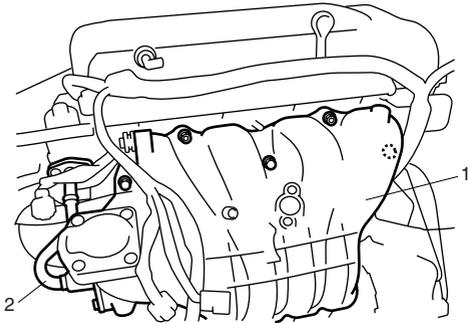


I4RS0A140004-01

5) Remove intake manifold (1) and EGR pipe (2) from cylinder head, and then remove its gasket and O-ring.



I3RM0A140018-01

Installation

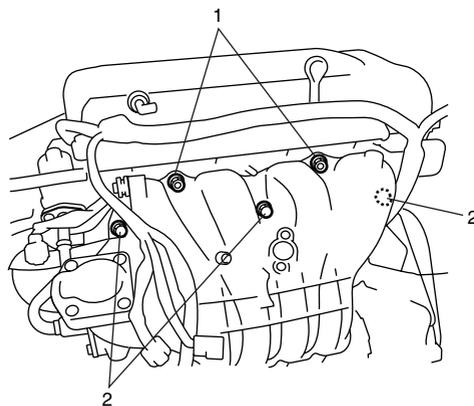
Reverse removal procedure for installation noting the followings.

- Use new intake manifold O-ring.
- Use new EGR pipe gasket and O-ring.
- Tighten EVAP canister purge valve bracket bolt to specified torque.

Tightening torque

EVAP canister purge valve bracket bolt: 5 N·m (0.5 kgf-m, 4.0 lb-ft)

- Install intake manifold bolt (2) and nut (1) as shown in figure.

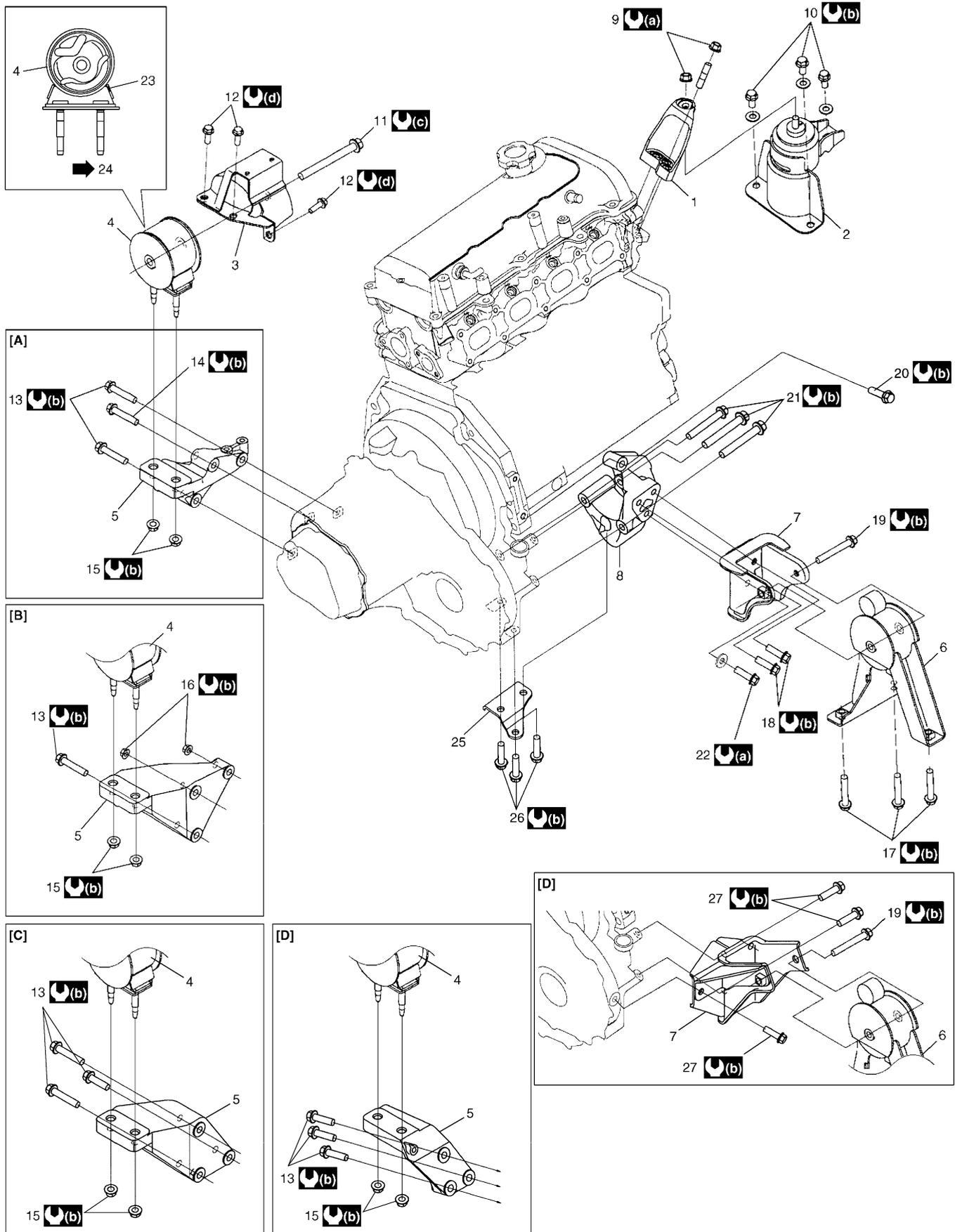


I4RS0A140005-01

- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Adjust accelerator cable play, referring to “Accelerator Cable Adjustment (For A/T and M/T Models): ”.
- Refill cooling system referring to “Cooling System Flush and Refill: in Section 1F”.
- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.

Engine Mountings Components

S4RS0B1406011



I4RS0B140008-02

[A]: For M15 engine with A/T	9. Engine right mounting nut	21. Engine rear mounting body bracket bolt
------------------------------	------------------------------	--

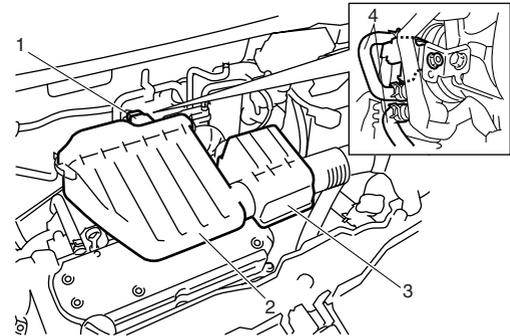
[B]: For M15 engine with M/T	10. Engine right mounting bolt	22. Engine rear mounting No.3 bracket bolt
[C]: For M13 engine with M/T	11. Engine left mounting bush bolt	23. Yellow mark
[D]: For M13 engine with Automated Manual Transaxle	12. Engine left mounting No.1 bracket bolt	24. Vehicle forward
1. Engine right mounting bracket	13. Engine left mounting No.2 bracket bolt (short)	25. Engine rear mounting stiffener
2. Engine right mounting	14. Engine left mounting No.2 bracket bolt (long)	26. Engine rear mounting stiffener bolt
3. Engine left mounting No.1 bracket	15. Engine left mounting bracket nut	27. Engine rear mounting No.4 bracket bolt
4. Engine left mounting	16. Engine left mounting nut	(a) : 65 N·m (6.5 kgf-m, 47.0 lb-ft)
5. Engine left mounting No.2 bracket	17. Engine rear mounting bolt	(b) : 55 N·m (5.5 kgf-m, 40.0 lb-ft)
6. Engine rear mounting	18. Engine rear mounting No.1 bracket bolt	(c) : 85 N·m (8.5 kgf-m, 61.5 lb-ft)
7. Engine rear mounting No.1 bracket	19. Engine rear mounting bush bolt	(d) : 25 N·m (2.5 kgf-m, 18.0 lb-ft)
8. Engine rear mounting No.2 bracket	20. Engine rear mounting No.2 bracket bolt	

Engine Assembly Removal and Installation

S4RS0B1406012

Removal

- 1) Initialize TCM (Automated Manual Transaxle) referring to “TCM (Automated Manual Transaxle) Initialization: in Section 5D”.
- 2) Set clutch to specific position before removing automated manual transaxle assembly referring to “Clutch Position Control: in Section 5D”.
- 3) Relieve fuel pressure according to “Fuel Pressure Relief Procedure: in Section 1G”.
- 4) Disconnect negative and positive cable at battery.
- 5) Remove battery and tray.
- 6) Remove engine hood after disconnecting windshield washer hose.
- 7) Remove right and left side engine under covers.
- 8) Remove A/C compressor belt by referring to “Compressor Drive Belt Removal and Installation: in Section 7B”.
- 9) Drain engine oil referring to “Engine Oil and Filter Change: in Section 0B”.
- 10) Drain transaxle oil referring to “Automated Manual Transaxle Oil Change: in Section 5D”, “Manual Transaxle Oil Change: For M13 Engine Model in Section 5B”, “Manual Transaxle Oil Change: For M15 Engine Model in Section 5B” or “A/T Fluid Change: in Section 5A”.
- 11) Drain coolant referring to “Cooling System Draining: in Section 1F”.
- 12) Remove cowl top plate referring to “Cowl Top Components: in Section 9K”.
- 13) Disconnect MAF sensor coupler (1).
- 14) Remove air cleaner case (2) and resonator (3).
- 15) Remove canister purge hose (4) from EVAP canister purge valve.



I3RM0A140022-01

- 16) With hose connected, detach A/C compressor from its bracket (if equipped) referring to “Compressor Assembly Removal and Installation: in Section 7B”.

CAUTION

Suspend removed A/C compressor at a place where no damage will be caused during removal and installation of engine assembly.

- 17) Disconnect the following electric wires:
 - TP sensor (1) (for A/T and M/T models)
 - MAP sensor (2)
 - ECT sensor (3)
 - EGR valve (4)
 - CMP sensor (5)
 - IAC valve (6) (for A/T and M/T models)
 - Ignition coil assembly (7)
 - Injectors (8)
 - Heated oxygen sensor (9)
 - Oil control valve (10) (for engine with VVT system)
 - Engine oil pressure switch (11)
 - CKP sensor (12)
 - Knock sensor (13)
 - VSS (14)
 - Back up light switch (15) (for M/T and Automated Manual Transaxle models)
 - Generator (16)
 - Starting motor (17)
 - Ground terminal (18) from cylinder block
 - Battery ground cable (19) from transaxle

1D-19 Engine Mechanical:

- Output shaft speed sensor (VSS) (28) (for A/T model)
- Solenoid valve (29) (for A/T model)
- Transmission range sensor (30) (for A/T model)
- Input shaft speed sensor (31) (for A/T and Automated Manual Transaxle models)
- Magnet clutch switch of A/C compressor (if equipped)
- Electric throttle body assembly connector (for Automated Manual Transaxle model)
- Clutch actuator motor (34) (for Automated Manual Transaxle model)
- Clutch stroke sensor (35) (for Automated Manual Transaxle model)
- Shift actuator motor (36) (for Automated Manual Transaxle model)
- Shift stroke sensor (37) (for Automated Manual Transaxle model)
- Select actuator motor (38) (for Automated Manual Transaxle model)
- Select stroke sensor (39) (for Automated Manual Transaxle model)
- Neutral start switch (33) (for Automated Manual Transaxle model)
- Each wire harness clamps

18) Remove fuse box from its bracket.

19) Disconnect the following cables:

- Accelerator cable (20) (for A/T and M/T models)
- Gear select control cable (21) (for M/T model)
- Gear shift control cable (22) (for M/T model)
- A/T select cable (32) (for A/T model)

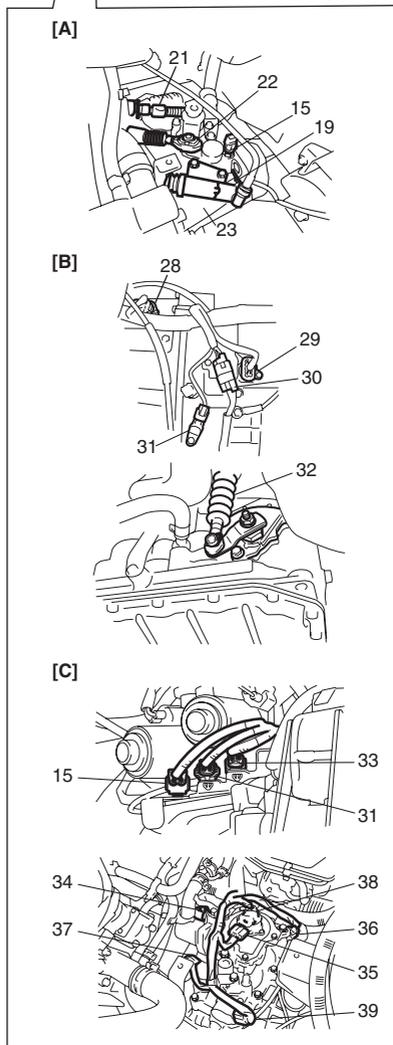
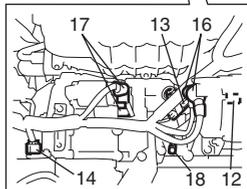
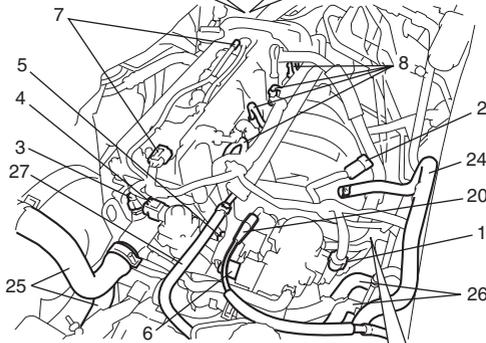
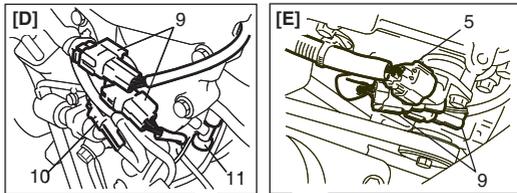
20) Disconnect the following hoses:

- A/T fluid cooler hoses
- Brake booster hose (24) from intake manifold
- Radiator inlet and outlet hoses (25) from each pipe
- Heater inlet and outlet hoses (26) from each pipe
- Fuel feed hoses (27) from fuel feed pipe

21) With hose connected, detach clutch operating cylinder (23). (for M/T model)

CAUTION

Suspend removed clutch operating cylinder at a place where no damage will be caused during removal and installation of engine assembly.



I4RS0B140009-01

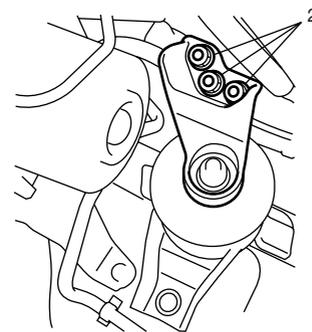
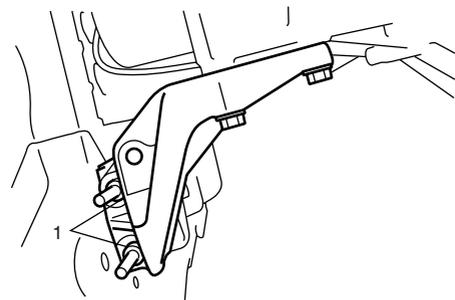
[A]: For M/T model
[B]: For A/T model
[C]: For Automated Manual Transaxle model
[D]: For M15 engine
[E]: For M13 engine

- 22) Disconnect right and left drive shaft joints from differential gear referring to "Front Drive Shaft Assembly Removal and Installation: in Section 3A".

NOTE

For engine and transaxle removal, it is not necessary to remove drive shafts from steering knuckle.

- 23) Remove exhaust No.1, No.2 and center pipes referring to "Exhaust Manifold Removal and Installation: in Section 1K".
- 24) Support engine assemble by using supporting device referring to "Engine Supporting Points: in Section 0A".
- 25) Remove suspension frame referring to "Front Suspension Frame, Stabilizer Bar and/or Bushings Removal and Installation: in Section 2B".
- 26) Remove engine rear mounting from engine rear mounting No.1 bracket.
- 27) Support engine and transaxle with jack, and then remove supporting device.
- 28) Remove engine left mounting bracket nuts (1) and engine right mounting nuts (2).

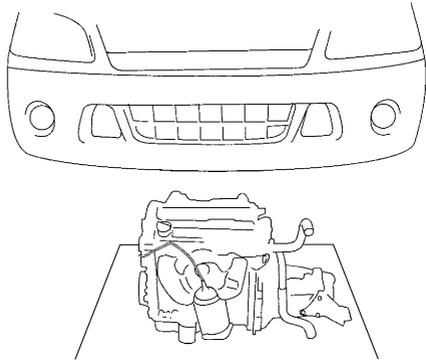


I4RS0A140008-01

- 29) Before removing engine with transaxle from engine compartment, recheck to make sure all hoses, electric wires and cables are disconnected from engine and transaxle.
- 30) Lower engine with transaxle from engine compartment.

⚠ CAUTION

Before lowering engine, to avoid damage to A/C compressor and clutch operating cylinder, make clearance by rising them. Be sure not to damage suspended A/C compressor and clutch operating cylinder.



I4RS0A140009-01

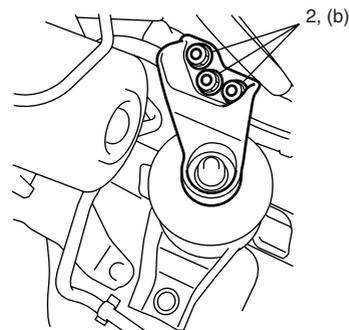
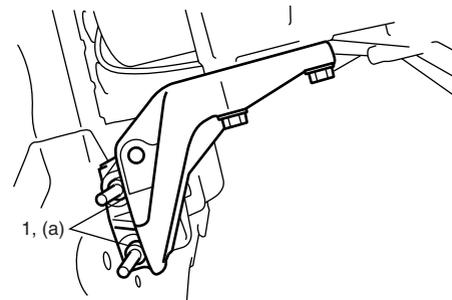
- 31) Disconnect transaxle from engine, referring to “Manual Transaxle Unit Dismounting and Remounting: For M13 Engine Model in Section 5B”, “Manual Transaxle Unit Dismounting and Remounting: For M15 Engine Model in Section 5B”, “Automatic Transaxle Unit Dismounting and Remounting: in Section 5A” or “Automated Manual Transaxle Unit Dismounting and Remounting: in Section 5D”.
- 32) Remove clutch cover and clutch disk referring to “Clutch Cover, Clutch Disc and Flywheel Removal and Installation: in Section 5C”.

Installation

- 1) Install clutch cover and clutch disk referring to “Clutch Cover, Clutch Disc and Flywheel Removal and Installation: in Section 5C” (for M/T model) or “Clutch Cover and Clutch Disc Removal and Installation: in Section 5D” (for Automated Manual Transaxle model).
- 2) Connect transaxle to engine referring to “Manual Transaxle Unit Dismounting and Remounting: For M13 Engine Model in Section 5B”, “Manual Transaxle Unit Dismounting and Remounting: For M15 Engine Model in Section 5B”, “Automatic Transaxle Unit Dismounting and Remounting: in Section 5A” or “Automated Manual Transaxle Unit Dismounting and Remounting: in Section 5D”.
- 3) Lift engine and transaxle into engine compartment with jack.
- 4) Install engine left mounting bracket nuts (1) and engine right mounting nuts (2).
Tighten these nuts to specified torque.

Tightening torque

Engine left mounting bracket nut (a): 55 N·m (5.5 kgf-m, 40.0 lb-ft)
Engine right mounting nut (b): 65 N·m (6.5 kgf-m, 47.0 lb-ft)



I4RS0A140010-01

- 5) Support engine assemble by using supporting device referring to “Engine Supporting Points: in Section 0A”.
- 6) Install engine rear mounting to engine rear mounting No.1 bracket.

Tightening torque

Engine rear mounting bush bolt: 55 N·m (5.5 kgf-m, 40.0 lb-ft)

- 7) Install suspension frame referring to “Front Suspension Frame, Stabilizer Bar and/or Bushings Removal and Installation: in Section 2B”.
- 8) Remove supporting device.
- 9) Install exhaust No.1, No.2 and center pipes referring to “Exhaust Pipe and Muffler Removal and Installation: in Section 1K”.
- 10) Connect drive shaft joints referring to “Front Drive Shaft Assembly Removal and Installation: in Section 3A”.
- 11) Reverse disconnected hoses, cables and electric wires for connection noting the followings.
 - Tighten nuts to specified torque.

Tightening torque

Starting motor terminal nut: 11 N·m (1.1 kgf-m, 8.0 lb-ft)
Generator terminal nut: 6 N·m (0.6 kgf-m, 4.5 lb-ft)

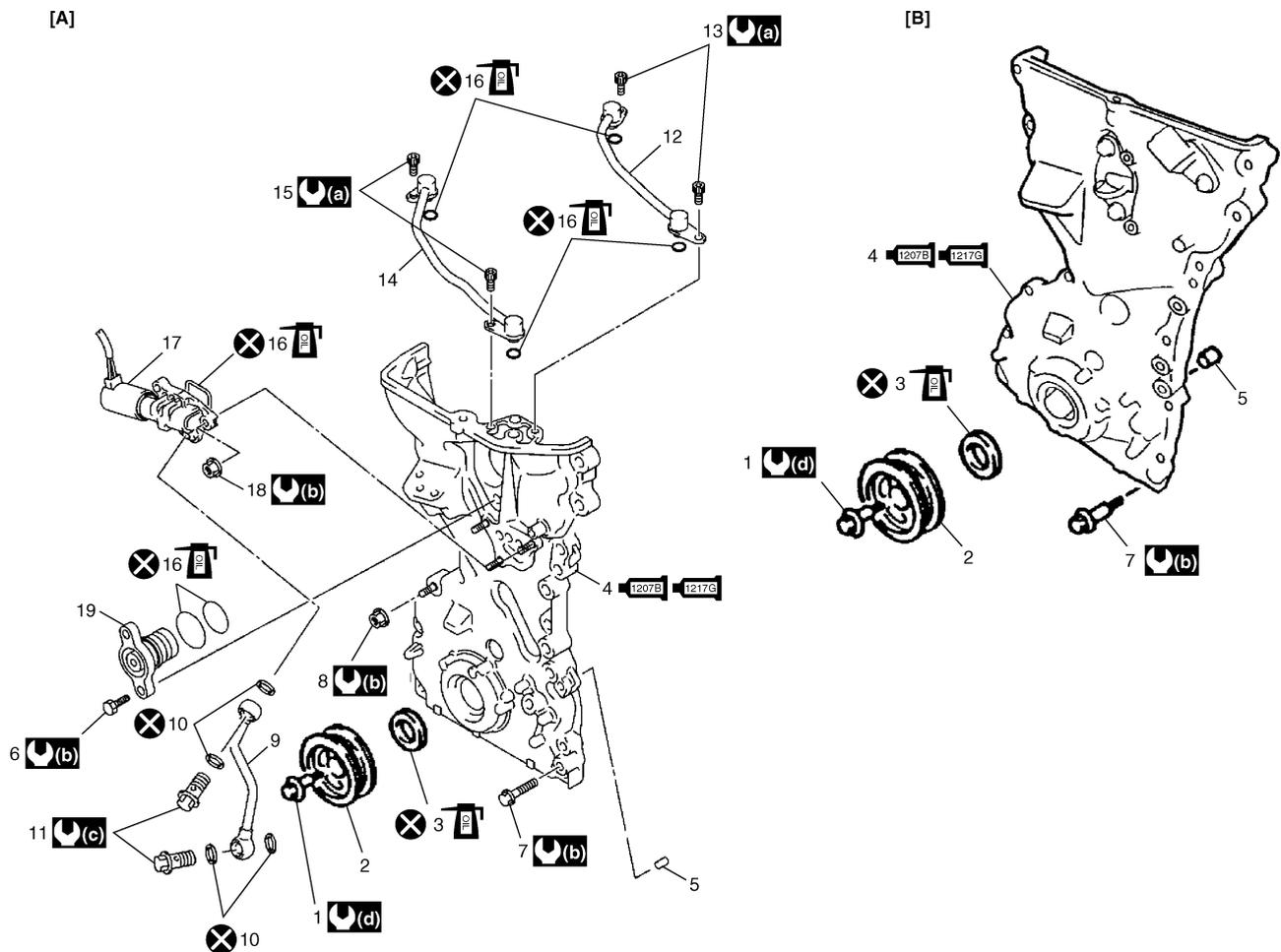
- 12) Install air cleaner case and resonator.
- 13) Install cowl top referring to “Cowl Top Components: in Section 9K”.

- 14) Install A/C compressor to its bracket (if equipped) referring to "Compressor Assembly Removal and Installation: in Section 7B".
- 15) Adjust A/C compressor belt tension (if equipped) referring to "Compressor Drive Belt Inspection and Adjustment: in Section 7B".
- 16) Adjust accelerator cable play referring to "Accelerator Cable Adjustment (For A/T and M/T Models): " in this section.
- 17) Check to ensure that all removed parts are back in place.
Reinstall any necessary parts which have not been reinstalled.
- 18) Refill cooling system with coolant referring to "Cooling System Flush and Refill: in Section 1F".

- 19) Refill engine with engine oil referring to "Engine Oil and Filter Change: in Section 0B".
- 20) Refill transaxle with transaxle oil referring to "Automated Manual Transaxle Unit Dismounting and Remounting: in Section 5D", "Manual Transaxle Oil Change: For M13 Engine Model in Section 5B", "Manual Transaxle Oil Change: For M15 Engine Model in Section 5B" or "A/T Fluid Change: in Section 5A".
- 21) Install battery and tray.
- 22) Connect positive and negative cable at battery.
- 23) Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

Timing Chain Cover Components

S4RS0B1406013



I4RS0B140010-02

[A]: For engine with VVT	8. Timing chain cover mounting nut	17. Oil control valve
[B]: For engine without VVT	9. Oil gallery pipe No.1	18. Oil control valve mounting nut
1. Crankshaft pulley bolt	10. Copper washer	19. Cap
2. Crankshaft pulley	11. Oil gallery pipe No.1 bolt	(a) : 11 N·m (1.1 kgf·m, 8.0 lb·ft)
3. Oil seal : Apply engine oil to oil seal lip.	12. Oil gallery pipe No.2	(b) : 25 N·m (2.5 kgf·m, 18.0 lb·ft)

1D-23 Engine Mechanical:

1207B 1217G 4. Timing chain cover : Apply sealant 99000-31140 to the mating surface of cylinder and cylinder head. : Apply sealant 99000-31260 to the mating surface of timing chain cover referring to the figure of Step 4) of "Installation" under "Timing Chain Cover Removal and Installation: ".	13. Oil gallery pipe No.2 bolt	 : 30 N-m (3.0 kgf-m, 22.0 lb-ft)
5. Pin	14. Oil gallery pipe No.3	 : 150 N-m (15.0 kgf-m, 108.5 lb-ft)
6. Cap bolt	15. Oil gallery pipe No.3 bolt	 : Do not reuse.
7. Timing chain cover mounting bolts	 16. O-ring : Apply engine oil.	

Timing Chain Cover Removal and Installation

S4RS0B1406014

CAUTION

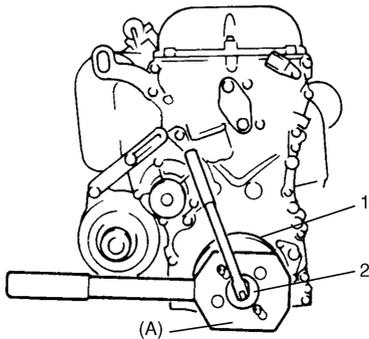
- Keep working table, tools and hands clean while overhauling.
- Use special care to handle aluminum parts so as not to damage them.
- Do not expose removed parts to dust. Keep them always clean.

Removal

- 1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation: ".
- 2) Remove water pump / generator drive belt referring to "Water Pump / Generator Drive Belt Removal and Installation: in Section 1F".
- 3) Remove crankshaft pulley bolt.
To lock crankshaft pulley (1), use special tool with it as shown in the figure.

Special tool

(A): 09917-68221



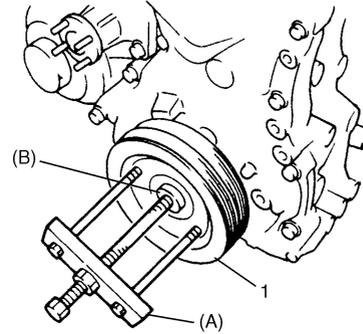
I2RH0B140051-01

- 4) Remove crankshaft pulley (1).
If it is hard to remove, use special tools as shown in the figure.

Special tool

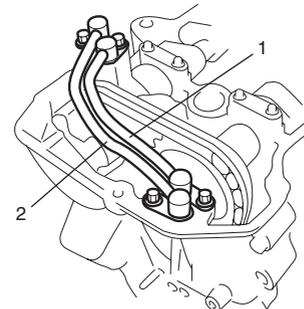
(A): 09944-36011

(B): 09926-58010



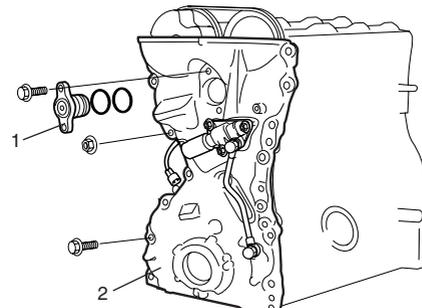
I2RH0B140052-01

- 5) Remove cylinder head cover referring to "Cylinder Head Cover Removal and Installation: ".
- 6) Remove oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E".
- 7) Remove water pump pulley.
- 8) Remove A/C bracket from cylinder block.
- 9) For engine with VVT, remove oil gallery pipes No.2 (1) and No.3 (2).



I3RH0B140021-01

- 10) Remove cap (1) from timing chain cover (2).
- 11) Remove timing chain cover (2).



I3RH0B140022-01

- 12) Remove oil control valve from timing chain cover referring to "Oil Control Valve Removal and Installation (For Engine with VVT): ".

Installation

- 1) Clean sealing surface on timing chain cover, cylinder block and cylinder head.
Remove oil, old sealant and dust from sealing surface.
- 2) Install oil seal (1) to timing chain cover, if removed.

NOTE

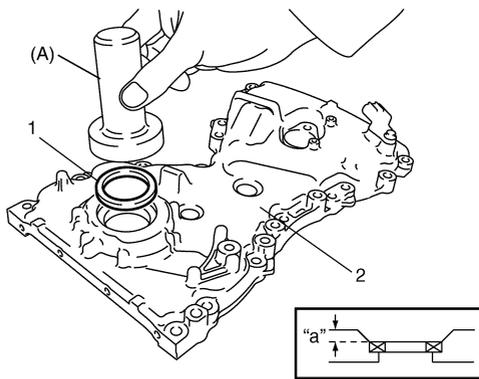
When installing new oil seal, press fit to timing chain cover (2) by using special tool (bearing installer) as shown in the figure.

Drive in dimension

“a”: 1.5 mm (0.06 in.)

Special tool

(A): 09913-75810



- 3) Install oil control valve to timing chain cover referring to “Oil Control Valve Removal and Installation (For Engine with VVT): ”.
- 4) Apply sealant “A” to mating surface of cylinder and cylinder head and “B” to mating surface of timing chain cover as shown in the figure.

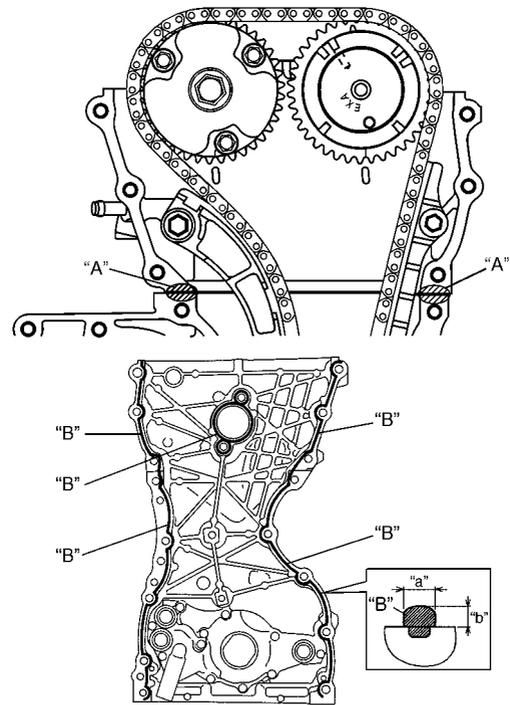
“A”: Sealant 99000-31140

“B”: Sealant 99000-31260

Sealant amount for timing chain cover

Width “a”: 3 mm (0.12 in.)

Height “b”: 2 mm (0.08 in.)



- 5) Apply engine oil to oil seal lip, then install timing chain cover (1). Tighten bolts and nut to specified torque.

NOTE

Before installing timing chain cover, check that pin is securely fitted.

Tightening torque

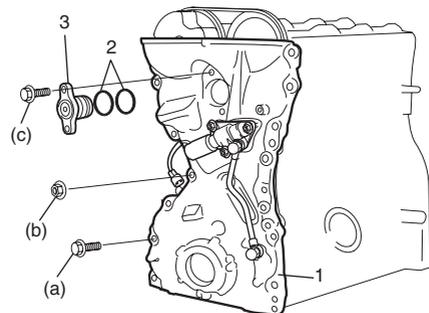
Timing chain cover bolt (a): 25 N·m (2.5 kgf-m, 18.0 lb-ft)

Timing chain cover nut (b): 25 N·m (2.5 kgf-m, 18.0 lb-ft)

- 6) Apply engine oil to new O-rings (2) and install them to cap (3).
- 7) Install cap (3) to timing chain cover (1). Tighten bolts to specified torque.

Tightening torque

Cap bolt (c): 25 N·m (2.5 kgf-m, 18.0 lb-ft)



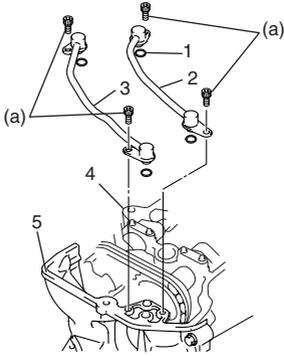
- 8) For engine with VVT, install new O-ring (1) to oil gallery pipes No.2 (2) and No.3 (3).

1D-25 Engine Mechanical:

- 9) For engine with VVT, install oil gallery pipes No.2 and No.3 to cylinder head (4) and timing chain cover (5).
Tighten bolts to specified torque.

Tightening torque

Oil gallery pipe No.2 and No.3 bolt (a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)



I3RH0B140027-01

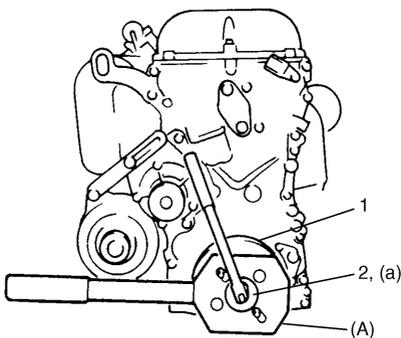
- 10) Install water pump pulley.
11) Install cylinder head cover referring to "Cylinder Head Cover Removal and Installation: ".
12) Install oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E".
13) Install crankshaft pulley (1). Tighten bolt (2) to specified torque. To lock crankshaft pulley, use special tool with it as shown in the figure.

Special tool

(A): 09917-68221

Tightening torque

Crankshaft pulley bolt (a): 150 N·m (15.0 kgf-m, 108.5 lb-ft)



I2RH0B140056-01

- 14) Install engine assembly to vehicle referring to "Engine Assembly Removal and Installation: ".

Timing Chain Cover Inspection

S4RS0B1406015

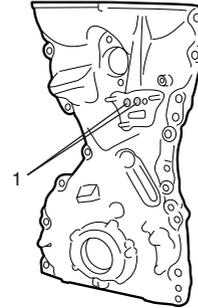
Oil Seal

Check oil seal lip for fault or other damage. Replace as necessary.

Timing Chain Cover

Inspect strainer (1) of oil passage for driving intake cam timing sprocket assembly (VVT actuator).

If clog or foreign matter exists, clean strainer.



I3RH0B140028-01

Oil Control Valve Removal and Installation (For Engine with VVT)

S4RS0B1406016

Removal

Remove oil gallery pipe No.1 (1) and oil control valve (2) from timing chain cover (3).

Installation

- 1) Install new O-ring (4) to oil control valve.
- 2) Install oil control valve to timing chain cover. Tighten nuts to specification.

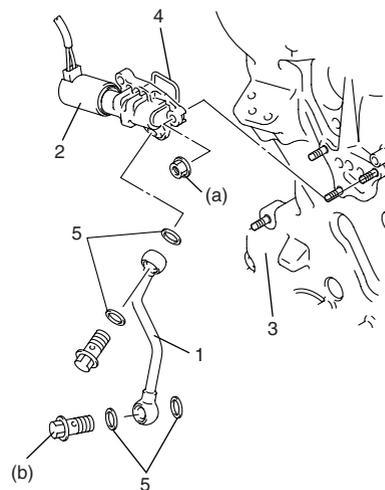
Tightening torque

Oil control valve mounting nut (a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)

- 3) Install oil gallery pipe No.1 with new copper washers (5) to timing chain cover. Tighten bolts to specification.

Tightening torque

Oil gallery pipe No.1 bolt (b): 30 N·m (3.0 kgf-m, 21.5 lb-ft)



I3RM0A140027-01

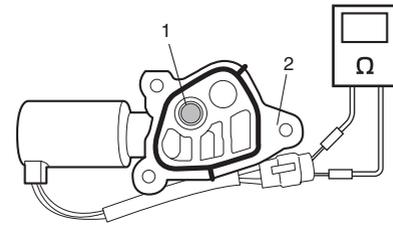
Oil Control Valve Inspection (For Engine with VVT)

S4RS0B1406017

Oil Control Valve

- 1) Inspect strainer (1) and mating surface (2) of oil control valve for clog or damage. Clean oil control valve if clog or foreign matter is present on strainer or mating surface of oil control valve. Replace oil control valve if its mating surface is damaged.
- 2) Check resistance between terminals of oil control valve.

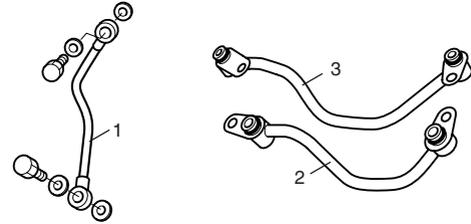
Oil control valve resistance
6.7 – 7.7 Ω (at 20 °C (68 °F))



I3RM0A140028-01

Oil Gallery Pipe

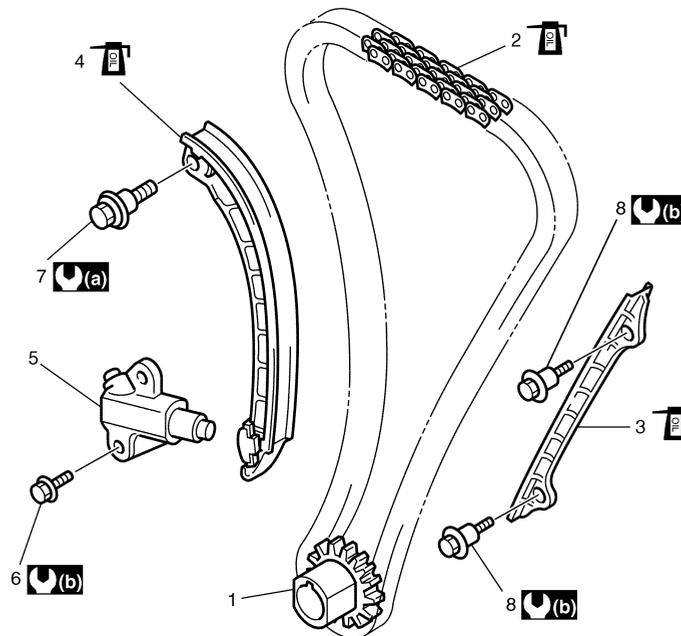
Inspect oil gallery pipes No.1, No.2 (2) and No.3 (3). Replace if crack, deformation or clog exists.



I3RH0B140030-01

Timing Chain and Chain Tensioner Components

S4RS0B1406018



I4RS0A140012-01

1. Crankshaft timing sprocket	5. Timing chain tensioner adjuster assembly	(a) : 25 N·m (2.5 kgf·m, 18.0 lb-ft)
2. Timing chain : Apply engine oil.	6. Chain tensioner adjuster mounting bolt	(b) : 11 N·m (1.1 kgf·m, 8.0 lb-ft)
3. Timing chain No.1 guide : Apply engine oil to sliding surface.	7. Timing chain tensioner bolt	
4. Timing chain tensioner : Apply engine oil to sliding surface.	8. Timing chain No.1 guide bolt	

Timing Chain and Chain Tensioner Removal and Installation

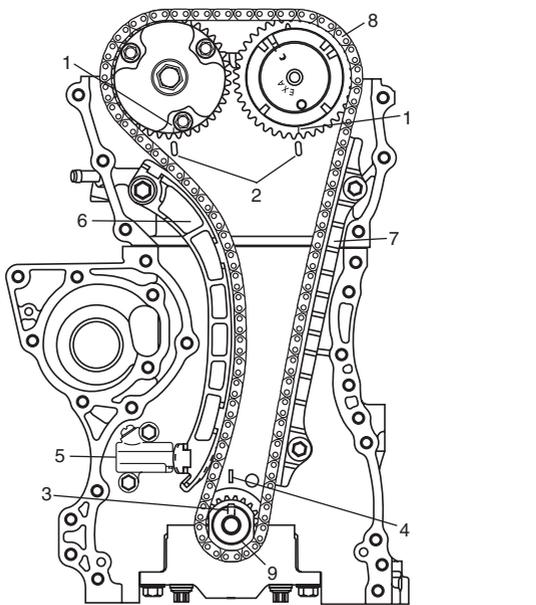
S4RS0B1406019

Removal

⚠ CAUTION

After timing chain is removed, never turn crankshaft and camshafts independently more than its allowable turning range described in "Installation".
If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

- 1) Remove timing chain cover referring to "Timing Chain Cover Removal and Installation: ".
- 2) By turning crankshaft, align camshafts and crankshaft at specific position as follows.
 - a) Align both intake and exhaust camshaft timing sprocket marks (1) with notches (2) of cylinder head respectively.
 - b) For engine with VVT, align crankshaft sprocket key (3) with notch of cylinder block (4).
For engine without VVT, position crankshaft sprocket key (3) at upside of crankshaft as shown in figure.
- 3) Remove timing chain tensioner adjuster assembly (5).
- 4) Remove timing chain tensioner (6).
- 5) Remove timing chain No.1 guide (7).
- 6) Remove timing chain (8) with crankshaft timing sprocket (9).



I3RH0B140032-01

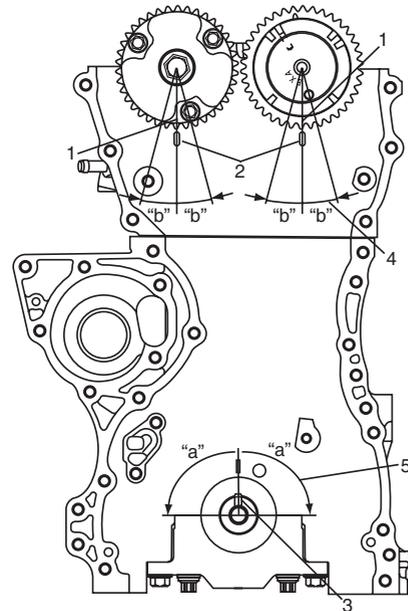
Installation

⚠ CAUTION

After timing chain is removed, never turn crankshaft and camshafts independently more than such an extent ("a", "b") as shown in the figure.

If turned, interference may occur between piston and valves and valves themselves, and parts related to piston and valves may be damaged.

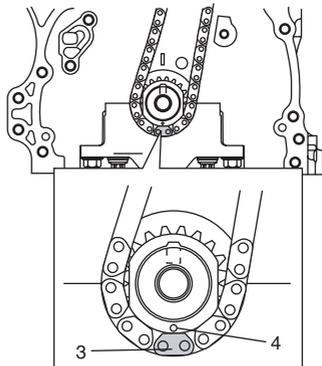
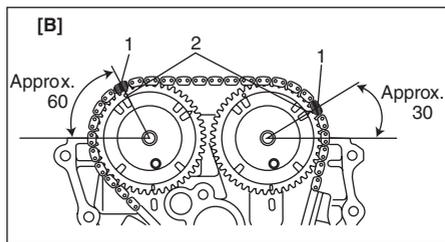
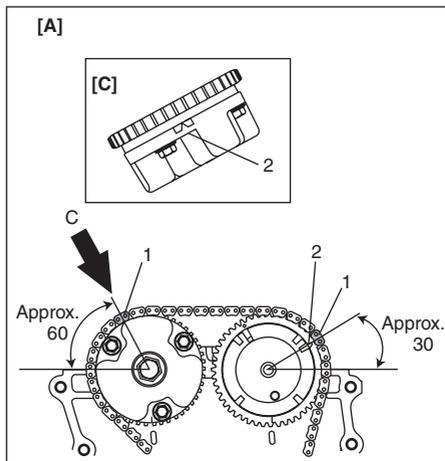
- 1) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head as shown in the figure.
- 2) Set key (3) and turn crankshaft to position key on upside of crankshaft.



I4RS0A140021-01

"a": 90°	4. Camshaft (IN and EX) allowable turning range. By marks on camshaft timing sprocket within 15° from notches on cylinder head on both right and left.
"b": 15°	5. Crankshaft allowable turning range. By key on crankshaft, within 90° from top on both right and left.

- 3) Install timing chain by aligning dark blue plate (1) of timing chain and triangle mark (2) on camshaft timing sprocket as shown in the figure.
- 4) Fit crankshaft timing sprocket to timing chain by aligning gold plate (3) of timing chain and circle mark (4) on crankshaft timing sprocket. Then install crankshaft timing sprocket fitted with chain to crankshaft.



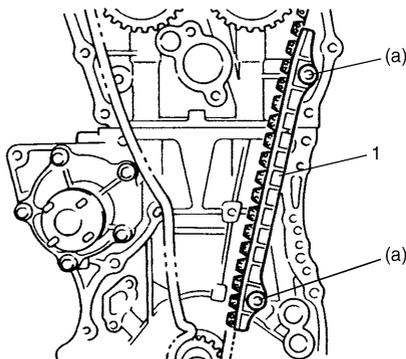
I4RS0B140012-02

[A]: For engine with VVT
[B]: For engine without VVT
[C]: View C

- 5) Apply engine oil to sliding surface of timing chain No.1 guide (1) and install it as shown in the figure. Tighten guide bolts to specified torque.

Tightening torque

Timing chain No.1 guide bolt (a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)

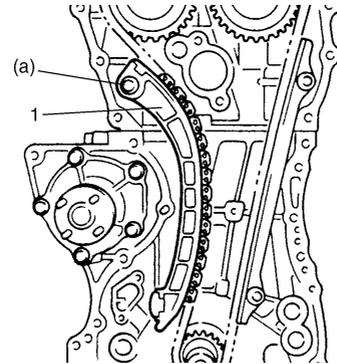


I2RH0B140062-01

- 6) Apply engine oil to sliding surface of chain tensioner (1) and install chain tensioner and spacer. Tighten tensioner bolt to specified torque.

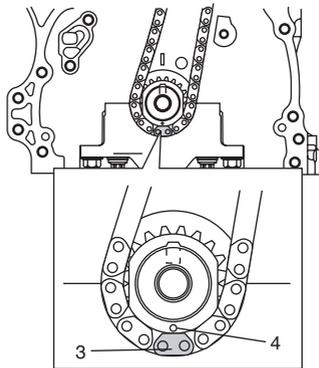
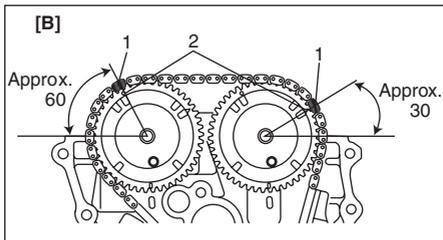
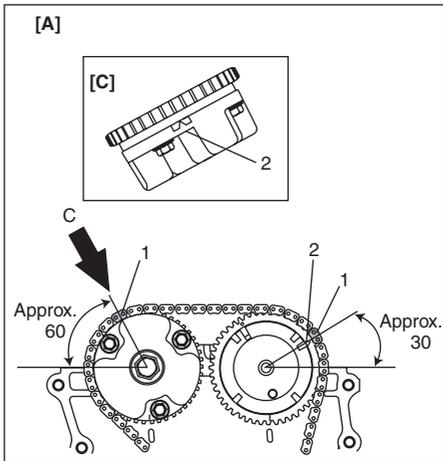
Tightening torque

Timing chain tensioner bolt (a): 25 N·m (2.5 kgf-m, 18.0 lb-ft)



I2RH0B140063-01

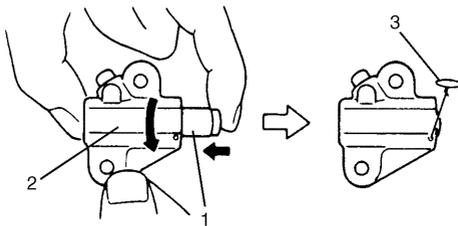
- 7) Check that match marks (1) on intake and exhaust camshaft timing sprockets are in match with dark blue plates (2) of timing chain and match mark (3) on crankshaft timing sprocket is in match with gold plate (4) of timing chain.



I4RS0B140012-02

[A]: For engine with VVT
[B]: For engine without VVT
[C]: View C

8) Screw in plunger (1) by turning body (2) in arrow direction and install a retainer (3) (wire) to hold plunger in place.

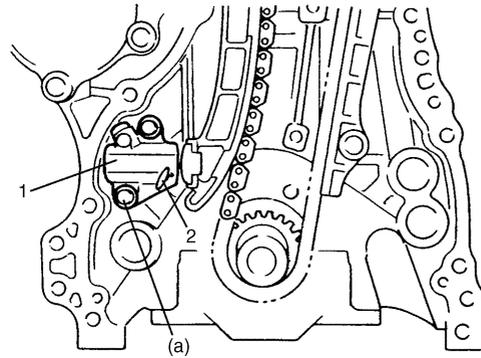


I2RH0B140065-01

9) Install timing chain tensioner adjuster assembly (1) with a retainer (2).
Tighten adjuster bolts to specified torque and then remove a retainer from chain tensioner adjuster assembly.

Tightening torque

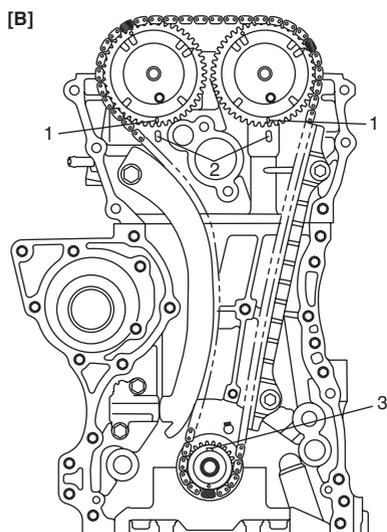
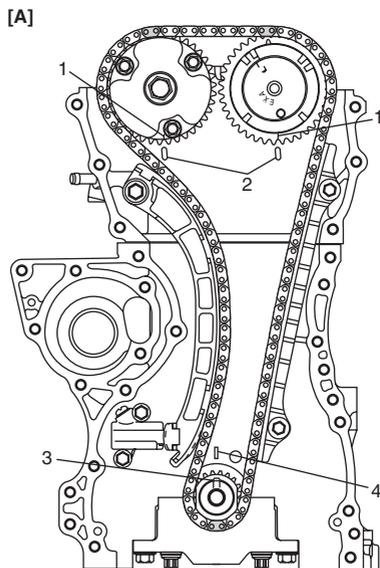
Timing chain tensioner adjuster bolt (a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)



I2RH0B140066-01

10) Apply engine oil to timing chain, and then turn crankshaft clockwise by 2 revolutions and check that match marks (1) are at the following specific positions.

- Intake and exhaust camshaft timing sprockets are in match with notches (2) on cylinder head and key (3).
- For engine with VVT, crankshaft sprocket key (3) is in match with notch of cylinder block (4).
- For engine without VVT, crankshaft sprocket key (3) is on upside of crankshaft as shown in figure.



I4RS0B140013-01

[A]: For engine with VVT
[B]: For engine without VVT

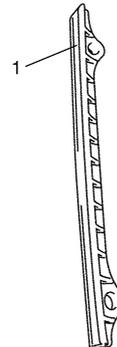
- 11) Install timing chain cover referring to "Timing Chain Cover Removal and Installation: "
- 12) Perform Steps 9) to 14) of "Installation" of "Timing Chain Cover Removal and Installation: "

Timing Chain and Chain Tensioner Inspection

S4RS0B1400620

Timing Chain No.1 Guide

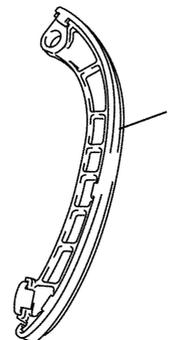
Check shoe (1) for wear or damage.



I2RH0B140068-01

Timing Chain Tensioner

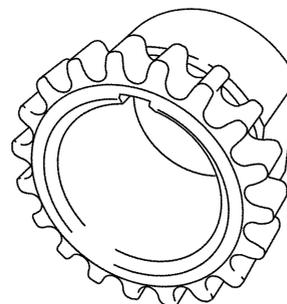
Check shoe (1) for wear or damage.



I2RH0B140069-01

Crankshaft Timing Sprocket

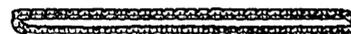
Check teeth of sprocket for wear or damage.



I2RH0B140070-01

Timing Chain

Check timing chain for wear or damage.

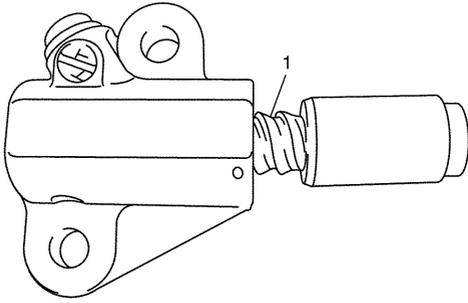


I2RH01140077-01

1D-31 Engine Mechanical:

Timing Chain Tensioner Adjuster

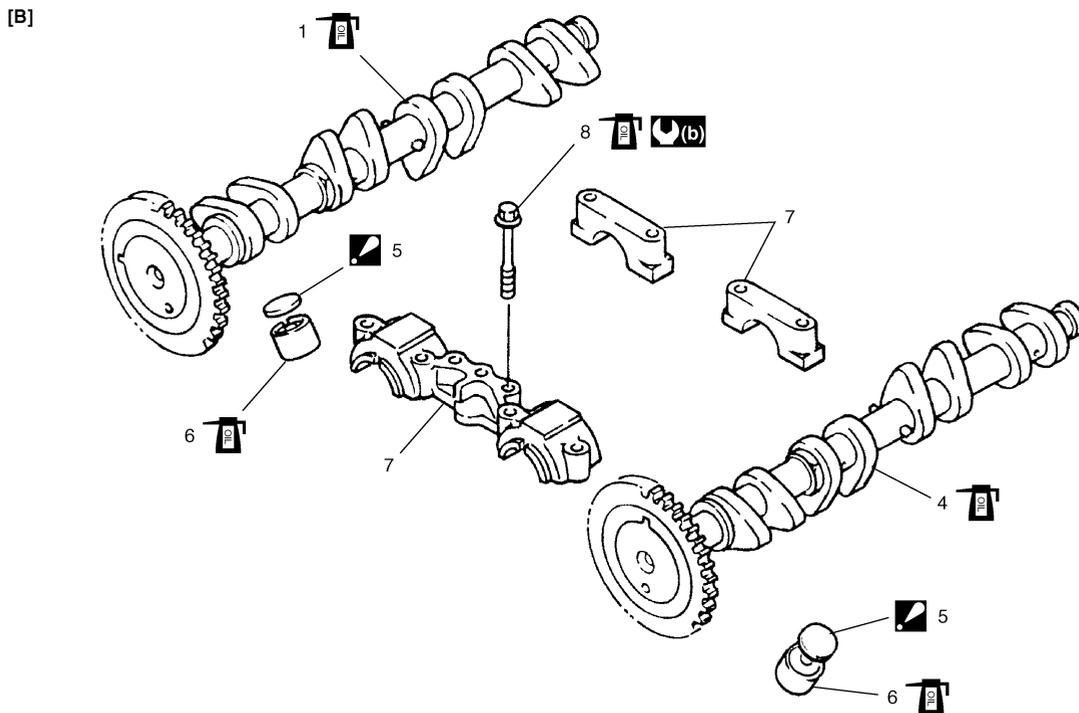
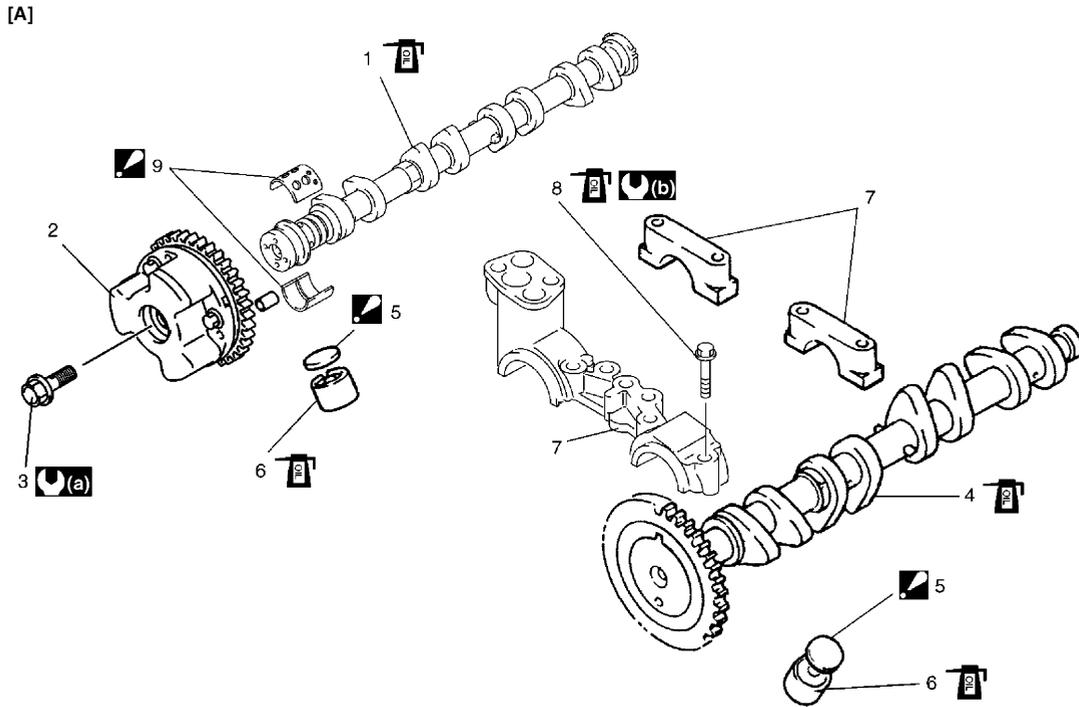
Check that tooth surface (1) are free from damage.



I2RH0B140071-01

Camshaft, Tappet and Shim Components

S4RS0B1406021



I4RS0B140014-01

[A]: For engine with VVT	4. Exhaust camshaft	9. Camshaft bearing : Install a bearing half with some holes to upper side of intake camshaft No.1 bearing.
[B]: For engine without VVT	5. Shim : Shim No. on it faces tappet side.	(a) : 60 N-m (6.0 kgf-m, 43.5 lb-ft)
1. Intake camshaft	6. Tappet	(b) : 11 N-m (1.1 kgf-m, 8.0 lb-ft)
2. Intake camshaft sprocket assembly	7. Camshaft housing	: Apply engine oil to sliding surface of each part.
3. Intake camshaft sprocket bolt	8. Camshaft housing bolt	

Camshaft, Tappet and Shim Removal and Installation

S4RS0B1406022

⚠ CAUTION

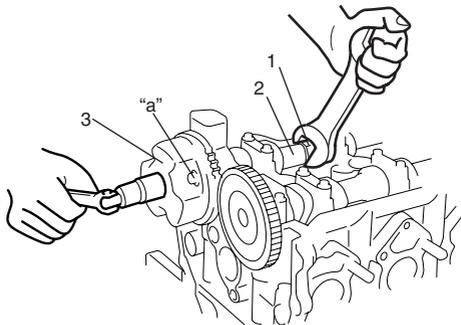
- Keep working table, tools and hands clean while overhauling.
- Use special care to handle aluminum parts so as not to damage them.
- Do not expose removed parts to dust. Keep them always clean.

Removal

- 1) Remove timing chain cover referring to "Timing Chain Cover Removal and Installation: ".
- 2) Remove timing chain referring to "Timing Chain and Chain Tensioner Removal and Installation: ".
- 3) For engine with VVT, with hexagonal section (1) of intake camshaft (2) held stationary with spanner or the like, loosen mounting bolt of intake cam timing sprocket assembly (3) and remove it.

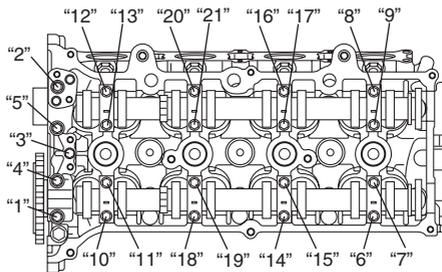
⚠ CAUTION

Never attempt to loosen mounting bolt with intake cam timing sprocket assembly held stationary. Failure to follow this could result in damage to lock pin. Do not loosen bolt "a" because intake cam timing sprocket assembly is not serviceable.



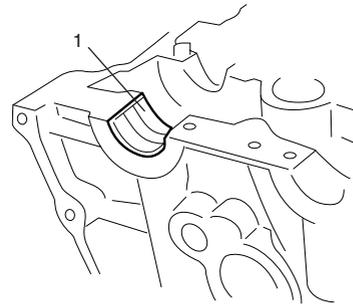
I3RM0A140030-01

- 4) Loosen camshaft housing bolts in such order as indicated in the figure and remove them.



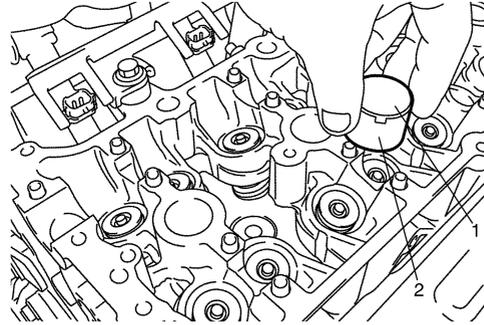
I3RM0A140031-01

- 5) Remove camshaft housings.
- 6) Remove intake and exhaust camshafts.
- 7) For engine with VVT, remove camshaft bearing (1).



I3RH0B140039-01

- 8) Remove tappets (2) with shims (1).



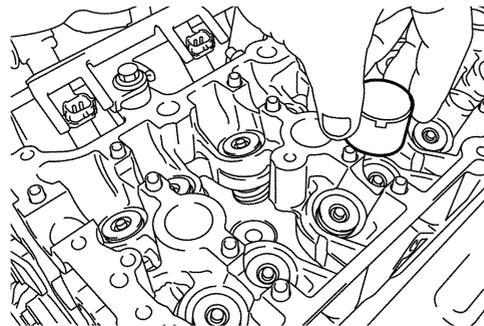
I2RH0B140074-01

Installation

- 1) Install tappets and shims to cylinder head. Apply engine oil around tappet and then install it to cylinder head.

NOTE

When installing shim, make sure to direct shim No. side toward tappet.

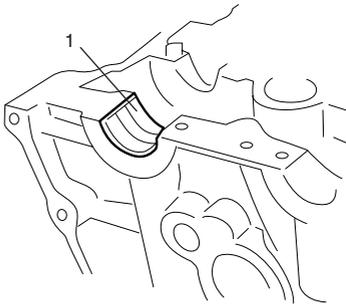


I2RH0B140075-01

- 2) For engine with VVT, install camshaft bearing (1) to cylinder head.

⚠ CAUTION

Do not apply engine oil to camshaft bearing back. Only a upper half bearing of intake camshaft bearing No.1 has some holes. Other bearings.

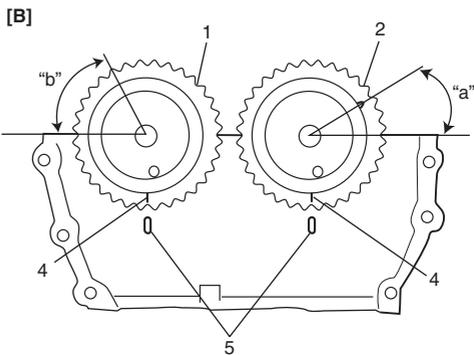
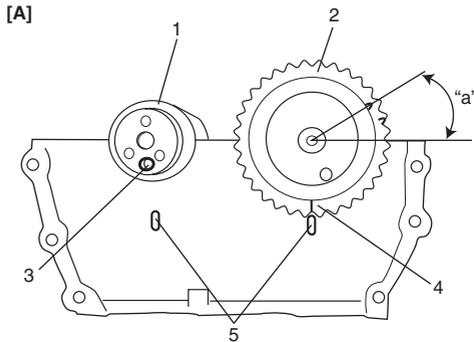


I3RH0B140039-01

- 3) Install intake camshaft (1) and exhaust camshaft (2). Align knock pin (3) and match mark (4) with notches (5) as shown in the figure.

NOTE

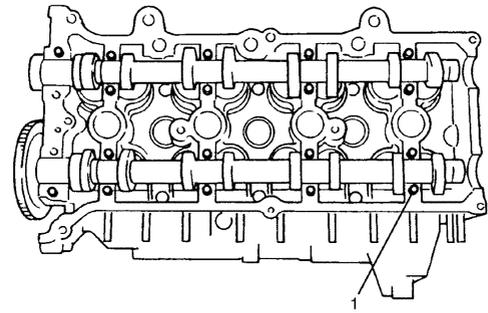
Before installing camshafts, turn crankshaft until key position faces upward. Refer to "Timing Chain and Chain Tensioner Removal and Installation: ".



I4RS0B140015-01

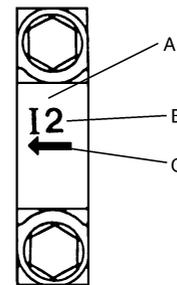
[A]: For engine with VVT
[B]: For engine without VVT
"a": Approx. 30°
"b": Approx. 60°

- 4) Apply engine oil to sliding surface of each camshaft and camshaft journal then install them as shown in the figure.
- 5) Install camshaft housing pins (1) as shown in the figure.



I3RM0A140033-01

- 6) Check position of camshaft housings. Embossed marks are provided on each camshaft housing, indicating position and direction for installation. Install housings as indicated by these marks.



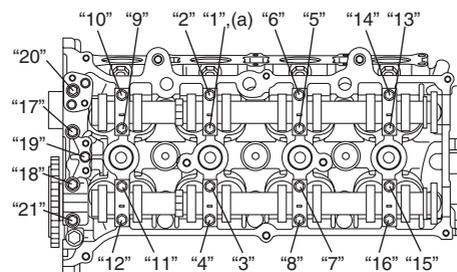
I2RH0B140078-01

A: I: Intake side or E: Exhaust side
B: Position from timing chain side
C: Pointing to timing chain side

- 7) After applying engine oil to housing bolts, tighten them temporarily first. Then tighten them by the numerical order in the figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

Tightening torque

Camshaft housing bolt (a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)

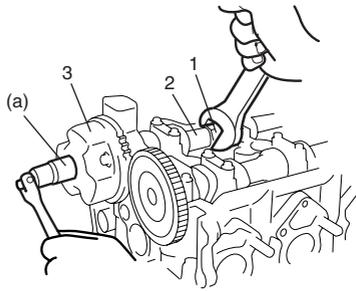


I3RH0B140041-01

- 8) For engine with VVT, with hexagonal section (1) of intake camshaft (2) held stationary with spanner or the like, tighten bolt of intake cam timing sprocket assembly (3) to specification.

Tightening torque

Intake cam timing sprocket bolt (a): 60 N·m (6.0 kgf-m, 43.5 lb-ft)



I3RH0B140042-01

- 9) Install timing chain with crankshaft sprocket referring to "Timing Chain and Chain Tensioner Removal and Installation: ".
- 10) Install timing chain cover referring to "Timing Chain Cover Removal and Installation: ".
- 11) Check valve lashes referring to "Valve Lash (Clearance) Inspection: ".
- 12) Perform Steps 9) to 14) of "Installation" of "Timing Chain Cover Removal and Installation: ".

Camshaft, Tappet and Shim Inspection

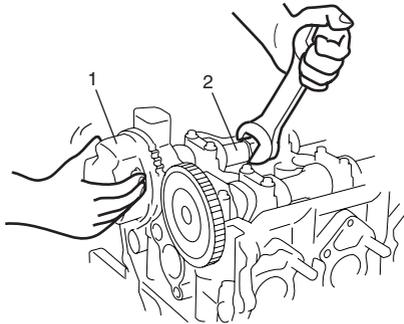
S4RS0B1406023

Intake Cam Timing Sprocket Assembly

Fit intake cam timing sprocket assembly to camshaft (2) and hold hexagonal section of camshaft by using spanner or the like.

Check if sprocket (1) is not turned by hand.

If moved, replace intake cam timing sprocket assembly.



I3RH0B140043-01

Cam Wear

Using a micrometer, measure cam height "a". If measured height underruns its limit, replace camshaft.

Cam height "a"

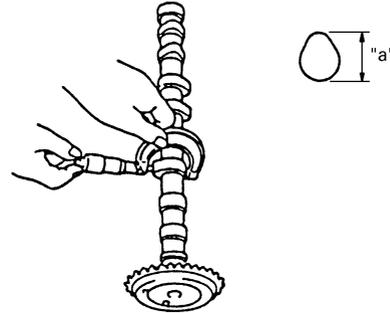
[For engine with VVT]

Cam height	Standard	Limit
Intake cam	44.929 – 45.089 mm (1.769 – 1.775 in.)	44.80 mm (1.764 in.)
Exhaust cam	44.399 – 44.559 mm (1.748 – 1.754 in.)	44.28 mm (1.743 in.)

[For engine without VVT]

Cam height	Standard	Limit
Intake cam	44.919 – 45.079 mm (1.768 – 1.775 in.)	44.80 mm (1.764 in.)

Cam height	Standard	Limit
Exhaust cam	44.399 – 44.559 mm (1.748 – 1.754 in.)	44.28 mm (1.743 in.)



I2RH0B140080-01

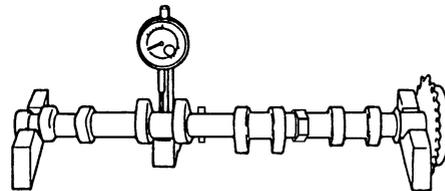
Camshaft Runout

Set camshaft between two "V" blocks, and measure its runout by using a dial gauge.

If measured runout exceeds limit, replace camshaft.

Camshaft runout limit

0.10 mm (0.0039 in.)

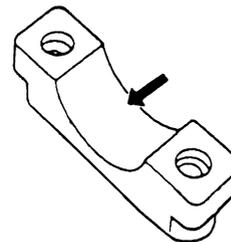


I2RH0B140081-01

Camshaft Journal Wear

Check camshaft journals and camshaft housings for pitting, scratches, wear or damage.

If any malcondition is found, replace camshaft or cylinder head with housing. Never replace cylinder head without replacing housings.



I2RH0B140082-01

Check clearance by using gauging plastic. Checking procedure is as follows.

- 1) Clean housings and camshaft journals.
- 2) Remove all tappets with shims.
- 3) Install camshafts to cylinder head.
- 4) Place a piece of gauging plastic to full width of journal of camshaft (parallel to camshaft).
- 5) Install camshaft housing.

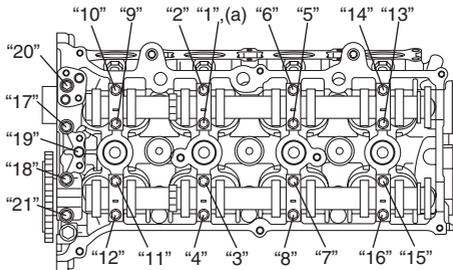
6) Tighten camshaft housing bolts in such order as indicated in the figure a little at a time till they are tightened to specified torque.

NOTE

Do not rotate camshaft while gauging plastic is installed.

Tightening torque

Camshaft housing bolt (a): 11 N·m (1.1 kgf·m, 8.0 lb-ft)



I3RH0B140041-01

7) Remove housing, and using scale (2) on gauging plastic envelop, measure gauging plastic (1) width at its widest point.

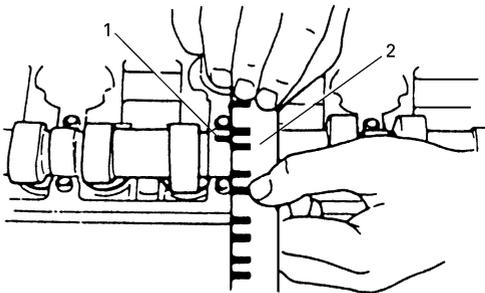
Camshaft journal clearance

[For engine with VVT system]

	Standard	Limit
Intake side No.1 housing	0.020 – 0.072 mm (0.0008 – 0.0028 in.)	0.10 mm (0.0039 in.)
Others	0.045 – 0.087 mm (0.0018 – 0.0034 in.)	0.12 mm (0.0047 in.)

[For engine without VVT system]

Standard	Limit
0.045 – 0.087 mm (0.0018 – 0.0034 in.)	0.12 mm (0.0047 in.)



I2RH0B140083-01

If measured camshaft journal clearance exceeds limit, measure journal (housing) bore and outside diameter of camshaft journal. Replace camshaft or cylinder head assembly whichever the difference from specification is greater.

Camshaft journal diameter [A]

[For engine with VVT system]

Item	Standard
Intake side No.1 housing	26.940 – 26.955 mm (1.0606 – 1.0612 in.)
Exhaust side No.1 housing	26.934 – 26.955 mm (1.0604 – 1.0612 in.)
Others	22.934 – 22.955 mm (0.9029 – 0.9037 in.)

[For engine without VVT system]

Item	Standard
Intake and Exhaust side No.1 housing	26.934 – 26.955 mm (1.0604 – 1.0612 in.)
Others	22.934 – 22.955 mm (0.9029 – 0.9037 in.)

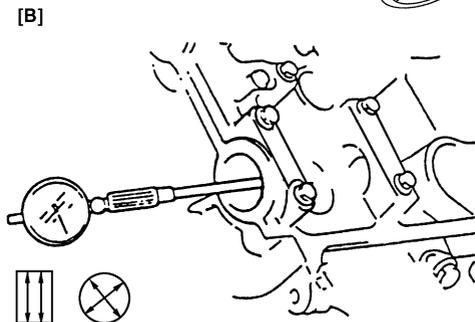
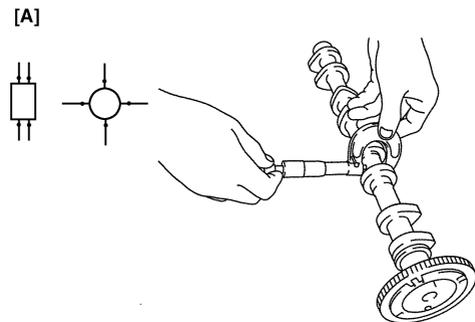
Camshaft journal bearing bore [B]

[For engine with VVT system]

Item	Standard
Intake side No.1 housing	—
Exhaust side No.1 housing	27.000 – 27.021 mm (1.0630 – 1.0638 in.)
Others	23.000 – 23.021 mm (0.9055 – 0.9063 in.)

[For engine without VVT system]

Item	Standard
Intake and Exhaust side No.1 housing	27.000 – 27.021 mm (1.0630 – 1.0638 in.)
Others	23.000 – 23.021 mm (0.9055 – 0.9063 in.)

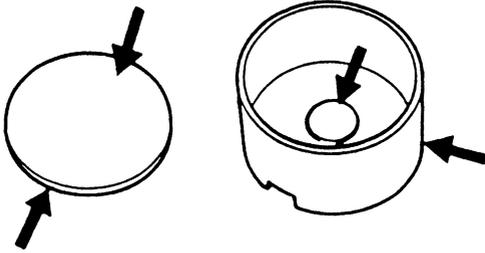


I2RH0B140084-01

1D-37 Engine Mechanical:

Wear of Tappet and Shim

Check tappet and shim for pitting, scratches, or damage. If any malcondition is found, replace.



I2RHOB140085-01

Measure cylinder head bore and tappet outside diameter to determine cylinder head-to-tappet clearance. If clearance exceeds limit, replace tappet or cylinder head.

Cylinder head to tappet clearance

Standard: 0.025 – 0.066 mm (0.0010 – 0.026 in.)

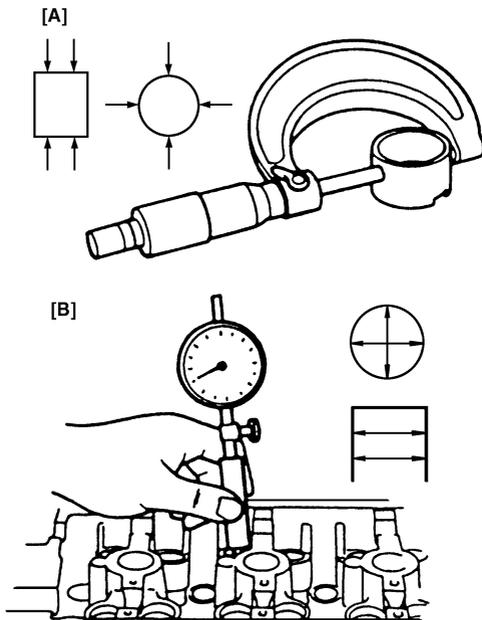
Limit: 0.15 mm (0.0059 in.)

Tappet outside diameter [A]

Standard: 30.959 – 30.975 mm (1.2189 – 1.2195 in.)

Cylinder head tappet bore [B]

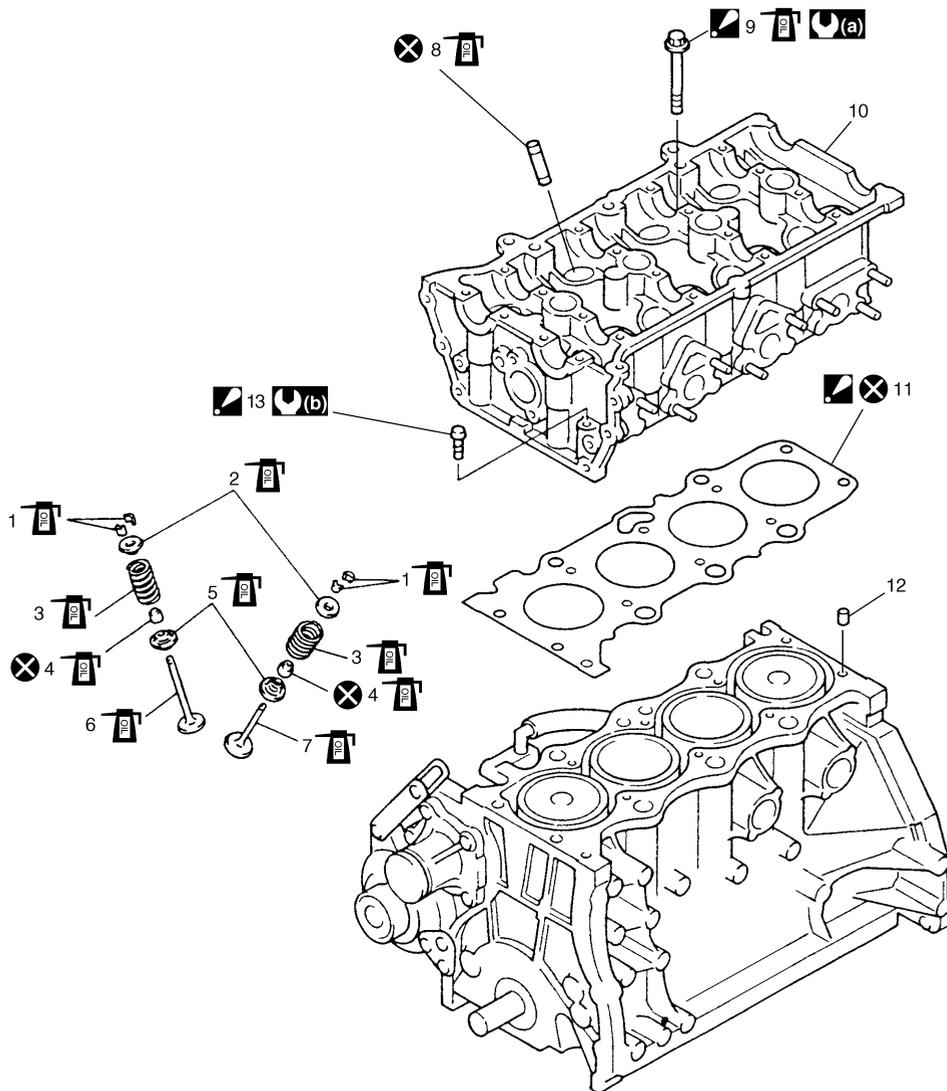
Standard: 31.000 – 31.025 mm (1.2205 – 1.2215 in.)



I2RHOB140086-01

Valves and Cylinder Head Components

S4RS0B1406024



I4RS0A140015-01

1. Valve cotters	7. Exhaust valve	13. Cylinder head bolt (M8) : Be sure to tighten cylinder head bolt (M8) after securing the other cylinder head bolt (M10).
2. Valve spring retainer	8. Valve guide	(a) : Tighten 20 N·m (2.0 kgf·m, 14.5 lb·ft), 40 N·m (4.0 kgf·m, 29.0 lb·ft), 60° and 60° by the specified procedure. (b) : 25 N·m (2.5 kgf·m, 18.0 lb·ft)
3. Valve spring	9. Cylinder head bolt (M10) : Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.	⊗ : Do not reuse.
4. Valve stem seal	10. Cylinder head	🛢️ : Apply engine oil to sliding surface of each part.
5. Valve spring seat	11. Cylinder head gasket : "TOP" mark provided on gasket comes to crankshaft pulley side, facing up.	
6. Intake valve	12. Knock pin	

Valves and Cylinder Head Removal and Installation

S4RS0B1406025

Removal

- 1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation: ".
- 2) Remove oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E".

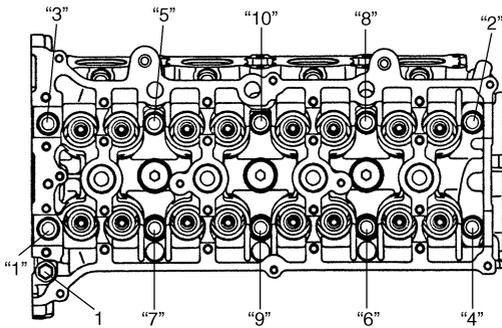
- 3) Remove cylinder head cover referring to "Cylinder Head Cover Removal and Installation: ".
- 4) Remove timing chain cover referring to Steps 2) to 11) of "Removal" in "Timing Chain Cover Removal and Installation: ".
- 5) Remove timing chain referring to Steps 2) to 6) of "Removal" in "Timing Chain and Chain Tensioner Removal and Installation: ".

1D-39 Engine Mechanical:

- 6) Remove intake and exhaust camshafts referring to Steps 3) to 8) of "Removal" in "Camshaft, Tappet and Shim Removal and Installation: ".
- 7) Loosen cylinder head bolts in such order as indicated in the figure by using a 12 corner socket wrenches and remove them.

NOTE

- Don't forget to remove bolt (M8) (1) as shown in the figure.
- Never reuse cylinder head bolts once disassembled it due to plastic deformation tightening. Be sure to use new cylinder head bolts when installing.

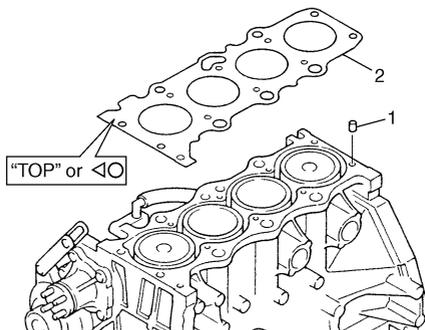


I2RH0B140088-01

- 8) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
- 9) Remove exhaust manifold, if necessary referring to "Exhaust Manifold Removal and Installation: in Section 1K".
- 10) Remove cylinder head with intake manifold and exhaust manifold. Use lifting device, if necessary.

Installation

- 1) Clean mating surface of cylinder head and cylinder block. Remove oil, old gasket and dust from mating surface.
- 2) Install knock pins (1) to cylinder block.
- 3) Install new cylinder head gasket (2) to cylinder block. "Top" or "Triangle/circle" mark provided on gasket comes to crankshaft pulley side, facing up (toward cylinder head side).

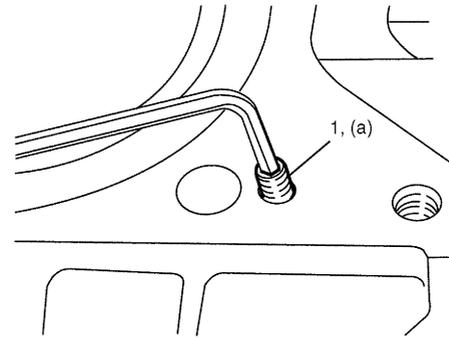


I4RS0B140018-01

- 4) Make sure that oil jet (venturi plug) (1) is not clogged. If it is not installed, install it as specified torque.

Tightening torque

Venturi plug (a): 5 N·m (0.5 kgf-m, 3.5 lb-ft)



I2RH0B140089-01

- 5) Install cylinder head to cylinder block. Apply engine oil to new cylinder head bolts and tighten them gradually as follows.
 - a) Tighten cylinder head bolts ("1" – "10") to 20 N·m (2.0 kgf-m, 14.5 lb-ft) according to numerical order as shown by using a 12 corner socket wrenches.
 - b) In the same manner as in Step a), tighten them to 40 N·m (4.0 kgf-m, 29.0 lb-ft).
 - c) Turn all bolts 60° according to numerical order in the figure.
 - d) Repeat Step c).
 - e) Tighten bolt "A" to specified torque.

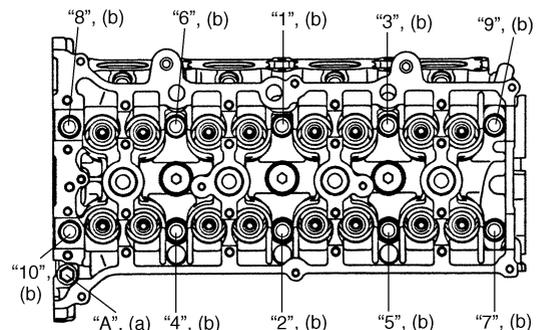
NOTE

Be sure to tighten M8 bolt "A" after securing the other bolts.

Tightening torque

Cylinder head bolt for M8 (a): 25 N·m (2.5 kgf-m, 18.0 lb-ft)

Cylinder head bolt for M10 (b): 20 N·m (2.0 kgf-m, 14.5 lb-ft), 40 N·m (4.0 kgf-m, 29.0 lb-ft) and then retighten by turning through to 60° twice



I2RH0B140091-01

NOTE

- If they are reused, check thread diameters of cylinder head bolt (1) for deformation according to the follows and replace them with new ones if thread diameter difference exceeds limit.
- Measure each thread diameter of cylinder head bolt (1) at "A" on 83.5 mm (2.81 in.) from seat side of flange bolt and "B" on 115 mm (4.53 in.) from seat side of flange bolt by using a micrometer (2). Then calculate difference in diameters ("A" – "B"). If it exceeds limit, replace with new one.

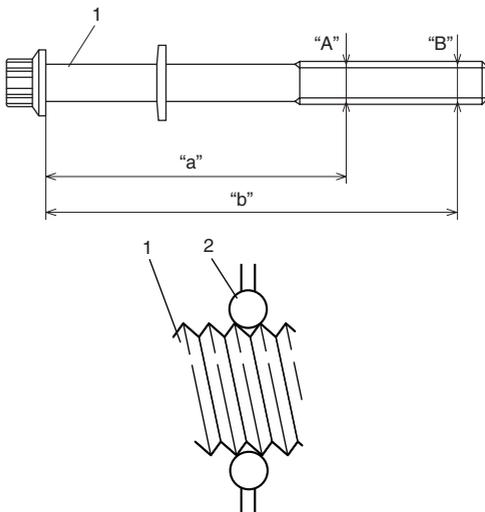
Cylinder head bolt diameter measurement points

"a": 83.5 mm (2.81 in.)

"b": 115 mm (4.53 in.)

Cylinder head bolt diameter difference (deformation)

Limit ("A" – "B"): 0.1 mm (0.004 in.)



I2RH0B140092-01

- 6) Install camshafts, tappet and shim referring to "Camshaft, Tappet and Shim Removal and Installation: ".
- 7) Install timing chain referring to "Timing Chain and Chain Tensioner Removal and Installation: ".
- 8) Install timing chain cover referring to "Timing Chain Cover Removal and Installation: ".
- 9) Install cylinder head cover referring to "Cylinder Head Cover Removal and Installation: ".
- 10) Install oil pan referring to "Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E".

Valves and Cylinder Head Disassembly and Assembly

S4RS0B1406026

Disassembly

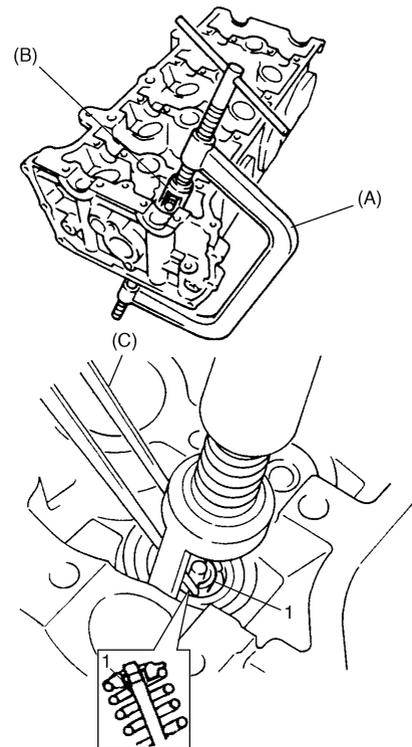
- 1) For ease in servicing cylinder head, remove intake manifold, injectors, exhaust manifold from cylinder head.
- 2) Using special tools (Valve lifter), compress valve spring and then remove valve cotters (1) also by using special tool (Forceps).

Special tool

(A): 09916-14510

(B): 09916-14521

(C): 09916-84511

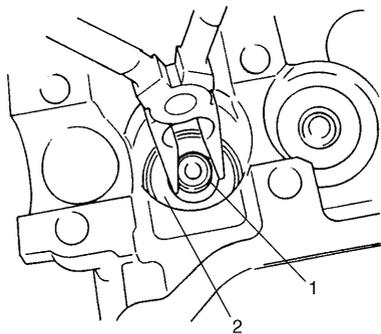


I2RH0B140093-01

- 3) Release special tools (Valve lifter), and remove spring retainer and valve spring.
- 4) Remove valve from combustion chamber side.
- 5) Remove valve stem seal (1) from valve guide and valve spring seat (2).

NOTE

Do not reuse valve stem seal once disassembled. Be sure to use new seal when assembling.



I2RH0B140094-01

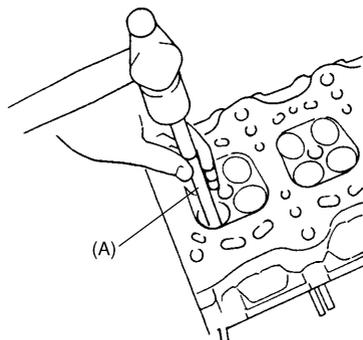
- 6) Using special tool (Valve guide remover), drive valve guide out from combustion chamber side to valve spring side.

Special tool

(A): 09916-44910

NOTE

Do not reuse valve guide once disassembled. Be sure to use new valve guide (oversize) when assembling.



I2RH0B140095-01

- 7) Place disassembled parts except valve stem seal and valve guide in order so that they can be installed in their original position.

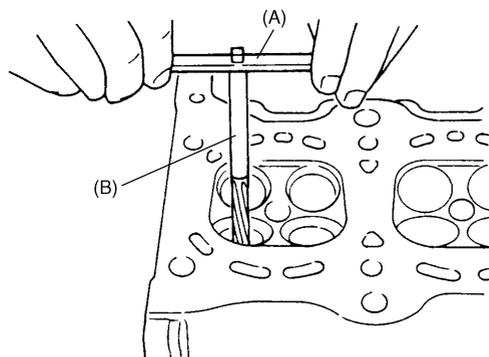
Assembly

- 1) Before installing valve guide into cylinder head, ream guide hole with special tool (10.5 mm reamer) so as to remove burrs and make it truly round.

Special tool

(A): 09916-34542

(B): 09916-37320



I2RH0B140096-01

- 2) Install valve guide to cylinder head. Heat cylinder head uniformly at a temperature of 80 to 100 °C (176 to 212 °F) so that head will not be distorted, and drive new valve guide into hole with special tools.

Drive in new valve guide until special tool (Valve guide installer) contacts cylinder head.

After installing, make sure that valve guide protrudes by specified dimension "a" from cylinder head.

Special tool

(A): 09916-58210

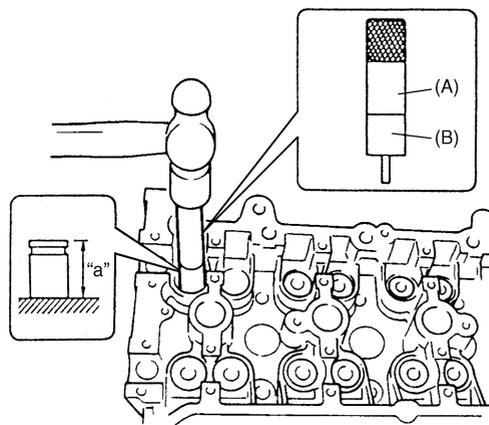
(B): 09916-56011

NOTE

- Never reuse valve guide once disassembled. Make sure to install new valve guide (Oversize).
- Intake and exhaust valve guides are identical.

Valve guide protrusion (In and Ex)

"a": 11.3 mm (0.44 in.)



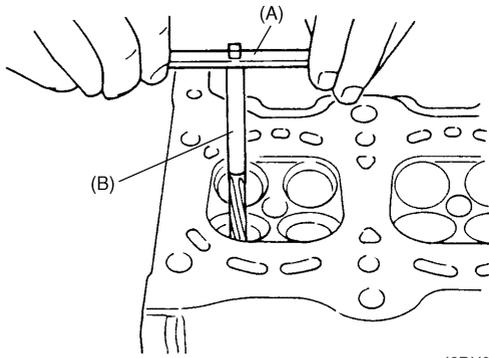
I2RH0B140097-01

- 3) Ream valve guide bore with special tool (5.5 mm reamer). After reaming, clean bore.

Special tool

(A): 09916-34542

(B): 09916-34550



I2RH0B140096-01

- 4) Install valve spring seat to cylinder head.
- 5) Install new valve stem seal (1) to valve guide. After applying engine oil to seal and spindle of special tool (Valve guide installer handle), fit oil seal to spindle, and then install seal to valve guide by pushing special tool by hand. After installing, check to be sure that seal is properly fixed to valve guide.

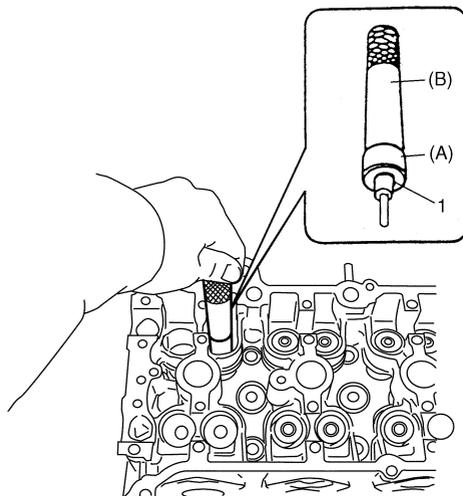
Special tool

(A): 09917-98221

(B): 09916-58210

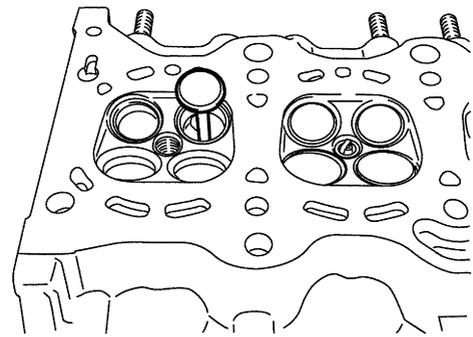
NOTE

- Do not reuse seal once disassembled. Be sure to install new seal.
- When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.



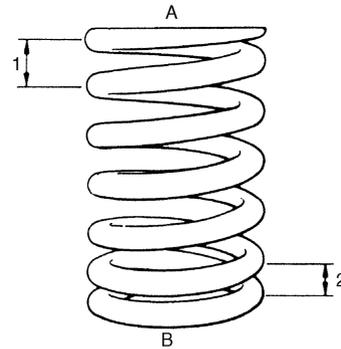
I2RH0B140098-01

- 6) Install valve to valve guide. Before installing valve to valve guide, apply engine oil to stem seal, valve guide bore and valve stem.



I2RH0B140099-01

- 7) Install valve spring and spring retainer. Each valve spring has top end (large-pitch end (1)) and bottom end (small-pitch end (2)). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom (valve spring seat side).



I2RH0B140100-01

A: Valve spring retainer side
B: Valve spring seat side

- 8) Using special tools (Valve lifter), compress valve spring and fit two valve cotters (1) into groove in valve stem.

NOTE

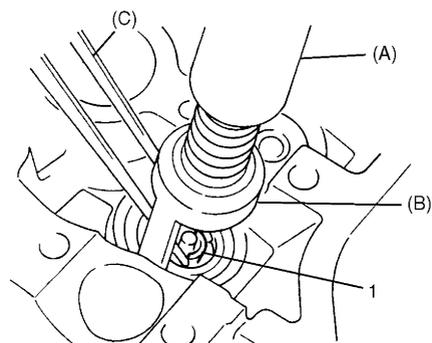
When compressing the valve spring, be carefully to free from damage in inside face of tappet installing hole.

Special tool

(A): 09916-14510

(B): 09916-14521

(C): 09916-84511



I2RH0B140101-01

1D-43 Engine Mechanical:

- 9) Install intake manifold referring to "Intake Manifold Removal and Installation: ".
 10) Install fuel injectors referring to "Fuel Injector Removal and Installation: in Section 1G".

- 11) Install exhaust manifold referring to "Exhaust Manifold Removal and Installation: in Section 1K".

Valves and Valve Guides Inspection

S4RS0B1406027

Valve Guide

Valve stem-to-guide clearance

Using a micrometer and bore gauge, take diameter readings on valve stems and guides to check stem-to-guide clearance.

Be sure to take reading at more than one place along the length of each stem and guide.

If clearance exceeds limit, replace valve and valve guide.

Valve stem and valve guide specification

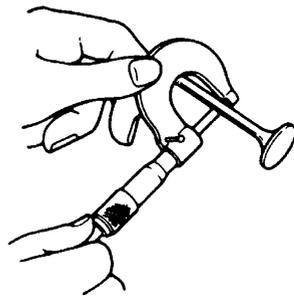
[For M15 engine]

Item		Standard	Limit
Valve stem diameter [A]	In	5.465 – 5.480 mm (0.2150 – 0.2157 in.)	—
	Ex	5.440 – 5.455 mm (0.2142 – 0.2148 in.)	—
Valve guide bore [B]	In & Ex	5.500 – 5.512 mm (0.2165 – 0.2170 in.)	—
Stem-to-guide clearance	In	0.020 – 0.047 mm (0.0008 – 0.0018 in.)	0.070 mm (0.0028 in.)
	Ex	0.045 – 0.072 mm (0.0017 – 0.0028 in.)	0.090 mm (0.0035 in.)

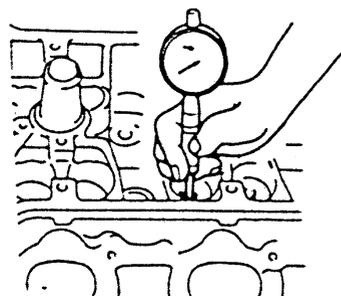
[For M13 engine]

Item		Standard	Limit
Valve stem diameter [A]	In	5.465 – 5.480 mm (0.2150 – 0.2157 in.)	—
	Ex	5.440 – 5.455 mm (0.2142 – 0.2148 in.)	—
Valve guide bore [B]	In & Ex	5.485 – 5.510 mm (0.2160 – 0.2170 in.)	—
Stem-to-guide clearance	In	0.005 – 0.045 mm (0.0002 – 0.0017 in.)	0.070 mm (0.0028 in.)
	Ex	0.030 – 0.070 mm (0.0012 – 0.0027 in.)	0.090 mm (0.0035 in.)

[A]



[B]



I4RS0B140016-01

Valve stem end deflection

If bore gauge is not available, check end deflection of valve stem with a dial gauge instead.

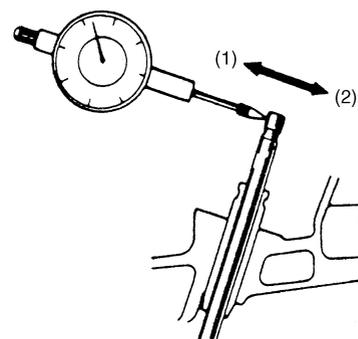
Move stem end in directions (1) and (2) to measure end deflection.

If deflection exceeds its limit, replace valve stem and valve guide.

Valve stem end deflection limit

In: 0.14 mm (0.005 in.)

Ex: 0.18 mm (0.007 in.)



IYSQ01141096-01

Valve

Visual inspection

- Remove all carbon from valves.
- Inspect each valve for wear, burn or distortion at its face and stem end, as necessary, replace it.
- Inspect valve stem end face for pitting and wear. If pitting or wear is found there, valve stem end may be resurfaced, but not too much to grind off its chamber. When it is worn out too much that its chamber is gone, replace valve.



I2RH01140135-01

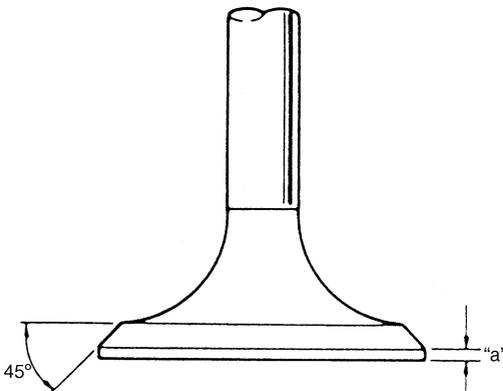
Valve head thickness

Measure thickness "a" of valve head. If measured thickness exceeds limit, replace valve.

Valve head thickness "a" (In and Ex)

Standard: 1.25 – 1.55 mm (0.049 – 0.061 in.)

Limit: 0.9 mm (0.035 in.)



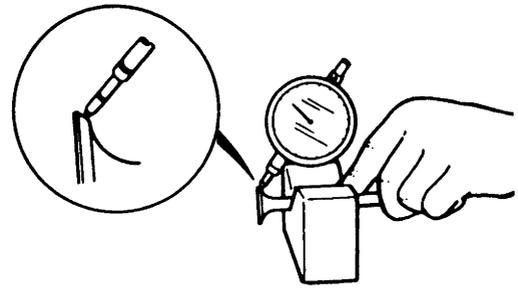
I2RH0B140102-01

Valve head radial runout

Check each valve for radial runout with a dial gauge and "V" block. To check runout, rotate valve slowly. If runout exceeds its limit, replace valve.

Valve head radial runout

Limit: 0.08 mm (0.003 in.)



I2RH01140136-01

Seating contact width

Create contact pattern on each valve in the usual manner, i.e., by giving uniform coat of marking compound to valve seat and by rotatingly tapping seat with valve head. Valve lapper (tool used in valve lapping) must be used.

Pattern produced on seating face of valve must be a continuous ring without any break, and the width of pattern must be within specified range.

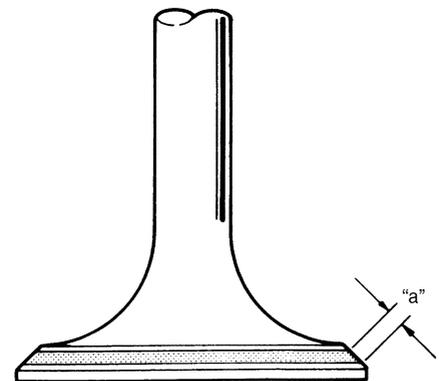
Standard seating width "a" revealed by contact pattern on valve face

[For M15 engine]

Intake and Exhaust: 1.0 – 1.4 mm (0.0389 – 0.0551 in.)

[For M13 engine]

Intake and Exhaust: 1.1 – 1.3 mm (0.0433 – 0.0512 in.)



I2RH0B140103-01

Valve seat repair

A valve seat not producing a uniform contact with its valve or showing width of seating contact that is out of specified range must be repaired by regrinding or by cutting and regrinding and finished by lapping.

1) Exhaust valve seat:

Use valve seat cutters (1) to make two cuts as illustrated in the figure. Two cutters must be used: the first for making 22° angle (for M15 engine) or 15° angle (for M13 engine), and the second for making 45° angle. The second cut must be made to produce desired seat width.

Seat width for exhaust valve seat

[For M15 engine]

"a": 1.0 – 1.4 mm (0.0389 – 0.0551 in.)

[For M13 engine]

"a": 1.1 – 1.3 mm (0.0433 – 0.0512 in.)

2) Intake valve seat:

Use valve seat cutters (1) to make three cuts as illustrated in the figure. Three cutters must be used: the 1st for making 22° angle, the 2nd for making 60° angle, and 3rd for making 45° angle. The 3rd cut (45°) must be made to produce desired seat width.

Seat width for intake valve seat

[For M15 engine]

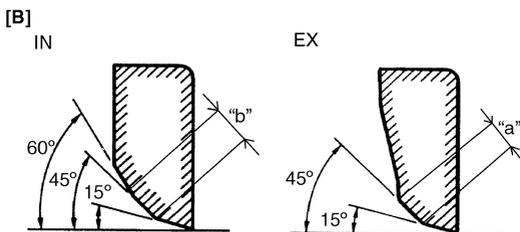
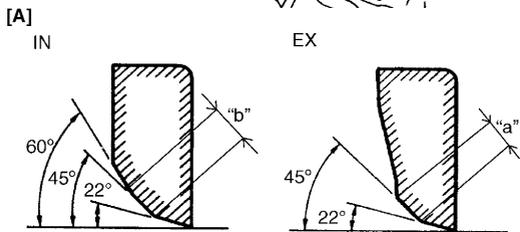
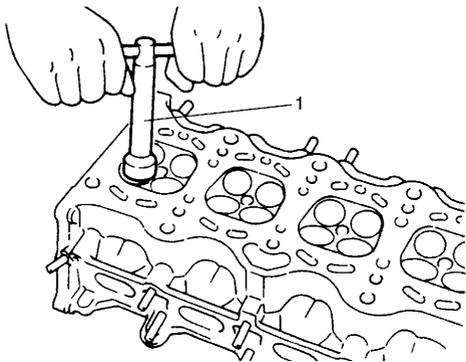
"b": 1.0 – 1.4 mm (0.0389 – 0.0551 in.)

[For M13 engine]

"b": 1.1 – 1.3 mm (0.0433 – 0.0512 in.)

3) Valve lapping:

Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine-size compound, each time using valve lapper according to usual lapping method.



I4RS0B140017-01

[A]: For M15 engine
[B]: For M13 engine

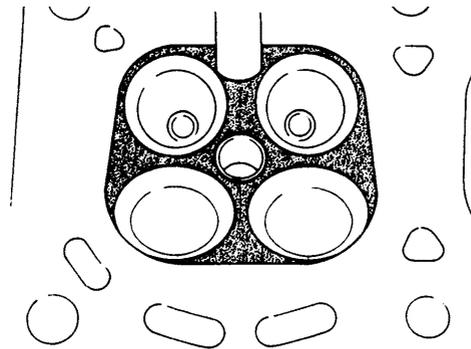
Cylinder Head Inspection

S4RS0B1406028

- Remove all carbon deposits from combustion chambers.

NOTE

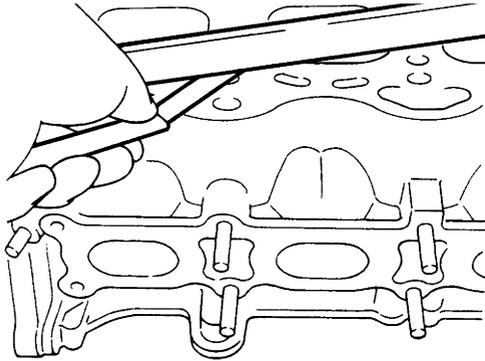
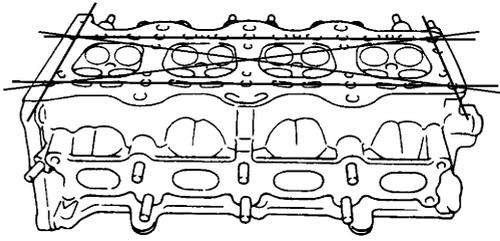
Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.



I2RH0B140105-01

- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface. Using a straightedge and thickness gauge, check flatness of gasketed surface at a total of 6 locations. If distortion limit is exceeded, correct gasketed surface with a surface plate and abrasive paper of about #400 (Waterproof silicon carbide abrasive paper): place abrasive paper on and over surface plate, and rub gasketed surface against paper to grind off high spots. Should this fail to reduce thickness gauge readings to within limit, replace cylinder head. Leakage of combustion gases from this gasketed joint is often due to warped gasketed surface: such leakage results in reduced power output.

Distortion for cylinder head surface on piston side
Limit: 0.03 mm (0.001 in.)

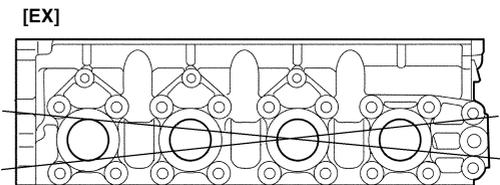
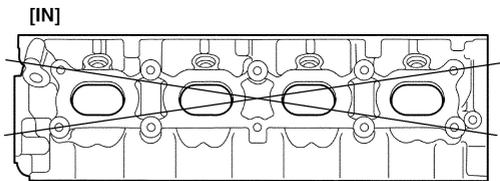


I2RH0B140106-01

- **Distortion of manifold seating faces:**
Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

Distortion for cylinder head surface on intake and exhaust manifold

Limit: 0.05 mm (0.002 in.)



I2RH0B140107-01

Valve Spring Inspection

S4RS0B1406029

Valve Spring Free Length and Preload

Referring to data, check to be sure that each spring is in sound condition, free of any evidence of breakage or weakening. Remember, weakened valve springs can cause chatter, not to mention possibility of reducing power output due to gas leakage caused by decreased seating pressure.

Valve spring free length

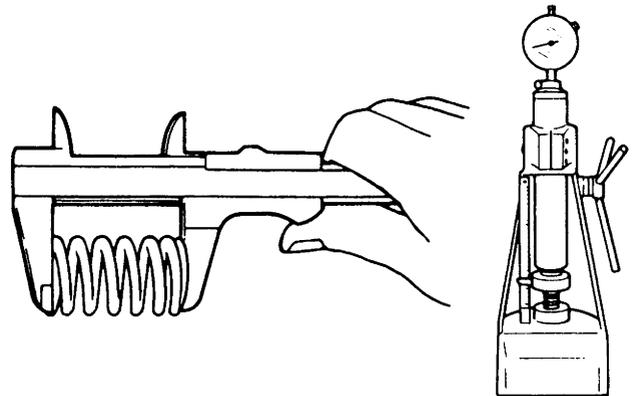
Standard: 36.83 mm (1.450 in.)

Limit: 35.83 mm (1.411 in.)

Valve spring preload

Standard: 107 – 125 N (10.7 – 12.5 kg) for 31.50 mm (23.6 – 27.6 lb/1.240 in.)

Limit: 102 N (10.2 kg) for 31.50 mm (22.5 lb/1.240 in.)



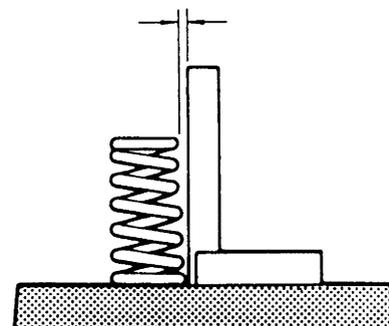
I2RH01140143-01

Spring Squareness

Use a square and surface plate to check each spring for squareness in terms of clearance between end of valve spring and square. Valve springs found to exhibit a larger clearance than limit must be replaced.

Valve spring squareness

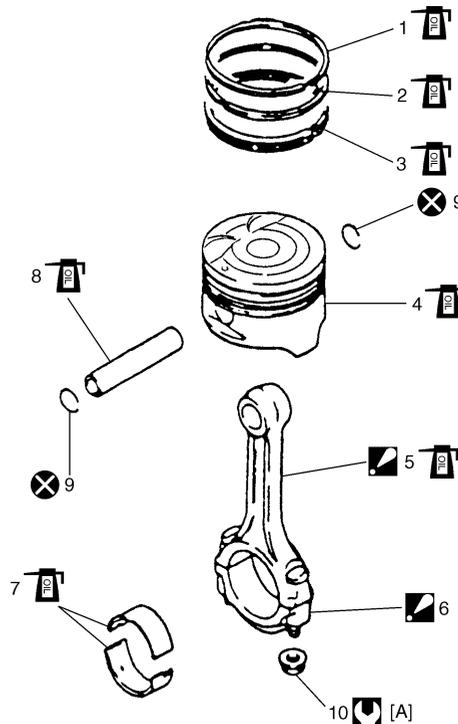
Limit: 1.6 mm (0.063 in.)



I2RH01140144-01

Pistons, Piston Rings, Connecting Rods and Cylinders Components

S4RS0B1406030



I2RH0B140108-01

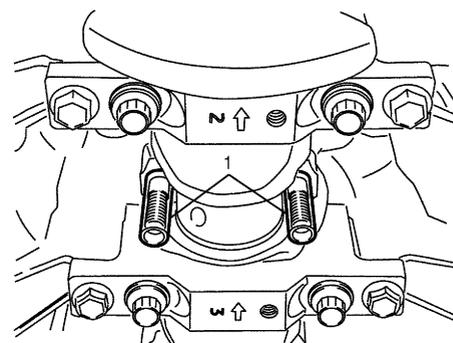
[A]: 1) Tighten all nuts to 15 N·m (1.5 kgf·m). 2) Then retighten all nuts by turning through 45°. 3) Repeat Step 2) again.	7. Connecting rod bearing
1. Top ring	8. Piston pin
2. 2nd ring	9. Piston pin circlip
3. Oil ring	10. Bearing cap nut
4. Piston	: Tightening torque
5. Connecting rod : See "A"	: Apply engine oil to sliding surface of each part.
6. Connecting rod bearing cap : See "B"	: Do not reuse.
"A": Apply engine oil to sliding surface except inner surface of big end, and rod bolts. Make sure rod bolt diameter when reuse it due to plastic deformation tightening. Refer to "Piston Pins and Connecting Rods Inspection: ".	
"B": Point arrow mark on cap to crankshaft pulley side.	

Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation

S4RS0B1406031

Removal

- 1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation: ".
- 2) Remove cylinder head referring to "Valves and Cylinder Head Removal and Installation: ".
- 3) Mark cylinder number on all pistons, connecting rods and connecting rod caps using silver pencil or quick drying paint.
- 4) Remove rod bearing caps.
- 5) Install guide hose (1) over threads of rod bolts. This prevents damage to bearing journal and rod bolt threads when removing connecting rod.



I2RH0B140109-01

- 6) Decarbonize top of cylinder bore before removing piston from cylinder.
- 7) Push piston and connecting rod assembly out through the top of cylinder bore.

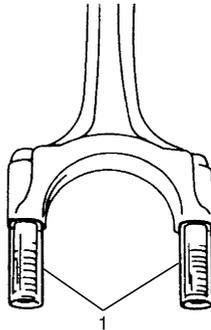
Installation

- 1) Apply engine oil to pistons, rings, cylinder walls, connecting rod bearings and crank pins.

NOTE

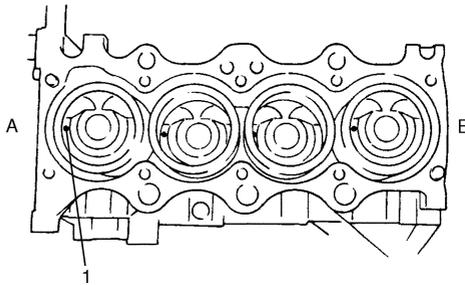
Do not apply oil between connecting rod and bearing or between bearing cap and bearing.

- 2) Install guide hoses (1) over connecting rod bolts. These guide hoses protect crank pin and threads of rod bolt from damage during installation of connecting rod and piston assembly.



I2RH01140147-01

- 3) When installing piston and connecting rod assembly into cylinder bore, point front mark (1) on piston head to crankshaft pulley side.



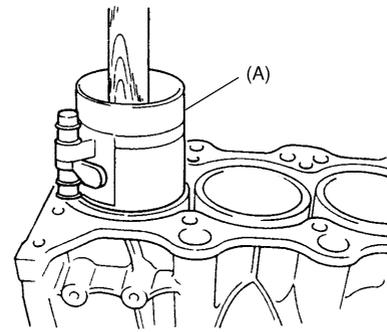
I2RH0B140110-01

A: Crankshaft pulley side
B: Flywheel side

- 4) Install piston and connecting rod assembly into cylinder bore. Use special tool (Piston ring compressor) to compress rings. Guide connecting rod into place on crankshaft. Using a hammer handle, tap piston head to install piston into bore. Hold ring compressor firmly against cylinder block until all piston rings have entered cylinder bore.

Special tool

(A): 09916-77310



I2RH0B140111-01

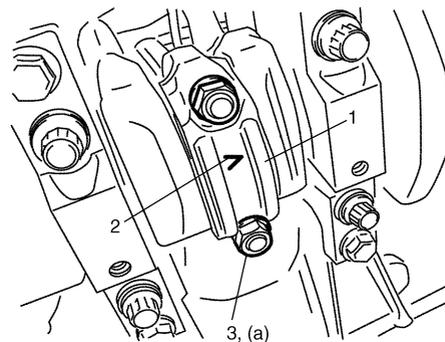
- 5) Install bearing cap (1):
Point arrow mark (2) on cap to crankshaft pulley side.
After applying engine oil to rod bolts and tighten cap nuts (3) gradually as follows.
 - a) Tighten all cap nuts to 15 N·m (1.5 kgf·m, 11.0 lb-ft).
 - b) Retighten them to 45°.
 - c) Repeat Step b) once again.

NOTE

Before installing bearing cap, make sure that checking for connecting rod bolt deformation. Refer to "Piston Pins and Connecting Rods Inspection: ".

Tightening torque

Connecting rod bearing cap nut (a): 15 N·m (1.5 kgf·m, 11.0 lb-ft) and then retighten by turning through 45° twice



I2RH0B140112-01

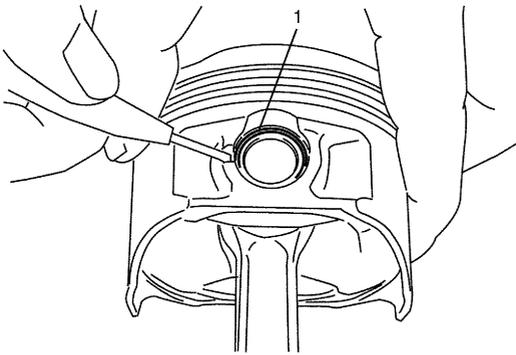
- 6) Install cylinder head referring to "Valves and Cylinder Head Removal and Installation: ".

Pistons, Piston Rings, Connecting Rods and Cylinders Disassembly and Assembly

S4RS0B1406032

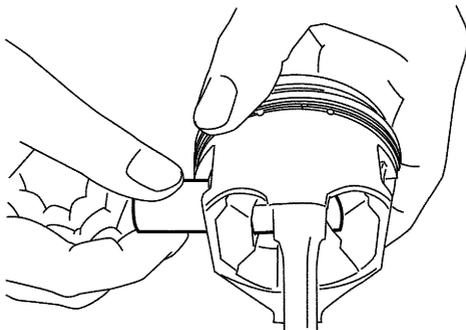
Disassembly

- 1) Using piston ring expander, remove two compression rings (Top and 2nd) and oil ring from piston.
- 2) Remove piston pin from connecting rod as follows.
 - a) Ease out piston pin circlips (1), as shown.



I2RH0B140113-01

b) Force piston pin out.



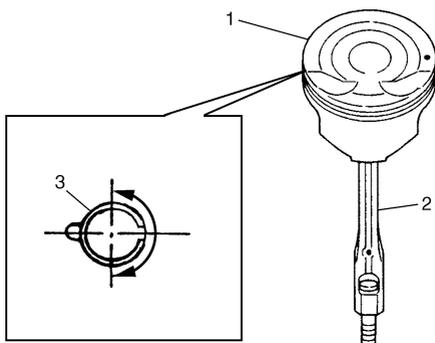
I2RH0B140114-01

Assembly

- 1) Decarbonize piston head and ring grooves using a suitable tool.
- 2) Install piston pin to piston (1) and connecting rod (2):
 - a) After applying engine oil to piston pin and piston pin holes in piston and connecting rod.
 - b) Fit connecting rod as shown in the figure.
 - c) Insert piston pin to piston and connecting rod.
 - d) Install piston pin circlips (3).

NOTE

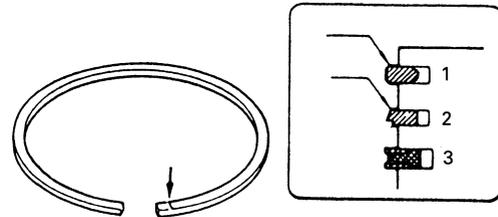
Circlip should be installed with its cut part facing as shown in the figure. Install so that circlip end gap comes within such range as indicated by arrow.



I2RH0B140115-01

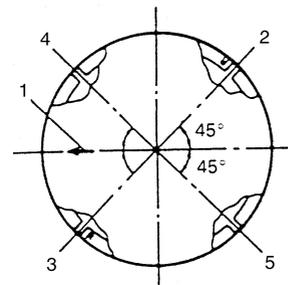
3) Install piston rings to piston:

- As indicated in the figure, 1st and 2nd rings have “T” mark respectively. When installing these piston rings to piston, direct marked side of each ring toward top of piston.
- 1st ring (1) differs from 2nd ring (2) in thickness, shape and color of surface contacting cylinder wall.
Distinguish 1st ring from 2nd ring by referring to the figure.
- When installing oil ring (3), install spacer first and then two rails.



I2RH0B140116-01

4) After installing three rings (1st, 2nd and oil rings), distribute their end gaps as shown in the figure.



IYSQ01142102-01

1. Arrow mark	4. Oil ring upper rail gap
2. 1st ring end gap	5. Oil ring lower rail gap
3. 2nd ring end gap and oil ring spacer gap	

Cylinders, Pistons and Piston Rings Inspection

S4RS0B1406033

Cylinder

Visual inspection

Inspect cylinder walls for scratches, roughness or ridges which indicate excessive wear. If cylinder bore is very rough or deeply scratched, or ridged, rebore cylinder and use over size piston.

Cylinder bore diameter, taper and out-of-round

Using a cylinder gauge (1), measure cylinder bore in thrust and axial directions at two positions (“a” and “b”) as shown in the figure.

If any of the following conditions is noted, rebore cylinder.

- 1) Cylinder bore dia. exceeds limit.
- 2) Difference of measurements at two positions exceeds taper limit.
- 3) Difference between thrust and axial measurements exceeds out-of-round limit.

Cylinder bore diameter

[For M15 engine]

Standard: 78.000 – 78.014 mm (3.0709 – 3.0714 in.)

Limit: 78.050 mm (3.073 in.)

[For M13 engine]

Standard: 78.000 – 78.014 mm (3.0709 – 3.0714 in.)

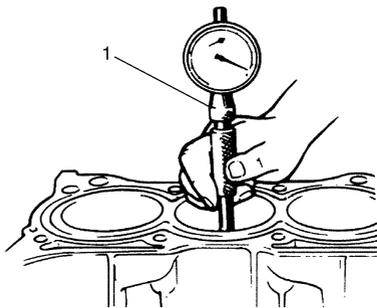
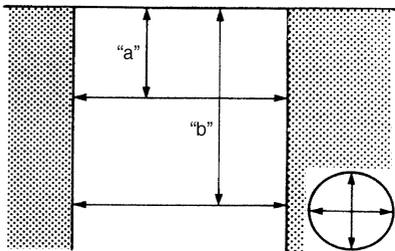
Limit: 78.114 mm (3.075 in.)

Cylinder taper and out-of-round

Limit: 0.10 mm (0.004 in.)

NOTE

If any one of four cylinders has to be rebored, rebore all four to the same next oversize. This is necessary for the sake of uniformity and balance.



I2RH0B140117-01

"a": 50 mm (1.96 in.)
"b": 100 mm (3.94 in.) (For M15 engine)
"b": 95 mm (3.74 in.) (For M13 engine)

Piston

Visual inspection

Inspect piston for faults, cracks or other damages. Damaged or faulty piston should be replaced.

Piston diameter

As indicated in the figure, piston diameter should be measured at a position 19.5 mm (0.77 in.) ("a") from piston skirt end in the direction perpendicular to piston pin.

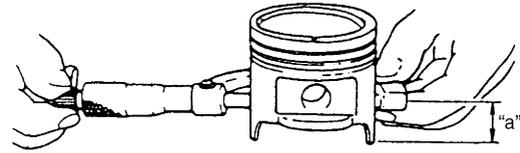
Piston diameter specification

Standard size (used piston): 77.953 – 77.968 mm (3.0690 – 3.0696 in.)

Standard size (new piston with coating): 77.969 –

77.984 mm (3.0697 – 3.0702 in.)

Oversize (0.50 mm (0.0196 in.)): 78.453 – 78.468 mm (3.0887 – 3.0893 in.)



I2RH01140157-01

Piston clearance

Measure cylinder bore diameter and piston diameter to find their difference which is piston clearance. Piston clearance should be within specification as follows. If it is out of specification, rebore cylinder and use oversize piston.

NOTE

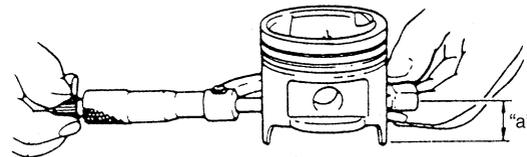
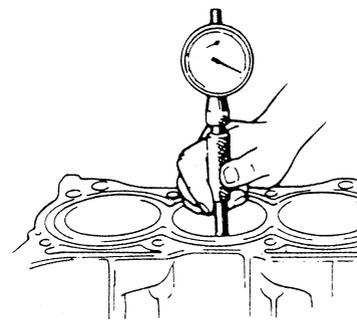
Cylinder bore diameters used here are measured in thrust direction at two positions.

Piston clearance

Standard (used piston): 0.032 – 0.061 mm (0.0013 – 0.0024 in.)

Standard (new piston with coating): 0.016 – 0.045 mm (0.0006 – 0.0018 in.)

Limit: 0.161 mm (0.0065 in.)



I4RS0A140022-01

"a": 19.5 mm (0.77 in.)

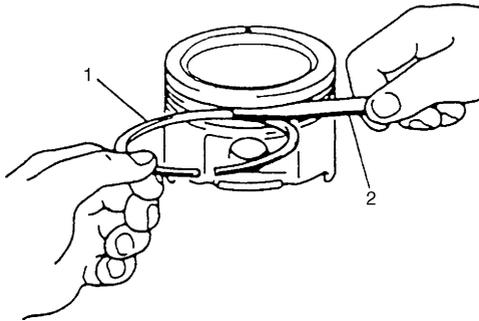
Ring groove clearance

Before checking, piston grooves must be clean, dry and free of carbon deposits.

Fit new piston ring (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2). If clearance is out of specification, replace piston.

Ring groove clearance

	Standard	Limit
Top ring	0.03 – 0.07 mm (0.0012 – 0.0028 in.)	0.12 mm (0.0047 in.)
2nd ring	0.02 – 0.06 mm (0.0008 – 0.0024 in.)	0.10 mm (0.0039 in.)
Oil ring	0.03 – 0.17 mm (0.0012 – 0.0067 in.)	—



I2RH01140159-01

Piston Ring

Piston ring end gap

To measure end gap, insert piston ring (2) into cylinder bore and then measure the gap by using thickness gauge (1).

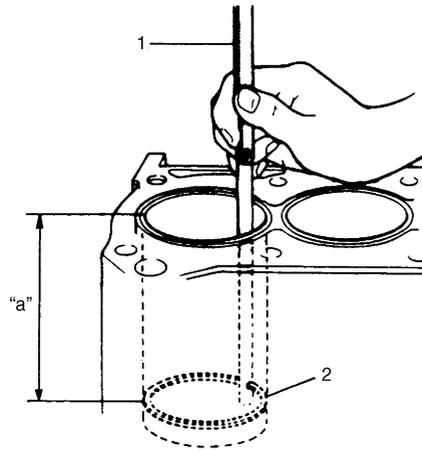
If measured gap exceeds limit, replace ring.

NOTE

Decarbonize and clean top of cylinder bore before inserting piston ring.

Piston ring end gap

Item	Standard	Limit
Top ring	0.20 – 0.35 mm (0.0079 – 0.0138 in.)	0.7 mm (0.0276 in.)
2nd ring	0.35 – 0.50 mm (0.0138 – 0.0197 in.)	1.0 mm (0.0394 in.)
Oil ring	0.20 – 0.70 mm (0.0079 – 0.0276 in.)	1.2 mm (0.0472 in.)



I2RH01140161-01

"a": 120 mm (4.72 in.)

Piston Pins and Connecting Rods Inspection

S4RS0B1406034

Piston Pin

Visual inspection

Check piston pin, connecting rod small end bore and piston bore for wear or damage, paying particular attention to condition of small end bore bush. If pin, connecting rod small end bore or piston bore is badly worn or damaged, replace pin, connecting rod and/or piston.

Piston pin clearance

Check piston pin clearance in small end and piston. Replace connecting rod and/or piston if its small end is badly worn or damaged or if measured clearance exceeds limit.

Piston pin clearance in connecting rod small end

Standard: 0.003 – 0.014 mm (0.0001 – 0.0006 in.)

Limit: 0.05 mm (0.0020 in.)

Piston pin clearance in piston

Standard: 0.006 – 0.017 mm (0.00024 – 0.00067 in.)

Limit: 0.05 mm (0.0020 in.)

Small-end bore

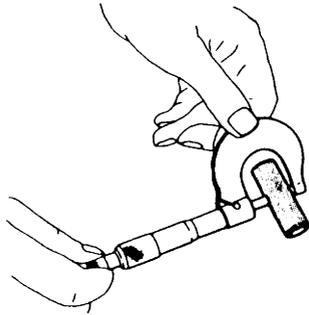
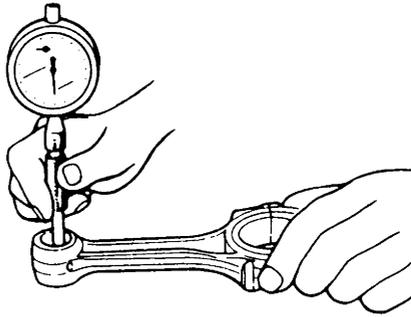
20.003 – 20.011 mm (0.7875 – 0.7878 in.)

Piston pin dia.

19.997 – 20.000 mm (0.7873 – 0.7874 in.)

Piston bore

20.006 – 20.014 mm (0.7876 – 0.7880 in.)



I4RS0A140023-01

Connecting Rod

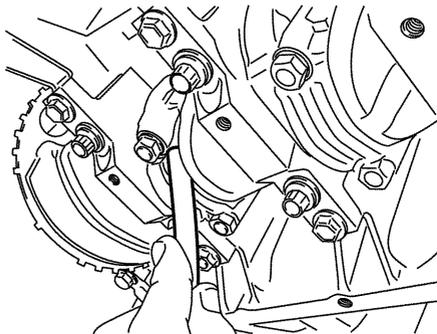
Big-end side clearance

Check big-end of connecting rod for side clearance, with rod fitted and connected to its crank pin in the normal manner. If measured clearance is found to exceed its limit, replace connecting rod.

Big-end side clearance

Standard: 0.25 – 0.40 mm (0.0098 – 0.0157 in.)

Limit: 0.55 mm (0.0217 in.)



I2RH0B140148-01

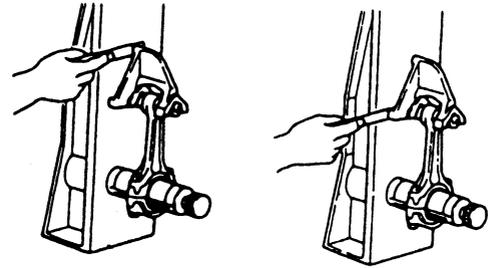
Connecting rod alignment

Mount connecting rod on aligner to check it for bow and twist. If measured value exceeds the limit, replace it.

Connecting rod alignment

Limit on bow: 0.05 mm (0.0020 in.)

Limit on twist: 0.10 mm (0.0039 in.)



I4RH01140053-01

Connecting rod bolt deformation (Plastic deformation tightening bolt)

Measure each thread diameter of connecting rod bolt (2) at "A" on 32 mm (1.25 in.) from bolt mounting surface and "B" on 40 mm (1.57 in.) from bolt mounting surface by using a micrometer (3).

Calculate difference in diameters ("A" – "B"). If it exceeds limit, replace connected rod (1).

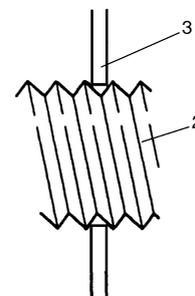
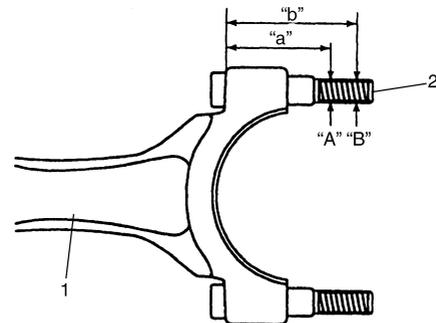
Connecting rod bolt measurement points

"a": 32 mm (1.25 in.)

"b": 40 mm (1.57 in.)

Connecting rod bolt diameter difference

Limit ("A" – "B"): 0.1 mm (0.004 in.)



I2RH0B140119-01

Crank Pin and Connecting Rod Bearings Inspection

S4RS0B1406035

Crank Pin Diameter

Inspect crank pin for uneven wear or damage. Measure crank pin for out-of-round or taper with a micrometer. If crank pin is damaged or out-of round or taper is out of limit, replace crankshaft or regrind crank pin to undersize and use undersize bearing.

Crank pin diameter

Connecting rod bearing size	Crank pin diameter
Standard	41.982 – 42.000 mm (1.6528 – 1.6535 in.)
0.25 mm (0.0098 in.) undersize	41.732 – 41.750 mm (1.6430 – 1.6437 in.)

Out-of-round

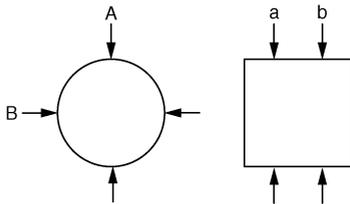
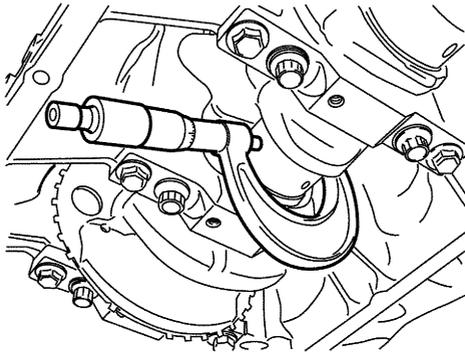
A – B

Taper

a – b

Crank pin taper and out-of-round

Limit: 0.01 mm (0.0004 in.)

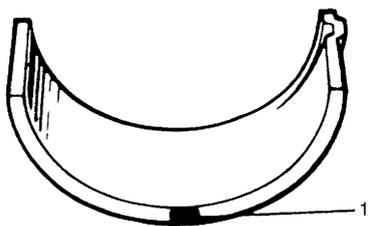


I2RH0B140120-01

Connecting Rod Bearing General Information

Service connecting rod bearings are available in standard size and 0.25 mm (0.0098 in.) undersize bearing, and standard size bearing has 5 kinds of bearings differing in tolerance.

For identification of undersize bearing, it is painted red at the position as indicated in the figure, undersize bearing thickness is 1.605 – 1.615 mm (0.0632 – 0.0635 in.) at the center of it.



I2RH01140164-01

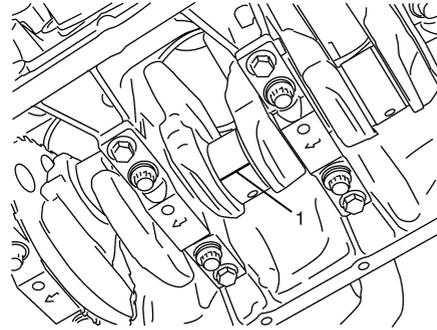
1. Red paint

Connecting Rod Bearing Visual Inspection

Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.

Connecting Rod Bearing Clearance

- 1) Before checking bearing clearance, clean bearing and crank pin.
- 2) Install bearing in connecting rod and bearing cap.
- 3) Place a piece of gauging plastic (1) to full width of crank pin as contacted by bearing (parallel to crankshaft), avoiding oil hole.

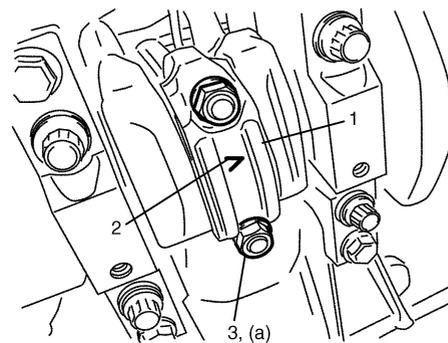


I2RH0B140121-01

- 4) Install rod bearing cap (1) to connecting rod. When installing cap, be sure to point arrow mark (2) on cap to crankshaft pulley side, as shown in the figure. After applying engine oil to rod bolts, tighten cap nuts (3) gradually as follows.
 - a) Tighten all cap nuts to 15 N·m (1.5 kgf·m, 11.0 lb·ft)
 - b) Retighten them to 45°
 - c) Repeat Step b) once again.

Tightening torque

Connecting rod bearing cap nut (a): 15 N·m (1.5 kgf·m, 11.0 lb·ft) and then retighten by turning through 45° twice



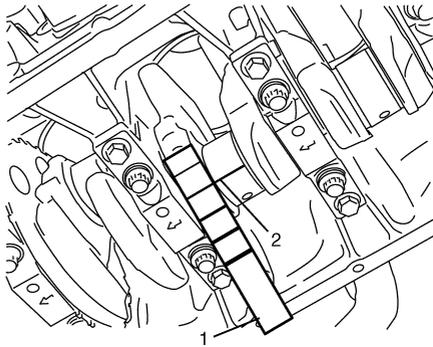
I2RH0B140122-01

- 5) Remove cap and using a scale (1) on gauging plastic envelope (2), measure gauging plastic (2) width at the widest point (clearance). If clearance exceed its limit, use a new standard size bearing referring to "Selection of Connecting Rod Bearings: ". After selecting new bearing, recheck clearance.

Connecting rod bearing clearance

Standard: 0.029 – 0.047 mm (0.0011 – 0.0018 in.)

Limit: 0.065 mm (0.0026 in.)



I2RH0B140123-01

- 6) If clearance can not be brought to its limit even by using a new standard size bearing, use next thicker bearing and recheck clearance or regrind crank pin to undersize and use 0.25 mm undersize bearing.

Selection of Connecting Rod Bearings

NOTE

- If bearing is in malcondition, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.
- When replacing crankshaft or connecting rod and its bearing due to any reason, select new standard bearings to be installed by referring to numbers stamped on connecting rod and its cap and/or alphabets stamped on crank web of No.3 cylinder.

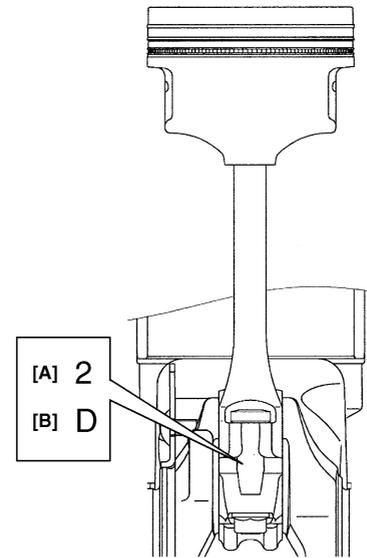
- 1) Check stamped numbers on connecting rod and its cap as shown.

Three kinds of numbers (“1”, “2” and “3”) represent the following connecting rod big end inside diameters.

For example, stamped number “1” indicates that corresponding connecting rod big end inside diameter is 45.000 – 45.006 mm (1.7717 – 1.7718 in.).

Connecting rod big end inside diameter

Stamped numbers	Connecting rod big end inside diameter
1	45.0000 – 45.0060 mm (1.7717 – 1.7718 in.)
2	45.0061 – 45.0120 mm (1.7719 – 1.7721 in.)
3	45.0121 – 45.0180 mm (1.7722 – 1.7723 in.)



I3RH0A140017-01

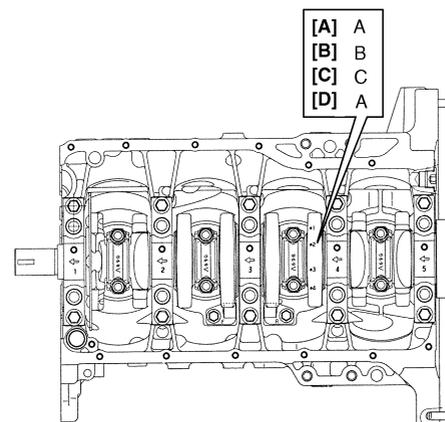
[A]:	Connecting rod big end inside diameter number
[B]:	Weight indication mark

- 2) Next, check crankshaft pin diameter. On crank web No.3, four alphabets are stamped as shown in the figure.

Three kinds of alphabet (“A”, “B” and “C”) represent the following crankshaft pin diameter respectively. For example, stamped “A” indicates that corresponding crankshaft pin diameter is 41.994 – 42.000 mm (1.6533 – 1.6534 in.).

Crankshaft pin outer diameter

Stamped alphabet	Crankshaft pin diameter
A	41.9940 – 42.0000 mm (1.6533 – 1.6534 in.)
B	41.9880 – 41.9939 mm (1.6531 – 1.6532 in.)
C	41.9820 – 41.9879 mm (1.6529 – 1.6530 in.)



I3RH0A140018-01

[A]:	Crankshaft pin diameter for No.1 cylinder
[B]:	Crankshaft pin diameter for No.2 cylinder
[C]:	Crankshaft pin diameter for No.3 cylinder
[D]:	Crankshaft pin diameter for No.4 cylinder

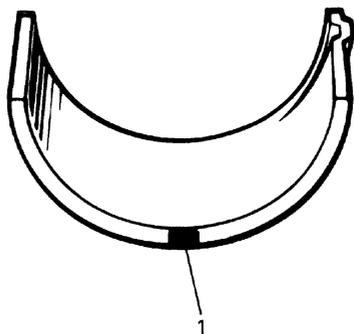
1D-55 Engine Mechanical:

3) There are five kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in the figure.

Each color indicated the following thickness at the center of bearing.

Standard size of connecting rod bearing thickness

Color painted	Bearing thickness
Blue	1.4991 – 1.5020 mm (0.05902 – 0.05913 in.)
Yellow	1.4961 – 1.4990 mm (0.05890 – 0.05901 in.)
Nothing	1.4931 – 1.4960 mm (0.05878 – 0.05889 in.)
Black	1.4901 – 1.4930 mm (0.05867 – 0.05877 in.)
Green	1.4870 – 1.4900 mm (0.05855 – 0.05866 in.)



I3RH0A140019-01

1. Paint

4) From number stamped on connecting rod and its cap and alphabets stamped on crank web No.3, determine new standard bearing to be installed to connecting rod big end inside, by referring to the table.

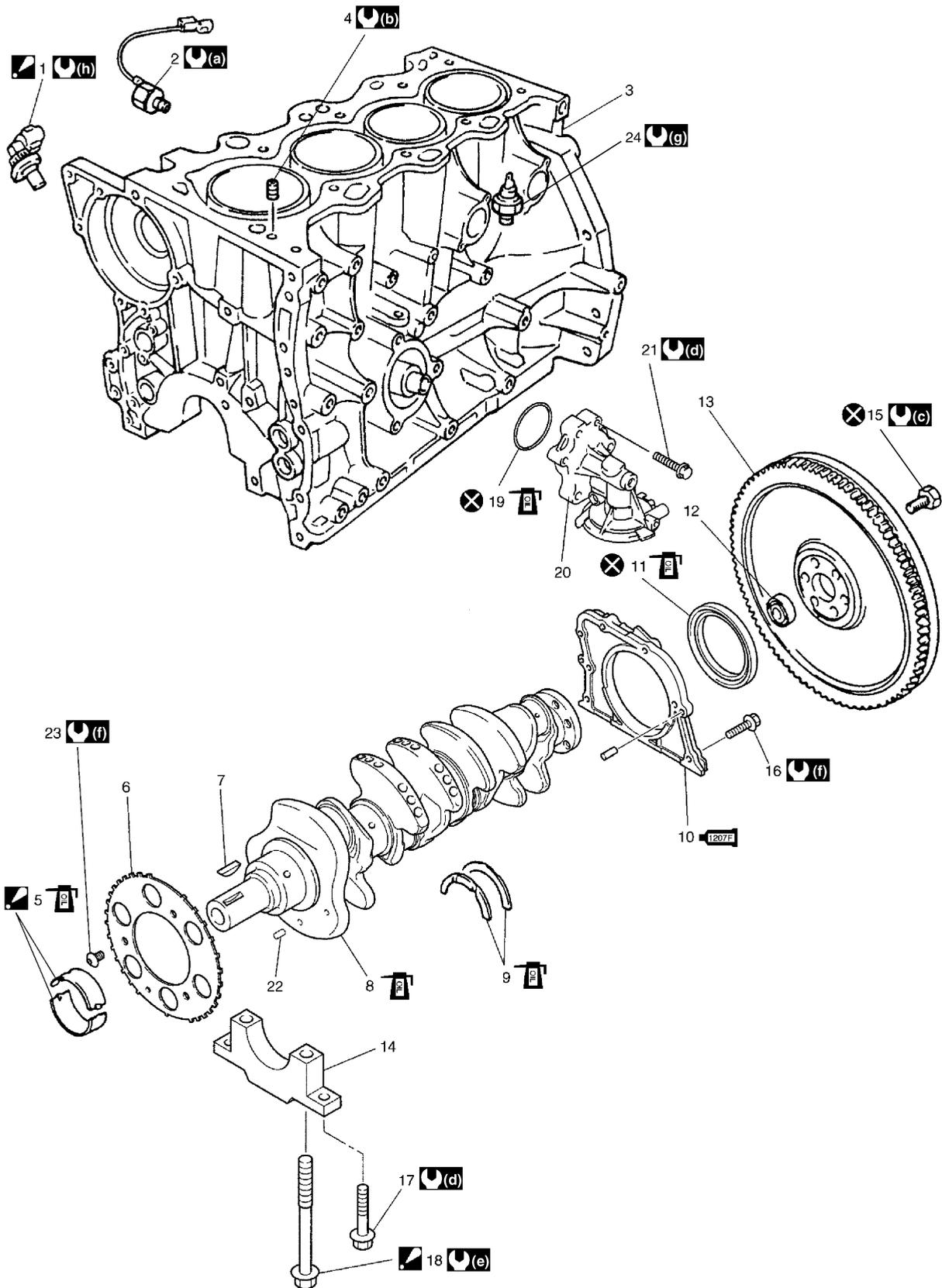
For example, if number stamped on connecting rod and its cap is “1” and alphabet stamped on crank web No.3 is “B”, install a new standard bearing painted in “Black” to its connecting rod big end inside.

Specification of new standard connecting rod bearing size

		Number stamped on connecting rod and its cap (connecting rod big end inside diameter)		
		1	2	3
Alphabet stamped on crank web No.3 (Crankshaft pin diameter)	A	Green	Black	Nothing
	B	Black	Nothing	Yellow
	C	Nothing	Yellow	Blue
		New standard bearing to be installed.		

Main Bearings, Crankshaft and Cylinder Block Components

S4RS0B1406036



I4RS0A140016-01

<p>1. CKP sensor (if equipped) : See "A"</p>	<p>11. Rear oil seal</p>	<p>21. Oil filter adapter bolt</p>
<p>2. Knock sensor</p>	<p>12. Input shaft bearing (For A/T and M/T models)</p>	<p>22. Spring pin</p>

1D-57 Engine Mechanical:

3. Cylinder block	13. Flywheel or drive plate	23. Sensor plate bolt
4. Venturi plug	14. Main bearing cap	24. Oil pressure switch
 5. Main bearing : See "B"	15. Flywheel or drive plate bolt	 (a) : 22 N·m (2.2 kgf-m, 16.0 lb-ft)
6. Sensor plate	16. Rear oil seal housing mounting bolt	 (b) : 5 N·m (0.5 kgf-m, 4.0 lb-ft)
7. Crankshaft timing sprocket key	17. Main bearing cap No.2 bolt	 (c) : 70 N·m (7.0 kgf-m, 51.0 lb-ft)
8. Crankshaft	 18. Main bearing cap No.1 bolt : See "D"	 (d) : Tighten 25 N·m (2.5 kgf-m, 18.0 lb-ft) by the specified procedure.
9. Thrust bearing	19. O-ring	 (e) : Tighten 30 N·m (3.0 kgf-m, 22.0 lb-ft), 50 N·m (5.0 kgf-m, 36.5 lb-ft) and 60° by the specified procedure.
 10. Rear oil seal housing : See "C"	20. Oil filter adapter case	 (f) : 11 N·m (1.1 kgf-m, 8.0 lb-ft)
"A": When installing CKP sensor, use new sensor mounting bolt.		 (g) : 13 N·m (1.3 kgf-m, 9.5 lb-ft)
"B": Upper half of bearing has an oil groove.		 (h) : 10 N·m (1.0 kgf-m, 7.5 lb-ft)
"C": Apply sealant 99000-31250 to mating surface.		 : Do not reuse.
"D": Make sure main bearing cap No.1 bolt deformation when reuse it due to plastic deformation tightening referring to "Main Bearings Inspection: "		 : Apply engine oil to inside / sliding surface.

Main Bearings, Crankshaft and Cylinder Block Removal and Installation

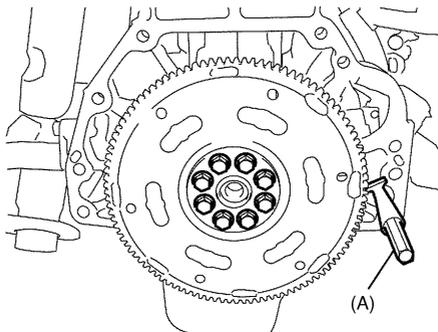
S4RS0B1406037

Removal

- 1) Remove engine assembly from vehicle referring to "Engine Assembly Removal and Installation: "
- 2) Remove clutch cover, clutch disc and flywheel (drive plate for A/T) by using special tool.

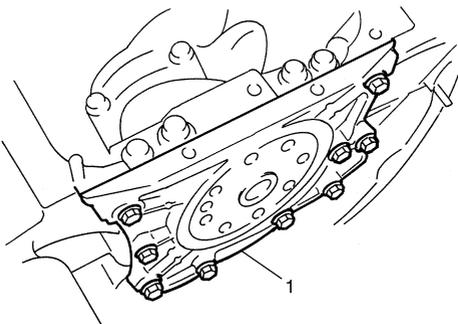
Special tool

(A): 09924-17810



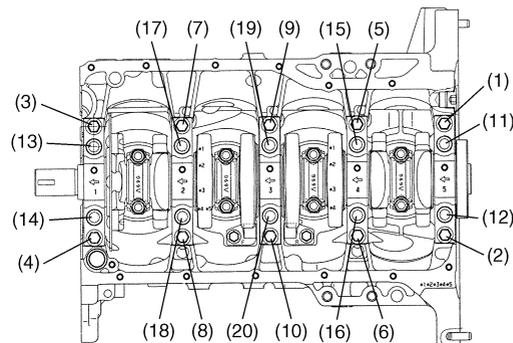
I2RH0B140125-01

- 3) Remove piston and connecting rod referring to "Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation: "
- 4) Remove rear oil seal housing (1).



I2RH0B140126-01

- 5) Loosen main bearing cap No.1 and No.2 bolts in such order as indicated in the figure and remove them.



I2RH0B140127-01

- 6) Remove crankshaft from cylinder block.

Installation

NOTE

- Use new bearing cap No.1 bolts. They are deformed once they are used because they are plastic deformation tightening bolts.
- All parts to be installed must be perfectly clean.
- Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, connecting rod bearings, pistons, piston rings and cylinder bores.
- Journal bearings, bearing caps, connecting rods, rod bearings, rod bearing caps, pistons and piston rings are in combination sets. Do not disturb such combination and make sure that each part goes back to where it came from, when installing.

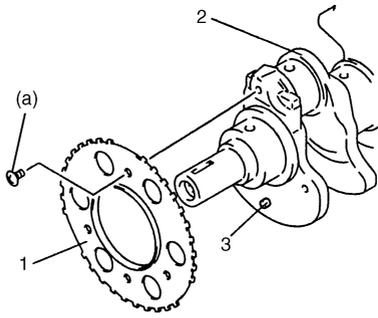
- 1) Install sensor plate (1) to crankshaft (2) and tighten bolts to specified torque.

NOTE

When installing sensor plate, align spring pin (3) on crankshaft and hole of sensor plate.

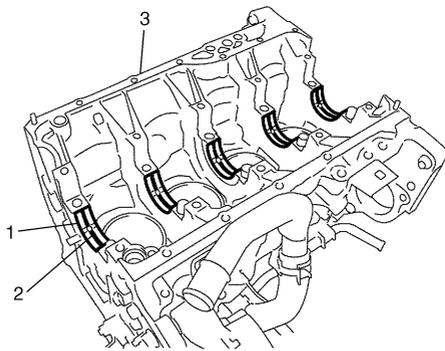
Tightening torque

Sensor plate bolt (a): 11 N·m (1.1 kgf-m, 8.0 lb-ft)



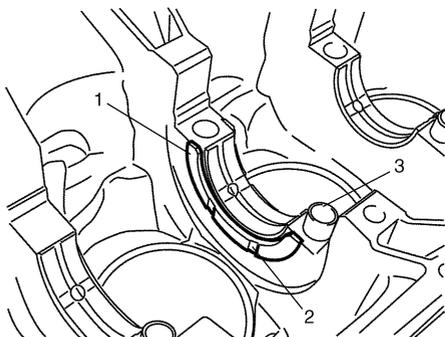
I2RH0B140128-01

- 2) Install main bearings to cylinder block. Upper half of bearing (1), has an oil groove (2). Install it to cylinder block (3), and the other half without oil groove to bearing cap. Make sure that two halves are painted in the same color.



I2RH0B140129-01

- 3) Install thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.
- 4) Confirm that dowel pins (3) are installed to intake side of each journal.



I2RH0B140130-01

- 5) Install crankshaft to cylinder block.
- 6) Install bearing cap to cylinder block, making sure to point arrow mark (on each cap) to crankshaft pulley side. Fit them sequentially in ascending order, 1, 2, 3, 4 and 5, starting from pulley side. After applying engine oil to main bearing cap No.1 bolts ((1) – (10)) and main bearing cap No.2 bolts ((11) – (20)), tighten them gradually as follows.

- a) Tighten bolts ((1) – (10)) to 30 N·m (3.0 kgf·m, 22.0 lb·ft) according to numerical order as shown by using a 12 corner socket wrenches.
- b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kgf·m, 36.5 lb·ft).
- c) In the same manner as in Step a), retighten them to 60°.
- d) Tighten bolts ((11) – (20)) to 25 N·m (2.5 kgf·m, 18.0 lb·ft) according to numerical order as shown.

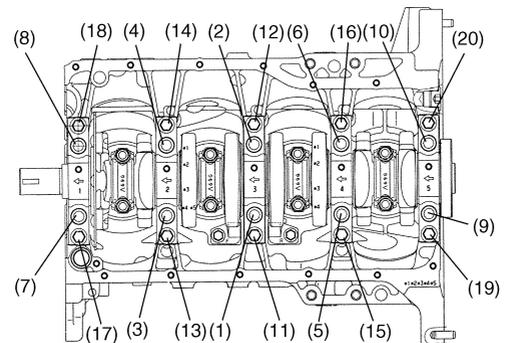
Tightening torque

Main bearing cap No.1 bolt ((1) – (10)): 30 N·m (3.0 kgf·m, 22.0 lb·ft), 50 N·m (5.0 kgf·m, 36.5 lb·ft) and then retighten by turning through 60°

Main bearing cap No.2 bolt ((11) – (20)): 25 N·m (2.5 kgf·m, 18.0 lb·ft)

⚠ CAUTION

After tightening cap bolts, check to be sure that crankshaft rotates smoothly when turning it by 12 N·m (1.2 kgf·m, 9.0 lb·ft) torque or below.



I2RH0B140131-01

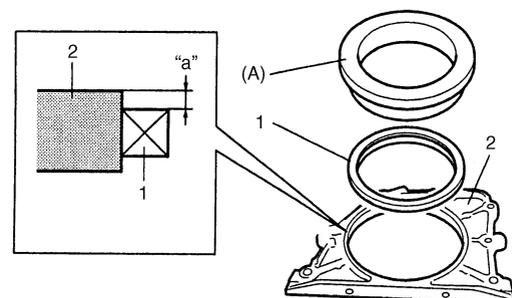
- 7) If necessary, press-fit rear oil seal (1) to oil seal housing (2) by using special tool as shown in the figure.

Special tool

(A): 09911–97820

Crank rear oil seal installing position (dimension)

“a”: 2 mm (0.08 in.)



I4RS0A140017-01

1D-59 Engine Mechanical:

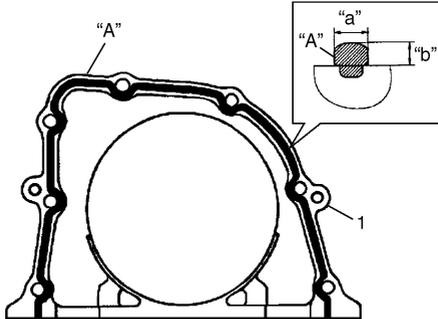
- 8) Apply sealant to mating surface of rear oil seal housing (1).

“A”: Water tight sealant 99000–31250

Sealant amount for rear oil seal housing

Width “a”: 3 mm (0.12 in.)

Height “b”: 2 mm (0.08 in.)



I4RS0A140018-01

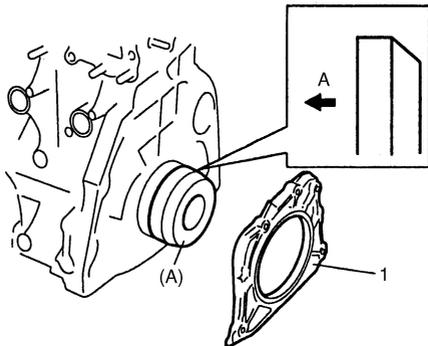
- 9) Install rear oil seal housing (1) and tighten bolts to specified torque by using special tool.

Special tool

(A): 09911–97720

Tightening torque

Rear oil seal housing bolt: 11 N·m (1.1 kgf·m, 8.0 lb-ft)



I4RS0A140019-01

A: Crankshaft side

- 10) Install flywheel (drive plate for A/T).
Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts to specified torque.

NOTE

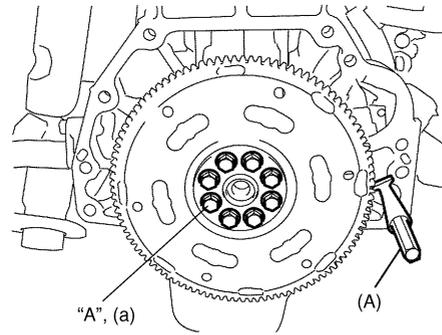
Use new flywheel or drive plate bolts.

Special tool

(A): 09924–17810

Tightening torque

Flywheel or drive plate bolt (a): 70 N·m (7.0 kgf·m, 51.0 lb-ft)



I2RH0B140134-01

- 11) Install piston and connecting rod referring to “Pistons, Piston Rings, Connecting Rods and Cylinders Removal and Installation:”.
- 12) Install cylinder head referring to “Valves and Cylinder Head Removal and Installation:”.
- 13) Install camshafts, tappet and shim referring to “Camshaft, Tappet and Shim Removal and Installation:”.
- 14) Install timing chain referring to “Timing Chain and Chain Tensioner Removal and Installation:”.
- 15) Install timing chain cover referring to “Timing Chain Cover Removal and Installation:”.
- 16) Install cylinder head cover referring to “Cylinder Head Cover Removal and Installation:”.
- 17) Install oil pan referring to “Oil Pan and Oil Pump Strainer Removal and Installation: in Section 1E”
- 18) Install engine assembly to vehicle referring to “Engine Assembly Removal and Installation:”.

Crankshaft Inspection

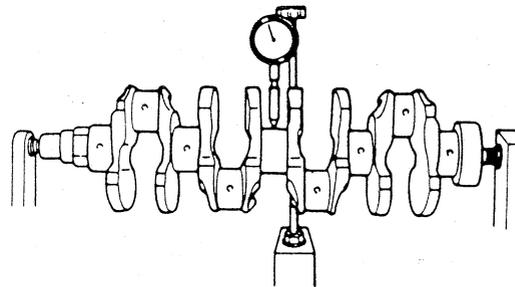
S4RS0B1406038

Crankshaft Runout

Using a dial gauge, measure runout at center journal. Rotate crankshaft slowly. If runout exceeds its limit, replace crankshaft.

Crankshaft runout

Limit: 0.02 mm (0.0008 in.)



I2RH0B140135-01

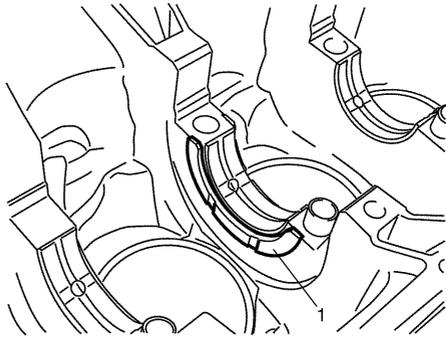
Crankshaft Thrust Play

- 1) Measure this play with crankshaft set in cylinder block in the normal manner, that is with thrust bearing (1) and journal bearing caps installed.

Thickness of crankshaft thrust bearing

Standard: 2.500 mm (0.0984 in.)

Oversize (0.125 mm (0.0049 in.)): 2.563 mm (0.1009 in.)



I2RH0B140136-01

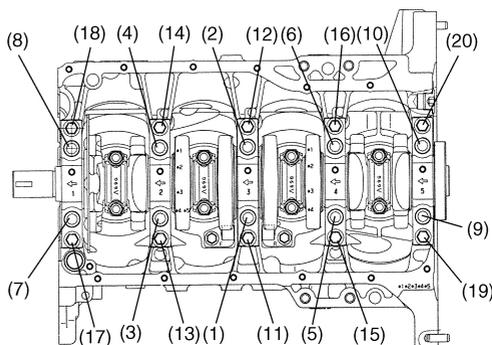
2) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing cap No.2 bolts (11) – (20) gradually as follows.

- a) Tighten bolts (1) – (10) to 30 N·m (3.0 kgf·m, 22.0 lb·ft) according to numerical order in the figure.
- b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kgf·m, 36.5 lb·ft).
- c) In the same manner as in Step a), retighten them to 60°.
- d) Tighten bolts (11) – (20) to 25 N·m (2.5 kgf·m, 18.0 lb·ft) according to numerical order in the figure.

Tightening torque

Main bearing cap No.1 bolt ((1) – (10)): 30 N·m (3.0 kgf·m, 22.0 lb·ft), 50 N·m (5.0 kgf·m, 36.5 lb·ft) and then retighten by turning through 60°

Main bearing cap No.2 bolt ((11) – (20)): 25 N·m (2.5 kgf·m, 18.0 lb·ft)



I2RH0B140137-01

3) Use a dial gauge to read displacement in axial (thrust) direction of crankshaft. If its limit is exceeded, replace thrust bearing with new standard one or oversize one to obtain standard thrust play.

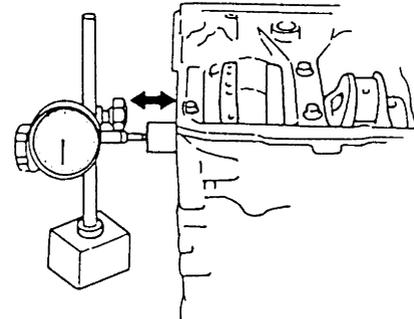
Crankshaft thrust play

Standard: 0.11 – 0.31 mm (0.0043 – 0.0122 in.)

Limit: 0.35 mm (0.0138 in.)

NOTE

After checking the thrust play, make sure that thread deformation of each bearing cap No.1 bolt referring to “Main Bearing Cap No.1 Bolt” in “Main Bearings Inspection: ”.



I2RH01140183-01

Out-of-Round and Taper (Uneven Wear) of Journals

An unevenly worn crankshaft journal shows up as a difference in diameter at a cross section or along its length (or both). This difference, if any, is determined by taking micrometer readings. If any one of journals is badly damaged or if amount of uneven wear in the sense exceeds its limit, regrind or replace crankshaft.

Crankshaft out-of-round and taper

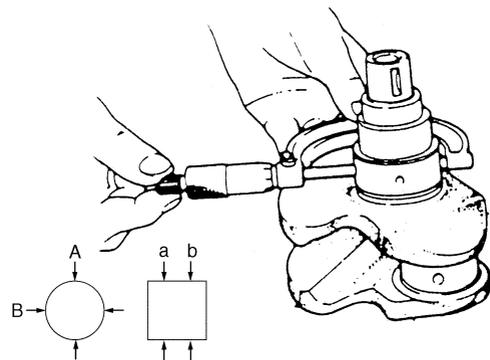
Limit: 0.01 mm (0.0004 in.)

Out-of-round

A – B

Taper

a – b



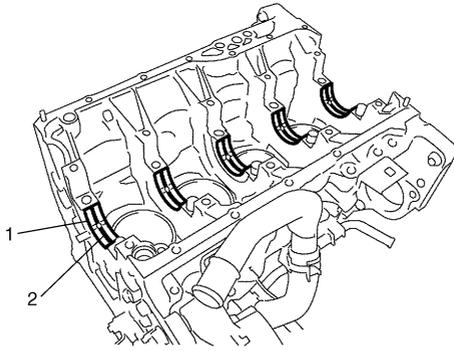
I2RH0B140138-01

Main Bearings Inspection

S4RS0B1406039

General Information

- Service main bearings are available in standard size and 0.25 mm (0.0098 in.) undersize, and each of them has 5 kinds of bearings differing in tolerance.
- Upper half of bearing (1) has oil groove (2) as shown in the figure. Install this half with oil groove to cylinder block.
- Lower half of bearing does not have an oil groove.



I2RH0B140139-01

Visual Inspection

Check bearings for pitting, scratches, wear or damage. If any malfunction is found, replace both upper and lower halves. Never replace either half without replacing the other half.

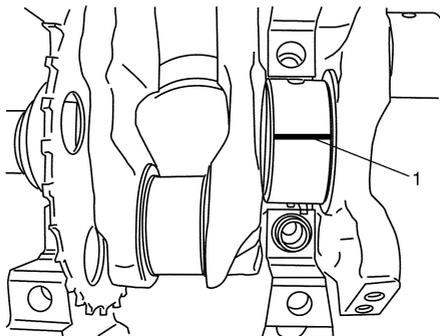
Main Bearing Clearance

NOTE

Do not rotate crankshaft while gauging plastic is installed.

Check clearance by using gauging plastic according to the following procedure.

- 1) Remove bearing caps.
- 2) Clean bearings and main journals.
- 3) Place a piece of gauging plastic (1) the full width of bearing (parallel to crankshaft) on journal, avoiding oil hole.



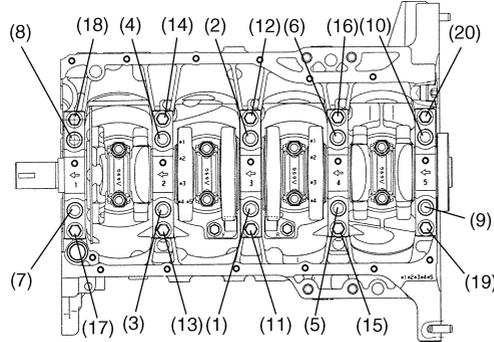
I2RH0B140140-01

- 4) Tighten main bearing cap No.1 bolts (1) – (10) and main bearing cap No.2 bolts (11) – (20) gradually as follows.
 - a) Tighten bolts (1) – (10) to 30 N·m (3.0 kgf-m, 22.0 lb-ft) according to numerical order in the figure.
 - b) In the same manner as in Step a), tighten them to 50 N·m (5.0 kgf-m, 36.5 lb-ft).
 - c) In the same manner as in Step a), retighten them to 60°.
 - d) Tighten bolts (11) – (20) to 25 N·m (2.5 kgf-m, 18.0 lb-ft) according to numerical order in the figure.

Tightening torque

Main bearing cap No.1 bolt ((1) – (10)): 30 Nm (3.0 kgf-m, 22.0 lb-ft), 50 Nm (5.0 kgf-m, 36.5 lb-ft) and then retighten by turning through 60°

Main bearing cap No.2 bolt ((11) – (20)): 25 N·m (2.5 kgf-m, 18.0 lb-ft)



I2RH0B140137-01

- 5) Remove bearing caps and using scale (1) on gauging plastic envelop (2), measure gauging plastic width at its widest point. If clearance exceeds its limit, replace bearing. Always replace both upper and lower inserts as a unit.

A new standard bearing may produce proper clearance. If not, it will be necessary to regrind crankshaft journal for use of 0.25 mm undersize bearing.

After selecting new bearing, recheck clearance.

Main bearing clearance

[For M15 engine]

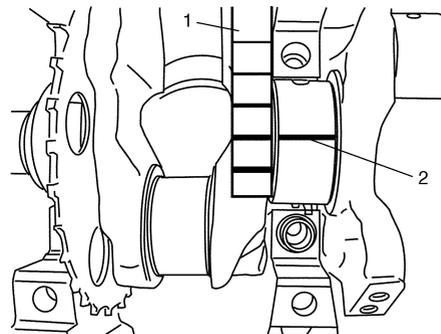
Standard: 0.021 – 0.041 mm (0.0008 – 0.0016 in.)

Limit: 0.054 mm (0.0021 in.)

[For M13 engine]

Standard: 0.025 – 0.045 mm (0.0010 – 0.0018 in.)

Limit: 0.065 mm (0.0026 in.)



I2RH0B140141-01

Selection of Main Bearings

Standard bearing

If bearing is in malfunction, or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.

- 1) First check journal diameter. As shown in the figure, crank web No.2 has stamped numbers.

Three kinds of numbers (“1”, “2” and “3”) represent the following journal diameters.

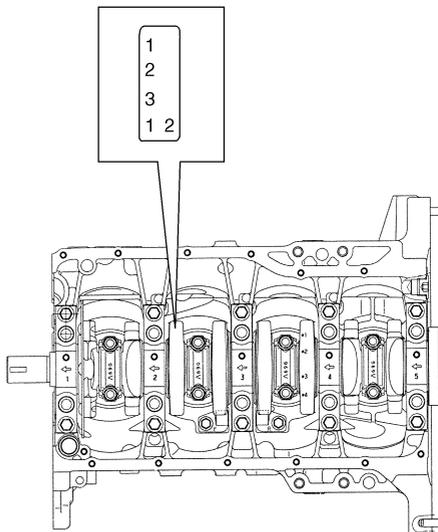
Stamped numbers on crank web No.2 represent journal diameters marked with an arrow in the figure respectively. For example of M15 engine, stamped number “1” indicates that corresponding journal diameter is 51.9940 – 52.0000 mm (2.0471 – 2.0472 in.).

Crankshaft journal diameter
[For M15 engine]

Stamped numbers	Journal diameter
1	51.9940 – 52.0000 mm (2.0471 – 2.0472 in.)
2	51.9880 – 51.9939 mm (2.0468 – 2.0470 in.)
3	51.9820 – 51.9879 mm (2.0465 – 2.0467 in.)

[For M13 engine]

Stamped numbers	Journal diameter
1	44.9940 – 45.0000 mm (1.7715 – 1.7716 in.)
2	44.9880 – 44.9939 mm (1.7712 – 1.7714 in.)
3	44.9820 – 44.9879 mm (1.7710 – 1.7711 in.)



I2RH0B140142-01

- Next, check bearing cap bore diameter without bearing. On mating surface of cylinder block, five alphabets are stamped as shown in the figure. Three kinds of alphabets (“A”, “B” and “C”) or numbers (“1”, “2” and “3”) represent the following cap bore diameters. Stamped alphabets or numbers on cylinder block represent bearing cap bore diameter marked with an arrow in the figure respectively.

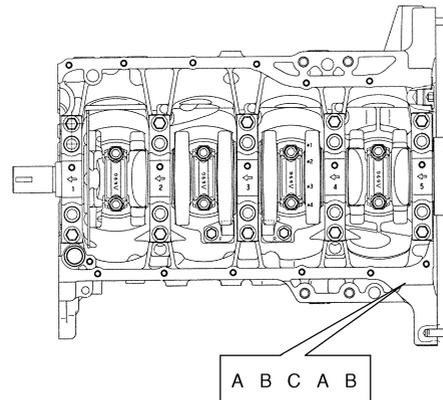
For example of M15 engine, stamped “A” or “1” indicates that corresponding bearing cap bore diameter is 56.0000 – 56.0060 mm (2.2048 – 2.2049 in.).

Crankshaft bearing cap bore
[For M15 engine]

Stamped alphabet (number)	Bearing cap bore diameter (without bearing)
A or 1	56.0000 – 56.0060 mm (2.2048 – 2.2049 in.)
B or 2	56.0061 – 56.0120 mm (2.2050 – 2.2051 in.)
C or 3	56.0121 – 56.0180 mm (2.2052 – 2.2054 in.)

[For M13 engine]

Stamped alphabet (number)	Bearing cap bore diameter (without bearing)
A or 1	49.0000 – 49.0060 mm (1.9292 – 1.9293 in.)
B or 2	49.0061 – 49.0120 mm (1.9294 – 1.9296 in.)
C or 3	49.0121 – 49.0180 mm (1.9297 – 1.9298 in.)



I2RH0B140143-01

1D-63 Engine Mechanical:

3) There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted in the following colors at the position as indicated in the figure.

Each color indicated the following thickness at the center of bearing.

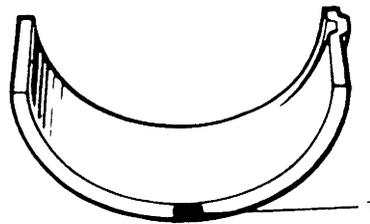
Standard size of crankshaft main bearing thickness

[For M15 engine]

Color painted	Bearing thickness
Purple	1.992 – 1.996 mm (0.07843 – 0.07858 in.)
Brown	1.995 – 1.999 mm (0.07855 – 0.07870 in.)
Green	1.998 – 2.002 mm (0.07867 – 0.07882 in.)
Black	2.001 – 2.005 mm (0.07878 – 0.07893 in.)
Colorless (no paint)	2.004 – 2.008 mm (0.07890 – 0.07906 in.)

[For M13 engine]

Color painted	Bearing thickness
Pink	1.990 – 1.994 mm (0.0783 – 0.0785 in.)
Purple	1.993 – 1.997 mm (0.0785 – 0.0786 in.)
Brown	1.996 – 2.000 mm (0.0786 – 0.0787 in.)
Green	1.999 – 2.003 mm (0.0787 – 0.0789 in.)
Black	2.002 – 2.006 mm (0.0788 – 0.0790 in.)



I2RH01140191-01

1. Paint

4) From number stamped on crank web No.2 and alphabets stamped on cylinder block, determine new standard bearing to be installed to journal, by referring to the table shown.

For example of M15 engine, if number stamped on crank web No.2 is “1” and alphabet stamped on cylinder block is “B”, install a new standard bearing painted in “Brown” to its journal.

New standard size crankshaft main bearing specification

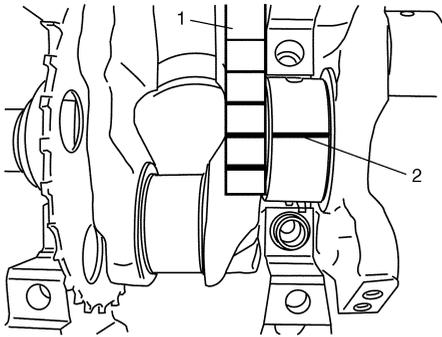
[For M15 engine]

		Number stamped on crank web No.2 (Journal diameter)		
		1	2	3
Alphabet stamped on cylinder block (Cap bore dia.)	A or 1	Purple	Brown	Green
	B or 2	Brown	Green	Black
	C or 3	Green	Black	Colorless
		New standard bearing to be installed		

[For M13 engine]

		Number stamped on crank web No.2 (Journal diameter)		
		1	2	3
Alphabet stamped on cylinder block (Cap bore dia.)	A or 1	Pink	Purple	Brown
	B or 2	Purple	Brown	Green
	C or 3	Brown	Green	Black
		New standard bearing to be installed		

5) Using scale (1) on gauging plastic (2), check bearing clearance with newly selected standard bearing. If clearance still exceeds its limit, use next thicker bearing and recheck clearance.



I2RH0B140141-01

6) When replacing crankshaft or cylinder block due to any reason, select new standard bearings to be installed by referring to number stamped on new crankshaft or alphabets stamped on new cylinder block.

Undersize bearing (0.25 mm (0.0098 in.))

- 0.25 mm (0.0098 in.) undersize bearing is available, in five kinds varying in thickness. To distinguish them, each bearing is painted in the following colors at such position as indicated in the figure. Each color represents the following thickness at the center of bearing.

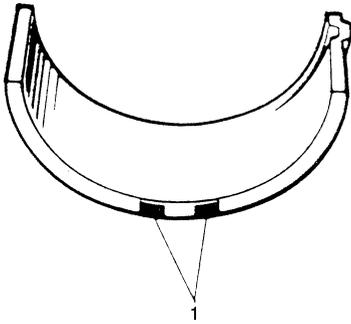
Undersize of crankshaft main bearing thickness

[For M15 engine]

Color painted	Bearing thickness
Red and Purple	2.117 – 2.121 mm (0.08335 – 0.08350 in.)
Red and Brown	2.120 – 2.124 mm (0.08347 – 0.08362 in.)
Red and Green	2.123 – 2.127 mm (0.08359 – 0.08374 in.)
Red and Black	2.126 – 2.130 mm (0.08371 – 0.08385 in.)
Red only	2.129 – 2.133 mm (0.08382 – 0.08397 in.)

[For M13 engine]

Color painted	Bearing thickness
Red and Pink	2.115 – 2.119 mm (0.0833 – 0.0834 in.)
Red and Purple	2.118 – 2.122 mm (0.0834 – 0.0835 in.)
Red and Brown	2.121 – 2.125 mm (0.0835 – 0.0837 in.)
Red and Green	2.124 – 2.128 mm (0.0836 – 0.0838 in.)
Red and Black	2.127 – 2.131 mm (0.0837 – 0.0839 in.)



I2RH01140192-01

1. Paint

- If necessary, regrind crankshaft journal and select undersize bearing to use with it as follows.
 - Regrind journal to the following finished diameter.

Finished journal diameter

[For M15 engine]

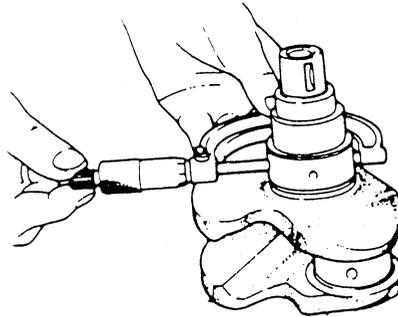
51.7320 – 51.7500 mm (2.0367 – 2.0374 in.)

[For M13 engine]

44.7320 – 44.7500 mm (1.7611 – 1.7618 in.)

1D-65 Engine Mechanical:

- b. Using micrometer, measure regrind journal diameter.
Measurement should be taken in two directions perpendicular to each other in order to check for out-of-round.
- c. Using journal diameter measured above and alphabets stamped on cylinder block, select an undersize bearing by referring to the following table.
Check bearing clearance with newly selected undersize bearing.



I2RH0B140144-01

New undersize crankshaft main bearing specification
[For M15 engine]

		Measured journal diameter		
		51.7320 – 51.7379 mm (2.0367 – 2.0369 in.)	51.7380 – 51.7439 mm (2.0370 – 2.0371 in.)	51.7440 – 51.7500 mm (2.0372 – 2.0373 in.)
Alphabets stamped on cylinder block	A (1)	Red and Green	Red and Brown	Red and Purple
	B (2)	Red and Black	Red and Green	Red and Brown
	C (3)	Red only	Red and Black	Red and Green
Undersize bearing to be installed				

[For M13 engine]

		Measured journal diameter		
		44.7320 – 44.7379 mm (1.7611 – 1.7613 in.)	44.7380 – 44.7439 mm (1.7614 – 1.7615 in.)	44.7440 – 44.7500 mm (1.7616 – 1.7618 in.)
Alphabets stamped on cylinder block	A (1)	Red and Brown	Red and Purple	Red and Pink
	B (2)	Red and Green	Red and Brown	Red and Purple
	C (3)	Red and Black	Red and Green	Red and Brown
Undersize bearing to be installed				

Main Bearing Cap No.1 Bolt

Measure each thread diameter main bearing cap No.1 bolts (1) at "A" on 60 mm (2.36 in.) from seat side of flange bolt and "B" on 90 mm (3.54 in.) from seat side of flange bolt by using a micrometer (2).
Calculate difference in diameters ("A" – "B").
If it exceeds limit, replace with new one.

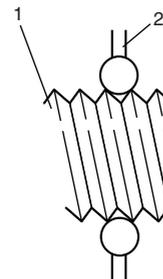
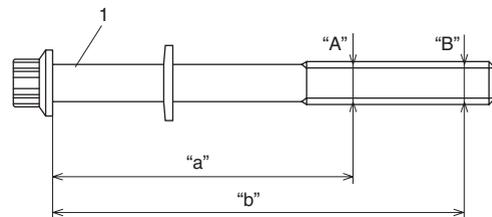
Main bearing cap No.1 bolt diameter measurement points

"a": 60 mm (2.36 in.)

"b": 90 mm (3.54 in.)

Main bearing cap No.1 bolt diameter difference

Limit ("A" – "B"): 0.2 mm (0.008 in.)



I2RH0B140145-01