	10 ± 2
Oil pan bolt <M8>	31 ± 2
Air compressor bracket bolt	23 ± 6
Oil drain plug	39 ± 5
Oil filter	14 ± 2
PCV valve	2.5 ± 0.4
Engine support bracket assembly washer bolt	48 ± 6
Timing chain	
Inlet V.V.T. sprocket bolt	59 ± 5
Exhaust camshaft sprocket bolt	59 ± 5
Timing chain tensioner bolt	10 ± 2
Tensioner lever bolt	10 ± 2
Timing chain guide bolt	10 ± 2
Camshaft	
Oil feeder control valve (OCV) bolt	10 ± 2
Camshaft bearing cap bolt	12 ± 1
Front camshaft bearing cap bolt	17 ± 3 → 30 ± 2
Cylinder head and valves	
Cylinder head bolt	35 ± 2 → +90°+90°
Oil pump chain	
Drive plate bolt	40 → 130
Oil pump case bolt	26 ± 2
Oil pump sprocket bolt	23 ± 2
Oil pump tensioner lever bolt	10 ± 2
Oil pump chain guide bolt	10 ± 2
Ladder frame bolt	24 ± 2
Balancer chain	
Drive plate bolt	40 → 130
Balancer shaft module bolt	20 → 44 → 0 → 20 → +135°
Balancer shaft chain tensioner bolt	10 ± 2
Lever tensioner bolt	10 ± 2
Balancer shaft chain guide bolt	10 ± 2
Ladder frame bolt	24 ± 2
Piston and connecting rod	
Connecting rod cap bolt	5.0 → 20 → +90°
Crankshaft and cylinder block	
Crankshaft sensing ring bolt	11 ± 1

Item	N·m
Bearing cap bolt	26.5 ± 2.0 → +45°

SEALANTS

M1113000503605

Item	Specified sealant
Drive plate bolt	ThreeBond 1324 or equivalent
Oil pan	ThreeBond 1227D, ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No,1000A923), ThreeBond 1207F (MITSUBISHI MOTORS GENUINE Part No,MD970389), LOCTITE 5970, LOCTITE 5900 or equivalent
Cylinder head cover (matching area of the cylinder head and the timing chain case assembly)	ThreeBond 1227D, ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), LOCTITE 5900 or equivalent
Ladder frame	ThreeBond 1227D, ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), LOCTITE 5970 or equivalent
Cylinder head gasket (matching area of the cylinder block and the cylinder head)	ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), LOCTITE 5900 or equivalent
Timing chain case	ThreeBond 1227D, ThreeBond 1217G (MITSUBISHI MOTORS GENUINE Part No.1000A923), LOCTITE 5900 or equivalent
Coolant temperature sensor	ThreeBond 1324N, LOCTITE 262 or equivalent
Oil pressure switch	ThreeBond 1212D, ThreeBond 1215 or equivalent

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

LIQUID GASKET (FIPG)

FIPG is used for some parts in the engine. It is necessary to pay attention to an application amount, application procedure and applied surface condition for this gasket to fully achieve its purpose.
Too small amount causes leakage while too much amount squeezes out to block or narrow water and oil passages. Therefore, it is absolutely essential to apply a correct amount of liquid sealant continuously without break to eliminate leakage from joints.
FIPG used for engine parts hardens reacting with moisture in the air, and is usually used for metal flanges.

⚠ CAUTION

Reapply the FIPG with care to the followings.

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

DISASSEMBLY

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

CLEANING OF GASKET SURFACE

Completely remove all deposits from the gasket surface with a gasket scraper or wire brush. Make sure that the surface to which FIPG is applied is smooth. The gasket surface must be free from grease and foreign substances. Be sure to remove old FIPG that has entered mounting holes and screw holes.

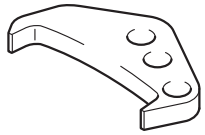
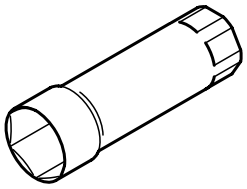
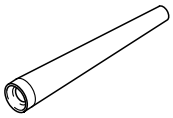
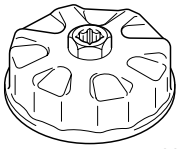
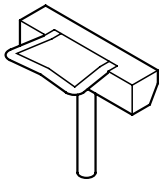
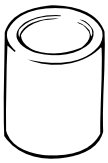
APPLICATION PROCEDURE

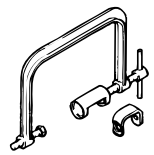
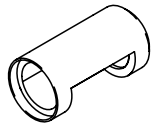
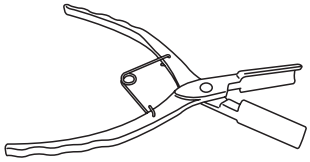
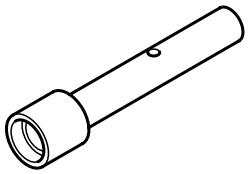
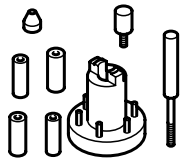
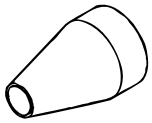
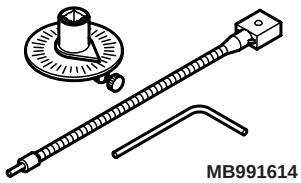
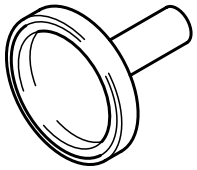
Apply FIPG in a determined diameter and continuously without break. Completely enclose the periphery of mounting holes. FIPG can be wiped off if it is not hardened. Install parts in place while FIPG is still wet. Take care not to allow FIPG to adhere to other locations than necessary locations during installa-

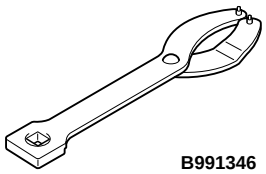
tion. Do not pour oil or water on applied locations or do not start the engine until sufficient time (approximately one hour) passes. The application procedure of FIPG may differ depending on areas. Follow the procedure in the body of the manual to apply FIPG.

SPECIAL TOOLS

M1113000603516

Tool	Part No.	Tool name	Application
 MB991883	MB991883	Flywheel stopper	Securing of drive plate
	MB991398	Spark plug wrench	Removal and installation of spark plug
 B992106	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	Removal of oil pan
	MB991448	Bushing remover and installer base	Press fit of front oil seal

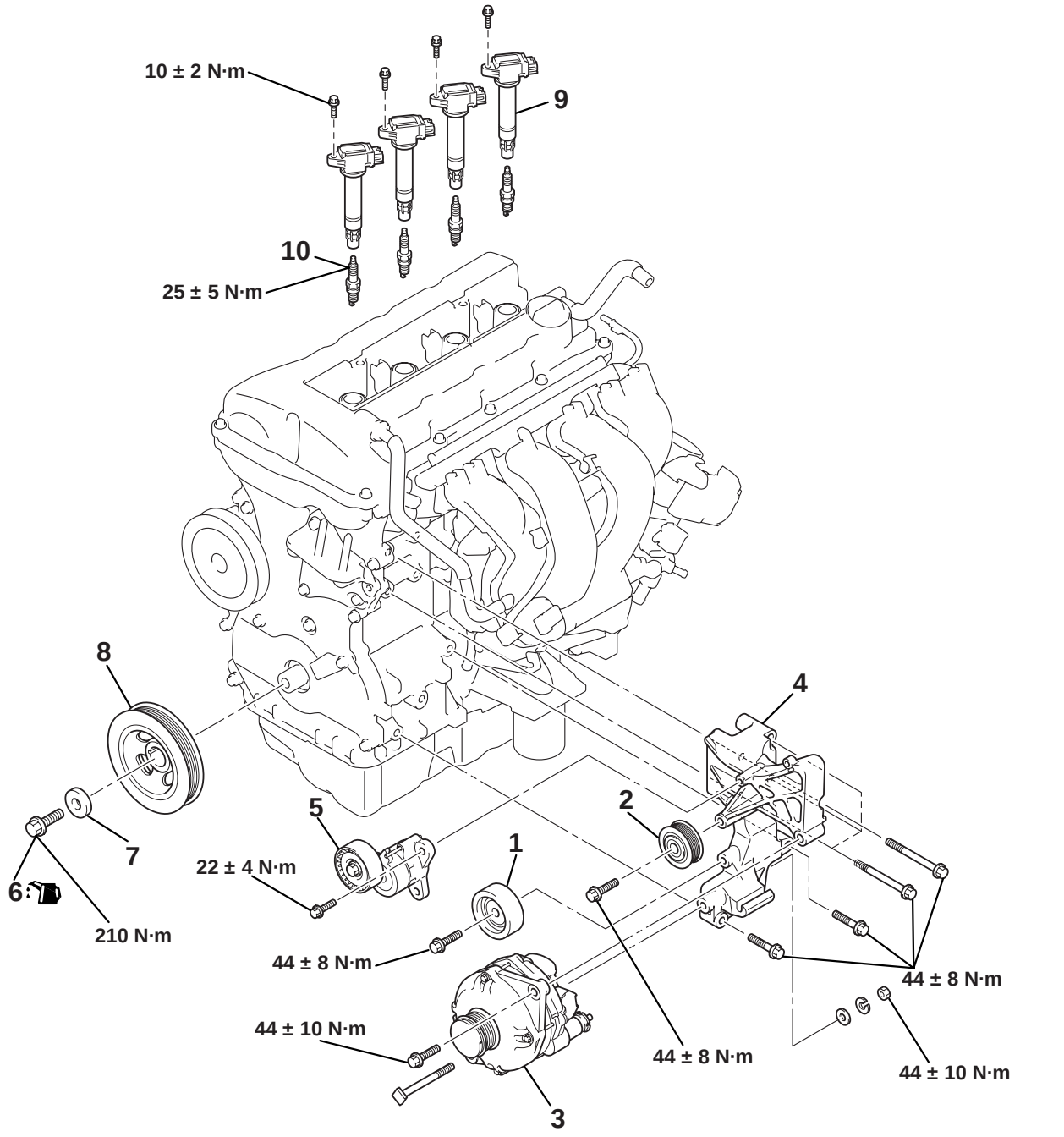
Tool	Part No.	Tool name	Application
	MD998735	Valve spring compressor	Compression of valve spring
	MB992089	Retainer holder C	
	MB992085	Valve stem seal pliers	Extraction of valve stem seal
	MD998737	Valve stem seal installer	Installation of valve stem seal
	MD998780	Piston pin setting tool	Extraction and press fit of piston pin
	MB991659	Guide D	
 MB991614	MB991614	Angle gauge	Installation of crankshaft bearing cap bolt
	MD998718	Rear oil seal installer	Press fit of rear oil seal

Tool	Part No.	Tool name	Application
 B991346	MB991346	Top cover wrench	Removal and installation of oil pump sprocket(4B11)

ALTERNATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION

M1113001002718



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Removal sequence

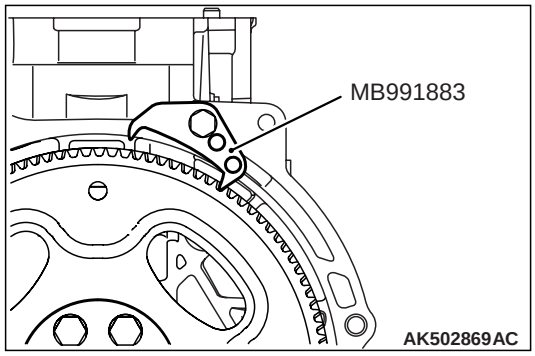
1. Idler pulley
2. Idler pulley
>>**C**<< 3. Alternator
>>**C**<< 4. Accessory bracket
5. Auto tensioner

Removal sequence (Continued)

<<**A**>> >>**B**<< 6. Crankshaft pulley centre bolt
>>**B**<< 7. Crankshaft pulley washer
>>**B**<< 8. Crankshaft pulley
9. Ignition coil
<<**B**>> >>**A**<< 10. Spark plug

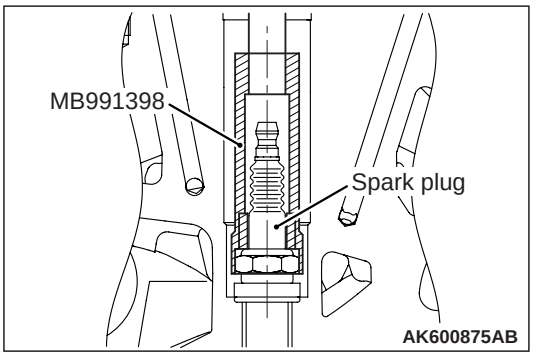
REMOVAL SERVICE POINTS

<<A>> CRANKSHAFT PULLEY CENTRE BOLT REMOVAL



1. Use special tool Flywheel stopper (MB991883) to secure the drive plate.
2. Remove the crankshaft pulley centre bolt.

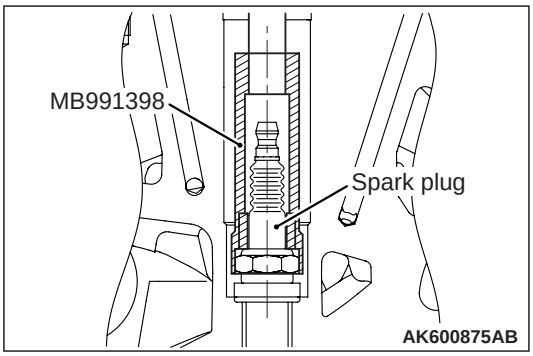
<<B>> SPARK PLUG REMOVAL



Using special tool Spark plug wrench (MB991398), remove the spark plug.

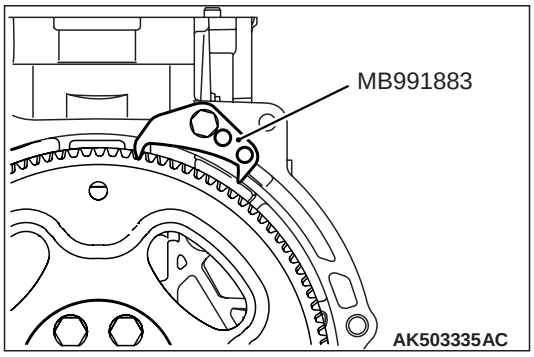
INSTALLATION SERVICE POINTS

>>A<< SPARK PLUG INSTALLATION

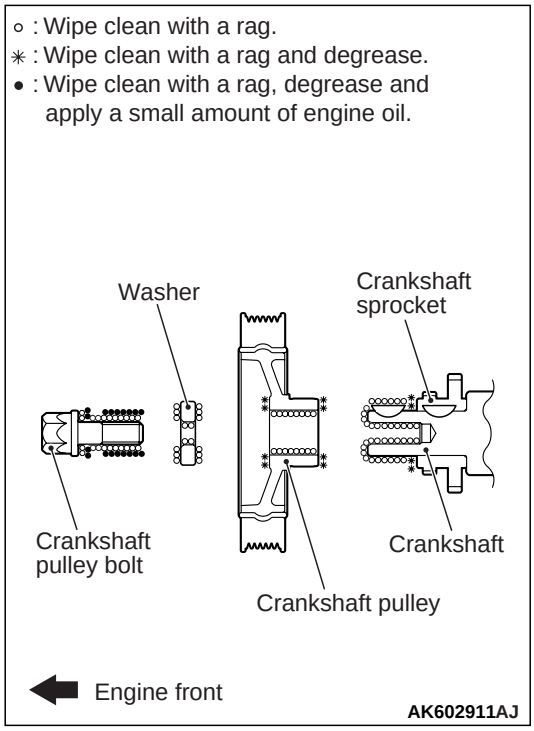


Use special tool Spark plug wrench (MB991398), tighten the spark plug to specified torque of 25 ± 5 N·m.

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



1. Use special tool Flywheel stopper (MB991883) to secure the drive plate.

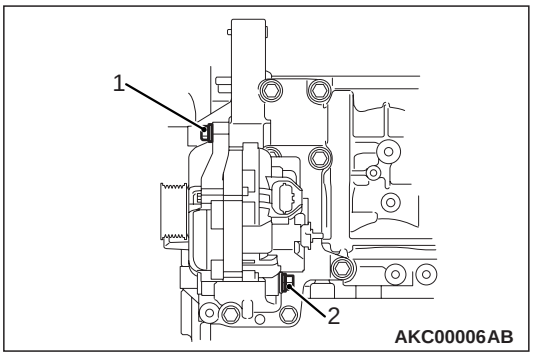


2. Wipe off the dirt on the crankshaft pulley washer and on the thread hole of the crankshaft using a rag.
3. Wipe off the dirt on the crankshaft pulley and the crankshaft sprocket using a rag, and then remove the grease from the portion shown in the illustration.

   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 the chamfered side on the inside of the washer facing the bolt top, install the crankshaft pulley washer to the crankshaft pulley centre bolt.
7. Tighten the crankshaft pulley centre bolt to the specified torque of 210 N·m.

>>C<< ALTERNATOR INSTALLATION



1. Temporarily tighten alternator bolt and nut.
2. First tighten the upper mounting bolt to the specified torque, and then tighten the lower nut.

Specified torque: 44 ± 10 N·m

THROTTLE BODY

REMOVAL AND INSTALLATION

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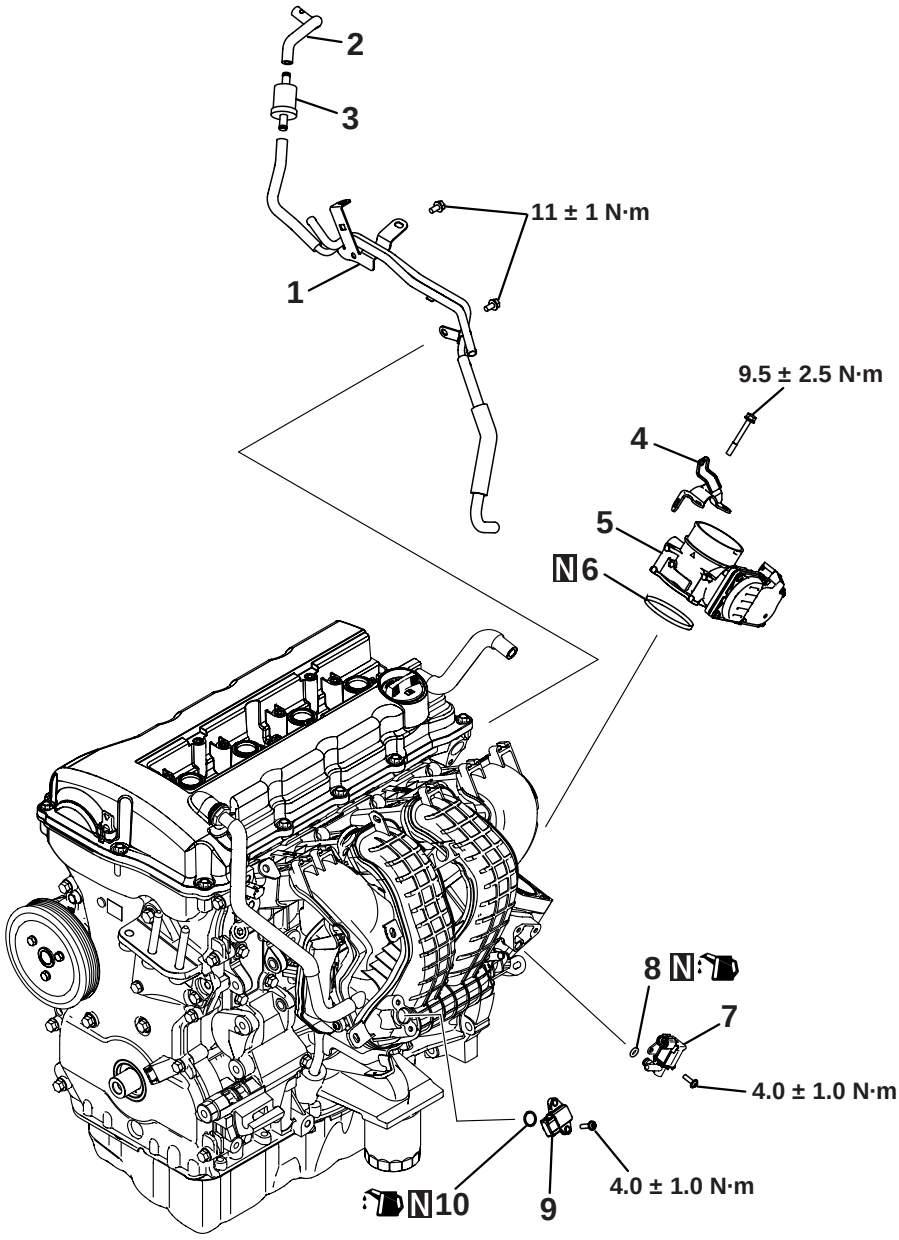

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Removal steps

1. Vacuum pipe and hose
2. Purge hose
3. Chamber
4. Throttle body stay
5. Throttle body
6. Throttle body gasket
7. Solenoid valve
8. O-ring

>>A<< 9. Manifold absolute pressure (MAP) sensor

10. O-ring

INSTALLATION SERVICE POINTS

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

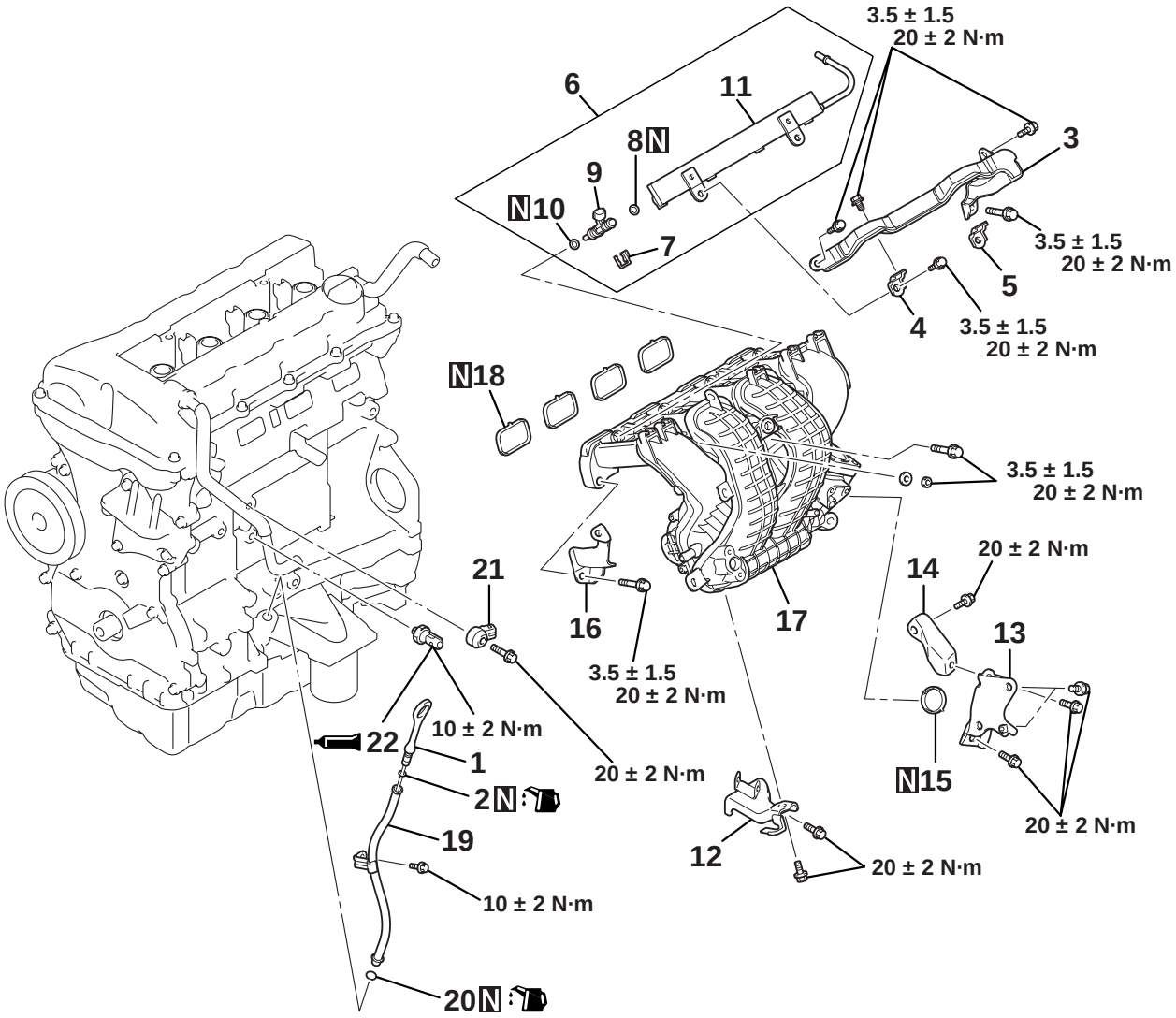
⚠ CAUTION

- **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 fallen down.**

INLET MANIFOLD AND FUEL SYSTEM

REMOVAL AND INSTALLATION

M1113032501169



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Removal sequence

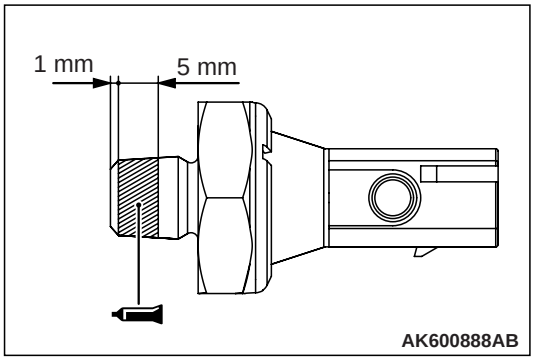
1. Oil level gauge rod
2. O-ring
- **>>G<<** 3. Injector protector rear
- **>>G<<** 4. Bracket
- **>>G<<** 5. Bracket
- **>>G<<** 6. Delivery pipe assembly
- **>>F<<** 7. Injection support
8. O-ring
- **>>F<<** 9. Injector
- **>>E<<** 10. O-ring
11. Delivery pipe

Removal sequence (Continued)

- **>>D<<** 12. Inlet manifold stay
13. Inlet manifold stay B
14. Inlet manifold stay C
15. EGR gasket
16. Injector protector front
- **>>C<<** 17. Inlet manifold
18. Inlet manifold gasket
19. Oil level gauge guide
20. O-ring
- **>>B<<** 21. Detonation sensor
- **>>A<<** 22. Oil pressure switch

INSTALLATION SERVICE POINTS

>>A<< OIL PRESSURE SWITCH INSTALLATION



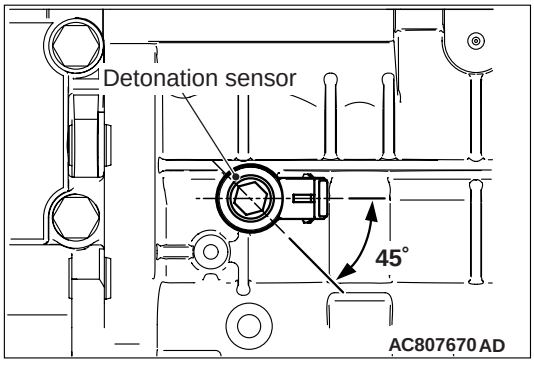
⚠ CAUTION

- **Do not allow sealant to squeeze out to the screw tip.**
- **Do not tighten, exceeding the specified torque.**

1. Completely remove sealant adhering to the oil pressure switch and cylinder block threaded holes.
2. Apply sealant of 5 mm to the threaded portion of the oil pressure switch shown in the illustration.

   Specified sealant:
   ThreeBond 1212D, ThreeBond 1215 or equivalent
3. Tighten the oil pressure switch to the cylinder block to the specified torque of 10 ± 2 N·m.

>>B<< DETONATION SENSOR INSTALLATION



Align the detonation sensor connector with the position shown in the illustration, and then tighten it to the specified torque of 20 ± 2 N·m.

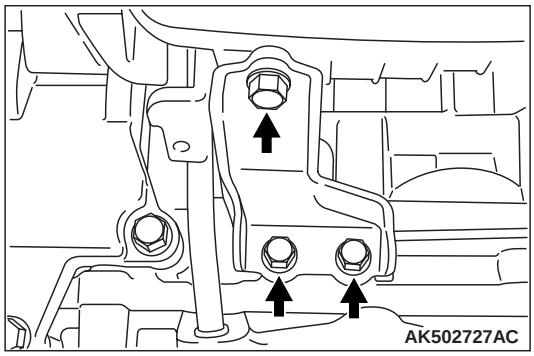
>>C<< INLET MANIFOLD INSTALLATION

⚠ CAUTION

Temporarily tighten the inlet manifold because there is a bolt tightening procedure for the inlet manifold, delivery pipe and injector protector.

Install the inlet manifold and temporarily tighten bolts.

>>D<< INLET MANIFOLD STAY INSTALLATION

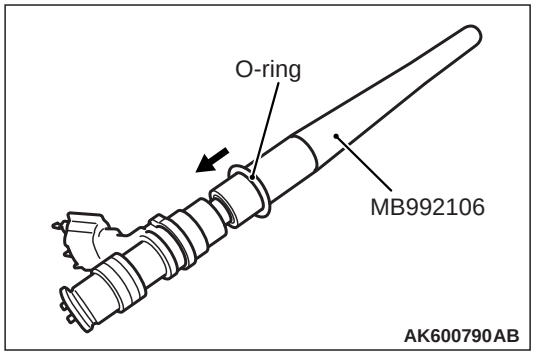


Make sure that the inlet manifold stay is in intimate contact with the inlet manifold and cylinder block boss before tightening it to the specified torque of 20 ± 2 N·m.

>>E<< O-RING INSTALLATION

⚠ CAUTION

Do not allow engine oil to enter the delivery pipe.

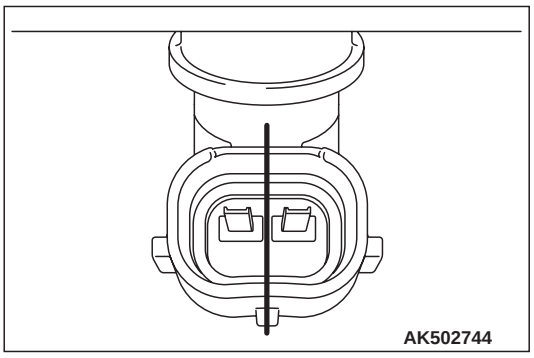


When inserting an O-ring into the injector on the injection nozzle side, use special tool O-ring installer (MB992106) to gradually expand the O-ring, and fit it in place.

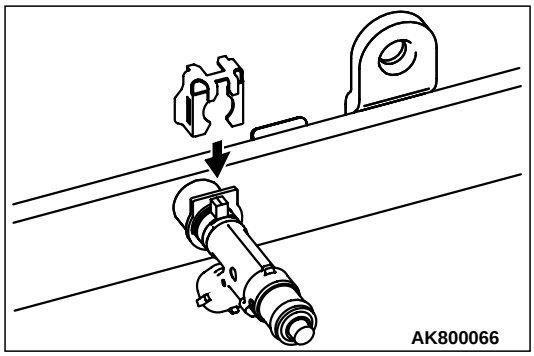
>>F<< INJECTOR AND INJECTOR SUPPORT INSTALLATION

1. Apply spindle oil or gasoline to the O-ring of the injector.
2. Insert the injector into the delivery pipe 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 delivery pipe and check.

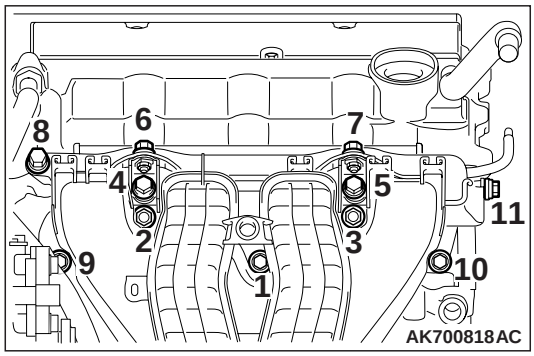


4. Make sure that the protrusion of the injector is at the centre as shown in the illustration.



5. Securely assemble the injector to the injector groove and delivery pipe collar.

>>G<< DELIVERY PIPE ASSEMBLY / BRACKET / INJECTOR PROTECTOR REAR INSTALLATION



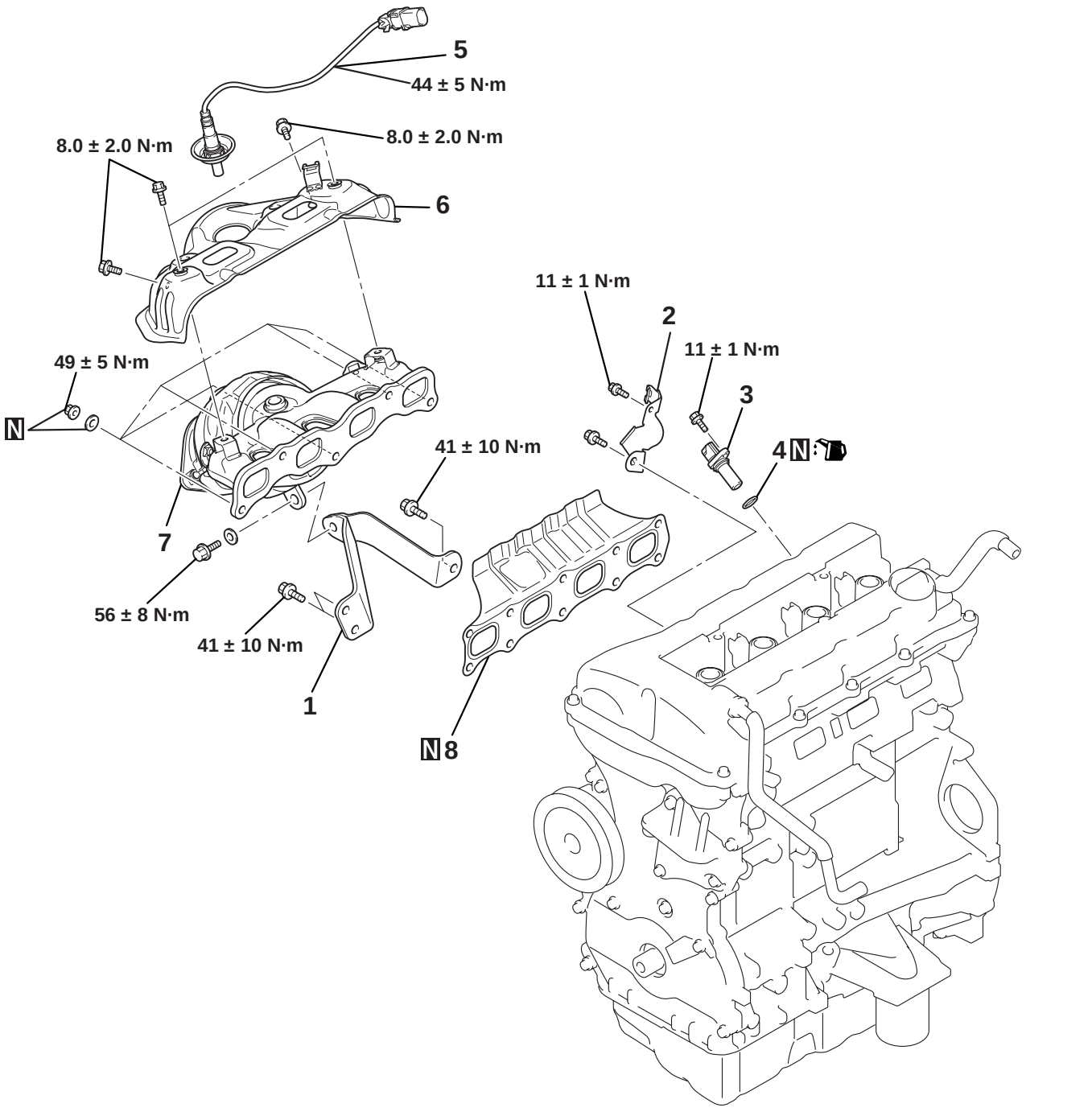
1. Install the delivery pipe assembly, bracket and injector protector on the cylinder head.
2. Tighten mounting bolts together with temporarily tightened inlet manifold mounting bolts in the order shown in the illustration.
3. Tighten the delivery pipe assembly, bracket, injector protector rear and inlet manifold in the order shown in the illustration.

   Temporarily torque: 3.5 ± 1.5 N·m
   Specified torque: 20 ± 2 N·m

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113011901247



AKB00728AB

Removal steps

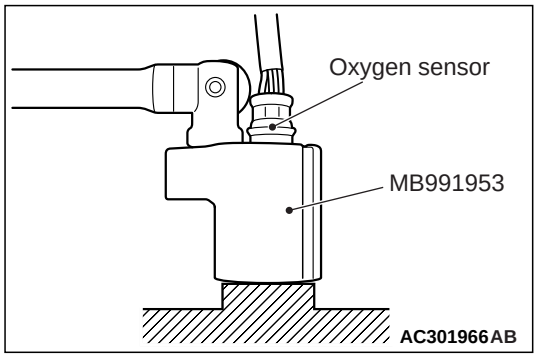
>>D<< 1. Exhaust manifold bracket
2. Crank angle sensor cover
>>C<< 3. Crank angle sensor
>>C<< 4. O-ring

Removal steps (Continued)

<<A>> >>B<< 5. Oxygen sensor
6. Exhaust manifold cover
>>A<< 7. Exhaust manifold
8. Exhaust manifold gasket

REMOVAL SERVICE POINTS

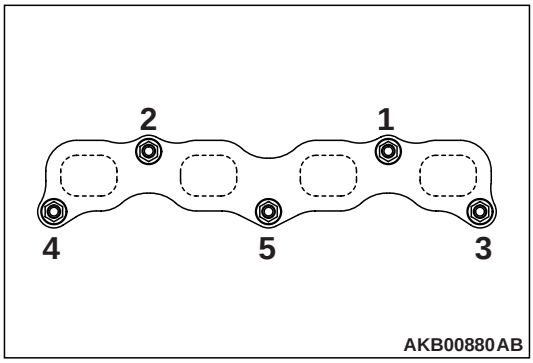
<<A>> OXYGEN SENSOR REMOVAL



Remove the connection and clamp of oxygen sensor connector, and then use special tool oxygen sensor wrench (MB991953) to remove the oxygen sensor.

INSTALLATION SERVICE POINTS

>>A<< EXHAUST MANIFOLD INSTALLATION

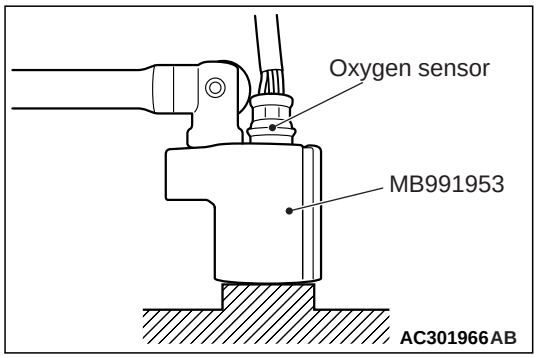


1. Tighten the exhaust manifold nut to the specified torque of 49 ± 5 N·m in the order shown in the illustration.

>>B<< OXYGEN SENSOR INSTALLATION

⚠ CAUTION

- **Do not use a sensor that has fallen down.**



Tighten the oxygen sensor to the specified torque by using special tool oxygen sensor wrench (MB991953).

Tightening torque: 44 ± 5 N·m

>>C<< CRANK ANGLE SENSOR / O-RING 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 fallen down.**

Tighten the crank angle sensor to the specified torque of 11 ± 1 N·m.

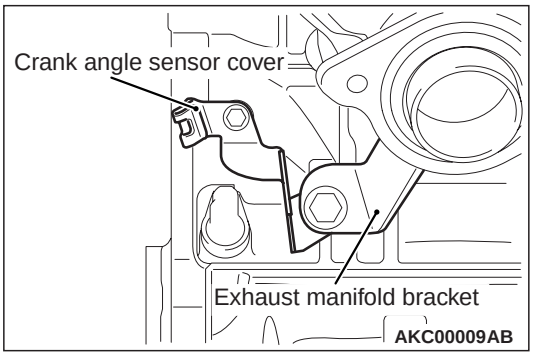
>>D<< EXHAUST MANIFOLD BRACKET INSTALLATION

⚠ CAUTION

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

1. After temporarily tightening the exhaust manifold bracket with the installation bolts, check the exhaust manifold fastens securely to the cylinder block.
2. Tighten the cylinder block side bolt to the specified tightening torque.

   Tightening torque: 41 ± 10 N·m



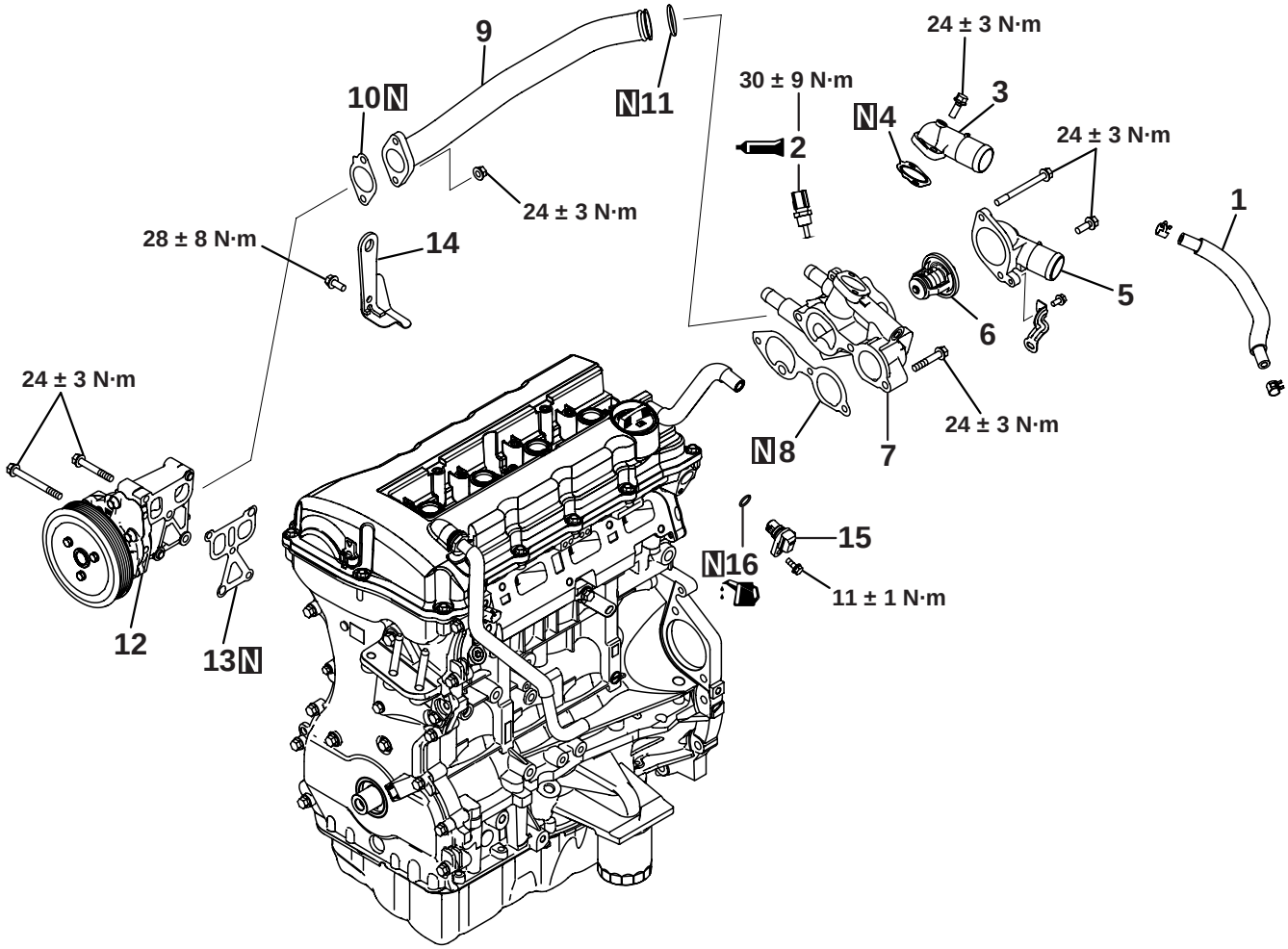
3. Tighten the exhaust manifold side bolt to the specified tightening torque.

   Tightening torque: 56 ± 8 N·m

WATER HOSE AND PIPE

REMOVAL AND INSTALLATION

M1113032900722



AKC00005 AB

Removal steps

1. Water hose
- **>>C<<** 2. Coolant temperature sensor
3. Water outlet fitting
4. Outlet fitting gasket
5. Water inlet fitting
- **>>B<<** 6. Thermostat
- **>>A<<** 7. Thermostat housing
8. Thermostat housing gasket
- **>>A<<** 9. Water pipe assembly
10. Water pipe gasket
11. O-ring
12. Water pump assembly
13. Water pump gasket
14. Engine hanger

Removal steps (Continued)

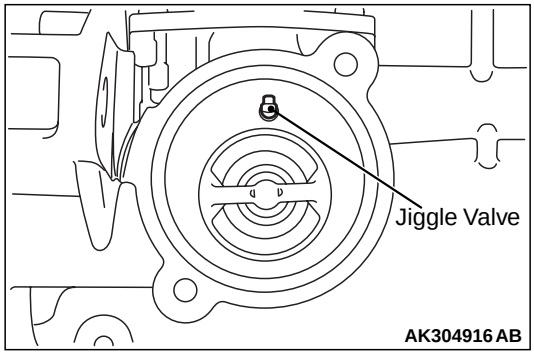
15. Camshaft position sensor
16. O-ring

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 of 24 ± 3 N·m.

>>B<< THERMOSTAT INSTALLATION

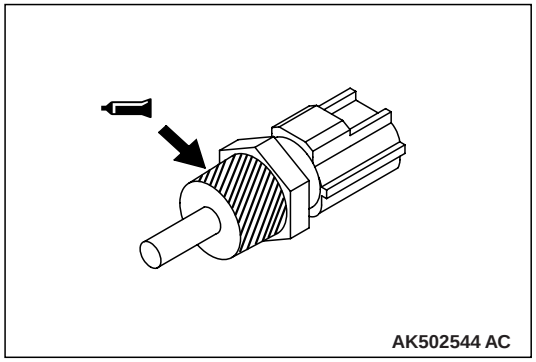


Install the thermostat with the jiggle-valve facing almost straight upwards.

>>C<< COOLANT TEMPERATURE SENSOR INSTALLATION

⚠ CAUTION

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



1. Apply an appropriate and minimum amount of sealant to the coolant temperature sensor, taking care not to allow sealant to squeeze out.

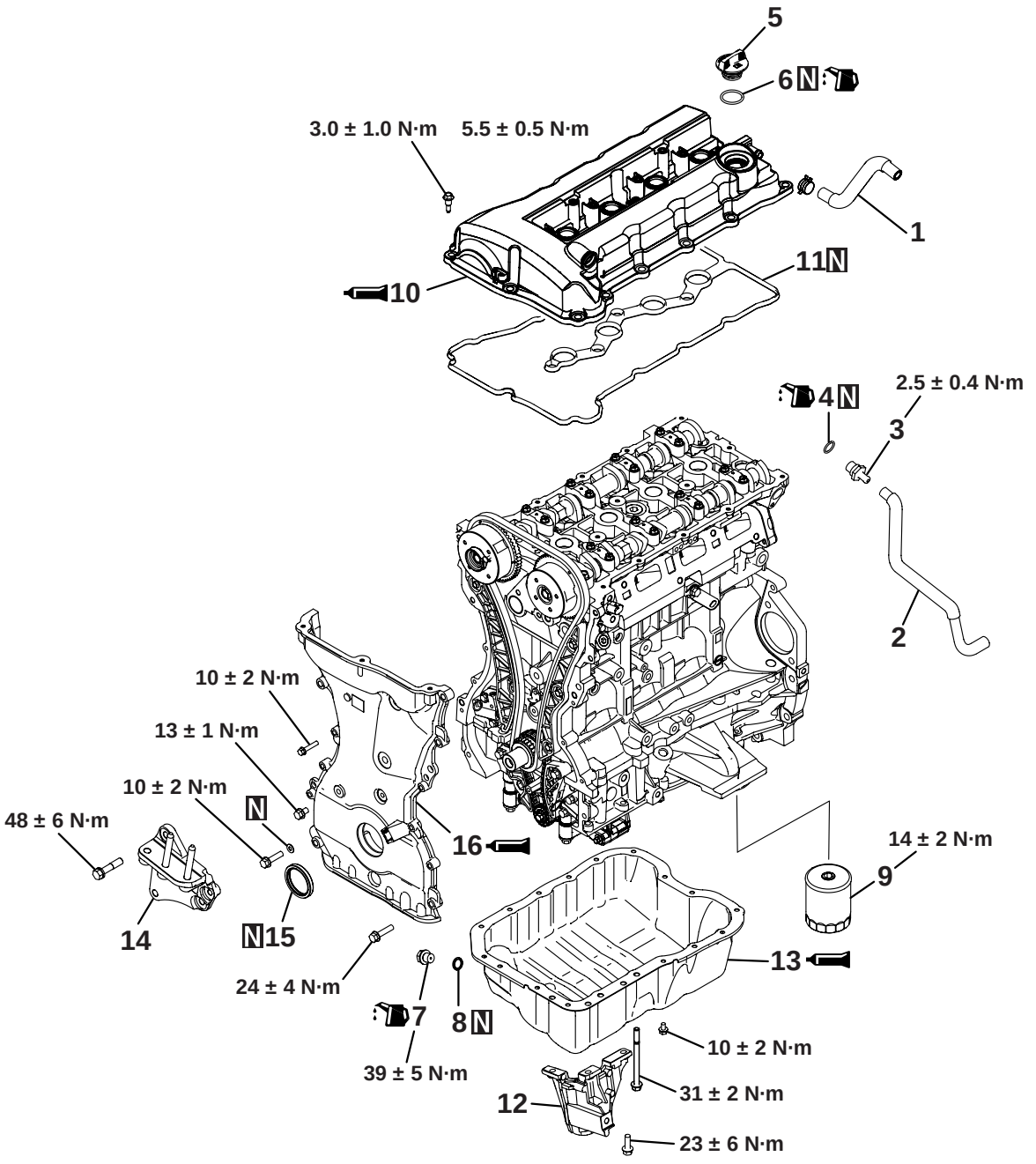
   Specified sealant:
   ThreeBond 1324N, Loctite 262 or equivalent

2. Tighten the coolant temperature sensor to the cylinder block to the specified torque of 30 ± 9 N·m.

OIL PAN AND TIMING CHAIN CASE

REMOVAL AND INSTALLATION

M1113026301520



AKB00212 AC

Removal steps

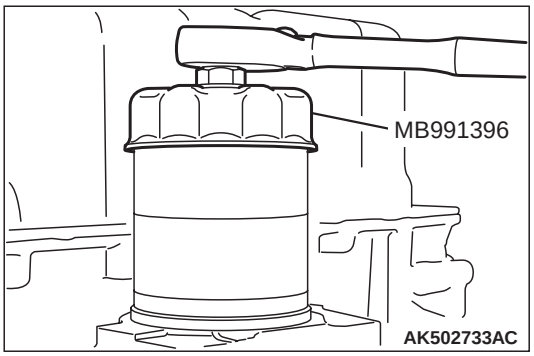
1. Breather hose
2. PCV hose
3. PCV valve
4. O-ring
5. Oil filler cap
6. O-ring
7. Oil drain plug
8. Oil drain plug gasket

Removal steps (Continued)

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

REMOVAL SERVICE POINTS

<<A>> OIL FILTER REMOVAL



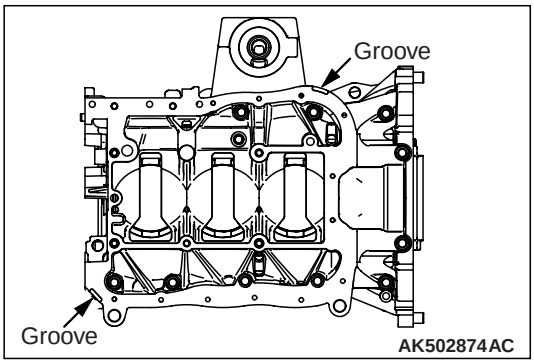
Use special tool Oil filter wrench (MB991396) to remove the oil filter.

<<B>> OIL PAN REMOVAL

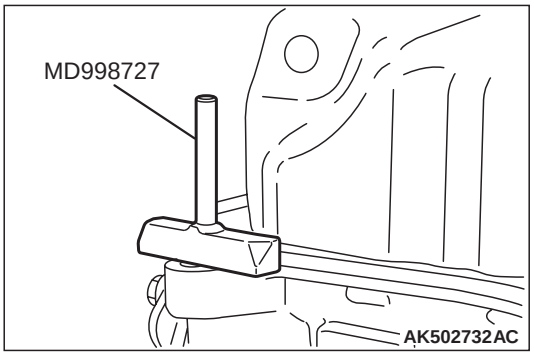
1. Remove oil pan tightening bolts.

⚠ CAUTION

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

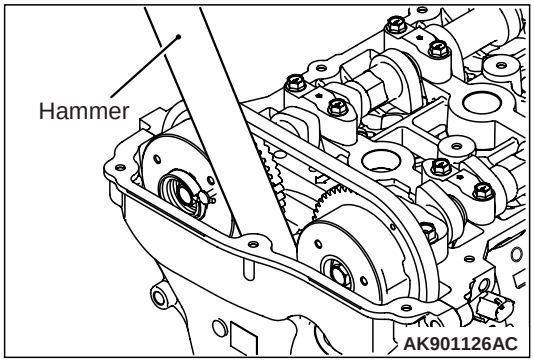


2. Lightly tap special tool Oil pan FIPG cutter (MD998727) to drive in the illustrated groove of the oil pan and ladder frame.



3. Lightly tap and slide special tool Oil pan FIPG cutter (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.

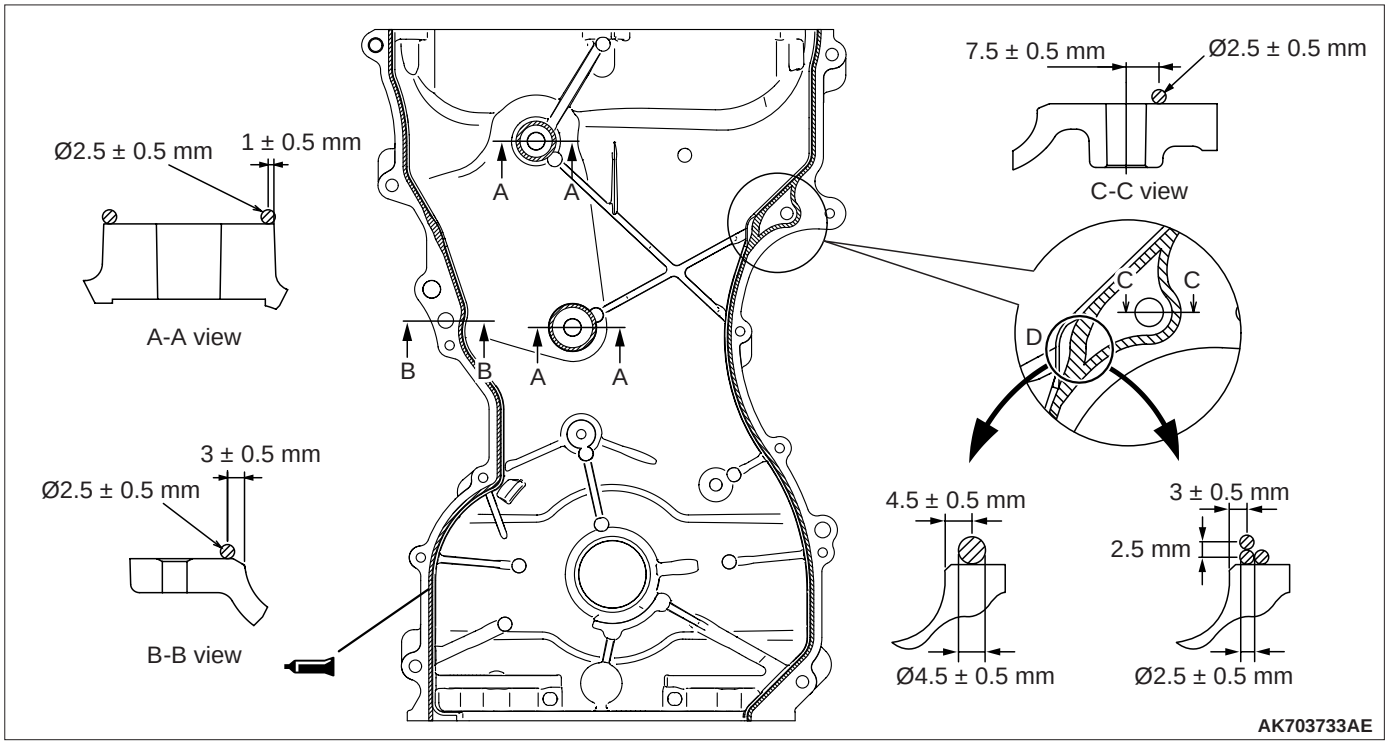
INSTALLATION SERVICE POINTS

>>A<< TIMING CHAIN CASE INSTALLATION

⚠ CAUTION

- **Completely remove all the old liquid gasket, which might be remaining in the installation hole, the O-ring groove or among the components such as the cylinder head gasket.**
- **Sufficiently check that there is no residual oil on the place where degreasing is performed. If fingerprints are left, do not touch it with bare hands after the degreasing, since the oils from your fingers will harm the seal ability.**

1. Completely remove liquid gasket adhering to the timing chain case, cylinder block and cylinder head.
2. Degrease the surface where the liquid gasket is applied and the contact surface between the cylinder block and the cylinder head.

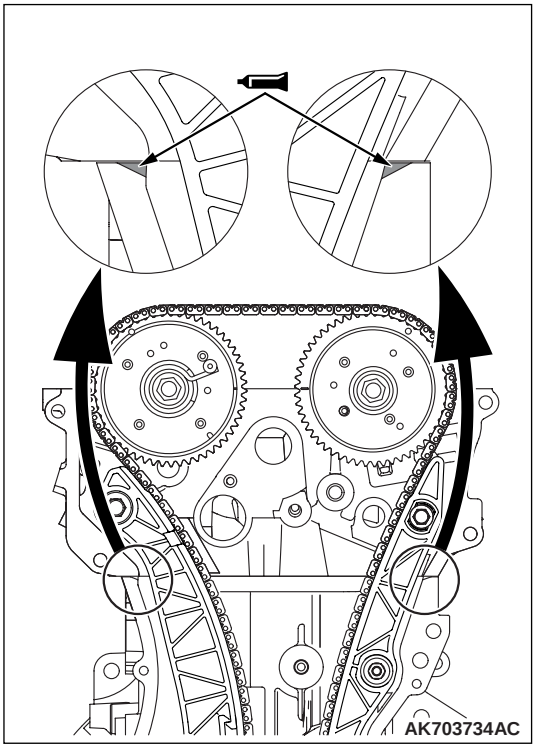


⚠ CAUTION

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

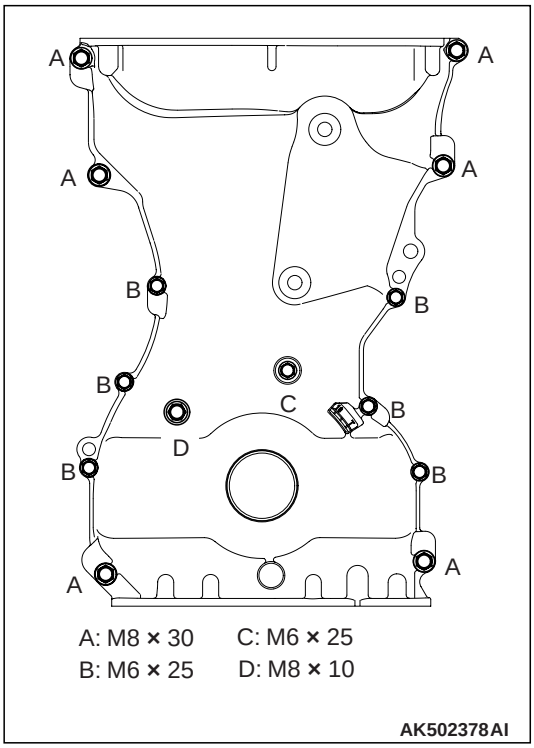
3. Apply liquid gasket of 2.5 ± 0.5 mm in thickness to the timing chain case. For the place "D" shown in the illustration, however, apply the liquid gasket whose diameter is 4.5 ± 0.5 mm or pile up the liquid gasket of 2.5 ± 0.5 mm as shown in the illustration.

   Specified sealant:
   ThreeBond 1217G or equivalent



4. The engine oil staying at the cylinder gasket oozes to the 3-plane contact surface described in Step 2 and 3. Swiftly apply the liquid gasket to this area after degreasing.

   Specified sealant:
   ThreeBond 1217G or equivalent

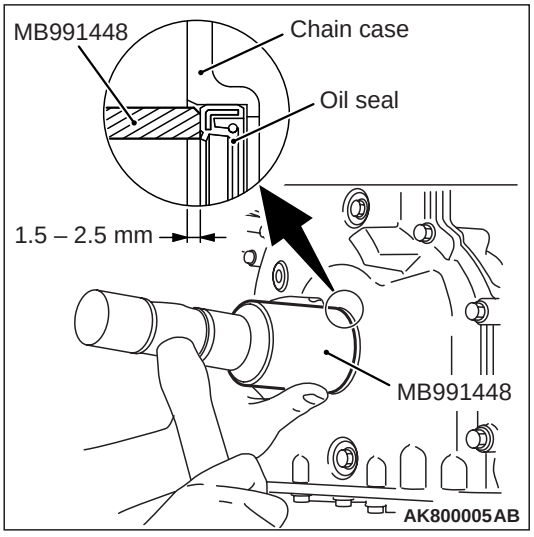


5. Tighten timing chain case mounting bolts to the specified torque.

Tightening torque
A: 24 ± 4 N·m
B: 10 ± 2 N·m
C: 10 ± 2 N·m
D: 13 ± 1 N·m

>>B<< FRONT OIL SEAL INSTALLATION

1. Apply a small amount of engine oil to the entire inner diameter of the front oil seal lip.



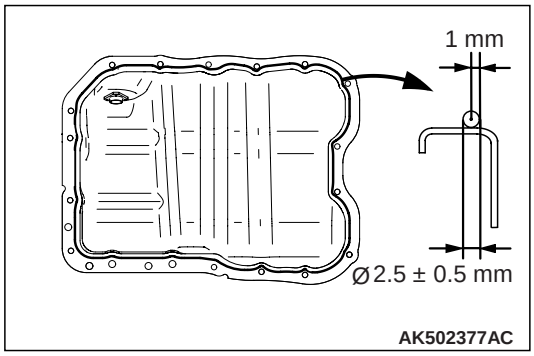
⚠ CAUTION
The front oil seal must not be a strong press fit. The strong press fit can possibly cause the oil leakage, damaging the front oil seal.

2. Use special tool Bush remover and installer base (MB991448) in order to press-fit the front oil seal into the timing chain case as shown in the illustration.

>>C<< OIL PAN INSTALLATION

1. Completely remove liquid gasket adhering to the cylinder block and oil pan.

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



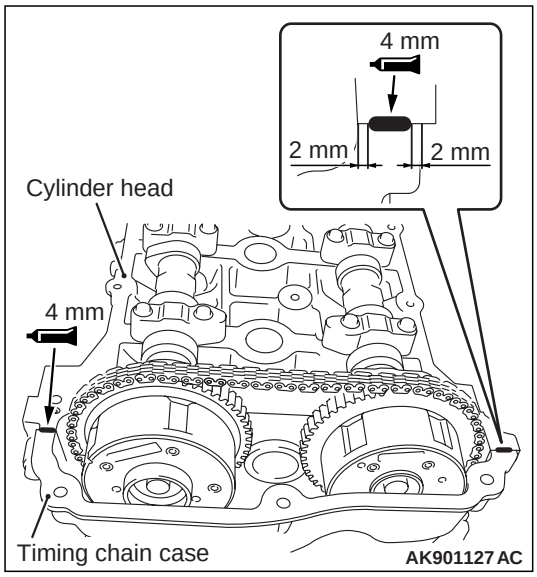
2. Apply liquid gasket of ϕ2.5 ± 0.5 mm of thickness in diameter to the illustrated area of the oil pan.

Specified sealant:
ThreeBond 1217G or equivalent

3. Tighten the oil pan to the specified torque of 10 ± 2 N·m (M6) and 29 ± 2 N·m (M8).

>>D<< CYLINDER HEAD COVER INSTALLATION

1. Completely remove liquid gasket adhering to the cylinder head cover, timing chain case and cylinder head.
2. Degrease the surface where the liquid gasket is applied and the contact.



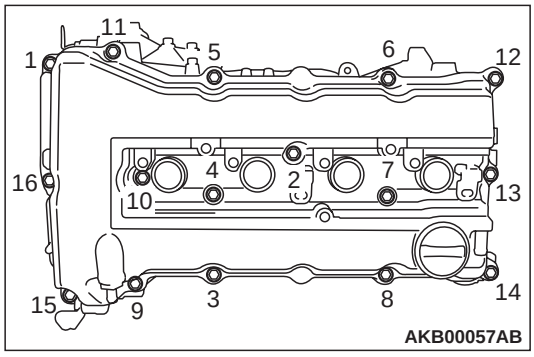
⚠ CAUTION

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

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

   Apply liquid gasket of 4 mm of thickness in diameter.

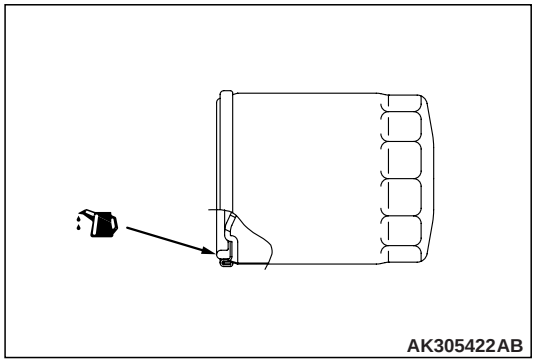
   Specified sealant:
   ThreeBond 1217G or equivalent



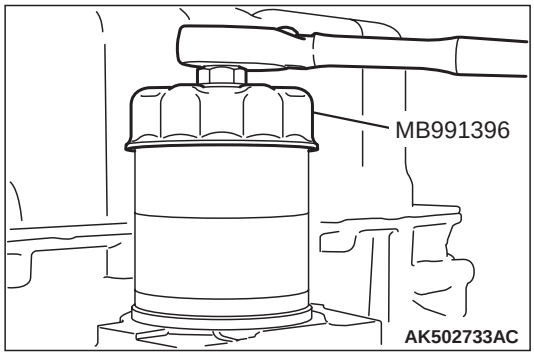
4. Tighten the cylinder head cover to the tightening torque of 3.0 ± 1.0 N·m in the order shown in the illustration.
5. Then, tighten it to the specified torque of 5.5 ± 0.5 N·m in the same order.

>>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

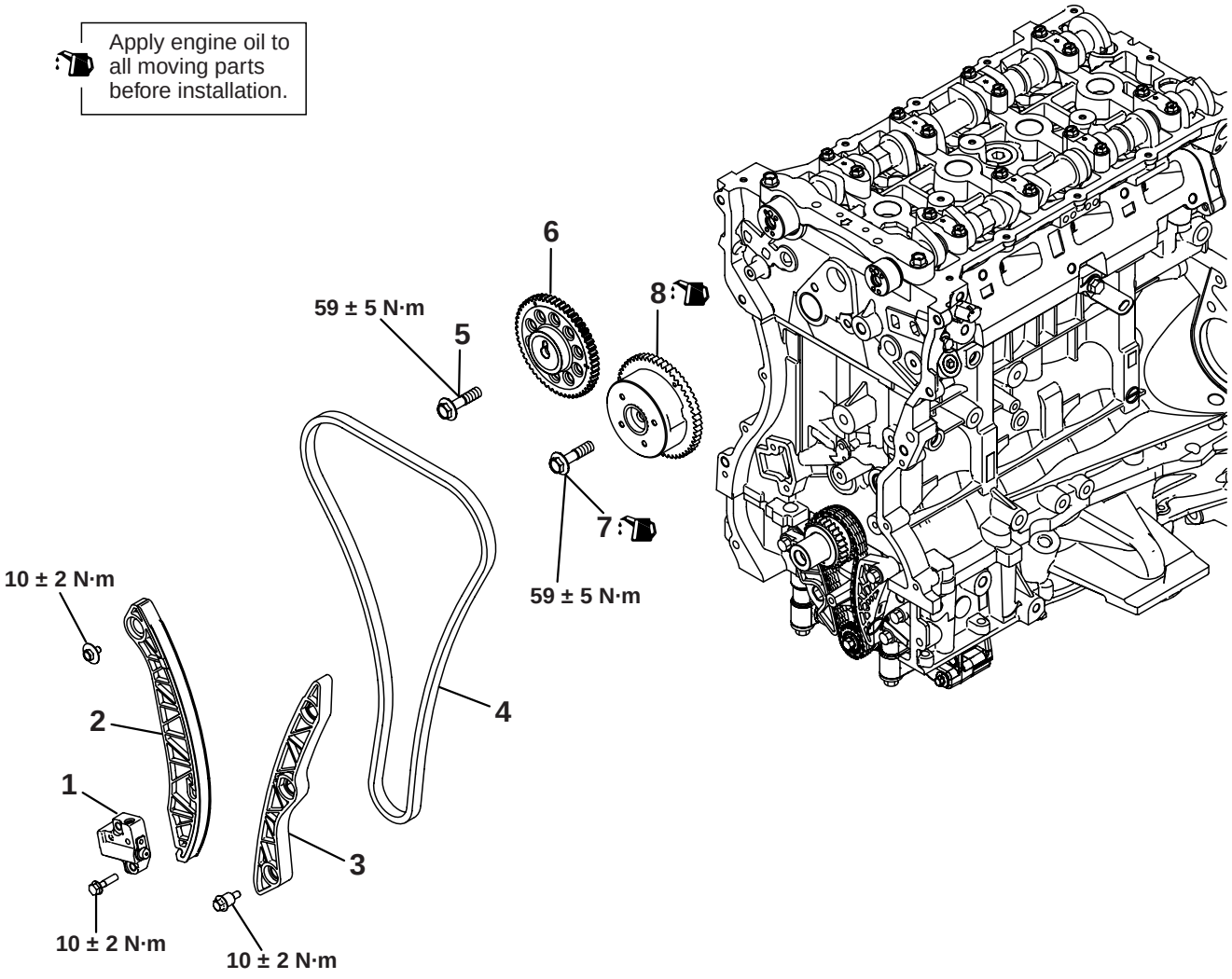
Use special tool Filter wrench (MB991396) to install the oil filter. Tightening it by hand causes oil leakage due to lack of torque.

3. Screw in the oil filter. When the O-ring contacts the mounting surface, use a filter wrench to tighten it 1 turns (14 ± 2 N·m).

TIMING CHAIN

REMOVAL AND INSTALLATION

M1113026601253



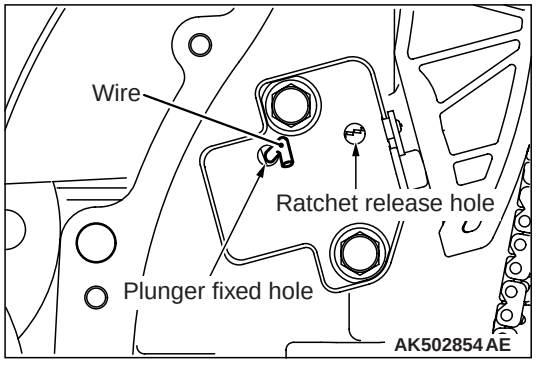
AKB00096AC

Removal steps

<<A>>	>>D<<	1. Timing chain tensioner
		2. Tensioner lever
		3. Timing chain guide
	>>C<<	4. Timing chain
<<B>>	>>B<<	5. Exhaust camshaft sprocket bolt
		6. Exhaust camshaft sprocket assembly
<<C>>	>>A<<	7. Inlet V.V.T. sprocket bolt
		8. Inlet V.V.T. sprocket assembly

REMOVAL SERVICE POINTS

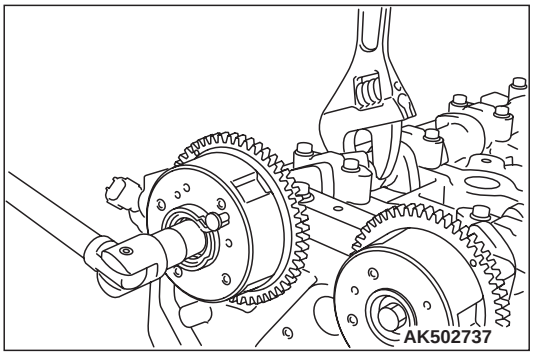
<<A>> TIMING CHAIN TENSIONER REMOVAL



1. Insert a flatblade screwdriver into the release hole of the timing chain tensioner to release the latch.

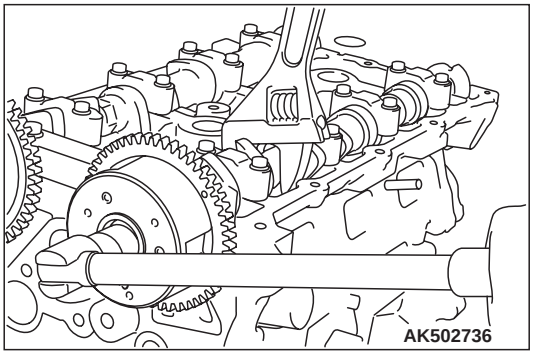
2. Push the tensioner lever by hand and push in the plunger of the timing chain tensioner until it hits the bottom. Then, insert a hard wire (piano wire or the like) of ϕ1.5 or hexagonal bar wrench (1.5 mm) into the fixing hole of the plunger.
3. Remove the timing chain tensioner.

<<B>> EXHAUST CAMSHAFT SPROCKET BOLT REMOVAL



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

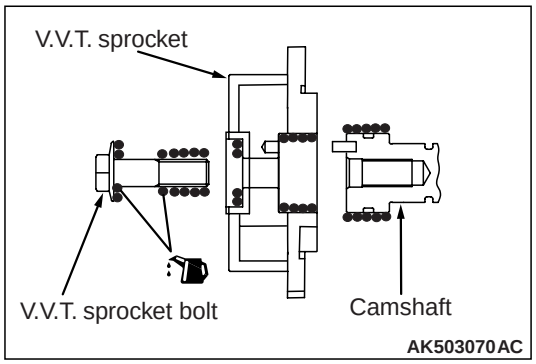
<<C>> INLET V.V.T. SPROCKET BOLT REMOVAL



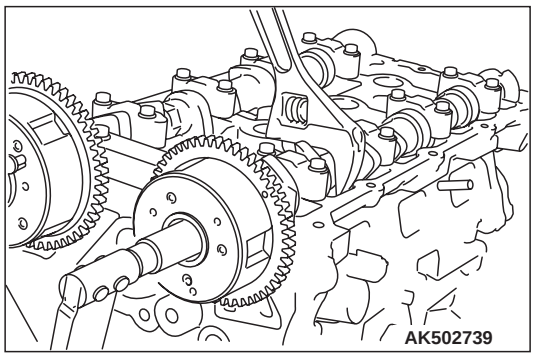
Hold the hexagonal portion of the inlet camshaft with a wrench and loosen the inlet V.V.T. sprocket bolt.

INSTALLATION SERVICE POINTS

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



1. Assemble the inlet 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 inlet V.V.T. sprocket assembly and the entire circumference of the area into which the inlet V.V.T. sprocket assembly is inserted.
   - Slowly insert the inlet 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.



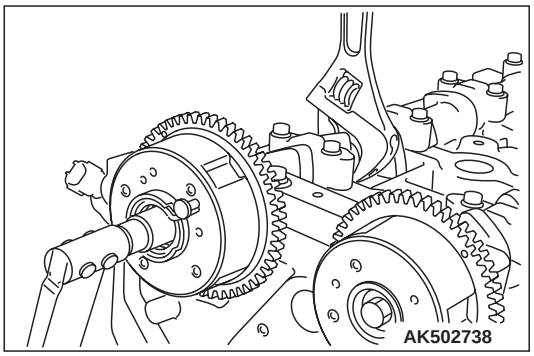
4. Hold the hexagonal portion of the camshaft with a wrench and tighten the inlet V.V.T. sprocket bolt to the specified torque of 59 ± 5 N·m.

>>B<< EXHAUST CAMSHAFT SPROCKET BOLT INSTALLATION

1. Assemble the exhaust camshaft sprocket assembly in the following procedure.

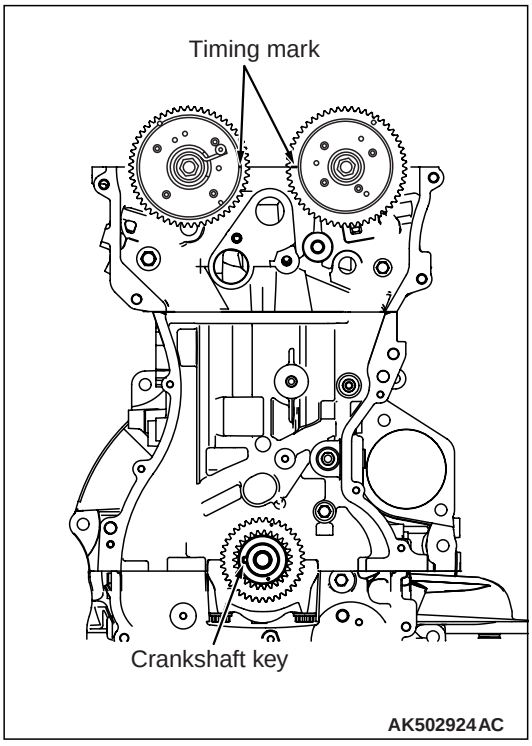
- Make sure that the knock pin of the exhaust camshaft assembly is positioned facing straight upward.
- Slowly insert the exhaust camshaft sprocket into the normal position of the exhaust camshaft assembly with its knock pin hole facing straight upward.

2. Install the exhaust camshaft sprocket.
3. Make sure that the exhaust camshaft sprocket is securely inserted into the bottom and that the exhaust camshaft sprocket does not rotate with the hexagonal portion of the camshaft secured with a wrench.

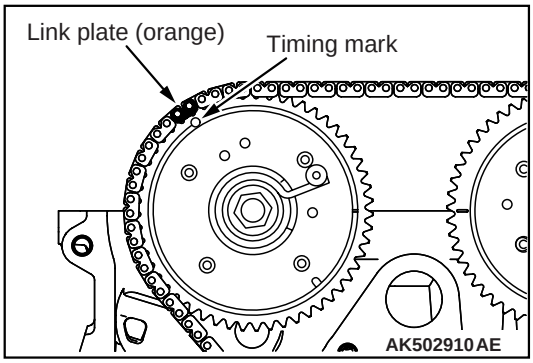


4. Hold the hexagonal portion of the camshaft with a wrench and tighten the camshaft sprocket bolt to the specified torque of 59 ± 5 N·m.

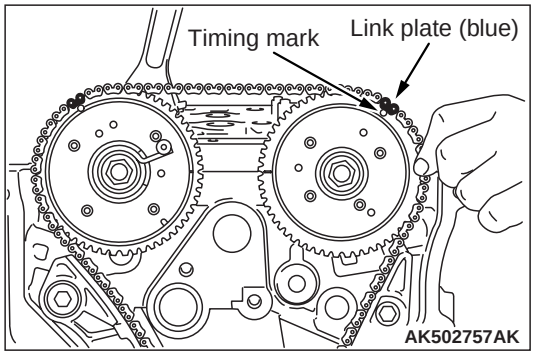
>>C<< TIMING CHAIN INSTALLATION



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

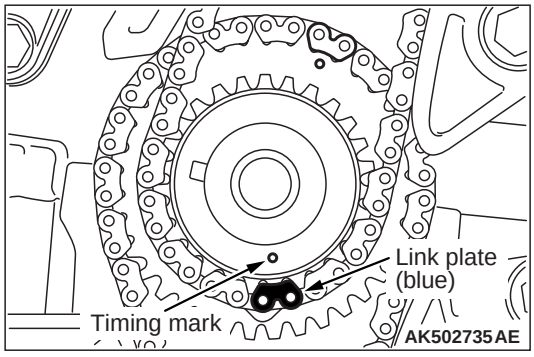


3. Align the link plate (orange) with the timing mark of the exhaust camshaft sprocket and loop the timing chain.

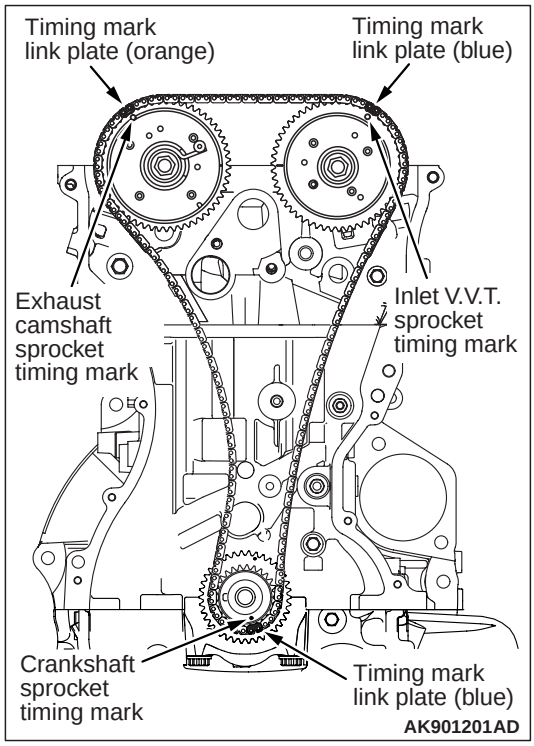


4. Align the link plate (blue) with the timing mark of the inlet V.V.T. sprocket to loop the timing chain.

   Rotate the inlet V.V.T. sprocket by one or two teeth to align with the timing mark.

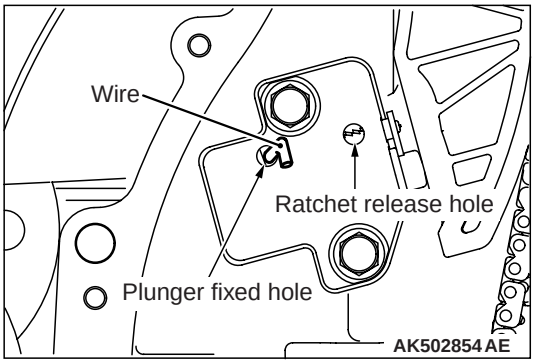


5. Align the timing mark of the crankshaft sprocket with the link plate (blue) to loop the timing chain. Because the timing chain slacks, hold it to prevent the timing mark from coming off the link plate.



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

>>D<< TIMING CHAIN TENSIONER INSTALLATION



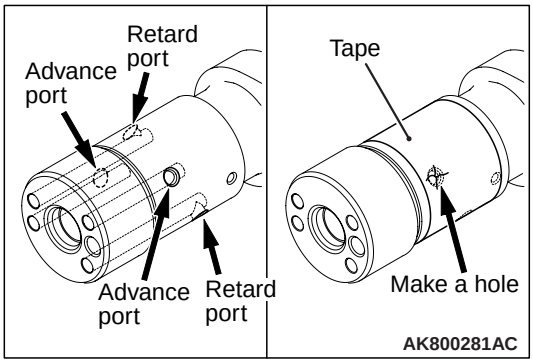
1. Install the timing chain tensioner on the cylinder block and tighten it to the specified torque of 10 ± 2 N·m.
2. Remove the hard wire (piano wire or the like) of ϕ1.5 or hexagonal bar wrench (1.5 mm) from the timing chain tensioner. This enables the plunger of the timing chain tensioner to push the tensioner lever to keep the timing chain tight.

INSPECTION

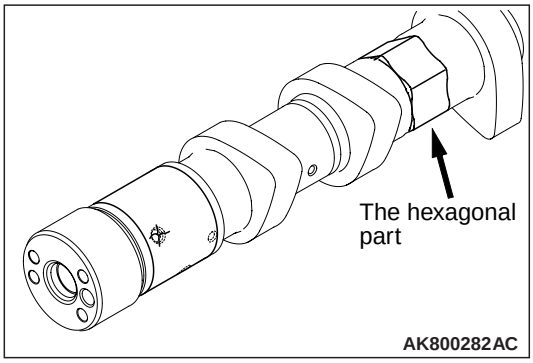
M1113026701216

INLET V.V.T. SPROCKET

⚠ CAUTION
Never overhaul the V.V.T. sprocket.

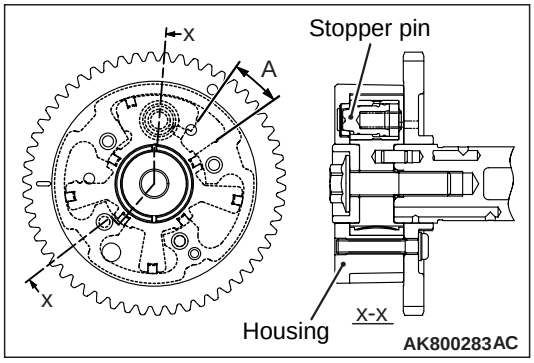


1. Seal with a tape all the inlet camshaft ports for the advanced angle and the retarded angle.
2. Make a hole on the port for the advanced angle.



⚠ CAUTION
Fix the camshaft on a vise not to damage it.

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



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

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

5. Turn the inlet V.V.T. sprocket housing in the right and left directions. Check it smoothly moves in the range of A (approximately 12.5°<4B11>,approximately 20°<4B12>)

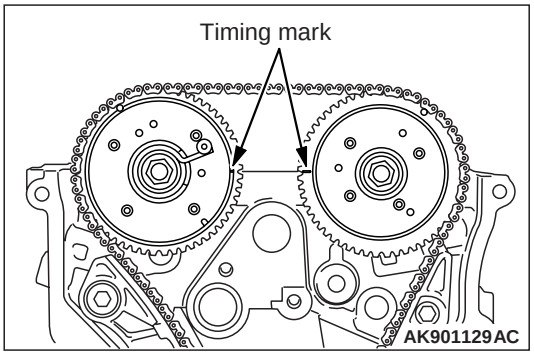
   NOTE: The stopper pin is locked in the most retarded angle position.
6. .After the check, remove the inlet V.V.T. sprocket from the inlet camshaft
7. Completely remove the tape sealing the inlet camshaft ports for the advanced angle and for the retarded angle.

VALVE CLEARANCE ADJUSTMENT

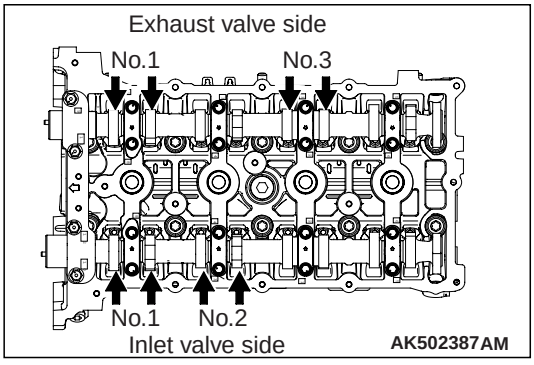
Measure valve clearance in the following procedure. Check and adjust the valve clearance with the timing chain installed.

⚠ CAUTION

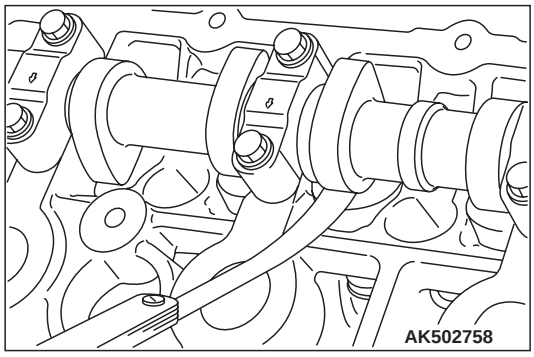
Always rotate the crankshaft clockwise.



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

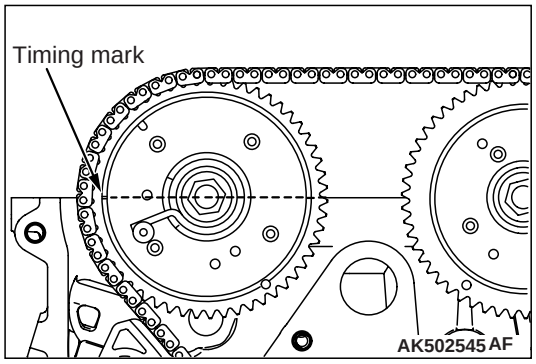


2. Valve clearance can be measured at the illustrated location in this condition.



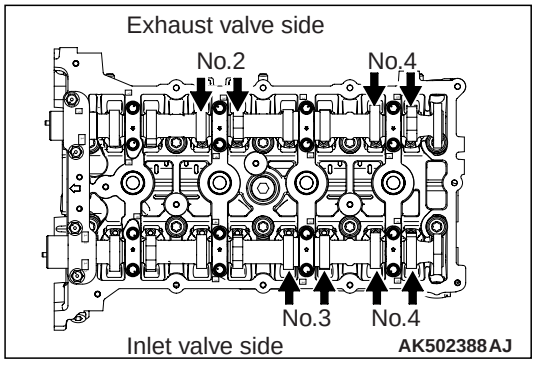
3. Use a thickness gauge to measure clearance between the camshaft and valve tappet.

   Standard value (cold engine)
   Inlet side: 0.20 ± 0.03 mm
   Exhaust side: 0.30 ± 0.03 mm
4. If measured values are out of the standard value, record measured values.



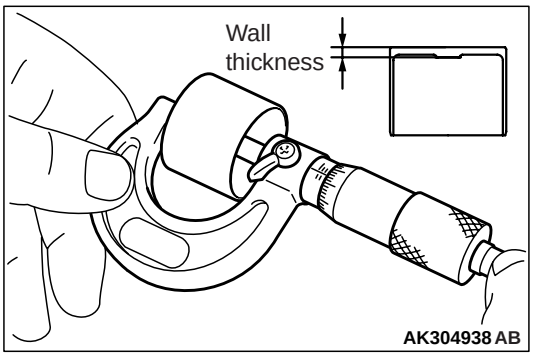
5. Rotate the crankshaft by one turn clockwise to set the No. 4 piston at top dead centre on the compression stroke.

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



6. Valve clearance can be measured at the illustrated location in this condition.
7. If measured values are out of the standard value, record measured values.
8. 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 in the range between 3.000 and 3.690 mm.



9. Select a valve tappet in the following procedure.
   (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

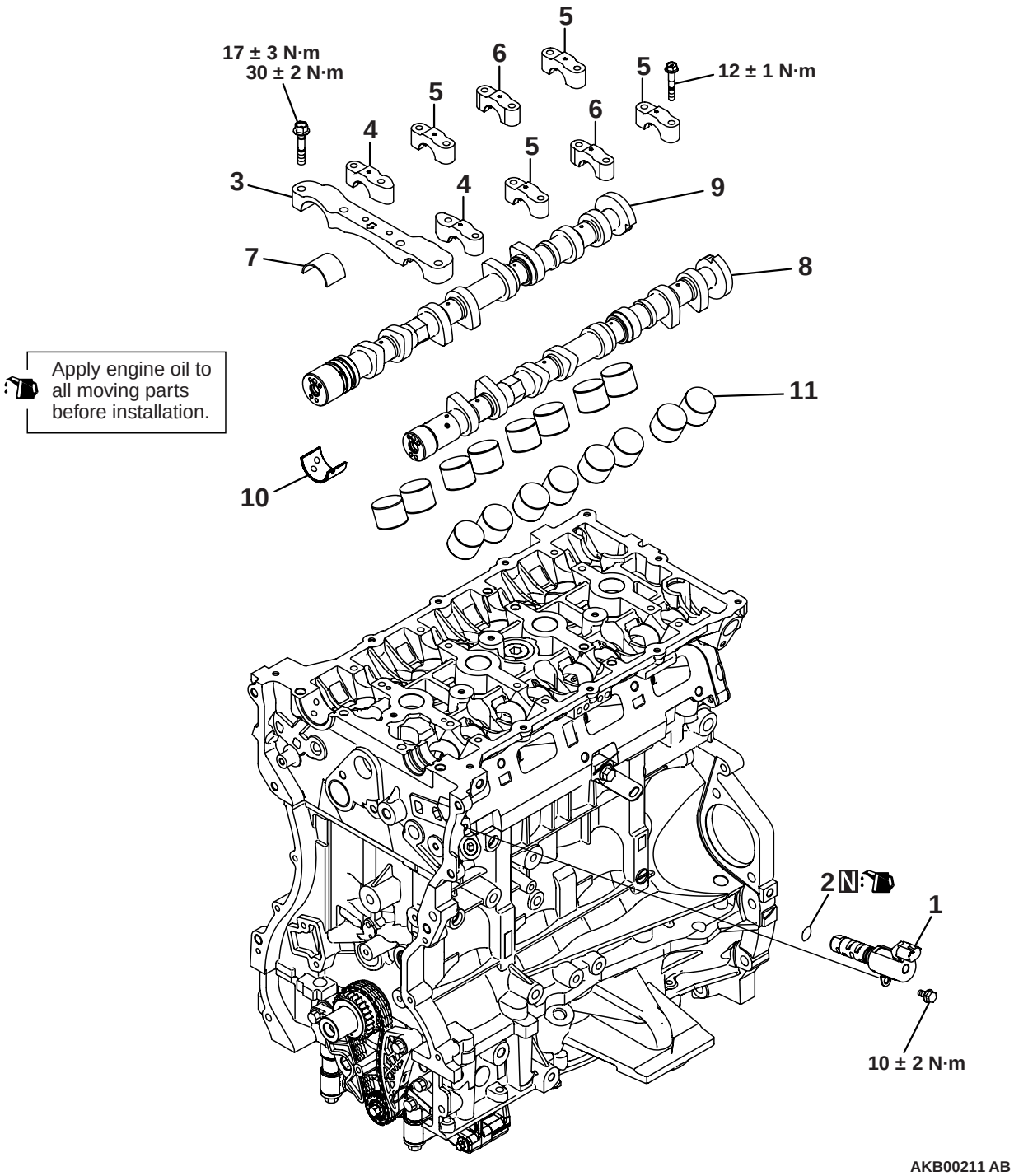
   Formula
   Inlet side: A = B + (C – 0.20 mm)
   Exhaust side: A = B + (C – 0.30 mm)

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

CAMSHAFT

REMOVAL AND INSTALLATION

M1113026900950



Removal steps

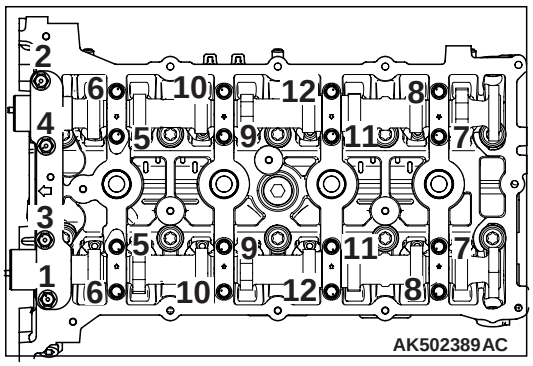
	>>C<<	1.	Oil feeder control valve (OCV) inlet
	>>C<<	2.	O-ring
<<A>>	>>B<<	3.	Front camshaft bearing cap
<<A>>	>>B<<	4.	Oil feeding camshaft bearing cap
<<A>>	>>B<<	5.	Camshaft bearing cap
<<A>>	>>B<<	6.	Thrust camshaft bearing cap

Removal steps (Continued)

	>>B<<	7.	Bearing
	>>B<<	8.	Inlet camshaft
	>>B<<	9.	Exhaust camshaft
		10.	Bearing
<<B>>	>>A<<	11.	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 installation bolts for the camshaft bearing cap at the same time causes the valve spring force, which makes the installation bolts jump out, resulting in the damaged threads. Always loose them in several stages.

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.

<<B>> VALVE TAPPET REMOVAL

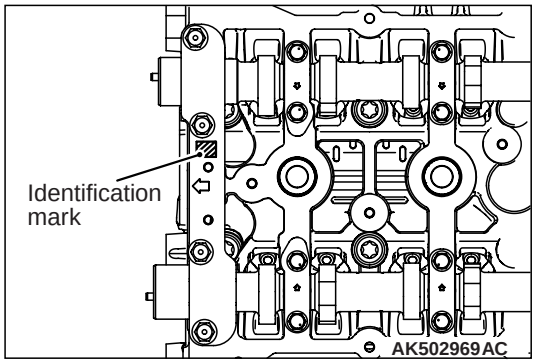
Pick out valve tappets with fingers and store removed valve tappets with tags describing the installed position attached for reassembly.

INSTALLATION SERVICE POINTS

>>A<< VALVE TAPPET INSTALLATION

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

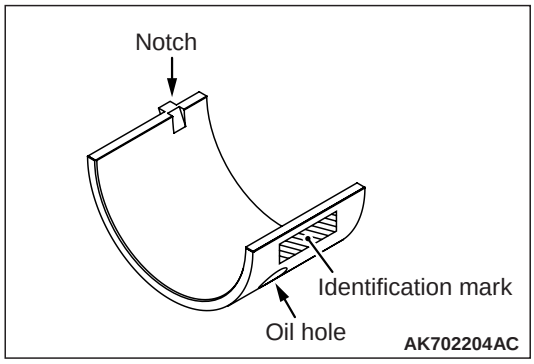
>>B<< CAMSHAFT / BEARING / THRUST CAMSHAFT BEARING CAP / CAMSHAFT BEARING CAP / OIL FEEDING CAMSHAFT BEARING CAP / FRONT CAMSHAFT BEARING CAP INSTALLATION



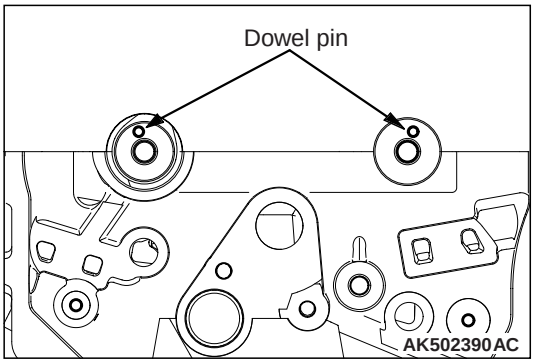
1. When replacing a camshaft bearing, select a bearing with the size corresponding to the identification mark in the table below.

Front camshaft bearing cap		Camshaft bearing identification mark
Identification mark	Inner diameter mm	
1	40.000 – 40.008	1
2	40.008 – 40.016	2
3	40.016 – 40.024	3

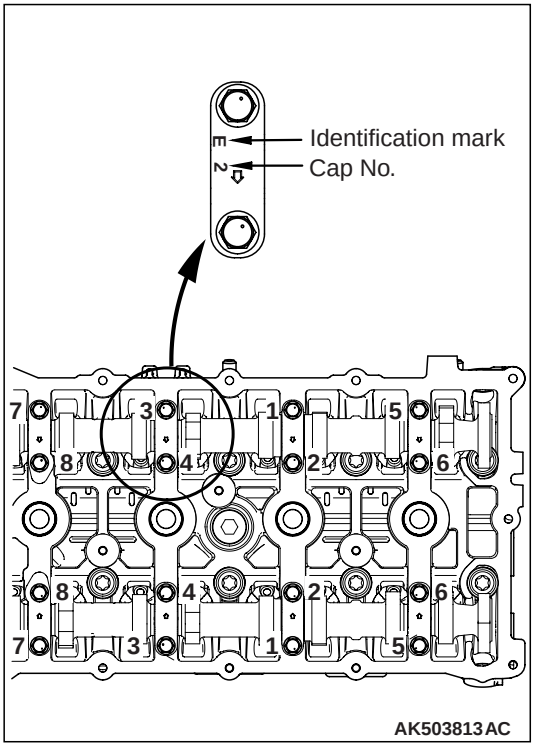
2. Install camshaft bearings on the cylinder head.



3. The identification mark of the camshaft bearing is painted at the illustrated position.



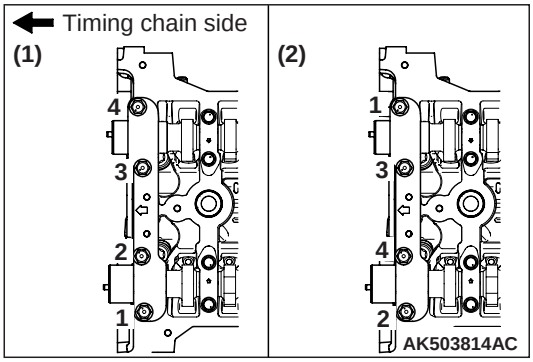
4. Set the dowel pins of the camshaft at the illustrated positions.



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

   Identification mark
   I: Inlet side
   E: Exhaust side

6. Tighten each camshaft bearing cap mounting bolt to the specified torque of 12 ± 1 N·m in the order of number shown in the figure in two or three steps.

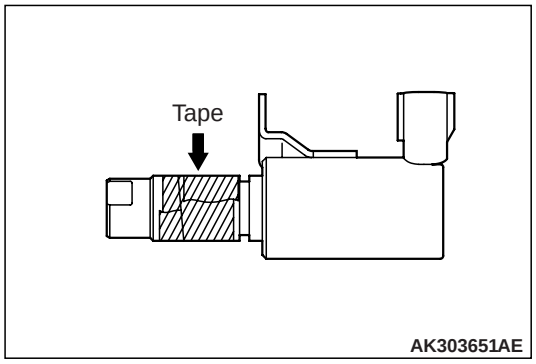


7. Tighten each front camshaft bearing cap mounting bolt to the temporarily torque of 17 ± 3 N·m in the order of number shown (1).
8. Tighten each front camshaft bearing cap mounting bolt to the specified torque of 30 ± 2 N·m in the order of number shown (2).

>>C<< O-RING / OIL FEEDER 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 oil feeder control valve before installing the O-ring to prevent damage. Damage to the O-ring causes oil leakage.**

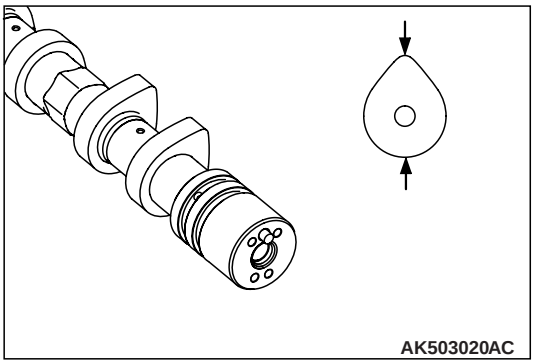


1. Apply a small amount of engine oil to the O-ring of the oil feeder control valve.
2. Install the oil feeder control valve on the cylinder head.
3. Tighten the oil feeder control valve to the specified torque of 10 ± 2 N·m.

INSPECTION

M1113027000961

CAMSHAFT



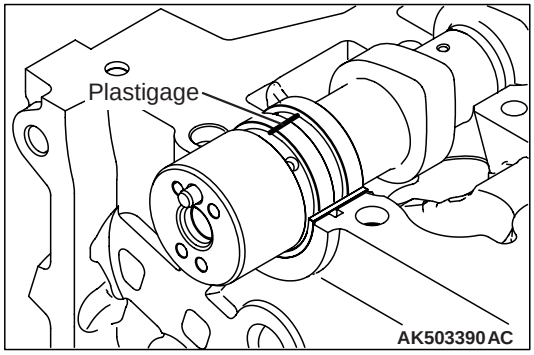
Measure camshaft height (camshaft major axis). If the height exceeds the limit, replace the camshaft.

Standard value:
Inlet: 43.25 mm
Exhaust: 45.00 mm

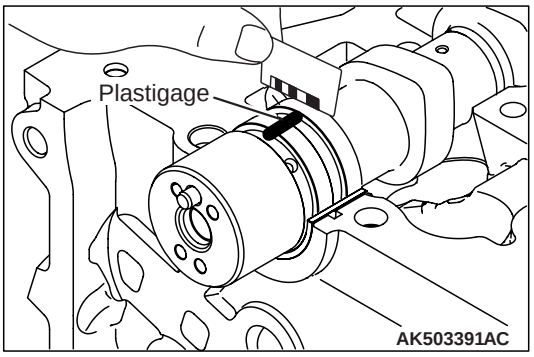
Limit:
Inlet: 42.75 mm
Exhaust: 44.50 mm

CAMSHAFT BEARING (METAL) 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, centring 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.

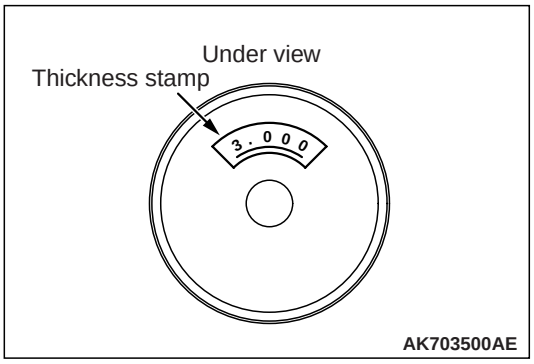


6. Measure the Plastigage whose width is most compressed using the scale printed on the Plastigage bag. When the measured value deviates from the standard one, replace the bearing.

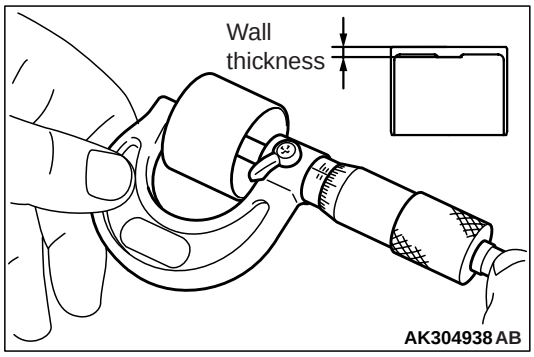
Standard value: 0 – 0.032 mm

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

VALVE TAPPET



1. Check the Thickness stamp.



2. If the measured value in the table value is not in agreement with the value in the table to the Thickness stamp, replace the valve tappet.

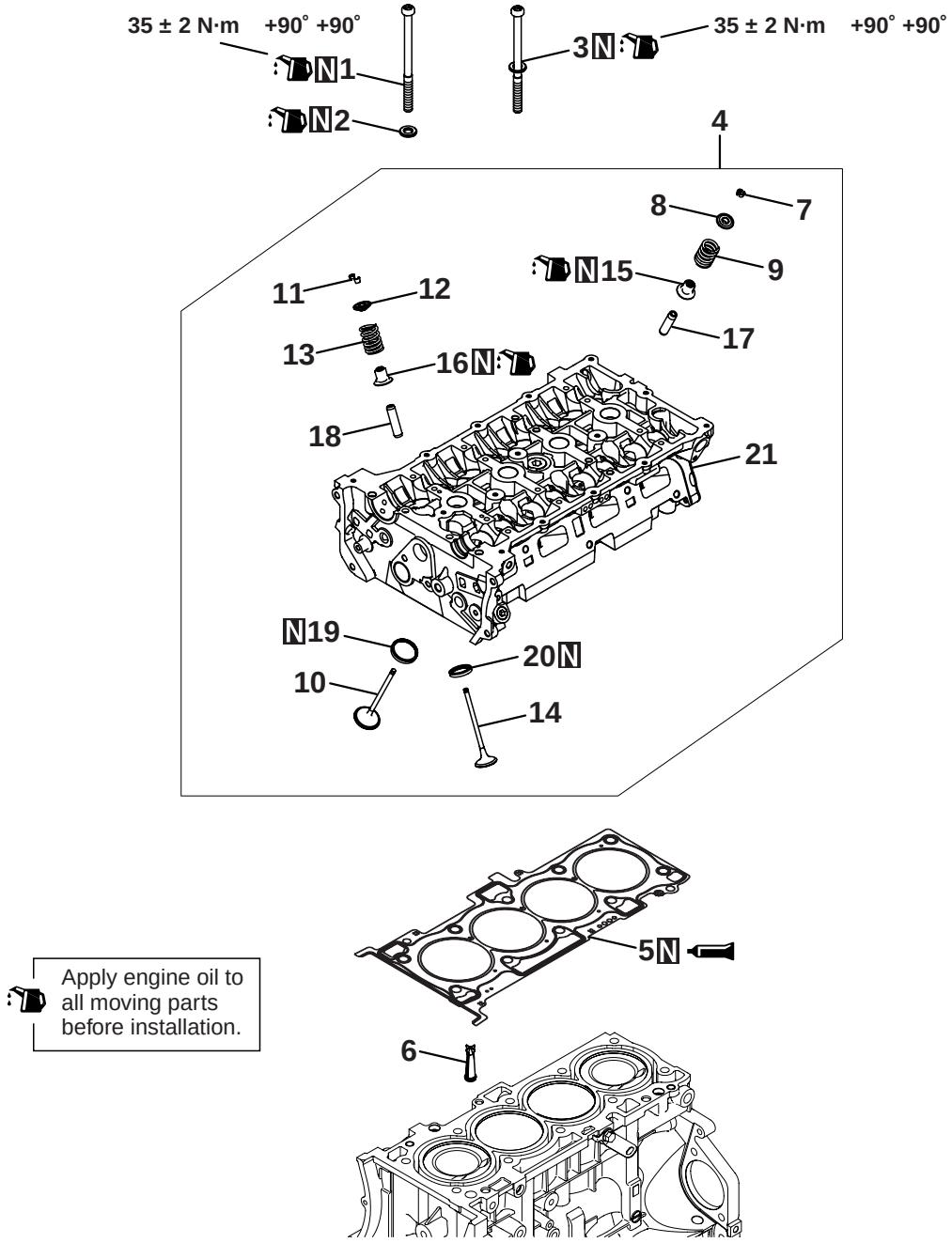
   There are 47 kinds of valve tappets at intervals of 0.015 mm in the range between 3.000 and 3.690 mm.

Thickness stamp	Thickness	Thickness stamp	Thickness	Thickness stamp	Thickness
3.000	3.000 mm	3.240	3.240 mm	3.480	3.480 mm
3.015	3.015 mm	3.255	3.255 mm	3.495	3.495 mm
3.030	3.030 mm	3.270	3.270 mm	3.510	3.510 mm
3.045	3.045 mm	3.285	3.285 mm	3.525	3.525 mm
3.060	3.060 mm	3.300	3.300 mm	3.540	3.540 mm
3.075	3.075 mm	3.315	3.315 mm	3.555	3.555 mm
3.090	3.090 mm	3.330	3.330 mm	3.570	3.570 mm
3.105	3.105 mm	3.345	3.345 mm	3.585	3.585 mm
3.120	3.120 mm	3.360	3.360 mm	3.600	3.600 mm
3.135	3.135 mm	3.375	3.375 mm	3.615	3.615 mm
3.150	3.150 mm	3.390	3.390 mm	3.630	3.630 mm
3.165	3.165 mm	3.405	3.405 mm	3.645	3.645 mm
3.180	3.180 mm	3.420	3.420 mm	3.660	3.660 mm
3.195	3.195 mm	3.435	3.435 mm	3.675	3.675 mm
3.210	3.210 mm	3.450	3.450 mm	3.690	3.690 mm
3.225	3.225 mm	3.465	3.465 mm		

CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006903463



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Removal steps

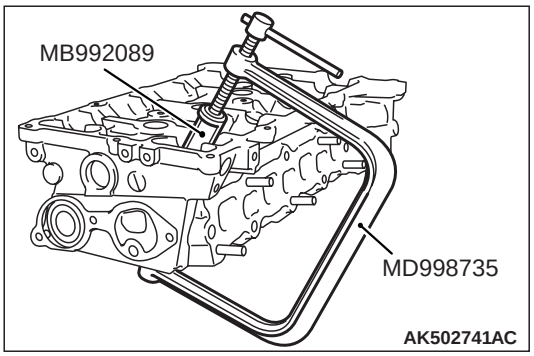
- >>D<< 1. Cylinder head bolt
- >>D<< 2. Cylinder head bolt washer
- >>D<< 3. Cylinder head bolt & washer assembly
- >>C<< 4. Cylinder head assembly
- >>C<< 5. Cylinder head gasket
- 6. Oil feeder control valve (OCV) filter
- <<A>> >>B<< 7. Retainer lock
- 8. Valve spring retainer
- 9. Valve spring
-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

Removal steps (Continued)

- <<A>> >>B<< 11. Retainer lock
- 12. Valve spring retainer
- 13. Valve spring
- 14. Exhaust valve
- <<B>> >>A<< 15. Valve stem seal
- <<B>> >>A<< 16. Valve stem seal
- 17. Inlet valve guide
- 18. Exhaust valve guide
- 19. Inlet valve seat
- 20. Exhaust valve seat
- 21. Cylinder head

REMOVAL SERVICE POINTS

<<A>> RETAINER LOCK REMOVAL



⚠ CAUTION

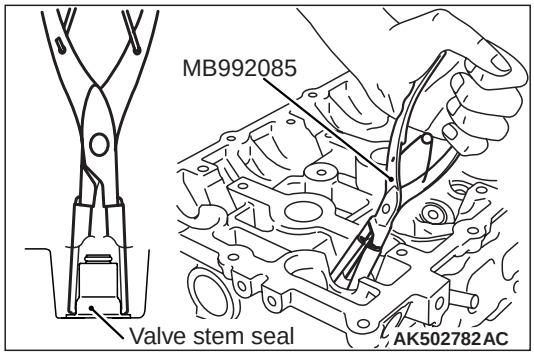
Be careful not to allow retainer holder C to interfere with the wall of the tappet hole and to damage it.

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

- Valve spring compressor (MD998735)
- Retainer holder C (MB992089)

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

<<B>> VALVE STEM SEAL REMOVAL



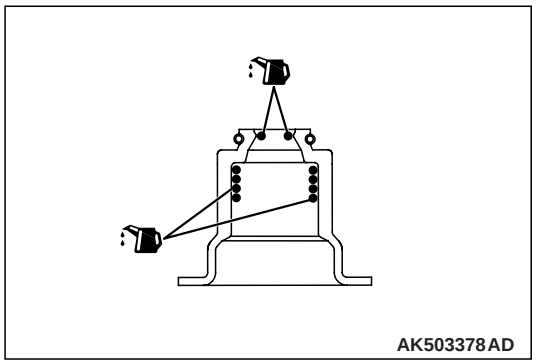
Use special tool Valve stem seal pliers (MB992085) to firmly pinch the base (larger external shape) of the stem seal and twist it right and left for pulling out.

INSTALLATION SERVICE POINTS

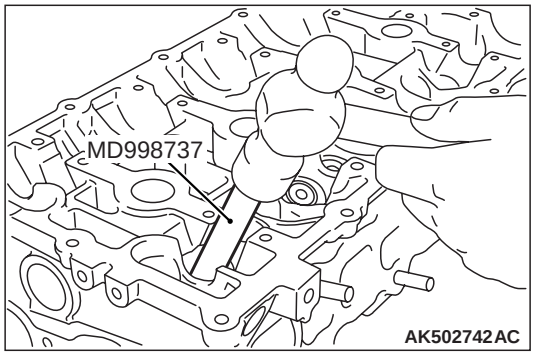
>>A<< VALVE STEM SEAL INSTALLATION

⚠ 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.**

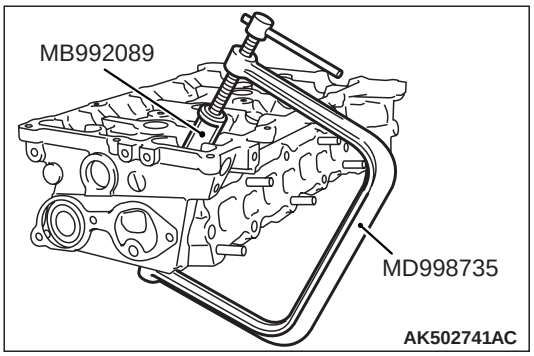


1. Apply a thin coat of engine oil to a new valve stem seal.



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

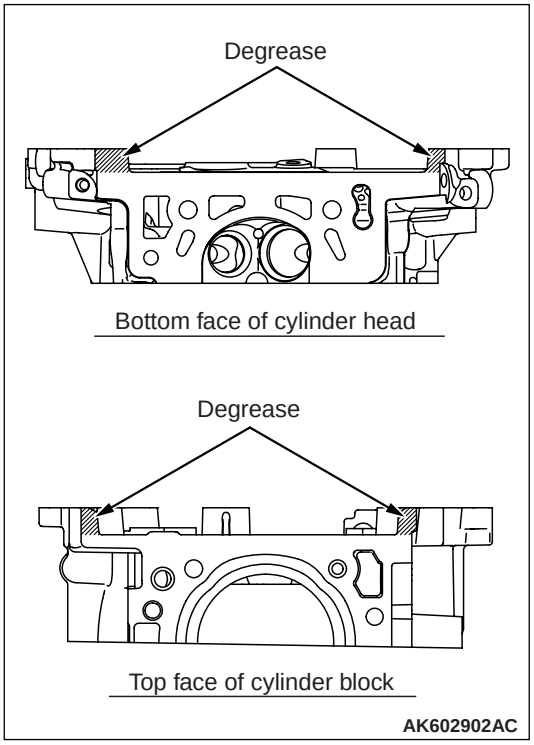
>>B<< RETAINER LOCK INSTALLATION



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

- Valve spring compressor (MD998735)
- Retainer holder C (MB992089)

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

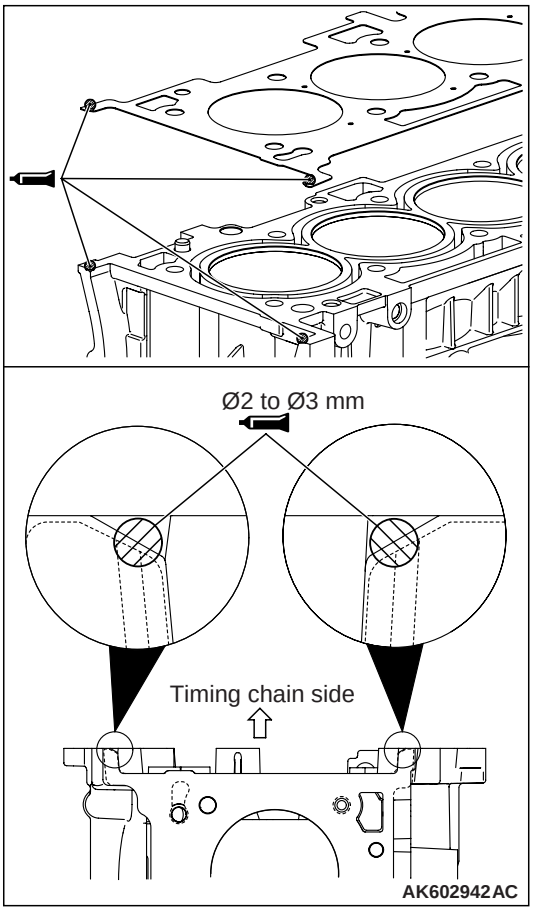


1. Completely remove the liquid gasket on the upper plane of the cylinder block and the lower plane of the cylinder head.

⚠ 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. Degrease the place specified in the illustration.



3. As shown in the illustration, apply a 2.5 ± 0.5 mm of sealant to the top face of cylinder block.

   Specified sealant:
   ThreeBond 1217G or equivalent

4. Install the cylinder head gasket.

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

5. As shown in the illustration, apply a 2.5 ± 0.5 mm of sealant to the top face of cylinder head gasket.

   Specified sealant:
   ThreeBond 1217G or equivalent

6. Install the cylinder head assembly.

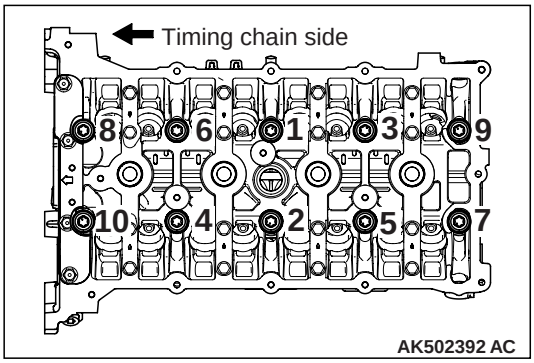
>>D<< CYLINDER HEAD BOLT INSTALLATION

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

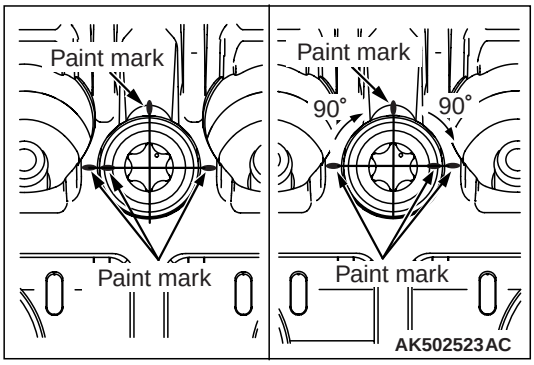
   NOTE: Cylinder head bolts and washers must not be reused.

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 of 35 ± 2 N·m according to the assembly order.



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

⚠ CAUTION

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

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

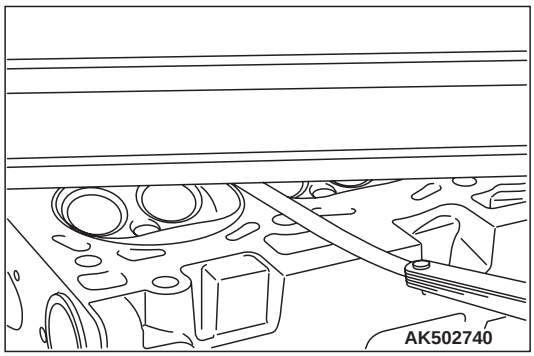
   Tighten it further 90° and make sure that the paint mark on the cylinder head bolt is in a straight line with that on the cylinder head.

INSPECTION

M1113007003106

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.



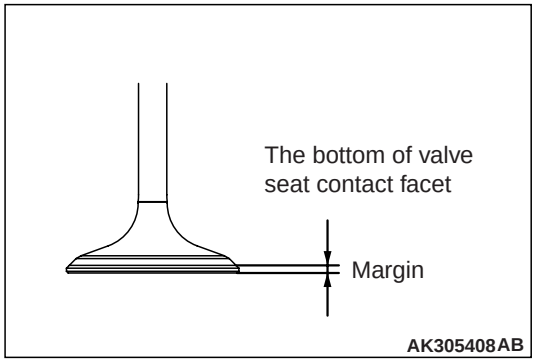
⚠ CAUTION

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

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

   Distortion on bottom
   Standard value: Within 0.05 mm
   Limit: 0.2 mm
   Grinding limit: 0.2 mm
   Cylinder head height: 128.5 mm

VALVE

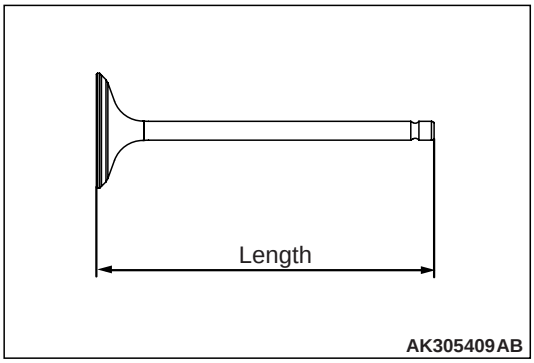


1. Repair the valve seat if contact with the valve seat is poor, uneven or broken.
2. Measure the margin.

   If the limit is exceeded, replace the valve.

   Standard value:
   Inlet 1.022 mm
   Exhaust 1.094 mm

   Limit:
   Inlet 0.522 mm
   Exhaust 0.594 mm



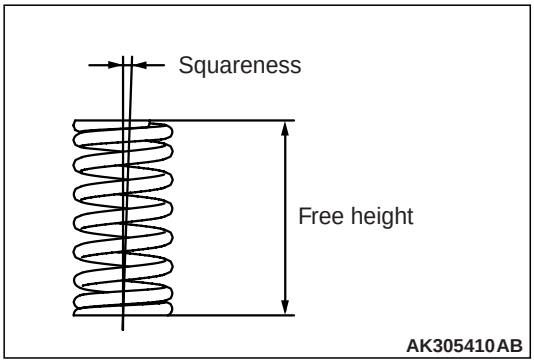
3. Measure overall length of the valve.

   If the limit is exceeded, replace the valve.

   Standard value:
   Inlet 113.18 mm
   Exhaust 105.89 mm

   Limit:
   Inlet 112.68 mm
   Exhaust 105.39 mm

VALVE SPRING



1. Measure free height of the spring.

   If the limit is exceeded, replace the spring.

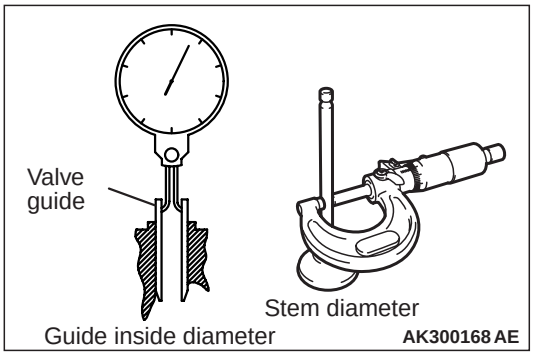
   Standard value: 49.4 mm
   Limit: 48.4 mm

2. Measure squareness of the spring.

   If the inclination exceeds the limit, replace the spring.

   Standard value: 2° or less
   Limit: 4°

VALVE GUIDE

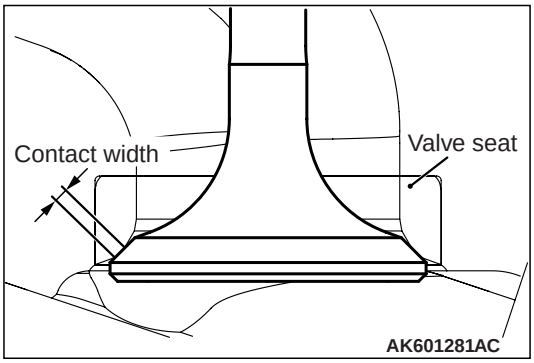


Measure clearance between the valve guide and valve stem. If the clearance exceeds the limit, replace the valve guide or valve, or both.

Standard value:
Inlet 0.020 – 0.047 mm
Exhaust 0.030 – 0.057 mm

Limit:
Inlet 0.10 mm
Exhaust 0.15 mm

VALVE SEAT



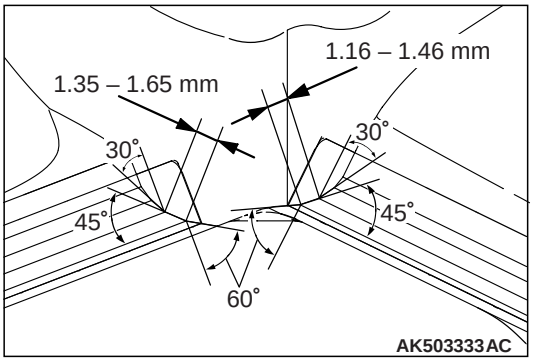
Assemble the valve, then measure the contact width. If the measurement exceeds the specified limit, replace the valve seat.

Standard value
Inlet: 1.16 – 1.46 mm
Exhaust: 1.35 – 1.65 mm

⚠ CAUTION
If the variation in the width exceeds 0.2 mm even if the contact width is within the standard value, replace or correct the valve sheet.

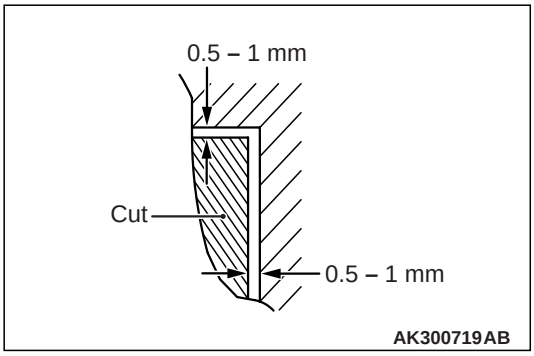
REPAIR PROCEDURE OF VALVE SEAT

1. Check clearance between valve guide and valve and replace the valve guide if necessary before repairing the valve seat.

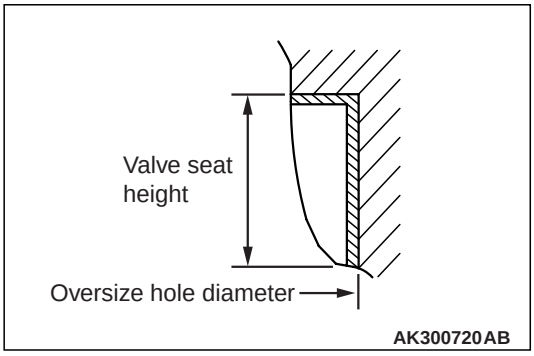


2. Repair the valve seat so that seat width and seat angle are to the specified shape.
3. Lap valve and valve seat with lapping compound after repairing valve seat.

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.

Inlet valve seat bore diameter:
0.3 O.S.: 36.22 – 36.24 mm

Exhaust valve seat bore diameter:
0.3 O.S.: 30.22 – 30.24 mm

3. Press fit the valve seat, taking care not to score the cylinder head bore at room temperature.
4. Ream the valve seat.

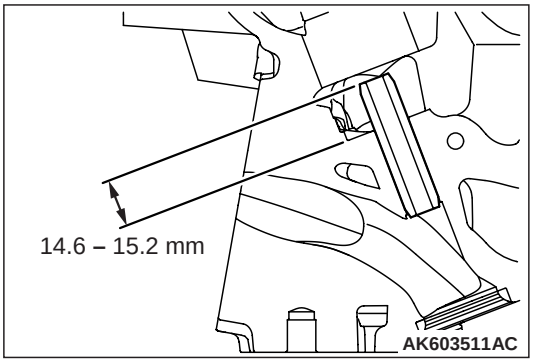
   Refer to "Repair procedure of valve seat."

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



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

   Standard value: 14.6 – 15.2 mm

   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 <4B11>

REMOVAL AND INSTALLATION

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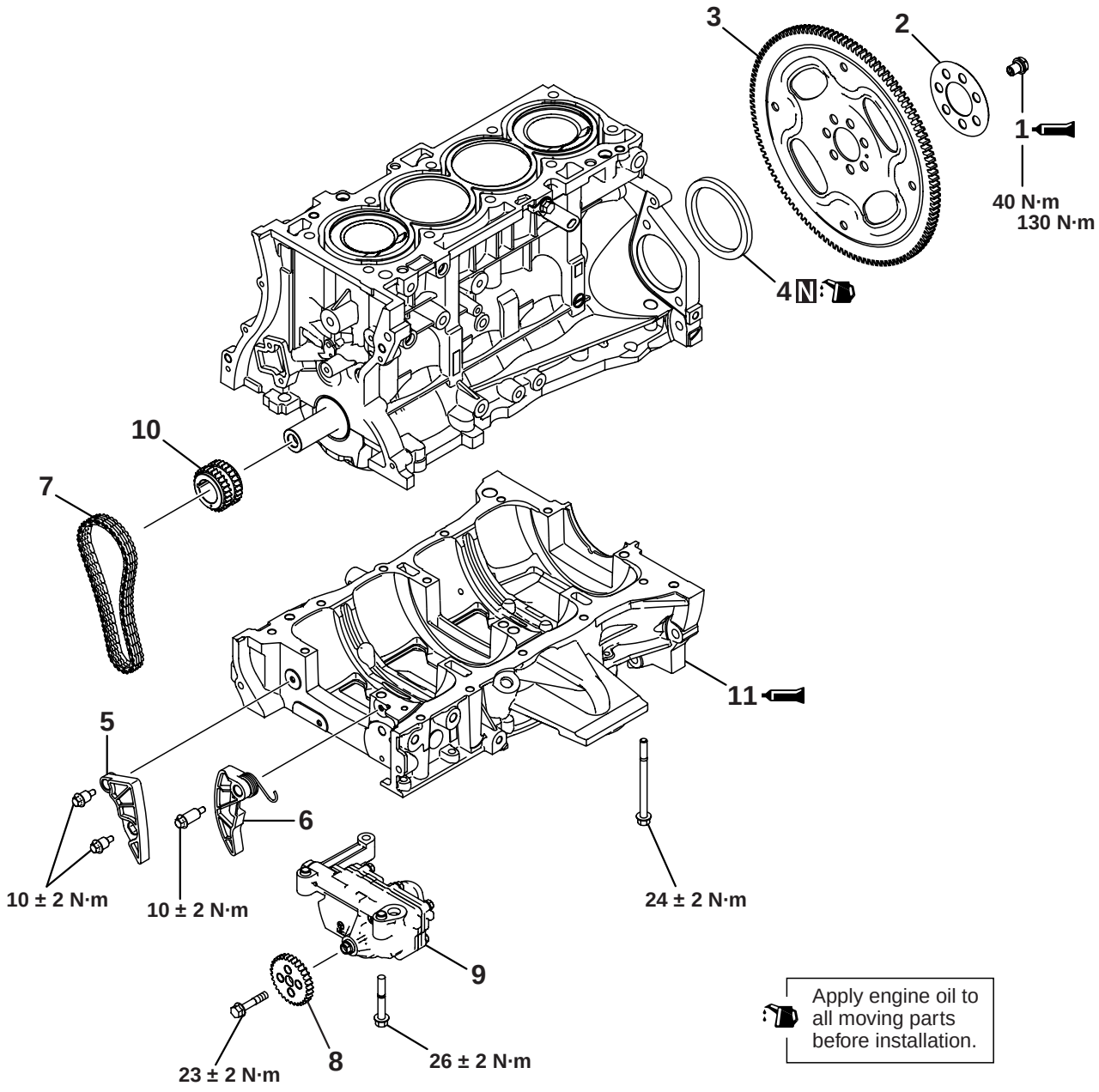

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Removal steps

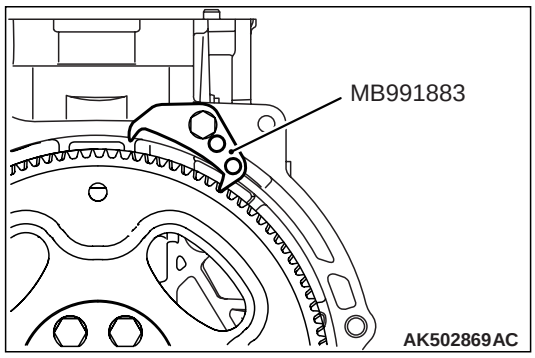
<<A>> >>E<< 1. Drive plate bolt
2. Adapter plate
3. Drive plate
>>D<< 4. Rear oil seal
5. Oil pump chain guide
6. Oil pump tensioner lever

Removal steps (Continued)

>>C<< 7. Oil pump chain
<<B>> >>C<< 8. Oil pump sprocket
9. Oil pump case
>>B<< 10. Crankshaft sprocket
<<C>> >>A<< 11. Ladder frame

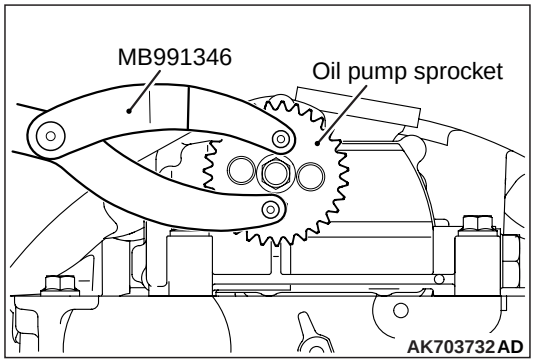
REMOVAL SERVICE POINTS

<<A>> DRIVE PLATE BOLT REMOVAL



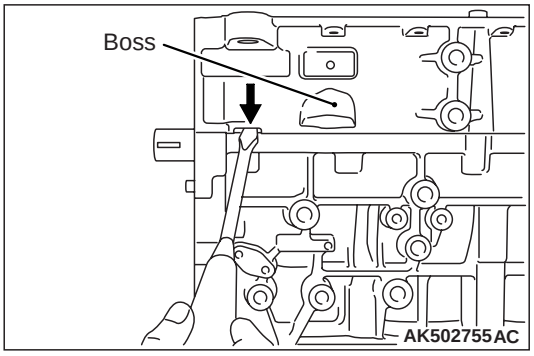
1. Use special tool Flywheel stopper (MB991883) to secure the drive plate.
2. Remove the drive plate bolt.

<<B>> OIL PUMP SPROCKET REMOVAL

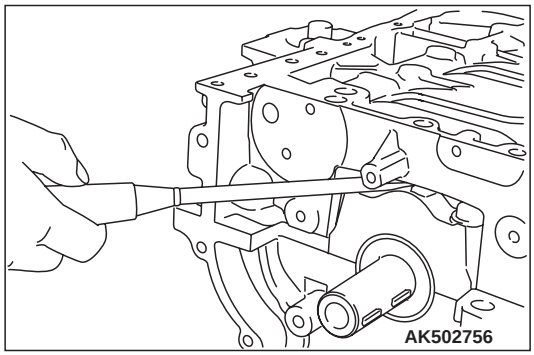


Fix the oil pump sprocket with a special tools Top cover wrench (MB991346), loosen a centre bolt, and remove the oil pump sprocket.

<<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

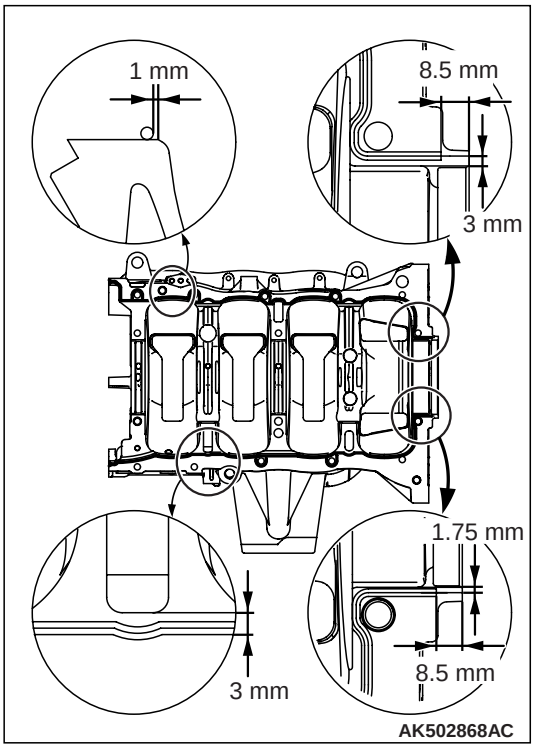
Be sure to remove liquid gasket that has entered mounting holes.

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

⚠ CAUTION

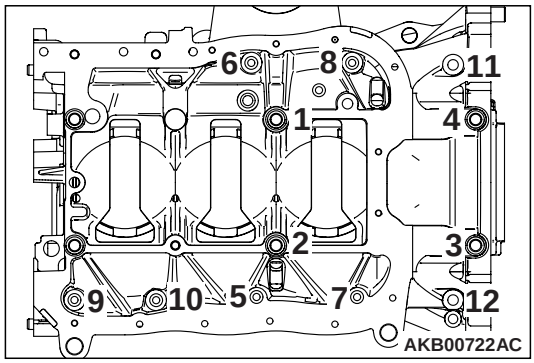
Sufficiently check that there is no residual oil on the place where degreasing is performed. If fingerprints are left, do not touch it with bare hands after the degreasing, since the oils from your fingers will harm the seal ability.

2. Degrease the surface where the liquid gasket is applied and the contact surface between the cylinder block and ladder frame.



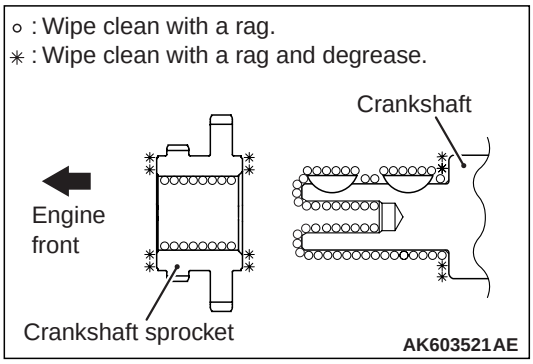
3. Squeeze liquid gasket of $\phi 2.5 \pm 0.5$ mm in thickness and apply it to the illustrated position of the ladder frame.

Specified sealant:
ThreeBond 1217G or equivalent



4. Tighten the ladder frame to the specified torque of 24 ± 2 N·m in the order shown in the illustration.

>>B<< CRANKSHAFT SPROCKET INSTALLATION

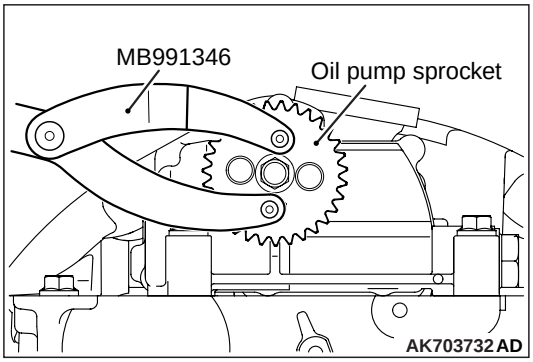


1. Wipe off the dirt on the crankshaft sprocket and the crankshaft using a rag, and then remove the grease from the portion shown in the illustration.

   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 centre on the compression stroke.
3. Install the crankshaft sprocket to the crankshaft.

>>C<< OIL PUMP SPROCKET / OIL PUMP CHAIN INSTALLATION

1. Set the No. 1 piston at top dead centre on the compression stroke.

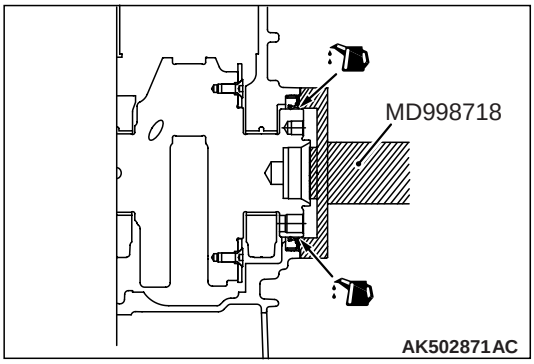


2. Using the special tool Top cover wrench (MB991346), install the oil pump sprocket to the oil pump case.
3. Install the oil pump chain to the crankshaft sprocket.
4. Install the oil pump chain to the oil pump sprocket.

>>D<< REAR OIL SEAL INSTALLATION

⚠ CAUTION

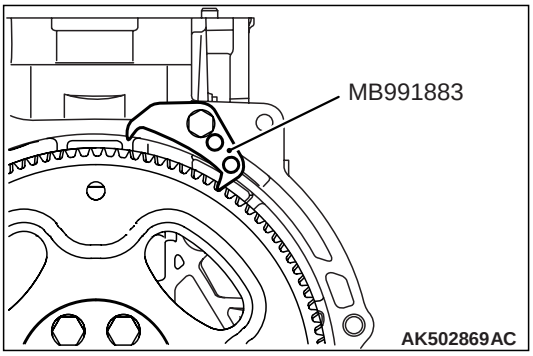
Do not apply oil to the circumference of the oil seal and oil seal pressing hole on the cylinder block side to prevent teeth from pulling out.



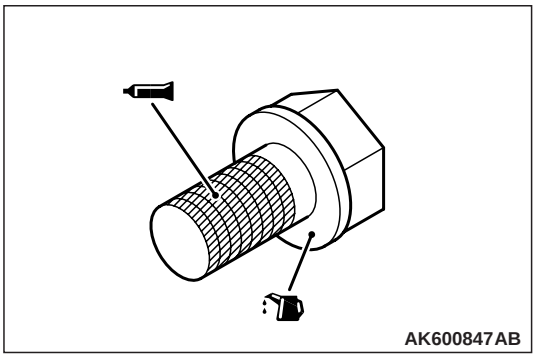
After applying a small amount of engine oil to the oil seal lip, use special tool Rear oil seal installer (MD998718) to press fit the oil seal.

>>E<< DRIVE PLATE BOLT INSTALLATION

1. Clean off sealant and oil of thread of crankshaft and drive plate bolts.

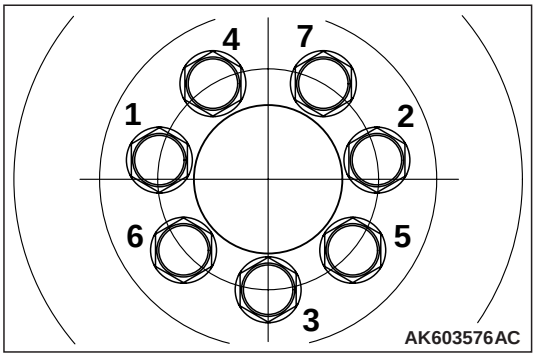


2. Use special tool Flywheel stopper (MB991883) to secure the drive plate.



3. Apply engine oil to thread of crankshaft and bolt seat area of drive plate.
4. Apply the sealant to the thread of drive plate bolt.

   Specified sealant:
   ThreeBond 1324 or equivalent



5. Tighten drive plate bolt to temporary torque of 40 N·m in the order shown to illustration.
6. Tighten drive plate bolt to specified torque of 130 N·m in the order shown in the illustration.

BALANCER CHAIN <4B12>

REMOVAL AND INSTALLATION

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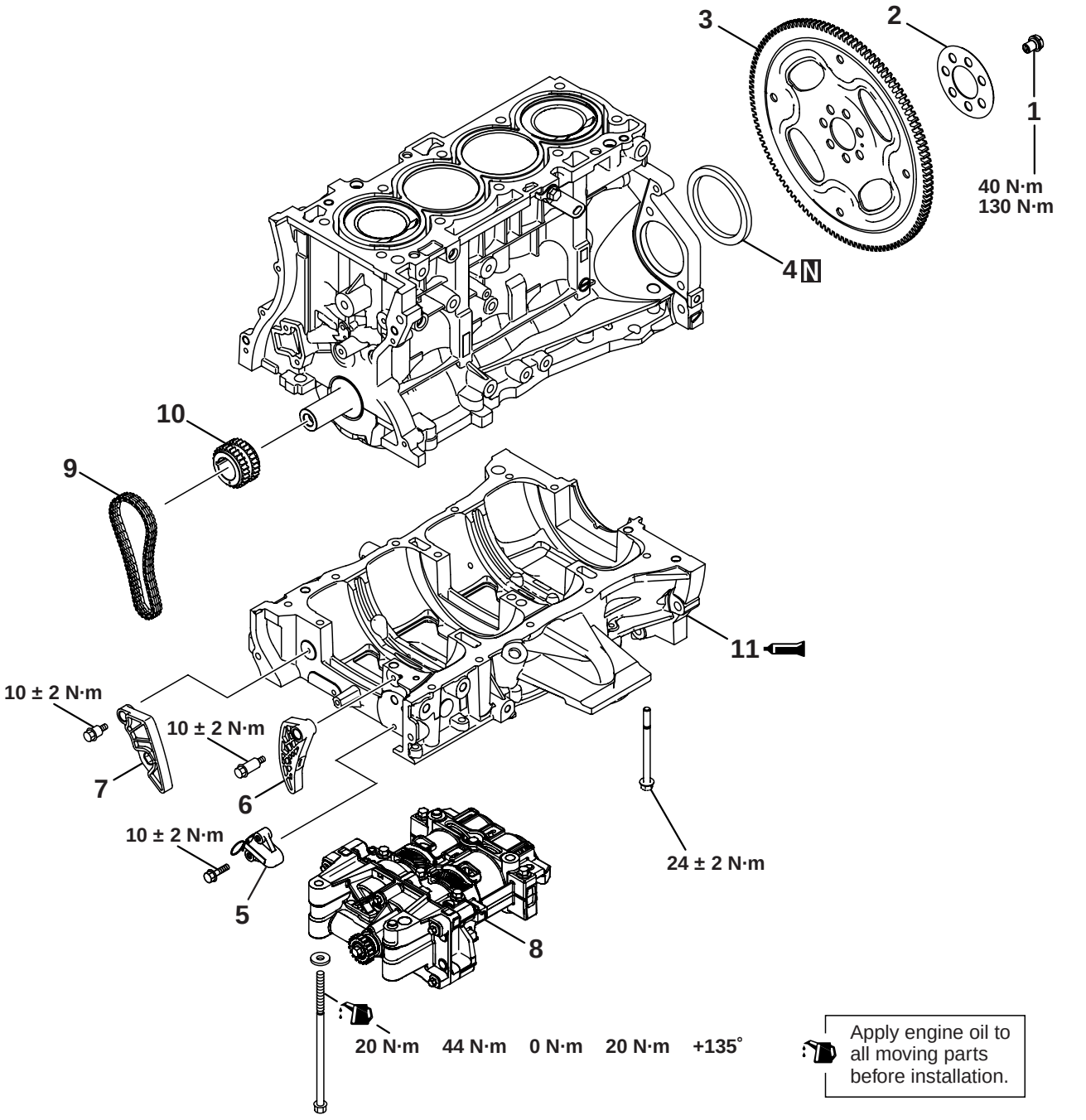

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Removal steps

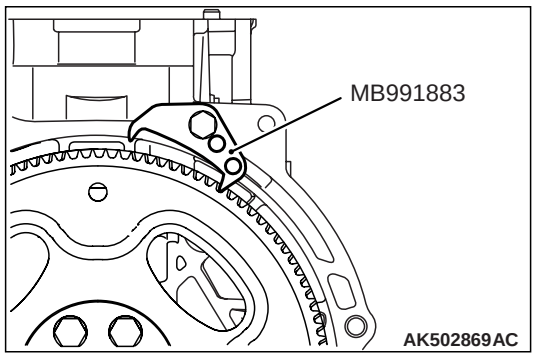
<<A>> >>E<< 1. Drive plate bolt
2. Adapter plate
3. Drive plate
>>D<< 4. Rear oil seal
<<B>> >>C<< 5. Balancer shaft chain tensioner
6. Balancer shaft tensioner lever

Removal steps (Continued)

7. Balancer shaft chain guide
<<B>> >>B<< 8. Balancer shaft module
<<B>> >>B<< 9. Balancer chain
<<B>> >>B<< 10. Crankshaft sprocket
<<C>> >>A<< 11. Ladder frame

REMOVAL SERVICE POINTS

<<A>> DRIVE PLATE BOLT REMOVAL

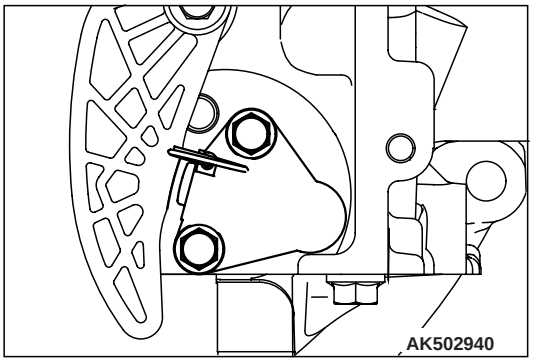


1. Use special tool Flywheel stopper (MB991883) to secure the drive plate.
2. Remove the drive plate bolts.

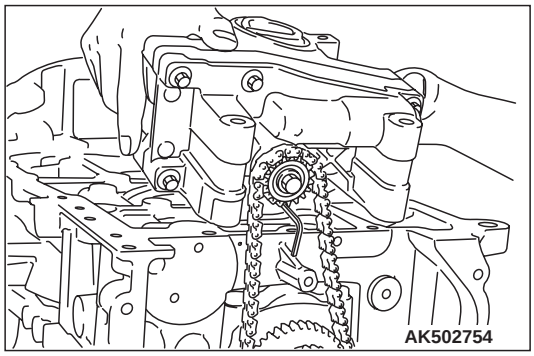
<<B>> BALANCER SHAFT CHAIN TENSIONER / CRANKSHAFT SPROCKET / BALANCER CHAIN / BALANCER SHAFT MODULE REMOVAL

⚠ CAUTION

Reliably secure the plunger of the chain tensioner with hard wire to prevent it from jumping out of the main body.



1. Push in the balancer shaft tensioner lever by hand and push in the plunger of the chain tensioner until it contacts the bottom. Then, insert hard wire (piano wire, etc.) of ϕ1.5 or hexagonal bar wrench (1.5 mm) into the plunger fixing hole to secure.
2. Remove the balancer shaft chain tensioner.

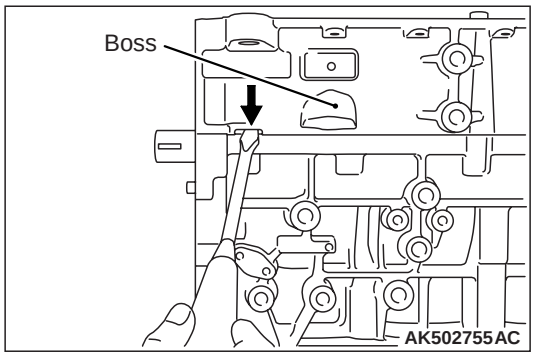


⚠ CAUTION

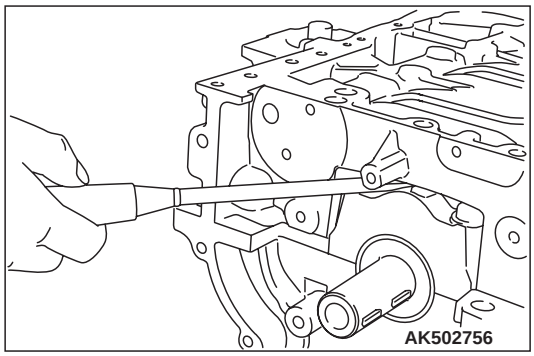
The balancer shaft module must not be disassembled because of assembly warranty.

3. Remove the crankshaft sprocket, balancer chain and balancer shaft module as a unit.

<<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

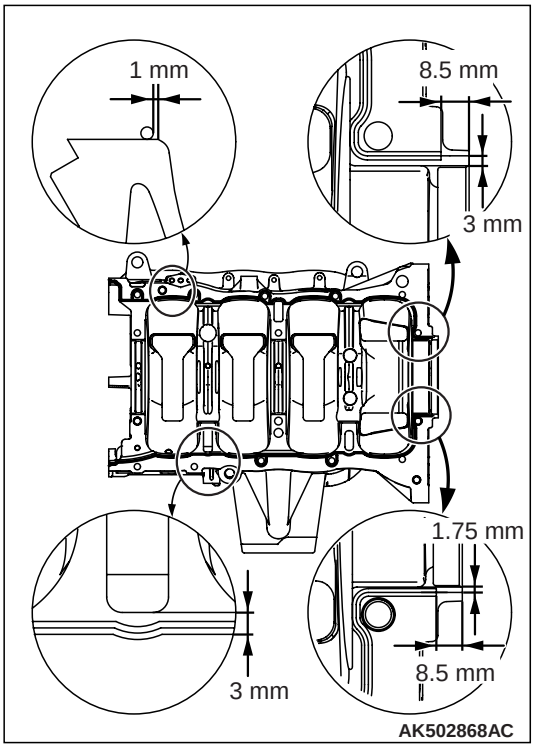
Be sure to remove liquid gasket that has entered mounting holes.

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

⚠ CAUTION

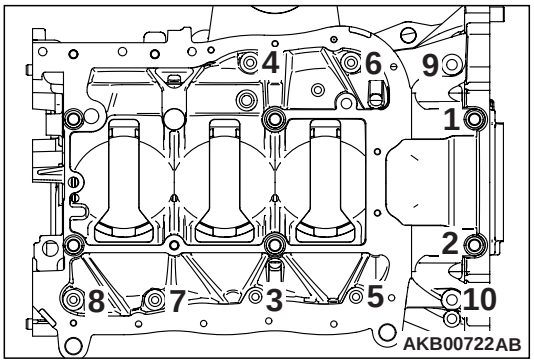
Sufficiently check that there is no residual oil on the place where degreasing is performed. If fingerprints are left, do not touch it with bare hands after the degreasing, since the oils from your fingers will harm the seal ability.

2. Degrease the surface where the liquid gasket is applied and the contact surface between the cylinder block and ladder frame.



3. Squeeze liquid gasket of $\phi 2.5 \pm 0.5$ mm in thickness and apply it to the illustrated position of the ladder frame.

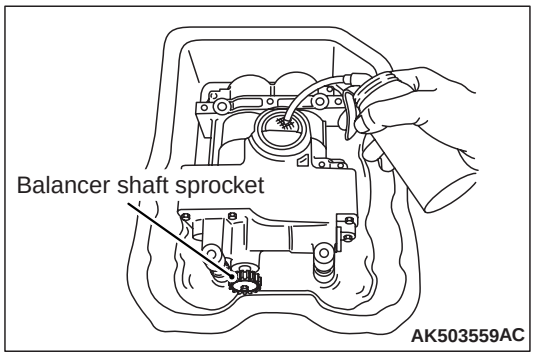
Specified sealant:
ThreeBond 1217G or equivalent



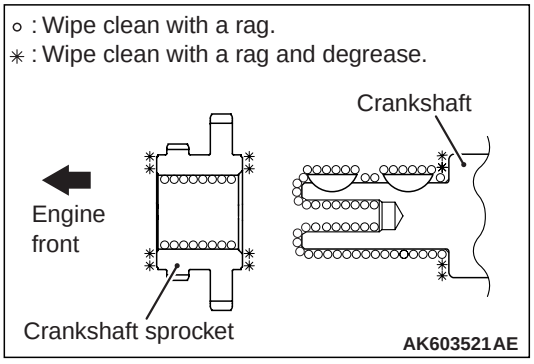
4. Tighten the ladder frame to the specified torque of 24 ± 2 N·m in the order shown in the illustration.

>>B<< CRANKSHAFT SPROCKET / BALANCER CHAIN / BALANCER SHAFT MODULE INSTALLATION

When the new balancer shaft module is installed, supply oil to the oil pump and the balancer shaft bearing in the balancer shaft module using the following procedures.

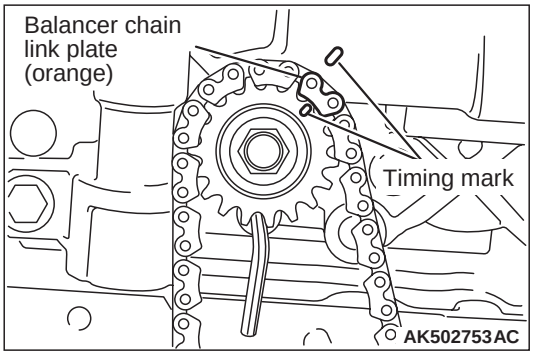


a. Clean the inside of the removed oil pan. Put the balancer shaft module carefully into the oil pan so that the oil inlet can be upward.
b. Pour the engine oil so that the two-third of the balancer module can be immersed.
c. Also, pour approximate 50 cc of engine oil from the oil inlet.
d. By giving four clockwise rotations or more to the balancer shaft sprocket, the oil is supplied to the oil pump and the balancer shaft bearing.



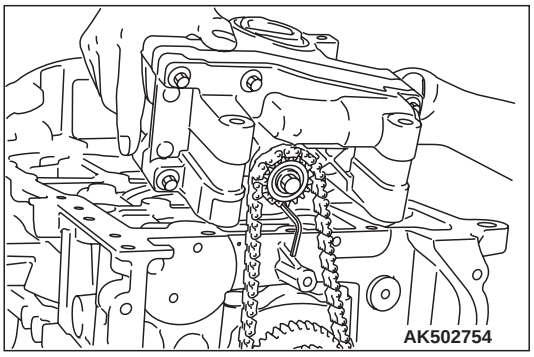
1. Wipe the dirt on the crankshaft sprocket and the crankshaft using a rag, and then remove the grease from the portion shown in the illustration.

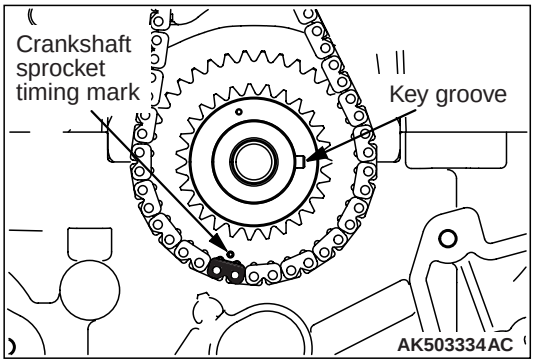
   NOTE: Remove grease to prevent a drop in the coefficient of friction of the pressing portion caused by adhesion of oil.



2. Align the timing mark of the balancer shaft module sprocket with that of the balancer shaft module.
3. Insert a hexagonal bar wrench (3 mm) as illustrated to prevent the balancer shaft module sprocket from moving.
4. Loop the balancer chain, aligning its link plate (orange) with the timing mark.
5. Install the crankshaft sprocket on the crankshaft.

   NOTE: Do not push in the crankshaft sprocket to the normal position. Push it in only up to the tip of the crankshaft.

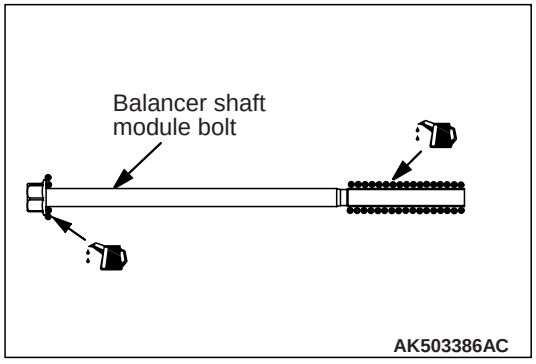




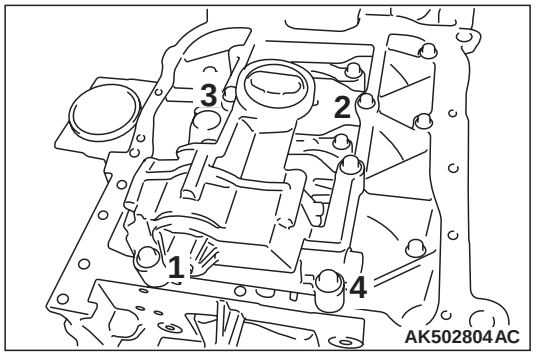
6. While slanting the balancer shaft module, align the link plate (blue) of another balancer chain with the timing mark of the crankshaft sprocket to loop. Gradually push in the crankshaft sprocket and fit it into the key groove of the crankshaft. Then, install the balancer shaft module on the ladder frame.

   NOTE: Make sure that the balancer shaft module is completely intimate contact with the ladder frame.

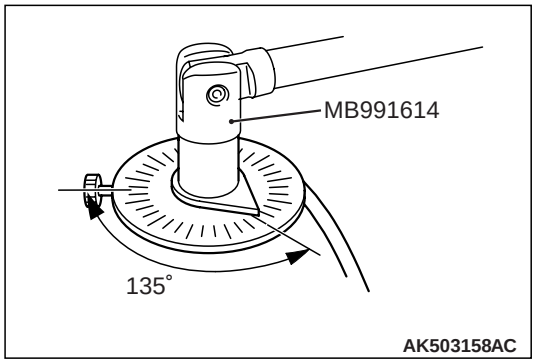
   NOTE: Make sure that the key groove of the crankshaft is aligned with the contact surface of the cylinder block and ladder frame as shown in the illustration.



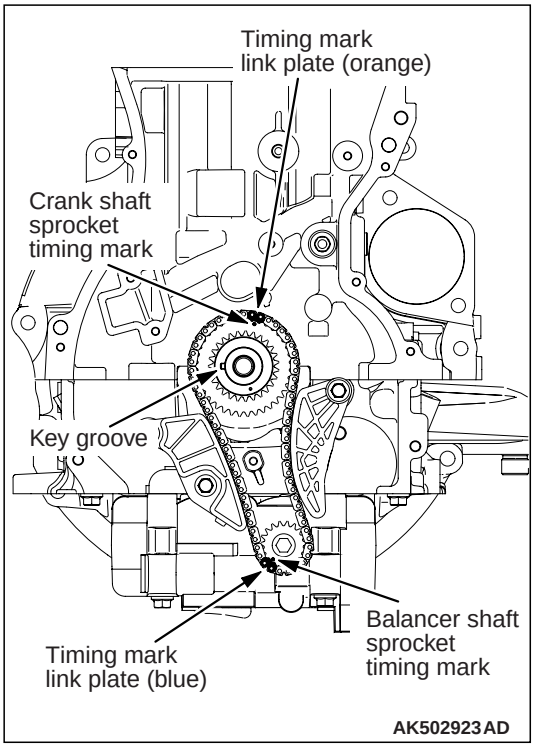
7. Apply an appropriate and minimum amount of engine oil to the screw thread of the balancer shaft module bolt.



8. Tighten bolts to the specified torque of 20 N·m according to the assembly order in the illustration, retighten them to 44 N·m, and then completely loosen them.

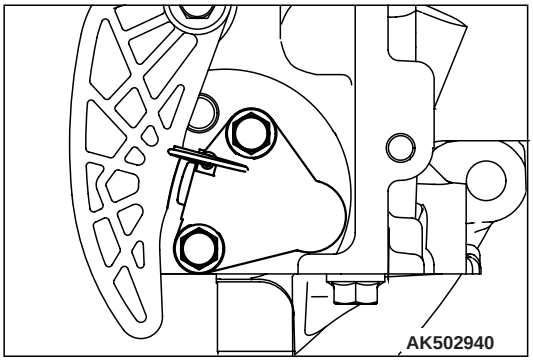


9. After tightening them to the specified torque of 20 N·m again, use special tool Angle gauge (MB991614) to tighten them up to 135°.
10. Pull out the hexagonal bar wrench from the balancer module sprocket.



11. Make sure that the respective timing mark is aligned with each other as illustrated.
12. Install the balancer chain tensioner lever and balancer chain guide.

>>C<< BALANCER SHAFT CHAIN TENSIONER INSTALLATION



1. Attach the chain tensioner to the ladder frame.

⚠ CAUTION

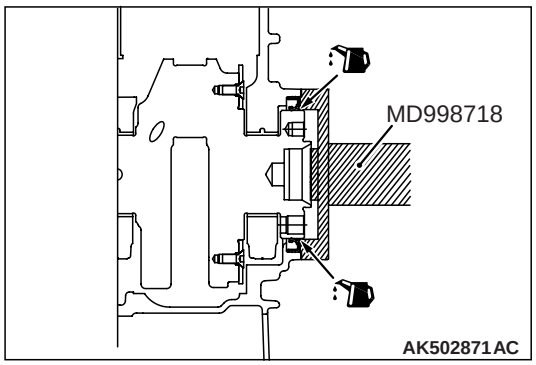
Install the chain tensioner precisely in place after installing the tensioner lever and chain guide to prevent the plunger of the chain tensioner from jumping out.

2. Remove the hard wire (piano wire, etc.) of ϕ1.5 or hexagonal bar wrench (1.5 mm) from the tensioner. This enables the plunger of the chain tensioner to push the balancer shaft tensioner lever to keep the balancer shaft chain tight.

>>D<< REAR OIL SEAL INSTALLATION

⚠ CAUTION

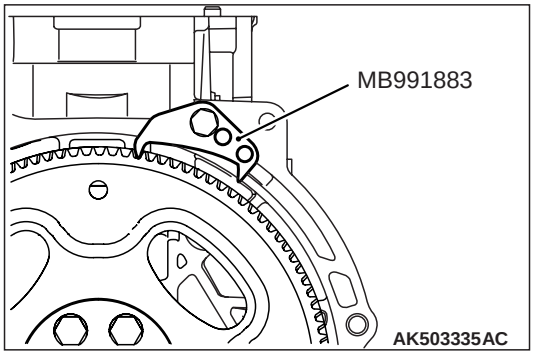
Do not apply oil to the circumference of the oil seal and oil seal pressing hole on the cylinder block side to prevent teeth from pulling out.



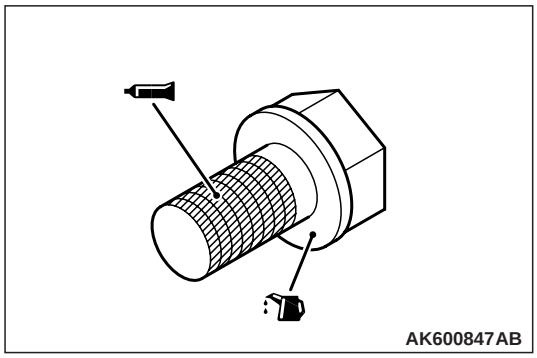
After applying a small amount of engine oil to the oil seal lip, use special tool Rear oil seal installer (MD998718) to press fit the oil seal.

>>E<< DRIVE PLATE BOLT INSTALLATION

1. Clean off sealant and oil of thread of crankshaft and drive plate bolts.

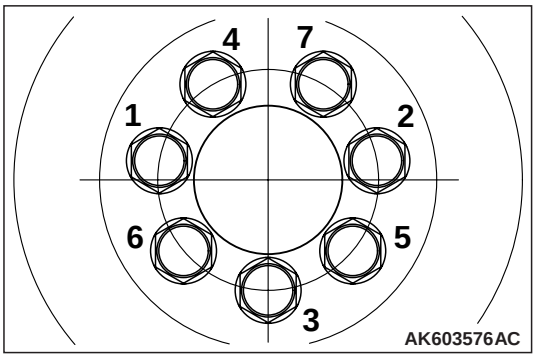


2. Use special tool Flywheel stopper (MB991883) to secure the drive plate.



3. Apply engine oil to thread of crankshaft and bolt seat area of drive plate.
4. Apply the sealant to the thread of drive plate bolts.

   Specified sealant:
   ThreeBond 1324 or equivalent

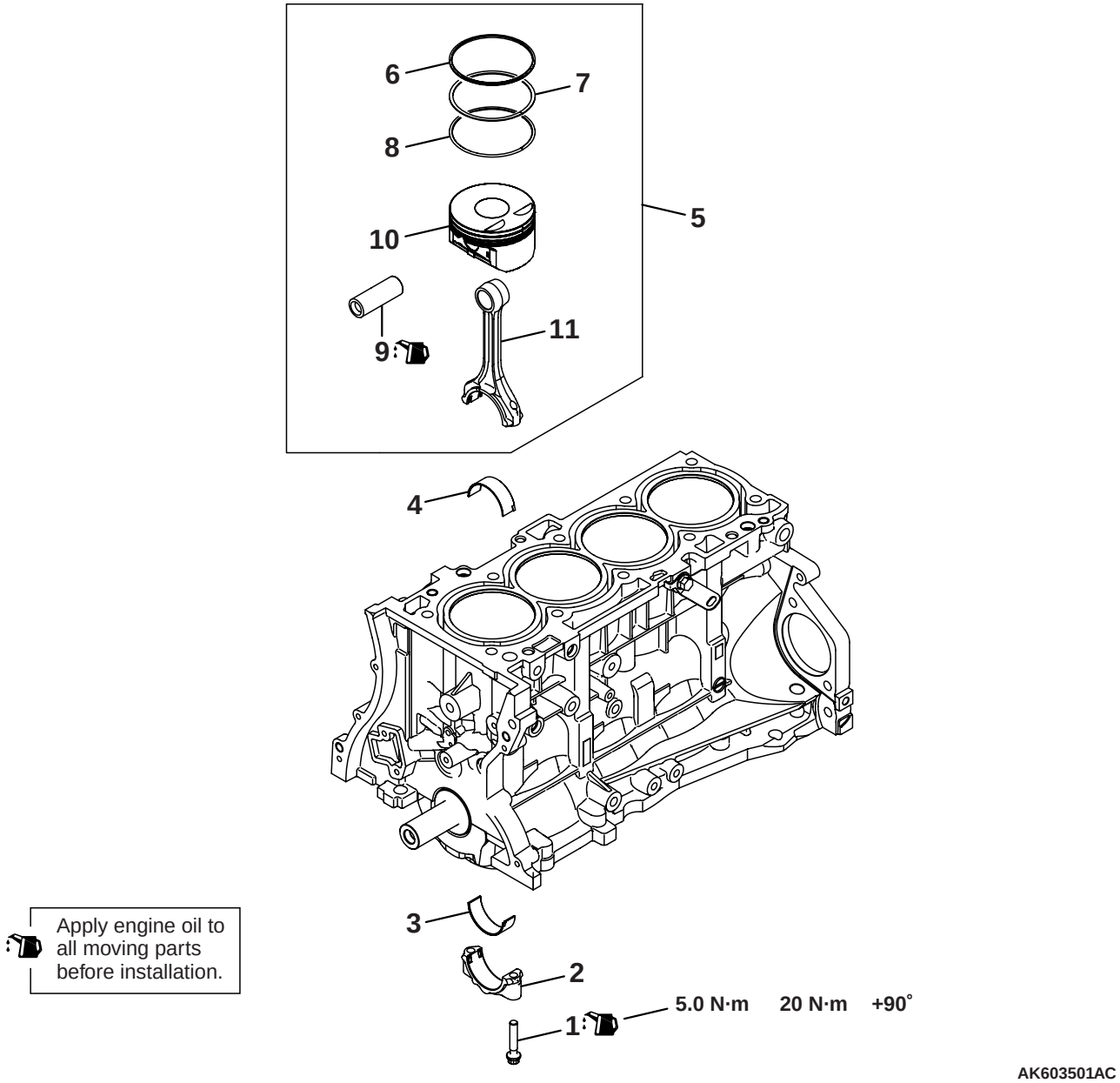


5. Tighten drive plate bolts to temporary torque of 40 N·m in the order shown to illustration.
6. Tighten drive plate bolts to specified torque of 130 N·m in the order shown in the illustration.

PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008403903



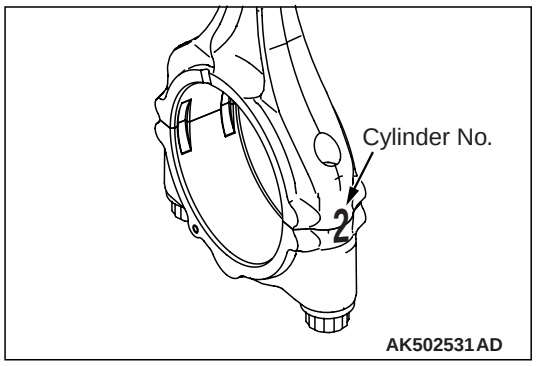
AK603501AC

Removal sequence

	>>G<<	1. Connecting rod cap bolt
<<A>>	>>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
	>>C<<	7. Piston ring No. 2
	>>B<<	8. Oil ring
<<B>>	>>A<<	9. Piston pin
		10. Piston
		11. Connecting rod

REMOVAL SERVICE POINTS

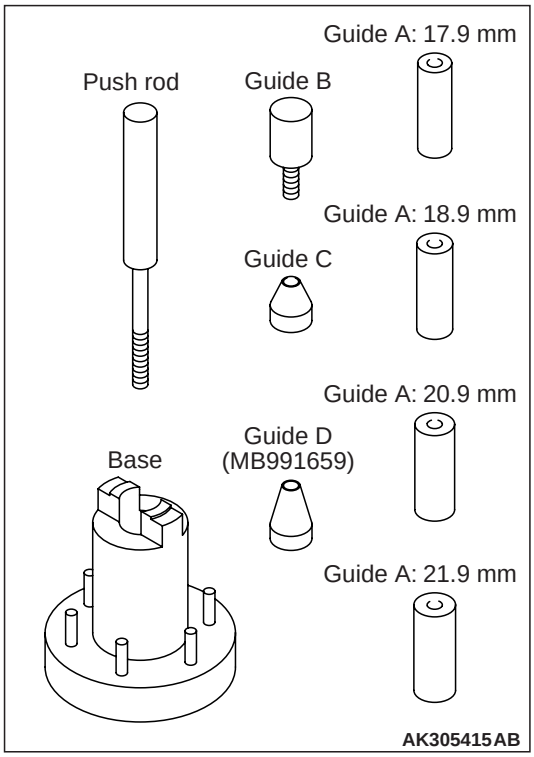
<<A>> CONNECTING ROD REMOVAL



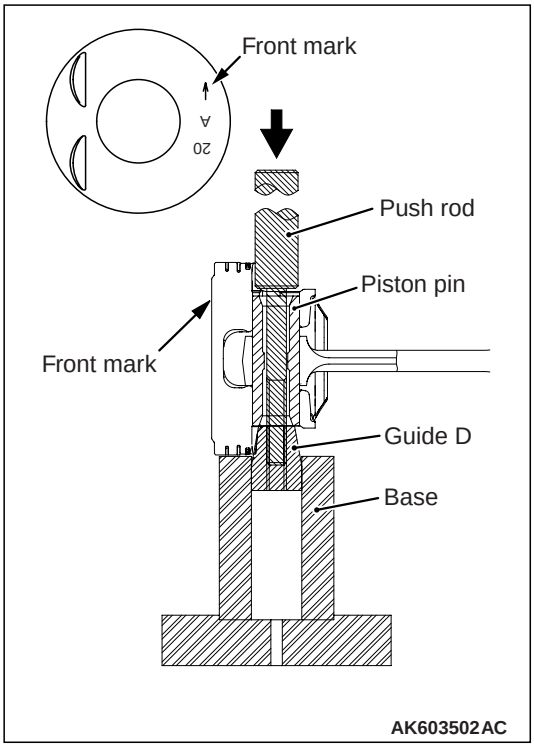
AK502531AD

Enter cylinder No. for reassembly on the side of the connecting rod big end.

<<B>> PISTON PIN REMOVAL



Special tool Piston pin setting tool (MD998780) consists of parts shown in the illustration. Use also special tool Guide D (MB991659) to remove the piston pin.

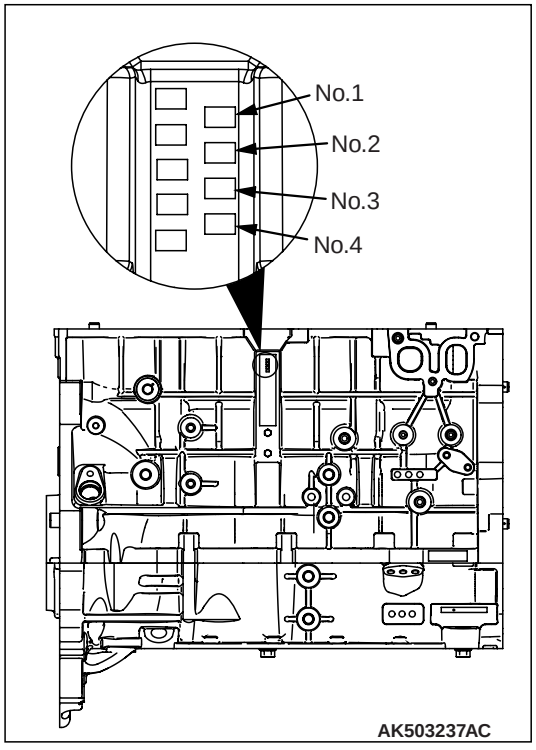


1. Insert the push rod into the piston pin from the front mark side of the piston top surface, and attach special tool Guide D (MB991659).
2. Set the piston and connecting rod assembly on the base so that the front mark of the piston faces upward.
3. Use a press to push the push rod and pull out the piston pin.

   NOTE: After pulling out the piston pin, organize pistons, piston pins and connecting rods by cylinder No.

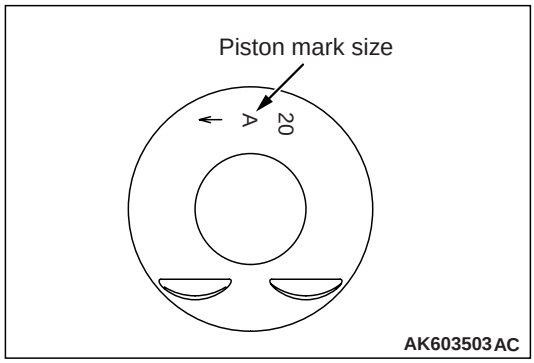
INSTALLATION SERVICE POINTS

>>A<< PISTON PIN INSTALLATION



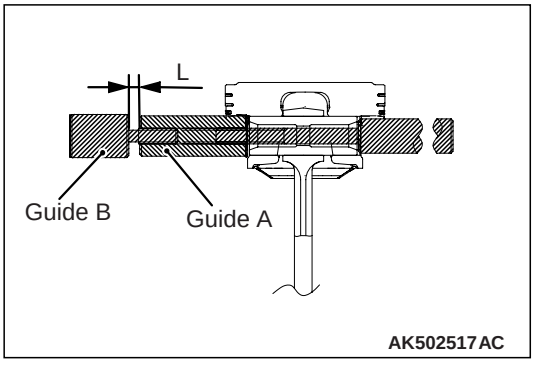
1. When replacing a piston, check the cylinder bore size mark stamped on the illustrated position of the cylinder block and select a corresponding piston from the table below.

Cylinder bore size mark	Piston size mark
A	A
B	B or None
C	C



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

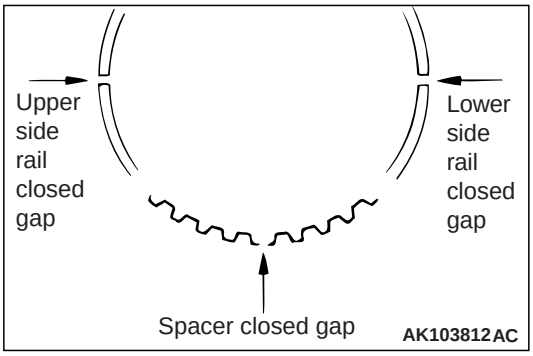
2. Insert the push rod into the piston pin and attach guide A.
3. Align the front mark of the piston with that of the connecting rod to assemble.
4. Apply engine oil to the circumference of the piston pin.
5. Insert the guide A side of the piston pin assembled in section 1 into the pin hole from the 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 (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.

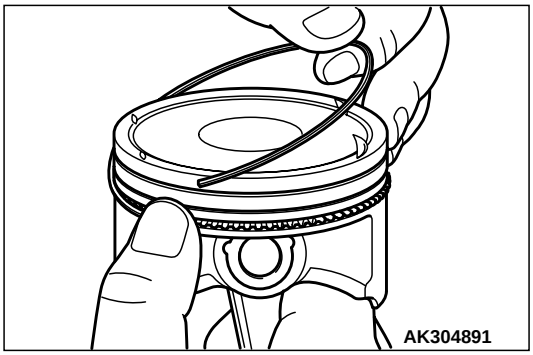
Standard value: 7,500 – 17,500 N

>>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.

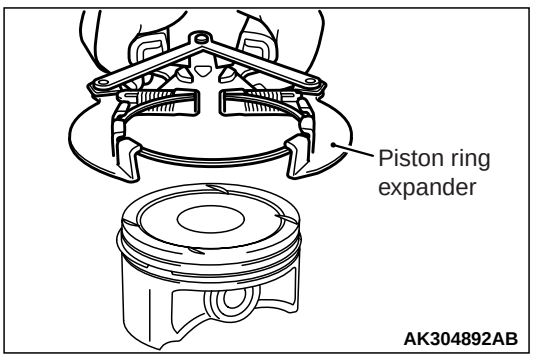


⚠ CAUTION

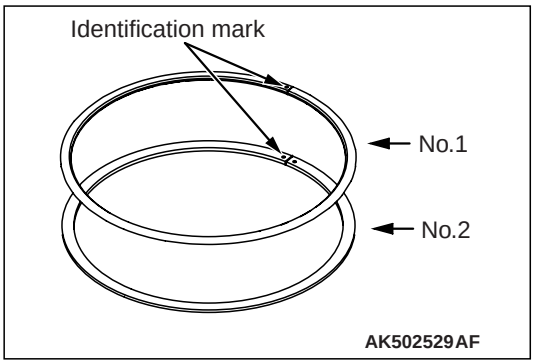
The side rail may be broken if its end gap is widened by a ring expander as in other piston rings.

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



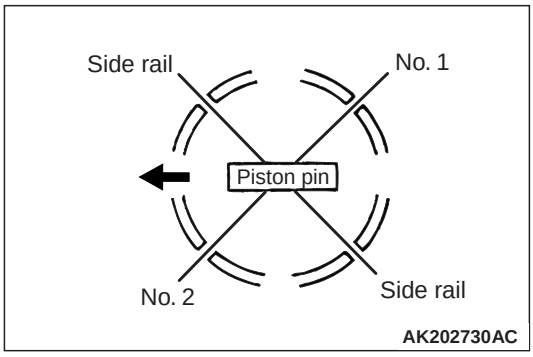
Use a piston ring expander to assemble piston rings with their identification marks facing upward. Piston rings can be assembled by hand without using the piston ring expander.



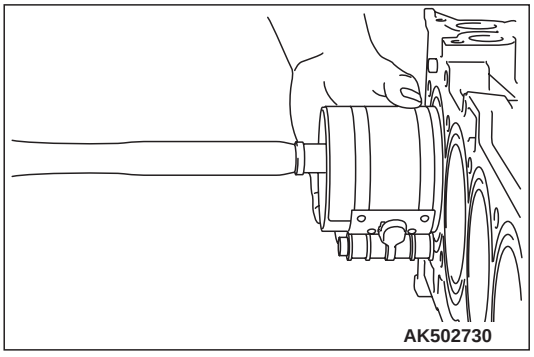
Identification mark:
No. 1 ring: T1 or 1T
No. 2 ring: T2 or 2T

>>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.



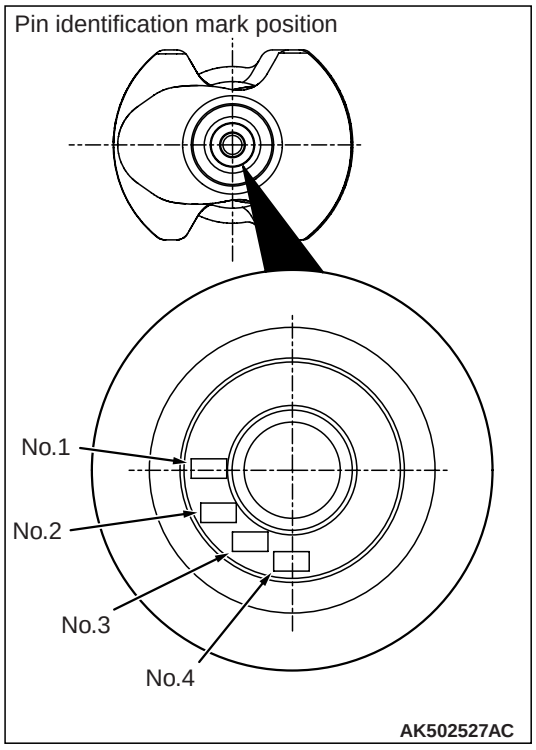
2. Arrange end gap positions of piston rings and oil ring (side rail and spacer) as shown in the illustration.
3. Insert the piston and connecting rod assembly from the top surface of the cylinder block with the front mark of the piston top face facing toward the timing belt side.



⚠ 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.

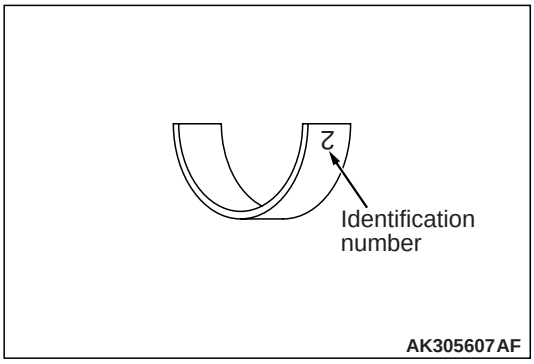
>>E<< CONNECTING ROD BEARING INSTALLATION



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**	**Identification mark**
1	47.966 – 47.972	1
2	47.960 – 47.966	2
3	47.954 – 47.960	3

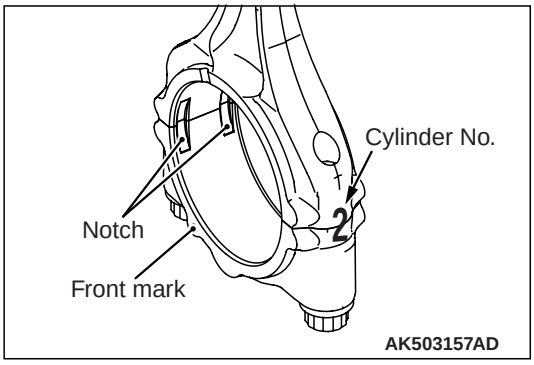
2. An identification mark of a crankshaft is stamped at the illustrated position by No.



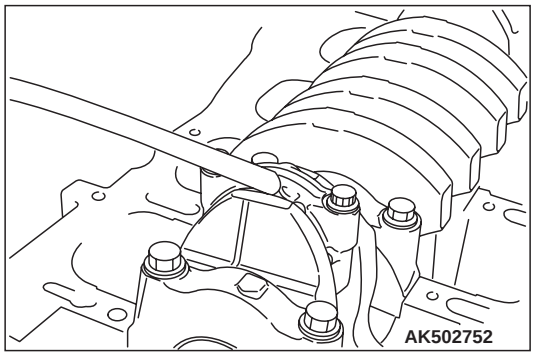
3. A connecting rod bearing has an identification mark at the illustrated position.

>>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 centre 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.

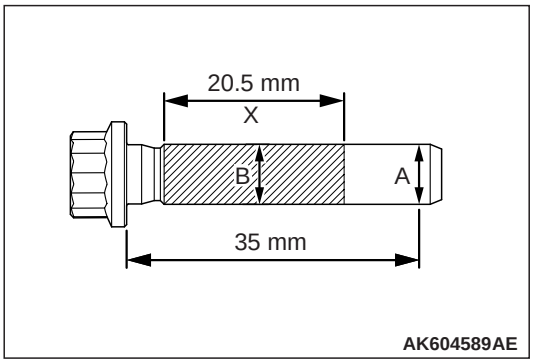


2. Make sure that clearance of the thrust of the connecting rod big end is appropriate.

Standard value: 0.10 – 0.25 mm
Limit: 0.4 mm

>>G<< CONNECTING ROD CAP BOLT INSTALLATION

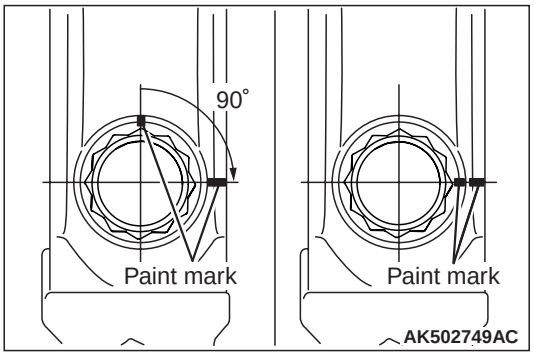
1. Check in the following procedure before reusing the connecting rod bolt.



(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.
5. Tighten the bolt in several steps until the torque reaches 20 N·m.



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

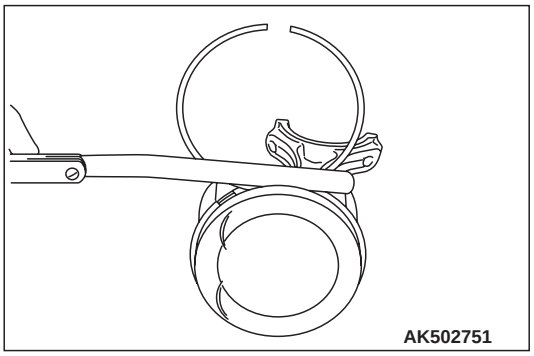
- **When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.**
- **When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.**

8. Tighten the bolt 90°, and make sure that the paint mark of the connecting rod is aligned with that of the bolt.

INSPECTION

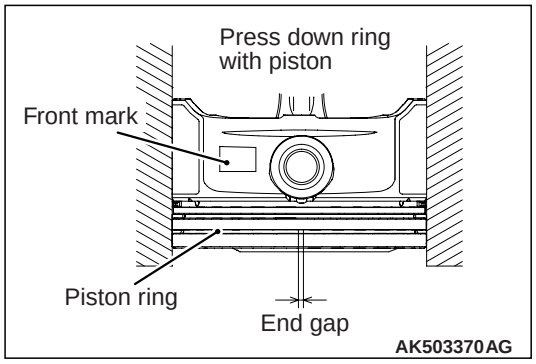
M1113008502703

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
No. 2 ring: 0.03 – 0.07 mm
Limit: 0.1 mm



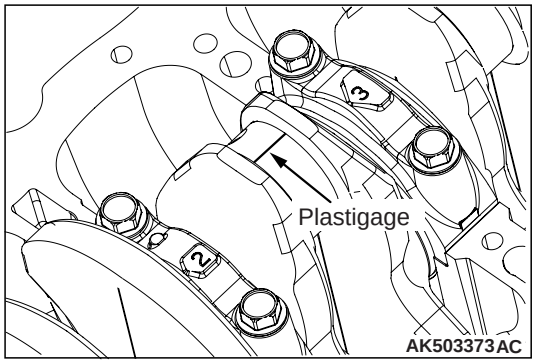
2. Put piston rings into the cylinder bore, press them against the piston top face, and push them in. After achieving squareness, measure the end gap with a thickness gauge. If the end gap is excessive, replace piston rings.

Standard value:
No. 1 ring: 0.15 – 0.28 mm <4B11>
No. 1 ring: 0.15 – 0.25 mm <4B12>
No. 2 ring: 0.30 – 0.45 mm <4B11>
No. 2 ring: 0.25 – 0.40 mm <4B12>
Oil ring: 0.10 – 0.35 mm

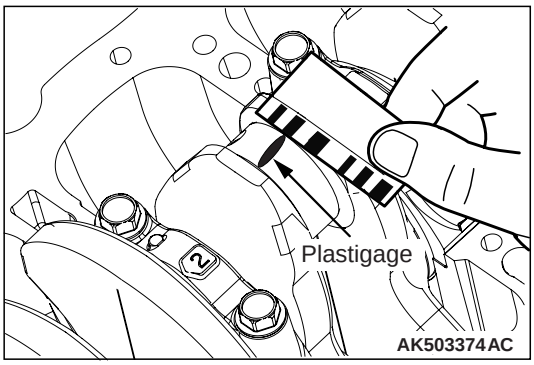
Limit:
No. 1 ring: 0.8 mm
No. 2 ring: 0.8 mm
Oil ring: 1.0 mm

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 centre.



3. Carefully install the connecting rod cap and tighten bolts to the specified torque of 5.0 N·m → 20 N·m → +90°.
4. Remove bolts and gently remove the connecting rod cap.



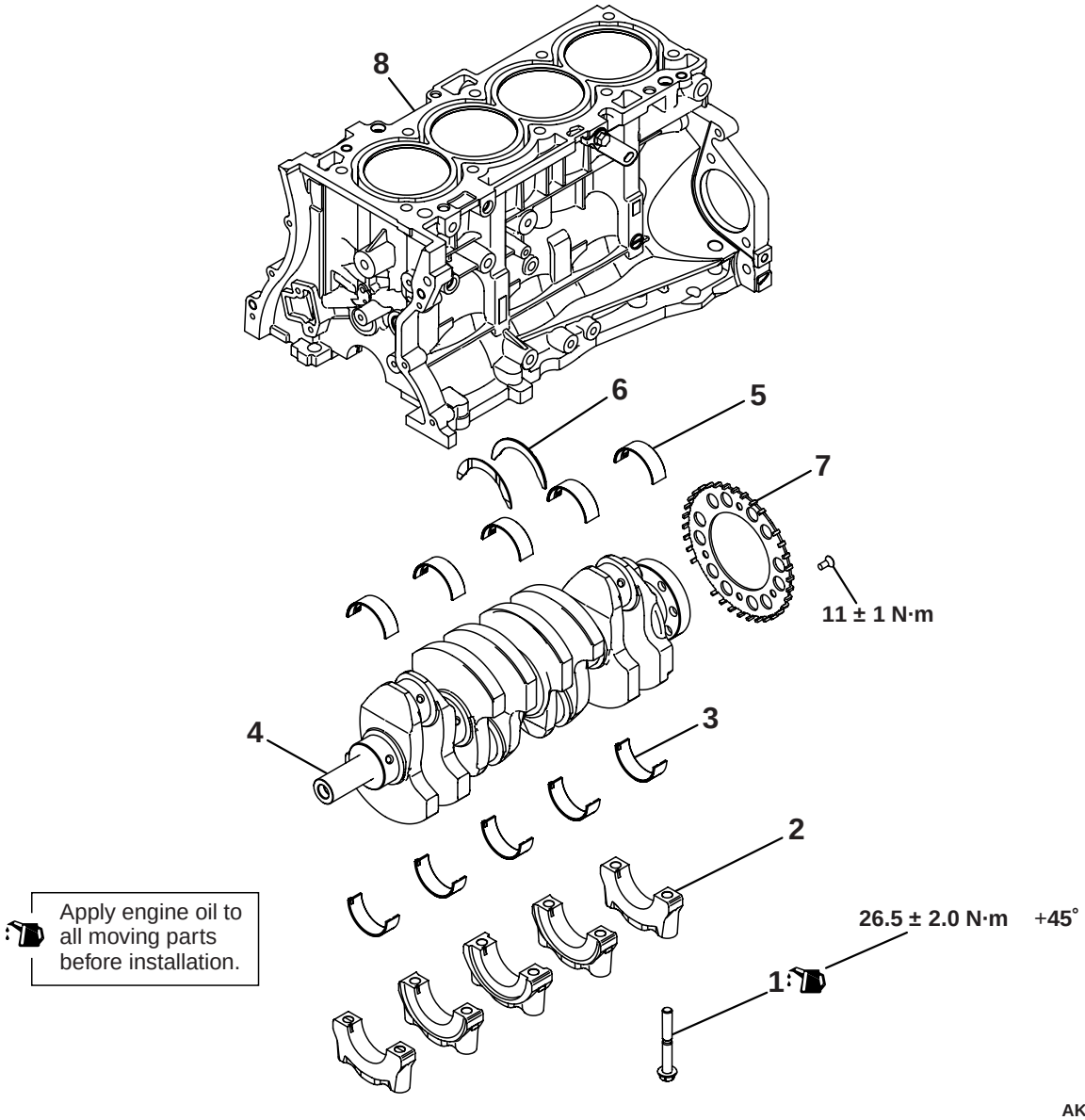
5. Measure the crushed Plastigage width (area most widely crushed) using a scale printed on the Plastigage bag.

   Standard value: 0.018 – 0.045 mm
   Limit: 0.1 mm

CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008704286



Removal steps

>>E<< 1. Crankshaft bearing cap bolt
>>E<< 2. Crankshaft bearing cap
>>D<< 3. Crankshaft bearing lower
<<A>> 4. Crankshaft
>>C<< 5. Crankshaft bearing upper
>>B<< 6. Thrust bearing
>>A<< 7. Crankshaft sensing ring
8. Cylinder block

REMOVAL SERVICE POINT

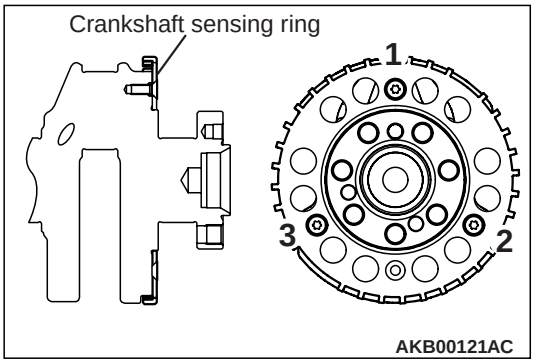
<<A>> CRANKSHAFT REMOVAL

When temporarily placing 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

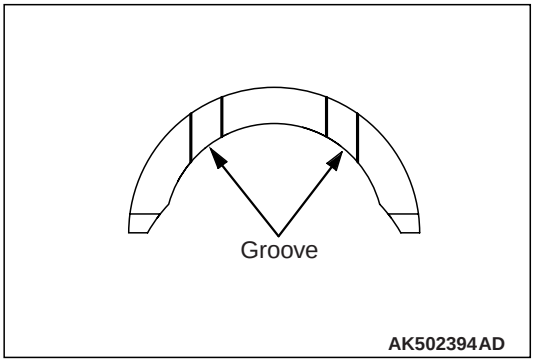
>>A<< CRANKSHAFT SENSING RING INSTALLATION



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

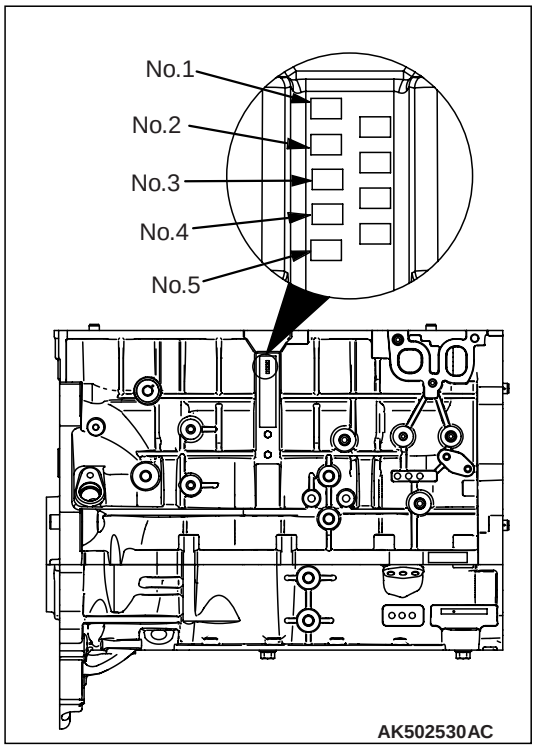
>>B<< THRUST BEARING INSTALLATION

1. Install the thrust bearing on the No. 3 bearing on the cylinder block side. Application of engine oil makes the installation easy.

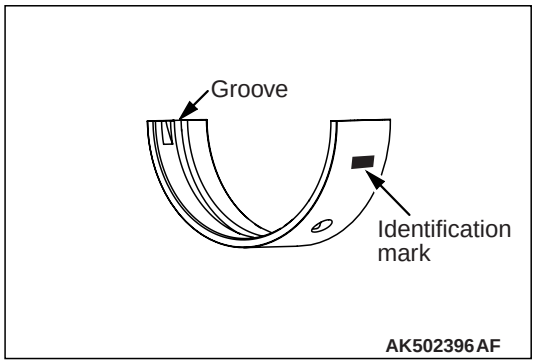


2. Install the thrust bearing so that the grooved side is on the crankshaft weight side.

>>C<< CRANKSHAFT BEARING UPPER INSTALLATION



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

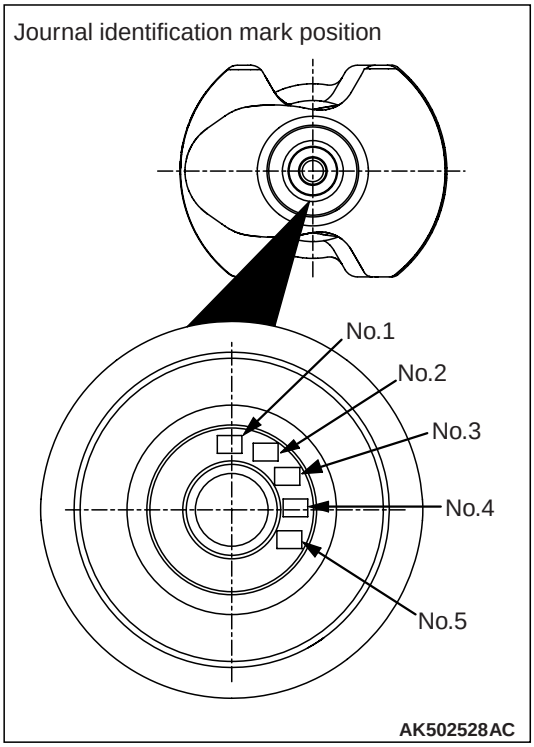


2. The crankshaft bearing upper has an identification mark at the illustrated position.

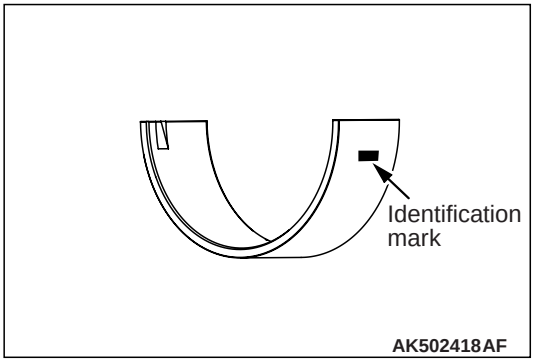
Cylinder block		Crankshaft bearing
Identification mark	Journal diameter mm	Identification mark
1	56.000 – 56.006	1
2	56.006 – 56.012	2
3	56.012 – 56.018	3

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.

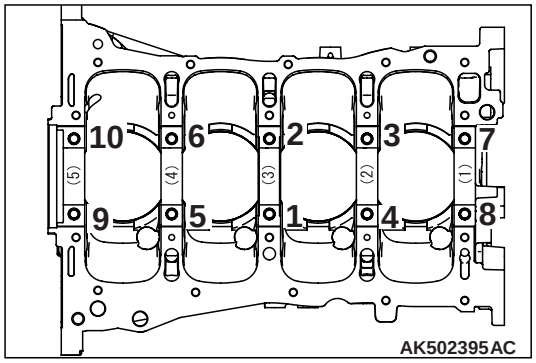


2. The crankshaft bearing lower has an identification mark at the illustrated position.

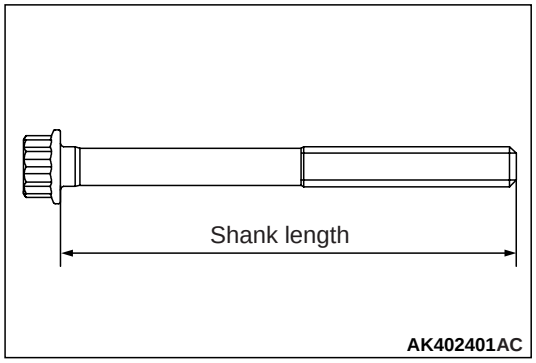
Crankshaft		Crankshaft bearing
Identification mark	**Journal diameter mm**	**Identification mark**
0	51.985 – 51.988	0
1	51.982 – 51.985	1
2	51.979 – 51.982	2
3	51.976 – 51.979	3
4	51.973 – 51.976	4

3. Install the selected crankshaft bearing lower.

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



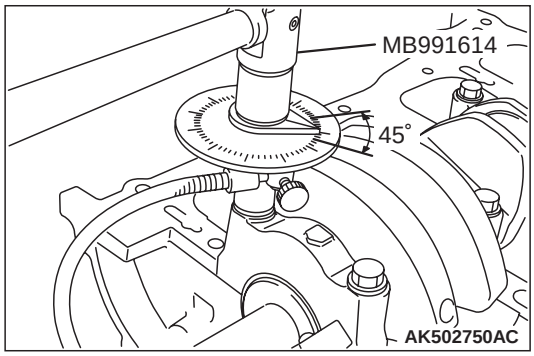
1. Install the crankshaft bearing cap with reference to the identification mark as illustrated.



2. Make sure that the shank 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: 75.5 – 76.5 mm

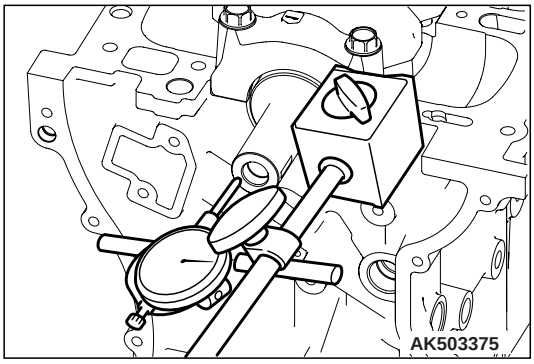
3. Apply engine oil to the threaded portion and seat surface of the bolt.
4. Tighten crankshaft bearing cap bolts to the torque of 26.5 ± 2.0 N·m according to the tightening order.



⚠ CAUTION

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

5. Use special tool Angle gauge (MB991614) to tighten bolts 45° according to the tightening order.



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

   Standard value: 0.05 – **0.25 mm**
   Limit: 0.4 mm

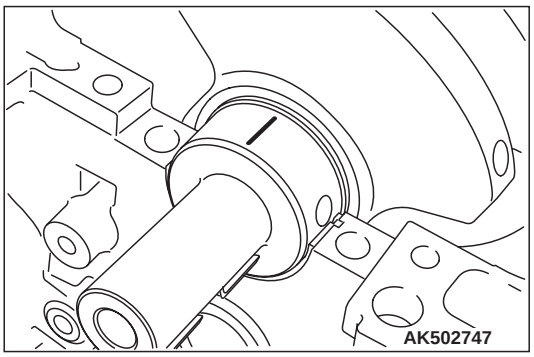
INSPECTION

M1113008802823

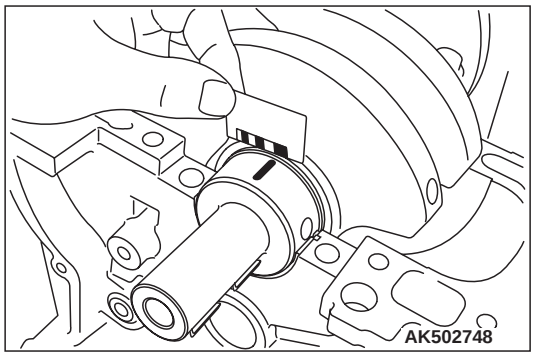
CRANKSHAFT OIL CLEARANCE (PLASTIGAGE METHOD)

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 centre.
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.

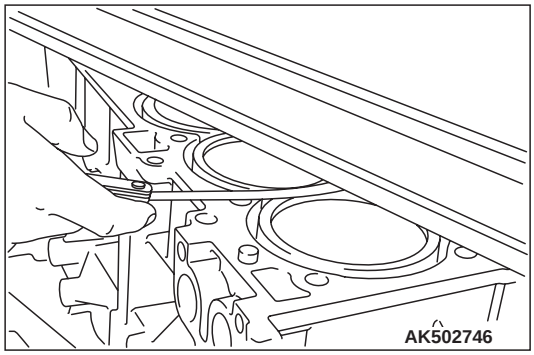


6. Measure the crushed Plastigage width (area most widely crushed) using a scale printed on the Plastigage bag.

   Standard value: 0.012 – **0.030 mm**
   Limit: 0.1 mm

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.



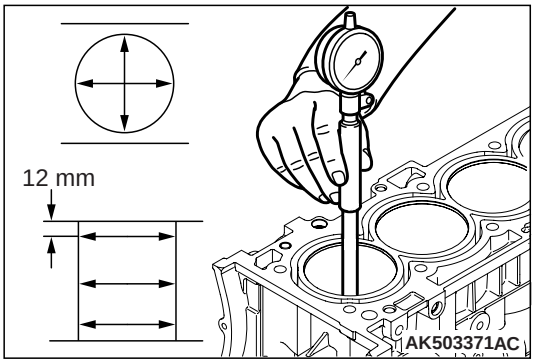
2. Measure distortion on the top surface of the cylinder block using a straight edge and thickness gauge.

   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
   Limit: 0.2 mm
   Grinding limit: 0.2 mm

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 <4B11>
   Cylinder bore: 88 mm <4B12>
   Cylindricity: 0.15 mm