GROUP 11B

ENGINE OVERHAUL

CONTENTS

HOW TO USE THIS MANUAL

M1113025100230

HOW TO USE THIS MANUAL

Scope of Service Explanations

This manual describes service procedures performed after removal of the engine from the vehicle.
For removal of the engine from the vehicle, installation of the engine in the vehicle, and on-vehicle inspection and service of the engine, please use the separate Workshop Manuals prepared for the vehicle.

How to Read Explanations

Service steps

(1) A component part drawing is shown at the beginning of each section to enable the technician to ascertain the installed condition of the component parts.
(2) Service steps are indicated by means of numbers in the component part drawing. Non-reusable parts are indicated as such, and tightening torques are shown.
- Removal steps
  The numbers of the part names match the numbers in the component part drawing and indicate the removal sequence.
- Installation steps
  Installation steps are omitted wherever installation can be achieved simply by performing the removal steps in reverse.
- Disassembly steps
  The numbers of the part names match the numbers in the component part drawing and indicate the disassembly sequence.
- Reassembly steps
  Reassembly steps are omitted wherever reassembly can be achieved simply by performing the disassembly steps in reverse.

Classification of Service Points

Key service points, service standards, and instructions for using special tools are collated as service points and explained in detail.

<<A>>: Outward-pointing brackets denote removal service points or disassembly service points.
>>A<<: Inward-pointing brackets denote installation service points or reassembly service points.

Lubricant and Sealant Symbols

Every location where a lubricant or sealant must be applied or added is indicated using a relevant symbol in the component part drawing and/or on the page after the component part drawing.

 . . . . . Grease
 . . . . . Sealant or form-in-place gasket (FIPG)
 . . . . . Brake fluid
 . . . . . Engine oil or gear oil

Inspection

Only those inspection procedures which use special tools or measuring appliances are described. You must perform general visual inspection and part cleaning whenever necessary although their procedures are not described in this manual.

AK202851

Page number

Group title

Section title

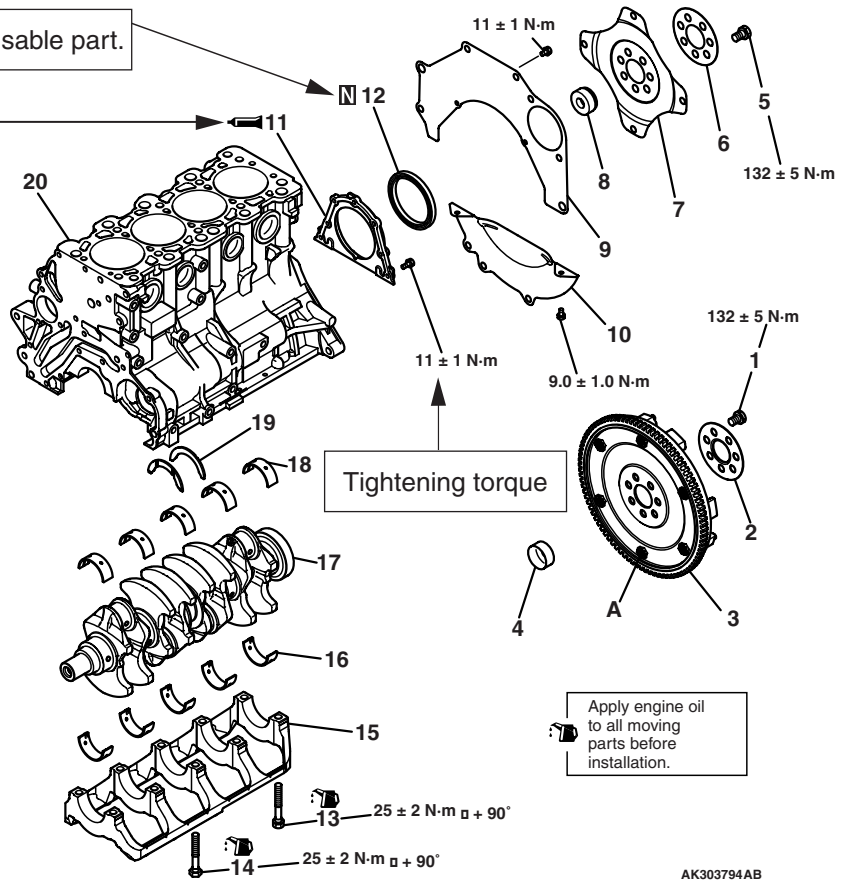
11-54

ENGINE OVERHAUL
CRANKSHAFT AND CYLINDER BLOCK

CRANKSHAFT AND CYLINDER BLOCK

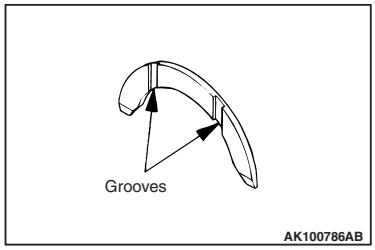
REMOVAL AND INSTALLATION

Denotes non-reusable part.



Removal steps
1. Flywheel bolt
2. Adapter plate
3. Flywheel
4. Crankshaft bushing
5. Drive plate bolt
6. Adapter plate
7. Drive plate
8. Crankshaft bushing
9. Rear plate
10. Bell housing cover
>>E<< 11. Oil seal case
>>D<< 12. Oil seal

INSTALLATION SERVICE POINTS
>>A<< THRUST BEARING INSTALLATION



The alphabetical character in this category of heading matches that of the relevant removal steps, installation steps, disassembly steps, or reassembly steps.

Procedures and cautions for removal, installation, disassembly, and reassembly are explained under this category of heading.

AK303970

GENERAL INFORMATION

M1113000100396

VEHICLE AND ENGINE MODELS

Vehicle name	Vehicle model	Engine model	Displacement mL	Specification
Grandis	NA4W	4G69-2	2,378	Single overhead camshaft, 16-valve

GENERAL SPECIFICATIONS

M1113000200638

Description			Specification
Type			In-line OHV, SOHC
Number of cylinders			4
Combustion chamber			Pent roof type
Total displacement cm^3			2,378
Cylinder bore mm			87
Piston stroke mm			100
Compression ratio			9.5
Valve timing	Intake valve	Opens (BTDC)	0° <Low speed cam A>
			2° <Low speed cam B>
			20° <High speed cam>
		Closes (ABDC)	46° <Low speed cam A>
			48° <Low speed cam B>
			72° <High speed cam>
	Exhaust valve	Opens (BBDC)	54°
		Closes (ATDC)	21°
Lubrication system			Pressure feed, full-flow filtration
Oil pump type			Involute gear type

SERVICE SPECIFICATIONS

M1113000300613

Item		Standard value	Limit
Timing belt			
Auto tensioner rod length mm		3.8 – 4.5	–
Auto-tensioner rod projection length mm		12	–
Auto-tensioner rod pushed-in amount [When pushed with a force of 98 – 196 N] mm		1.0 or less	–
Valve clearance mm	Intake	0.11	–
	Exhaust	0.20	–
Rocker arms and camshaft			

Item			Standard value	Limit
Camshaft cam height mm	Intake	Low speed cam A	34.41	Minimum 33.91
		Low speed cam B	37.47	Minimum 36.97
		High speed cam	37.21	Minimum 36.71
	Exhaust		37.86	Minimum 37.36
Camshaft journal outside diameter mm			45	–
Cylinder head and valves				
Cylinder head flatness of gasket surface mm			Less than 0.03	0.2
Cylinder head grinding limit of gasket surface mm (Total resurfacing depth of cylinder head and cylinder block)			–	0.2
Cylinder head overall height mm			120	–
Cylinder head bolt shank length mm			–	99.4
Valve thickness of valve head (margin) mm	Intake		1.0	Minimum 0.5
	Exhaust		1.2	Minimum 0.7
Valve overall height mm	Intake		111.33	Minimum 110.83
	Exhaust		113.54	Minimum 113.04
Valve stem outside diameter mm			6.0	–
Valve thickness to valve guide clearance mm	Intake		0.02 – 0.04	0.10
	Exhaust		0.04 – 0.06	0.15
Valve face angle mm			43.5° – 44°	–
Valve spring free length mm	Intake		54.8	Minimum 53.8
	Exhaust		56.1	Minimum 55.1
Valve spring load/installed height N/mm	Intake		235/44.2	–
	Exhaust		226/44.2	–
Valve spring out-of-squareness			2° or less	4°
Valve seat valve contact width mm			0.9 – 1.3	–
Valve guide inside diameter mm			6.0	–
Valve guide projection from cylinder head upper surface mm			14.0	–
Valve stem projection mm	Intake		48.33	48.83
	Exhaust		48.34	48.84
Oil pan and oil pump				
Oil pump side clearance mm	Drive gear		0.08 – 0.14	–
	Driven gear		0.06 – 0.12	–
Oil pressure at curb idle speed kPa [oil temperature is 75 to 90°]			78 or more	–
Piston and connecting rod				
Piston outside diameter mm			87	–

Item		Standard value	Limit
Piston ring side clearance mm	No. 1	0.03 – 0.07	0.1
	No. 2	0.02 – 0.06	0.1
Piston ring end gap mm	No. 1	0.15 – 0.30	0.8
	No. 2	0.28 – 0.43	0.8
	Oil ring side rail	0.10 – 0.40	1.0
Piston pin outside diameter mm		22.0	–
Piston pin press-in load N (Room temperature)		7,350 – 17,200	–
Crankshaft pin oil clearance mm		0.02 – 0.05	0.1
Connecting rod big end side clearance mm		0.10 – 0.25	0.4
Crankshaft and cylinder block			
Crankshaft end play mm		0.05 – 0.25	0.40
Crankshaft journal outside diameter mm		57.0	–
Crankshaft pin outside diameter mm		45.0	–
Crankshaft journal oil clearance mm		0.02 – 0.04	0.1
Bearing cap bolt shank length mm		–	71.1
Piston to cylinder clearance mm		0.02 – 0.04	–
Cylinder block flatness of gasket surface mm		0.05	0.1
Cylinder block grinding limit of gasket surface mm (Total resurfacing depth of both cylinder head and cylinder block)		–	0.2
Cylinder block overall height mm		284	–
Cylinder block inside diameter mm		87.0	–
Cylindricity mm		0.01	–

REWORK DIMENSIONS

M1113024300253

Item			Standard value
Cylinder head And valves			
Diameter of oversize valve seat ring hole in cylinder head mm	Intake	0.3 oversize	35.30 – 35.33
		0.6 oversize	35.60 – 35.63
	Exhaust	0.3 oversize	33.30 – 33.33
		0.6 oversize	33.60 – 33.63
Diameter of oversize valve guide hole in cylinder head mm		0.05 oversize	11.05 – 11.07
		0.25 oversize	11.25 – 11.27
		0.50 oversize	11.50 – 11.52

TORQUE SPECIFICATIONS

M1113023400785

Item	Specification
Alternator and ignition system	
Auto-tensioner bracket bolt M10	44 ± 10 N·m
Auto-tensioner bracket bolt M8	22 ± 4 N·m
Camshaft position sensing cylinder bolt	22 ± 4 N·m
Camshaft position sensor bolt	10 ± 2 N·m
Camshaft position sensor support bolts	14 ± 1 N·m
Connector bracket bolts	10 ± 1 N·m
Crankshaft pulley bolts	25 ± 4 N·m
Alternator bolt	49 ± 9 N·m
Alternator pivot nut	44 ± 10 N·m
Idler pulley bolt	79 ± 5 N·m
Ignition coil bolts	10 ± 2 N·m
Oil level gauge guide bolts	13 ± 1 N·m
Spark plugs	25 ± 5 N·m
Water pump pulley bolts	8.8 ± 1.0 N·m
Exhaust manifold	
Oxygen sensors	44 ± 5 N·m
Engine hanger bolt	24 ± 3 N·m
Exhaust manifold cover bolts	14 ± 1 N·m
Exhaust manifold bracket B bolt	44 ± 5 N·m
Exhaust manifold nuts	49 ± 5 N·m
Exhaust manifold bracket A bolts	36 ± 5 N·m
Timing belt	
Auto-tensioner bolts	23 ± 2 N·m
Camshaft sprocket bolt	89 ± 9 N·m
Counterbalance shaft sprocket bolt	45 ± 3 N·m
Crankshaft bolt	167 N·m
Crankshaft angle sensor bolts	8.5 ± 0.5 N·m
Engine support bracket bolts	49 ± 5 N·m
Alternator bracket bolts	49 ± 9 N·m
Idler pulley bolt	35 ± 6 N·m
Oil pump sprocket nut	54 ± 4 N·m
Tensioner "B" bolt	19 ± 3 N·m
Tensioner arm bolt	21 ± 4 N·m
Tensioner pulley bolt	48 ± 5 N·m
Timing belt cover bolts M6 (Bolt, washer assembly)	9.0 ± 1.0 N·m
Timing belt cover bolts M6 (Flange bolt and nut)	11 ± 1 N·m
Timing belt cover bolts M8	14 ± 1 N·m

Item	Specification
Fuel and emission parts	
EGR valve bolts	24 ± 3 N·m
Fuel pressure regulator bolts	9.0 ± 1.0 N·m
Injectors and delivery pipe bolts	11 ± 1 N·m
Solenoid valve bracket bolts	11 ± 1 N·m
Solenoid valve nut	9.0 ± 1.0 N·m
Throttle body bolts	14 ± 3 N·m
Vacuum pipe and hose bolts	11 ± 1 N·m
Inlet manifold and water pump	
Engine coolant temperature sensor	30 ± 9 N·m
Engine hanger bolt	24 ± 3 N·m
Harness bracket bolts	11 ± 1 N·m
Inlet manifold bolts	24 ± 3 N·m
Inlet manifold nuts	20 ± 2 N·m
Inlet manifold stay bolts	31 ± 3 N·m
Detonation sensor	23 ± 2 N·m
Oil pressure switch	19 ± 3 N·m
Thermostat housing bolts	24 ± 4 N·m
Water inlet fitting bolts	13 ± 2 N·m
Water inlet pipe bolt	13 ± 2 N·m
Water outlet fitting bolts	13 ± 2 N·m
Water pump bolts	14 ± 1 N·m
Rocker arms and camshaft	
Accumulator body bolt	44 ± 5 N·m
Oil control valve bolt	11 ± 1 N·m
Nut	9.0 ± 1.0 N·m
Rocker arms and rocker arm shaft bolts <exhaust side>	13 ± 1 N·m
Rocker arms and rocker arm shaft bolts <intake side>	31 ± 3 N·m
Rocker cover bolts	3.5 ± 0.5 N·m
Taper plug	47 ± 7 N·m
Cylinder head and valves	
Cylinder head bolts	78 ± 2 N·m → 0 N·m → 20 ± 2 N·m → +90° → +90°
Oil pan and oil pump	
Baffle plate bolts	9.0 ± 2.0 N·m
Drain plug	39 ± 5 N·m
Flange bolt	36 ± 3 N·m
Front case bolts	23 ± 3 N·m
Oil filter bracket bolts	19 ± 3 N·m
Oil filter (except part number MD356000)	17 ± 3 N·m

Item	Specification
Oil filter (part number MD356000)	14 ± 2 N·m
Oil level sensor bolts	9.0 ± 1.0 N·m
Oil pan bolts	9.0 ± 3.0 N·m
Oil pump cover bolts	17 ± 1 N·m
Oil pump cover screws	10 ± 2 N·m
Oil screen bolts	19 ± 3 N·m
Plug	23 ± 3 N·m
Relief plug	44 ± 5 N·m
Transmission stay bolts	22 ± 4 N·m
Piston and connecting rod	
Connecting rod cap nuts	20 ± 2 N·m → +90° to 94°
Crankshaft and cylinder block	
Bearing cap bolts	25 ± 2 N·m → +90°
Bell housing cover bolts	9.0 ± 1.0 N·m
Drive plate bolts (A/T)	132 ± 5 N·m
Flywheel bolt s(M/T)	132 ± 5 N·m
Oil seal case bolts	11 ± 1 N·m
Rear plate bolts	11 ± 1 N·m

SEALANTS

M1113000500565

Items	Specified sealants
Engine support bracket bolts	Mitsubishi Genuine Part No.MD970389 or equivalent
Engine coolant temperature sensor	LOCTITE 262 or equivalent
Water outlet fitting*	Mitsubishi Genuine Part No. MD970389 or equivalent
Thermostat housing*	
Thermostat housing seal bolt	3M™ AAD Part No. 8672 or equivalent
Camshaft position sensor support*	Mitsubishi Genuine Part No. MD970389 or equivalent
Oil pressure switch	Three bond 1141E , 1215 or 1212D or equivalent
Oil pan*	Mitsubishi Genuine Part No. MD970389 or equivalent
Rear oil seal case*	

*NOTE: *: Part to be sealed with a form-in-place gasket (FIPG)*

FORM-IN-PLACE GASKET (FIPG)

This engine has several areas where the form-in-place gasket (FIPG) is used for sealing. To ensure that the FIPG fully serves its purpose, it is necessary to observe some precautions when applying it.

Bead size, continuity and location are of paramount importance. Too thin a bead could cause leaks. Too thick a bead, on the other hand, could be squeezed out of location, causing blocking or narrowing of fluid passages. To prevent leaks or blocking of passages, therefore, it is absolutely necessary to apply the FIPG evenly without a break, while observing the correct bead size.
FIPG hardens as it reacts with the moisture in the atmospheric air, and it is usually used for sealing metallic flange areas.

REMOVAL OF FIPG SEALED PARTS

Parts sealed with a FIPG can be easily removed without need for the use of a special method. In some cases, however, the FIPG in joints may have to be broken by tapping parts with a mallet or similar tool. You can also tap a flat, thin gasket scraper into the joint to break the FIPG, taking extreme care not to damage the mating surfaces.The oil pan remover (MD998727) is available as a special tool for removing the oil pan. The tool, however, must not be

CLEANING FIPG APPLICATION SURFACE

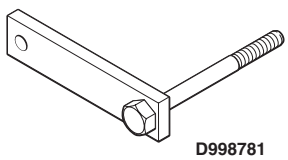
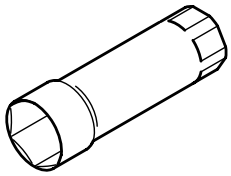
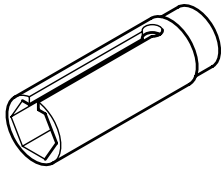
Thoroughly remove all substances deposited on the FIPG application surface, using a gasket scraper or wire brush. Make sure that the FIPG application surface is flat and smooth. Also make sure that the surface is free from oils, greases and foreign substances. Do not fail to remove old FIPG that may remain in the fastener fitting holes.

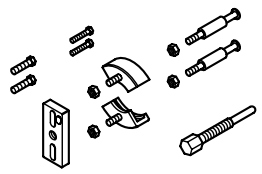
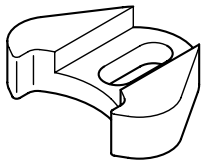
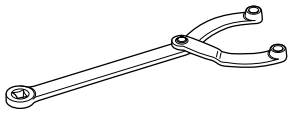
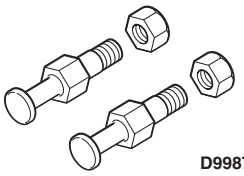
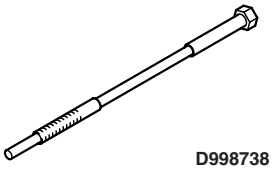
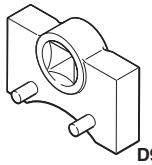
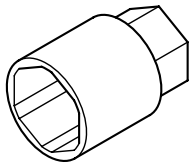
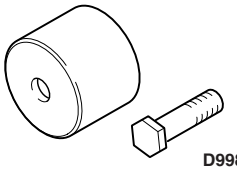
APPLICATION OF FIPG

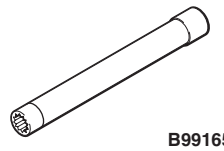
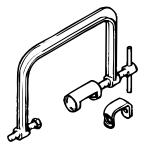
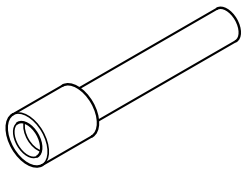
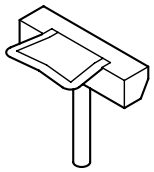
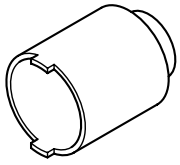
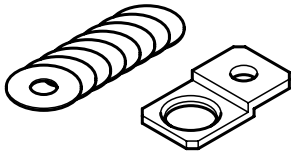
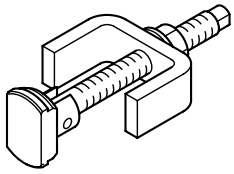
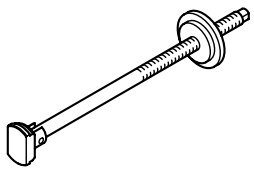
Applied FIPG bead should be of the specified size and free of any break. FIPG can be wiped away unless it has completely hardened. Install the mating parts in position while the FIPG is still wet (in less than 15 minutes after application). Do not allow FIPG to spread beyond the sealing areas during installation. Avoid operating the engine or letting oils or water come in contact with the sealed area before a time sufficient for FIPG to harden (approximately one hour) has passed. FIPG application method may vary from location to location. Follow the instruction for each particular case described later in this manual.

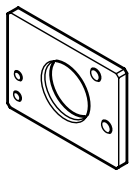
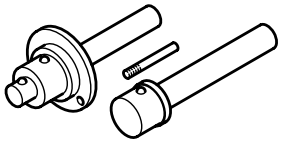
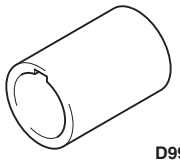
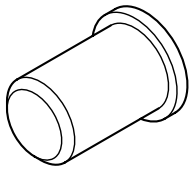
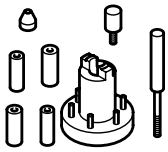
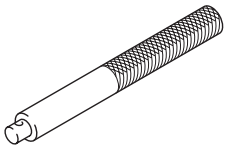
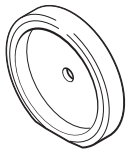
SPECIAL TOOLS

M1113000600658

Tool	Number	Name	Use
 D998781	MD998781	Flywheel stopper	Supporting flywheel and drive plate
	MB991398	Spark plug wrench	Removal and installation of spark plug
	MD998770	Oxygen sensor wrench	Removal and installation of oxygen sensor

Tool	Number	Name	Use
	MD998778	Crankshaft sprocket puller	Removal of crankshaft sprocket
	MD998785	Sprocket stopper	Supporting counterbalance shaft sprocket
 B990767	MB990767	End yoke holder	Holding camshaft sprocket when loosening or torquing bolt
 D998719	MD998719	Pins	
 D998738	MD998738	Adjusting screw	• Holding the auto-tensioner • Timing belt tension adjustment
 D998767	MD998767	Tension pulley wrench	Adjustment of timing belt tension
	MD998054	Oil pressure switch wrench	Removal and installation of oil pressure switch <to cylinder block>
 D998713	MD998713	Camshaft oil seal installer	Installation of camshaft oil seal

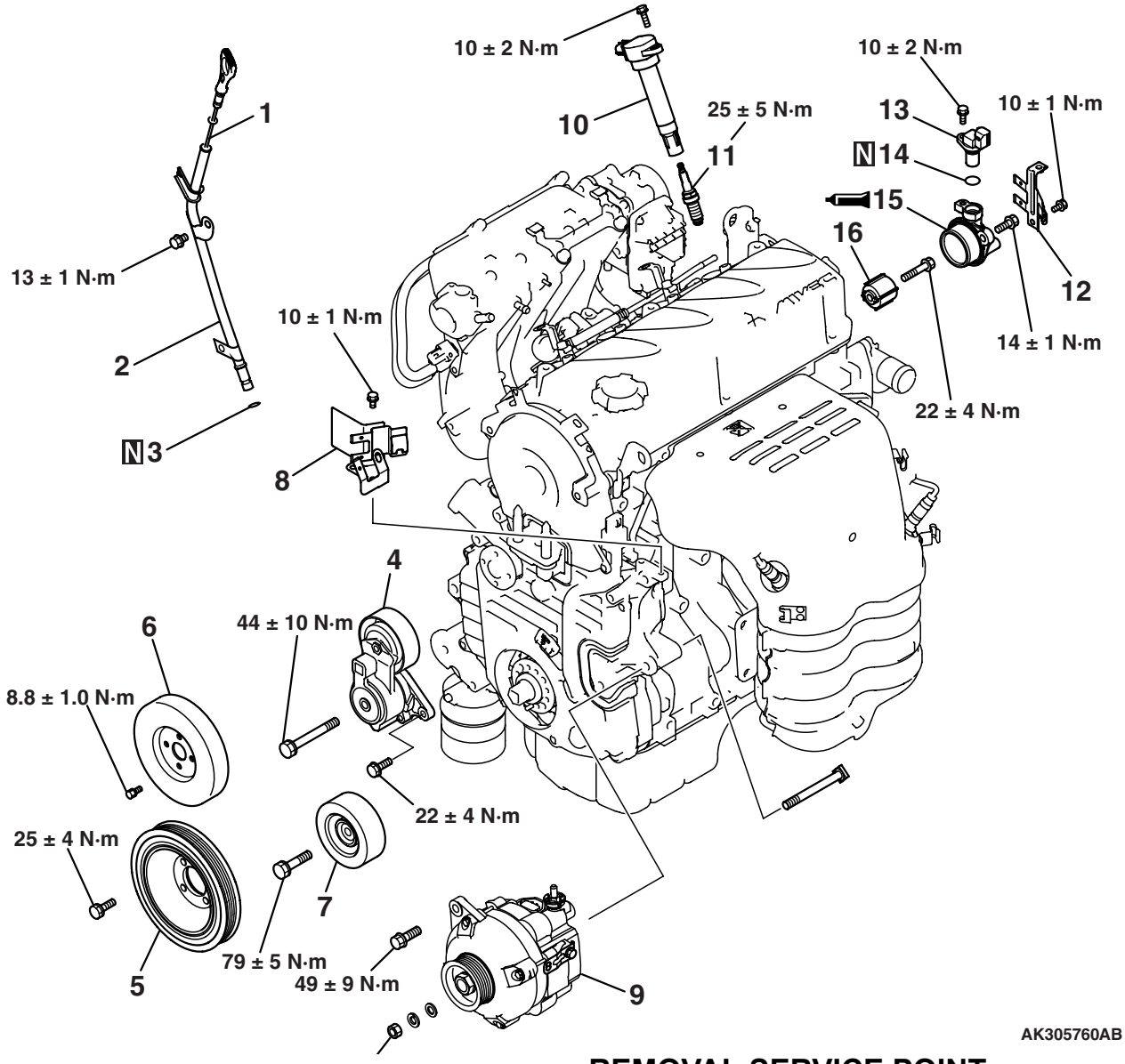
Tool	Number	Name	Use
 B991654	MB991654	Cylinder head bolt wrench (12)	Removal and installation of cylinder head bolt
	MD998735	Valve spring compressor	Compression of valve spring
	MD998774	Valve steam seal installer	Installation of valve steam seal
 D998727	MD998727	Oil pan remover	Removal of oil pan
	MD998162	Plug wrench	Removal and installation of front case cap plug
	MD998783	Plug wrench retainer	
	MD998371	Silent shaft bearing puller	Removal of counterbalance shaft front bearing
	MD998372	Silent shaft bearing puller	Removal of counterbalance shaft rear bearing

Tool	Number	Name	Use
	MB991603	Bearing installer stopper	Removal and installation of rear bearing
	MD998705	Silent shaft bearing installer	Installation of counterbalance shaft bearing
 D998285	MD998285	Crankshaft front oil seal guide	Installation of crankshaft front oil seal
	MD998375	Crankshaft front oil seal installer	
	MD998780	Piston pin setting tool	Removal and installation of piston pin
	MB990938	Handle	Installation of crankshaft rear oil seal
 D998776	MD998776	Crankshaft rear oil seal installer	

ALTERNATOR AND IGNITION SYSTEM

REMOVAL AND INSTALLATION

M1113001000574



Removal steps

1. Oil level gauge
2. Oil level gauge guide
3. O-ring
4. Auto tensioner
5. Crankshaft pulley
6. Water pump pulley
7. Idler pulley
8. Connector bracket
9. Alternator
10. Ignition coil

<<A>> >>C<< 11. Spark plug

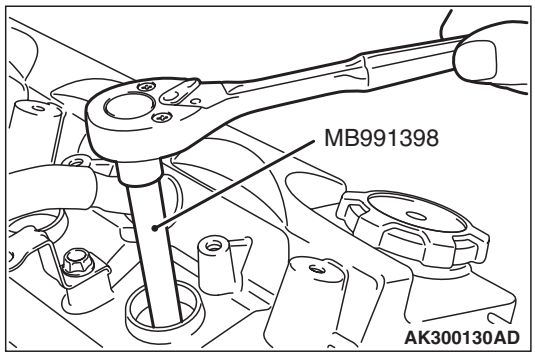
12. Connector bracket
13. Camshaft position sensor
14. O-ring

>>B<< 15. Camshaft position sensor support

<<B>> >>A<< 16. Camshaft position sensing cylinder

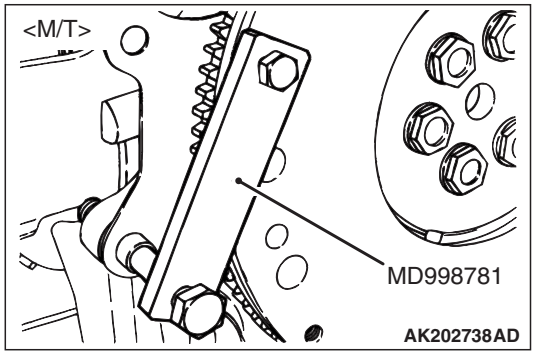
REMOVAL SERVICE POINT

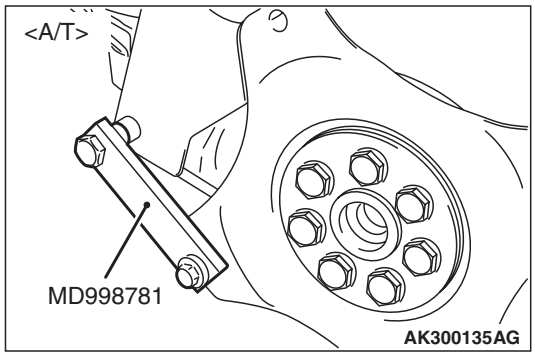
<<A>> SPARK PLUG REMOVAL



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

<<B>> CAMSHAFT POSITION SENSING CYLINDER REMOVAL

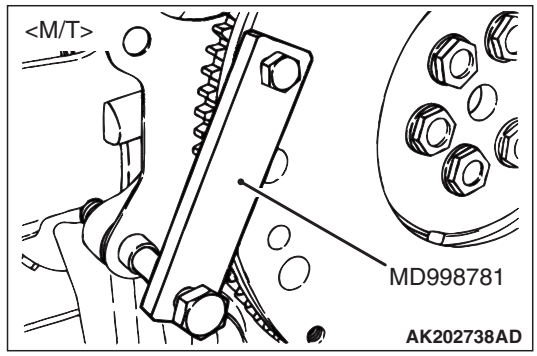


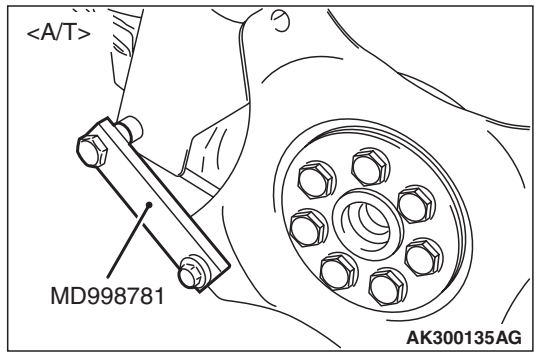


1. Using special tool Fly wheel stopper (MD998781), hold the drive plate.
2. Removal the camshaft position sensing cylinder.

INSTALLATION SERVICE POINT

>>A<< CAMSHAFT POSITION SENSING CYLINDER INSTALLATION

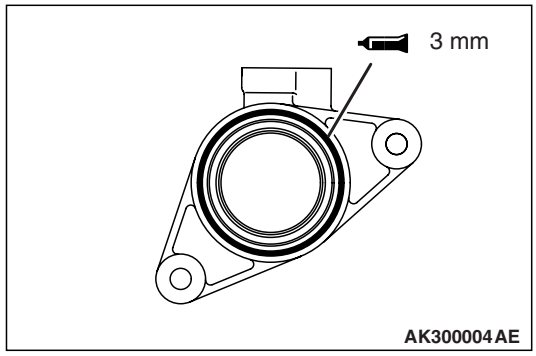




1. Using special tool Fly wheel stopper (MD998781), hold the drive plate.
2. Tighten the camshaft position sensing cylinder to the specified torque.

   Tightening torque: 22 ± 4 N·m

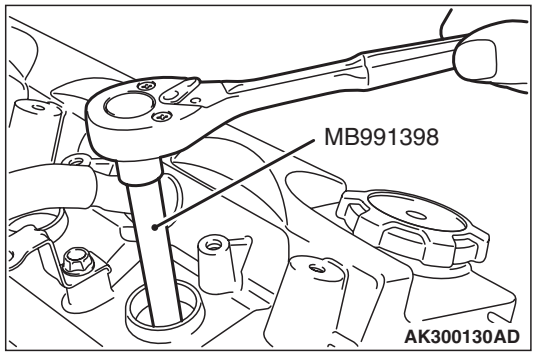
>>B<< CAMSHAFT POSITION SENSOR SUPPORT INSTALLATION



1. Remove completely the FIPG remaining on the camshaft position sensor support and cylinder head.
2. Apply a 3 ± 1 mm diameter bead of FIPG to the indicated surface of the camshaft position sensor support.

Specified sealant:
Mitsubishi Genuine Part No.MD970389 or equivalent

>>C<< SPARK PLUG INSTALLATION



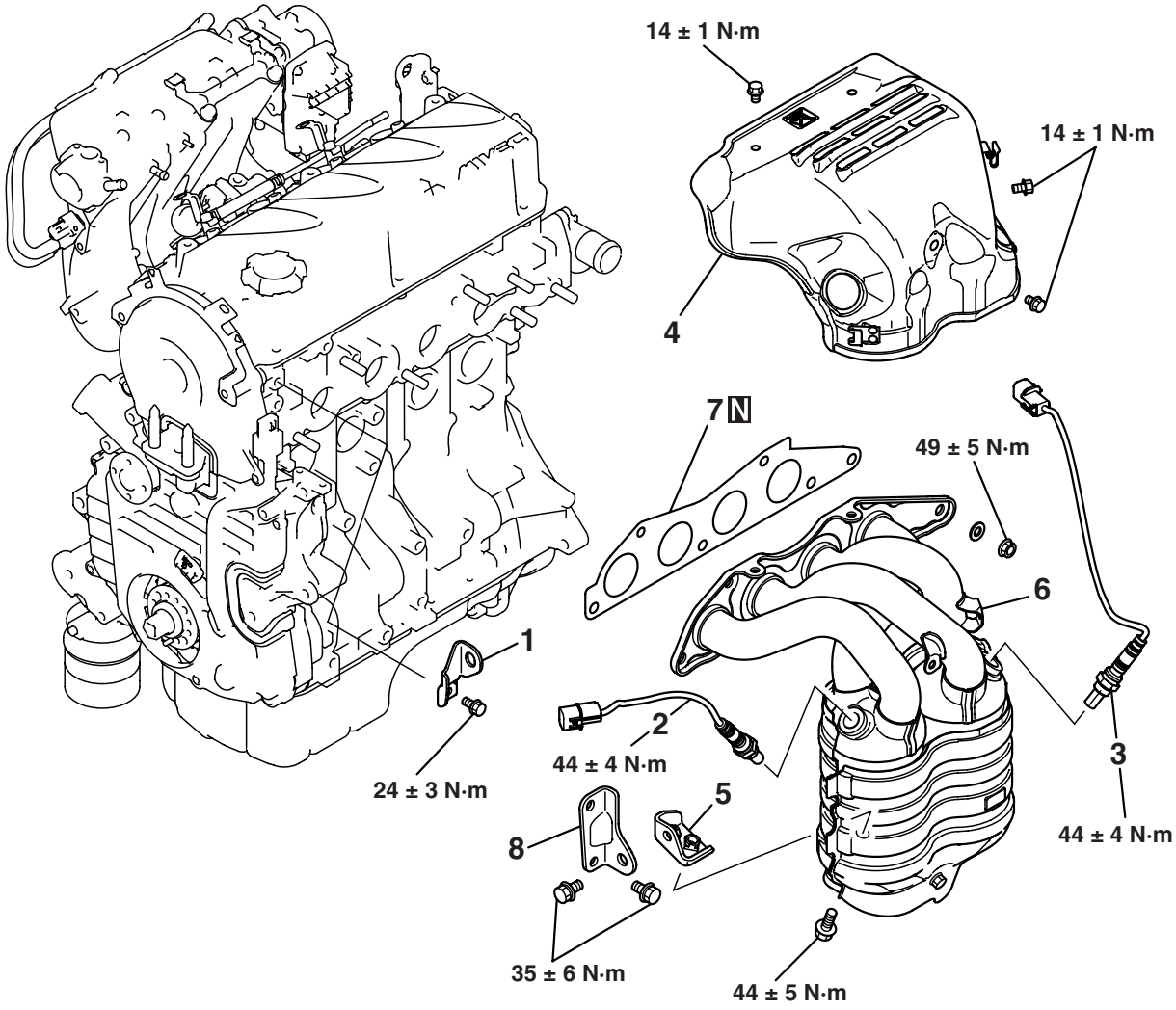
Using special tool Spark plug wrench (MB991398), tighten the spark plug to the specified torque.

Tightening torque: 25 ± 5 N·m

EXHAUST MANIFOLD

REMOVAL AND INSTALLATION

M1113004900510



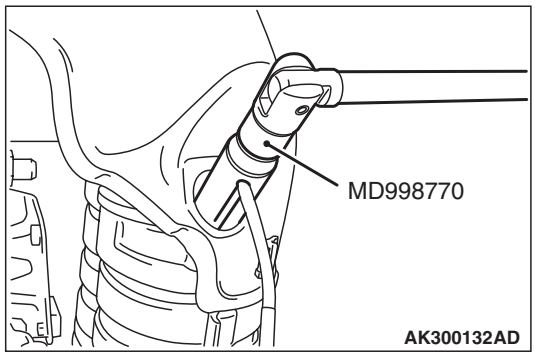
AK305761AB

Removal steps

1. Engine hanger
<<A>> >>B<< 2. Oxygen sensor
<<A>> >>B<< 3. Oxygen sensor
4. Exhaust manifold cover
>>A<< 5. Exhaust manifold bracket B
6. Exhaust manifold
7. Exhaust manifold gasket
8. Exhaust manifold bracket A

REMOVAL SERVICE POINT

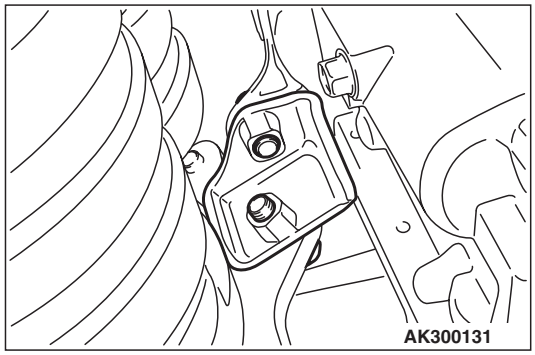
<<A>> OXYGEN SENSOR REMOVE



Using special tool Oxygen sensor wrench (MD998770), removal the oxygen sensor.

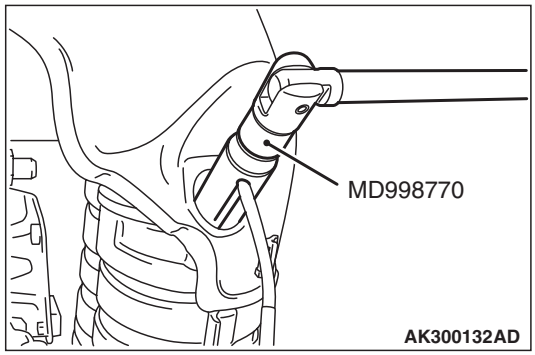
INSTALLATION SERVICE POINT

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



Check to ensure that the exhaust manifold bracket "B" is in close contact with the exhaust manifold and the cylinder block before tightening the respective mounting bolts to the specified torque.

>>B<< OXYGEN SENSOR INSTALLATION

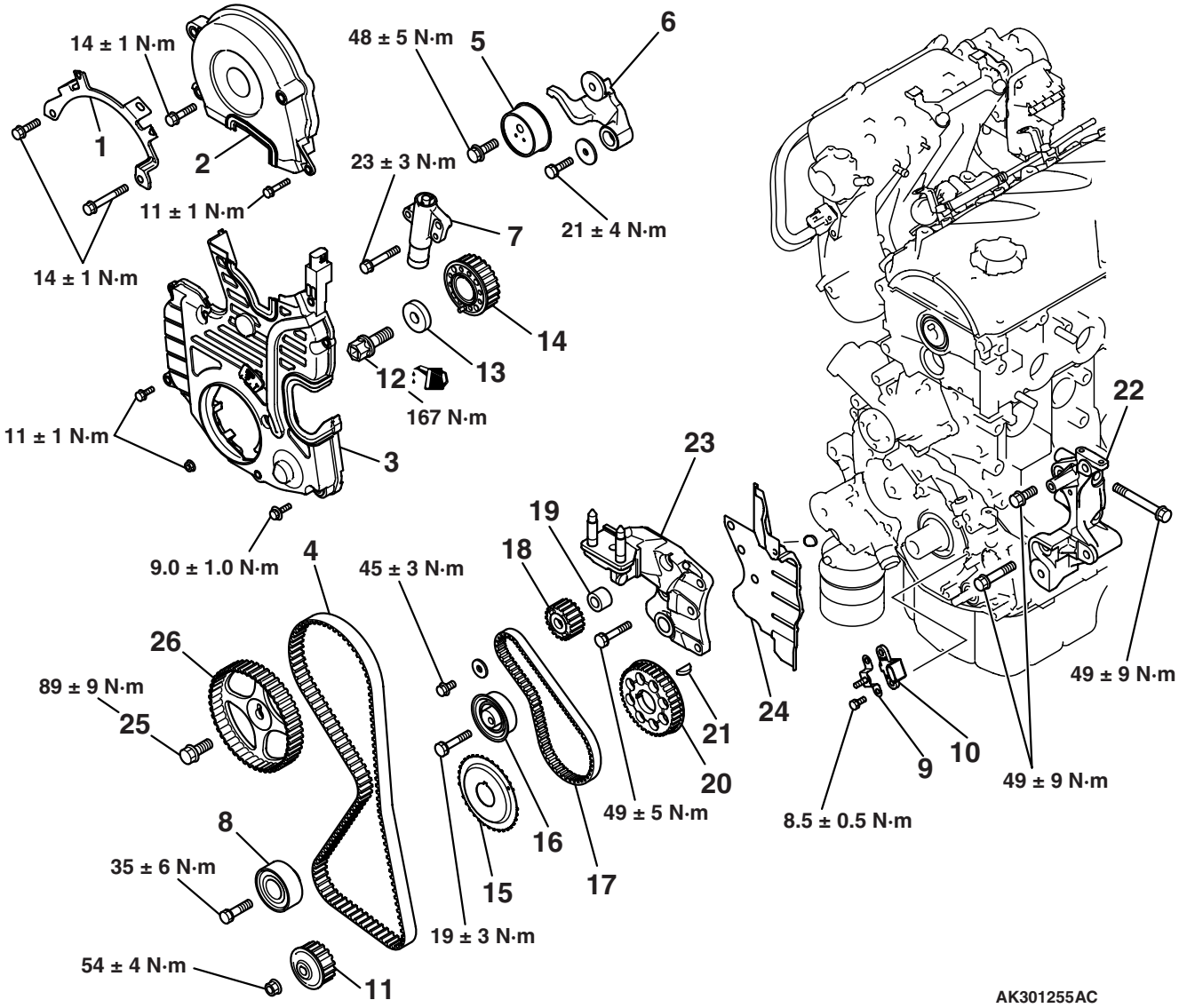


Using special tool Oxygen sensor wrench (MD998770), installation the oxygen sensor.

TIMING BELT

REMOVAL AND INSTALLATION

M1113001900715



Removal steps

1. Connector bracket
2. Timing belt front upper cover
3. Timing belt front lower cover

<<A>> >>K<< 4. Timing belt

>>J<< 5. Tensioner pulley

6. Tensioner arm

>>I<< 7. Auto-tensioner

8. Idler pulley
9. Bracket
10. Crankshaft angle sensor

<<B>> >>H<< 11. Oil pump sprocket

<<C>> >>G<< 12. Crankshaft bolt

>>G<< 13. Crankshaft pulley washer

Removal steps (Continued)

<<D>> >>G<< 14. Crankshaft sprocket

>>G<< 15. Crankshaft sensing blade

16. Tensioner "B"

<<E>> >>F<< 17. Timing belt "B"

<<F>> >>E<< 18. Counterbalance shaft sprocket

>>D<< 19. Spacer

<<G>> >>C<< 20. Crankshaft sprocket "B"

21. Crankshaft key
22. Alternator bracket

>>B<< 23. Engine support bracket

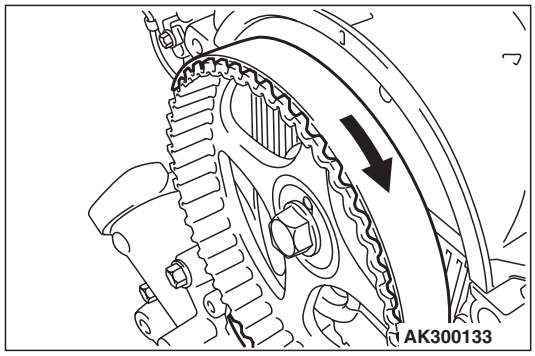
24. Timing belt rear cover

<<H>> >>A<< 25. Camshaft sprocket bolt

26. Camshaft sprocket

REMOVAL SERVICE POINTS

<<A>> TIMING BELT REMOVAL



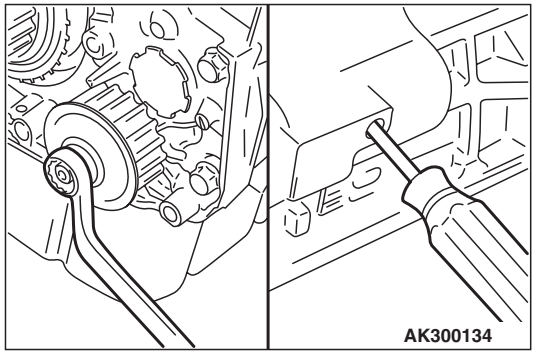
⚠ CAUTION

Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be washed or immersed in solvent. Replace parts if contaminated. If there is oil or water on any part, check the front case oil seals, camshaft oil seal, and water pump for leaks.

1. Mark the belt running direction for reinstallation.
2. Loosen the tensioner pulley bolt, and then remove the timing belt.

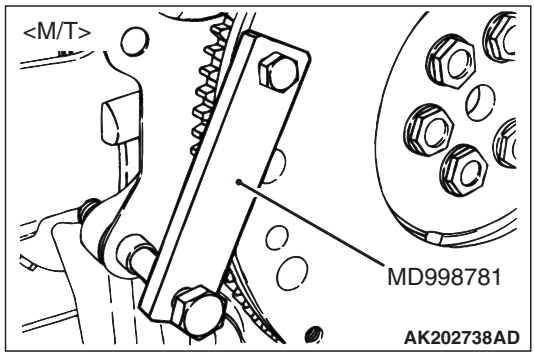
<<B>> OIL PUMP SPROCKET REMOVAL

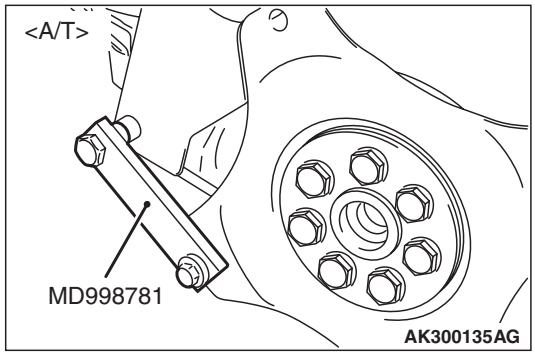
1. Remove the plug on the left side of the cylinder block.



2. Insert a Phillips screwdriver (shank diameter 8 mm) through the plug hole to block the left counterbalance shaft.
3. Loosen the nut, and then remove the oil pump sprocket.

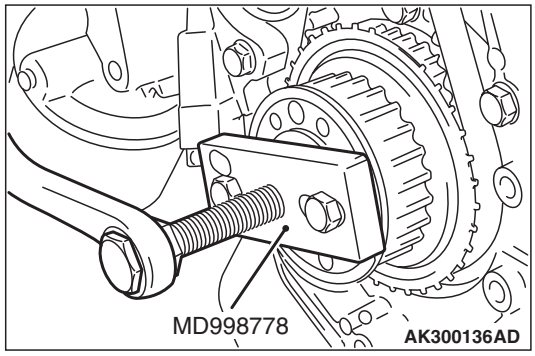
<<C>> CRANKSHAFT BOLT LOOSENING





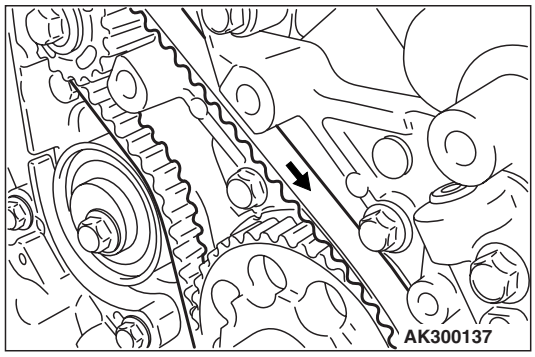
1. Using special tool Fly wheel stopper (MD998781), hold the drive plate.
2. Removal the crankshaft bolt and washer.

<<D>> CRANKSHAFT SPROCKET REMOVAL



1. Set special tool Crankshaft sprocket puller (MD998778) as shown in the illustration.
2. Screw in the center bolt of the special tool to remove the crankshaft sprocket.

<<E>> TIMING BELT "B" REMOVAL

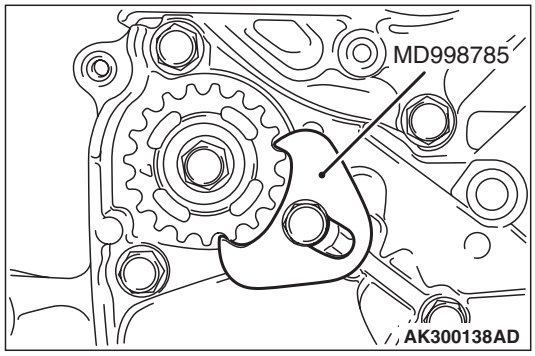


⚠ CAUTION

Water or oil on the belt shortens its life drastically, so the removed timing belt, sprocket, and tensioner must be free from oil and water. These parts should not be washed or immersed in solvent. Replace parts if contaminated. If there is oil or water on each part, check the front case oil seals, camshaft oil seal and water pump for leaks.

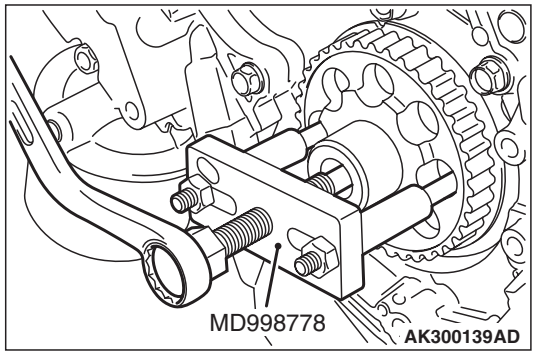
1. Mark the belt running direction for reinstallation.
2. Loosen the tensioner "B" bolt, and then remove the timing belt "B."

<<F>> COUNTERBALANCE SHAFT SPROCKET REMOVAL



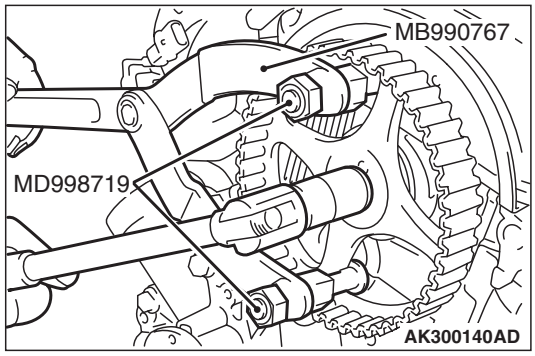
1. Set special tool Sprocket stopper (MD998785) as shown to prevent the counterbalance shaft sprocket from turning together.
2. Loosen the bolt and remove the sprocket.

<<G>> CRANKSHAFT SPROCKET "B" REMOVAL



1. Set special tool Crankshaft sprocket puller (MD998778) as shown in the illustration.
2. Screw in the center bolt of the special tool to remove crankshaft sprocket "B."

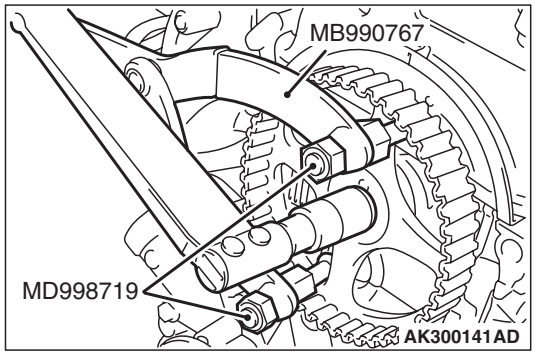
<<H>> CAMSHAFT SPROCKET REMOVAL



1. Using special tools to prevent the camshaft sprocket from rotating.
   - End yoke holder (MB990767)
   - Pulley holder pin (MD998719)
2. Remove the camshaft sprocket.

INSTALLATION SERVICE POINTS

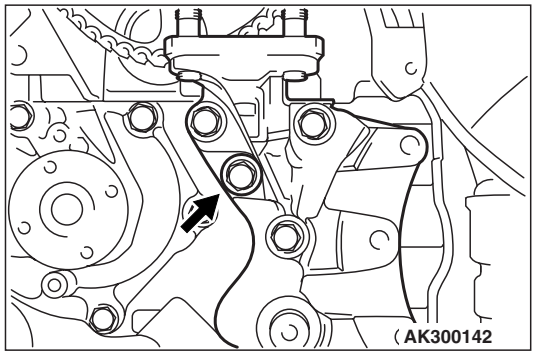
>>A<< CAMSHAFT SPROCKET INSTALLATION



1. Using special tools to prevent the camshaft sprocket from rotating.
   - End yoke holder (MB990767)
   - Pulley holder pin (MD998719)
2. Tighten the camshaft sprocket bolt to the specified torque.

   Tightening torque: 88 ± 10 N·m

>>B<< ENGINE SUPPORT BRACKET INSTALLATION

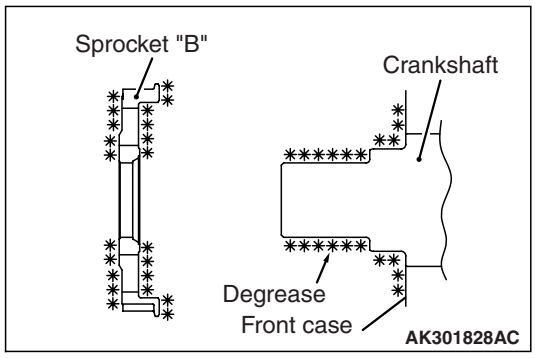


1. Remove thoroughly the old sealant remaining on the indicated bolt and in its hole.
2. Coat the bolt with sealant, then install and tighten it.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

   Tightening torque: 49 ± 5 N·m

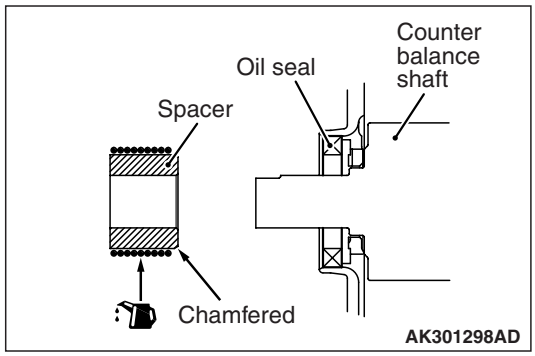
>>C<< CRANKSHAFT SPROCKET "B" INSTALLATION



Clean and then degrease the front case of the front case, crankshaft sprocket "B" and crankshaft surface on which sprocket "B" is attached.

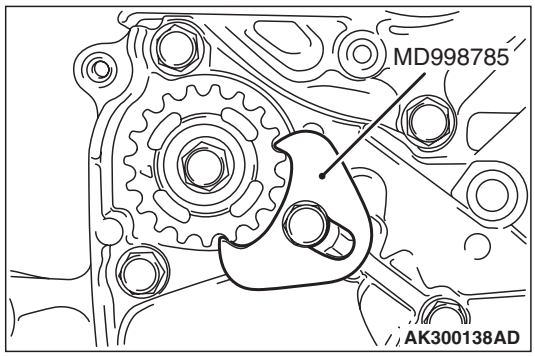
NOTE: Degreasing is necessary to prevent decrease in the friction between contacting surfaces.

>>D<< SPACER INSTALLATION



1. Apply a thin coat of clean engine oil to the lip area of the oil seal.
2. Install the spacer with the chamfered end facing toward the oil seal.

>>E<< COUNTERBALANCE SHAFT SPROCKET INSTALLATION

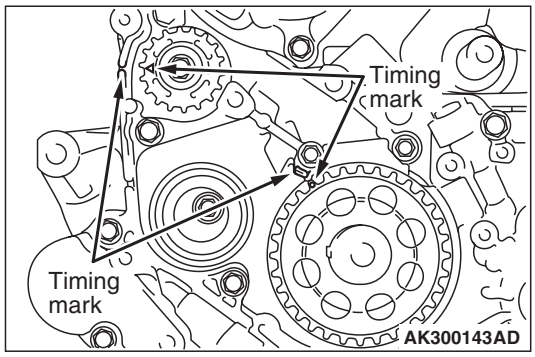


1. Install the counterbalance shaft sprocket and screw on the bolt.

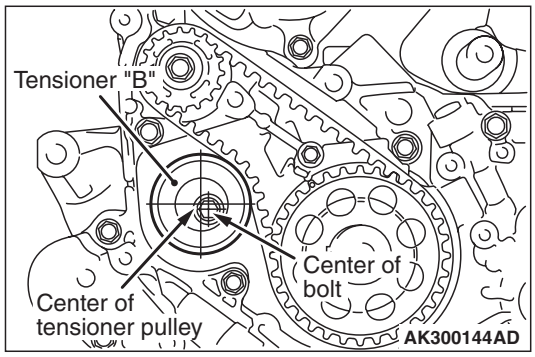
2. Install special tool Sprocket stopper (MD998785) as shown in the illustration to lock the counterbalance shaft.
3. Tighten the bolt, and then remove the special tool.

Tightening torque: 45 ± 3 N·m

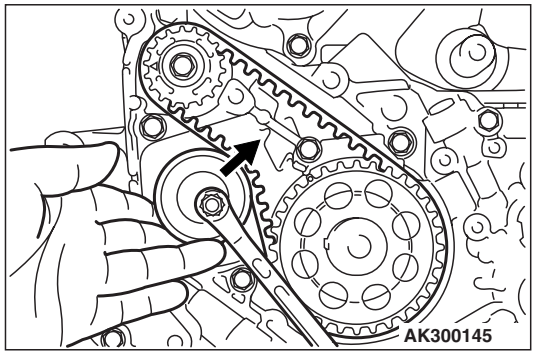
>>F<< TIMING BELT "B" INSTALLATION



1. Align timing marks on the crankshaft sprocket "B" and counterbalance shaft sprocket with the marks on the front case.
2. Install the timing belt "B" on the crankshaft sprocket "B" and counterbalance shaft sprocket. There should be no slack on the tension side.

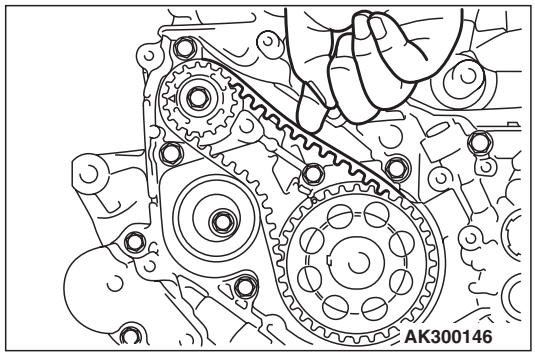


3. Make sure that the tensioner pulley center and the bolt center are positioned as shown in the illustration.



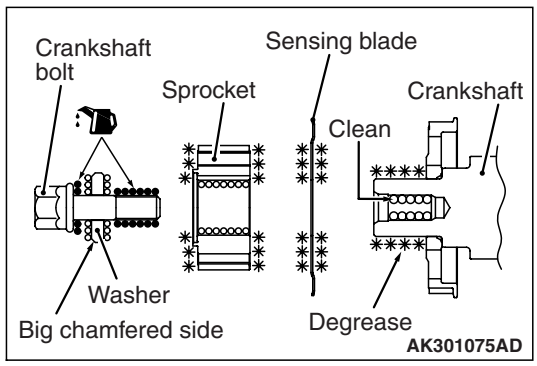
4. Move tensioner "B" in the direction of the arrow while lifting with your finger to give sufficient tension to the tension side of timing belt. In this condition, tighten the bolt to secure tensioner "B." When the bolt is tightened, use care to prevent the tensioner pulley shaft from turning with the bolt. If the shaft is turned with the bolt, the belt will be over tensioned.

Tightening torque: 19 ± 3 N·m



5. Check that timing marks on the sprockets are aligned with the timing marks on the front case.
6. With your index finger, press the midway of span on the tension side of timing belt "B." The bolt must deflect 5 to 7 mm.

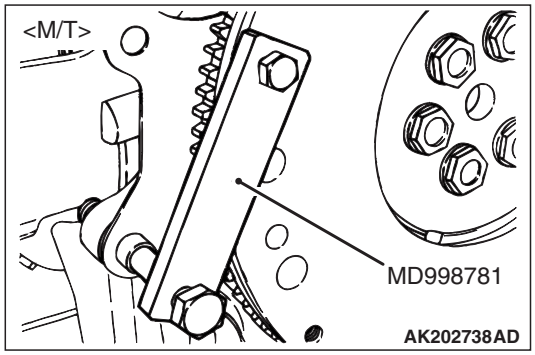
>>G<< CRANKSHAFT SENSING BLADE/CRANKSHAFT SPROCKET/CRANKSHAFT PULLEY WASHER/CRANKSHAFT BOLT INSTALLATION

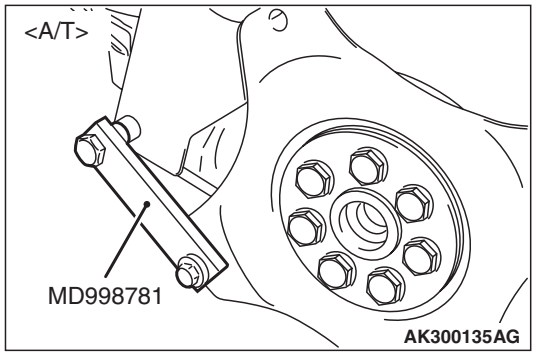


1. Clean and then degrease the contacting surfaces of the crankshaft sprocket, sensing blade and crankshaft.

   NOTE: Degreasing is necessary to prevent decrease in the friction between contacting surfaces.
2. Clean the bolt hole in the crankshaft, the crankshaft contacting surface of the crankshaft sprocket, and the washer.

3. Install the sensing blade and the crankshaft sprocket to the crankshaft.
4. Apply a small amount of engine oil to the threads and seating surface of the crankshaft bolt.
5. Install the washer to the crankshaft bolt with the larger chamfered side toward the bolt head.

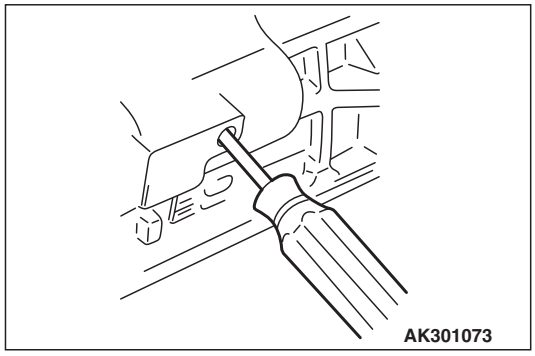




6. Using special tool Fly wheel stopper (MD998781), hold the drive plate.
7. Tighten the crankshaft bolt to the specified torque.

Tightening torque: 167 N·m

>>H<< OIL PUMP SPROCKET INSTALLATION

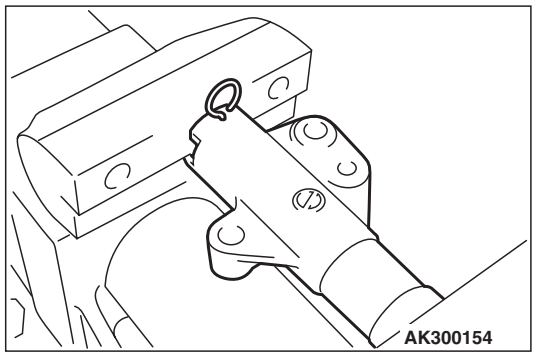


1. Insert a Phillips head screwdriver (shank diameter 8 mm) through the plug hole on the left side of the cylinder block to block the left counterbalance shaft.
2. Install the oil pump sprocket.
3. Apply a thin coat of engine oil to the seating surface of the nut.
4. Tighten the nut to the specified torque.

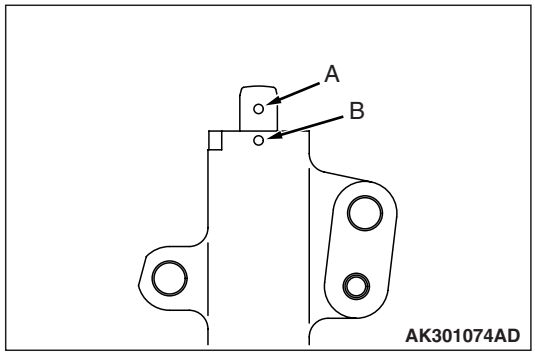
Tightening torque: 54 ± 5 N·m

>>I<< AUTO-TENSIONER INSTALLATION

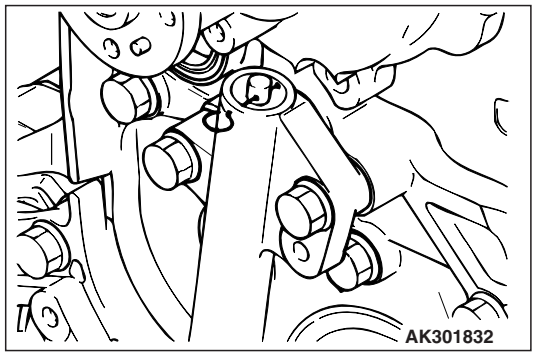
If the auto-tensioner rod is fully extended, reset it as follows:



1. Clamp the auto-tensioner in a vise with soft jaws.



2. Push in the rod little by little with the vise until the set hole A in the rod is aligned with hole B in the cylinder.
3. Insert a wire (1.4 mm in diameter) into the set holes. This auto-tensioner setting wire will be used during timing belt alignment.
4. Unclamp the auto-tensioner from the vise.

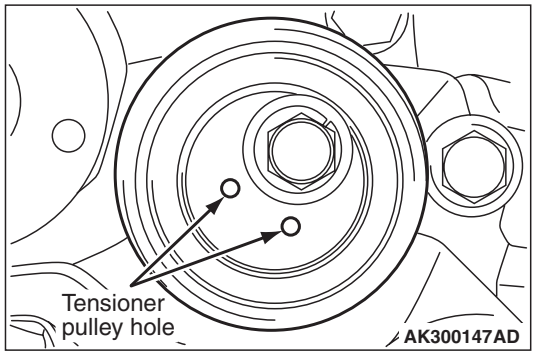


⚠ CAUTION
Leave the wire installed in the auto-tensioner.

5. Install the auto-tensioner onto the front case and tighten to the specified torque.

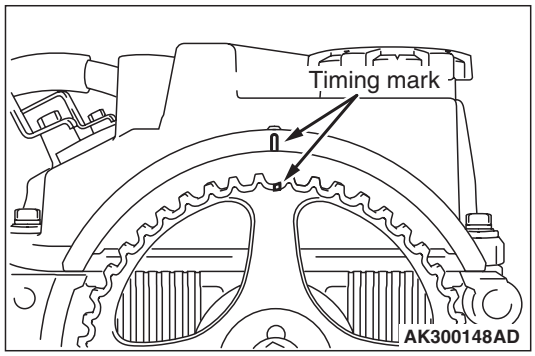
   Tightening torque: 23 ± 3 N·m

>>J<< TENSIONER PULLEY INSTALLATION

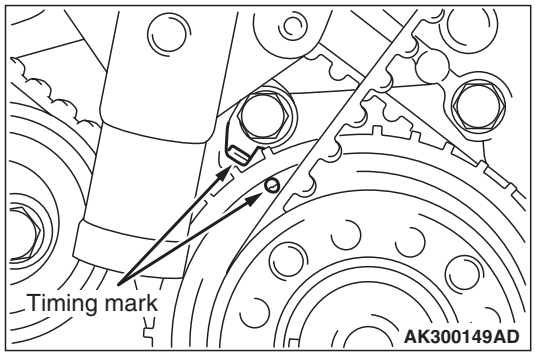


Set the tensioner pulley so that the holes for attaching a wrench may be positioned as shown in the illustration.

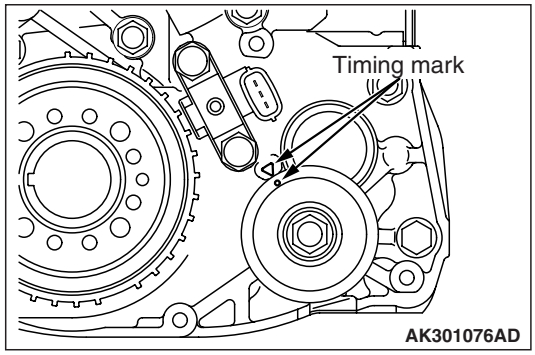
>>K<< TIMING BELT INSTALLATION



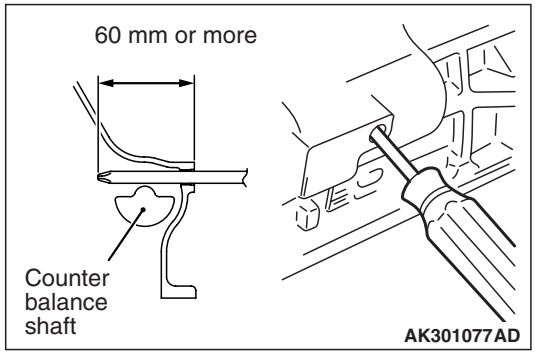
1. Align the timing mark on the camshaft sprocket with the timing mark on the rocker cover.



2. Align the timing mark on the crankshaft sprocket with the timing mark on the front case.



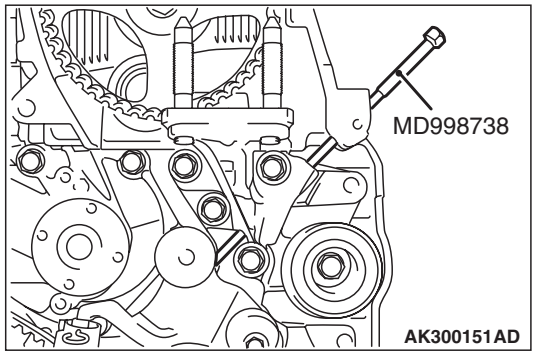
3. Align the timing mark on oil pump sprocket with its mating mark.



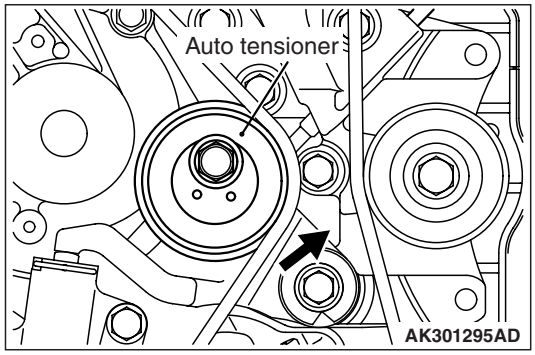
4. Remove the plug on the cylinder block and insert a Phillips head screwdriver (shank diameter 8 mm) through the hole.

   If it can be inserted as deep as 60 mm or more, the timing marks are correctly aligned.

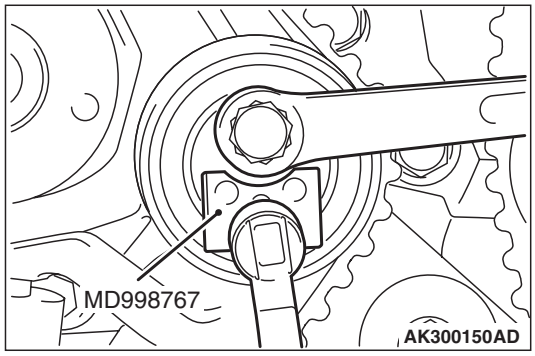
   If the inserted depth is only 20 to 25 mm, turn the oil pump sprocket one turn and realign the timing marks. Then check to ensure that the screwdriver can be inserted 60 mm or more. Keep the screwdriver inserted until the timing belt is completely installed.



5. Set the special tool Set screw (MD998738) as shown and screw it in up to the position where the wire inserted in the auto-tensioner when installing it can be moved lightly.
6. Install the timing belt on the crankshaft sprocket, oil pump sprocket, idler pulley, camshaft sprocket, and tensioner pulley in that order.



7. Lift up the tensioner pulley in the direction of the arrow and tighten the center bolt.
8. Check that all timing marks are aligned.
9. Remove the screwdriver inserted in step 5 and install the plug.
10. Turn the crankshaft a quarter turn counterclockwise. Then, turn it clockwise until the timing marks are aligned again.

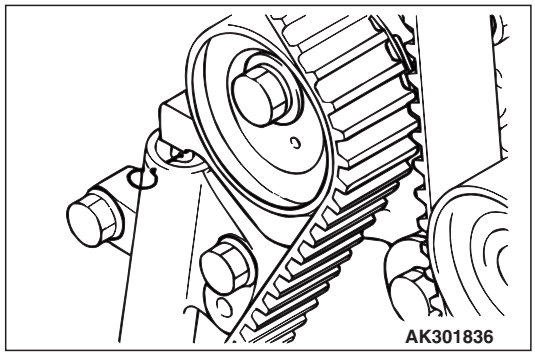


11. Install special tool Tension pulley socket wrench (MD998767), socket wrench and torque wrench, onto the tensioner pulley, and loosen the tensioner pulley center bolt.

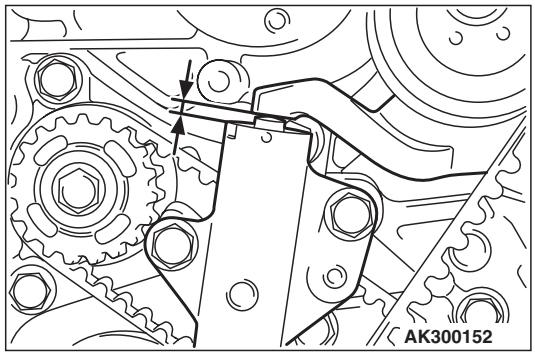
    NOTE: Use a torque wrench that can measure 0 to 5.0 N·m.

12. Torque to 3.5 N·m with the torque wrench.
13. Holding the tensioner pulley with special tool Tension pulley socket wrench (MD998767) and torque wrench, tighten the center bolt to specification.

Tightening torque: 48 ± 5 N·m



14. The wire inserted at the auto-tensioner installation is pulled out and then the special tool Set screw (MD998738) is removed by hand.
15. Give two clockwise turns to the crankshaft. Wait for 15 minutes, then proceed with the following inspection steps.



16. Check to see whether the metal wire (inserted when the auto-tensioner was installed) can be removed without any resistance. If the metal wire can be removed without any resistance, it means that the belt has a proper tension. Therefore, remove the metal wire. In this condition, check that the rod protrusion of the auto-tensioner is within the standard value.

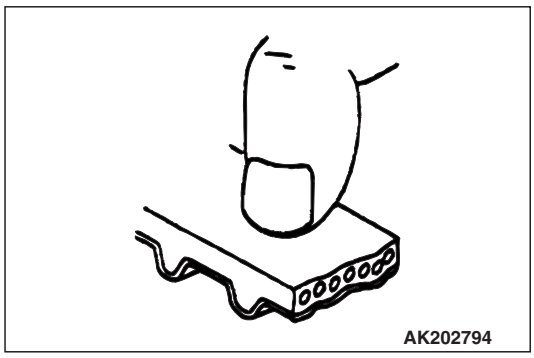
    Standard value: 3.8 – 4.5 mm

17. If the metal wire offers resistance when removed, repeat the previous steps 10 through 15 until the standard value is obtained as measured by the rod projection of the auto-tensioner rod.

INSPECTION

M1113002000544

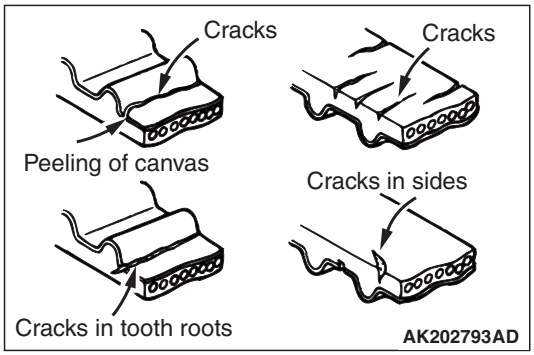
TIMING BELT



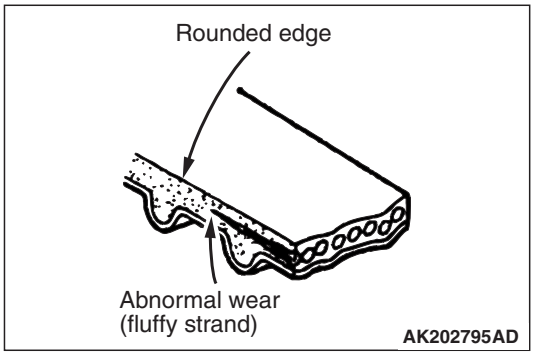
Replace the belt if any of the following conditions exist:

1. Hardening of rubber backing.

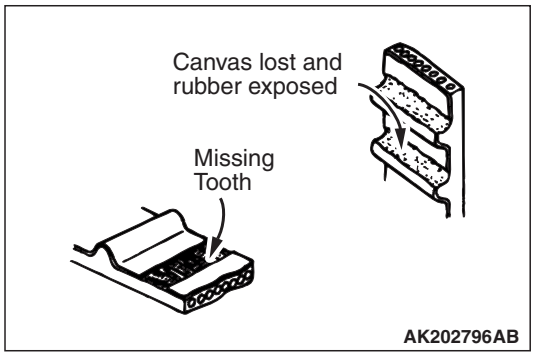
   Back side should be glossy without resilience and leave no indent when pressed with fingernail.



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.

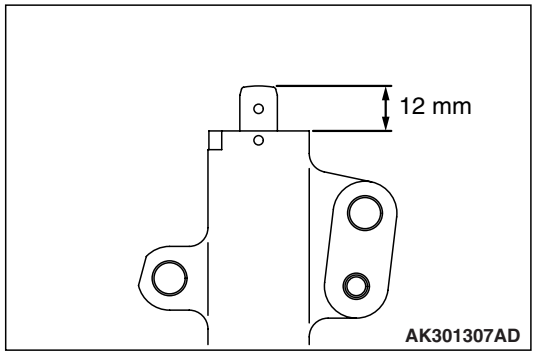


7. Abnormal wear on teeth.

   Initial stage:
   Canvas worn (fluffy canvas fibers, rubbery texture gone, white discoloration, canvas texture indistinct)
   Final stage:
   Canvas worn, exposing rubber (tooth width reduced)

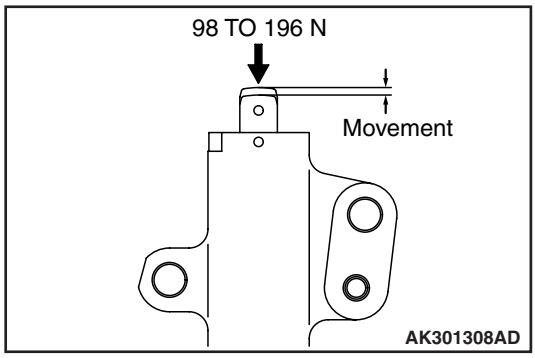
8. Missing tooth.

AUTO-TENSIONER



1. Check for oil leaks. If oil leaks are evident, replace the auto-tensioner.
2. Check the rod end for wear or damage and replace the auto-tensioner if necessary.
3. Measure the rod protrusion. If it is out of specification, replace the auto tensioner.

   Standard value: 12 mm



4. Press the rod with a force of 98 to 196 N and measure the movement of the rod.

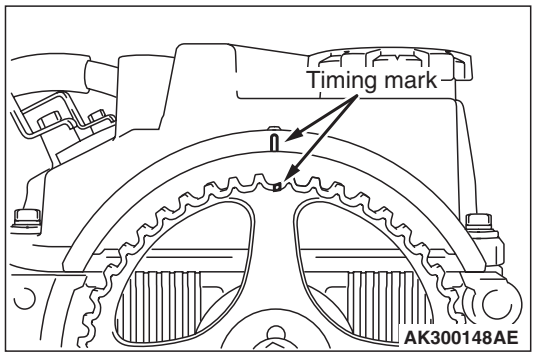
   If the measured value is out of the standard value, replace the auto-tensioner.

   Standard value: 1.0 mm or less

VALVE CLEARANCE ADJUSTMENT

Perform the adjustment of the valve clearance in the following procedure.

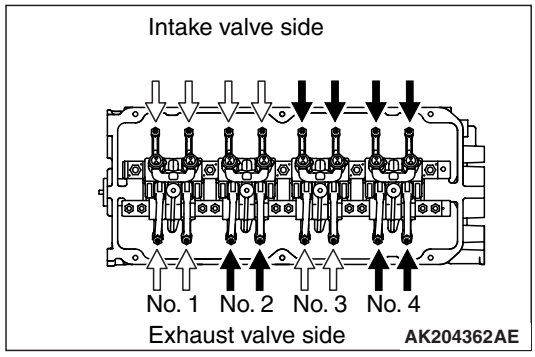
1. Remove the rocker cover.



⚠ CAUTION

Rotate the crankshaft clockwise at any time.

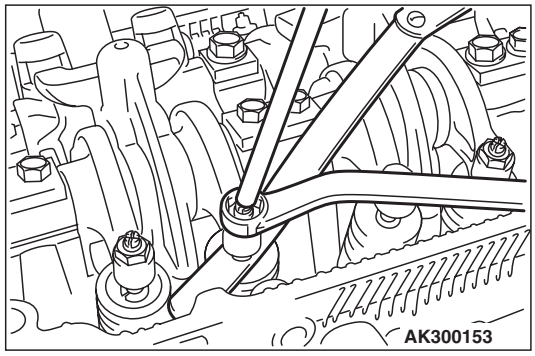
2. Rotate crankshaft clockwise and then align the timing mark on the camshaft sprocket with the timing mark on the cylinder head. (Place No.1 cylinder on the top dead center of compression stroke.)



3. Measure the valve clearance marked with arrows shown in the figure.

   White arrow mark: When No.1 cylinder is on the top dead center of compression stroke.

   Black arrow mark: When No.4 cylinder is on the top dead center of compression stroke.



4. Using a thickness gauge, adjust the clearance between the valve shaft end and the adjusting screw.

   Standard value (in cold state):
   Intake side: 0.11 mm
   Exhaust side: 0.20 mm

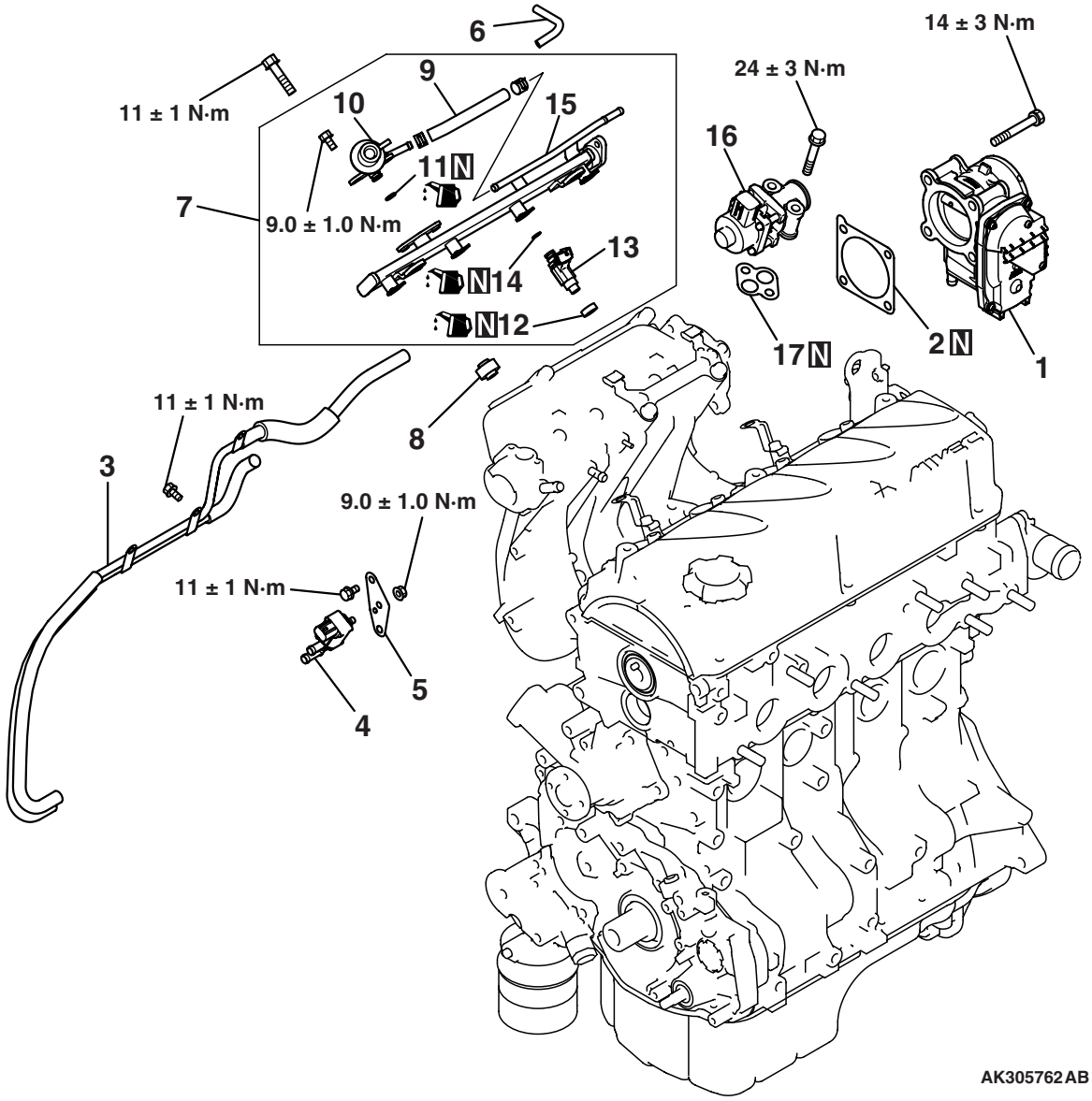
   NOTE: After the engine assembly is installed on the vehicle, check the valve clearance again in the engine warm-up state. Adjust if necessary.

5. Hold the adjusting screw not rotating through a driver and then tighten the rock nut.
6. Rotate the crankshaft one time clockwise and then align the timing mark with the timing mark on the crankshaft sprocket. (Place No.4 cylinder on the top dead center of compression stroke.)
7. Adjust the valve clearance for the rest of the valves.
8. Install the rocker cover.

FUEL AND EMISSION PARTS

REMOVAL AND INSTALLATION

M1113002200559



Removal steps

1. Throttle body
>>C<< 2. Throttle body gasket
3. Vacuum pipe and hose
4. Solenoid valve
5. Solenoid valve bracket
6. Vacuum hose
7. Injector and delivery pipe
8. Insulator
9. Fuel hose

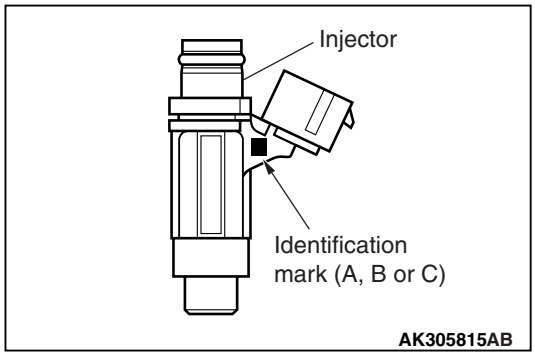
Removal steps (Continued)

10. Fuel pressure regulator
11. O-ring
12. Insulator
>>B<< 13. Injector
14. O-ring
15. Delivery pipe
16. EGR valve
>>A<< 17. EGR gasket

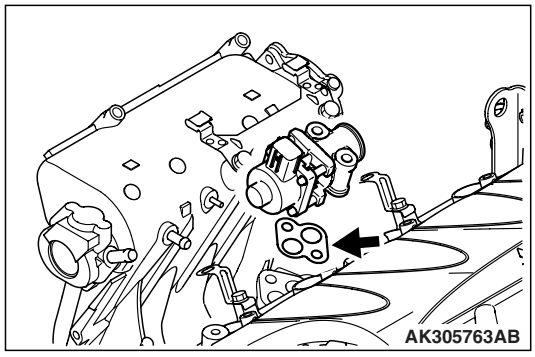
INSTALLATION SERVICE POINTS

>>A<< EGR VALVE INSTALLATION

⚠ CAUTION

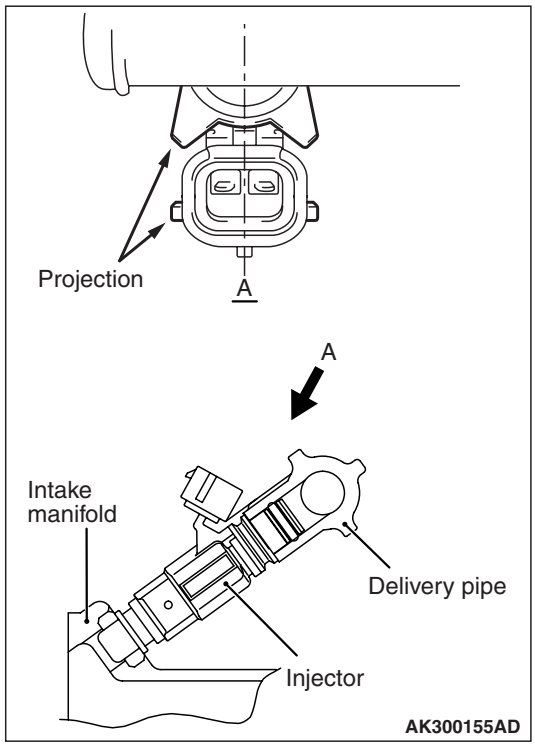


- **The fuel injectors are classified into A, B and C by the injection quantity. When replacing one of fuel injectors, use a same identification mark fuel injector as the other fuel injectors.**
- **When replacing the fuel injectors of all cylinders, use the same identification mark fuel injectors.**



Install a new gasket is positioned as shown in the illustration.

>>B<< INJECTORS INSTALLATION



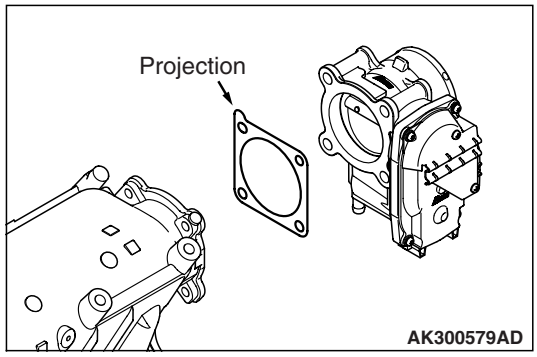
⚠ CAUTION

Use care not to let engine oil enter the delivery pipe.

1. Apply clean engine oil to the O-ring.
2. Insert the injector into the delivery pipe.
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, reinstall the injector and check that it rotates smoothly.

>>C<< THROTTLE BODY GASKET INSTALLATION

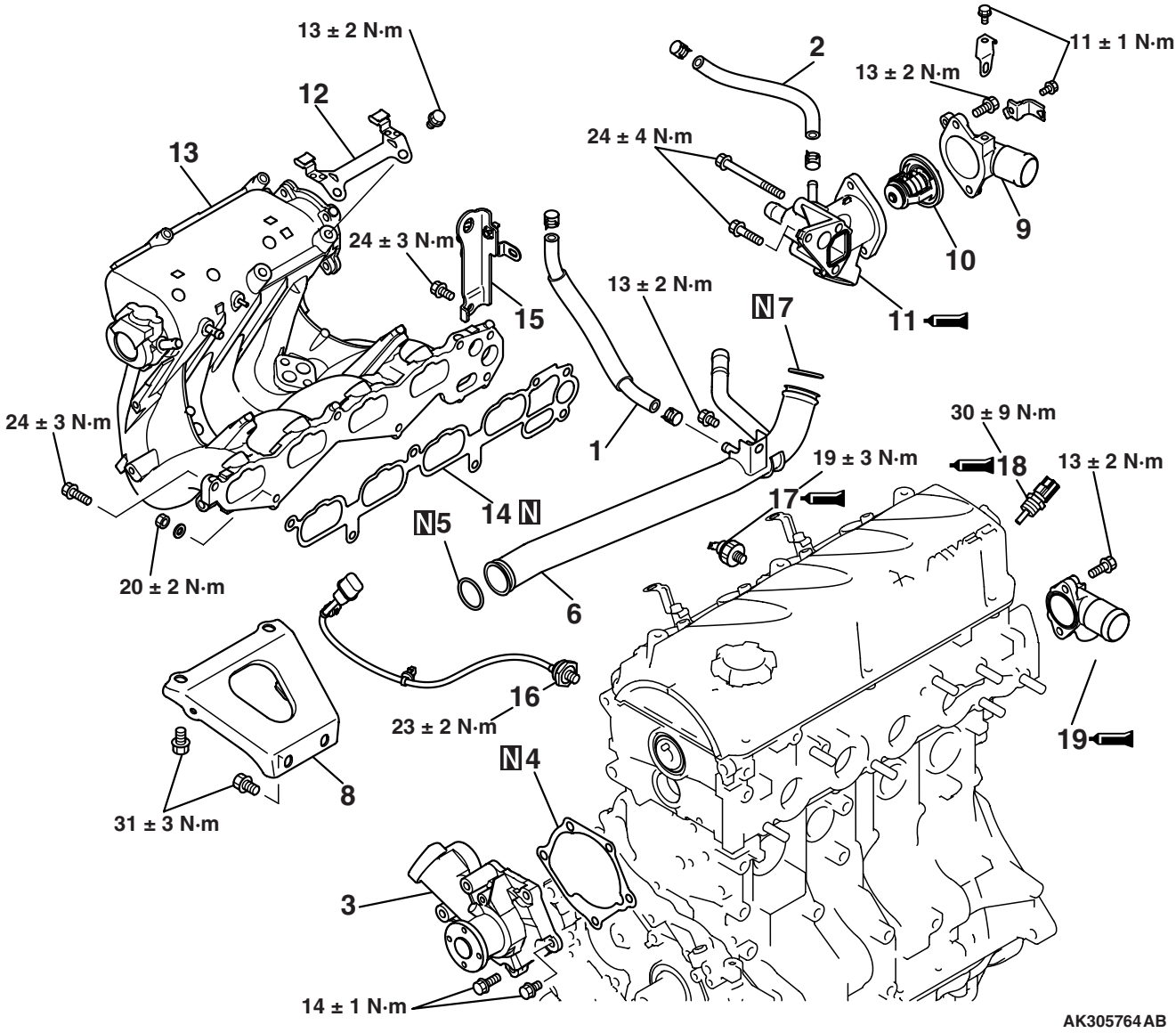


Install a new gasket so that the projection is positioned as shown in the illustration.

INLET MANIFOLD AND WATER PUMP

REMOVAL AND INSTALLATION

M1113025500067



Removal steps

1. Water hose
2. Water hose
3. Water pump
4. Water pump gasket

>>G<< 5. O-ring

>>G<< 6. Water inlet pipe

>>G<< 7. O-ring

>>F<< 8. Inlet manifold stay

9. Water inlet fitting

>>E<< 10. Thermostat

>>D<< 11. Thermostat housing

Removal steps (Continued)

12. Engine cover bracket
13. Inlet manifold
14. Inlet manifold gasket
15. Engine hanger
16. Detonation sensor

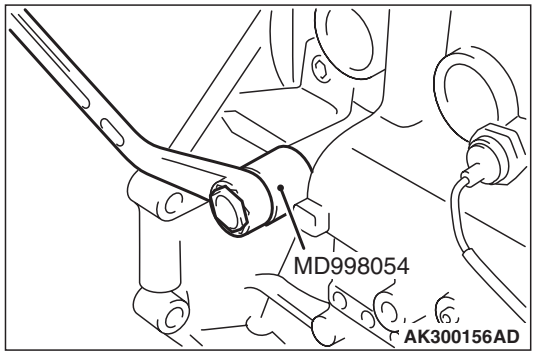
<<A>> >>C<< 17. Oil pressure switch

>>B<< 18 Engine coolant temperature sensor

>>A<< 19. Water outlet fitting

REMOVAL SERVICE POINT

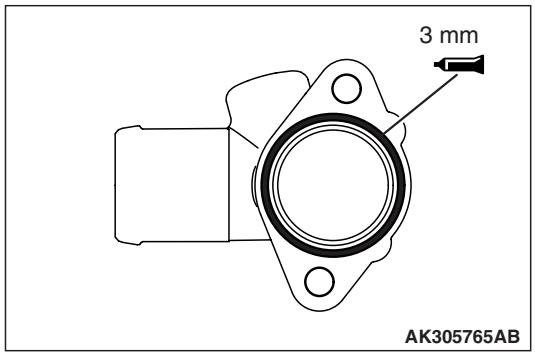
<<A>> OIL PRESSURE SWITCH REMOVAL



Using special tool Oil pressure switch wrench (MD998054), removal the oil pressure switch.

INSTALLATION SERVICE POINTS

>>A<< WATER OUTLET FITTING INSTALLATION



1. Apply a 3 mm diameter bead of FIPG to the indicated surface of the water outlet fitting.

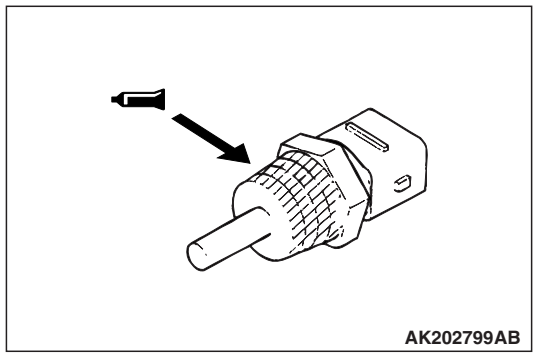
   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

2. Install the housing quickly (within 15 minutes) while the sealant is wet and tighten the bolts to the specified torque.

   Tightening torque: 13 ± 2 N·m

NOTE: After installation, keep the sealed area away from the coolant for approximately one hour.

>>B<< SEALANT APPLICATION TO ENGINE COOLANT TEMPERATURE SENSOR

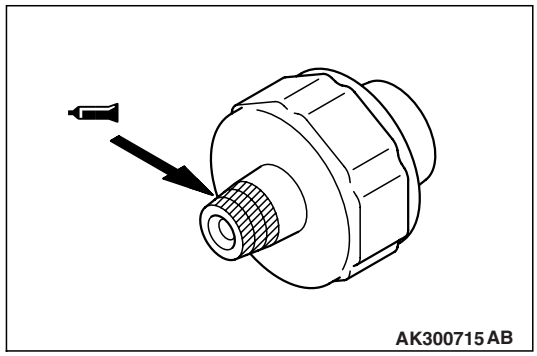


⚠ CAUTION
When using a tool, avoid letting it touch the connector portion which is made of plastic.

1. Remove all old sealant remaining on the threads of the coolant temperature sensor and in the threaded hole in the thermostat housing.
2. Apply sealant to the coolant temperature sensor's threads indicated in the drawing.

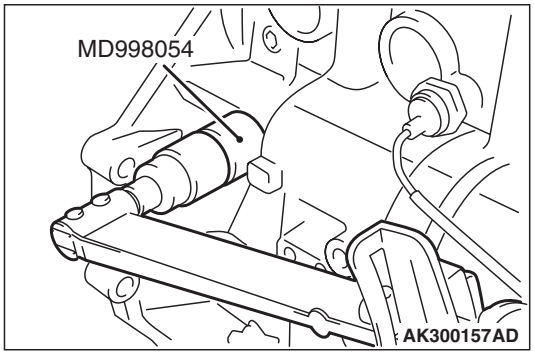
   Specified sealant:
   LOCTITE 262 or equivalent

>>C<< SEALANT APPLICATION TO OIL PRESSURE SWITCH



1. Apply sealant to the threaded portion.

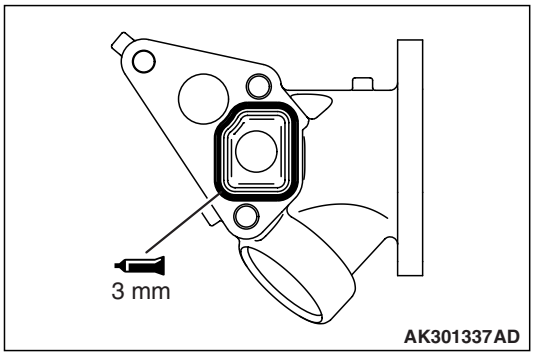
   Specified Sealant:
   Three bond 1215 or equivalent



2. Using special tool Oil pressure switch wrench (MD998054), tighten the oil pressure switch to the specified torque.

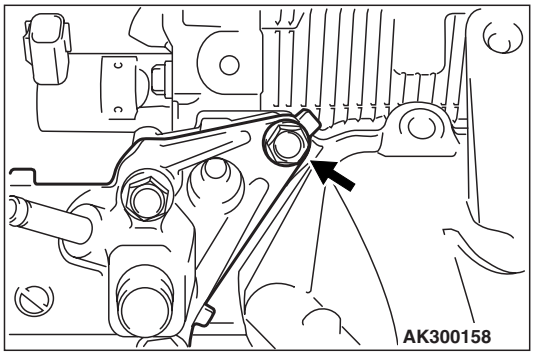
   Tightening torque: 19 ± 3 N·m

>>D<< THERMOSTAT HOUSING INSTALLATION



1. Remove all old FIPG remaining on the thermostat housing and cylinder head.
2. Apply a 3 mm diameter bead of FIPG on the indicated surface of the thermostat housing.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent



3. Coat the bolt with sealant, then install and tighten it.

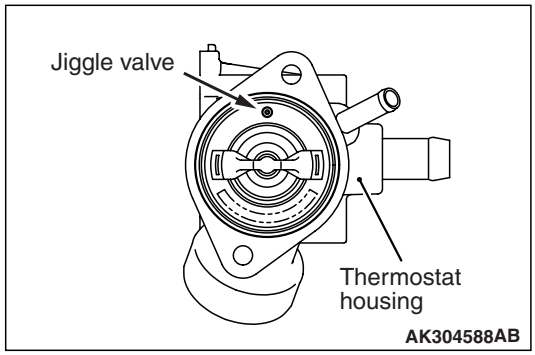
   Specified sealant:
   3M ATD Part No.8672 or equivalent

4. Install the housing quickly (within 15 minutes) while the sealant is wet and tighten the bolts to the specified torque.

   Tightening torque: 24 ± 4 N·m

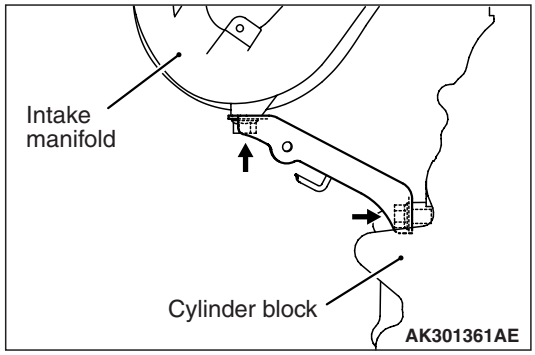
   NOTE: After installation, keep the sealed area away from the coolant for approximately one hour.

>>E<< THERMOSTAT INSTALLATION



1. Check that the rubber ring is undamaged and seated correctly in the thermostat flange.
2. Install the thermostat as shown in the illustration. The jiggle valve must be at the uppermost position.

>>F<< INLET MANIFOLD STAY INSTALLATION



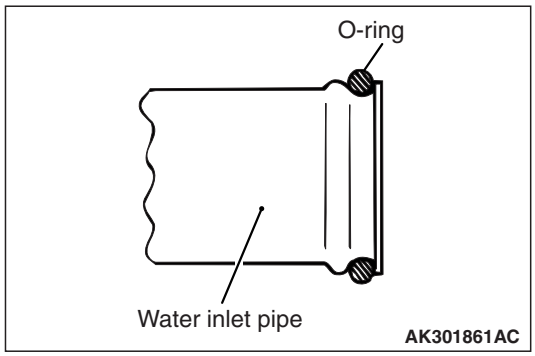
1. Install the inlet manifold stay and tighten the bolts just finger tight.
2. Check to ensure that the stay is in close contact with the bosses of the inlet manifold and cylinder block.
3. First tighten the inlet manifold side bolts to the specified torque, then the cylinder block side bolts to the specified torque.

   Tightening torque: 31 ± 3 N·m

>>G<< WATER INLET PIPE/O-RING INSTALLATION

⚠ CAUTION

Keep the O-ring free of oil or grease.

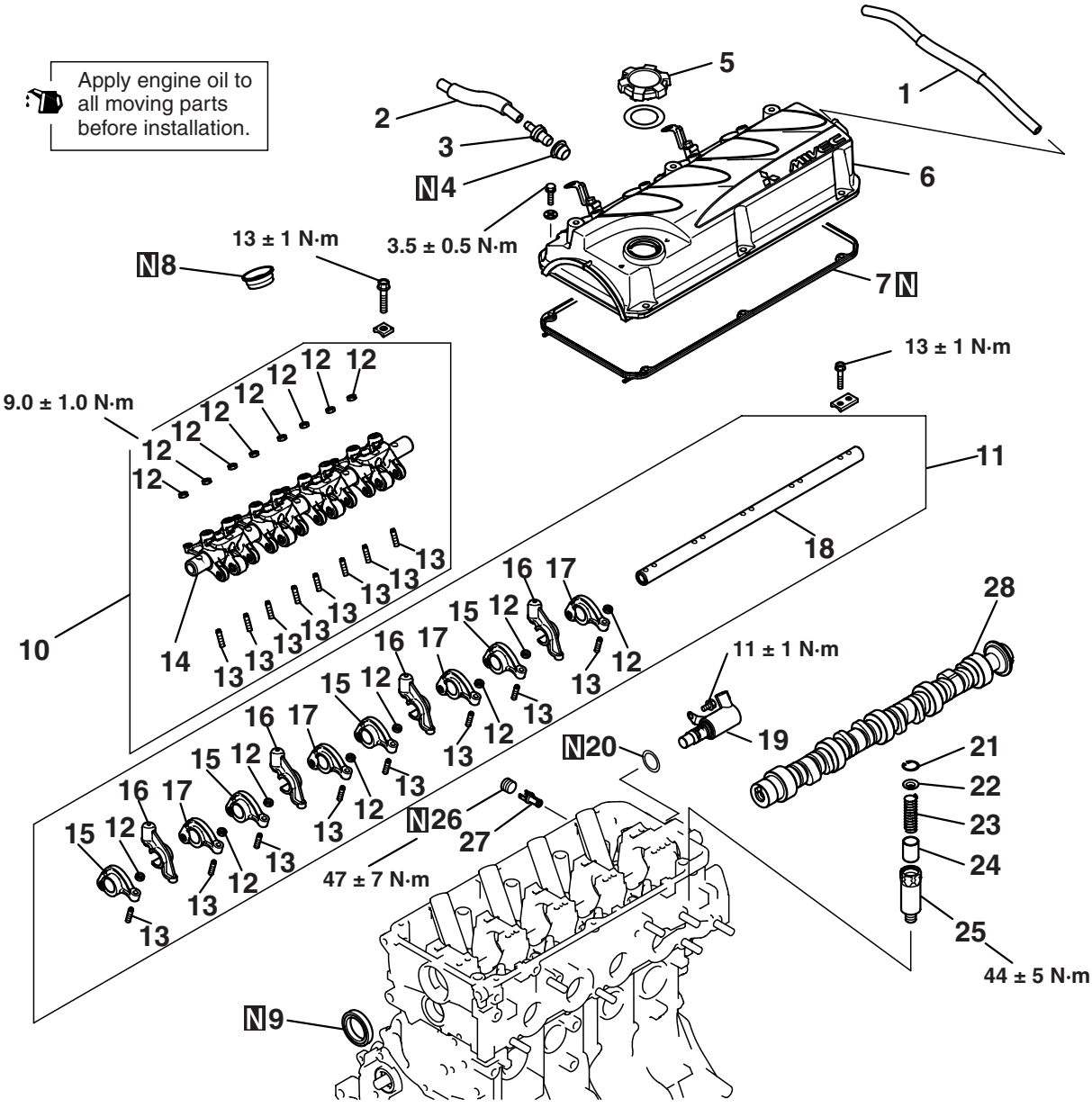


1. Attach a new O-ring to each end of the water inlet pipe.
2. Wet the O-ring with water.
3. Insert the rear end of the pipe into the thermostat housing.

ROCKER ARMS AND CAMSHAFT

REMOVAL AND INSTALLATION

M1113005400693



AK305650AB

Removal steps

1. Breather hose
2. PCV hose
3. PCV valve
4. PCV valve gasket
5. Oil filler cap
6. Rocker cover
7. Rocker cover gasket
8. Oil seal

>>D<< 9. Oil seal

<<A>> >>C<< 10. Rocker arms and rocker arm shaft (Intake side)

Removal steps (Continued)

<<A>> >>C<< 11. Rocker arms and rocker arm shaft (Exhaust side)

12. Nut

>>B<< 13. Adjusting screw

14. Rocker arm shaft assembly (Intake side)

15. Rocker arm "C"

16. Piston arm assembly

17. Rocker arm "D"

18. Rocker arm shaft (Exhaust side)

>>A<< 19. Oil control valve

Removal steps (Continued)
20. O-ring
21. Snap ring
22. Accumulator spring seat
23. Plunger spring
24. Accumulator plunger
25. Accumulator body
26. Taper plug
27. Oil control valve filter
28. Camshaft

REMOVAL SERVICE POINT

<<A>> ROCKER ARMS AND ROCKER ARM SHAFT REMOVAL

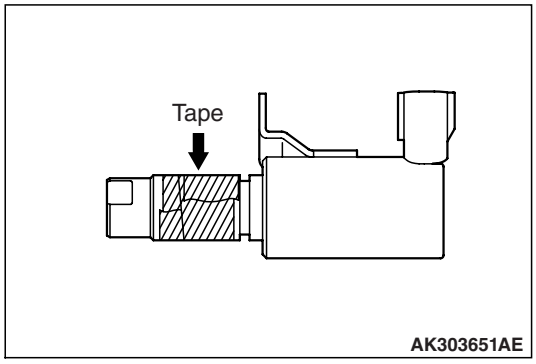
When the rocker arm is removed from the rocker shaft, keep them with the tags that show the installation location for the reinstallation of the rocker arm, the T-lever, the piston arm assembly and so on.

INSTALLATION SERVICE POINTS

>>A<< OIL CONTROL VALVE INSTALLATION

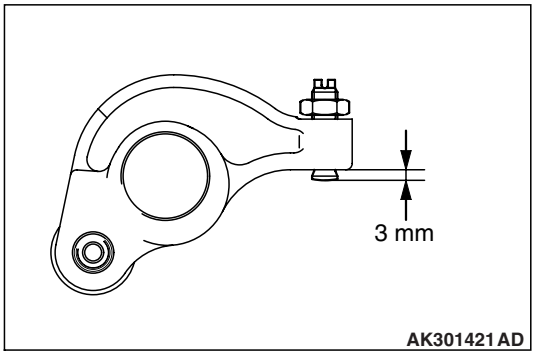
⚠ CAUTION

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



1. Apply a little amount of engine oil to the O-ring of oil control valve.
2. Install the oil control valve to the cylinder head.
3. Tighten the oil control valve to the specified torque of 11 ± 1 N·m.

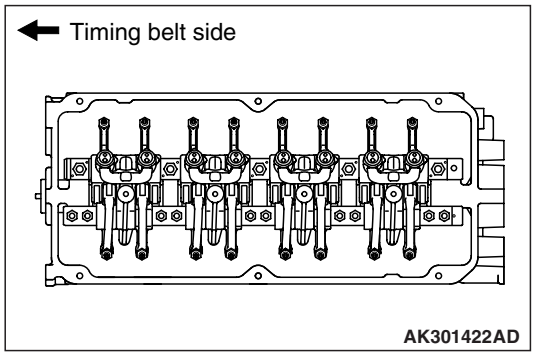
>>B<< ADJUSTING SCREW INSTALLATION



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.

>>C<< ROCKER SHAFT SPRING/ROCKER ARMS AND ROCKER ARM SHAFT INSTALLATION

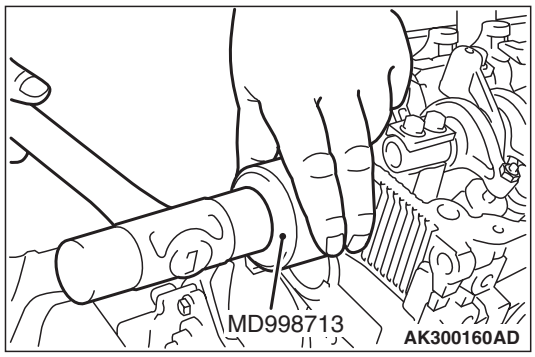
1. In accordance with the tags for the reinstallation, install the rocker arm and so on to the rocker arm shaft.
2. Install the rocker arm shaft with oil hole to the lower (cylinder head) side.



3. Install the rocker arm, rocker arm shaft assembly and intake temporarily.
4. Install the rocker arm, rocker arm shaft assembly and exhaust temporarily.
5. Confirm the each rocker arm and rocker arm shaft assembly are in position and then tighten to the specified torque.

Tightening torque:
M6: 13 ± 1 N·m
M8: 31 ± 3 N·m

>>D<< CAMSHAFT OIL SEAL INSTALLATION

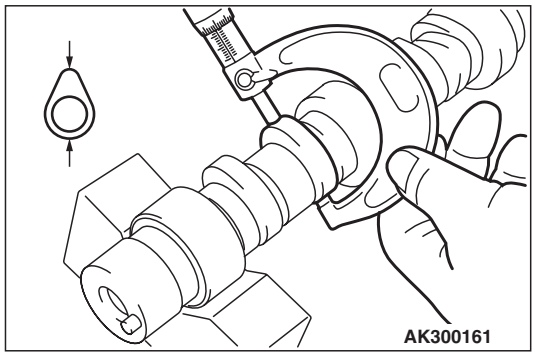


1. Apply engine oil to the lip area of the oil seal and the front end outside diameter of camshaft.
2. Using special tool Camshaft oil seal installer (MD998713), install the camshaft oil seal.

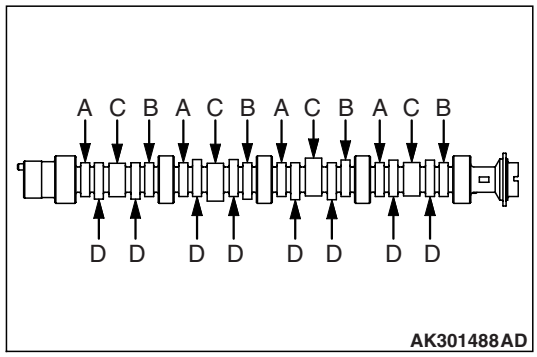
INSPECTION

M1113005500560

CAMSHAFT



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

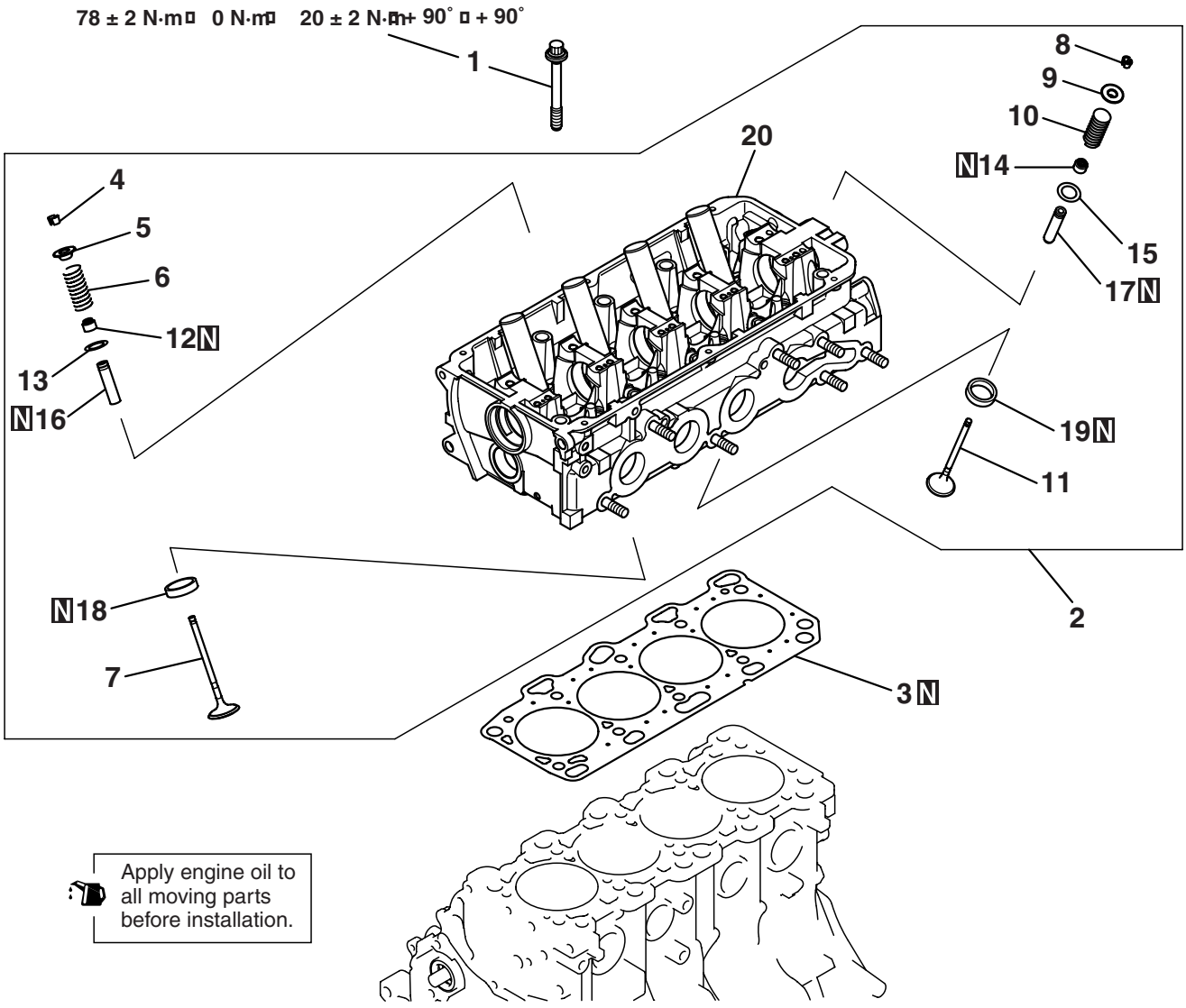


	Standard value	Minimum limit
A: Intake low speed cam A	34.41 mm	33.91 mm
B: Intake low speed cam B	37.47 mm	36.97 mm
C: Intake high speed cam	37.21 mm	36.71 mm
D: Exhaust cam	37.86 mm	37.36 mm

CYLINDER HEAD AND VALVES

REMOVAL AND INSTALLATION

M1113006900635



AK301262AE

Removal steps

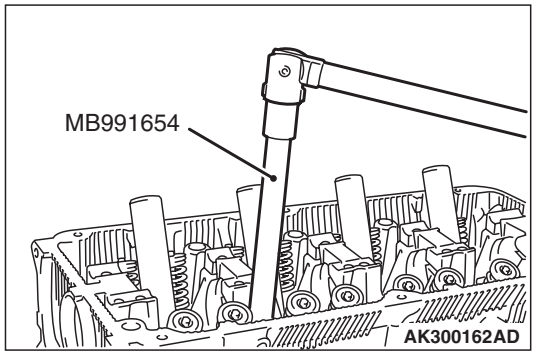
<<A>> >>D<< 1. Cylinder head bolt
2. Cylinder head assembly
3. Cylinder head gasket
<<B>> >>C<< 4. Retainer lock
5. Valve spring retainer
>>B<< 6. Valve spring
7. Intake valve
<<B>> >>C<< 8. Retainer lock
9. Valve spring retainer
>>B<< 10. Valve spring
11. Exhaust valve

Removal steps (Continued)

>>A<< 12. Valve stem seal
13. Valve spring seat
>>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

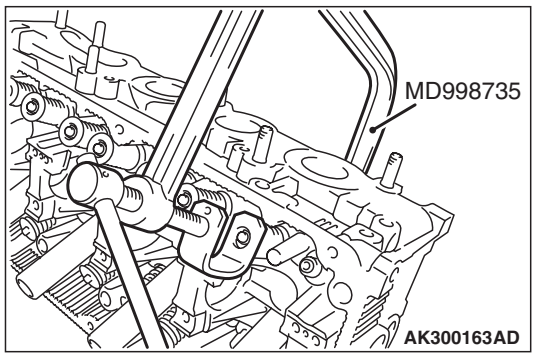
REMOVAL SERVICE POINTS

<<A>> CYLINDER HEAD BOLTS REMOVAL



Using special tool Cylinder head bolt wrench (MB991654), loosen the cylinder head bolts. Loosen each bolt evenly, little by little, by two or three steps.

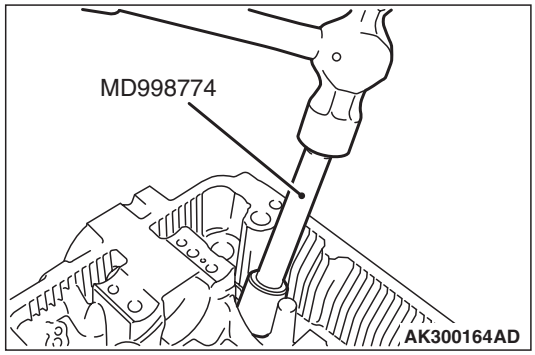
<<B>> RETAINER LOCK REMOVAL



1. Set special tool Valve spring compressor (MD998735) as illustrated to compress the valve spring. Remove the retainer lock.
2. Relieve the spring tension and remove the valve, retainer, spring, etc. Store removed valves, springs, and other parts, tagged to indicate their cylinder number and location for assembly.

INSTALLATION SERVICE POINTS

>>A<< VALVE STEM SEAL INSTALLATION

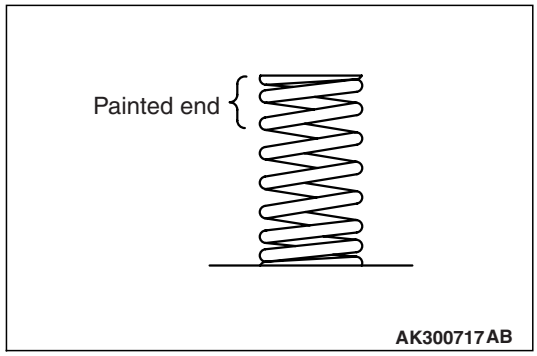


⚠ CAUTION

The special tool must be used to install the valve stem seal. Improper installation could result in oil leaking past the valve guide.

1. Install the valve spring seat.
2. Using special tool Valve stem seal installer (MD998774), install a new valve stem seal.

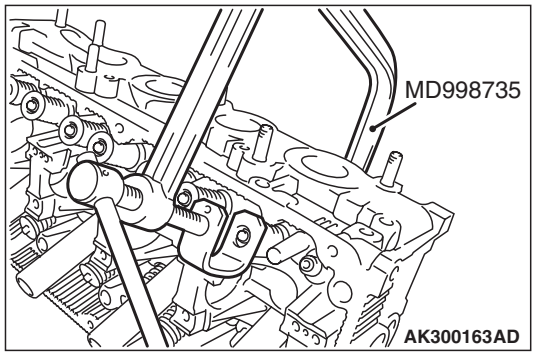
>>B<< VALVE SPRING INSTALLATION



Install the valve spring with its identification color painted end (larger pitch side) upward (toward the valve spring retainer).

Identification:
<Intake> Light blue
<Exhaust> Orange

>>C<< RETAINER LOCK INSTALLATION

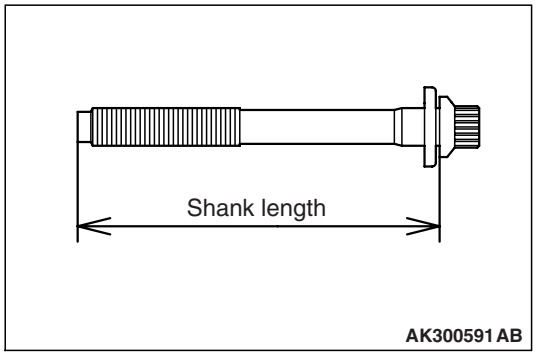


⚠ CAUTION

Do not compress the valve spring excessively. It can damage the stem seal.

1. Set special tool Valve spring compressor (MD998735) as illustrated to compress the valve spring. Install the retainer locks.
2. Relieve the spring tension. Check that the retainer locks are seated correctly.

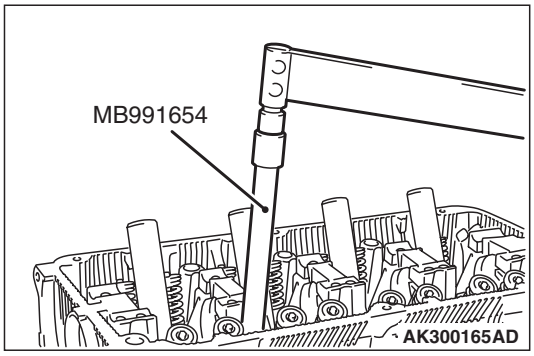
>>D<< CYLINDER HEAD BOLT INSTALLATION

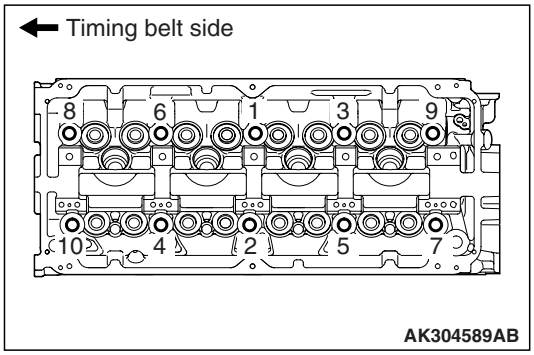


1. When the removed cylinder head bolts are to be reused, check that the shank length of each bolt meets the limit. If it exceeds the limit, replace the bolts.

   Limit: 99.4 mm

2. Apply engine oil to the thread of the bolts and to the washers.



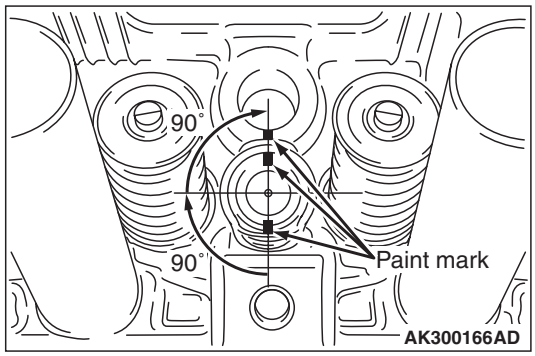


3. Using special tool Cylinder head bolt wrench (MB991654) tighten the bolts to the specified torque, using the tightening sequence shown.

   Tightening torque: 78 ± 2 N·m

4. Loosen all bolts fully in the reverse order of tightening.
5. Retighten the loosened bolts to in the tightening sequence shown.

   Tightening torque: 20 ± 2 N·m



6. Make a paint mark across each bolt head and cylinder head.
7. Tighten the cylinder head bolts 90 degrees in the specified order.

⚠ CAUTION

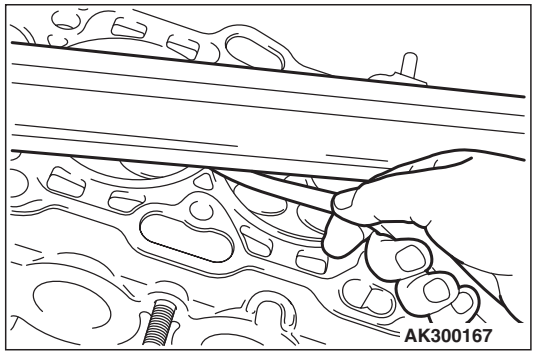
- **If the bolt is turned less than 90 degrees, proper fastening performance may not be achieved. Be careful to turn each bolt exactly 90 degrees.**
- **If the bolt is overtightened, loosen the bolt completely and then retighten it by repeating the tightening procedure from step 1.**

8. Tighten the bolts another 90 degrees in the same order as in step 7, and check that the paint marks on the cylinder head bolt are aligned with the paint marks on the cylinder head.

INSPECTION

M1113007000549

CYLINDER HEAD



1. Check the cylinder head gasket surface for flatness by using a straight edge and feeler gauge.

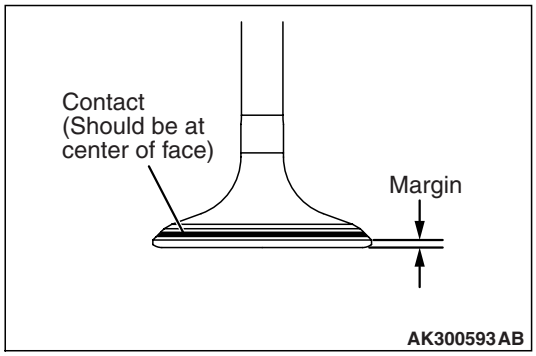
   Standard value: 0.03 mm
   Limit: 0.2 mm

2. If it exceeds the limit, correct to meet specification.

   Grinding limit: *0.2 mm
   *** Includes combined with cylinder block grinding.**

Cylinder head height (Specification when new): 120 mm

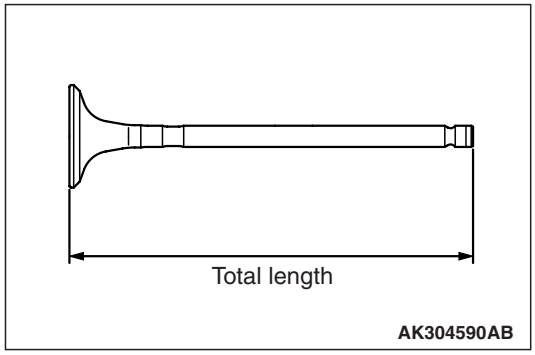
VALVE



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
   <Exhaust> 1.2 mm

   Minimum limit:
   <Intake> 0.5 mm
   <Exhaust> 0.7mm

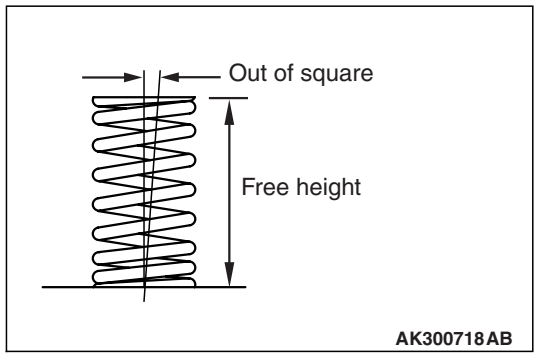


3. Measure the valve's total length. If the measurement is less than the limit, replace the valve.

   Standard value:
   <Intake> 111.33 mm
   <Exhaust> 113.54 mm

   Minimum limit:
   <Intake> 110.83 mm
   <Exhaust> 113.04 mm

VALVE SPRING



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

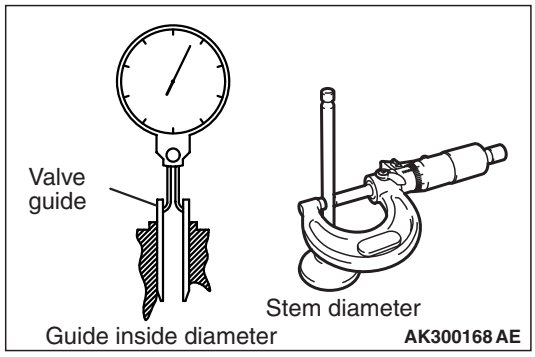
   Standard value:
   <Intake> 54.8 mm
   <Exhaust> 56.1 mm

   Minimum limit:
   <Intake> 53.8 mm
   <Exhaust> 55.1 mm

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

   Standard value: 2 degrees or less
   Limit: 4 degrees

VALVE GUIDE

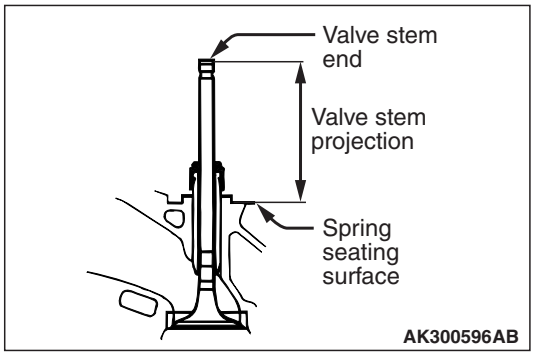


Measure the clearance between the valve guide and valve stem. If it exceeds the limit, replace the valve guide or valve, or both.

Standard value:
<Intake> 0.02 – 0.04 mm
<Exhaust> 0.04 – 0.06 mm

Limit:
<Intake> 0.10 mm
<Exhaust> 0.15 mm

VALVE SEAT

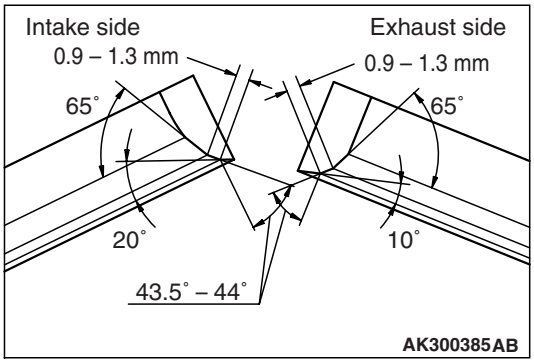


Assemble the valve, then measure the valve stem projection between the end of the valve stem and the spring seating surface. If the measurement exceeds the specified limit, replace the valve seat.

Standard value:
<Intake> 48.33 mm
<Exhaust> 48.34 mm

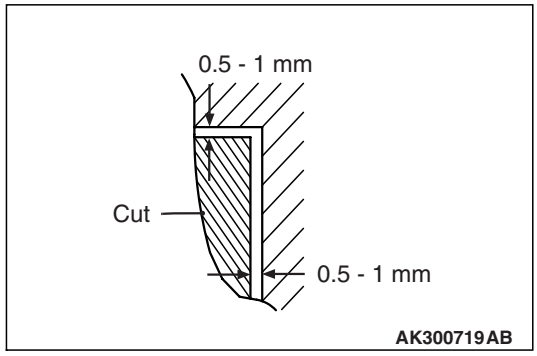
Limit:
<Intake> 48.83 mm
<Exhaust> 48.84 mm

VALVE SEAT RECONDITIONING PROCEDURE

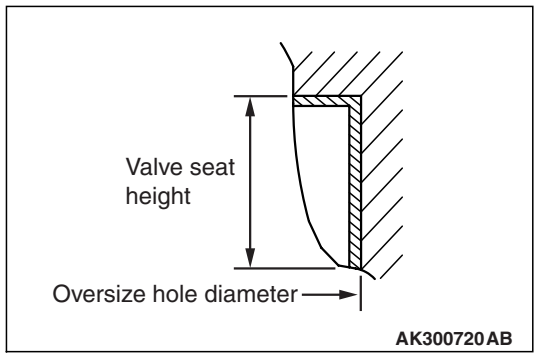


1. Before correcting the valve seat, check for clearance between the valve guide and valve and, if necessary, replace the valve guide.
2. Using the seat grinder, correct to obtain the specified seat width and angle.
3. After correcting the valve seat, lap the valve and valve seat using lapping compound.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

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: 35.30 – 35.33 mm
   0.6 oversize: 35.60 – 35.63 mm

   Exhaust seat ring hole diameters
   0.3 oversize: 33.30 – 33.33 mm
   0.6 oversize: 33.60 – 33.63 mm

3. Before fitting the valve seat, either heat the cylinder head up to approximately 250°C 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 GUIDE REPLACEMENT PROCEDURE

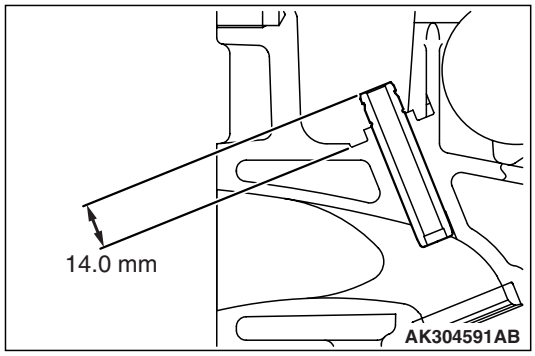
1. Using a press, remove the valve guide toward the cylinder block.

⚠ 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 11.05 – 11.07 mm
   0.25 oversize 11.25 – 11.27 mm
   0.50 oversize 11.50 – 11.52 mm



3. Press-fit the valve guide until it protrudes 14.0 mm from the cylinder head top surface as shown in the illustration.

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

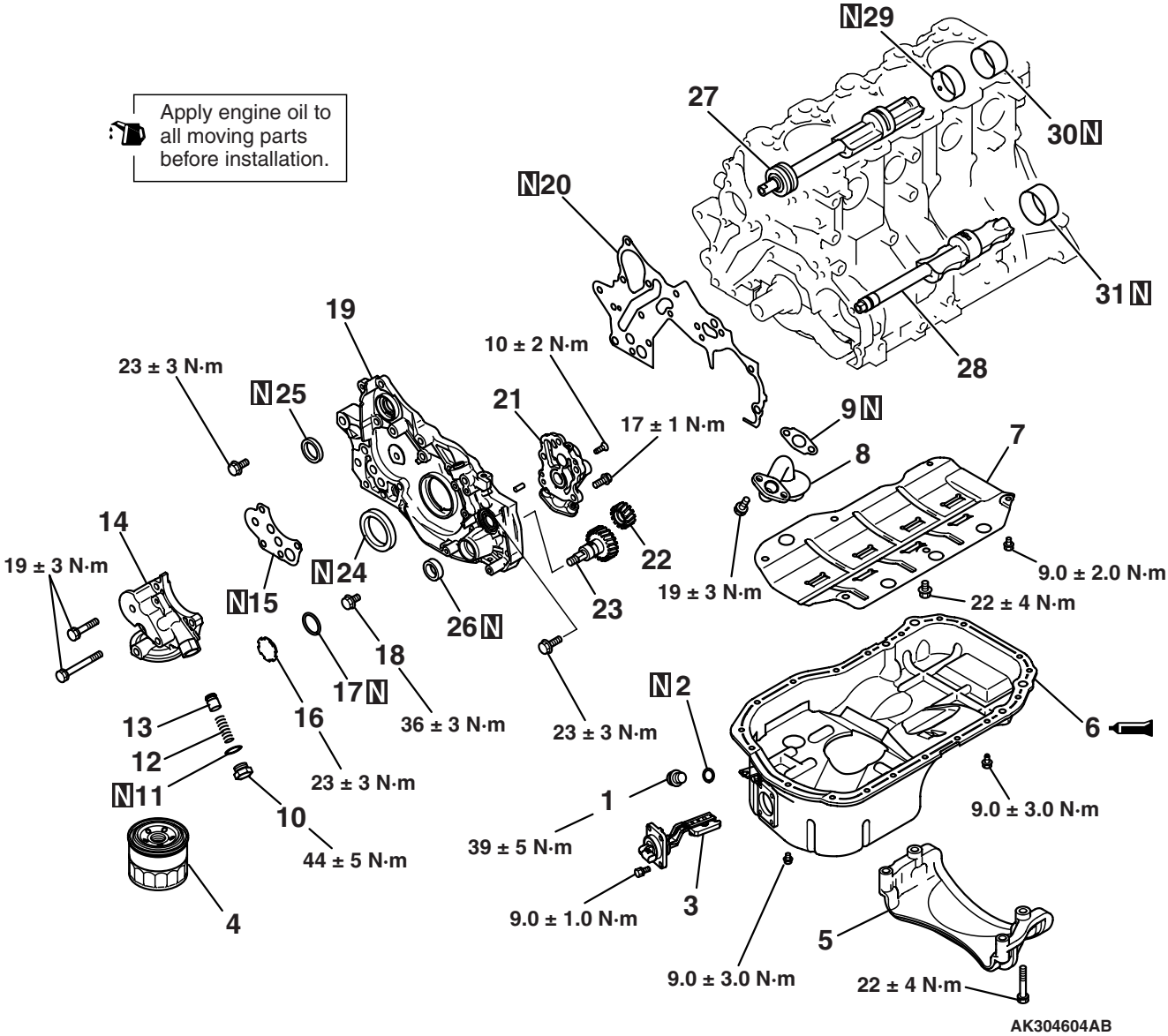
   NOTE: Pay attention to the difference in length of the valve guides. (Intake side: 45.5 mm; exhaust side: 50.5 mm)

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

OIL PAN AND OIL PUMP

REMOVAL AND INSTALLATION

M1113008100527



Removal steps

1. Drain plug
- **>>M<<** 2. Drain plug gasket
3. Oil level sensor
- **<<A>> >>L<<** 4. Oil filter
5. Transmission stay
- **<<B>> >>K<<** 6. Oil pan
7. Baffle plate
8. Oil screen
9. Oil screen gasket
10. Relief plug
11. Gasket
12. Relief spring
13. Relief plunger
14. Oil filter bracket
15. Oil filter bracket gasket
- **<<C>> >>J<<** 16. Plug

Removal steps (Continued)

17. O-ring
- **<<D>> >>I<<** 18. Flange bolt
- **>>H<<** 19. Front case
20. Front case gasket
21. Oil pump cover
- **>>G<<** 22. Oil pump driven gear
- **>>G<<** 23. Oil pump drive gear
- **>>F<<** 24. Crankshaft front oil seal
- **>>E<<** 25. Oil pump oil seal
- **>>D<<** 26. Counterbalance shaft oil seal
27. Counterbalance shaft, left
28. Counterbalance shaft, right
- **<<E>> >>C<<** 29. Counterbalance shaft, front bearing

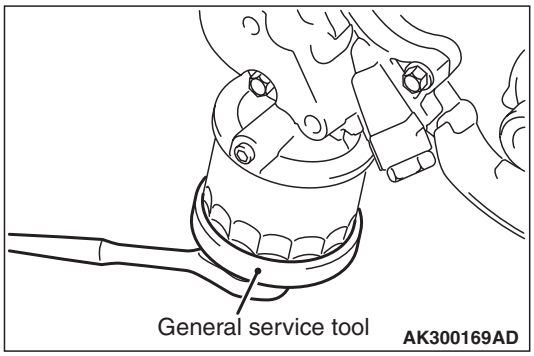
Removal steps (Continued)

<<F>> >>B<< 30. Counterbalance shaft, rear bearing, right

<<F>> >>A<< 31. Counterbalance shaft, rear bearing, left

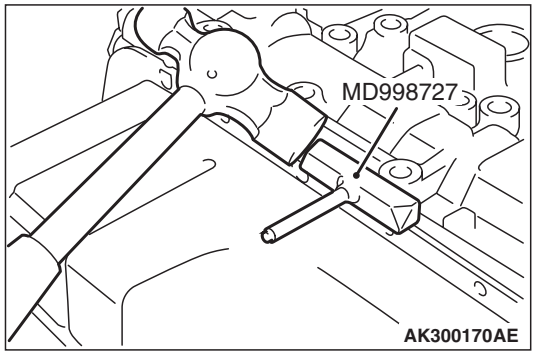
REMOVAL SERVICE POINTS

<<A>> OIL FILTER REMOVAL



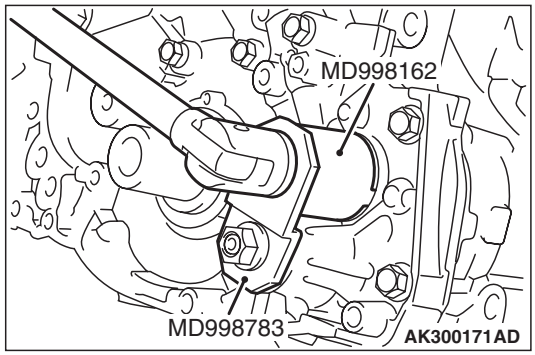
1. Using general service tool, remove the oil filter from the oil filter bracket.

<<B>> OIL PAN REMOVAL



1. Remove the oil pan bolts.
2. Insert the special tool Oil pen remover (MD998727) into the joint between the cylinder block and oil pan by tapping the tool with a hammer.
3. Remove the oil pan by tapping an edge of the special tool Oil pen remover (MD998727) with a hammer to move it sideways.

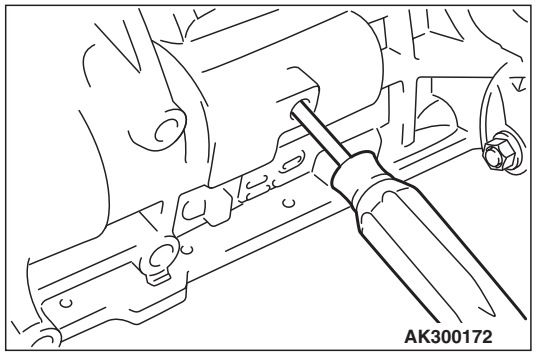
<<C>> PLUG REMOVAL



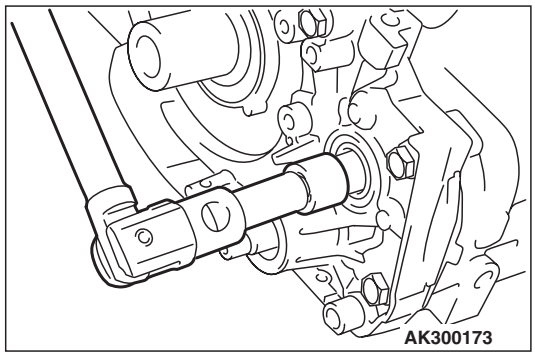
Fit the teeth of the special tool in notches of the plug as shown in the drawing and support the tool with the special tool to loosen the plug.

- Plug wrench (MD998162)
- Plug wrench retainer (MD998783)

<<D>> FLANGE BOLT REMOVAL

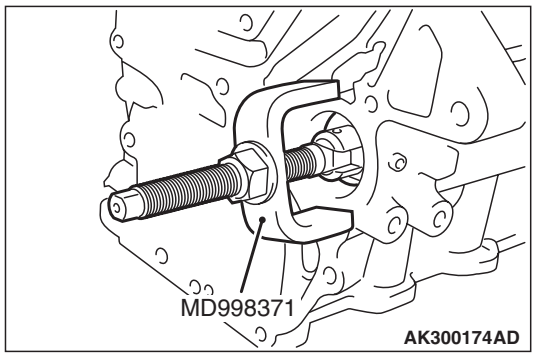


1. Remove the plug on the side of the cylinder block.
2. Insert a Phillips screwdriver (shank diameter 8 mm) into the plug hole to lock the counterbalance shaft.



3. Loosen the flange bolt.

<<E>> COUNTERBALANCE SHAFT FRONT BEARING REMOVAL

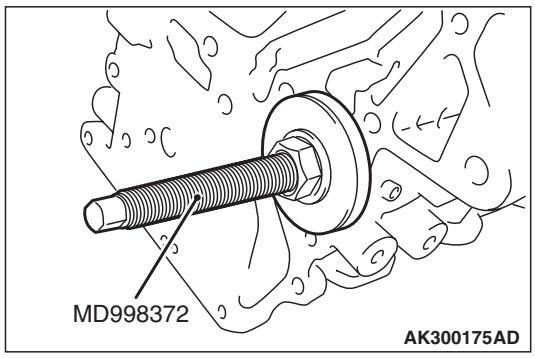


⚠ CAUTION

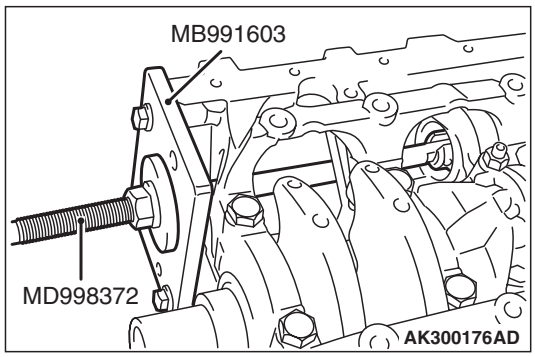
Be sure to remove the front bearing first. If it has not been removed, special tool Silent shaft bearing puller (MD998372) cannot be used for rear balance shaft bearing removal.

Using special tool Silent shaft bearing puller (MD998371), remove the counterbalance shaft front bearing from the cylinder block.

<<F>> COUNTERBALANCE SHAFT REAR BEARING REMOVAL



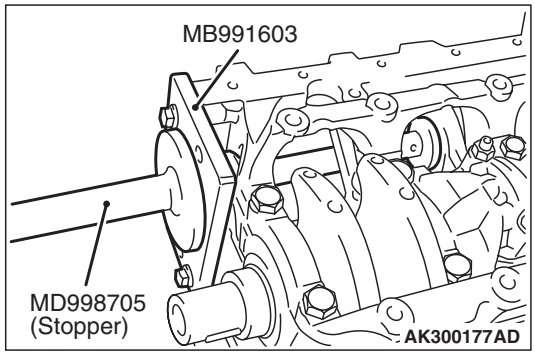
1. Using special tool Silent shaft bearing puller (MD998372), remove the right counterbalance shaft rear bearing from the cylinder block.

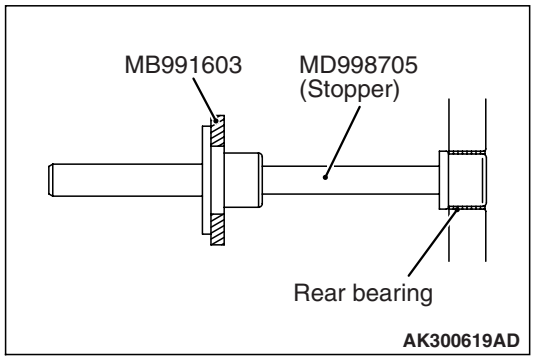


2. Using special tools, remove the left counterbalance shaft rear bearing from the cylinder block.
   - Silent shaft bearing puller (MD998372)
   - Bearing installer stopper (MB991603)

INSTALLATION SERVICE POINTS

>>A<< LEFT COUNTERBALANCE SHAFT REAR BEARING INSTALLATION

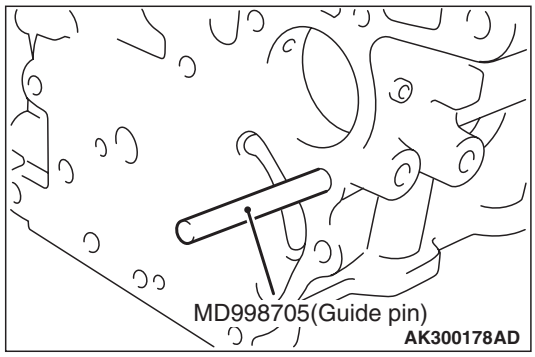




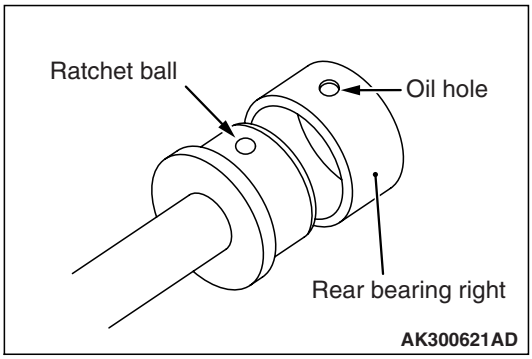
1. Install special tool Silent shaft bearing installer stopper (MB991603) to the cylinder block.
2. Apply engine oil to the rear bearing outer surface and bearing hole in the cylinder block.
3. Using special tool Silent shaft bearing installer (MD998705), install the rear bearing.

   NOTE: The left rear bearing has no oil holes.

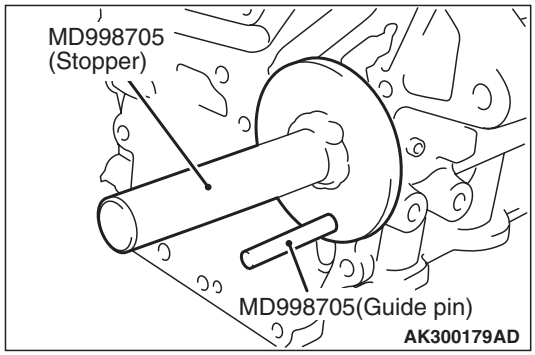
>>B<< RIGHT COUNTERBALANCE SHAFT REAR BEARING INSTALLATION

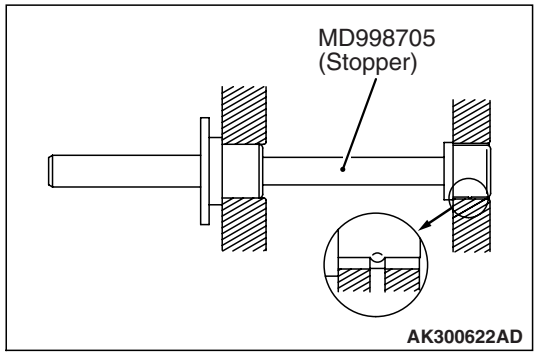


1. Install special tool the guide pin of the Silent shaft bearing installer (MD998705) in the threaded hole of the cylinder block as shown.



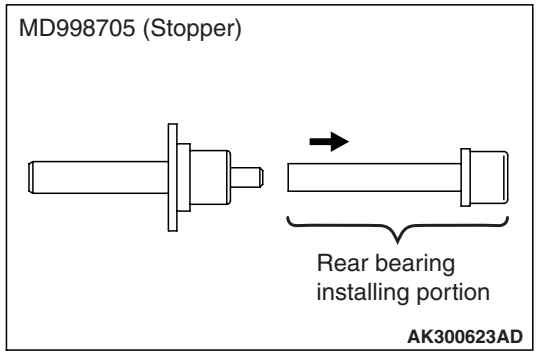
2. Align the ratchet ball of the special tool with the oil hole in the rear bearing to install the bearing of the special tool.
3. Apply engine oil to the bearing outer surface and bearing hole in the cylinder block.



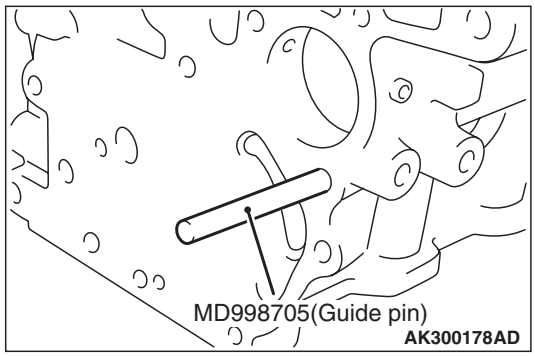


4. Using special tool, install the rear bearing. Make sure that the oil hole of the bearing is aligned with the oil hole of the cylinder block.

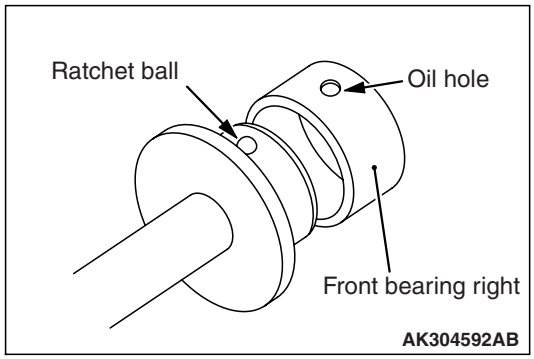
>>C<< COUNTERBALANCE SHAFT FRONT BEARING INSTALLATION



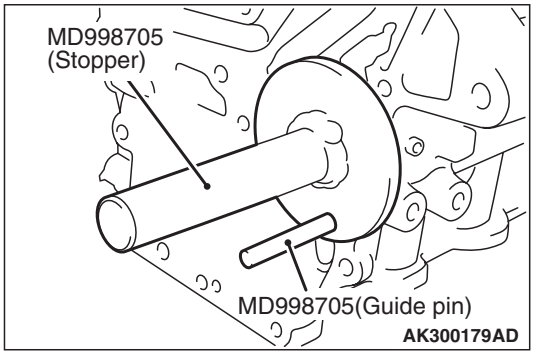
1. Remove the rear bearing installing portion from the special tool Silent shaft bearing installer (MD998705).

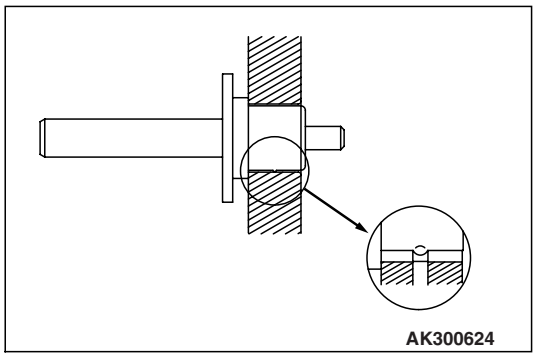


2. Install special tool the guide pin of the Silent shaft bearing installer (MD998705) in the threaded hole of the cylinder block as shown.



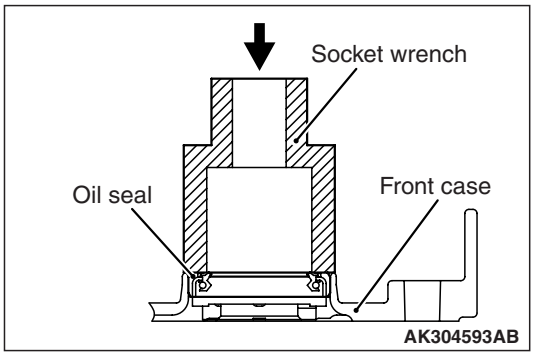
3. Align the ratchet ball of the special tool with the oil hole in the rear bearing to install the bearing of the special tool.
4. Apply engine oil to the front bearing outer surface and bearing hole in the cylinder.





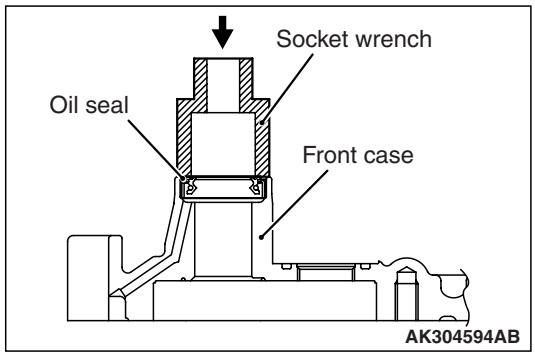
5. Using special tool, install the rear bearing. Make sure that the oil hole of the bearing is aligned with the oil hole of the cylinder block.

>>D<< COUNTERBALANCE SHAFT OIL SEAL INSTALLATION



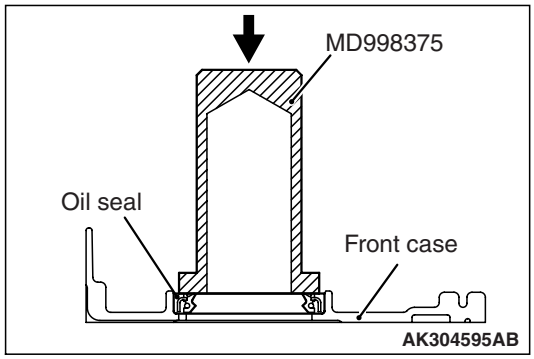
Using a suitable socket wrench, install the counterbalance shaft oil seal into the front case.

>>E<< OIL PUMP OIL SEAL INSTALLATION



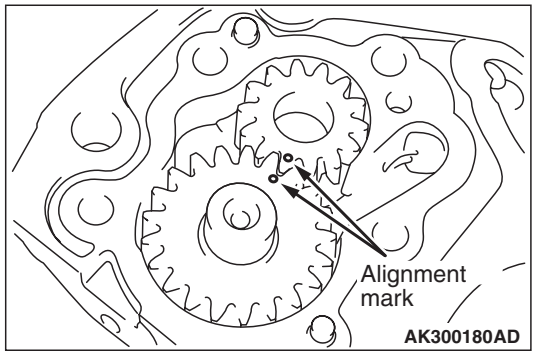
Using a suitable socket wrench, install the oil pump oil seal into the front case.

>>F<< CRANKSHAFT FRONT OIL SEAL INSTALLATION



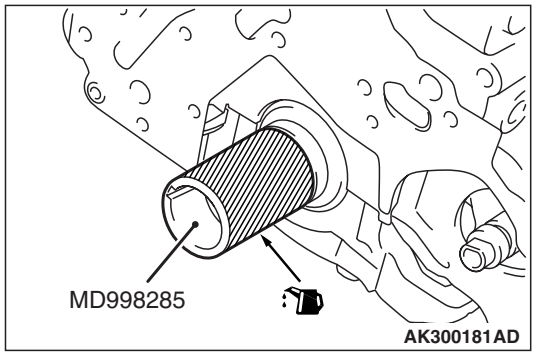
Using special tool Crankshaft front oil seal installer (MD998375), install the crankshaft front oil seal into the front case.

>>G<< OIL PUMP DRIVEN GEAR/OIL PUMP DRIVE GEAR INSTALLATION

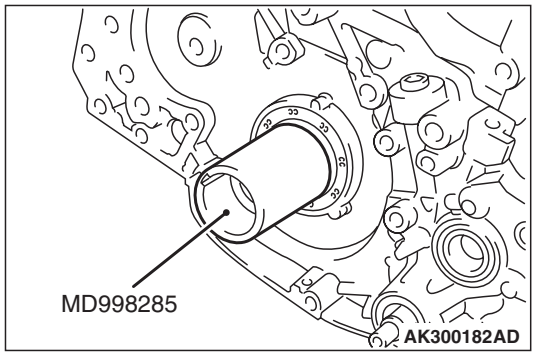


Install the oil pump gears into the front case and align the alignment marks.

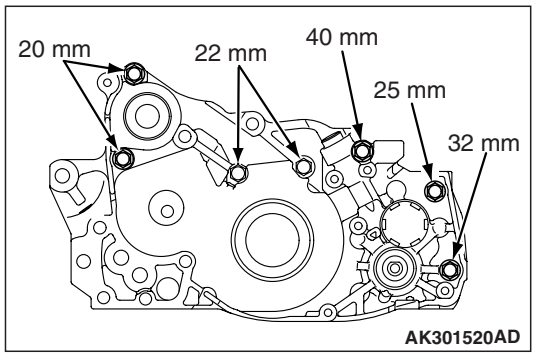
>>H<< OIL PUMP CASE INSTALLATION



1. Set special tool Crankshaft front oil seal guide (MD998258) on the front end of crankshaft and apply a thin coat of engine oil to the outer surface of special tool.
2. Apply engine oil to the lip of the crankshaft front oil seal.



3. Install the front case carefully not to damage the oil seal.



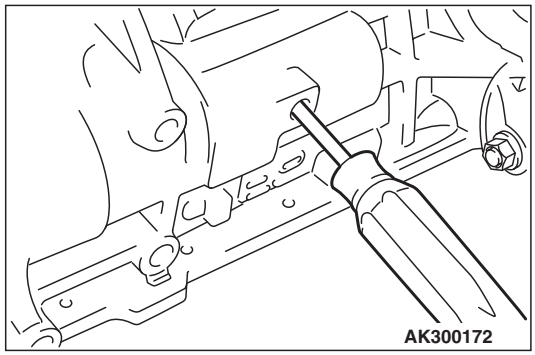
⚠ CAUTION

Carefully install the tightening bolts because of the different length respectively.

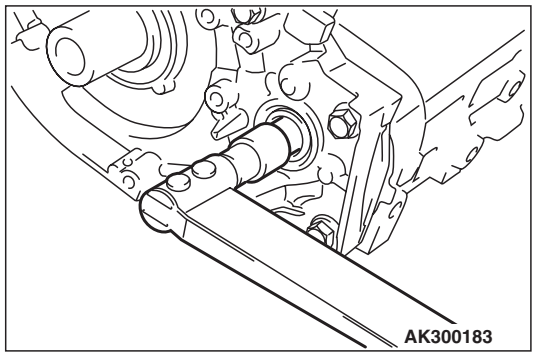
4. Tighten all flange bolts to the specified torque.

   Tightening torque: 23 ± 3 N·m

>>I<< FLANGE BOLT INSTALLATION



1. Insert a Phillips head screwdriver (shank diameter 8 mm) into the hole in the left side of the cylinder block to lock the counterbalance shaft.

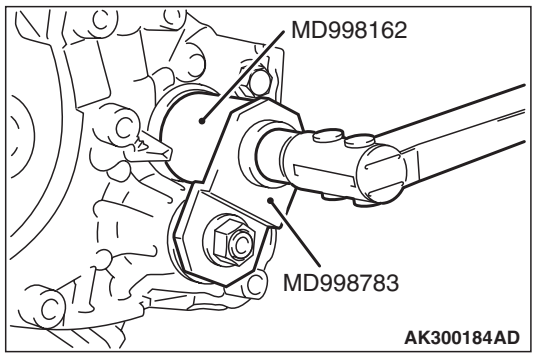


2. Secure the oil pump driven gear onto the left counterbalance shaft by tightening the flange bolt to the specified torque.

   Tightening torque: 36 ± 3 N·m

3. Pull out the screwdriver and screw in the plug.

>>J<< PLUG INSTALLATION



1. Install a new O-ring to the groove of the front case.
2. Install the plug to the front case.
3. Use the special tool to tighten the plug to the specified torque.
   - Plug wrench (MD998162)
   - Plug wrench retainer (MD998783)

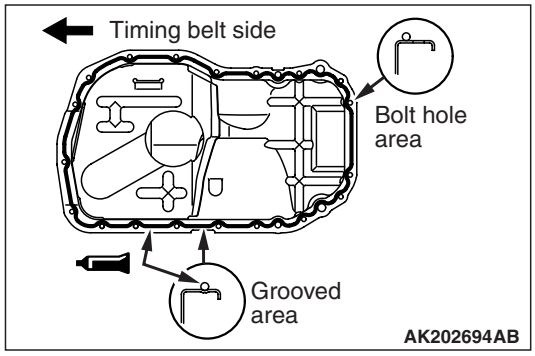
   Tightening torque: 23 ± 3 N·m

>>K<< OIL PAN INSTALLATION

⚠ CAUTION

Do not apply FIPG over remaining old FIPG. Doing so could result in oil leakage.

1. Thoroughly remove old FIPG from the gasket surfaces of the cylinder block and oil pan.



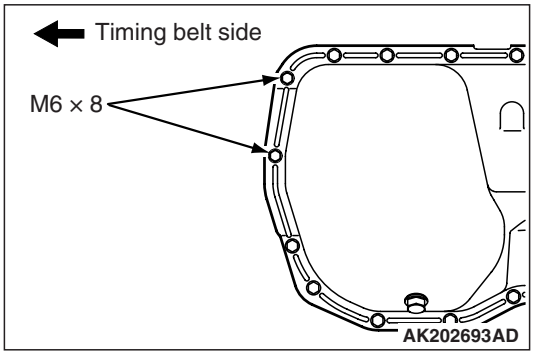
⚠ CAUTION

Too much FIPG will squeeze out, blocking coolant or oil passages, while too thin a bead could result in leakage.

2. Apply a 4 mm diameter bead of FIPG to the flange surface all around the oil pan.

   Specified sealant:
   Mitsubishi Genuine Part No.MD970389 or equivalent

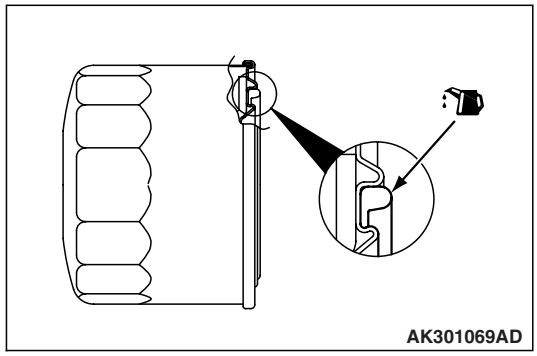
   NOTE: In the grooved areas on the oil pan flange, apply FIPG bead along the center of the groove.



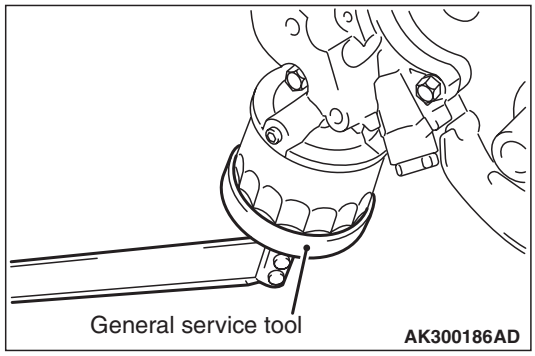
3. Install the shorter bolts in the locations indicated in the drawing.

>>L<< OIL FILTER INSTALLATION

1. Clean the installation surface of the filter bracket.



2. Apply engine oil to the o-ring of the oil filter.



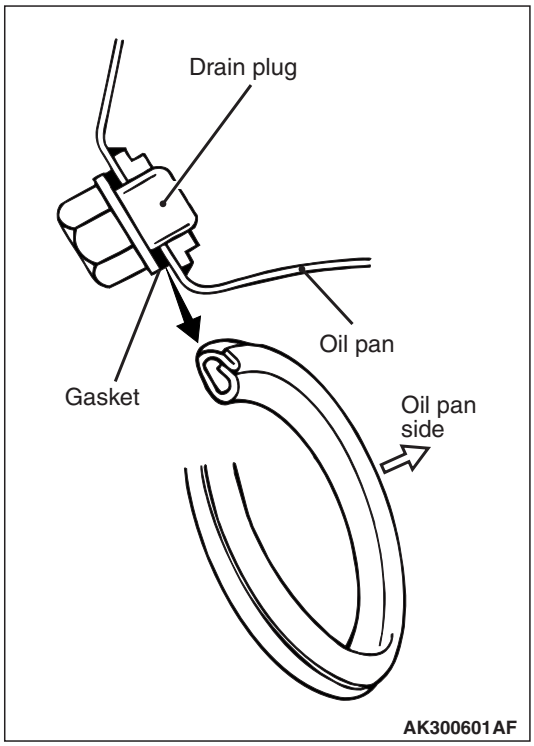
3. Using general service tool, Install the oil filter to the bracket and tighten it to the specified torque.

   Tightening torque
   Part number MD356000 filter: 14 ± 2 N·m
   Other Mitsubishi Genuine filter: 17 ± 3 N·m

4. If a torque wrench cannot be used use the following procedure:
   (1) Screw in the oil filter until its o-ring contacts the oil filter bracket.
   (2) Tighten the oil filter as follows:

   Mitsubishi Genuine filter: 3/4 turn

>>M<< DRAIN PLUG GASKET INSTALLATION



⚠ CAUTION

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

Install the drain plug gasket in the direction shown.

INSPECTION

M1113008200342

FRONT CASE

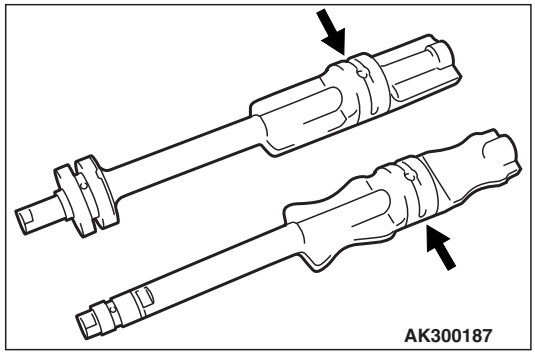
1. Check the oil passage for clogging. Clean if necessary.
2. Check the left counterbalance shaft front bearing for wear, damage and seizure. If the bearing is damaged, replace the front case.
3. Check the front case for cracks and other damage.

   Replace cracked or damaged front case.

OIL SEAL

1. Check the oil seal lip for wear and damage. Replace the oil seal if necessary.
2. Check the oil seal lip for deterioration. Replace the oil seal if necessary.

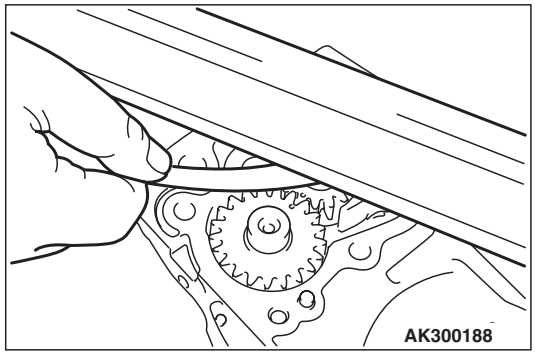
COUNTERBALANCE SHAFT



1. Check the oil holes for clogging and clean if necessary.
2. Check the journal for seizure, damage and contact with bearing. If there is anything wrong with the journal, replace the counterbalance shaft, bearing or front case assembly if required.

OIL PUMP

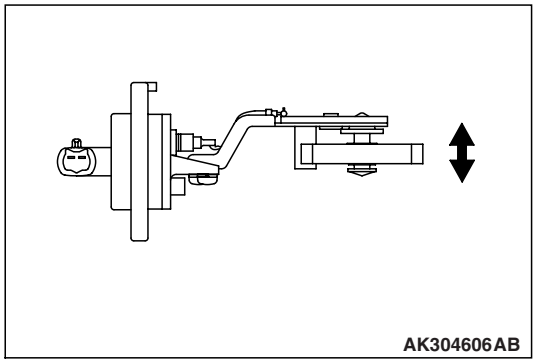
1. Assemble the oil pump gears to the front case and rotate it to ensure smooth rotation with no looseness.
2. Ensure that there is no ridge wear on the contact surface between the front case and the gear surface of the oil pump cover.



3. Check the side clearance.

   Standard value:
   Drive gear 0.08 – 0.14 mm
   Driven gear 0.06 – 0.12 mm

OIL LEVEL SENSOR



Put the oil level sensor in oil, then move the float up and down with the oil at a temperature either lower than 40°C or higher than 80°C, and check for continuity.

40°C

Float position	Switch ON/OFF
Condition when down	ON (continuity)
Condition when up	ON (continuity)

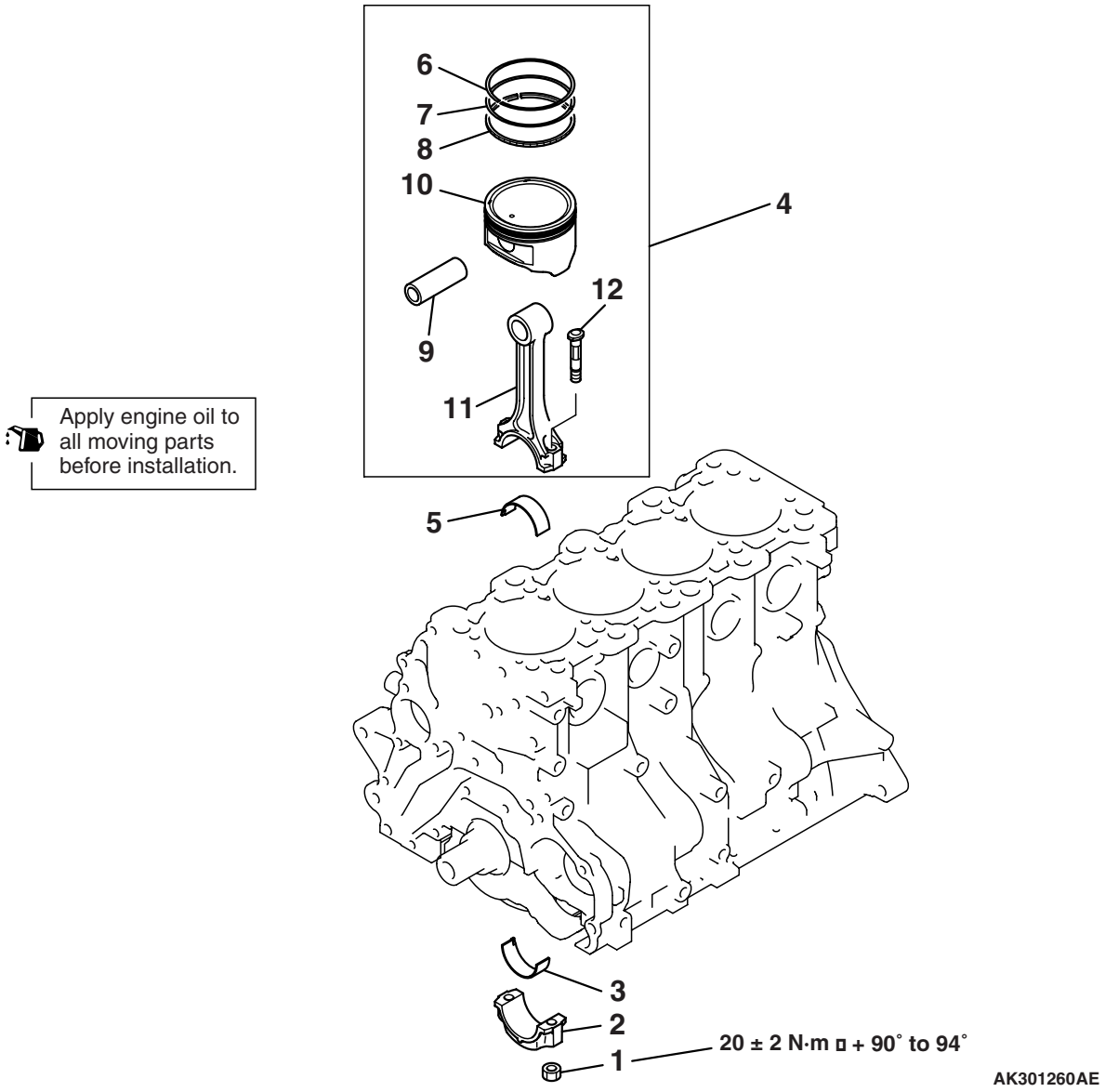
80°C

Float position	Switch ON/OFF
Condition when down	OFF (no continuity)
Condition when up	ON (continuity)

PISTON AND CONNECTING ROD

REMOVAL AND INSTALLATION

M1113008400733

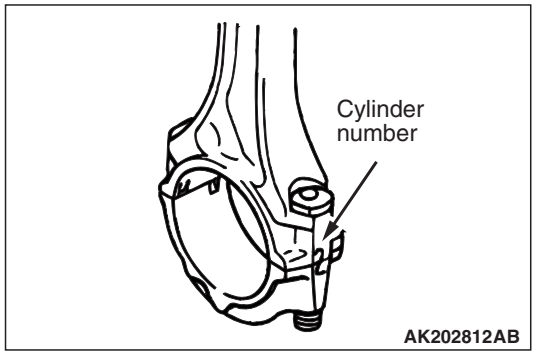


Removal steps

- >>G<< 1. Nut
- <<A>> >>F<< 2. Connecting rod cap
- >>D<< 3. Connecting rod bearing
- >>E<< 4. Piston and connecting rod assembly
- >>D<< 5. Connecting rod bearing
- >>C<< 6. Piston ring No. 1
- >>C<< 7. Piston ring No. 2
- >>B<< 8. Oil ring
- <<B>> >>A<< 9. Piston pin
- 10. Piston
- 11. Connecting rod
- 12. Bolt

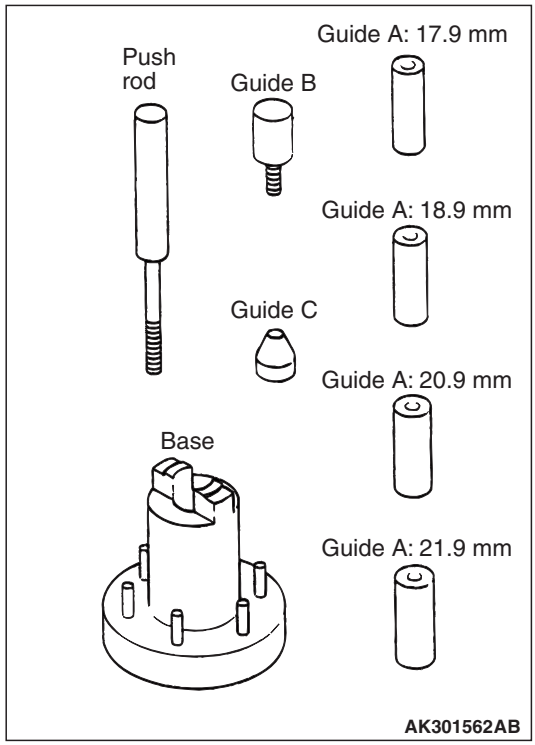
REMOVAL SERVICE POINTS

<<A>>CONNECTING ROD CAP REMOVAL

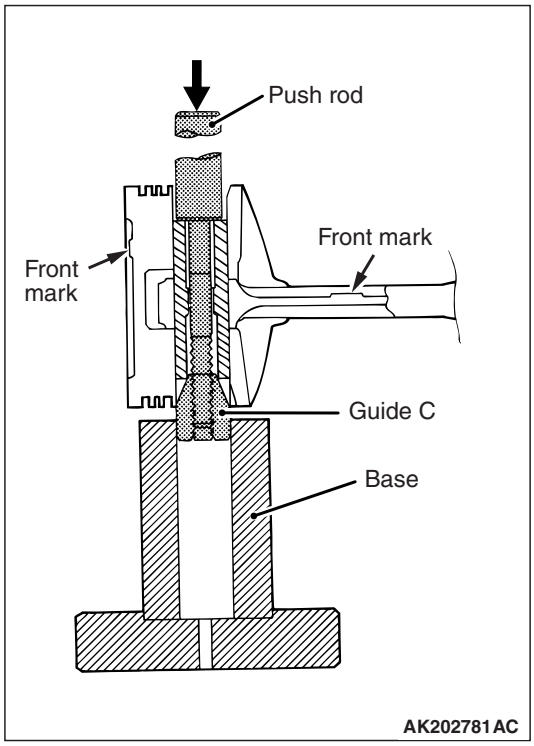


1. Mark the cylinder number on the side of the connecting rod big end for correct reassembly.
2. Keep the removed connecting rods, caps, and bearings in that order according to the cylinder number.

<<B>> PISTON PIN REMOVAL



The special tool Piston pin setting tool (MD998780), consists of the elements shown in the drawing.

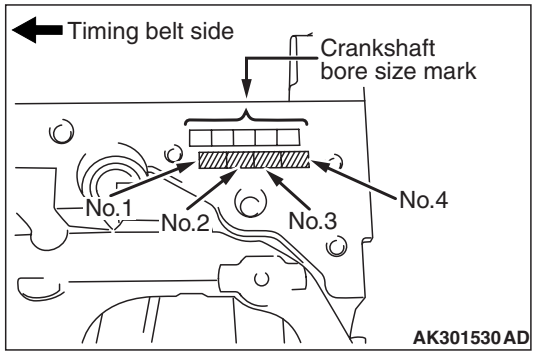


1. Insert the tool element, Push rod, into the piston from the front mark side, then attach the element, Guide C, to the push rod.
2. Place the piston and connecting rod assembly on the element, Base, with the front mark facing up.
3. Use a press to remove the piston pin.

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

INSTALLATION SERVICE POINTS

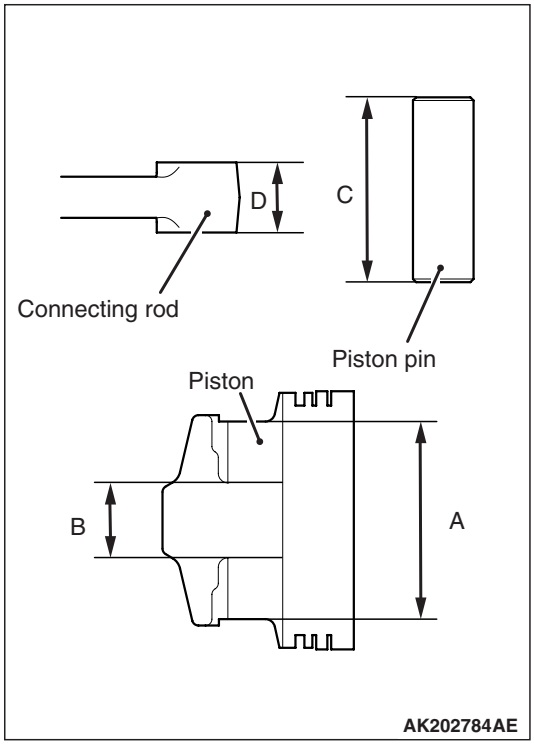
>>A<< PISTON PIN INSTALLATION



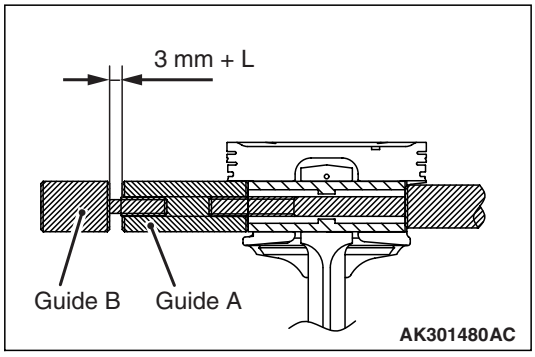
1. When replacing a piston, check the cylinder bore size mark stamped at the indicated location on the cylinder block and select an appropriate replacement piston using the following table.

Cylinder bore size mark	Piston size mark
I	A
II	No mark
III	C

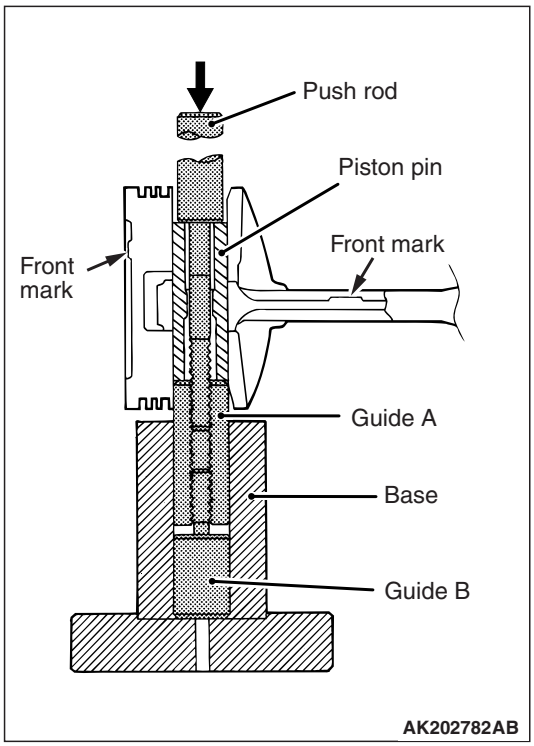
NOTE: The piston size mark is located on the piston top surface.



2. Measure the following dimensions:
   A: Piston pin insertion hole length
   B: Distance between piston bosses
   C: Piston pin length
   D: Connecting rod small end width
3. Obtain dimension L from the measurements using the following formula.
   L = [(A-C) – (B-D)] ÷ 2
4. Insert the tool element, Push rod, into the piston pin and attach the element, Guide A, to the push rod end.
5. Assemble the connecting rod with the piston with their front marks facing in the same direction.
6. Apply engine oil to the outside surface of the piston pin.
7. Insert the assembly of piston pin, Push rod, and Guide A (put together in step 4.) into the piston holes from the front mark side.

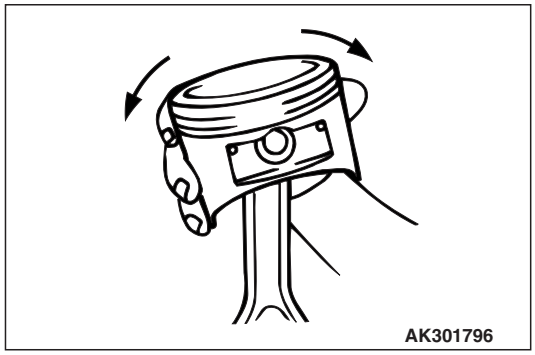


8. Screw the tool element, Guide B, into the tool element, Guide A until the gap between both the elements is equal to the dimension L (obtained in step 3.) plus 3 mm.



9. Place the piston and connecting rod assembly onto the element, Piston setting base, with the front marks facing up.
10. 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.

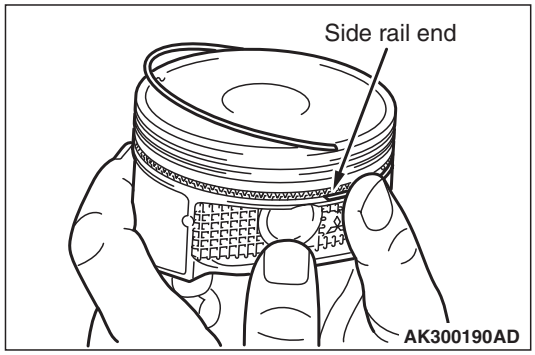
Standard value: 7,350 – 17,200 N

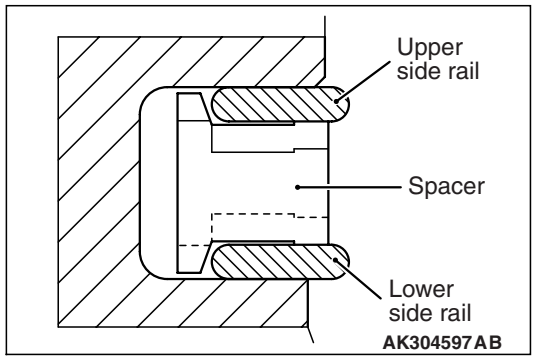


11.Check that the piston moves smoothly.

>>B<< OIL RING INSTALLATION

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





⚠ CAUTION

Do not use a piston ring expander when installing 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 position by hand. See illustration.

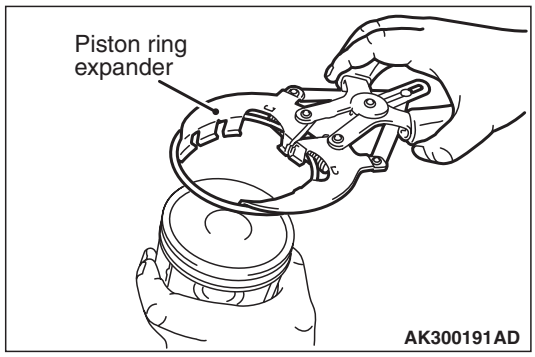
   NOTE: The side rails and spacer may be installed in either direction.

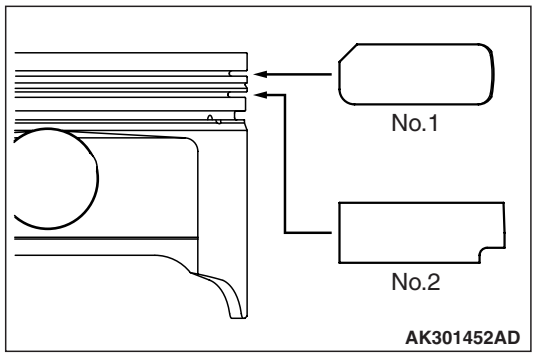
   NOTE: New spacers and side rails are colored for identification of their sizes.

Size	Identification color
Standard	None
0.50 mm oversize diameter	Red

3. Install the lower side rail in the same manner as described in step 2.
4. Make sure that the side rails move smoothly in both directions.

>>C<< PISTON RING NUMBER 2/PISTON RING NUMBER 1 INSTALLATION





1. Using the piston ring expander, fit number 2 into the number 2 groove of piston.

   NOTE: Install piston rings with identification mark facing up, to the piston crown side.

2. Install the number 1 piston ring in the same manner as step 1.

   Identification mark:
   Number 1 ring: 1R
   Number 2 ring: 2R

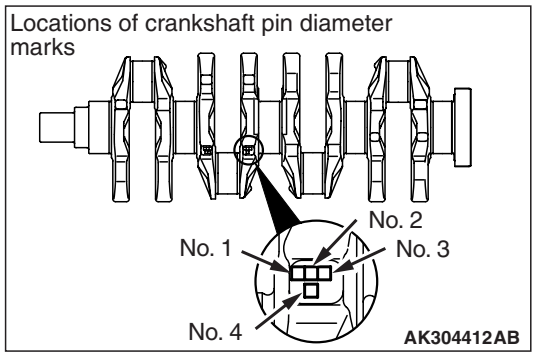
   NOTE: Confirm the profile for No.1 and No.2 piston rings carefully. Install them correctly by careful attention to the direction of top and bottom.

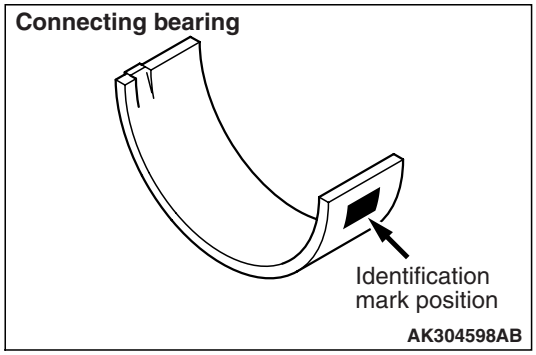
   NOTE: The identification mark and the size mark are stamped on the upper plane of the piston ring (piston top side).

Size	Size mark
Standard	None
0.50 mm oversize diameter	50

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

>>D<< CONNECTING ROD BEARING INSTALLATION





1. Measure the crankshaft pin diameter and confirm its classification from the following table. On a crankshaft supplied as a service part, identification marks of its pins are stamped at the positions shown in the illustration.

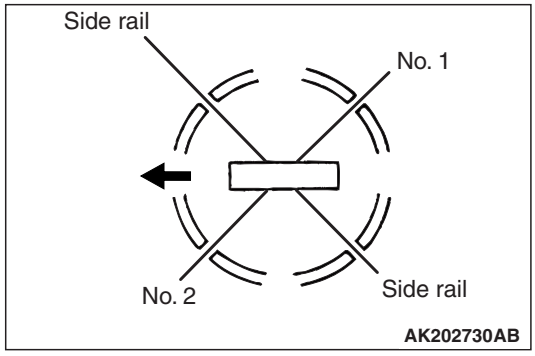
Crankshaft pin outside diameter		Connecting rod bearing
Identification mark	Size mm	Identification mark
I	44.995 – 45.000	1
II	44.985 – 44.995	2
III	44.980 – 44.985	3

2. If the crankshaft pin outside diameter identification mark is "I," for example, select a bearing whose identification mark is "1."

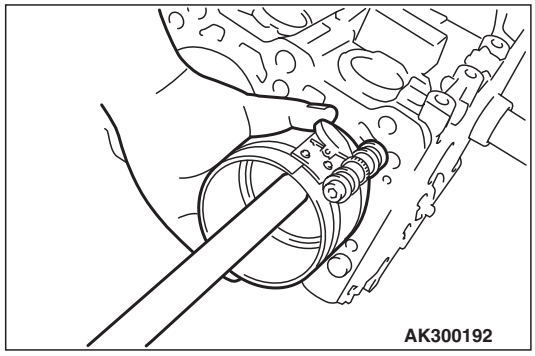
   If there is no identification color paint on the crankshaft, measure the pin outside diameter and select a bearing appropriate for the measured value.

3. Install the selected bearing in the big end and in the cap of the connecting rod.

>>E<< PISTON AND CONNECTING ROD INSTALLATION



1. Apply engine oil on the circumference of the piston, piston rings, and oil ring.
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.

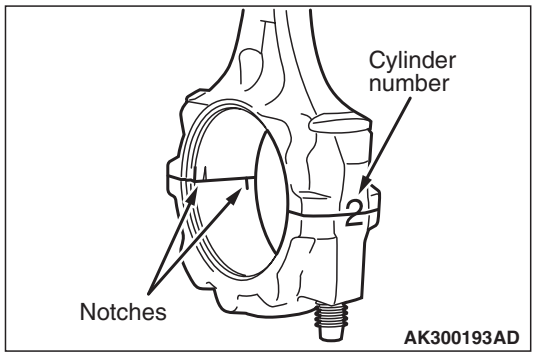


4. Use suitable thread protectors on the connecting rod bolts before inserting the piston and connecting rod assembly into the cylinder block.

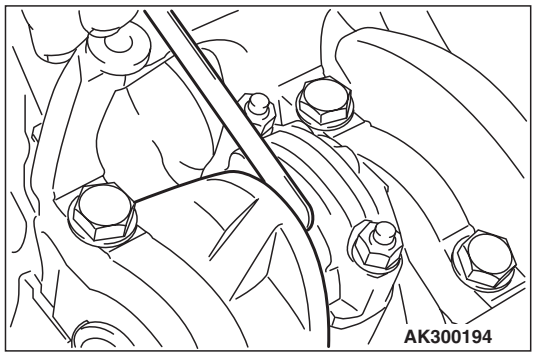
   Care must be taken not to nick the crank pin.

5. Insert the piston and connecting rod assembly into the cylinder with the front mark on the piston crown pointing to the timing belt side.
6. 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.

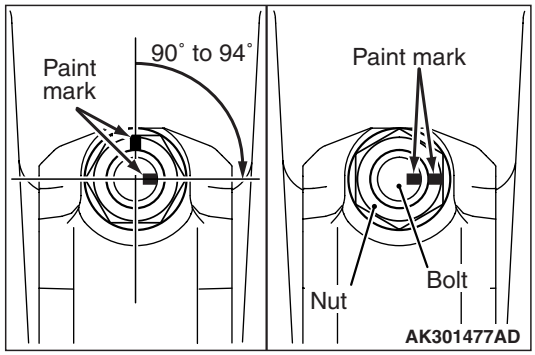
Standard value: 0.10 – 0.25 mm
Limit: 0.4 mm

>>G<< CONNECTING ROD CAP NUT TIGHTENING

1. The connecting rod bolts should be examined before reuse. If the bolt threads are damaged, the bolt should be replaced.

   Hand-thread the nut to the full length of the bolt threads. If the nut does not run down smoothly, the bolt should be replaced.
2. Before installing each nut, apply engine oil to the threaded portion and bearing surface of the nut.
3. Loosely tighten each nut to the bolt.
4. Then tighten the nuts alternately to the specified torque to install the cap properly.

Tightening torque: 20 ± 2 N·m



5. Make a paint mark on the head of each nut.
6. Make a paint mark on the bolt end at the position 90 to 94 degrees from the paint mark made on the nut in the direction of tightening the nut.

⚠ CAUTION

- **If the nut is turned less than 90 degrees, proper fastening performance may not be achieved. Be careful to tighten the nut exactly 90 degrees.**
- **If the nut is overtightened (exceeding 94 degrees), loosen the nut completely and then retighten it by repeating the tightening procedure from step 3.**

7. Turn the nut 90 to 94 degrees and make sure that the paint marks on the nut and bolt are aligned.

INSPECTION

M1113008500547

PISTON

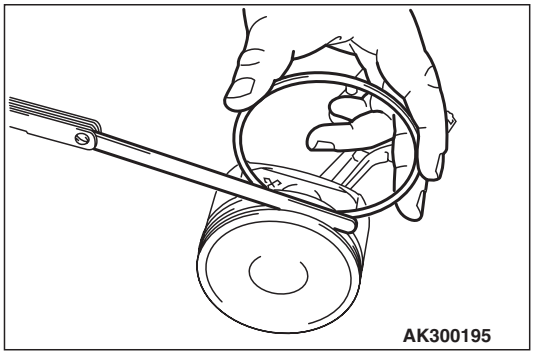
Replace the piston if scratches or seizure is evident on its surfaces (especially the thrust surface). Replace the piston if it is cracked.

PISTON PIN

1. Insert the piston pin into the piston pin hole with your thumb. You should feel a slight resistance. Replace the piston pin if it can be easily inserted or there is an excessive play.
2. The piston and piston pin must be replaced as an assembly.

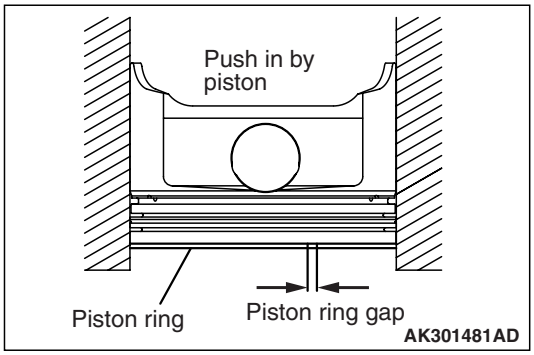
PISTON RING

1. Check the piston ring for damage, excessive wear, and breakage. Replace if defects are evident. If the piston has been replaced, the piston rings must also be replaced.



2. Check for clearance between the piston ring and ring groove. If it exceeds the limit, replace the ring or piston, or both.

Standard value:
Number 1: 0.03 – 0.07 mm
Number 2: 0.02 – 0.06 mm
Limit: 0.1 mm



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.

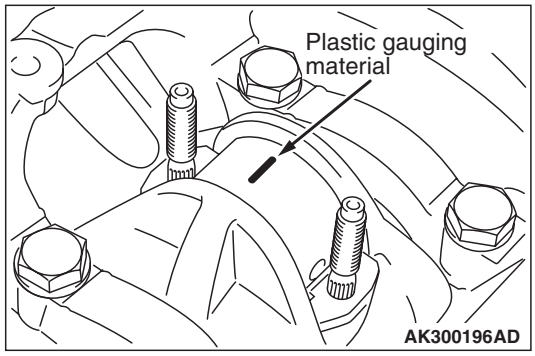
   If the ring gap is excessive, replace the piston ring.

Standard value:
Number 1: 0.15 – 0.30 mm
Number 2: 0.28 – 0.43 mm
Oil: 0.10 – 0.40 mm

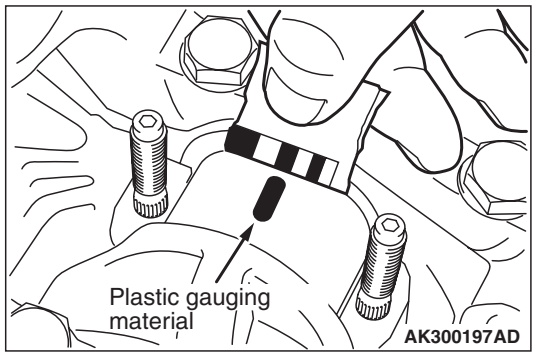
Limit:
Number 1, Number 2: 0.8 mm
Oil: 1.0 mm

CRANKSHAFT PIN OIL CLEARANCE <PLASTIC GAUGING MATERIAL METHOD>

1. Remove oil from the crankshaft pin and the connecting rod bearing.



2. Cut plastic gauging material to the same length as the width of the bearing and place it on the pin, 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 plastic gauging material at its widest part by using a scale printed on the plastic gauging material package.

Standard value: 0.02 – 0.05 mm
Limit: 0.1 mm

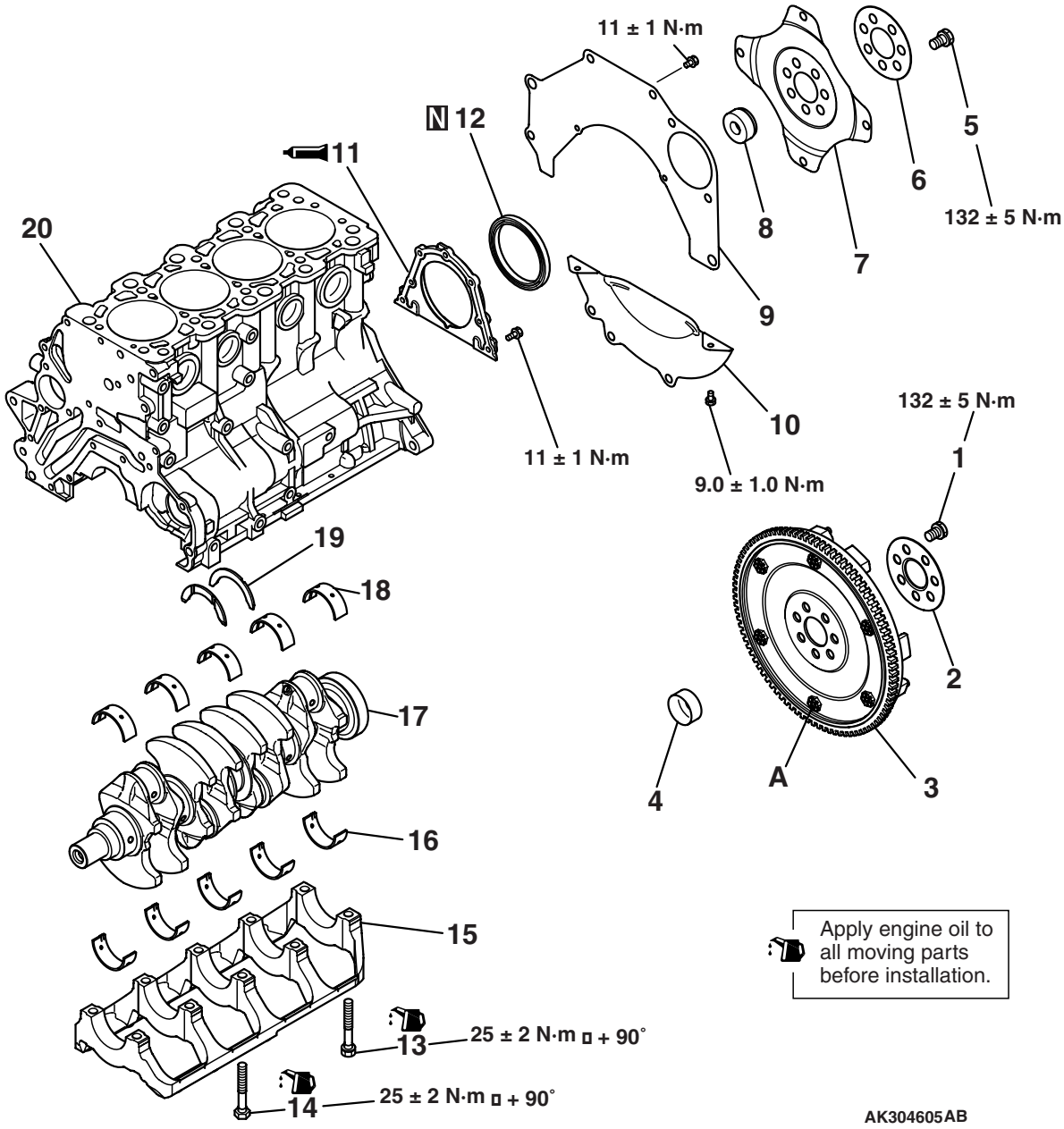
CRANKSHAFT AND CYLINDER BLOCK

REMOVAL AND INSTALLATION

M1113008700756

⚠ CAUTION

On the flexible flywheel equipped engines, do not remove any of the bolts "A" of the flywheel shown in the illustration. The balance of the flexible flywheel is adjusted in an assembled condition. Removing the bolt, therefore, can cause the flexible flywheel to be out of balance giving and resulting in damage.



Removal steps

1. Flywheel bolt (M/T)
2. Adapter plate (M/T)
3. Flywheel (M/T)
4. Crankshaft bushing (M/T)
5. Drive plate bolt (A/T)
6. Adapter plate (A/T)
7. Drive plate (A/T)

Removal steps (Continued)

8. Crankshaft bushing (A/T)
9. Rear plate
10. Bell housing cover

>>E<< 11. Oil seal case

>>D<< 12. Oil seal

>>C<< 13. Bearing cap bolt (Head 14)

>>C<< 14. Bearing cap bolt (Head 17)

>>C<< 15. Bearing cap

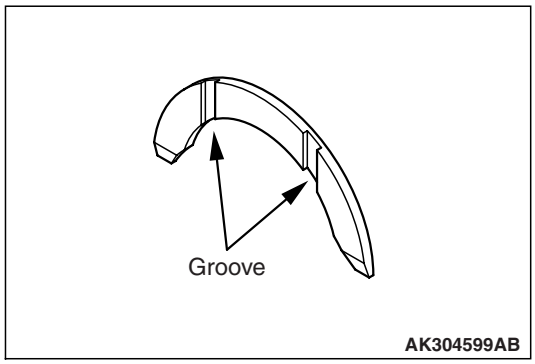
Removal steps (Continued)

>>B<< 16. Crankshaft bearing (Lower)
17. Crankshaft
>>B<< 18. Crankshaft bearing (Upper)
>>A<< 19. Crankshaft thrust bearing
20. Cylinder block

INSTALLATION SERVICE POINTS

>>A<< CRANKSHAFT THRUST BEARING INSTALLATION

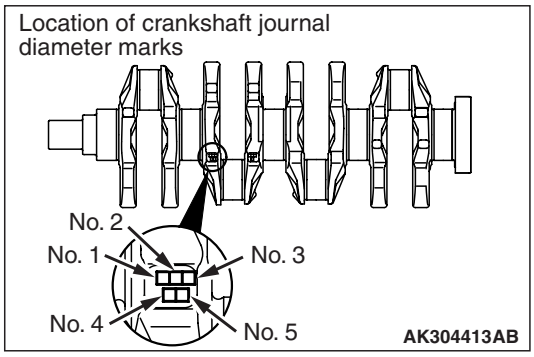
1. Install the two thrust bearings in the number 3 bearing bore in the cylinder block. For easier installation, apply engine oil to the bearings; this will help hold them in position.



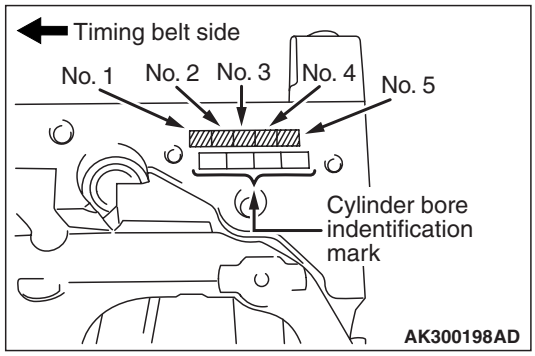
2. The thrust bearings must be installed with their groove side toward the crankshaft web.

>>B<< CRANKSHAFT BEARING INSTALLATION

When bearing replacement is required, select and install the correct bearing by the following procedure.

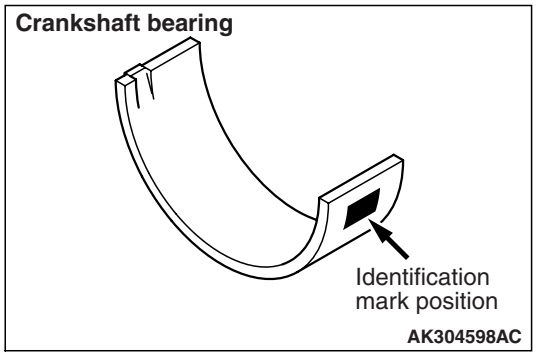


1. Measure the crankshaft journal diameter and confirm its classification from the following table. In the case of a crankshaft supplied as a service part, identification marks of its journals are stamped at the positions shown in the illustration.

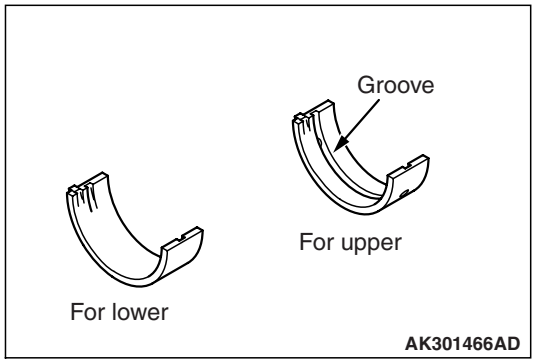


2. The cylinder block bearing bore diameter identification marks are stamped at the position shown in the illustration from left to right, beginning at No.1.

Crankshaft journal outside diameter		Cylinder block bearing bore	Crankshaft bearing	Crankshaft bearing for No.3
Identification mark	Size mm	Identification mark	Identification mark	Identification mark
0	56.994 – 57.000	0	1	0
		1	2	1
		2	3	2
1	56.988 – 56.994	0	2	1
		1	3	2
		2	4	3
2	56.982 – 56.988	0	3	2
		1	4	3
		2	5	4



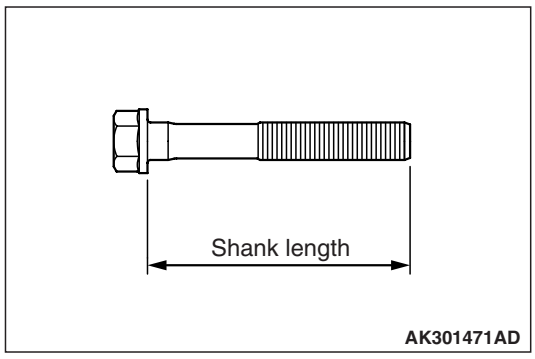
For example, if the crankshaft journal outside diameter identification mark is "0" and cylinder block bearing bore identification mark is "1," select a bearing whose identification mark is "2" for number 1, 2, 4 and 5, and a bearing whose identification mark is "1" for number 3.
If there is no identification mark on the crankshaft, measure the journal outside diameter and select a bearing appropriate for the measured value.



3. Install the bearings having an oil groove to the cylinder block.
4. Install the bearings having no oil groove to the bearing cap.

>>C<< BEARING CAP/BEARING CAP BOLT INSTALLATION

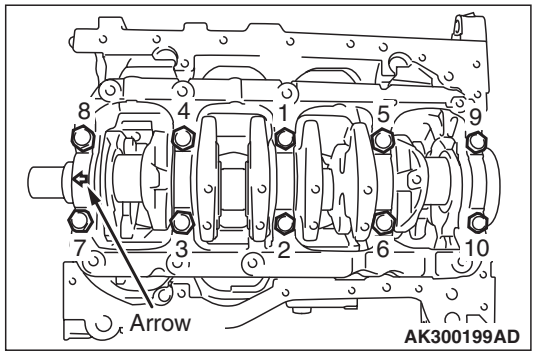
1. Install the bearing caps so that the arrow points to the timing belt side.



2. Before installing the bearing cap bolts, check that the shank length of each bolt meets the limit. If it exceeds the limit, replace the bolt.

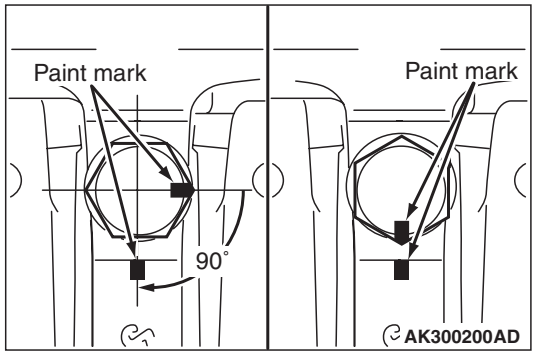
   Limit: 71.1 mm

3. Apply engine oil to the threaded portion and bearing surface of the bolt.



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

   Tightening torque: 25 ± 2 N·m

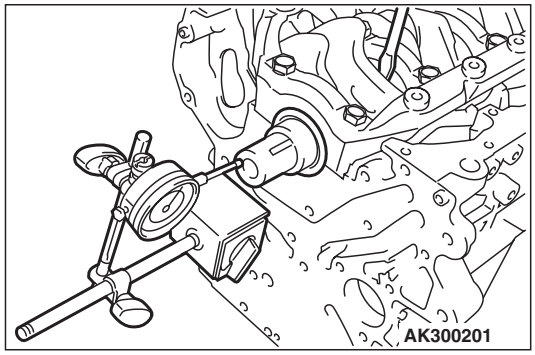


5. Make a paint mark on the head of each bolt.
6. Make a paint mark on the bearing cap 90 degrees from the paint mark made on the bolt in the direction of tightening the bolt.

⚠ CAUTION

- **If the bolt is overtightened, loosen the bolt completely and then retighten it by repeating the tightening procedure from step 4.**
- **If the bolt is turned less than 90 degrees, proper fastening performance may not be achieved. Be sure to turn the bolt exactly 90 degrees.**

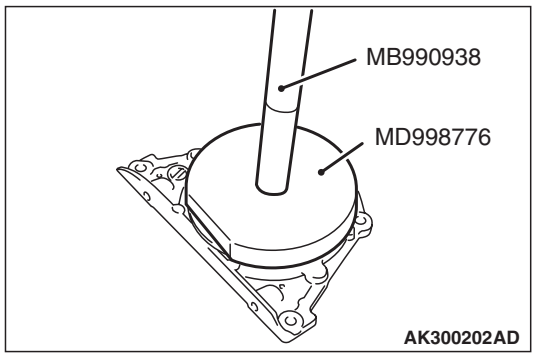
7. Turn each bolt 90 degrees in the tightening sequence specified in step 4, and make sure that the paint marks on the bolt and cap are aligned.



8. Make sure that the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace the number 3 crankshaft bearings.

Standard value: 0.05 – 0.25 mm
Limit: 0.40 mm

>>D<< OIL SEAL INSTALLATION

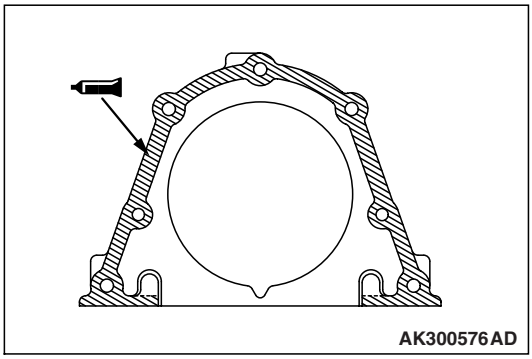


Use the special tools to press-fit the rear oil seal in the rear oil seal case.

- Handle (MB990938)
- Crankshaft rear oil seal installer (MD998776)

>>E<< SEALANT APPLICATION TO OIL SEAL CASE

1. Remove completely old FIPG remaining on the rear oil seal case and cylinder block.



2. Apply a bead of FIPG to the surface of the rear oil seal case as shown in the drawing.

Specified sealant:
Mitsubishi Genuine Part No.MD970389 or equivalent

NOTE: Be sure to install the case quickly while the sealant is wet (within 15 minutes).

3. Install the oil seal into the cylinder block after applying an appropriate amount of engine oil to the entire circumference of its lip portion.
4. Install the rear oil seal case by tightening its bolts to 11 ± 1 N·m.

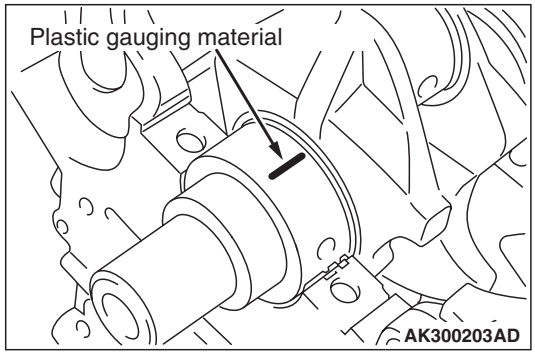
NOTE: After installation, keep the sealed area away from the oil for approximately one hour.

INSPECTION

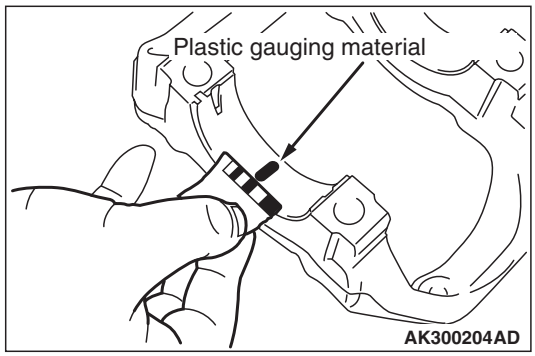
M1113008800537

CRANKSHAFT JOURNAL OIL CLEARANCE <PLASTIC GAUGING MATERIAL METHOD>

1. Remove oil from the crankshaft journal and crankshaft bearing.
2. Install the crankshaft.



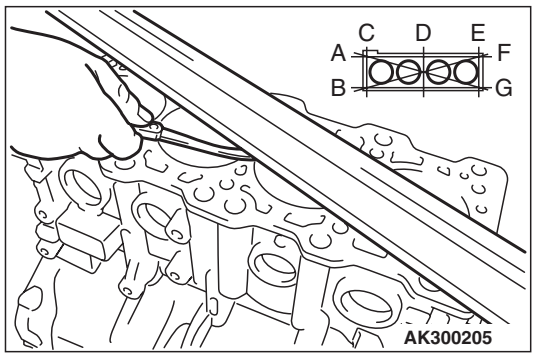
3. Cut the plastic gauging material to the same length as the width of bearing and place it on journal in parallel with its axis.
4. Install the crankshaft bearing cap carefully and tighten the bolts to the specified torque.
5. Carefully remove the crankshaft bearing cap.



6. Measure the width of the plastic gauging material at its widest part by using a scale printed on the plastic gauging material package.

   Standard value: 0.02 – 0.04 mm
   Limit: 0.1 mm

CYLINDER BLOCK



1. Visually check for scratches, rust, and corrosion.

   Use also a flaw detecting agent for the check. If defects are evident, correct or replace.

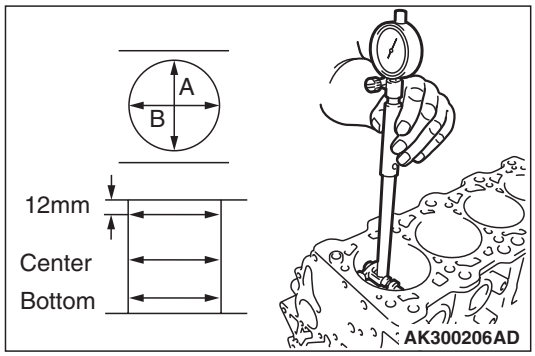
2. Using a straightedge and feeler gauge, check the block top surface for warpage. Make sure that the surface is free from gasket chips and other foreign matter.

   Standard value: 0.05 mm
   Limit: 0.1 mm

3. If the distortion is excessive, correct within the allowable limit or replace.

   Grinding limit: 0.2 mm
   ***Includes/combined with cylinder head grinding**
   Cylinder block height (when new):
   284 mm

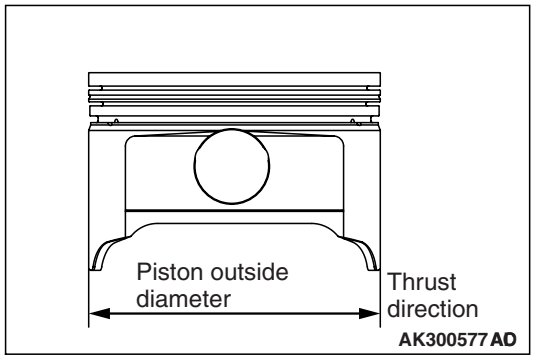
4. Check cylinder walls for scratches and seizure. If defects are evident, replace or bore to oversize and replace pistons and piston rings.



5. Using a cylinder gauge, measure the cylinder bore and cylindrically. If worn badly, correct the cylinder to an oversize and replace the piston and piston rings. Measure at the points shown in the illustration.

   Standard value:
   Cylinder inner diameter 87.0 mm
   Cylindrically 0.01 mm or less

BORING CYLINDER



1. Oversize pistons to be used should be determined on the basis of the largest bore cylinder.

Piston size identification

Size	Identification mark
0.50 mm oversize diameter	50

NOTE: Size mark is stamped on the piston top.

2. Measure the outside diameter (OD) of the piston to be used. Measure it in thrust direction as shown.
3. Based on the measured piston OD, calculate the boring finish dimension.

   Boring finish dimension = [Piston OD] + [0.02 - 0.04 mm(clearance between piston OD and cylinder)] –[0.02 mm (honing margin)]

⚠ CAUTION
To prevent distortion that may result from temperature rise during honing, bore cylinders, working from number 2 to number 4 to number 1 to number 3.

4. Bore all cylinders to the calculated boring finish dimension.
5. Hone to the final finish dimension (piston OD + clearance between piston OD and cylinder).
6. Check the clearance between the piston and cylinder.

   Clearance between piston and cylinder:
   0.02 – 0.04 mm

NOTE: When boring cylinders, finish all of four cylinders to the same oversize. Do not bore only one cylinder to an oversize.