GROUP 11D

ENGINE OVERHAUL <3.0L ENGINE>

CONTENTS

GENERAL SPECIFICATIONS

M1113000202571

Descriptions			Specifications
Engine model			6B31
Type			60° V, SOHC
Number of cylinders			6
Combustion chamber			Pentroof type
Total displacement cm^3 (cu in)			2,998 (182.9)
Cylinder bore mm (in)			87.6 (3.45)
Piston stroke mm (in)			82.9 (3.54)
Compression ratio			10.5
Valve timing	Intake valve	Opens	-1°BTDC – 18°BTDC
		Closes	37°ABDC – 86°ABDC
	Exhaust valve	Opens	55°BBDC
		Closes	20°ATDC
Lubrication system			Pressure feed, full-flow filtration
Oil pump type			Trochoid type

SERVICE SPECIFICATIONS

M1113000303117

Item			Standard value	Limit
Timing belt				
Auto tensioner rod length mm (in)			9.1 – 13.4 (0.36 – 0.52)	–
Valve clearance mm (in)			0.07 – 0.13 (0.003 – 0.005)	–
Rocker cover and camshaft				
Camshaft cam height mm (in)	Intake	Low speed cam	37.28 (1.468)	Minimum 36.78 (1.448)
		High speed cam	36.23 (1.426)	Minimum 35.73 (1.407)
	Exhaust		37.84 (1.490)	Minimum 37.34 (1.470)
Camshaft journal outside diameter mm (in)			45 (1.8)	–

Item		Standard value	Limit
Cylinder head and valves			
Cylinder head flatness of gasket surface mm (in)		Less than 0.03 (0.0012)	0.05 (0.002)
Cylinder head grinding limit of gasket surface mm (in) (Total resurfacing depth of cylinder head and cylinder block)		–	0.15 (0.006)
Cylinder head overall height mm (in)		120 (4.7)	–
Valve thickness of valve head (margin) mm (in)	Intake	1.0 (0.03)	Minimum 0.5 (0.02)
	Exhaust	1.2 (0.04)	Minimum 0.7 (0.03)
Valve overall height mm (in)	Intake	111.84 (4.403)	Minimum 111.34 (4.384)
	Exhaust	114.04 (4.490)	Minimum 113.54 (4.470)
Valve spring free height mm (in)	Intake	63.77 (2.511)	Minimum 62.77 (2.471)
	Exhaust	59.90 (2.358)	Minimum 58.90 (2.319)
Valve spring out-of-squareness		2° or less	4°
Valve spring load / installed height N (lb) / mm (in)		245.2 (55.13) / 49.2 (1.94)	–
Valve stem outside diameter mm (in)		6.0 (0.24)	–
Valve thickness to valve guide clearance mm (in)	Intake	0.020 – 0.047 (0.0008 – 0.0018)	0.10 (0.003)
	Exhaust	0.035 – 0.062 (0.0014 – 0.0024)	0.15 (0.005)
Valve seat valve contact width mm (in)		0.9 – 1.3 (0.04 – 0.05)	–
Valve guide inside diameter mm (in)		6.0 (0.24)	–
Valve guide press-in height mm (in)		16.7 – 17.3 (0.66 – 0.68)	–
Oversize rework dimensions of valve guide hole mm (in)	0.05 oversize diameter	11.050 – 11.068 (0.4351 – 0.4357)	–
Intake oversize rework dimensions of valve seat hole mm (in)	0.3 oversize diameter	36.300 – 36.325 (1.4292 – 1.4301)	–
Exhaust oversize rework dimensions of valve seat hole mm (in)	0.3 oversize diameter	32.300 – 32.325 (1.2717 – 1.2726)	–

Item		Standard value	Limit
Piston and connecting rod			
Piston outside diameter mm (in)		87.6 (3.45)	–
Piston ring side clearance mm (in)	Number 1	0.04 – 0.08 (0.0016 – 0.0031)	0.1 (0.004)
	Number 2	0.03 – 0.07 (0.0012 – 0.0027)	0.1 (0.004)
Piston ring end gap mm (in)	Number 1	0.18 – 0.33 (0.008 – 0.012)	0.8 (0.03)
	Number 2	0.28 – 0.48 (0.012 – 0.018)	0.8 (0.03)
	Oil ring side rail	0.10 – 0.60 (0.004 – 0.023)	1.0 (0.04)
Piston pin outside diameter mm (in)		22.0 (0.87)	–
Piston pin press-in load N (lb)		5,000 – 15,000 (1,124 – 3,372)	–
Crankshaft pin oil clearance mm (in)		0.012 – 0.039 (0.0005 – 0.0015)	0.1 (0.004)
Connecting rod big end side clearance mm (in)		0.10 – 0.25 (0.004 – 0.009)	0.4 (0.02)
Crankshaft and cylinder block			
Crankshaft end play mm (in)		0.05 – 0.25 (0.002 – 0.009)	0.3 (0.01)
Crankshaft journal outside diameter mm (in)		69 (2.7)	–
Crankshaft pin outside diameter mm (in)		53 (2.1)	–
Crankshaft journal oil clearance mm (in)	Number1, 4 journal	0.018 – 0.038 (0.0008 – 0.0014)	0.1 (0.004)
	Number2, 3 journal	0.024 – 0.044 (0.0010 – 0.0017)	0.1 (0.004)
Cylinder block flatness of gasket surface mm (in)		0.05 (0.002)	0.1 (0.004)
Cylinder block grinding limit of gasket surface mm (in) [Total resurfacing depth of both cylinder head and cylinder block]		–	0.15 (0.006)
Cylinder block overall height mm (in) [Crankshaft center to cylinder head top]		215 (8.46)	–
Cylinder block inside diameter mm (in)		87.6 (3.45)	–
Cylindricity mm (in)		0.015 (0.0006)	–

FASTENER TIGHTENING SPECIFICATIONS

M1113023404260

Item	Specification
Generator and drive belt	
Crankshaft bolt	200 N·m (148 ft-lb) → 0 N·m (0 ft-lb) → 110 N·m (81 ft-lb) → +60°
Drive belt auto tensioner bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Generator bracket bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Generator bolt	47 ± 11 N·m (35 ± 7 ft-lb)
Intake manifold plenum and throttle body assembly	
Exhaust gas recirculation pipe bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Throttle body bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Boost sensor bolt	5.0 ± 1.0 N·m (45 ± 8 in-lb)
Solenoid valve bolt	5.0 ± 1.0 N·m (45 ± 8 in-lb)
Throttle body stay bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Engine hanger right bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Intake manifold plenum stay bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Intake manifold plenum bolt	22 ± 1 N·m (16 ± 1 ft-lb)
Timing belt	
Timing belt front cover bolt	7.0 ± 1.0 N·m (62 ± 8 in-lb)
Engine support bracket bolt M8	20 ± 5 N·m (15 ± 3 ft-lb)
Engine support bracket bolt M10	48 ± 11 N·m (36 ± 7 ft-lb)
Crankshaft position sensor bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Auto-tensioner bolt	23 ± 3 N·m (18 ± 2 ft-lb)
Tensioner arm bolt	41 ± 10 N·m (30 ± 7 ft-lb)
Idler pulley bolt	41 ± 10 N·m (30 ± 7 ft-lb)
Camshaft sprocket bolt	90 ± 10 N·m (65 ± 7 ft-lb)
Timing belt rear cover bolt	10 ± 2 N·m (89 ± 17 in-lb)
Intake manifold	
Ignition coil bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Spark plugs	18 ± 2 N·m (13 ± 1 ft-lb)
Injector and fuel rail bolt	12 ± 1 N·m (104 ± 9 in-lb)
Intake manifold nut	22 ± 1 N·m (16 ± 1 ft-lb)

Item	Specification
Water hose and pipe	
Engine coolant temperature sensor	30 ± 9 N·m (22 ± 6 ft-lb)
Exhaust gas recirculation valve bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Oil pipe bolt	11 ± 1 N·m (98 ± 8 in-lb)
Water inlet fitting bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Thermostat housing bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Engine oil control valve bolt	11 ± 1 N·m (98 ± 8 in-lb)
Engine oil pressure switch	10 ± 2 N·m (89 ± 17 in-lb)
Engine oil control valve housing bolt	24 ± 3 N·m (18 ± 1 ft-lb)
Water pump bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Eye bolt	30 ± 3 N·m (22 ± 2 ft-lb)
Exhaust manifold	
Heated oxygen sensor	44 ± 5 N·m (35 ± 5 ft-lb)
Exhaust manifold cover bolt	16 ± 4 N·m (13 ± 3 ft-lb)
Exhaust manifold bracket bolt (bolt, washer assembly)	41 ± 10 N·m (30 ± 7 ft-lb)
Exhaust manifold bracket bolt (flange bolt)	47 ± 11 N·m (35 ± 7 ft-lb)
Engine hanger bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Exhaust manifold nut	49 ± 5 N·m (36 ± 3 ft-lb)
Rocker cover and camshaft	
Positive crankcase ventilation valve	2.5 ± 0.4 N·m (22 ± 3 in-lb)
Rocker cover bolt	8.3 ± 1.0 N·m (74 ± 8 in-lb)
Rocker arms and shaft bolt intake side	31 ± 3 N·m (23 ± 2 ft-lb)
Rocker arms and shaft bolt exhaust side	13 ± 1 N·m (115 ± 8 in-lb)
Rocker arm adjusting nut	9.0 ± 1.0 N·m (80 ± 8 in-lb)
Camshaft position sensor bolt	9.5 ± 2.5 N·m (84 ± 22 in-lb)
Camshaft position sensor support bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Camshaft position sensing cylinder bolt	22 ± 4 N·m (17 ± 2 ft-lb)
Cylinder head and valves	
Cylinder head bolt	45 ± 2 N·m (33 ± 1 ft-lb) → +150°

Item	Specification
Oil pan and oil pump	
Drain plug	39 ± 5 N·m (29 ± 3 ft-lb)
Oil filter <MD360935>	14 ± 2 N·m (124 ± 17 in-lb)
Oil filter <MD332687, MD365876>	16 ± 4 N·m (13 ± 3 ft-lb)
Oil filter cover bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Heat protector bolt	10 ± 2 N·m (89 ± 17 in-lb)
Engine oil pressure switch	10 ± 2 N·m (89 ± 17 in-lb)
Oil pan, lower bolt	10 ± 2 N·m (89 ± 17 in-lb)
Oil pan cover bolt	10 ± 2 N·m (89 ± 17 in-lb)
Oil pan, upper bolt	10 ± 2 N·m (89 ± 17 in-lb)
Oil screen bolt	20 ± 5 N·m (15 ± 3 ft-lb)
Beam bolt	24 ± 2 N·m (18 ± 1 ft-lb) → +60°
Plate bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Oil pump case bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Piston and connecting rod	
Connecting rod cap nut	20 ± 2 N·m (15 ± 1 ft-lb) → +90°
Crankshaft and cylinder block	
Drive plate bolt	76 ± 4 N·m (57 ± 2 ft-lb)
Rear plate bolt	10 ± 2 N·m (89 ± 17 in-lb)
Oil seal case bolt	10 ± 2 N·m (89 ± 17 in-lb)
Bearing cap bolt	24 ± 2 N·m (18 ± 1 ft-lb) → +90°
Crankshaft sensing ring bolt	12 ± 2 N·m (106 ± 17 in-lb)
Knock sensor	20 ± 2 N·m (15 ± 1 ft-lb)
Bank stiffener bolt	23 ± 6 N·m (17 ± 4 ft-lb)
Harness bracket bolt	10 ± 2 N·m (89 ± 17 in-lb)

SEALANTS AND ADHESIVES

M1113000503111

Item	Specified sealant
Engine coolant temperature sensor	Three bond 1324N, LOCTITE 262
Engine oil pressure switch <to oil control valve housing>	Three bond 1141J, Three bond 1212D, Three bond 1215
Engine oil pressure switch <to cylinder block>	
Oil pan upper	Three bond 1227D, Three bond 1217G (Mitsubishi Part No,1000A923), LOCTITE 5900, LOCTITE 5970
Oil pan lower	Three bond 1227D, Three bond 1217G (Mitsubishi Part No,1000A923), Three bond 1207F (Mitsubishi Part No.1000A992), LOCTITE 5900, LOCTITE 5970
Oil pump case	
Oil seal case	
Drive plate bolt	Three bond 1324 or equivalent

NOTE: The number in square 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 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 too oil pan FIPG cutter (MD998727) is set, use this tool.

CLEANING OF GASKET SURFACE

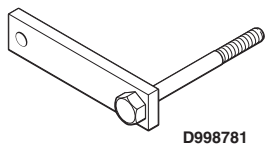
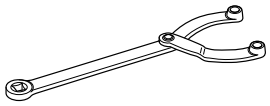
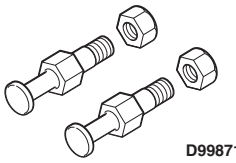
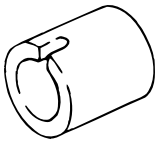
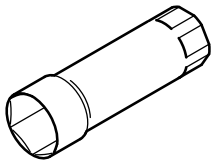
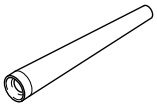
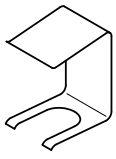
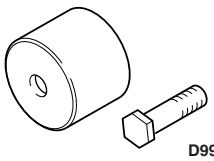
Completely remove all deposits from the gasket surface with a gasket scraper or wire brush. Make sure that the surface to which FIPG is applied is smooth. The gasket surface must be free from grease and foreign substances. Be sure to remove old FIPG that has entered mounting holes and screw holes.

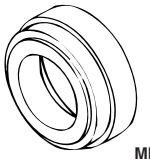
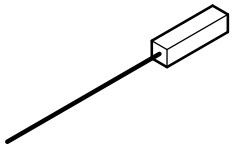
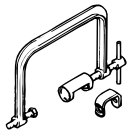
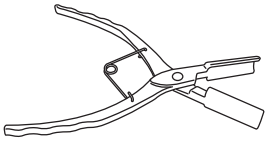
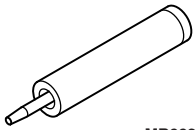
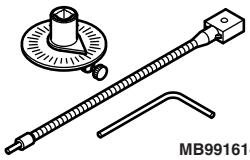
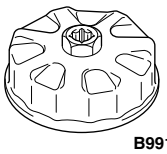
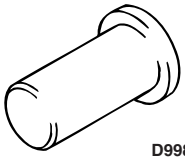
APPLICATION PROCEDURE

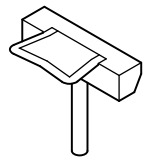
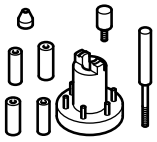
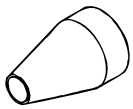
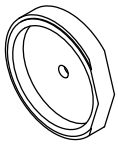
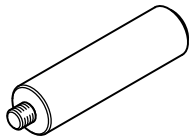
Apply FIPG in a determined diameter and continuously without break. Completely enclose the periphery of mounting holes. FIPG can be wiped off if it is not hardened. Install parts in place while FIPG is still wet. Take care not to allow FIPG to adhere to other locations than necessary locations during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

SPECIAL TOOLS

M1113000602364

Tool	Tool number and name	Supersession	Application
 D998781	MD998781 Flywheel stopper	General service tool	Holding drive plate
 B990767	MB990767 End yoke holder	MB990767-01	Holding camshaft sprocket when loosening or torquing bolt
 D998719	MD998719 Pin	MIT308239	
	MD998716 Crankshaft wrench	MD998716-01	Turning crankshaft
	MB991398 Spark plug wrench	General service tool	Removal and installation of spark plug
 B992106	MB992106 O-ring installer	–	Installation of O-ring on injector injection nozzle side
 D998443	MD998443 Lash adjuster holder (8)	MD998443-01	Supporting of the lash adjuster to prevent it from falling when rocker shaft assembly is removed or installed
 D998713	MD998713 Camshaft oil seal installer	MD998713-01	Installation of camshaft oil seal

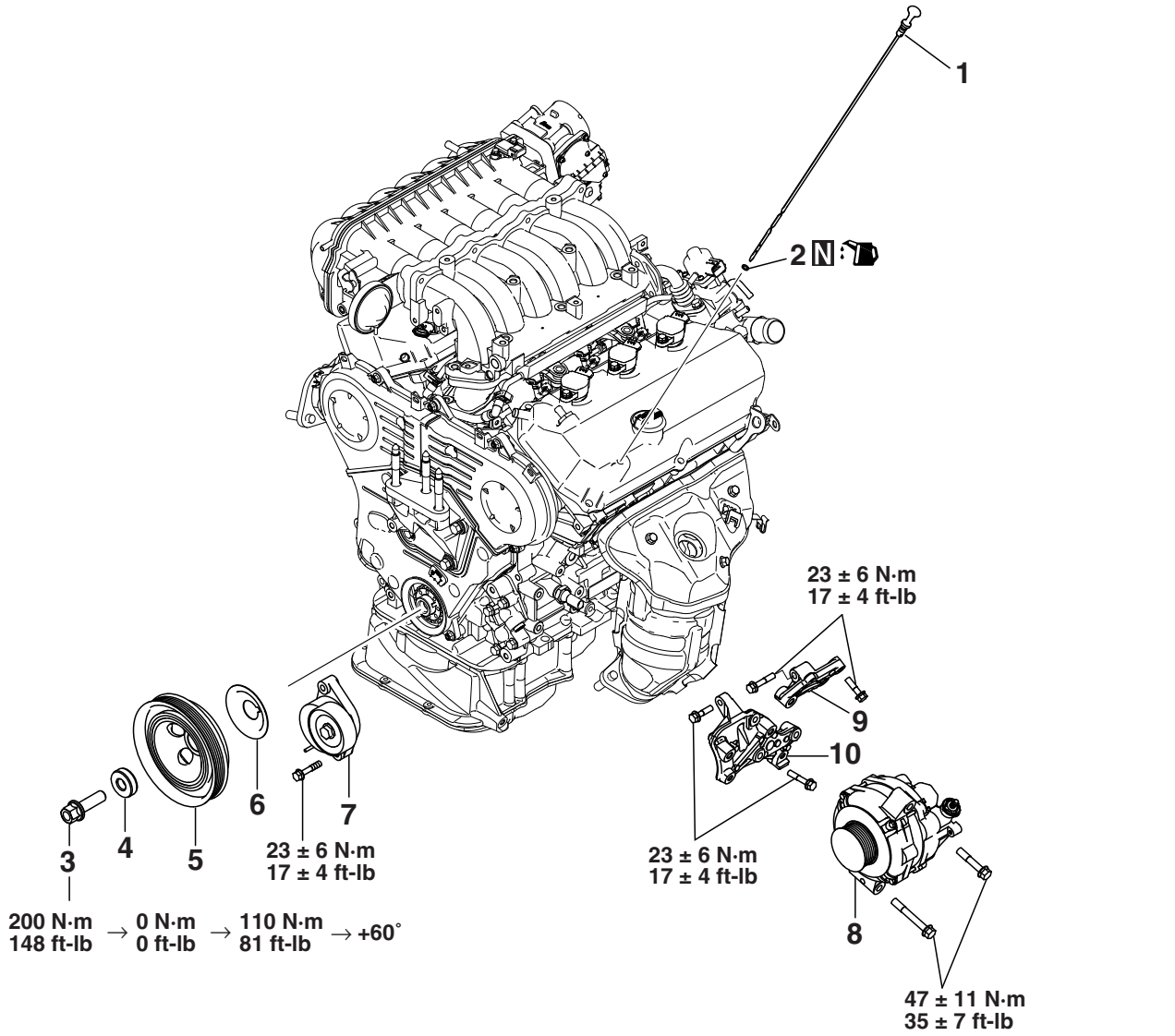
Tool	Tool number and name	Supersession	Application
 MD998777	MD998777 Camshaft oil seal installer adaptor	–	Installation of camshaft oil seal (left bank) (use with MD998713)
	MD998442 Air bleed wire	General service tool	Air bleeding of auto lash adjuster
	MD998735 Valve spring compressor	MD998735-01	Compression of valve spring
	MB992085 Valve stem seal plier	–	Removal of valve stem seal
 MB992182	MB992182 Valve stem seal installer	–	Installation of valve stem seal
 MB991614	MB991614 Angle gauge	General service tool	Installation of cylinder head bolt and bearing cap bolt (beam side)
 B991396	MB991396 Oil filter wrench	–	Installation of oil filter wrench
 D998382	MD998382 Crankshaft front oil seal installer	MD998382-01	Installation of crankshaft front oil seal

Tool	Tool number and name	Supersession	Application
 D998727	MD998727 Oil pan FIPG cutter	MD998727-01	Removal of oil pan lower
	MD998780 Piston pin setting tool	MIT216941	Removal and installation of piston pin
	MB991659 Guide D	–	
 MB992183	MB992183 Crankshaft rear oil seal installer	–	Installation of crankshaft rear oil seal
	MB992075 Handle	–	

GENERATOR AND DRIVE BELT

REMOVAL AND INSTALLATAION

M1113001300746



AK800459AB

Removal steps

1. Oil dipstick
2. O-ring

<<A>> >>B<< 3. Crankshaft bolt

4. Crankshaft pulley washer
5. Crankshaft pulley

Removal steps (Continued)

6. Front flange
7. Drive belt auto tensioner

>>A<< 8. Generator

9. Generator bracket upper
10. Generator bracket lower

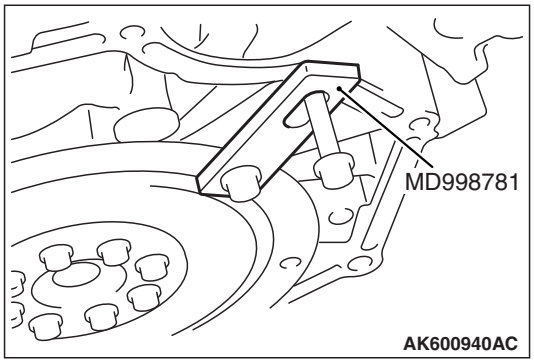
Required Special Tool:

- MD998781: Flywheel Stopper

TSB Revision

REMOVAL SERVICE POINT

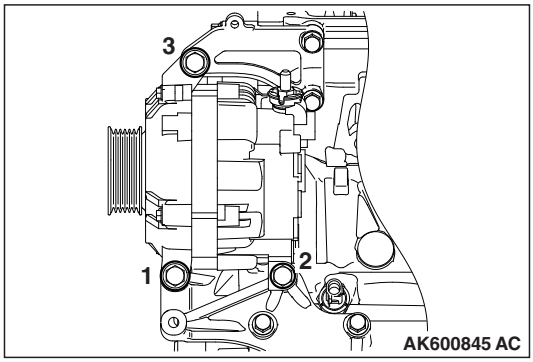
<<A>> CRANKSHAFT BOLT REMOVAL



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

INSTALLATION SERVICE POINT

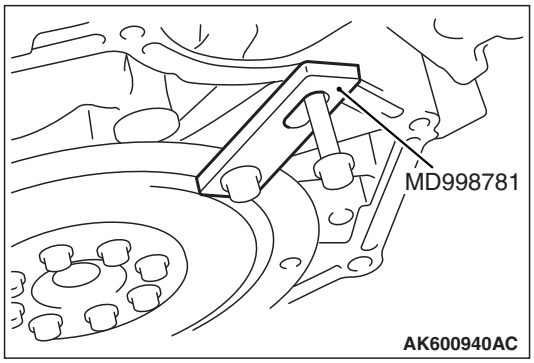
>>A<< GENERATOR INSTALLATION



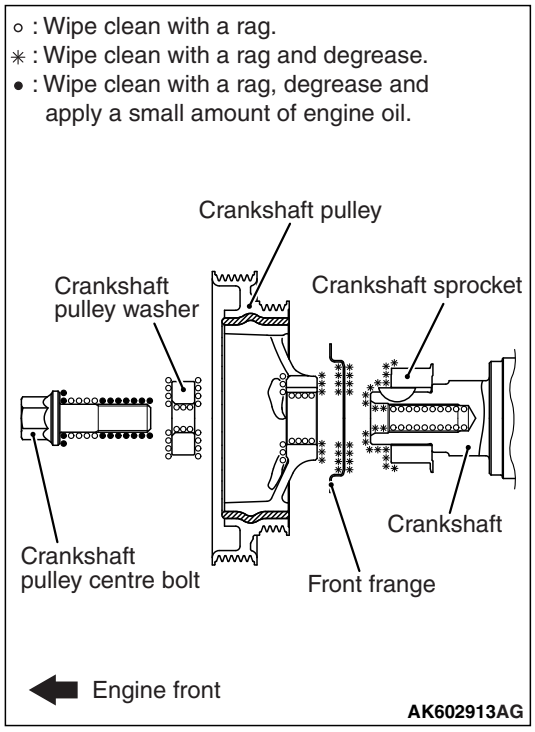
1. Temporarily tighten the alternator to the alternator bracket.
2. In accordance with the tightening order shown in the illustration, tighten the installation bolts for the alternator to the specified torque.

Tightening torque: 47 ± 11 N·m (35 ± 7 ft-lb)

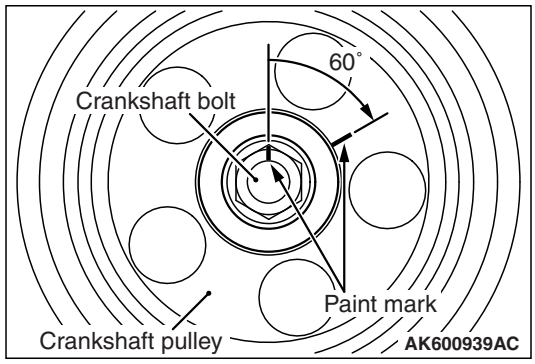
>>B<< CRANKSHAFT BOLT INSTALLATION



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



2. Wipe the dirt on the crankshaft pulley washer using a rag.
3. Using a rag, wipe the dirt on the crankshaft pulley, the front flange, the crankshaft sprocket, the thread hole of the crankshaft and then remove the grease.
4. Install the front flange and crankshaft pulley.
5. Apply an appropriate and minimum amount of engine oil to the threads of crankshaft pulley centre bolt and lower part of the flange.
6. Install the crankshaft pulley washer to the crankshaft pulley centre bolt.
7. Tighten the crankshaft pulley centre bolt to 200 N·m (148 ft-lb).
8. Loosen the crankshaft pulley centre bolt fully.
9. Tighten the crankshaft pulley centre bolt to 110 N·m (81 ft-lb).



10. Make a paint mark on the crankshaft bolt.

⚠ CAUTION

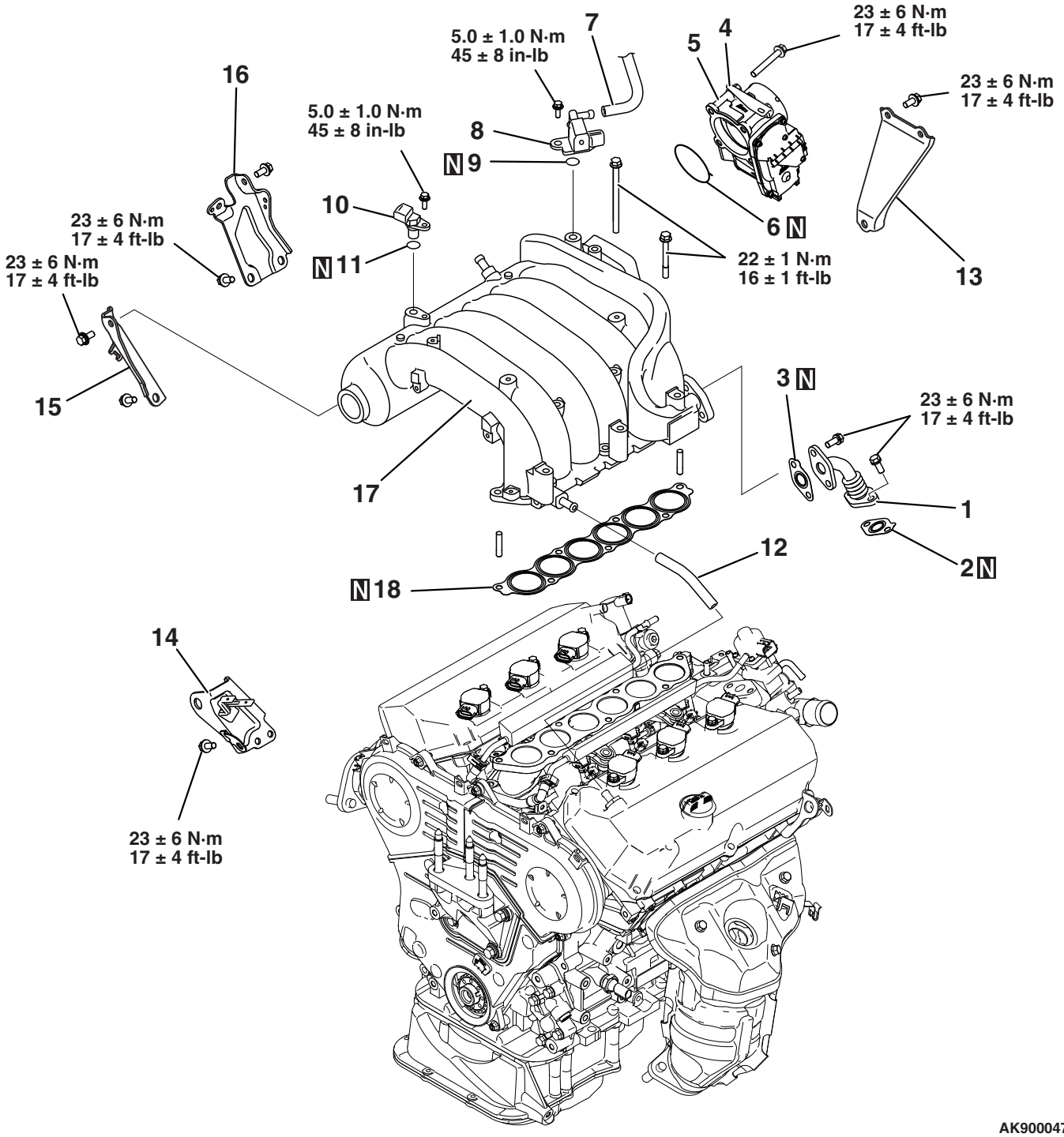
- **When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.**
- **When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.**

11. Make a paint mark on the bolt end at a position 60 degrees from the paint mark made on the crankshaft pulley in the direction of tightening the crankshaft bolt.
12. Turn the crankshaft bolt another 60 degrees and make sure that the paint marks on the crankshaft pulley and crankshaft bolt are aligned.

INTAKE MANIFOLD PLENUM AND THROTTLE BODY ASSEMBLY

REMOVAL AND INSTALLATION

M1113003200176



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Removal steps

1. Exhaust gas recirculation pipe
>>E<< 2. Exhaust gas recirculation pipe gasket
3. Exhaust gas recirculation pipe gasket
4. Harness bracket
5. Throttle body
>>D<< 6. Throttle body gasket

Removal steps (Continued)

7. Vacuum hose
8. Solenoid valve
9. O-ring
10. Boost sensor
11. O-ring
12. Purge hose

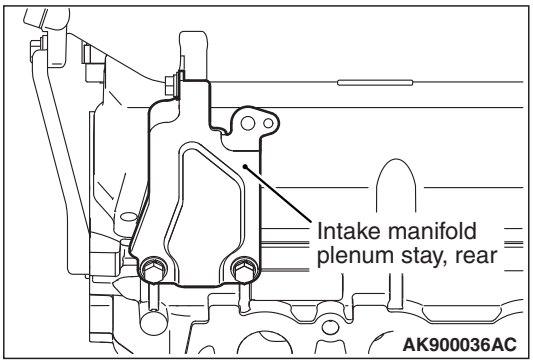
TSB Revision

Removal steps (Continued)

>>C<< 13. Throttle body stay
14. Engine hanger, right
>>B<< 15. Intake manifold plenum stay, front
>>A<< 16. Intake manifold plenum stay, rear
17. Intake manifold plenum
18. Intake manifold plenum gasket

INSTALLATION SERVICE POINT

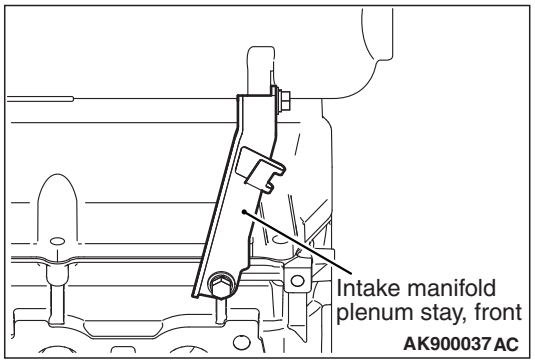
>>A<< INTAKE MANIFOLD PLENUM STAY, REAR INSTALLATION



1. After temporarily tightening the rear intake manifold plenum stay with the installation bolts, check that the intake manifold fastens securely to the cylinder head.
2. Tighten the rear intake manifold plenum stay to the specified torque.

Tightening torque: 23 ± 6 N·m (17 ± 4 ft-lb)

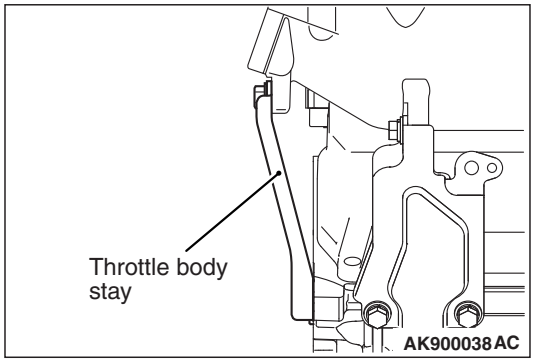
>>B<< INTAKE MANIFOLD PLENUM STAY, FRONT INSTALLATION



1. After temporarily tightening the front manifold plenum stay with the installation bolts, check that the intake manifold fastens securely to the cylinder head.
2. Tighten the front manifold plenum stay to the specified torque.

Tightening torque: 23 ± 6 N·m (17 ± 4 ft-lb)

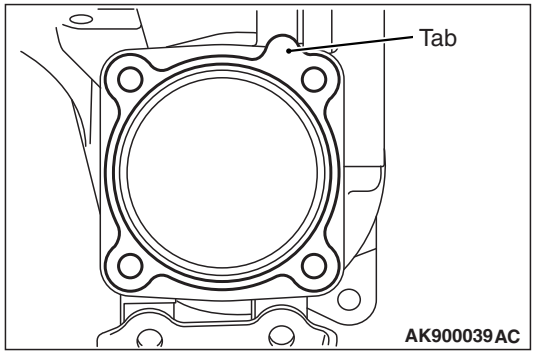
>>C<< THROTTLE BODY STAY INSTALLATION



1. After temporarily tightening the throttle body stay with the installation bolts, check that the throttle body fastens securely to the cylinder head.
2. Tighten the throttle body stay to the specified torque.

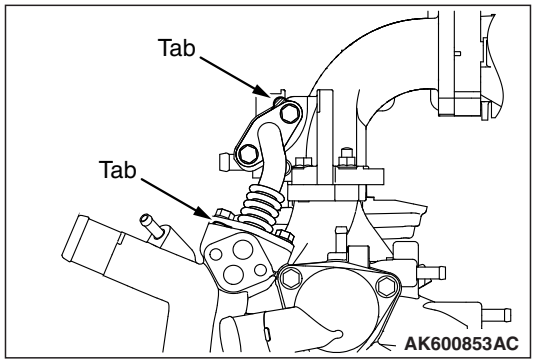
Tightening torque: 23 ± 6 N·m (17 ± 4 ft-lb)

>>D<< THROTTLE BODY GASKET INSTALLATION



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

>>E<< EXHAUST GAS RECIRCULATION PIPE GASKET INSTALLATION



Install the exhaust gas recirculation pipe gasket so that the tab is positioned as shown in the illustration.

TIMING BELT

REMOVAL AND INSTALLATION

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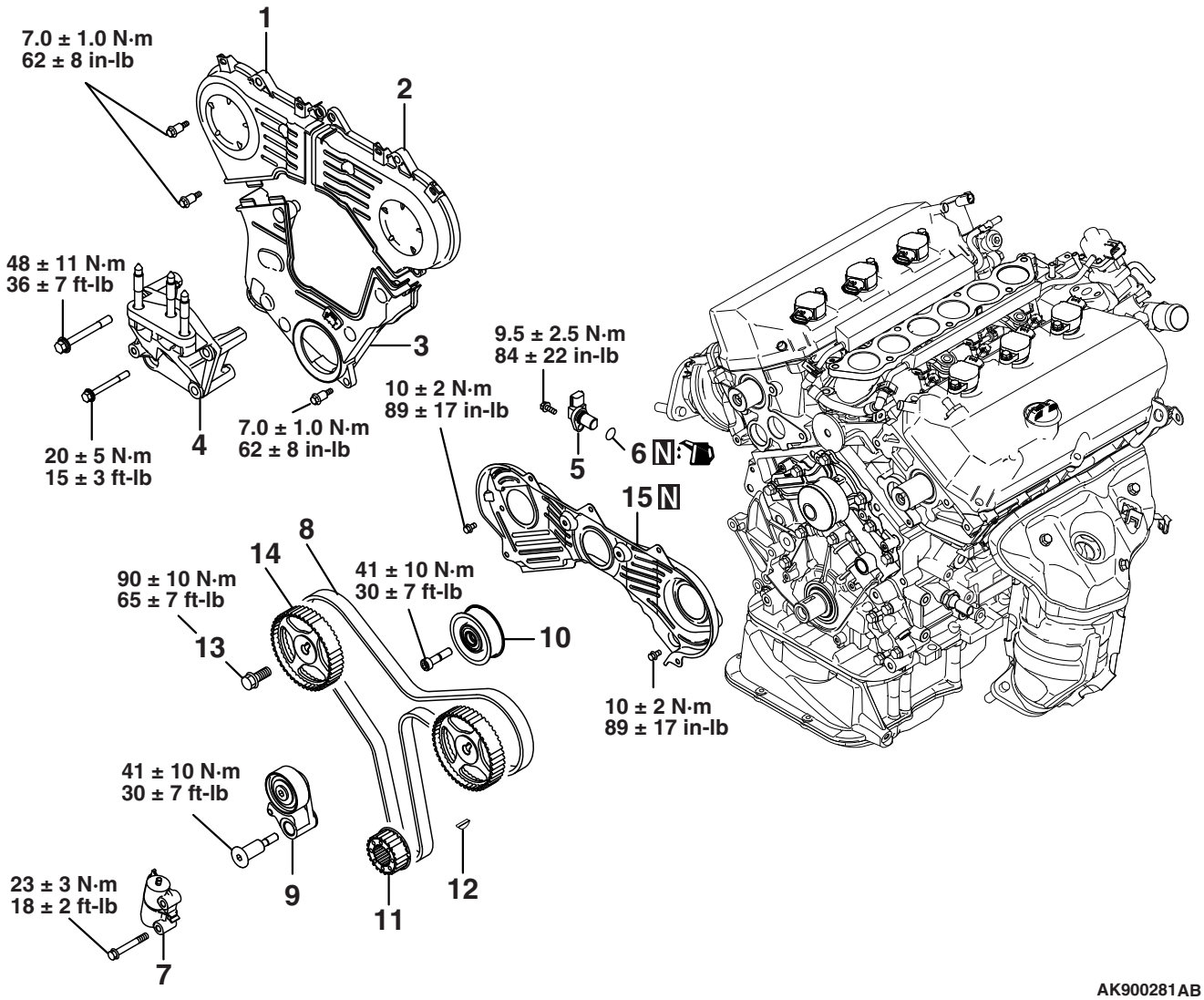

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Removal steps

1. Timing belt front upper cover, right
2. Timing belt front upper cover, left
3. Timing belt front lower cover
4. Engine support bracket, right
5. Crankshaft position sensor
6. O-ring

<<A>> >>E<< 7. Auto-tensioner

<<B>> >>D<< 8. Timing belt

Removal steps (Continued)

9. Tensioner arm

<<C>> >>C<< 10. Idler pulley

>>B<< 11. Crankshaft sprocket

12. Key

<<D>> >>A<< 13. Camshaft sprocket bolt

14. Camshaft sprocket
15. Timing belt rear cover

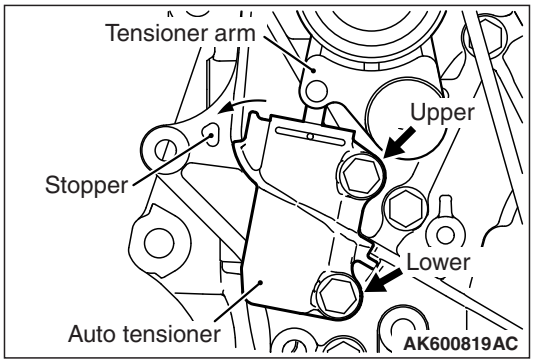
Required Special Tools:

- MB990767: End Yoke Holder
- MD998716: Crankshaft Wrench
- MD998719: Pins

TSB Revision

REMOVAL SERVICE POINTS

<<A>> AUTO-TENSIONER REMOVAL



1. Remove the upper tightening bolt of the auto-tensioner.

⚠ CAUTION

The auto-tensioner rotates centering on the flange bolt due to the rod thrust, so please make sure your finger is not trapped.

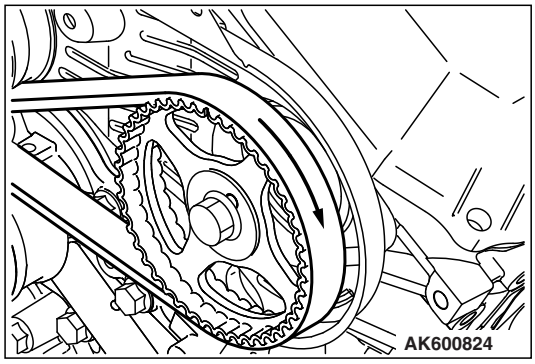
2. Slowly loosen the (lower) tightening bolts of the auto-tensioner. Remove the auto-tensioner rod from the tensioner arm and tilt the auto-tensioner to the stopper position.
3. Remove the lower tightening bolt of the auto-tensioner.

<<B>> TIMING BELT REMOVAL

1. Before the timing belt is removed, align the timing marks of the camshaft sprocket and crankshaft sprocket with the Number1 at the Top Dead Center of the compression stroke.

⚠ CAUTION

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

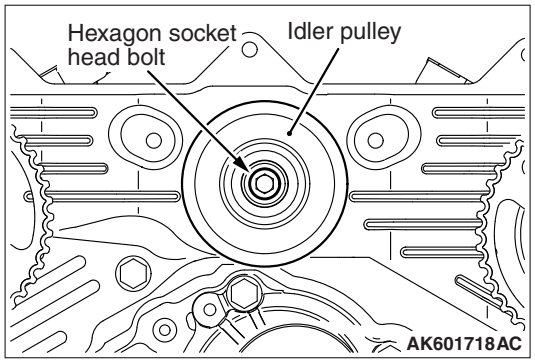


2. Mark the belt running direction for reference in reinstallation.

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

NOTE: After the timing belt is removed, do not turn the crankshaft sprocket and the camshaft sprocket.

<<C>> IDLER PULLEY REMOVAL

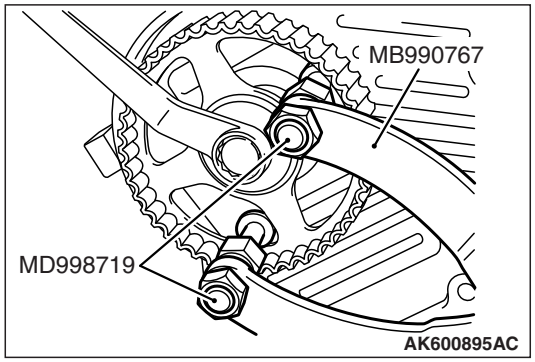


⚠ CAUTION

Because of the shallow hexagon hole of the hexagon socket head bolt, firmly insert the tool and carefully work not to damage the hexagon hole.

Remove the idler pulley using a hexagon wrench with 8 mm width across flats.

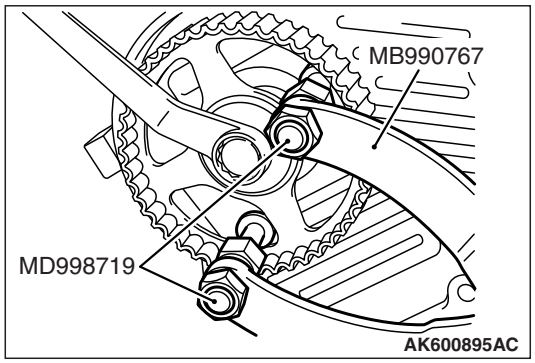
<<D>> CAMSHAFT SPROCKET BOLT REMOVAL



Use special tools MB990767 and MD998719 to prevent the camshaft sprocket from turning, and then loosen the camshaft sprocket bolt.

INSTALLATION SERVICE POINTS

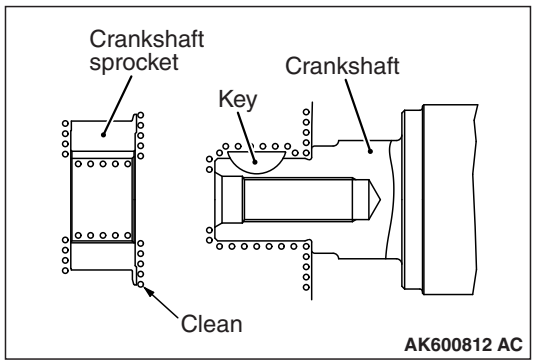
>>A<< CAMSHAFT SPROCKET BOLT INSTALLATION



Use special tools MB990767 and MD998719 to prevent the camshaft sprocket from turning, and then tighten the camshaft sprocket bolt.

Tightening torque: 90 ± 10 N·m (65 ± 7 ft-lb)

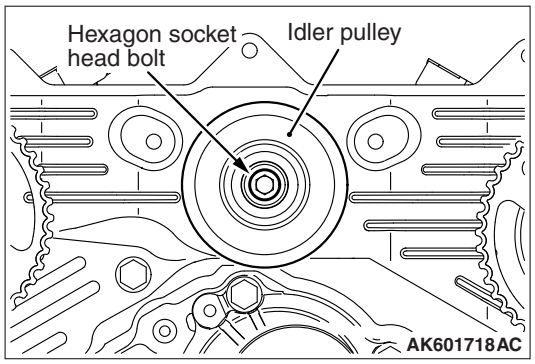
>>B<< CRANKSHAFT SPROCKET INSTALLATION



1. Clean the hole in the crankshaft sprocket.
2. Clean and degrease the mating surfaces of the crankshaft sprocket.

   NOTE: Degreasing is necessary to prevent decrease in friction on the mating surfaces.
3. Install the crankshaft sprocket to the crankshaft.

>>C<< IDLER PULLEY INSTALLATION



⚠ CAUTION

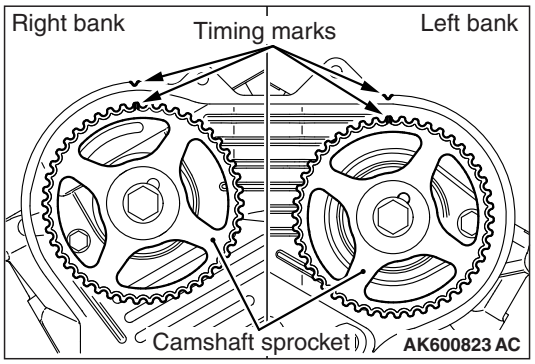
Because of the shallow hexagon hole of the hexagon socket head bolt, firmly insert the tool and carefully work not to damage the hexagon hole.

Install the idler pulley using a hexagon wrench with 8 mm width across flats.

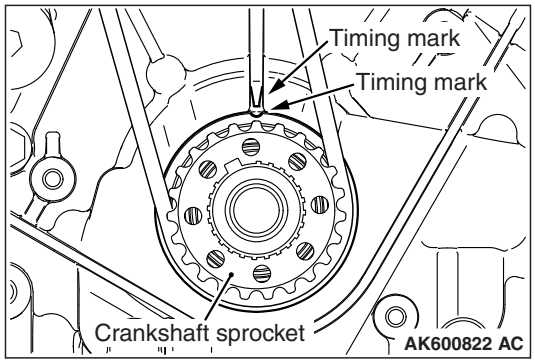
>>D<< TIMING BELT INSTALLATION

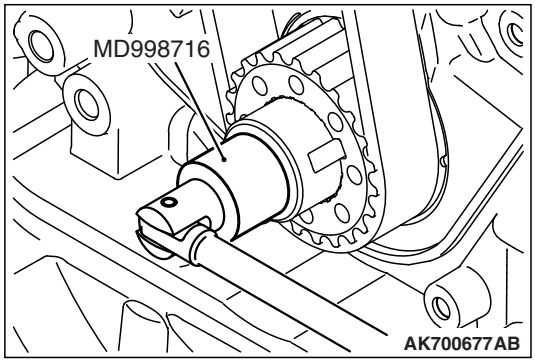
⚠ CAUTION

Remove and install the timing belt, aligning the timing marks of the crankshaft sprocket and the camshaft sprocket with the Number1 at the Top Dead Center of the compression stroke.

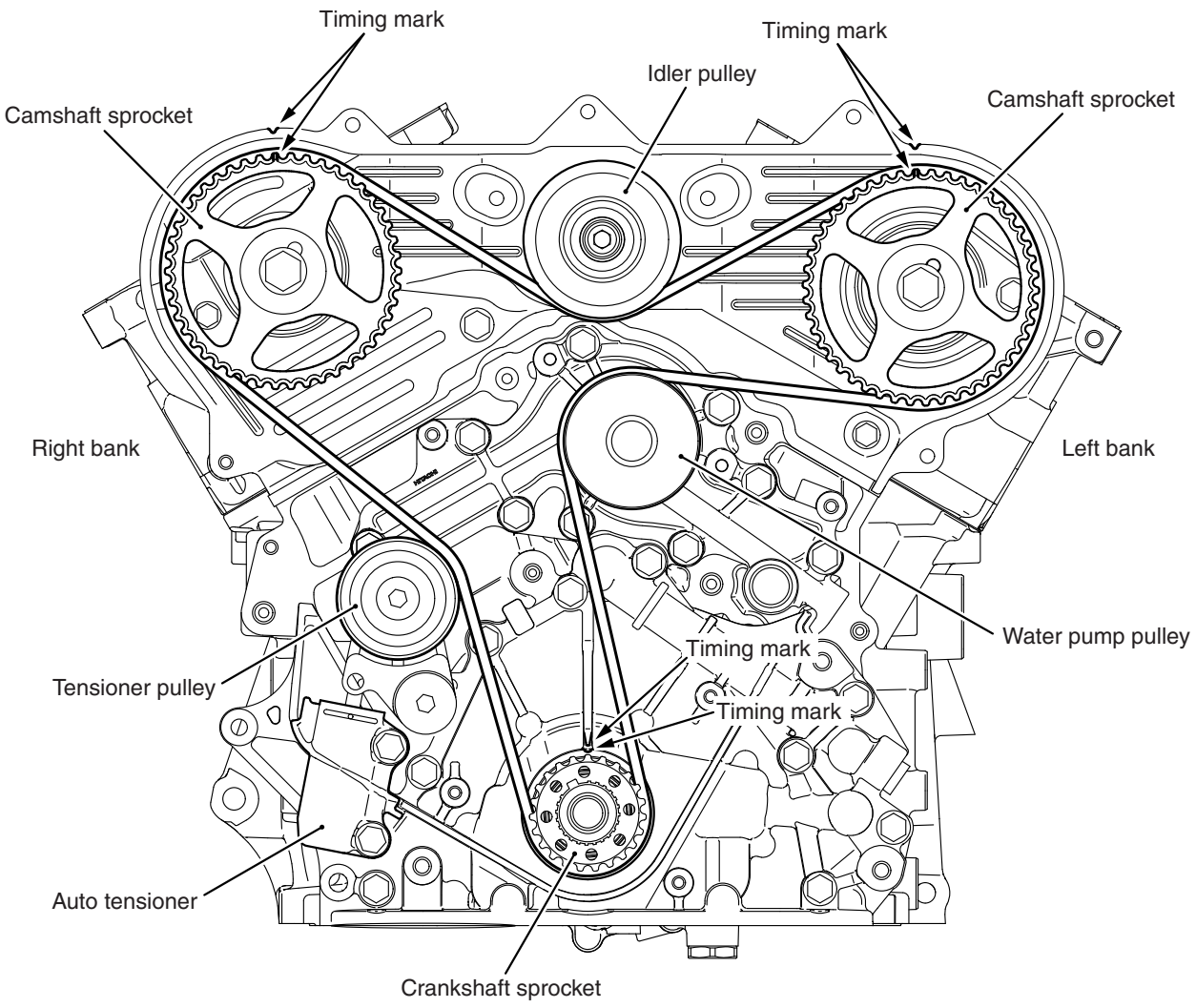


1. Check the timing marks of the crankshaft sprocket and the camshaft sprocket are aligned with the Number1 at the Top Dead Center of the compression stroke. If they are not, align the timing marks again, paying attention to the interference between the valve and the piston.
2. Install the timing belt on each sprocket in the following sequence.
   (1) Install the timing belt on the crankshaft sprocket and then on the water pump pulley, while tightening it to prevent slackness.
   (2) Line up the timing marks of the left bank camshaft sprockets.
   (3) Install the timing belt on the idler pulley, while taking up the slack.
   (4) Install the timing belt on the right bank camshaft sprocket.
   (5) Install the timing belt on the tensioner pulley.
3. Check to see that the timing marks of all the sprockets are in a alignment.





4. Using special tool MD998716, rotate the crankshaft a quarter of a turn counterclockwise. Then rotate it back clockwise to verify that all the timing marks are in alignment.
5. Pull out the pin of the auto-tensioner.



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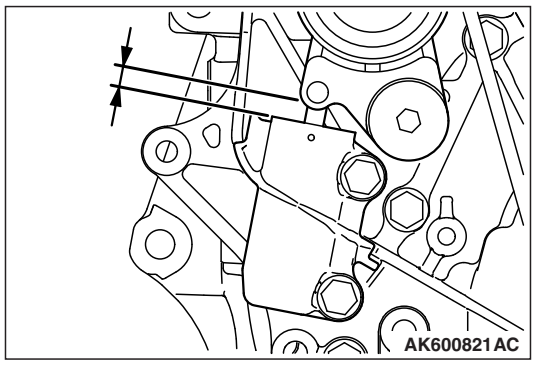
6. Rotate the crankshaft two turns clockwise and leave it alone for approximately five minutes.
7. Check that the projection of the rod of the auto-tensioner is within the standard value.

Standard value: 9.1 – 13.4 mm (0.36 – 0.52 inch)



>>E<< AUTO-TENSIONER INSTALLATION

⚠ CAUTION

Always bleed the auto-tensioner of air before installing the auto-tensioner. (Refer to Air bleeding method)

TSB Revision

INSPECTION

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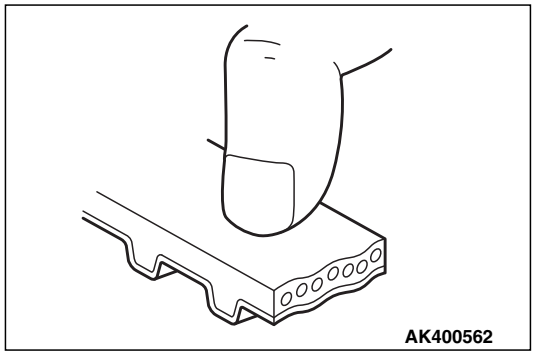
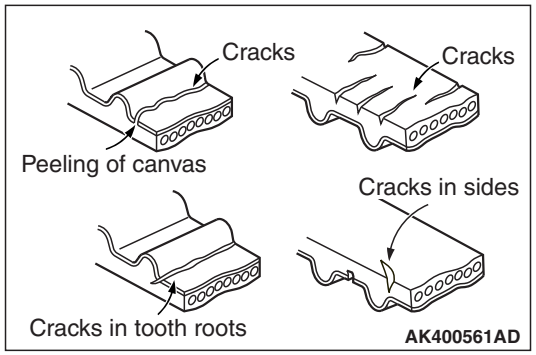
TIMING BELT

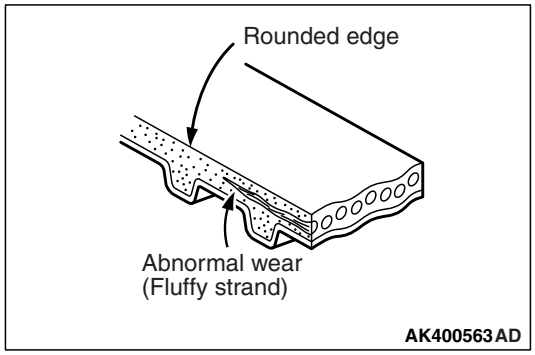
Replace the belt if any of the following conditions exist:



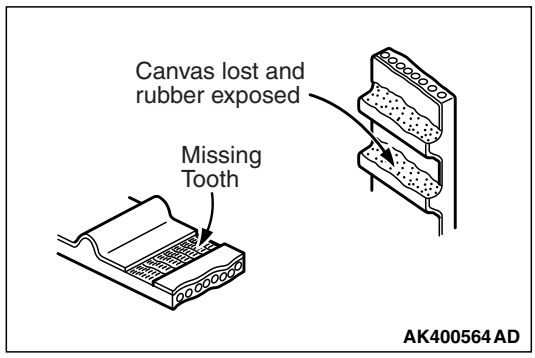
1. Hardening of rubber backing.
   Back side should be glossy without resilience and leave no indent when pressed with fingernail.



2. Cracks on rubber back.
3. Cracks or peeling of canvas.
4. Cracks at bottom of ribs.
5. Cracks on belt sides.

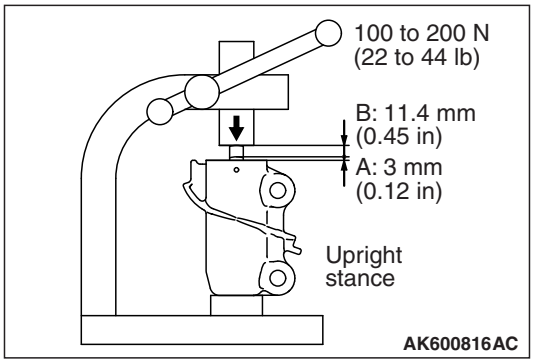


6. Abnormal wear of belt sides. Normal wear is indicated if the sides are sharp as if cut by a knife. Abnormal wear is indicated if the sides are ragged.



7. Abnormal wear on teeth.
   Initial stage:
   Canvas worn (fluffy canvas fibers, rubbery texture gone, white discoloration, canvas texture indistinct)
   Final stage:
   Canvas worn, exposing rubber (tooth width reduced)
8. Missing tooth.

AIR BLEEDING METHOD



⚠ CAUTION

- **Always use the vertical press and put the auto-tensioner vertically.**
- **For breakage prevention, Do not apply the load of 5,000 N (1,124 pound) or more to the rod.**
- **Do not press the rod beyond Dimension "A" shown in the illustration.**

1. Set the auto tensioner as shown in the illustration.
2. Press the rod slowly down to the lowest point "A" shown in the illustration.
3. Repeat the procedure 2 three times.
4. While the rod is projected at the point "B" shown in the illustration, push the rod with 100 – 200 N (22 – 44 pound). Check the enough stiffness. If the stiffness is not enough, replace the auto tensioner.
5. Press the rod slowly down. Put the pin through the hole and fix it.

⚠ CAUTION

After the air bleeding operation has been completed, do not tilt the auto-tensioner to 60° or more from the right angle position.

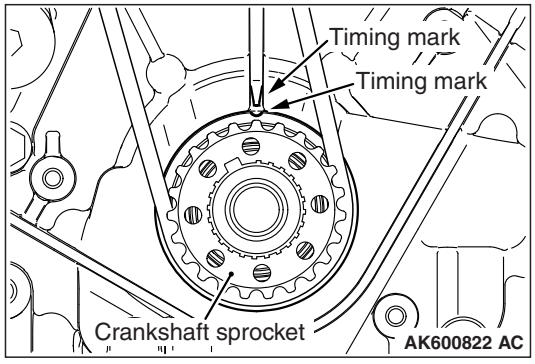
VALVE CLEARANCE ADJUSTMENT

1. Remove the rocker cover and ignition coil.

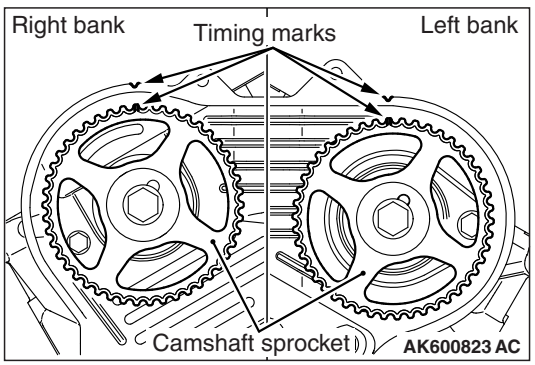
⚠ CAUTION

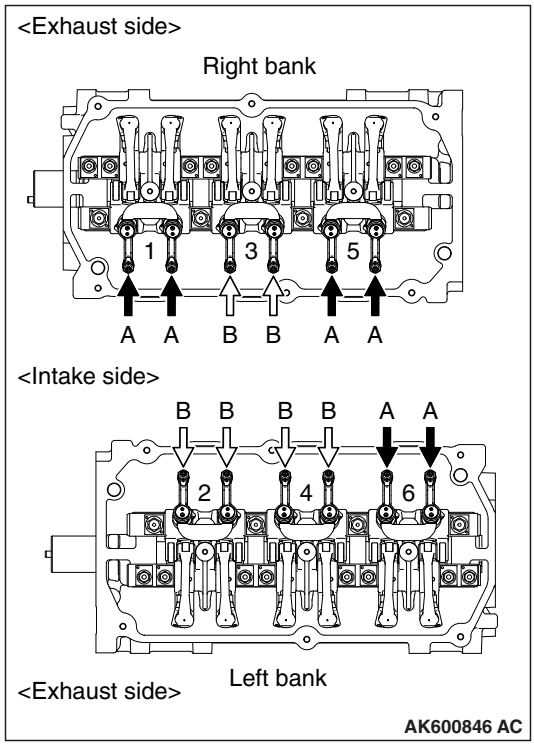
Rotate the crankshaft clockwise at any time.

2. Turn the crankshaft clockwise, and align the crankshaft sprocket timing mark with the position shown in the illustration.

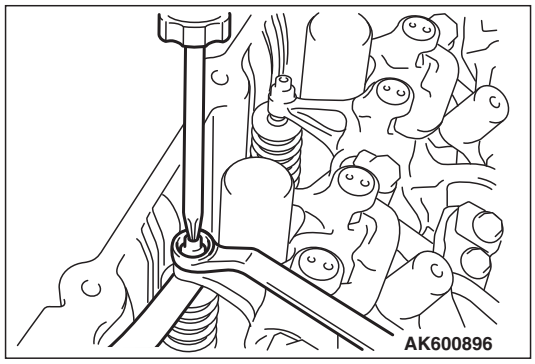


3. At that time, check the right and left camshaft sprocket timing marks are in position as shown in the illustration.

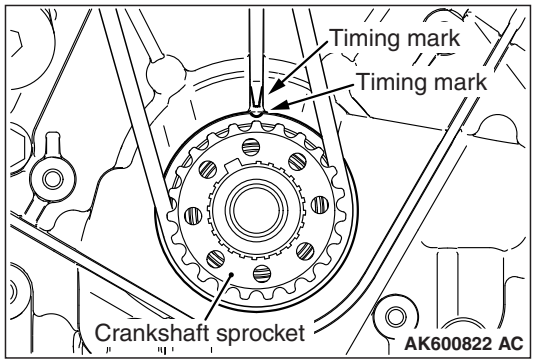




4. Measure the valve clearances marked with arrows shown in the illustration.
   A: When Number1 cylinder is on the top dead center of compression stroke.
   B: When Number4 cylinder is on the top dead center of compression stroke.
   NOTE: The valve clearance adjustment at the exhaust side is not necessary because the auto lash adjuster exists.



5. Using a thickness gauge, adjust the clearance between the valve stem end and the adjusting screw.
   Standard value: 0.07 – 0.13 mm (0.003 – 0.005 inch)
6. Hold the adjusting screw not rotating through a driver and then tighten the rock nut.



7. Rotate the crankshaft one time clockwise and then align the timing mark with the timing mark on the crankshaft sprocket. (Place Number 4 cylinder on the top dead center of compression stroke.)
8. Adjust the valve clearance for the rest of the valves.
9. Install the rocker cover and ignition coil.

INTAKE MANIFOLD

REMOVAL AND INSTALLATION

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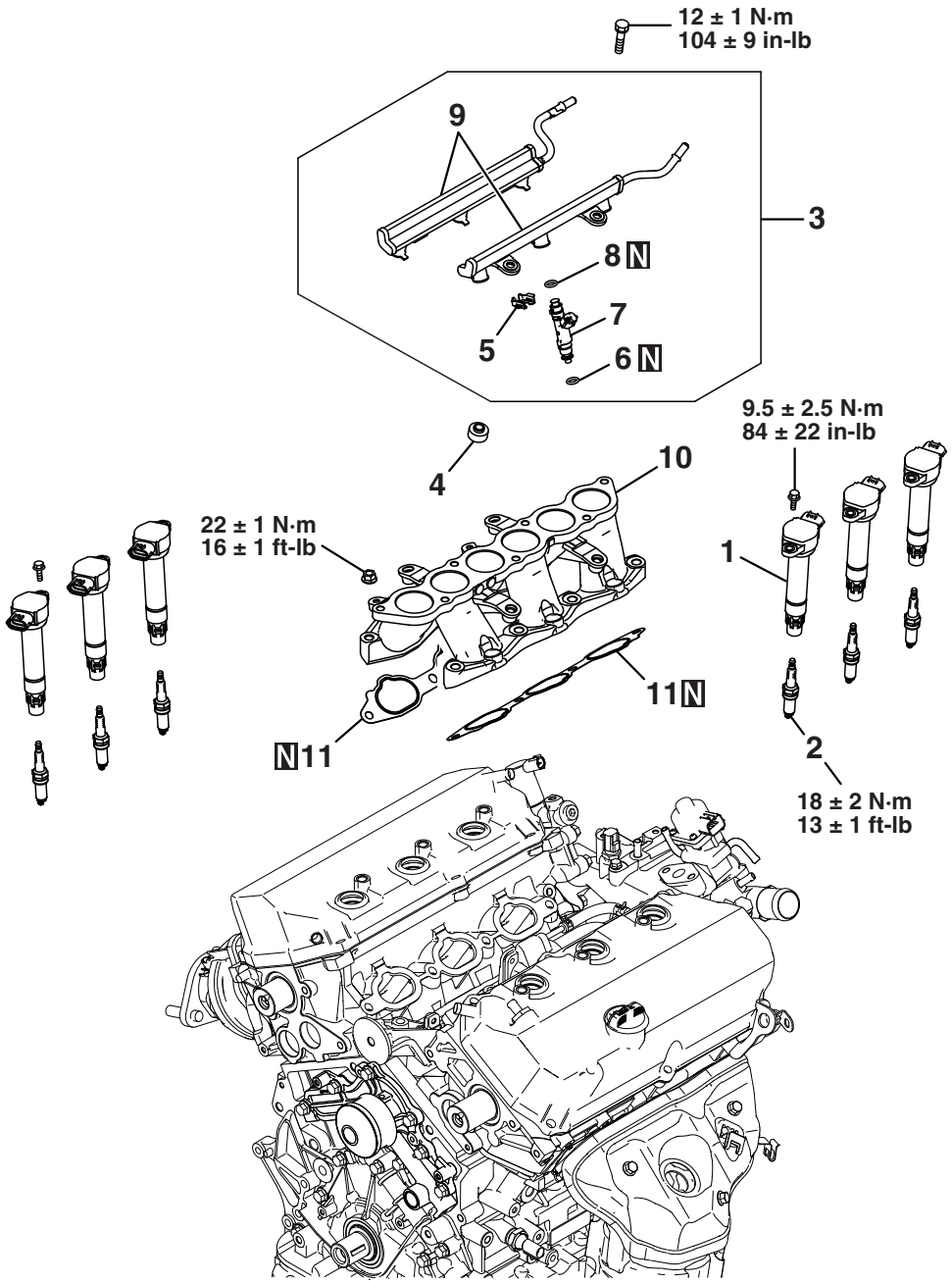

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Removal steps

1. Ignition coil
<<A>> >>E<< 2. Spark plugs
3. Fuel rail and injector
4. Insulator
>>D<< 5. Injector support
>>C<< 6. O-ring

Removal steps (Continued)

>>B<< 7. Injector
8. O-ring
9. Fuel rail
>>A<< 10. Intake manifold
11. Intake manifold gasket

Required Special Tools:

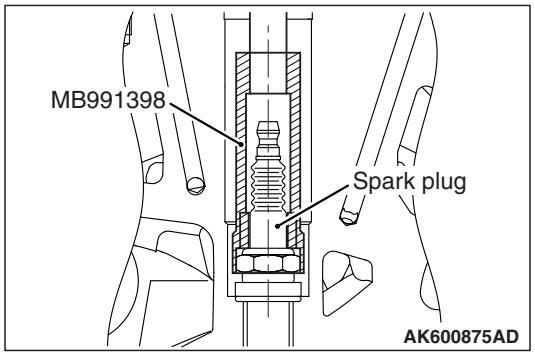
- MB991398: Spark Plug Wrench
- MB992106: O-ring Installer

TSB Revision

REMOVAL SERVICE POINT

<<A>> SPARK PLUG REMOVAL

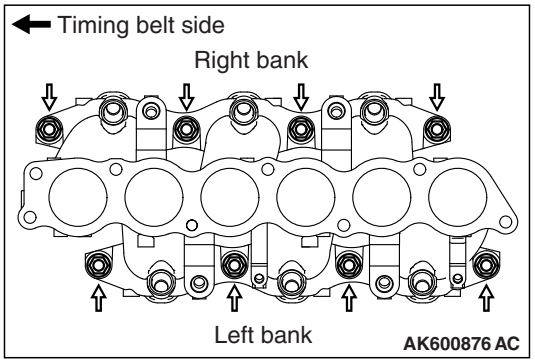
Using special tool MB991398, removal the spark plug.



INSTALLATION SERVICE POINTS

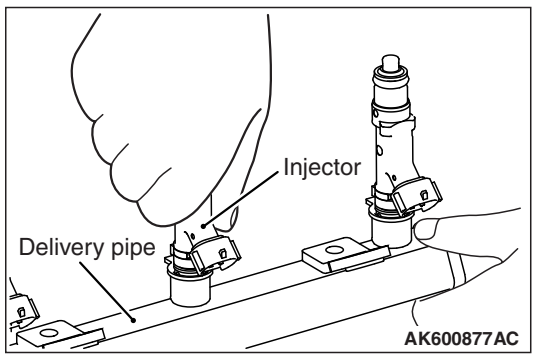
>>A<< INTAKE MANIFOLD INSTALLATION

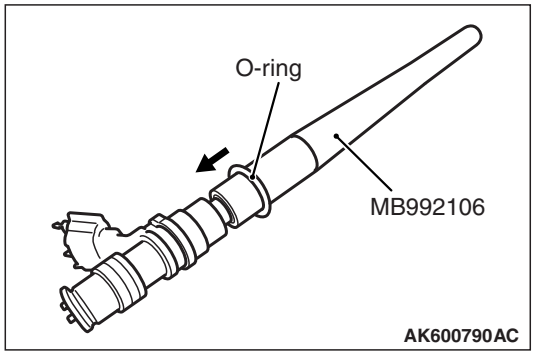
1. Tighten the nuts on the left bank to 6.5 ± 1.5 N·m (58 ± 13 in-lb).
2. Tighten the nuts on the right bank to the specified torque.
   Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)
3. Tighten the nuts on the left bank to the specified torque.
   Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)
4. Tighten the nuts on the right bank and those on the left bank again in that order.
   Tightening torque: 22 ± 1 N·m (16 ± 1 ft-lb)



>>B<< INJECTOR INSTALLATION

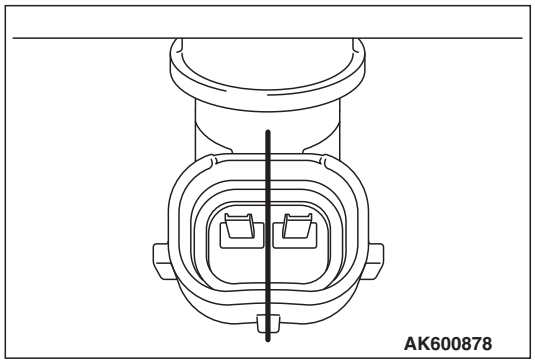
1. Apply clean gasoline to the O-ring.
2. Insert the injector into the fuel rail.
3. Make sure the injector rotates smoothly. If not, remove the injector to check the O-ring for damage, and replace the O-ring if necessary. Then reinsert the injector and check that it rotates smoothly.





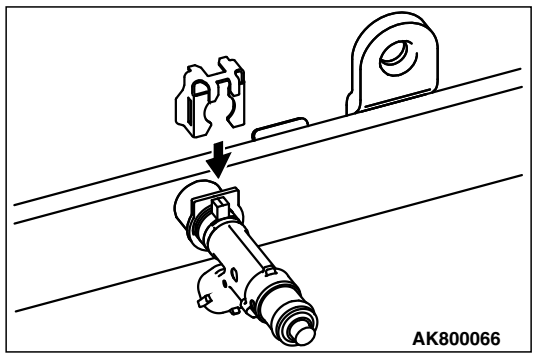
>>C<< O-RING INSTALLATION

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

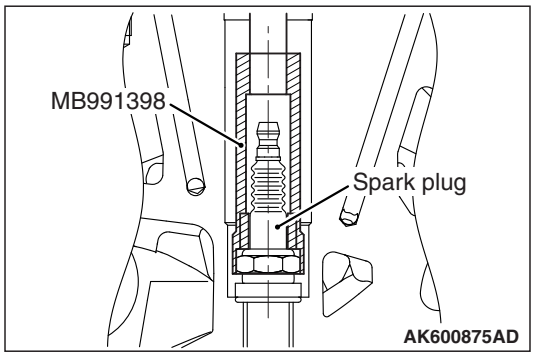


>>D<< INJECTOR SUPPORT INSTALLATION

1. Make sure that the protrusion of the injector is at the center as shown in the illustration.



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



>>E<< SPARK PLUG INSTALLATION

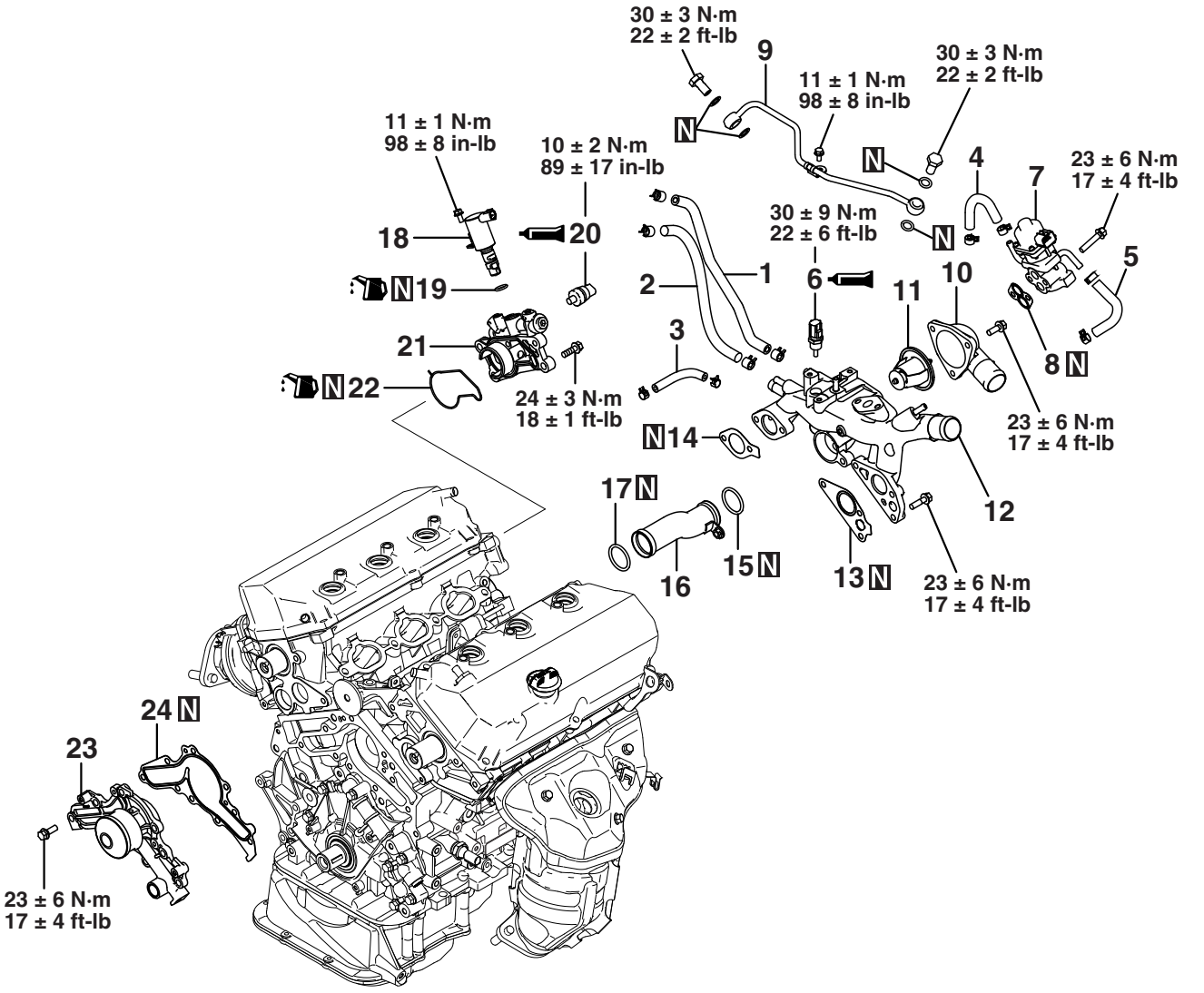
Using special tool MB991398, tighten the spark plug to the specified torque.

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

WATER HOSE AND PIPE

REMOVAL AND INSTALLATION

M1113010200877



AK800540AB

Removal steps

1. Water hose
2. Water hose
3. Water hose
4. Water hose
5. Water hose

>>I<< 6. Engine coolant temperature sensor

7. Exhaust gas recirculation valve

>>H<< 8. Exhaust gas recirculation valve gasket

>>G<< 9. Oil pipe

10. Water inlet fitting

>>F<< 11. Thermostat

12. Thermostat housing

Removal steps (Continued)

13. Thermostat housing gasket

>>E<< 14. Thermostat housing gasket

>>D<< 15. O-ring

>>D<< 16. Water pipe

>>D<< 17. O-ring

>>C<< 18. Engine oil control valve

19. O-ring

>>B<< 20. Engine oil pressure switch

>>A<< 21. Engine oil control valve housing

22. Engine oil control valve housing gasket

23. Water pump

24. Water pump gasket

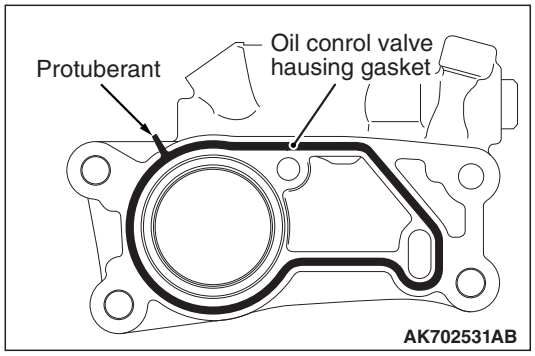
TSB Revision

INSTALLATION SERVICE POINTS

>>A<< ENGINE OIL CONTROL VALVE HOUSING INSTALLATION

⚠ CAUTION

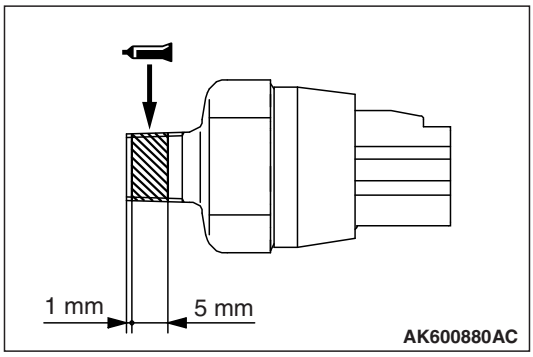
- **Oil passage shall be free from foreign matters.**
- **Shall confirm fully that matching plane and such are free from foreign matters.**



1. Install the engine oil control valve housing gasket and oil seal case gasket so that the protuberant is positioned as shown in the illustration.
2. Tighten the engine oil control valve housing and oil seal case to the specified torque.

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

>>B<< ENGINE OIL PRESSURE SWITCH INSTALLATION

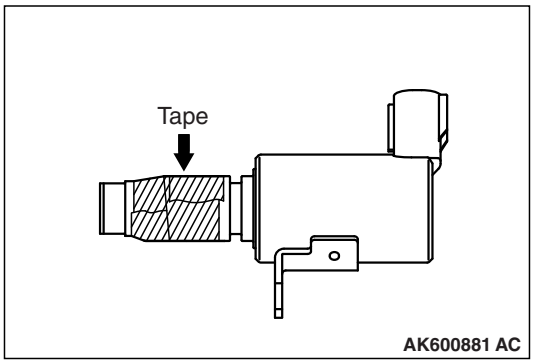


1. Apply sealant (Three bond 1212D, Three bond 1215 or equivalent) to the threads of the engine oil pressure switch.
2. Install the engine oil pressure switch to the oil control valve housing.

>>C<< ENGINE OIL CONTROL VALVE INSTALLATION

⚠ CAUTION

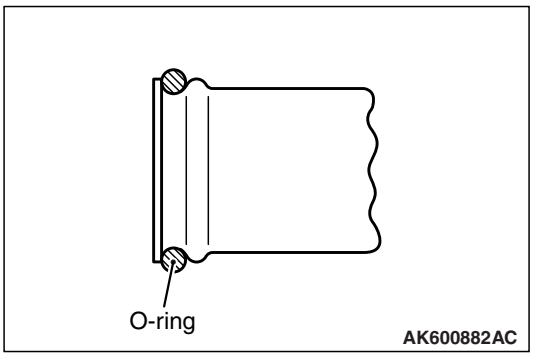
- **Never re-use the O-ring.**
- **Before installing O-ring, wind sealing tape around the oil passages cut-out area of engine oil control valve, to prevent damage. If the O-ring is damaged, it can cause an oil leak.**



1. Apply a small amount of engine oil to the O-ring and then install it to the engine oil control valve.
2. Install the engine oil control valve to the cylinder head.
3. Tighten the engine oil control valve.

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

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

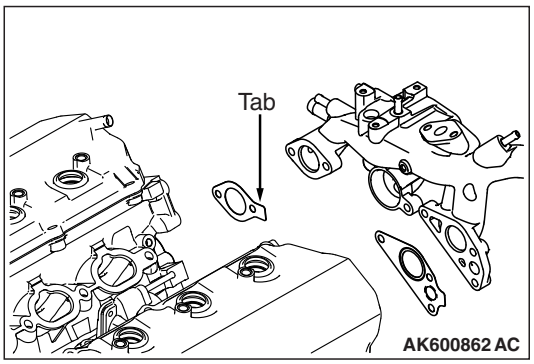


⚠ CAUTION

Keep the O-ring free of oil or grease.

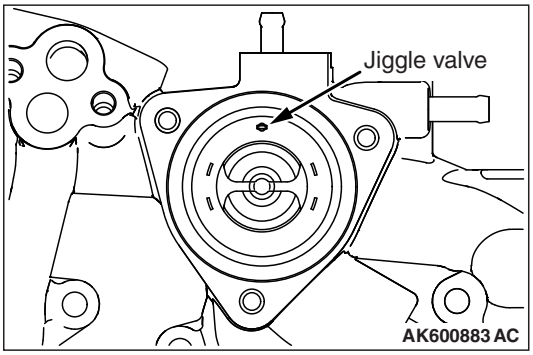
1. Wet the O-ring (with water) to ease assembly.
2. Install the water pipe into the thermostat housing.

>>E<< THERMOSTAT HOUSING GASKET INSTALLATION



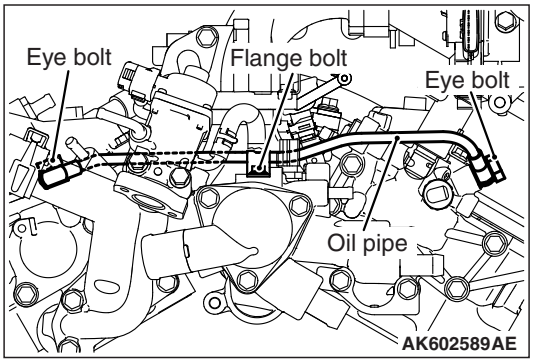
Install the thermostat housing gasket so that the tab is positioned as shown in the illustration.

>>F<< THERMOSTAT INSTALLATION



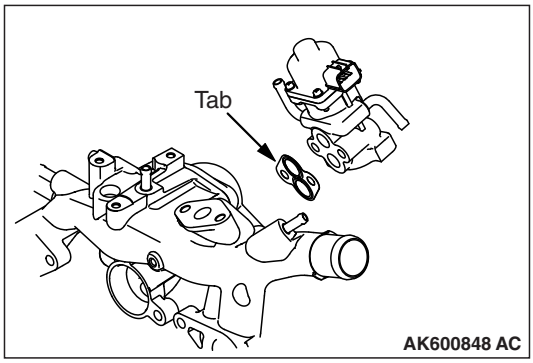
Install the thermostat in the thermostat housing with its jiggle valve located at the top position.

>>G<< OIL PIPE INSTALLATION



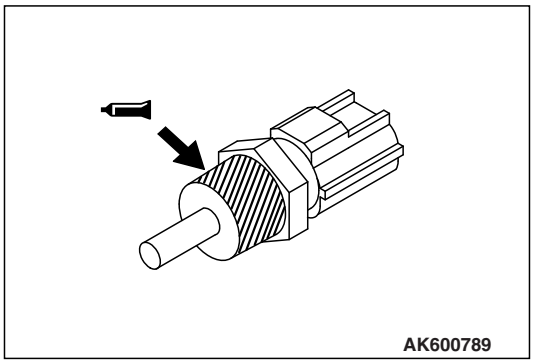
1. Temporarily tighten the eye bolts on the both ends of the oil pipe.
2. Temporarily tighten the flange bolt on the clamp.
3. Tighten the eye bolts on the both ends of the oil pipe to the specified torque.
4. Tighten the flange bolt on the clamp to the specified torque.

>>H<< EXHAUST GAS RECIRCULATION VALVE GASKET INSTALLATION



Install the exhaust gas recirculation valve gasket so that the tab is positioned as shown in the illustration.

>>I<< ENGINE COOLANT TEMPERATURE SENSOR INSTALLATION

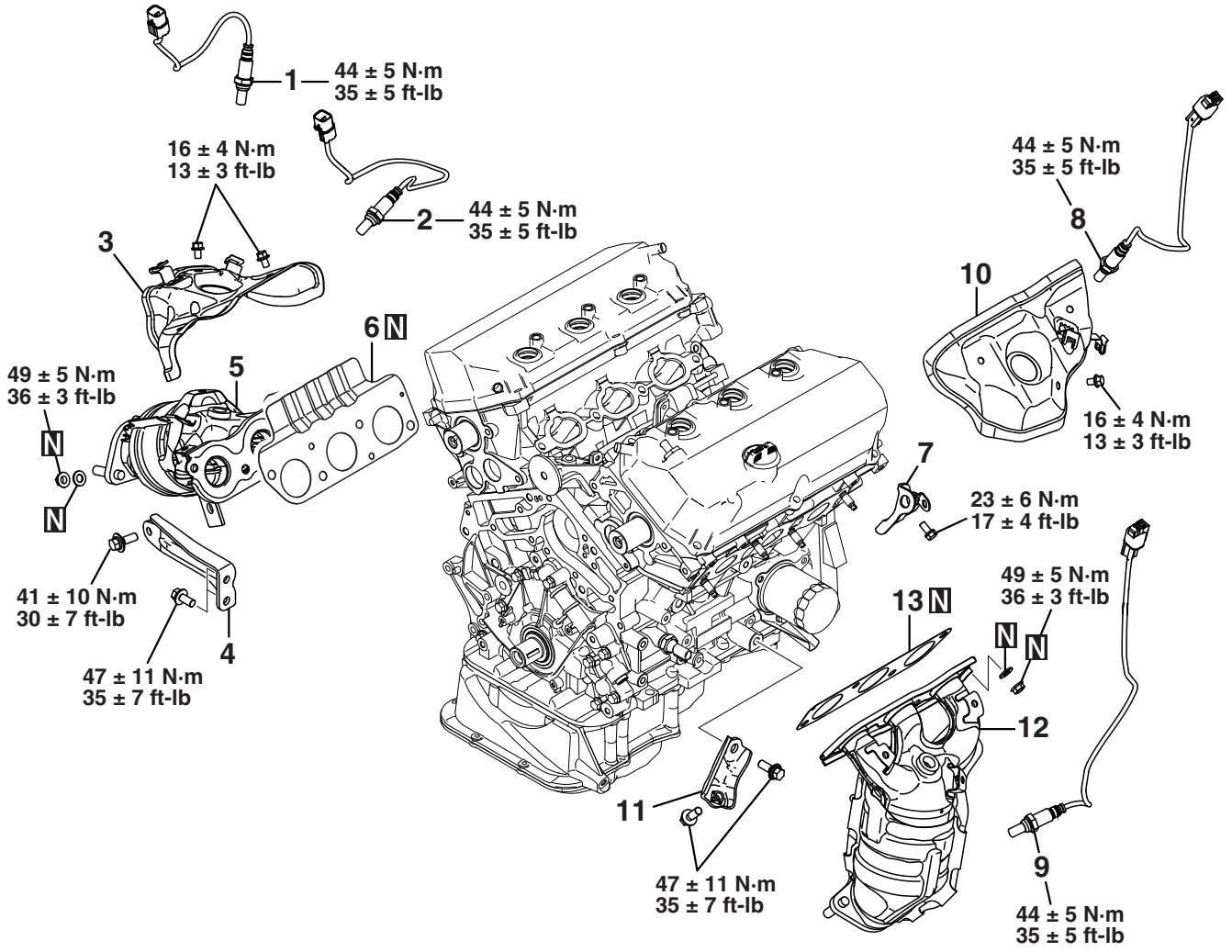


Apply sealant (Three bond 1324N, LOCTITE 262 or equivalent) to the engine coolant temperature sensor.

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004901911



AK703461AG

Removal steps

1. Right bank heated oxygen sensor (front)
2. Right bank heated oxygen sensor (rear)
3. Exhaust manifold cover, right

>>D<< 4. Exhaust manifold bracket, right <Vehicles without Electronically-controlled 4WD>

5. Exhaust manifold, right

Removal steps (Continued)

>>C<< 6. Exhaust manifold gasket

7. Engine hanger
8. Left bank heated oxygen sensor (front)
9. Left bank heated oxygen sensor (rear)
10. Exhaust manifold cover, left

>>B<< 11. Exhaust manifold bracket, left

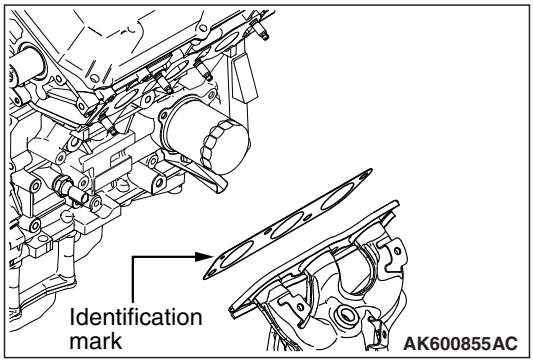
12. Exhaust manifold, left

>>A<< 13. Exhaust manifold gasket

TSB Revision

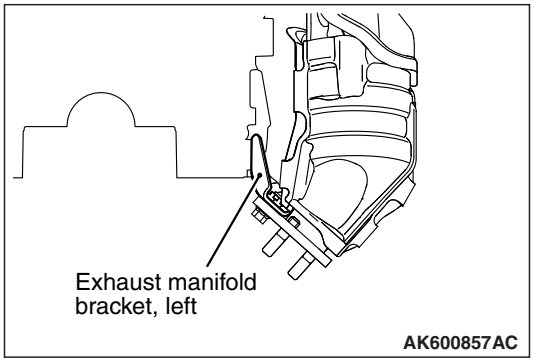
INSTALLATION SERVICE POINTS

>>A<< EXHAUST MANIFOLD GASKET INSTALLATION



Install the exhaust manifold gasket so that the identification mark is positioned as shown in the illustration.

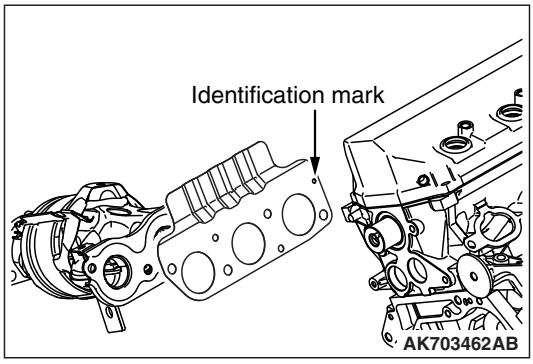
>>B<< EXHAUST MANIFOLD BRACKET, LEFT INSTALLATION



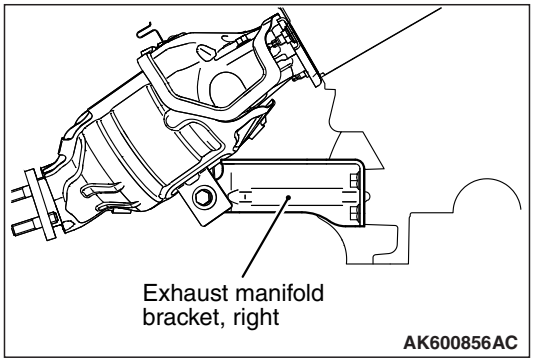
After temporarily tightening the left exhaust manifold bracket with the installation bolts, check the exhaust manifold fastens securely to the cylinder block. Tighten the left exhaust manifold bracket to the specified tightening torque.

Tightening torque: 47 ± 11 N·m (35 ± 7 ft-lb)

>>C<< EXHAUST MANIFOLD GASKET INSTALLATION



Install the exhaust manifold gasket so that the identification mark is positioned as shown in the illustration.



>>D<< EXHAUST MANIFOLD BRACKET, RIGHT INSTALLATION

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

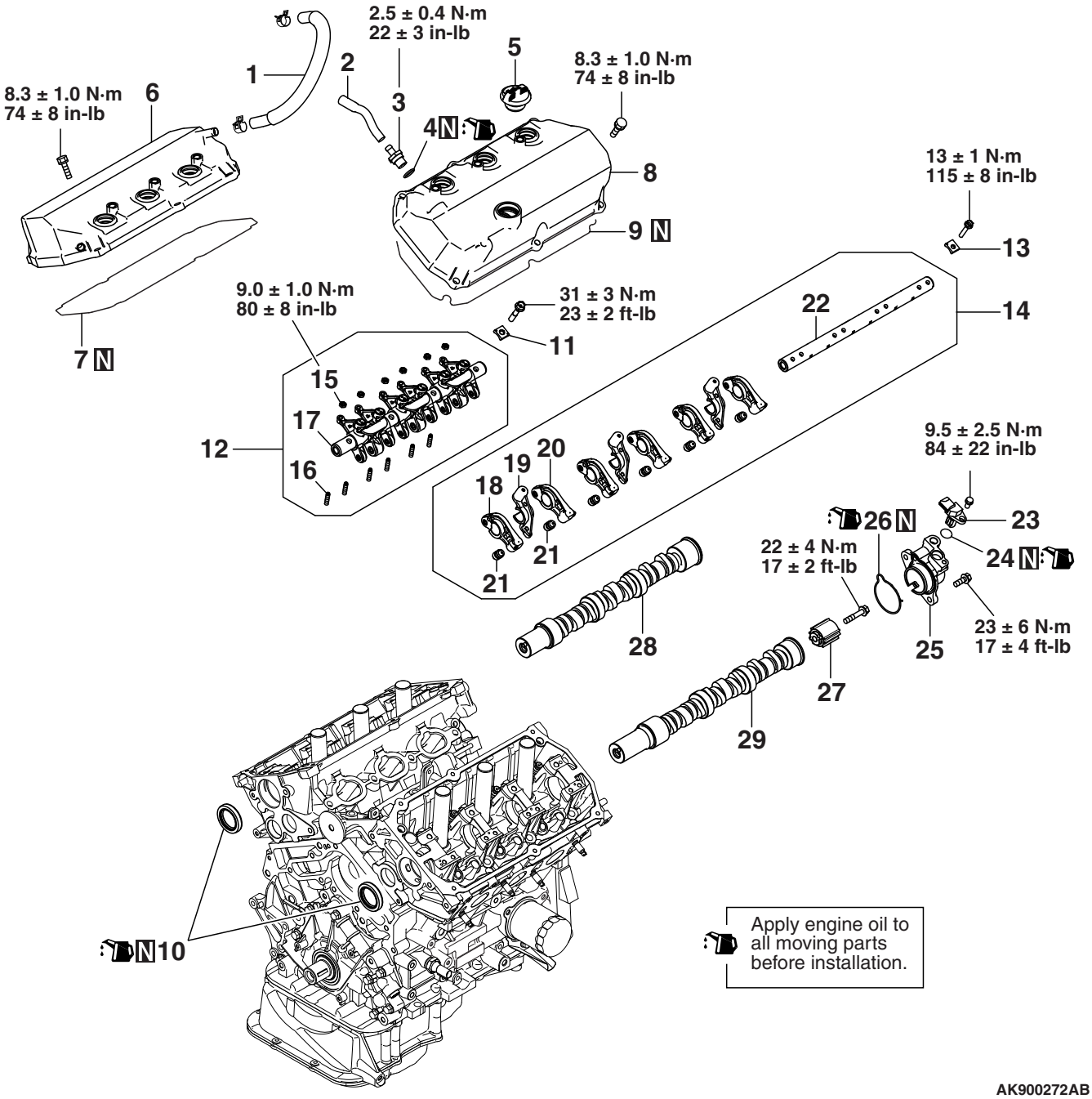
   Tightening torque: 47 ± 11 N·m (35 ± 7 ft-lb)
3. Tighten the exhaust manifold side bolt to the specified tightening torque.

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

ROCKER COVER AND CAMSHAFT

REMOVAL AND INSTALLATION

M1113005700166



AK900272AB

Removal steps

1. Blow-by hose
2. Positive crankcase ventilation hose
3. Positive crankcase ventilation vale
4. O-ring
5. Oil filler cap

>>G<< 6. Rocker cover, right

7. Rocker cover gasket

>>G<< 8. Rocker cover, left

9. Rocker cover gasket

>>F<< 10. Camshaft oil seal

>>E<< 11. Rocker shaft cap, intake

Removal steps (Continued)

>>E<< 12. Rocker arms and shaft, intake

>>E<< 13. Rocker shaft cap, exhaust

<<A>> >>E<< 14. Rocker arms and shaft, exhaust

15. Nut

>>D<< 16. Adjusting screw

<<B>> 17. Rocker arm shaft assembly

18. Rocker arm C

19. Piston arm assembly

20. Rocker arm D

>>C<< 21. Lash adjuster

22. Rocker arm shaft

TSB Revision

Removal steps (Continued)

23. Camshaft position sensor
24. O-ring
25. Camshaft position sensor support
26. Camshaft position sensor support gasket

<<C>> >>B<< 27. Camshaft position sensing cylinder
>>A<< 28. Camshaft, right
>>A<< 29. Camshaft, left

Required Special Tools:

- MD998443: Lash Adjuster Holder
- MD998713: Camshaft Oil Seal Installer
- MD998777: Camshaft Oil Seal Installer Adapter
- MB990767: End Yoke Holder
- MD998719: Pins

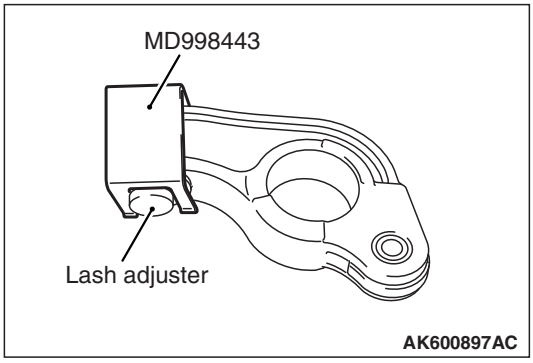
REMOVAL SERVICE POINT

<<A>> ROCKER ARMS AND SHAFT, EXHAUST REMOVAL

⚠ CAUTION

If the lash adjuster is re-used, clean the lash adjuster. (Refer to lash adjuster inspection P.11D-41.)

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



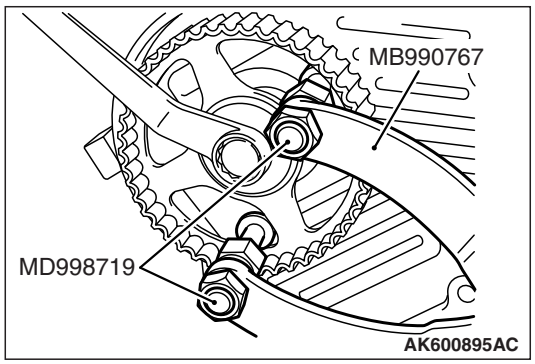
<<B>> ROCKER ARM SHAFT ASSEMBLY REMOVAL

⚠ CAUTION

Never overhaul the rocker arm shaft assembly.

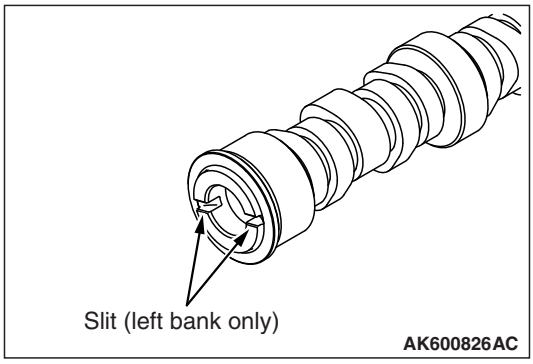
<<C>> CAMSHAFT POSITION SENSING CYLINDER REMOVAL

Install the camshaft sprocket and the camshaft sprocket bolt to the camshaft. Using the special tools MB990767 and MD998719, prevent the camshaft position sensing cylinder from rotating and remove it.



INSTALLATION SERVICE POINTS

>>A<< CAMSHAFT, RIGHT / CAMSHAFT, LEFT INSTALLATION



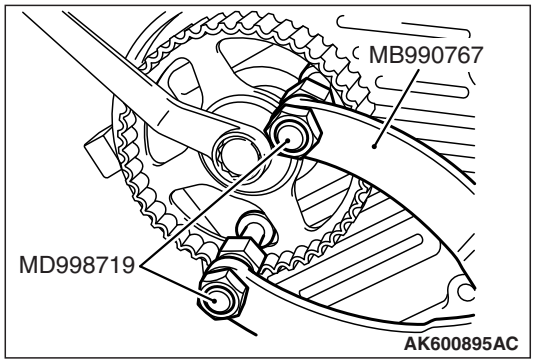
⚠ CAUTION

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

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

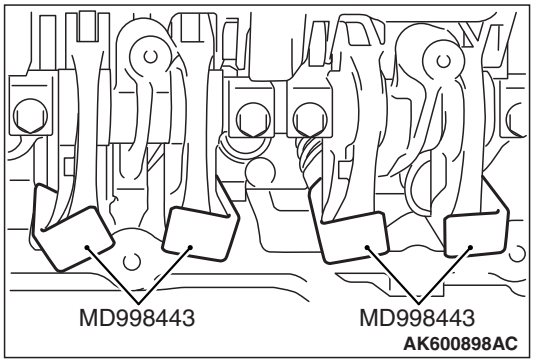
   NOTE: The left bank camshaft is identified by a slit 4 mm (0.16 inch) wide at the rear end of the camshaft.
2. Install the cylinder head, placing the dowel pin of the camshaft upward.

>>B<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION



1. Mate the groove on the camshaft rear end face properly with the protrusion of the camshaft position sensing cylinder so that the camshaft position sensing cylinder can be installed.
2. Install the camshaft sprocket and the camshaft sprocket bolt to the camshaft. Using the special tools MB990767 and MD998719, prevent the camshaft position sensing cylinder from rotating and tighten it to the specified torque.

>>C<< LASH ADJUSTER INSTALLATION

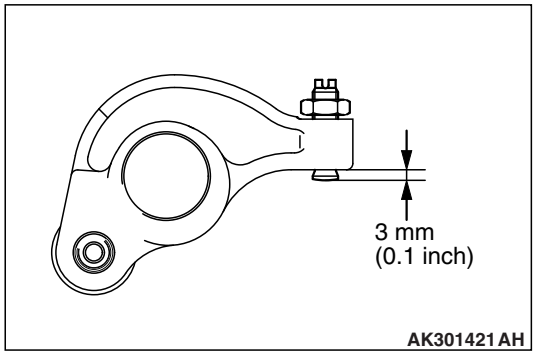


⚠ CAUTION

If the lash adjuster is re-used, clean the lash adjuster. (Refer to lash adjuster inspection P.11D-41.)

Fit the lash adjuster onto the rocker arm without allowing diesel fuel to spill out. Fit special tool MD998443 to prevent the lash adjuster coming from free and falling to the floor.

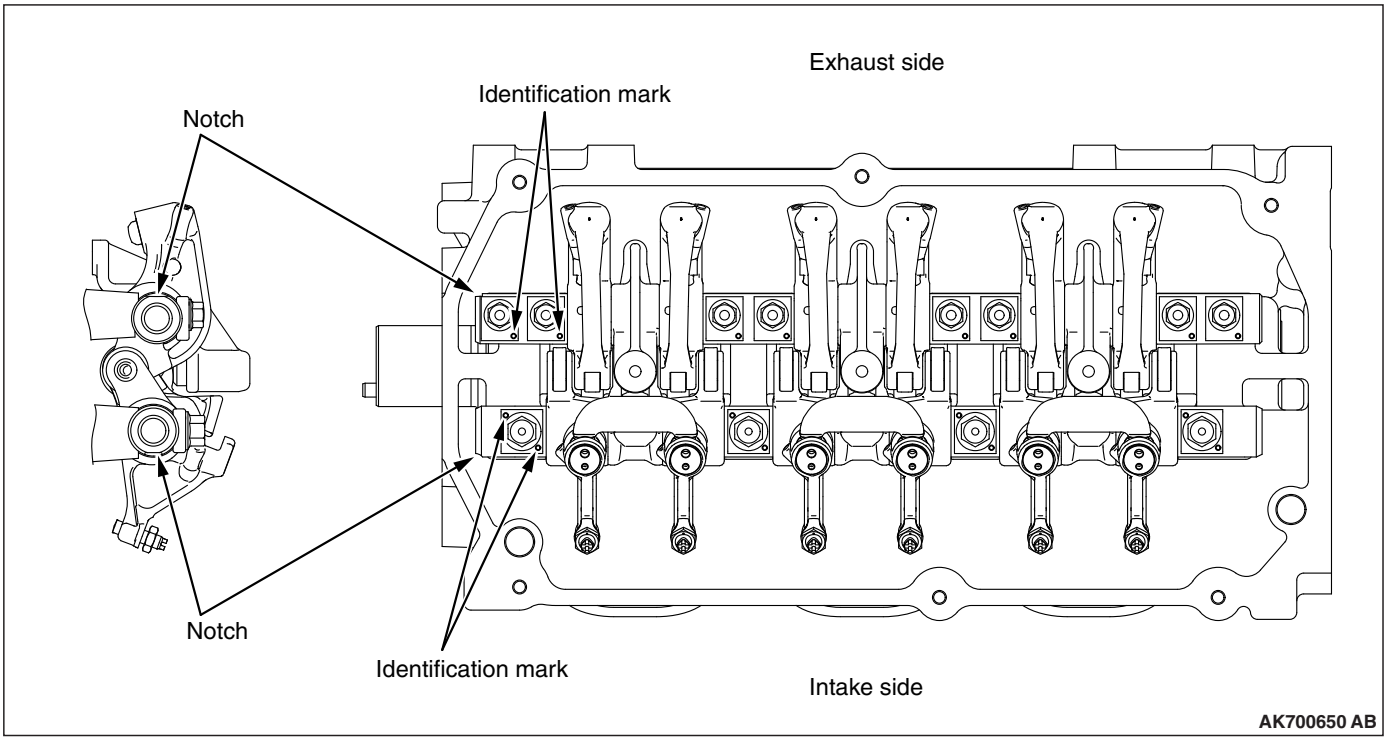
>>D<< ADJUSTING SCREW INSTALLATION



Install provisionally the screw to rocker arm, insert it so that end of the screw is flush with the edge of the rocker arm or projects slightly 3 mm (0.1 inch).

>>E<< ROCKER ARMS AND SHAFT / ROCKER SHAFT CAP INSTALLATION

1. In accordance with the tags for the reinstallation, install the rocker arm and so on to the rocker arm shaft.



2. Temporarily install the intake rocker arms and shaft.

   NOTE: Place the notch on the end face in the direction shown in the illustration.

3. Temporarily install the exhaust rocker arms shaft.

   NOTE: Place the notch on the end face in the direction shown in the illustration.

   NOTE: Install the rocker arm shaft with oil hole to the lower (cylinder head) side.

4. Install the rocker shaft cap.

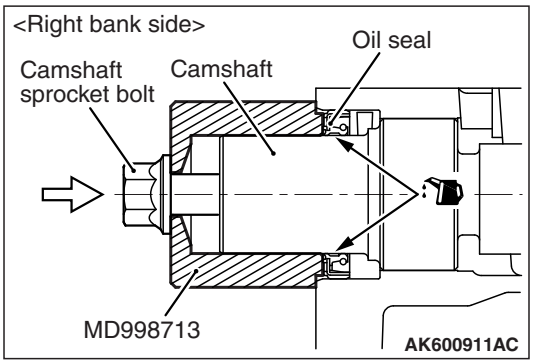
   NOTE: Pay attention to the installation direction of the rocker shaft cap at the exhaust side.

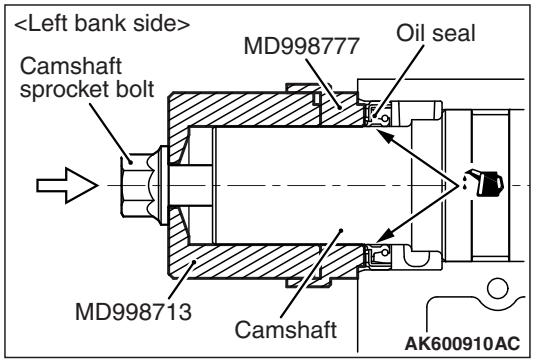
5. Confirm the each rocker arm and rocker arm shaft assembly are in position and then tighten to the specified torque.

Tightening torque:
Exhaust side (M6): 13 ± 1 N·m (115 ± 8 in-lb)
Intake side (M8): 31 ± 3 N·m (23 ± 2 ft-lb)

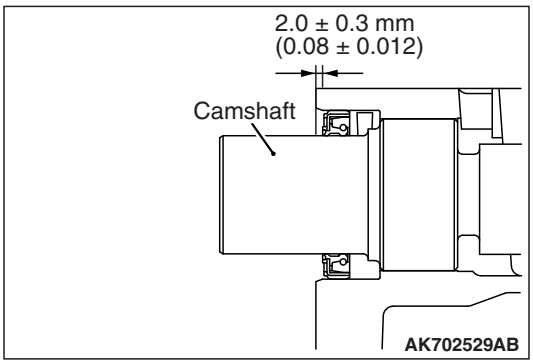
>>F<< CAMSHAFT OIL SEAL INSTALLATION

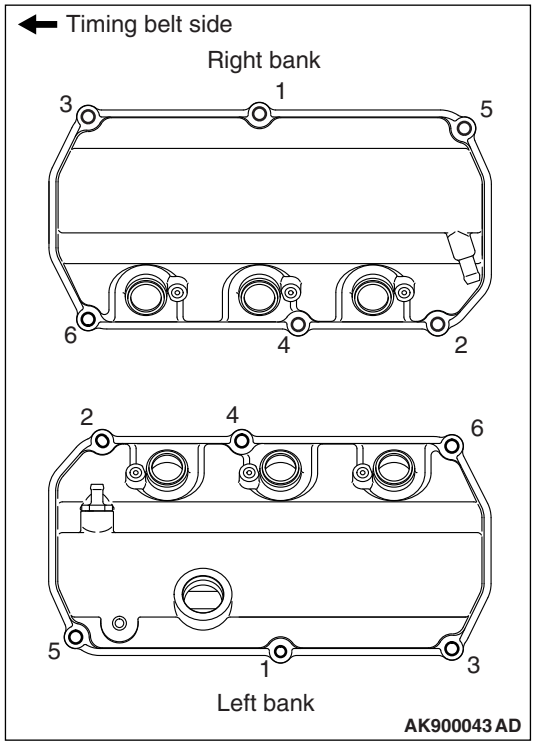
1. Use special tools MD998713 and MD998777 to install the camshaft oil seal.
2. Screw the camshaft sprocket bolt until the special tool touches the end face of the cylinder head.





3. Oil seal shall be pressed fit to position.





>>G<< ROCKER COVER, RIGHT / ROCKER COVER, LEFT INSTALLATION

Tighten the rocker cover to the specified torque in the sequence shown in the illustration.

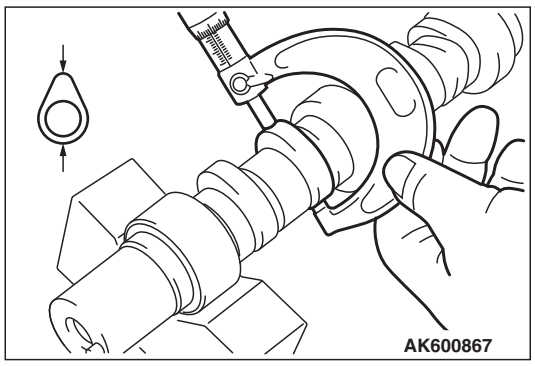
Tightening torque: 8.3 ± 1.0 N·m (74 ± 8 in-lb)

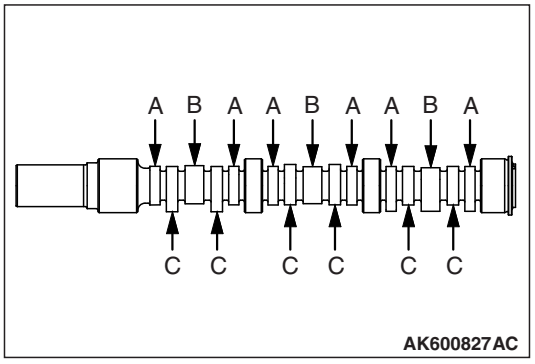
INSPECTION

M1113005800066

CAMSHAFT

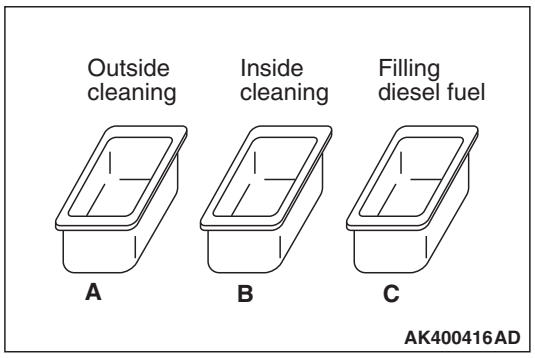
Measure the cam height. If it is below the limit, replace the camshaft.

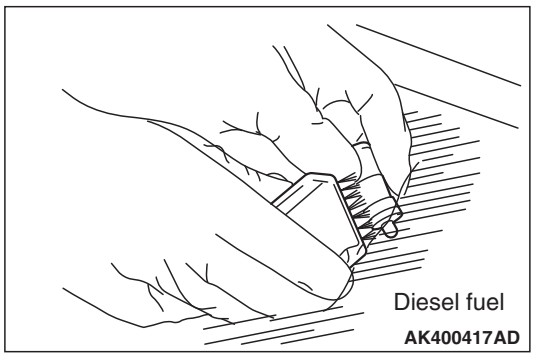




	Standard value	Minimum limit
A: Intake low speed cam	37.28 mm (1.468 inches)	36.78 mm (1.448 inches)
B: Intake high speed cam	36.23 mm (1.426 inches)	35.73 mm (1.407 inches)
C: Exhaust cam	37.84 mm (1.490 inches)	37.34 mm (1.470 inches)

LASH ADJUSTER





⚠ CAUTION

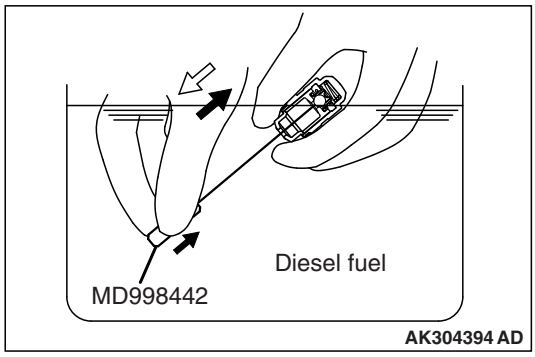
- **The lash adjusters are precision-engineered mechanisms. Do not allow them to become contaminated by dirt or other foreign substances.**
- **Do not attempt to disassemble the lash adjusters.**
- **Use only fresh diesel fuel to clean the lash adjusters.**

1. Prepare three containers and approximately 5 dm^3 (30.5 quart) of diesel fuel. Into each container, pour enough diesel fuel to completely cover a lash adjuster when it is standing upright. Then, perform the following steps with each lash adjuster.
2. Place the lash adjuster in container A and clean its outside surface.

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

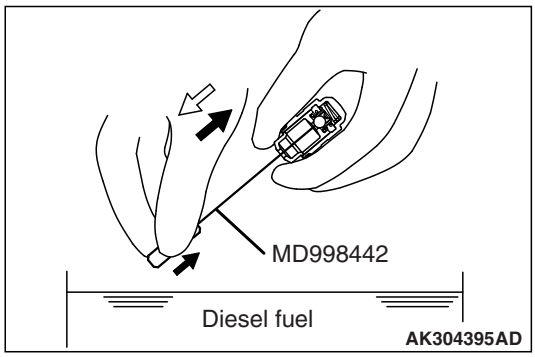
⚠ CAUTION

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



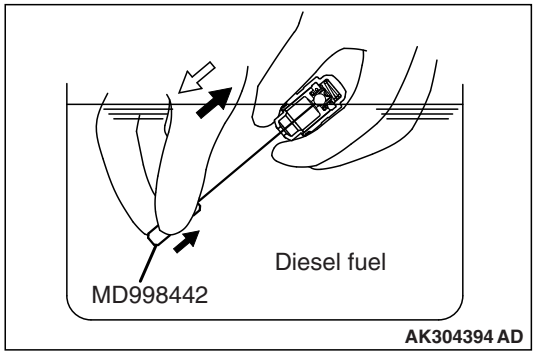
3. While gently pushing down the internal steel ball using wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442, move the plunger through five to ten strokes until it slides smoothly. In addition to eliminating stiffness in the plunger, this operation will remove dirty oil.

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

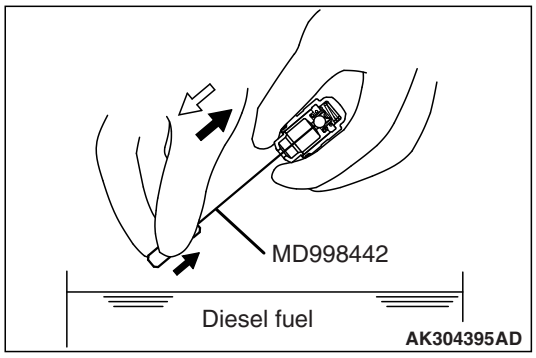


4. Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

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

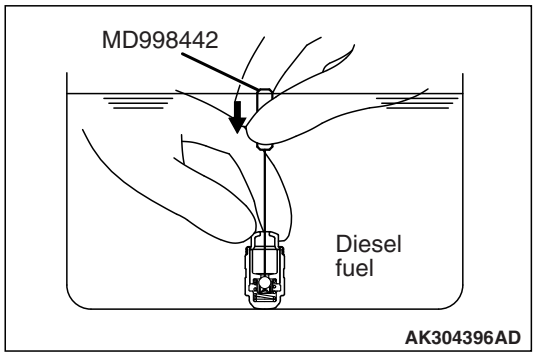


5. Place the lash adjuster in container B. Then, gently push down the internal steel ball using a wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442 and move the plunger through five to ten strokes until it slides smoothly. This operation will clean the lash adjuster's pressure chamber.

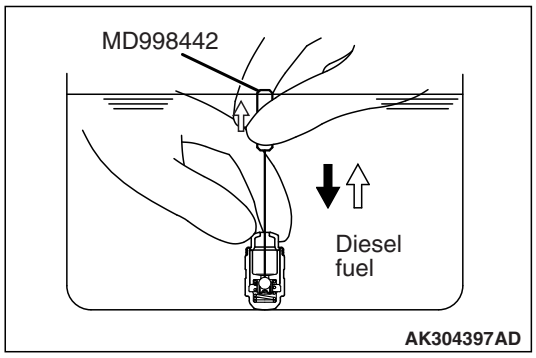


6. Remove the lash adjuster from the container. Then, push down the steel ball gently and push the plunger to eliminate diesel fuel from the pressure chamber.

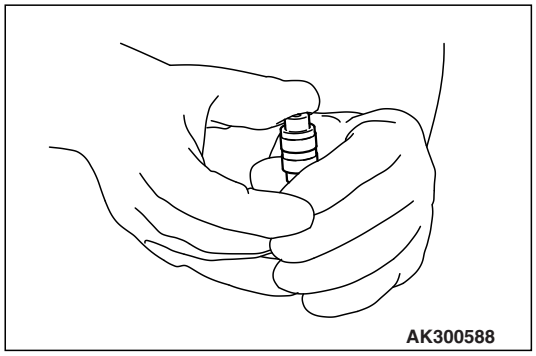
⚠ CAUTION
Do not use container C for cleaning. If cleaning is performed in container C, foreign matter could enter the pressure chamber when the chamber is filled with diesel fuel.



7. Place the lash adjuster in container C. Then, gently push down the internal steel ball using a wire [0.5 mm (0.020 inch) in diameter] or special tool MD998442.



8. Stand the lash adjuster with its plunger at the top, then push the plunger downward firmly until it moves through its greatest possible stroke. Return the plunger slowly, then release the steel ball and allow the pressure chamber to fill with diesel fuel.



9. Remove the lash adjuster from the container, then stand the lash adjuster with its plunger at the top. Push the plunger firmly and check that it does not move.

   NOTE: If the lash adjuster contracts or moves, repeat steps 7 through 9 again to fill it with diesel fuel completely. Replace the lash adjuster if it still contracts or moves after performing these steps.

10. Stand the lash adjuster upright to prevent diesel fuel from spilling out. Do not allow the lash adjuster to become contaminated by dirt or other foreign matter. Install the lash adjuster onto the engine as soon as possible.

CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

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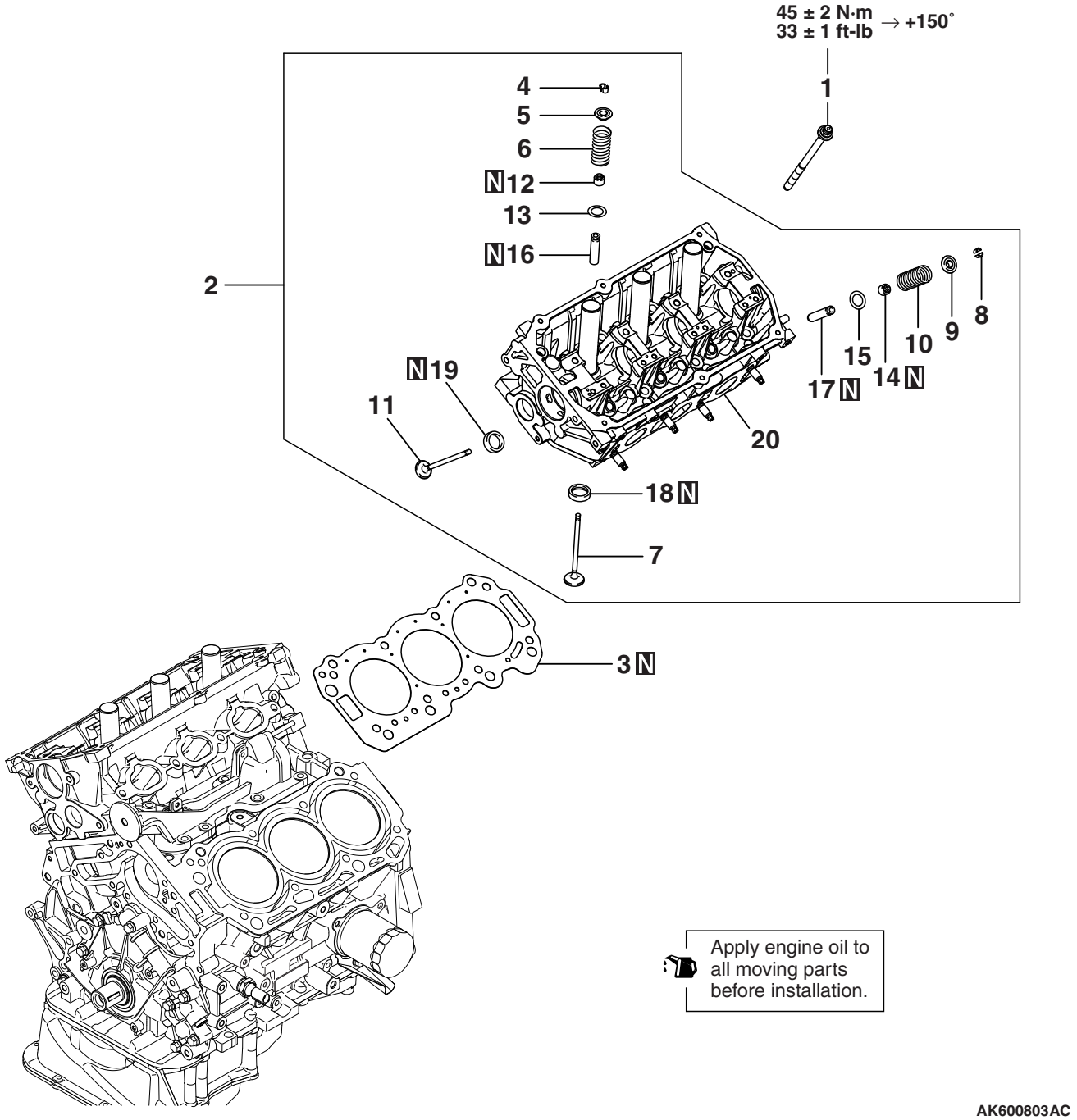


Removal steps

- >>D<< 1. Cylinder head bolt
- 2. Cylinder head assembly
- 3. Cylinder head gasket
- <<A>> >>C<< 4. Retainer lock
- 5. Valve spring retainer
- >>B<< 6. Valve spring
- 7. Intake valve
- <<A>> >>C<< 8. Retainer lock
- 9. Valve spring retainer
- >>B<< 10. Valve spring

Removal steps (Continued)

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

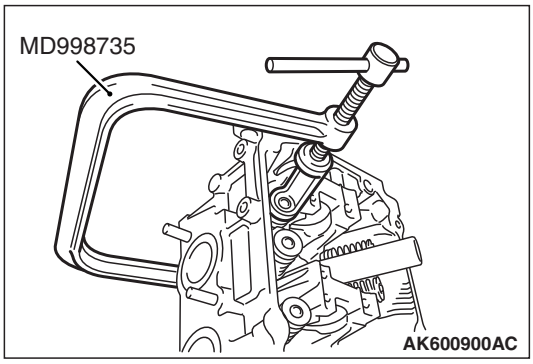
TSB Revision

Required Special Tools:

- MB991614: Angle Gauge
- MB992085: Valve Stem Seal Plier
- MB992182: Valve Stem Seal Installer
- MD998735: Valve Spring Compressor

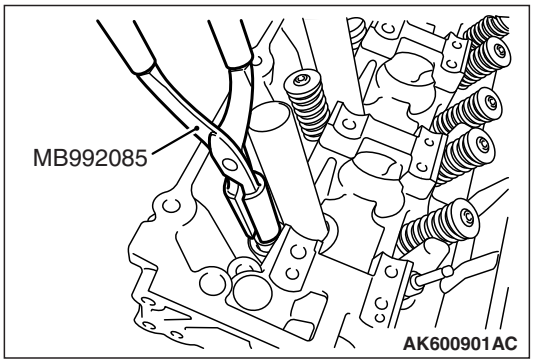
REMOVAL SERVICE POINTS

<<A>> RETAINER LOCK REMOVAL



1. Using special tool MD998735, compress the spring.
2. Remove the retainer locks.

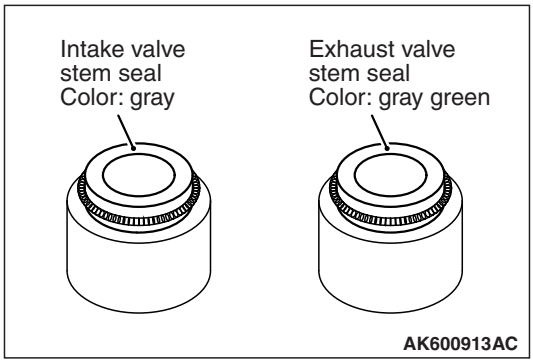
<<B>> VALVE STEM SEAL REMOVAL



Using the special tool MB992085, nip the valve stem seal and remove it.

INSTALLATION SERVICE POINTS

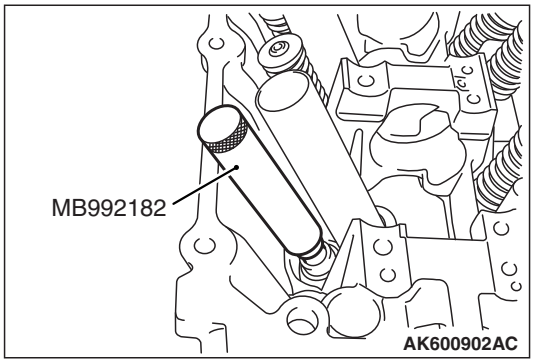
>>A<< VALVE STEM SEAL INSTALLATION



1. Install the valve spring seat to the valve guide.

⚠ CAUTION

- **Valve stem seals for intake valves and for exhaust valves are different. Be sure to install the correct ones.**
- **Valve stem seal identification color.**
  Intake: GRAY
  Exhaust: GRAY GREEN

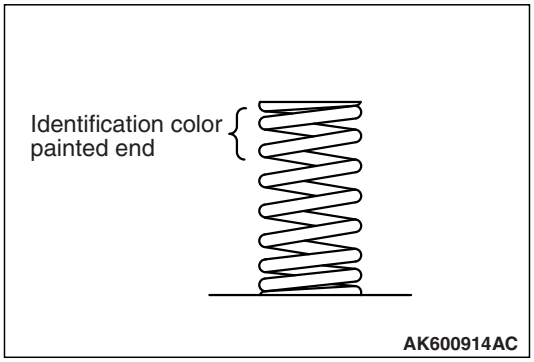


⚠ CAUTION

- **Always use the special tool to install the valve stem seal. Improperly installed valve stem seals may leak oil.**
- **Do not strike the valve stem seal strongly because it might be damaged.**

2. Using special tool MB992182, install a new stem seal to the valve guide.

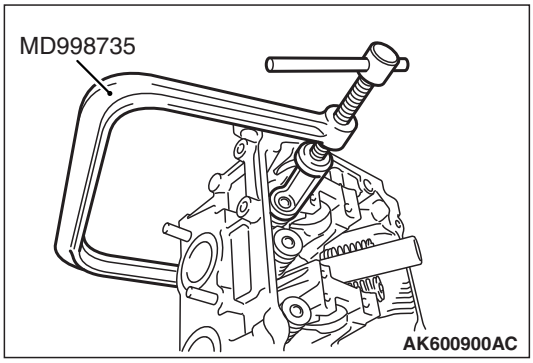
   NOTE: After install, check the special tool does not stick to the valve spring sheet. Put the valve spring sheet in position.



>>B<< VALVE SPRING INSTALLATION

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

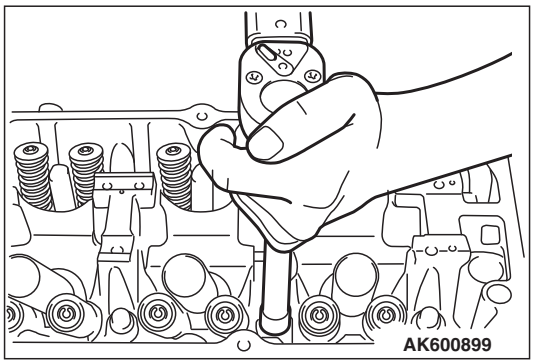
Identification color
Intake: White
Exhaust: Blue



>>C<< RETAINER LOCK INSTALLATION

Using special tool MD998735, compress the valve spring and insert the retainer lock into position.

>>D<< CYLINDER HEAD BOLT INSTALLATION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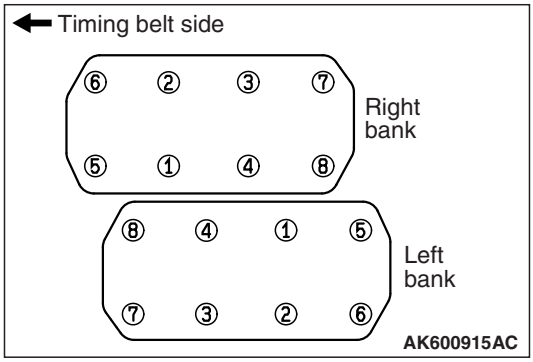

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⚠ CAUTION

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

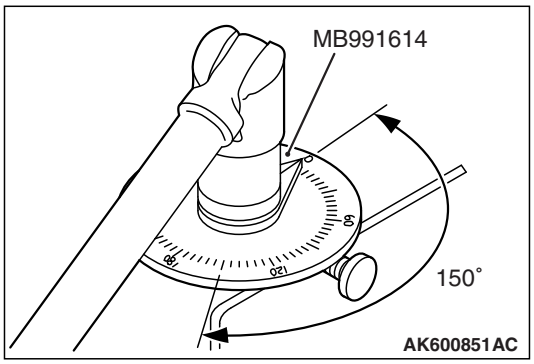
1. Tighten the bolts in the illustrated sequence two or three rounds.

   Tightening torque: 45 ± 2 N·m (33 ± 1 ft-lb)

⚠ CAUTION

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

2. Using the special tool MB991614, tighten the cylinder head bolt another 150 degrees.



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INSPECTION

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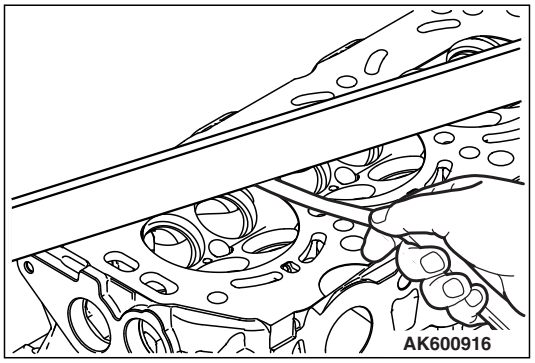


CYLINDER HEAD

1. Check the cylinder head for water leakages, gas leakages, damages or cracks before cleaning.
2. Remove oil, water deposits, sealants, carbon deposits completely. Blow air after cleaning the oil passage to check whether the oil passage is not clogged.
3. Check the flatness of the lower surface of the cylinder head for distortions using a straight edgs gauge and thickness gauge. Unless being within the limit, the distortion must be ground and corrected.

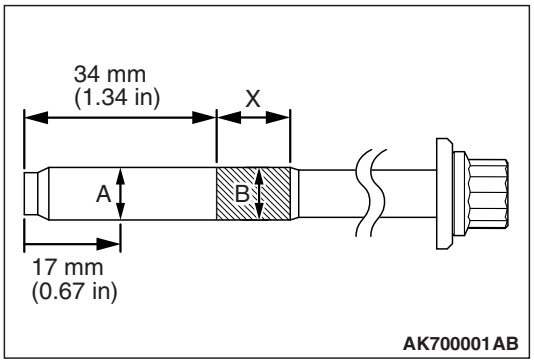
   Standard value: 0.03 mm (0.0012 inch)
   Limit: 0.05 mm (0.002 inch)

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

⚠ CAUTION

***The grinding limit must be within 0.15mm including the cylinder block.**

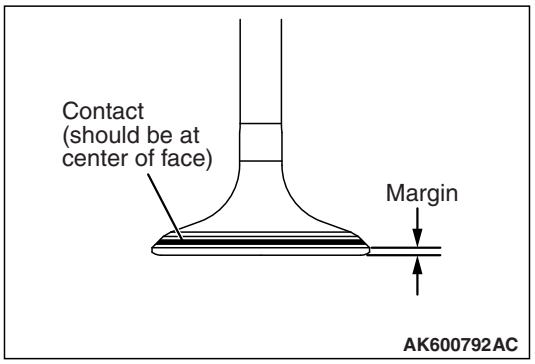
Grinding limit: *0.15 mm (0.006 inch)



CYLINDER HEAD BOLT

1. Check in the following procedure before reusing the cylinder head 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 cylinder head bolt.

   Limit: 0.1mm (0.0039 inch)

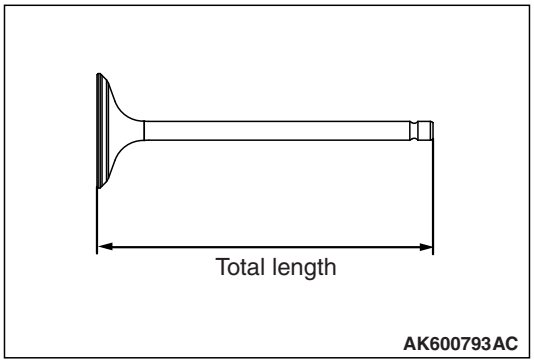


VALVE

1. Check the valve seat contact. Valve seat contact should be uniform at the center of the valve face. If incorrect, reface using a valve refacer.
2. If the margin is below the limit, replace the valve.

   Standard value:
   Intake 1.0 mm (0.03 inch)
   Exhaust 1.2 mm (0.04 inch)

   Minimum limit:
   Intake 0.5 mm (0.02 inch)
   Exhaust 0.7 mm (0.03 inch)

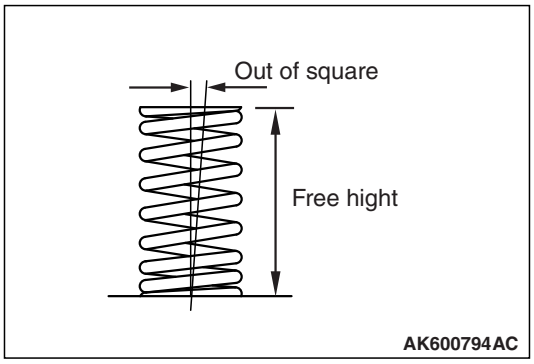


3. Measure the valve's total length. If the measurement is less than the limit, replace the valve.

Standard value:
Intake 111.84 mm (4.403 inches)
Exhaust 114.04 mm (4.490 inches)

Minimum limit:
Intake 111.34 mm (4.384 inches)
Exhaust 113.54 mm (4.470 inches)

VALVE SPRING



1. Measure the free height of the spring. If it is less than the limit, replace.

Standard value:
Intake 63.77 mm (2.5111 inches)
Exhaust 59.90 mm (2.358 inches)

Minimum limit:
Intake 62.77 mm (2.471 inches)
Exhaust 58.90 mm (2.319 inches)

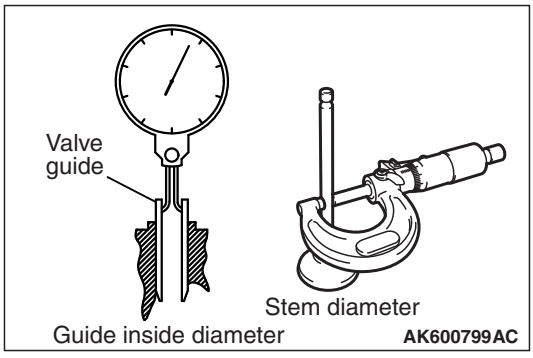
2. Measure the squareness of the spring. If it exceeds the limit, replace.

Standard value: 2 degrees or less
Limit: 4 degrees

3. Valve spring load / installed height.

Standard value: 245.2 N (55.13 lb) / 49.2 mm (1.94 in)

VALVE GUIDE INSPECTION



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

Standard value:
Intake 0.020 – 0.047 mm (0.0008 – 0.0018 inch)
Exhaust 0.035 – 0.062 mm (0.0014 – 0.0024 inch)

Limit:
Intake 0.10 mm (0.003 inch)
Exhaust 0.15 mm (0.005 inch)

VALVE GUIDE REPLACEMENT PROCEDURE

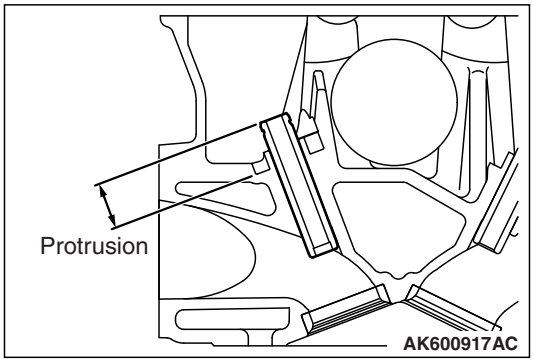
1. Using a press, remove the valve guide toward the cylinder block.

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

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

Valve guide hole diameters
0.05 oversize: 11.050 – 11.068 mm (0.4351 – 0.4357 inch)

TSB Revision



3. Press-fit the valve guide until it projects by the specified amount.

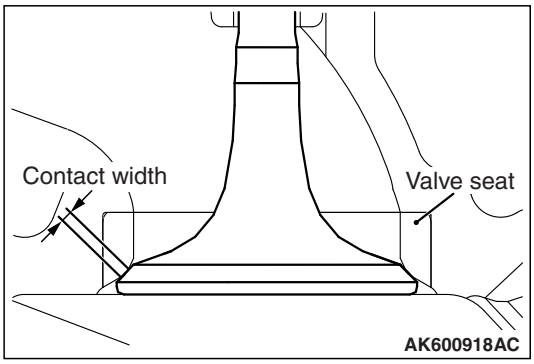
   Protrusion: 16.7 – 17.3 mm (0.66 – 0.68 inch)

   NOTE: When press-fitting the valve guide, work from the cylinder head top surface.

   NOTE: Pay attention to the difference in length of the valve guides. [Intake side: 45.5 mm (1.79 inches); exhaust side: 52.5 mm (2.07 inches)]

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

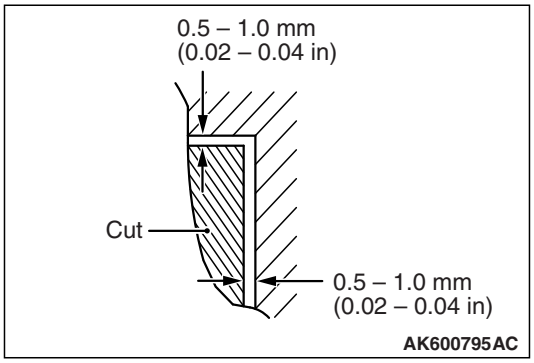
VALVE SEAT INSPECTION



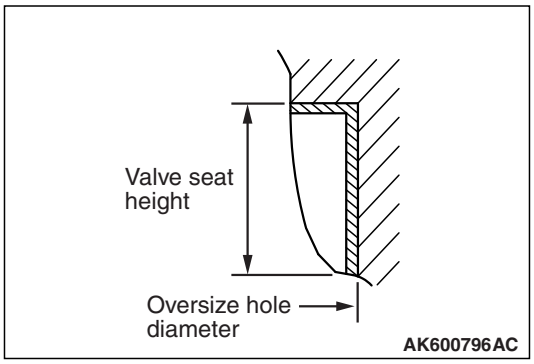
Assemble the valve, then measure the contact width. If the measurement exceeds the specified limit, replace the valve seat.

Standard value: 0.9 – 1.3 mm (0.04 – 0.05 inch)

VALVE SEAT REPLACEMENT PROCEDURE



1. Cut the valve seat from the inside to thin the wall thickness. Then, remove the valve seat.



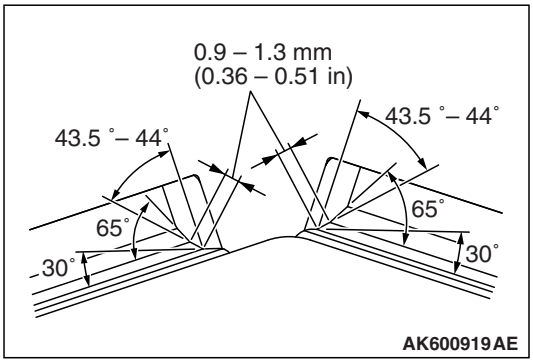
2. Rebore the valve seat hole in the cylinder head to a selected oversize valve seat diameter.

   Intake seat ring hole diameters
   0.3 oversize:
   36.300 – 36.325 mm (1.4292 – 1.4301 inches)

   Exhaust seat ring hole diameters
   0.3 oversize:
   32.300 – 32.325 mm (1.2717 – 1.2726 inches)

3. Before fitting the valve seat, either heat the cylinder head up to approximately 250°C (482°F) or cool the valve seat in liquid nitrogen, to prevent the cylinder head bore from galling.
4. Using a valve seat cutter, correct the valve seat to the specified width and angle.
   See "VALVE SEAT RECONDITIONING PROCEDURE" on the previous page.

VALVE SEAT RECONDITIONING PROCEDURE



1. Before correcting the valve seat, check for clearance between the valve guide and valve and, if necessary, replace the valve guide.
2. Using the seat grinder, correct to obtain the specified seat width and angle.
3. After correcting the valve seat, lap the valve and valve seat using lapping compound. Then, check the valve stem projection.

OIL PAN AND OIL PUMP

REMOVAL AND INSTALLATION

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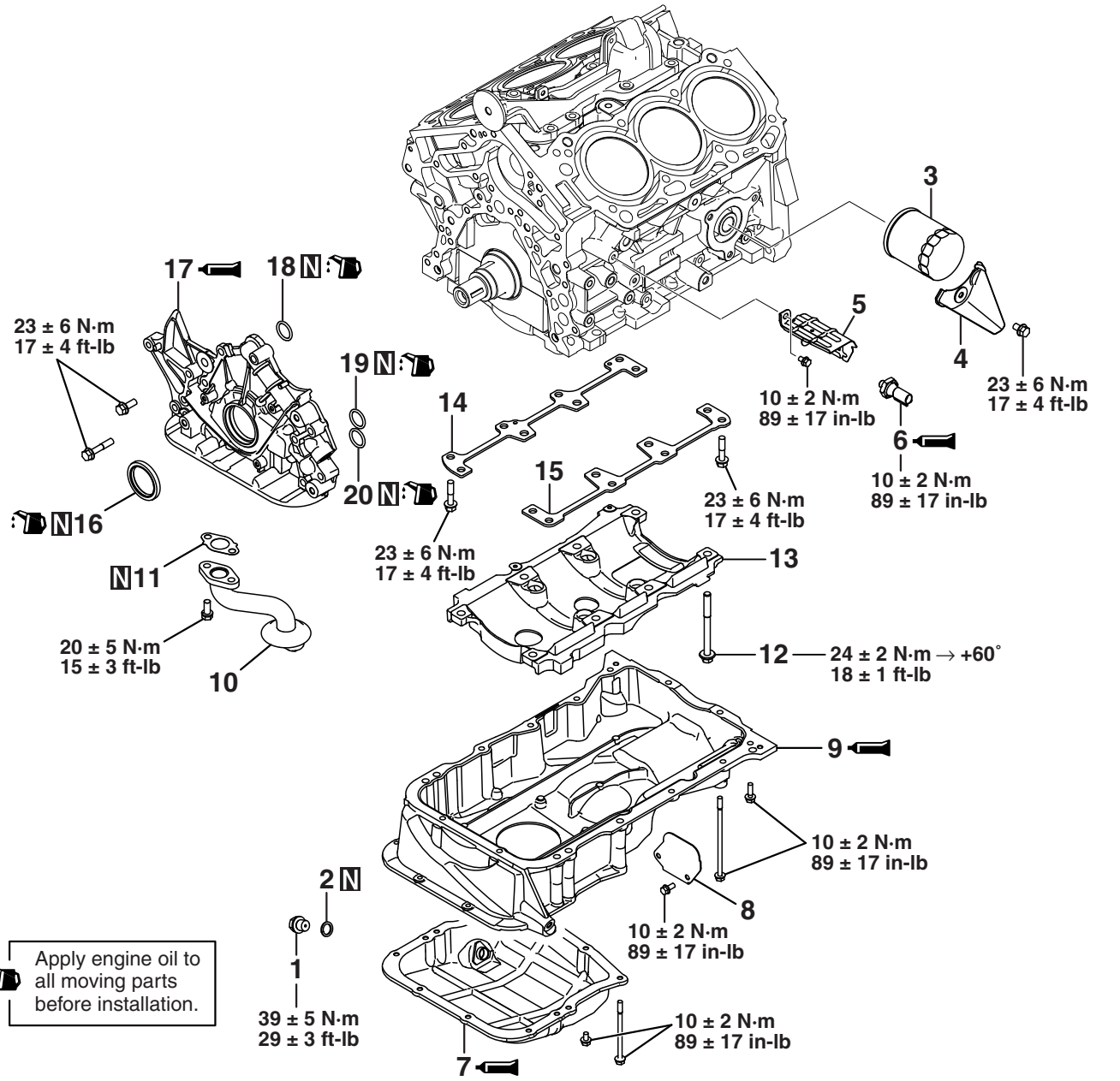


AK600802AF

Removal steps

1. Drain plug
- **>>J<<** 2. Drain plug gasket
- **>>I<<** 3. Oil filter
- **>>H<<** 4. Oil filter cover
5. Heat protector
- **>>G<<** 6. Engine oil pressure switch
- **<<A>> >>F<<** 7. Oil pan, lower
8. Oil pan cover
- **<<B>> >>E<<** 9. Oil pan, upper
10. Oil screen

Removal steps (Continued)

- **>>D<<** 11. Oil screen gasket
- **>>C<<** 12. Bearing cap bolt
- **>>C<<** 13. Beam
- **>>C<<** 14. Right plate
- **>>C<<** 15. Left plate
- **>>B<<** 16. Crankshaft front oil seal
- **>>A<<** 17. Oil pump case
18. O-ring
19. O-ring
20 O-ring

TSB Revision

Required Special Tools:

- MB991396: Oil Filter Wrench
- MB991614: Angle Gauge
- MD998382: Crankshaft Front Oil Seal Installer
- MD998727: Oil Pan FIPG Cutter

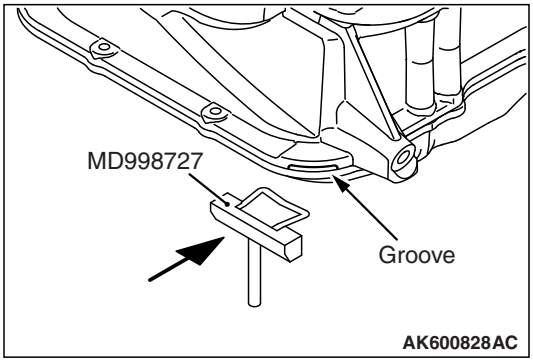
REMOVAL SERVICE POINTS

<<A>> OIL PAN LOWER REMOVAL

⚠ CAUTION

To prevent the sealed area from being damaged, carefully insert the special tool.

Insert the special tool MD998727, into the groove shown in the illustration. Strike and slide it and then cut the liquid gasket.

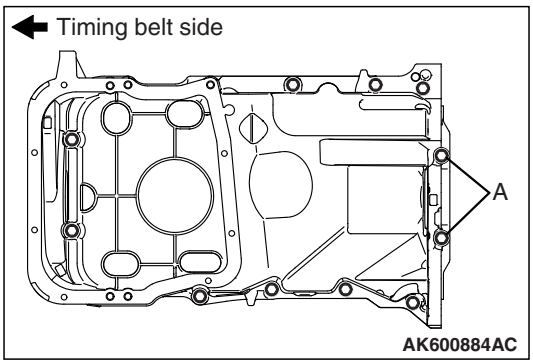


<<B>> OIL PAN UPPER REMOVAL

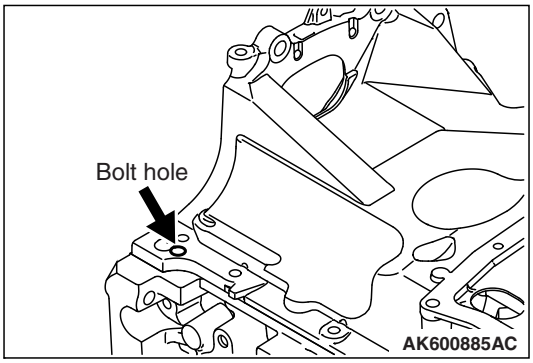
1. Remove the bolts A shown in the illustration first.
2. Remove all other bolts.

⚠ CAUTION

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



3. Thread the M10 × 1.25 pitch bolt into the illustrated bolt hole to remove the oil pan upper.



INSTALLATION SERVICE POINTS

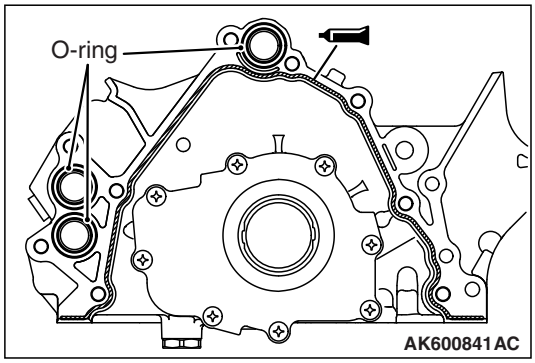
>>A<< OIL PUMP CASE INSTALLATION

⚠ CAUTION

Carefully work so that the rests of the liquid gasket cannot enter to the oil passage or water passage.

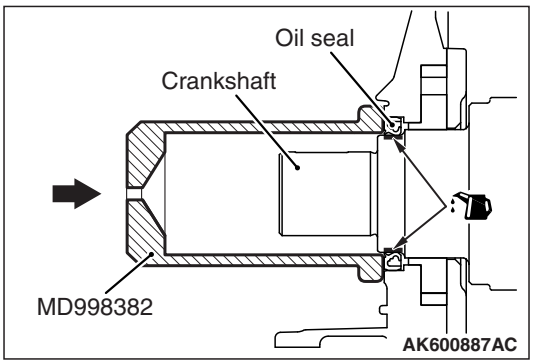
1. Remove the remaining liquid gasket on the oil pump case and the cylinder block.
2. Degrease and clean the plane where the liquid gasket is applied and the both sides of the chamfered areas where the liquid gasket collects.
3. After degreasing and cleaning the plane and the both sides, always spray compressed air into the oil passage and the water passage. Check that the oil passage and the water passage are free of foreign materials such as liquid gasket.
4. As shown in the illustration, apply a 2.0 ± 0.5 mm (0.08 ± 0.01 inch) diameter bead of sealant (Three bond 1217G or exact equivalent) to the area on the oil pump case.
5. After checking that the o-ring is installed at three places, install the oil pump case to the cylinder block.
6. Tighten the oil pump case to the specified torque.

   Tightening torque: 23 ± 6 N·m (17 ± 4 ft-lb)

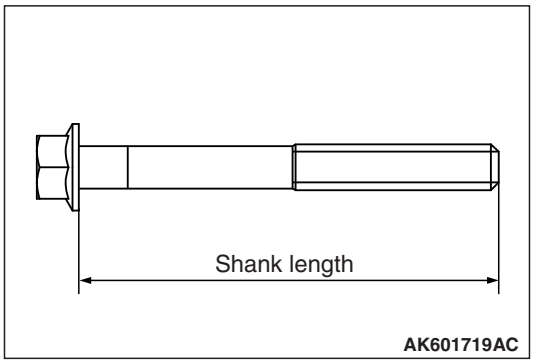


>>B<< CRANKSHAFT FRONT OIL SEAL INSTALLATION

Using special tool MD998382, press-fit the oil seal into the oil pump case.



>>C<< BEAM / BEARING CAP BOLT / RIGHT PLATE / LEFT PLATE INSTALLATION

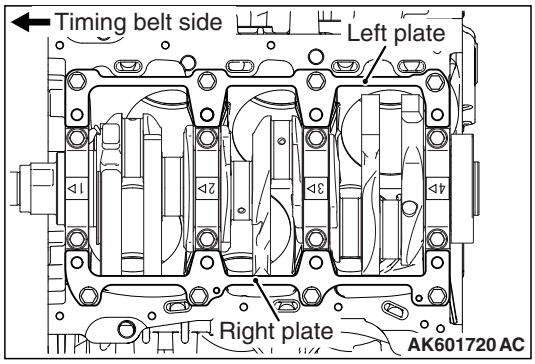


1. Before installing the bearing cap bolt, check the bolt screw head is not damaged. If the screw head extremely gets damaged, replace it with a new bolt. The standard length of the new bolt measured from under the head is as follows:

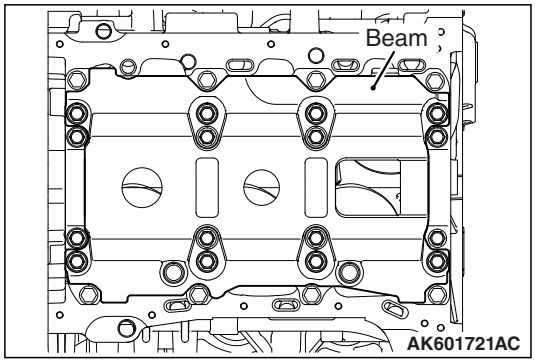
   Standard value: 100.7 – 101.7 mm (3.97 – 4.00 inches)

⚠ CAUTION

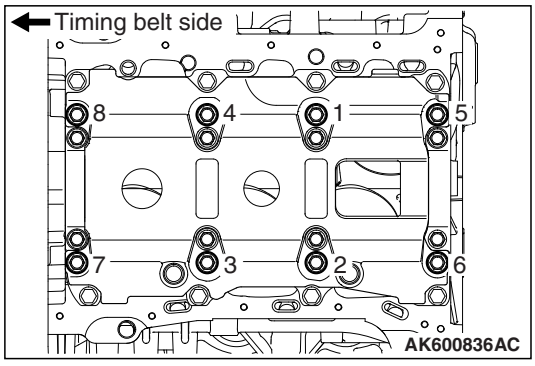
When the beam is removed and installed, never loosen the tightening bolts of the crankshaft bearing cap.



2. Put the right and left plates on the crankshaft bearing, Temporarily tighten bolt.

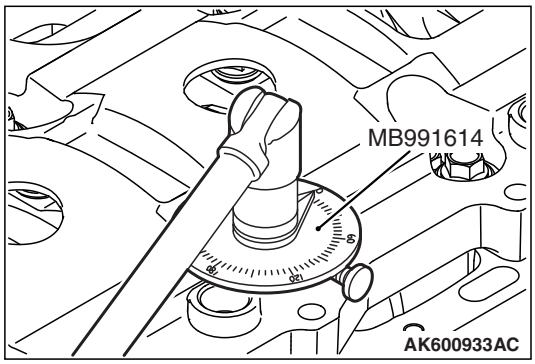


3. Put the beam on them, Temporarily tighten bolt.



4. Tighten the beam bolts to the specified torque in the tightening sequence shown.

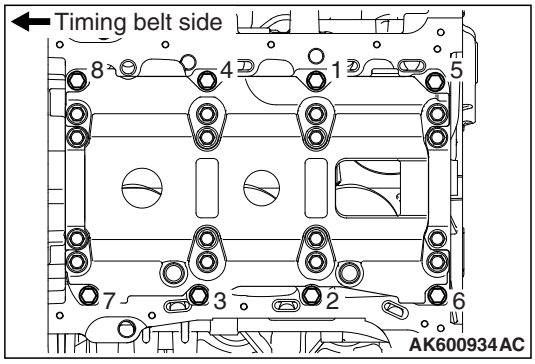
   Tightening torque: 24 ± 2 N·m (18 ± 1 ft-lb)



⚠ CAUTION

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

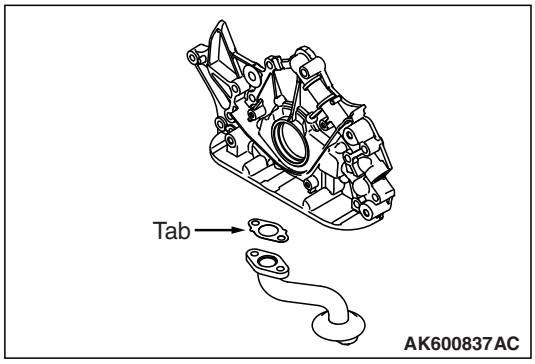
5. Using the special tool MB991614, tighten the beam bolt (M9) 60 degrees in accordance with the tightening order.



6. Tighten the plate bolts to the specified torque in the tightening sequence shown.

   Tightening torque: 23 ± 6 N·m (17 ± 4 ft-lb)

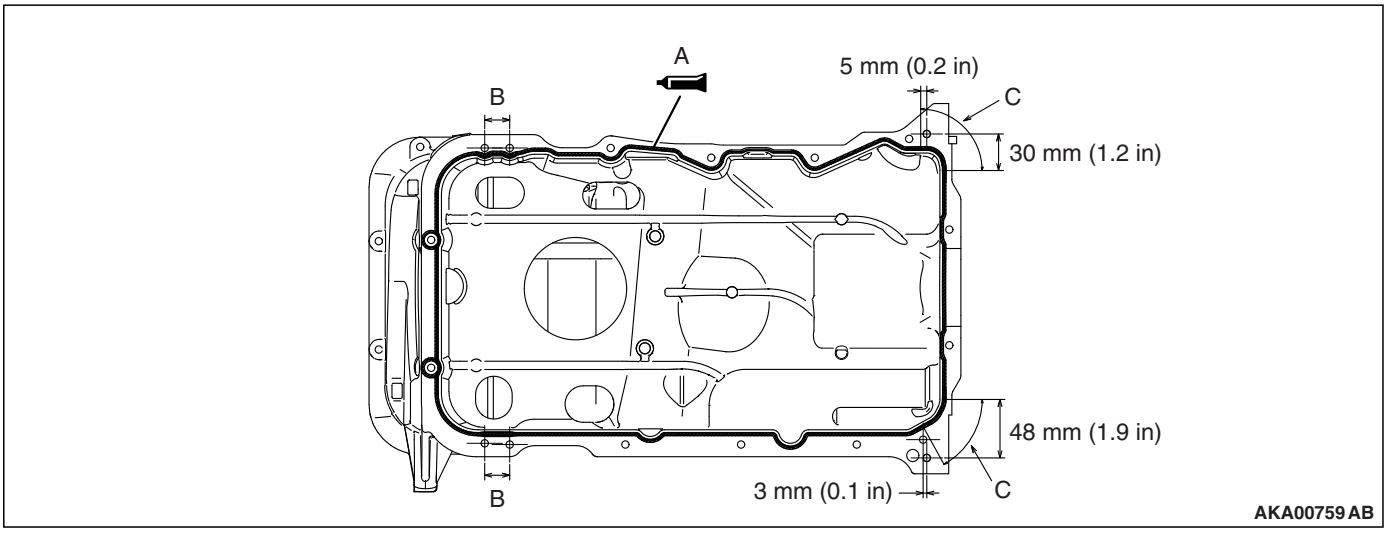
>>D<< OIL SCREEN GASKET INSTALLATION



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

>>E<< OIL PAN UPPER INSTALLATION

1. Clean the gasket surfaces of the oil pan upper and oil pan lower.



2. Apply a 2.5 ± 0.5 mm (0.10 ± 0.01 inch) bead of liquid gasket to location A, and a 4.0 ± 0.5 mm (0.20 ± 0.01 inch) bead of liquid gasket to location B, and a 3.2 ± 0.5 mm (0.13 ± 0.01 inch) bead of liquid gasket to location C on the oil pan respectively as illustrated.

   Specified sealant:
   Three bond 1217G or equivalent

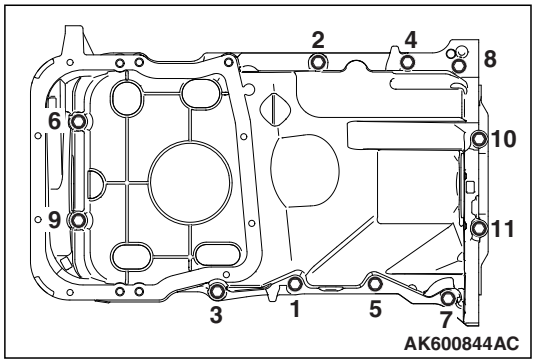
   NOTE: Install the oil pan within 15 minutes after applying liquid gasket.

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

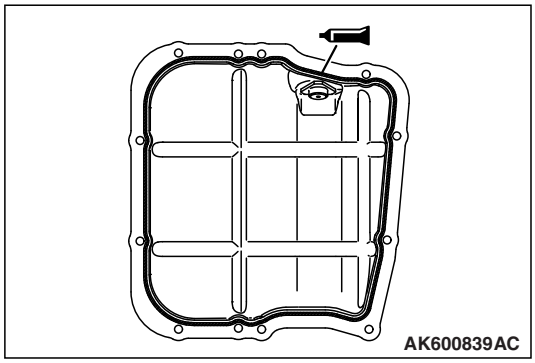
3. Tighten the upper oil pan bolts in the sequence shown.

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

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



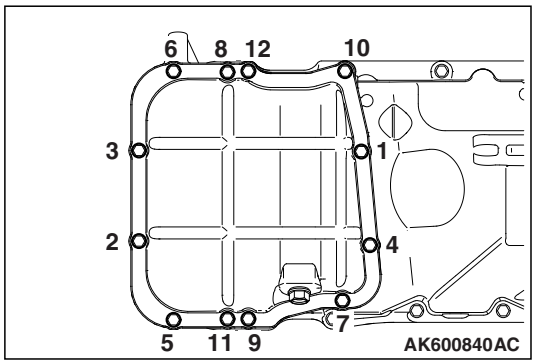
>>F<< OIL PAN LOWER INSTALLATION



1. Clean the gasket surfaces of the cylinder block and oil pan lower.
2. Apply a 2.5 ± 0.5 mm (0.10 ± 0.01 inch) diameter bead of sealant (Three bond 1217G or exact equivalent) to the oil pan. Be sure to install the oil pan quickly while the sealant is wet.

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

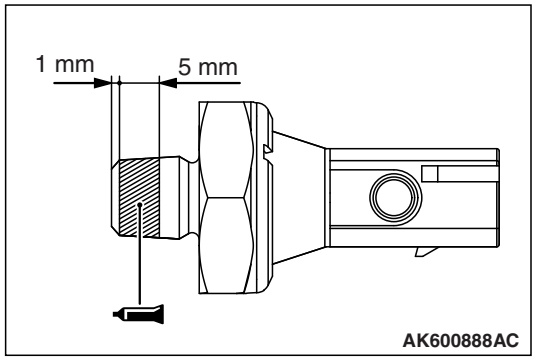
   NOTE: Then wait at least one hour. Never start the engine or let engine oil or coolant touch the adhesion surface during that time.



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

   Tightening torque: 10 ± 2 N·m (89 ± 17 in-lb)
4. After installation, keep the sealed area away from the oil and coolant for approximately one hour.

>>G<< ENGINE OIL PRESSURE SWITCH INSTALLATION



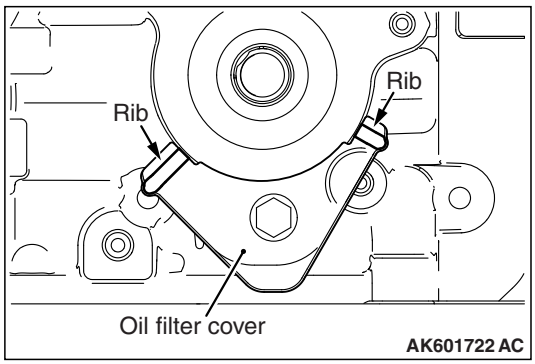
⚠ CAUTION

- **The threaded part tip of the switch must be clear of the sealant.**
- **Use care not to allow the sealant to plug the oil passage.**

1. Completely remove existing sealant from the oil pressure switch and the switch mounting hole on the oil pump case.
2. Apply sealant (Three bond 1215, Three bond 1212D or equivalent) to the threaded part of the oil pressure switch as shown.
3. Install the oil pressure switch to the oil pump case by tightening to a specified torque.

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

>>H<< OIL FILTER COVER INSTALLATION

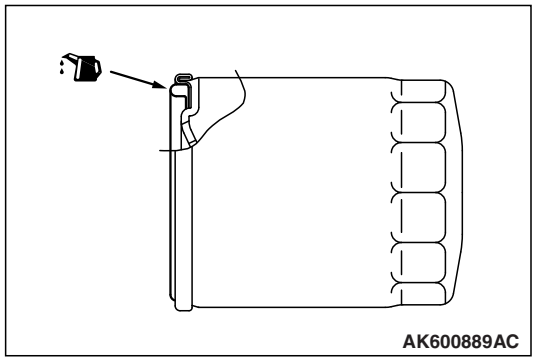


⚠ CAUTION

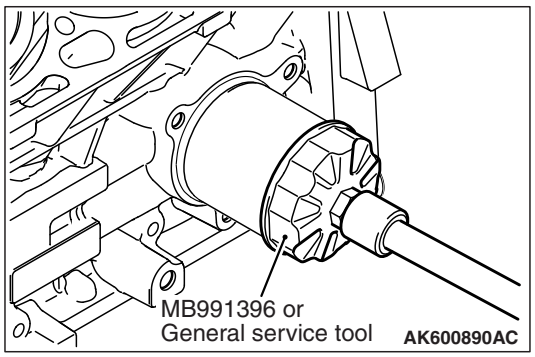
Do not damage the sealed area.

Check the right and left ribs of the oil filter cover touch the outer circumference of the oil filter boss.

>>I<< OIL FILTER INSTALLATION



1. Clean the filter mounting surface on the front case.
2. Apply engine oil to the O-ring of the oil filter.



⚠ CAUTION

If the filter is tightened by hand only, it will be insufficiently torqued, resulting in oil leaks.

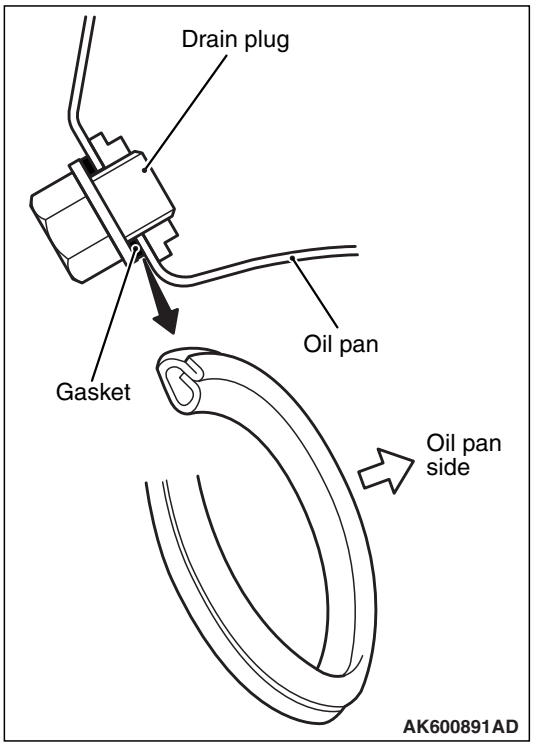
3. Screw the oil filter in and tighten the oil filter to the specified torque using a commercially available special tool MB991396 or general tool from where the O-ring has come into contact with the oil filter mounting surface.

   Tightening torque:

   MD332687, MD365876 16 ± 4 N·m (13 ± 3 ft-lb) <approx. 1 turn>

   MD360935 14 ± 2 N·m (124 ± 17 in-lb) <approx. 3/4 of a turn>

>>J<< DRAIN PLUG GASKET INSTALLATION



⚠ CAUTION

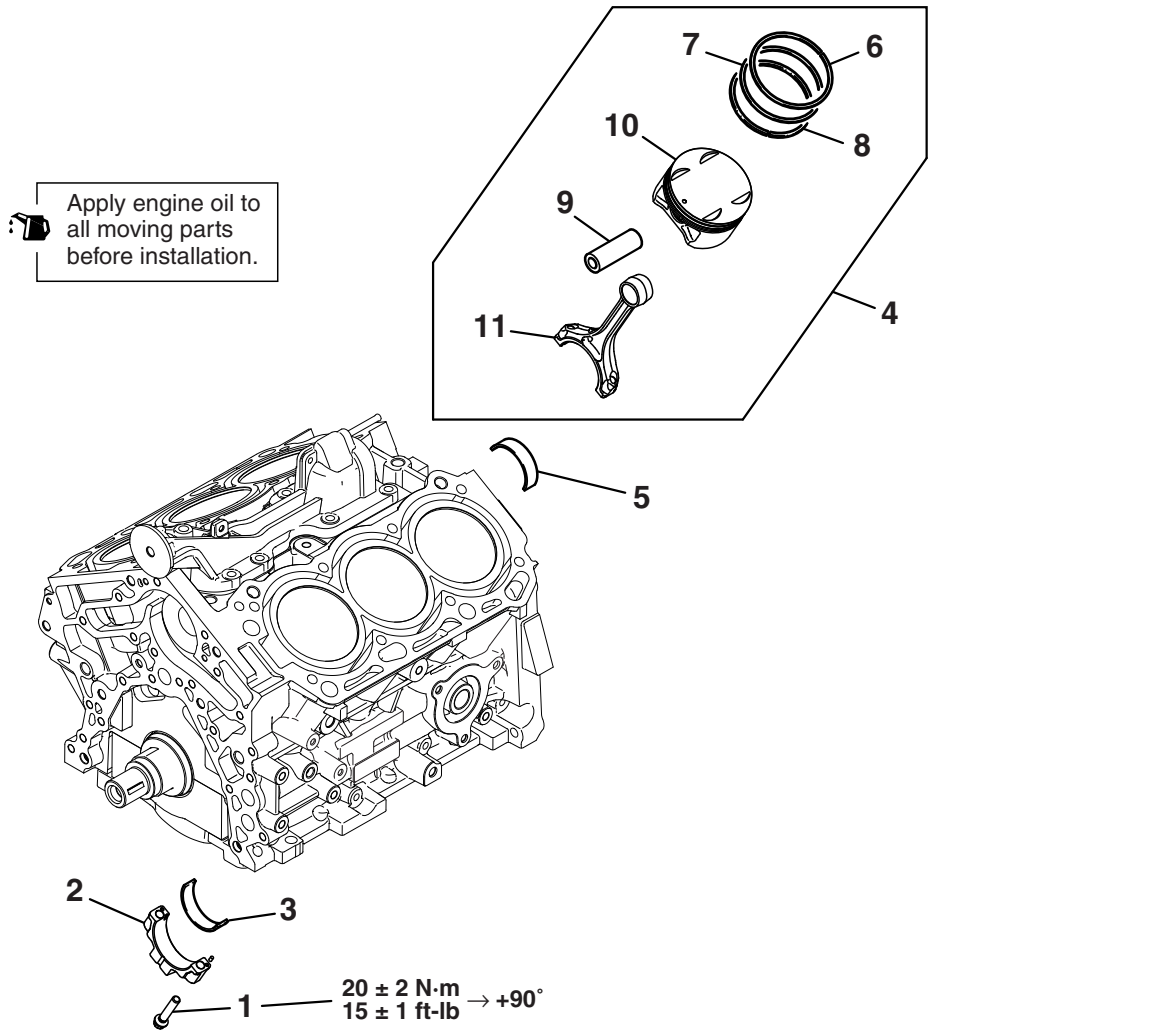
If the gasket is installed in the wrong direction, oil leaks will occur.

Install the drain plug gasket as illustrated.

PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008403226



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Removal steps

- >>G<< 1. Connecting rod bolt
- <<A>> >>F<< 2. Connecting rod cap
- >>D<< 3. Connecting rod bearing, lower
- >>E<< 4. Piston and connecting rod assembly
- >>D<< 5. Connecting rod bearing, upper
- >>C<< 6. Piston ring Number1

Removal steps (Continued)

- >>C<< 7. Piston ring Number2
- >>B<< 8. Oil ring
- <<B>> >>A<< 9. Piston pin
- 10. Piston
- 11. Connecting rod

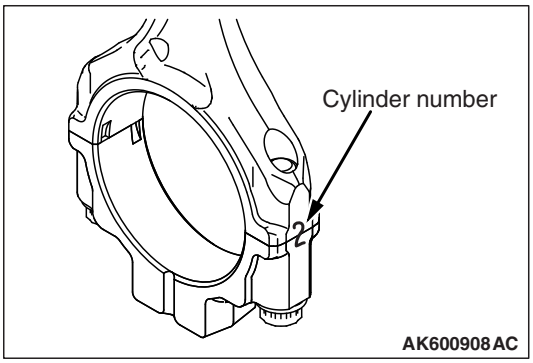
Required Special Tools:

- MD998780: Piston Pin Setting Tool
- MB991659: Guide D

TSB Revision

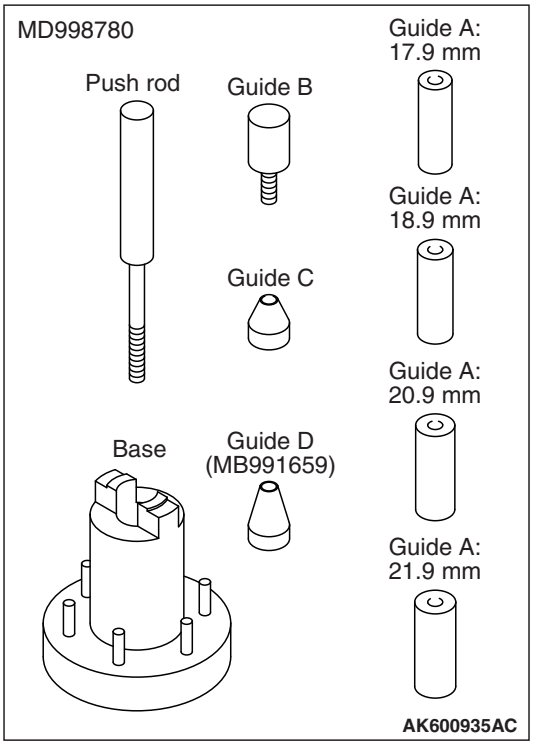
REMOVAL SERVICE POINTS

<<A>> CONNECTING ROD CAP REMOVAL

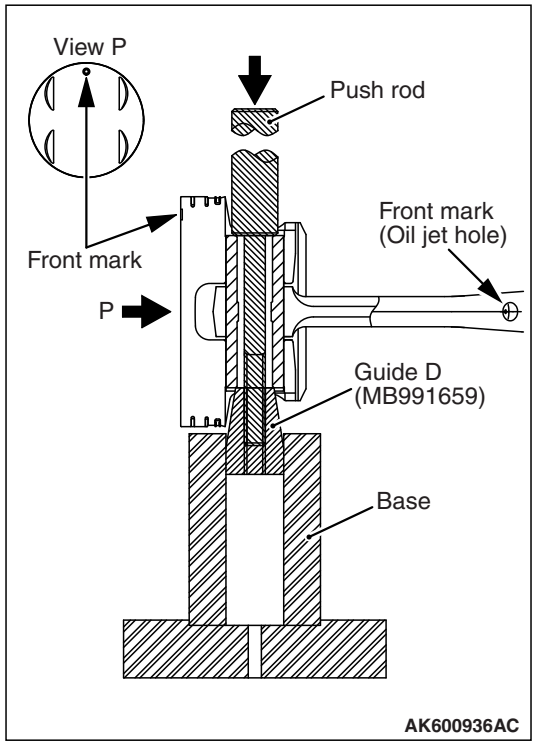


1. Mark the cylinder number on the side of the connecting rod big end for correct reassembly.
2. Keep the removed connecting rods, caps, and bearings in order according to the cylinder number.

<<B>> PISTON PIN REMOVAL



1. The special tool MD998780 consists of the elements shown in the illustration.
2. When removing the piston pin, the special tool MB991659 is also used.

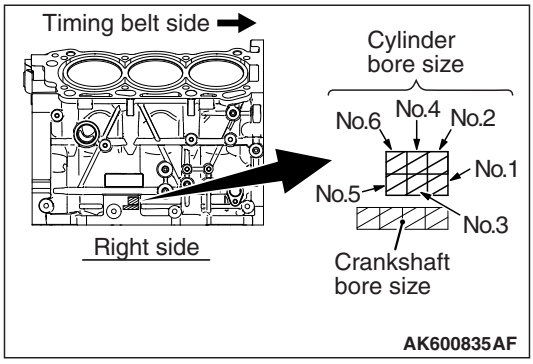


3. Insert Push rod, into the piston from the front mark side, then attach Guide D, to the push rod.
4. Place the piston and connecting rod assembly on Base, with the front mark facing up.
5. Use a press to remove the piston pin.

   NOTE: Keep the disassembled pistons, piston pins and connecting rods per cylinder.

INSTALLATION SERVICE POINTS

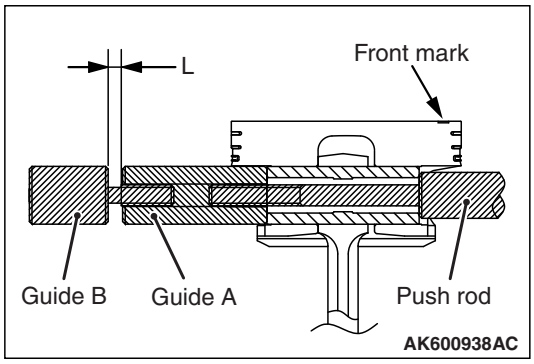
>>A<< PISTON PIN INSTALLATION

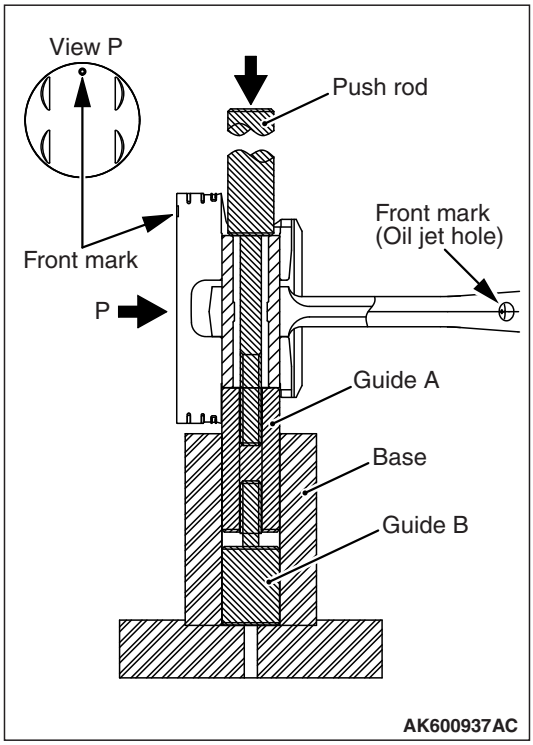


1. When replacing the piston, note the cylinder bore size mark on the cylinder block as illustrated, and select a piston according to the flowing table.

Cylinder bore size mark	Piston size mark
A	A
B	B

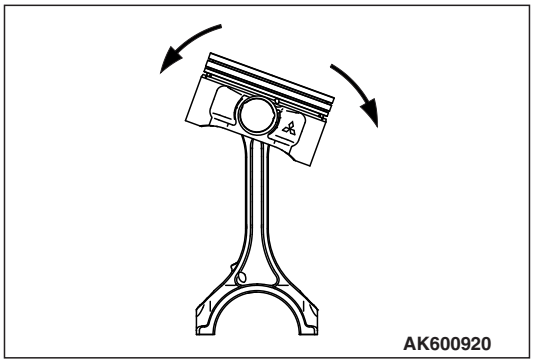
   NOTE: The piston size mark shows on the top of the piston.
2. Insert the push rod into the piston pin and install the guide A.
3. Align the front mark of the piston with that of the connecting rod. Align the piston with the connecting rod.
4. Apply engine oil to the outer circumference of the piston pin.
5. Insert the piston pin guide A installed at step 2 into the pin hole from the front mark of the piston.
6. Screw the guide B into A until the clearance "L" reaches 3.75 mm (0.147 inch) between A and B.





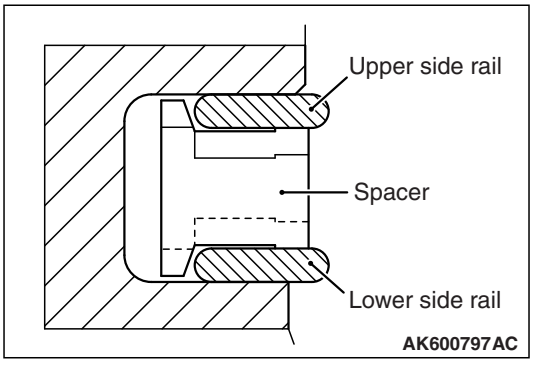
7. Place the piston and connecting rod assembly onto Base, with the front marks facing up.
8. Install the piston pin using a press. If the required press force is less than the standard value, replace the piston and piston pin assembly or the connecting rod, or both.

   Standard value: 5,000 – 15,000 N (1,124 – 3,372 lb)



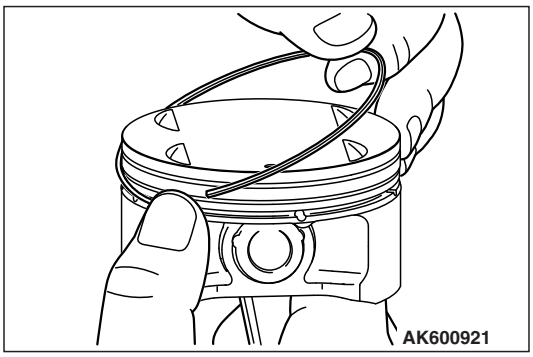
9. Check that the piston moves smoothly.

>>B<< OIL RING INSTALLATION



1. Fit the oil ring spacer into the piston ring groove.

   NOTE: The side rails and spacer may be installed in either direction.

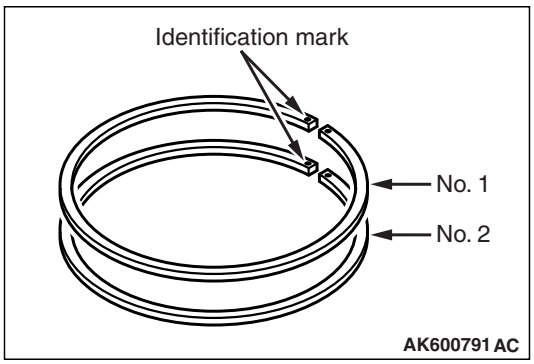


⚠ CAUTION

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

2. Install the upper side rail.
   To install the side rail, first fit one end of the rail into the piston groove, then press the remaining portion into the position by finger. See illustration.
3. Install the lower side rail in the same procedure as described in step 2.
4. Make sure that the side rails move smoothly in both directions.

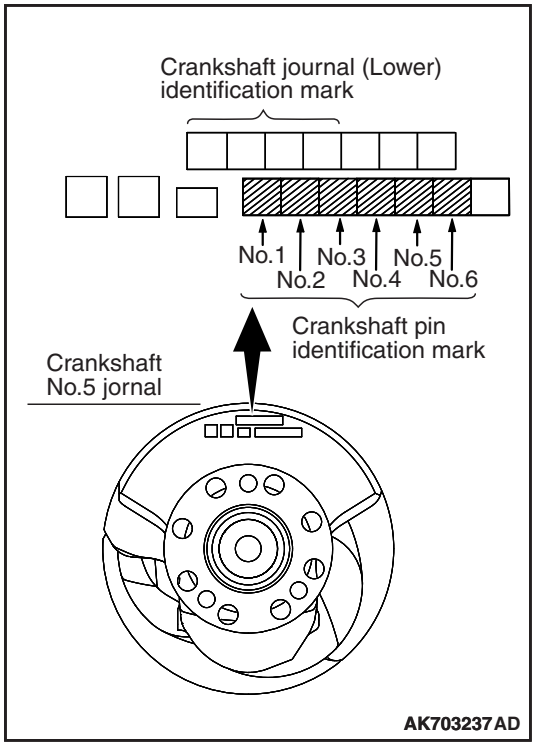
>>C<< PISTON RING NUMBER2 / PISTON RING NUMBER1 INSTALLATION



To prevent wrong installation, check the identification mark of each piston ring. The identification mark is stamped near the ring gap:

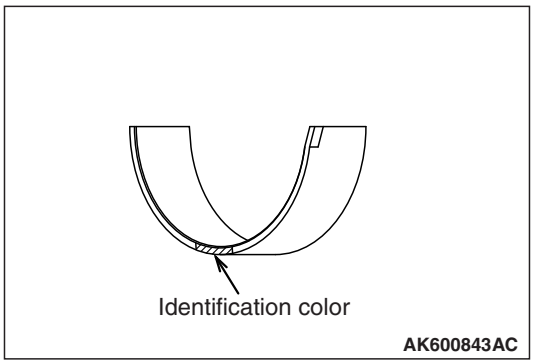
Identification mark
Number 1 ring: 1T
Number 2 ring: 2T

>>D<< CONNECTING ROD BEARING INSTALLATION



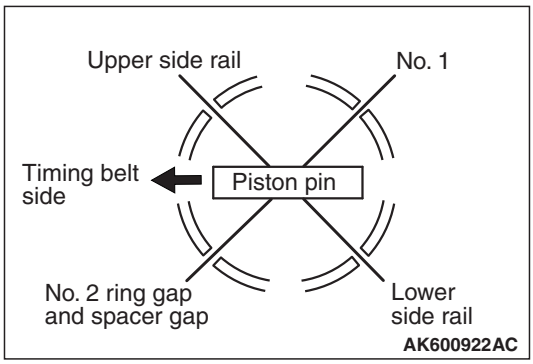
1. If the connecting rod bearing is replaced, select based on the identification mark of crankshaft (illustrated) and the table shown below.

Crankshaft pin identification mark	Bearing identification color
1	Black
2	Purple
3	Green

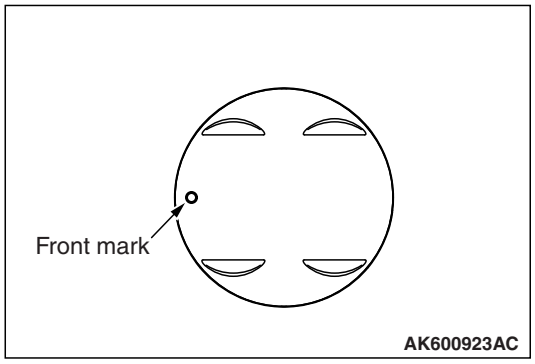


2. Every connecting rod bearing is identified by the identification color at the illustrated location.
3. Install the selected bearing in the big end and in the cap of the connecting rod.

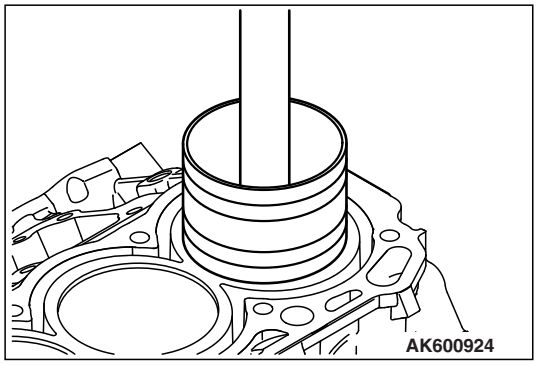
>>E<< PISTON AND CONNECTING ROD INSTALLATION



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

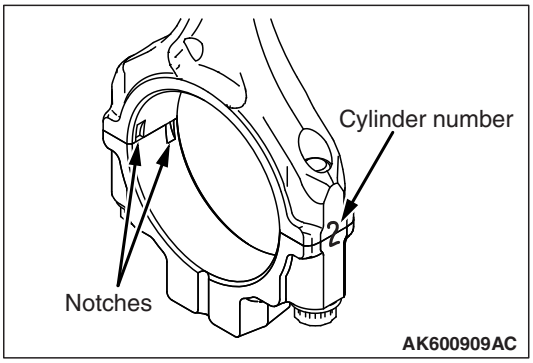


4. Insert the piston and connecting rod assembly into the cylinder with the front mark on the piston crown pointing to the timing belt side.

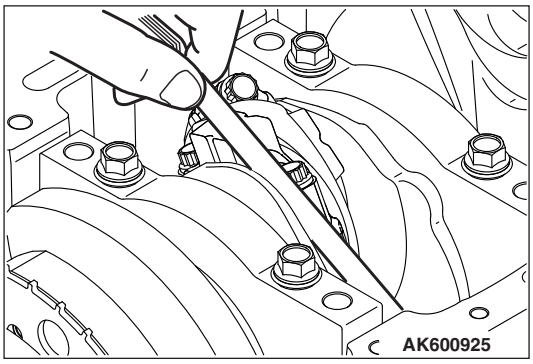


5. Using a suitable piston ring compressor tool, install the piston and connecting rod assembly into the cylinder block.

>>F<< CONNECTING ROD CAP INSTALLATION



1. Verifying the mark made during disassembly, install the bearing cap to the connecting rod. If the connecting rod is new with no index mark, make sure that the bearing locking notches are on the same side as shown.

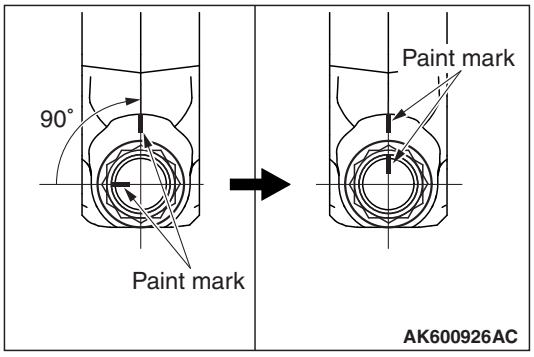


2. Make sure that the connecting rod big end side clearance meets the specification.

   Standard value: 0.10 – 0.25 mm (0.004 – 0.009 inch)
   Limit: 0.4 mm (0.02 inch)

>>G<< CONNECTING ROD BOLT INSTALLATION

1. Apply engine oil to the threaded portion and seating face of the bolt.
2. To correctly install the cap, loosely install the bolts with fingers.
3. Alternately, tighten the bolts in several steps to the specified torque of 20 ± 2 N·m (15 ± 1 ft-lb).
4. Make a paint mark on the head of each 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.**

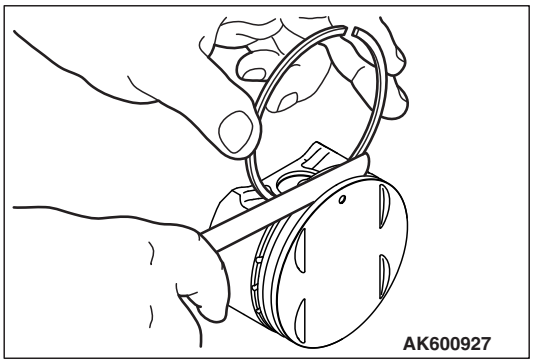
5. Put another paint mark on the bolt head at 90 degrees in the tightening direction from the first paint mark.
6. Tighten the bolt 90 degrees. The paint mark on the connecting rod should be aligned with the paint mark on the bolt.

PISTON AND CONNECTING ROD INSPECTION

M1113008501647

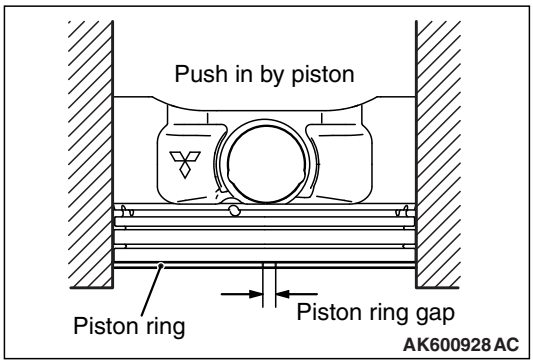
PISTON RING INSPECTION

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



Standard value:
Number 1: 0.04 – 0.08 mm (0.0016 – 0.0031 inch)
Number 2: 0.03 – 0.07 mm (0.0012 – 0.0027 inch)
Limit: 0.1 mm (0.004 inch)

3. Insert the piston ring into the cylinder bore. Force the ring down with a piston, the piston crown being in contact with the ring, to correctly position it at right angles to the cylinder wall. Then, measure the end gap with a feeler gauge.
   If the ring gap is excessive, replace the piston ring.



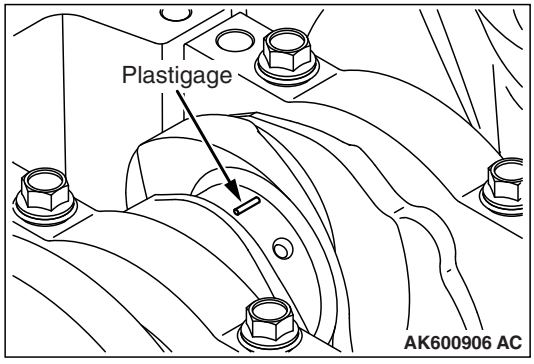
Standard value:
Number 1: 0.18 – 0.33 mm (0.008 – 0.012 inch)
Number 2: 0.28 – 0.48 mm (0.012 – 0.018 inch)
Oil: 0.10 – 0.60 mm (0.004 – 0.023 inch)

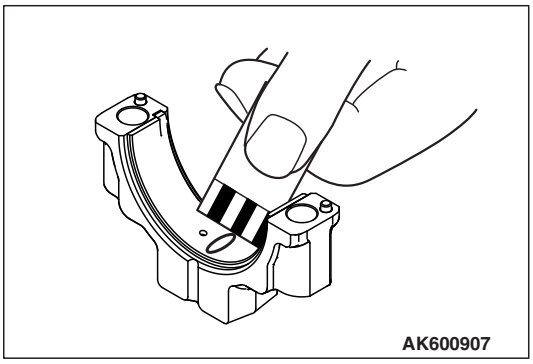
Limit:
Number 1, Number 2: 0.8 mm (0.03 inch)
Oil: 1.0 mm (0.04 inch)

CRANKSHAFT PIN OIL CLEARANCE <PLASTIGAGE METHOD>

The crankshaft oil clearance can be measured easily by using plastigage method, as follows:

1. Remove oil from the crankshaft pin and the bearing inner surface.
2. Cut plastigage to the same length as the width of the bearing and place it on the pin in parallel with its axis.
3. Install the connecting rod cap carefully and tighten the nuts to the specified torque.
4. Carefully remove the connecting rod cap.



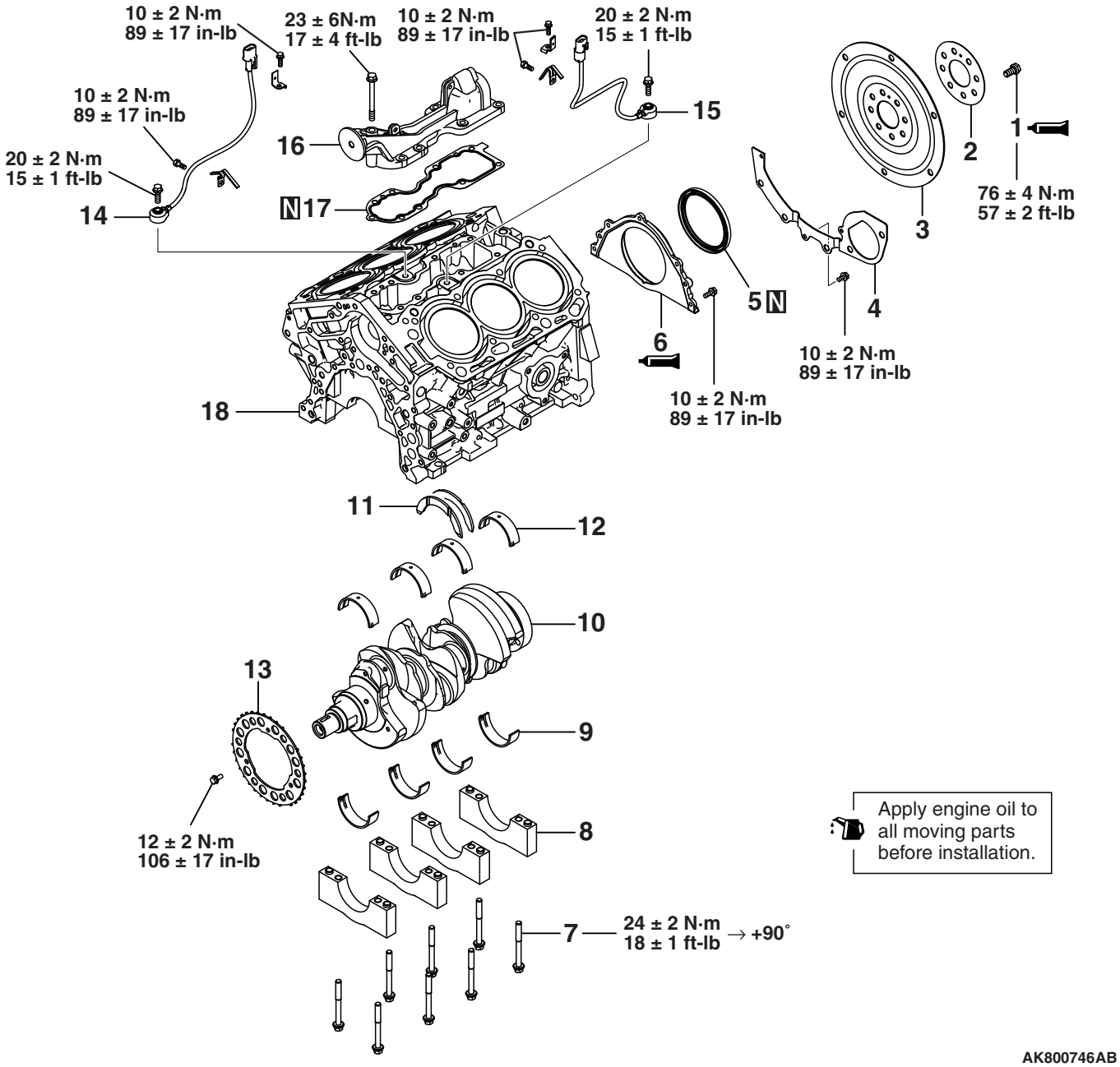


5. Measure the width of the smashed plastigage at its widest section by using a scale printed on the plastigage bag.
   Standard value: 0.012 – 0.039 mm (0.0005 – 0.0015 inch)
   Limit: 0.1 mm (0.004 inch)

CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008703744



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Removal steps

<<A>> >>H<< 1. Drive plate bolt
2. Adapter plate
3. Drive plate
4. Rear plate
>>F<< 5. Crankshaft rear oil seal
>>G<< 6. Oil seal case
>>E<< 7. Bearing cap bolt
>>E<< 8. Bearing cap
>>D<< 9. Crankshaft bearing, lower

Removal steps (Continued)

10. Crankshaft
>>C<< 11. Thrust bearing
>>B<< 12. Crankshaft bearing, upper
>>A<< 13. Crankshaft sensing ring
14. Knock sensor
15. Knock sensor
16. Bank stiffener
17. Bank stiffener gasket
18. Cylinder block

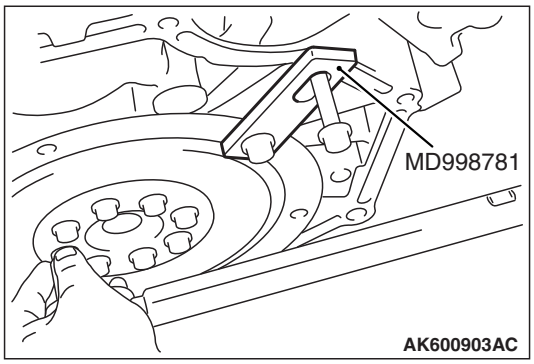
TSB Revision

Required Special Tools:

- MB992075: Handle
- MB992183: Crankshaft Rear Oil Seal Installer
- MD998781: Flywheel Stopper

REMOVAL SERVICE POINT

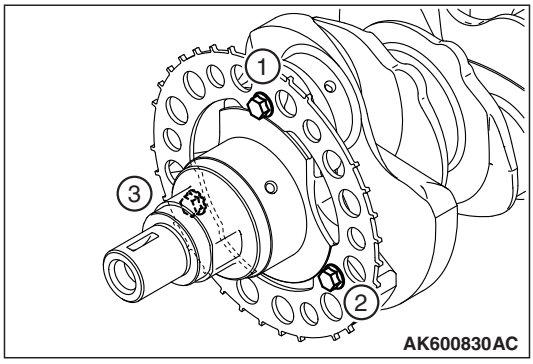
<<A>> DRIVE PLATE BOLT REMOVAL



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

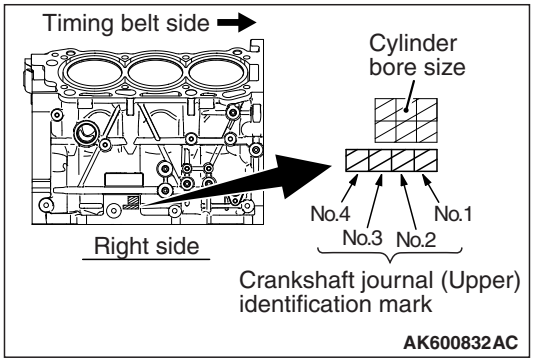
INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT SENSING RING INSTALLATION



1. Apply the engine oil to the thread portions and the sealed portions on the installation bolts.
2. In accordance with the tightening order shown in the illustration, tighten the crankshaft sensing ring to the specified torque.

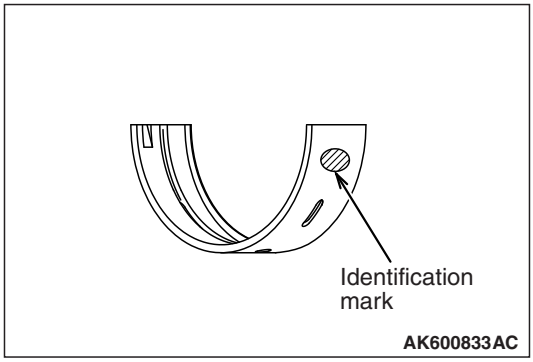
   Tightening torque: 12 ± 2 N·m (106 ± 17 in-lb)



>>B<< CRANKSHAFT BEARING UPPER INSTALLATION

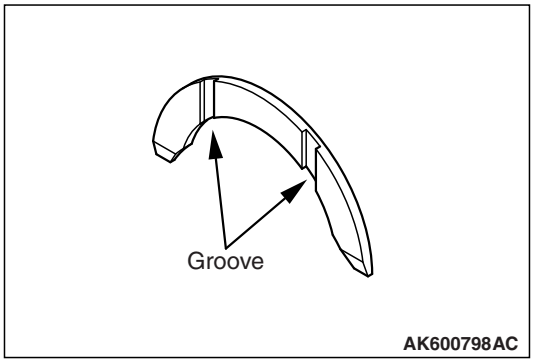
1. If the upper crankshaft bearing is replaced, select based on the identification mark of cylinder block (illustrated) and the table shown below.

Crankshaft journal (Upper)	Crankshaft bearing
Identification mark	**Identification mark**
Number 1 and 4 journal	
1	1
2	2
3	3
Number 2 and 3 journal	
0	0
1	1
2	2



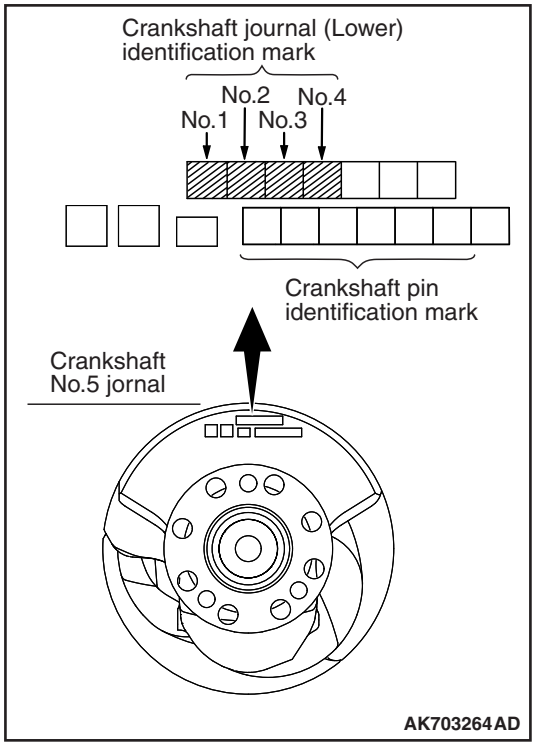
2. The upper crankshaft bearing has the identification mark on the location shown in the illustration.
3. Install the upper selected crankshaft bearing.

>>C<< CRANKSHAFT THRUST BEARING INSTALLATION



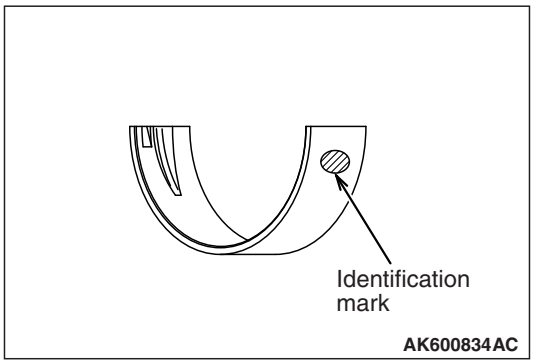
1. Install the thrust bearing in the Number3 bearing bore in the cylinder block and in the bearing cap. For easier installation, apply engine oil to the bearings; this will help hold them in position.
2. The thrust bearings must be installed with their groove toward the crankshaft web.

>>D<< CRANKSHAFT BEARING LOWER INSTALLATION



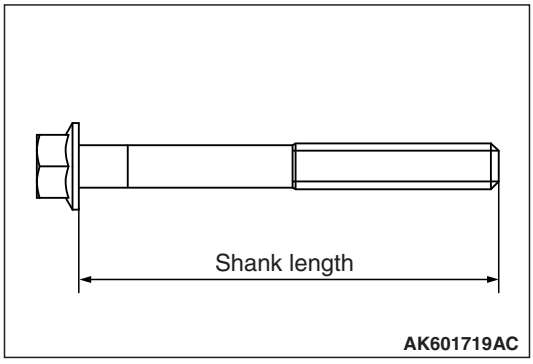
1. If the lower crankshaft bearing is replaced, select based on the identification mark of crankshaft (illustrated) and the table shown below.

Crankshaft journal (Lower)	Crankshaft bearing
Identification mark	Identification mark
0	0
1	1
2	2
3	3
4	4



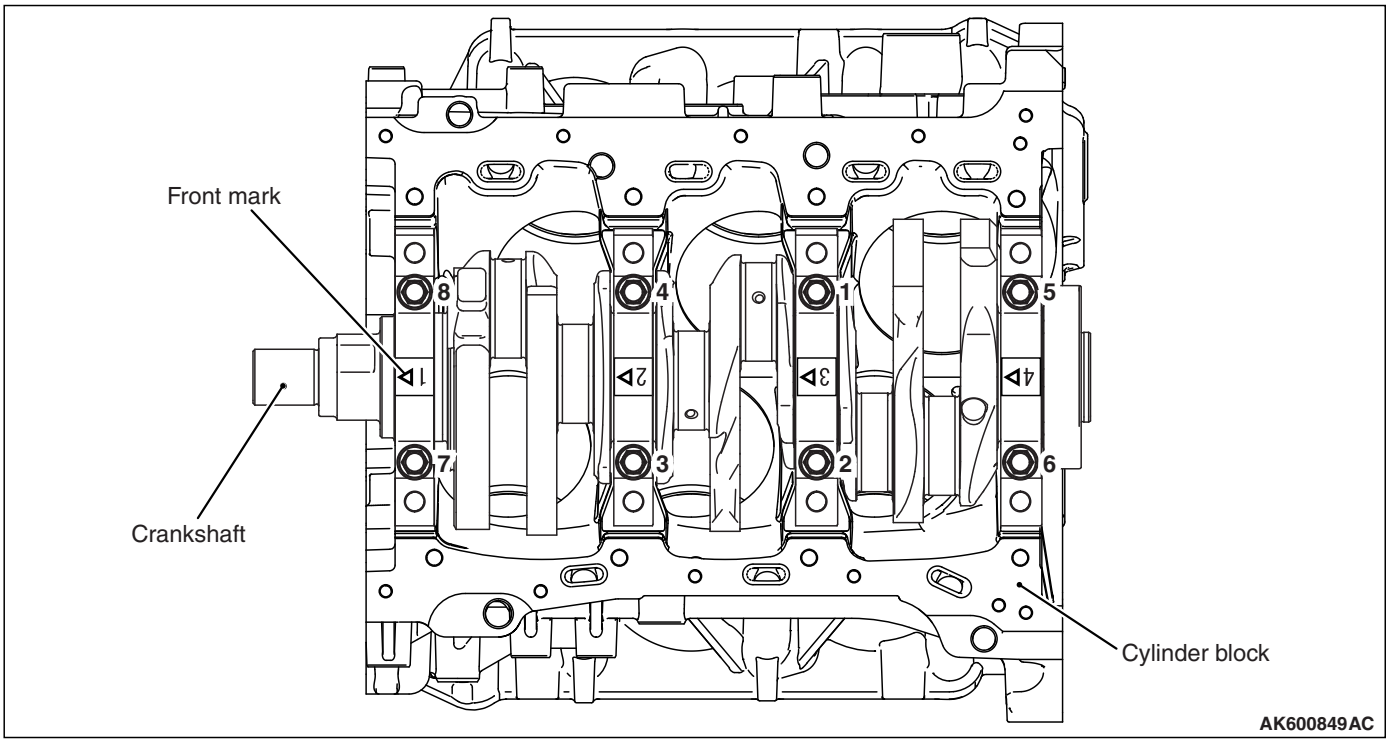
2. The lower crankshaft bearing has the identification mark on the location shown in the illustration.
3. Install the lower selected crankshaft bearing.

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



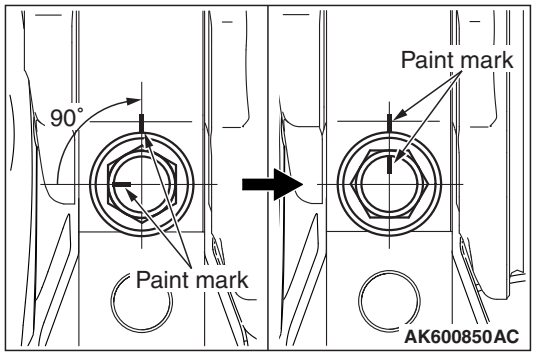
1. Before installing the bearing cap bolt, check the bolt screw head is not damaged. If the screw head extremely gets damaged, replace it with a new bolt. The standard length of the new bolt measured from under the head is as follows:

Standard value: 91.2 – 92.2 mm (3.59 – 3.63 inches)



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

   Tightening torque: 24 ± 2 N·m (18 ± 1 ft-lb)
4. Make a paint mark on the head of each bolt.

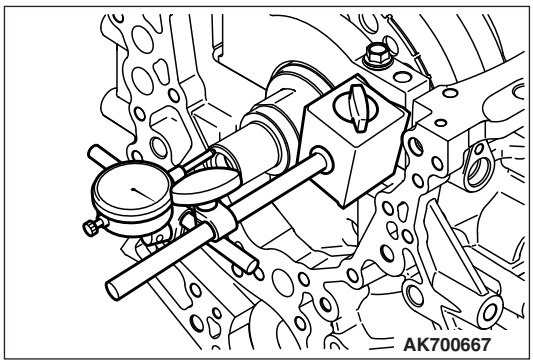


⚠ CAUTION

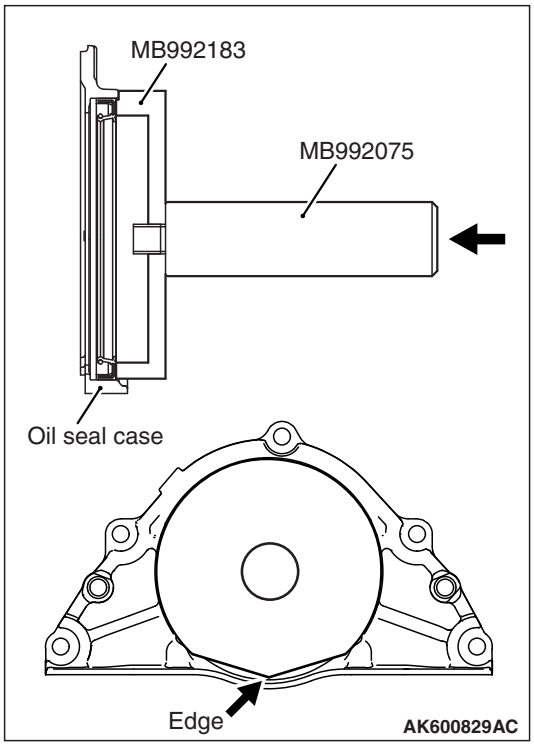
- **When the tightening angle is smaller than the specified tightening angle, the appropriate tightening capacity cannot be secured.**
- **When the tightening angle is larger than the specified tightening angle, remove the bolt to start from the beginning again according to the procedure.**

5. Make a paint mark on the bearing cap 90 degrees from the paint mark made on the bolt, in the direction of tightening the bolt.
6. Turn each bolt 90 degrees in the tightening sequence specified in step 2, and make sure that the paint marks on the bolt and cap are aligned.
7. Check that the crankshaft rotates smoothly.
8. Check the end play. If it exceeds the limit value, replace the thrust bearing.

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



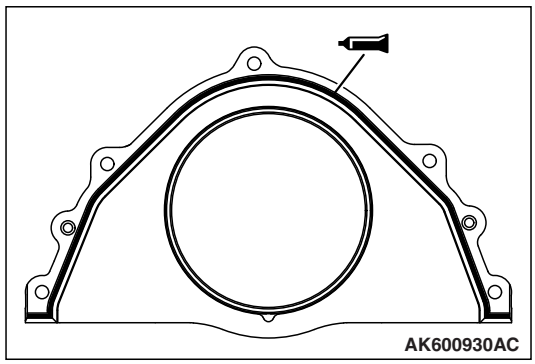
TSB Revision



>>F<< CRANKSHAFT REAR OIL SEAL INSTALLATION

Using special tools MB992075 and MB992183, press-fit a new crankshaft rear oil seal into the oil seal case.

NOTE: Put the edge position in place as shown in the illustration.

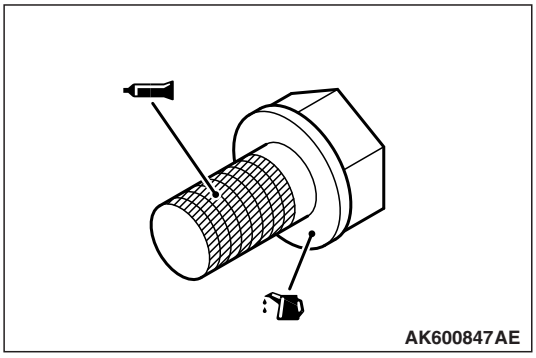


>>G<< OIL SEAL CASE INSTALLATION

1. Apply a 2.5 ± 0.5 mm (0.10 ± 0.01 inch) diameter bead of sealant (Three bond 1217G or exact equivalent) to the oil seal case.
2. Apply a small amount of engine oil to the entire circumference of the oil seal lip section, and place the oil seal case on the cylinder block.

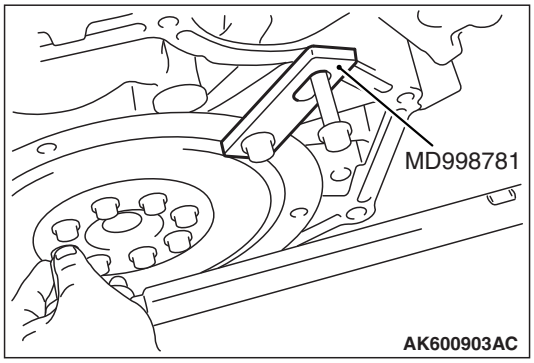
   NOTE: Install the oil seal case within 15 minutes after applying liquid gasket.

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



>>H<< DRIVE PLATE BOLT INSTALLATION

1. Cleanly remove sealant, oil and dust on the drive plate bolt, the drive plate and the threaded portions of the crankshaft.
2. Apply oil to the drive plate and the seating surface of the drive plate bolt.
3. Apply oil to the threaded hole of the crankshaft
4. Apply sealant (Three bond 1324 or equivalent) to the thread portions of the drive plate bolt.



5. Using special tool MD998781, hold the drive plate.
6. Tighten the drive plate bolt to the specified torque.
   Tightening torque: 76 ± 4 N·m (57 ± 2 ft-lb)

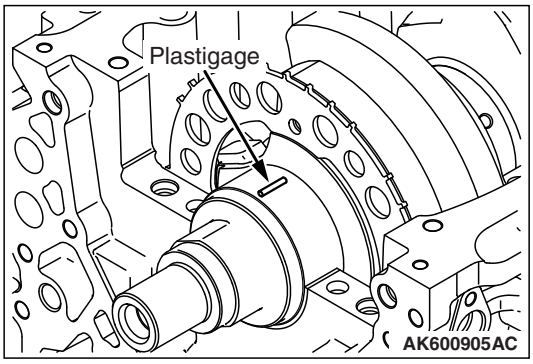
CYLINDER BLOCK INSPECTION

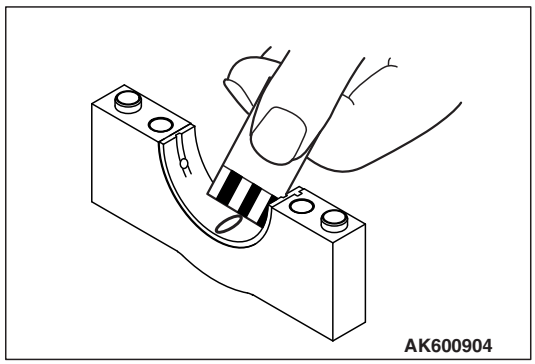
M1113008801659

CRANKSHAFT OIL CLEARANCE (PLASTIGAGE METHOD)

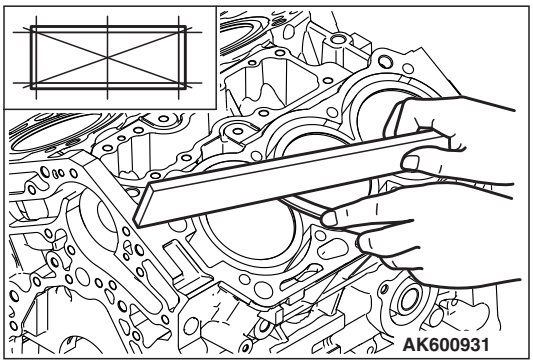
The crankshaft oil clearance can be measured easily by using a plastigage, as follows:

1. Remove oil and grease and any other foreign matters from crankshaft journal and bearing inner surface.
2. Install the crankshaft.
3. Cut the plastigage to the same length as the width of bearing and place it on journal in parallel with its axis.





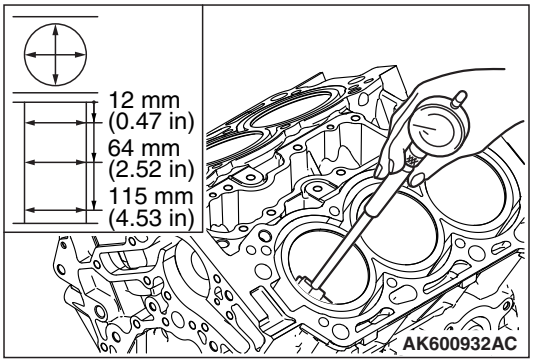
4. Gently place the crankshaft bearing cap over it and tighten the bolts to the specified torque.
5. Remove the bolts and gently remove the crankshaft bearing cap.
6. Measure the width of the smashed plastigage at its widest section by using a scale printed on the plastigage bag.
   Standard value:
   Number 1 and 4 journal
   0.018 – 0.038 mm (0.0008 – 0.0014 inch)
   Number 2 and 3 journal
   0.024 – 0.044 mm (0.0010 – 0.0017 inch)
   Limit: 0.1 mm (0.004 inch)



1. Using a straightedge and thickness gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other objects.

   Standard value: 0.05 mm (0.002 inch)
   Limit: 0.1 mm (0.004 inch)

2. If the distortion is excessive, replace the cylinder block.



3. Check cylinder walls for scratches and seizure. If defects are evident, correct (bored to oversize) or replace.
4. Using a cylinder gauge, measure the cylinder bore, and cylindricity. If worn badly, correct cylinder to an oversize and replace piston and piston rings. Measurement points are shown in illustration.

   Standard value
   Cylinder I.D.: 87.6 mm (3.45 inch)
   Cylindricity: 0.015 mm (0.0006 inch)