ENGINE

MECHANICAL

SYSTEM

Specification

Item \ Engine model				A3E	A5D
Type				Gasoline, 4 cycle	
Cylinder arrangement and number				In line, 4 cylinders	
Combustion chamber				Multispherical	Pentroof
Valve system				SOHC, belt driven (IN : 1, EX : 1)	DOHC, belt driven (IN : 2, EX : 2)
Displacement			cc (cu in)	1,343 (83.1)	1,493 (91.1)
Compression ratio				9.5 : 1	
Valve timing	IN	Open	BTDC	10°	6°
		Close	ABDC	46°	46°
	EX	Open	BBDC	46°	46°
		Close	ATDC	10°	6°
Valve clearance		IN	mm (in)	0 : Maintenance-free	
		EX		0 : Maintenance-free	
Idle speed			rpm	750±50	
Ignition timing			BTDC	8°±5°	8°±5° (6°±5°)(1)
Firing order				1-3-4-2	
Lubrication system				Force-fed type	
Oil pump	Type			Trochoid gear	
	Relief pressure		kPa (kg/cm², psi)	466~564 (4.75~5.75, 66~80)	
Oil filter	Type			Full-flow, paper element	
	Relief-valve opening pressure		kPa (kg/cm² psi)	98 (1.0, 14)	
Oil pressure switch activation pressure			kPa (kg/cm² psi)	25 (0.25, 3.6)	
Oil capacity	Total (dry engine)		liters (US qt, Imp qt)	3.4 (3.6, 3.0)	
	Oil pan		liters (US qt, Imp qt)	3.0 (3.2, 2.6)	
	Oil filter		liter (US qt, Imp qt)	0.20 (0.21, 0.18)	
Engine oil				API service SG	
Cooling system				**Water-cooled, forced circulation**	
Coolant capacity(with heater)			liters (US qt, Imp qt)	6.0 (6.3, 5.3)	
Thermostat	Type			Wax type	
	Opening temperature		°C (°F)	86.5~89.5 (187.7~193.1)	
	Full-open temperature		°C (°F)	100 (212)	
	Full-open lift		mm (in)	8.0(0.31)	
Water pump	Type			Centrifugal	
Radiator	Type			Corrugated fin type	
	Cap valve pressure		kPa (kg/cm², psi)	74~103 (0.75~1.05, 11~15)	
Cooling fan	Outer diameter		mm (in)	300 (11.8)	
	Number of blades			4	

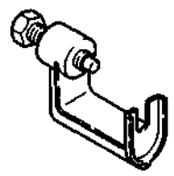
Intake and exhaust system	
Air cleaner element type	Dried
Accelerator cable free play mm(in)	1~3 (0.039~0.11)

(1) : Only Europe

Special service tools

0K670 321 019

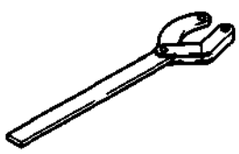
Ball joint puller



Used to remove tie-rod end.

0K130 111 004

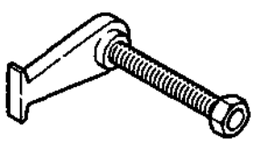
Coupling flange holder



Used to disassemble and assemble timing belt pulley.

0K130 111 002

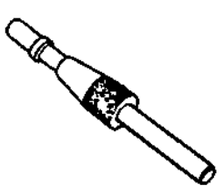
Ring gear Brake



Used to prevent engine rotation.

0K130 160 010

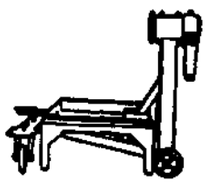
Clutch disc centering tool



Used to install clutch disc.

0K130 990 007

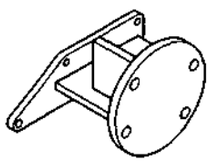
Engine stand



Used to disassemble and assemble engine.

0KK30 101 001

Engine stand hanger



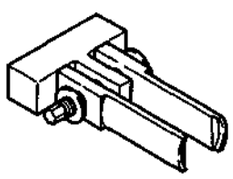
Used to disassemble and assemble engine.

0K993 120 001
Valve spring lifter arm

Used to remove and install valve.

0K993 120 004

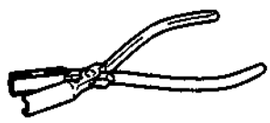
Valve spring lifter pivot.



Used to remove and install valve.

0K1993 120 006

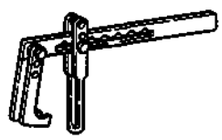
Valve seal remover



Used to remove valve seal.

0K12CA 120 AA0

Valve spring compressor set



Used to replace valve seal and valve spring.

0K30 140 001

Oil pressure gauge

Used to measure fuel pressure.

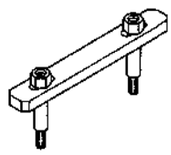
0K130 120 006

Valve guide remover & installer

Used to remove and install valve guide.

0K2CA 120 001

Valve spring compressor hook



Used to replace valve seal and valve spring.

Troubleshooting
Engine mechanical system

Problem	Possible cause	Action
Engine will not crank	Battery, starting system or other electrical problems	Refer to starting system, section EE, charging system, section EE, or electrical troubleshooting manual
	Liquid in combustion chamber	Remove with suction gun, then crank engine over with spark plugs removed
	Seized engine	Repair
Engine cranks normally, but does not start	Fuel system malfunction	Refer to fuel system, section FL
	Ignition system malfunction	Refer to ignition system, section EE
	Improper valve clearance	Check HLA's
	Restricted exhaust system	Refer to exhaust system, page EM-52
	Timing belt and/or related parts	Inspect timing belt and related parts; replace if necessary
	Low compression due to: stuck or burned valves; worn piston, piston ring or cylinder; failed cylinder head gasket	Perform a compression test, as outlined in this section; repair engine as necessary
	Camshaft worn	Replace
Poor idle quality	Fuel system malfunction	Refer to fuel system, section FL
	Emission system malfunction	Refer to emission control system, section FL
	Ignition system malfunction	Refer to ignition system, section EE
	Improper valve clearance	Check HLA's
	Uneven cylinder compression	Perform a compression test, as outlined in this section ; repair engine as necessary
	Poor valve-to-valve seat contact	Repair or replace
	Broken valve spring	Repair
	Failed cylinder head gasket	Replace
White exhaust smoke	Usually caused by water vapor, which is a normal by-product of combustion on cold days	None required
	Excessive white smoke with engine warmed up could be caused by a failed cylinder head or intake gasket. Could also be a cracked block, cylinder head or intake manifold	Repair or replace

Problem	Possible cause	Action
Black exhaust smoke	Fuel system malfunction	Refer to fuel system, section FL
	Emission system malfunction	
Blue exhaust smoke	Usually caused by oil burning in the combustion chambers from: worn rings, worn valve guides, worn valve seals or failed cylinder head gasket	Replace
Valve train noise	Worn valve guides	Repair
	Low oil pressure	Refer to lubrication system, page EM-47
	Improper valve clearance	Check HLA's
	Broken valve spring	Replace
	Sticking valves	Free valves
	Camshaft worn or faulty	Replace
Insufficient power	Insufficient compression caused by:	
	1. Improper valve clearance	Check HLA's
	2. Leakage from valve seat	Repair or replace
	3. Seized valve stem	Replace
	4. Weak or broken valve spring	Replace
	5. Failed cylinder head gasket	Replace
	6. Cracked or distorted cylinder head	Repair or replace
	7. Sticking, damaged or worn piston ring	Replace
	8. Cracked or worn piston	Replace
	Fuel system malfunction	Refer to fuel system, section FL
	Slipping clutch	Refer to clutch, section CL
	Dragging brakes	Refer to brake system, section BR
	Wrong tire size	Refer to wheels and tires,
	Restricted exhaust system	Refer to exhaust system, page EM-52
Abnormal combustion	Improper valve clearance	Check HLA's
	Sticking or burned valve	Replace
	Weak or broken valve spring	Replace
	Carbon accumulation in combustion chamber	Eliminate carbon
Engine knocks at idle when hot	Loose or worn accessory drive belt/tensioner	Check belts and tensioners
	A/C compressor or generator bearing	Replace if necessary Replace
	Improper oil viscosity	Install proper oil viscosity for expected temperatures
	Excessive piston pin clearance	Install new piston, pin and/ or connecting rod
	Connecting rod clearance	Check and replace rods if necessary

Problem	Possible cause	Action
Engine knocks at idle when hot	Insufficient piston-to-bore clearance	Hone and replace rods if necessary
	Faulty timing belt tensioner or guide	Replace
	Loose damper pulley	Tighten or replace if necessary
Slight noise at idle, becomes louder as engine speed is increased	Valve spring clicking on cap, off square or broken	Repair or replace
	Excessive stem to guide clearance	Repair
	Excessive valve seat runout	Repair
Engine knocks when cold	Excessive piston to wall clearance	Replace pistons
	Loose or broken damper pulley	Tighten or replace
Knock increases with torque	Excessive piston to bore clearance	Replace piston
	Bent connecting rod	Replace
Engine has heavy knock when hot and torque is applied	Broken damper pulley	Replace
	Accessory belts too tight or damaged	Adjust or replace belt
	Belt tensioned damaged	Replace
	Flywheel cracked or loose clutch plate	Replace flywheel or clutch plate
	Excessive main bearing clearance	Repair
	Excessive rod bearing clearance	Repair
Engine has light knock when hot and under light load conditions	Improper timing	Check timing
	Piston pin and/or connecting rod	Replace piston pin and/or rod
	Poor quality fuel	Use recommended or higher grade fuel
	Exhaust leak at manifold	Tighten bolts and/or replace exhaust manifold gaskets if necessary
	Excessive rod bearing clearance	Repair
Engine knocks during initial start up and lasts only a few seconds	Improper oil viscosity	Install proper oil viscosity for expected temperatures

Problem	Possible cause	Action
Tooth is broken or cracked	Camshaft jamming	Inspect camshaft by removing cylinder head cover Repair or replace if necessary
Back surface is cracked and/or worn	Tensioner jamming	Remove tensioner and inspect Replace if necessary
	Engine overheating	Inspect cooling system Refer to engine cooling system, page EM-39
	Interference with timing belt cover	Remove timing belt cover and inspect Replace if necessary
Side surface is worn and / or frayed	Improper installation of timing belt	Remove timing belt and reinstall
	Malfunction of timing belt guide plate	Remove timing belt and inspect guide plate
Teeth are worn	Poor belt cover sealing	Remove timing belt cover and inspect Replace if necessary
	Coolant leak at water pump	Inspect water pump Replace if necessary
	Camshaft malfunction	Inspect camshaft by removing the cylinder head cover Repair or replace if necessary
	Excessive belt tension	Remove tensioner spring and inspect Replace if necessary
Oil or coolant is on the belt	Poor oil sealing	Inspect front oil seals Replace if necessary
	Coolant leak at water pump	Inspect water pump Replace if necessary
	Poor belt cover sealing	Remove timing belt cover and inspect Replace if necessary

HLA(Hydraulic lash adjuster)

Problem	Possible cause	Action
1. Noise when engine is started immediately after oil is changed. 2. Noise when engine is started after setting approx. one day.	Oil leakage in Oil passage	Run engine at 2,000~3,000 rpm. If noise stops after 2 seconds - 10 minutes*, HLA is normal. If not, replace HLA. * Time required for engine oil to circulate within engine includes tolerance for engine oil condition and ambient temperature.
3. Noise when engine is started after cranking for 3 seconds or more. 4. Noise when engine is started after new HLA is installed.	Oil leakage in HLA	
5. Noise continues more than 10 minutes.	Insufficient oil pressure	Check oil pressure. If lower than specification, check for cause. Oil pressure: 43~57 Psi (294~392 kpa, 3.0~4.0 kg/cm²) - 3,000 rpm
	Faulty HLA	Press down HLA by hand. If it does not move, HLA is normal. If it moves, replace HLA. Measure valve clearance. If more than 0 mm (0 in), replace HLA.
6. Noise during idle after high-speed running.	Incorrect oil amount	Check oil level. Drain or add oil as necessary.
	Deteriorated oil	Check oil quality. If deteriorated, replace with specified type and amount of oil.

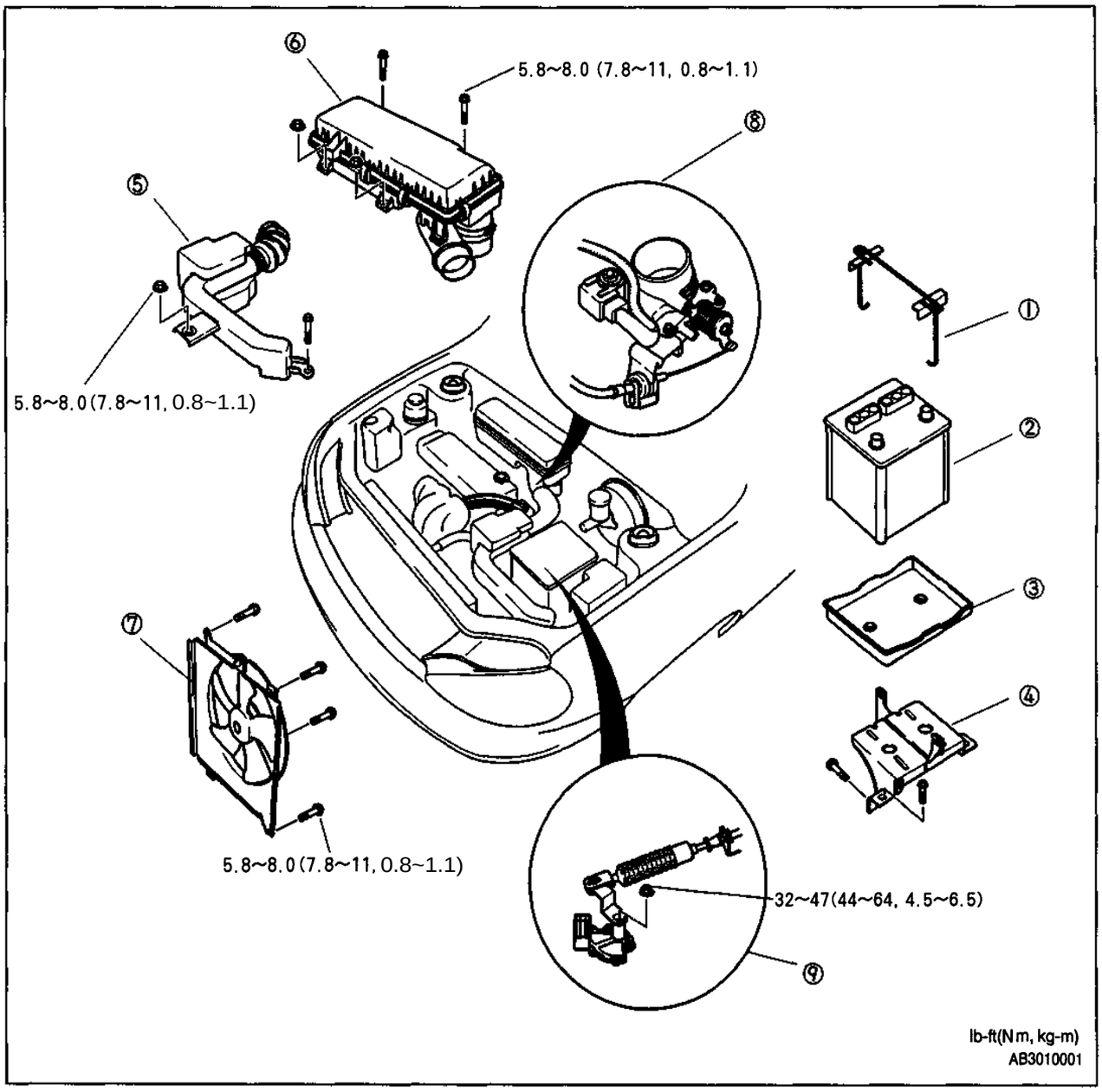
Lubrication system

Problem	Possible Cause	Action
Engine hard starting	Improper engine oil Insufficient engine oil	Replace Add oil
Excessive oil consumption	Internal engine wear Oil leak	*Refer to page EM-47* Repair
Oil pressure drop	Insufficient oil Oil leakage Worn and/or damaged oil pump gear Worn plunger (inside oil pump) or weak spring Clogged oil strainer Excessive main bearing or connecting rod bearing clearance	Add oil Repair Replace Replace Clean *Refer to page EM-47*
Warning lamp illuminates while engine is running	Oil pressure drop Malfunction of oil pressure switch Malfunction of electrical system	As described above *(Refer to section BE, Electrical diagnosis; Except for Europe)* *(Refer to Wiring Diagram; For Europe)*

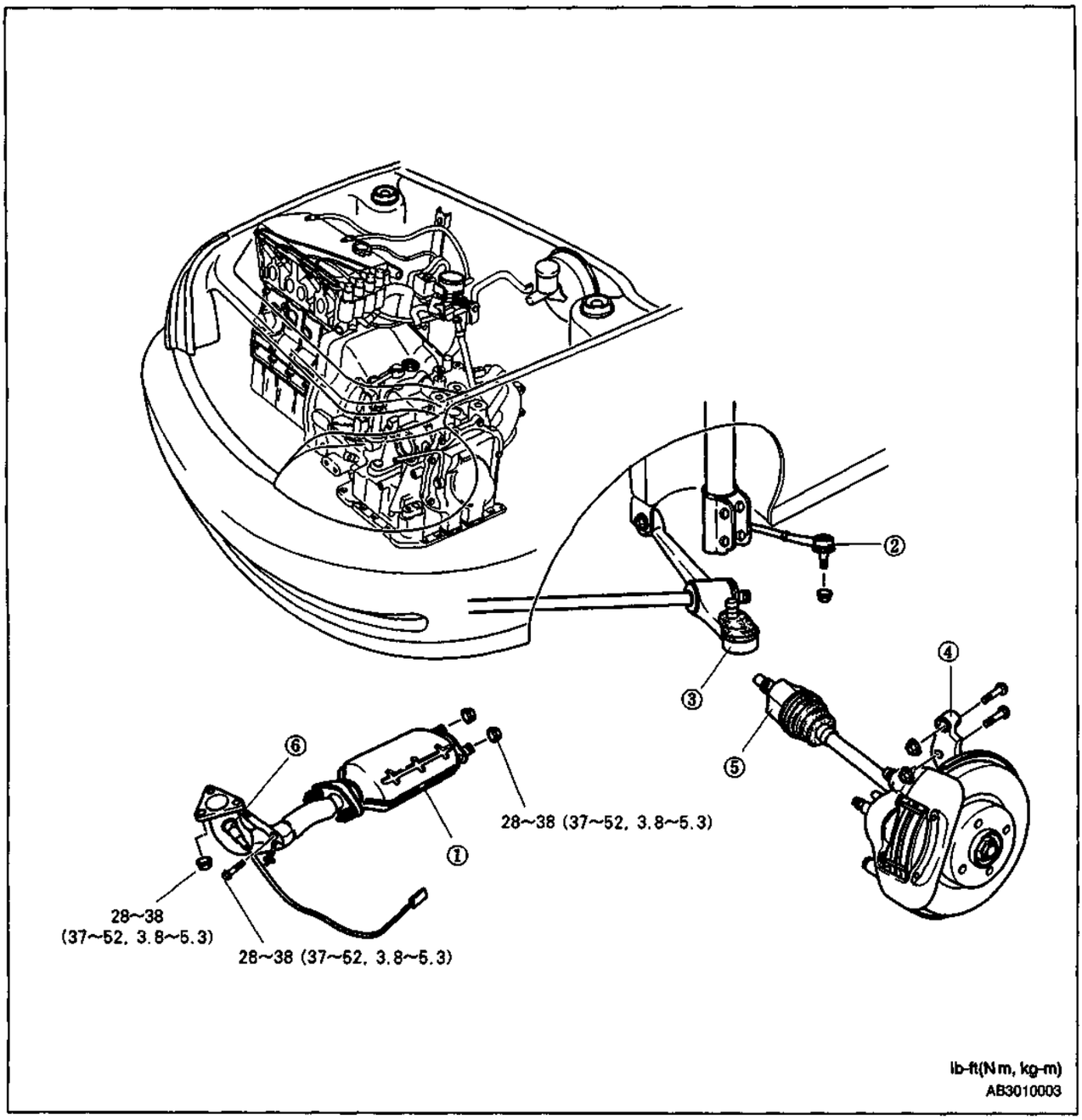
Cooling system

Problem	Possible Cause	Action
Overheating	Coolant level insufficient Coolant leakage Radiator fins clogged Radiator cap malfunction Fan motor malfunction Thermostat malfunction Water passage clogged Water pump malfunction	Add Repair Clean Replace Replace Replace Clean Replace
Corrosion	Impurities in coolant	Replace

Engine Block

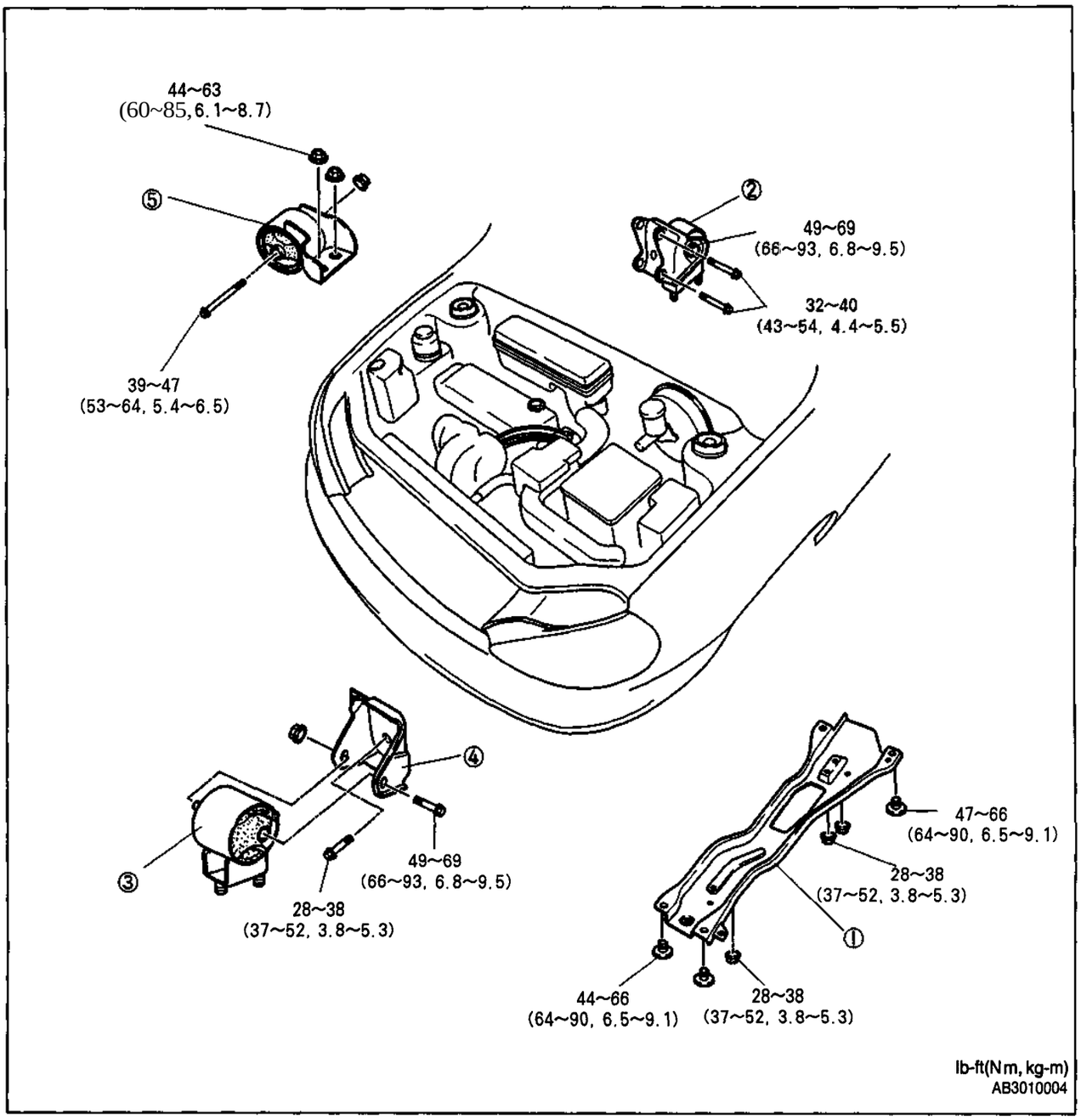


(1) Battery clamp
(2) Battery
(3) Battery tray
(4) Battery bracket
(5) Fresh air duct
(6) Air cleaner assembly
(7) Cooling fan
(8) Accelerator cable
(9) Shift control cable

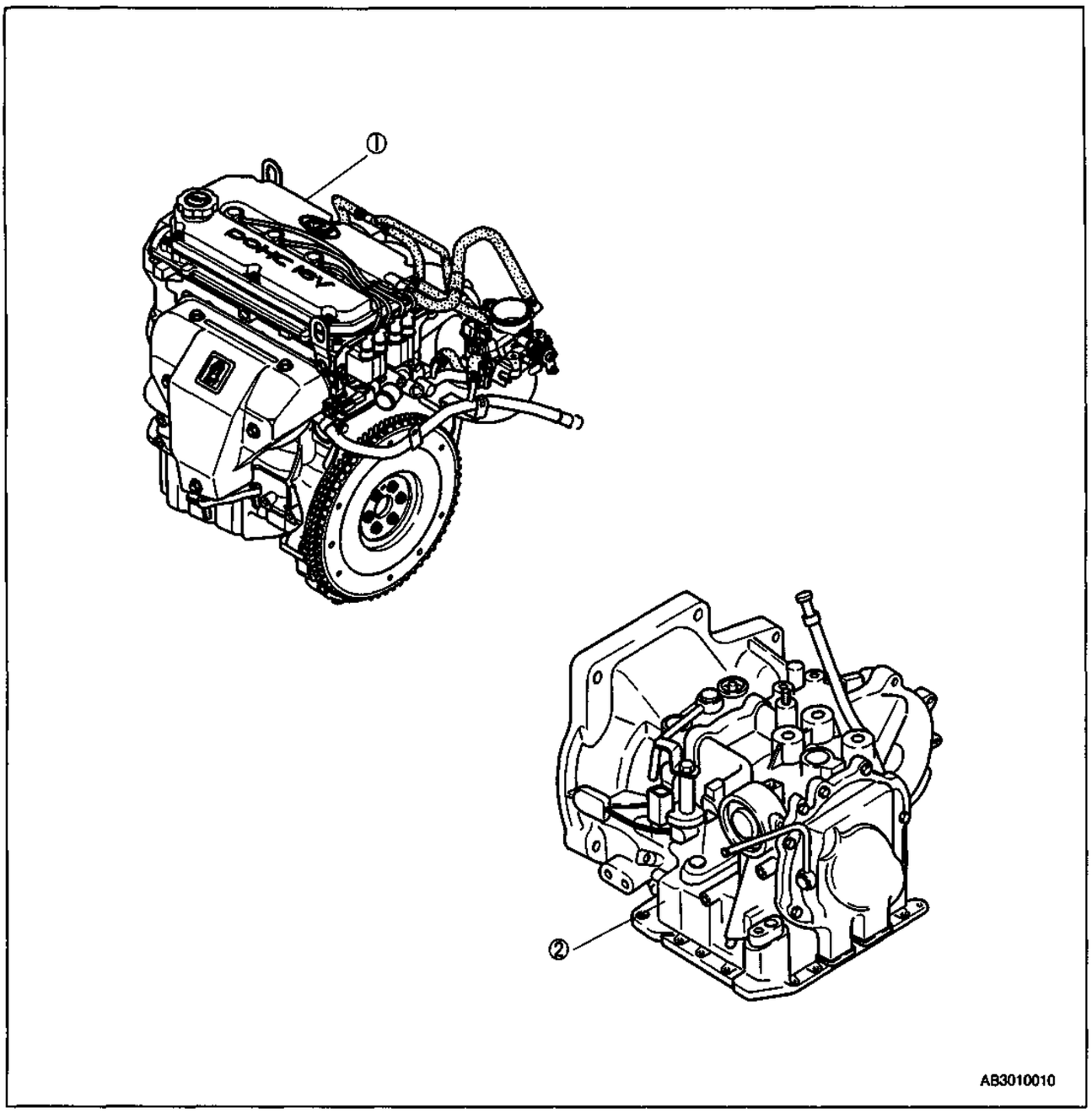


(1) Exhaust pipe & catalytic converter
(2) Tie rod end
(3) Lower arm
(4) Knuckle
(5) Driveshaft
(6) HO2S

Engine mounting



(1) Engine Mounting Member
(2) No.1 Engine Mounting Bracket
(3) No.2 Engine Mounting Rubber
(4) No.2 Engine Mounting Bracket
(5) No.3 Engine Mounting Bracket



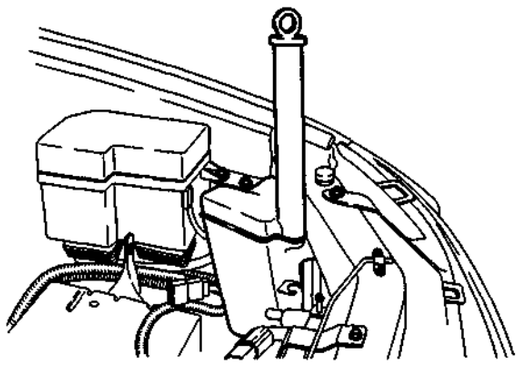
(1) Engine

(2) Transaxle

Engine and transaxle assembly

Removal

1. Disconnect battery cables.
2. Remove battery and battery tray.



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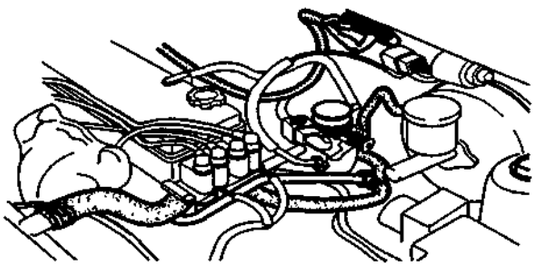
3. Drain engine coolant.
4. Remove fresh air duct.
5. Remove upper and lower radiator hose.



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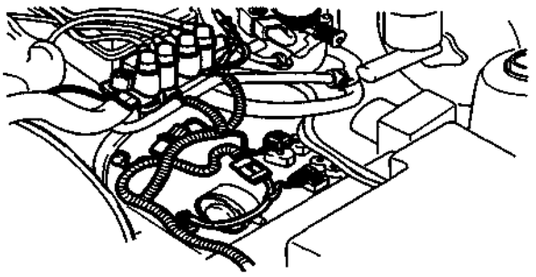
6. Remove accelerator cable.
7. Disconnect fuel hose from fuel injector rail.
8. Remove heater hose.
9. Disconnect brake vacuum hose and purge control vacuum hose from dynamic chamber.
10. Disconnect injector connectors.
11. Disconnect electric connectors.



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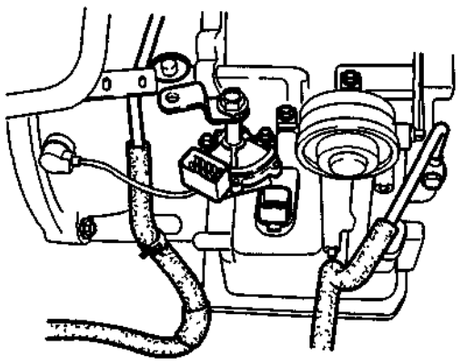
12. Remove transaxle linkage (A/T).
13. Remove manual transaxle linkage and extension bar (M/T).
14. Remove clutch release cylinder and pipe (M/T).

16. Disconnect transaxle range switch connector (A/T).
17. Disconnect solenoid valve connector (A/T).
18. Disconnect ATF cooler hose (A/T).



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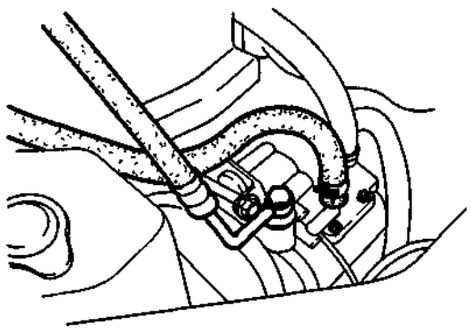
19. Disconnect power steering pump hose.



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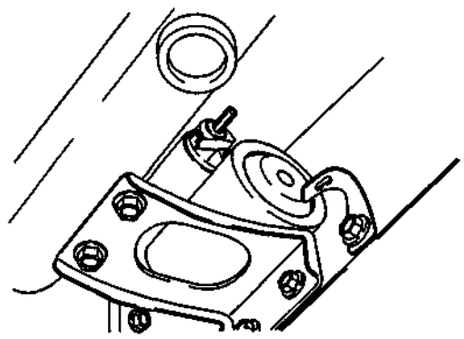
20. Disconnect B-terminal and S-terminal connector from starter.



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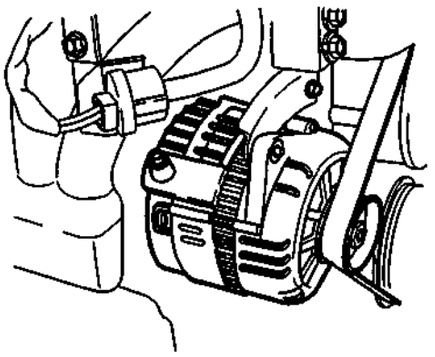
21. Disconnect generator B-terminal connector from generator.



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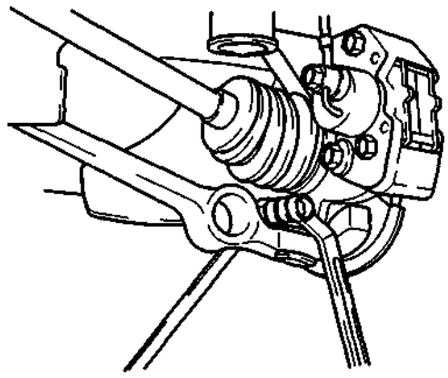
22. Remove four A/C compressor bolts.
23. Remove both front wheels.
24. Disconnect front exhaust pipe and catalytic converter.
25. Remove both right and left tie rod ends from steering Knuckles by removing one cottor pin and one nut each.

26. Remove bolt and nut from both right and left lower arm and separate low arm from steering knuckles.
27. Remove 2bolts and nuts from damper and separate damper from steering knuckles.



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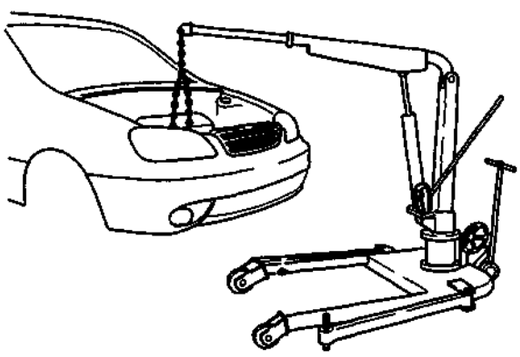
28. Gently pry both driveshafts from transaxle.
29. Support engine with engine hoist.



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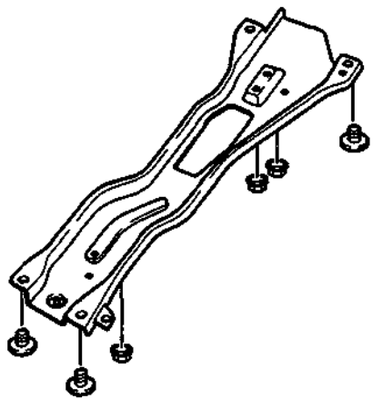
30. Remove four nuts and four bolts from engine mounting member.



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31. Remove two bolts from No.1 engine mounting bracket.
32. Remove one nut from No.2 engine mounting rubber.
33. Remove four bolts from No.2 engine mounting bracket.
34. Remove two nuts from No.3 engine mounting rubber.
35. Lift engine and transaxle out as a unit.

Installation

1. Install engine and transaxle into engine compartment as a unit.
2. Install two No.3 engine mounting rubber.

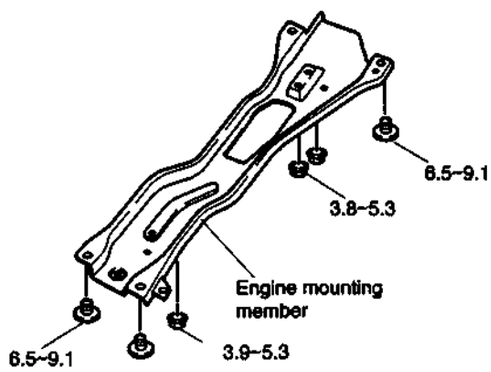
Tightening torque:
49~68 lb-ft (68~93 N•m, 6.8~9.5 kg-m)

3. Install No.2 engine mounting nut bracket bolts and rubber.

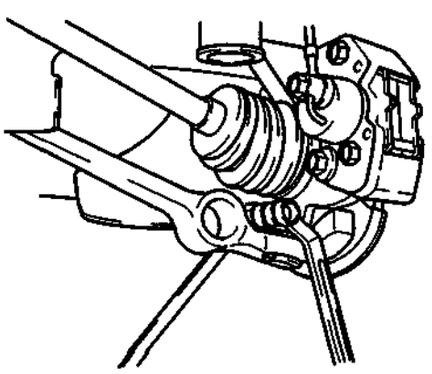
Tightening torque:
Nut:49~68 lb-ft (68~93 N•m, 6.8~9.5 kg-m)
Bolts:28~38lb-ft (39~52 N•m, 3.9~5.3 kg-m)

4. Install four engine mounting member bolts & nuts.

Tightening torque:
Nut:28~38 lb-ft (39~52 N•m, 3.9~5.3 kg-m)
Bolts:47~66lb-ft (65~91 N•m, 6.5~9.1 kg-m)



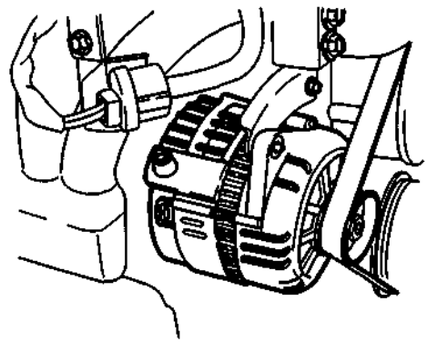
5. Remove engine hoist.
6. Install new clips on driveshaft.
7. Push driveshaft and joint shaft into transaxle with opening of clips pointing upward.
8. Install damper to steering knuckles.
9. Install both right and left lower arm to steering knuckles.
10. Install both right and left tie rod ends to steering knuckles.



11. Install front exhsust pipe and catalytic converter.

Tightening torque:
27~38 lb-ft (37.2~52 N•m, 3.8~5.3 kg-m)

12. Install A/C compressor.



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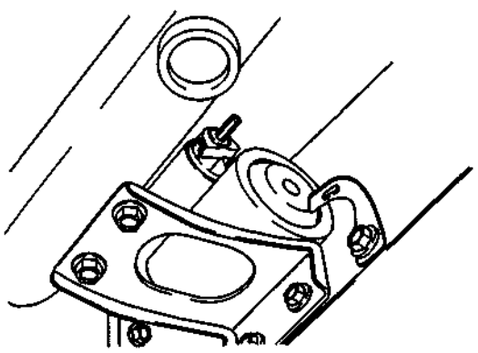
13. Connect B-terminal connector to generator.
14. Connect B-terminal and S-terminal connector to starter.



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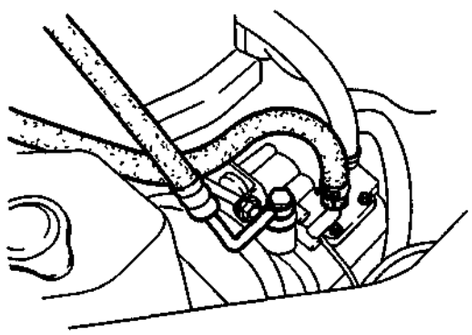
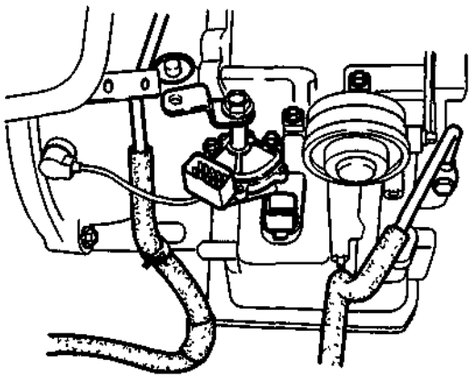
15. Connect power steering pump hose.
16. Connect ATF clooler hose(A/T).
17. Connect solenoid valve connector(A/T).



AB3010002

18. Connect transaxle range switch connector(A/T).



AB3010002

19. Install clutch release cylinder and pipe(M/T).

Tightening torque:
13.7~18.8 lb-ft (18.6~25.5 N•m, 1.9~2.6 kg-m)

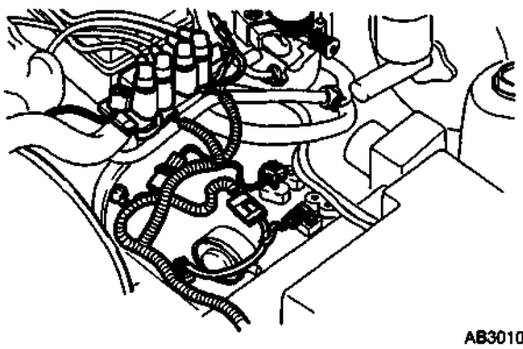
20. Install extension bar and manual transaxle linkage(M/T).

Tightening torque:
Extension bar: 27~38 lb-ft (37.2-52 N•m, 3.8~5.3 kg-m)
Manual transaxle linkage: 12~17 lb-ft (16~23 N•m)

21. Install transaxle linkage(A/T).

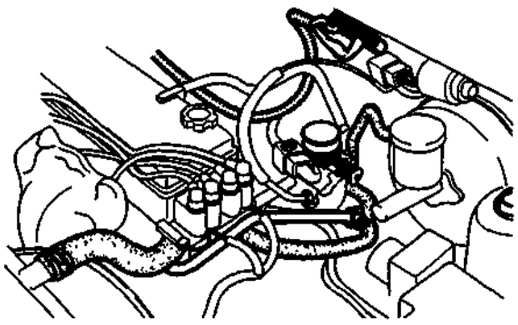
Tightening torque:
24~83lb-ft (32~46 N•m, 3.2~4.7 kg-m)

22. Connect electric connectors.



AB3010002

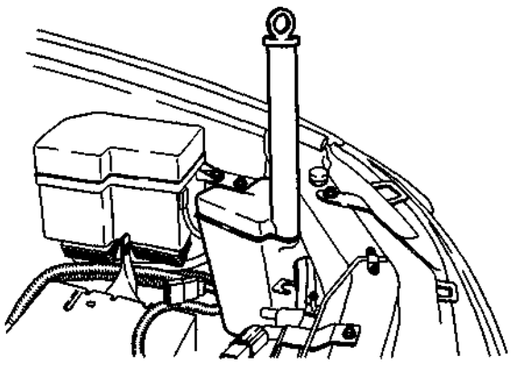
23. Connect injector connectors to injector rail.
24. Connect brake vacuum hose and purge control vacuum hose to dynamic chamber.
25. Install heater hose.
26. Connect fuel hose to injector rail.



AB3010002

27. Install accelerator cable.
28. Install upper and lower radiator hose.
29. Install fresh air duct.
30. Install battery tray and battery.

Tightening torque:
10~12 lb-ft (13.5~16 N•m, 1.4~1.6 kg-m)

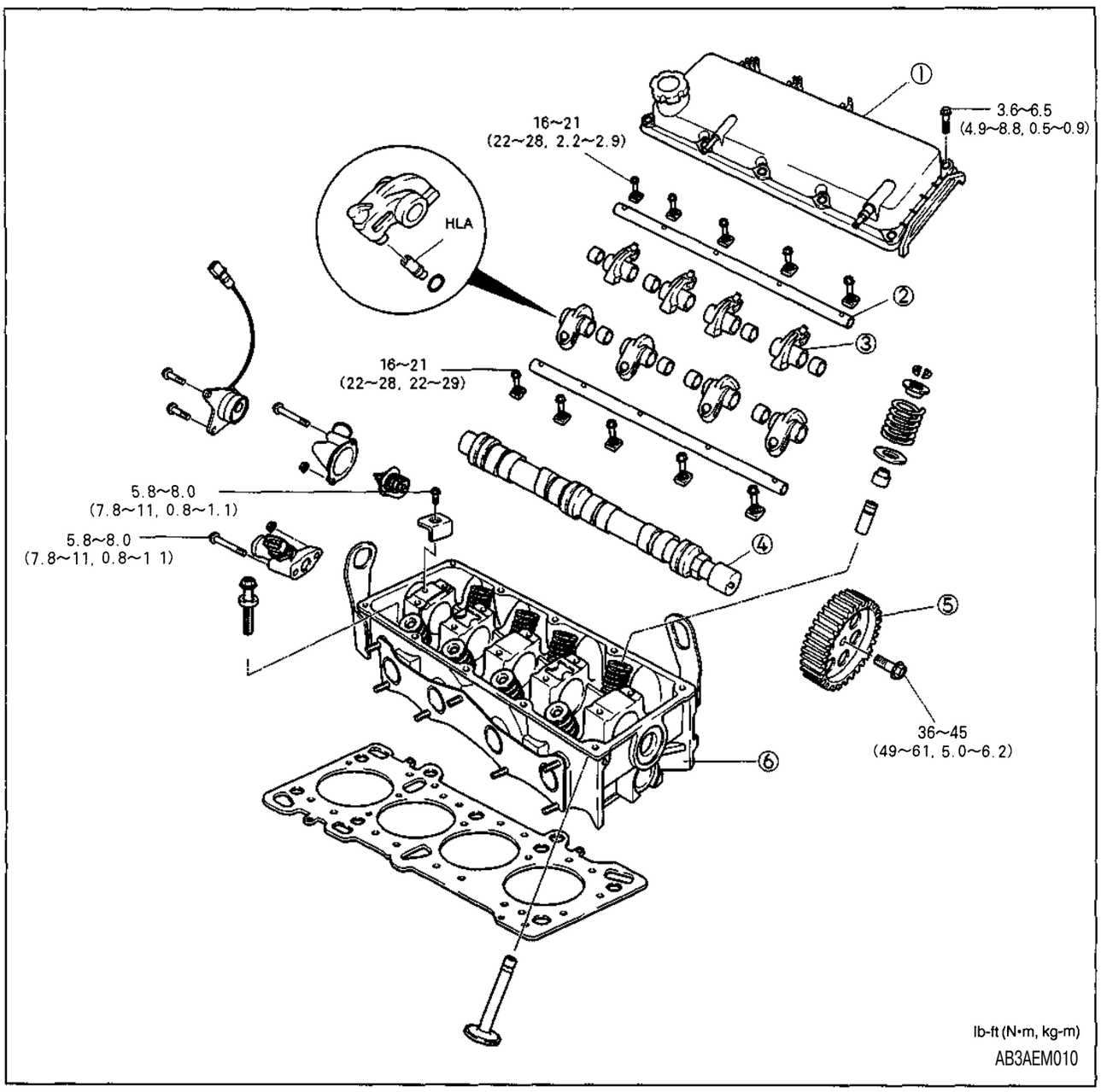


AB3010016

31. Fill engine coolant with specified type and amount.
32. Connect both battery cables.
33. Check and/or fill all fluids.
34. Test run engine perform an overall check.

Camshaft

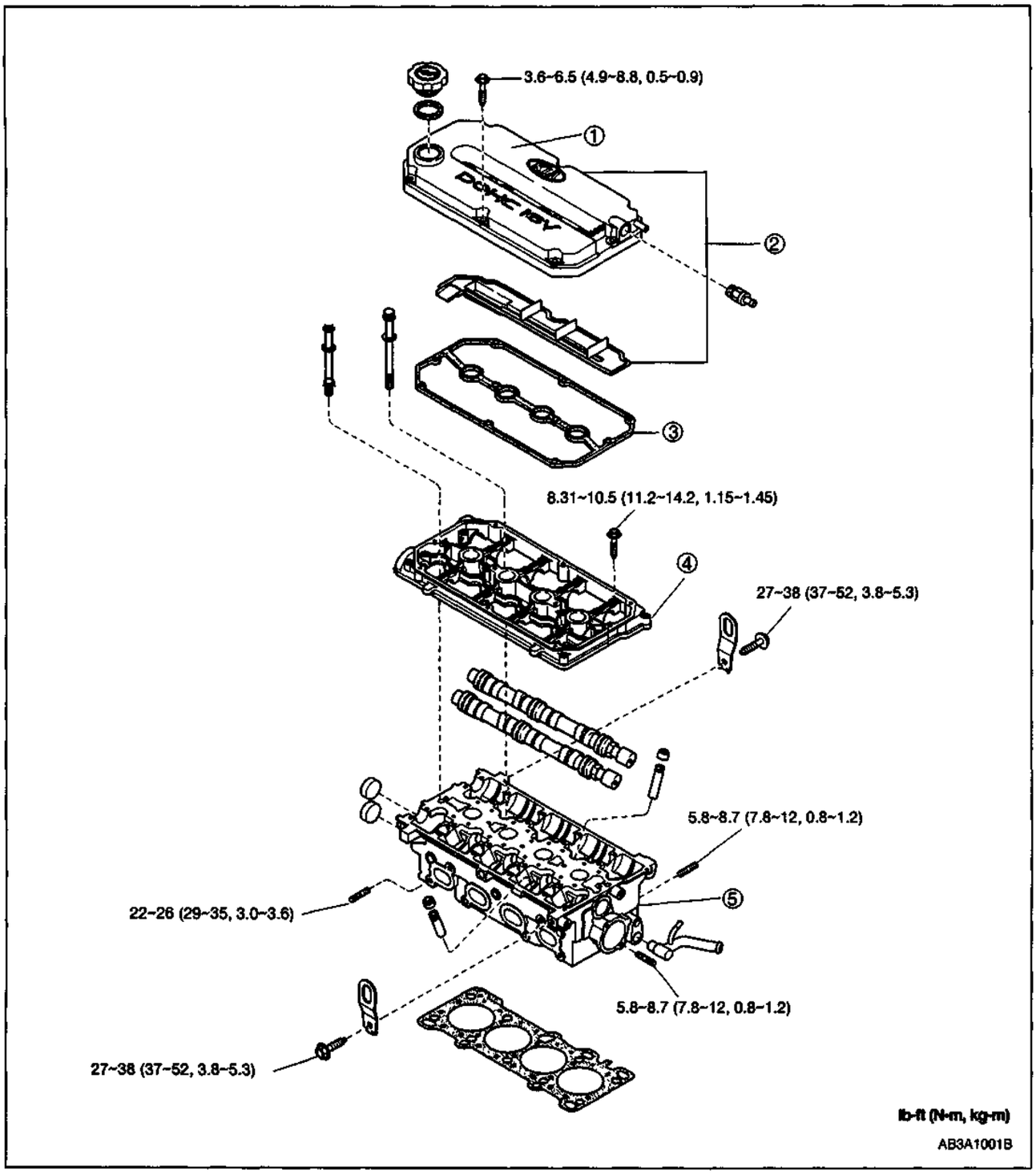
Components(SOHC)



(1) Cylinder head cover
(2) Rocker arm shaft
(3) Rocker arm
(4) Camshaft
(5) Camshaft pulley
(6) Cylinder head

Camshaft

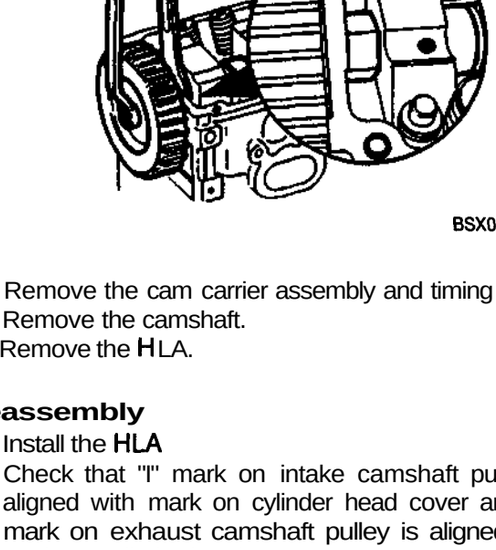
Components (DOHC)



(1) Cylinder head cover
(2) Cylinder head cover
(3) Cylinder head cover gasket
(4) Cam carrier assembly
(5) Cylinder head

Disassembly

1. Disconnect the breather hose and the PCV hose.
2. Remove the coolant pump pulley and crankshaft pulley.
3. Remove the timing belt cover.
4. Loosen the timing bolt tensioner pulley and temporarily secure it.
5. Remove the timing belt from the camshaft sprocket.
6. Loosen the center cover bolts and then remove the center cover.
7. Remove the ignition coil assembly.
8. Loosen the cylinder head cover bolts and then remove it.
9. Remove the camshaft pulley.



BSX010A084

10. Remove the cam carrier assembly and timing belt.
11. Remove the camshaft.
12. Remove the HLA.

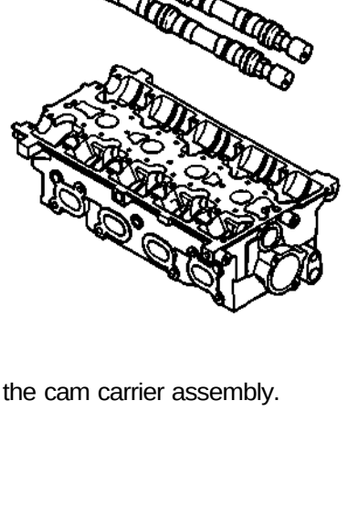
Reassembly

1. Install the HLA
2. Check that "I" mark on intake camshaft pulley is aligned with mark on cylinder head cover and "E" mark on exhaust camshaft pulley is aligned with mark on cylinder head cover.

(A5D)

AS2A10054

3. Install the camshaft after lubricating the journal of camshaft with engine oil.

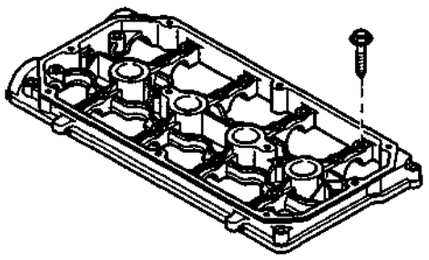


AB3AEM001

4. Install the cam carrier assembly.

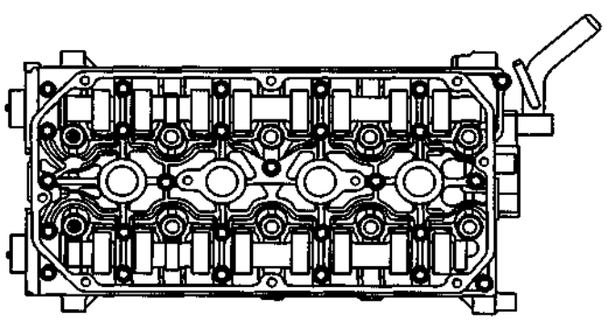
5. Tighten the cam carrier bolts to the specified torque in two or three steps.

Tightening torque:
8.31~10.5 lb-ft (11.2~14.2 N•m, 1.15~1.45 kg-m)



AB3AEM002

6. Using special tool, camshaft oil seal installer **(09221-21000),** press the camshaft oil seal. Be sure to apply engine oil to the external surface of the oil seal. Insert the oil seal along the camshaft front end install by driving the installer with a hammer until the oil seal is fully seated.



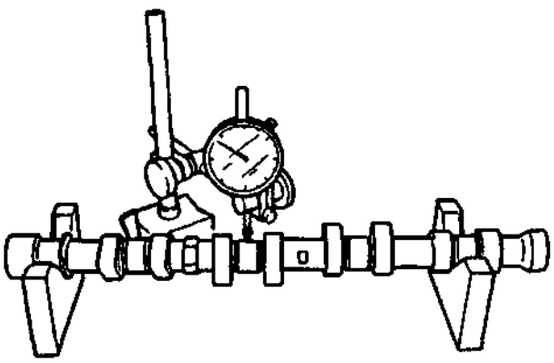
AB3010B001

Inspection

Camshaft

1. Set front and rear camshaft bearing journals on V-blocks.
2. Position a dial indicator on center bearing journal and zero dial.
3. Rotate camshaft in V-blocks and check runout.

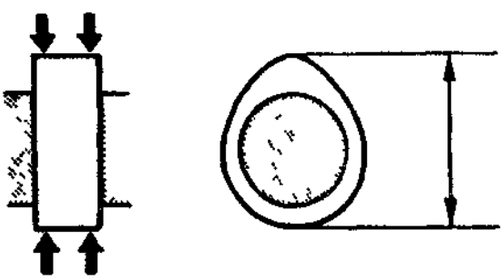
Runout:
0.0012 In (0.03 mm) maximum



BSX010B088

4. Check camshaft for uneven wear patterns, cracks, or damage.
5. Measure cam lobe heights at two points as shown.

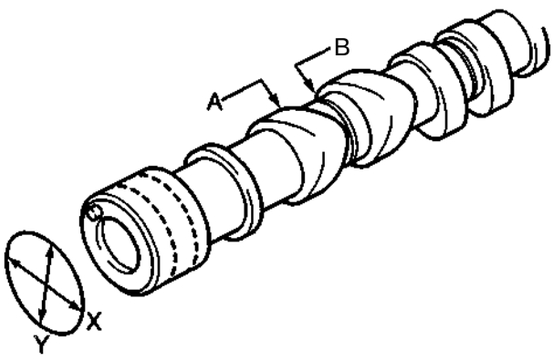
Lobe height
Intake: Standard: 1.6848 In (42.87 mm)
Exhaust:minimum: 1.6877 In (42.868 mm)



BSX010A126

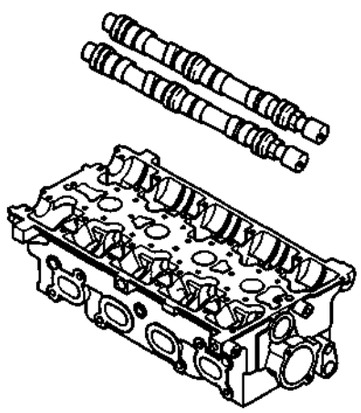
6. Check camshaft bearing journal diameter (X and Y directions) on both sides (A and B) of journal as shown in figure.

Standard diameter:
1.324~1326 In (33.961~34.0 mm)
Minimum diameter:
1.0594 In (26.910 mm)
Out–of–round:
0.0012 In (0.03 mm) maximum



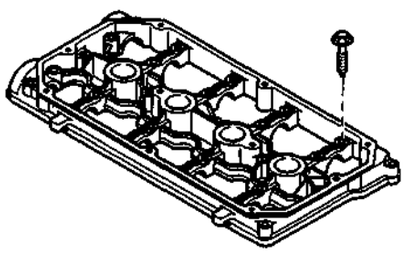
0S2010036

7. Replace camshafts if necessary.



AB3AEM001

8. Measure camshaft journal oil clearance with HLA's removed.
9. Remove all foreign material and oil from journals and bearing surfaces.
10. Set camshafts onto cylinder head.
11. Position Plastigage® on journals in axial direction.
12. Do not rotate camshafts.
13. Install cam carrier assembly.



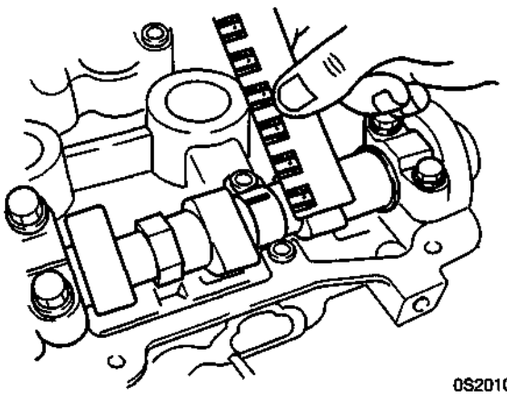
AB3AEM002

14. Install cam carrier bolts.

Tightening torque:
8.31~10.5 lb-ft (11.2~14.2 N•m, 1.15~1.45 kg-m)

15. Loosen cam carrier assembly bolts.
16. Remove cam carrier assembly.
17. Measure oil clearances.

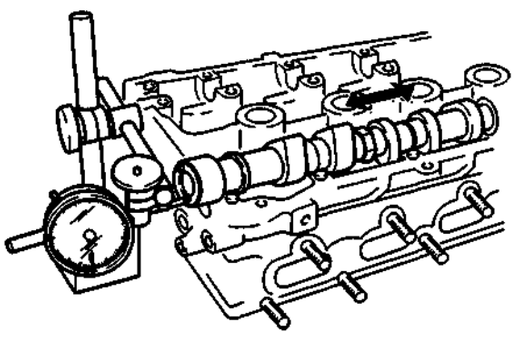
OH clearance:
0.0014~0.0031 in (0.035~0.081 mm)
Maximum:
0.006 In (0.15 mm)



0S2010038

18. If oil clearance exceeds specification, replace cylinder head.
19. Install camshafts.
20. Place a dial indicator against end of camshaft.
21. Using a prying tool, move camshaft as far forward as possible.
22. Zero dial.
23. Using prying tool, move camshaft as far rearward as possible.
24. Check gauge to determine how much end play is present.

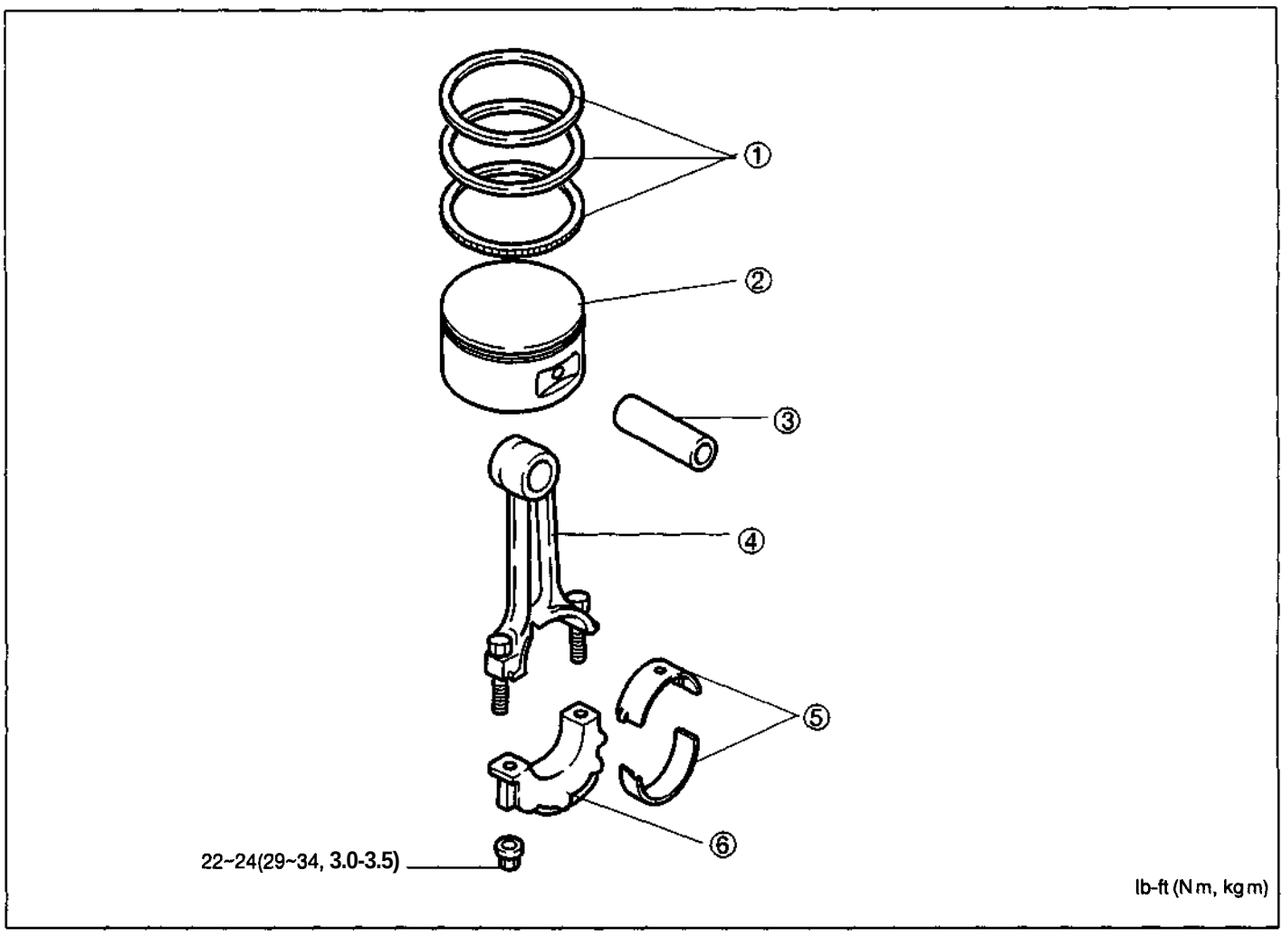
End play:
0.0003~0.0004 In (0.08~0.10 mm)
Maximum:
0.008 In (0.20 mm)



0S2010039

Connecting rod

Component



(1) Piston ring
(2) Piston
(3) Piston pin
(4) Connecting rod
(5) Connecting rod bearing
(6) Connecting rod cap

Diassembly

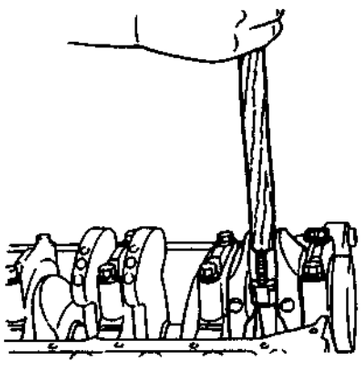
1. Use a numbering stamp and mark rod cap and connecting rod with their corresponding cylinder number.

✱ *Notice*
Mark connecting rods on same side and make a reference mark on block so that rods are installed in correct position and direction. Failure to install rods properly with result in oil starvation, spun bearings, or damaged internal engine components.

2. Rotate crankshaft so that cylinders No.2 and No.3 are at Bottom Dead Center (BDC) and repeat marking procedure.
3. Remove connecting rod nuts and gently loosen rod caps by tapping cap with a light plastic mallet.
4. Remove rod caps.

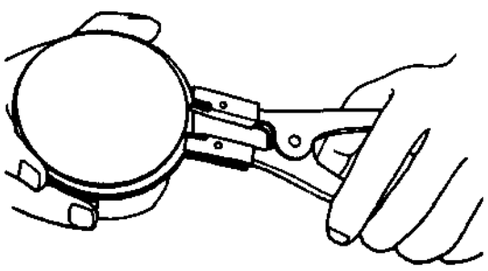
Notice
Coter connecting rod bolts to protect crankshaft jounals.

5. Push connecting rod and piston as far up into cylinder as possible. Using a wooden dowel, tap gently on piston to release it from cylinder.



BSX010A100

6. Repeat this procedure for each cylinder.
7. Mark tops of pistons with corresponding cylinder numbers they were removed from.
8. Using a piston ring expander, remove piston rings.

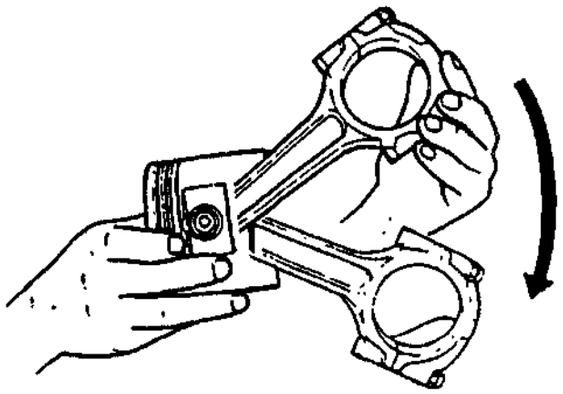


BSX010A101

9. Hold piston upright and gently move connecting rod.
10. Release connecting rod and observe its movement.

✱ *Notice*
Do not swing connecting rod widely. Constant, hard contact with piston will cause a bell-mouth condition that will require piston replacement.

11. If connecting rod does not move freely, check piston pin bore and connecting rod for straightness and deformation.

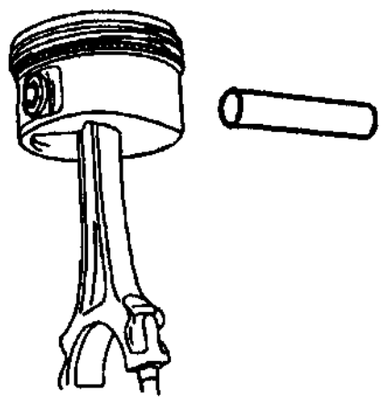


AS2A10086

12. Remove piston pin clip from ends of piston pin bore.
13. Tilt piston and allow piston pin to slide out into your hand. Piston pins may need to be pressed out.

✱ *Notice*
Do not allow pins to drop to the ground.

14. Remove connecting rod from piston. Keep individual piston, piston pin, and piston clips together for reassembly.



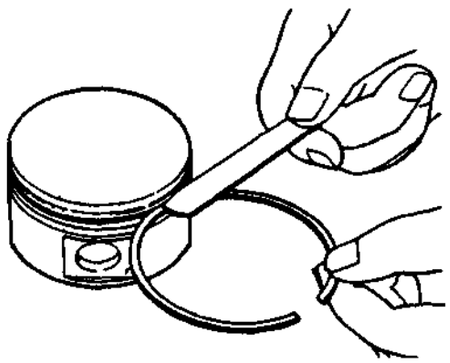
AS2A10087A

Inspection

Piston ring

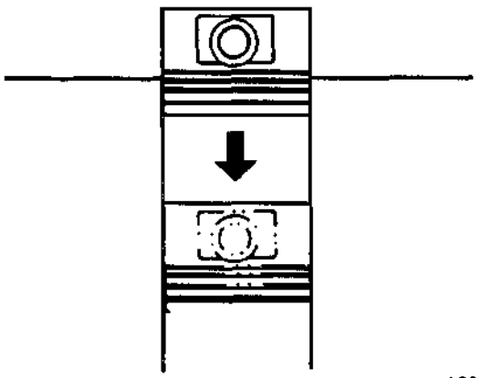
1. Insert a new piston ring into a piston ring groove and check clearance between piston ring and ring end.Clearance between ring and ring end

Standard: A5D: 0.03~0.07 mm
A3E: 0.04~0.08mm
Maximum: 0.10 mm



AS2A10081

2. If clearance exceeds the maximum, replace piston.
3. Inspect piston rings for damage, abnormal wear, or breakage.
4. Replace piston rings if necessary.
5. Insert piston ring into cylinder by hand.
6. Square ring in cylinder by inserting a piston into cylinder and pushing ring to the bottom of its travel in cylinder.
7. Place a feeler gauge in end gap and check end gap clearance.



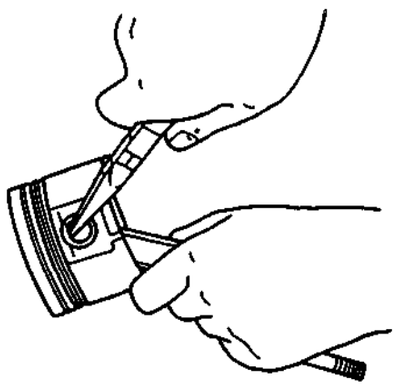
AS2A10082

End gap clearance

Ring	A3E	A5D
Top ring	0.008~0.013 in (0.20~0.35 mm)	0.006 ~ 0.011 in (0.15 ~ 0.30 mm)
Second ring	0.014~0.028 in (0.37~0.52 mm)	0.016 ~ 0.021 in (0.40 ~ 0.55 mm)
Oil rail	0.08~0.27 in (0.20~0.70 mm)	0.008 ~ 0.027 in (0.20 ~ 0.70 mm)
Maximum	0.039 in(1.0 mm)	

Reassembly

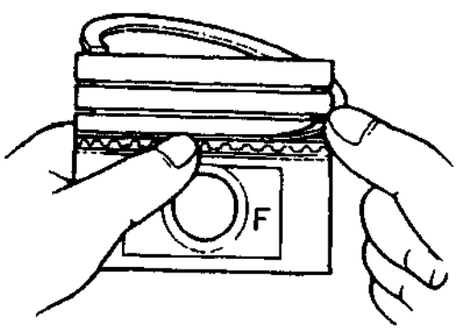
1. Insert connecting rod into piston and slide piston pin through piston and through connecting rod until it makes contact with the piston pin clip already installed.



AS2A10097

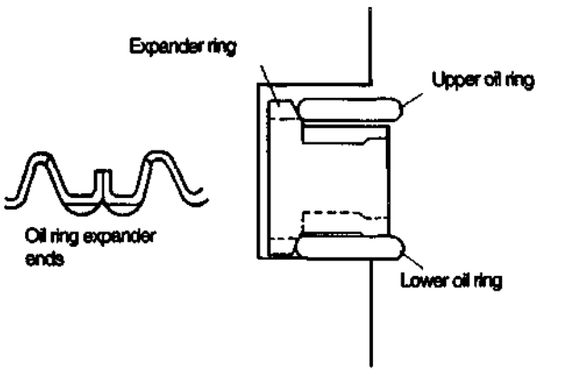
✱ *Notice*
Verify that piston ***and*** *rod are assembled in same direction as* ***they were*** *prior to disassembly.*

2. Install second piston pin clip into clip grooves on opposite side of piston.



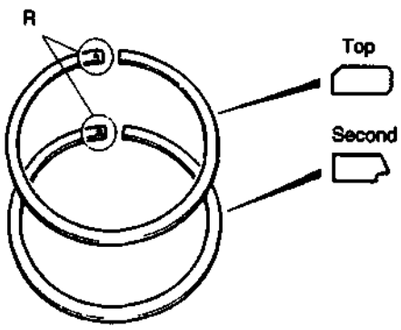
AS2A10085

3. Hold piston upright and move connecting rod back and forth. Check that rod moves freely.
4. Install three piece oil ring onto piston.
   a. Apply clean engine oil to the oil ring expander and upper and lower oil rings.
   b. Install expander onto piston so that expander ends face upward.
   c. Install lower oil ring onto piston. Ring may be installed with either face upward.
   d. Install upper oil ring onto piston. Ring may be installed with either face upward.
5. Check that oil ring expander separates upper and lower oil rings, and that oil ring assembly spins freely on piston.



ABT010170

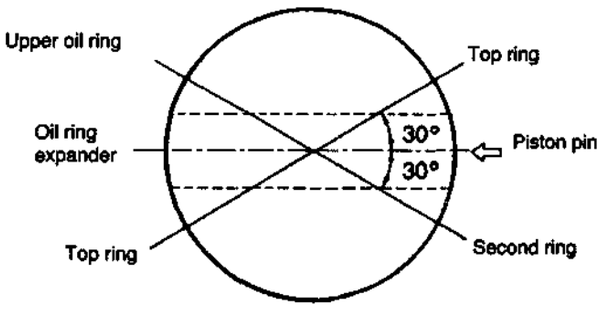
6. Use a ring expander and install second ring.
7. Use a ring expander and install top ring.



ABT010169A

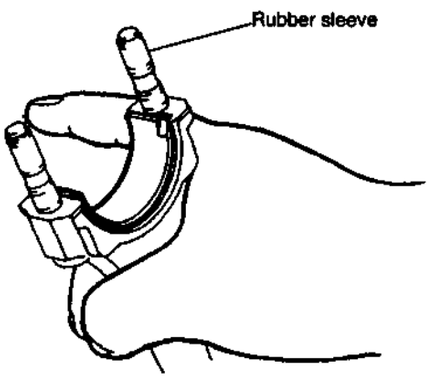
✱ *Notice*
Top ring and second ring should be installed with "R" or "Y" mark facing up.

8. Align piston ring gaps as shown.



ABT010171

9. Install a bearing into connecting rod.
10. Place rubber sleeves (rubber fuel line works well) on connecting rod bolts to protect crankshaft from damage.
11. Check piston rings for correct end gap stagger.



BSX010B102

12. Place piston (cylinder number one) with "F" mark facing front of engine block, then slip piston and connecting rod assembly into a piston ring compressor.

BSX010B103

13. Rotate crankshaft so that crank pin journal for specific cylinder is at its lowest point (bottom dead center).
14. Lower piston and connecting rod assembly until piston ring compressor makes contact with deck surface of engine block.
15. Using butt end of a hammer, tap the top of piston into cylinder and continue tapping until connecting rod makes contact with crankshaft.

✱ *Notice*
Follow this procedure for remaining piston and connecting rod assemblies.

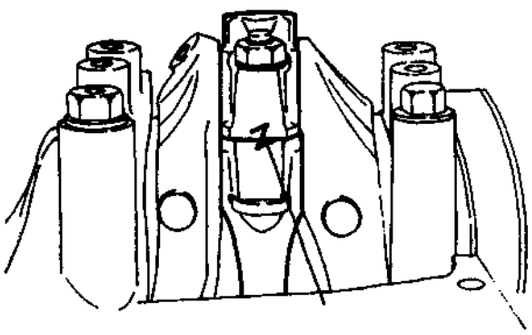
16. Install a connecting rod bearing in each connecting rod cap.
17. Place a piece of Plastigage® on crank pin journals.
18. Install connecting rod caps, aligning marks made previous to disassembly and torque to specification.

Tightening torque:
47~51 lb-ft (64~69 N•m, 6.5~7.0 kg-m)

✱ *Notice*
When installing the connecting rods, match marks made on the connecting rod and cap to reference mark made on cylinder block to prevent oil starvation to the connecting rod bearings.

19. Loosen and remove connecting rod caps.
20. Check the connecting rod bearing clearance.

Oil clearance:
0.0010 ~ 0.0021 In (0.026 ~ 0.054 mm)
Maximum: 0.004 In (0.10 mm)

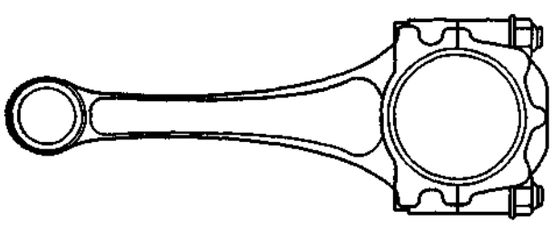


BSX010A170

21. If oil clearance exceeds maximum oil clearance specification, grind the crankshaft and use undersized connecting rod bearings.
1)Connecting rod bearing selection table

Connecting rod code / Pin journal shaft diameter	1	2	3
39.940~ 39.956mm	(Green)	(Blue)	(Red)

*Marking code is coated in the bearing side.



AB3010027

2)Connecting rod bearing housing bore size

Unit:mm

Code	Connecting rod bearing housing bore size
1	43.000~43.006
2	43.006~43.012
3	43.012~43.018

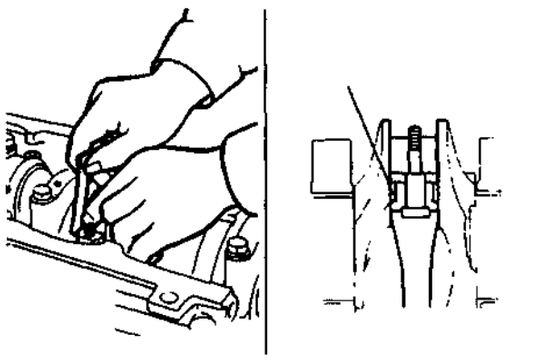
3)Connecting rod bearing thickness Unit:mm

Connecting rod bearing		bearing thickness
Standard bearing	(Green)	1.506~1.509
	(Blue)	1.509~1.512
	(Red)	1.512~1.515
Undersize bearing	0.25	1.631~1.635
	0.50	1.756~1.760
	0.75	1.881~1.885

22. Apply a coat of clean engine oil to connecting rod bearing in connecting rod cap.
23. Install connecting rod cap and torque to specification.

Tightening torque:
47~51 lb-ft (64~69 N•m, 6.5~7.0 kg-m)

24. Insert a thickness gauge between connecting rod and crankshaft and check connecting rod side clearance.



AN7010A171

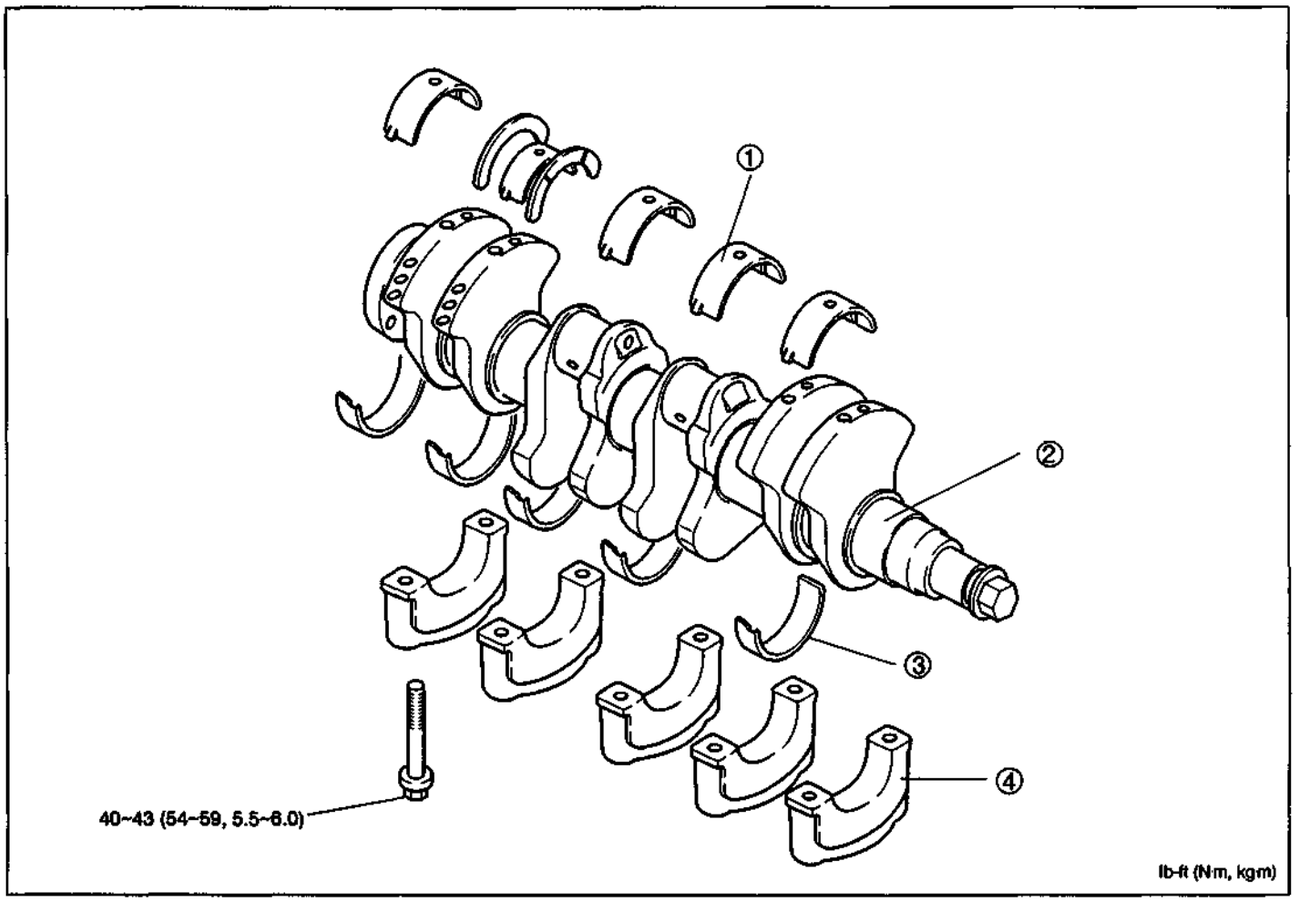
Notice
Do not measure between connecting rod cap and crankshaft.

Side clearance:
0.0044~0.0103 In (0.110~0.262 mm)
Maximum: 0.012 In (0.30 mm)

25. If side clearance exceeds maximum side clearance specification, replace connecting rod and cap.

Crankshaft

Component



(1) Main bearing
(2) Crank shaft
(3) Main bearing
(4) Main bearing cap

Disassembly

1. Remove the timing belt, front case, flywheel cylinder head assembly and oil pan. For details, refer to respective chapters,
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.

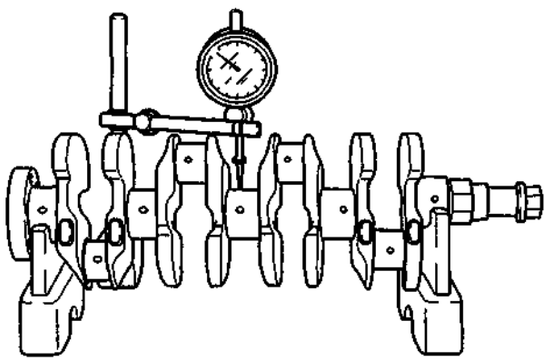
Notice
Mark the main bearing caps to permit reassembly in the original position and direction.

4. Remove the main bearing caps and remove the crankshaft. Keep the bearings in order by cap number.

Inspection

Crankshaft

1. Check crankshaft bearing and crank pin journals for damage and scoring.
2. Check oil holes for clogging.
3. Set crankshaft on V-blocks.
4. Measure crankshaft run-out at center journal. Replace crankshaft if it is not within specification.



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Run-out:
0.0016 in (0.04 mm)

6. Grind crankshaft only if there is visible scoring, or if out-of-round is excessive.
7. Only grind crankshaft amount necessary to correct condition.
8. If a crankshaft must be ground 0.020 in (0.50 mm) or more, heat-treat crankshaft to ensure durability.

Main journal diameter undersizes:

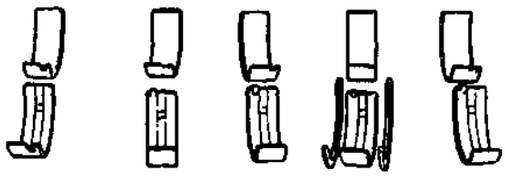
Bearing size	Journal diameter
0.010 in (0.25 mm) undersize	1.9562~1.9569 in (49.688~49.706 mm)
0.020 in (0.50 mm) undersize	1.9464~1.9471 in (49.438~49.456 mm)
0.030 in (0.75 mm) undersize	1.9365~1.9372 in (49.188~49.206 mm)

Crank pin journal diameter undersizes:

Bearing size	Journal diameter
0.010 in (0.25 mm) undersize	1.5626~1.5632 in (39.690~39.706 mm)
0.020 in (0.50 mm) undersize	1.5528~1.5534 in (39.440~39.456 mm)
0.030 in (0.75 mm) undersize	1.5429~1.5435 in (39.190~39.206 mm)

Main Bearing and Connecting Rod Bearings

1. Check main and connecting rod bearings for peeling, scoring and other damage.



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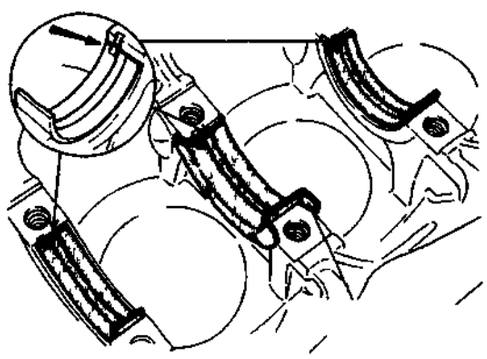
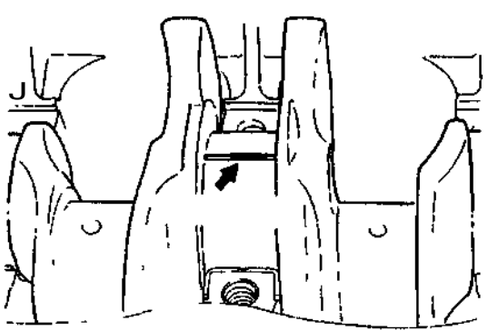
Reassembly

1. Inspect journals and bearings for any foreign material. Clean crankshaft, oil holes, and main bearing journals thoroughly, and dry components with compressed air.
2. Install grooved main bearings into saddles on engine block.
3. Install thrust bearings with oil groove facing crankshaft.



AN7010A160

4. Set crankshaft on installed bearings.
5. Install remaining main bearings into main bearing caps.
6. Position Plastigage® on crankshaft journals.
7. Install main bearing caps along with lower main bearings according to cap number and ⬅ mark.
8. Tighten main bearing cap bolts.

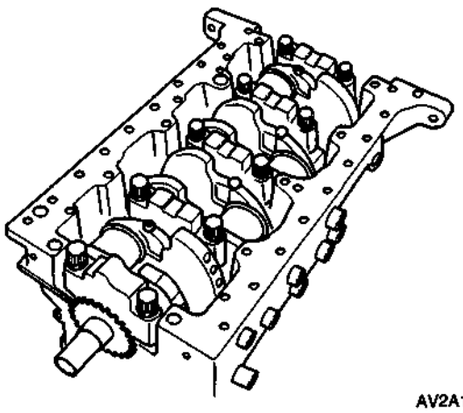


AN7010A161

Tightening torque:
40~43 lb-ft (54~59 N•m, 5.5~6.0 kg-m)

Caution
Do not rotate crankshaft with Plastigage® on crankshaft Journals.

9. Remove main bearing caps and check bearing clearance.



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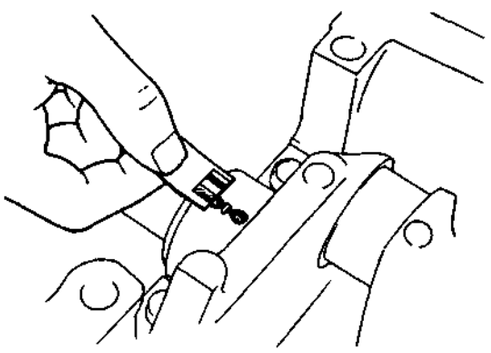
✱ *Notice*
The widest point of Plastigage® is the smallest clearance, and the narrowest point of Plastigage is the largest clearance.

10. If oil clearance exceeds specification, grind and polish crankshaft and use undersized main bearings.

Oil Clearance:
0.0007~0.0014 in (0.018~0.036 mm)
MAXIMUM: 0.0031 In (0.08 mm)



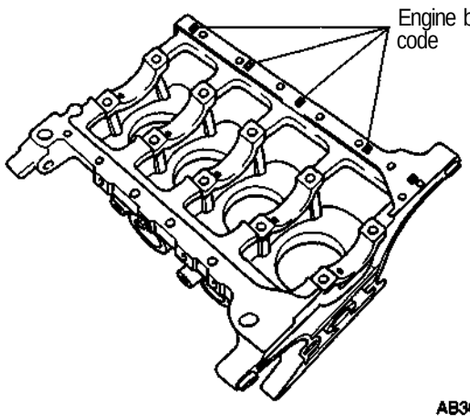
AN7010A163

Main moving system

1) Standard main bearing selection

Main journal code \ Engine block code	A	•	C
A	Black	Blue	Red
•	Brown	Black	Blue
C	Green	Brown	Black

*Marking code is recorded on the face of bearing



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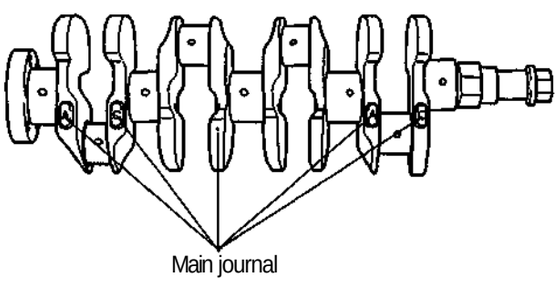

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2) Main bearing housing bore size

Unit: mm

Code	Main bearing housing bore size
A	54.000~54.006
•	54.006~54.012
C	54.012~54.018

3) Main journal shaft diameter

Unit: mm

Code	Main journal shaft diameter
A	49.938~49.944
•	49.944~49.950
C	49.950~49.956

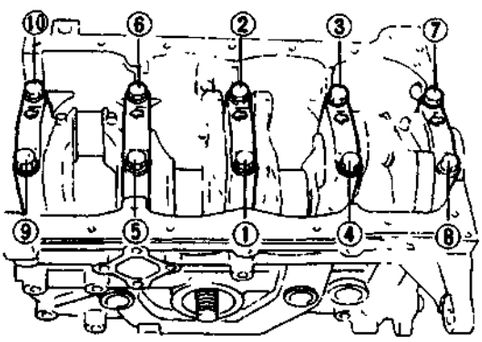
4) Main bearing thickness

Unit: mm

Main beaning		Thickness
Standard bearing	Yellow	2.007~2.010
	Green	2.010~2.013
	Brown	2.013~2.016
	Black	2.016~2.019
	Blue	2.019~2.022
	Red	2.022~2.025
Undersize bearing	0.25	2.133~2.137
	0.50	2.258~2.262
	0.75	2.383~2.387

11. Lift crankshaft out of cylinder block and carefully remove Plastigage® from main bearings and crankshaft journals.
12. Apply a light coat of engine oil on main bearings and install crankshaft by gently lowering it onto bearings.
13. Apply a light coat of oil on crankshaft main bearing journals and on main bearings on main bearing caps.
14. Install main bearing caps along with lower main bearings according to cap number and ← mark.
15. Tighten main bearing cap bolts according to the following procedure:
    Tighten bolts in order shown

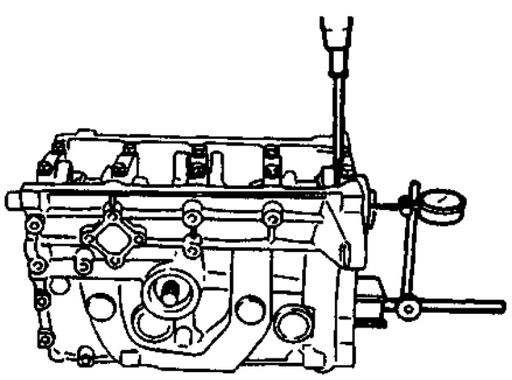
Tightening torque:
40~43 lb-ft (54~59 N•m, 5.5~6.0kg-m)



AN7010A162

16. Rotate crankshaft to ensure it does not bind.
17. Place a dial indicator against front of crankshaft and zero gauge.
18. Using a prying tool, move crankshaft forward and zero dial indicator.
19. Move the crankshaft toward the rear of block with prying tool and check the amount of movement on dial indicator.

End Play:
0.0032~0.0111 In (0.080~0.282 mm)



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20. If end play exceeds specification, grind crankshaft and install oversized thrust bearings, or replace crankshaft and thrust bearings.
    oversize thrust bearing width

Thrust bearing size	Specification
Standard	0.0985~0.1003in (2.5000~2.550mm)
Standard +0.010 in (0.25 mm)	0.1034~0.1053in (2.625~2.675mm)
Standard +0.020 in (0.50 mm)	0.1083~0.1102 in (2.750~2.800mm)
Standard +0.030 in (0.75 mm)	0.1132~0.1151 in (2.875~2.925mm)

21. Install the oil seal in the crankshaft rear oil seal case. Press fit the oil seal all the way in, being careful not misalign it.
22. Install the rear plate and tighten the bolts.
23. Insall the connecting rod caps. Refer to "Piston and Connecting Rods".
24. Install the flywheel, front case, oil pan and timing belt. For further details, refer to the respective chapters.

Engine coolant

Inspection

⚠WARNING

- **NEVER REMOVE RADIATOR CAP WHILE ENGINE IS HOT.**
- **WRAP A THICK CLOTH AROUND RADIATOR CAP BEFORE REMOVING.**
- **WHEN REMOVING RADIATOR CAP, LOOSEN SLOWLY TO FIRST STOP AND WAIT UNTIL PRESSURE IN RADIATOR IS RELEASED, THEN COMPLETELY REMOVE.**

Level (engine cold)

1. Verify that there is no build-up of rust or scale around radiator cap or radiator filler neck.
2. Verify that coolant is free of contaminants. Replace coolant if necessary.

Coolant quality

1. Verify that there is no build-up of rust or scale around radiator cap or radiator filler neck.
2. Verify that coolant is free of contaminants. Replace coolant if necessary.

Replacement

⚠WARNING

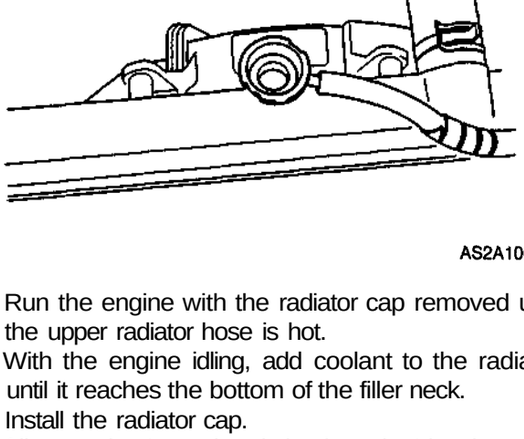
- **NEVER OPEN RADIATOR CAP WHILE ENGINE IS HOT.**
- **WRAP A THICK CLOTH AROUND CAP BEFORE LOOSENING.**
- **USE CAUTION WHEN DRAINING HOT COOLANT.**

Caution

- ***Do not use alcohol or methanol-based coolant***
- ***Use only demineralized water In coolant mixture.***

1. Remove radiator cap and loosen drain plug.
2. Drain coolant into a suitable container.
3. Flush cooling system with water until all traces of color are gone; then let system drain completely.
4. Install drain plug.
5. Fill with proper mixture of ethylene glycol–based coolant.

   Coolant Capacity: 6.3 gal (6.0L)



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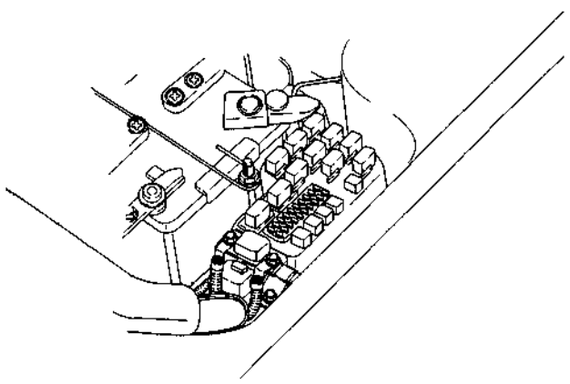
6. Run the engine with the radiator cap removed until the upper radiator hose is hot.
7. With the engine idling, add coolant to the radiator until it reaches the bottom of the filler neck.
8. Install the radiator cap.
9. Allow engine to cool and check coolant level.

Cooling fan relay

Inspection

* *Notice*
Cooling fan motor relay is located in the engine compartment fuse/relay box.

1. Disconnect negative battery cable.
2. Remove cooling fan motor relay from engine compartment fuse/relay box.



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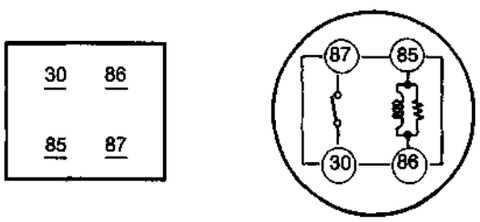
3. Check continuity with an ohmmeter.

Terminal	Continuity
30~87	No
85~86	Yes

4. Apply 12V to terminal 85 and ground to terminal 86. Check for continuity between terminals 30 and 87.



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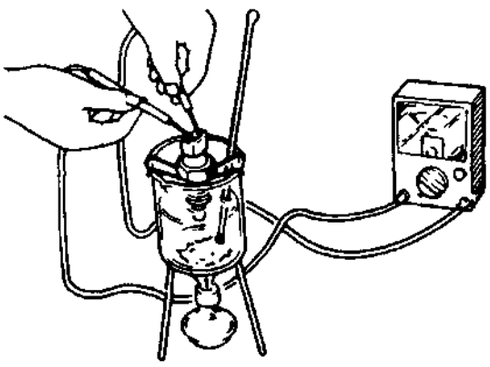
5. If there is no continuity, replace fan motor relay.

Engine coolant temperature Sensor

Inspection

1. Check for resistance.

Water temperature	Resistance (kΩ)
-4°F (-20°C)	14.6~17.8
68°F (20°C)	2.2~2.7
176°F (80°C)	0.29~0.35



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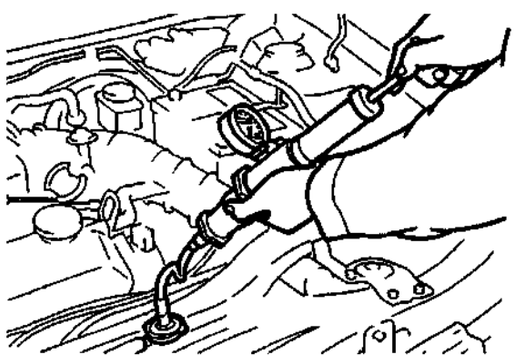
2. If not as specified, replace the engine coolant temperature sensor.

Radiator

Leakage

1. Connect a coolant system pressure tester to the radiator filler neck.
2. Apply 15 psi (103 kPa) pressure to the system.



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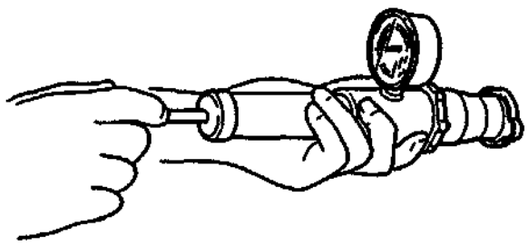
3. Verify that the pressure remains steady at 15psi (103 kPa).
4. If not, check system for coolant leakage.

Radiator cap

Inspection

Radiator cap valve

1. Remove foreign material from radiator cap valve and the valve seat.
2. Attach radiator cap to a radiator cap tester. Apply pressure gradually to 15 psi (103 kPa).



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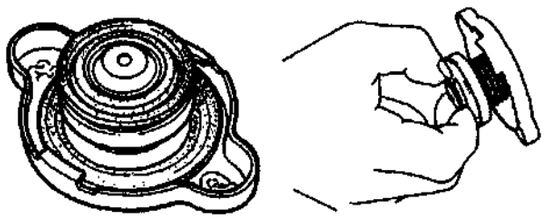
3. Wait about **10 seconds.** Verify that pressure has not decreased.
4. Replace radiator cap as necessary.

Negative pressure valve

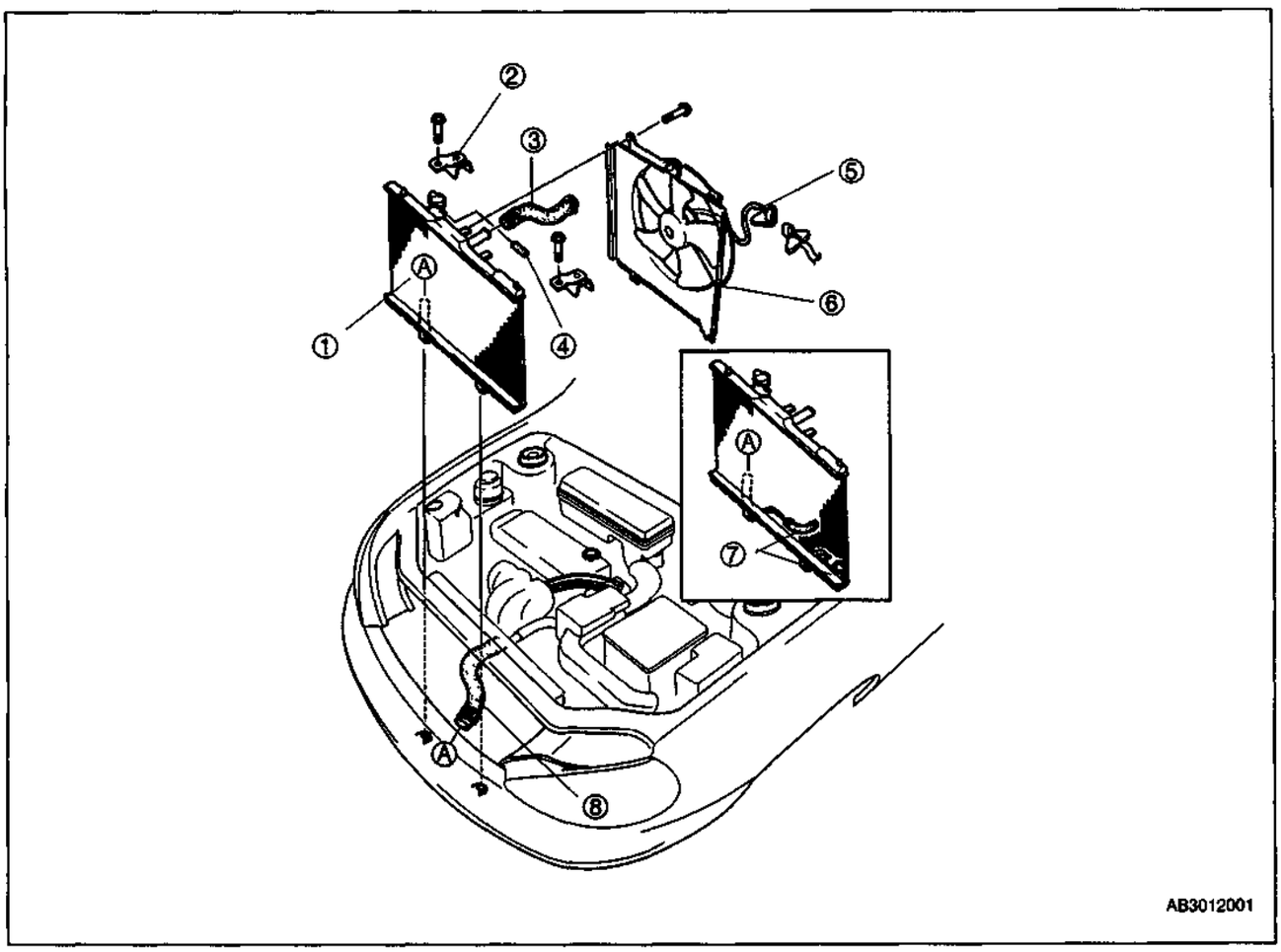
1. Pull negative pressure valve to open it. Verify that it closes completely when released.



BSX012005

2. Check for damage on contact surfaces, and for a cracked or deformed seal.
3. Replace radiator cap as necessary.

Radiator



(1) Radiator
(2) Radiator bracket
(3) Radiator hose
(4) Coolant reservoir hose
(5) Cooling fan connector
(6) Cooling fan
(7) Oil cooler hose
(8) Radiator hose

Removal

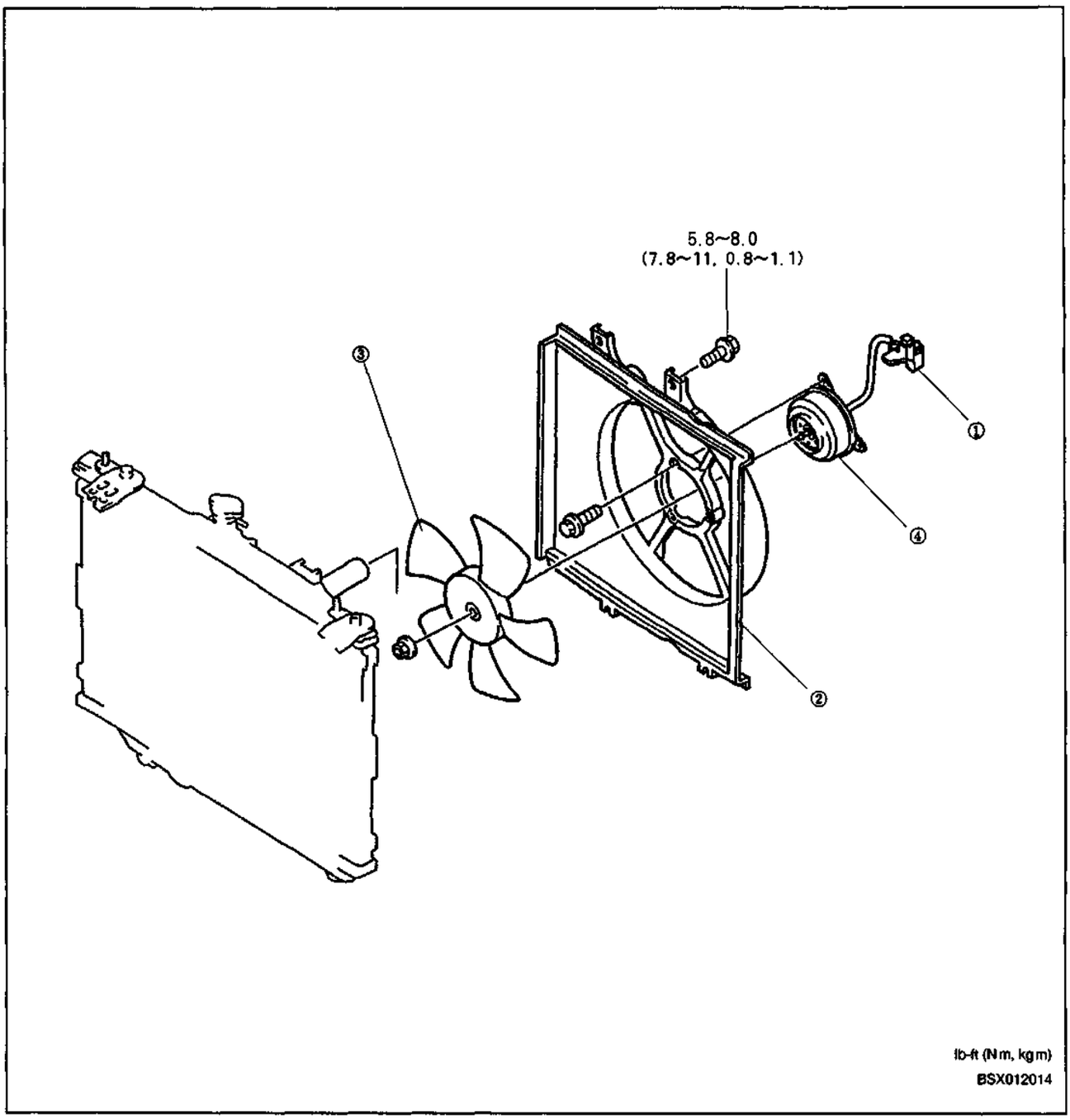
1. Disconnect negative battery cable.
2. Remove fresh air duct.
3. Drain coolant.
4. Remove components in the order shown in the above figure.

Installation

1. Install in the reverse order of removal.
2. After installation, fill engine coolant and check coolant leakage

Cooling fan

Component



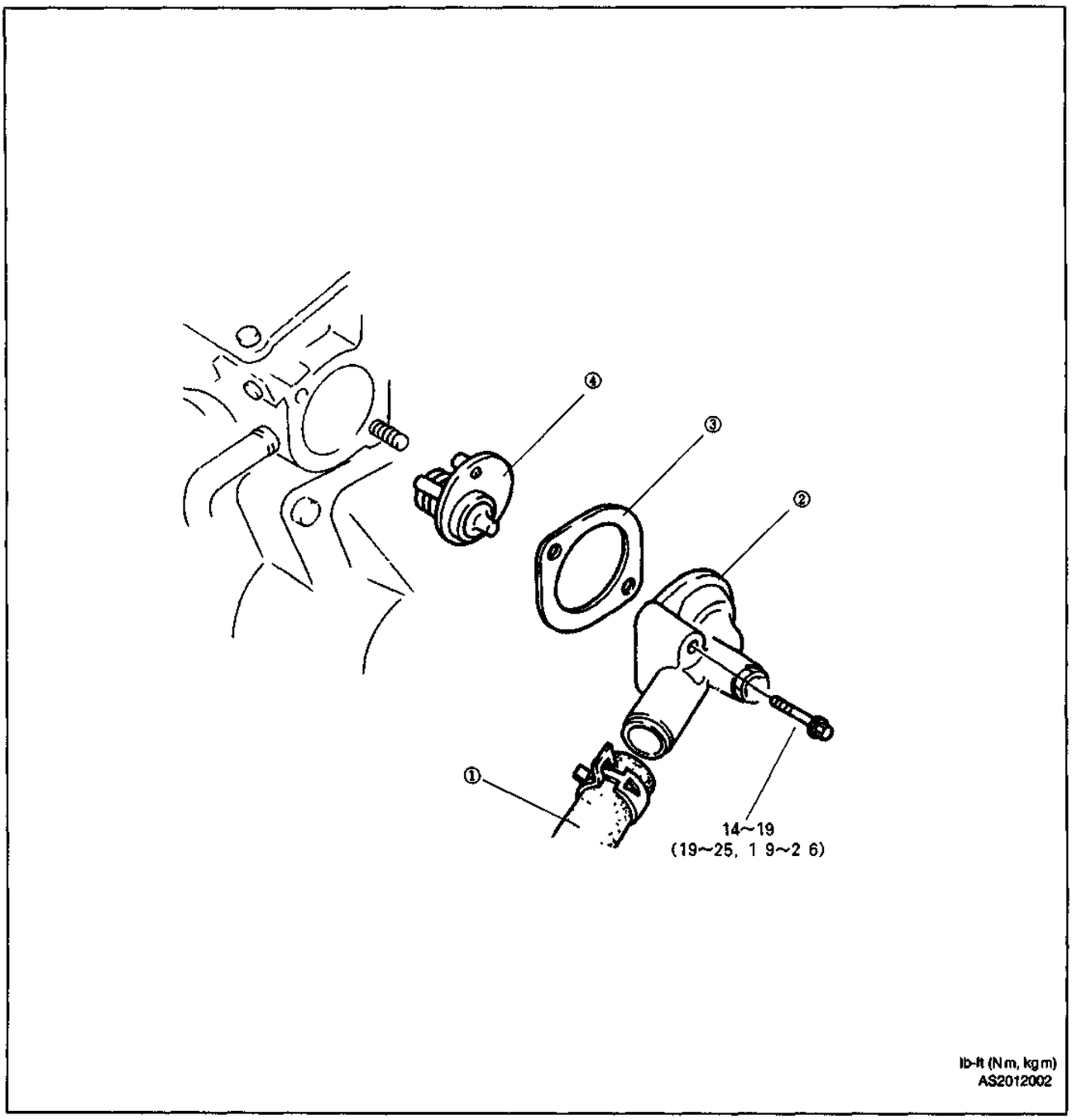
(1) Cooling fan connector
(2) Radiator cowling
(3) Cooling fan
(4) Fan motor

Romoval

Remove components in the order shown in above figure.

Thermostat

Component



(1) Radiator upper hose
(2) Thermostat cover
(3) Gasket
(4) Thermostat

Removal

Remove components in the order shown in above figure.

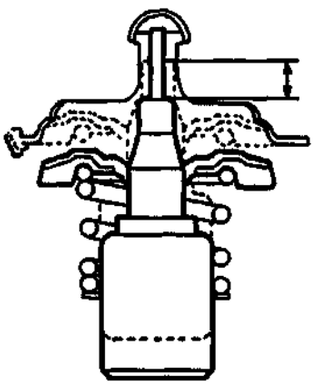
Inspection

1. Visually check that thermostat is airtight.
2. Place thermostat and a thermometer in water.
3. Gradually heat water and check following.

Initial opening temperature:
188~193°F (86.5~89.5°C)

Full open temperature:
212°F (100°C)

Full open lift:
0.31 in (8.0 mm) min



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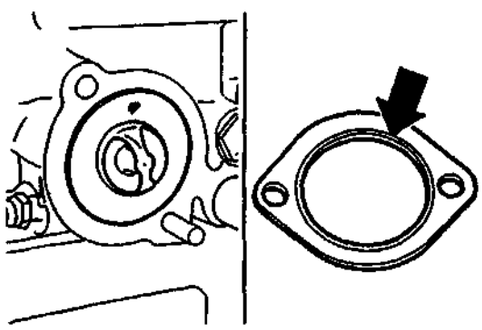
Installation

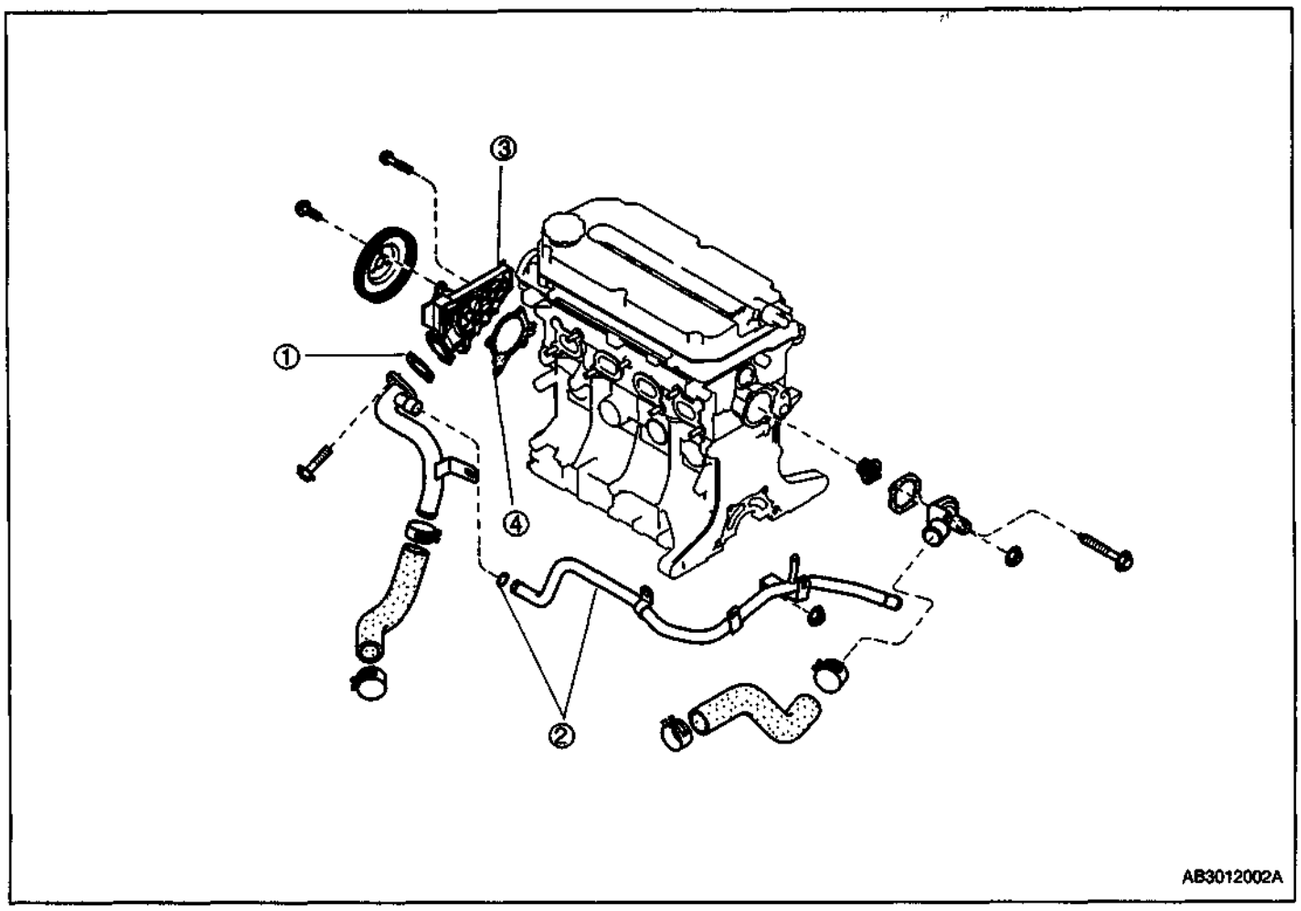
1. Install thermostat into cylinder head with jiggle pin positioned up.
2. Install in the reverse of removal.



BSX012010

Water pump

Component



(1) Water inlet pipe and gasket
(2) Water bypass pipe and 0-ring
(3) Water pump assembly
(4) Water pump gasket

Removal

Caution
Do not disassemble water pump assembly. If a problem Is found, replaed assembly as a unlt.

1. Disconnect negative battery cable.
2. Remove drive belt.
3. Remove timing belt.
4. Remove power steering pump in order to remove water inlet pipe.
5. Remove components in the order shown in above figure.

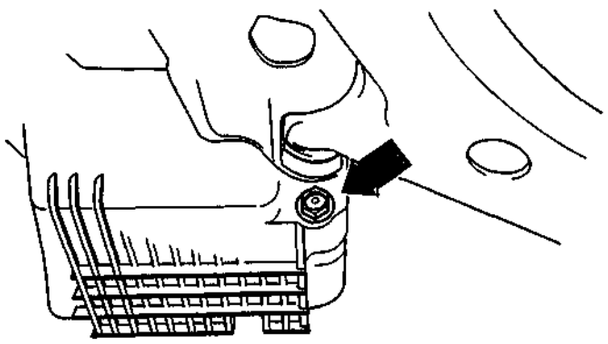
Lubrication system
Oil replacement

⚠WARNING
BE CAREFUL WHEN DRAINING BECAUSE OIL IS HOT AND COULD CAUSE PERSONAL INJURY.

1. Warm engine to normal operating temperature and turn engine off. Position a suitable container under oil pan.
2. Remove oil filler cap and oil pan drain plug.
3. Allow oil to be fully drained.
4. Install drain plug with new gasket.

Tightening torque:
22~30 lb-ft (29~41 N·m, 3.0~4.2 kg-m)

5. Refill engine with specified type and amount of engine oil.
6. Run engine and check for leaks.



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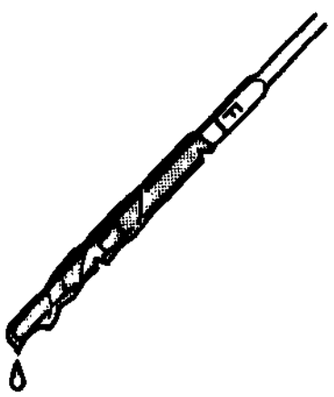
7. Check oil level and add oil if necessary.

Oil pan capacity:
3.2 U.S. qt (3.0 liters, 2.6 Imp qt)



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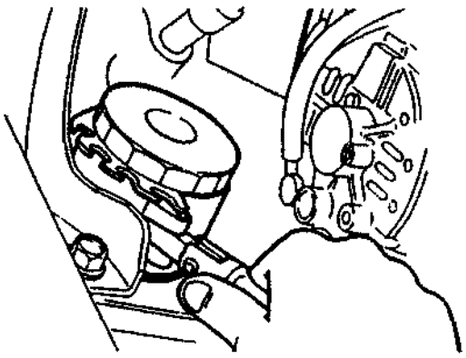
8. Install oil filler cap.

Oil filter replacement

1. Raise vehicle.
2. Remove oil filter with oil filter wrench. If rubber seal is stuck to engine, remove it.
3. Apply a small amount of clean engine oil to rubber seal of new filter.
4. Install oil filter and turn it by hand until rubber seal contacts base.
5. Tighten filter 1-1/6 turns with filter wrench.
6. Start engine and check for leaks.
7. Turn engine off, and wait 5 minutes. Check oil level and add oil if necessary.

Oil filter capacity:
0.21 U.S. qt (0.20 liter, 0.18 Imp qt)



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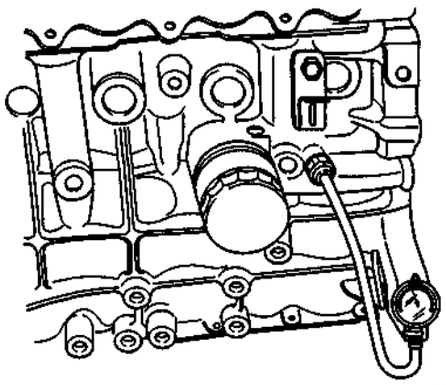
Oil pressure check

1. Disconnect and remove oil pressure switch.
2. Install oil pressure gauge into oil pressure switch installation hole.
3. Warm engine to normal operating temperature.
4. Run engine at 3,000 rpm, and note gauge readings.

OH pressure:
43~57 psi (294~392 kPa, 3.0~4.0 kg/cm²)



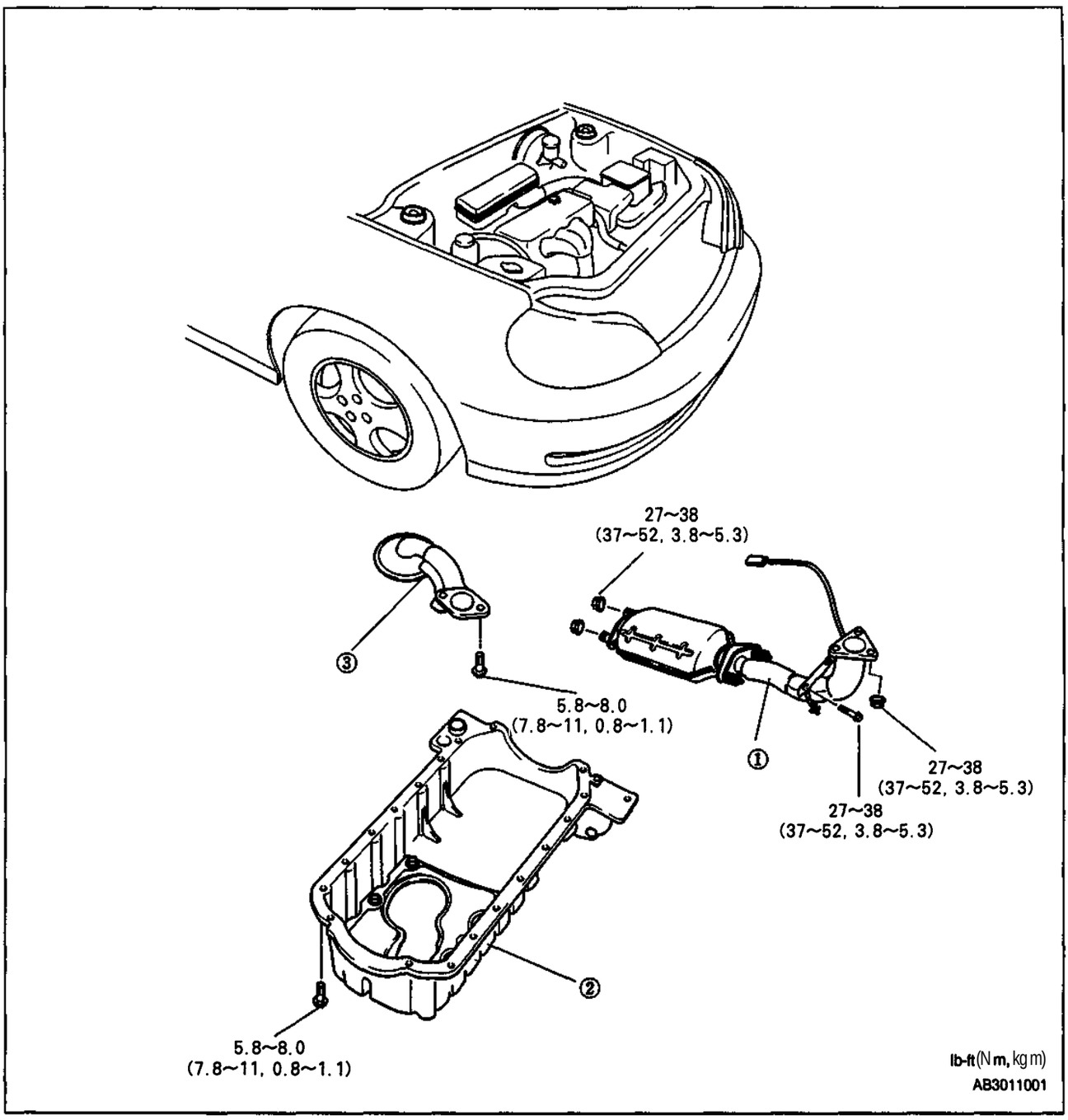
AS2011002

5. If pressure is not within specification, check for cause, and repair.
6. Remove oil pressure gauge and install oil pressure switch.

Tightening torque:
104~156 lb-in (12~18 N•m, 1.2~1.8 kg-m)

Oil pan

Components



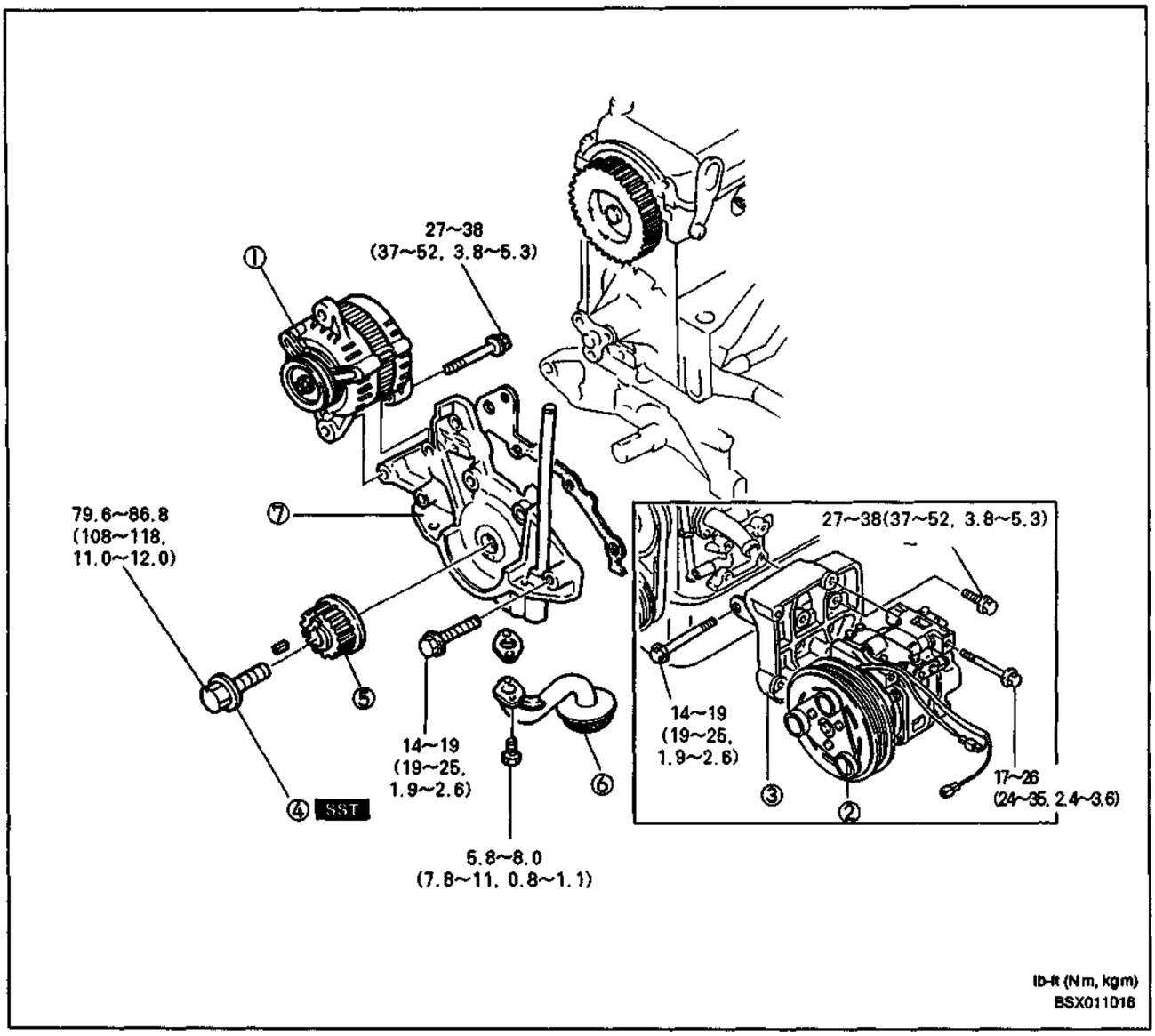
(1) Front exhaust pipe & catalytic converter
(2) Oil pan
(3) Oil strainer

Removal

1. Disconnect negative battery cable.
2. Drain engine oil.
3. Remove as shown in figure above.

Oil pump

Component

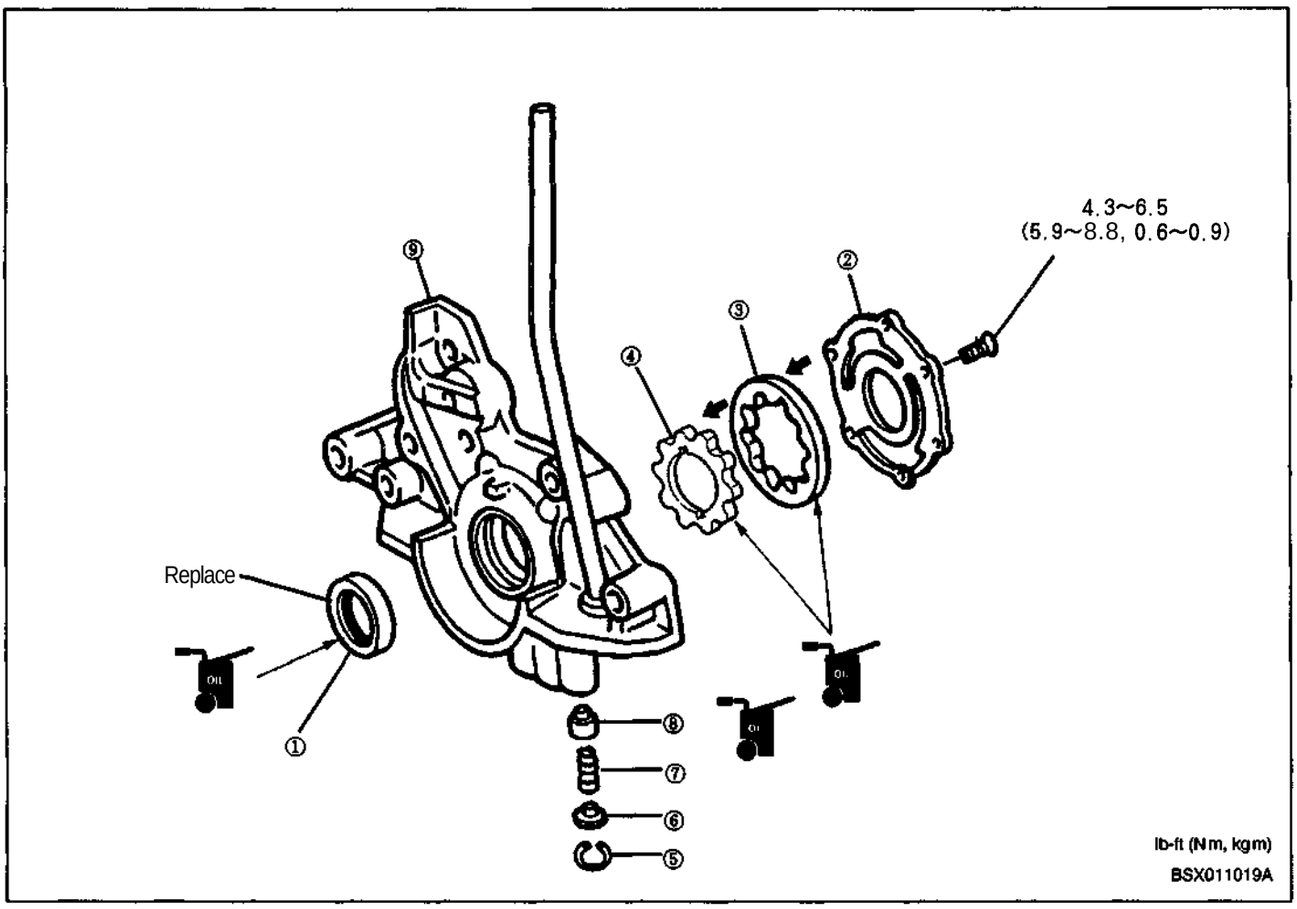


(1) Alternator
(2) Compressor assembly
(3) Compressor bracket
(4) Timing belt pulley lock bolt
(5) Timing belt pulley
(6) Oil strainer
(7) Oil pump assembly

Removal

1. Disconnect negative battery cable.
2. Drain engine oil.
3. Remove Drive belt.
4. Remove timing belt.
5. Remove components in the order shown in above figure.

Reassembly



(1) Oil seal
(2) Pump cover
(3) Outer rotor
(4) Inner rotor
(5) Snap ring
(6) Spring seat
(7) Pressure spring
(8) Control plunger
(9) Pump body

Inspection

1. Clean all components and clean off dust from all components.
2. Check all components with specifications and replace as necessary.

Component		Specification
Oil pump side clearance	in(mm)	0.0039 (0.10)
Tooth tip clearance	in(mm)	0.007 (0.18)
Outer roter to pump body clearance	in(mm)	0.0078 (0.20)

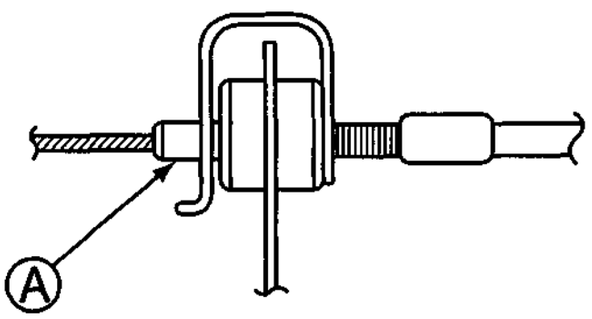
Intake and exhaust system

Accelerator cable

Inspection/Adjustment

1. Depress the accelerator pedal to the floor and check that the throttle valve is fully opened.
   Adjust with nut ® , if necessary.
2. Measure the free play of the accelerator cable.

Free play: 0.16~0.28 In (4~7 mm)

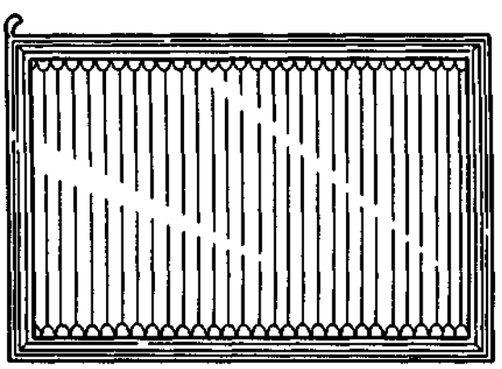


AB3010017

Air cleaner element

Inspection

1. Check the air cleaner element for excessive dirt, damage, or oil, and replace or clean if necessary.

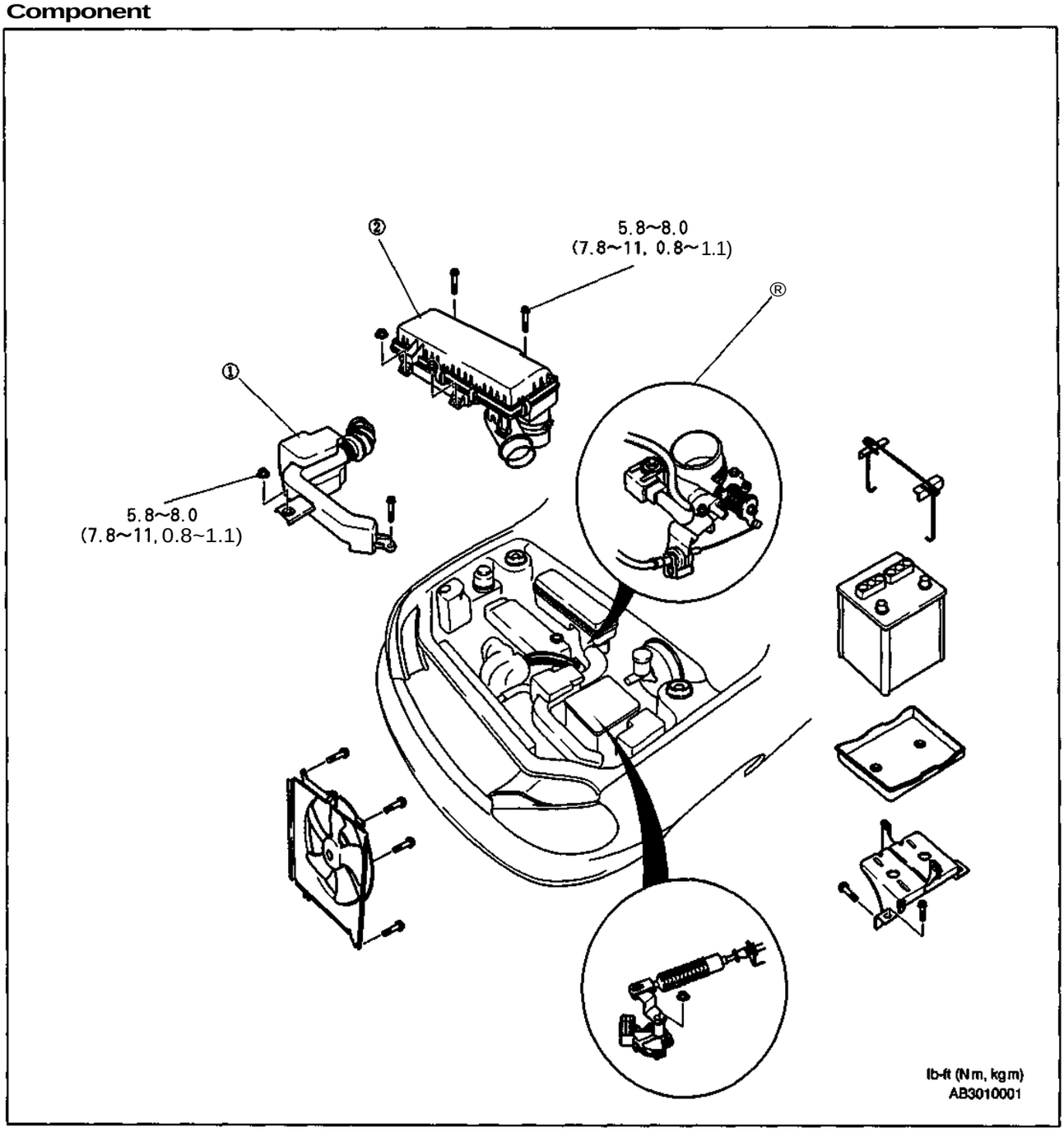


AS2A21013

✱ *Notice*
Use a compressed air to clean the element from the internal side to the external side, or from the upper to the lower.

Intake system

Component



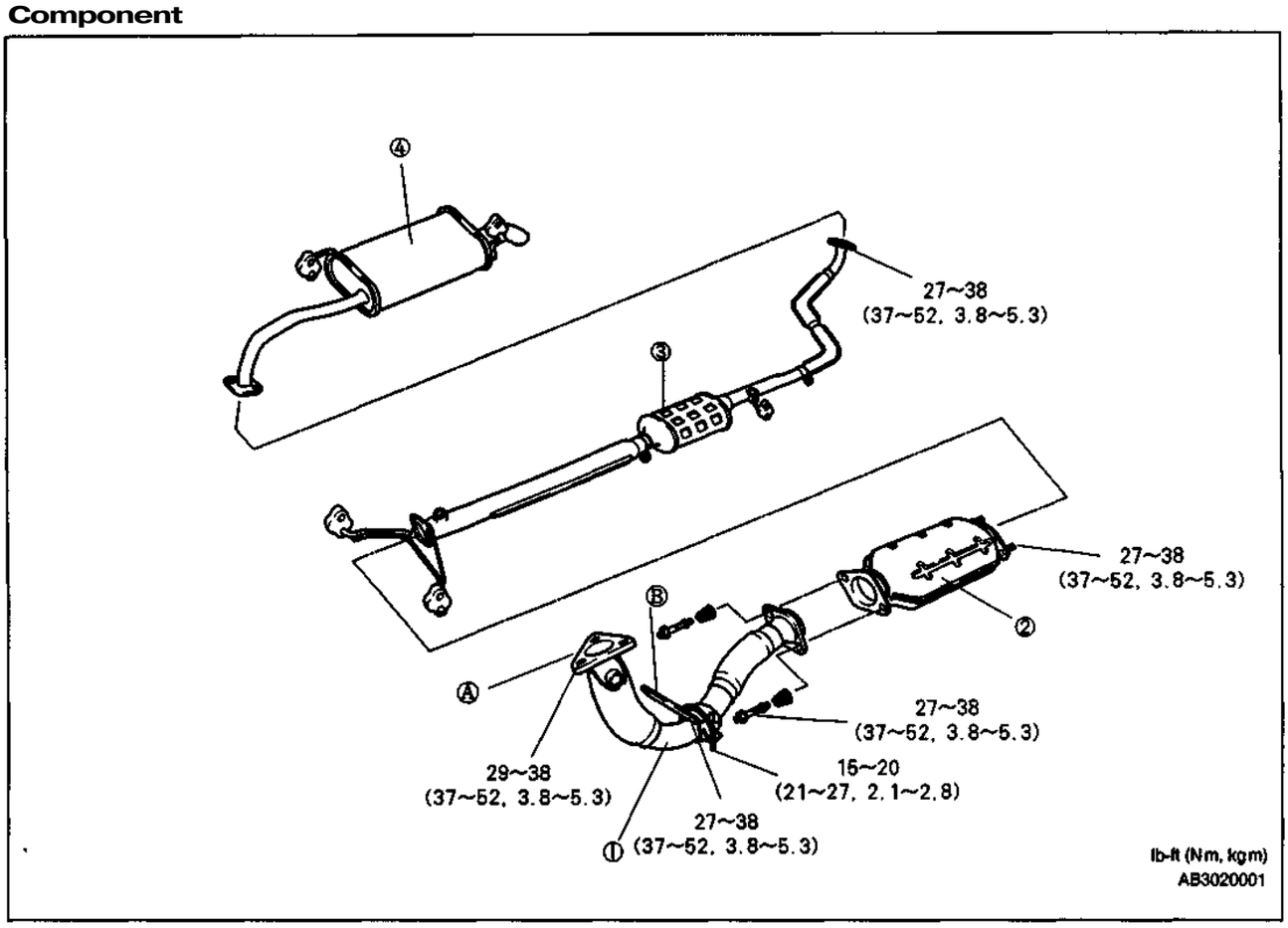
(1) Fresh air duct
(2) Air cleaner assembly
(3) Accelerator

Removal

Remove components in the order shown in above figure.

Exhaust system

Component



(1) Front pipe assembly
(2) Catalytic converter
(3) Pre silencer assembly
(4) Main silencer assembly

Removal

Remove components in the order shown in above figure.

Installation

Install front exhaust as follows:

© Tighten ® temporarily
(D Tighten ® temporarily
③ Tighten ® fully
© Check the connection between the pipe of ® and bracket
(D Tighten ® fully

Cylinder head assembly

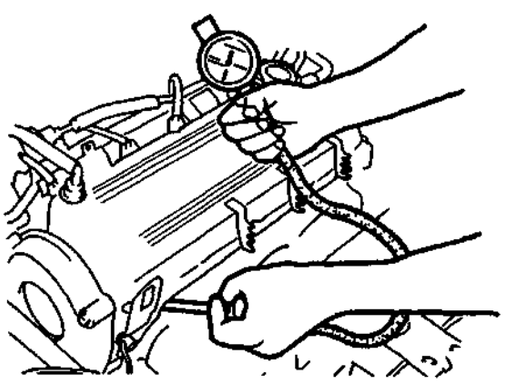
Compression

If the engine exhibits low power, poor fuel economy, or poor idle, check the following :

1. Ignition system
2. Compression
3. Fuel system

Inspection

1. Check that the battery if fully charged. Recharge it if necessary.
2. Warm up the engine to normal operating temperature.
3. Remove the center cover.
4. Disconnect the high tension lead and ignition coil.
5. Remove all spark plugs.
6. Connect a compression gauge to the No.1 spark plug hole.



BSX010A018

7. Fully depress the accelerator pedal and crank the engine.
8. Record the maximum gauge reading.
9. Check each cylinder.

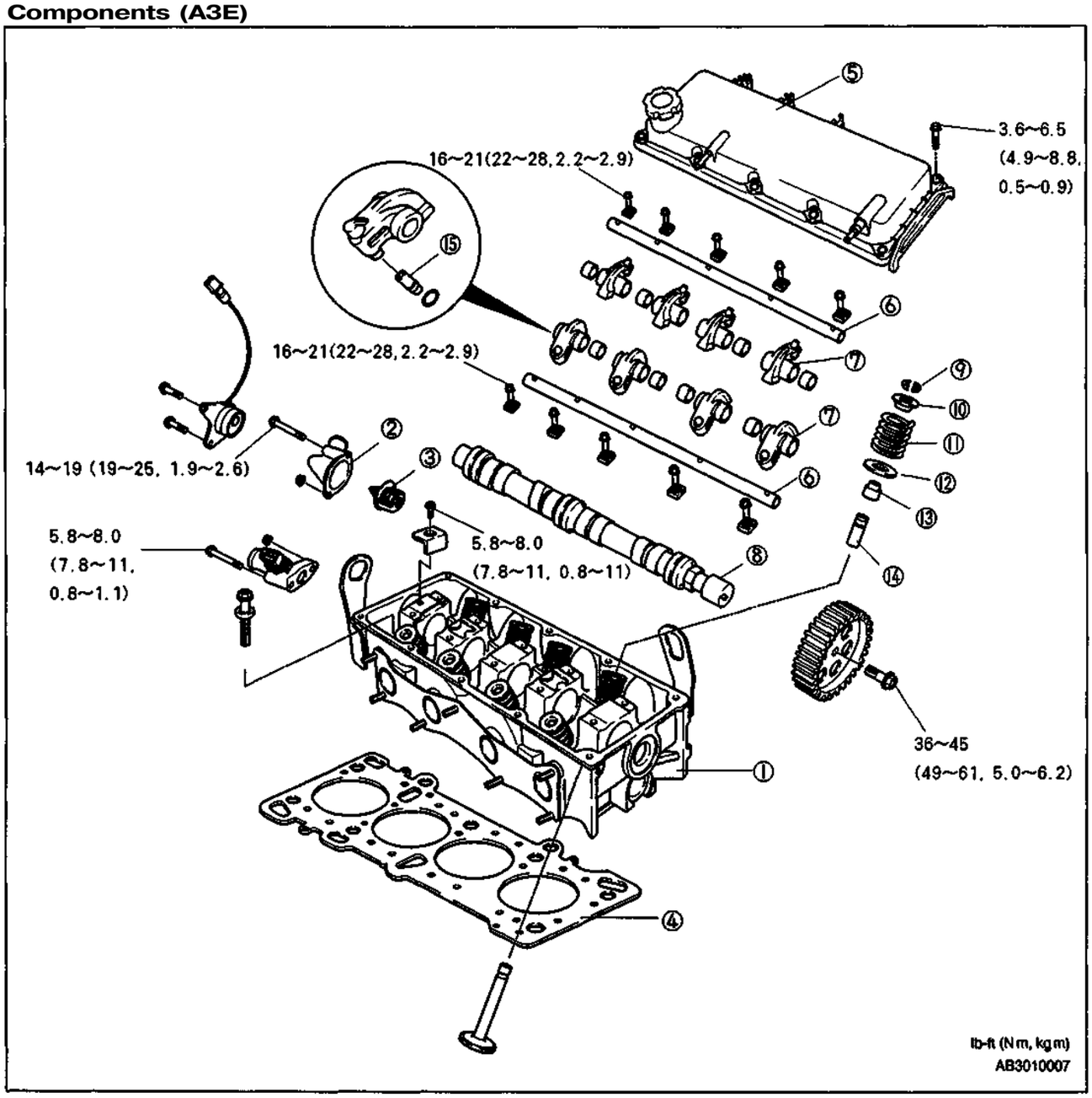
kPa (kg/cm², psi)-rpm

Compression	Standard	1275 (13, 184)
	Difference between cylinders	98 (1, 14.2)

10. If the compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder and recheck the compression.
    (1) If the compression increases, the piston, piston rings, or cylinder wall may be worn.
    (2) If the compression stays low, the valve may be stuck or seating improperly.
    (3) If the compression in adjacent cylinders stays low, the cylinder head gasket may be defective or the cylinder head distorted.

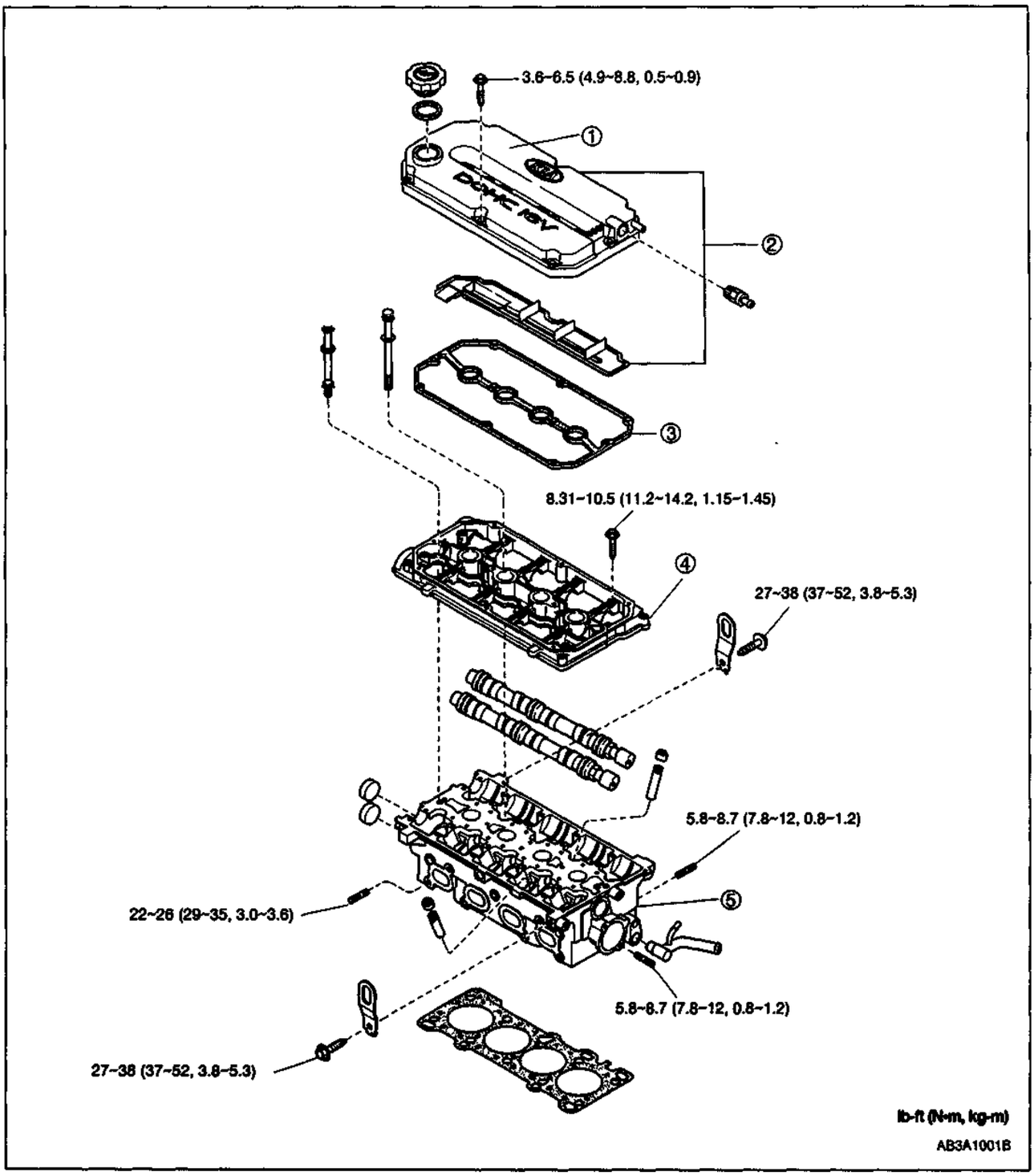
Cylinder head

Components (A3E)



(1) Cylinder **head**
(2) Thermostat cover
(3) Thermostat
(4) Cylinder head gasket
(5) Cylinder head cover
(6) Rocker arm shaft
(7) Rocker arm
(8) Camshaft
(9) Valve cotter
(10) Valve spring seat
(11) Valve spring
(12) Valve seal
(13) Valve guide
(14) Camshaft pulley
(15) **HLA**

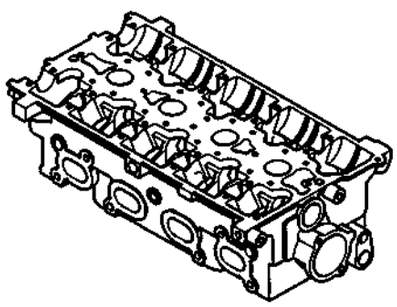
Cylinder head



(1) Cylinder head cover
(2) Cylinder head cover
(3) Cylinder head cover gasket
(4) Cam carrier assembly
(5) Cylinder head

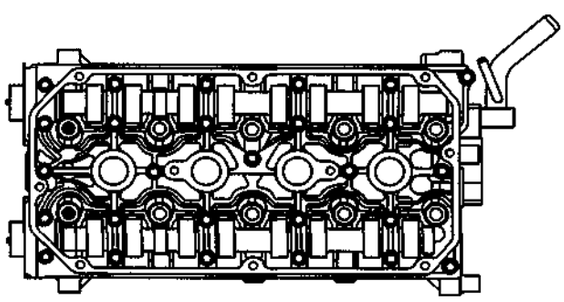
Disassembly

1. Drain the coolant and disconnect the upper radiator hose.
2. Remove the breather hose (beween the air cleaner and the head cover).
3. Remove the air-intake hose.
4. Remove the vacuum hose, fuel hose and coolant hose
5. Remove the cables from the spark plugs. The cables should be removed by holding the boot portion.
6. Remove the ignition coil.
7. Remove the power steering oil pump and bracket.
8. Remove the intake manifold.
9. Remove the heat protector and exhaust manifold assembly.
10. Remove the coolant pump pulley and the crankshaft pulley.
11. Remove the timing belt cover.
12. Remove the timing belt tensioner pulley.
13. Remove the timing belt.
14. Remove the head cover and cam carrier assembly.
15. Remove the cylinder head assembly. The cylinder head bolts should be removed by using Special Tool, Cylinder Head Bolt Wrench, in the sequence as shown in the illustration in two or three steps.



AB3AEM004

16. Remove the gasket pieces from cylinder block top surface and cylinder head bottom surface.



AB3010B001

✱ *Notice*
Make sure that the gasket pieces do not fall in the engine

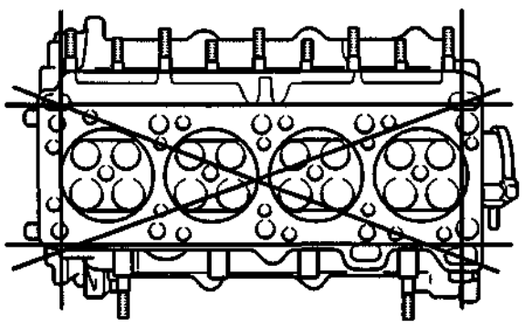
Inspection

1. Clean all components.
2. Remove gasket fragments, dirt, oil, grease, carbon, moisture, residue, and other foreign materials.

Cylinder head

1. Inspect cylinder head for damage, cracks, and leakage of oil and water. Replace cylinder head if necessary.
2. Measure cylinder head mating surface in six directions as shown in figure.

Distortion:
A5D: 0.001 In (0.03 mm) maximum
A3E: 0.002 In (0.05 mm) maximum



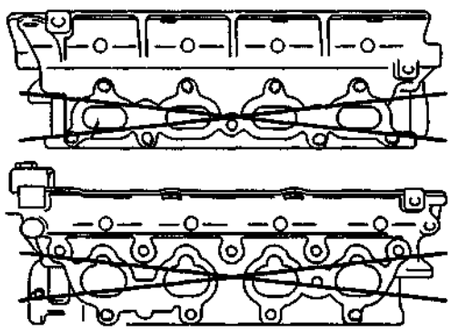
0S2010011

✱ *Notice*
Before resurfacing cylinder head, check following repair or replace cylinder head if necessary

- *Sunken valve seats*
- *Damage at intake and exhaust manifold mating surfaces.*
- *Camshaft oil clearances and end play.*

3. Grind cylinder head mating surface if distortion exceeds specification.

Distortion:
A5D: 0.001 In (0.03 mm) maximum
A3E: 0.002 In (0.05 mm) maximum



0S2010012

4. Check cylinder head height by measuring from cylinder deck surface to cylinder head cover gasket surface.
5. If cylinder head height is not within specification, replace cylinder head.

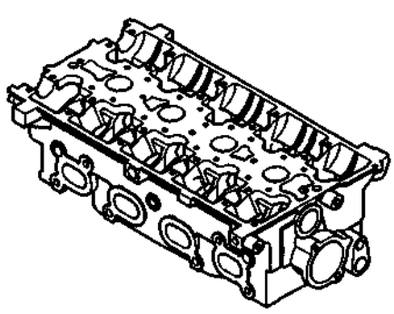
Hight:
A5D: 5.031~5.039 In (127.8~128 mm)
A3E: 4.228~4.236 In (107.4~107.6 mm)

6. Measure intake and exhaust manifold mating surface distortion at two directions shown in figure.

Distortion:
0.002 in (0.05 mm) maximum

7. If distortion exceeds specification, resurface or replace cylinder head.

Distortion:
0.002 In (0.05 mm) maximum



AB3AEM004

Reassembly

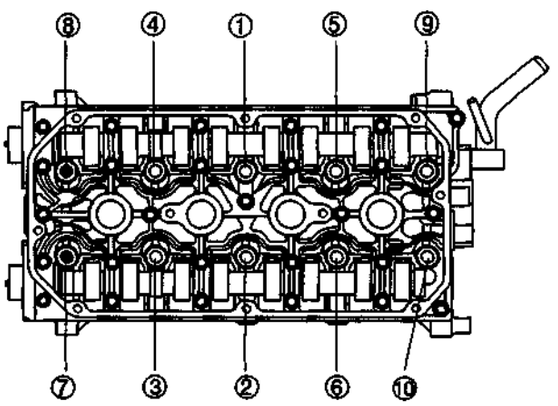
1. Clean all gasket surfaces of the cylinder block and the cylinder head.
2. Install a new cylinder head gasket onto the cylinder head assembly. Do not reuse the old cylinder head gasket.
   a. Tighten cylinder head bolts in order shown.

Tightening torque:
36.1 lb-In (49 N•m, 5 kg-m)

   b. Loosen bolts in reverse of order shown.
   c. Retighten cylinder head bolts in order shown.

Tightening torque:
18 lb-In (25 N•m, 2.5 kg-m)

   d. Mark cylinder head bolts for rotational reference.
   e. Rotate cylinder head bolts 90° (1/4 Turn) in order shown.



AB3010B001

Caution
a) Do not rotate crankshaft without timing belt.
b) Make sure that all pistons are positioned In the middle of cylinder before Installing cylinder head.
c) Two bolts (No.7 and No.8) are shorter than other bolts. Never Install the two bolts In other position. (for A5D)
d) Do not reuse the old cylinder head bolts.

3. Install the timing belt tensioner pulley.
4. Install the timing belt on the camshaft sprocket, marking sure that the tension side is tightened by turning the camshaft sprocket in reverse, all timing marks are in alignment.
5. Adjust the timing according to "Timing Belt".
6. Install the rocker cover and tighten the bolts to the specifiifed torque.

Tightening torque:
Rocker cover bolt
3.6~6.5 lb-ft (5~9 N•m, 0.5~0.9 kg-m)

7. Install the timing belt cover.
8. Install the new intake manifold gasket and the intake manifold. Tighten the nuts and bolts to the specified torque.
9. Install the exhaust manifold gasket and the exhaust manifold. Tighten the exhaust manifold attaching nuts to the Specified torque.
10. Install the surge tank and tighten the nuts and bolts to the specified torque.

Tightening torque:
Manifold nuts and bolts (both Intake and exhaust)
11~14 lb-ft (15~20 N•m, 150~200 kg-m)

Tightening torque:
Surge tank to Inlet manifold nuts and bolts
11~14 lb-ft (15~20 N•m, 150~200 kg-m)

11. Install the power steering oil pump and bracket.
12. Install the ignition coil.
13. Install the air intake hose.
14. Connect the vacuum hose, fuel hose and water hose.
15. Install breather hose.

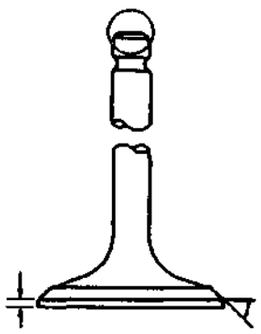
Valves

Inspection

Valve mechanism

1. Inspect each valve for following:
   a. Damaged or bent valve stem
   b. Rough or damaged face
   c. Damaged or unevenly worn stem tip
2. Resurface or replace valve as needed.

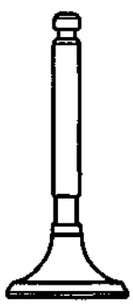
Margin thickness
Intake: 0.0394 In (1.0mm)
Exhaust: 0.0394 In (1.0mm)



BSX010A110

3. Measure length of each valve.

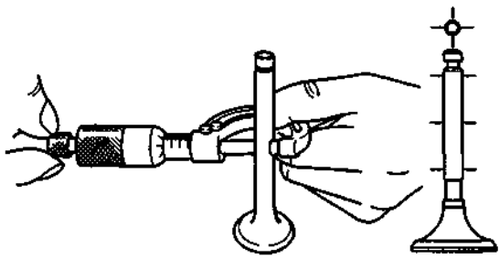
Length
Intake: 3.761 in (96.45 mm)
Exhaust: 3.726 in (95.55 mm)



0S2010026

4. Measure diameter of each valve stem.

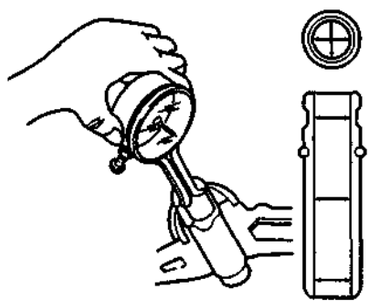
Diameter
Intake: 0.2131~0.21372 In (5.465~5.48 mm)
Exhaust: 0.2117~0.2125 In (5.43-5.45 mm)



0S2010027

5. Measure inside diameter of each valve guide at points shown in figure.

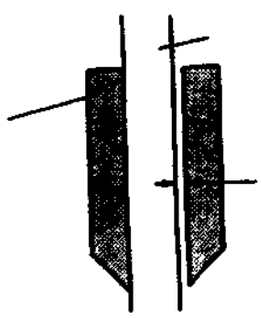
Diameter intake and exhaust valve guide:
A5D: 0.2165~0.2171 In (5.5~5.515 mm)
A3E: 0.2559~0.2565 in (6.5~6.515 mm)



0S2010028

6. Calculate valve stem-to-valve guide clearance. Subtract outer diameter of valve stem from inside diameter of respective valve guide.

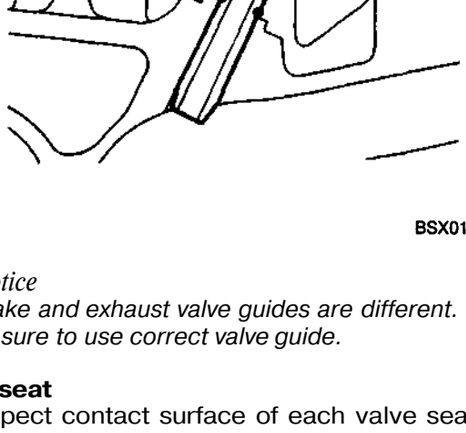
Clearance
Intake valve:
0.0007~0.0019 In (0.020~0.050 mm)
Exhaust valve:
0.0019~0.0033 In (0.050~~0.085 mm)
Max: 0.008 In (0.20 mm)



BSX010A113

7. If clearance exceeds specification, replace valve, and/or valve guide.
8. Measure protrusion height of each valve guide. Replace valve guide as needed.

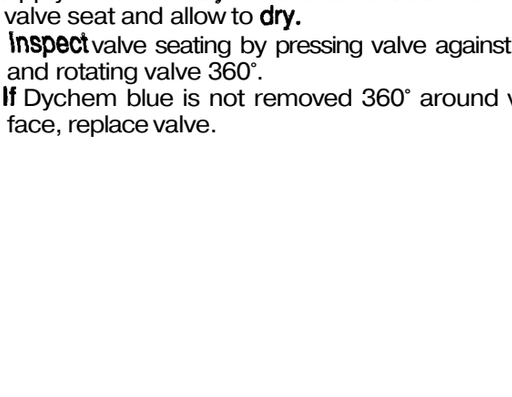
A5D
Intake: 0.5118~0.5196 In (13.0~13.2 mm)
Exhaust: 0.5118~0.5196 In (13.0~13.2 mm)
A3E
Intake: 0.4094~0.4173 In (10.4~10.6 mm)
Exhaust: 0.4094~0.4173 In (10.4~10.6 mm)



BSX010B080

* *Notice*
Intake and exhaust valve guides are different. Be sure to use correct valve guide.

Valve seat
1. Inspect contact surface of each valve seat and valve face for following:
   a. Roughness
   b. Damage
   c. Pitting
   d. Cracks
2. Resurface valve seats with a 45° valve seat cutter. Resurface valve faces as needed.



0S2010031

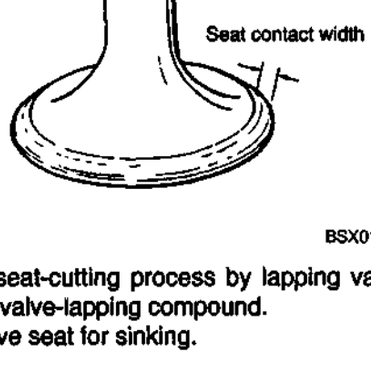
3. Apply a coat of Dychem blue to valve face and valve seat and allow to dry.
4. Inspect valve seating by pressing valve against seat and rotating valve 360°.

a. If Dychem blue is not removed 360° around valve face, replace valve.

b. If Dychem blue is not removed 360° around valve seat, resurface valve seat.

5. Measure seat contact width.

Width:0.037~0.061 In (0.97~1.57 mm)



BSX010A120

6. Complete seat-cutting process by lapping valve to seat using valve-lapping compound.
7. Inspect valve seat for sinking.

A5D
Intake: 1.0433 In (26.5 mm)
Exhaust: 0.9291 In (23.6 mm)
A3E
Intake: 1.3976 In (35.5 mm)
Exhaust: 1.1811 In (30.0 mm)

* *Notice*
Clean valves thoroughly before reassembly, and ensure that all traces of lapping compound has been removed.

8. Check for valve sink by measuring protruding length (Dimension L) of valve stem to lower valve spring seat.

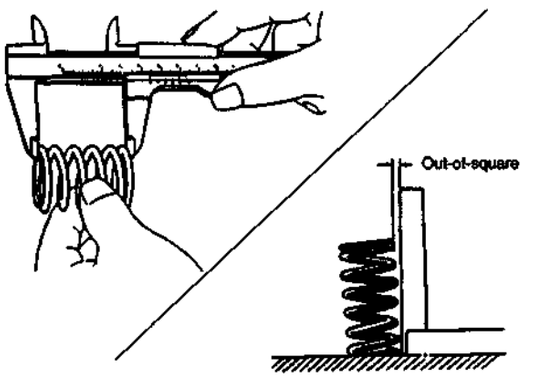
Dimension L: Intake - 1.6107 In (41.3 mm)
Exhaust - 1.6068 In (41.2 mm)

0S2010034

Valve spring

1. Inspect each valve spring for cracks and damage.
2. Measure free length and **out-of-square.** Replace valve springs as needed.

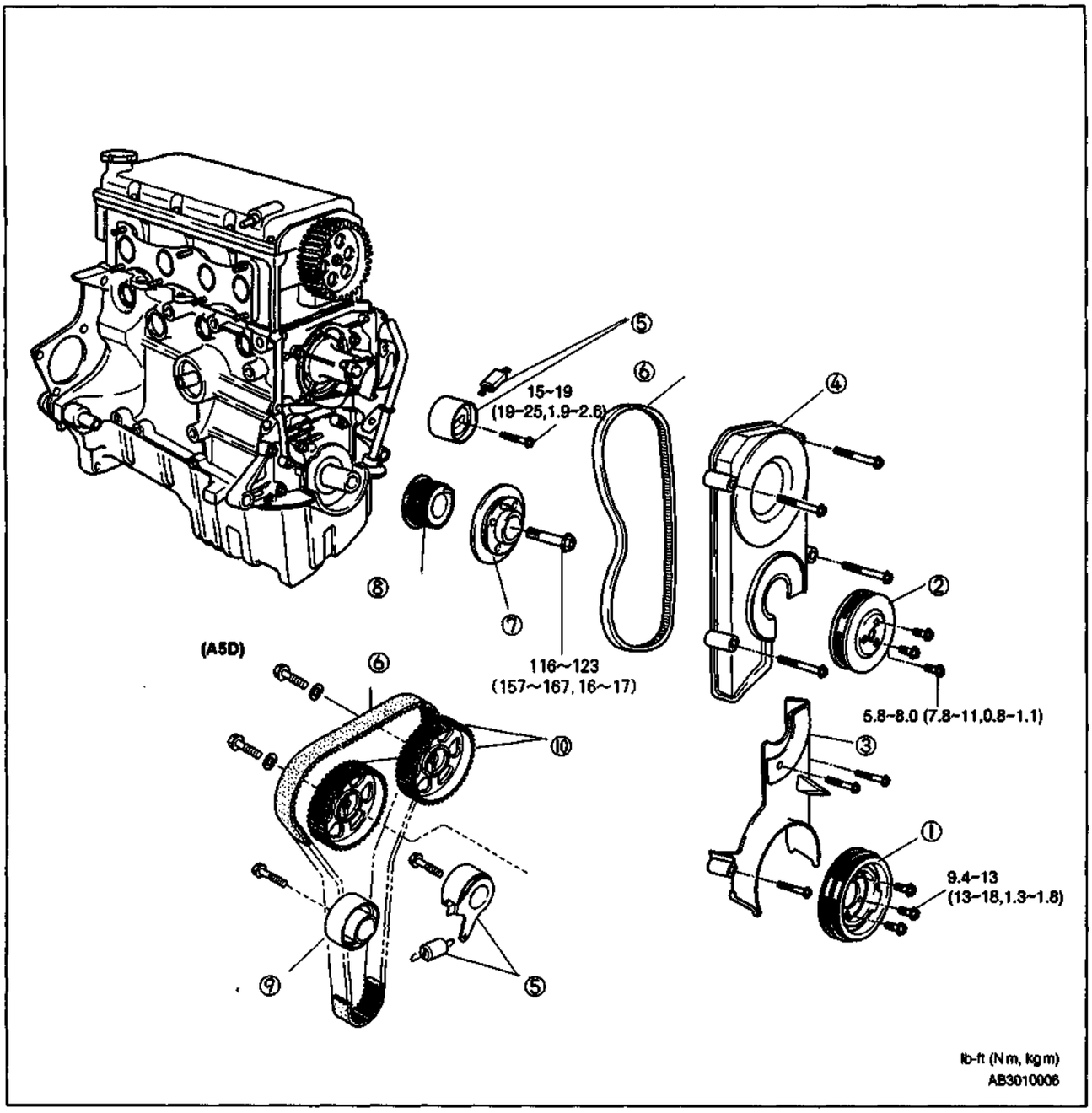
Free length: Standard: 1.653 In (42.4 mm)
Limit: 1.646 In (42.2 mm)
Out-of-square: 0.433 In (1.11 mm)



AS2A10139

Timing belt

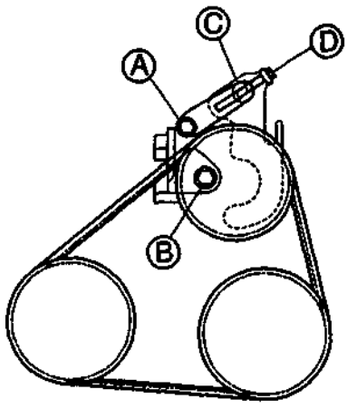
Component



(1) Crankshaft pulley
(2) Water pump pulley
(3) Timing belt cover (lower)
(4) Timing belt cover (upper)
(5) Timing belt Tensioner & spring
(6) Body Timing belt
(7) Timing belt guide plate
(8) Timing belt pulley
(9) Idler
(10) Camshaft pulley

Removal

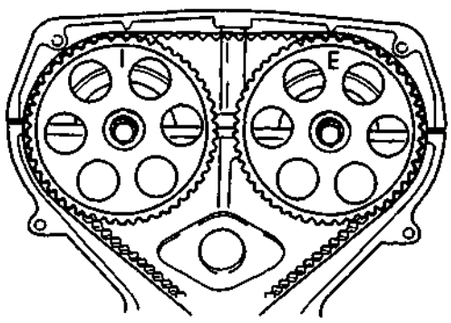
1. Disconnect negative battery cable.
2. Loosen power steering lock bolts and nuts accordingly and remove tension from power steering *(PIS)* **and/or** air conditioning **(A/C)** compressor drive belt.



AB3010013

3. Remove P/S **and/or A/C** drive belt.
4. Loosen generator mounting bolts and adjusting bolt.
5. Remove generator bolts.
6. Remove water pump pulley.
7. Remove crankshaft pulley and timing belt guide plate.
8. Remove upper and lower timing belt covers.
9. Turn crankshaft so that timing mark on timing belt pulley is aligned with timing mark on engine.
10. Check that T mark on intake camshaft pulley is aligned with mark on cylinder head cover and **"E"** mark on exhaust camshaft pulley is aligned with mark on cylinder head cover.

A5D

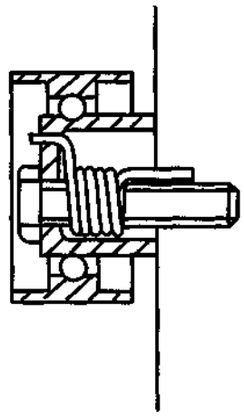


AS2A10023

✱ *Notice*
Do not ***move*** *camshaft or crankshaft once timing marks have been correctly positioned.*

11. Loosen tensioner pulley lock bolt.

A5D



AS2A10052

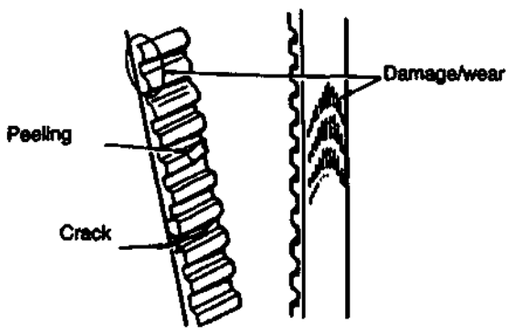
12. Protect timing belt with a rag.
13. Remove tensioner pulley.
14. Remove timing belt.

✱ *Notice*
Mark the direction of timing belt rotation (on the timing belt) for proper ***reinstallation.***

Inspection

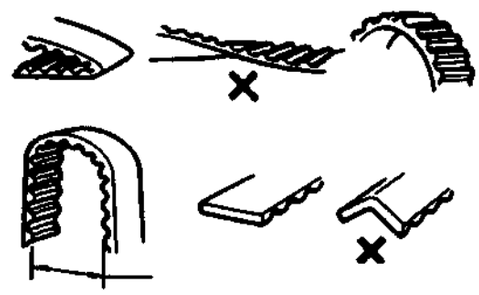
✱ *Notice*
***Never** forcefully twist, turn inside out **or** bend timing belt. Do not allow oil or grease to come in contact with timing belt.*

1. Replace timing belt if it is contaminated with oil or grease.
2. Check timing belt for uneven wear, fraying, peeling, cracking and hardening. Replace timing belt as necessary.



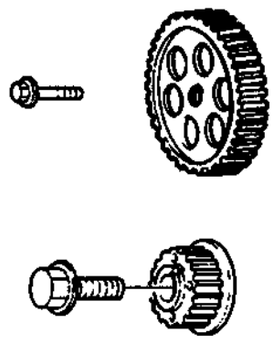
ABT010217

3. Bend timing belt **into** a "U" shape as shown in figure. Distance "A" must be at least 1.0 in (25 mm).
4. Inspect both idler pulley and tensioner pulley for uneven wear and smooth bearing **operation.**



ABT010216

5. Inspect camshaft pulleys and timing belt pulley for broken teeth or damage.



AN7010B090

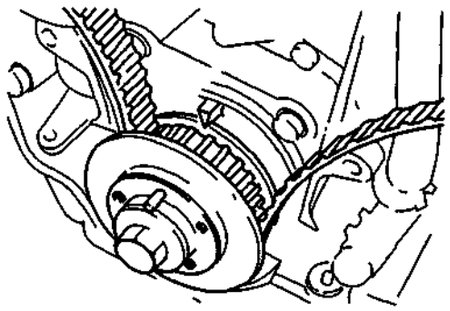
✱ *Notice*
Replace any component that shows damage, excessive wear, or that appears prone to a possible failure.

Installation

1. Install tensioner pulley.

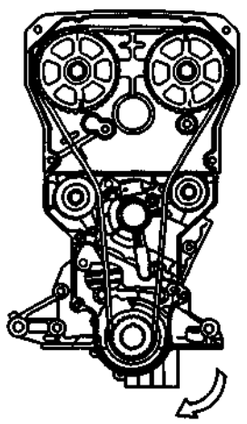
✱ *Notice*
Replace tensioner spring whenever timing belt is replaced.

2. Pull tensioner pulley to its furthest point and tighten lock bolt.



10B023

3. **Check that timing mark on timing belt pulley is aligned with timing mark on engine.**
4. **Check that "I" mark on intake camshaft pulley is aligned with mark on cylinder head cover and "E" mark on exhaust camshaft pulley is aligned with mark on cylinder head cover.**



AB3010B003

* *Notice*
If existing timing belt is being reused, install belt in proper rotation direction marked prior to removal.

5. Install timing belt onto timing belt pulley first, then idler pulley, exhaust camshaft pulley, intake camshaft pulley, and tensioner pulley in that order.
6. Check that there is no looseness in belt between idler pulley and exhaust camshaft pulley or between intake and exhaust camshaft pulleys.
7. Loosen tensioner pulley lock bolt and allow tensioner spring to apply tension to timing belt.

✱ *Notice*
Do not add additional tension.

8. Tighten tensioner pulley lock bolt to specified torque.

Tightening torque:
28~38 lb-ft (38~51 N•m, 3.9~5.2 kg-m)

9. Rotate crankshaft two full revolutions (clockwise only) and align timing mark on timing belt pulley with timing mark on engine block.
10. Check that T **mark** on intake camshaft pulley "E" mark on exhaust camshaft pulley are aligned with marks on cylinder head cover.
11. If they are not aligned, remove timing belt and start process from tensioner installation.
12. Measure timing belt deflection by applying moderate pressure midway between camshaft pulleys. If deflection is not correct, repeat from tensioner installation.

Deflection pressure:
22 lb. (98 N, 10 kg)
Deflection:
0.39~0.50 In. (11~13 mm)

13. *Install* lower and upper timing belt covers in that order.

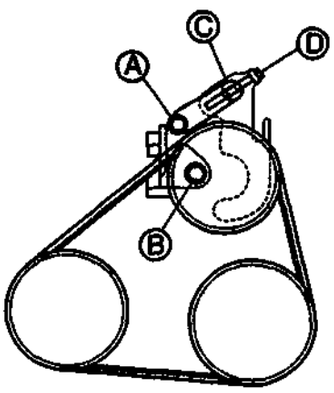
Tightening torque:
70~96 lb-ft (7.9~10.7 N•m, 0.8~1.1 kg-m)

14. Install timing belt guide plate and crankshaft pulley.

Tightening torque:
9.0~12.6 lb-ft (12.3~17.2 N•m, 1.3~1.8 kg-m)

15. Install water pump pulley.

Tightening torque:
9.0~12.6 lb-ft (12.3~17.2 N•m, 1.3~1.8 kg-m)



AB3010013

16. Install generator belt and adjust the tension.
17. Install P/S and/or **A/C** drive belt and adjust the tension.
18. Connect negative battery cable.

Installation

1. Install tensioner pulley.

✱ *Notice*
Replace tensioner spring whenever timing belt is replaced.

2. Pull tensioner pulley to its furthest point and tighten lock bolt.
3. Check that timing mark on timing belt pulley is aligned with timing mark on engine.
4. Check that T mark on intake camshaft pulley is aligned with mark on cylinder head cover and "E" mark on exhaust camshaft pulley is aligned with mark on cylinder head cover.

* *Notice*
If existing timing belt is being reused, install belt in proper rotation direction marked prior to removal.

5. Install timing belt onto timing belt pulley first, then idler pulley, exhaust camshaft pulley, intake camshaft pulley, and tensioner pulley in that order.
6. Check that there is no looseness in belt between idler pulley and exhaust camshaft pulley or between intake and exhaust camshaft pulleys.
7. Loosen tensioner pulley lock bolt and allow tensioner spring to apply tension to timing belt.

* *Notice*
Do not add additional tension.

8. Tighten tensioner pulley lock bolt to specified torque.

Tightening torque:
28~38 lb-ft (38~51 N•m, 3.9-5.2 kg-m)

9. Rotate crankshaft two full revolutions (clockwise only) and align timing mark on timing belt pulley with timing mark on engine block.
10. Check that T mark on intake camshaft pulley "E" mark on exhaust camshaft pulley are aligned with marks on cylinder head cover.
11. If they are not aligned, remove timing belt and start process from tensioner installation.
12. Measure timing belt deflection by applying moderate pressure midway between camshaft pulleys. If deflection is not correct, repeat from tensioner installation.

Deflection pressure:
22 lb. (98 N, 10 kg)
Deflection:
0.39~0.50 In. (11~13 mm)