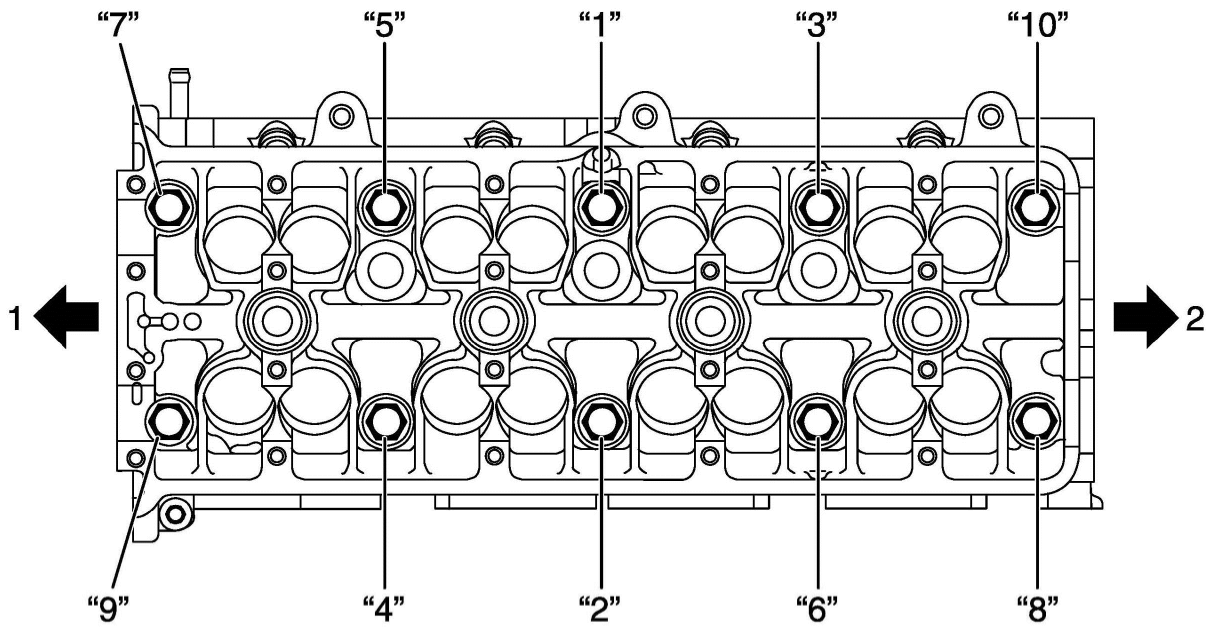


## Tightening Torque Specifications

Fastening part	Tightening torque		
	N-m	kgf-m	lb-ft
Camshaft housing bolt	11	1.1	8.0
Air cleaner outlet hose clamp	3	0.3	2.5
IMT valve actuator bolt	6	0.6	4.5
Cylinder head cover nut	Tighten 11 N-m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure		
Suspension frame mounting bolt	150	15.0	108.5
Front lower cross member bolt	55	5.5	40.0
Starting motor terminal nut	11	1.1	8.0
Generator terminal nut	5	0.5	4.0
Battery ground bolt	25	2.5	18.0
Ground terminal bolt	11	1.1	8.0
Timing chain cover bolt and nut	11	1.1	8.0
Idler pulley nut	42	4.2	30.5
Generator belt tensioner bolt	25	2.5	18.5
Crankshaft pulley bolt	150	15.0	108.5
Camshaft timing sprocket bolt	80	8.0	57.5
Timing chain tensioner adjuster No.2 bolt	11	1.1	8.0
Timing chain tensioner adjuster No.2 nut	45	4.5	33.0
Timing chain tensioner nut	25	2.5	18.0
Timing chain tensioner adjuster No.1 bolt	11	1.1	8.0
Timing chain guide No.1 bolt	9	0.9	6.5
Camshaft housing bolt	Tighten 11 N-m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure		
Cylinder head bolt (M10)	Tighten 52 N-m (5.2 kgf-m, 38.0 lb-ft), 82 N-m (8.2 kgf-m, 59.5 lb-ft), 0 N-m (0 kgf-m, 0 lb-ft), 52 N-m (5.2 kgf-m, 38.0 lb-ft) and 103 N-m (10.3 kgf-m, 74.5 lb-ft) by the specified procedure		
Cylinder head bolt (M6)	11	1.1	8.0
Connecting rod bolt	Tighten 15 N-m (1.5 kgf-m, 11.0 lb-ft), 45° and 45° by the specified procedure		
Cylinder block heater mounting bolt	11	1.1	8.0
Crankcase bolt with 10 mm thread diameter ((1) - (10))	Tighten 40 N-m (4.0 kgf-m, 29.0 lb-ft), 0 N-m (0 kgf-m, 0 lb-ft), 40 N-m (4.0 kgf-m, 29.0 lb-ft), 58 N-m (5.8 kgf-m, 42.0 lb-ft) by the specified procedure		
Crankcase bolt with 8 mm thread diameter ((11) - (22))	Tighten 26 N-m (2.6 kgf-m, 19.0 lb-ft) by the specified procedure		
CKP sensor bolt	11	1.1	8.0
Flywheel or drive plate bolt	70	7.0	51.0
Engine front mounting bracket bolt	55	5.5	40.0

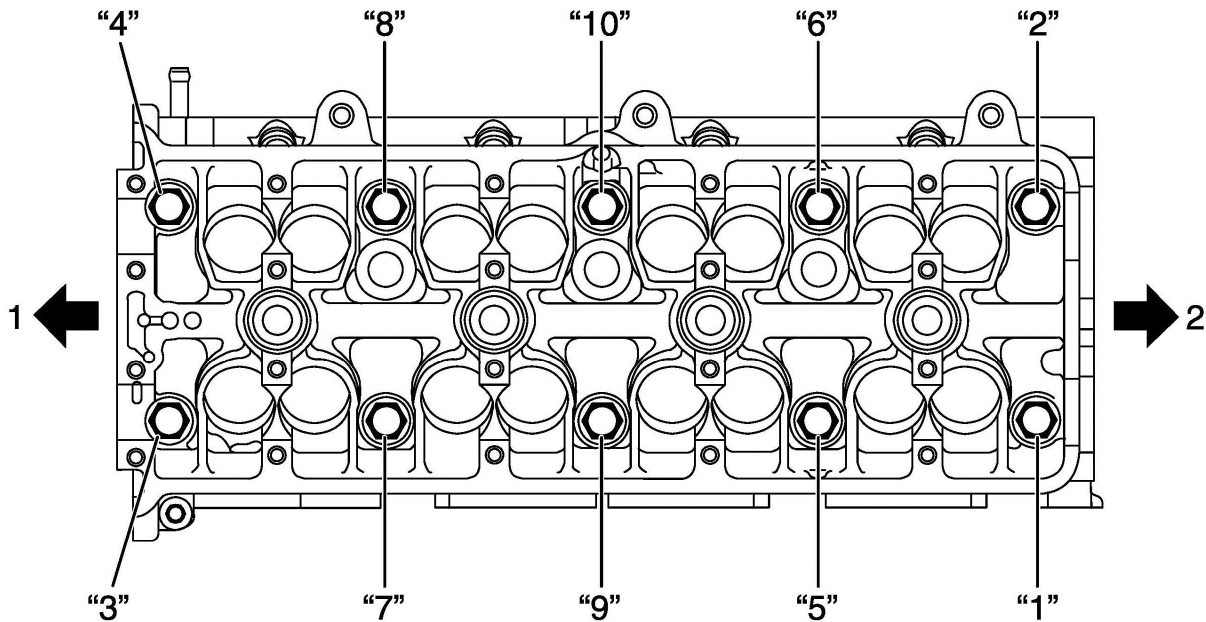
## Cylinder Head Torque and Sequence

1. Install cylinder head to cylinder block. Apply engine oil to cylinder head bolts and tighten them gradually as follows.
  - a. Tighten cylinder head bolts (M10) to **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)** according to numerical order in figure.
  - b. In the same manner as in step a), retighten cylinder head bolts (M10) to **82 Nm (8.2 kgf-m, 59.5 ft. lbs.)** .



1. Crankshaft pulley side	2. Flywheel side
---------------------------	------------------

c. Loosen cylinder head bolts (M10) until tightening torque is reduced to 0 according to numerical order in figure.



1. Crankshaft pulley side	2. Flywheel side
---------------------------	------------------

- d. Tighten cylinder head bolts (M10) to **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)** according to numerical order in figure.
- e. In the same manner as in step b), retighten cylinder head bolts (M10) to **103 Nm (10.3 kgf-m, 74.5 ft. lbs.)**.

f) Tighten cylinder head bolt (M6) to specified torque.

**Tightening torque**

Cylinder head bolt (M10) a: Tighten **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)**, **82 Nm (8.2 kgf-m, 59.5 ft. lbs.)**, **0 Nm (0 kgf-m, 0 ft. lbs.)**, **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)** and **103 Nm (10.3 kgf-m, 74.5 ft. lbs.)** by the specified procedure

Cylinder head bolt (M6) b: **11 Nm (1.1 kgf-m 8.0 ft. lbs.)**

**Cylinder Head Bolt Reusability**

No information provided by manufacturer

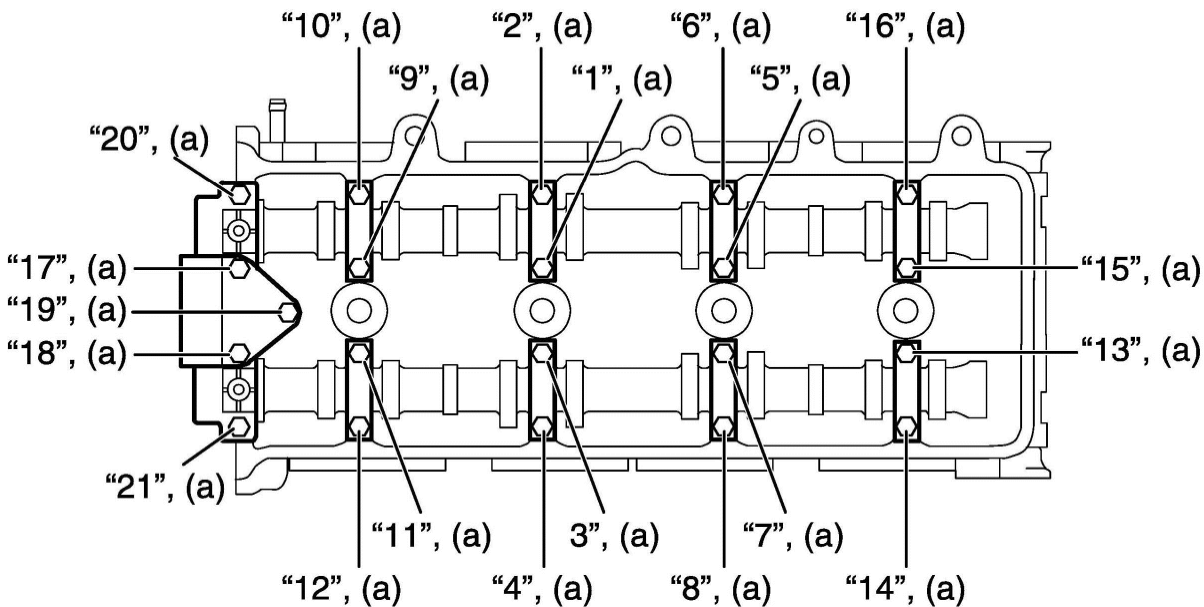
**Intake Manifold Torque and Sequence**

No sequence or torque given by manufacturer.

**Camshaft Bearing Cap Torque and Sequence**

Camshaft Housing Bolt (a)

11 Nm (1.1 kgf-m, 8.0 ft. lbs.)



## Main Bearing Cap Torque and Sequence

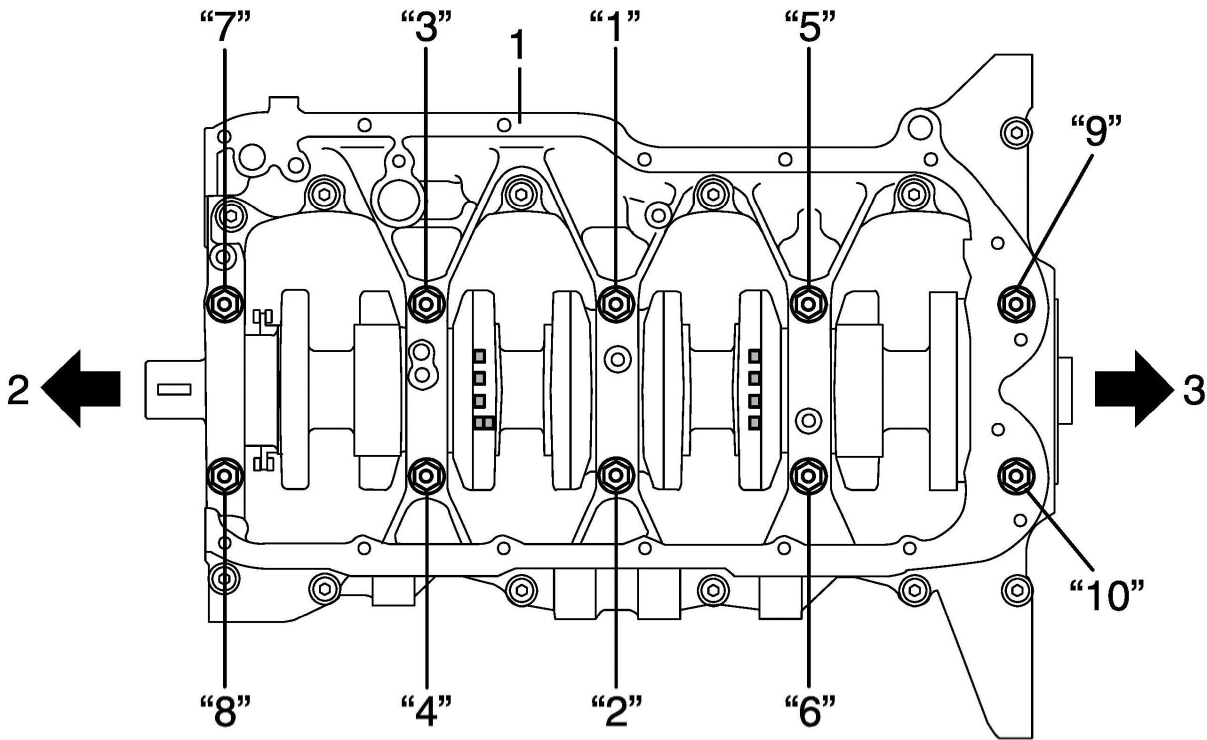
Crankcase bolts

a) 1 - 10

40 Nm (4.0 kgf-m, 29.0 ft. lbs.)

b) Loosen bolts 1 - 10

0 Nm (0 kgf-m, 0 ft. lbs.)



c) 1 - 10

40 Nm (4.0 kgf-m, 29.0 ft. lbs.)

d) Retighten bolts 1 - 10  
ft. lbs.)

58 Nm (5.8 kgf-m, 42.0

e) 11 - 22

26 Nm (2.6 kgf-m, 19.0 ft. lbs.)

## Connecting Rod Bearing Torque

Connecting Rod Bolt

15 Nm (1.5 kgf-m, 11.0 ft. lbs.), 45° and 45° again

## Crankshaft Pulley Torque

Crankshaft Pulley Bolt

150 Nm (108.5 ft. lbs./15 kgf-m)

## Flywheel/Flex Plate Torque and Sequence

Flywheel Or Drive Plate Bolt

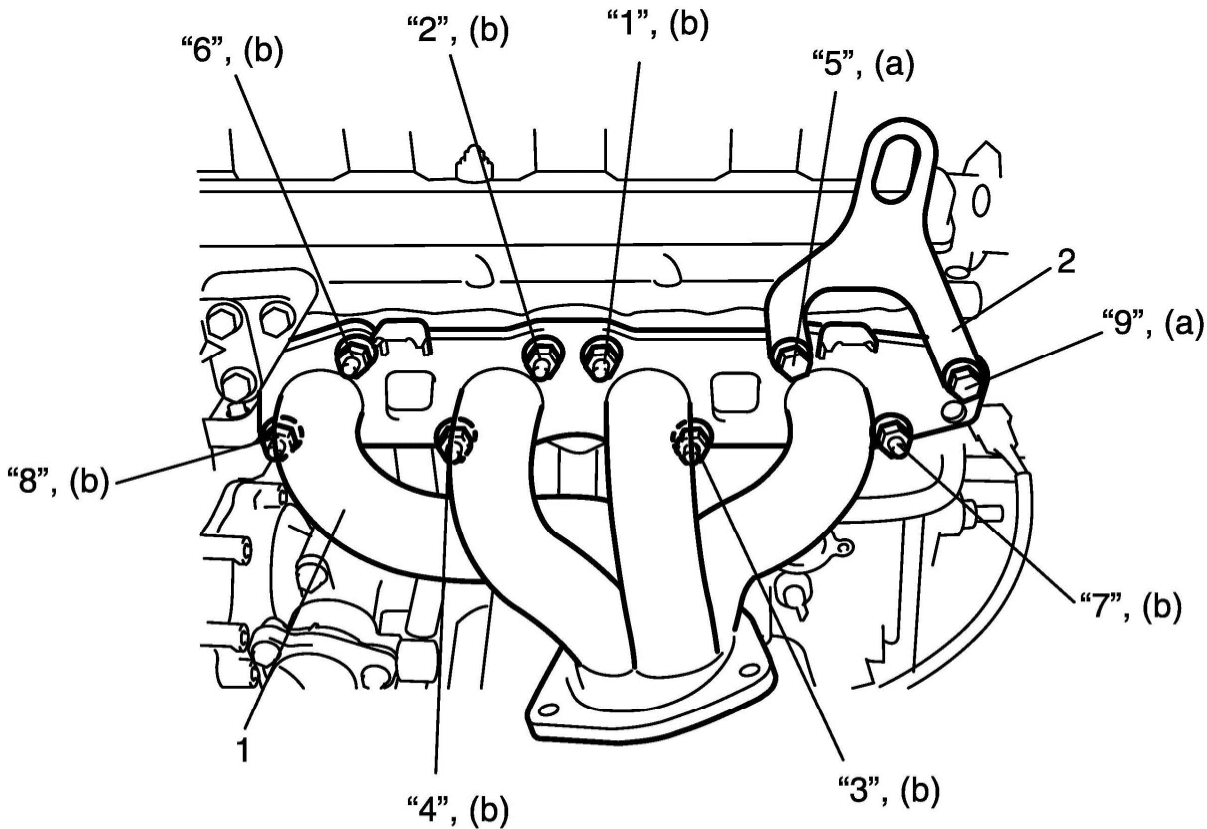
70 Nm (51.0 ft. lbs.)

## Oil Pump Torque and Sequence

Oil Pump Mounting Bolt (M8 bolt)	25 Nm (2.5 kgf-m, 18.0 ft. lbs.)
Baffle Plate Bolt (M6 bolt)	11 Nm (1.1 kgf-m, 8.0 ft. lbs.)

## Exhaust Manifold Torque and Sequence

Exhaust Manifold Bolt a	50 Nm (5.0 kgf-m, 36.5 ft. lbs.)
Exhaust Manifold Nut b	50 Nm (5.0 kgf-m, 36.5 ft. lbs.)



## Water Pump Torque and Sequence

Water Pump Bolt	25 Nm (2.5 kgf-m, 18.0 ft. lbs.)
-----------------	----------------------------------

## Recommended Service Material

### Recommended Service Material

Material	SUZUKI recommended product or Specification	
Sealant	SUZUKI Bond No.1217G	P/No.: 99000-31260
Thread lock cement	Thread Lock Cement Super 1322	P/No.: 99000-32110
Water tight sealant	SUZUKI Bond No.1207B	P/No.: 99000-31140
	SUZUKI Bond No.1207F	P/No.: 99000-31250

**NOTE:** Required service material is also described in the following.

Timing Chain Cover Components

2nd Timing Chain and Chain Tensioner Components

1st Timing Chain and Chain Tensioner Components

Camshaft, Tappet and Shim Components

Valves and Cylinder Head Components

Pistons C finders Components

Piston Rings

Connecting Rods and

Main Bearings, Crankshaft and Cylinder Block Components

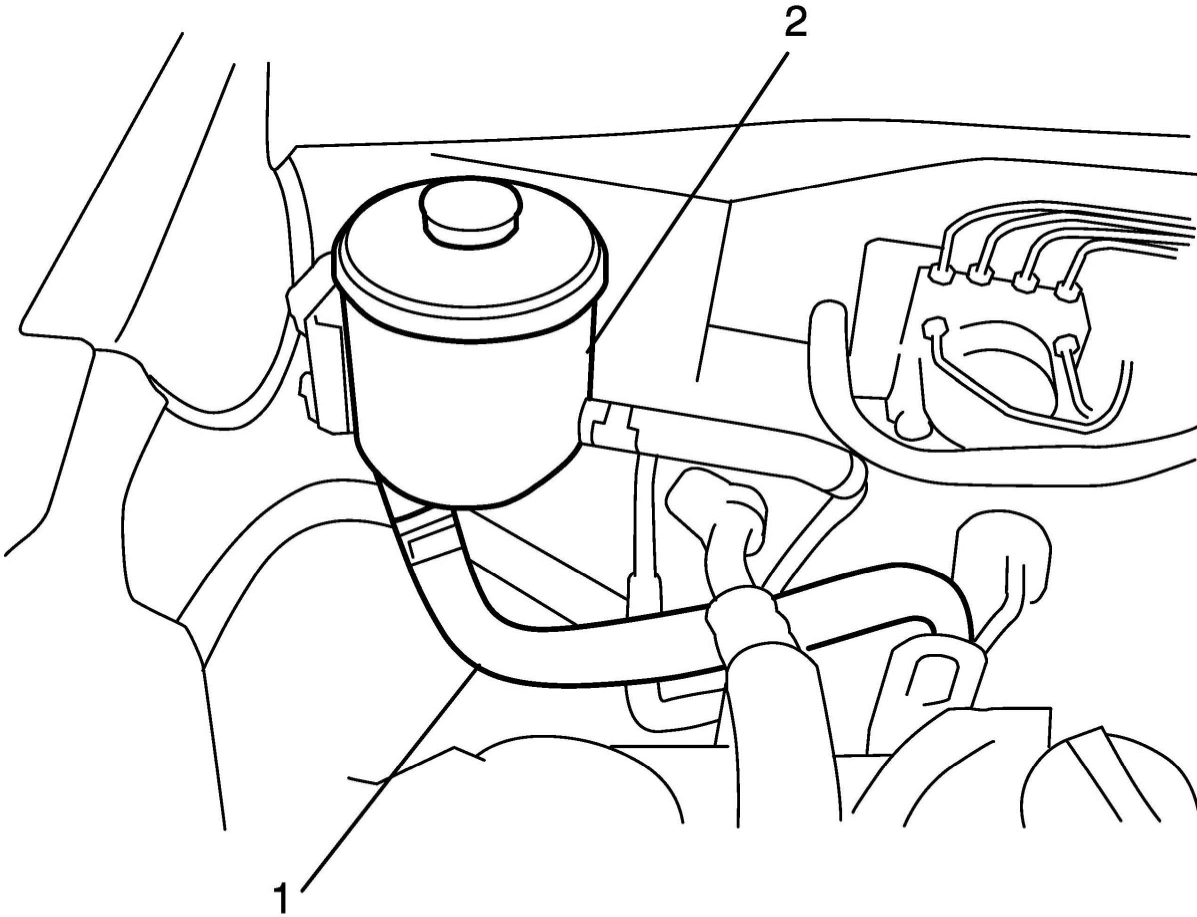
## **Engine Assembly Removal and Installation**

### **Removal**

1. Relieve fuel pressure according to Fuel Pressure Relief Procedure.
2. Disconnect negative and positive cables at battery.
3. Disconnect ECM connectors.
4. Remove battery and battery tray with ECM.
5. Remove right and left side engine under covers.
6. Remove water pump and generator drive belt.
7. Drain engine oil.
8. Drain transaxle oil.
9. Drain transfer oil (4WD model).
10. Drain coolant.
11. Remove air cleaner assembly.
12. With hose connected, detach A/C compressor from its bracket.

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

13. Remove condenser cooling fan from radiator.
14. Drain P/S fluid.
15. Disconnect P/S fluid reservoir hose (1) and then remove P/S fluid reservoir (2) from bracket.



16. Disconnect the following electric wires/connectors and each clamps.

- Electric throttle body (1)
- ECT sensor (2)
- CMP sensor (3)
- Ignition coil assembly (4)
- Injector (5)
- H02S (6)
- A/F sensor (7)
- Engine oil pressure switch (8)
- CKP sensor (9)
- Knock sensor (10)
- Generator (11)
- Starting motor (12)
- Ground terminal (13) from cylinder block
- Ground terminal (14) from exhaust manifold
- Battery ground cable (15) from transaxle
- Back-up light switch (16) (M/T model)
- Torque sensor (17) (electric P/S model)
- P/S motor (18) (electric P/S model)
- P/S pump (19) (hydraulic P/S model)
- Output shaft speed sensor (VSS) (20) (A/T model)
- Solenoid valve (21) (A/T model)

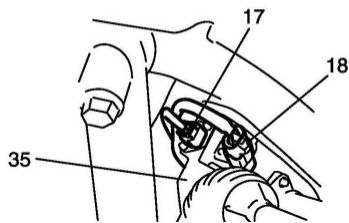
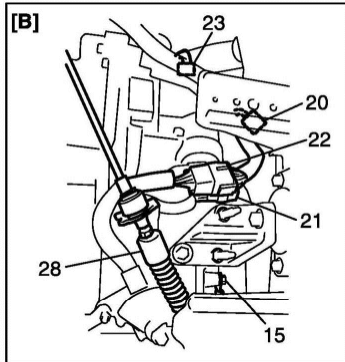
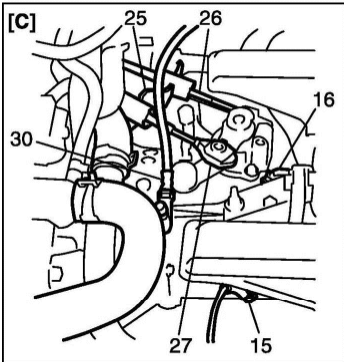
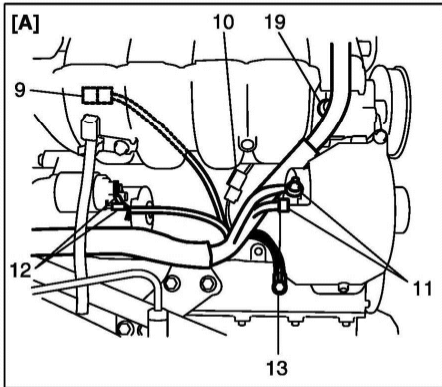
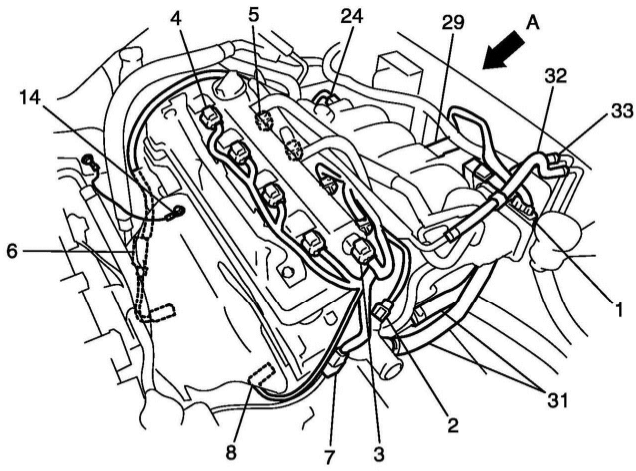
- Transmission range sensor (22) (A/T model)
- Input shaft speed sensor (23) (A/T model)
- IMT sensor (24)

17. Disconnect the following cables, and remove control cable bracket (25)

- Gear select control cable (26) (M/T model)
- Gear shift control cable (27) (M/T model)
- A/T select cable with select cable bracket (28) (A/T model)

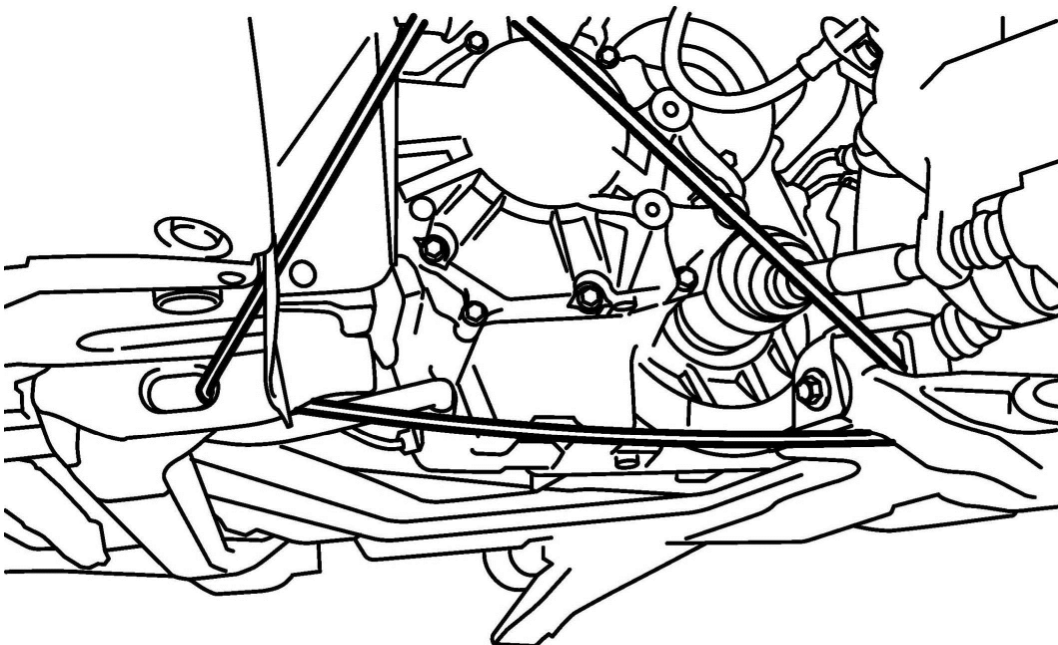
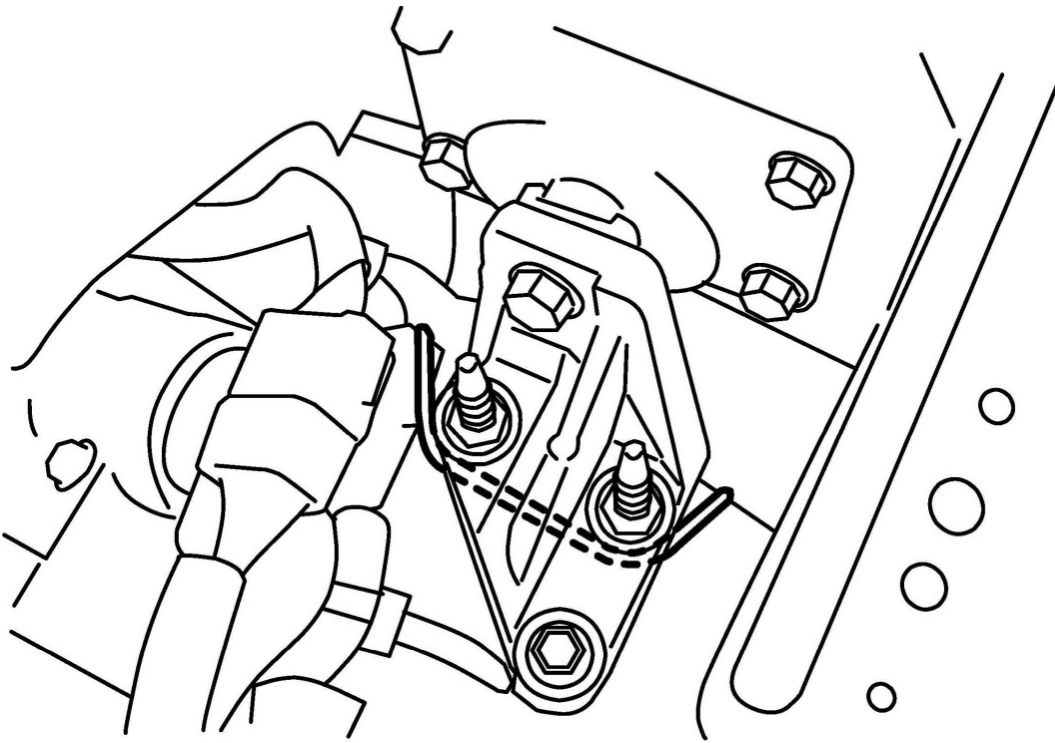
18. Disconnect the following hoses.

- Brake booster hose (29) from intake manifold
- Radiator inlet and outlet hoses from radiator
- Heater inlet and outlet hoses (31) from heater core
- Fuel feed hose (32) from fuel feed pipe
- Purge hose (33) from purge valve
- Clutch hose (30) from transaxle (M/T model)
- A/T fluid cooler hoses (A/T model)

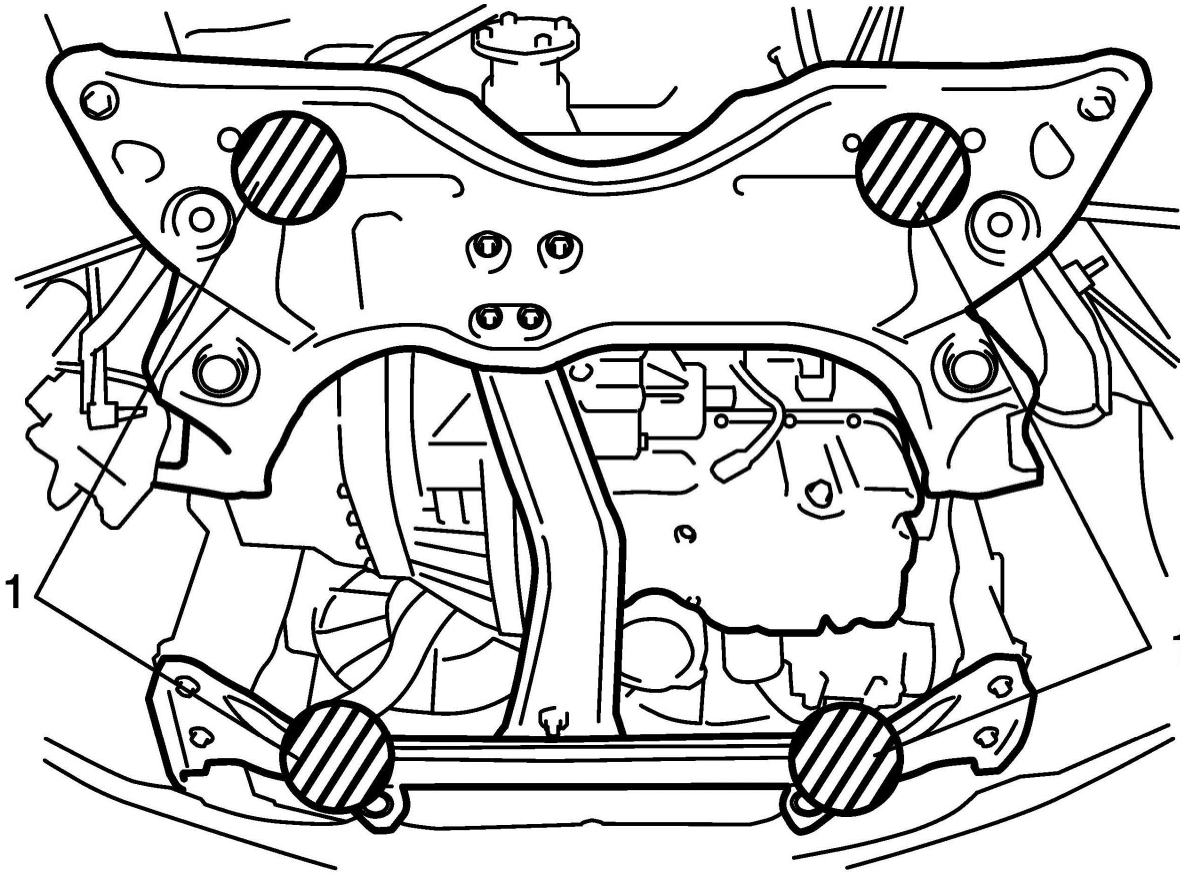


[A]: View A
[B]: A/T model
[C]: M/T model
35. Steering gear box (electric P/S model)

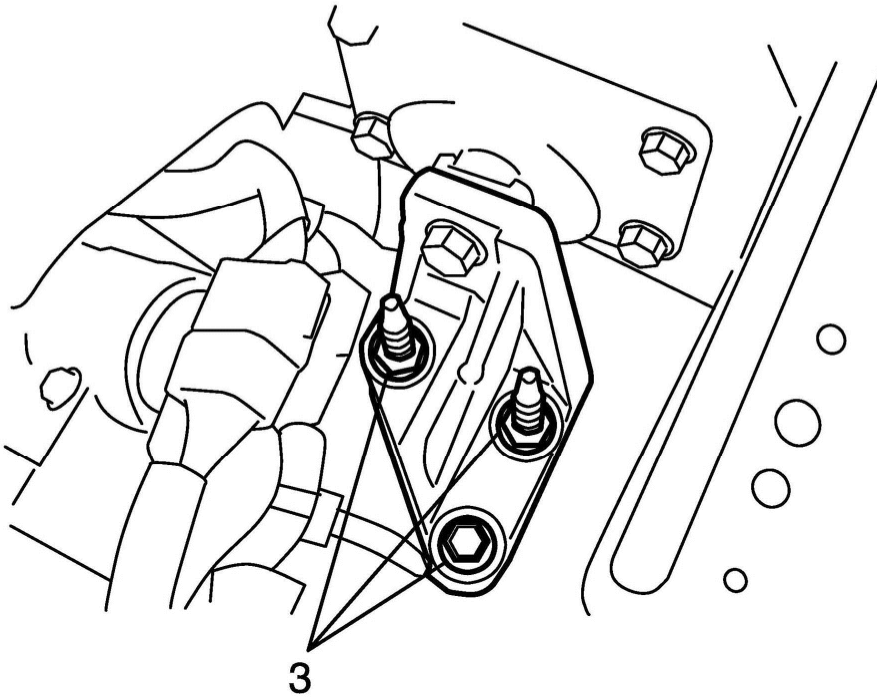
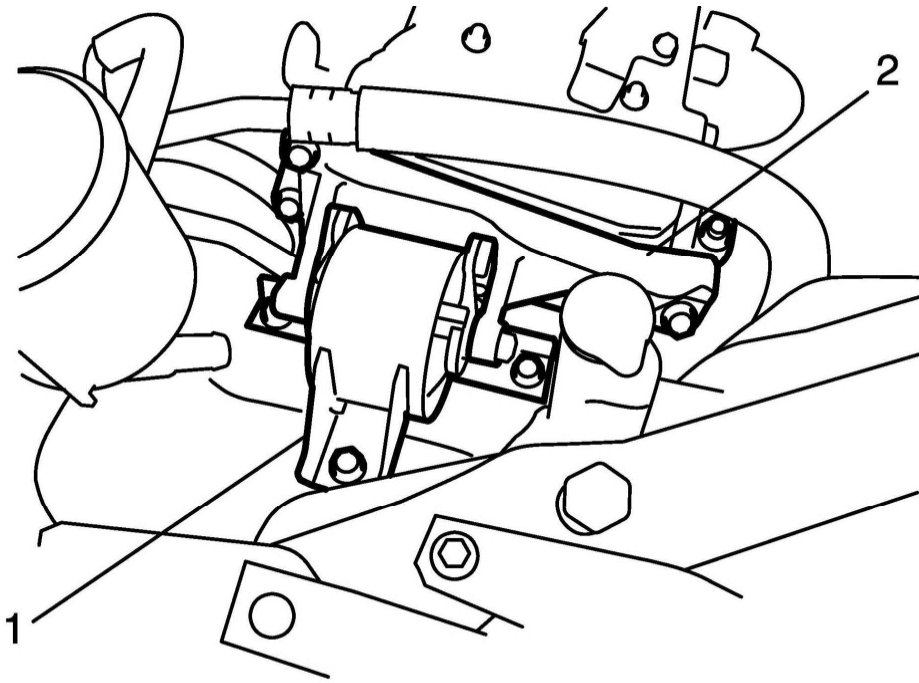
19. Disconnect right and left drive shaft joints from differential gear.
20. Remove exhaust center pipe.
21. Disconnect propeller shaft from transfer.
22. Disconnect steering lower shaft from pinion shaft.
23. Fix radiator to body with rope in order to avoid the radiator fall off when front lower cross member lowered.
24. Fix transaxle to suspension frame with rope in order to avoid the engine assembly inclines when engine assembly lowered.



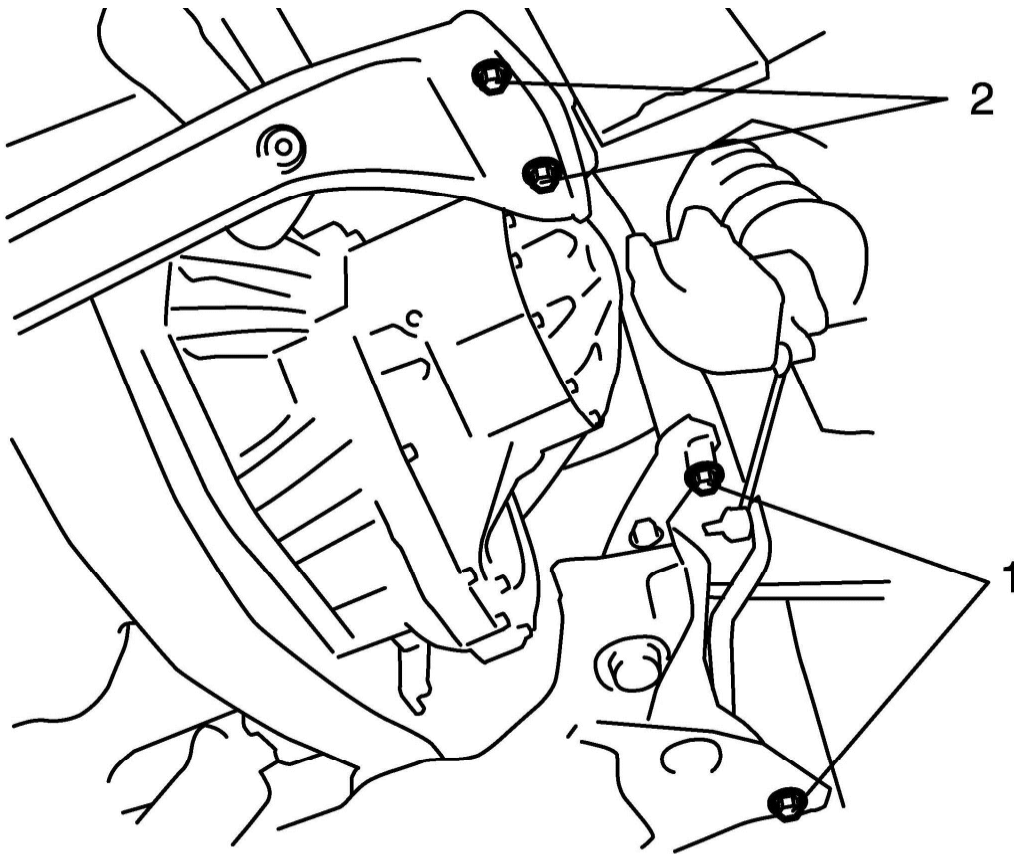
25. Support front suspension frame and front lower cross member using jack at hatched parts (1) indicated in figure.



26. Remove engine right mounting (1), engine right mounting No.1 bracket (2) and engine left mounting bracket bolt and nuts(3).



27. Remove suspension frame mounting bolts (1) and front lower cross member bolts (2).



28. Lower engine with transaxle, front suspension frame, front lower cross member, transfer (4WD model) and steering gear case.

**CAUTION: Before lowering engine, in order to avoid damage to A/C compressor, make clearance by rising it.**

29. Disconnect steering gear case from suspension frame.
30. Disconnect transfer.
31. Disconnect transaxle from engine.
32. Remove clutch cover and clutch disk.

### **Installation**

1. Install clutch cover and clutch disk.
2. Connect transaxle to engine.
3. Connect transfer to suspension frame.
4. Connect steering gear case to suspension frame.
5. Lift engine with transaxle, front suspension frame, front lower cross member, transfer (4WD model) and steering gear case into engine compartment with jack.

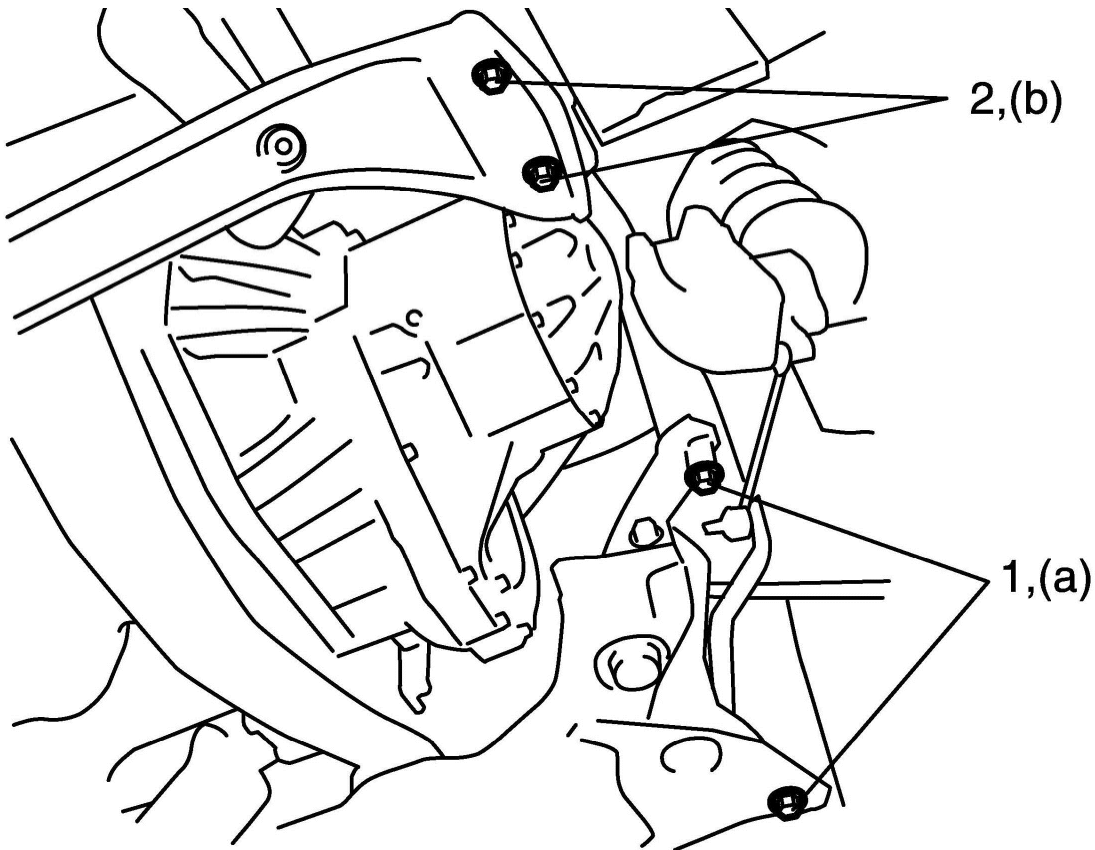
**CAUTION: Before lifting engine, in order to avoid damage to A/C compressor, make clearance by rising it.**

6. Tighten suspension frame mounting bolts and front lower cross member bolts, and then tighten bolts to specified torque.

Tightening torque

Suspension frame mounting bolt a: **150 Nm (15.0 kgf-m, 108.5 ft. lbs.)**

Front lower cross member bolt b: **55 Nm (5.5 kgf-m, 40.0 ft. lbs.)**



7. Install engine right mounting, engine right mounting No. 1 bracket and engine left mounting bracket, and then tighten bolts and nuts to specified torque.
8. Remove jack.
9. Connect steering lower shaft to pinion shaft.
10. Connect propeller shaft.
11. Install exhaust center pipe.
12. Connect right and left drive shaft joints to differential gear.
13. Reverse disconnected hoses, cables and electric wires for connection noting the following. Tighten bolts and nuts to specified torque.

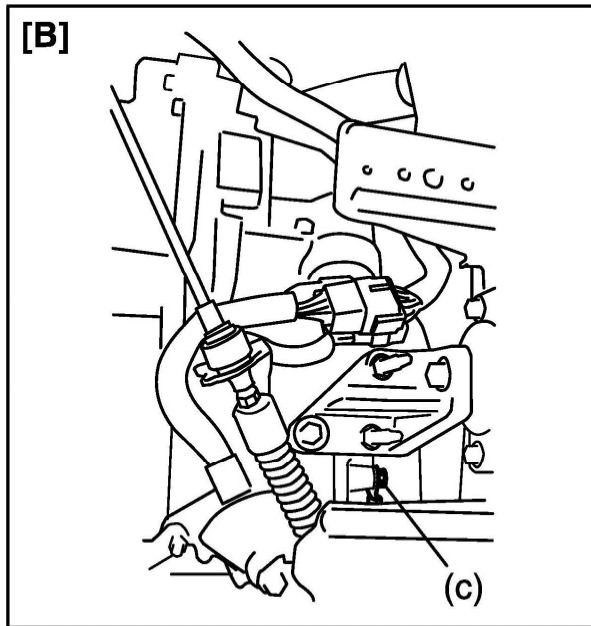
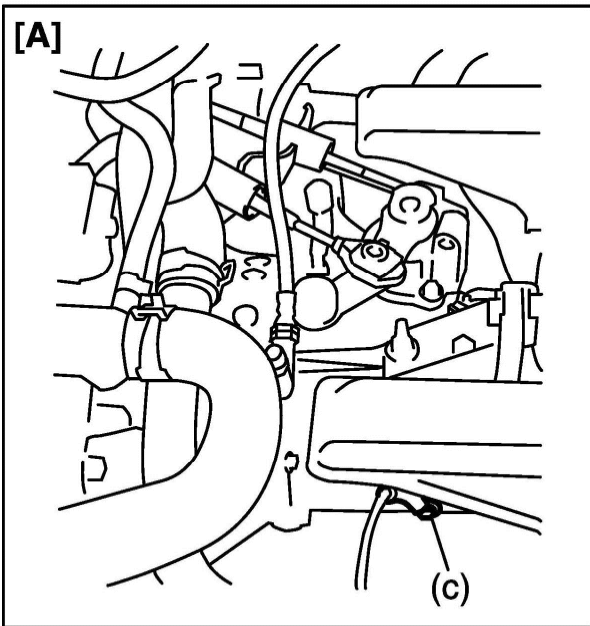
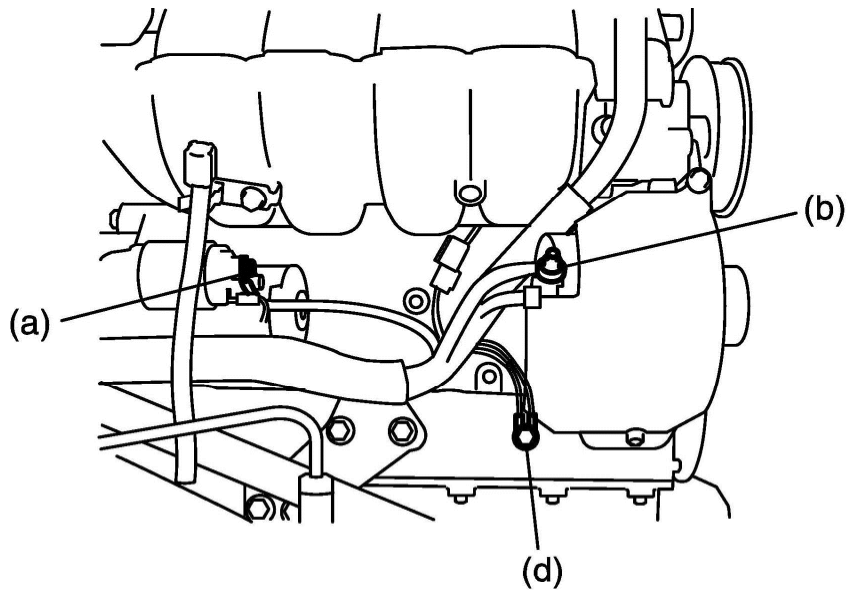
Tightening torque

Starting motor terminal nut a: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**

Generator terminal nut b: **5 Nm (0.5 kgf-m, 4.0 ft. lbs.)**

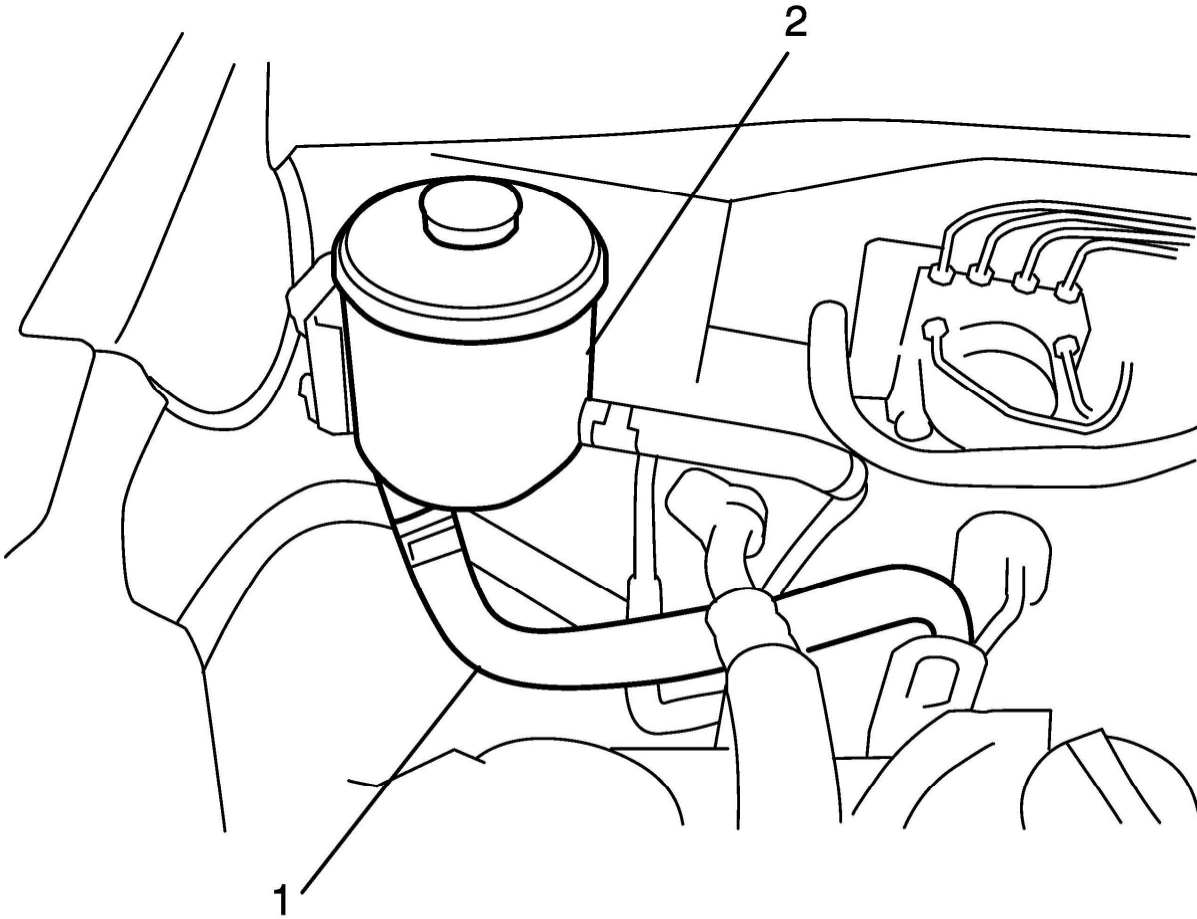
Battery ground bolt c: **25 Nm (2.5 kgf-m, 18.0 ft. lbs.)**

Ground terminal bolt d: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**



[A]: M/T model
[B]: A/T model

14. Connect P/S fluid reservoir hose (1) and then install P/S fluid reservoir (2) to bracket.



15. Refill P/S fluid.
16. Install condenser cooling fan to radiator.
17. Install A/C compressor to its bracket (if removed).
18. Install air cleaner assembly.
19. Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
20. Refill coolant.
21. Refill transfer oil.
22. Refill transaxle oil.
23. Refill engine oil.
24. Install water pump and generator drive belt.
25. Install right and left side engine under covers.
26. Install battery and battery tray with ECM.
27. Connect ECM connectors.
28. Connect negative and positive cable at battery.
29. Verify that there is no fuel leakage, coolant leakage, oil leakage and exhaust gas leakage at each connection.

Division: Automotive  
Category: Technical  
Section Title: Engine  
TSB No: TS 08 12220  
SUBJECT:

SERVICE MANUAL UPDATE: CORRECTION OF THE NOMINAL DIAMETER FOR THE CYLINDER HEAD BOLT

MODEL(S): SX-4 (RW420)

YEAR: 2007-2009

CONDITION:

This bulletin is to inform you that there has been a correction made for the nominal diameter of the cylinder head bolt(s) mentioned in the Service Manual for the 2007, 2008, and 2009 SX-4 (RW420)

CORRECTION:

For users of the Online Service Manuals, please refer to the corrections illustrated in this bulletin that have been made to the service manual sections applying to the Valves and Cylinder Head Removal and Installation. The following table describes the Service Manual and the corresponding pages that were corrected.

For the printed version of the 2007 SX-4 (RW420) Service Manual, please print the attached pages and insert them to replace the affected pages in the book.

Manual Name	Part Number	Corresponding Item
2009 SX-4 (RW420) Service Manual (Online)	30D2009SX4	<u>Section 1D: Engine Mechanical:</u> <u>Repair Instructions</u> <ul style="list-style-type: none"><li>Valves and Cylinder Head Removal and Installation</li></ul>
2008 SX-4 (RW420) Service Manual (Online)	30D2008SX4	
2007 SX-4 (RW420) Service Manual (Online)	30D2007SX4	
2007 SX-4 (RW420) Service Manual (Printed Version)	99500S80J00-33E	

## Valves and Cylinder Head Removal and Installation

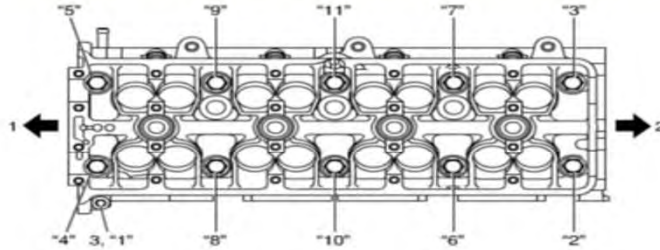
Reference: *Valves and Cylinder Head Components*

### Removal

- 1) Remove camshafts, tappets and shims. Refer to *Camshafts, Tappet and Shim Removal and Installation* for removal.
- 2) Loosen cylinder head bolts in such order as numbered in figure and remove them.

**NOTE:**

Don't forget to remove cylinder head bolt (M6) (3) as shown in figure.



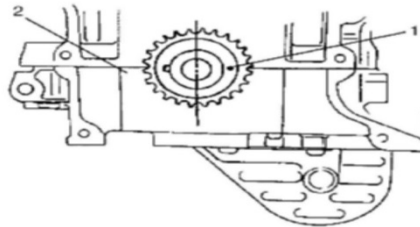
1. Crankshaft pulley side	2. Flywheel side
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- 3) Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
- 4) Remove cylinder head with intake manifold, exhaust manifold and water outlet cap. Use lifting device, if necessary.

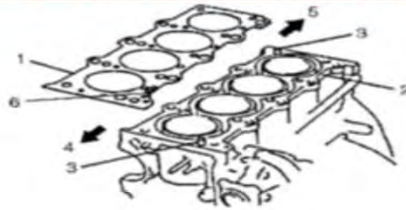
### Installation

Reference: *Valves and Cylinder Head Disassembly and Reassembly*

- 1) Match match mark (1) on crank timing sprocket and mating surface (2) of cylinder block and lower crankcase.



- 2) Clean mating surface of cylinder head and cylinder block (2). Remove oil, old gasket and dust from mating surface.
- 3) Install knock pins (3) to cylinder block.
- 4) Install new cylinder head gasket (1) to cylinder block. Identification number (6) provided on gasket comes to crankshaft pulley side (4), facing up (toward cylinder head side).

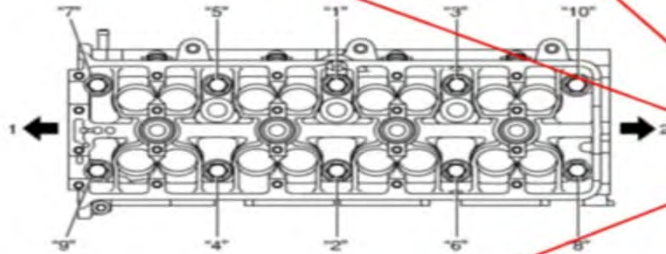


5. Flywheel side

5) Install cylinder head to cylinder block.

Apply engine oil to cylinder head bolts and tighten them gradually as follows.

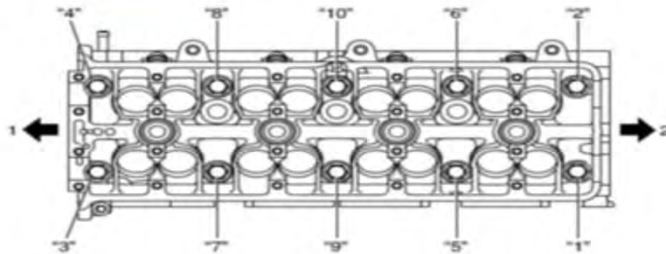
- a) Tighten cylinder head bolts (M11) to 52 N·m (5.2 kgf-m, 38.0 lb-ft) according to numerical order in figure.
- b) In the same manner as in step a), retighten cylinder head bolts (M11) to 82 N·m (8.2 kgf-m, 59.5 lb-ft).



CORRECTED

1. Crankshaft pulley side    2. Flywheel side

- c) Loosen cylinder head bolts (M11) until tightening torque is reduced to 0 according to numerical order in figure.



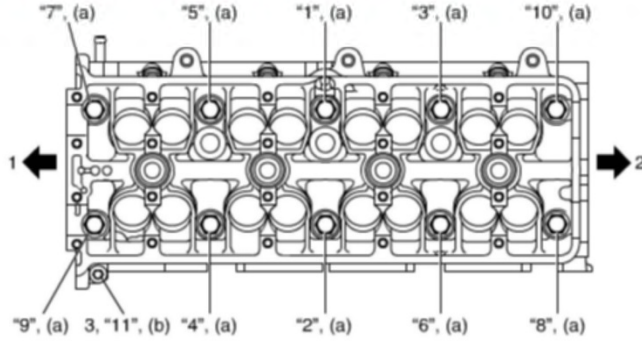
1. Crankshaft pulley side    2. Flywheel side

- d) Tighten cylinder head bolts (M11) to 52 N·m (5.2 kgf-m, 38.0 lb-ft) according to numerical order in figure.
- e) In the same manner as in step b), retighten cylinder head bolts (M11) to 103 N·m (10.3 kgf-m, 74.5 lb-ft).
- f) Tighten cylinder head bolt (M6) to specified torque.

CORRECTED

**Tightening torque**

**Cylinder head bolt (M11) (a): Tighten 52 N·m (5.2 kgf-m, 38.0 lb-ft), 82 N·m (8.2 kgf-m, 59.5 lb-ft), 0 N·m (0 kgf-m, 0 lb-ft), 52 N·m (5.2 kgf-m, 38.0 lb-ft) and 103 N·m (10.3 kgf-m, 74.5 lb-ft) by the specified procedure**  
**Cylinder head bolt (M6) (b): 11 N·m (1.1 kgf-m, 8.0 lbf-ft)**



1. Crankshaft pulley side	2. Flywheel side
---------------------------	------------------

- 6) Install camshafts, tappets and shims. Refer to [Camshafts, Tappet and Shim Removal and Installation](#) for installation.
- 7) Install 1st timing chain. Refer to [1st Timing Chain and Chain Tensioner Removal and Installation](#) for installation.
- 8) Install 2nd timing chain. Refer to [2nd Timing Chain and Chain Tensioner Removal and Installation](#) for installation.
- 9) Install timing chain cover. Refer to [Timing Chain Cover Removal and Installation](#) for installation.
- 10) Check intake and exhaust valve lashes referring to [Valve Lash \(Clearance\) Inspection](#).
- 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](#).
- 13) Install engine assembly to vehicle referring to [Engine Assembly Removal and Installation](#).

Section Title: General Information

TSB No.: TS 07 07018

Division: Automotive

Category: Technical

SUBJECT:

OIL LEAK IDENTIFICATION

MODEL(S):

ALL

YEAR:

ALL

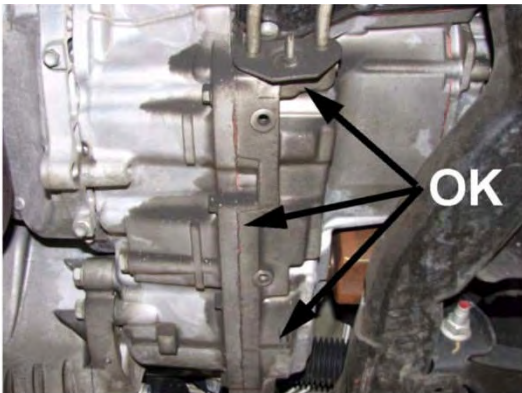
CONDITION:

Signs of oil leakage from any component which contains oil.

CAUSE:

It is possible for some oil and /or assembly lube to pass through the seal and leave residue around and below the seal. **THIS IS NORMAL AND IS NOT CONSIDERED A LEAK!**

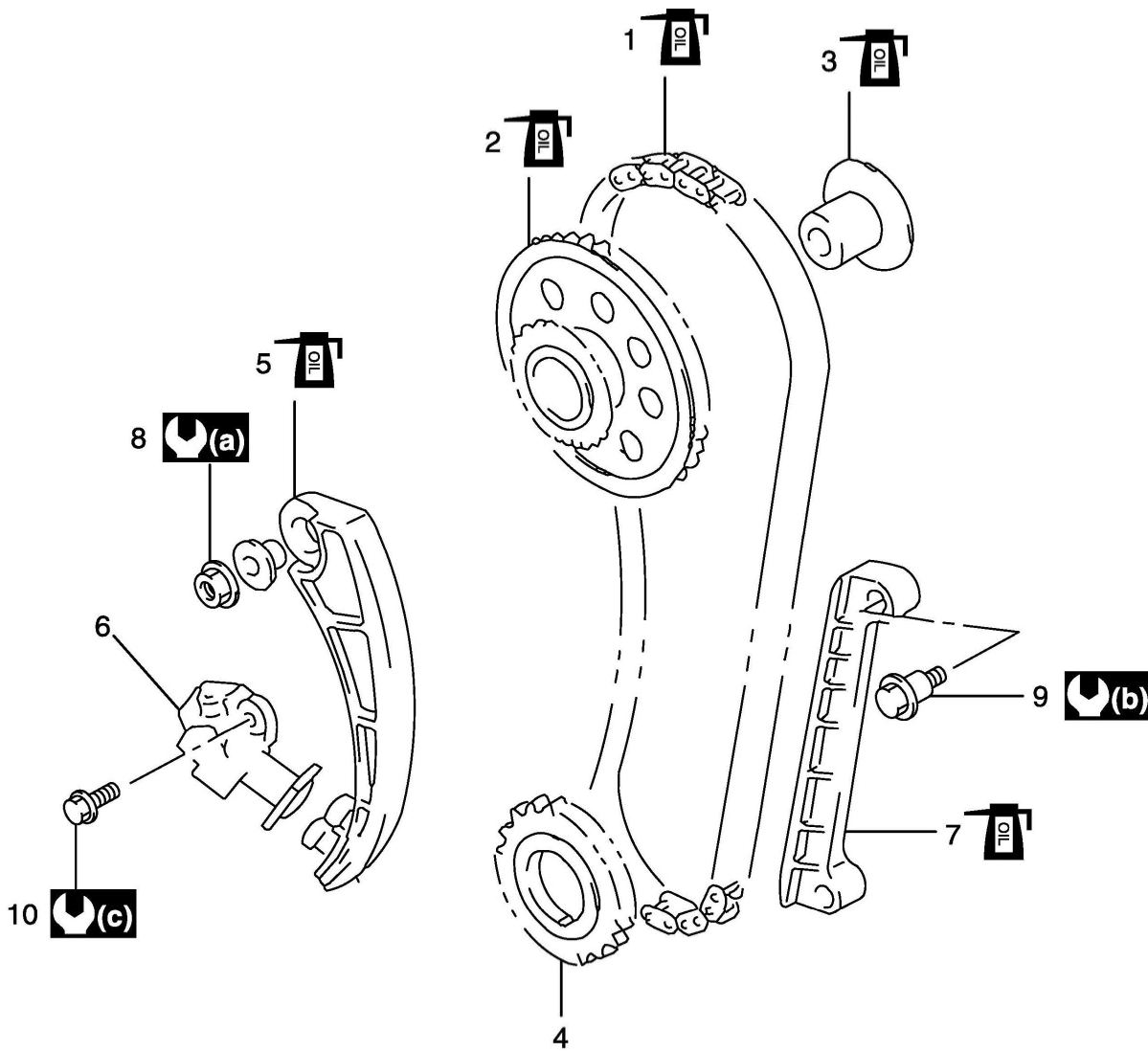
CORRECTION:



This residue does not indicate that a seal or gasket requires replacement! An oil leak will leave oil on the ground. If oil residue is found around any weep hole, seal or mating surface, do not replace the seal, gasket, or re-seal, this is not considered a leak. (See above) If the oil residue is found and oil is visibly leaking from the weep hole, seal or mating surface enough to drip on to the ground, replace the seal, gasket, or sealant by following the service manual procedure.

Suzuki bulletins are intended for use by professional technicians, NOT a "do-it-yourselfer." They are written to inform these technicians of conditions that may occur on some vehicles, or to provide information that could assist in the proper service of a vehicle. Properly trained technicians have the equipment, tools, safety instructions, and know-how to do a job properly and safely. If a condition is described, DO NOT assume that the bulletin applies to your vehicle, or that your vehicle will have that condition. See your authorized Suzuki dealer for information on whether your vehicle may benefit from the information. Suzuki reserves the right to change technical specifications at any time without prior notice.

## 1st Timing Chain and Chain Tensioner Components



1. 1st timing chain	6. Timing chain tensioner adjuster No.1	: 25 N·m (2.5 kgf-m, 18.0 lb-ft)
2. Idler sprocket	7. Timing chain guide No.1	: 9 N·m (0.9 kgf-m, 6.5 lb-ft)
3. Idler sprocket shaft	8. Timing chain tensioner nut	: 11 N·m (1.1 kgf-m, 8.0 lb-ft)
4. Crankshaft timing sprocket	9. Timing chain guide No.1 bolt	: Apply engine oil to sliding surface.
5. Timing chain tensioner	10. Timing chain tensioner adjuster No.1 bolt	

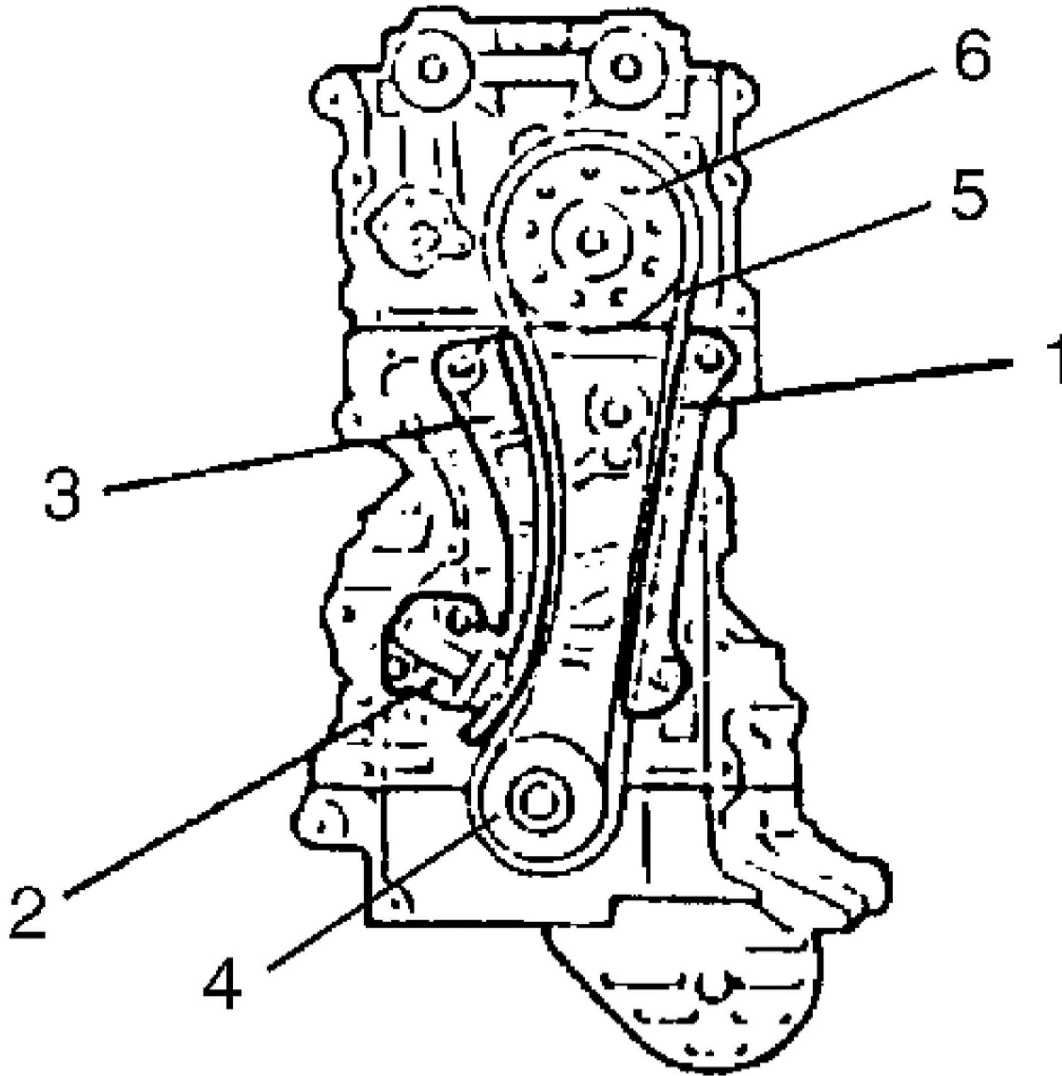
## 1st Timing Chain and Chain Tensioner Removal and Installation

**CAUTION:** After timing chain is removed, never turn [crankshaft](#) and camshafts independently more than its allowable turning range described referring to [2nd Timing Chain and Chain Tensioner Removal and Installation](#). If turned, interference may occur between [piston](#) and valves and valves themselves, and

parts related to piston and valves may be damaged.

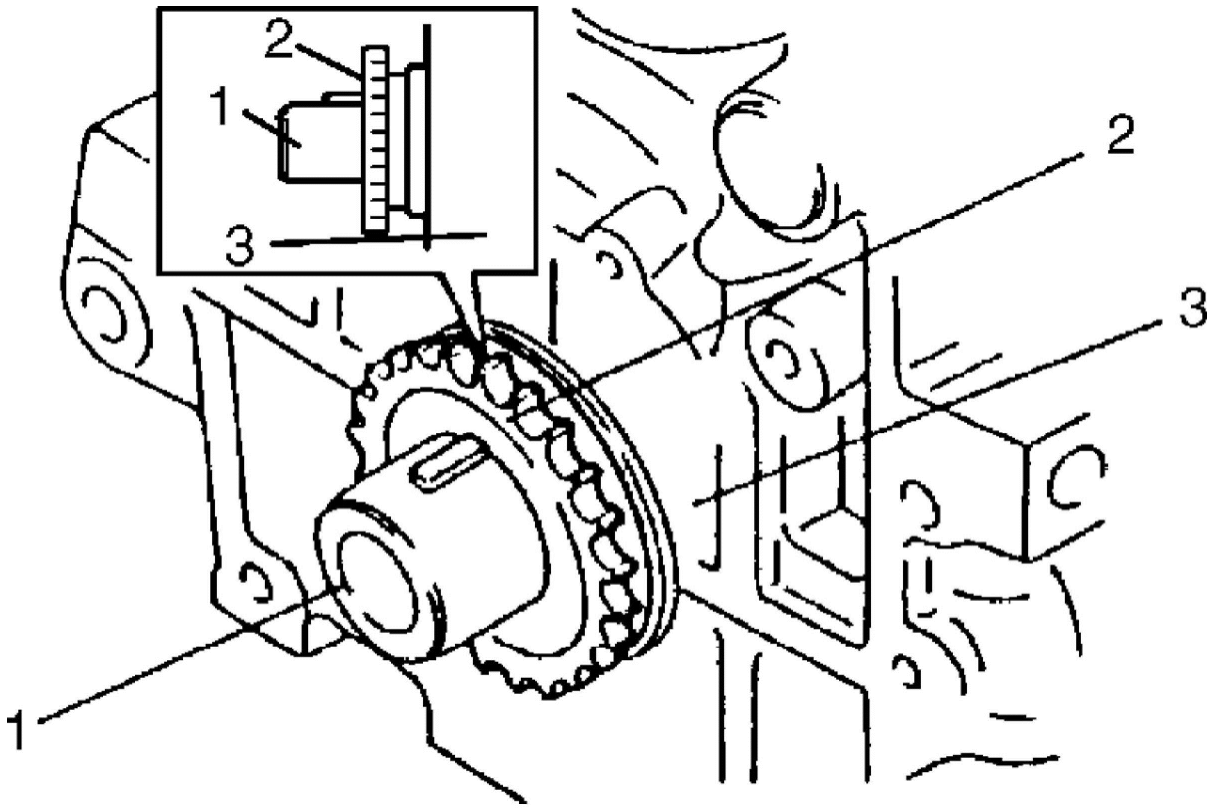
## Removal

1. Remove 2nd timing chain.
2. Remove [timing chain guide](#) No. 1 (1).
3. Remove [timing chain tensioner](#) adjuster No. 1 (2).
4. Remove [timing chain tensioner](#) (3).
5. Remove idler sprocket (6) and 1st timing chain (5).
6. Remove crankshaft timing sprocket (4).



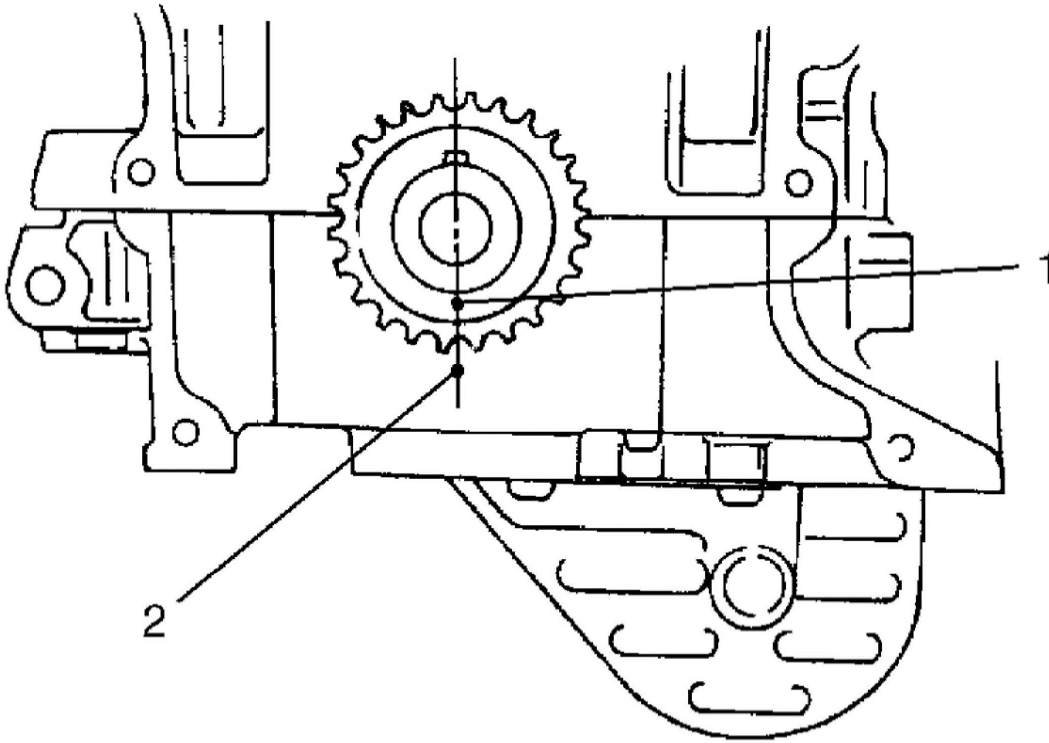
## Installation

1. Install crankshaft timing sprocket (2) as shown in figure.

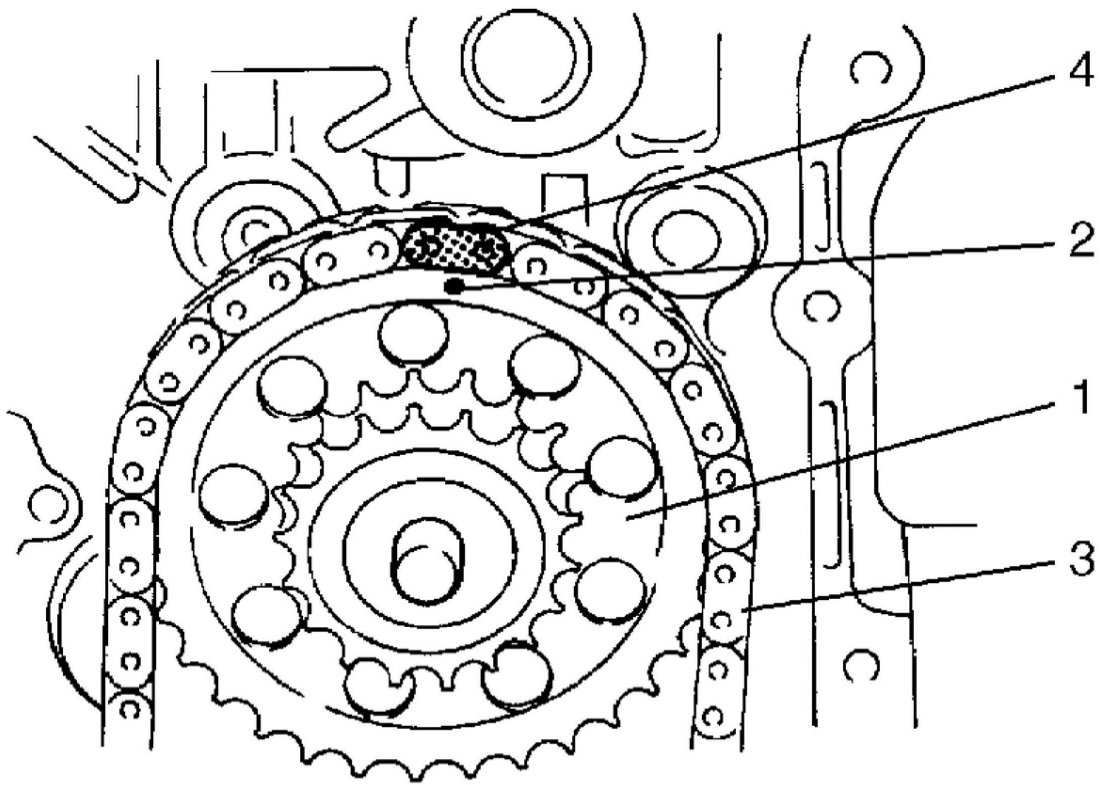


1. Crankshaft	3. Cylinder block
---------------	-------------------

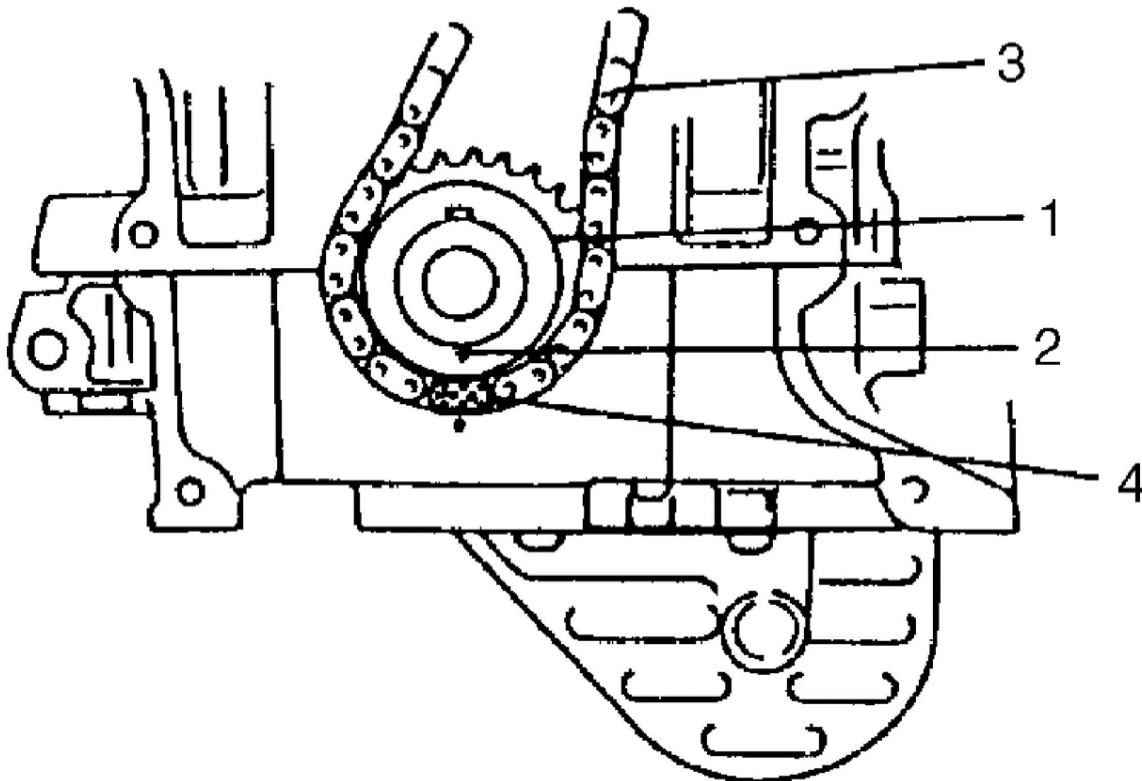
2. Check that match mark (1) on crankshaft timing sprocket is in match with timing mark (2) on lower crankcase.



3. Apply engine oil to idler sprocket shaft and bush of idler sprocket (1).
4. Install idler sprocket and idler sprocket shaft.
5. Install 1st timing chain by aligning dark blue plate (4) of 1st timing chain (3) and match mark (2) on idler sprocket (1).



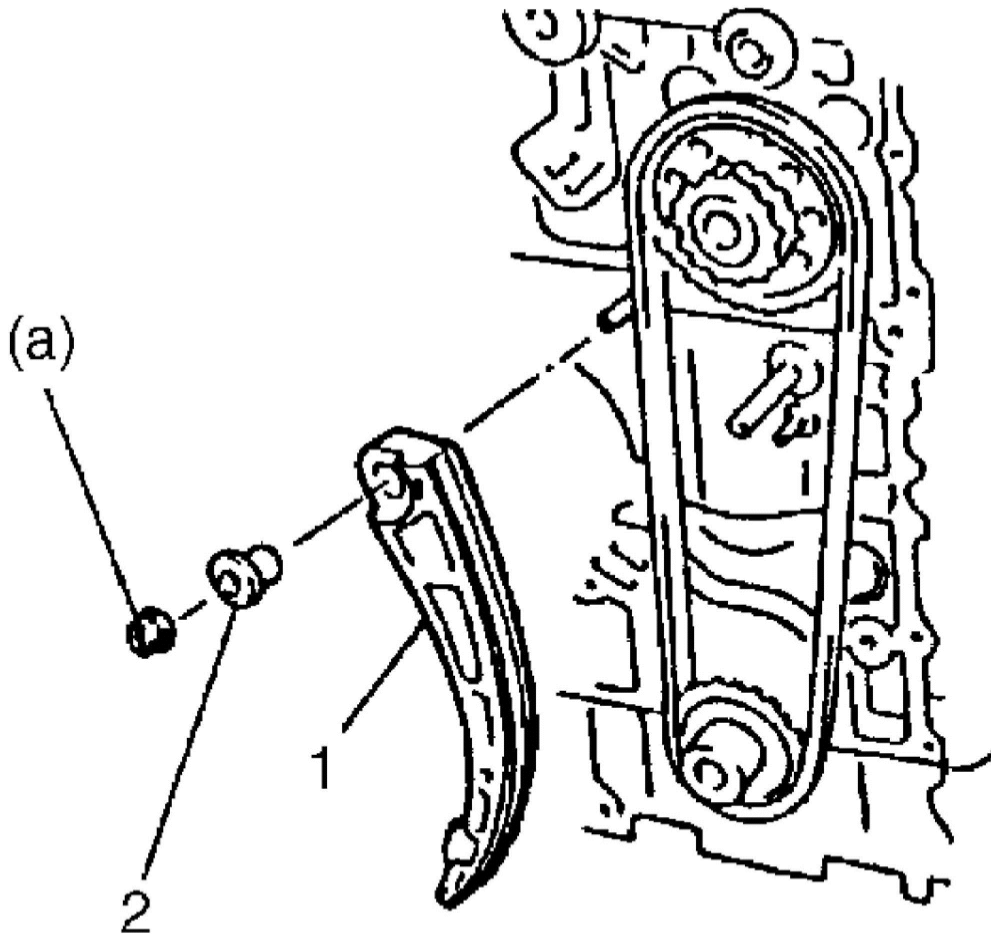
6. Bring gold plate (4) of 1st timing chain (3) into match with match mark (2) on crankshaft timing sprocket (1).



7. Apply engine oil to sliding surface of [timing chain tensioner](#) (1) and then install it as shown in figure. Tighten tensioner nut to specified torque.

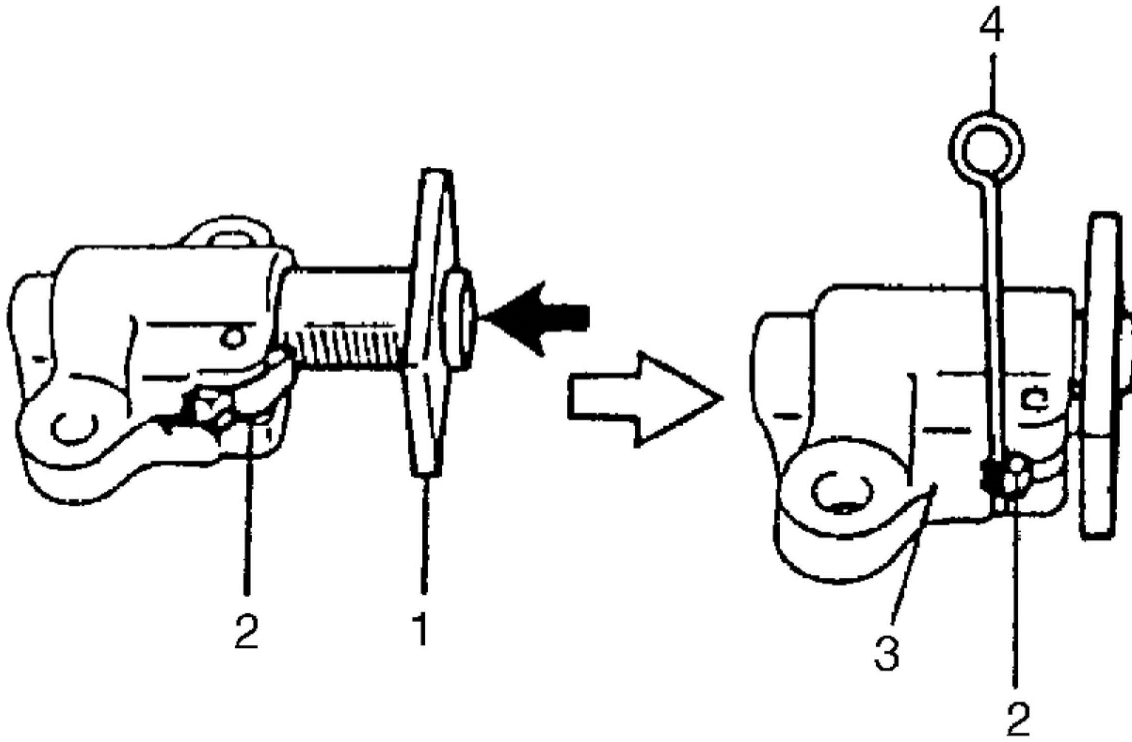
Tightening torque

[Timing chain tensioner](#) nut a: 25 Nm (2.5 kgf-m, 18.0 ft. lbs.)



2. Spacer

8. With latch of tensioner adjuster No. 1 returned and plunger (1) pushed back into body, insert stopper (4) into latch (2) and body (3). After inserting it, check to make sure that plunger will not come out.

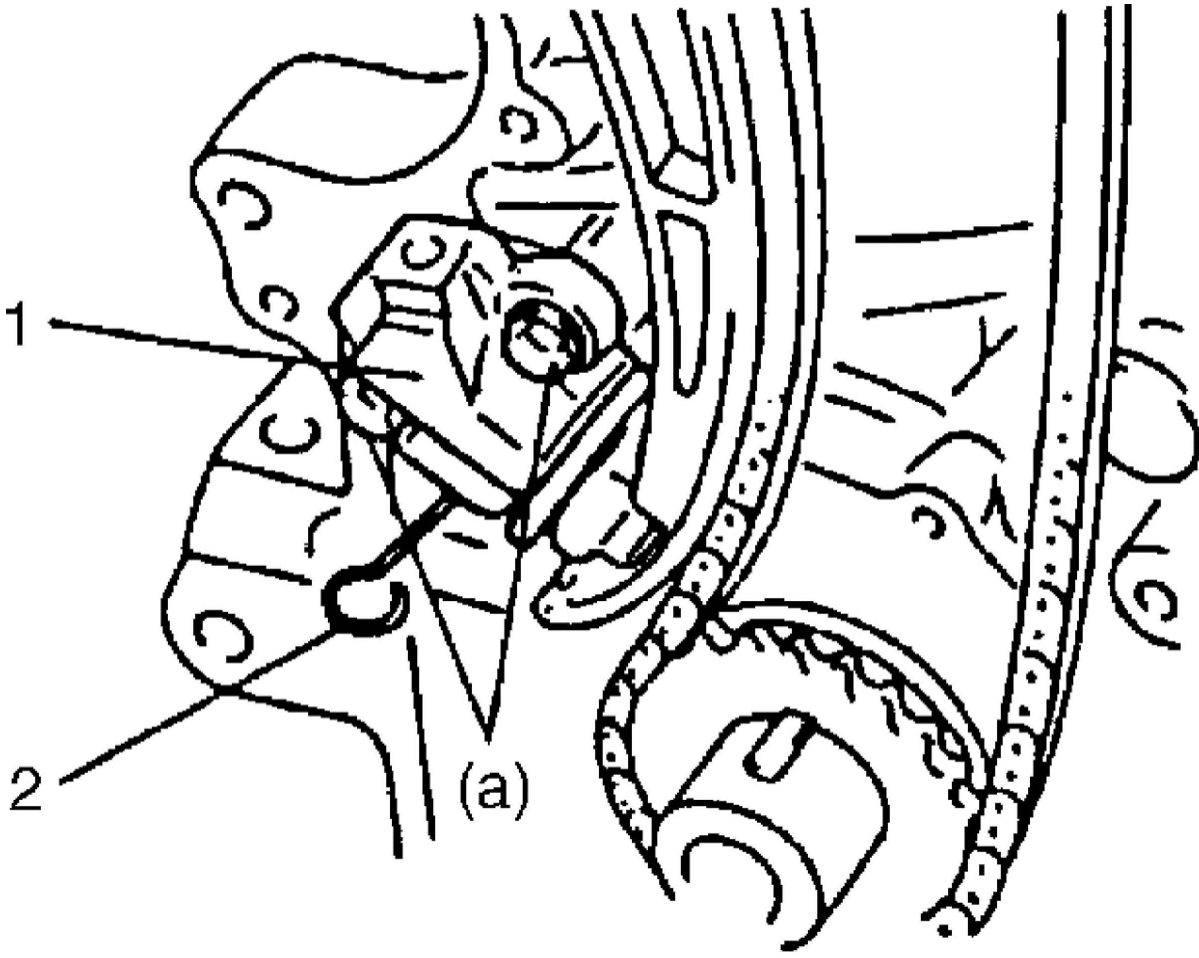


9. Install [timing chain tensioner](#) adjuster No. 1 (1).

Tightening torque

[Timing chain tensioner](#) adjuster No.1 bolt a: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**

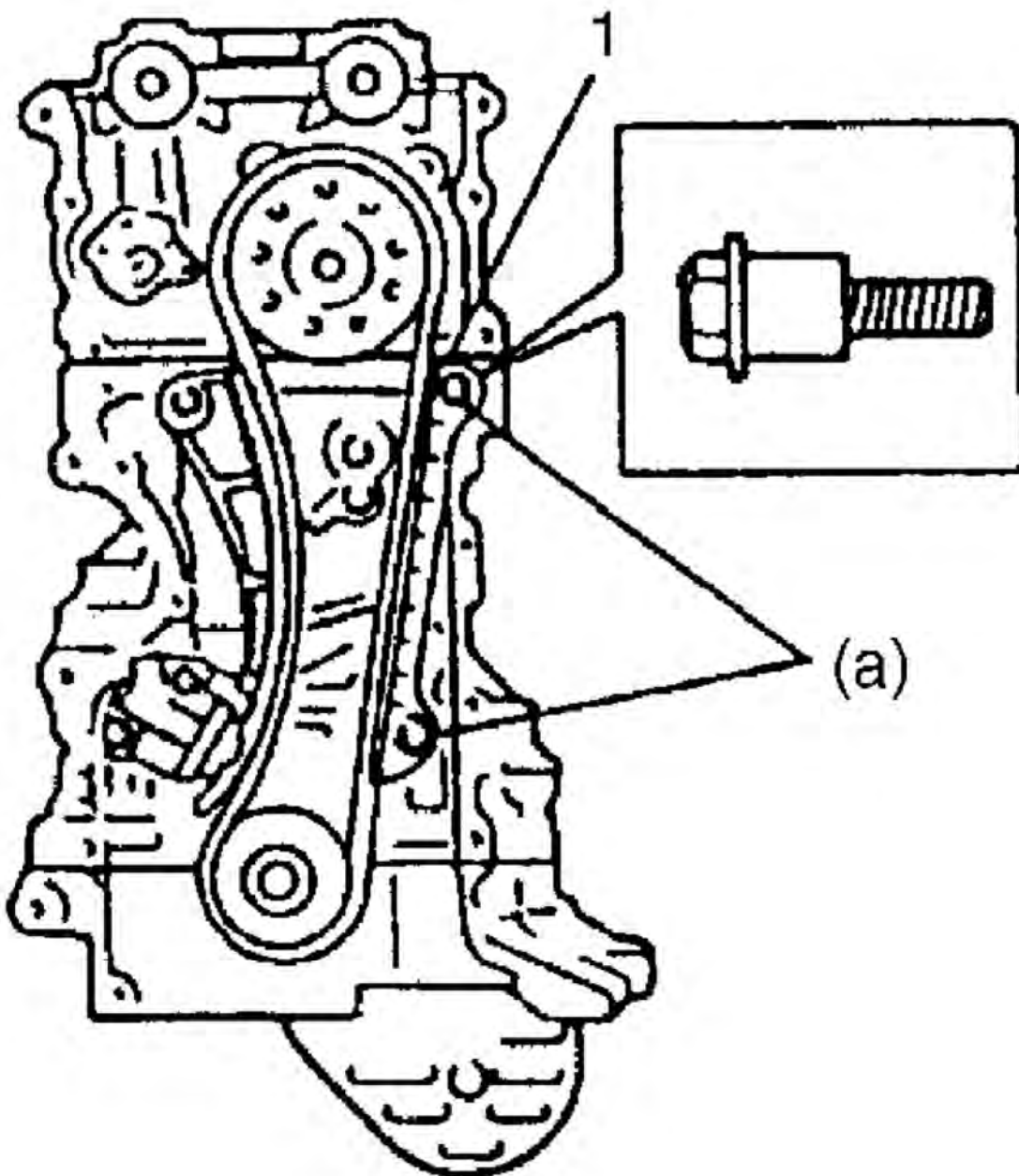
10. Pull out stopper (2) from [timing chain tensioner](#) adjuster No. 1.



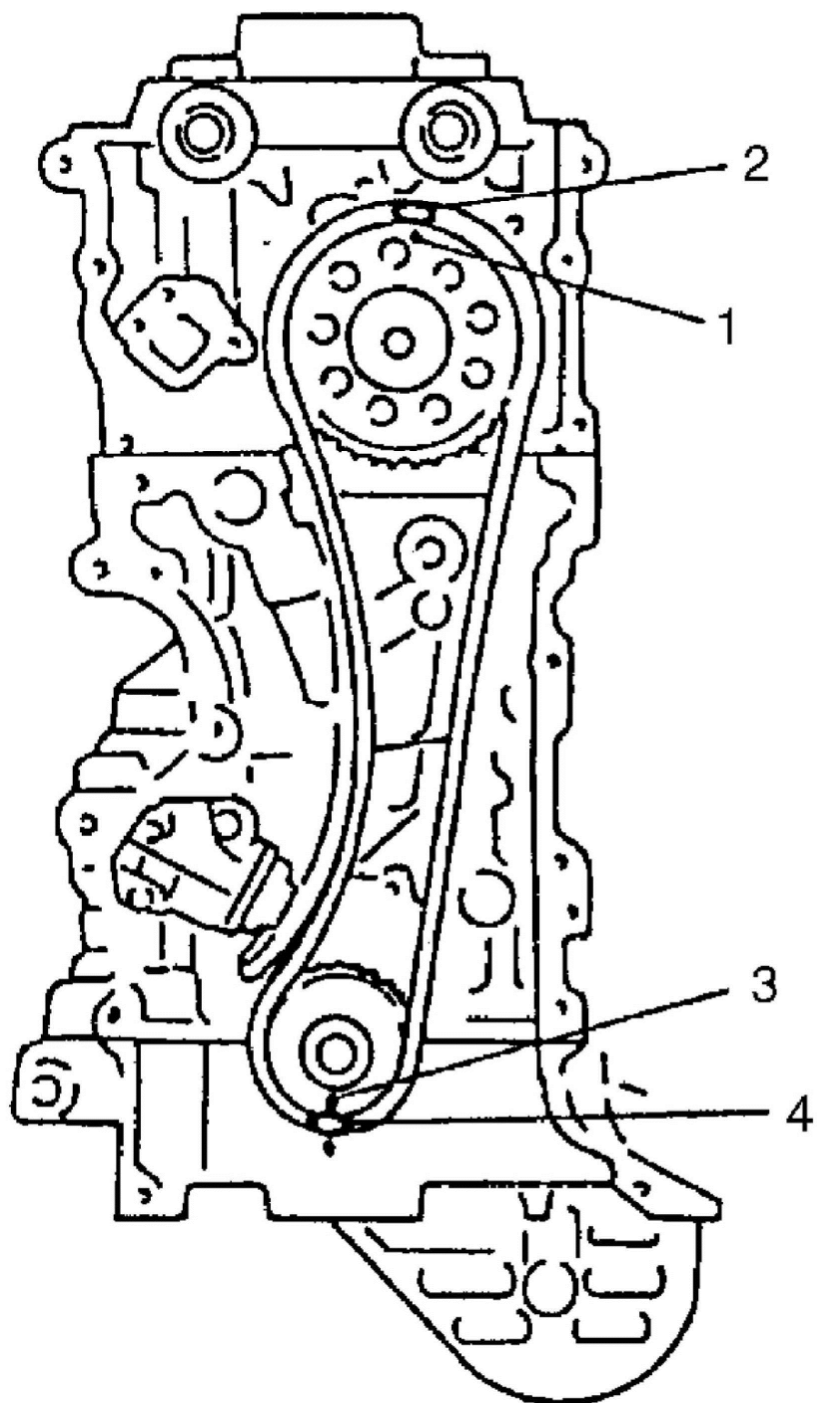
11. Apply engine oil to sliding surface of [timing chain guide](#) No.1 (1) and then install it. Tighten guide bolts to specified torque.

Tightening torque

[Timing chain guide](#) No.1 bolt a: **9 Nm (0.9 kgf-m, 6.5 ft. lbs.)**

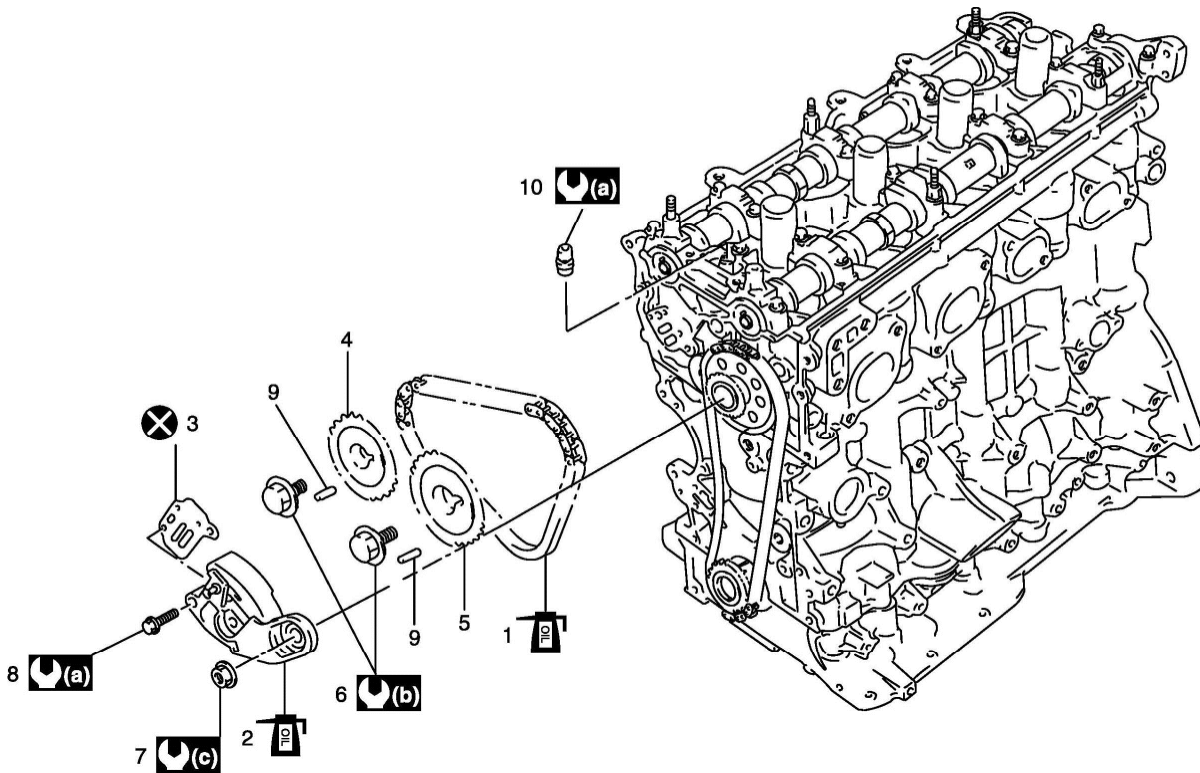


12. Check that dark blue and gold plates of 1st timing chain are in match with match marks on sprockets respectively.









1. Match mark on idler sprocket
2. Dark blue plate
3. Match mark on crankshaft timing sprocket
4. Gold plate

13. Install 2nd timing chain.
14. Install timing chain cover.
15. Install cylinder head cover.
16. Install [oil pan](#).
17. Install engine assembly to vehicle.
18. **2nd Timing Chain and Chain Tensioner Components**

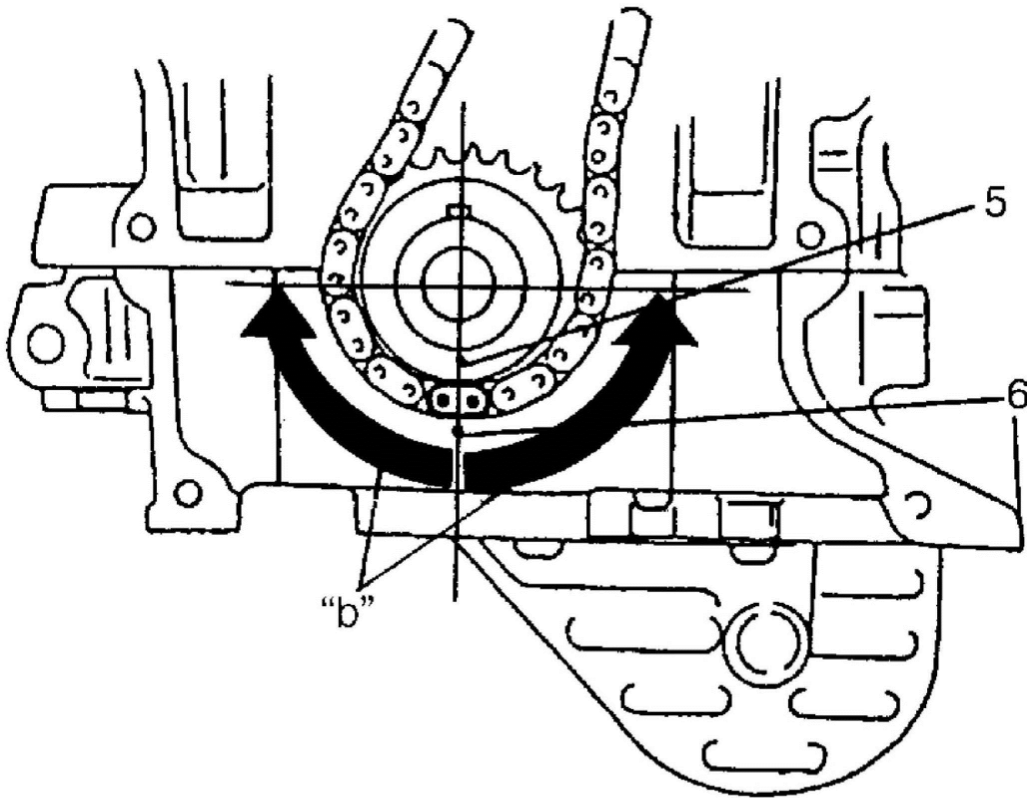
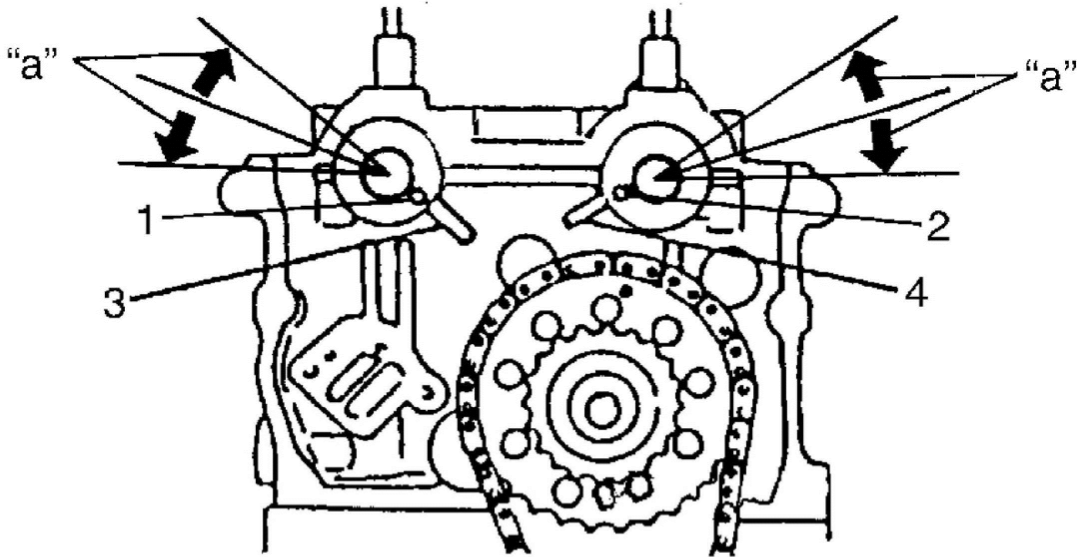


20.

 1. 2nd timing chain : Apply engine oil	6. Camshaft timing sprocket bolt	 (a) : 11 N·m (1.1 kgf-m, 8.0 lb-ft)
 2. Timing chain tensioner adjuster No.2 : Apply engine oil to sliding surface.	7. Timing chain tensioner adjuster No.2 nut	 (b) : 80 N·m (8.0 kgf-m, 58.0 lb-ft)
3. Tensioner adjuster No.2 gasket	8. Timing chain tensioner adjuster No.2 bolt	 (c) : 45 N·m (4.5 kgf-m, 32.5 lb-ft)
4. Intake camshaft timing sprocket	9. Knock pin	 : Do not reuse.
5. Exhaust camshaft timing sprocket	10. Oil relief valve	

## 2nd Timing Chain and Chain Tensioner Removal and Installation

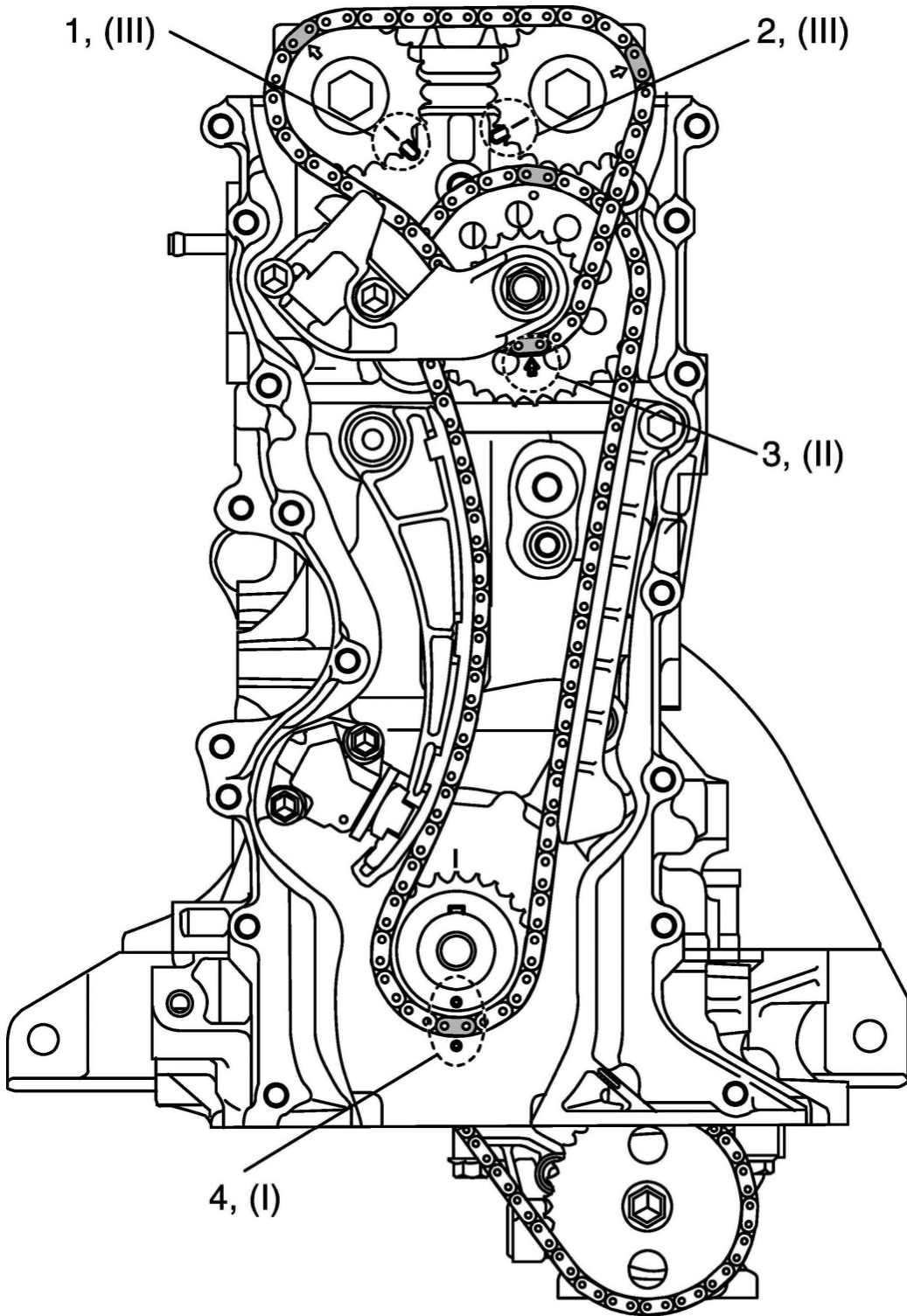
**CAUTION:** After 2nd timing chain is removed, never turn intake [camshaft](#), exhaust camshaft and [crankshaft](#) independently more than such an extent as shown. If turned, interference may occur between [piston](#) and valves and valves themselves, and parts related to piston and valves may be damaged.



1. Knock pin of intake camshaft
2. Knock pin of exhaust camshaft
3. Timing mark of intake side
4. Timing mark of exhaust side
5. Match mark on crank timing sprocket
6. Timing mark on lower crankcase
"a": Camshafts (IN & EX) allowable turning range..... Within 20° on both right and left
"b": Crankshaft allowable turning range..... Within 90° on both right and left

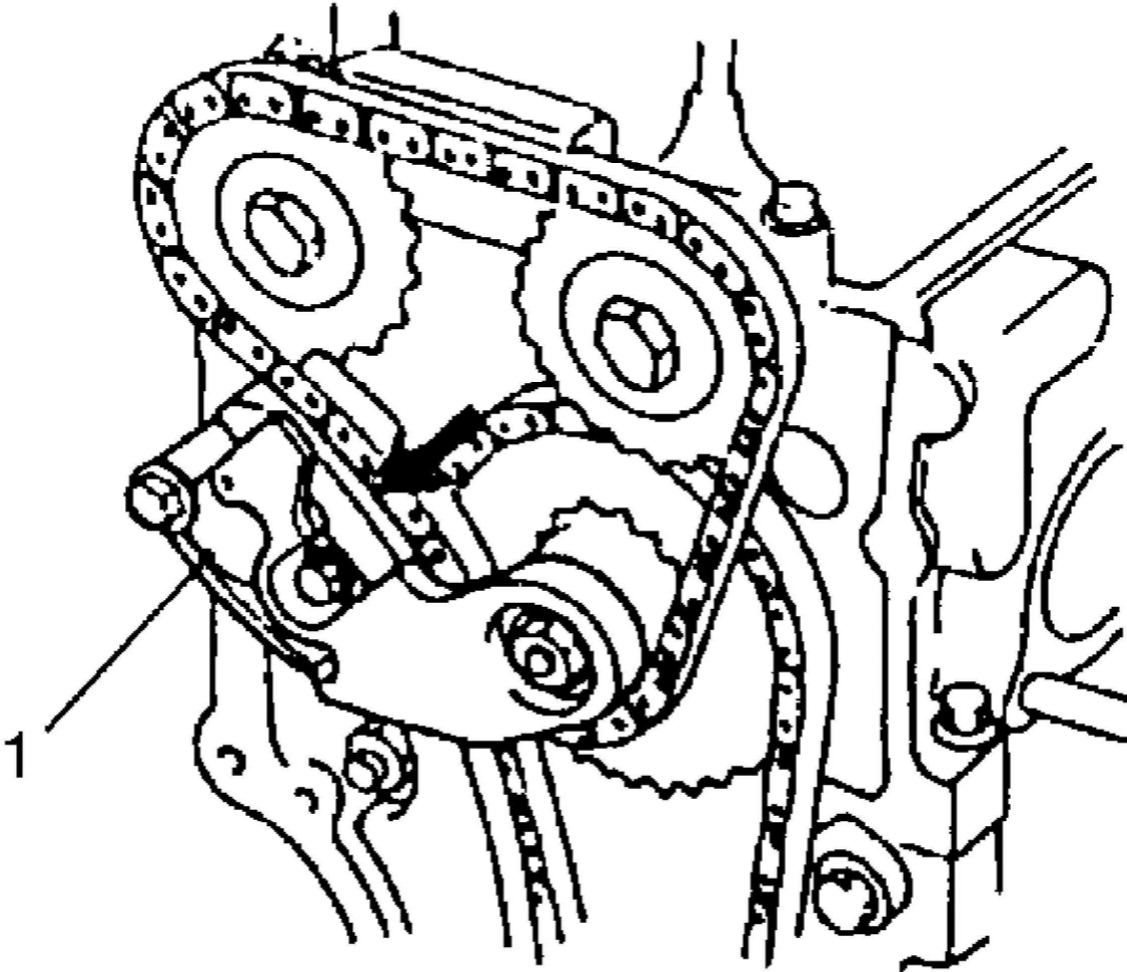
## Removal

1. Remove timing chain cover.
2. Turn [crankshaft](#) clockwise to meet the following conditions.
  - Mark on crank sprocket match with mark on lower crankcase (I).
  - Arrow mark on idler sprocket points upward (II).
  - Marks on cam sprockets match with marks on cylinder head (III).

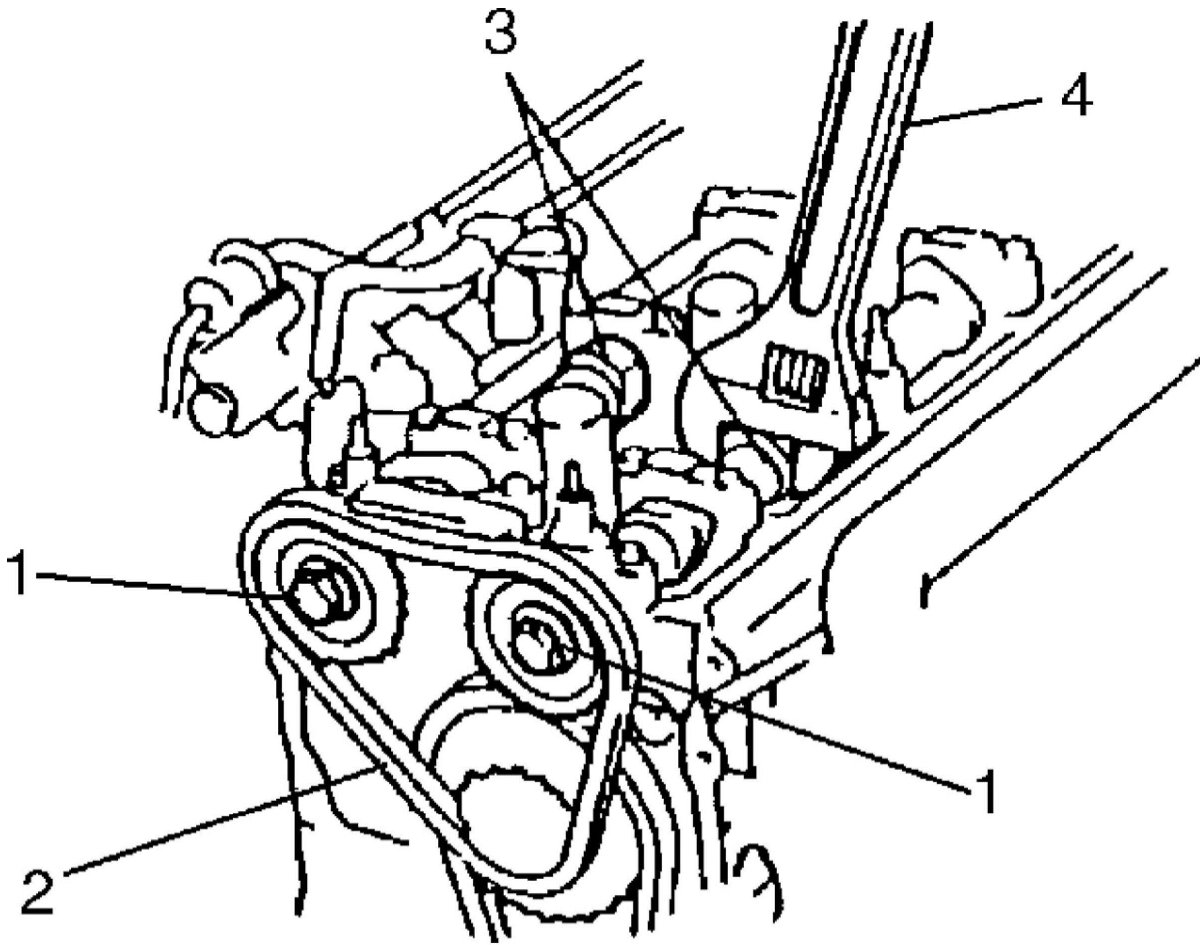


1.	Timing marks of intake camshaft timing sprocket
2.	Timing marks of exhaust camshaft timing sprocket
3.	Arrow mark on idler sprocket
4.	Timing mark of crankshaft timing sprocket

3. Remove [timing chain tensioner](#) adjuster No.2 (1) and gasket. To remove them, slacken 2nd timing chain by turning intake [camshaft](#) counterclockwise a little while pushing back pad.

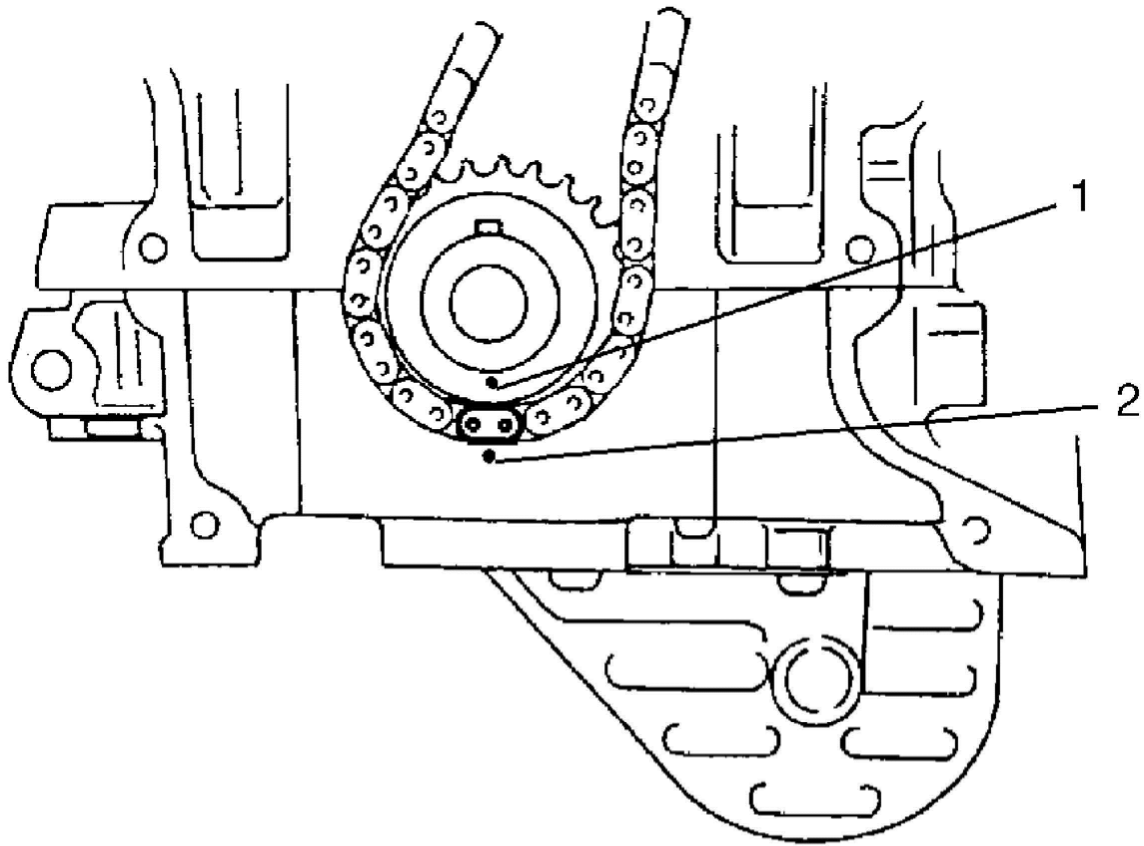


4. Remove intake and exhaust camshaft timing sprocket bolts (1). To remove them, fit a spanner (4) to hexagonal part (3) at the center of [camshaft](#) to hold it stationary.
5. Remove camshaft timing sprockets and 2nd timing chain (2).

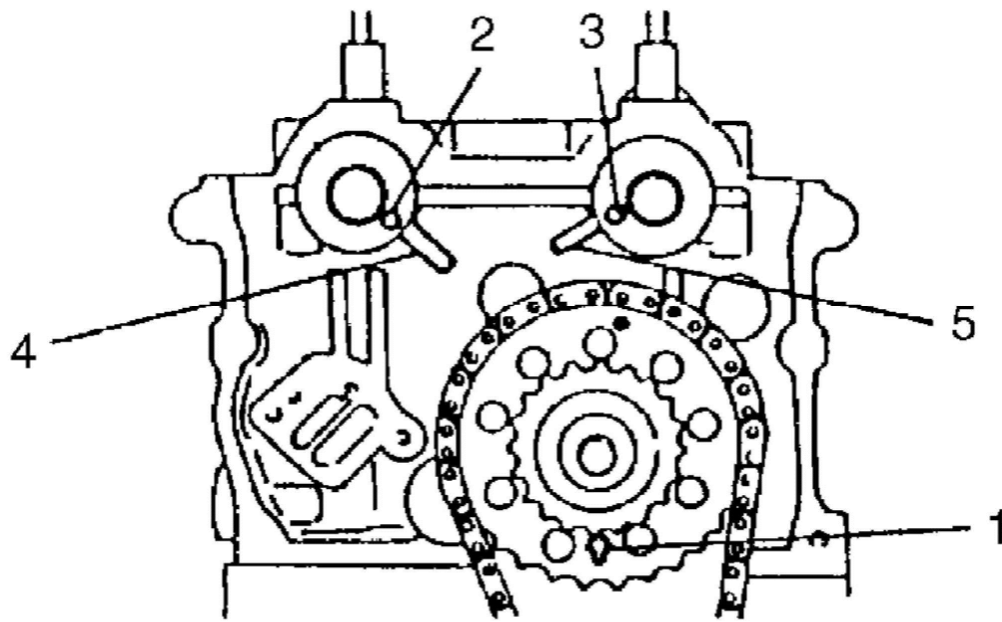


### Installation

1. Check that match mark (1) on crank timing sprocket is in match with timing mark (2) on lower crankcase as shown in figure.

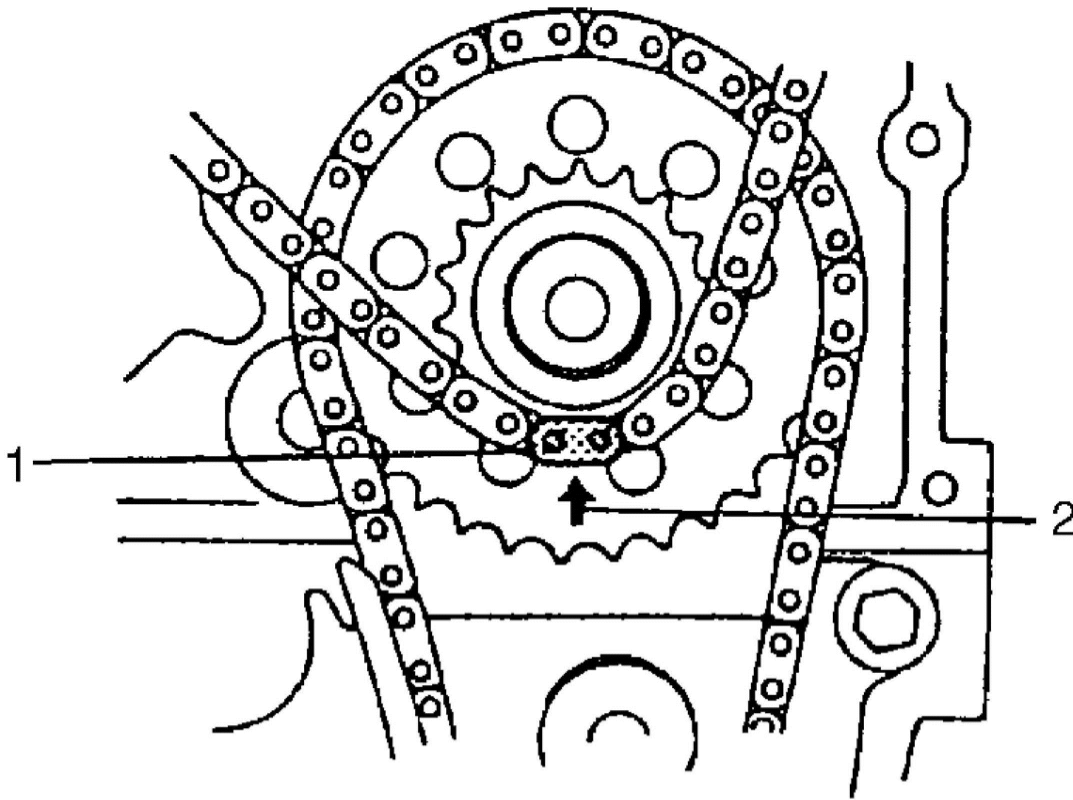


2. Check that arrow mark (1) on idler sprocket faces upward as shown in figure.
3. Check that knock pins of intake (2) and exhaust (3) camshafts are aligned with timing marks on cylinder head as shown in figure.



4. Timing mark of intake side
5. Timing mark of exhaust side

4. Install 2nd timing chain by aligning yellow plate (1) of 2nd timing chain and match marks on idler sprocket.

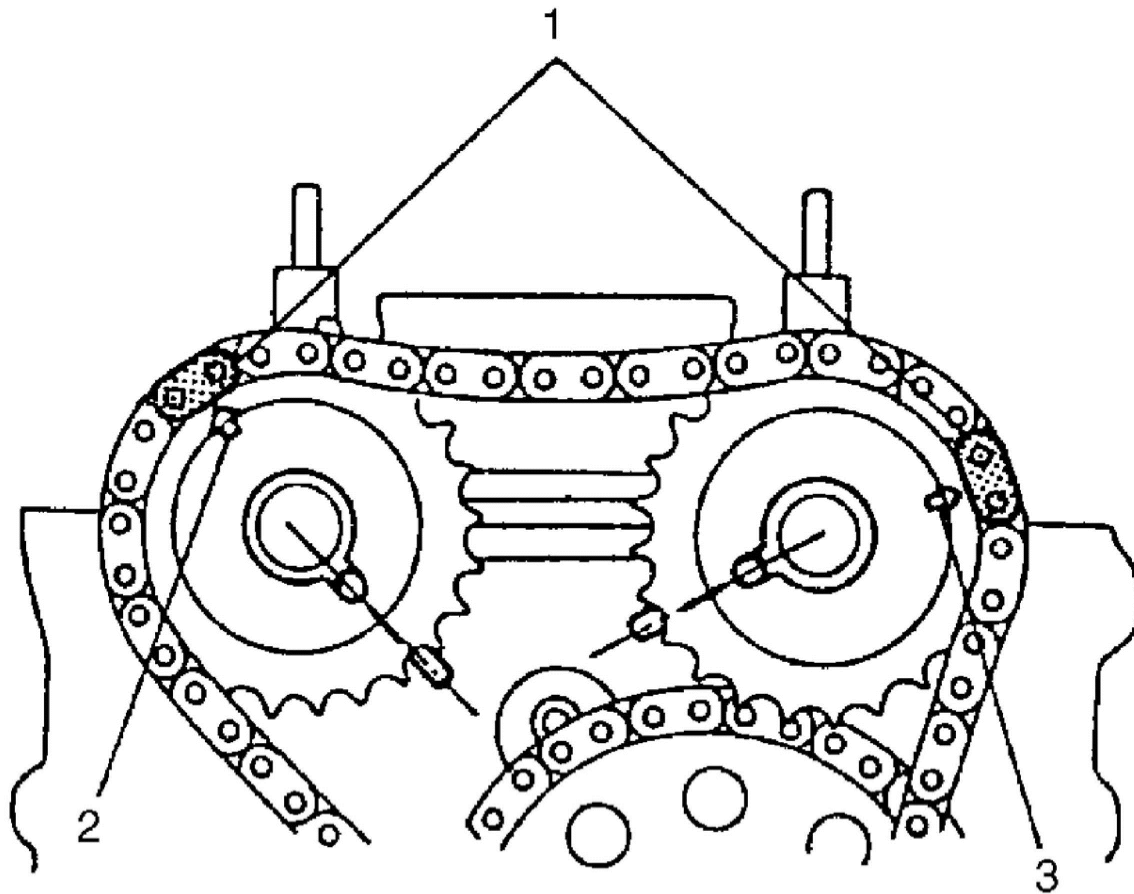


2. Match mark of 2nd timing chain (Arrow mark)

5. Install sprockets to intake and exhaust camshafts by aligning dark blue plate of 2nd timing chain, match marks on intake sprocket and exhaust sprocket respectively.

**CAUTION:** Do not turn more than allowable turning range. If turned excessively, valve and [piston](#) may be damaged.

**NOTE:** As an arrow mark is provided on both sides, camshaft timing sprocket has no specific installation direction.

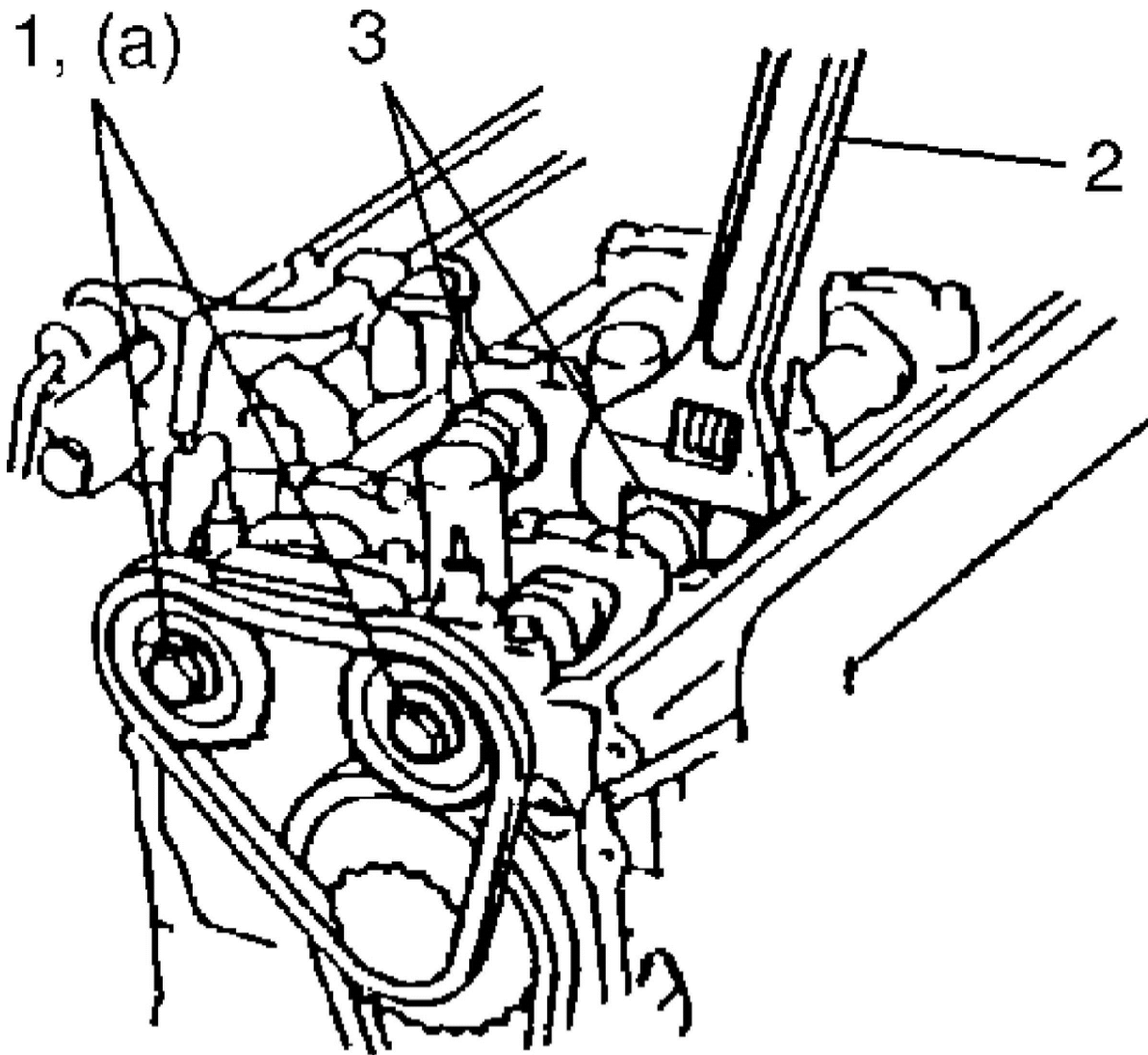


1. Dark blue plate
2. Arrow mark on intake camshaft timing sprocket
3. Arrow mark on exhaust camshaft timing sprocket

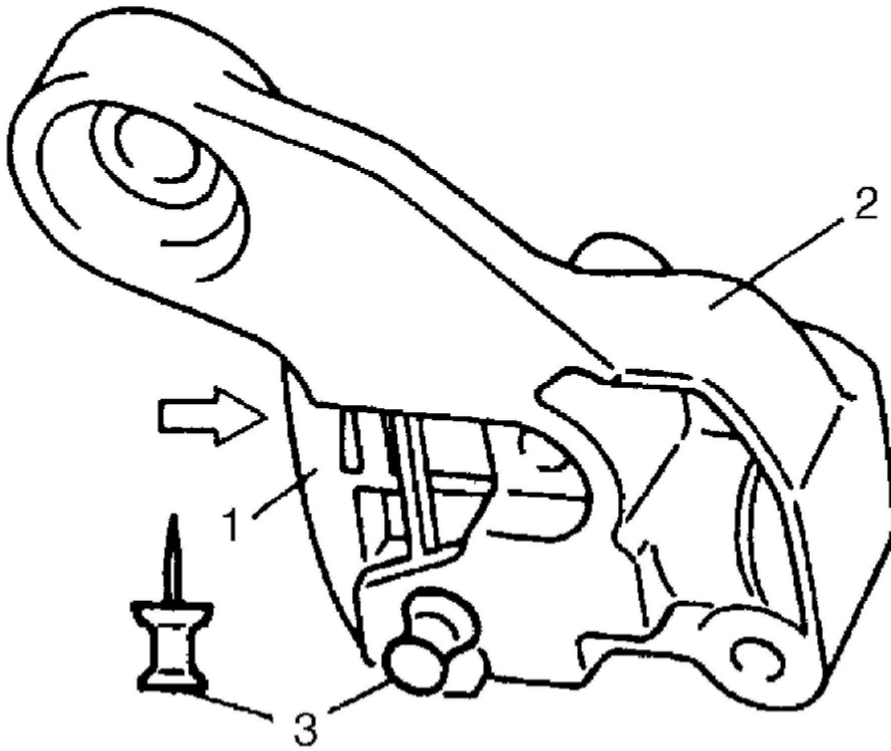
6. Tighten intake and exhaust camshaft timing sprocket bolts (1) to specified torque. To tighten it, fit a spanner (2) to hexagonal part (3) at the center of [camshaft](#) to hold it stationary.

Tightening torque

Camshaft timing sprocket bolt a: **80 Nm (8.0 kgf-m, 57.5 ft. lbs.)**



7. Push back plunger (1) into tensioner body (2), and hold it at the position by inserting stopper (3) into body.



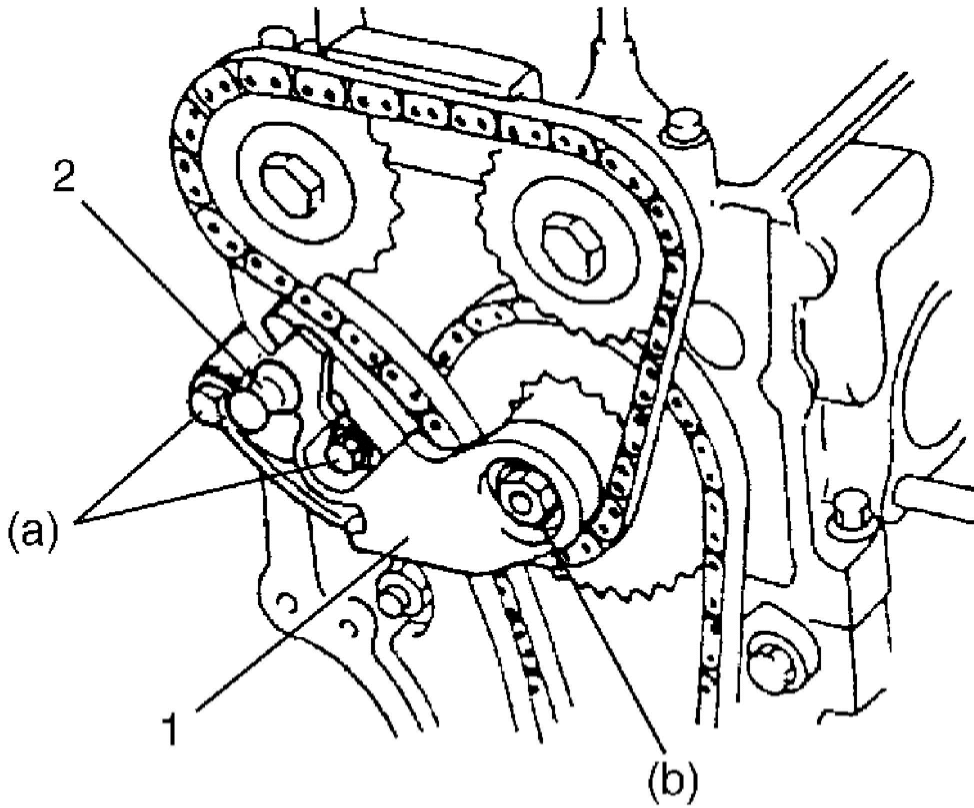
8. Install [timing chain tensioner](#) adjuster No.2 (1) with new gasket.

Tightening torque

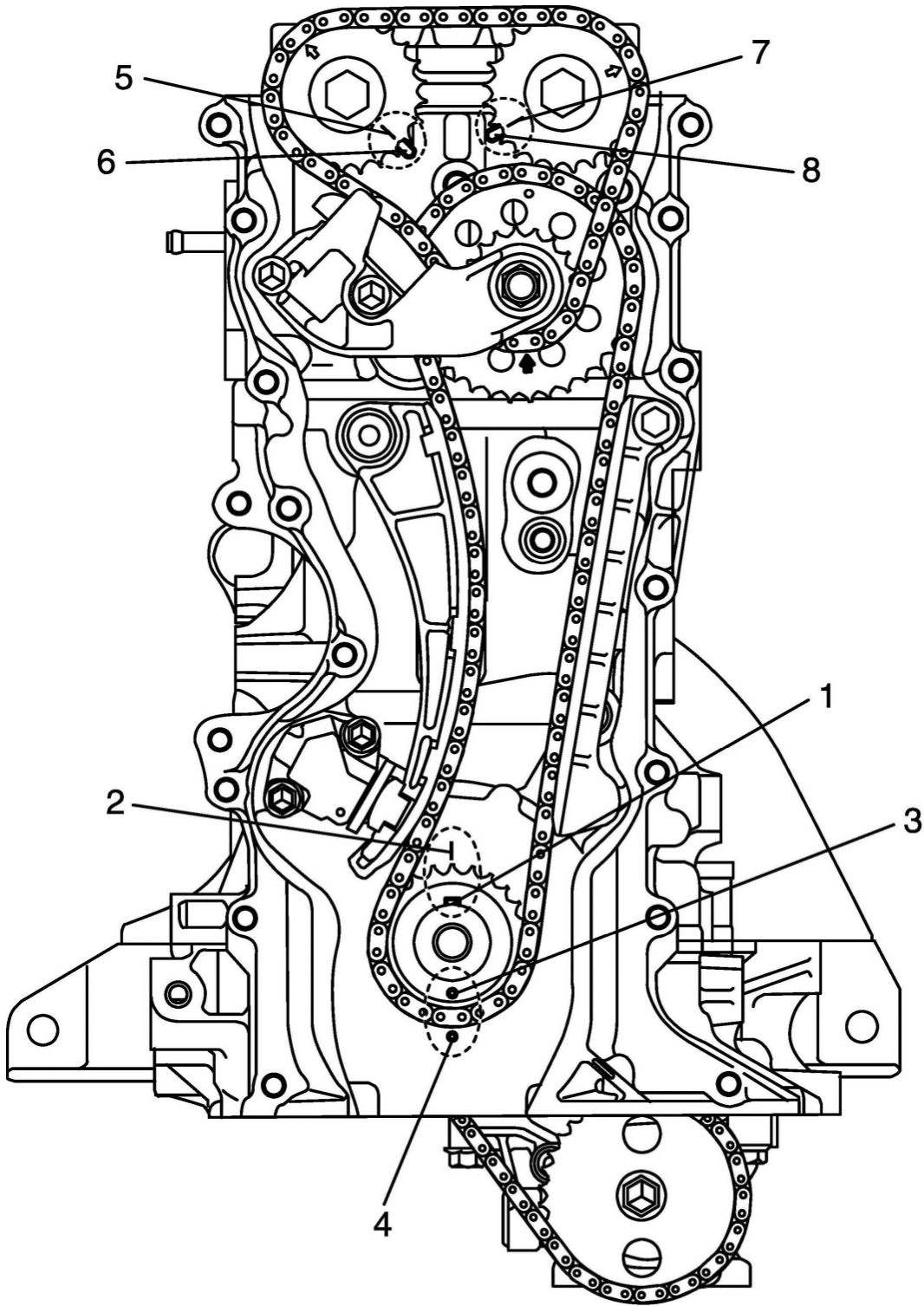
[Timing chain tensioner](#) adjuster No.2 bolt a: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**

Timing chain tensioner adjuster No.2 nut b: **45 Nm (4.5 kgf-m, 33.0 ft. lbs.)**

9. Pull out stopper (2) from [timing chain tensioner](#) adjuster No.2.



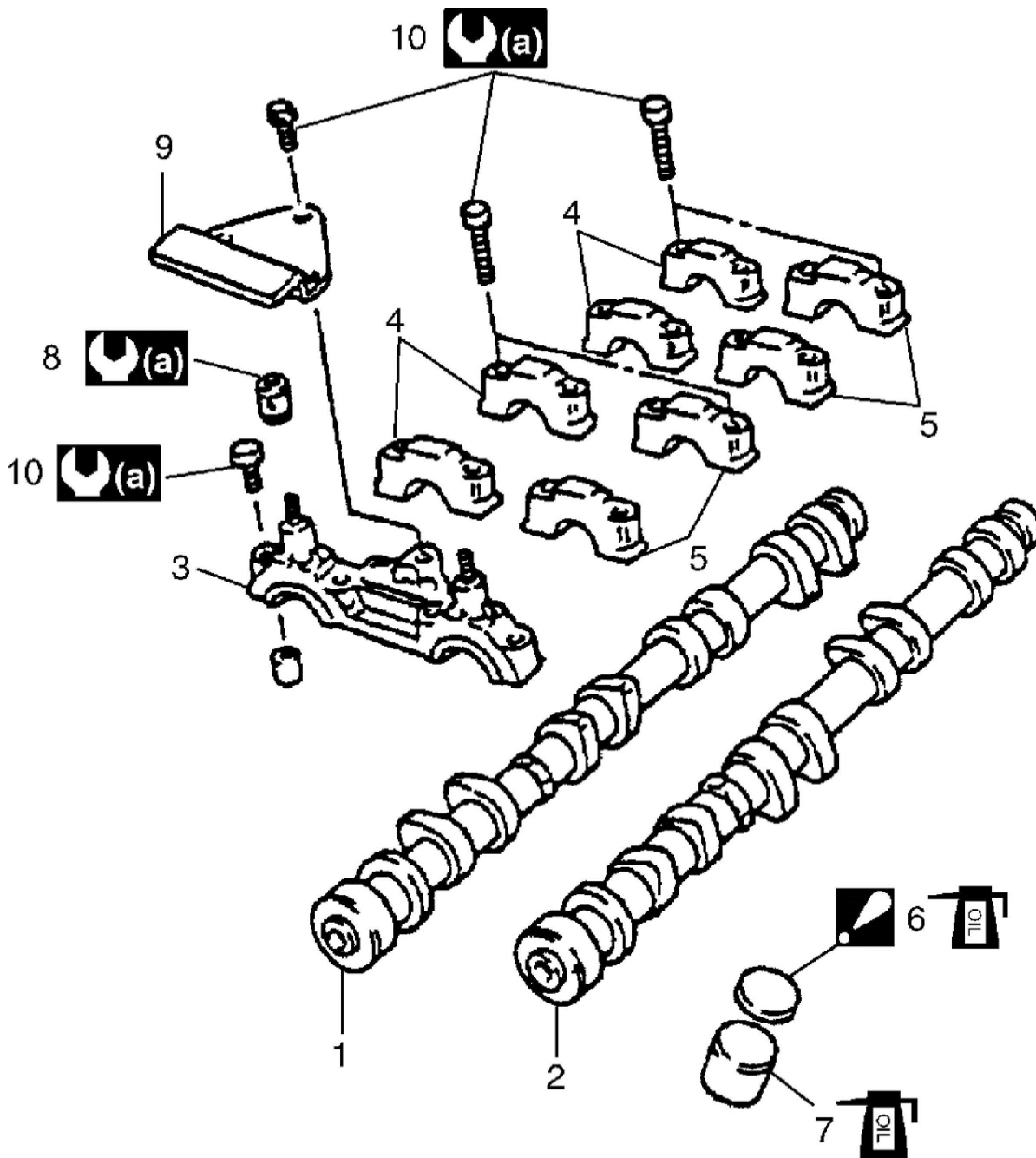
10. Turn [crankshaft](#) two rotations clockwise, and then align timing mark (1) on crankshaft and timing mark (2) on cylinder block as shown in figure. At this time, check timing marks (3, 5 and 7) of sprockets are in match with timing marks (4, 6 and 8) of cylinder head, cylinder block and lower crank case.






3.	Timing mark on crank timing sprocket
4.	Timing mark on lower crankcase
5.	Timing mark on intake camshaft timing sprocket
6.	Timing mark of intake camshaft timing sprocket
7.	Timing mark on exhaust camshaft timing sprocket
8.	Timing mark of exhaust camshaft timing sprocket

11. Apply oil to timing chains, tensioner, tensioner adjusters, sprockets and guides.
12. Install timing chain cover.
13. Install cylinder head cover.
14. Install [oil pan](#).
15. Install engine assembly to vehicle.

## Camshafts, Tappet and Shim Components



17.

1. Intake camshaft	5. Exhaust camshaft housing	9. Timing chain guide No.2
2. Exhaust camshaft	 6. Shim : Direct shim No. side toward tappet.	10. Camshaft housing bolt
3. Camshaft housing	7. Tappet	 : Tighten 11 N·m (1.1 kgf-m, 8.0 lb-ft) by the specified procedure.
4. Intake camshaft housing	8. Oil relief valve	 : Apply engine oil to sliding surface of each part.

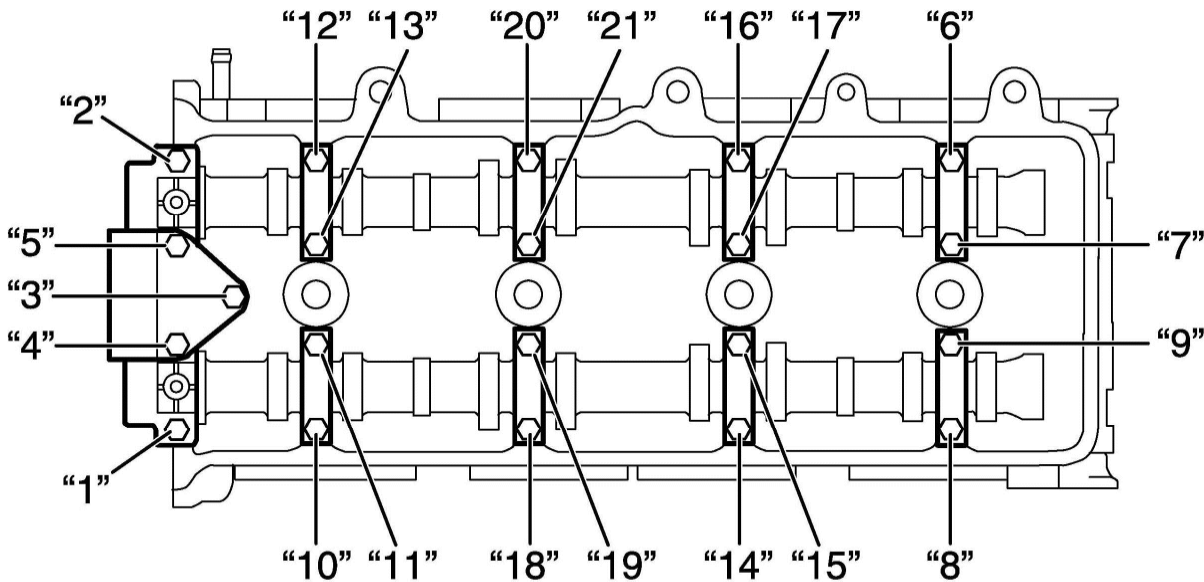
## Camshafts, Tappet and Shim Removal and Installation

### 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 2nd [timing chain](#).
2. Loosen camshaft housing bolts in such order as indicated in figure and remove them.

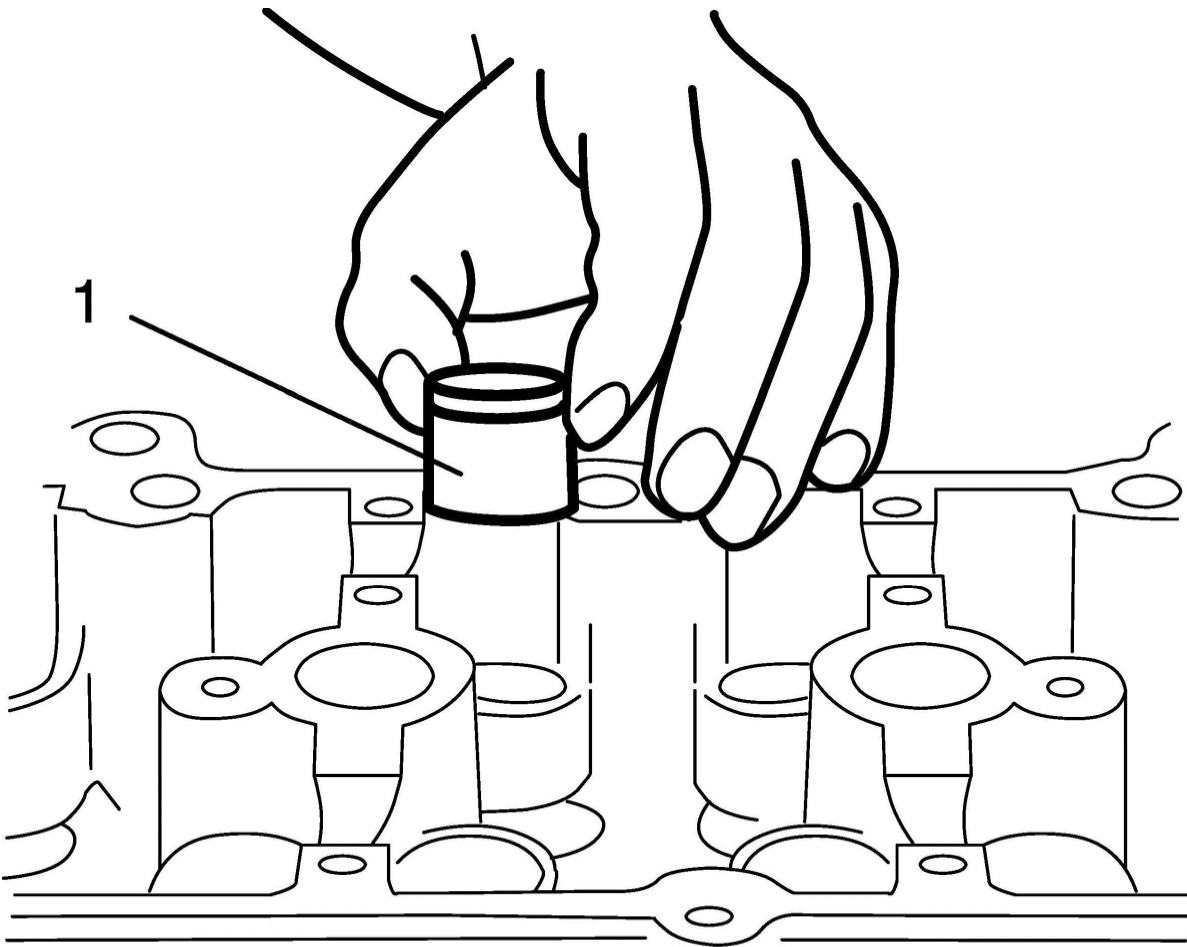


3. Remove camshaft housings.
4. Remove camshafts.
5. Remove tappets with shims.

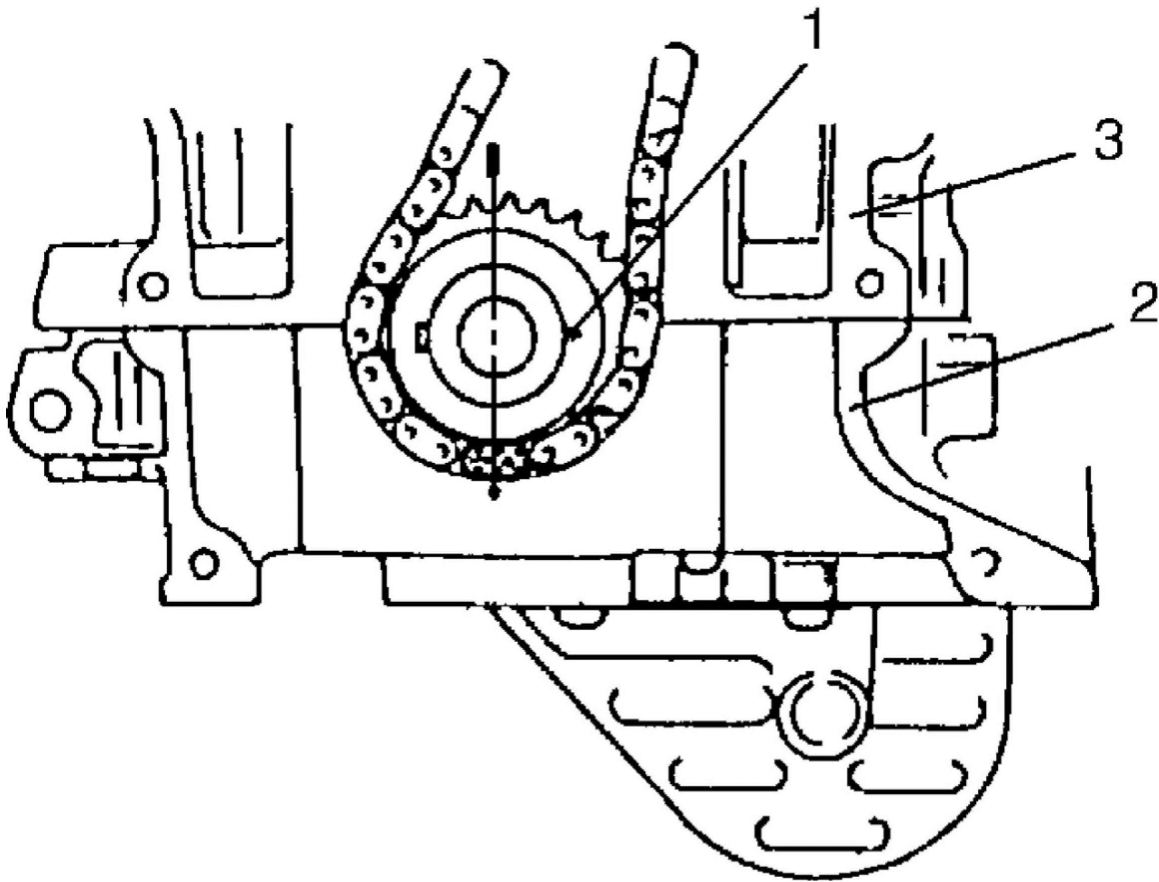
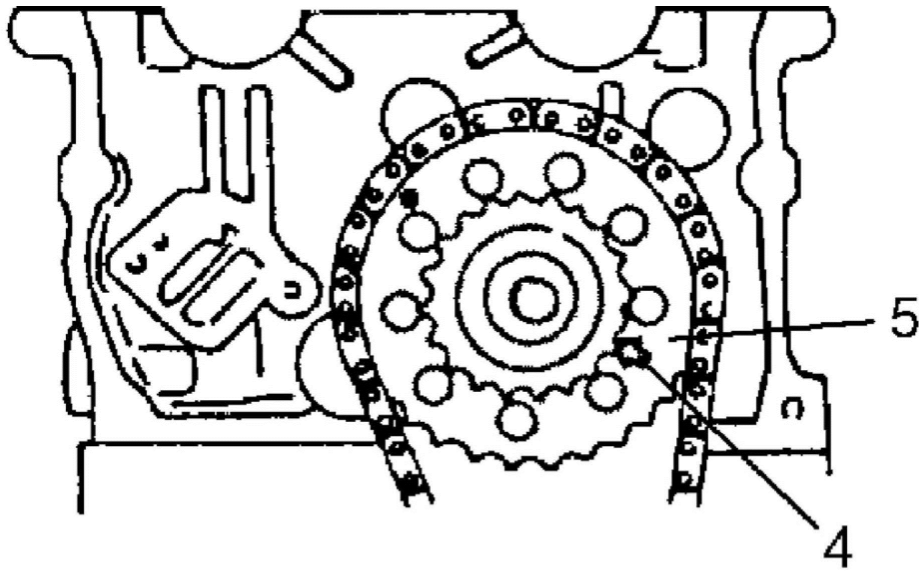
### Installation

1. Apply engine oil around tappet (1) and shim, and then install tappets with shims to cylinder head.

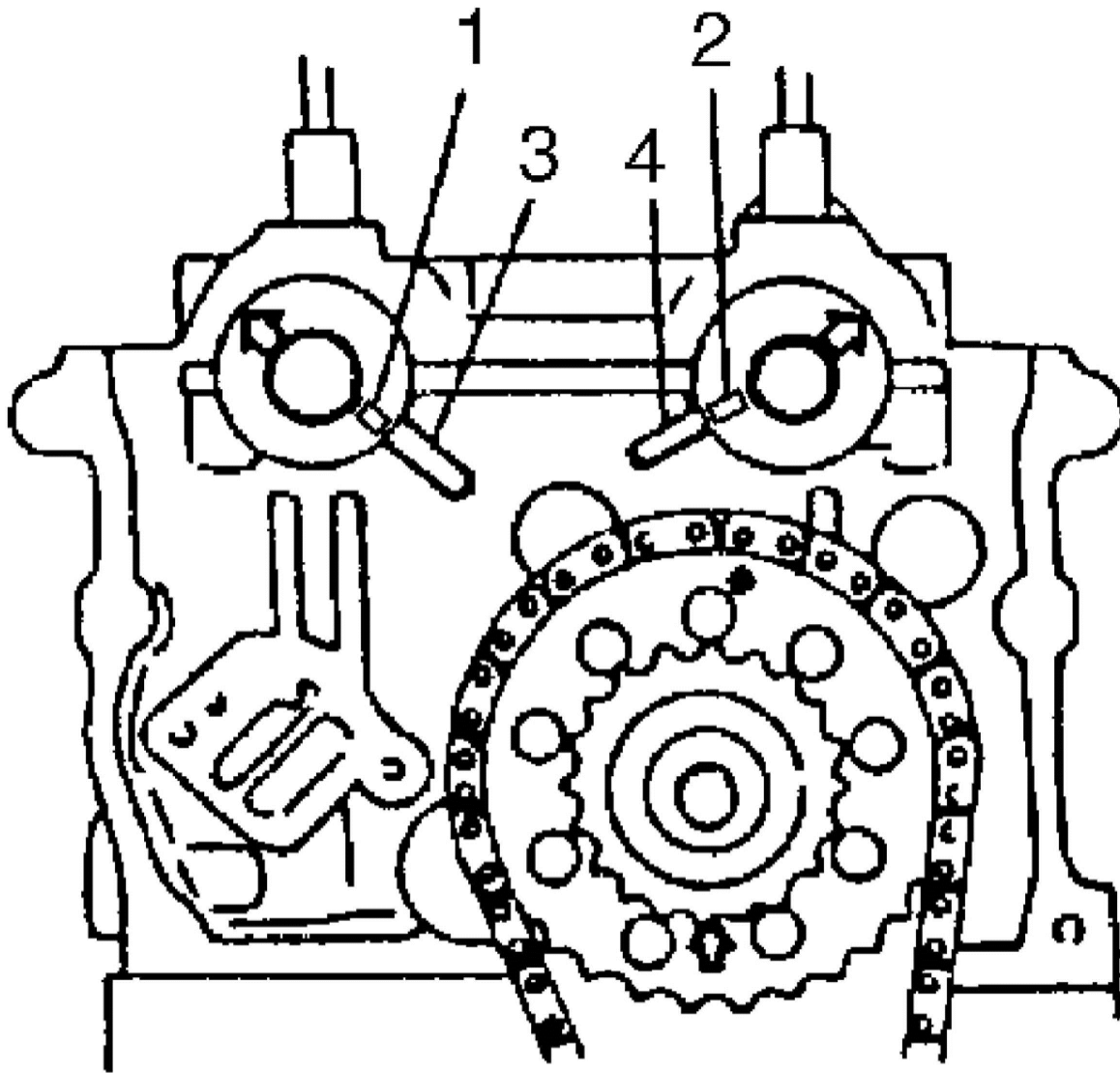
**NOTE:** When installing shim, make sure to direct shim No. side toward tappet.



2. Match match mark (1) on crank timing sprocket and mating surface of cylinder block (3) and lower crankcase (2) as shown in figure. At this time, make sure that arrow mark (4) on idler sprocket (5) at the position as shown in figure.

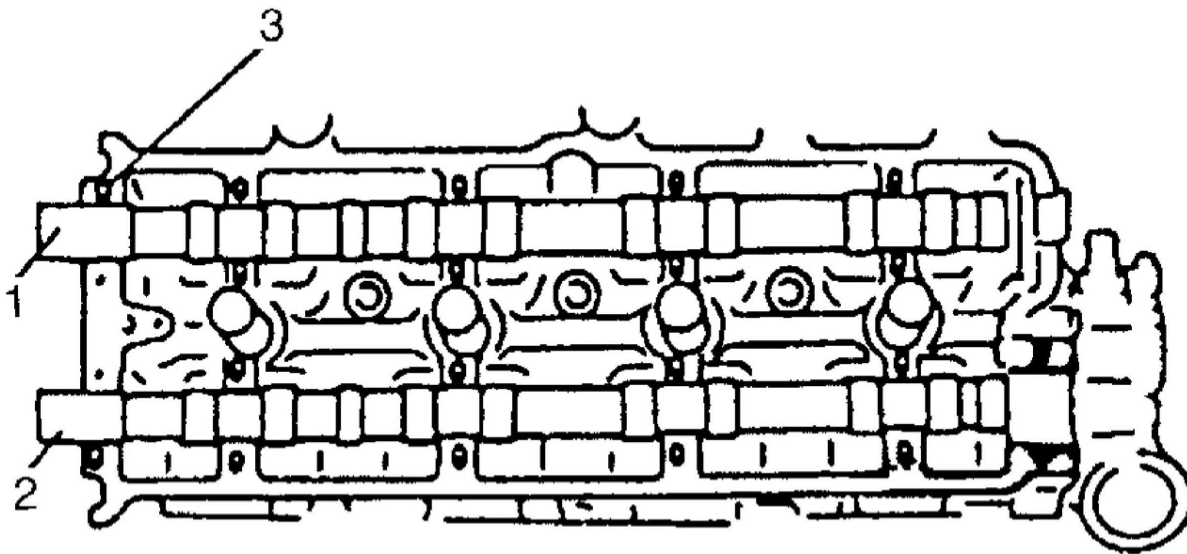


3. Install camshafts. Apply oil to sliding surface of each [camshaft](#) and camshaft journal then install them by aligning match marks on cylinder head and camshafts as shown in figure.



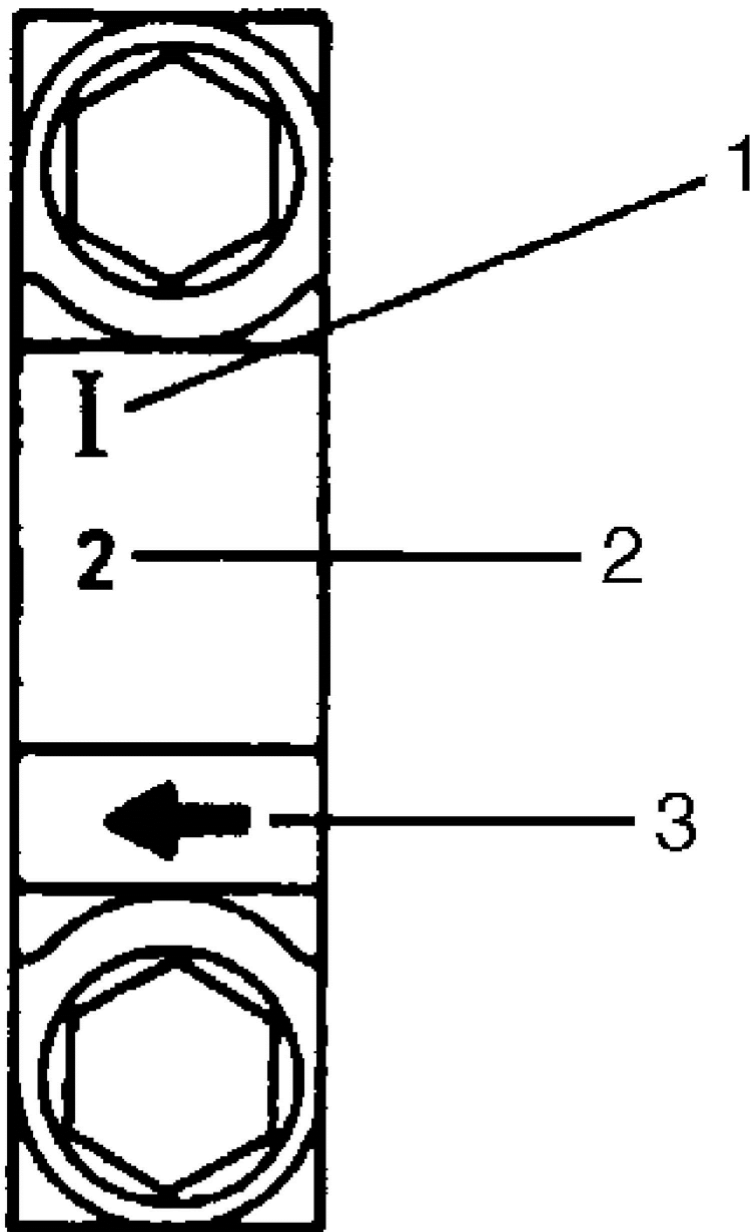
1. Knock pin of intake camshaft
2. Knock pin of exhaust camshaft
3. Match mark of intake camshaft
4. Match mark of exhaust camshaft

4. Install camshaft housing pins (3) as shown in figure.



1. Intake camshaft	2. Exhaust camshaft
--------------------	---------------------

5. 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.

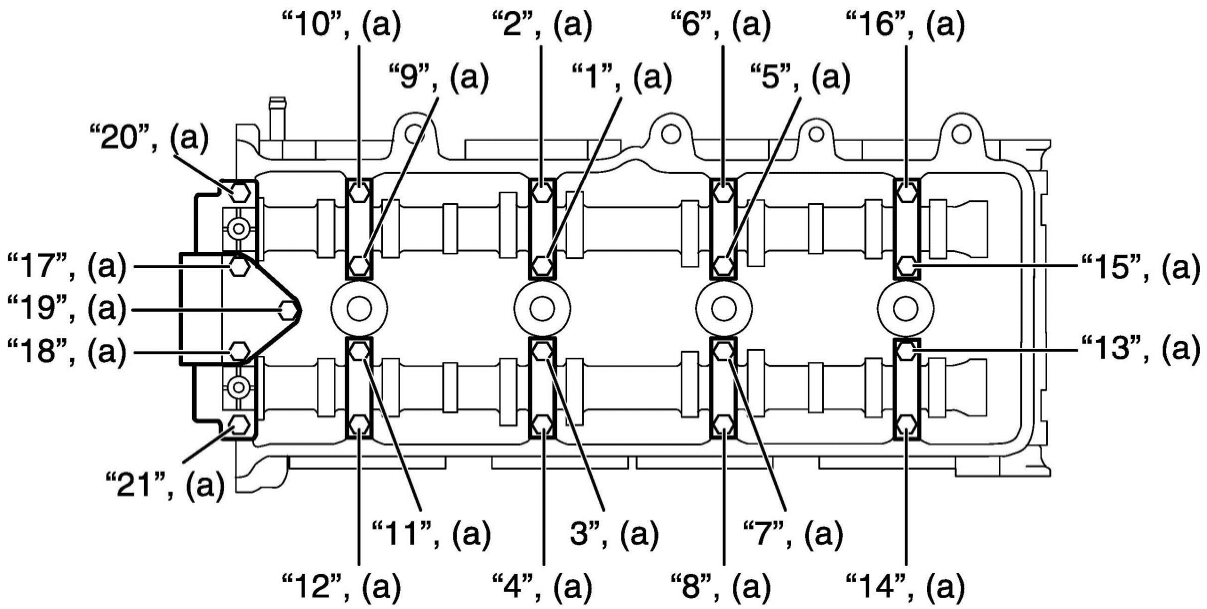


1. I: Intake side or E: Exhaust side
2. Position from timing chain side
3. Pointing to timing chain side

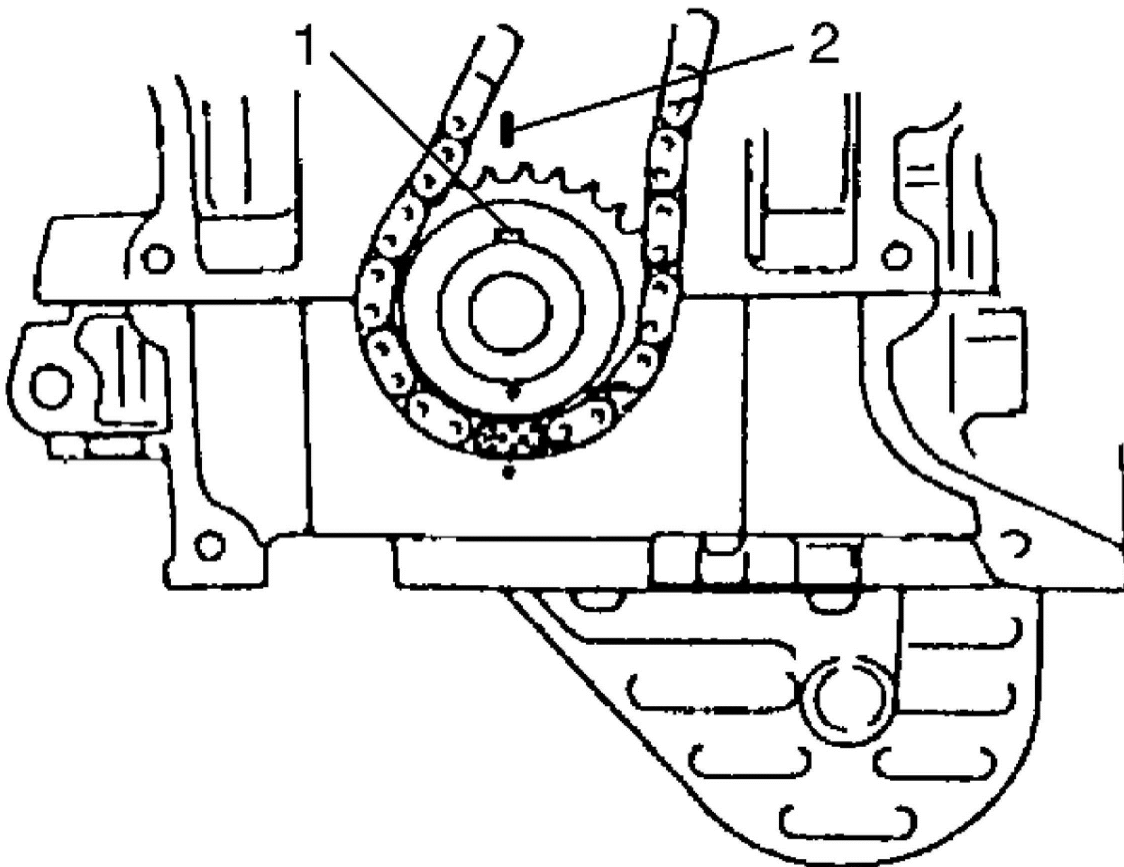
6. After applying oil to housing bolts, tighten them temporarily first. Then tighten them by following numerical order in figure. Tighten a little at a time and evenly among bolts and repeat tightening sequence two or three times before they are tightened to specified torque.

Tightening torque

Camshaft housing bolt a: Tighten **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)** by the specified procedure



7. Turn [crankshaft](#) clockwise then align crankshaft timing sprocket key (1) with timing mark (2).



8. Install 2nd [timing chain](#).
9. Install [timing chain](#) cover.
10. Install cylinder head cover.
11. Install [oil pan](#).
12. Install engine assembly to vehicle.
13. Check valve lashes.

## Pistons, [Piston Rings](#), Connecting Rods and Cylinders Removal and Installation

### Removal

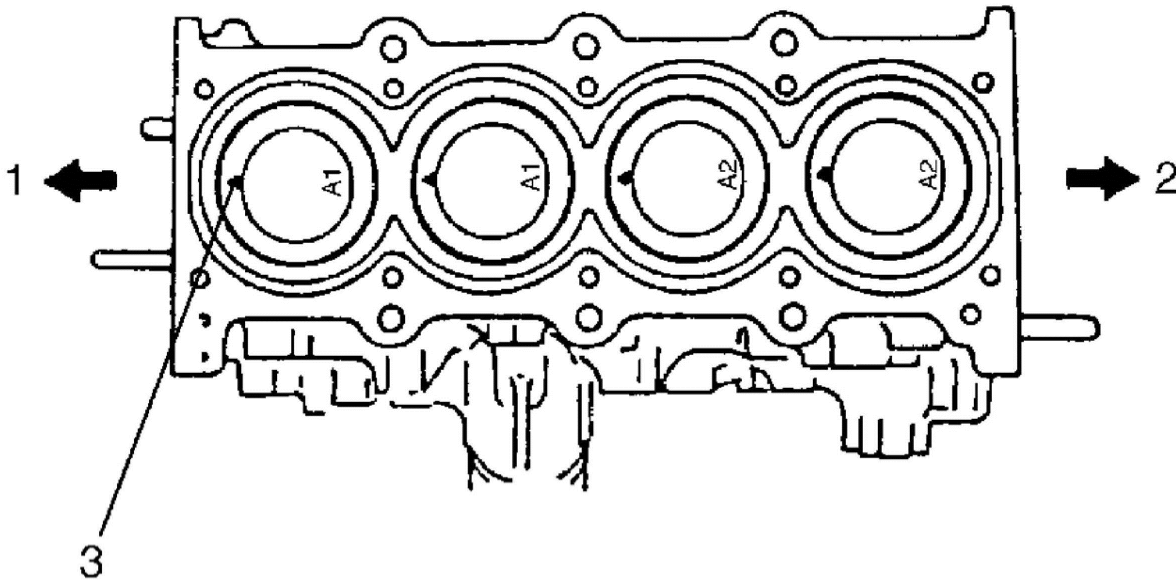
1. Remove [oil pump](#) with oil pump strainer.
2. Remove cylinder head.
3. Mark cylinder number on all pistons, connecting rods and connecting rod caps.
4. Remove [connecting rod bearing](#) caps.
5. Clean carbon from top of cylinder bore before removing [piston](#) from cylinder.
6. Push [piston](#) and connecting rod assembly out through the top of cylinder bore.

### Installation

1. Apply engine oil to pistons, [piston 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.

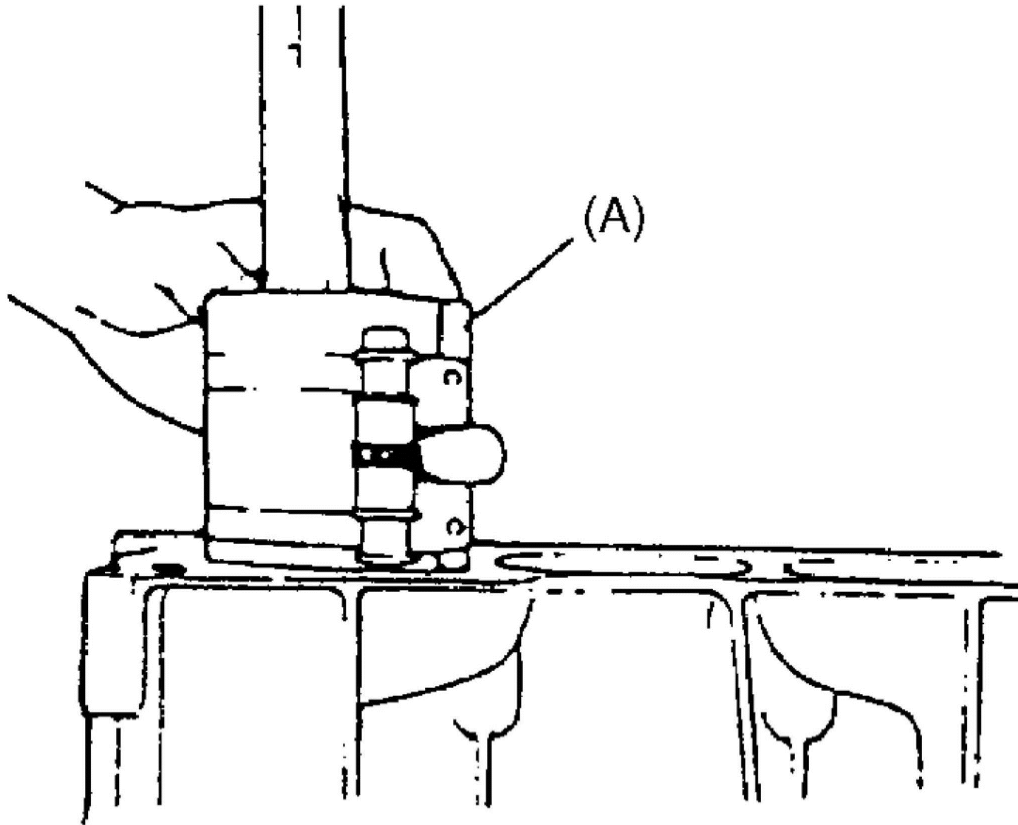
2. When installing [piston](#) and connecting rod assembly into cylinder bore, point front mark (3) on piston head to crankshaft pulley side (1).



2. Flywheel side

3. 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



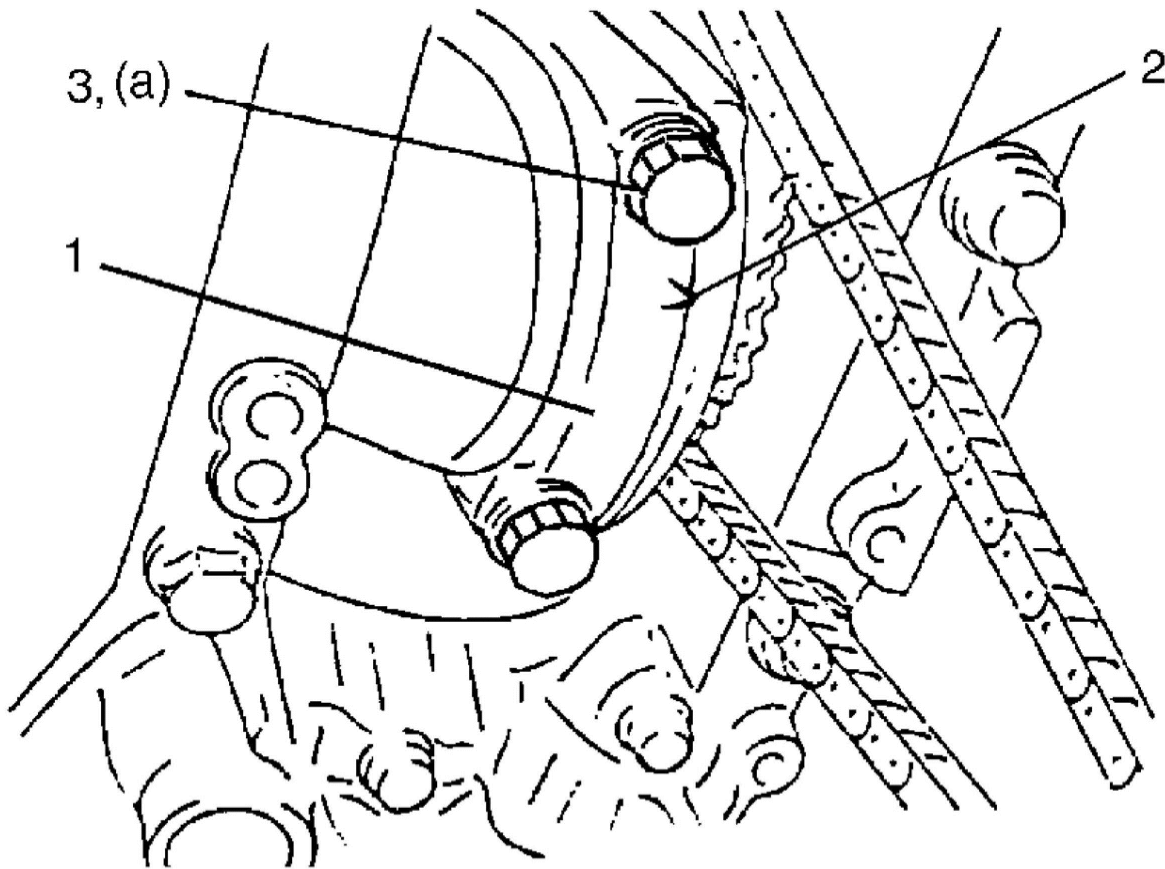
4. Install [connecting rod bearing cap](#) (1) as follows.

**NOTE:** If connecting rod bolt is reused, make sure to check connecting rod bolt for deformation.

- a) Point arrow mark (2) on cap to crankshaft pulley side.
- b) Apply engine oil to new connecting rod bolts (3).
- c) Tighten all connecting rod bolts to **15 Nm (1.5 kgf-m, 11.0 ft. lbs.)**.
- d) Retighten them by turning through **45°**.
- e. Repeat step d) once again.

Tightening torque

Connecting rod bolt a: Tighten **15 Nm (1.5 kgf-m, 11.0 ft. lbs.)**, **45° and 45°** by the specified procedure

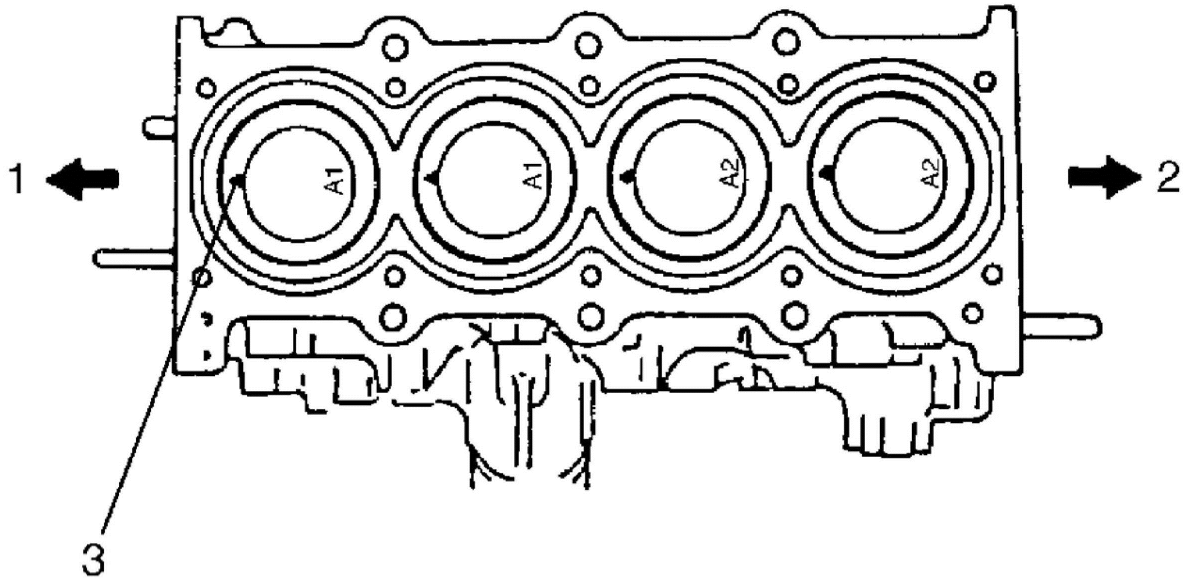


5. Install cylinder head.
6. Install [oil pan](#).
7. Install camshafts and tappets and shims.
8. Install 1st [timing chain](#).
9. Install 2nd [timing chain](#).
10. Install [timing chain](#) cover.
11. Check intake and exhaust valve lashes.
12. Install cylinder head cover.
13. Install engine assembly to vehicle.

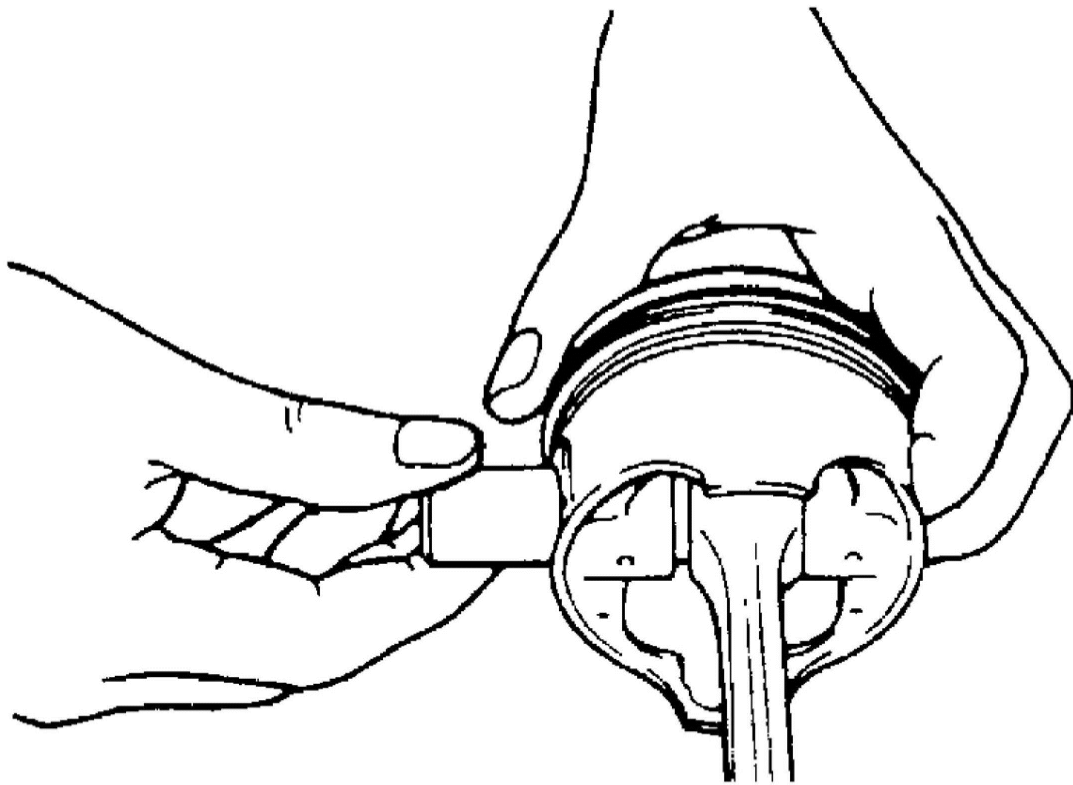
## **Pistons, [Piston Rings](#), Connecting Rods and Cylinders Disassembly and Reassembly**

### **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.
  - Ease out piston pin circlips (1), as shown.



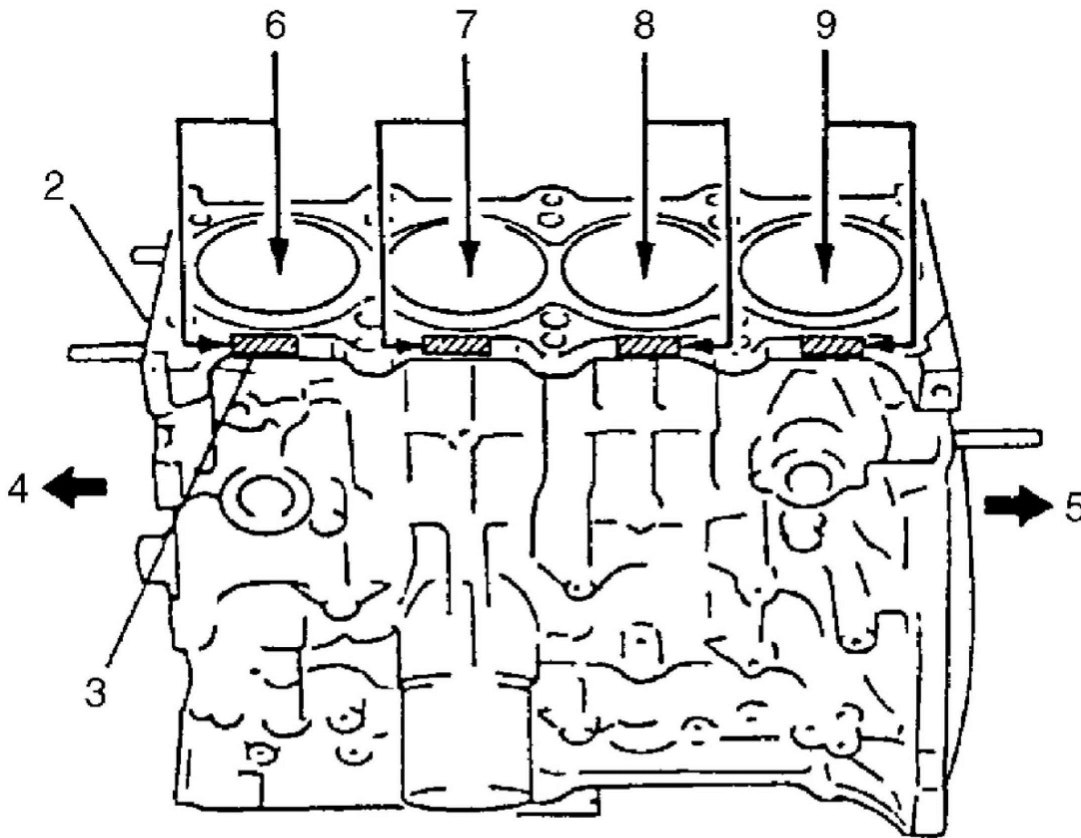
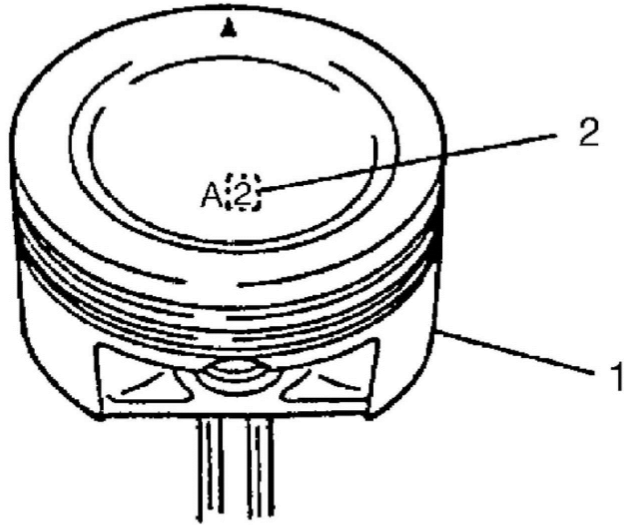
- Force piston pin out.



**Reassembly**

**NOTE:** Two sizes of [piston](#) are available as standard size spare part so as to ensure proper piston-to-cylinder clearance. When installing a standard size piston, make sure to match piston with cylinder as follows.

1. Each [piston](#) (1) has stamped number (2) as shown. It represents outer diameter of piston.
2. There are also painted color (3) of red or blue on cylinder block (2) as shown.



4. Crank shaft pulley side	7. No.2 cylinder
5. Flywheel side	8. No.3 cylinder
6. No.1 cylinder	9. No.4 cylinder

3. Stamped number on [piston](#) and painted color (or stamped number) on cylinder block should correspond. That is, install number "2" stamped piston to cylinder which is identified with blue painted (or "2" stamped) and a number "1" piston to cylinder with red painted (or "1" stamped). Also, a letter "A" or "B" is stamped on [piston](#) head but ordinarily it is not necessary to discriminate each piston by this letter.

### **Piston outer diameter and cylinder bore diameter specification**

Piston outer diameter and cylinder bore diameter specification

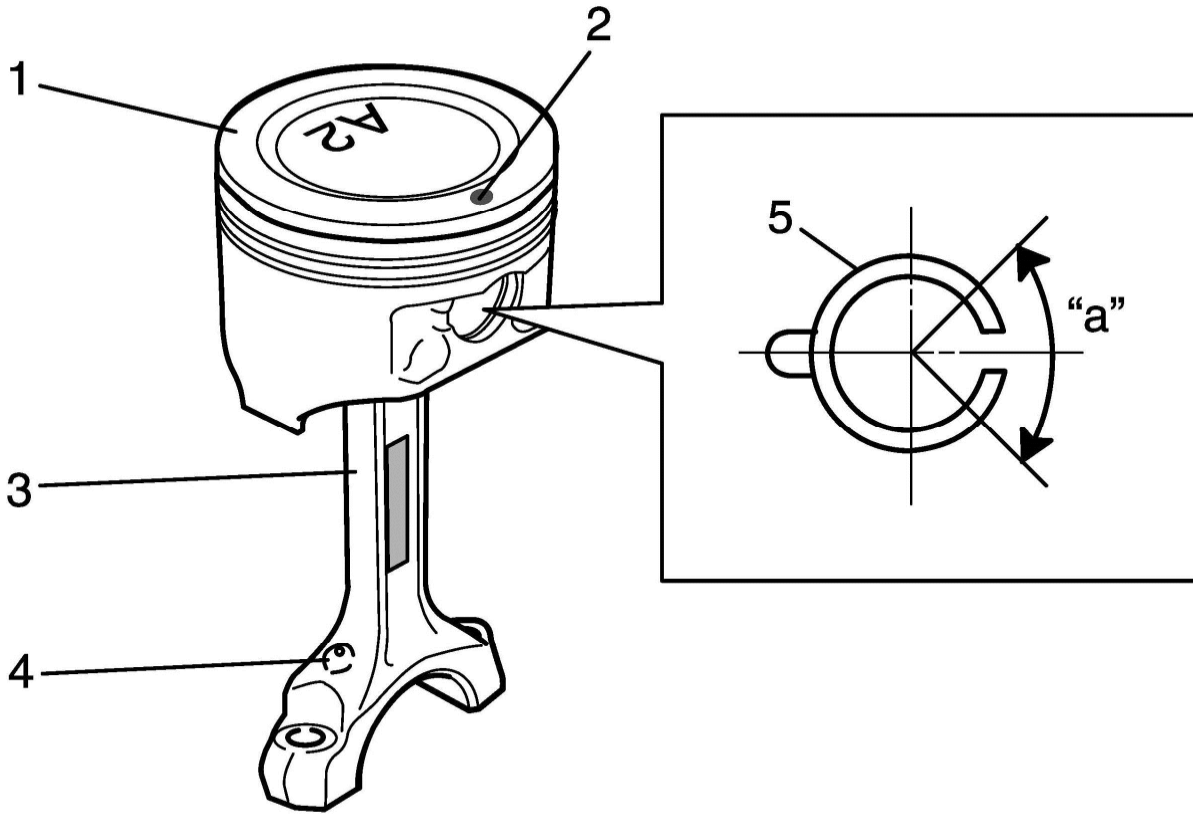
#### **Piston outer diameter and cylinder bore diameter specification**

Piston		Cylinder	
Number	Outer diameter	Paint (Number)	Bore diameter
1	83.9800 – 83.9900 mm (3.3063 – 3.3066 in.)	Red (1)	84.0101 – 84.0200 mm (3.3075 – 3.3078 in.)
2	83.9700 – 83.9799 mm (3.3059 – 3.3062 in.)	Blue (2)	84.0000 – 84.0100 mm (3.3071 – 3.3074 in.)

4. Install piston pin to [piston](#) (1) and connecting rod (3): After applying engine oil to piston pin, piston pin holes in [piston](#) and inner surface of connecting rod small end, fit connecting rod to piston as shown in figure and insert piston pin to piston and connecting rod, and install piston pin circlips.

#### **NOTE:**

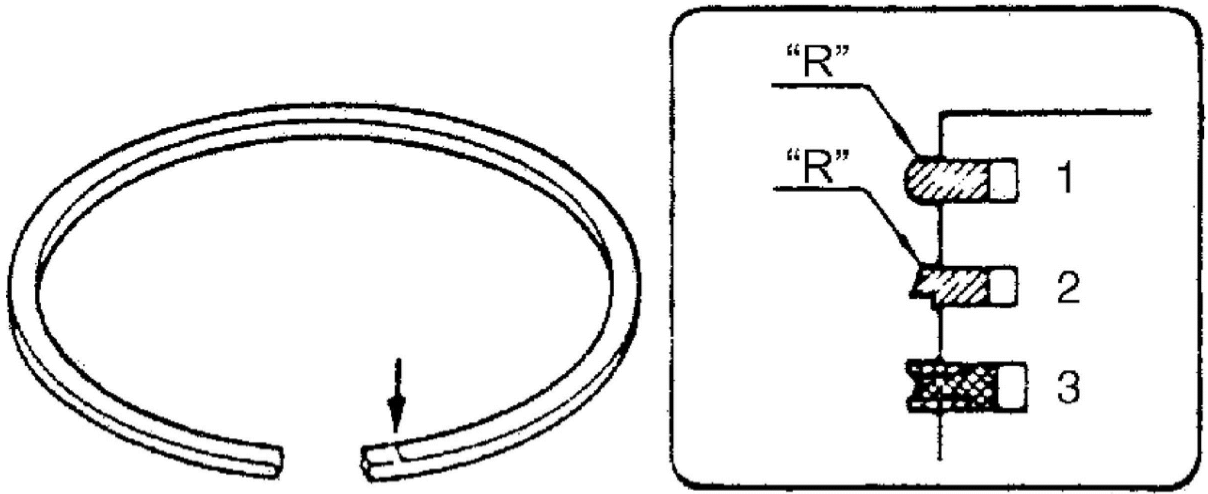
- Oil hole (4) comes on intake side.
- Circlip (5) should be installed so that circlip end gap comes within such range as indicated by arrow.



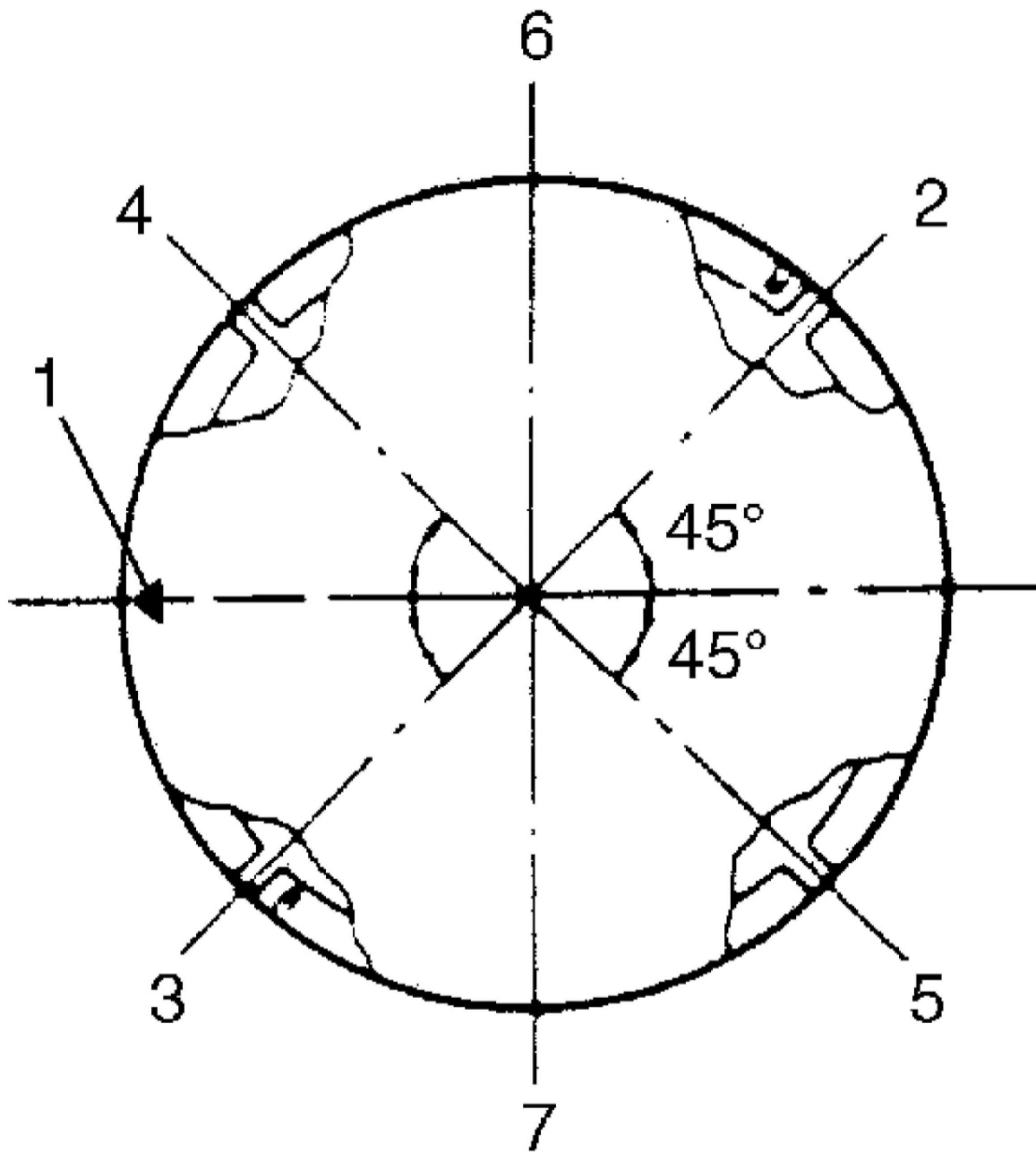
"a": 90°	4. Oil hole
2. Front mark	

5. Install [piston rings](#) to [piston](#):

- As indicated in figure at the left, 1st and 2nd rings have "R" 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 figure.
- When installing oil ring (3), install spacer first and then two rails.



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



1. Front mark
2. 1st ring end gap
3. 2nd ring end gap and oil ring spacer gap
4. Oil ring upper rail gap
5. Oil ring lower rail gap
6. Intake side
7. Exhaust side

## Pistons, [Piston Rings](#), Connecting Rods and Cylinders Inspection and Cleaning

### Inspection

#### Cylinder

- 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](#).
- Using a cylinder gauge, measure cylinder bore in thrust and axial directions at two positions as shown in figure. If any of following conditions is noted, rebore cylinder.
  1. Cylinder bore diameter 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

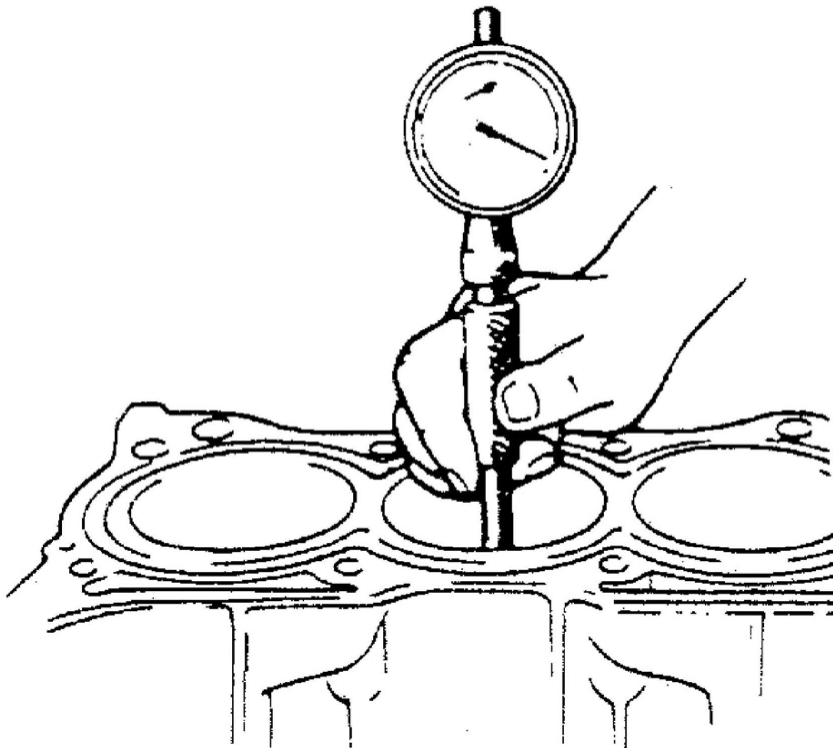
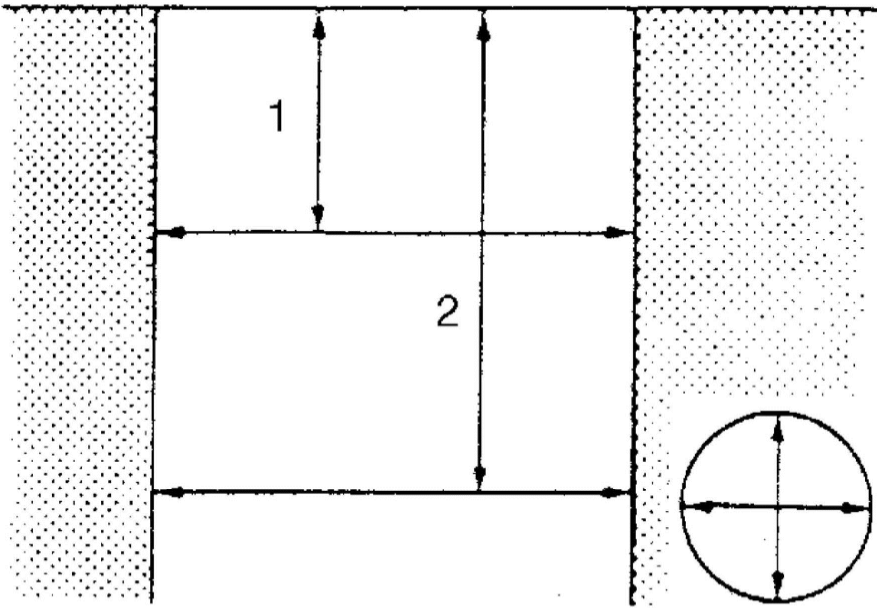
Standard: **84.000 - 84.020 mm (3.3070 - 3.3078 in.)**

Limit: **84.050 mm (3.3090 in.)**

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.



1. 50 mm (1.96 in.)	2. 95 mm (3.74 in.)
---------------------	---------------------

## Pistons

- Inspect [piston](#) for faults, cracks or other damages. Damaged or faulty piston should be replaced.

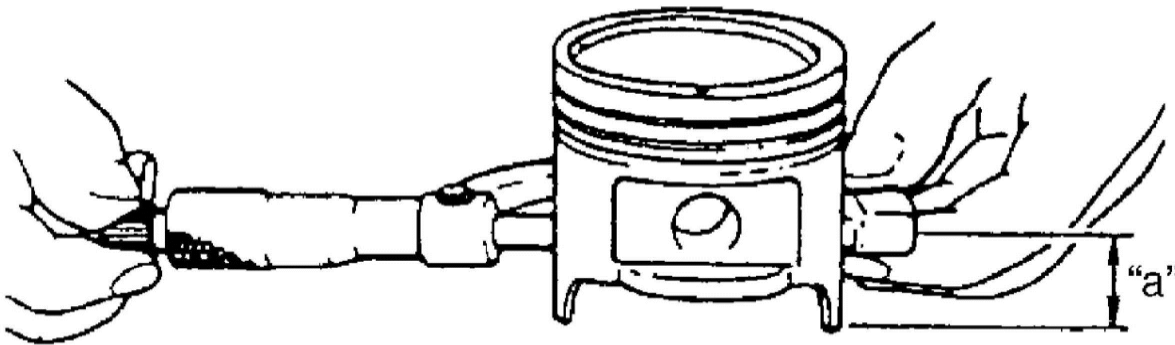
- **Piston** diameter: As indicated in figure, **piston** diameter should be measured at a position **26.5 mm (1.04 in.)** ("a") from piston skirt end in the direction perpendicular to piston pin.

## **Piston diameter**

Piston Diameter

### **Piston diameter**

<b>Standard</b>	<b>83.9700 – 83.9900 mm (3.3059 – 3.3067 in.)</b>
<b>Oversize: 0.50 mm (0.0196 in.)</b>	<b>84.4700 – 84.4900 mm (3.3256 – 3.3264 in.)</b>



- **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.

**Piston clearance 0.02 - 0.04 mm (0.0008 - 0.0015 in.)**

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

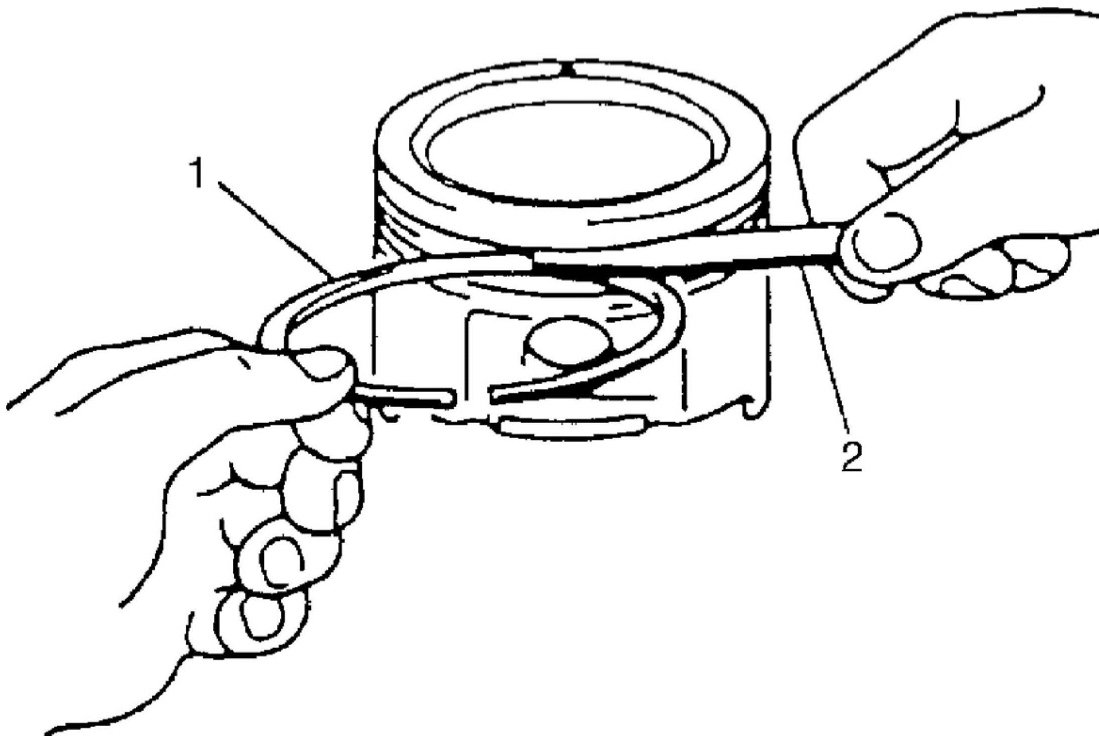
- Ring groove clearance: Before checking, **piston** grooves must be clean, dry and free of carbon. Fit new **piston ring** (1) into piston groove, and measure clearance between ring and ring land by using thickness gauge (2). If clearance is out of specification, replace piston.

## **Ring groove clearance**

Ring Groove Clearance

## Ring groove clearance

Item	Standard	Limit
Top ring	0.03 – 0.07 mm (0.0120 – 0.0027 in.)	0.12 mm (0.0047 in.)
2nd ring	0.02 – 0.06 mm (0.0008 – 0.0023 in.)	0.1 mm (0.0039 in.)
Oil ring	0.06 – 0.15 mm (0.0024 – 0.0059 in.)	–



## Piston pin

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

Piston pin clearance in small end

Standard: **0.003 - 0.014 mm (0.0001 - 0.0005 in.)**

Piston pin clearance in [piston](#)

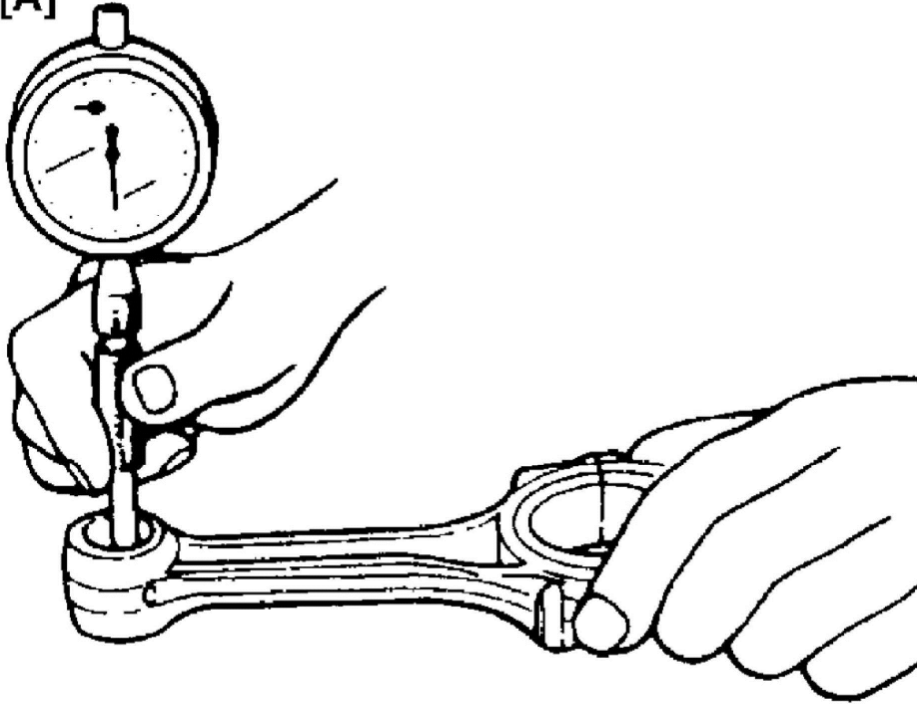
Standard: **0.006 - 0.017 mm (0.00024 - 0.00067 in.)**

Small-end bore [A] 21.003 - 21.011 mm (0.8269 - 0.8272 in.)

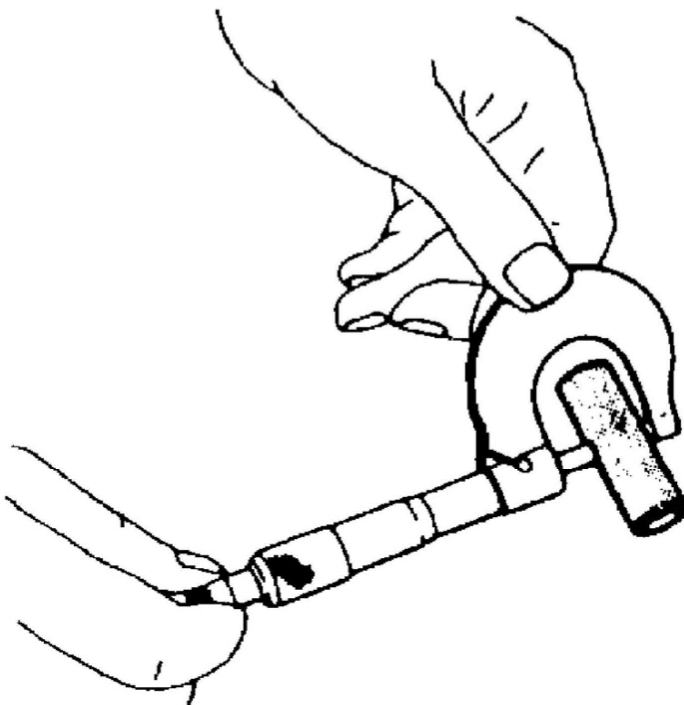
Piston pin diameter [B] 20.997 - 21.000 mm (0.8267 - 0.8268 in.)

Piston bore 21.006 - 21.014 mm (0.8270 - 0.8273 in.)

[A]



[B]



Piston rings

To measure end gap, insert [piston ring](#) (2) into cylinder bore and then measure the gap by using thickness gauge (1). If measured gap is out of specification, replace ring.

**NOTE:** Clean carbon and any other dirt from top of cylinder bore before inserting [piston ring](#).

### **Piston ring end gap**

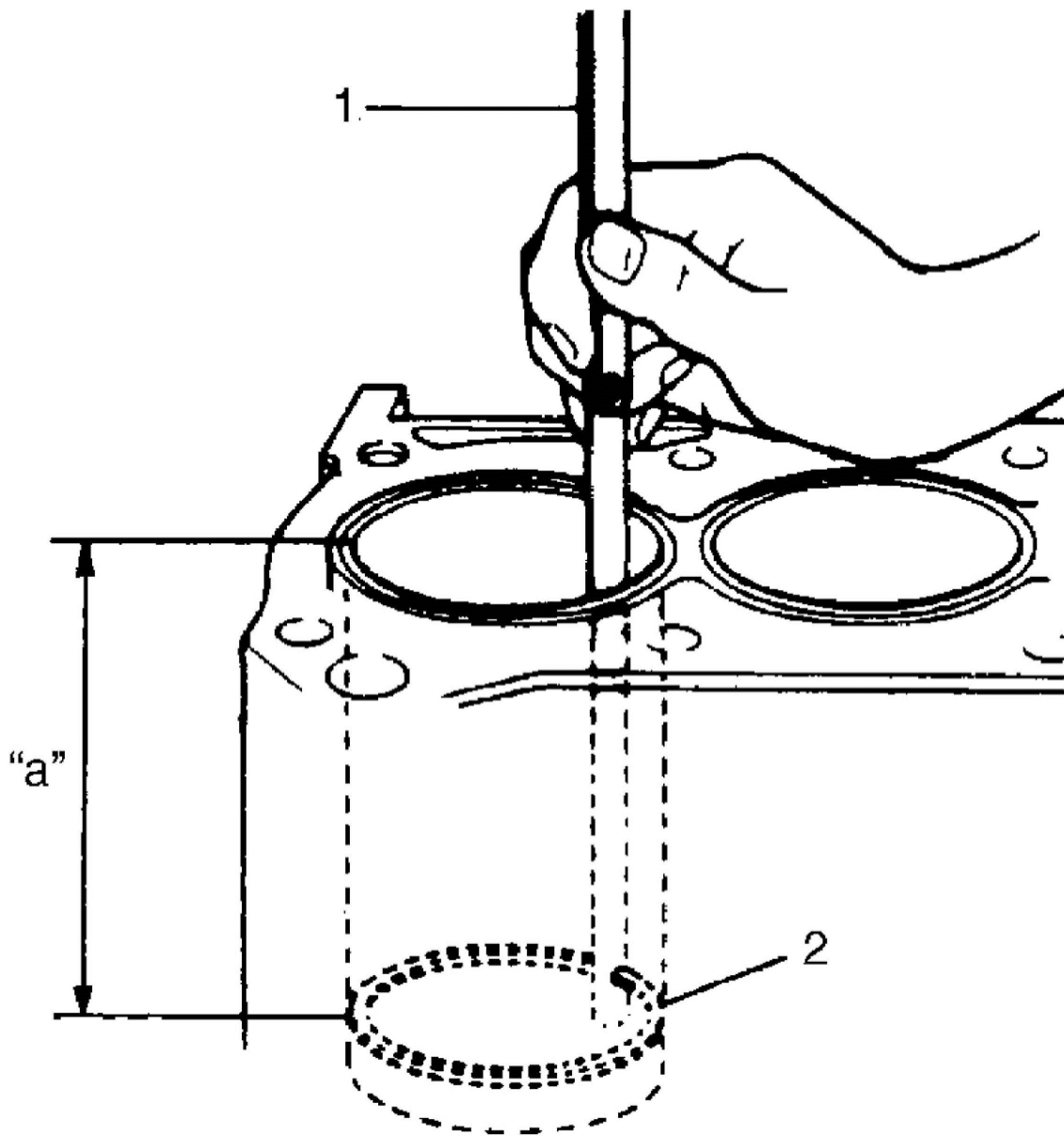
Piston Ring End Gap

#### **Piston ring end gap**

Item	Standard	Limit
Top ring	0.20 – 0.33 mm (0.0079 – 0.0129 in.)	0.7 mm (0.0276 in.)
2nd ring	0.33 – 0.48 mm (0.0129 – 0.0188 in.)	0.7 mm (0.0276 in.)
Oil ring	0.20 – 0.50 mm (0.0079 – 0.0196 in.)	1.8 mm (0.0709 in.)

[Piston rings](#) end gap

"a": 120 mm (4.72 in.)



### 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.

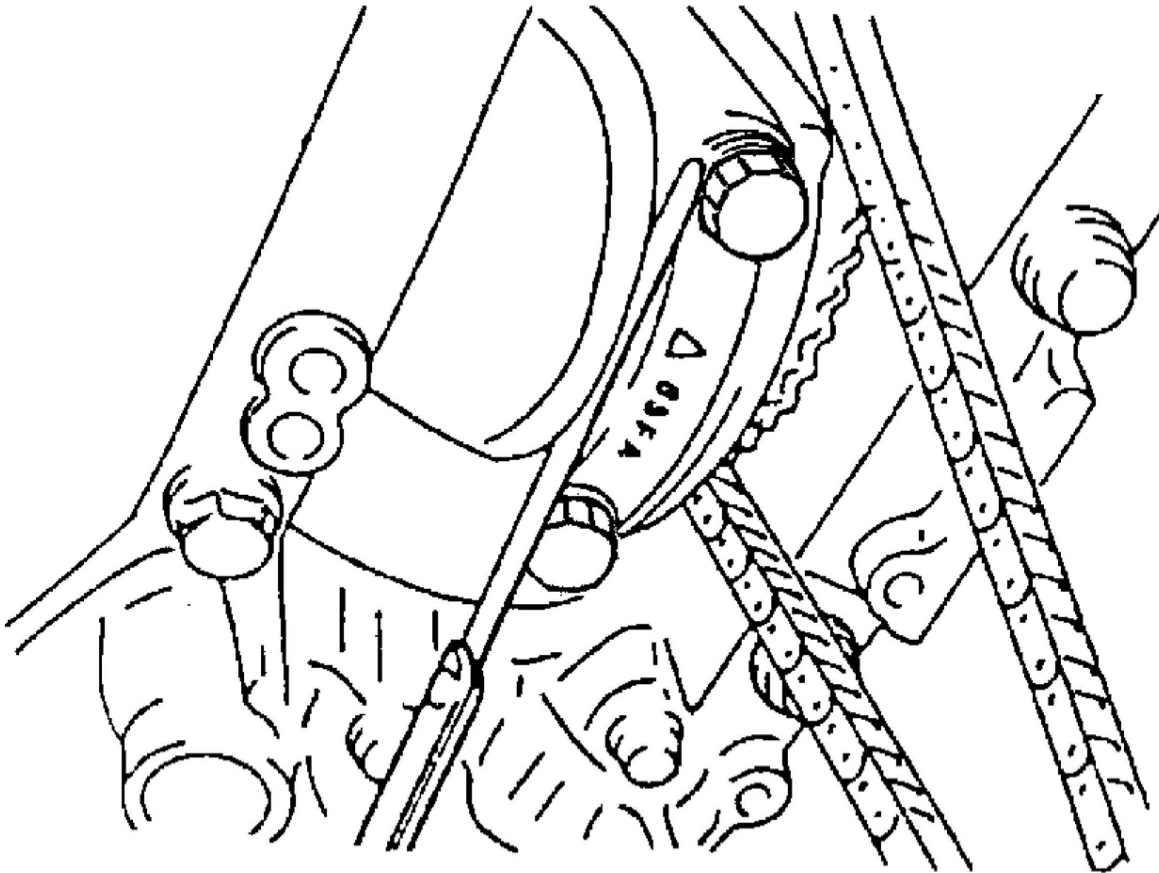
### Big-end side clearance

Connecting Rod Side Clearance

### Big-end side clearance

Standard	Limit
0.25 - 0.40 mm (0.0099 - 0.0150 in.)	0.45 mm (0.0177 in.)

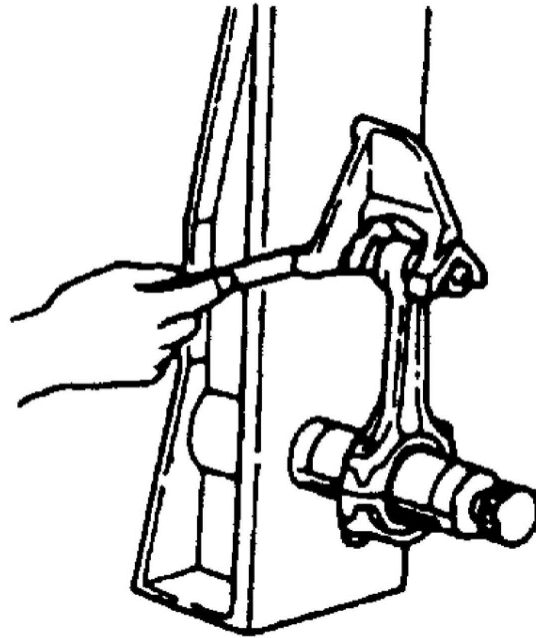
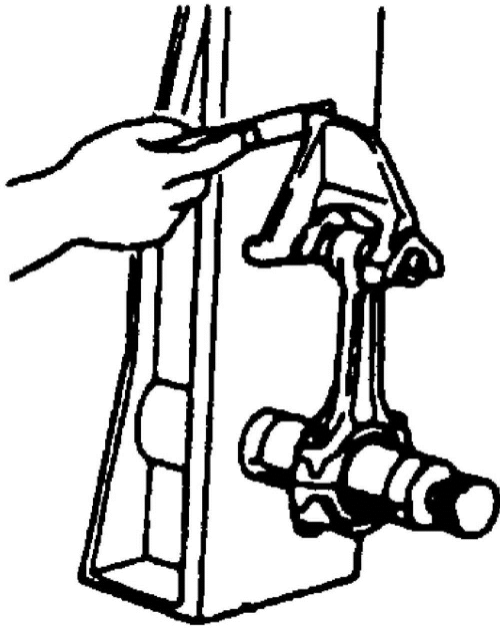
### Connecting Rod Side Clearance



- Connecting rod alignment: Mount connecting rod on aligner to check it for bow and twist. If limit is exceeded, replace it.

Limit on bow **0.05 mm (0.0020 in.)**

Limit on twist **0.10 mm (0.0039 in.)**



### Crank pin and [connecting rod bearings](#)

- 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.

### [Connecting rod bearing](#) and crank pin

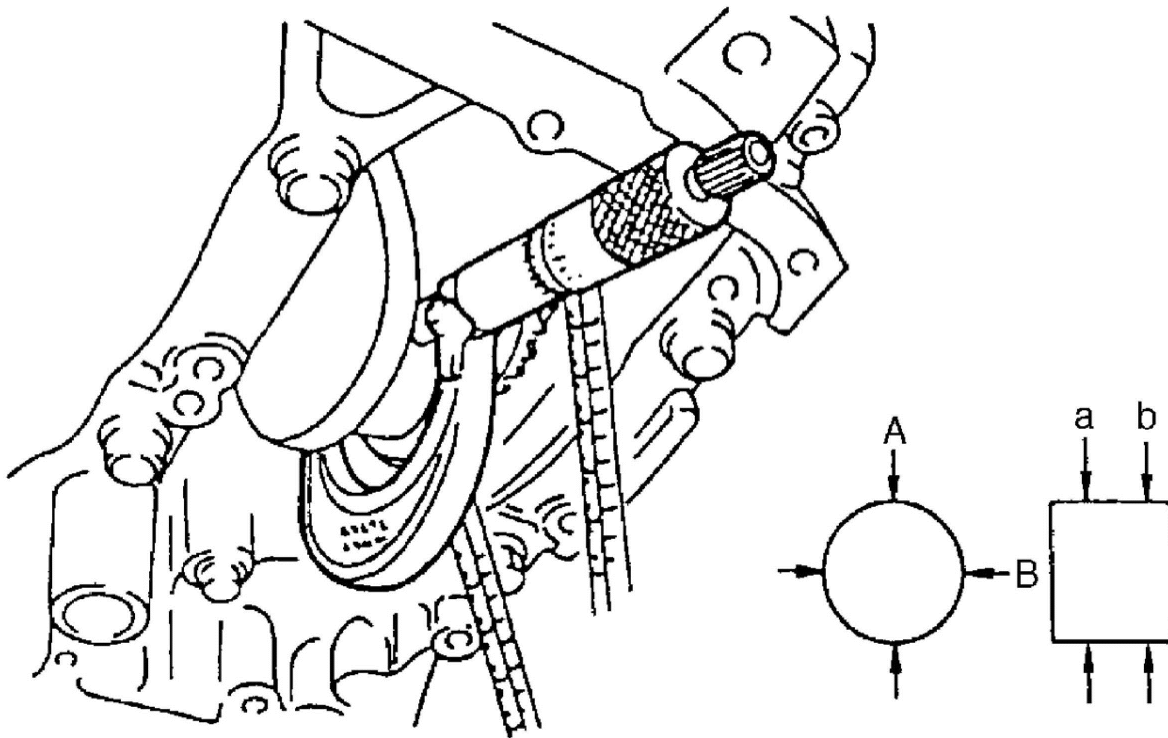
#### Connecting rod bearing and crank pin

Item	Standard
Crank pin diameter	49.982 – 50.000 mm (1.9768 – 1.9685 in.)

Out-of-round "A"-"B"

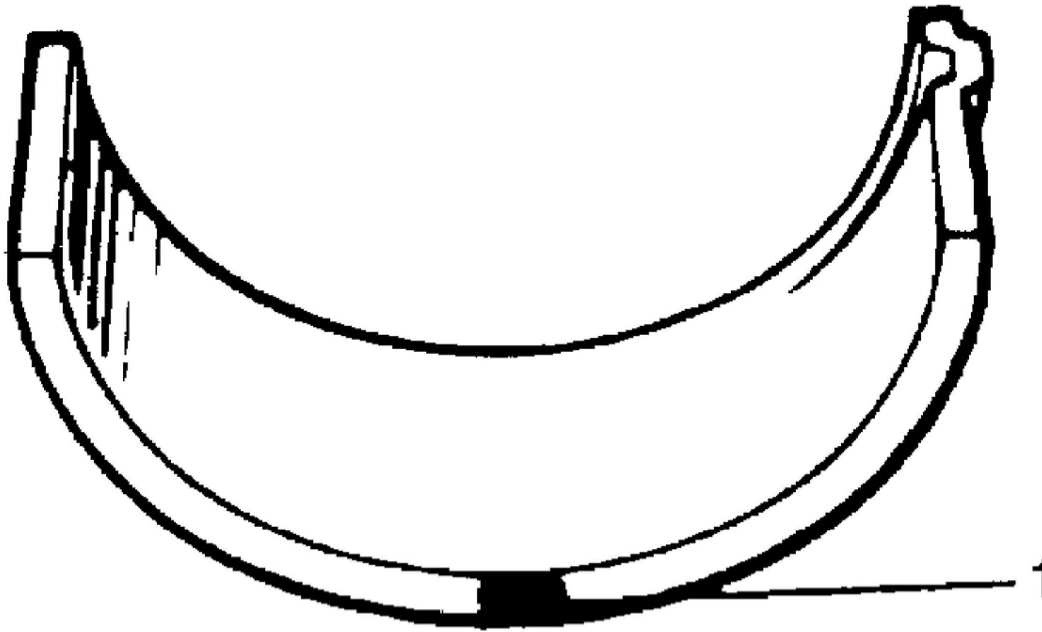
Taper "a"-"b"

Out-of-round and taper limits **0.01 mm (0.0004 in.)**

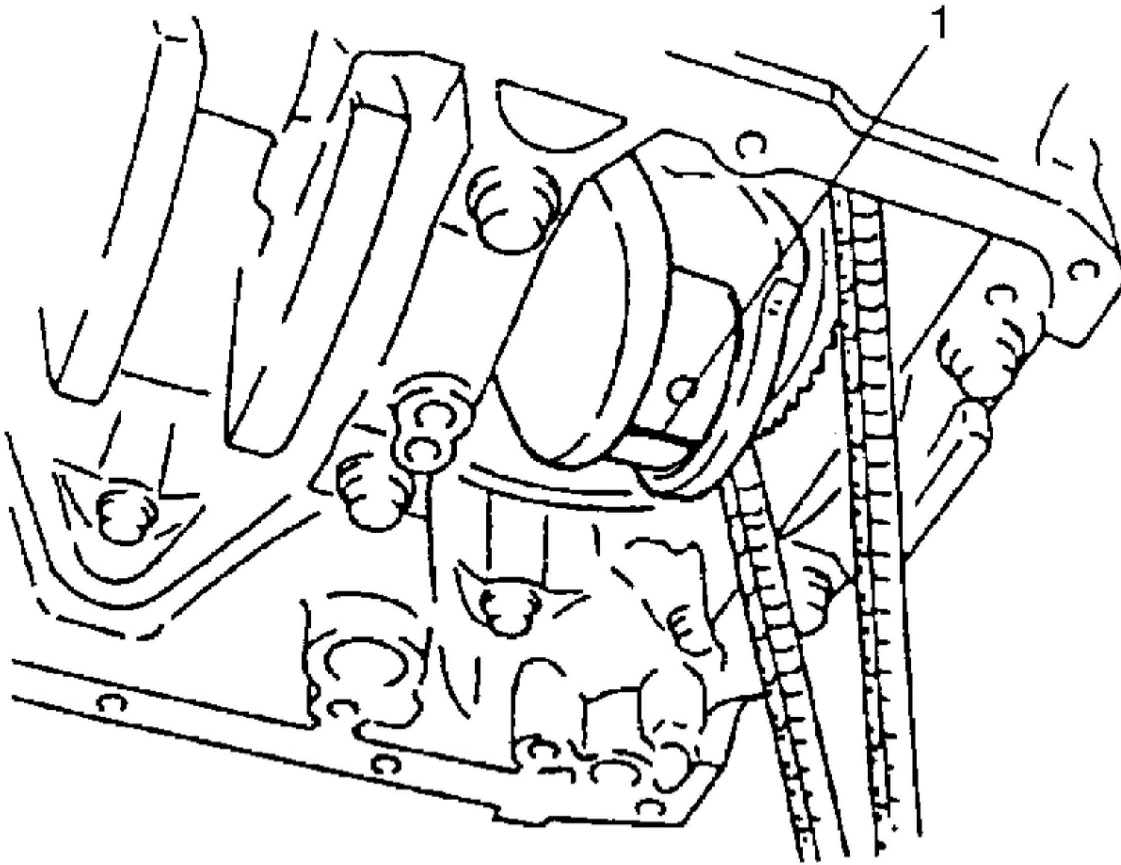


- [Connecting rod bearing](#) general information: Inspect bearing shells for signs of fusion, pitting, burn or flaking and observe contact pattern. Bearing shells found in defective condition must be replaced.

Two kinds of [connecting rod bearings](#) are available; standard size bearing and **0.25 mm (0.0098 in.)** undersize bearing. For identification of undersize bearing, it is painted red (1) 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.



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

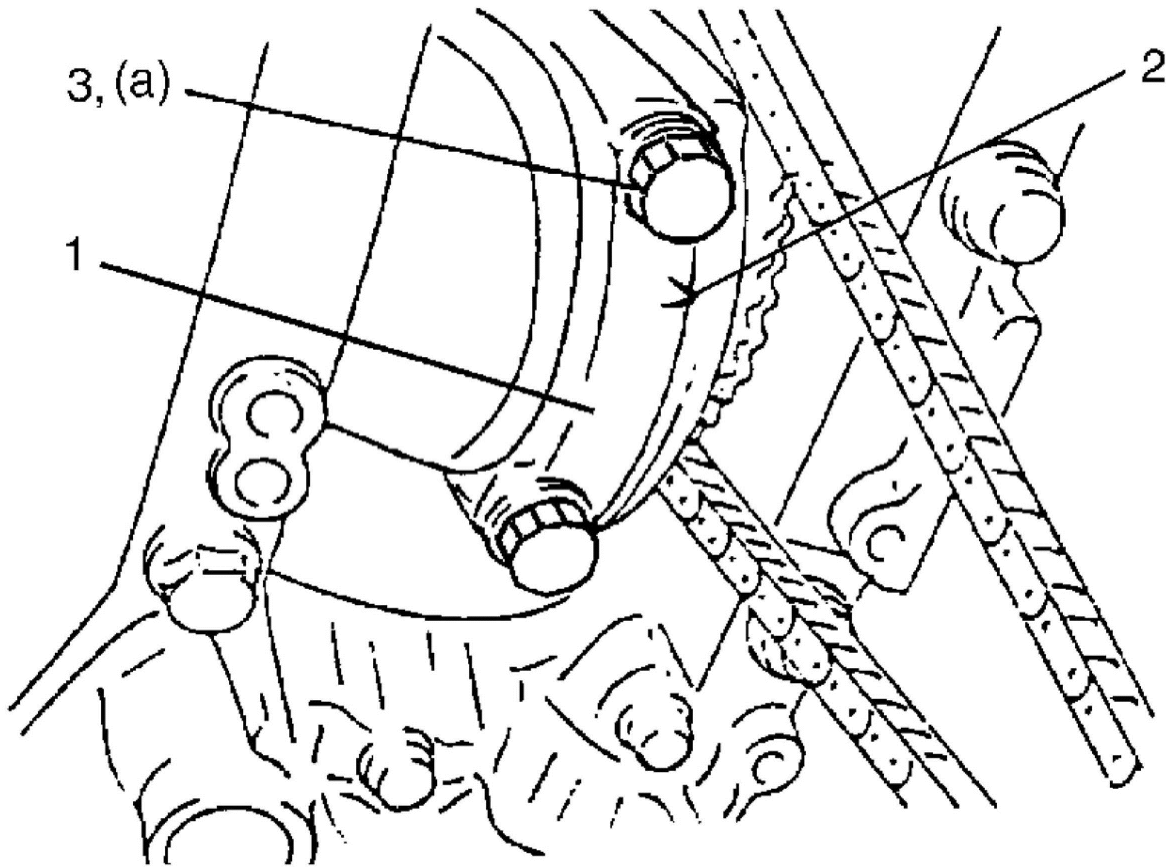


- d. Install [connecting rod bearing cap](#) (1) as follows.
  - i. Point arrow mark (2) on cap to crankshaft pulley side.
    - ii. Apply engine oil to connecting rod bolts (3).
    - iii. Tighten all connecting rod bolts to **15 Nm (1.5 kgf-m, 11.0 ft. lbs.)** .
    - iv. Retighten them by turning through **45°** .
  - v. Repeat step d) once again.

Tightening torque

Connecting rod bolt a: Tighten **15 Nm (1.5 kgf-m, 11.0 ft. lbs.)**, **45°** and **45°** by the specified procedure

**NOTE:** Do not turn [crankshaft](#) with gauging plastic installed.



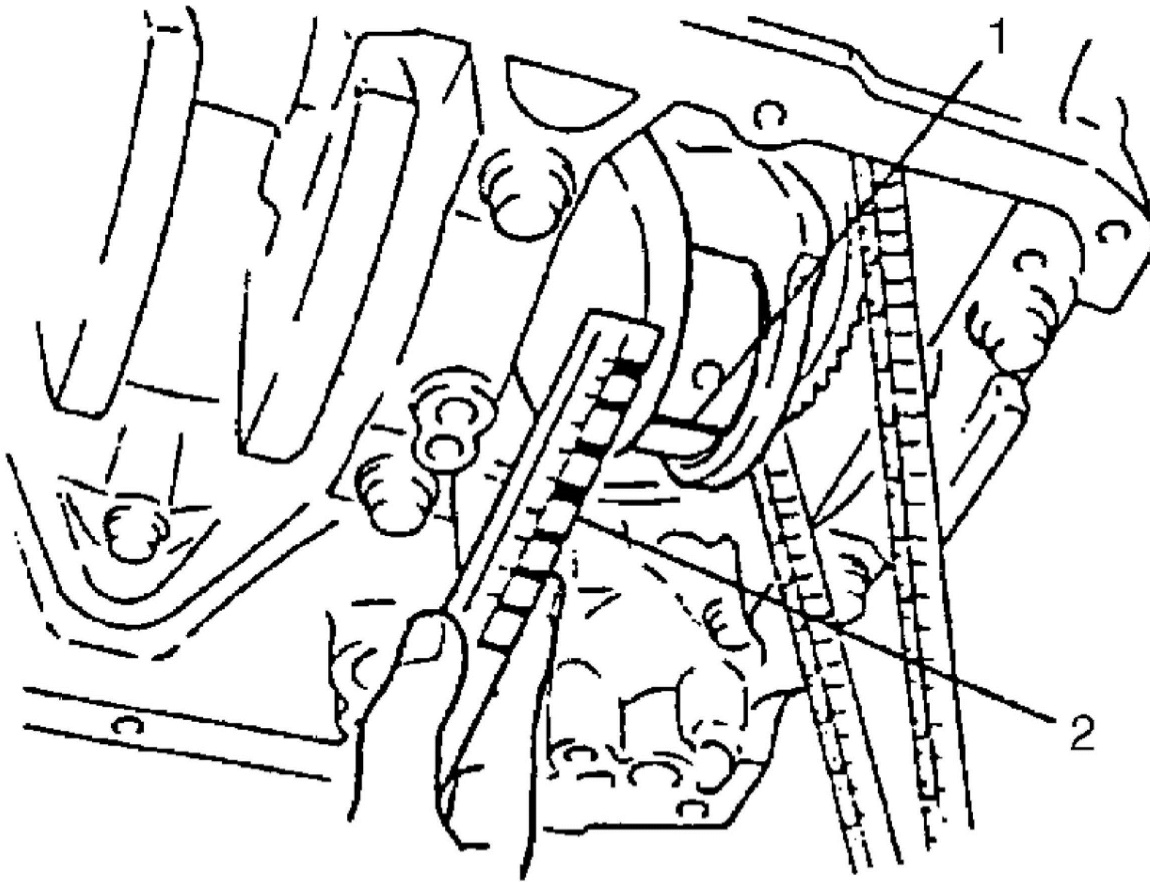
- e. Remove [connecting rod bearing](#) cap, and using a scale (2) on gauging plastic envelope, measure gauging plastic (1) width at the widest point (clearance). If clearance exceeds its limit, select connecting rod bearing below mentioned item. After selecting new bearing, recheck clearance.

### Bearing clearance

Bearing Clearance

#### Bearing clearance

Standard	Limit
0.045 - 0.063 mm (0.0018 - 0.0025 in.)	0.08 mm (0.0031 in.)



f. If clearance can not be brought to within its limit even by using a new standard size bearing, replace [crankshaft](#) or regrind crankpin to undersize as follows.

- Install **0.25 mm** undersize bearing to connecting rod big end.
- Measure bore diameter of connecting rod big end.
- Regrind crankpin to the following finished diameter.

Finished Crankpin Diameter = Measured big end bore diameter (including undersize bearing) - **0.054 mm (0.0021 in.)**

- Confirm that bearing clearance is within the standard value.

**NOTE:** After checking the [connecting rod bearing](#) clearance, make sure to check for "Connecting rod bolt" under Pistons [Piston Rings](#) Connecting Rods and Cylinders Inspection and Cleaning.

- Selection of [connecting rod bearings](#):

**NOTE:**

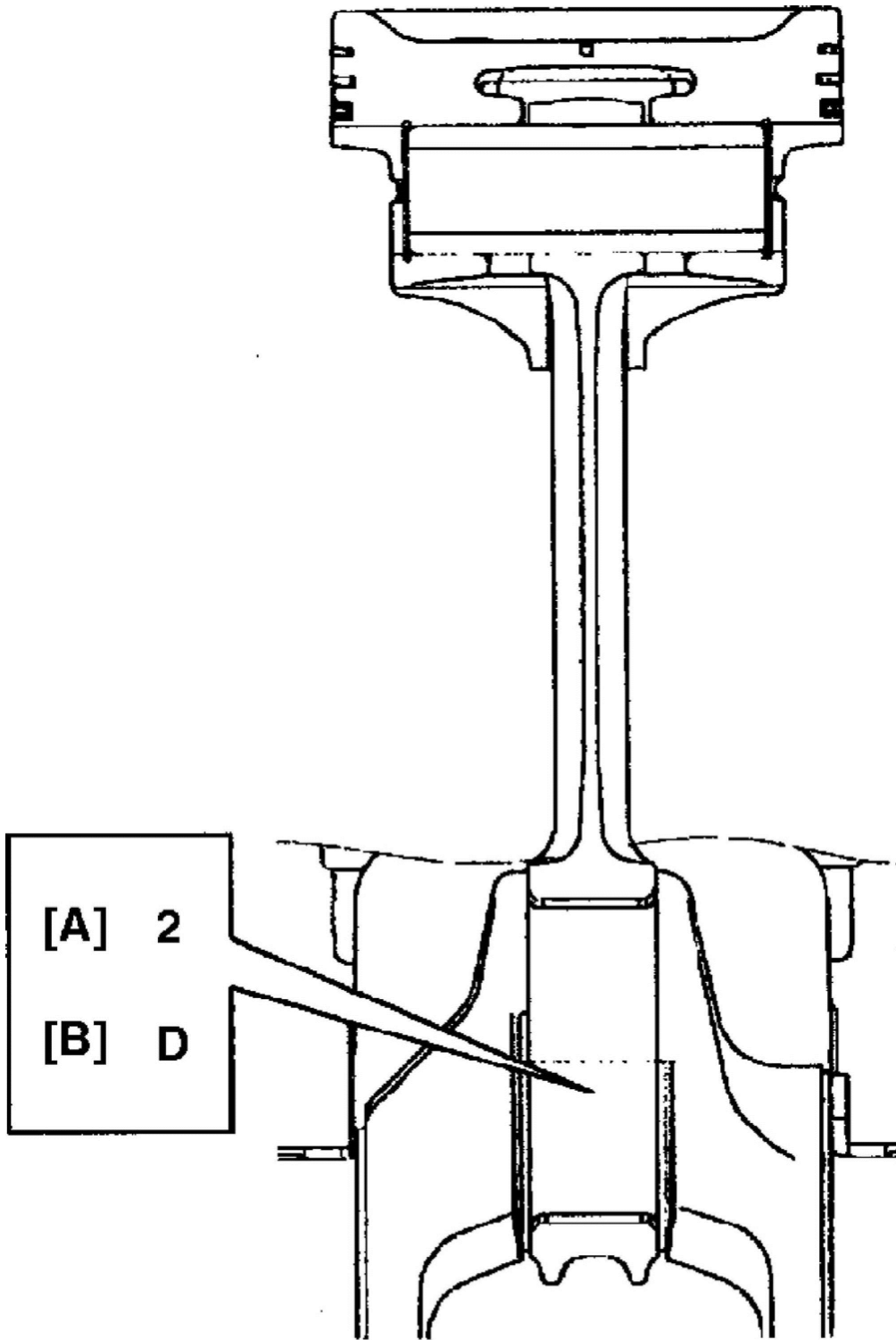
- If bearing is in malcondition or bearing clearance is out of specification, select a new standard bearing according to the following procedure and install it.

- When replacing [crankshaft](#) or connecting rod and its bearing due to any reason, select new standard bearings to be installed referring to numbers stamped on connecting rod and its cap and/or alphabets stamped on crank web of No. 3 cylinder.
- a. 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 **53.0000 - 53.0060 mm (2.0867 - 2.0868 in.)** .

### Connecting rod big-end inside diameter

#### Connecting rod big-end inside diameter

Stamped numbers	Connecting rod big-end inside diameter
1	53.0000 – 53.0060 mm (2.0867 – 2.0868 in.)
2	53.0061 – 53.0120 mm (2.0869 – 2.0870 in.)
3	53.0121 – 53.0180 mm (2.0871 – 2.0873 in.)



[A] 2

[B] D

[A]: Connecting rod big-end inside diameter number

[B]: Weight indication mark (It is not necessary in servicing)

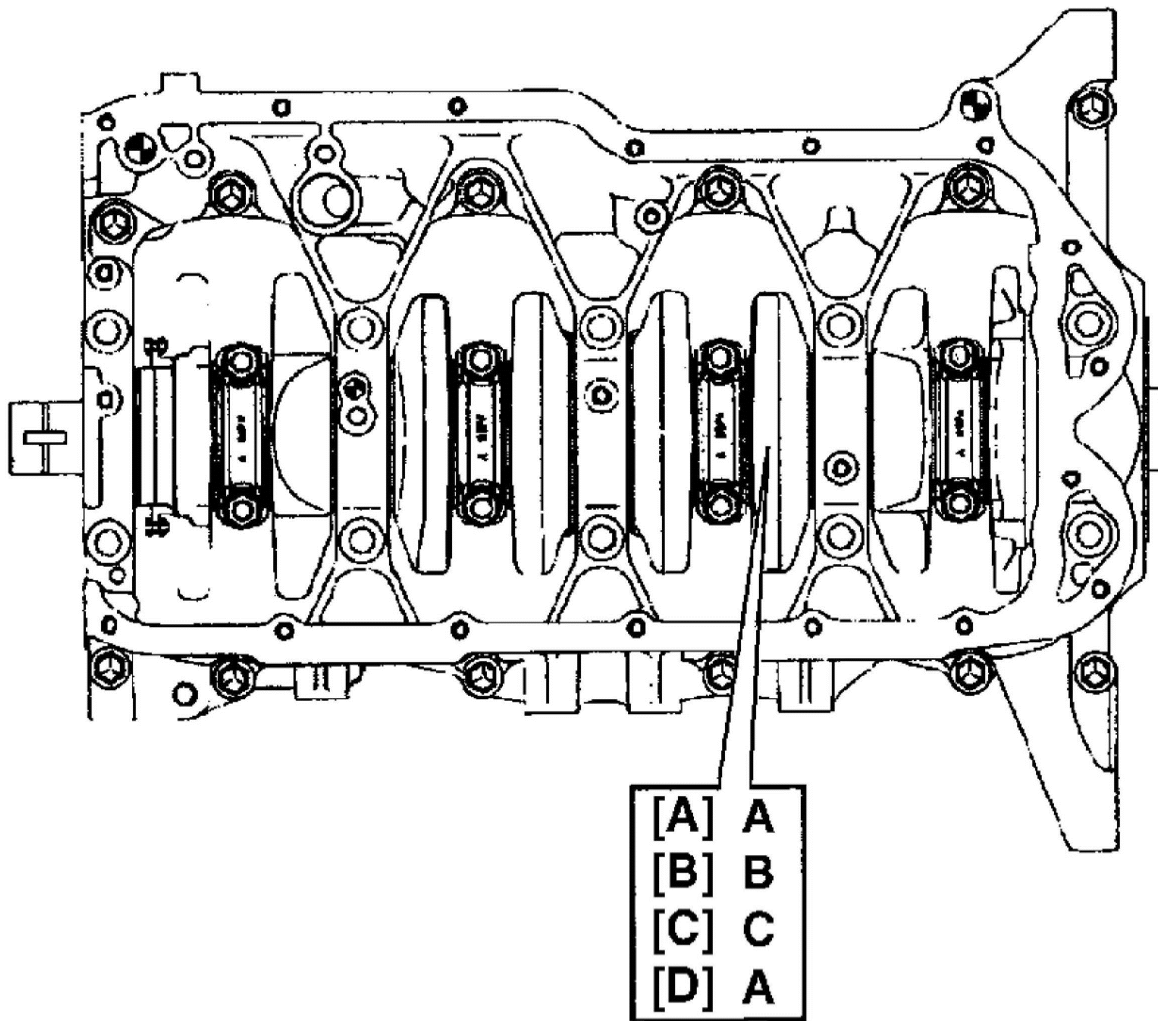
- b. Next, check crank pin diameter. On crank web of No. 3 cylinder, four alphabets are stamped as shown in the figure. Three kinds of alphabet ("A", "B" and "C") represent the following crank pin diameter respectively.

For example, stamped "A" indicates that corresponding crank pin diameter is **49.9940 - 50.0000 mm (1.9683 - 1.9685 in.)** .

### **Crank pin diameter**

#### **Crank pin diameter**

<b>Stamped alphabet</b>	<b>Crank pin diameter (without bearing)</b>
<b>A</b>	<b>49.9940 – 50.0000 mm (1.9683 – 1.9685 in.)</b>
<b>B</b>	<b>49.9880 – 49.9939 mm (1.9681 – 1.9682 in.)</b>
<b>C</b>	<b>49.9820 – 49.9879 mm (1.9677 – 1.9680 in.)</b>



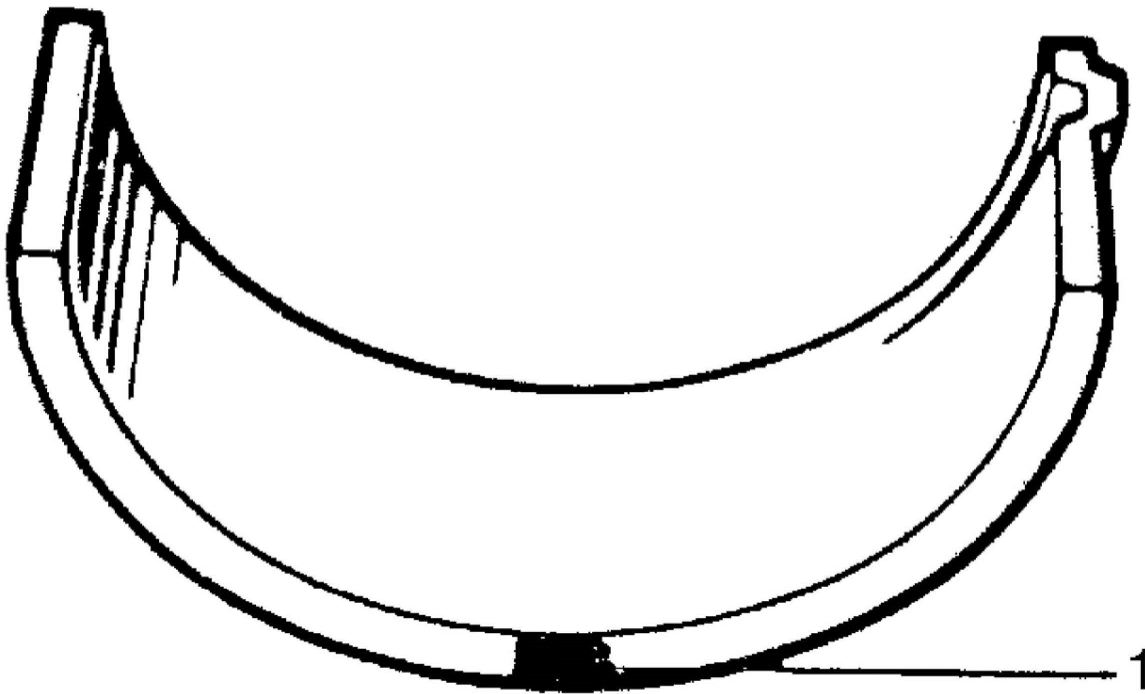
[A]:	Crankshaft pin diameter for No.1 cylinder
[B]:	Crankshaft pin diameter for No.2 cylinder
[C]:	Crankshaft pin diameter for No.3 cylinder
[D]:	Crankshaft pin diameter for No.4 cylinder

- c. 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 connecting rod bearing thickness

### Standard size of connecting rod bearing thickness

Color painted	Bearing thickness
Green	1.482 – 1.485 mm (0.05835 – 0.05846 in.)
Black	1.485 – 1.488 mm (0.05847 – 0.05858 in.)
Colorless	1.488 – 1.491 mm (0.05859 – 0.05870 in.)
Yellow	1.491 – 1.494 mm (0.05871 – 0.05881 in.)
Blue	1.494 – 1.497 mm (0.05882 – 0.05893 in.)



1. Paint

- d. From number stamped on connecting rod and its cap and alphabet stamped on crank web No. 3 cylinder, 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 cylinder is "B", install a new standard bearing painted in "Black" to its connecting rod big-end inside.

**Specifications of new standard connecting rod bearing size**

**Specifications 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 of No. 3 cylinder (Crank pin diameter)	A	Green	Black	Colorless
	B	Black	Colorless	Yellow
	C	Colorless	Yellow	Blue

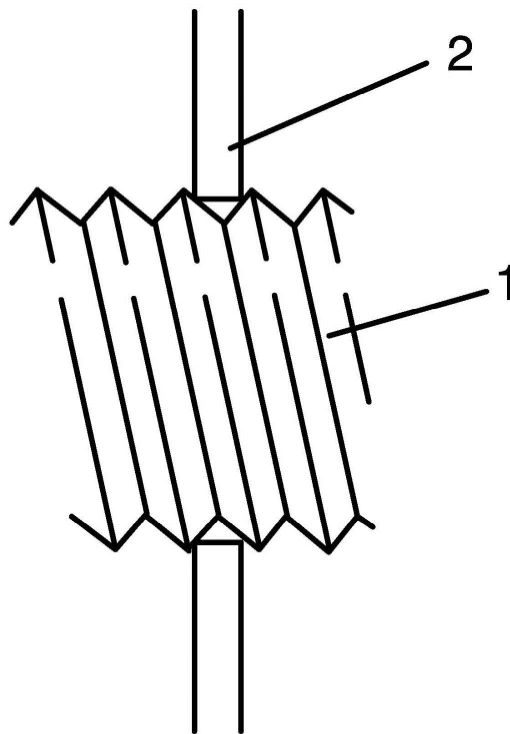
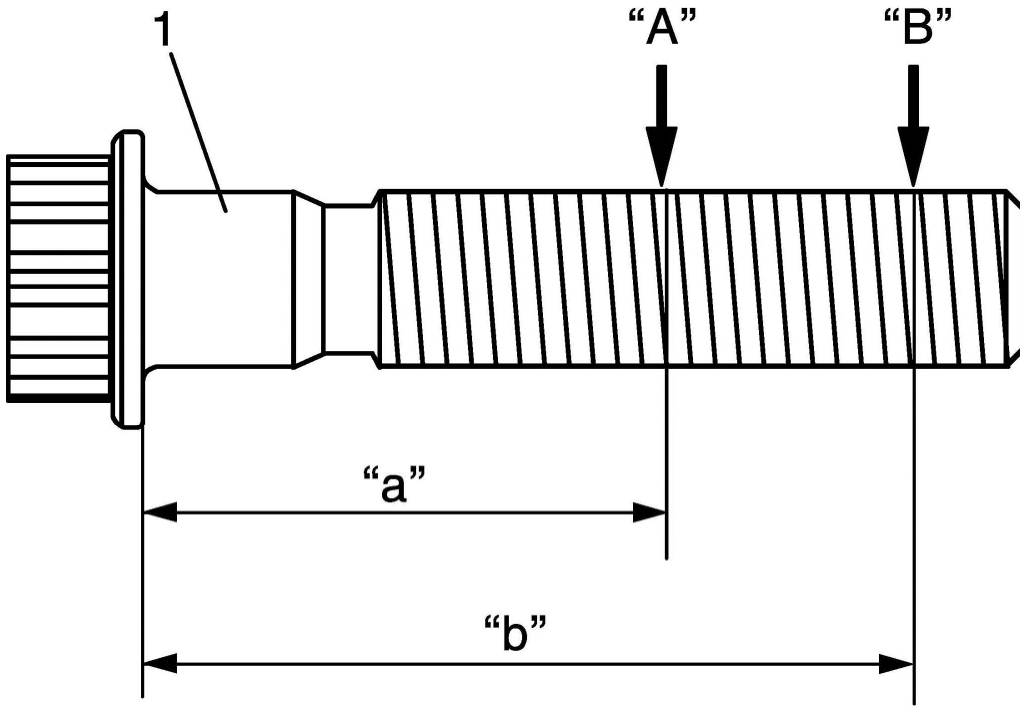
- e. Check bearing clearance with newly selected standard bearing. If clearance still exceeds its limit, use next thicker bearing and recheck clearance.
  - Connecting rod bolt Measure each thread diameter of connecting rod bolts (1) at "A" on **28.5 mm (1.12 in.)** from bolt mounting surface and "B" on **42.0 mm (1.65 in.)** from bolt mounting surface by using a micrometer (2). Calculate difference in diameters ("A"- "B"). If it exceeds limit, replace connecting rod.

Connecting rod bolt measurement points

"a": **28.5 mm (1.12 in.)**

"b": **42.0 mm (1.65 in.)**

Connecting rod bolt diameter difference limit ("A"- "B"): **0.1 mm (0.004 in.)**



### Cleaning

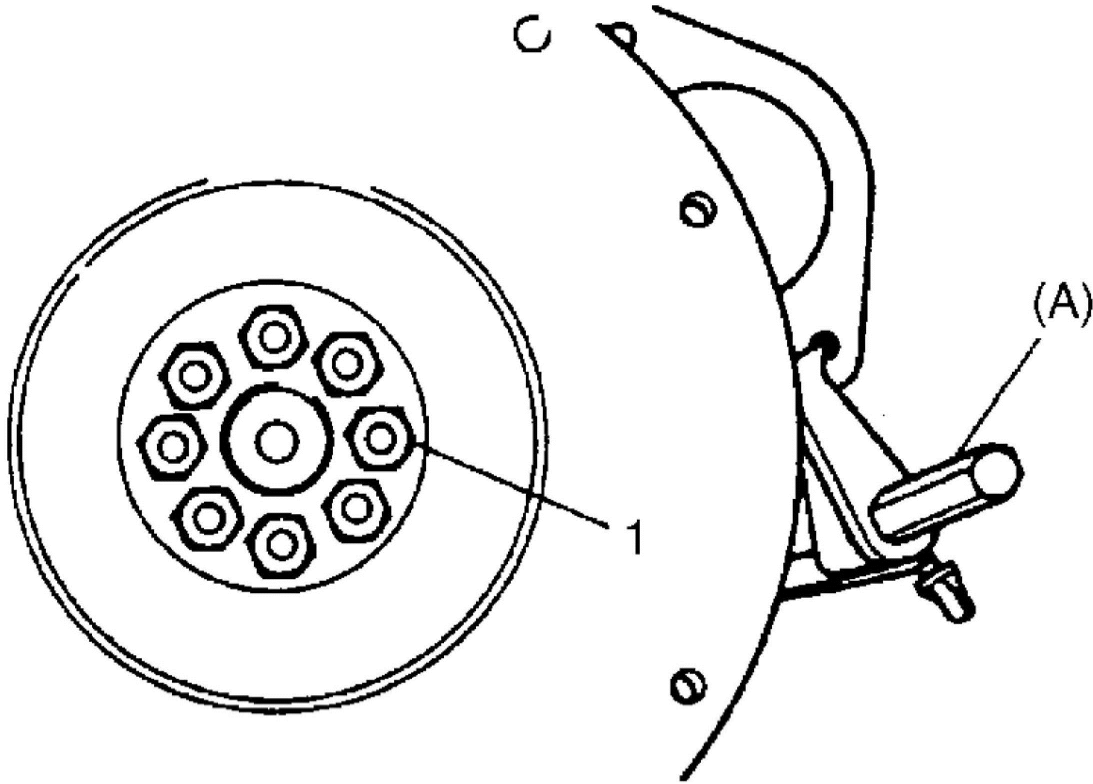
Clean carbon from [piston](#) head and ring grooves, using a suitable tool.

### Main Bearings, Crankshaft and Cylinder Block Removal and Installation

#### Removal

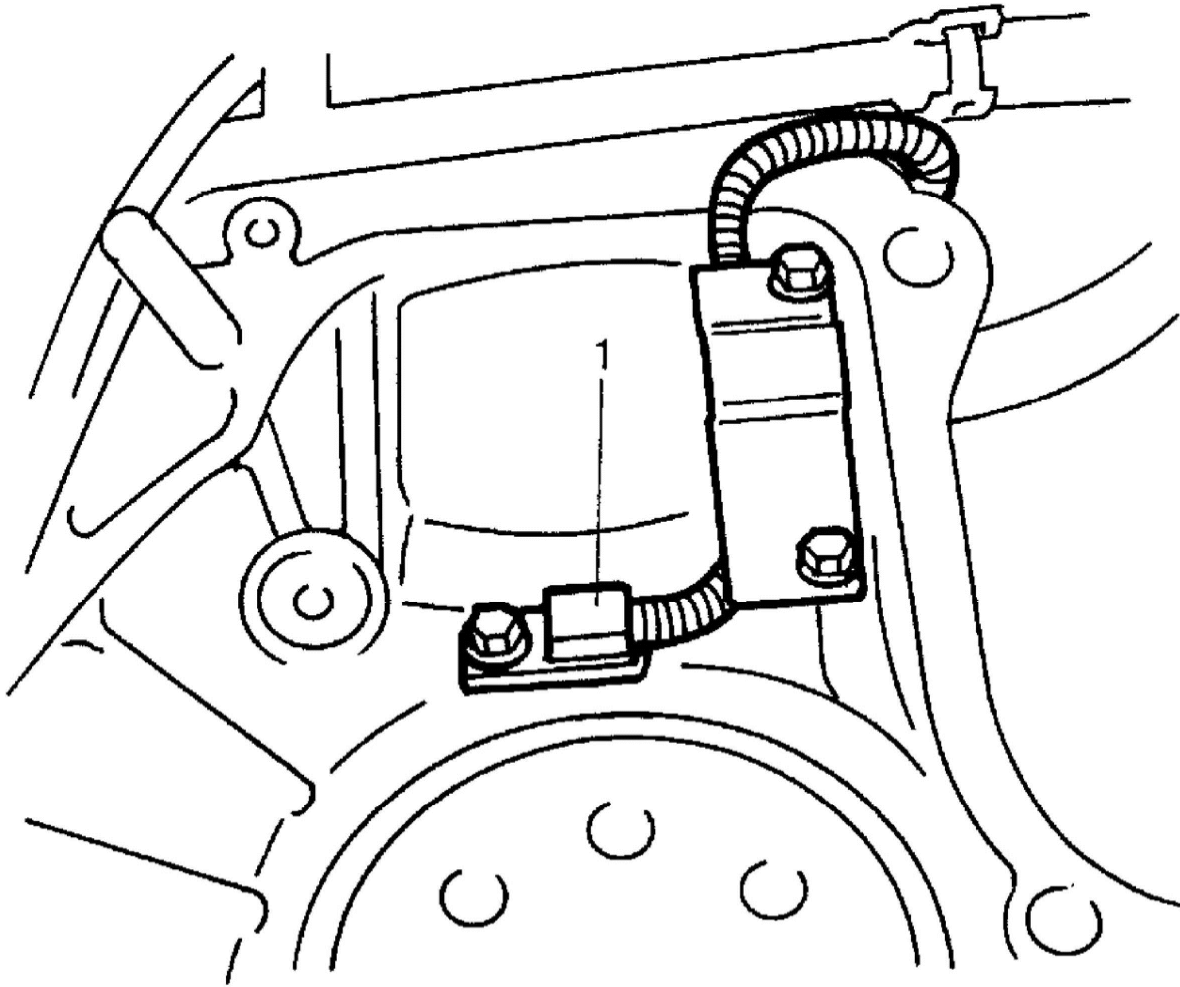
1. Remove engine assembly from vehicle.

2. Remove flywheel (drive plate for A/T) by using special tool. Special Tool (A):09924-17811

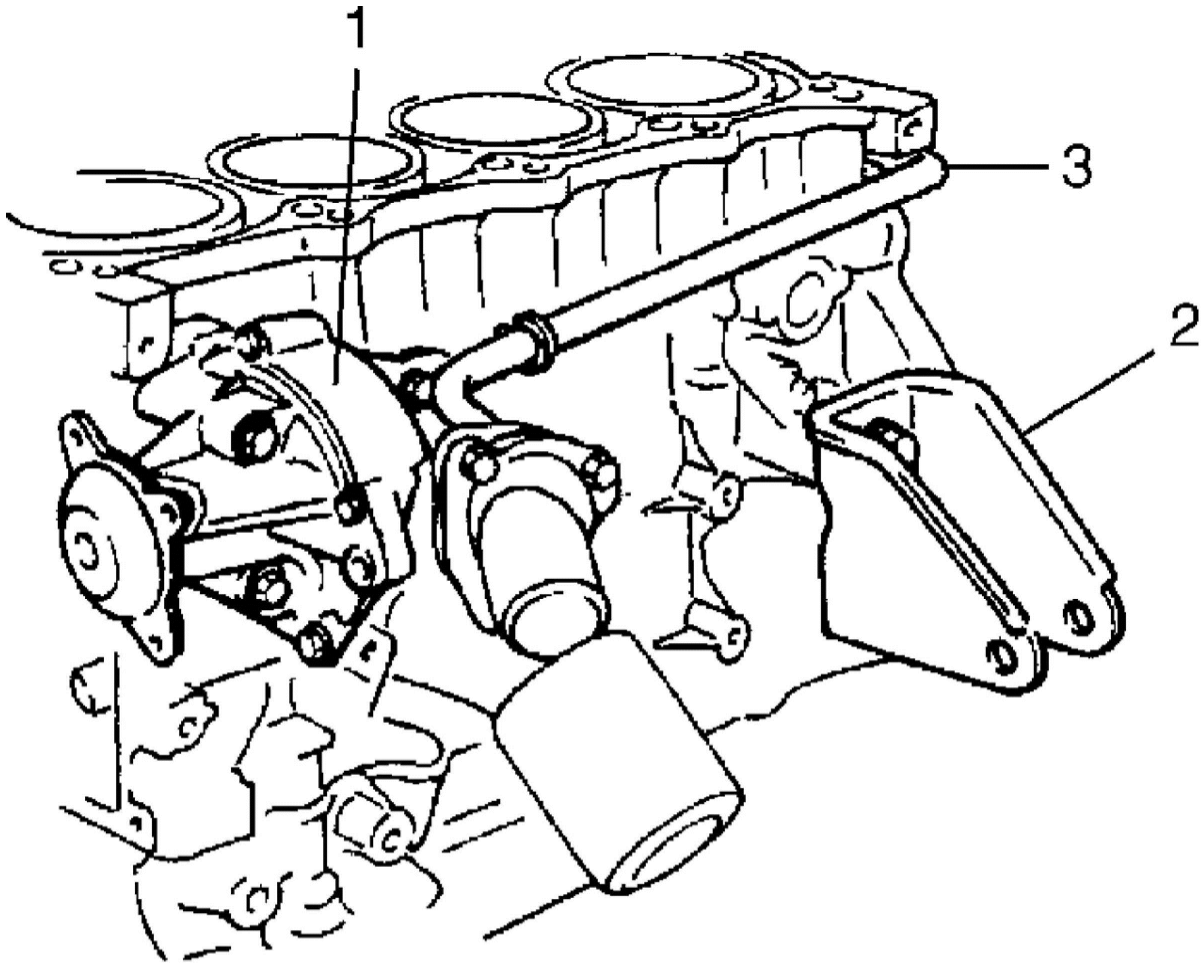


1. Flywheel bolt

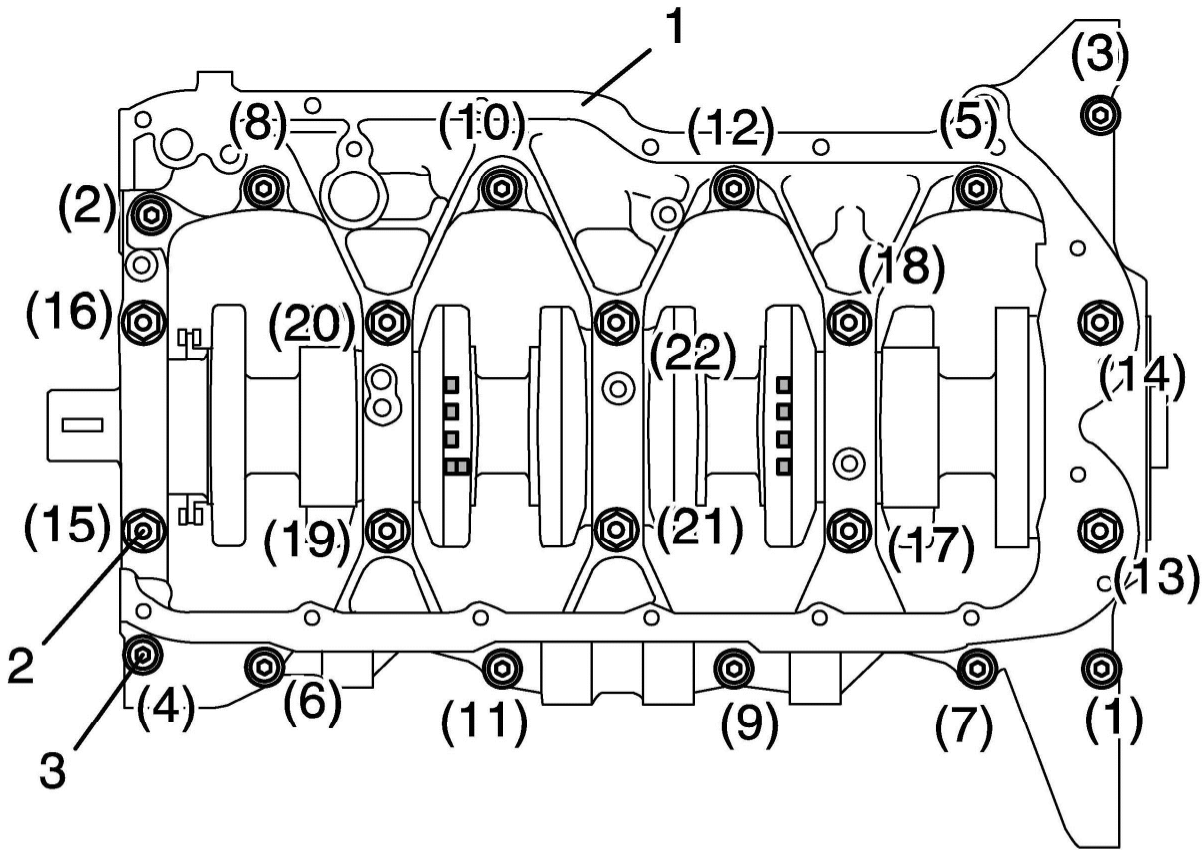
3. Remove pistons and [connecting rods](#).
4. Remove CKP sensor (1).



5. Remove [water pump](#) (1) and heater outlet pipe (3).
6. Remove engine front mounting brackets (2).



7. Loosen crankcase bolts, in sequence shown in figure and remove them.



1. Lower crankcase
2. Crankcase bolts (10 mm thread diameter)
3. Crankcase bolts (8 mm thread diameter)

8. Remove crankshaft from cylinder block.

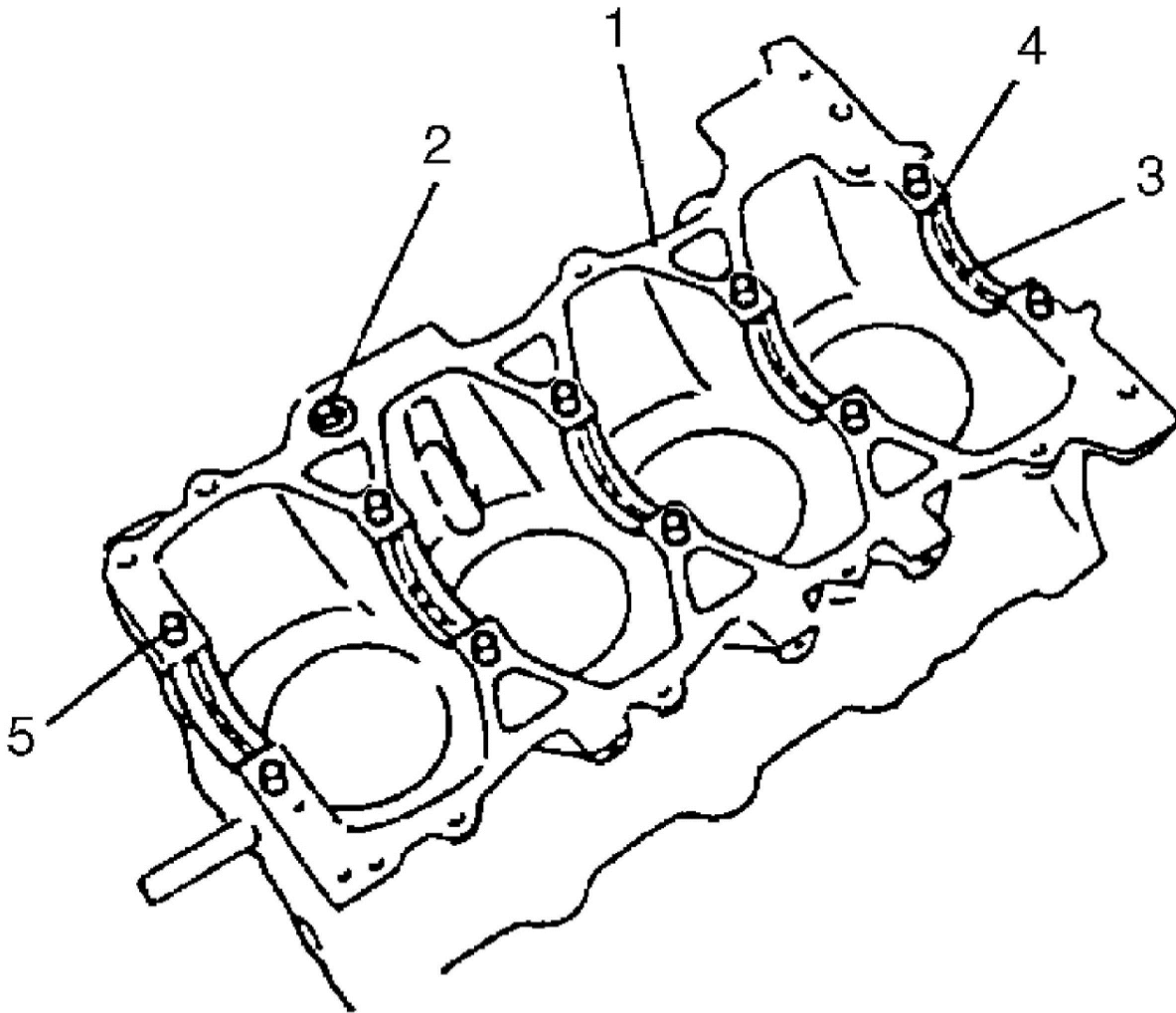
## Installation

### NOTE:

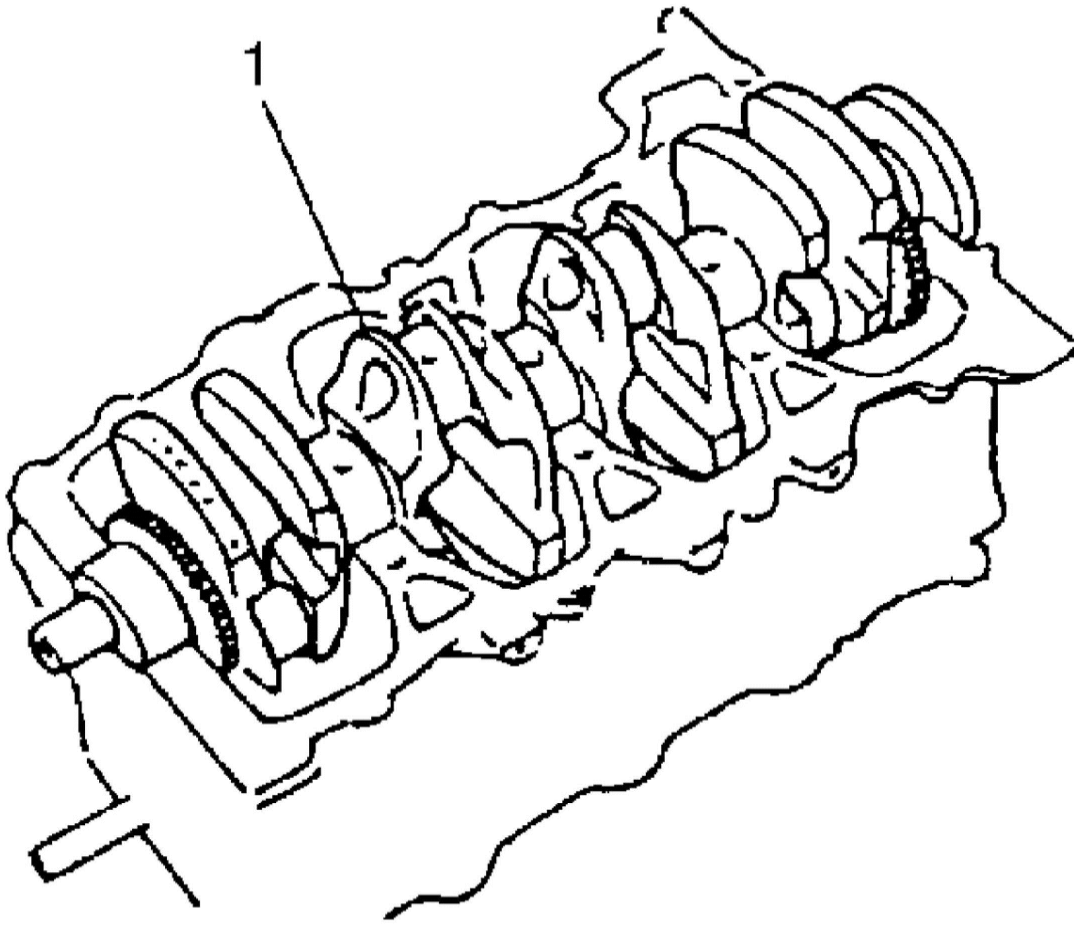
- All parts to be installed must be perfectly clean.
  - Be sure to oil crankshaft journals, journal bearings, thrust bearings, crankpins, [connecting rod bearings](#), pistons, [piston rings](#) and cylinder bores.
  - Journal bearings, crankcase (bearings caps), [connecting rods](#), rod bearings, rod bearing caps, pistons and [piston rings](#) are in combination sets. Do not disturb combination and try to see that each part goes back to where it came from, when installing.
  - Clean mating surface of cylinder block and lower crankcase, remove oil, old sealant and dust from mating surface.
1. Fit main bearings to cylinder block (1). One of two halves of main bearing (4) has oil groove (3).

Install this half with oil groove to cylinder block and another half without oil groove to lower crankcase. Make sure that two halves are painted in the same color.

2. Install new O-ring (2) to cylinder block.
3. Install knock pins (5) to cylinder block.



4. Fit thrust bearings (1) to cylinder block between No.2 and No.3 cylinders. Face oil groove (2) sides to crank webs.
5. Put crankshaft (1) with [oil pump](#) chain to cylinder block.

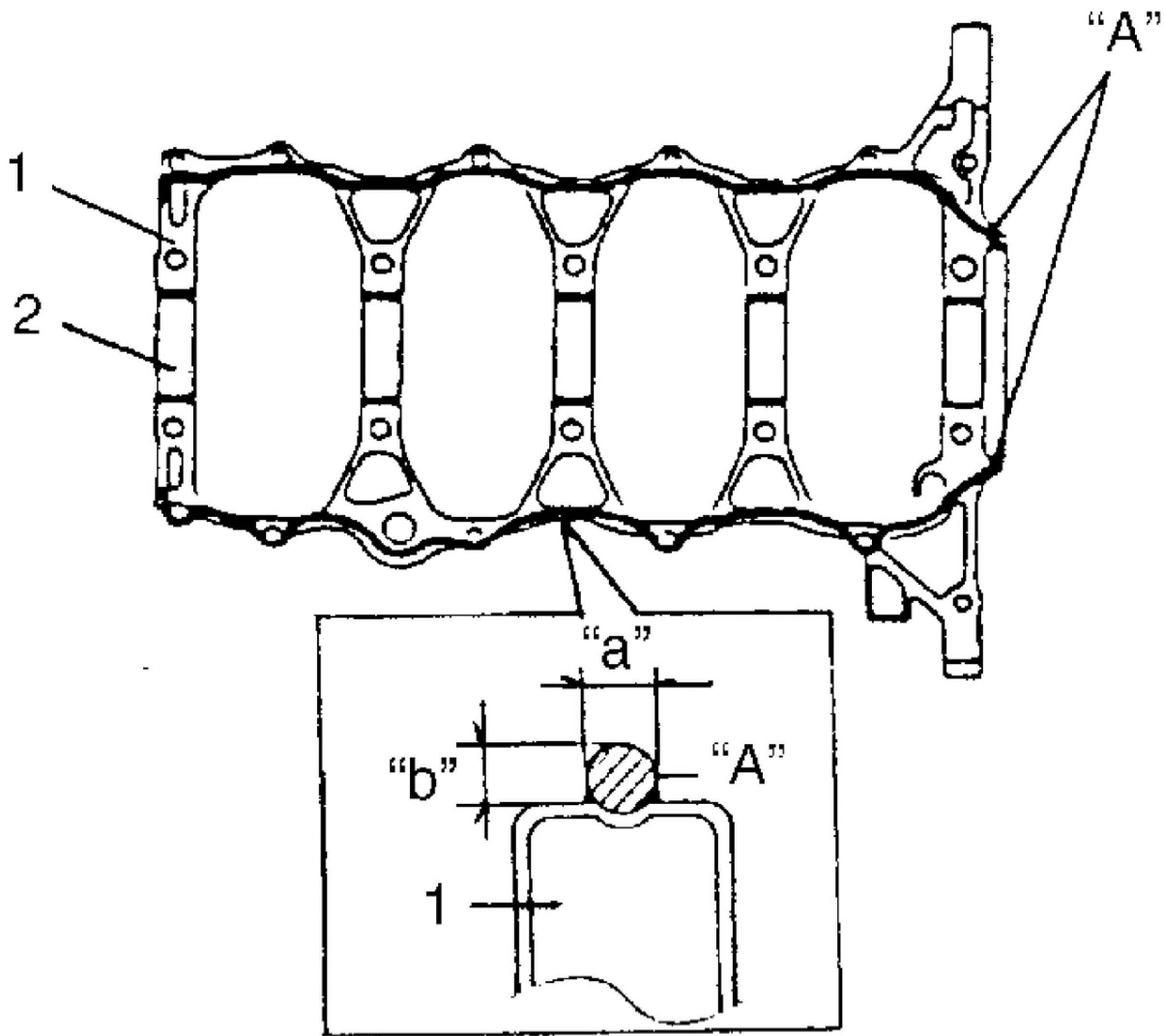


6. Apply sealant "A" to lower crankcase (1) mating surface area as shown in figure. "A": Water tight sealant 99000-31250SUZUKI Bond No.1207F ( )

Sealant amount for lower crankcase

Width "a": **3 mm (0.12 in.)**

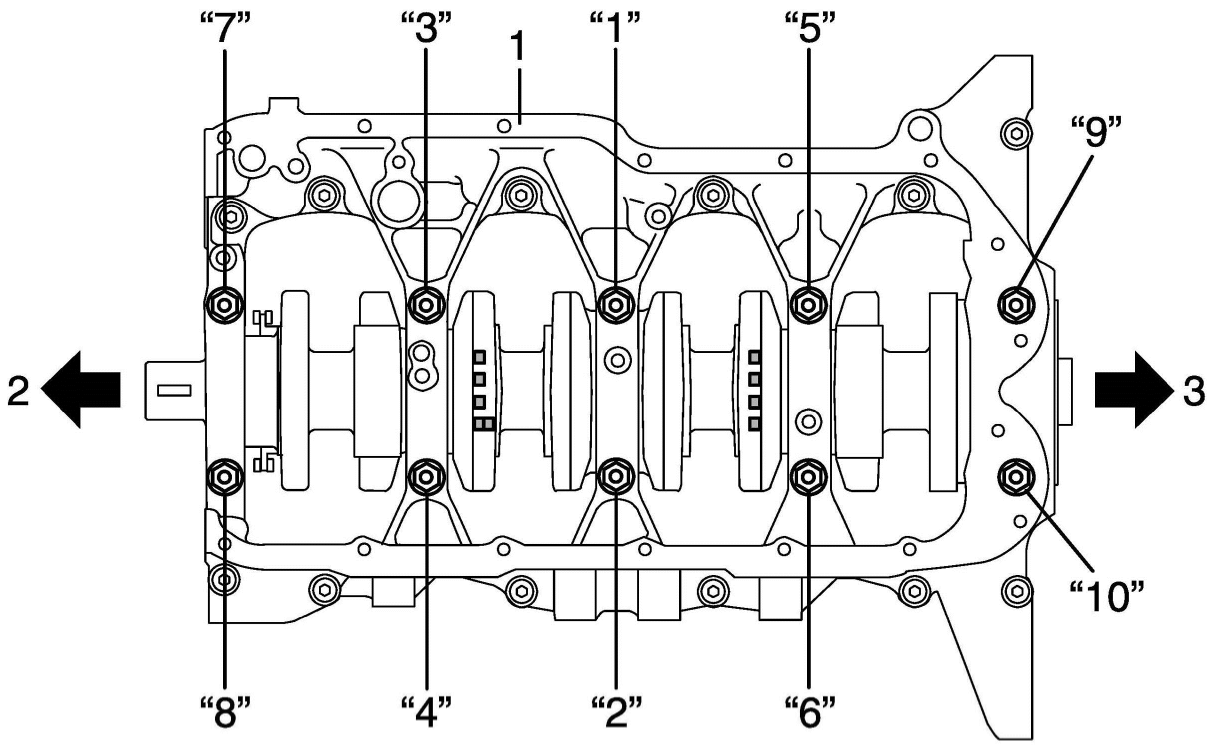
Height "b": **2 mm (0.08 in.)**



2. Bearing

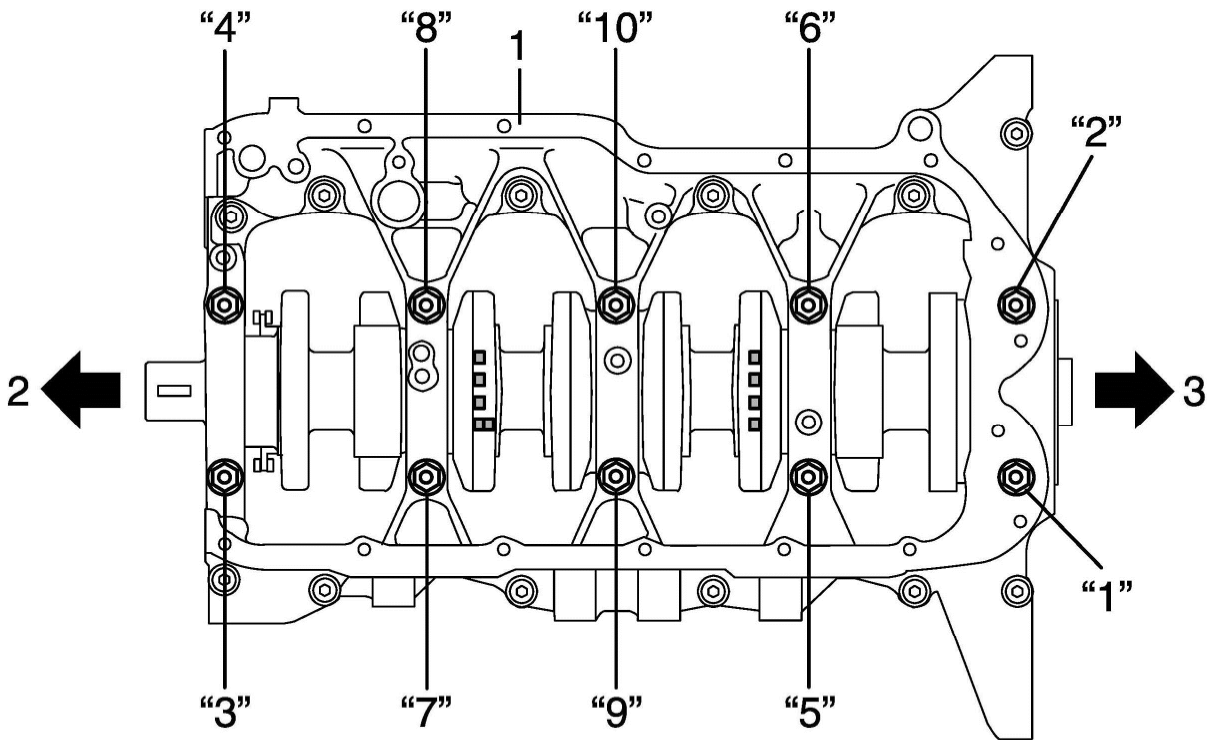
7. Install lower crankcase (1) to cylinder block. Apply engine oil to all crankcase bolts ((1) - (10)) and tighten them gradually as follows.

a) Tighten bolts ((1) - (10)) to **40 Nm (4.0 kgf-m, 29.0 ft. lbs.)** according to numerical order in figure.



2. Crankshaft pulley side	3. Flywheel side
---------------------------	------------------

b) Loosen bolts ((1) - (10)) until tightening torque is reduced to 0 according to numerical order in figure.



2. Crankshaft pulley side	3. Flywheel side
---------------------------	------------------

- c) Tighten bolts ((1) - (10)) to **40 Nm (4.0 kgf-m, 29.0 ft. lbs.)** according to numerical order in figure.
- d) In the same manner as in step c), retighten bolts ((1) - (10)) to **58 Nm (5.8 kgf-m, 42.0 ft. lbs.)** .
- e) Tighten bolts ((11) - (22)) to specified torque according to numerical order in figure.

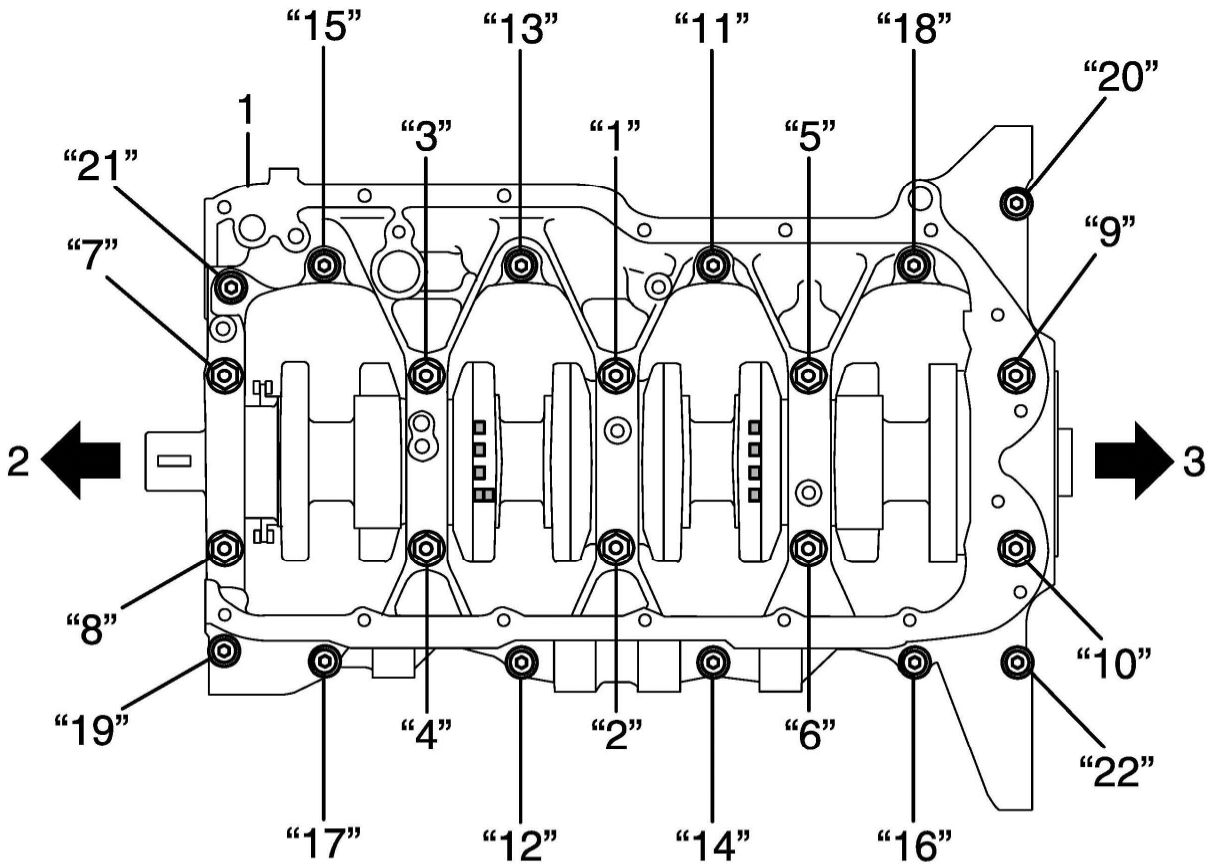
**Tightening torque**

Crankcase bolt with **10 mm** thread diameter ((1) - (10)): Tighten **40 Nm (4.0 kgf-m, 29.0 ft. lbs.)**, **0 Nm (0 kgf-m, 0 ft. lbs.)**, **40 Nm (4.0 kgf-m, 29.0 ft. lbs.)**, **58 Nm (5.8 kgf-m, 42.0 ft. lbs.)** by the specified procedure

Crankcase bolt with **8 mm** thread diameter ((11) - (22)): Tighten **26 Nm (2.6 kgf-m, 19.0 ft. lbs.)** by the specified procedure

**NOTE:**

- After tightening crankcase bolts, check to be sure that crankshaft rotates smoothly when turned by hand.
- Use new crankcase bolt (**10 mm** thread diameter).



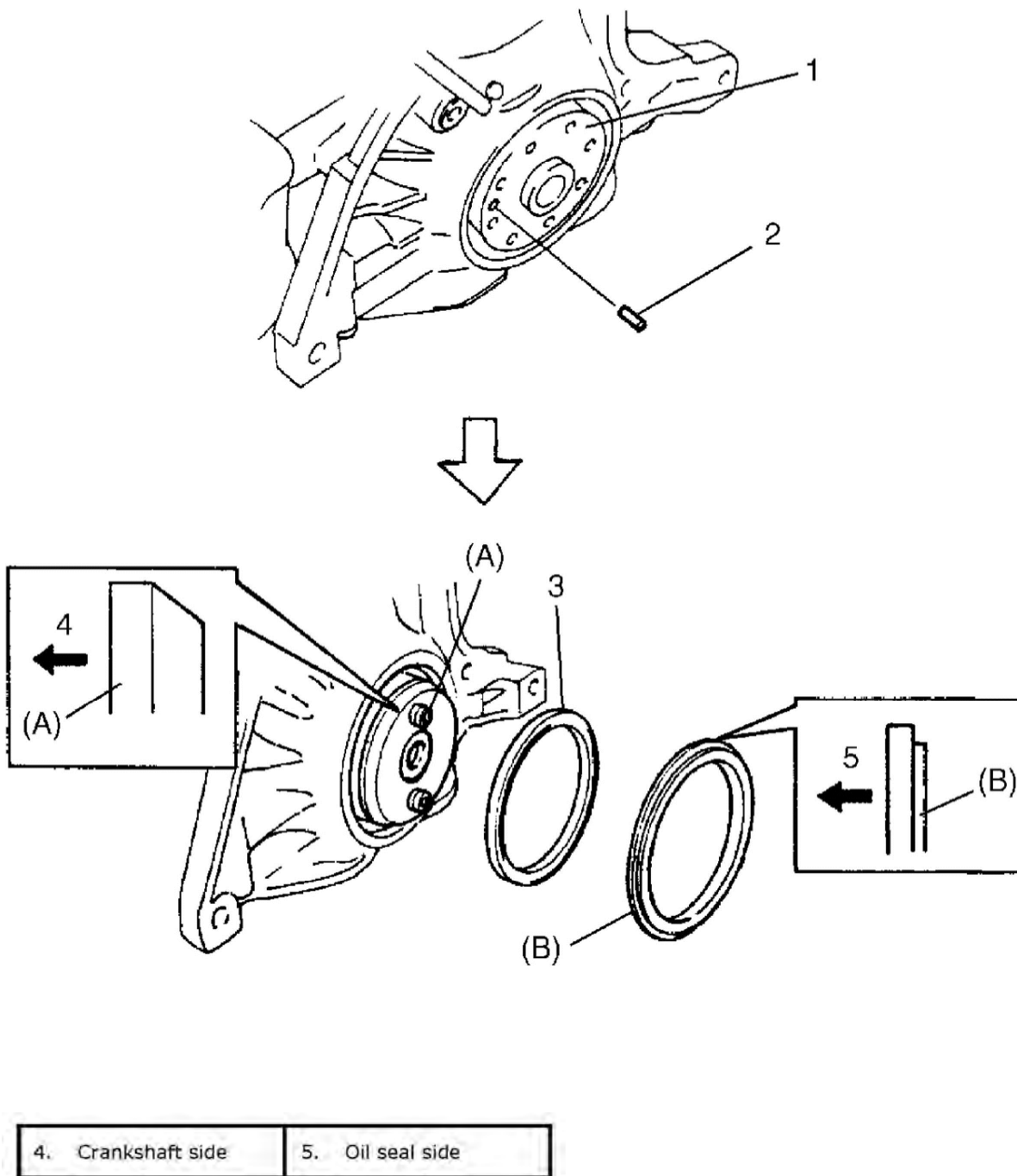
2. Crankshaft pulley side	3. Flywheel side
---------------------------	------------------

8. Pull out dowel pin (2) from crankshaft (1) and then install rear oil seal (3) until it becomes flush with cylinder block surface using special tools and plastic hammer. Special Tool

(A): 09911-97710

(B): 09911-97811

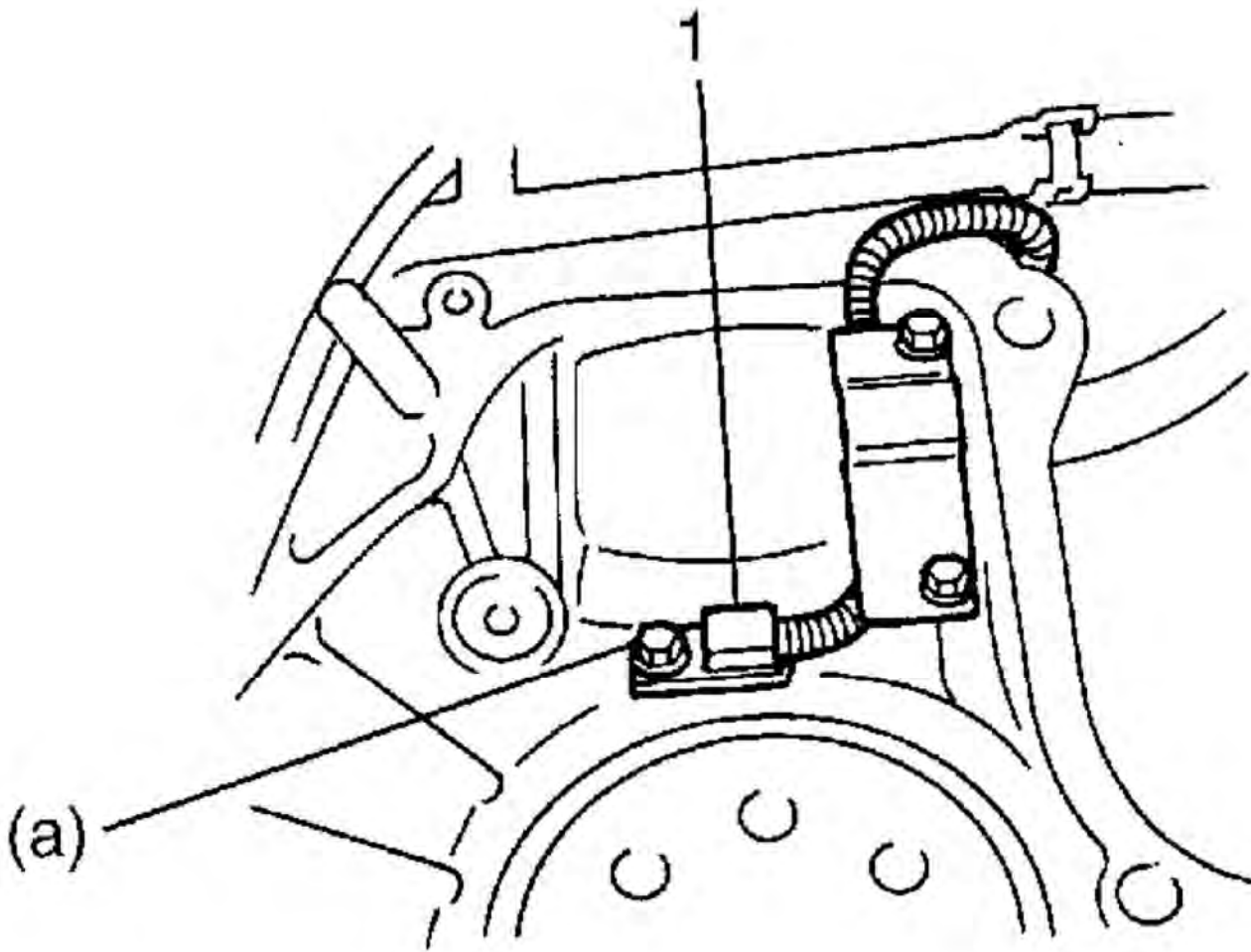
9. Install dowel pin (2).



10. Install CKP sensor (1) and fix its wire harness with bracket.

Tightening torque

CKP sensor bolt a: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**



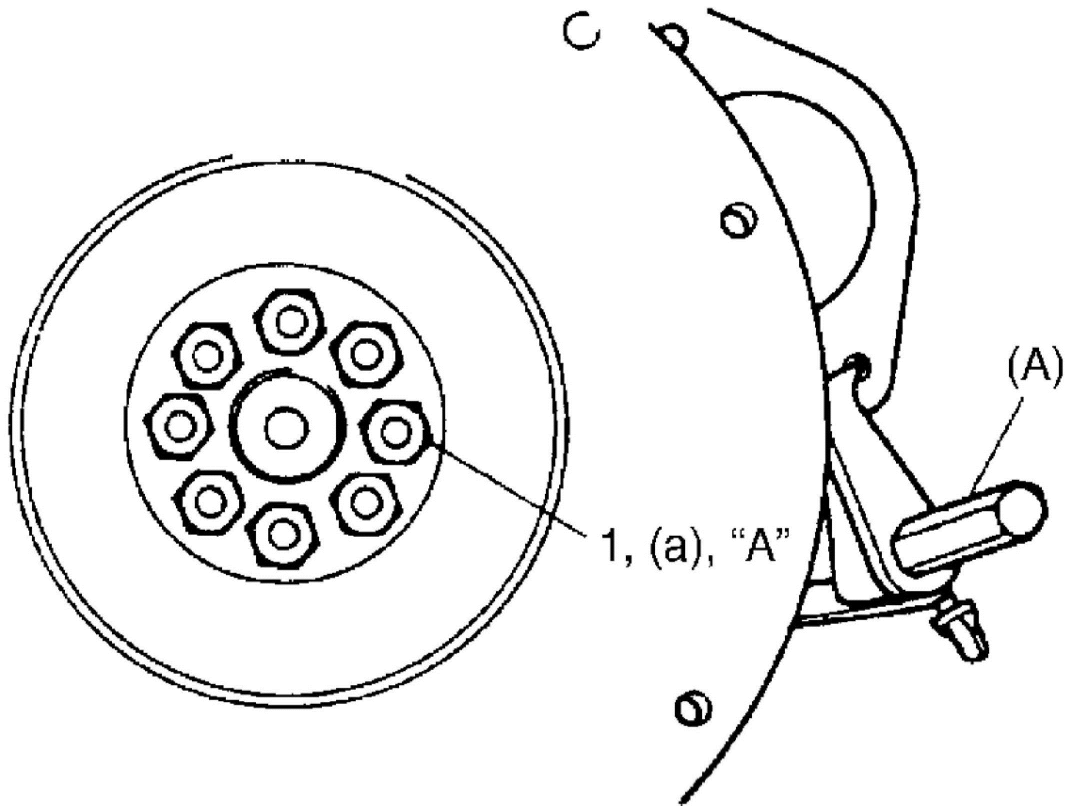
11. Install flywheel (drive plate for A/T). Using special tool, lock flywheel or drive plate, and tighten flywheel or drive plate bolts (1) to specified torque.

**NOTE:** Use new flywheel or drive plate bolt.

Special Tool (A): 09924-17811

Tightening torque

Flywheel or drive plate bolt a: **70 Nm (7.0 kgf-m, 51.0 ft. lbs.)**

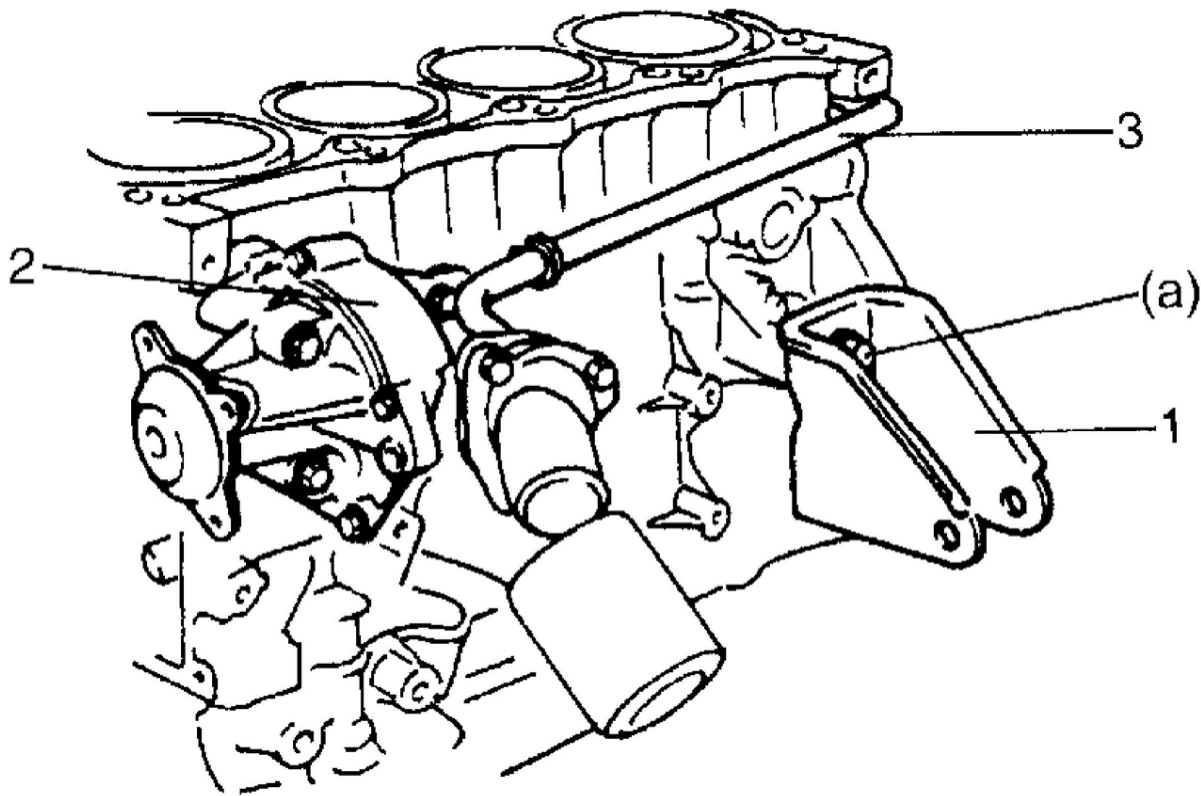


12. Install engine front mounting brackets (1). Tighten bracket bolts to specified torque.

Tightening torque

Engine front mounting bracket bolt a: **55 Nm (5.5 kgf-m, 40.0 ft. lbs.)**

13. Install [water pump](#) (2) and heater outlet pipe (3).



14. Install pistons and [connecting rods](#).
15. Install [oil pump](#).
16. Install [cylinder head assembly](#) to cylinder.
17. Install camshafts and tappets and shims.
18. Check intake and exhaust valve lashes.
19. Install, [timing chain](#) sprockets, timing chains, [timing chain tensioner](#), tensioner adjusters, [timing chain guides](#), timing chain cover, crankshaft pulley, [water pump](#) pulley.
20. Install cylinder head cover.
21. Install [oil pump](#) strainer and [oil pan](#).
22. Install clutch cover and clutch disc to flywheel (for M/T vehicle). For clutch installation, refer to Clutch Cover and Clutch Disc Removal and Installation.
23. Install engine assembly to vehicle.

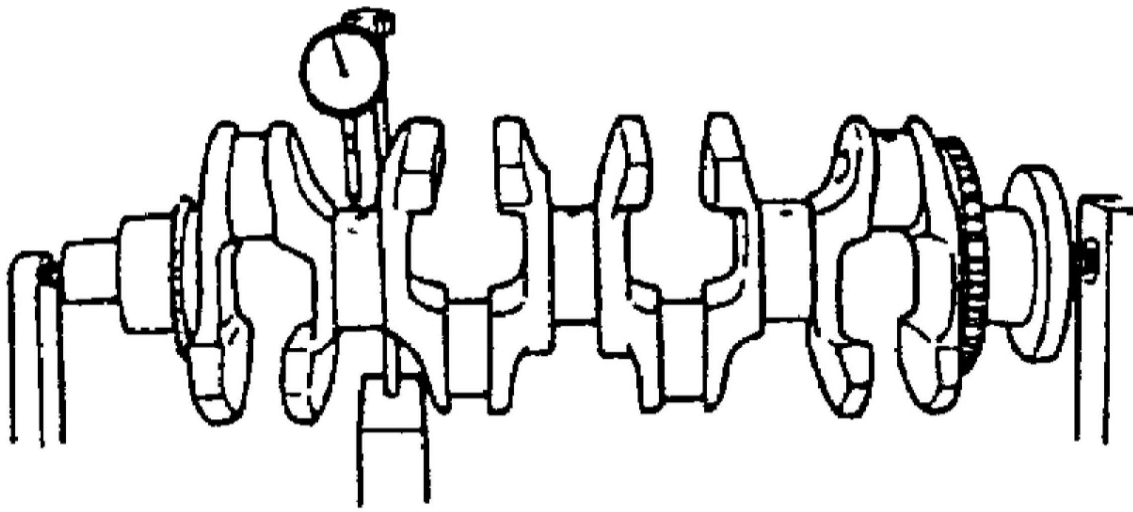
## Main Bearings, Crankshaft and Cylinder Block Inspection

### Crankshaft

#### Crankshaft runout

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

Limit on runout **0.06 mm (0.0023 in.)**



### **Crankshaft thrust play**

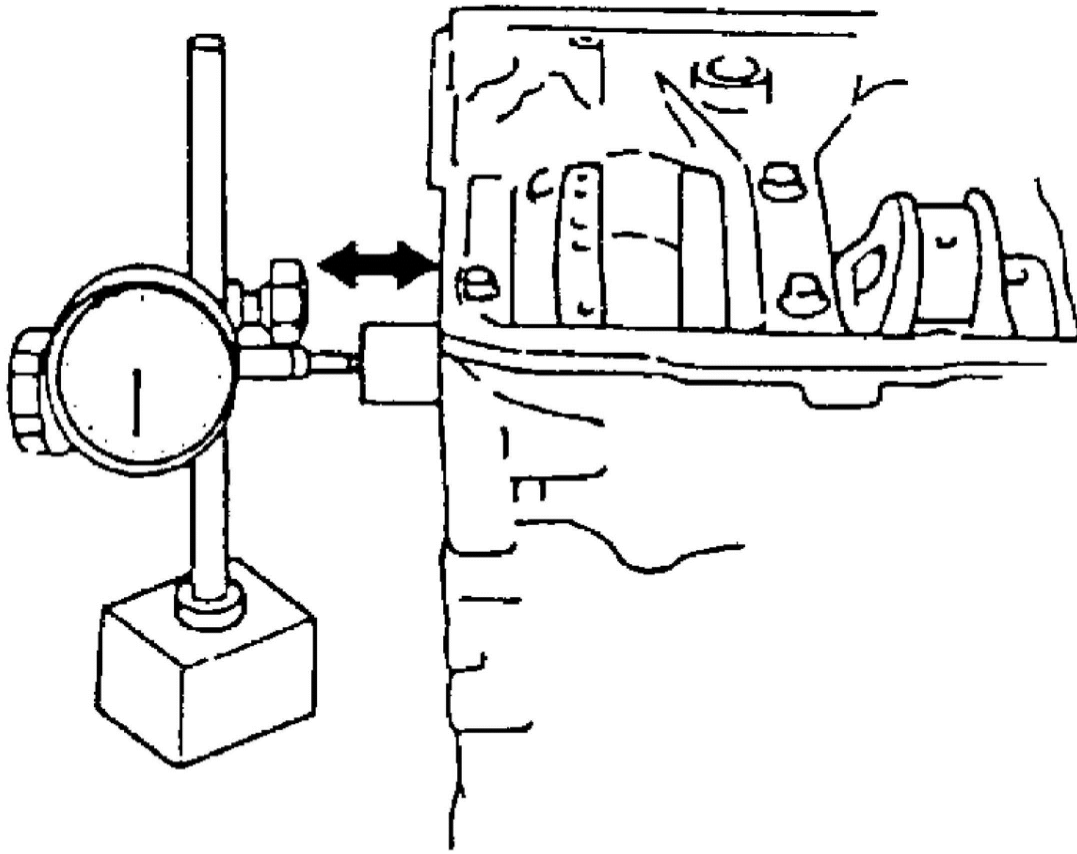
Measure this play with crankshaft set in cylinder block in the normal manner, that is, with thrust bearing and lower crankcase installed. Tighten crankcase bolts.

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: **0.10 - 0.35 mm (0.0039 - 0.0137 in.)**

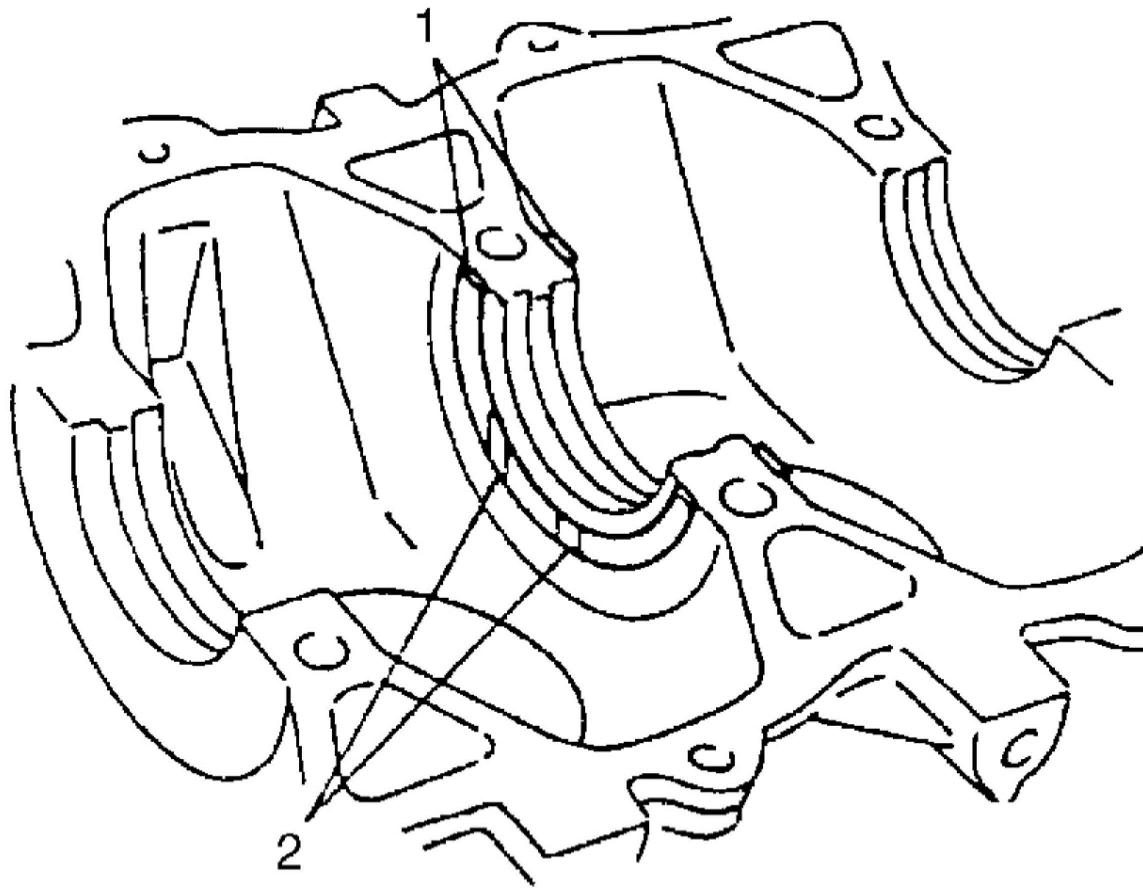
Limit: **0.42 mm (0.0149 in.)**



### Thickness of crankshaft thrust bearing

#### Thickness of crankshaft thrust bearing

Standard	2.425 – 2.475 mm (0.09796 – 0.09992 in.)
Oversize: 0.125 mm (0.0049 in.)	2.488 – 2.538 mm (0.09548 – 0.09744 in.)



1. Thrust bearing	2. Oil groove
-------------------	---------------

### **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.

### **Limit on out-of-round and taper**

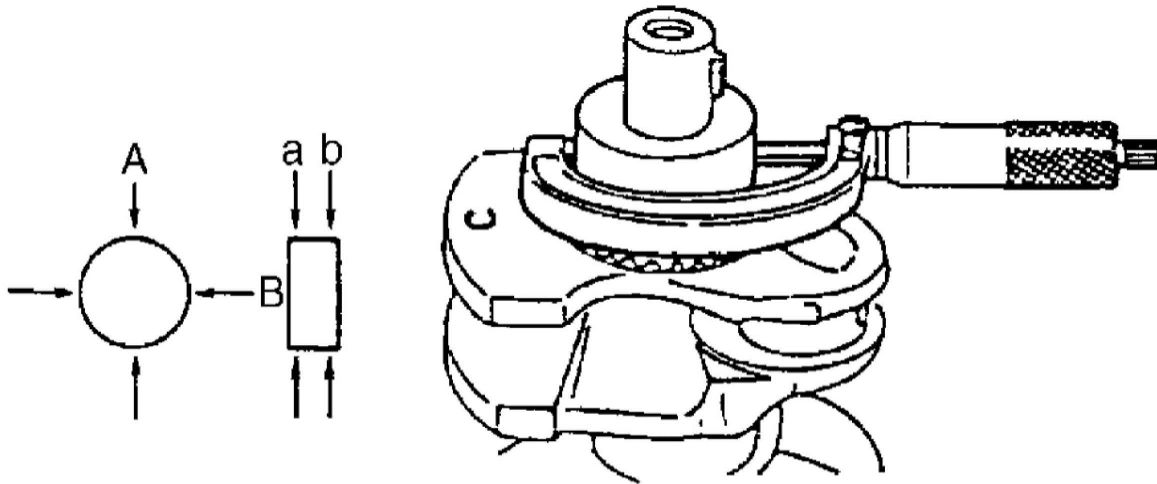
**0.01 mm (0.0004 in.)**

### **Out-of-round**

"A"-"B"

### **Taper**

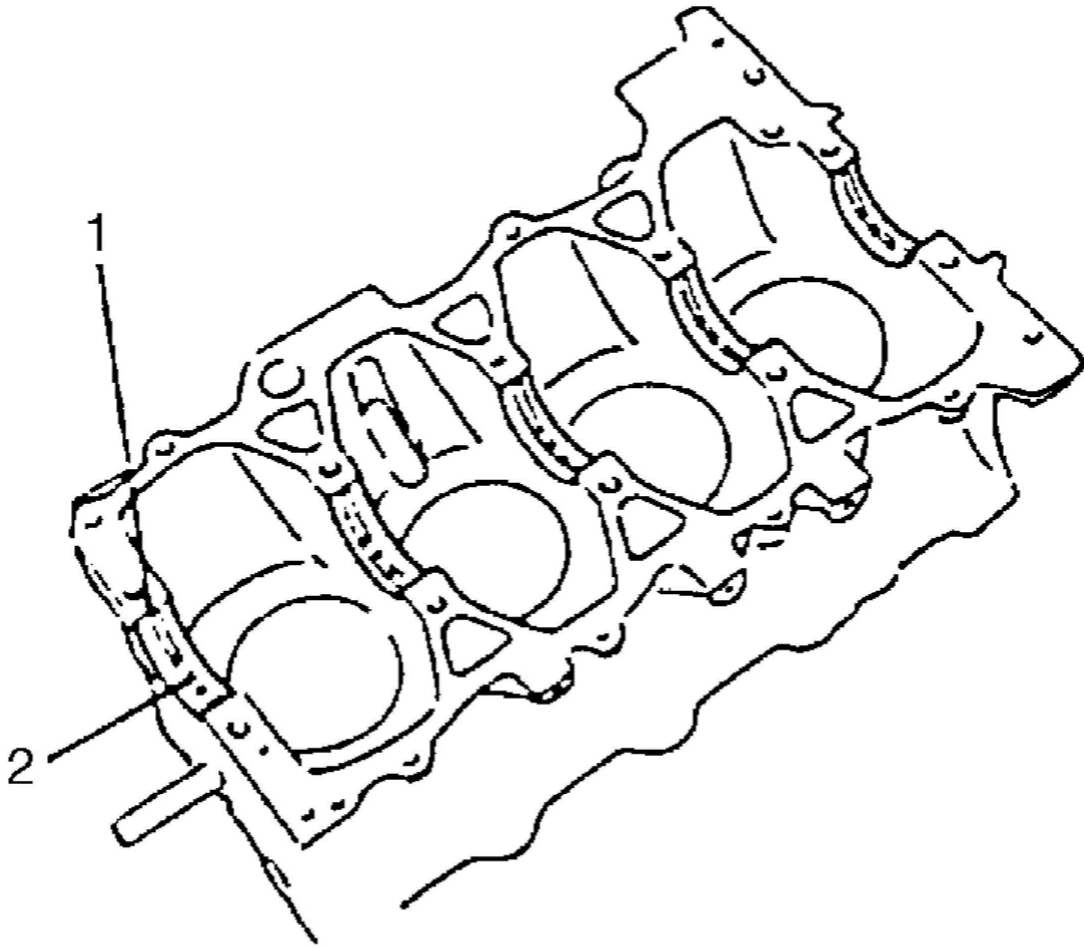
"a"-"b"



## Main Bearings

### Main bearings general information

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



### **Main bearings inspection**

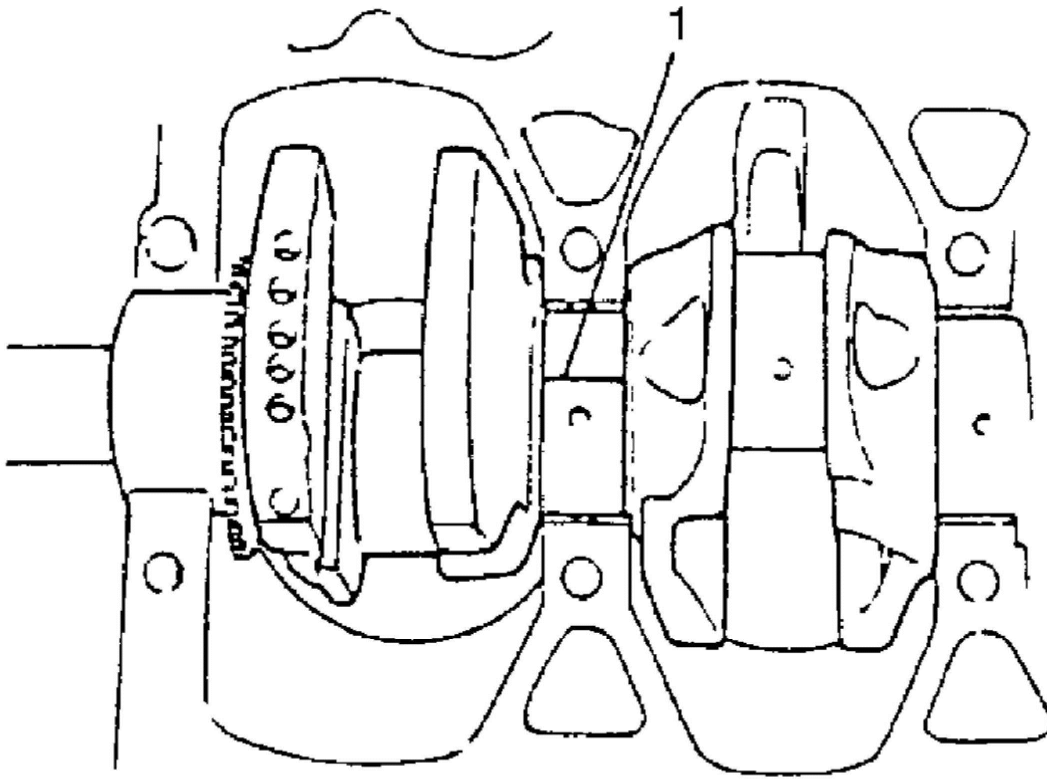
Check bearings for pitting, scratches, wear or damage.

If any malcondition is found, replace both upper and lower halves. Never replace either half without replacing the other half.

### **Main bearing clearance**

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

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



4. Install lower crankcase to cylinder block.

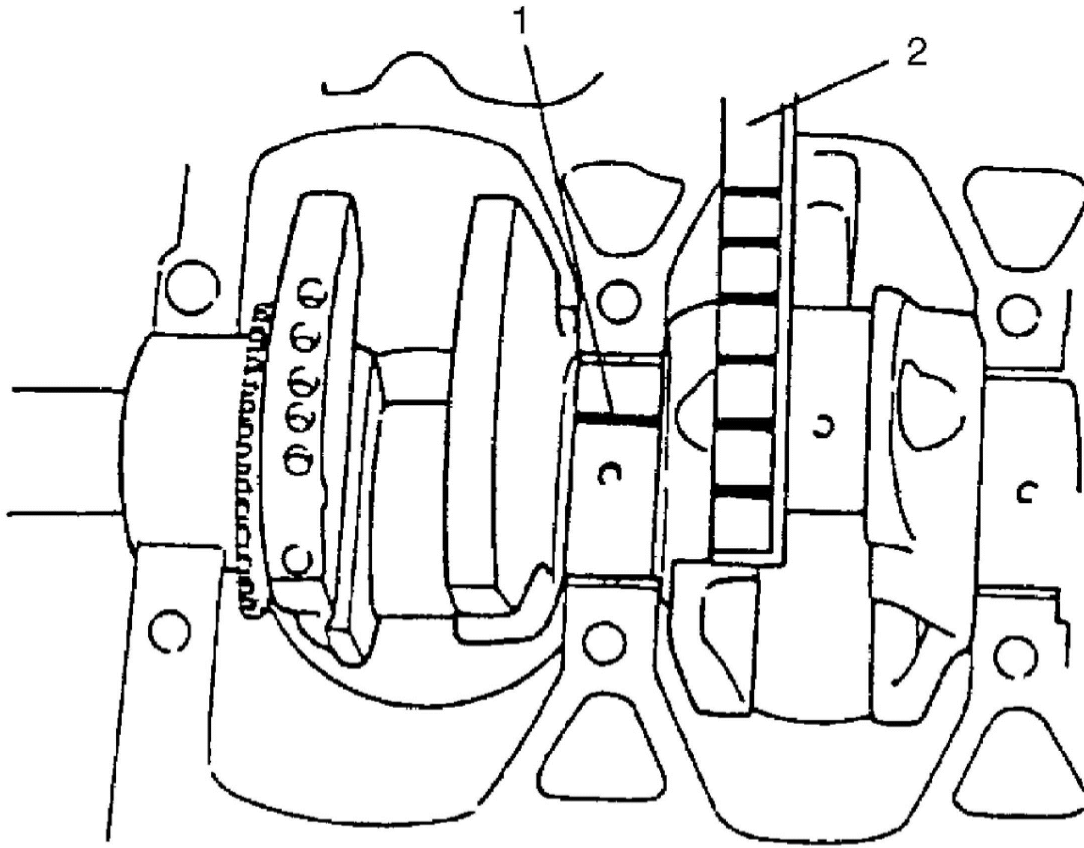
**NOTE:** Do not rotate crankshaft while gauging plastic is installed.

5. Remove lower crankcase and using scale (2) on gauging plastic envelop (1), 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

Standard: **0.020 - 0.038 mm (0.00079 - 0.00149 in.)**

Limit: **0.063 mm (0.0024 in.)**



## Selection of main bearings

### STANDARD BEARING:

If engine is under the following conditions, select a new standard bearing as followings and install it.

- Bearing is in malcondition.
- Bearing clearance is out of specification.
- Crankshaft or cylinder block is replaced.

1. First check journal diameter. As shown in figure, crank web No.2 has stamped numbers. Six kinds of numbers ("4" through "9") represent the following journal diameters.

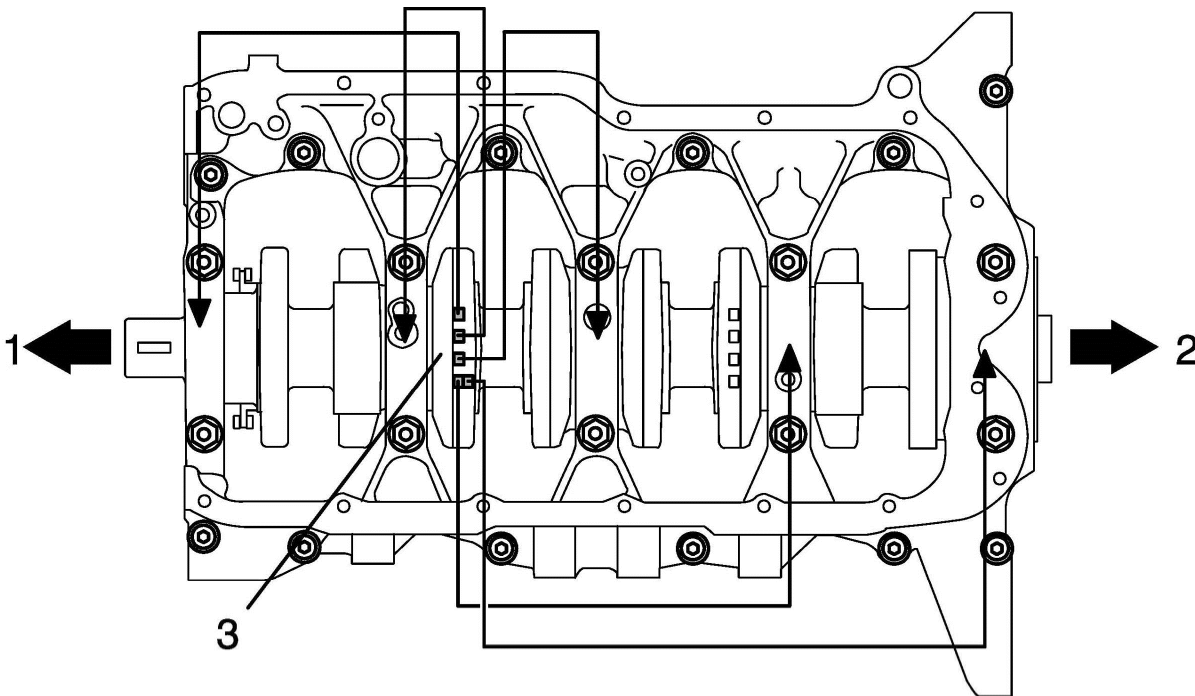
### Journal diameter

Journal diameter

### Journal diameter

Stamped numbers	Journal diameter
4	58.0030 – 58.0060 mm (2.28358 – 2.28369 in.)
5	58.0000 – 58.0029 mm (2.28346 – 2.28357 in.)
6	57.9970 – 57.9999 mm (2.28334 – 2.28345 in.)
7	57.9940 – 57.9969 mm (2.28323 – 2.28333 in.)
8	57.9910 – 57.9939 mm (2.28311 – 2.28322 in.)
9	57.9880 – 57.9909 mm (2.28299 – 2.28310 in.)

Stamped numbers on crank web No.2 (3) represent journal diameters marked with an arrow in figure respectively. For example, stamped number "5" indicates that corresponding journal diameter is **58.0000 - 58.0029 mm (2.28346 - 2.28357 in.)** .



1. Crankshaft pulley side	2. Flywheel side
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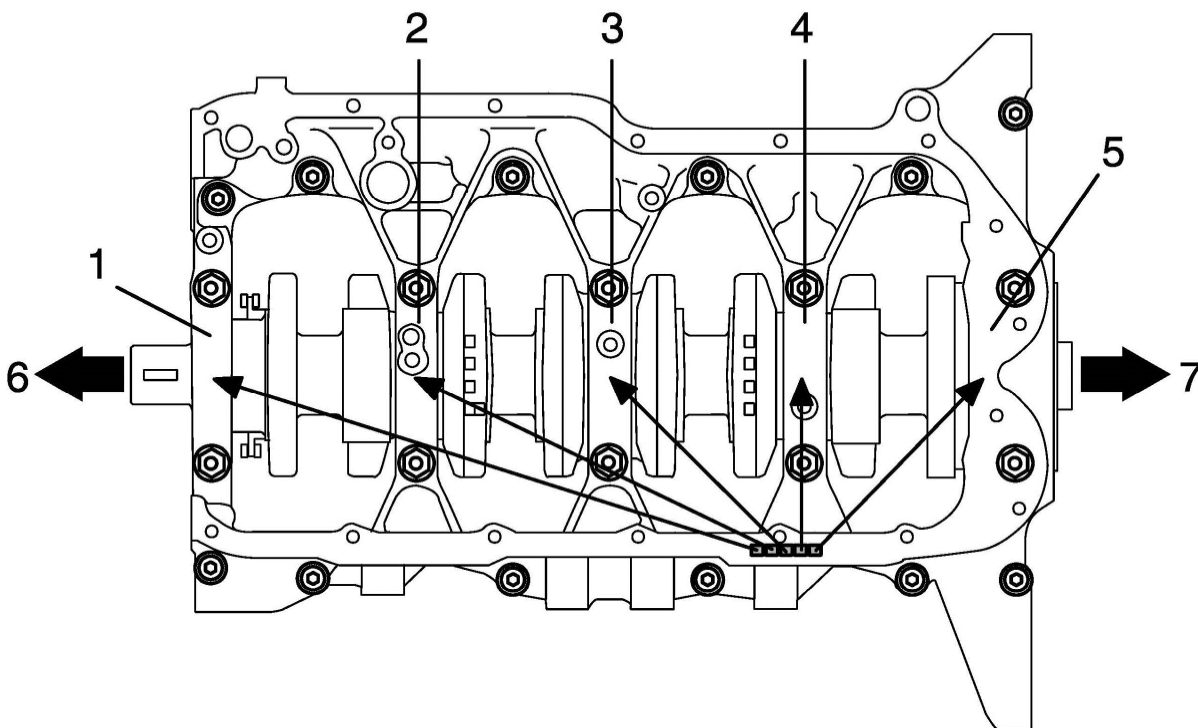
2. Next, check journal bore diameter. On lower crankcase five alphabets are stamped as shown in figure. Three kinds of alphabets ("A", "B" and "C") represent the following journal bore diameters.

### Journal bore diameter

#### Journal bore diameter

Stamped alphabet	Journal bore diameter
A	61.9940 - 62.0000 mm (2.44070 - 2.44094 in.)
B	62.0001 - 62.0060 mm (2.44095 - 2.44117 in.)
C	62.0061 - 62.0120 mm (2.44118 - 2.44141 in.)

Stamped alphabets on lower crankcase represent journal diameter marked with an arrow in figure respectively. For example, stamped alphabet "A" at No.2 journal indicates that (journal) bore diameter of No.2 journal is 61.9940 62.0000 mm (2.44070 - 2.44094 in.) .



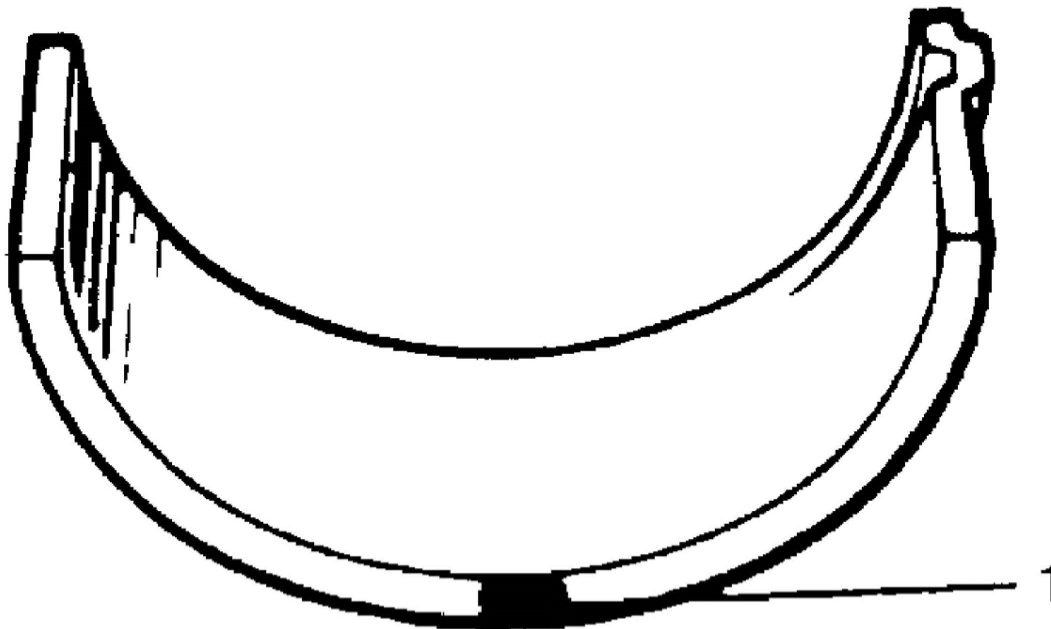
1. No.1 journal	5. No.5 journal
2. No.2 journal	6. Crankshaft pulley side
3. No.3 journal	7. Flywheel side
4. No.4 journal	

3. There are 5 kinds of standard bearings differing in thickness. To distinguish them, they are painted (1) in the following colors at the position as indicated in figure. Each color indicates the following thickness at the center of bearing.

**Standard size main bearing thickness**

**Standard size main bearing thickness**

Color painted	Bearing thickness
Green	1.9910 – 1.9940 mm (0.07839 – 0.07850 in.)
Black	1.9940 – 1.9970 mm (0.07851 – 0.07862 in.)
Colorless (no painted)	1.9970 – 2.0000 mm (0.07863 – 0.07874 in.)
Yellow	2.0000 – 2.0030 mm (0.07874 – 0.07885 in.)
Blue	2.0030 – 2.0060 mm (0.07886 – 0.07897 in.)



- From number stamped on crank web No.2 and alphabets stamped on lower crankcase, determine new standard bearing to be installed to journal by referring to table shown. For example, if number stamped on crank web No.2 is "5" and alphabet stamped on lower crankcase is "A", install new standard bearings painted in "Green" to cylinder block side journal and "Black" to lower crankcase side journal.

**NOTE:** The meaning of "Upper" and "Lower" described in below table are the following.

- Upper: It is instruction of main bearing installed in cylinder block side journal.
- Lower: It is instruction of main bearing installed in lower crankcase side journal.

**Main bearing cross-reference table (new standard bearing)**

**Main bearing cross-reference table (new standard bearing)**

		Standard number on crank web No.2					
		4	5	6	7	8	9
Standard alphabet on lower crankcase	A	Green	Upper: Green Lower: Black	Black	Upper: Black Lower: Colorless	Colorless	Upper: Colorless Lower: Yellow
	B	Black	Upper: Black Lower: Colorless	Colorless	Upper: Colorless Lower: Yellow	Yellow	Upper: Yellow Lower: Blue
	C	Colorless	Upper: Colorless Lower: Yellow	Yellow	Upper: Yellow Lower: Blue	Blue	Blue

- Check main bearing clearance with newly selected standard bearing. If clearance still exceeds its limit, use next thicker bearing and recheck clearance.

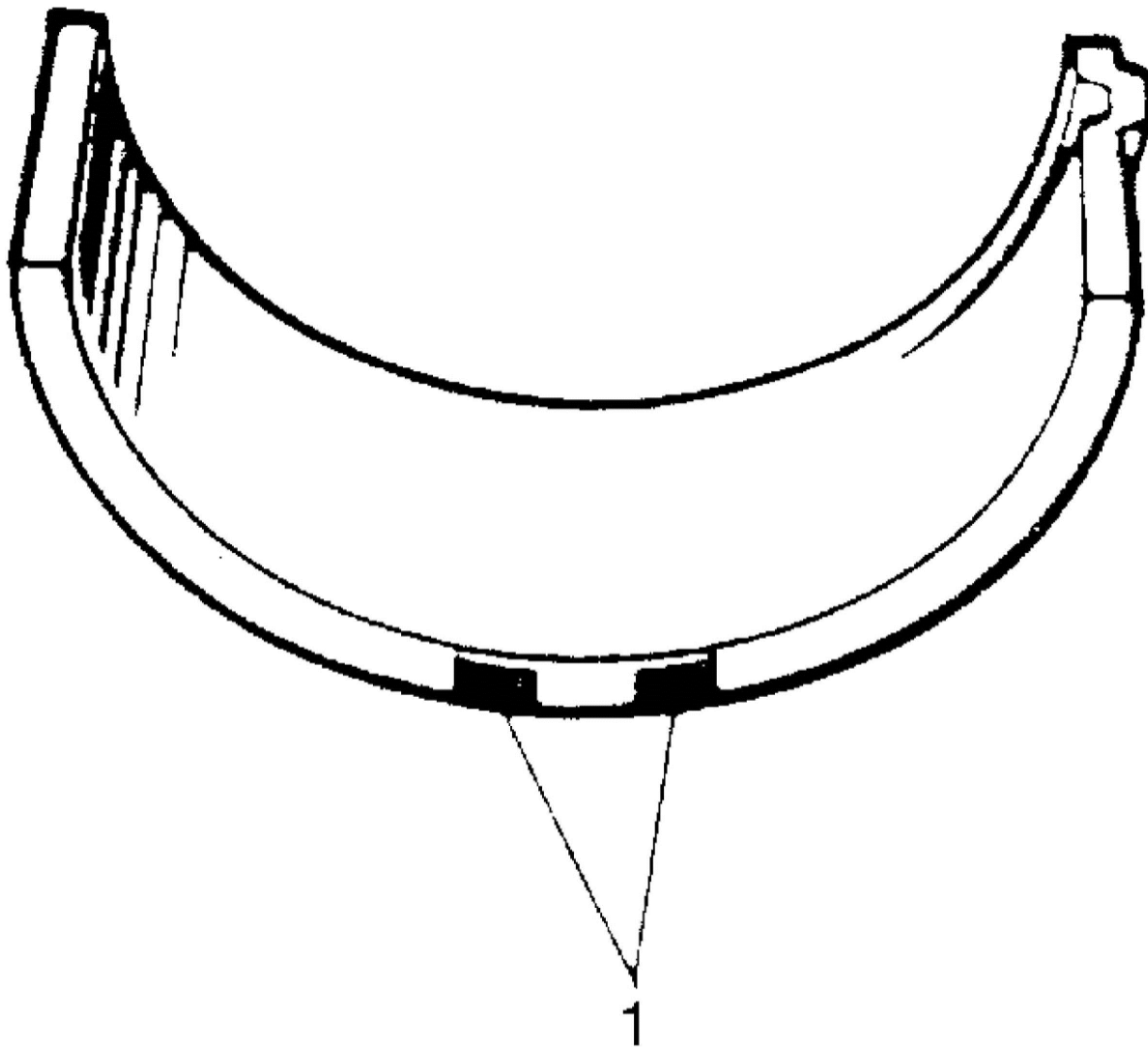
**UNDERSIZE BEARING (0.25 mm):**

- 0.25 mm** undersize bearing is available, in five kinds varying in thickness. To distinguish them, each bearing is painted (1) in the following colors at such position as indicated in figure. Each color represents the following thickness at the center of bearing.

**Undersize main bearing thickness**

**Undersize main bearing thickness**

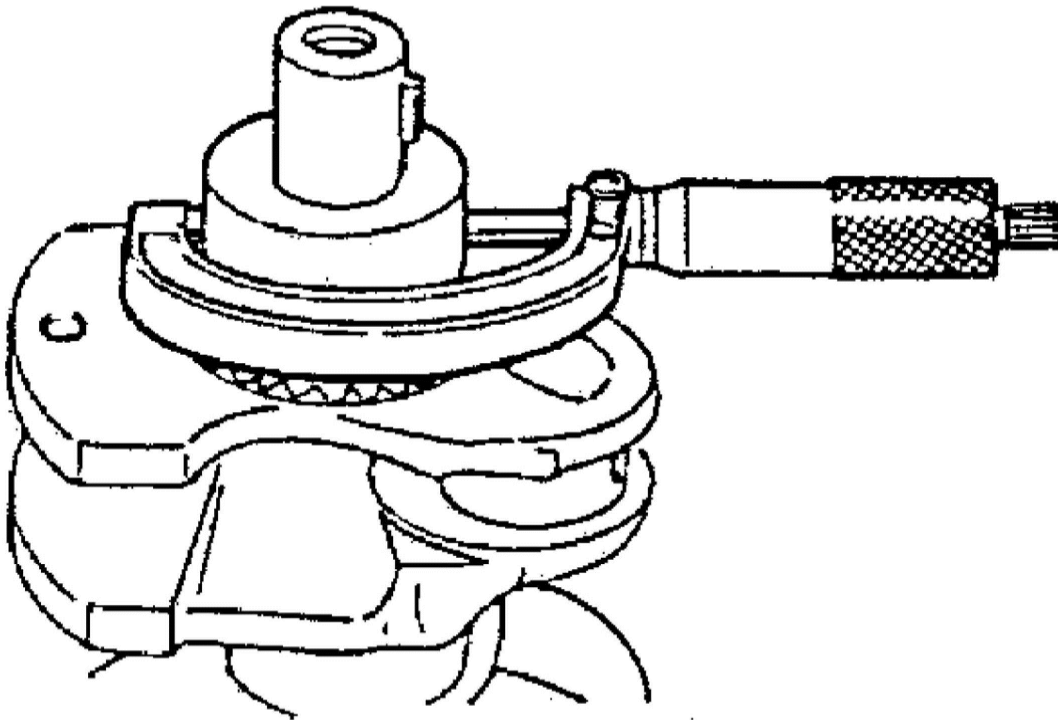
Color painted	Bearing thickness
Green & Red	2.1160 – 2.1190 mm (0.08331 – 0.08342 in.)
Black & Red	2.1190 – 2.1220 mm (0.08343 – 0.08354 in.)
Red only	2.1220 – 2.1250 mm (0.08355 – 0.08366 in.)
Yellow & Red	2.1250 – 2.1280 mm (0.08367 – 0.08377 in.)
Blue & Red	2.1280 – 2.1310 mm (0.08378 – 0.08389 in.)



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

Finished journal diameter **57.7380 - 57.7560 mm (2.27315 - 2.27385 in.)**

- b. Using micrometer, measure reground 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 and alphabets stamped on lower crankcase, select an undersize bearing by referring to the following table. Check bearing clearance with newly selected undersize bearing.



## Undersize bearing specification

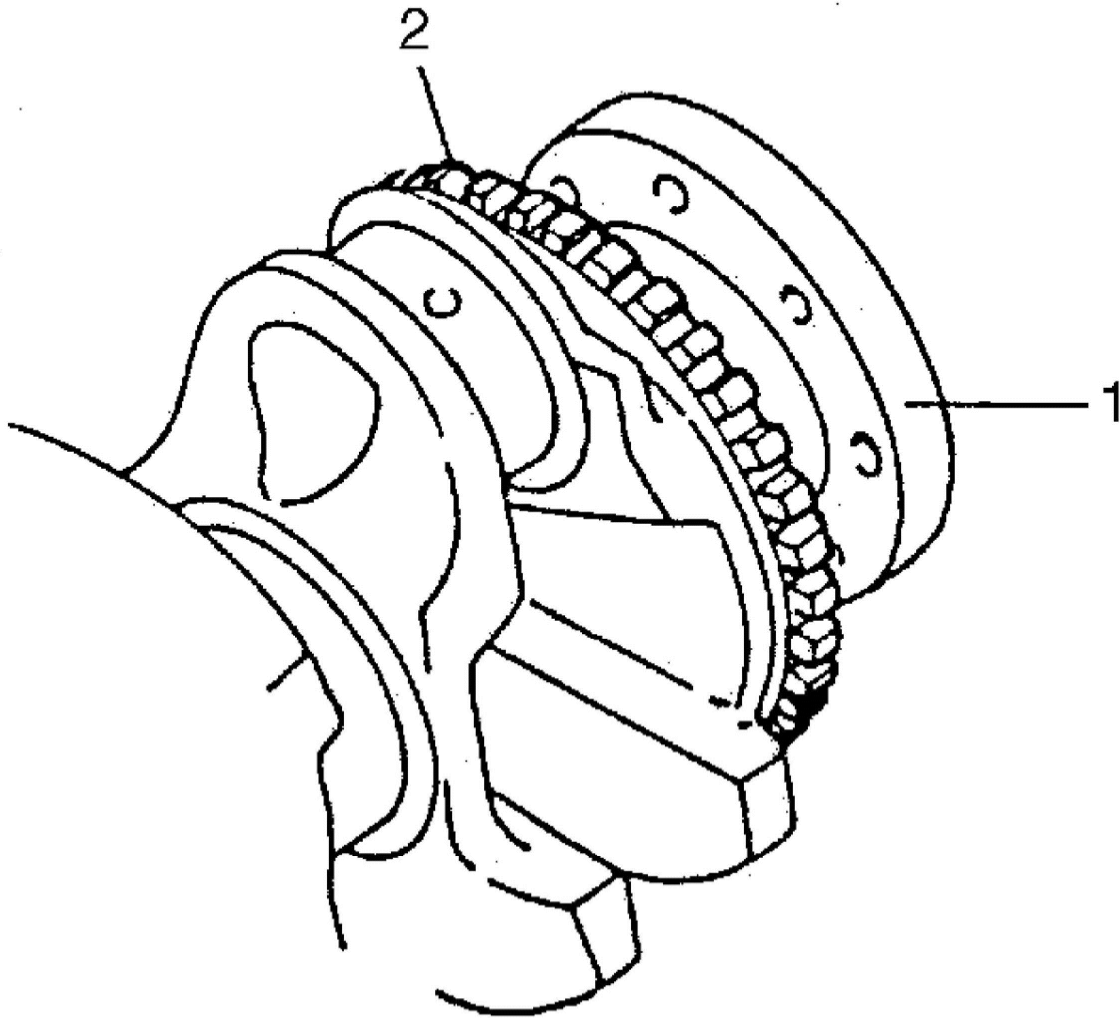
### Undersize bearing specification

		Measured journal diameter		
		57.7500 – 57.7560 mm (2.27362 – 2.27385 in.)	57.7440 – 57.7499 mm (2.27338 – 2.27361 in.)	57.7380 – 57.7439 mm (2.27315 – 2.27337 in.)
Alphabets stamped on lower crankcase	A	Green & Red	Black & Red	Red only
	B	Black & Red	Red only	Yellow & Red
	C	Red only	Yellow & Red	Blue & Red

## Crankshaft Position Sensor Plate

Check teeth of plate for damage.

If any damage is found, replace crankshaft (1).

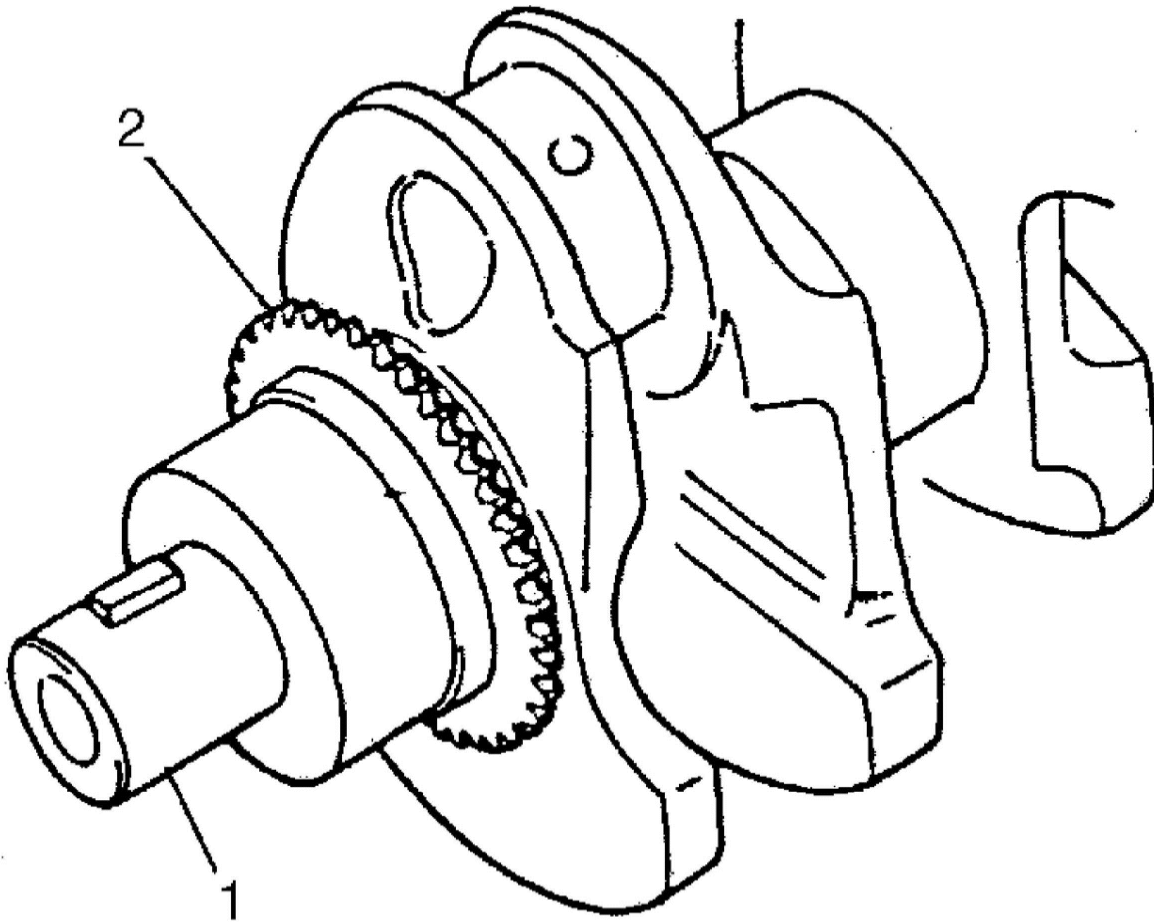


2. Crankshaft position sensor plate

### **Oil Pump Sprocket**

Check teeth of sprocket for wear or damage.

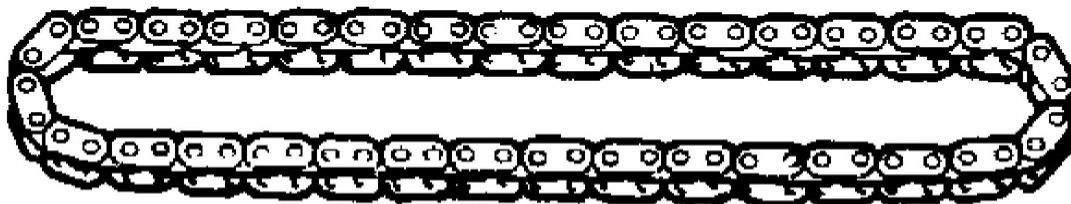
If any damage or wear is found, replace crankshaft (1).



2. Oil pump sprocket

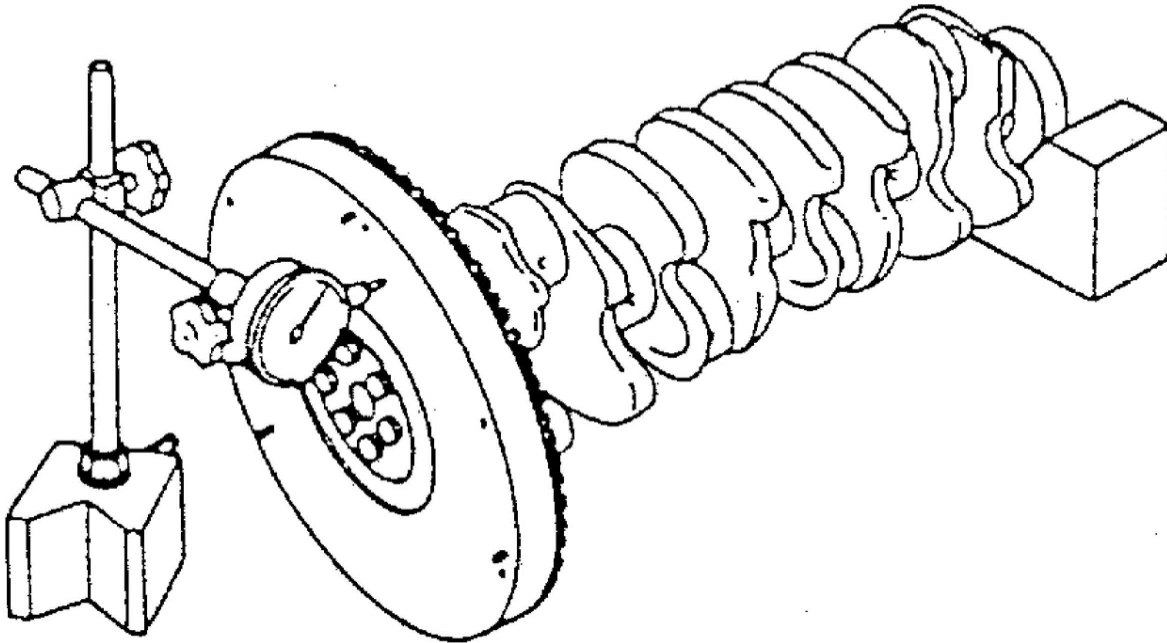
**Oil Pump Chain**

Check oil pump chain for wear or damage.



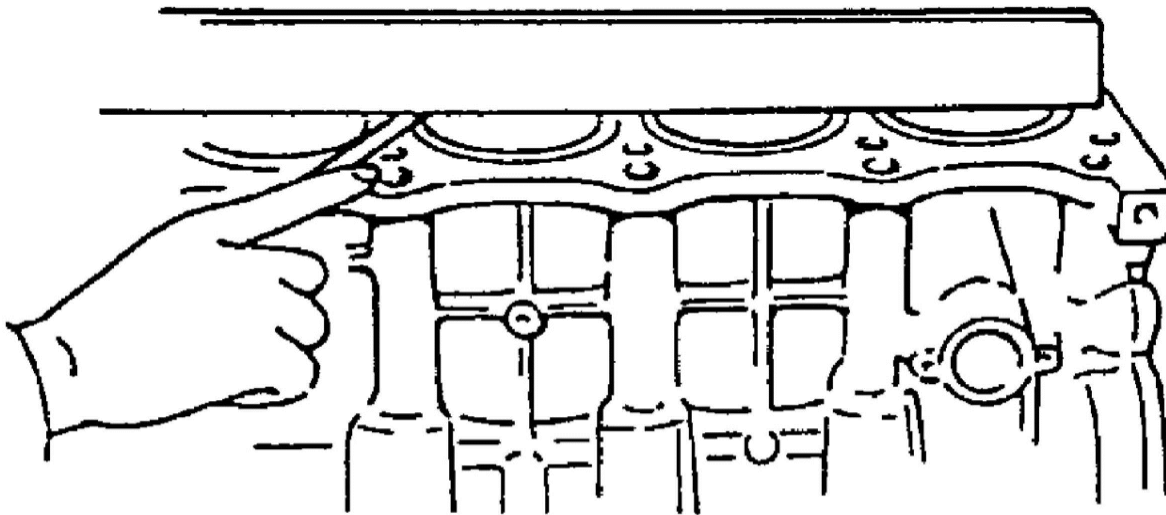
**Flywheel**

- If ring gear is damaged, cracked or worn, replace flywheel.
- If the surface contacting clutch disc is damaged, or excessively worn, replace flywheel.
- Check flywheel for face runout with a dial gauge. If runout exceeds its limit, replace flywheel. Limit on runout **0.2 mm (0.0078 in.)**



### Cylinder Block

- Distortion of gasket surface.
- Using straightedge and thickness gauge, check gasket surface for distortion and, if flatness exceeds its limit, correct it. Flatness Limit **0.06 mm (0.0024 in.)**



## Honing or reboring cylinders

1. When any cylinder needs reboring, all other cylinders must also be rebored at the same time.

## Oversize [piston](#) specification

### Oversize piston specification

Size	Piston diameter
STD	83.970 – 83.990 mm (3.3059 – 3.3067 in.)
O/S 0.50	84.470 – 84.490 mm (3.3256 – 3.3264 in.)

2. Using micrometer, measure [piston](#) diameter.
3. Calculate cylinder bore diameter to be rebored as follows.  $D = A + B - C$

D: Cylinder bore diameter to be rebored.

A: [Piston](#) diameter as measured.

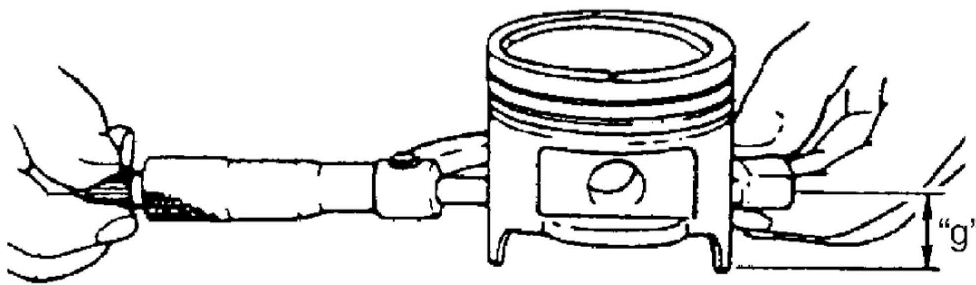
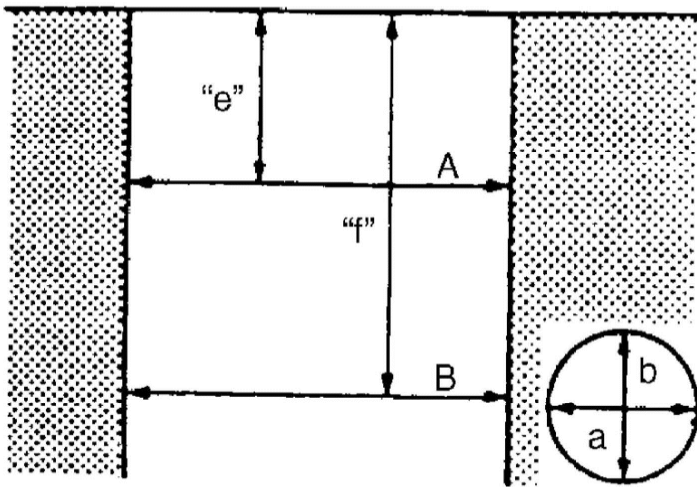
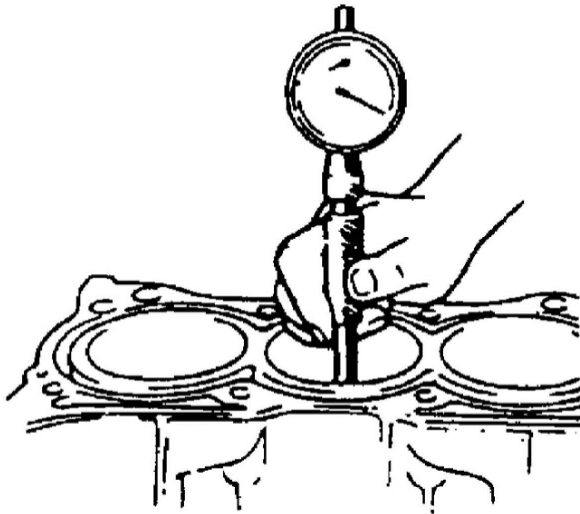
B: [Piston](#) clearance = **0.02 - 0.04 mm (0.0008 - 0.0015 in.)**

C: Allowance for honing = **0.02 mm (0.0008 in.)**

4. Rebore and hone cylinder to calculated dimension.

**NOTE:** Before reboring, install lower crankcase and tighten to specification to avoid distortion of bearing bores.

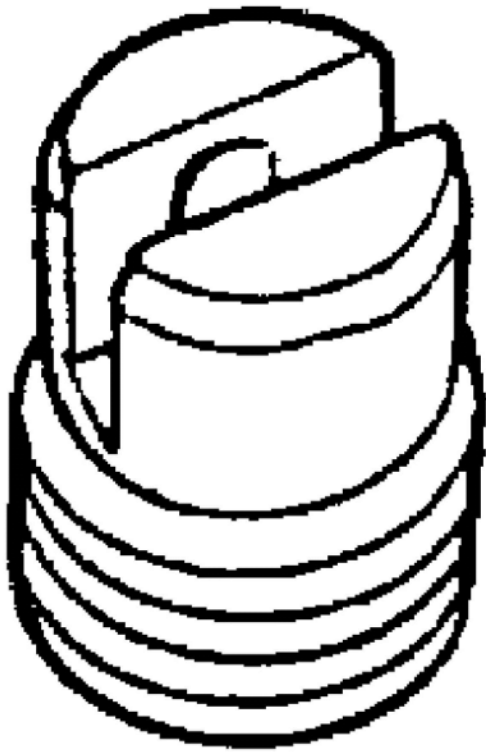
5. Measure [piston](#) clearance after honing.



"e": 50 mm (1.96 in.)	"g": 26.5 mm (1.04 in.)
"f": 95 mm (3.74 in.)	

**Check Valve**

Check check valve for clogging and ball for being stuck.

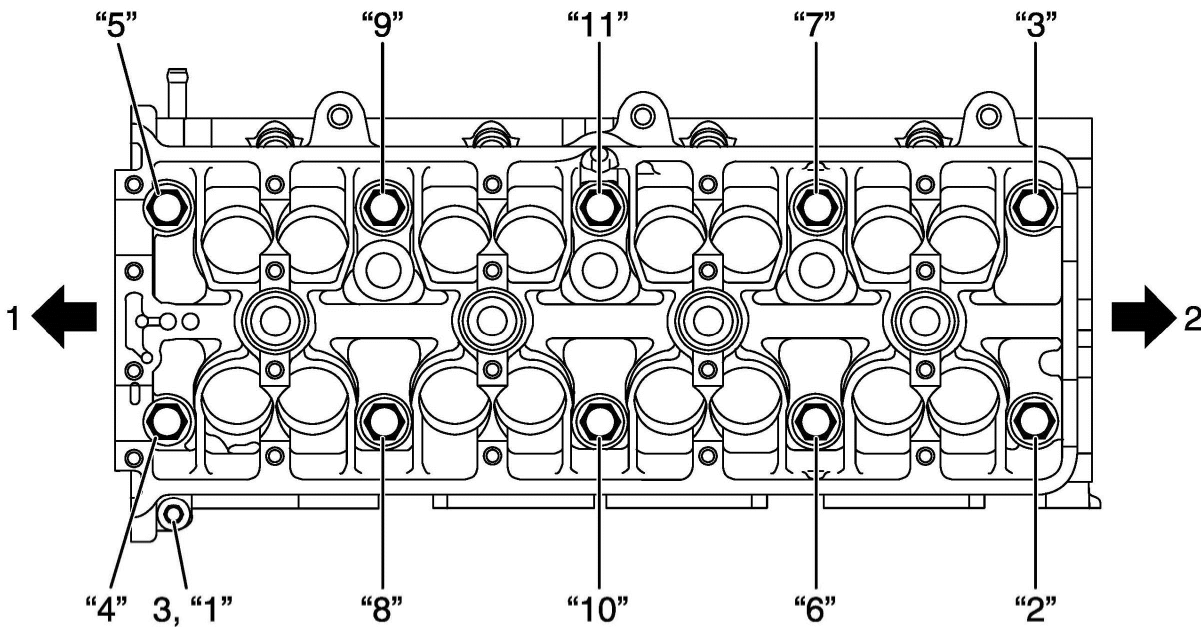


## Valves and Cylinder Head Removal and Installation

### Removal

1. Remove camshafts tappets and shims.
2. Loosen [cylinder head bolts](#) in such order as numbered in figure and remove them.

**NOTE:** Don't forget to remove cylinder head bolt (M6) (3) as shown in figure.

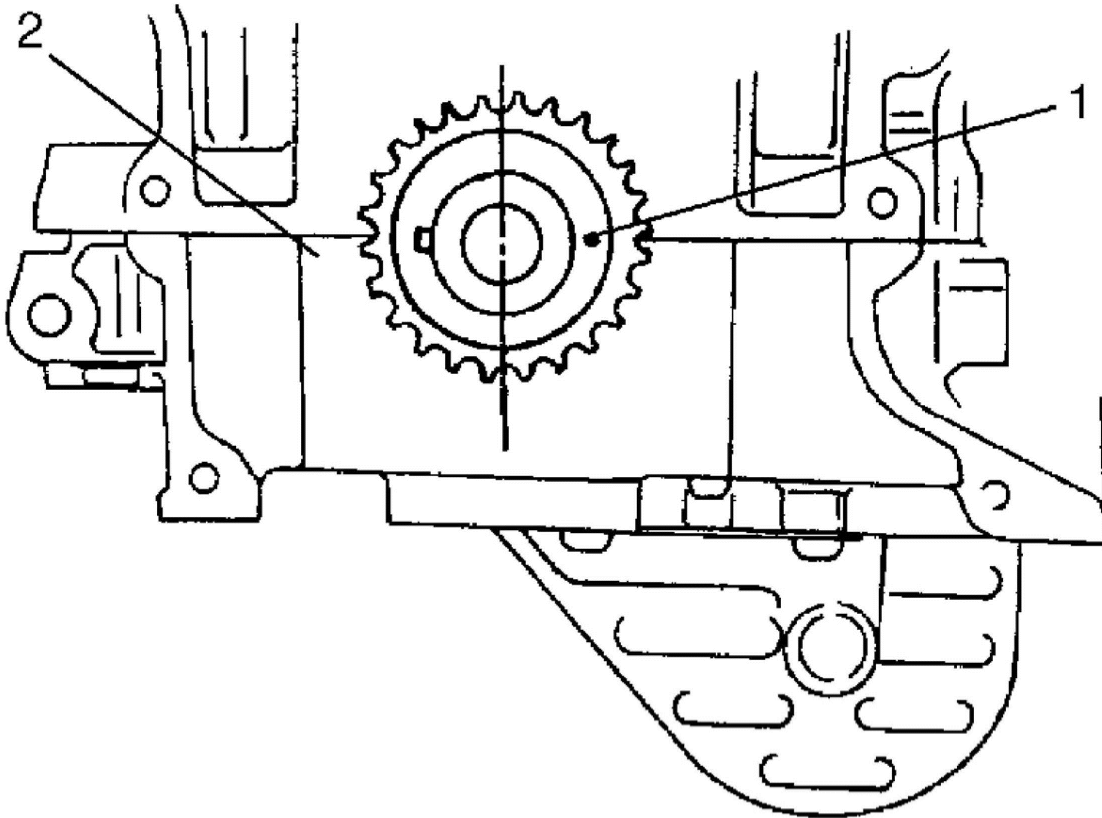


1. Crankshaft pulley side	2. Flywheel side
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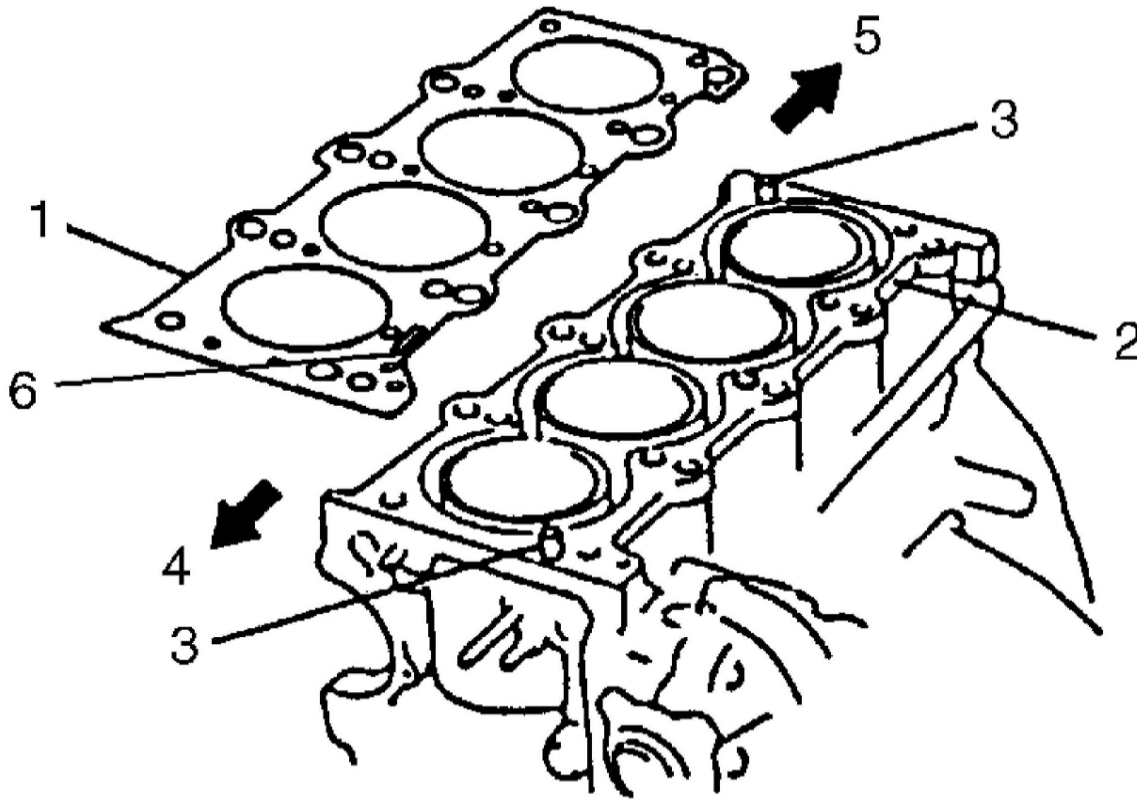
3. Check all around cylinder head for any other parts required to be removed or disconnected and remove or disconnect whatever necessary.
4. Remove cylinder head with [intake manifold](#), [exhaust manifold](#) and water outlet cap. Use lifting device, if necessary.

### Installation

1. Match match mark (1) on crank timing sprocket and mating surface (2) of cylinder block and lower crankcase.

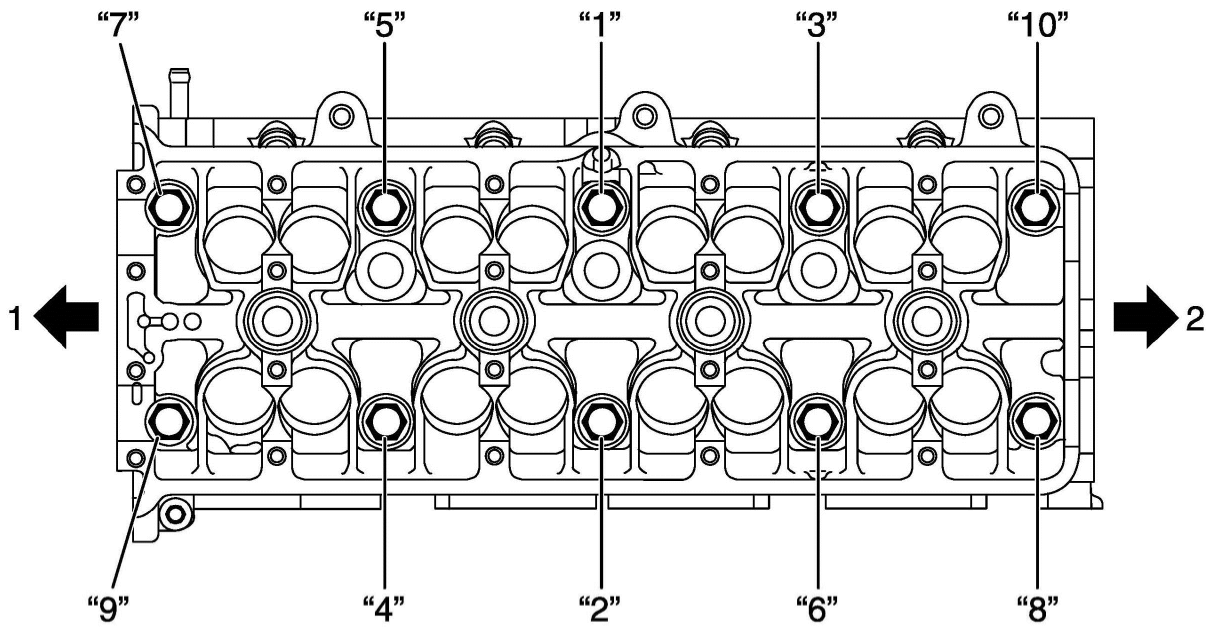


2. Clean mating surface of cylinder head and cylinder block (2). Remove oil, old gasket and dust from mating surface.
3. Install knock pins (3) to cylinder block.
4. Install new [cylinder head gasket](#) (1) to cylinder block. Identification number (6) provided on gasket comes to crankshaft pulley side (4), facing up (toward cylinder head side).



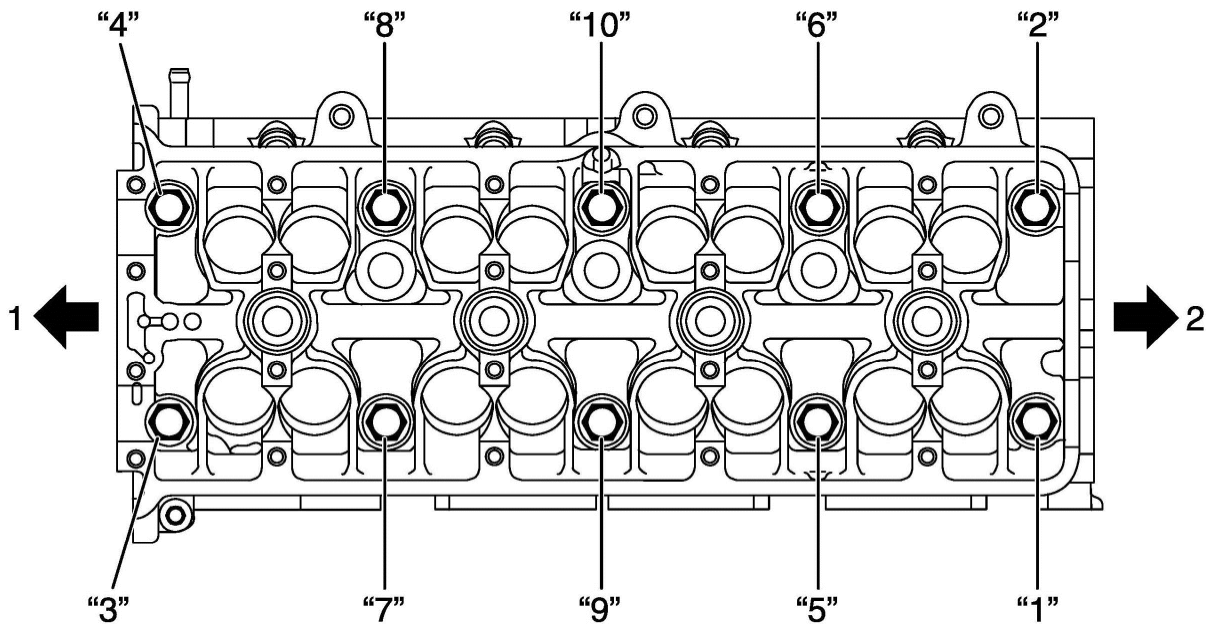
5. Flywheel side

5. Install cylinder head to cylinder block. Apply engine oil to [cylinder head bolts](#) and tighten them gradually as follows.
- Tighten [cylinder head bolts](#) (M10) to **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)** according to numerical order in figure.
  - In the same manner as in step a), retighten [cylinder head bolts](#) (M10) to **82 Nm (8.2 kgf-m, 59.5 ft. lbs.)**.



1. Crankshaft pulley side	2. Flywheel side
---------------------------	------------------

c) Loosen [cylinder head bolts](#) (M10) until tightening torque is reduced to 0 according to numerical order in figure.



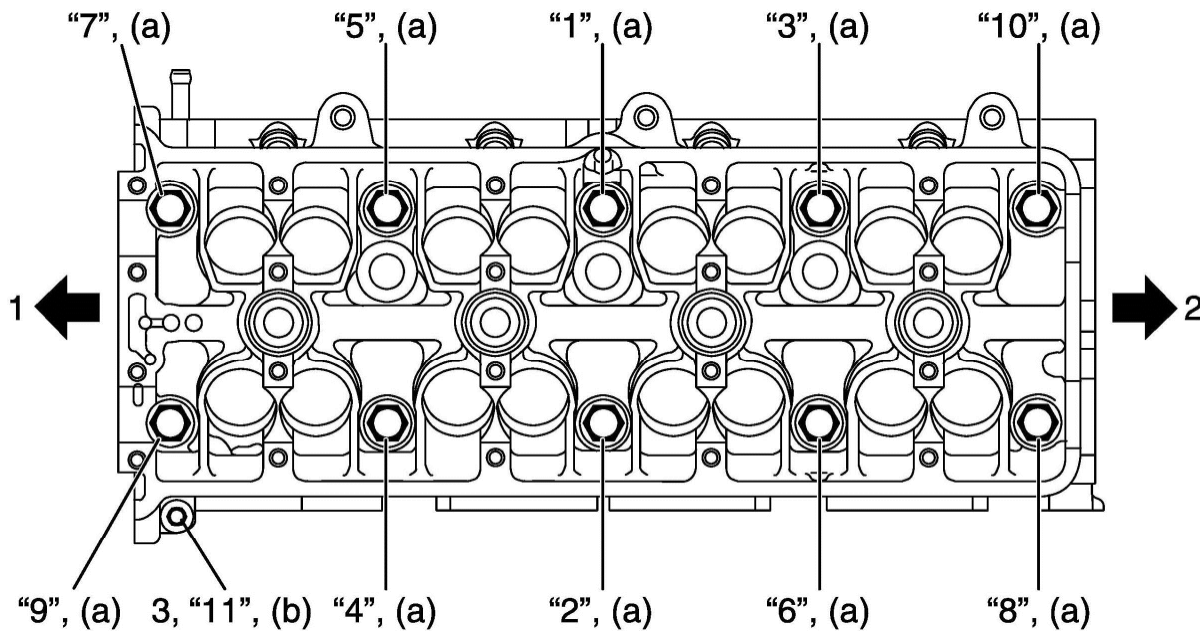
1. Crankshaft pulley side	2. Flywheel side
---------------------------	------------------

- d) Tighten [cylinder head bolts](#) (M10) to **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)** according to numerical order in figure.
- e) In the same manner as in step b), retighten [cylinder head bolts](#) (M10) to **103 Nm (10.3 kgf-m, 74.5 ft. lbs.)**.
- f) Tighten cylinder head bolt (M6) to specified torque.

Tightening torque

Cylinder head bolt (M10) a: Tighten **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)**, **82 Nm (8.2 kgf-m, 59.5 ft. lbs.)**, **0 Nm (0 kgf-m, 0 ft. lbs.)**, **52 Nm (5.2 kgf-m, 38.0 ft. lbs.)** and **103 Nm (10.3 kgf-m, 74.5 ft. lbs.)** by the specified procedure

Cylinder head bolt (M6) b: **11 Nm (1.1 kgf-m 8.0 ft. lbs.)**



1. Crankshaft pulley side	2. Flywheel side
---------------------------	------------------

- 6. Install camshafts, tappets and shims.
- 7. Install 1st [timing chain](#).
- 8. Install 2nd [timing chain](#).
- 9. Install [timing chain](#) cover.
- 10. Check intake and exhaust valve lashes.

11. Install cylinder head cover.
12. Install [oil pan](#).
13. Install engine assembly to vehicle.

## Valves and [Valve Guides](#) Inspection

### [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.

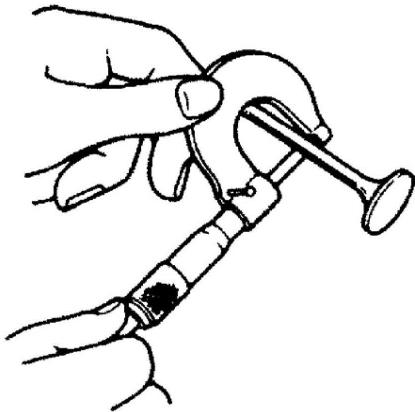
Be sure to take reading at more than one place along the length of each stem and guide. If clearance exceeds limit, replace valve and [valve guide](#).

#### Valve stem and [valve guide](#) specification

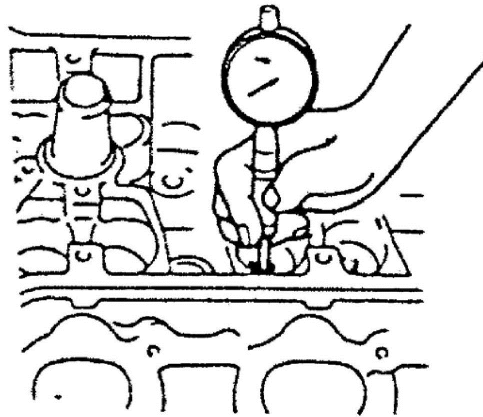
Valve stem and valve guide specification

Item		Standard	Limit
Valve stem diameter [A]	In	5.965 – 5.980 mm (0.2348 – 0.2354 in.)	—
	Ex	5.940 – 5.955 mm (0.2339 – 0.2344 in.)	—
Valve guide bore [B]	In & Ex	6.000 – 6.012 mm (0.2362 – 0.2366 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.)

[A]



[B]



#### Valve stem end deflection

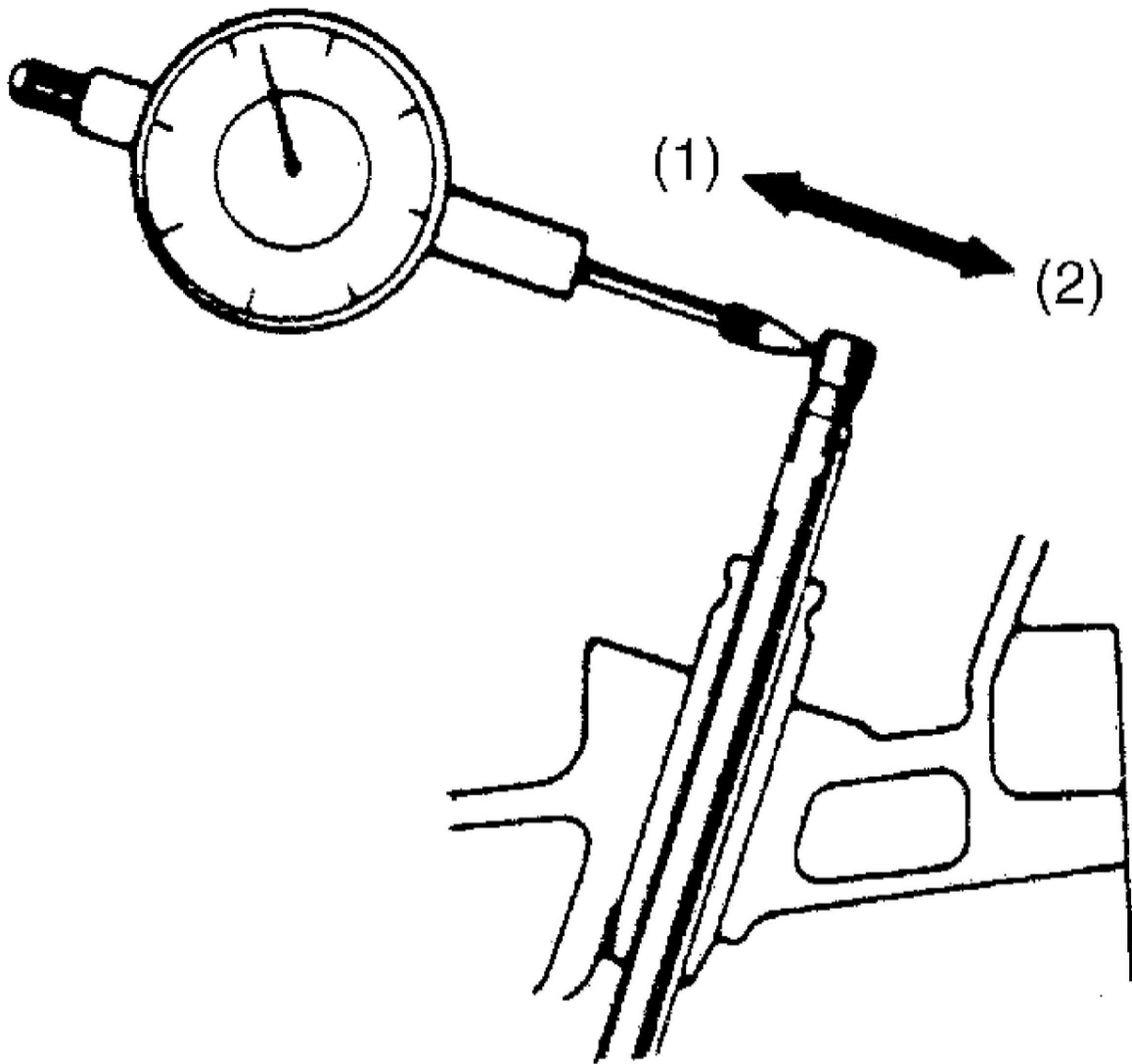
If bore gauge is not available, check end deflection of valve stem with a dial gauge instead. Move stem end in directions (1) and (2) to measure end deflection.

If deflection exceeds its limit, replace valve stem and [valve guide](#).

Valve stem end deflection limit

In: **0.14 mm (0.005 in.)**

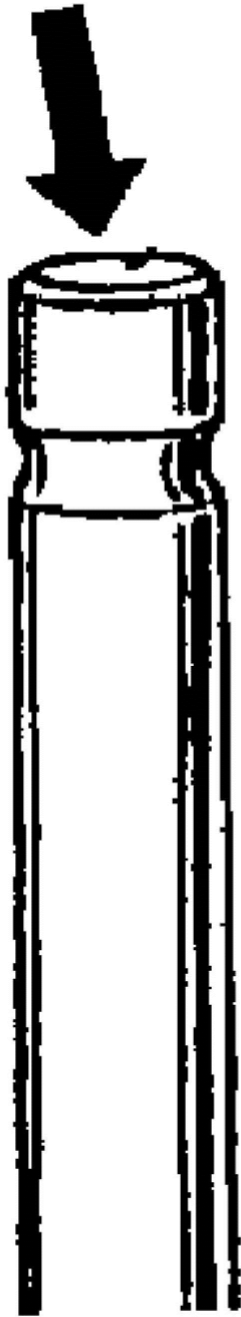
Ex: **0.18 mm (0.007 in.)**



## 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 chamfer. When it is worn out too much that its chamfer is gone, replace valve.



**Valve head thickness**

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

Valve head thickness "a"

Intake

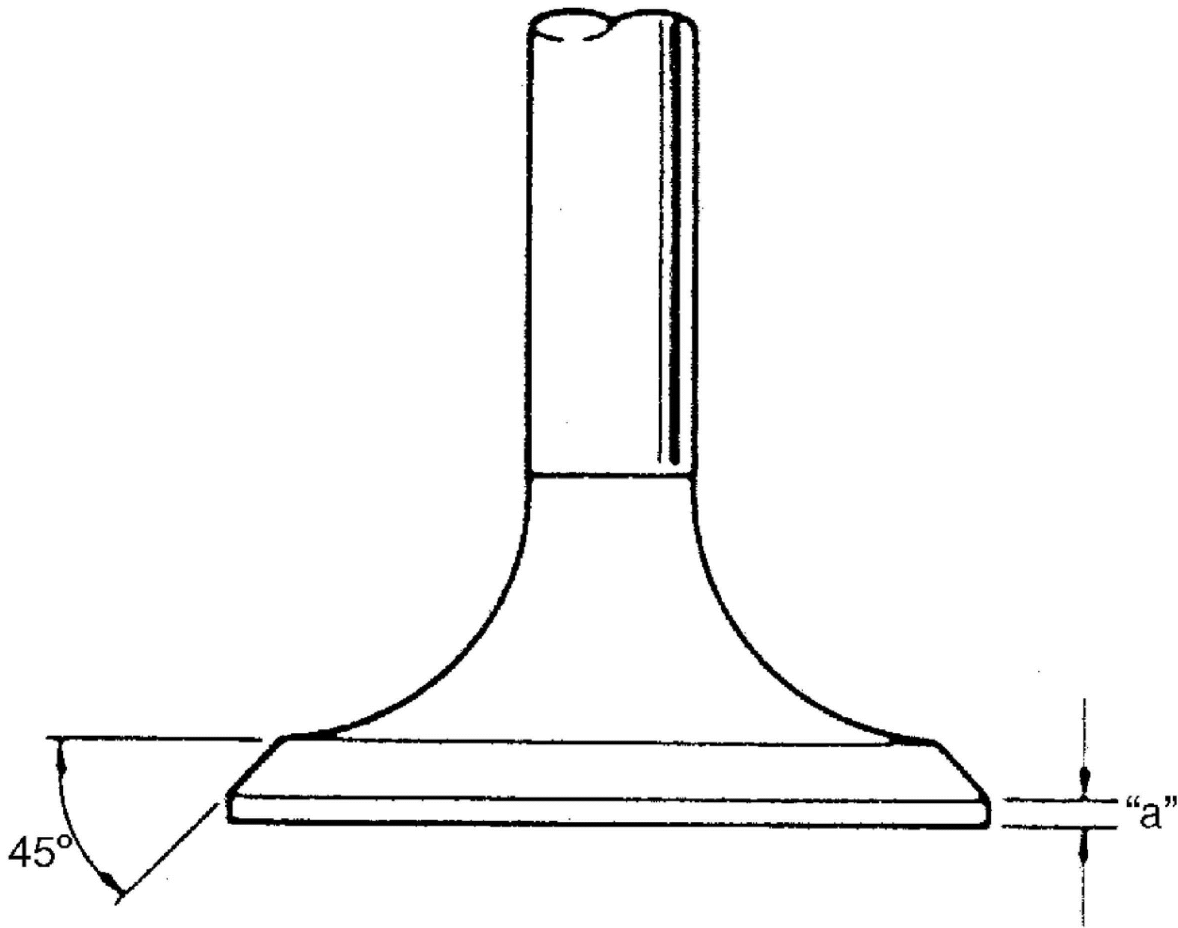
Standard: **1.25 - 1.55 mm (0.049 - 0.061 in.)**

Limit: **0.9 mm (0.035 in.)**

Exhaust

Standard: **1.45 - 1.75 mm (0.057 - 0.069 in.)**

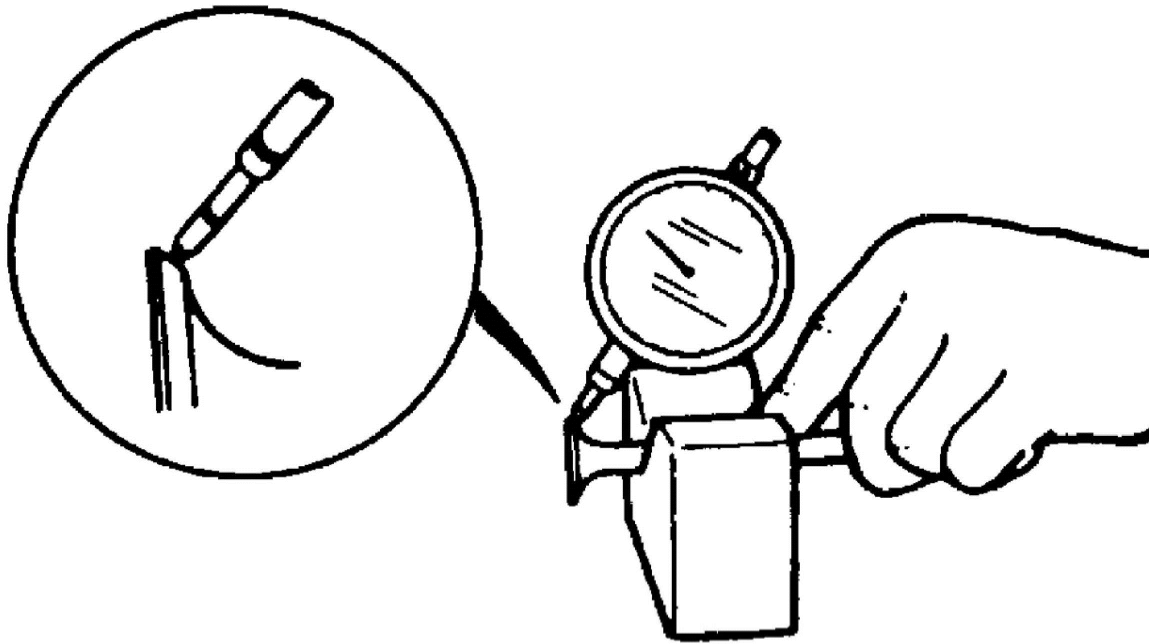
Limit: **1.1 mm (0.04 in.)**



### 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.)**

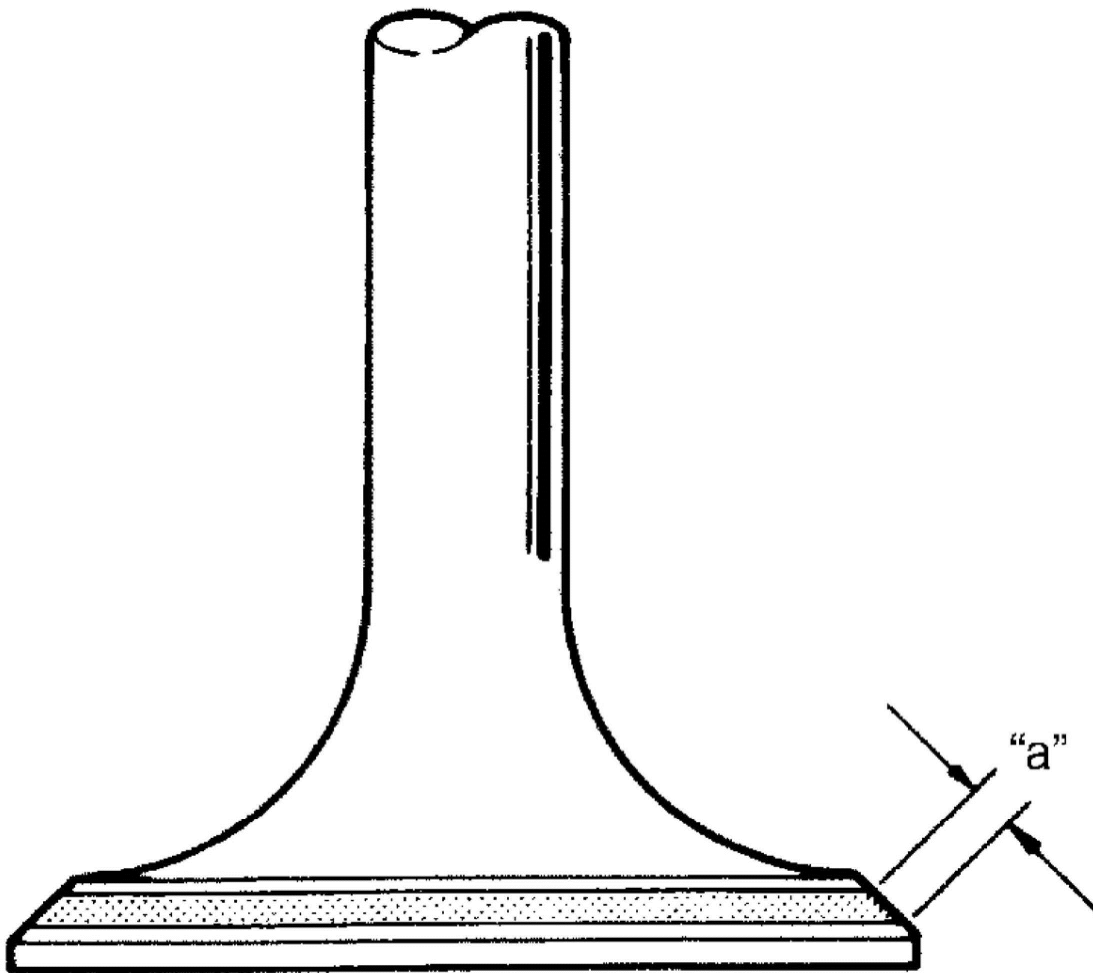


### **Seating contact width**

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



### 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 150 angle, and the second for making 450 angle. The second cut must be made to produce desired seat width.

Seat width for exhaust valve seat

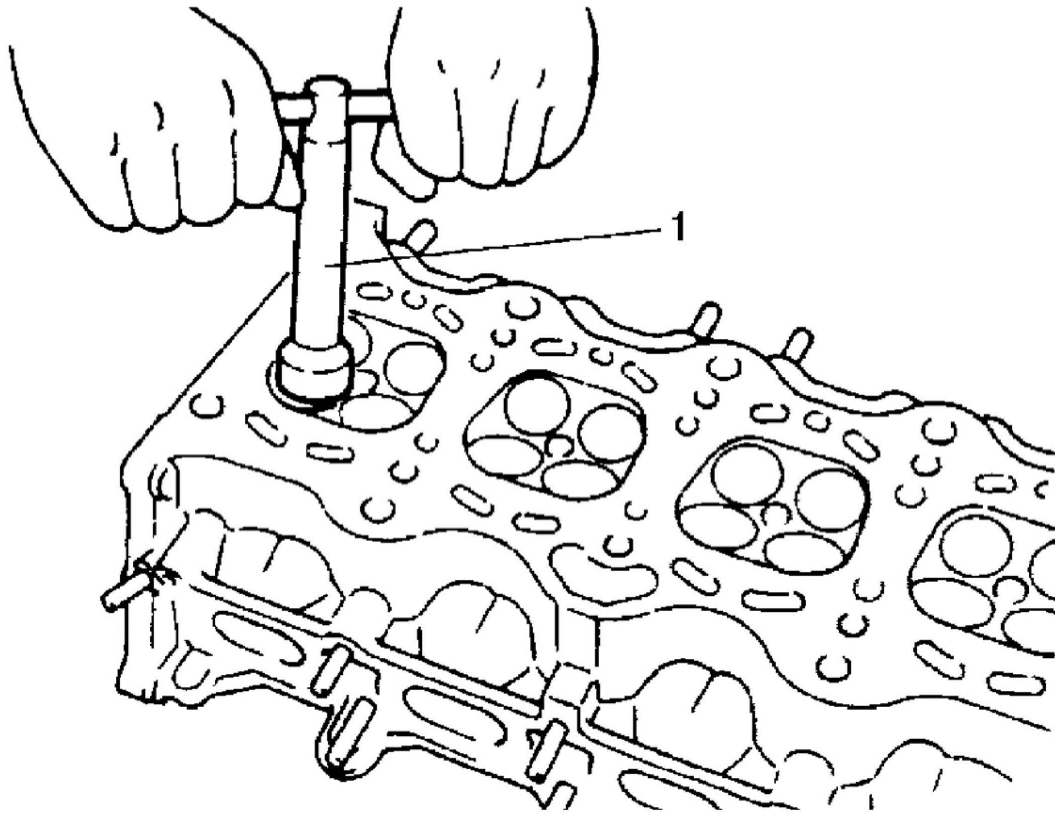
"a": **1.0 - 1.4 mm (0.0389 - 0.0551 in.)**

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 25° 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.

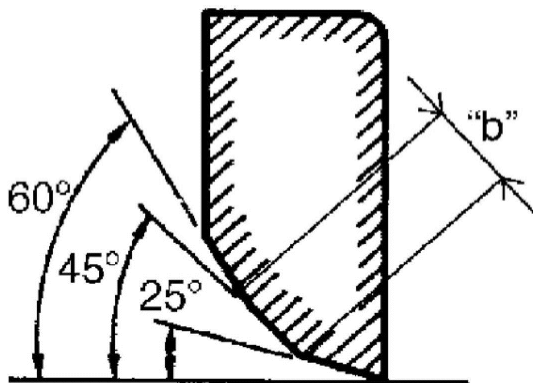
Seat width for intake valve seat

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

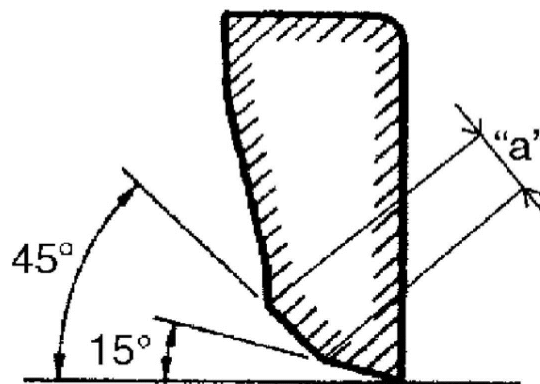
3. Valve lapping: Lap valve on seat in two steps, first with coarse size lapping compound applied to face and the second with fine size compound, each time using valve lapper according to usual lapping method.



IN



EX

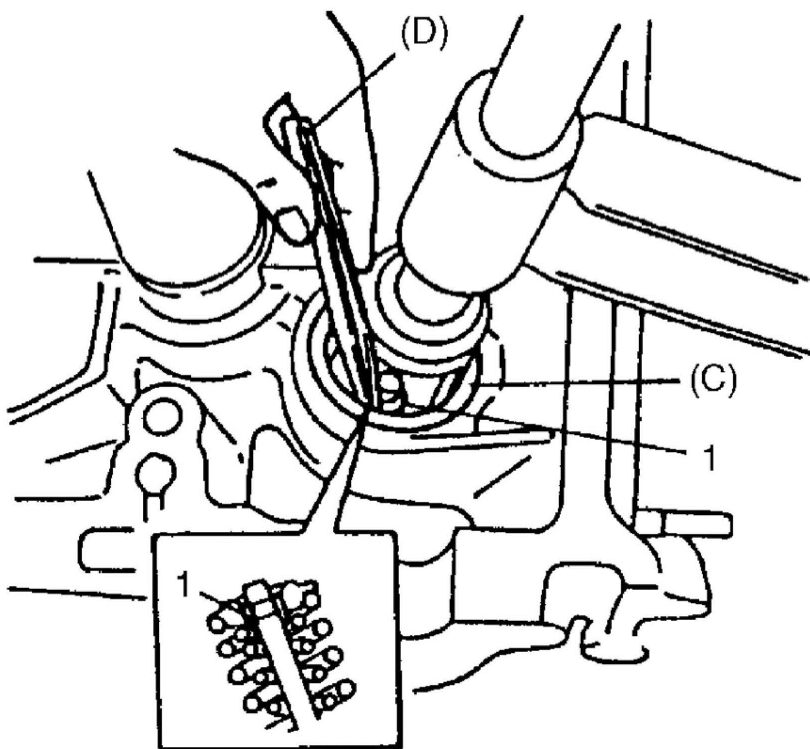
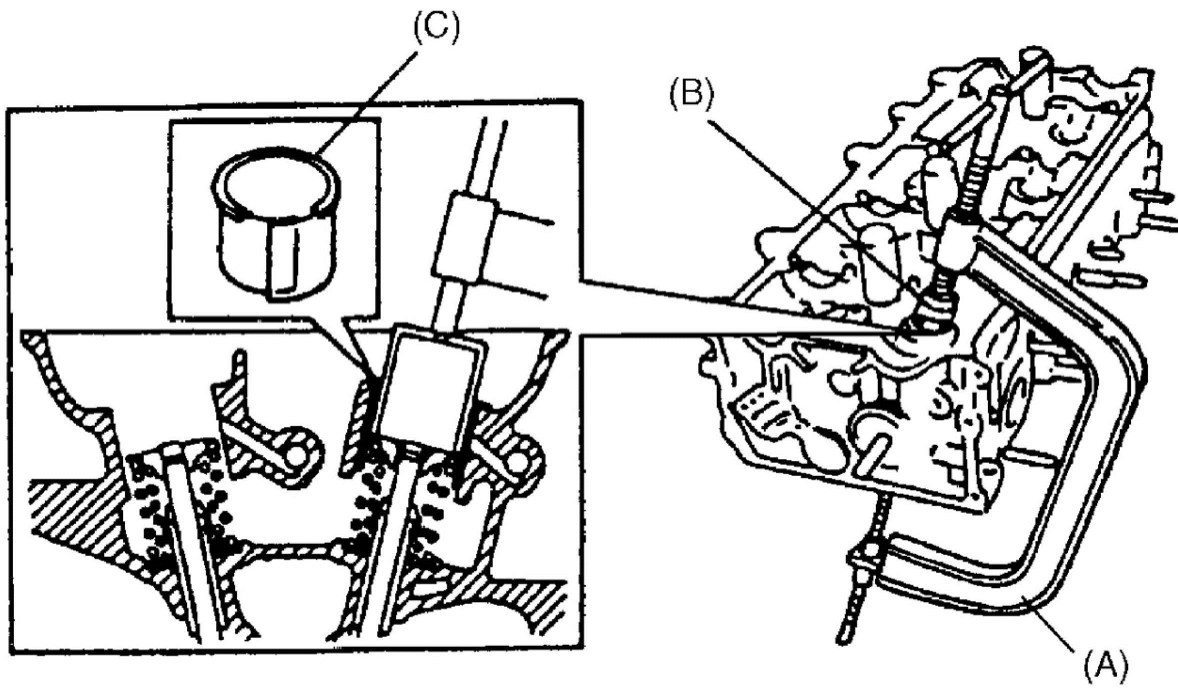


## Valves and Cylinder Head Disassembly and Reassembly

### Disassembly

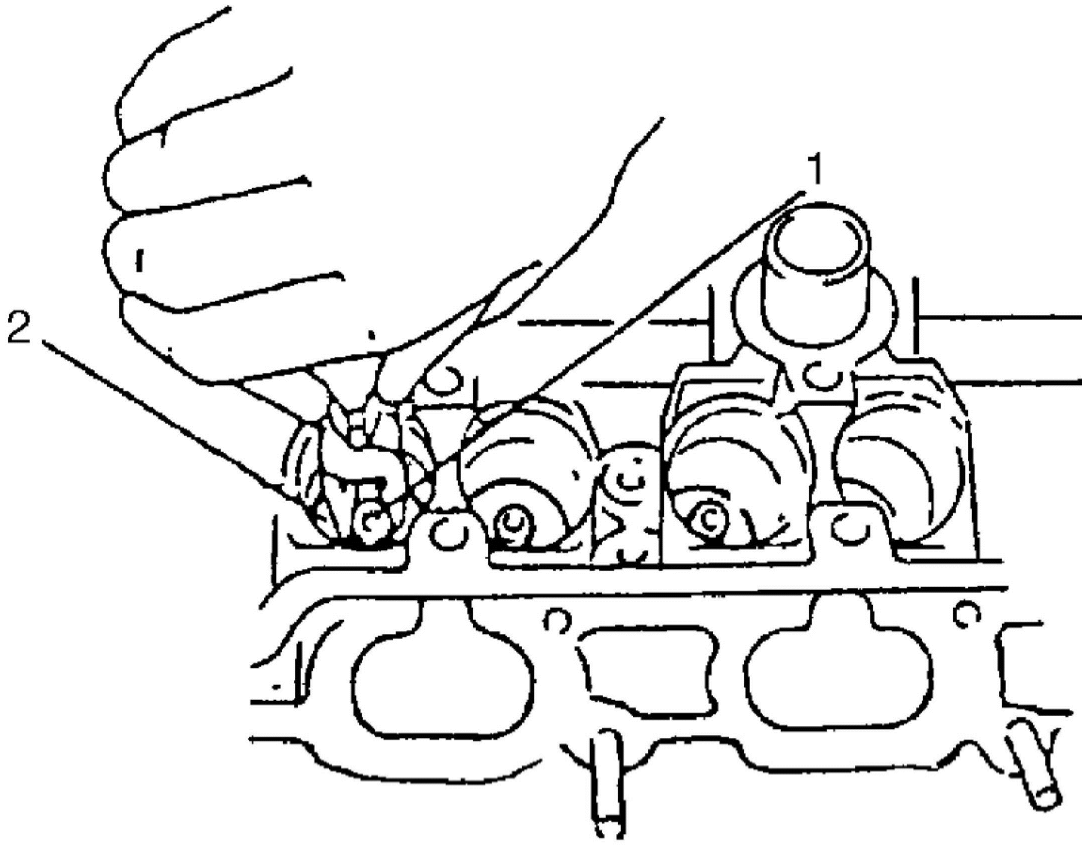
1. When servicing cylinder head, remove [intake manifold](#), injectors, [exhaust manifold](#) and water outlet cap from cylinder head.
2. Using special tools, compress [valve springs](#) and then remove valve cotters (1) also by using special tool. Special Tool

- (A):09916-14510
- (B):09916-16510
- (C):09919-28610
- (D):09916-84511



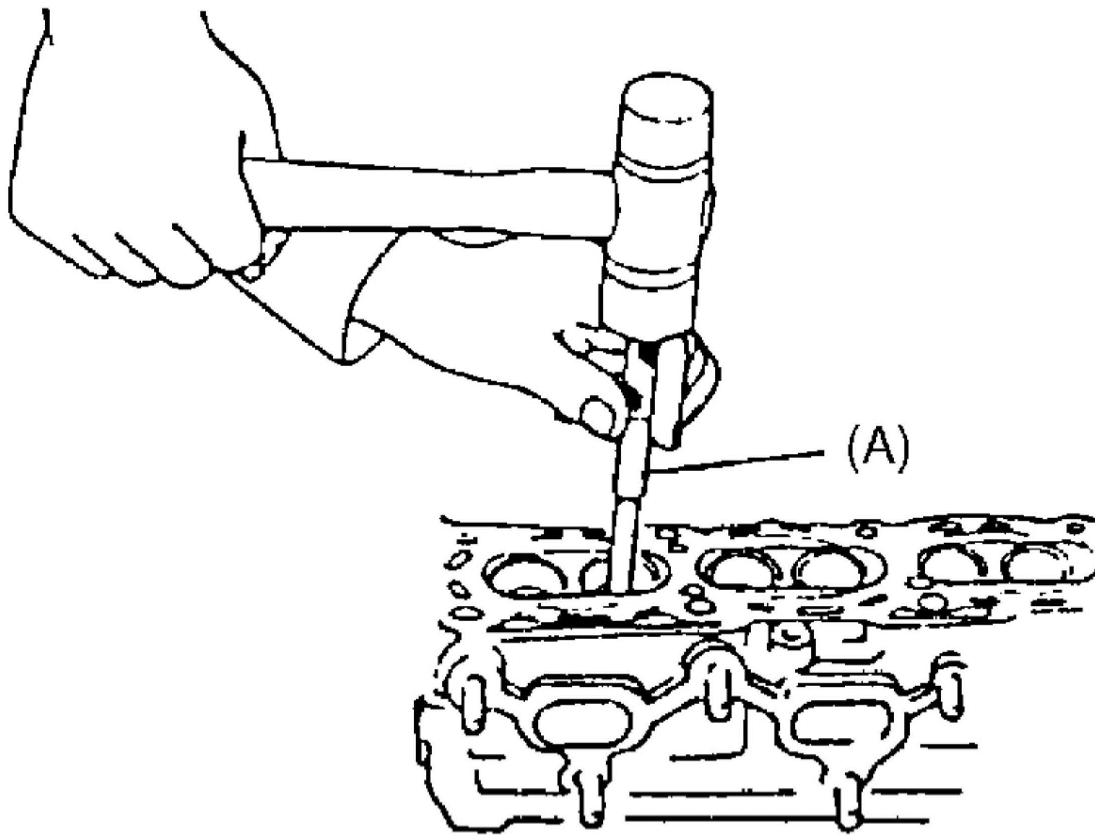
3. Release special tool, and remove spring retainers and [valve springs](#).
4. Remove valve from combustion chamber side.
5. Remove valve stem seal (1) from [valve guide](#), and then [valve spring seat](#) (2).

**NOTE:** Do not reuse seal once disassembled. Be sure to use new seal when assembling.



6. Using special tool ([Valve guide](#) remover), drive valve guide out from combustion chamber side to [valve spring](#) side. Special Tool (A):09916-46020

**NOTE:** Do not reuse [valve guide](#) once disassembled. Be sure to use new valve guide (oversize) when assembling.



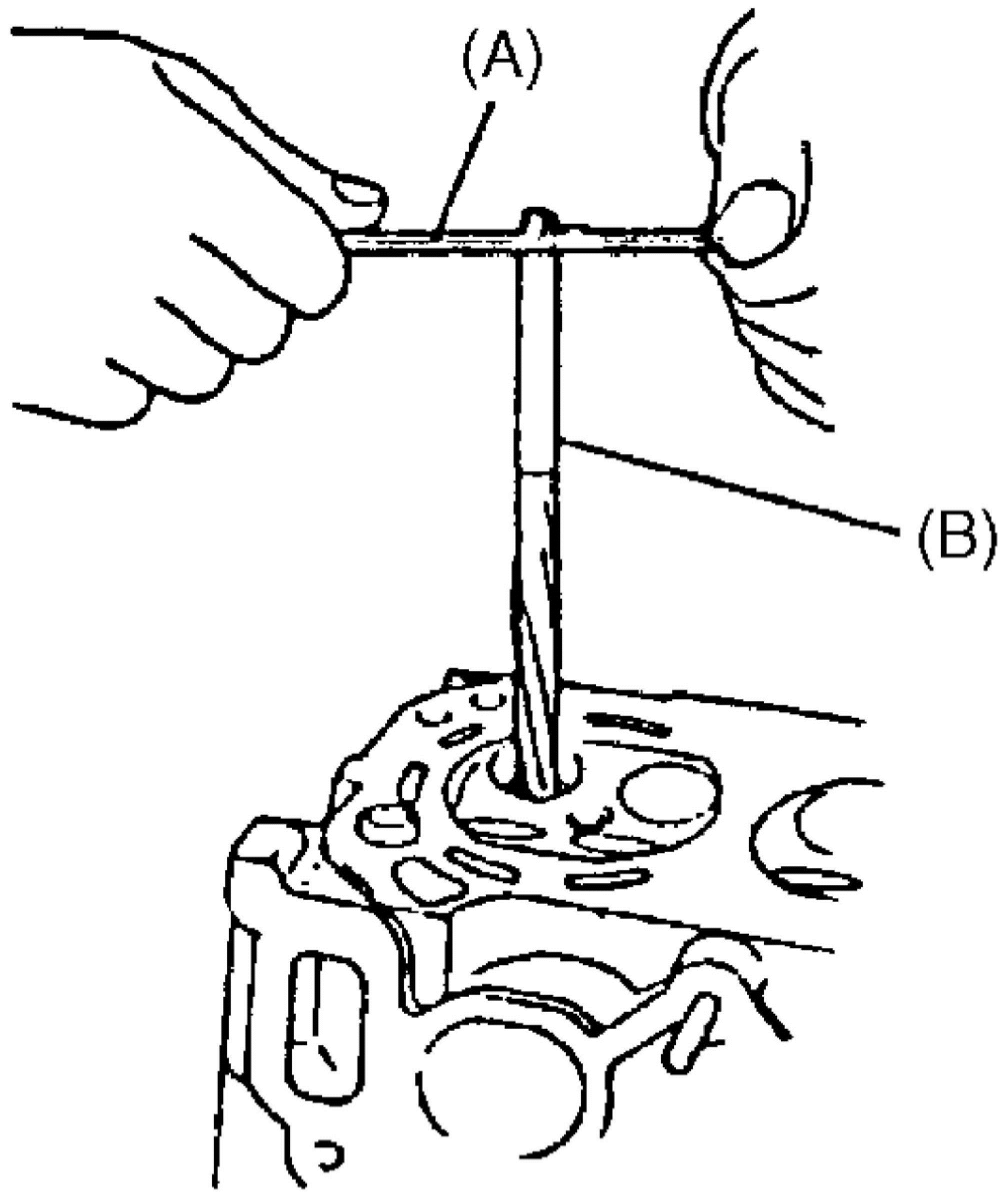
7. Place disassembled parts except valve stem seal and [valve guide](#) in order so that they can be installed in their original positions.

### Reassembly

1. Before installing [valve guide](#) into cylinder head, ream guide hole with special tool (**11 mm** reamer) so as to remove burrs and make it truly round. Special Tool

(A):09916-34542

(B):09916-38210



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 value from cylinder head.

Special Tool

(A):09916-57350

(B):09916-57340

**NOTE:**

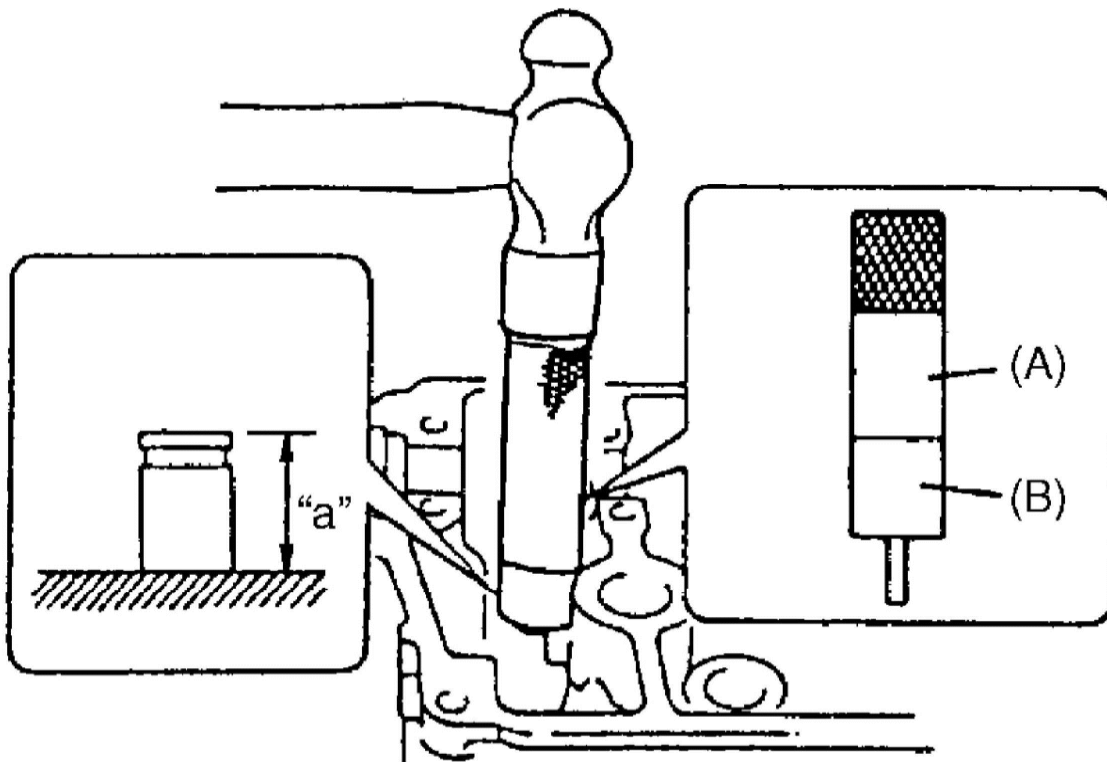
- Do not reuse [valve guide](#) once disassembled. Install new valve guide (Oversize).
- Intake and exhaust [valve guides](#) are identical.

Valve guide oversize **0.03 mm (0.0012 in.)**

Valve guide protrusion "a"

In: **14.5 mm (0.57 in.)**

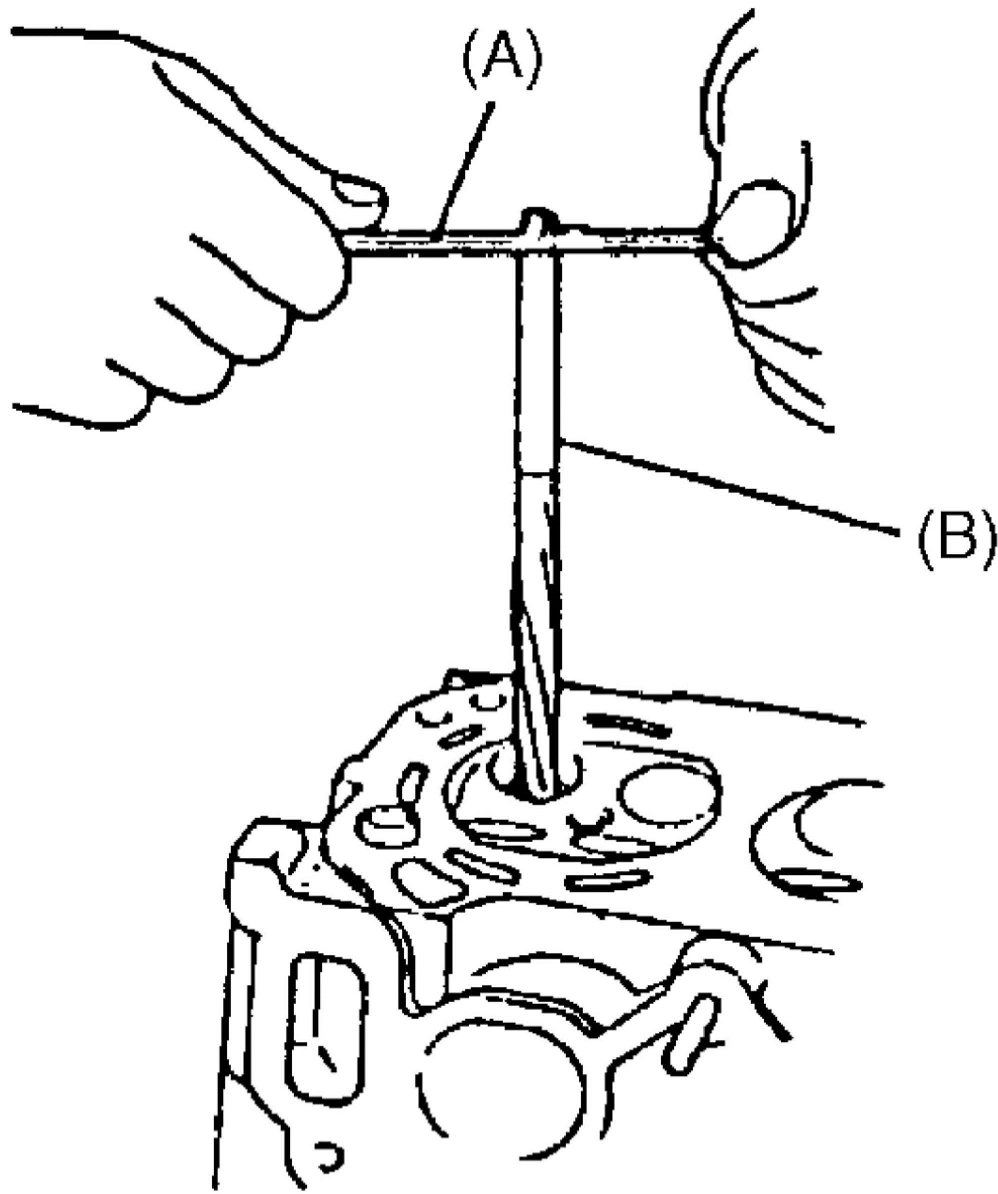
Ex: **13.5 mm (0.53 in.)**



3. Ream valve guide bore with special tool (**6.0 mm** reamer). After reaming, clean bore. Special Tool

(A):09916-34542

(B):09916-37810



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.

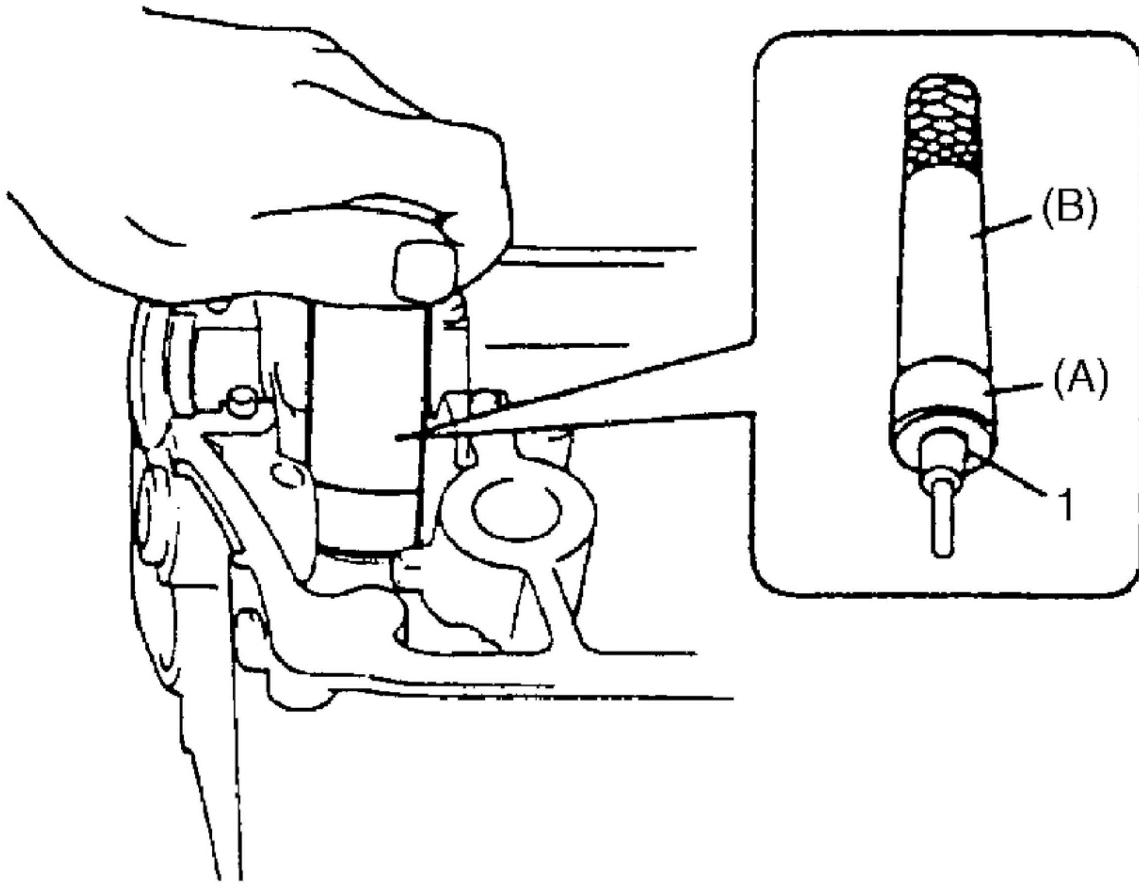
Special Tool

(A):09917-98221

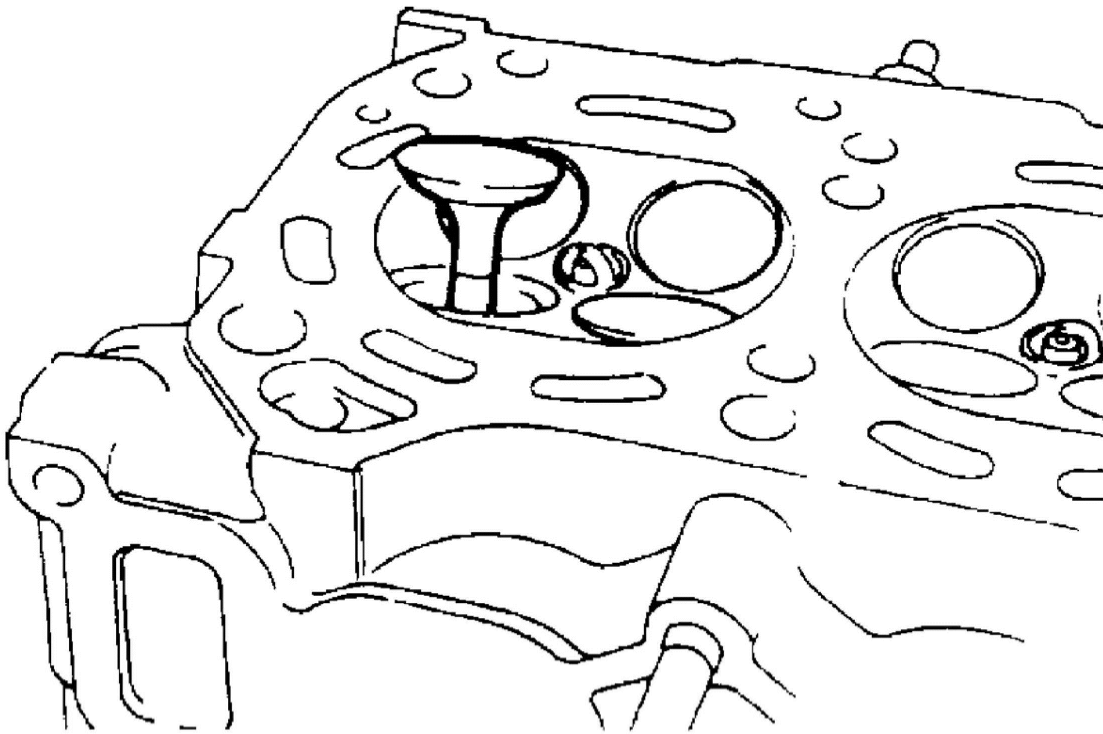
(B):09916-57350

**NOTE:**

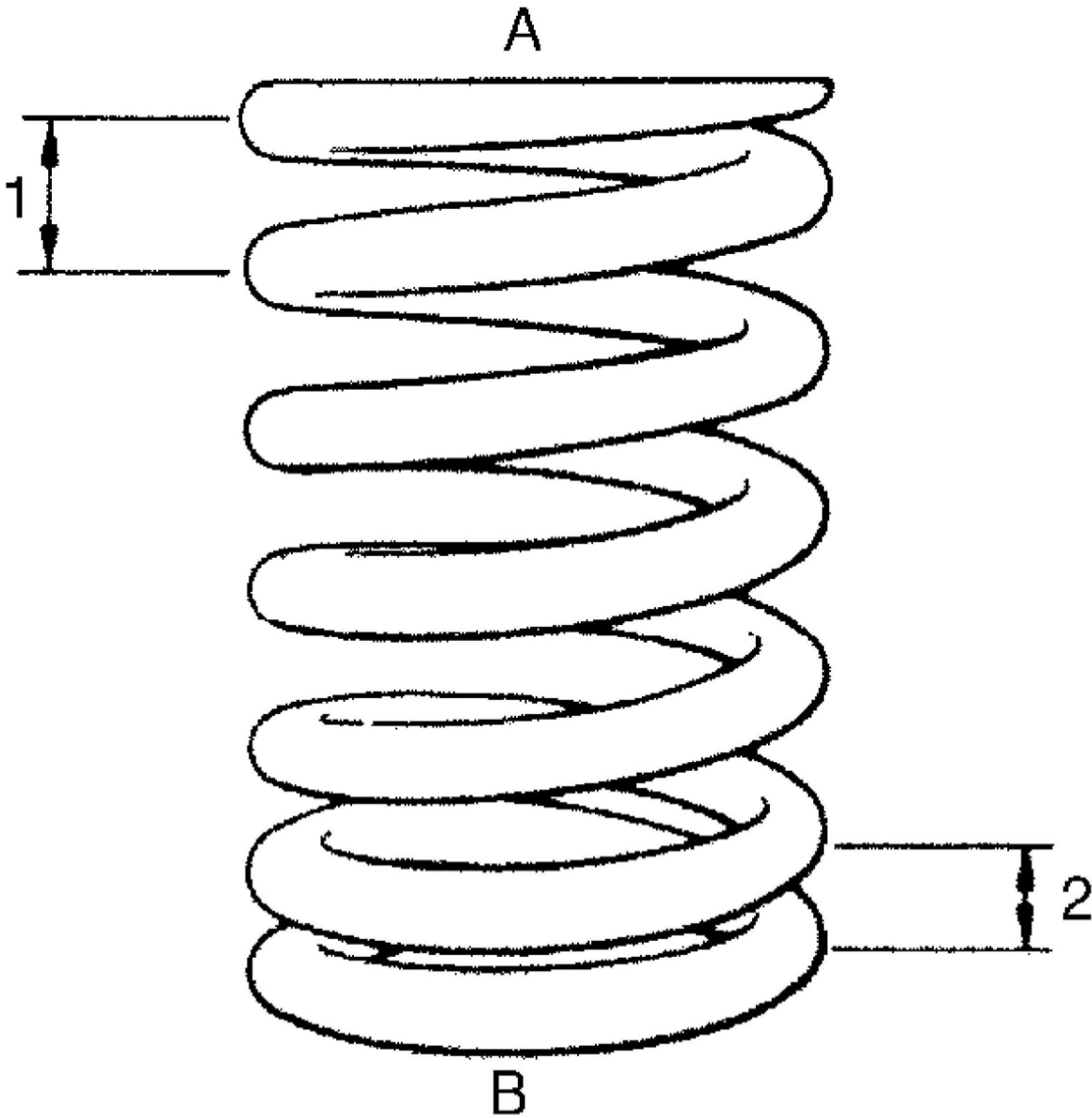
- Do not reuse seal once disassembled. Be sure to install new seal.
- When installing, never tap or hit special tool with a hammer or else. Install seal to guide only by pushing special tool by hand. Tapping or hitting special tool may cause damage to seal.



6. Install valve to [valve guide](#). Before installing valve to [valve guide](#), apply engine oil to stem seal, valve guide bore, and valve stem.



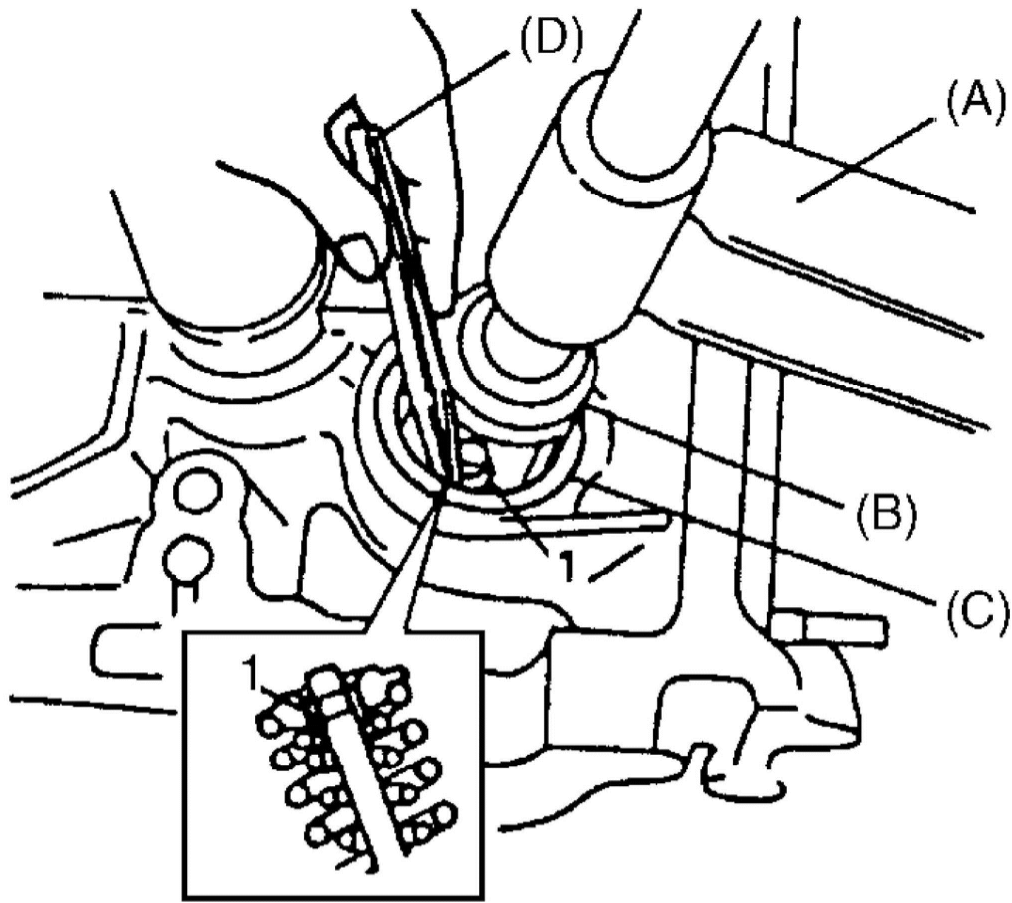
7. Install [valve spring](#) and spring retainer. Each [valve spring](#) has top end (large-pitch end (1)) and bottom end (small-pitch end (2)). Be sure to position spring in place with its bottom end (small-pitch end) facing the bottom ([valve spring seat](#) side).



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

8. Using special tool (Valve lifter), compress [valve spring](#) and fit two valve cotters (1) into groove in valve stem. Special Tool

- (A):09916-14510
- (B):09916-16510
- (C):09919-28610
- (D):09916-84511

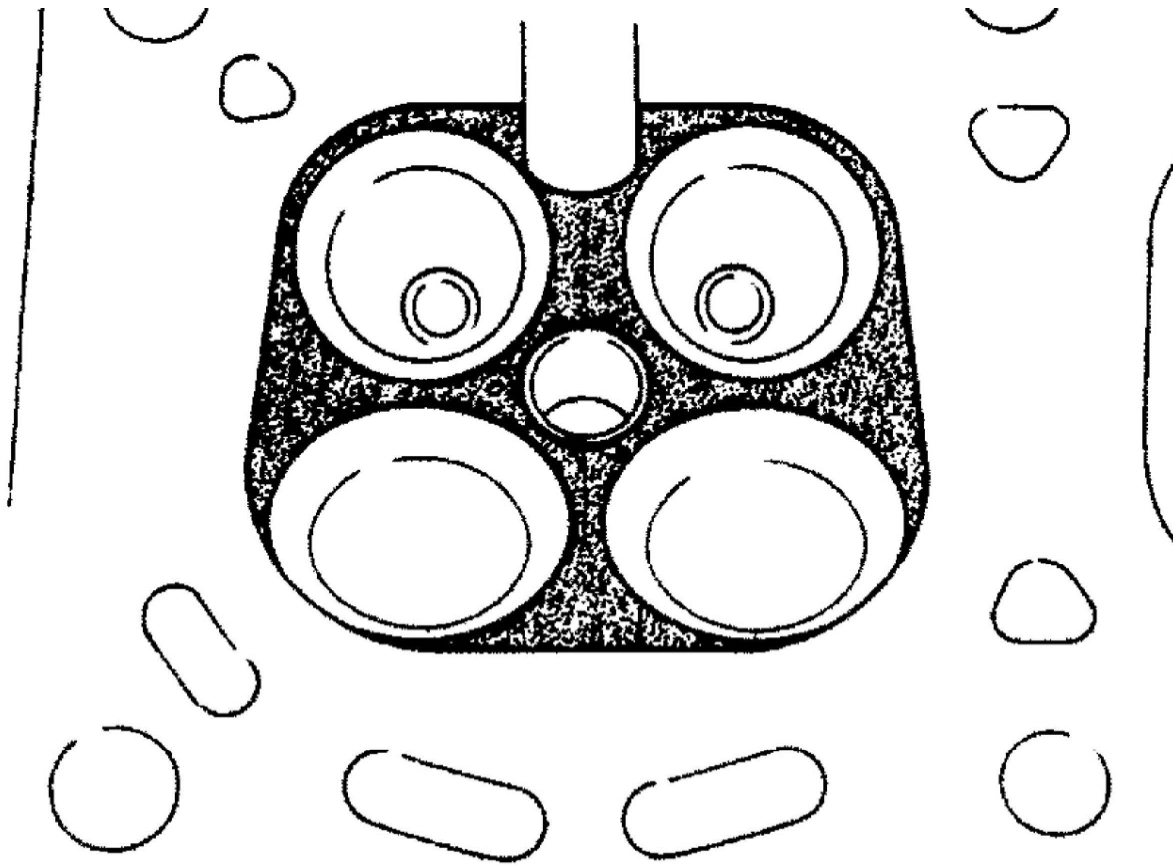


9. Install [intake manifold](#).
10. Install [exhaust manifold](#).
11. Install injectors.

### Cylinder Head Inspection

- Remove all carbon deposits from combustion chambers.

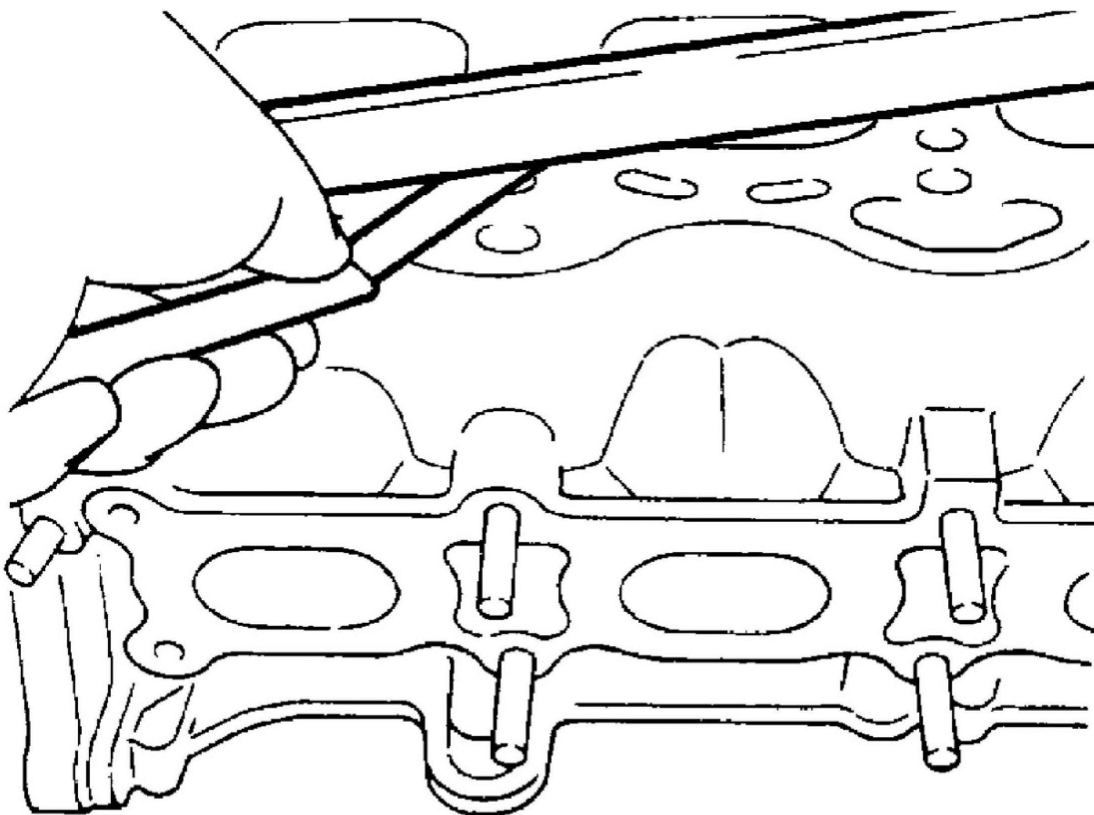
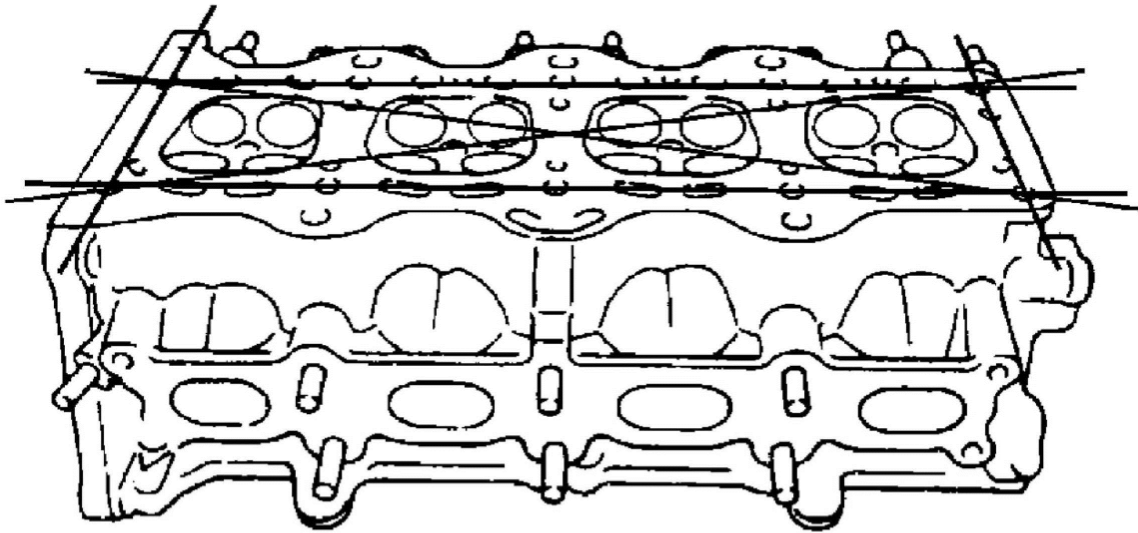
**NOTE:** Do not use any sharp-edged tool to scrape off carbon deposits. Be careful not to scuff or nick metal surfaces when decarbonizing. The same applies to valves and valve seats, too.



- Check cylinder head for cracks on intake and exhaust ports, combustion chambers, and head surface. Using a straightedge and thickness gauge, check flatness of gasket surface at a total of 6 locations. If distortion limit is exceeded, correct gasket 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 gasket 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 gasket joint is often due to warped gasket surface: such leakage results in reduced power output.

Distortion for cylinder head surface on [piston](#) side

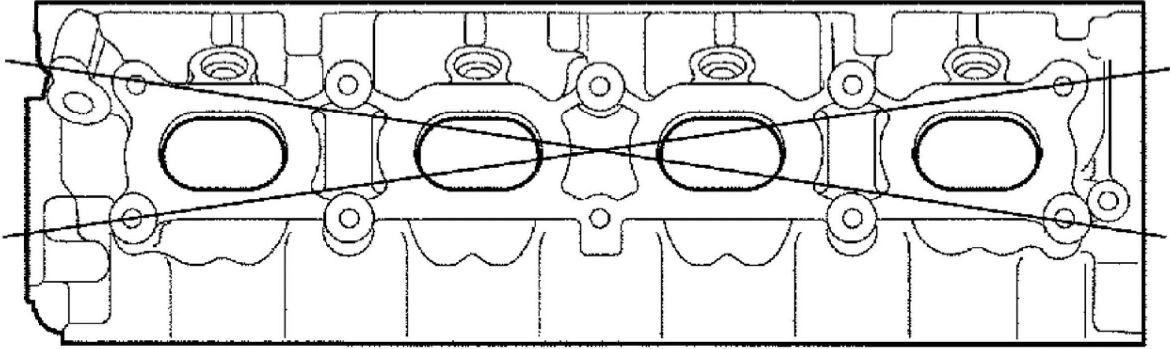
Limit: **0.03 mm (0.001 in.)**



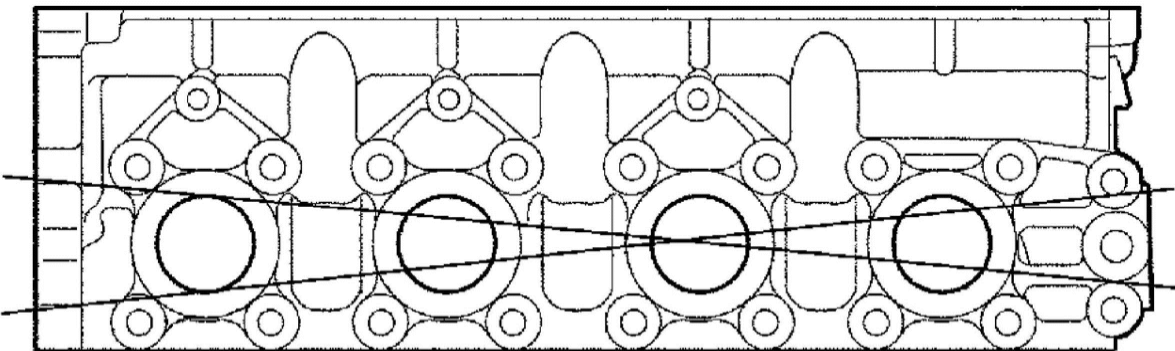
- Distortion of manifold seating faces: Check seating faces of cylinder head for manifolds, using a straightedge and thickness gauge, in order to determine whether these faces should be corrected or cylinder head replaced.

Distortion for cylinder head surface on intake and [exhaust manifold](#)  
Limit: **0.05 mm (0.002 in.)**

[IN]



[EX]

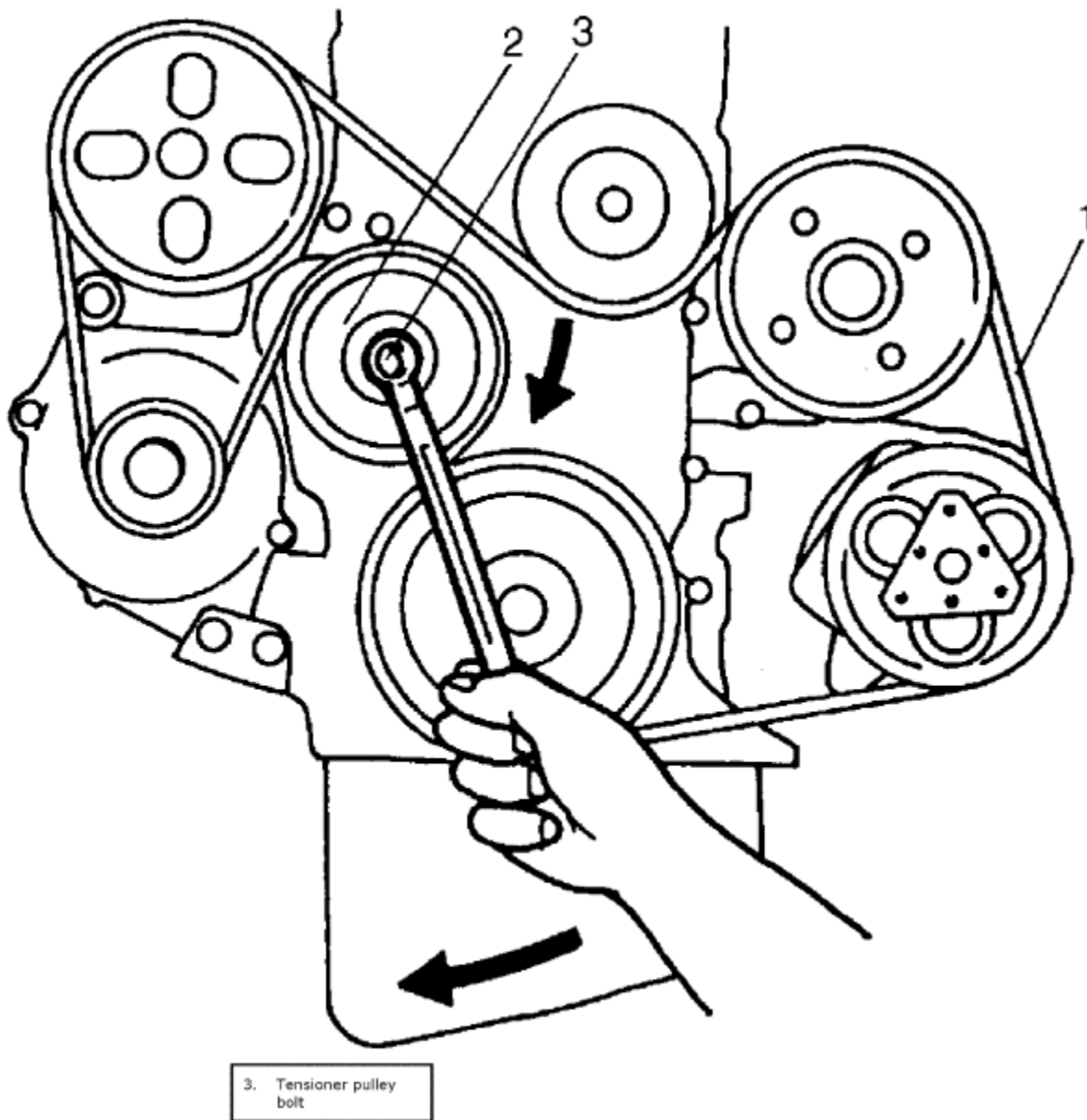


## Water Pump and Generator Drive Belt Removal and Installation

### Removal

**WARNING: Disconnect negative (-) cable at battery before removing and installing generator belt.**

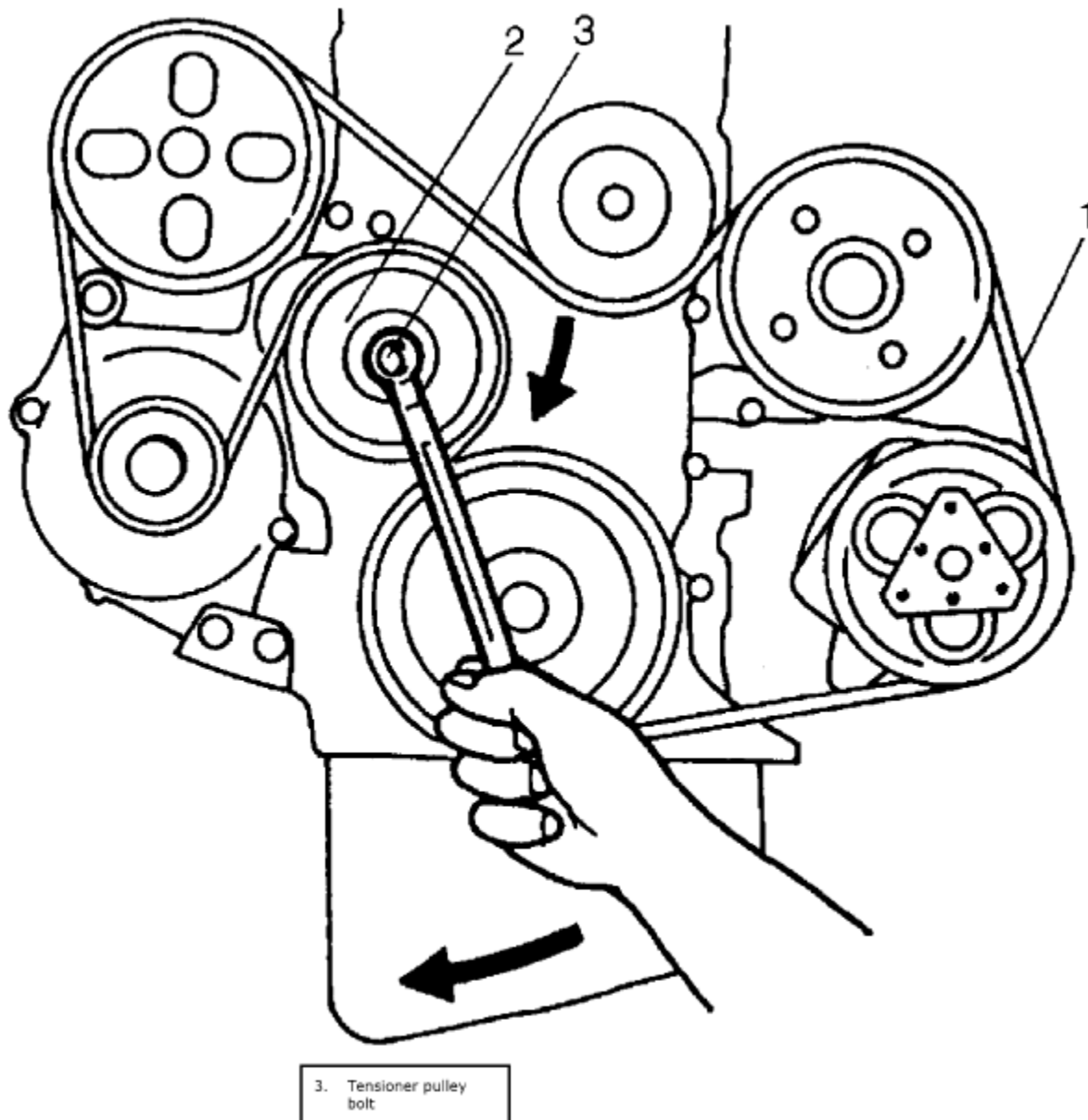
1. Hoist vehicle.
2. Remove right side engine under cover.
3. Loosen tensioner by turning the tensioner pulley (2) clockwise.



4. While holding the tensioner and belt loose, remove generator belt (1).

### Installation

1. Loosen tensioner by turning the tensioner pulley (2) clockwise.
2. While holding the tensioner, install generator belt (1).



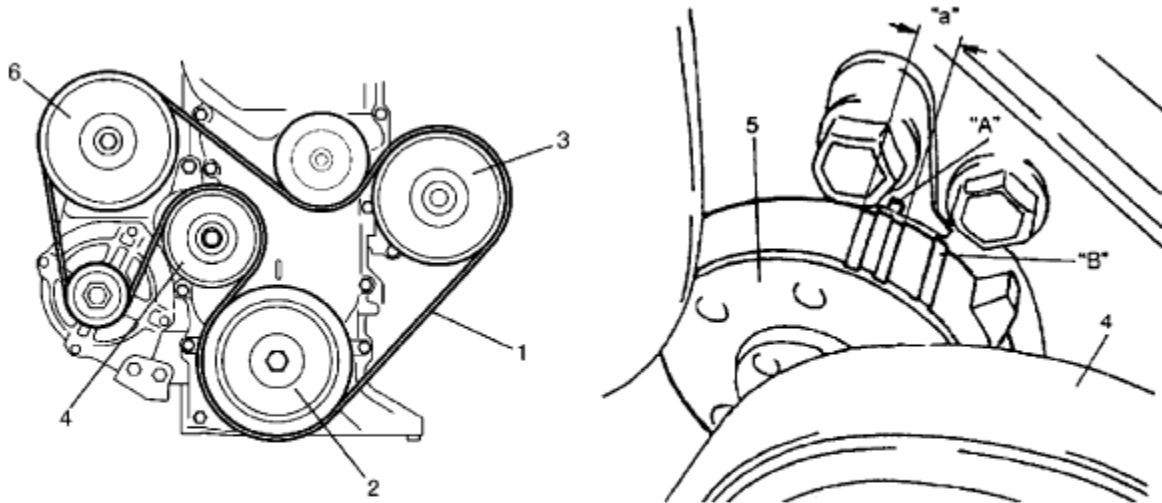
3. Install right side engine under cover.

**NOTE:**

- Make sure that the belt fits each pulley's groove properly.
- After installing generator belt, make sure that tension indicator is within standard range referring to Water Pump and Generator Drive Belt On-Vehicle Inspection.

**Compressor Drive Belt Inspection and Adjustment**

- Inspect belt for cracks, cuts, deformation, wear and cleanliness. If any of these conditions are found, replace belt, referring to Water Pump and Generator Drive Belt Removal and Installation.
- Check to make sure that tension indicators are as follows in the figure by using mirror.
  - a. If the tension indicator "B" is found to the left of the indicator "A", replace the generator belt.



1. Water pump and generator drive belt	3. Water pump pulley	5. Tensioner
2. Crankshaft pulley	4. Tension pulley	6. Power steering pump pulley

- b. If new generator belt has been installed, indicator "A" should be within a of the figure. If isn't, it means that belt is not installed properly.

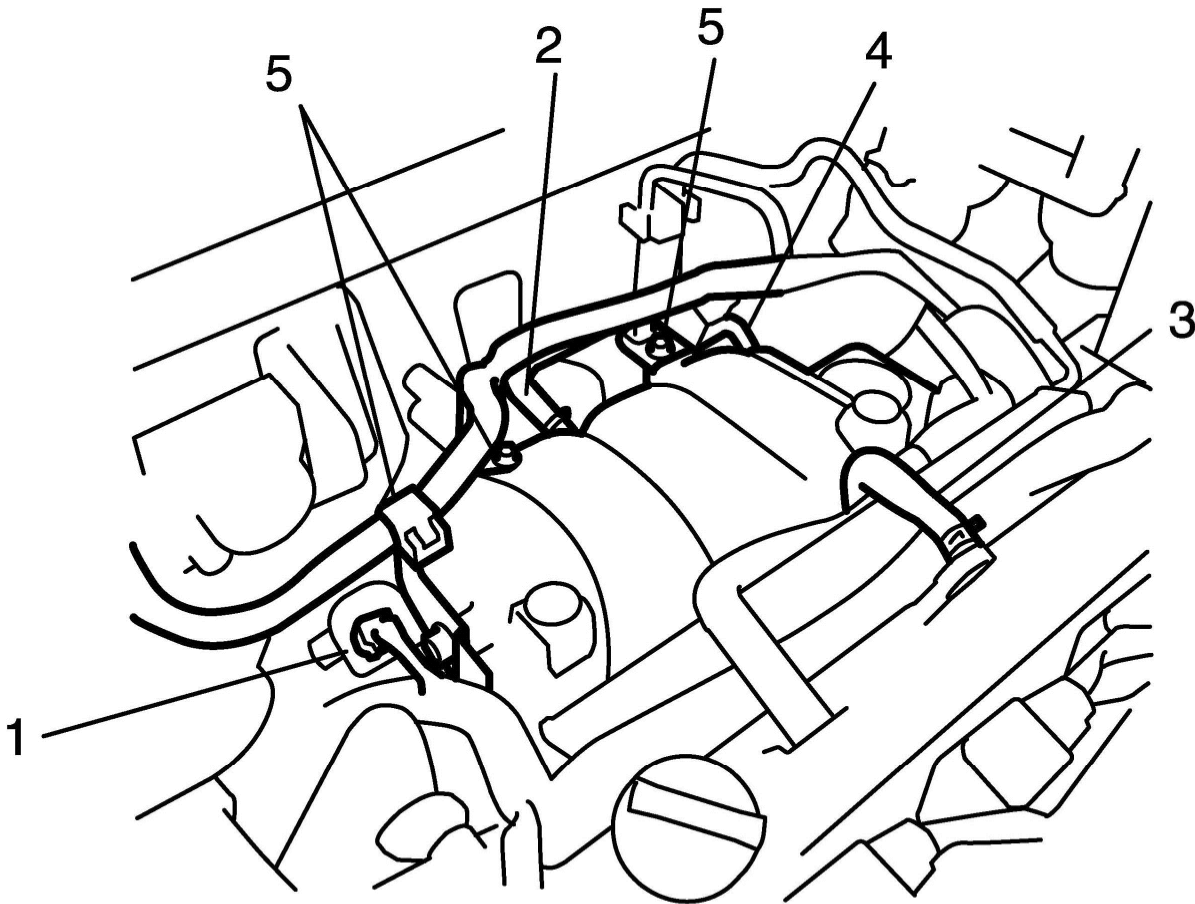
Reinstall it properly.

### Intake Manifold Removal and Installation

**CAUTION: Never disassemble intake manifold. Disassembly will spoil its original performance. If faulty condition is found, replace it with new one.**

#### Removal

1. Disconnect negative (-) cable at battery.
2. Drain cooling.
3. Remove electric throttle body assembly.
4. Disconnect the following electric lead wires:
  - IMT connector (1)
5. Disconnect the following hoses:
  - Brake booster hose (2) from intake manifold
  - PCV hose (3) from PCV valve
  - Vacuum hose (4) from EVAP canister purge valve
  - Breather hose from intake manifold
6. Remove harness brackets (5) from intake manifold.



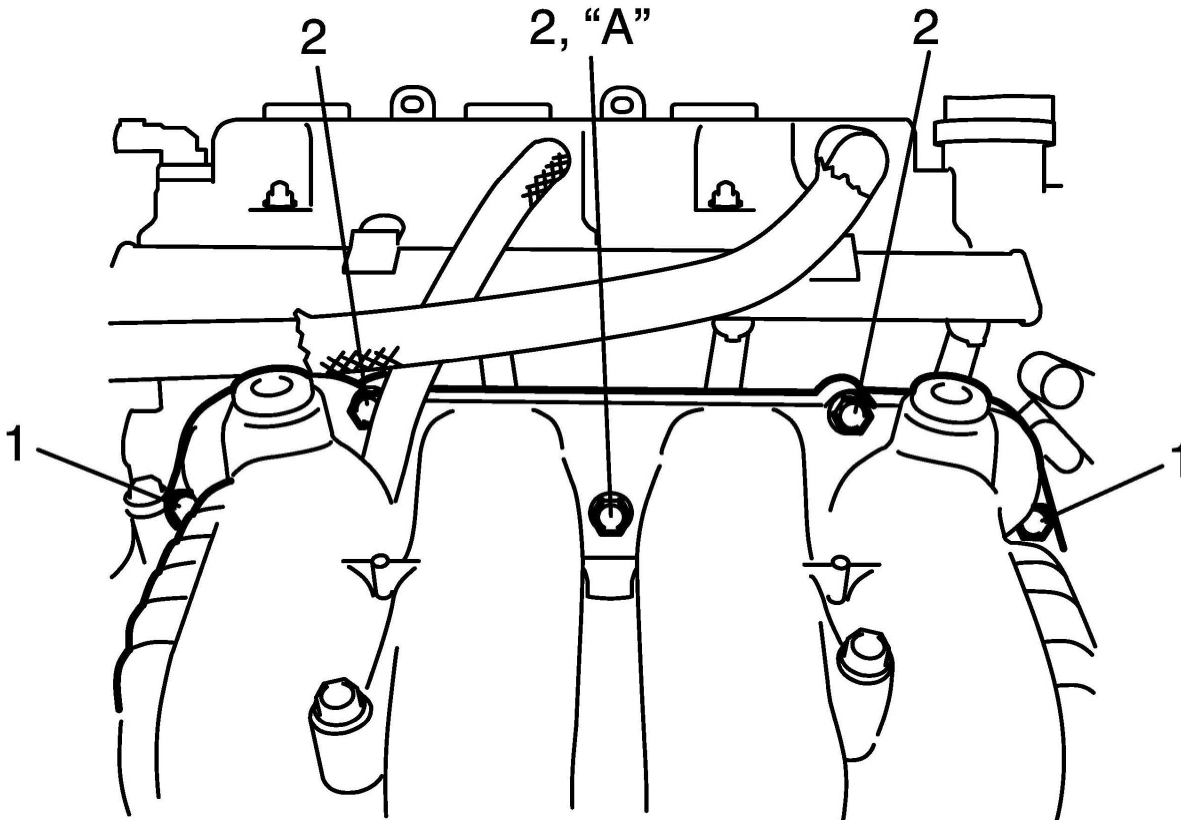
7. Remove intake manifold and O-ring from cylinder head.

### **Installation**

Reverse removal procedure for installation noting the followings.

- Use new intake manifold O-ring
- Install intake manifold bolts (2) and nuts (1) as shown in figure. Apply thread lock cement to intake manifold bolt.

"A": Thread lock cement 99000-32110 Thread Lock Cement Super 1322

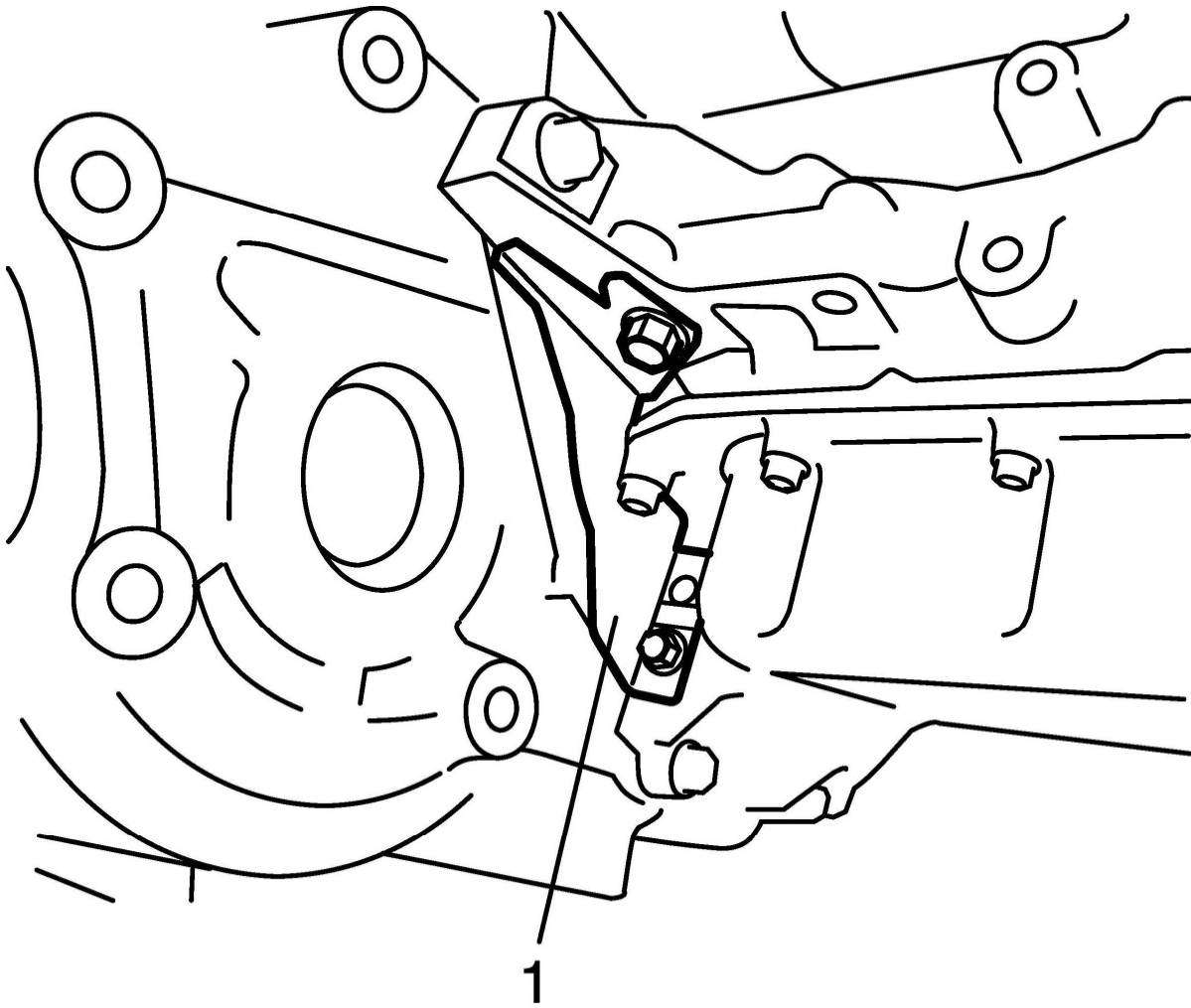


- Check to ensure that all removed parts are back in place. Reinstall any necessary parts which have not been reinstalled.
- Refill [cooling system](#).
- Upon completion of installation, turn ignition switch ON but engine OFF and check for fuel leaks.
- Finally, start engine and check for engine coolant leaks.

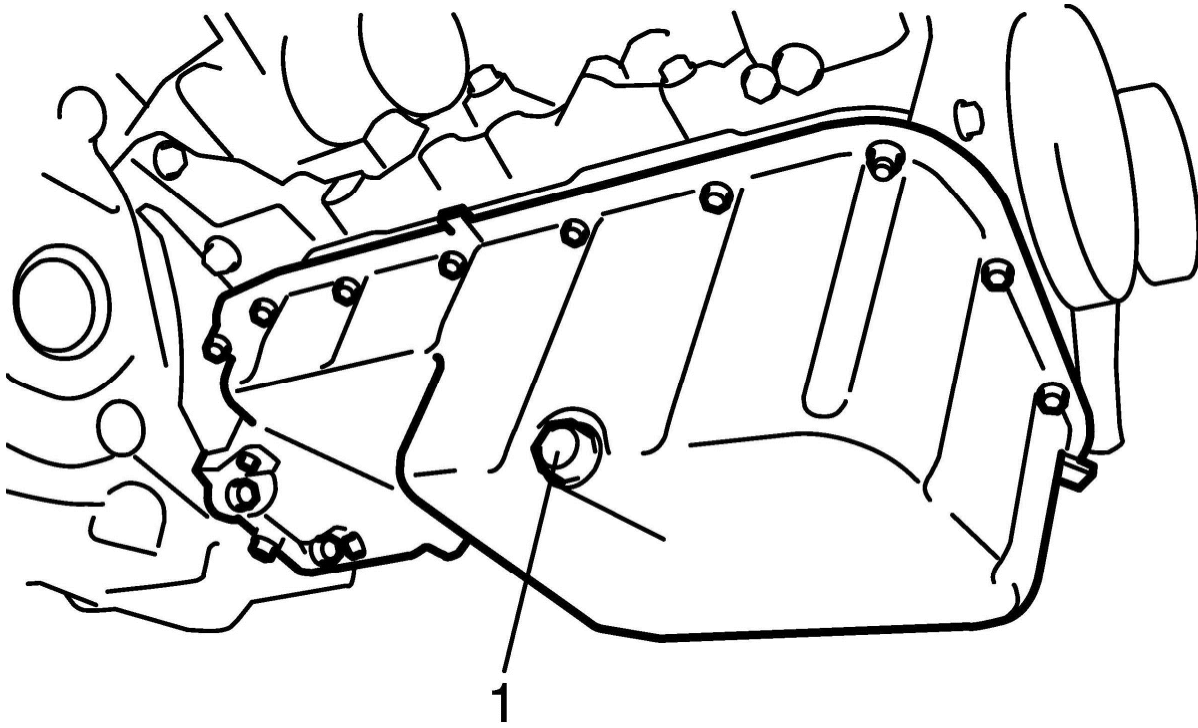
### Oil Pan and [Oil Pump](#) Strainer Removal and Installation

#### Removal

1. Remove oil level gauge.
2. Raise vehicle.
3. Remove engine under cover.
4. Remove exhaust No. 1 pipe.
5. Remove transfer.
6. Remove clutch housing plate (1).



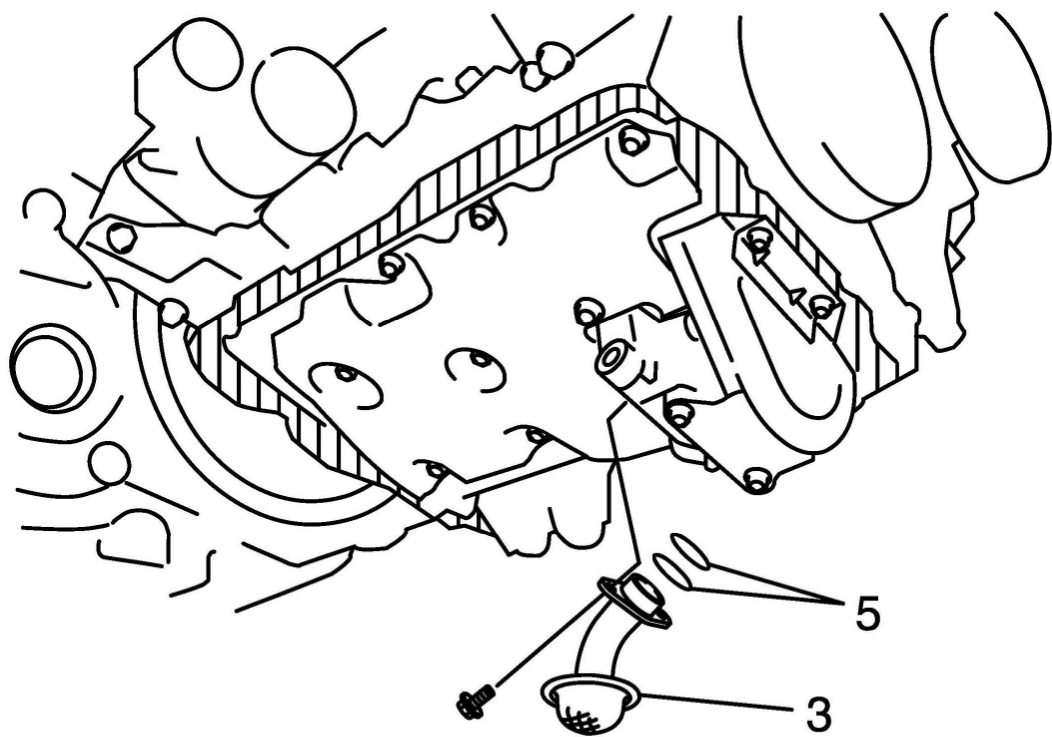
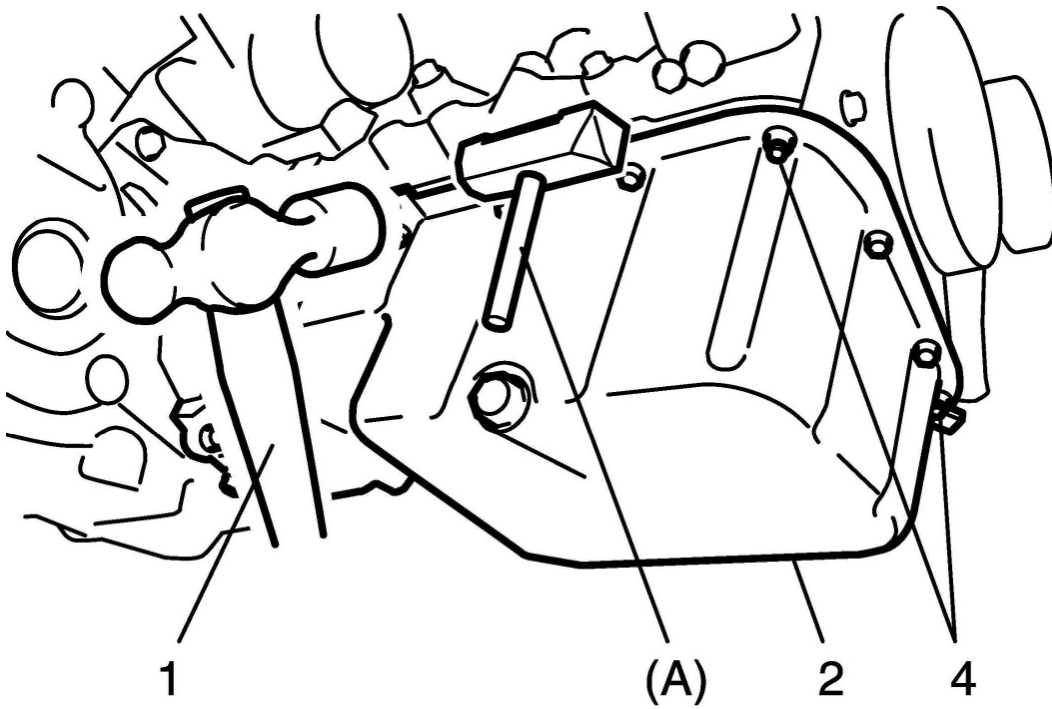
7. Drain engine oil by removing drain plug (1).



8. Cut sealant at hatched part shown in the figure using special tool and hammer (1). Special Tool (A):09921-96510

**NOTE:** Be careful not to damage stud bolt (4) between oil pan and crankcase when cutting sealant.

9. Remove oil pan (2), [oil pump](#) strainer (3) and O-rings (5) from lower crankcase.

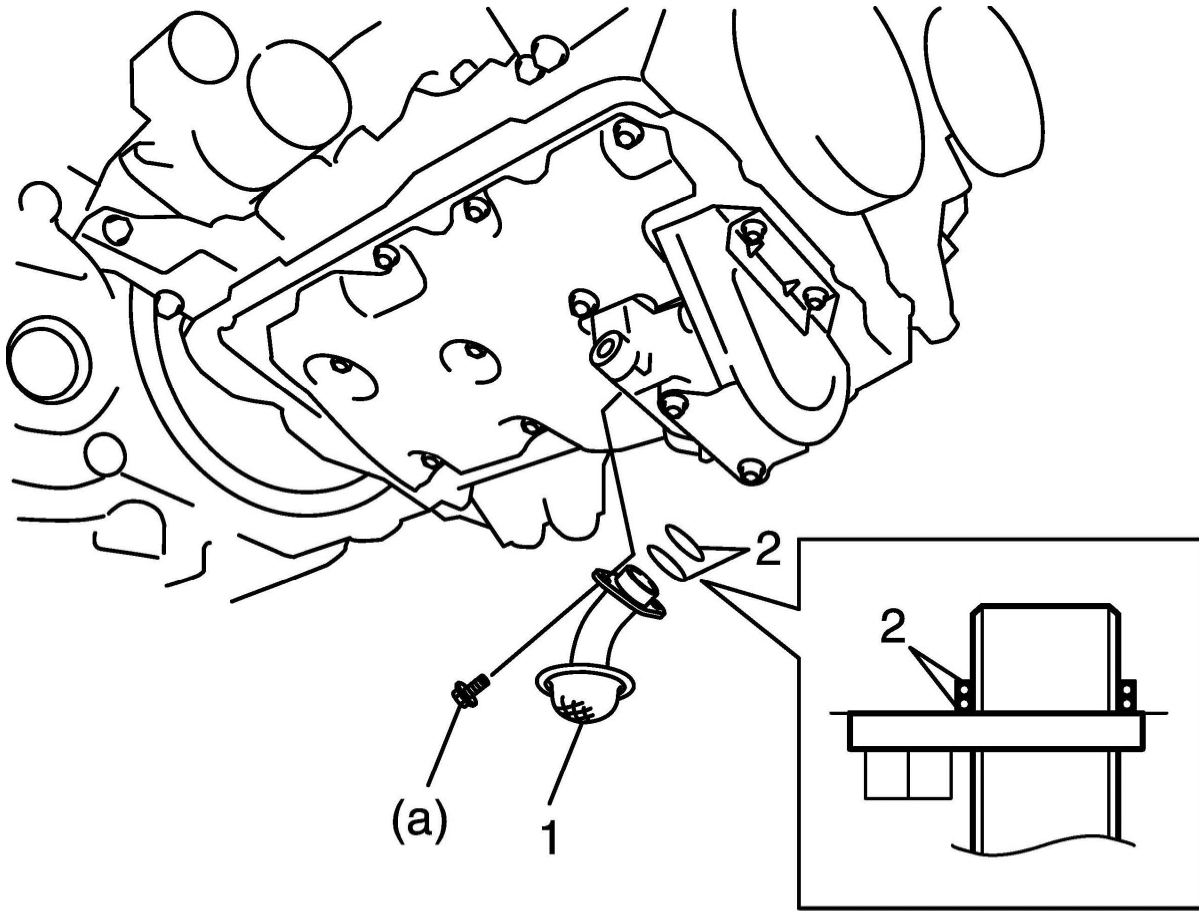


## Installation

1. Install new O-rings (2) to [oil pump](#) strainer (1) securely as shown in figure. Tighten strainer bolts to specified torque.

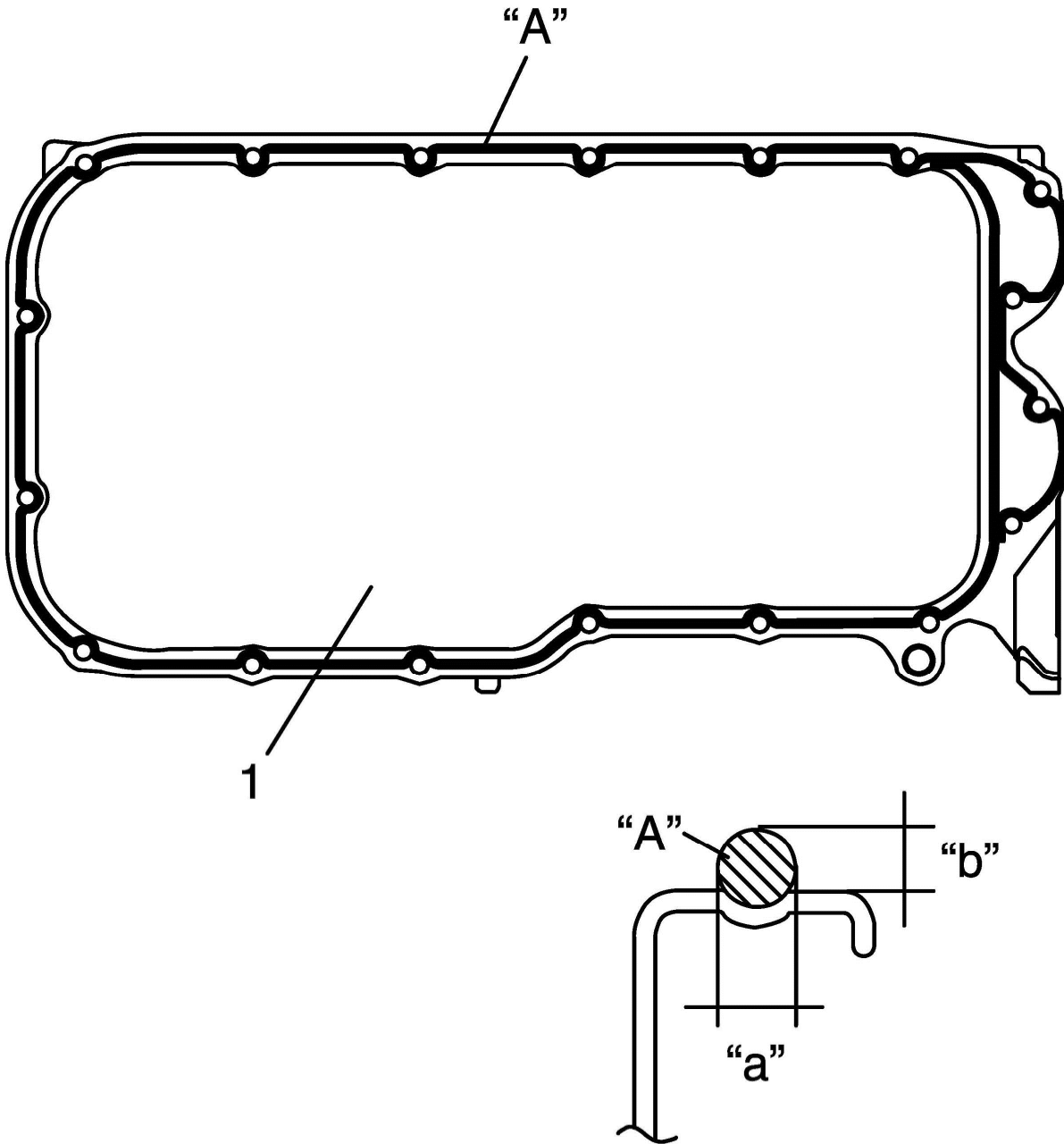
Tightening torque

[Oil pump](#) strainer bolt a: 11 Nm (1.1 kgf-m, 8.0 ft. lbs.)



2. Apply sealant to oil pan (1) mating surface continuously as shown in figure. "A": Sealant 99000-31260SUZUKI Bond No.1217G

Sealant amount for oil pan  
Width "a": **2 mm (0.08 in.)**  
Height "b": **2 mm (0.08 in.)**



3. After fitting oil pan (1) to cylinder block, run in securing bolts and start tightening at the center move wrench outward, tightening one bolt at a time. Tighten bolts and nuts to specified torque.

Tightening torque

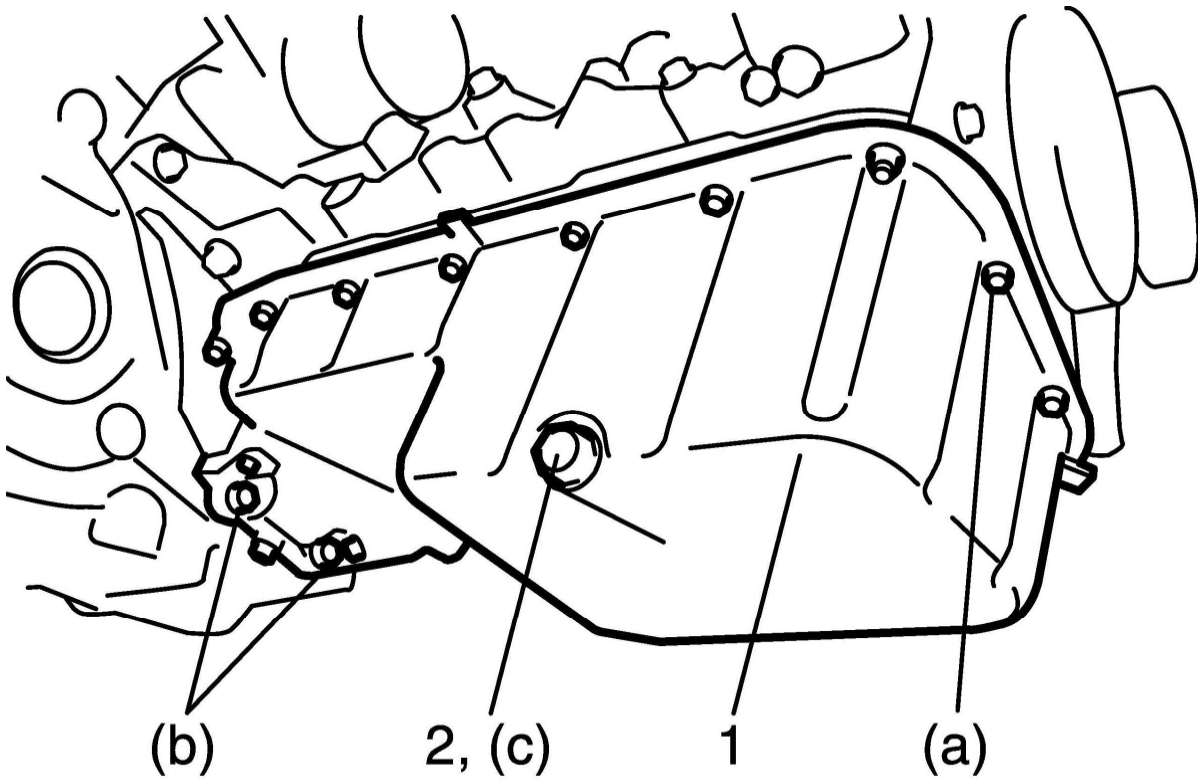
Oil pan bolt and nut a: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**

Transmission case No.1 bolt b: **55 Nm (5.5 kgf-m, 40.0 ft. lbs.)**

4. Install new gasket and drain plug (2) to oil pan after applying engine oil. Tighten drain plug to specified torque.

Tightening torque

Oil drain plug c: **35 Nm (3.5 kgf-m, 25.5 ft. lbs.)**

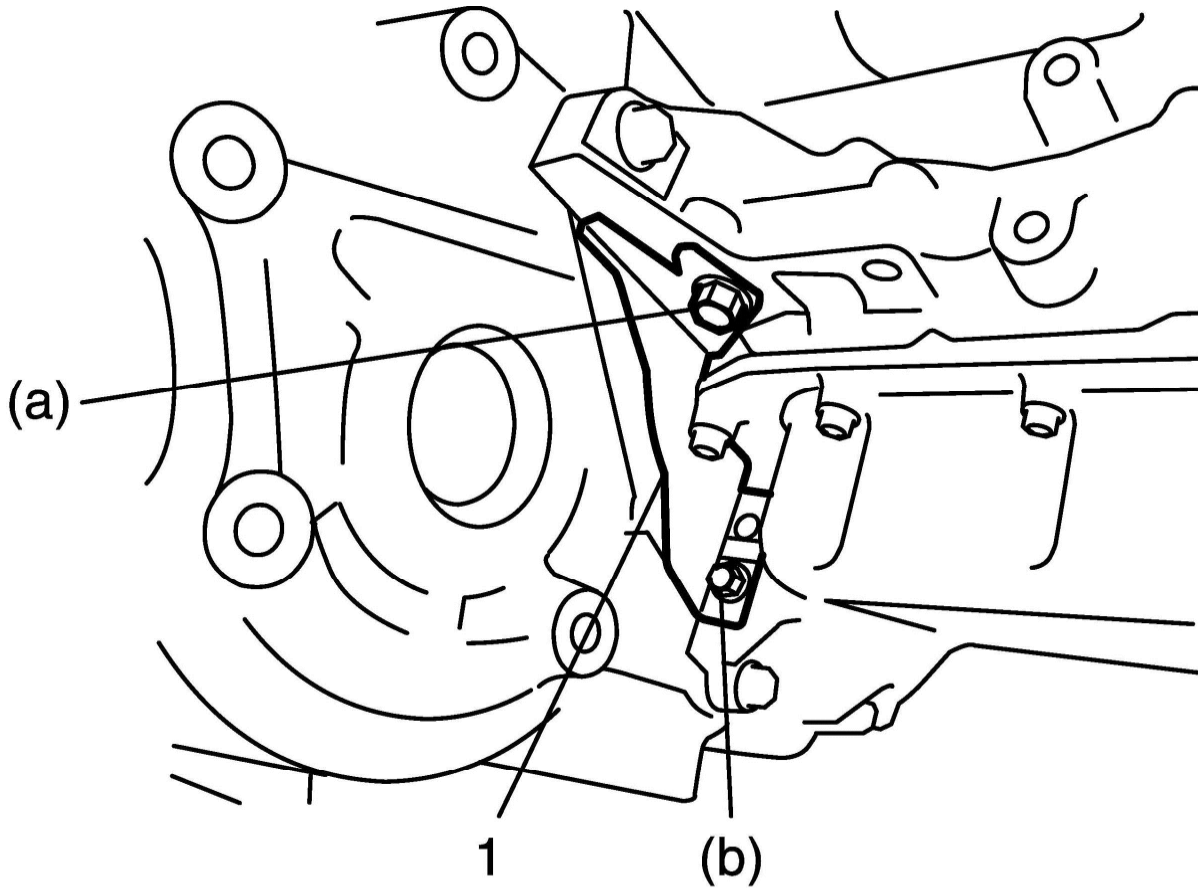


5. Install clutch housing plate (1). Tighten upper bolt first, then tighten lower bolt to specified torque.

Tightening torque

Clutch housing plate upper bolt a: **30 Nm (3.0 kgf-m 22.0 ft. lbs.)**

Clutch housing plate lower bolt b: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**



6. Install transfer.
7. Install exhaust No. 1 pipe.
8. Install engine under cover.
9. Install oil level gauge. 10) Refill engine with engine oil.

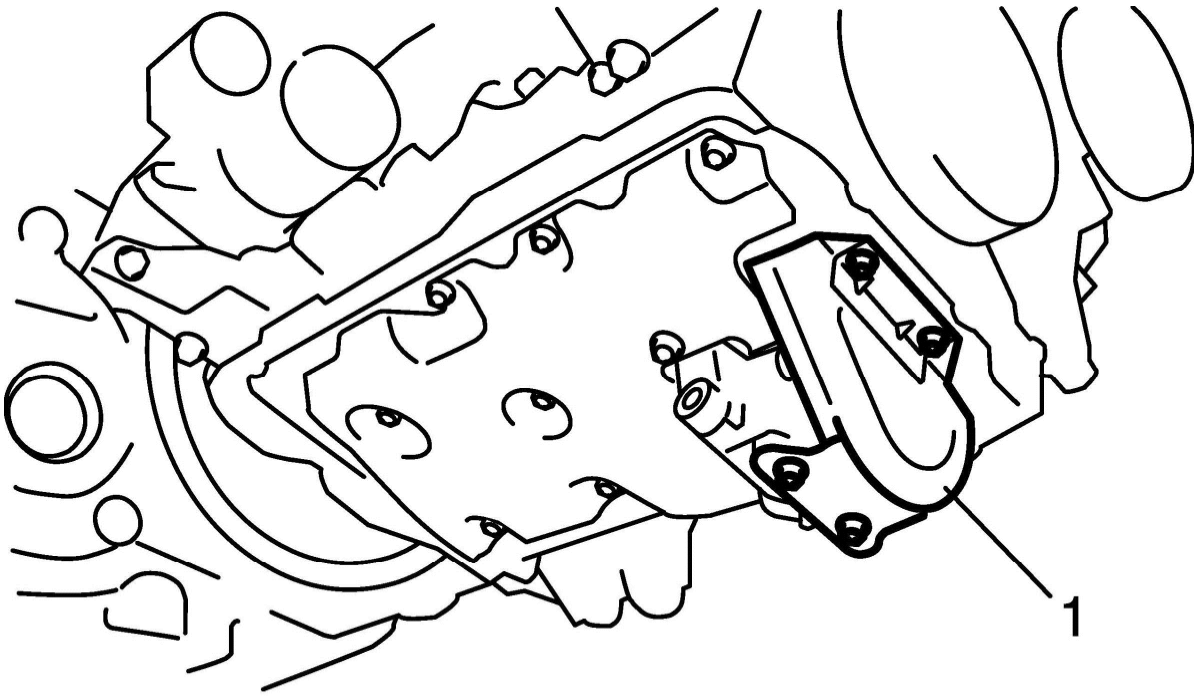
### **Oil Pump Removal and Installation**

**CAUTION: Don't remove sprocket and inner rotor from oil pump, otherwise damage of oil pump center shaft and abnormal operation of oil pump could result.**

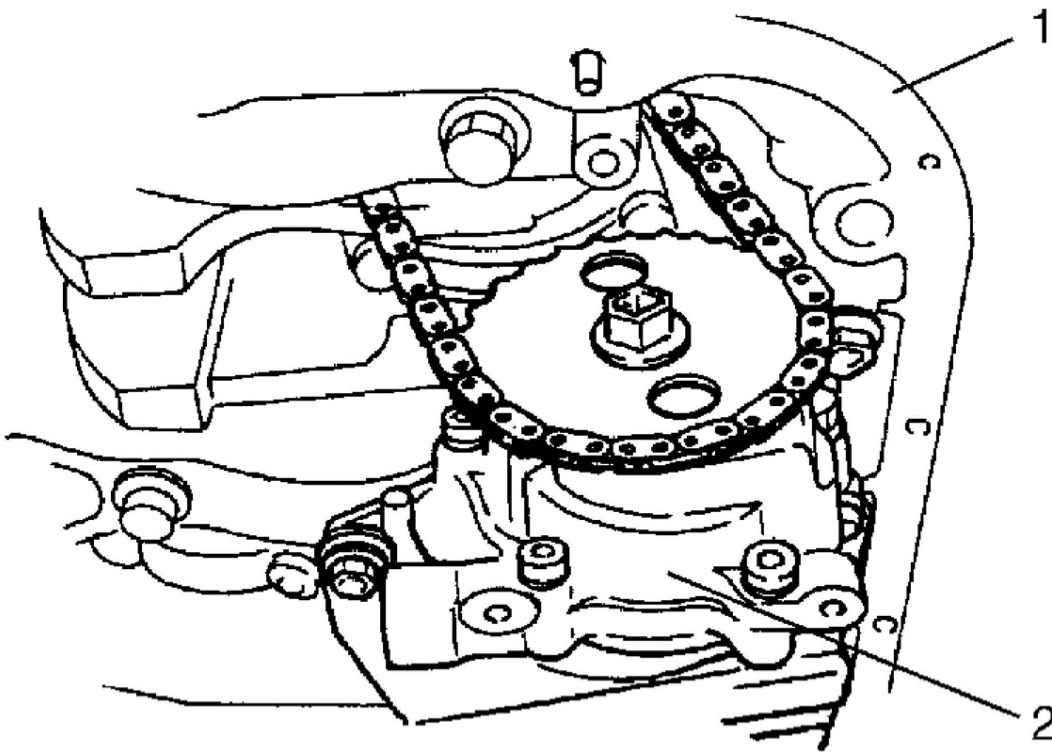
Reference: Oil Pump Components

#### **Removal**

1. Disconnect negative (-) cable at battery.
2. Drain engine oil.
3. Remove [oil pan](#) and oil pump strainer.
4. Remove baffle plate from lower crank case (1).
5. Remove oil pump chain guide.
6. Remove oil pump sprocket cover (1).



7. Remove oil pump (2) with sprocket from lower crank case (1).



**Installation**

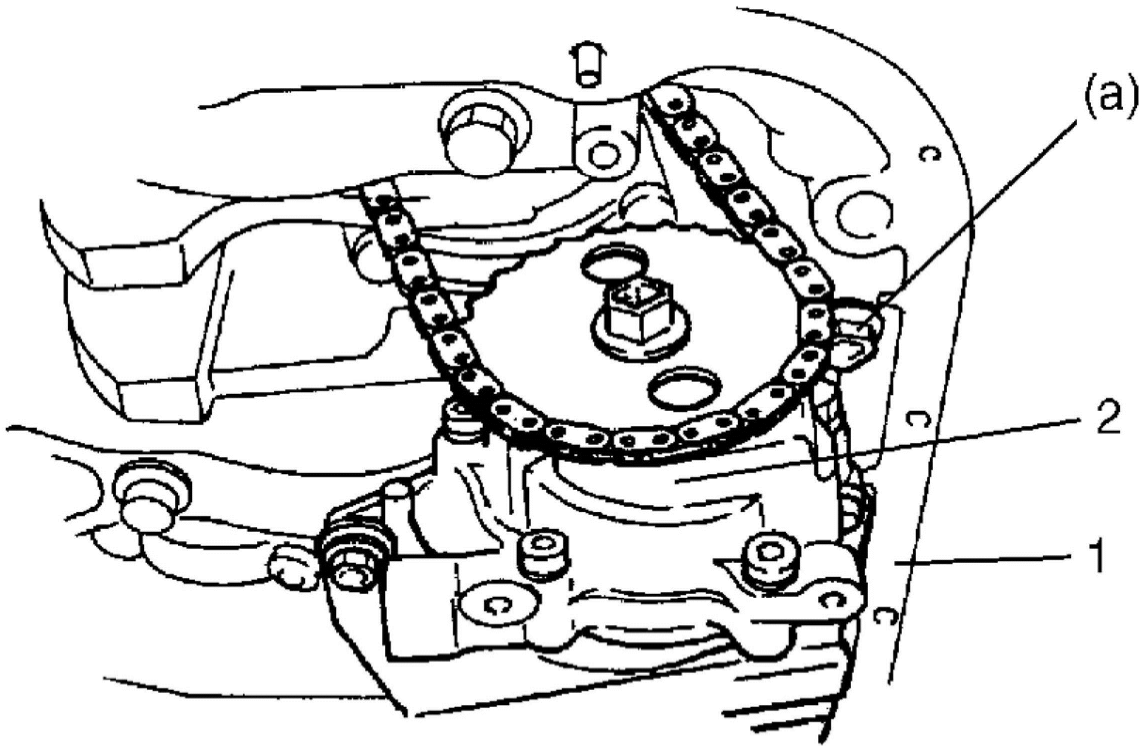
1. Install oil pump (2) and baffle plate to lower crank case (1) and tighten bolts to specified torque.

**NOTE:** When installing oil pump, be careful not to allow pins to fall off.

Tightening torque

Oil pump mounting bolt (M8 bolt) a: **25 Nm (2.5 kgf-m, 18.0 ft. lbs.)**

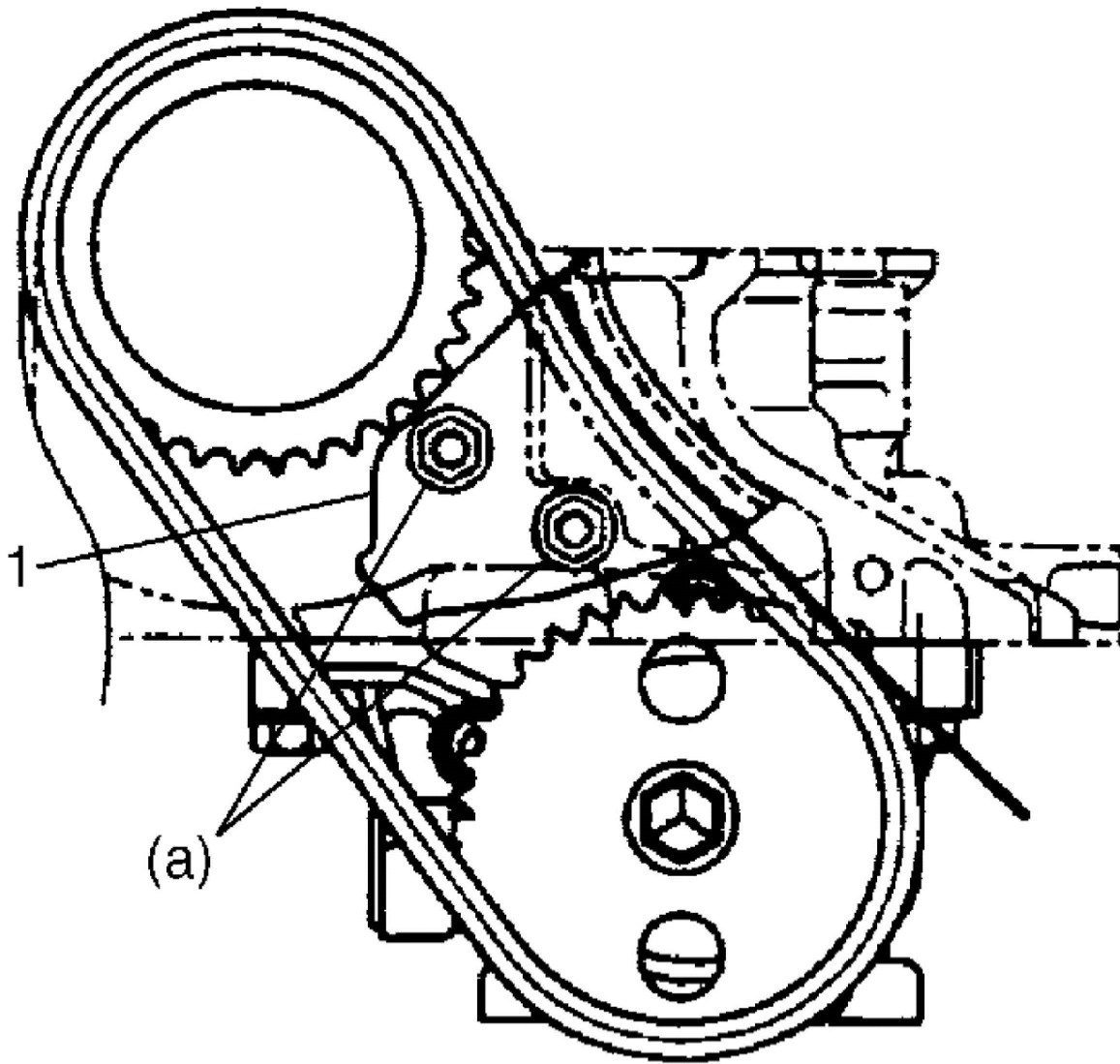
Baffle plate bolt (M6 bolt): **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**



2. Install oil pump chain guide (1), and tighten bolts to specified torque.

Tightening torque

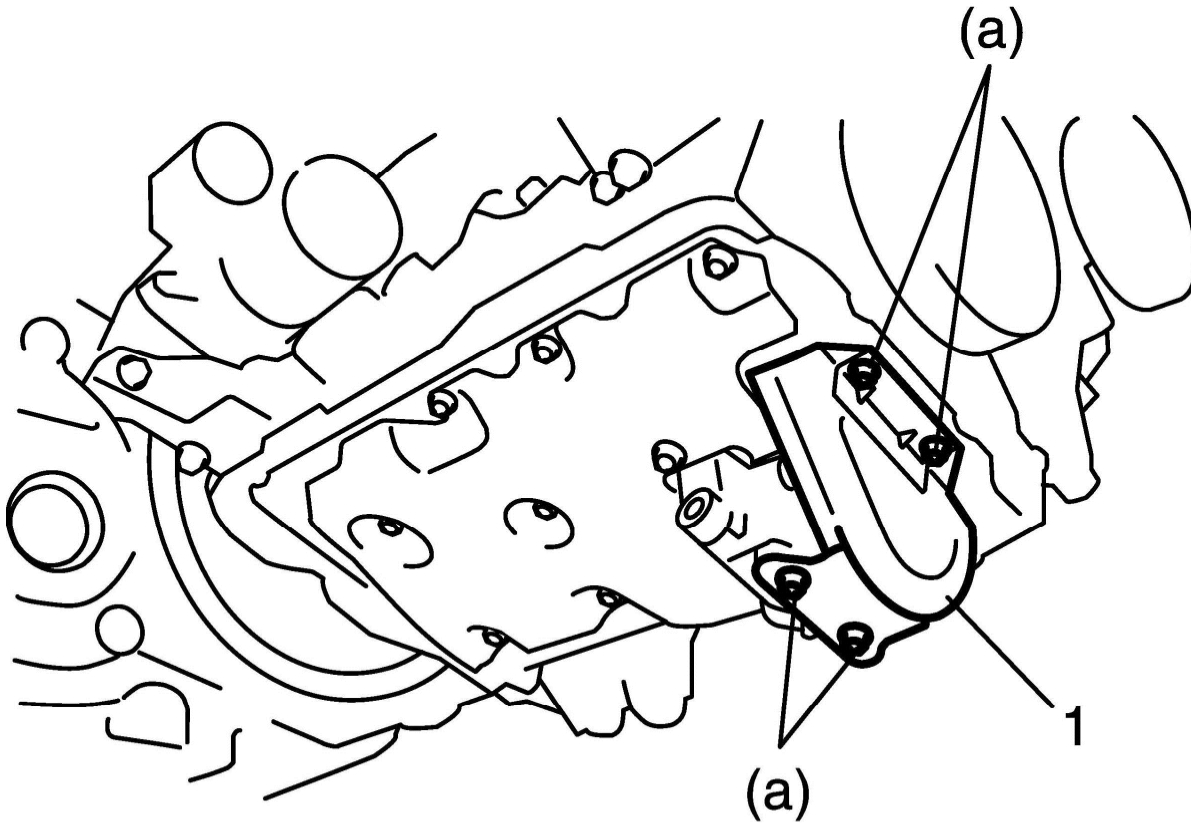
Oil pump chain guide nut a: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**



3. Install oil pump sprocket cover (1), and tighten bolts to specified torque.

Tightening torque

Oil pump sprocket cover bolt a: **11 Nm (1.1 kgf-m, 8.0 ft. lbs.)**



4. Install [oil pan](#) and oil pump strainer.
5. Refill engine with engine oil.
6. Connect negative cable at battery.
7. After completing installation, check oil pressure by running engine.

### Oil Pump Disassembly and Reassembly

**CAUTION: Don't remove sprocket and inner rotor from oil pump, otherwise damage of oil pump center shaft and abnormal operation of oil pump could result.**

#### Disassembly

- Disassemble oil pump.

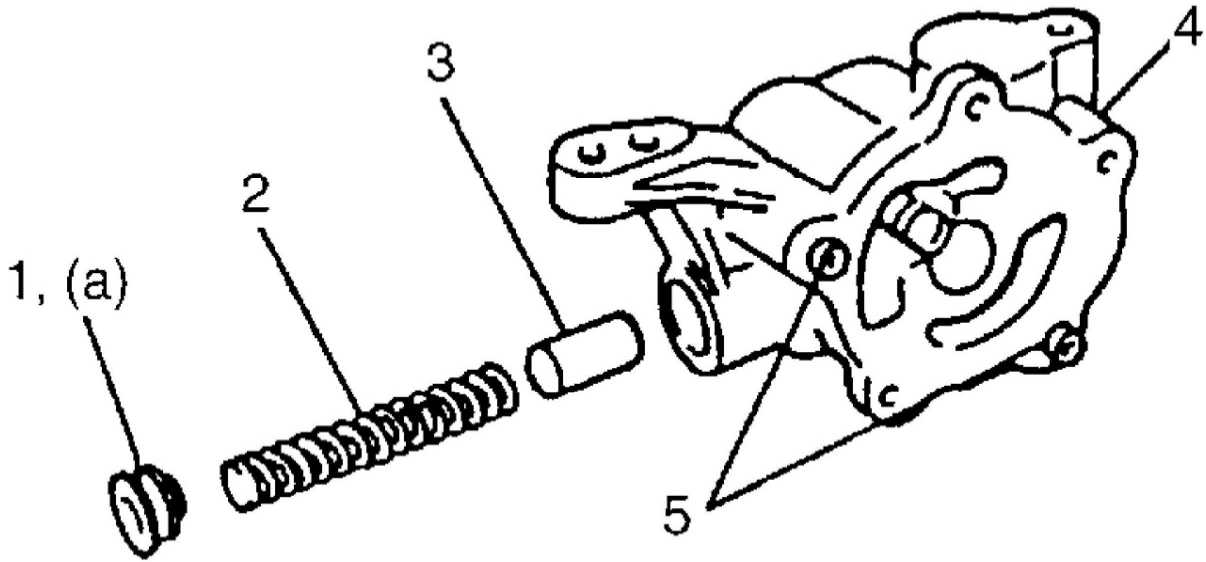
#### Reassembly

1. Wash, clean and then dry all disassembled parts.
2. Apply thin coat of engine oil to inner and outer rotors, and inside surfaces of oil pump case.
3. Install outer rotor to pump case No. 1.
4. Install relief valve (3), relief spring (2) and retainer (1) to oil pump case No.2 (4). Tighten retainer to specified torque.

Tightening torque

Oil pump relief valve retainer a: **28 Nm (2.8 kgf-m, 20.5 ft. lbs.)**

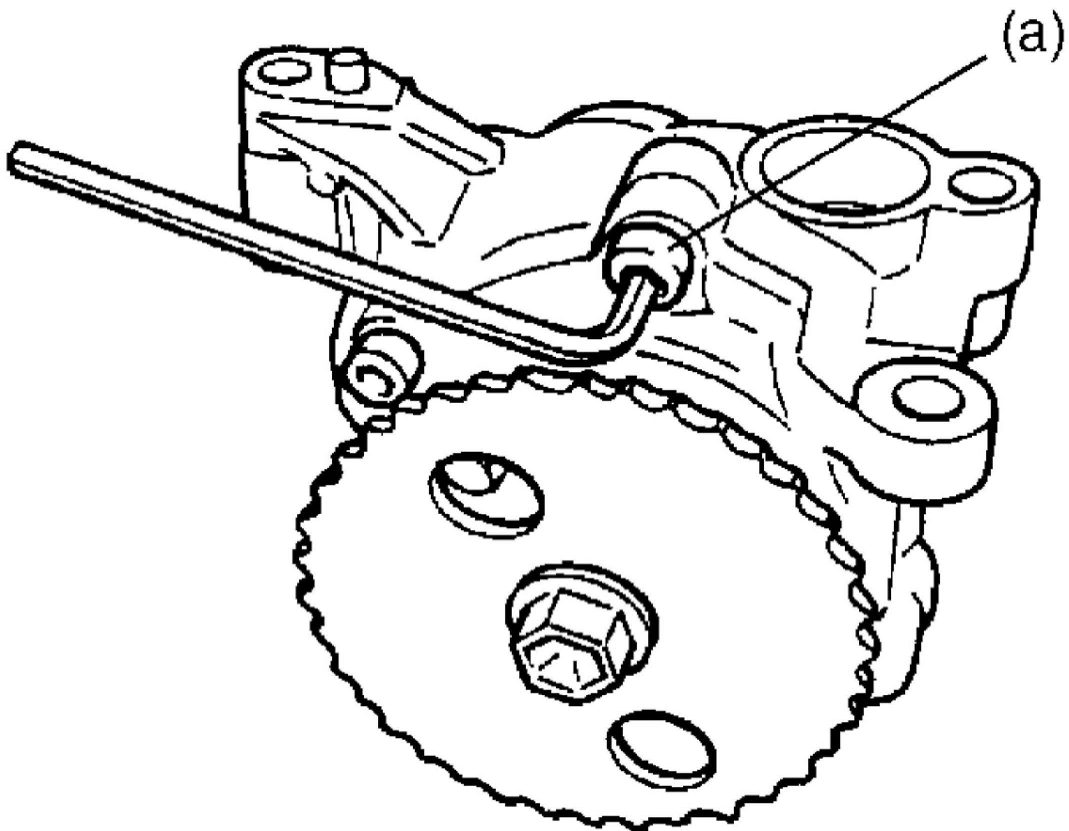
5. Install oil pump case pins (5) to oil pump case No.2.



6. Assemble oil pump. After assembling oil pump, check to be sure that rotor turns smoothly by hand.

Tightening torque

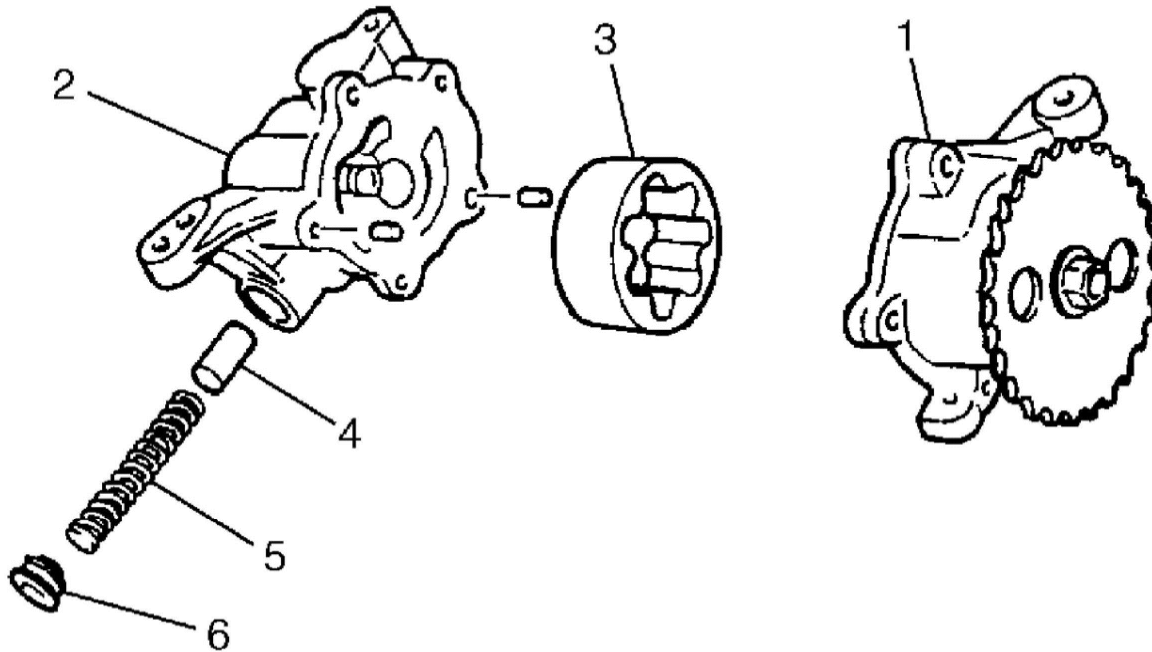
Oil pump case bolt a: 12 Nm (1.2 kgf-m, 9.0 ft. lbs.)



## Oil Pump Inspection

### Visual Inspection

- Check outer rotor (3), inner rotor and oil pump cases (1), (2) for excessive wear or damage. If abnormal condition is found in above checks, replace oil pump assembly.
- Check relief valve (4) for excessive wear or damage. If abnormal condition is found in above checks, replace oil pump relief valve set.



5. Relief spring
6. Retainer

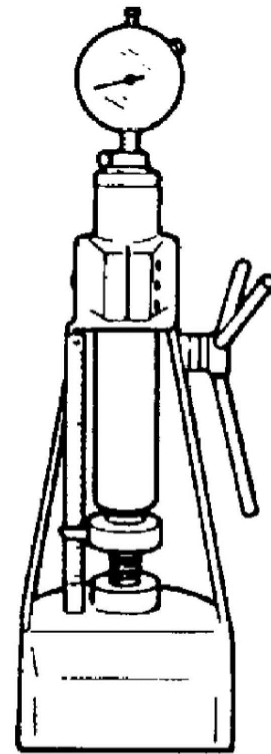
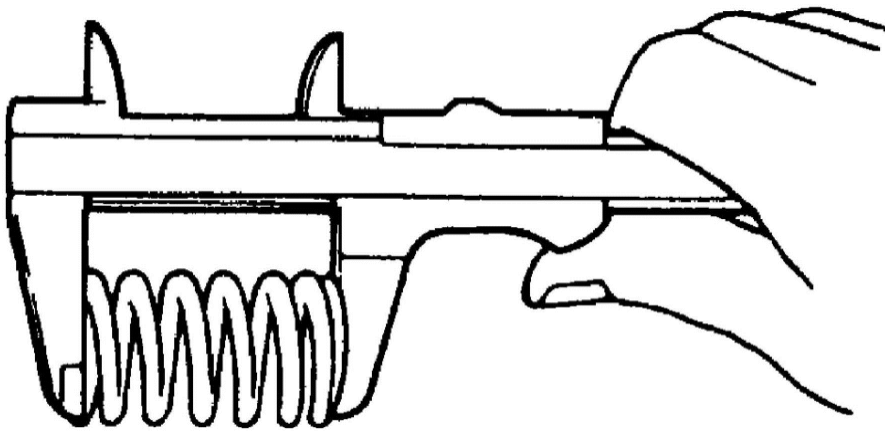
### Relief Valve Spring Free Length and Load

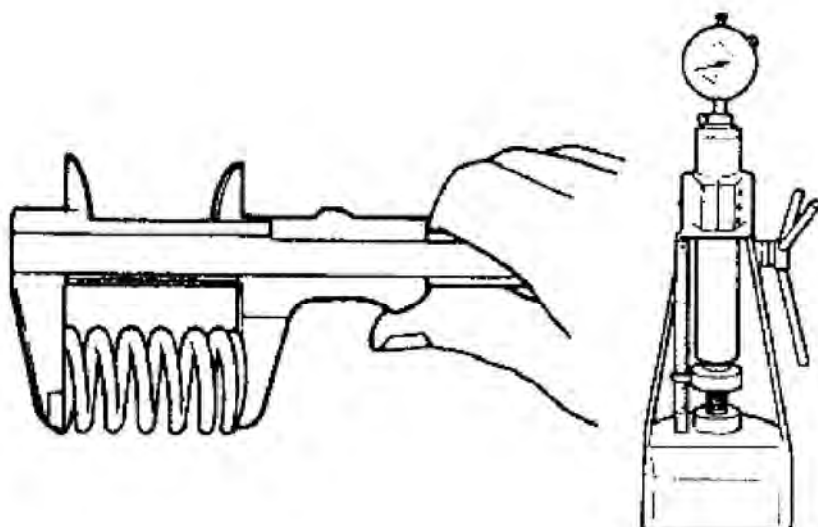
- Measure free length and tension of oil relief spring. If the measured values of length or tension is less than the specification, replace oil pump relief valve set.

### Oil relief spring

### Oil relief spring

Item	Standard
Spring free length	63.5 mm (2.5 in.)
Spring preload	85.0 N for 52.0 mm (8.5 kgf for 52.0 mm, 19.0 lb/2.05 in.)



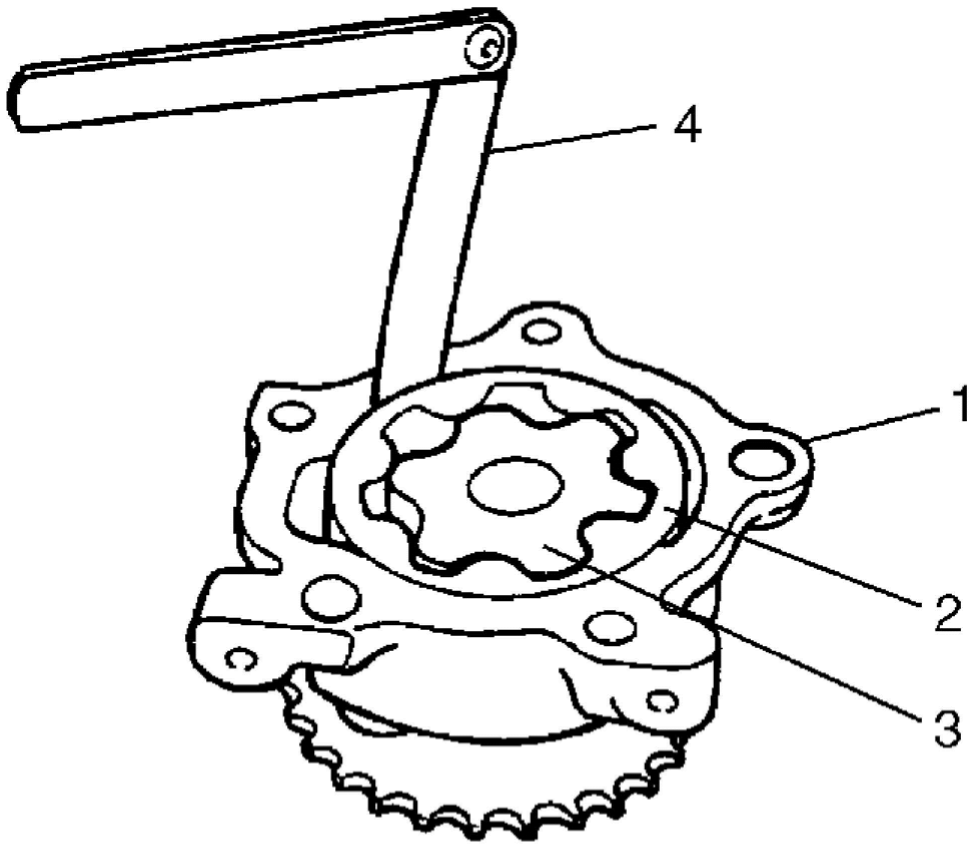


***Expand image***

### **Radial Clearance**

Check radial clearance between outer rotor (2) and case No. 1 (1), using thickness gauge (4). If clearance exceeds its limit, replace oil pump assembly.

Limit on radial clearance between outer rotor and case **0.20 mm (0.0079 in.)**

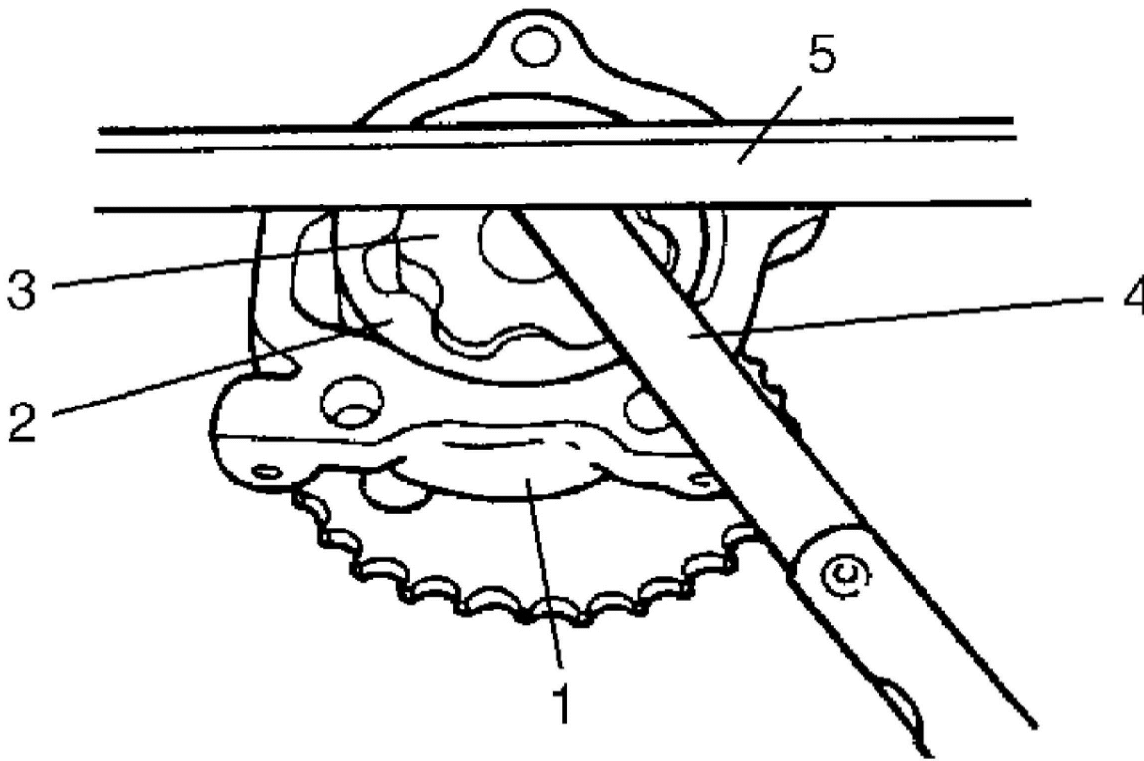


3. Inner rotor

**Side Clearance**

Using straightedge (5) and thickness gauge (4), measure side clearance. If side clearance exceeds its limit, replace oil pump assembly.

Limit on side clearance **0.11 mm (0.0043 in.)**



1. Oil pump case No.1	3. Inner rotor
2. Outer rotor	

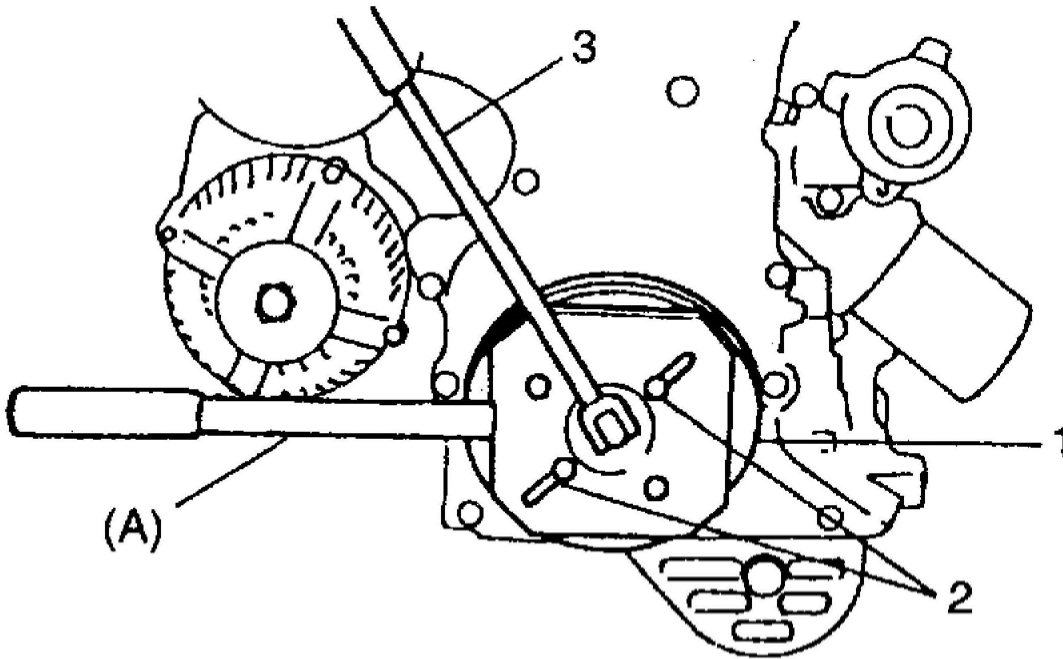
### Timing Chain Cover Removal and Installation

#### Removal

1. Remove engine assembly from vehicle.
2. Remove [oil pan](#).
3. Remove cylinder head cover.
4. Remove crankshaft pulley bolt. To lock crankshaft pulley (1), use special tool (camshaft pulley holder) as shown in figure.

Special Tool (A):09917-68221

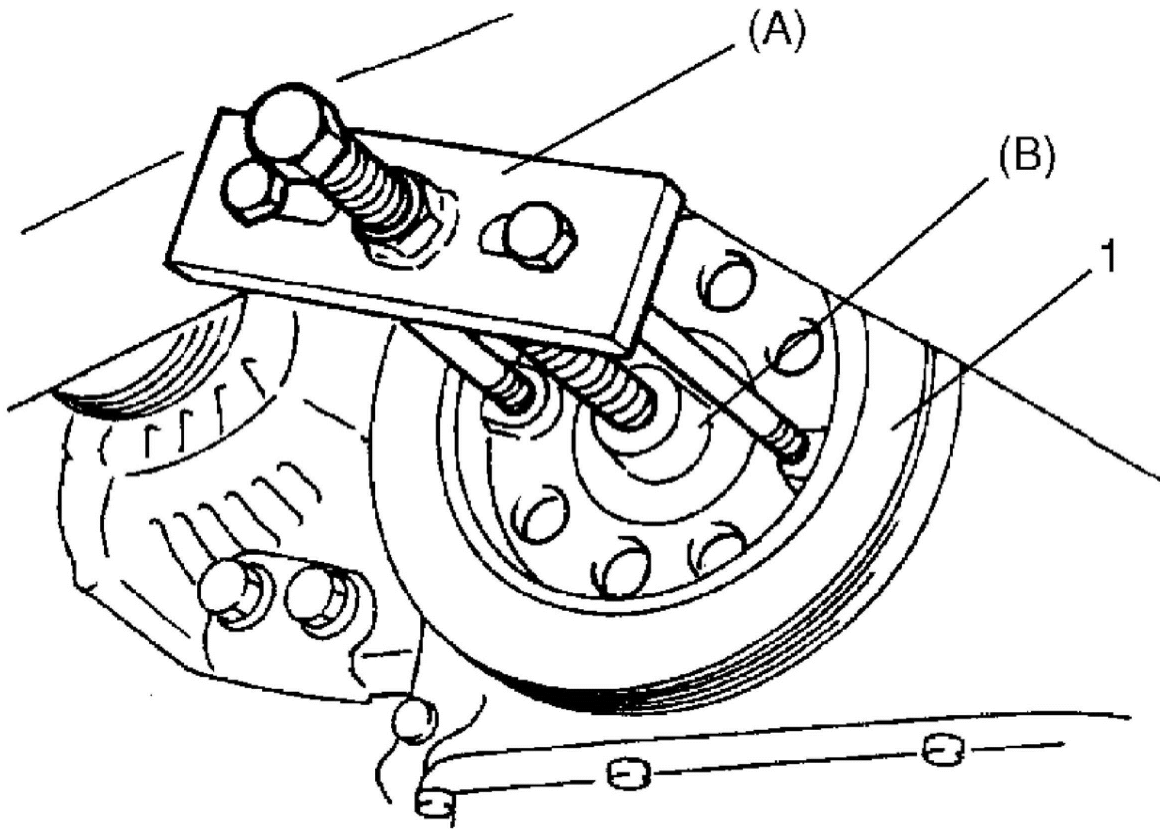
**NOTE:** Be sure to use the following bolts instead of pins in order to fix crankshaft pulley by special tool. Bolt size: M8, **P1.25 L = 25 mm (0.98 in.) Strength: 7T**



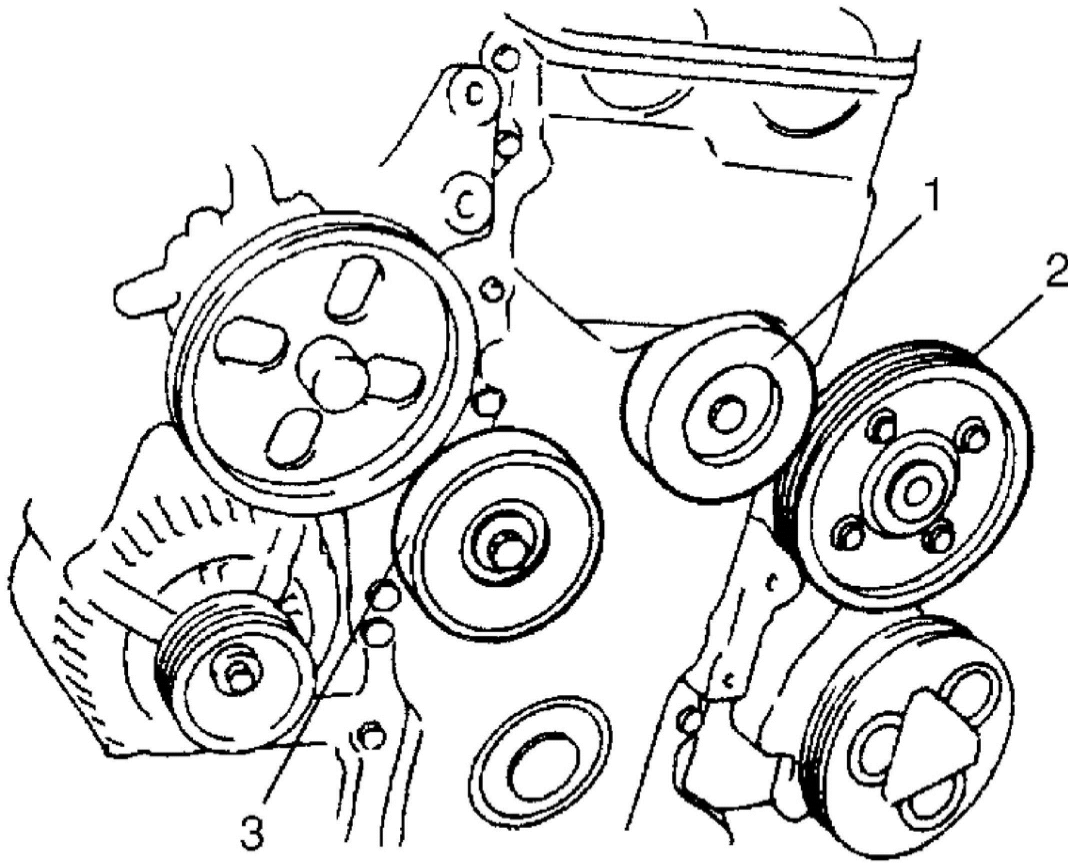
2. Bolt	3. Wrench
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5. Remove crankshaft pulley (1). To remove crankshaft pulley, use special tools (Steering wheel remover, Bearing puller attachment) with it as shown in figure.

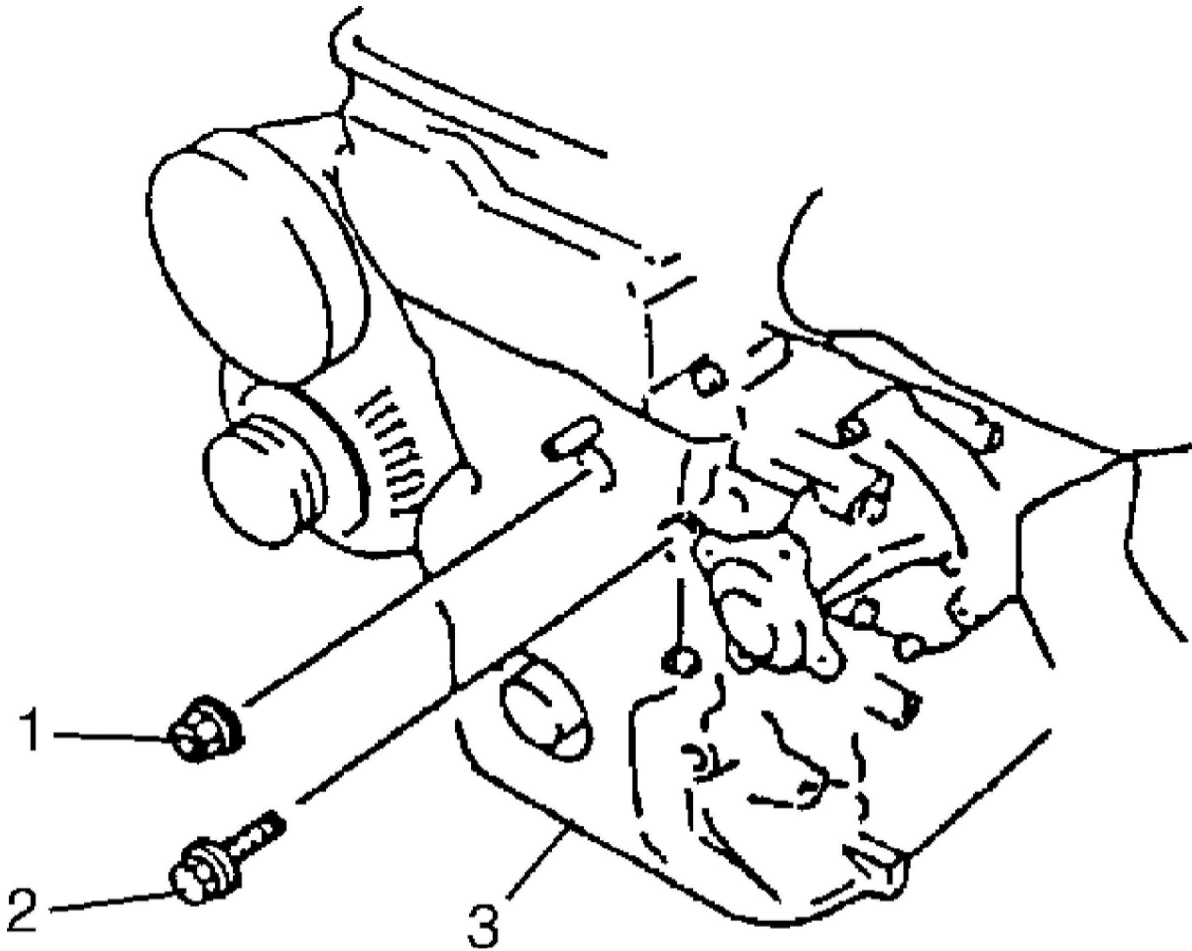
Special Tool  
(A):09944-36011  
(B):09926-58010



6. Remove idler pulley (1), water pump pulley (2) and belt tensioner (3).



7. Remove timing chain cover bolts (2) and nut (1).
8. Remove timing chain cover (3).

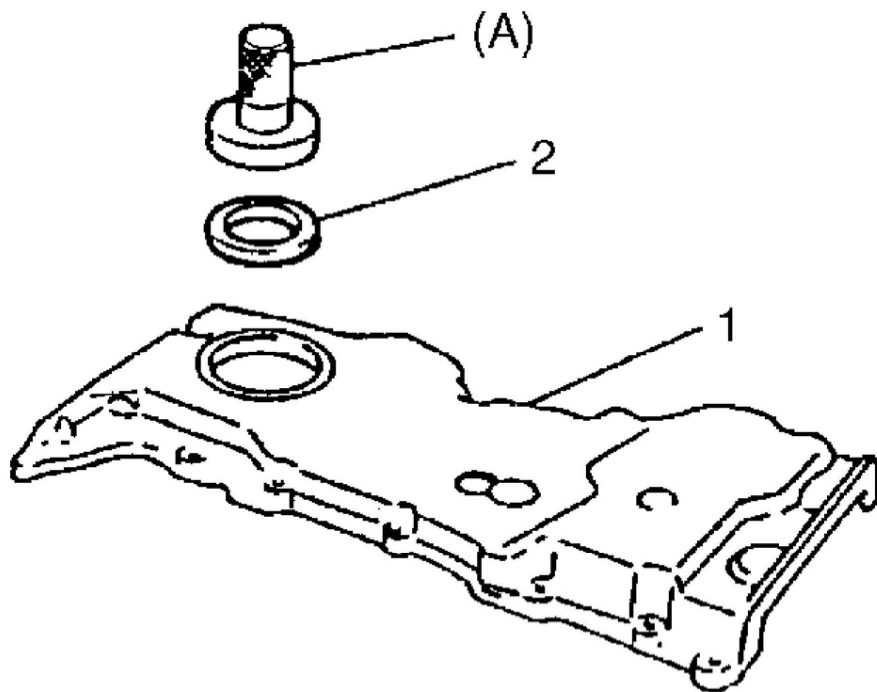


## Installation

1. Clean sealing surfaces on [timing chain](#) cover, cylinder block and cylinder head. Remove oil, old sealant and dust from sealing surface.
2. Install new oil seal (2) to [timing chain](#) cover using special tool, if removed.

**NOTE:** When installing new oil seal (2), drive it until its surface is flush with edge of [timing chain](#) cover (1).

**Special Tool (A):09913-75510**



3. Apply sealant "A" and "B" to specific area as shown in figure. "A": Sealant 99000-31260SUZUKI Bond No.1217G

"B": Water tight sealant 99000-31140SUZUKI Bond No.1207B

Sealant amount for [timing chain](#) cover

"a": 3 mm (0.12 in.)

"b": 2 mm (0.08 in.)

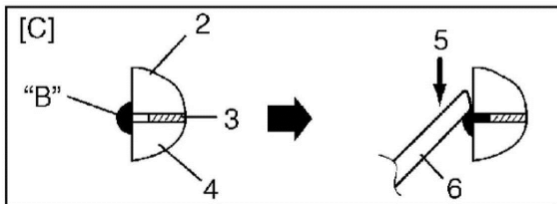
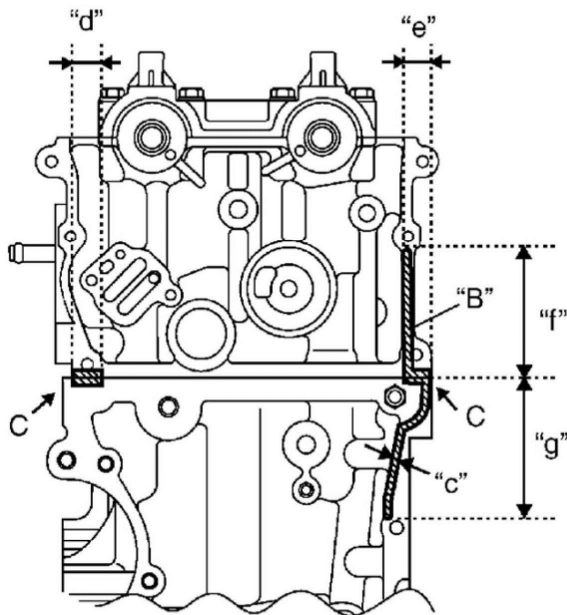
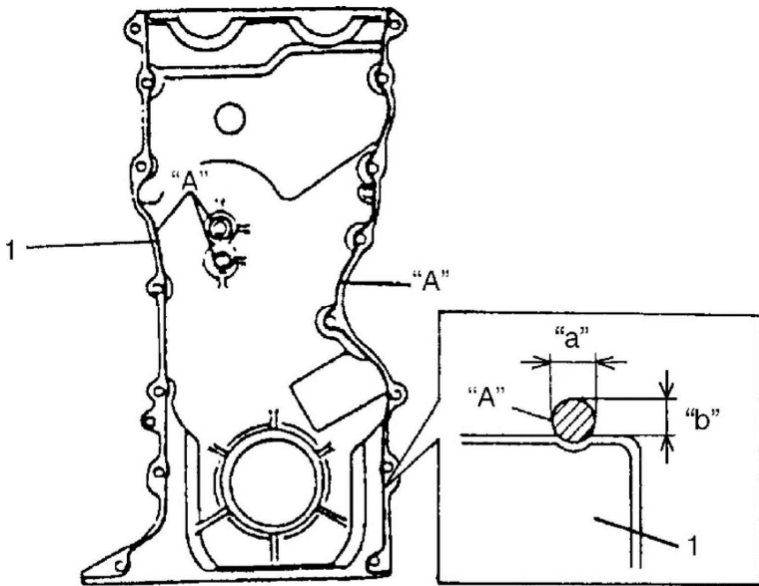
"c": 4 mm (0.16 in.)

"d" 16 mm (0.63 in.)

"e": 14 mm (0.55 in.)

"f": 65 mm (2.56 in.)

"g": 73 mm (2.87 in.)



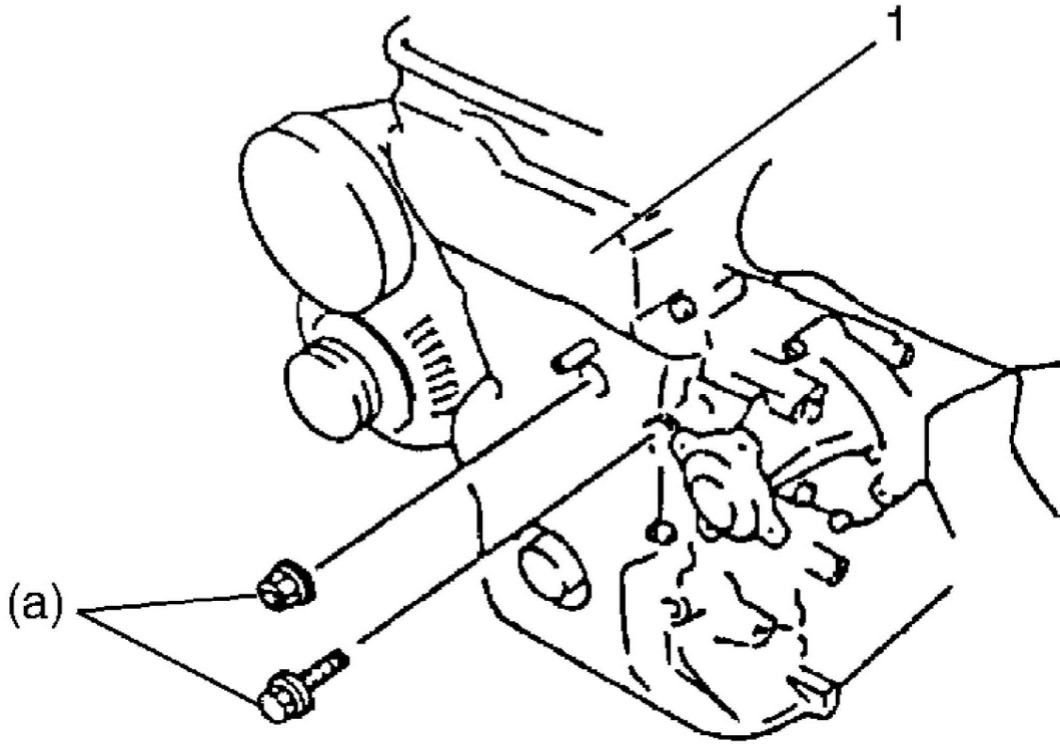
1. Timing chain cover	5. Rub into
2. Cylinder head	6. Jig
3. Cylinder head gasket	[C]: View C
4. Cylinder block	

4. 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 and nut a: 11 Nm (1.1 kgf-m, 8.0 ft. lbs.)



5. Install belt idler pulley (1). Tighten nut to specified torque.

Tightening torque

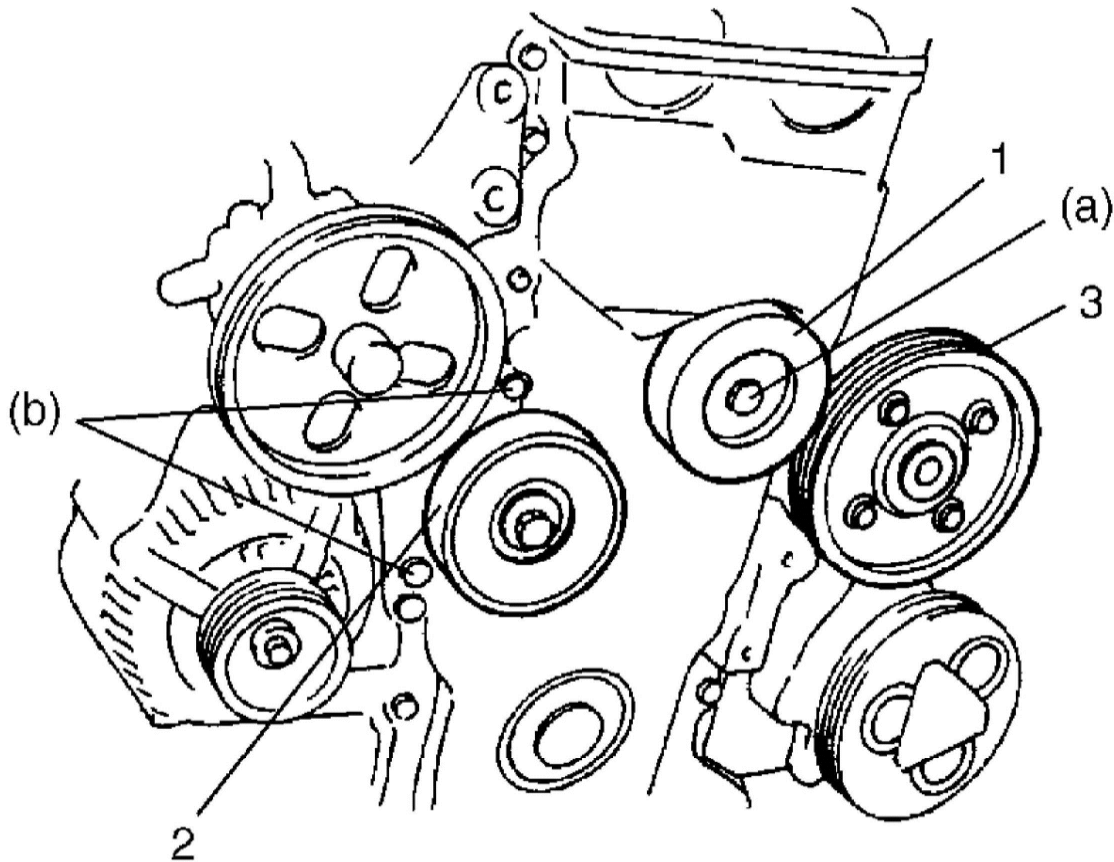
[Idler pulley](#) nut a: 42 Nm (4.2 kgf-m, 30.5 ft. lbs.)

6. Install belt tensioner (2). Tighten bolts to specified torque.

Tightening torque

Generator belt tensioner bolt b: 25 Nm (2.5 kgf-m, 18.5 ft. lbs.)

7. Install [water pump](#) pulley (3).



8. Install cylinder head cover.

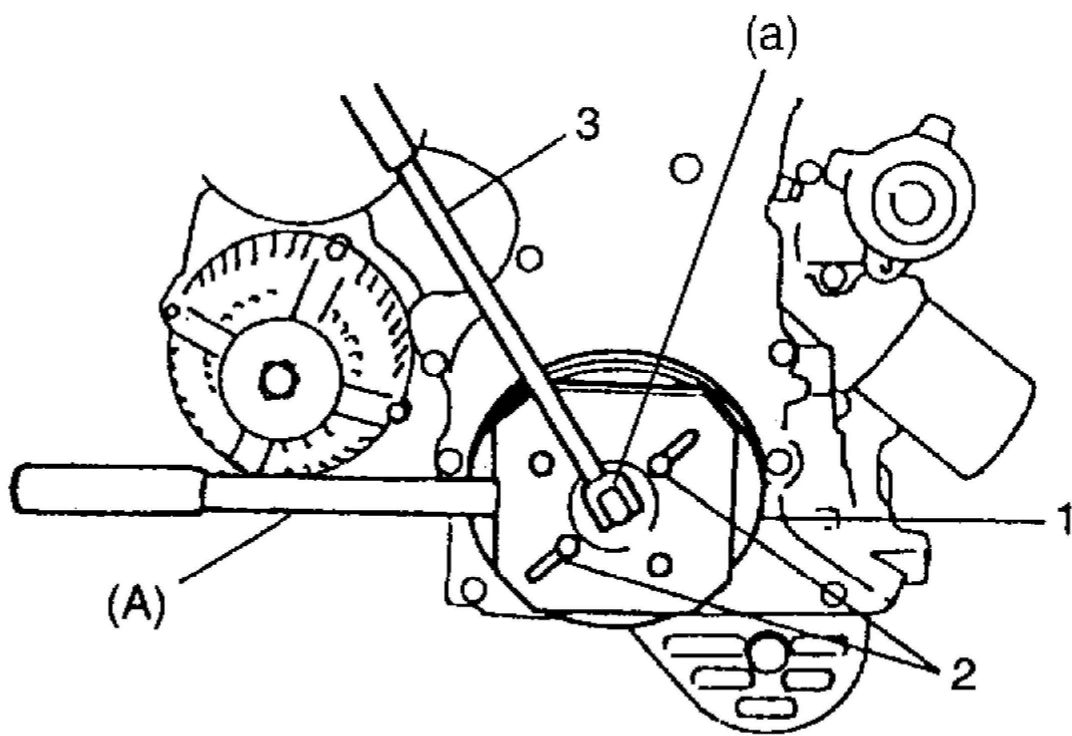
9. Install [oil pan](#).

10. Install crankshaft pulley. To lock crankshaft pulley (1), use special tool (camshaft pulley holder) as shown in figure. Special Tool (A):09917-68221

**NOTE:** Be sure to use the following bolts instead of pins in order to fix crank pulley by special tool. Bolt size: M8, P1.25 L = 25 mm (0.98 in.) Strength: 7T

**Tightening torque**

Crankshaft pulley bolt a: 150 Nm (15.0 kgf-m, 108.5 ft. lbs.)



2. Bolt	3. Wrench
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