

# A GENERAL INFORMATION

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## **1 HOW TO USE THIS MANUAL**

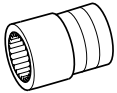
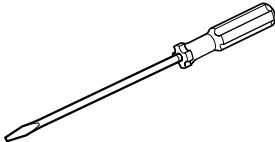
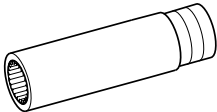
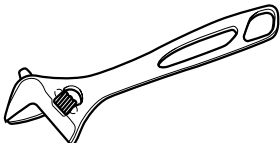
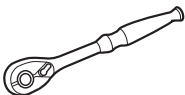
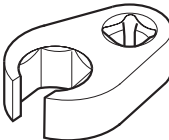

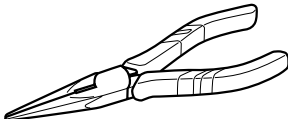
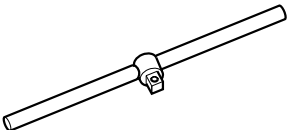
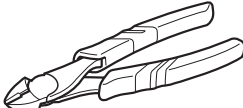
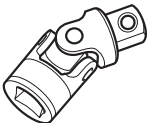
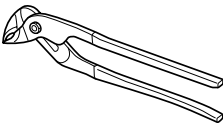
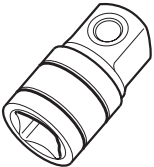
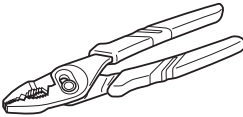
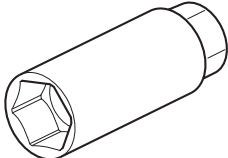
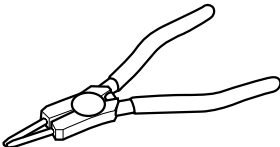
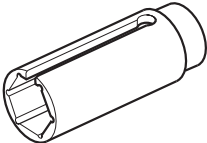
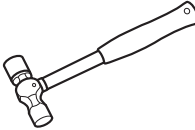
### **1-1 SCOPE OF DESCRIPTION IN THIS MANUAL**



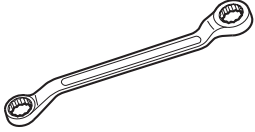
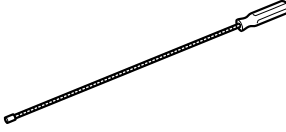

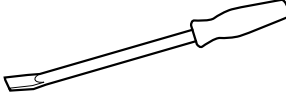

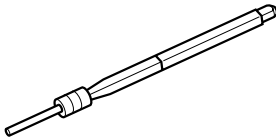
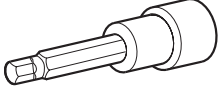
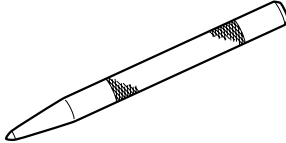
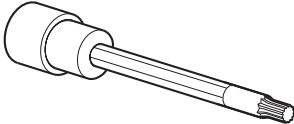
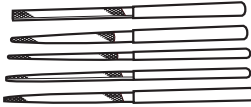
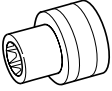
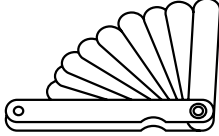
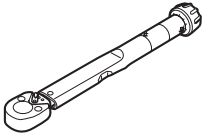
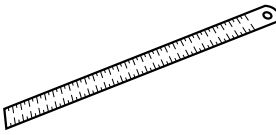
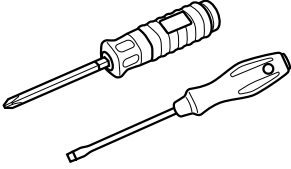

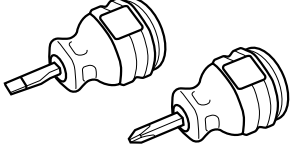
This manual describes the Disassembling and Assembling Procedures for the Type 1KR engine assembly. The procedures for removal and installation from and to the vehicle as well as the procedures for oil supply, checks and adjustment after completion of the mounting of the engine, are described in each vehicle model's repair manual.

## 1-2 ARTICLES TO BE PREPARED

When SSTs, tools, measuring instruments, and various kinds of oils and lubricants need to be prepared before operations, they are described as preparation tools in a table at the beginning of each item. However, general tools, jacks, and fixtures that are considered standard equipment in the service shop are usually omitted.

### STANDARD TOOLS

	Socket 9.5sq (7, 8, 10, 12, 14, 17, 19, 21, 22) 12.7sq (12, 14, 17, 19, 21, 22, 23, 24, 26, 27, 30, 32, 36)		Baby screwdriver
	Deep socket 9.5sq. (8, 10, 12, 14) 12.7sq. (12, 14, 17, 19, 21, 22, 24, 27, 30)		Crescent wrench
	Ratchet handle (9.5sq., 12.7sq.)		Crow foot wrench (10, 12, 14, 17., 19)
	Spinner handle (12.7sq.)		Longnose pliers
	Sliding T-handle (9.5sq.)		Nipper
	Universal joint (9.5sq., 12.7sq.)		Water pump pliers
	Socket adapter (6.3sq., 9.5sq., 12.7sq.)		Combination pliers
	Plug wrench 9.5sq. (16, 20.8)		Internal snap ring pliers ( $\phi$ 2.0, $\phi$ 1.2)
	Oxygen sensor socket		Combination hammer

	Extention bar 9.5sq. (30mm, 75mm, 100mm, 150mm, 270mm) 12.7sq. (75mm, 150mm, 270mm, 600mm)		Stainless scrapers
	Long offset wrench (8×10, 10×12, 12×14, 14×17, 17×19, 19×21, 22×24, 24×27)		Magnet hand
	Spanner wrench (6×7, 8×10, 10×12, 12×14, 14×17, 17×19)		Handy bar (330mm, 420mm, 600mm)
	Combination wrench (10, 12, 14, 17)		Knock pin punch (φ3, φ4, φ5)
	Hexagon bit socket 9.5sq. (4, 5, 6, 8, 10, 12, 12.7sq. (14)		Centering punch
	T-type long torx bit socket 12.7sq. (T55)		A set of files (5pieces)
	T-type torx wrench 9.5sq. (E10, E14)		Thickness gauge (9 pieces, 5 pieces on one side and 11 pieces on the other)
	Ratchet-equipped preset type torque wrench 9.5sq. (5 - 25, 10 - 50) 12.7sq. (20 - 100, 30 - 140, 40 - 200)		Square (150mm, 300mm)
	Screwdriver		Oil jug
	Stubby screwdriver		

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### 1-3 COMPONENTS

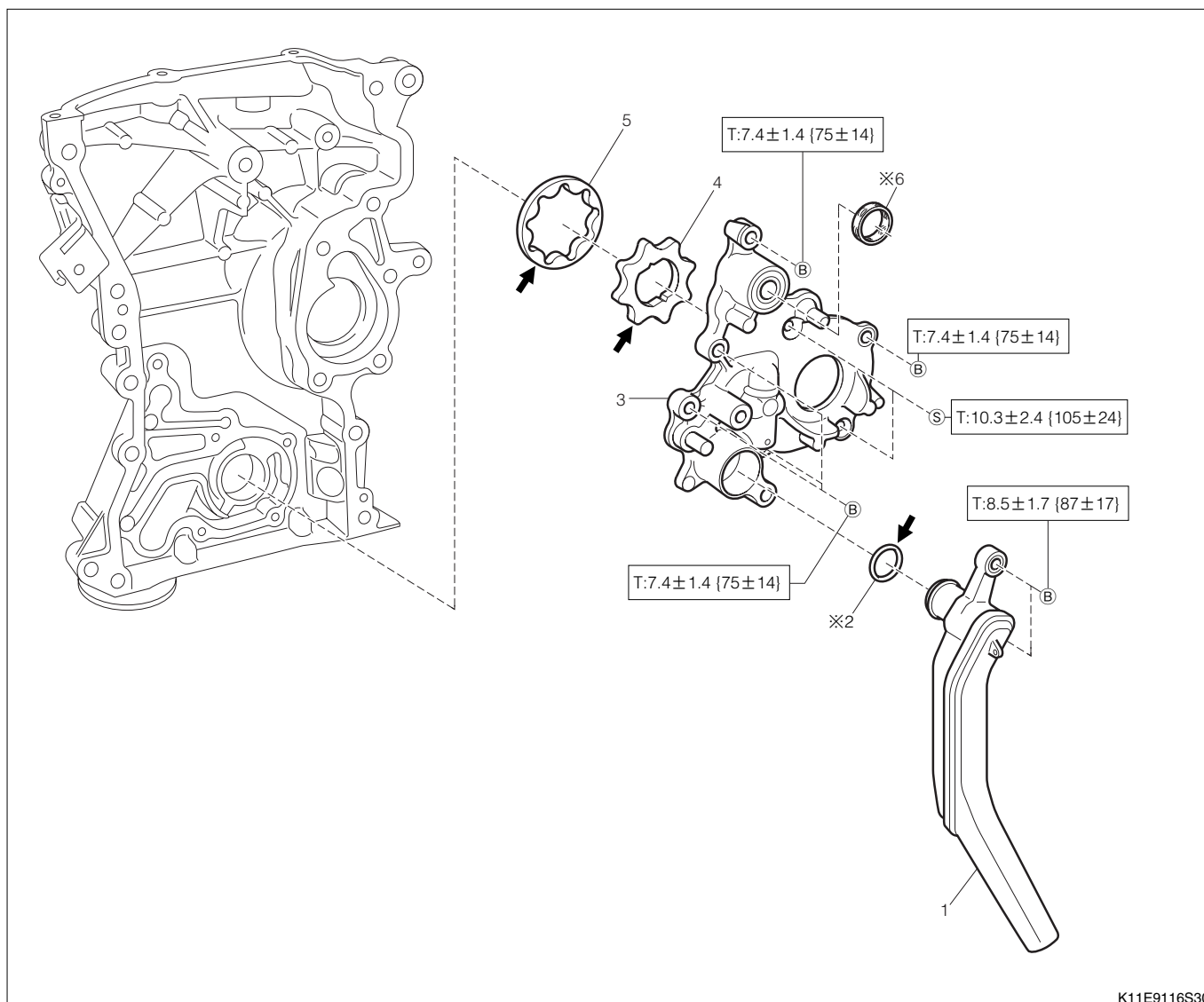
1. The essential points for the disassembly and assembly of each component part are described in the order below. However, the operations for cleaning, inspections, adjustments and replacements are only described if necessary.
  - 1-1-1 ARTICLES TO BE PREPARED
  - 1-1-2 OPERATION BEFORE DISASSEMBLY
  - 1-1-3 DISASSEMBLING AND ASSEMBLING PROCEDURES
  - 1-1-4 POINTS OF DISASSEMBLY
  - 1-1-5 CLEANING
  - 1-1-6 CHECK
  - 1-1-7 ADJUSTMENT
  - 1-1-8 REPLACEMENT
  - 1-1-9 POINTS OF ASSEMBLY
  - 1-1-10 OPERATION AFTER ASSEMBLY
2. Components diagrams and cross-sectional views are posted for disassembling and assembling procedures to show the installed state of each part.
3. In the components diagram, the application points for the grease, lubricant and sealer are indicated by arrows. Tightening torques and non-reusable parts are also indicated. The meaning of each code is given below the components diagram.
4. The disassembling procedure and the list of part names are shown just below the components diagram. And the number before each part name is linked to a number in the diagram.
5. In principle, reverse the removal (or disassembly) procedure to install (or assemble) the parts.

#### NOTE

- The installation (or assembly) procedure is provided only in cases where the installation (or assembly) can not be carried out by reversing the removal (or disassembly) procedure.

## 1-3-1 ENTRY EXAMPLE

### (1) COMPONENTS



K11E9116S30

➡: Engine oil

※: Non-reusable parts

Unit: N·m{kgf·cm}

### (2) DISASSEMBLING AND ASSEMBLING PROCEDURES

- |   |                        |   |                                  |
|---|------------------------|---|----------------------------------|
| 1 | Strainer S/A, oil      | 6 | Ring, O(timing chain cover side) |
| 2 | Ring, O(strainer side) |   |                                  |
| 3 | Cover S/A, oil pump    |   |                                  |
| 4 | Gear, oil pump drive   |   |                                  |
| 5 | Gear, oil pump driven  |   |                                  |

## 1-4 CONTENTS NOT DESCRIBED IN THIS MANUAL

The description of the next elemental operation may be omitted in this service manual, but please perform the actual operation.

1. Cleaning and washing of removed parts to be performed if necessary.
2. Visual inspection
3. Basic check after assembly

## 1-5 DEFINITIONS OF TERMS

SPECIFIED VALUE	This mark shows the standard value at the time of the check or adjustment.
ALLOWABLE LIMIT	This mark shows the maximum or minimum value at the time of the check or adjustment.
DEVIATION	This value refers to the difference between the maximum clearance and the minimum clearance.
WARNING	This symbol means that there is the possibility of personal injury of the operator himself or the nearby workers if the operator fails to follow the operating procedure prescribed in this manual.
CAUTION	This symbol means that there is the possibility of damage to the component being repaired if the operator fails to follow the operating procedure prescribed in this manual.
NOTE	Supplementary explanation which facilitates the operation is posted separately from the explanation. Because of difficulties in measurements to determine specified values, there may be cases where the specified values for simple measurement methods are indicated if malfunctions are unlikely to take place actually.

## 2 ABBREVIATION CODES

The abbreviation codes that appear in this manual stand for the following, respectively.

Abbrevia- tion code	Original word	Meaning
A/T	Automatic Transmission	Automatic transmission
Ay	Assembly	A module that consists of two or more single parts, or that is an aggregate of combined sub-assembly parts.
DVVT	Dynamic Variable Valve Timing	DVVT (Dynamic Variable Valve Timing)
ECU	Electronic Control Unit	Electronic Control Unit
EFI	Electronic Fuel Injection	Electronically-controlled fuel injection system
EX	Exhaust	Indicates the exhaust system.
FR	Front	Front
F/L	Fusible Link	Fusible link
GND	Ground	Ground
IG	Ignition	Ignition
IN	Intake	Indicates the intake system.
LH	Left Hand	Left side
M/T	Manual Transmission	Manual transmission
N/A	Natural Aspiration	natural aspiration
O/S	Over Size	Over Size
RH	Right Hand	Right side
RR	Rear	REAR
S/A	Sub Assembly	A module that consists of two or more single parts welded or caulked together.
SST	Special Service Tool	Special Service Tool
SW	Switch	Switch
T	Torque	Tightening torque
T/C	Turbocharger	turbocharger
U/S	Under Size	Under Size
W/	With	with
Ⓑ	Bolt	Symbols showing abbreviation of standard bolts, screws, nuts, washers, etc. in diagrams
Ⓢ	Screw	
Ⓝ	Nut	
Ⓦ	Washer	
ⓒ	Clip	

The name [EFI] (Electronic fuel injection system) is a registered trademark of the Toyota motor corporation. (authorized use)



### 3 UNIT

The units are the SI units [International System of Units]. (The representative conventional units are also indicated.)

Example:  $33.3 \pm 13.3 \text{ N} \cdot \text{m}$  {  $340 \pm 135 \text{ kgf} \cdot \text{cm}$  }

#### 3-1 NEW UNIT BECAUSE OF THE INTRODUCTION OF THE SI UNIT

As a result of the introduction of the SI units, representative conventional units will be changed as follows.

Detected item	New units	Conventional units	Convention table
Force	N (newton)	kgf	1 kgf = 9.80665N
Torque	N·m (newton meter)	kgf·cm	1 kgf·cm = 0.0980665N·m
Spring constant	N/mm	kgf/mm	1 kgf/mm = 9.80665N/mm
Pressure	Pa (Pascal)	kgf/cm <sup>2</sup>	1 kgf/cm <sup>2</sup> = 98.0665kPa
		mmHg	1 mmHg = 0.133322kPa

#### 3-2 PREFIX USER IN SI UNIT

The following are typical prefixes used in SI Unit (10 to the power of n).

M(mega)	$10^6$
k(kilo)	$10^3$
h(hecto)	$10^2$
da (deca)	$10^1$
d (deci)	$10^{-1} = 0.1$
c(centi)	$10^{-2} = 0.01$
m(milli)	$10^{-3} = 0.001$
μ(micro)	$10^{-6} = 0.000001$

4 HOW TO GRASP SPECIFIED TIGHTENING TORQUE FOR GENERAL STANDARD BOLT AND NUT

4-1 DETERMINING PROCEDURE FOR TIGHTENING TORQUE FOR GENERAL STANDARD BOLTS AND NUTS

4-1-1 DETERMINING PROCEDURE FOR TIGHTENING TORQUE FOR BOLTS






Determine the strength division of bolts, based on the table below.  
Then, obtain the value, based on the tightening torque table.

4-1-2 DETERMINING PROCEDURE FOR TIGHTENING TORQUE FOR NUTS

Determine with the aforesaid method, based on the mating bolt.

4-1-3 IDENTIFICATION

Identification of strength division by checking bolts themselves

Classification (Strength division)	Shape of head (how to know strength division)	
	Bolt without collar	Bolt with collar
4 T		
5 T		—
6 T	—	
7 T		—

Identification by part number


Hexagonal bolt

Example of part number 9 1 1 1 - 4 0 6 2 0

Strength division

Nominal diameter (mm)

Nominal length (mm)



Nominal diameter

Nominal length

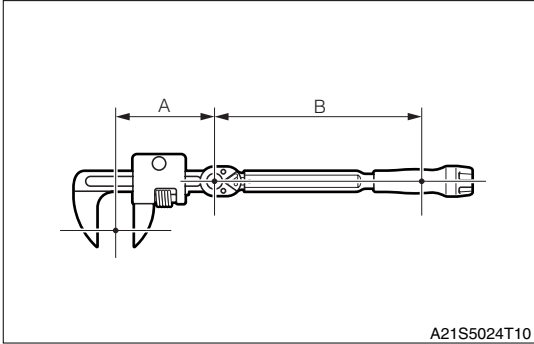
## 4-1-4 TIGHTENING TORQUE TABLE FOR GENERAL STANDARD BOLTS

Strength division	Nominal diameter (mm)	Pitch (mm)	Standard tightening torque (N·m{kgf·cm})	
			Bolt without flange	Bolt with flange
4 T	6	1	5.4 {55}	5.9 {60}
	8	1.25	13 {130}	14 {145}
	10	1.25	25 {260}	28 {290}
	12	1.25	47 {480}	53 {540}
	14	1.5	74 {760}	83 {850}
	16	1.5	113 {1150}	—
5 T	6	1	6.4 {65}	7.5 {75}
	8	1.25	16 {160}	17.5 {175}
	10	1.25	32 {330}	36.0 {360}
	12	1.25	59 {600}	65.0 {670}
	14	1.5	91 {930}	100.0 {1050}
	16	1.5	137 {1400}	-
6 T	6	1	7.8 {80}	8.8 {90}
	8	1.25	19 {195}	20.5 {210}
	10	1.25	39 {400}	43 {440}
	12	1.25	72 {730}	79 {810}
	14	1.5	109 {1100}	123 {1250}
	16	1.5	170.0 {1750}	-
7 T	6	1	11 {110}	12 {120}
	8	1.25	25 {260}	28 {290}
	10	1.25	52 {530}	58 {590}
	12	1.25	95 {970}	103 {1050}
	14	1.5	147 {1500}	167 {1700}
	16	1.5	225 {2300}	—

4-1-5 WHEN AN EXTENSION TOOL IS USED

- 1. When tightening with the SST or a tool connected to the torque wrench for a drive-end extension, a higher tightening torque will result, if tightened until the reading on the torque wrench indicates the specified torque.
- 2. This manual contains specified torques only. When using the SST or an extension tool, the torque wrench reading must be computed using the following formula.
- 3. Calculation formula:  $T' = T \times B / (A + B)$

Abbrevia- tion code	Meaning	UNIT
T'	Torque wrench reading	N·m{kgf·cm}
T	Specified tightening torque	N·m{kgf·cm}
A	Length of the SST or a tool	cm
B	Torque wrench length	cm



## **5 CAUTIONS FOR THE DISASSEMBLY AND ASSEMBLY PROCEDURES FOR THE ENGINE AY.**

### **5-1 USE OF THE SST**

1. For increased work efficiency and improved accuracy, be sure to utilize the SSTs (Special Service Tools) effectively.

### **5-2 BEFORE DISASSEMBLY**

1. Prior to the disassembling, be sure to wash away any sands and mud that has adhered to the exterior of the transaxle so that it will not be admitted to the interior at the time of the disassembling and assembling.
2. After installing the engine assembly to the engine stand, drain the coolant from the interior out through the drain plug if necessary. And, remove the oil filter and drain the engine oil using the drain plug of the oil pan or the SST.

SST: 09228-87201-000

### **5-3 DURING DISASSEMBLING**

1. When the joint section of light-alloy parts such as the transaxle is to be disassembled, do not pry using a screwdriver or the like, but perform the disassembling by lightly tapping with a plastic hammer.
2. Place the disassembled parts in order at all times. Keep them away from dust.
3. Extreme care must be exercised to ensure that the mating surface of the case is not damaged, as this could lead to oil leakage.
4. When a part is to be secured in a vise, be sure to secure it with the aluminum sheets interposed.
5. For complicated places, to make the assembly easier, add stamping marks and alignment marks in places where there will not be any effect on function.
6. Whenever a part is removed, check its condition when assembled, looking for deformation, breakage, roughness and the existence of scratches.
7. Arrange the removed parts in order, and divide them into parts to replace and parts to reuse.
8. Each part to be reused must be cleaned and washed thoroughly.

### **5-4 CLEANING AND WASHING**

1. Thoroughly wash each part before assembling. After drying, apply the designated oil.
2. Never wash aluminum and rubber parts with alkali chemicals.
3. Never wash rubber parts, such as O-rings and oil seals, with cleaning oil (white gasoline or the like).
4. Prior to the application of the seal agent, be sure to completely remove any oil seal agent remaining on the seal section. Then, wash the seal agent application section with white gasoline and dry it thoroughly.

### **5-5 INSPECTION, MEASUREMENT AND ADJUSTMENT**

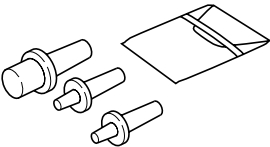
1. With regards to those parts to be used again, perform thorough checks and measurements, as required.
2. Adjust to the specified service standard value using the gauge and the tester.

5-6 REPLACE AND ASSEMBLE

- 1. After the seal section has been assembled, wait at least one hour, until the seal agent dries completely. Then, fill the oil.
- 2. Replace any snap ring that has been scratched or deformed with a new one.
- 3. Be sure to apply the designated oil to sliding surfaces and rotating surfaces before assembly.
- 4. Assemble the good parts using the correct procedures in accordance with the specified standard (Values for adjustment, tightening torque).
- 5. Use genuine parts for replacements
- 6. Do not forget to apply sealing packing and greases, depending on the part.
- 7. Ensure that you use new packing, gaskets or the like, and O-rings, etc.
- 8. When using seal bolts, ensure that you use the specified liquid gasket or apply seal lock chemicals.
- 9. Use the specified bolts and nuts. Unless otherwise specified, the side for which the torque is indicated should be tightened to the specified torque, using a torque wrench. If there is no means to prevent turning on the opposite side, be sure to prevent turning using box wrenches, spanners or the like.

5-7 HANDLING OF HOSES ETC

- 1. Check the plug depth and clamp position before removing the hose.
- 2. When disconnecting hose, plug the hose using SST (plug—set hose) to prevent grease and oil, etc. and cooling water, etc. from leaking.

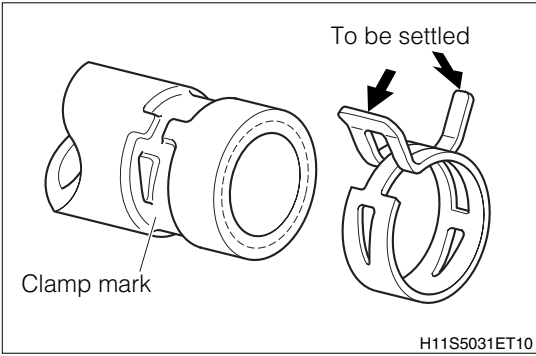
Shape	Part No	Item name
	09258-00030-000	Plug—set hose

CAUTION

- Before using SST, make sure that it is free from attachment of foreign object such as dirt, dust, or iron powder. If not, clean the pipe thoroughly.
3. When re-using the hose, install the clamps so that they match the clamp marks remaining on the hose.

CAUTION

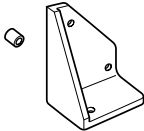
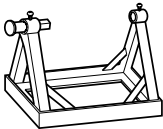
- Replace the clamps if they are deformed or flattened.
  - Replace the hose with a new one if the fitting between the hose and the joint is loose.
4. Ensure that the spring type clamp is properly seated after installation.
5. Ensure that you insert the hoses, etc. securely, so that they do not come out or leak.



## 6 INSTALLATION TO THE ENGINE OVERHAUL STAND

### 6-1 ARTICLES TO BE PREPARED

SST

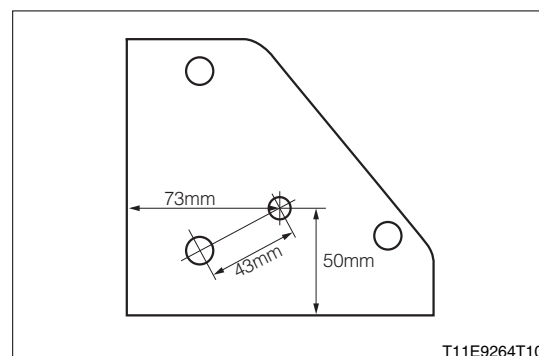
Shape	Part No.	Part name
	09219-87101-000	Attachment,engine overhaul
	09219-87202-000	Stand,engine overhaul

### 6-2 CONNECTING PROCEDURE

1. Install the SST to the partial engine.

- (1) Make a hole 10mm in diameter in the engine overhaul stand attachment.

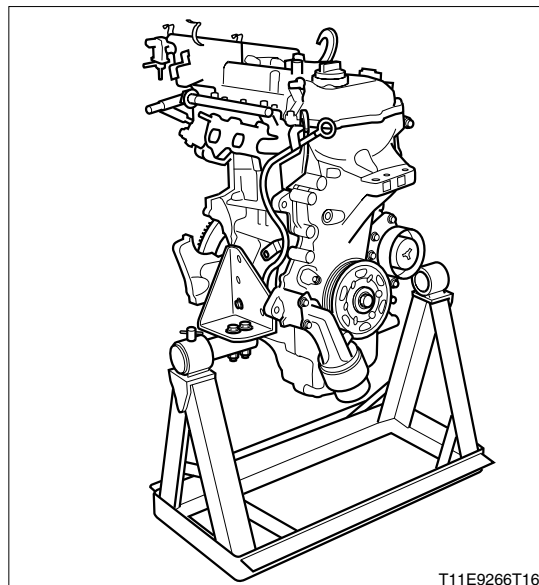
SST: 09219-87101-000



(2) Install the partial engine to the engine stand.

SST: 09219-87101-000

09219-87202-000



## B ENGINE UNIT

TIMING CHAIN COVER-----	B—1
DISASSEMBLING AND ASSEMBLING --	B—1
TIMING CHAIN -----	B—10
DISASSEMBLING AND ASSEMBLING	
-----	B—10
CAMSHAFT AY-----	B—15
DISASSEMBLING AND ASSEMBLING	
-----	B—15
CYLINDER HEAD AY-----	B—25
DISASSEMBLING AND ASSEMBLING	
-----	B—25
CYLINDER BLOCK AY-----	B—35
DISASSEMBLING AND ASSEMBLING	
-----	B—35



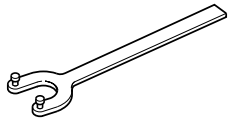


# B-1

## 1 TIMING CHAIN COVER

### 1-1 DISASSEMBLING AND ASSEMBLING

#### 1-1-1 ARTICLES TO BE PREPARED

SST

Shape	Part No.	Part name
	09278-87201-000	Tool,timing belt pulley holding
	09223-87202-000	Replacer,crankshaft front oil seal
	09091-1C100-000 (09032-00100-000)	Cutter,oil pan seal

Tool

Scraper
---------

Instrument

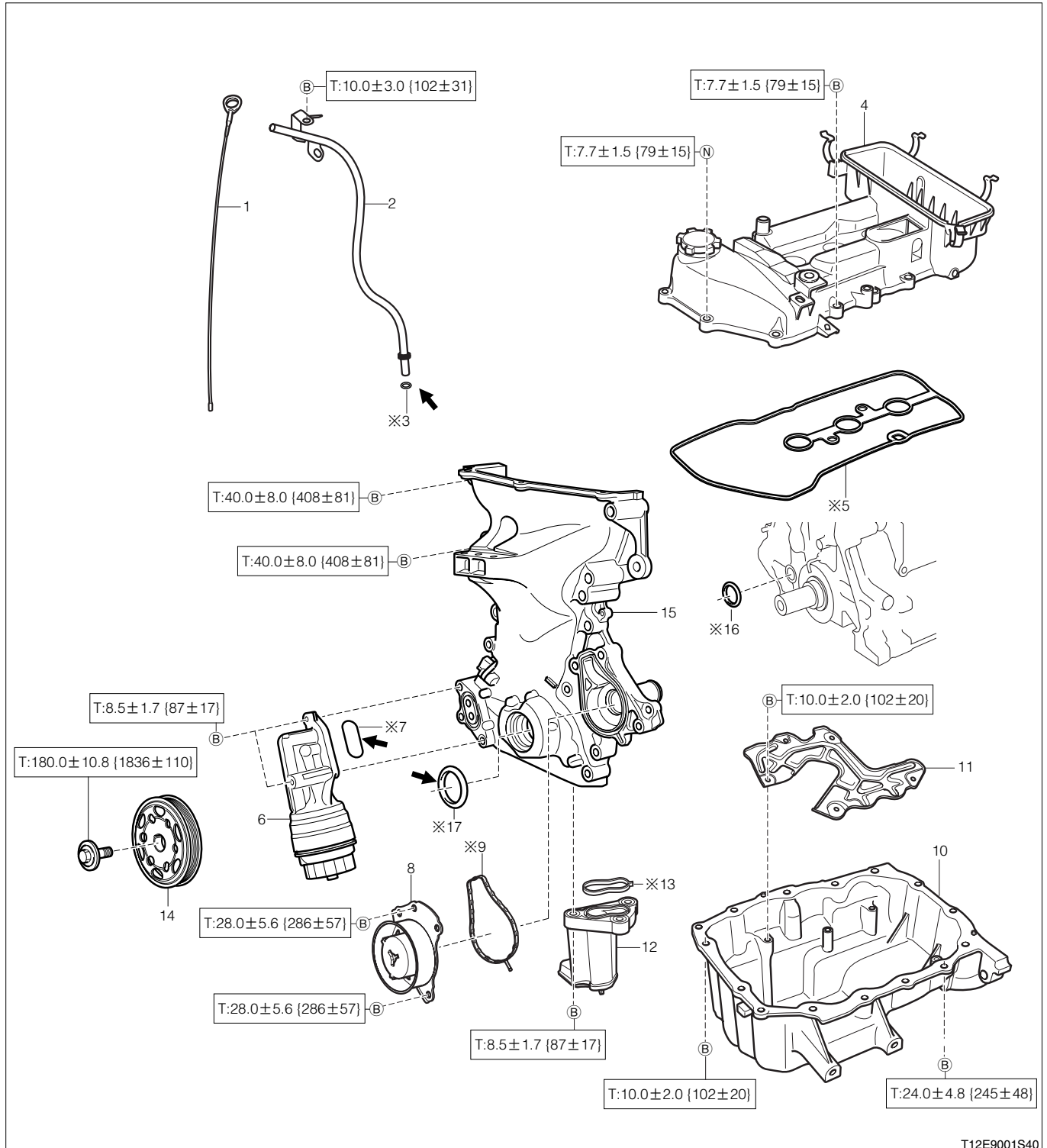
Vernier calipers,Torque wrench
--------------------------------

Lubricant,adhesive,others

Engine oil,Three Bond1207C,Three Bond1280E
--

## 1-1-2 DISASSEMBLING AND ASSEMBLING

## (1) Components



T12E9001S40

➔: Engin oil

Unit: N·m{kgf·cm}

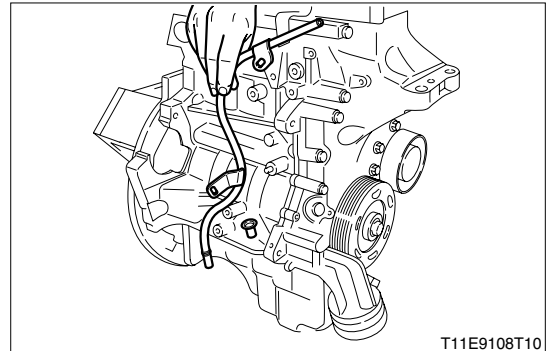
※: Non-reusable parts

## (2) Disassembling and assembling procedure

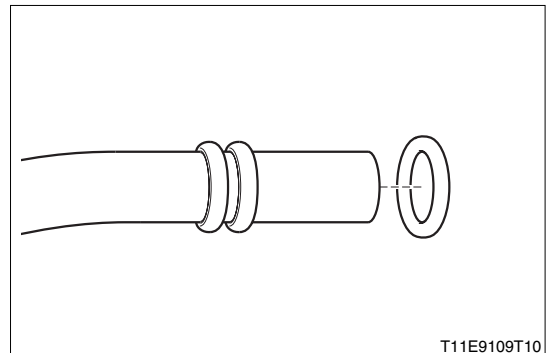
- |   |                             |    |                       |
|---|-----------------------------|----|-----------------------|
| 1 | Gage S/A, oil level         | 10 | Pan S/A, oil          |
| 2 | Guide S/A, oil level gage   | 11 | Plate, oil pan baffle |
| 3 | Ring, O                     | 12 | Strainer S/A, oil     |
| 4 | Cover Ay, cylinder head     | 13 | Gasket, oil strainer  |
| 5 | Gasket, cylinder head cover | 14 | Pulley, crankshaft    |
| 6 | Bracket, oil filter         | 15 | CoverAy, timing chain |
| 7 | Gasket, oil filter          | 16 | Gasket, oil pump      |
| 8 | Pump Ay, water              | 17 | Seal, type T oil      |
| 9 | Gasket, water pump          |    |                       |

### 1-1-3 POINTS OF DISASSEMBLY

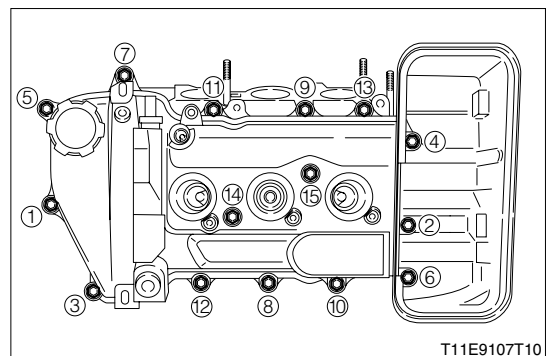
1. Pull out the oil level gauge S/A. Remove the oil level gauge guide S/A.



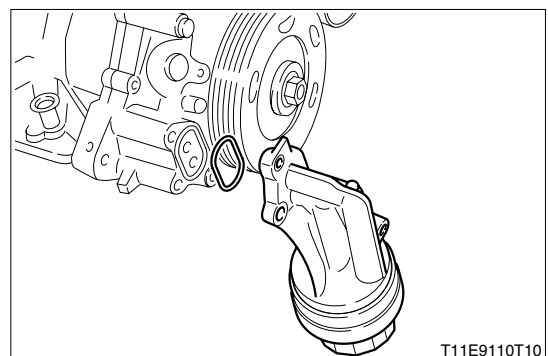
2. Remove the O ring from the Oil level gage guide S/A.



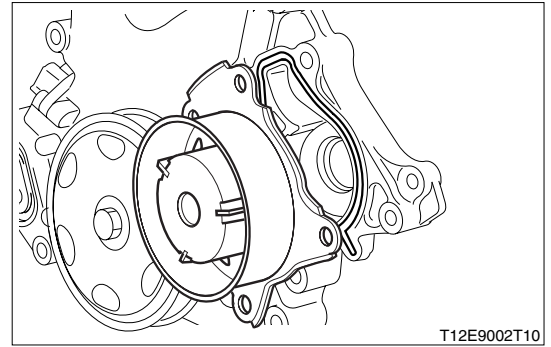
3. Remove the cylinder head cover Ay and cylinder head cover gasket by removing the attaching bolts and nuts in the sequence shown at the right figure.



4. Remove the oil filter gasket by removing the oil filter bracket.



5. Remove the water pump gasket by removing the water pump Ay.

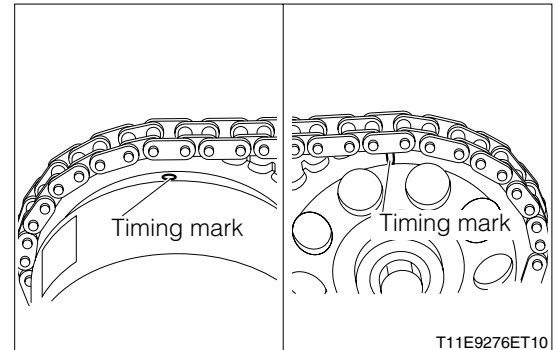


6. Set the No.1 cylinder to the top dead center under the exhaust stroke.

- (1) Turn the crankshaft pulley in the normal direction, until the timing mark (0 degrees) of the crankshaft pulley is aligned with the timing point of the timing chain cover Ay.

- (2) Ensure that the timing mark of the camshaft timing sprocket is at the top position.

If the timing mark is not at the top position, turn the pulley one turn so that the timing mark comes at the top.

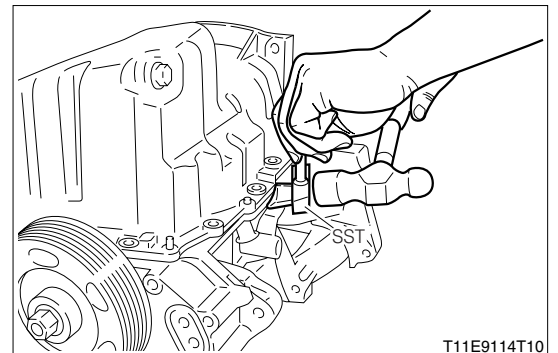


7. Remove the oil pan S/A from the cylinder block Ay, using the SST, by removing the attaching bolts and nuts of the oil pan S/A.

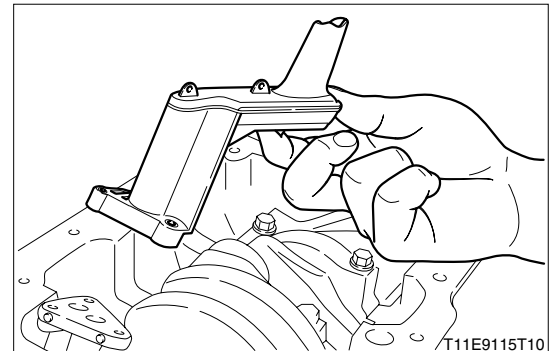
SST: 09091-1C100-000

**CAUTION**

- Be very careful not to deform the flange section of the oil pan S/A during the removal.

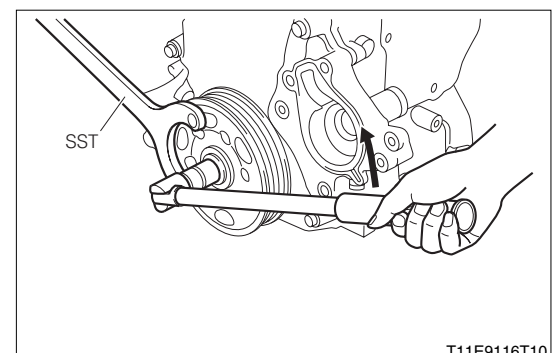


8. Remove the oil strainer gasket by removing the oil strainer S/A.



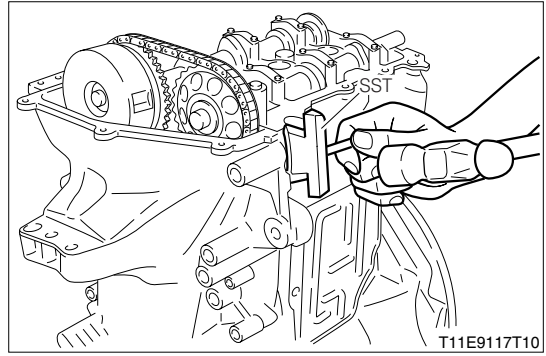
9. While preventing rotation, using the SST, remove the crankshaft pulley.

SST: 09278-87201-000

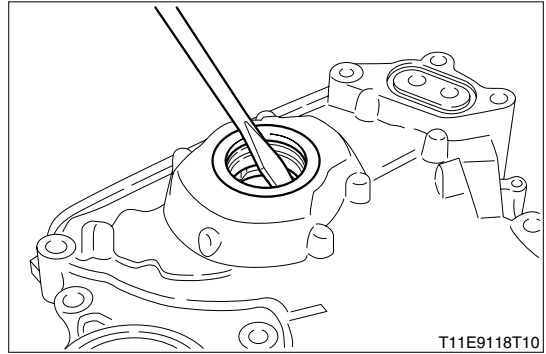


10. Remove the timing chain cover Ay, using the SST, by removing the attaching bolts and nuts.

SST: 09091-1C100-000

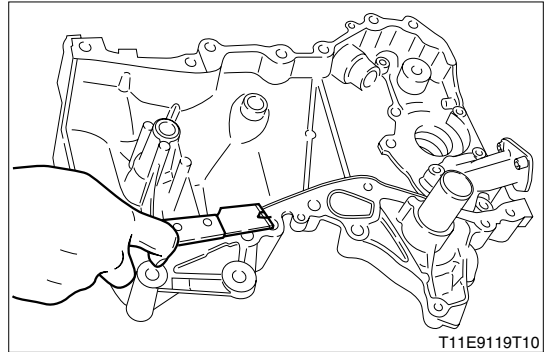


11. With a flat screwdriver, remove the type T oil seal.

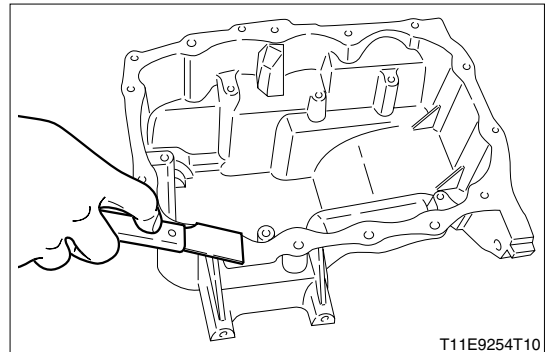


## 1-1-4 CLEANING

1. Clean the oil pan S/A and cylinder block Ay installation surfaces of the timing chain cover Ay.



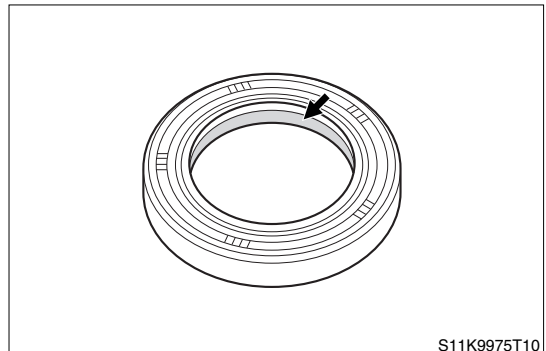
2. Clean the installation surface of the oil pan S/A.



## 1-1-5 POINTS OF ASSEMBLY

1. Install the type T oil seal to the timing chain cover Ay.  
(1) Apply engine oil to the lip section of the type T oil seal.

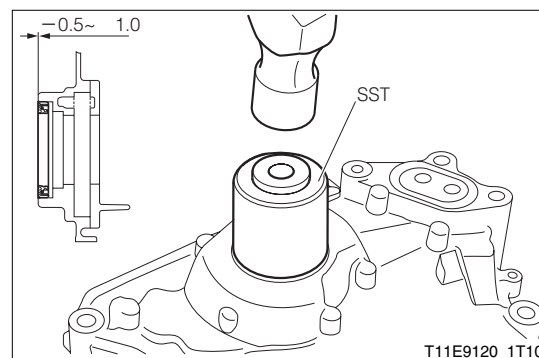
LUBRICANT: Engine oil



(2) Drive the type T oil seal vertically, using the SST.

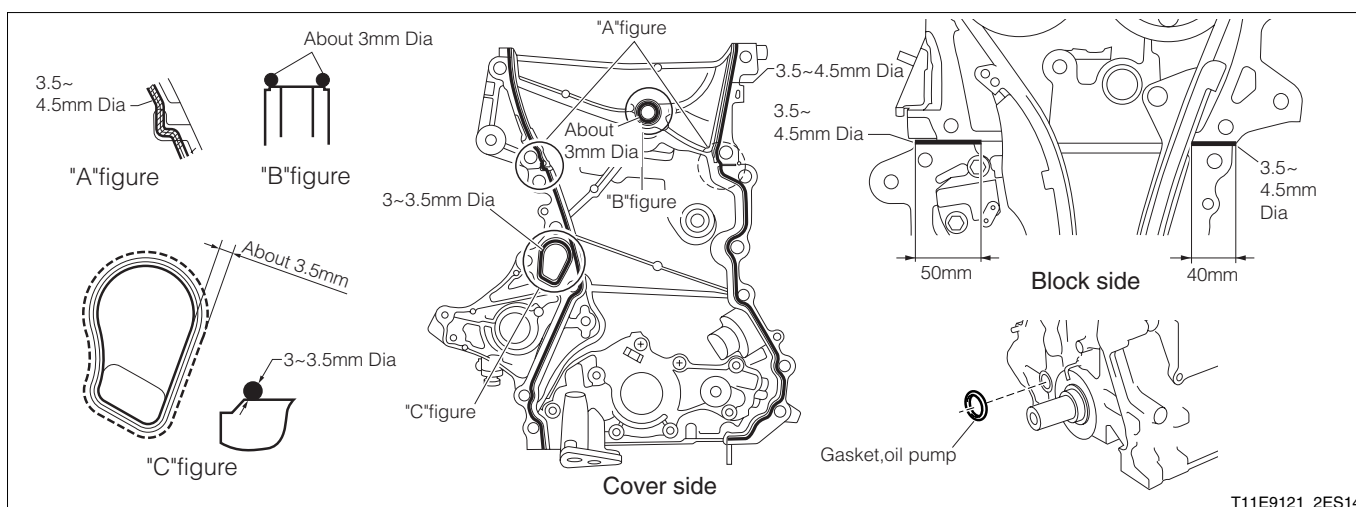
**SPECIFIED VALUE:** Press-fitting amount  
from chain cover edge  
Protruding amount: within 0.5  
mm  
Press-fitting depth: within 1 mm

SST: 09223-87202-000



2. Install the timing chain cover Ay.

- (1) Remove oil and grease from the installation surface of the cylinder block Ay and timing chain cover Ay.
- (2) Apply liquid gasket at positions shown at the figure and perform the installation.



**ADHESIVE:** Three Bond1207C / Apply to the points in the figure C at the cover side as shown in the figure.

**ADHESIVE:** Three Bond1280E / Apply to the points in the figure A and B at the cover side as shown in the figure and at the block side.

### CAUTION

- Completely remove foreign matters, oil and grease from the installation surface.

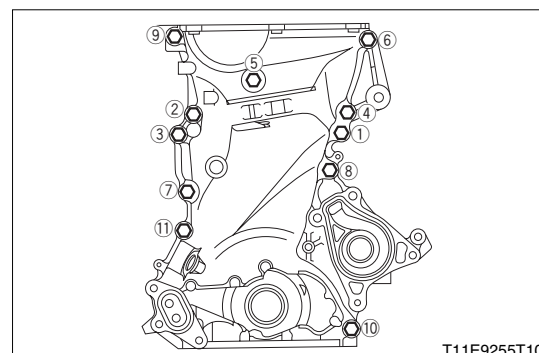
(3) Tighten the bolts in the sequence shown at the right figure.

### CAUTION

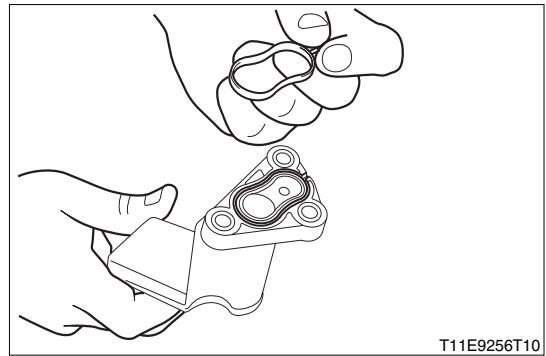
- Perform the assembling within three minutes after application of the liquid gasket.

(4) Wipe off any liquid gasket that has oozed out.

**SPECIFIED VALUE:** Permissible oozing amount: within 1.5 mm



3. Install the oil strainer gasket to the oil strainer S/A and install it to the timing chain cover Ay.



4. Installation of oil pan S/A.

- (1) Ensure that no oil nor grease adheres to the oil pan S/A installation surface of the cylinder block Ay and the flange section of the oil pan S/A.
- (2) Apply liquid gasket to the oil pan S/A and assemble it to the cylinder block Ay.

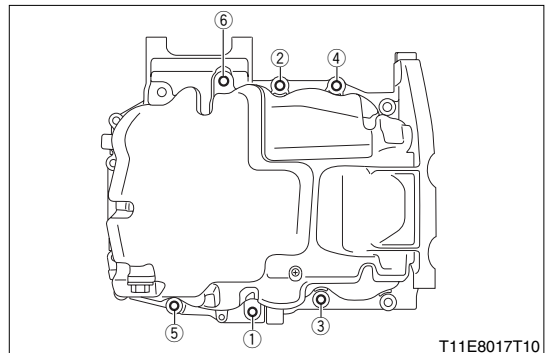
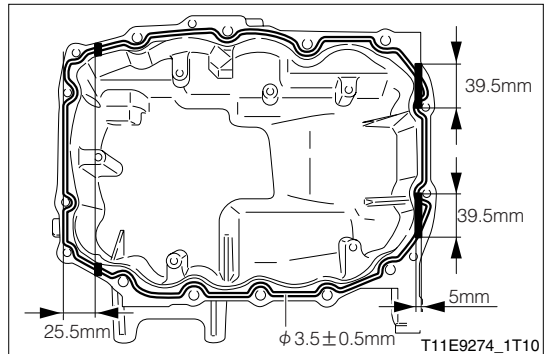
**ADHESIVE:** Three Bond1280E

## CAUTION

- Application of the liquid gasket should be started and finished at the seal surface with the cylinder block Ay.
- (3) Tighten the bolts in the sequence shown at the right figure.  
As for other bolts, they can be tightened in any sequence.

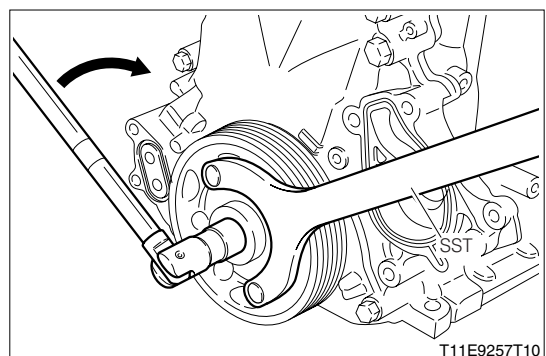
## CAUTION

- Assembling should be started within three minutes after application of the liquid gasket and the oil pan S/A should be tightened within 15 minutes.



5. While preventing the crankshaft pulley with the SST, tighten the attaching bolt.

**SST:** 09278-87201-000

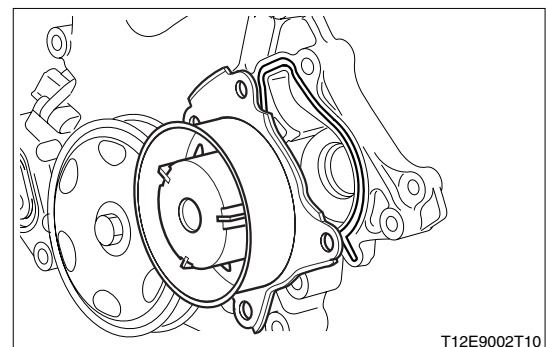


6. Installation of water pump Ay.

- (1) Assemble the new water pump gasket to the timing chain cover Ay. Then, install the water pump Ay.

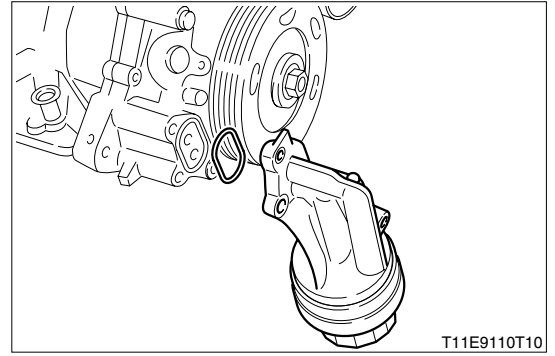
## CAUTION

- The protrusion for identifying the front and back of the water pump gasket should face the water pump side.

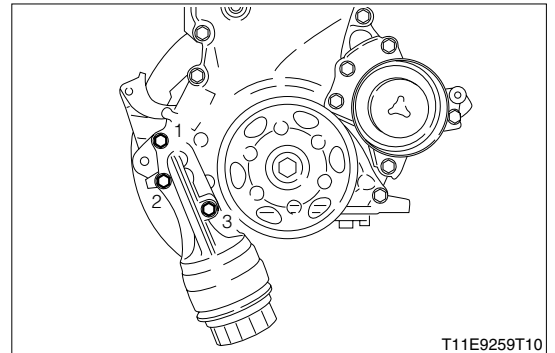


## 7. Installation of oil filter bracket.

- (1) Install the oil filter gasket to the timing chain cover Ay and install the oil filter bracket.



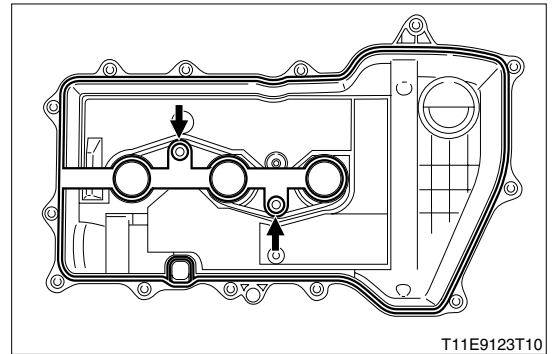
- (2) Tighten the bolts in the sequence shown at the right figure.



## 8. Installation of cylinder head cover.

- (1) Insert the cylinder head cover gasket to the gasket groove and central boss of the coil Ay with ignitor.

**SPECIFIED VALUE:** Insert the gasket completely until it contacts the end of the rib. (arrow marked)

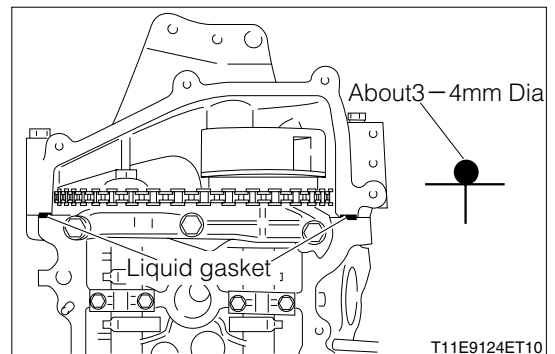


- (2) Apply liquid gasket to the mating surface between the cylinder head Ay and timing chain cover.

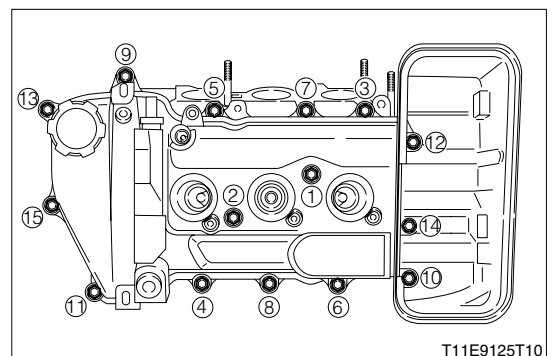
**ADHESIVE:** Three Bond1280E

### CAUTION

- Assembling should be started within three minutes after application of the liquid gasket and the cylinder head cover should be tightened within 15 minutes.



- (3) Tighten the attaching bolts in the sequence shown at the right figure. After tightening all the bolts to the specified torque, ensure again that the bolts ① and ② have been tightened to the specified torque.



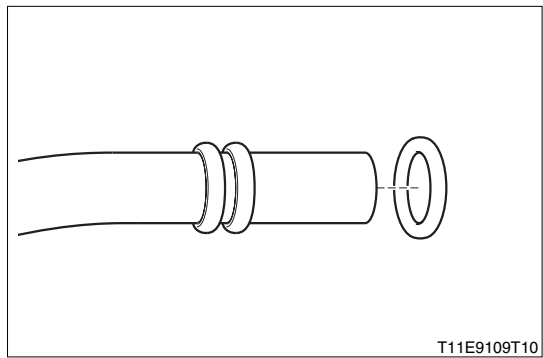


## B-9

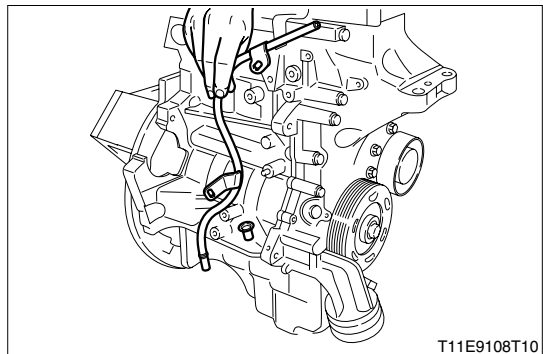
9. Install the O-ring to the oil level gage guide S/A.

(1) Apply engine oil to the O-ring, and install it to the guide S/A.

**LUBRICANT:** Engine oil



10. Install the oil level gauge guide S/A and insert the oil level gauge S/A.



## 2 TIMING CHAIN

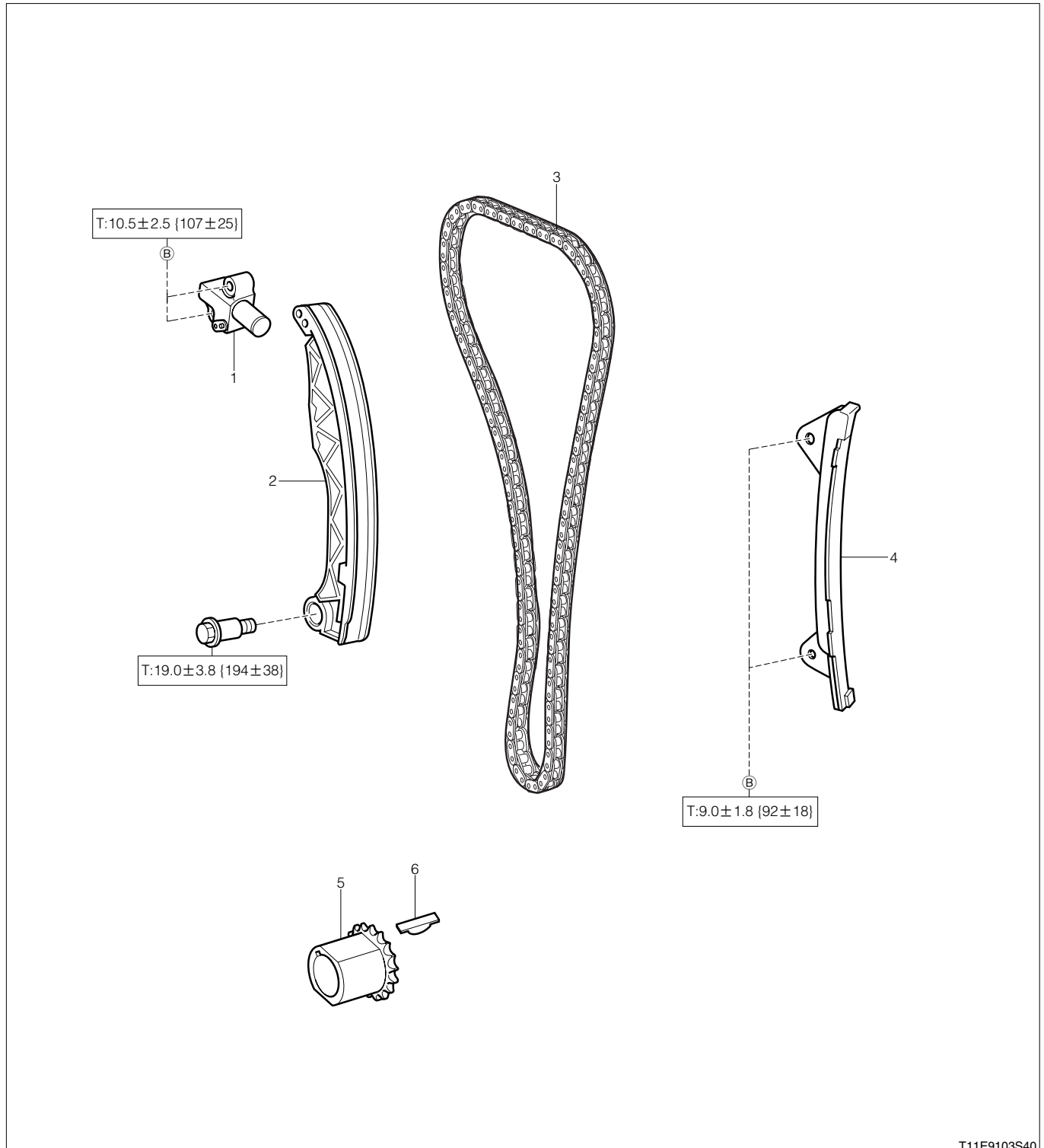
### 2-1 DISASSEMBLING AND ASSEMBLING

#### 2-1-1 ARTICLES TO BE PREPARED

Tool

Hexagonal rod wrench(Width across flats:2.5mm)

#### (1) Components



Unit: N · m {kgf · cm}

T11E9103S40

## (2) Disassembling and assembling procedure

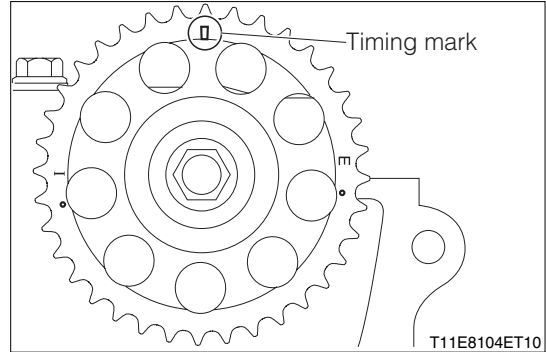
- |   |                             |   |               |
|---|-----------------------------|---|---------------|
| 1 | Tensioner Ay, chain         | 6 | Key, woodruff |
| 2 | Arm, timing chain tension   |   |               |
| 3 | Chain, timing               |   |               |
| 4 | Guide, timing chain         |   |               |
| 5 | Sprocket, crankshaft timing |   |               |

### 2-1-2 POINTS OF DISASSEMBLY

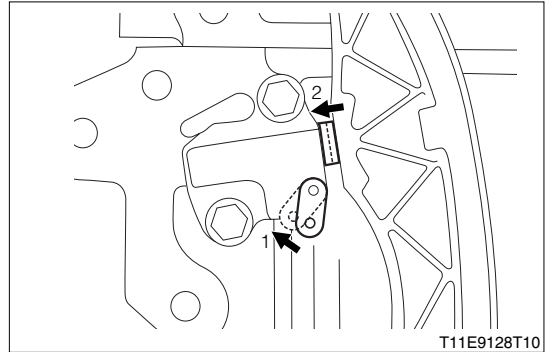
#### 1. Remove the timing chain.

- (1) Ensure that the timing mark of the camshaft timing sprocket is at the top position.

If the timing mark is not at the top position, turn the pulley one turn so that the timing mark comes at the top. (Set to the top dead center under exhaust stroke of No.1 cylinder.)



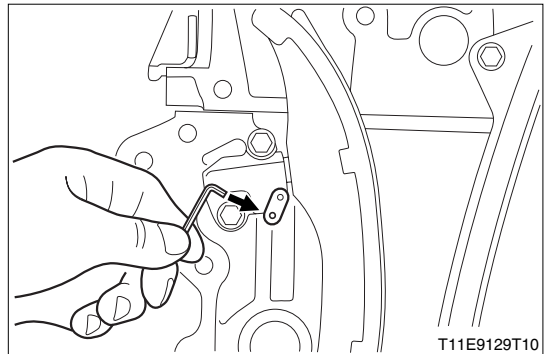
- (2) Move the stopper plate of the chain tensioner Ay clockwise. Under the unlocked state, push the plunger as far as it will go.



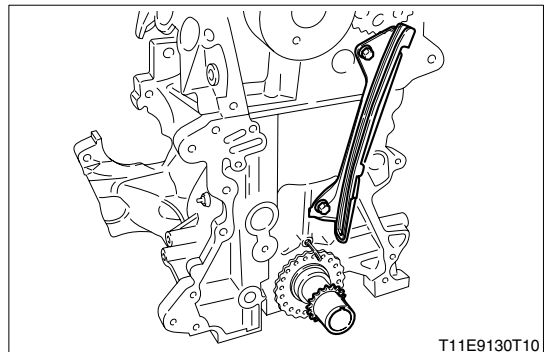
- (3) With the plunger pushed in, lock the plunger in this pushed-in state by inserting an Allen wrench or the like into the hole of the stopper plate.

**TOOL: Hexagonal rod wrench(Width across flats:2.5mm)**

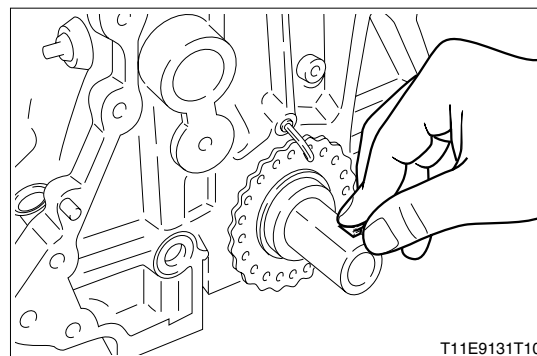
- (4) Remove the timing chain tensioner Ay by removing the bolts.
- (5) Remove the timing chain tensioner arm and timing chain by removing the bolts.



#### 2. Remove the timing chain guide and crankshaft timing sprocket.



3. Remove the woodruff key.



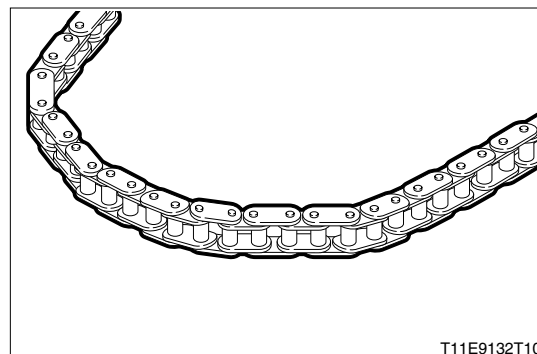
## 2-1-3 CHECK

### (1) Check of chain, timing

1. Visually check the timing chain for wear, cracks, etc.

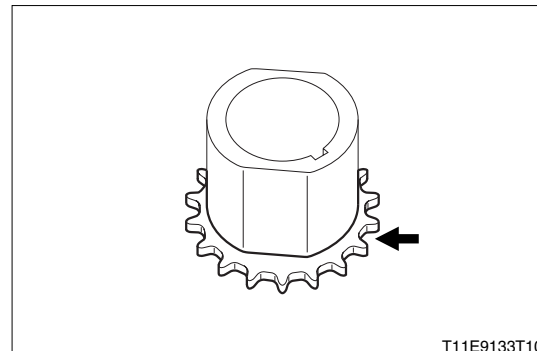
#### CAUTION

- If the timing chain exhibits any abnormality, check the sprocket side, too.



### (2) Check of sprocket, crankshaft timing

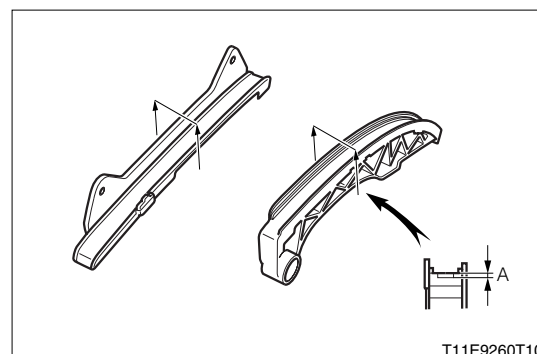
1. Check to see if the crankshaft timing sprocket is damaged.



### (3) Check of guide, timing chain / Check of arm, timing chain tension

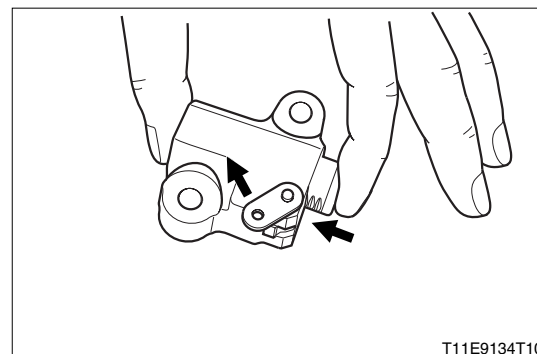
1. Check the timing chain guide and the section (A) of the timing chain tension arm for wear condition.

ALLOWABLE LIMIT: 0.5mm



### (4) Check of tensioner Ay, timing chain

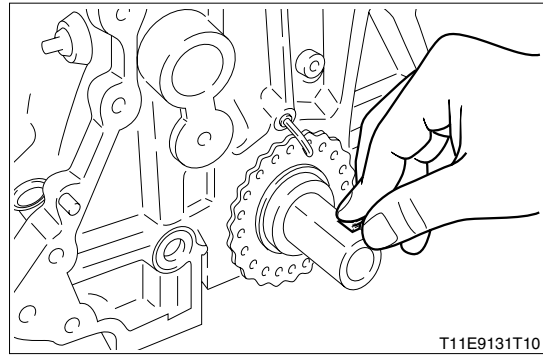
1. With the stopper plate of the timing chain tensioner Ay held clockwise by your finger, ensure that the plunger operates smoothly.
2. With your finger released from the stopper plate, push the plunger while the stopper plate is locked. Ensure that the plunger will not operate.



# B-13

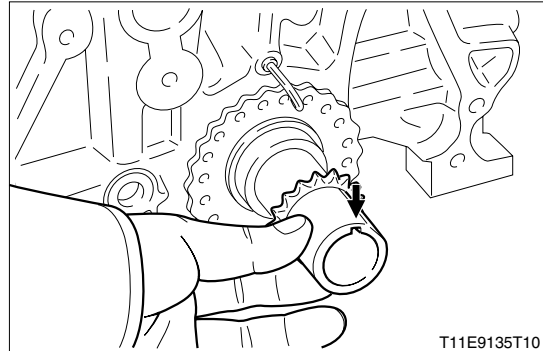
## 2-1-4 POINTS OF ASSEMBLY

1. Install the woodruff key into the groove of the crankshaft.

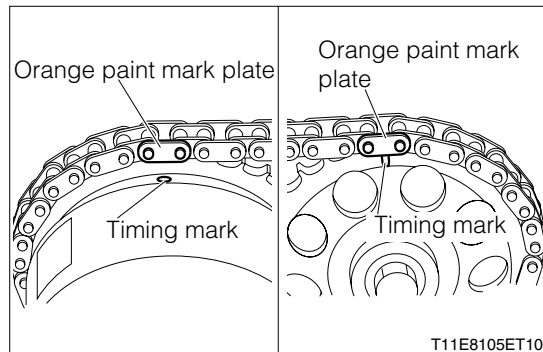


2. Install the crankshaft timing sprocket while aligning its groove with the crankshaft woodruff key.

3. Install the timing chain guide.

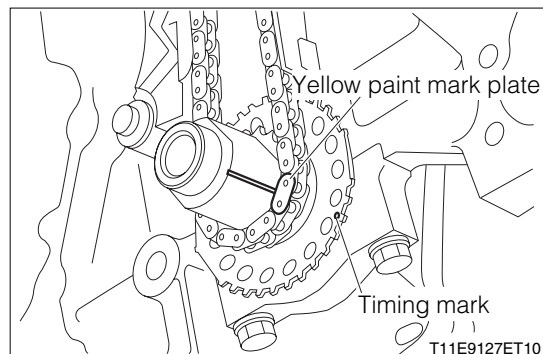


4. During the installation, align the two orange mark plates of the chain with the timing marks of the camshaft timing sprocket as shown in the figure.



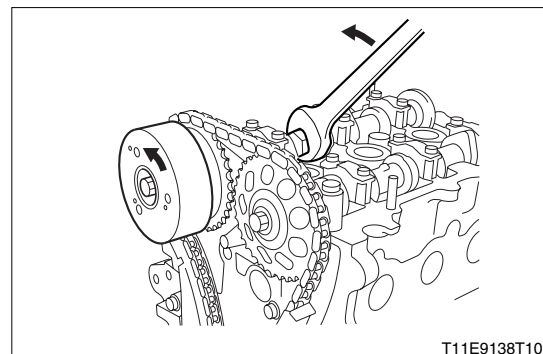
5. During the installation, align the yellow mark plate of the chain with the timing mark of the crankshaft timing sprocket as shown in the figure.

6. Install the timing chain tensioner arm.

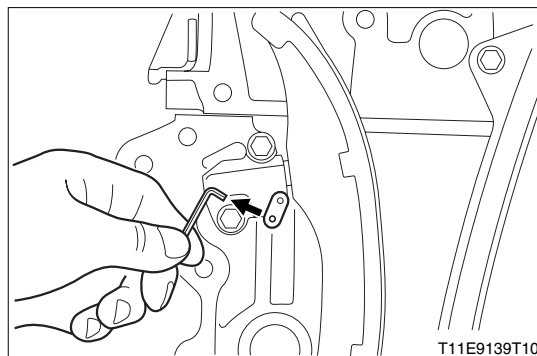


7. Install the chain tensioner Ay.

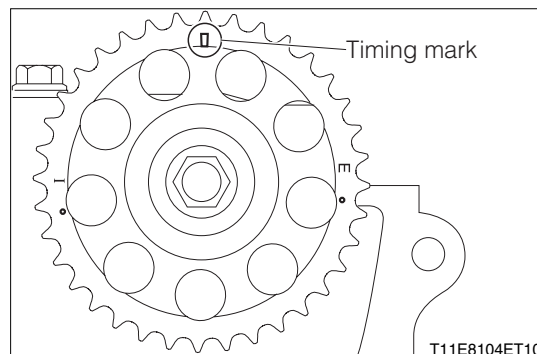
- (1) Slightly turn the hexagonal section for servicing of the camshaft (IN side) counterclockwise (reverse rotation) so as to give a slack to the chain at the tensioner side. Under this state, install the tensioner.



- (2) Pull out the Allen wrench of the tensioner and turn the crankshaft two turns to move the chain tensioner Ay.



- (3) With the timing chain tensed, ensure that the timing mark of the camshaft timing sprocket is at the top position. (The cylinder No.1 is set to the top dead center under the exhaust stroke.)



3 CAMSHAFT AY  
3-1 DISASSEMBLING AND ASSEMBLING  
3-1-1 ARTICLES TO BE PREPARED

Tool

Scraper

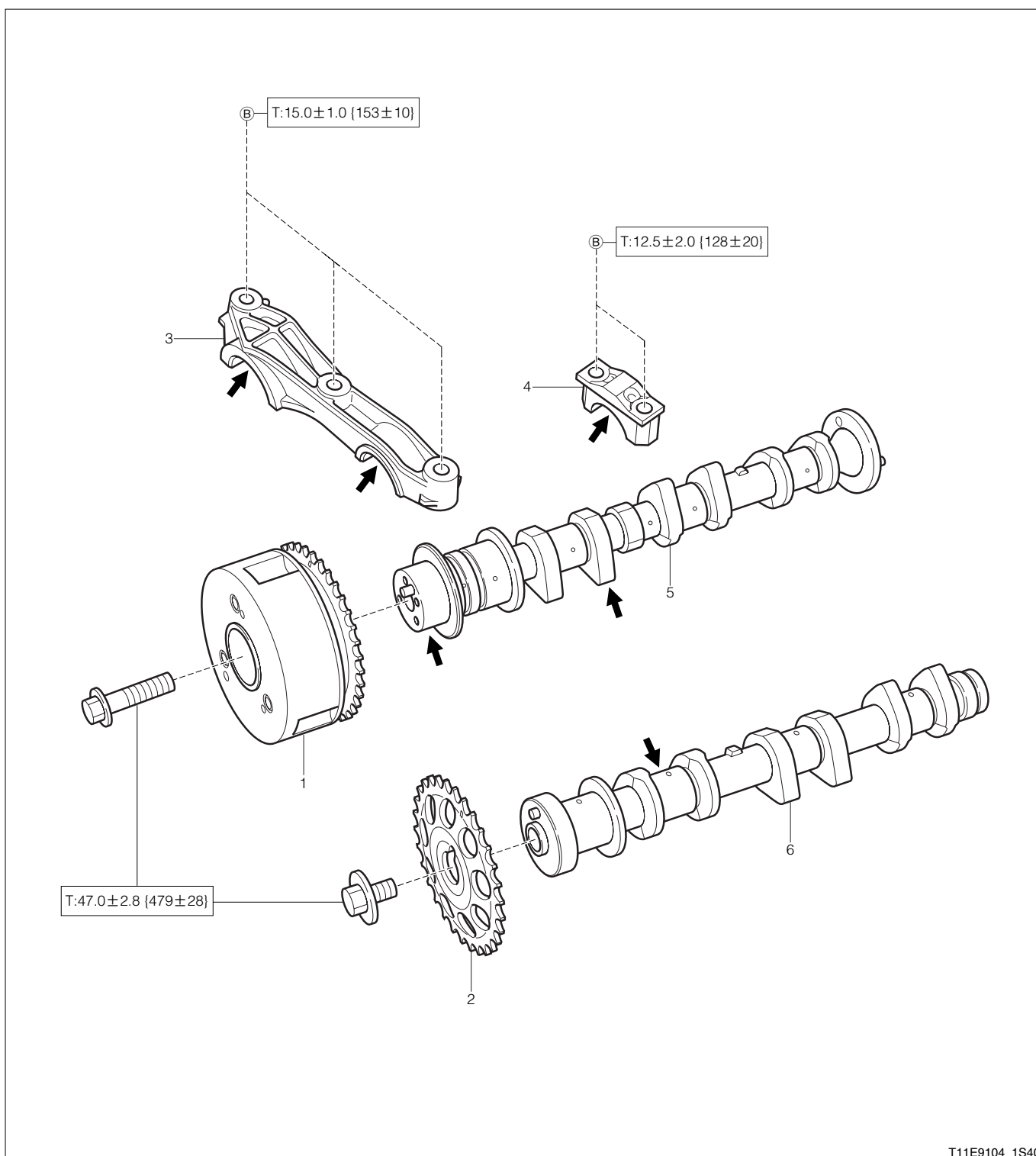
Instrument

Vernier calipers,Torque wrench,Thickness gauge

Lubricant,adhesive,others

Engine oil

## (1) Components



T11E9104\_1S40

➡: Engin oil

Unit: N·m{kgf·cm}

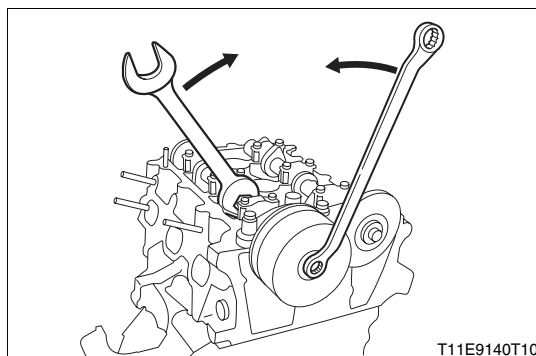
## (2) Disassembling and assembling procedure

- |   |   |   |                                  |
|---|---|---|----------------------------------|
| 1 | Sprocket Ay, camshaft timing(DVVT Controller) | 6 | Camshaft S/A, No.2(Exhaust side) |
| 2 | Sprocket, camshaft timing No.2                |   |                                  |
| 3 | Cap, camshaft bearing, No.1                   |   |                                  |
| 4 | Cap, camshaft bearing, No.2                   |   |                                  |
| 5 | Camshaft S/A, No.1(Intake side)               |   |                                  |

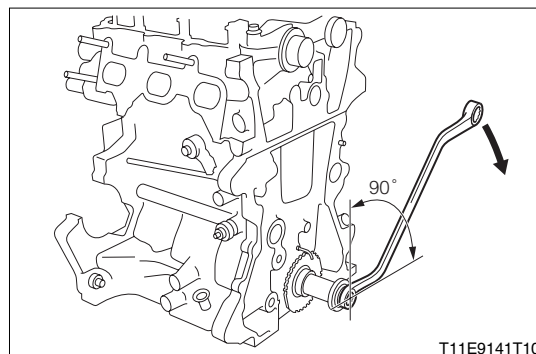


## 3-1-2 POINTS OF DISASSEMBLY

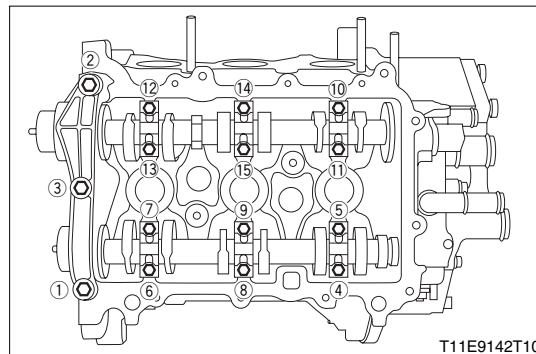
1. With the hexagonal section for servicing of the camshaft Ay locked by means of a spanner or the like, loosen the attaching bolts of the camshaft timing sprocket Ay (DVVT controller) and camshaft timing No.2 sprocket. Remove each sprocket.



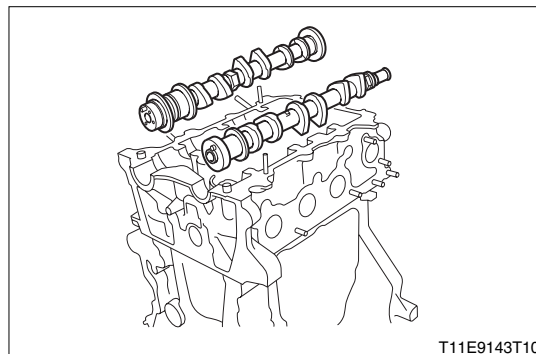
2. Temporarily install the attaching bolt of the crankshaft pulley. Turn the crankshaft 90 degrees (crank angle) in the engine rotation direction from the top dead center under the compression stroke of the cylinder No.1 so that the lifted valve will not interfere with the piston during the removal of the camshaft Ay.



3. Remove the camshaft bearing No.1 and No.2 caps by removing the bolts in the sequence shown at the right figure.

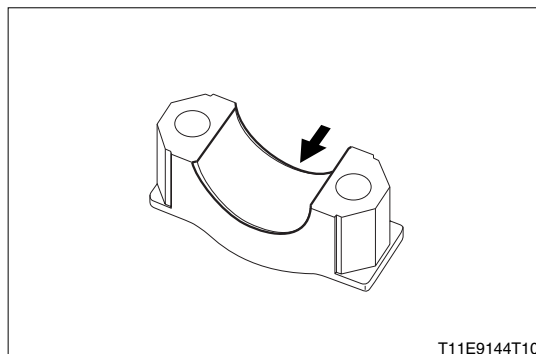


4. Remove the No.1/No.2 camshaft S/A.



## 3-1-3 CLEANING

1. Clean the installation surface of the camshaft bearing No.1/No.2 caps.



### 3-1-4 CHECK

#### (1) Check of camshaft

1. Check the camshaft for bending.

- (1) Measure the No.3 journal section for bending, using a V-block and a dial gauge.

**ALLOWABLE LIMIT:** 0.03mm

#### NOTE

- The bend is a half of the gauge reading (runout) when the camshaft is turned one turn.

2. Check the height of the cam.

- (1) Measure the cam height with a micrometer.

#### Camshaft specifications

Specified value (mm)	IN	41.54–41.64
	EX	40.97–41.07
Limit value (mm)	IN	41.44
	EX	40.87

3. Check the thrust clearance of the camshaft.

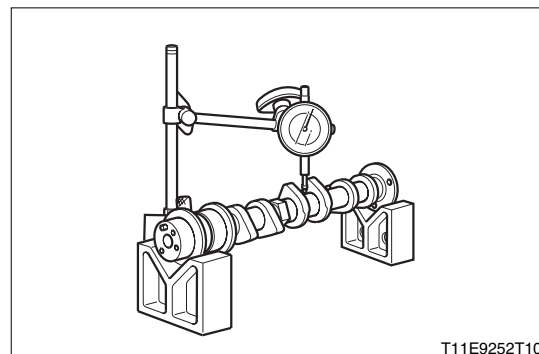
- (1) Using a dial gauge, measure the thrust clearance.

**SPECIFIED VALUE:** 0.100–0.225mm for both IN and EX

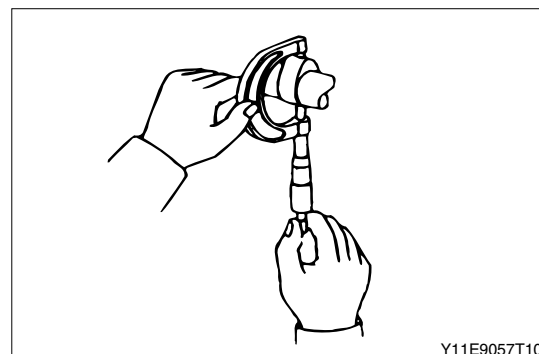
**ALLOWABLE LIMIT:** 0.24mm

#### Camshaft bearing cap/camshaft journal specifications

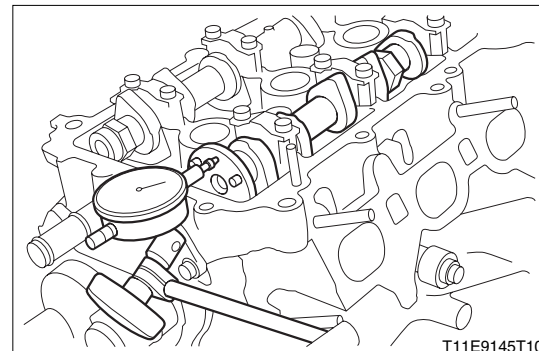
Detected item		No.1 CAMCAP	CAMSHAFT JOURNAL(J1)
Specified value (mm)	IN	(Side width)	(Thrust surface width)
		33.175–33.200	33.3–33.4
	EX	(Side width)	(Thrust surface width)
		23.175–23.200	23.3–23.4



T11E9252T10



Y11E9057T10

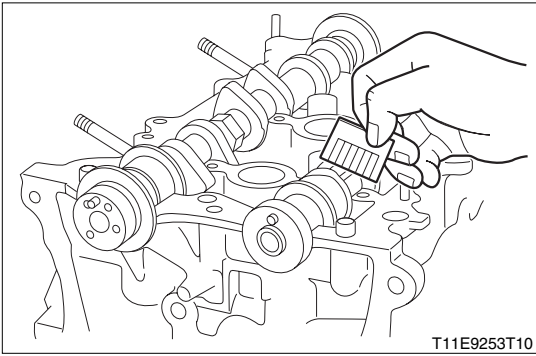


T11E9145T10

4. Check the oil clearance of the camshaft.
- (1) Set a plastigage in the axial direction of the journal section. Confirm the front mark of the camshaft bearing No.1/No.2 cap and journal number. Tighten the bolt to the specified torque.
  - (2) Remove the camshaft bearing cap. Measure the widest part of the plastigage.

SPECIFIED VALUE: Camshaft oil clearances

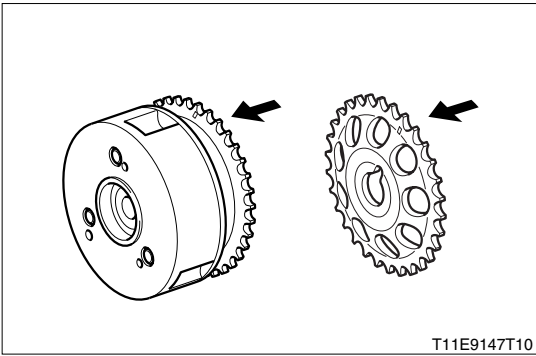
Detected item			Specified value
Camshaft Journal diameter	IN	1J	33.984－34.000
		2－4J	22.949－22.965
	EX	1J	25.979－25.995
		2－4J	22.949－22.965
Cylinder head Journal inner diame- ter	IN	1J	34.025－34.045
		2－4J	23.000－23.021
	EX	1J	26.032－26.052
		2－4J	23.000－23.021
Camshaft oil clearances	IN	1J	0.025－0.061
		2－4J	0.035－0.072
	EX	1J	0.037－0.073
		2－4J	0.035－0.072



ALLOWABLE LIMIT: Camshaft oil clearances

Detected item			Limit value
Camshaft oil clearances	IN	1J	0.09
		2－4J	0.1
	EX	1J	0.1
		2－4J	0.1

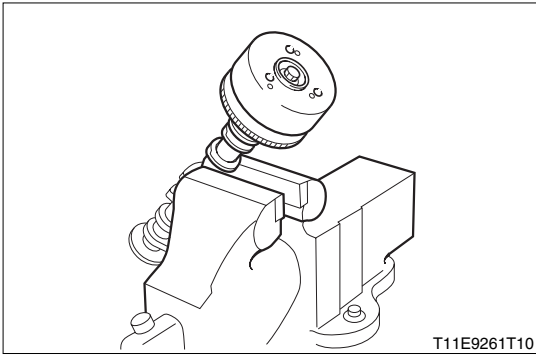
5. Check the camshaft timing sprocket Ay and camshaft timing No.2 sprocket for wear and damage.



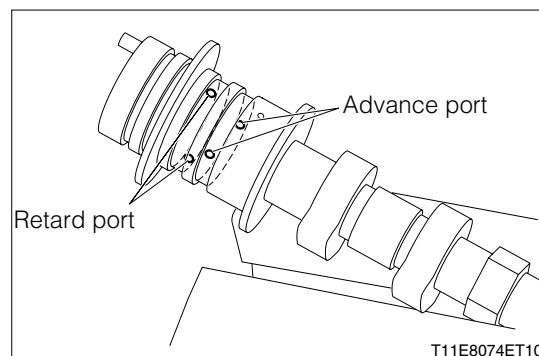
(2) Check of sprocket Ay, camshaft timing  
WARNING

- Do not disassemble the camshaft timing (DVVT controller) sprocket Ay.

- 1. Secure the hexagonal section provided for servicing the camshaft to a vice.
- 2. Temporarily install the camshaft timing sprocket Ay by means of the attaching bolt.



3. Hold one of the two advanced timing side ports at the camshaft with your finger.



4. Apply air pressure to the other advanced timing port by means of an air tool.

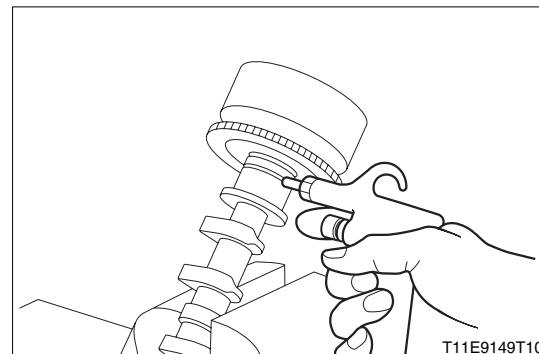
**CAUTION**

- Care must be exercised as to splashing oil.

**NOTE**

- The most retard timing lock is disengaged.

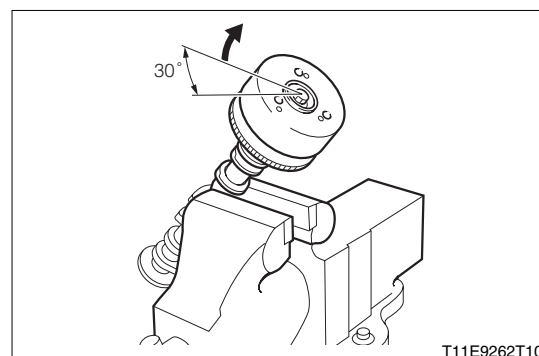
5. At this time, ensure that the most retard timing angle lock of the camshaft timing sprocket Ay is disengaged and the sprocket can be freely moved by your hand without any binding in the range of about 30 degrees.



**NOTE**

- The camshaft timing sprocket Ay is locked when it comes at the most retard angle position.

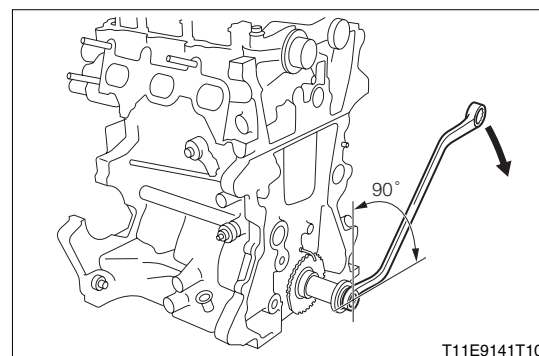
6. After the inspection, lock the camshaft timing sprocket Ay at the most retard timing position. Remove the sprocket.



### 3-1-5 POINTS OF ASSEMBLY

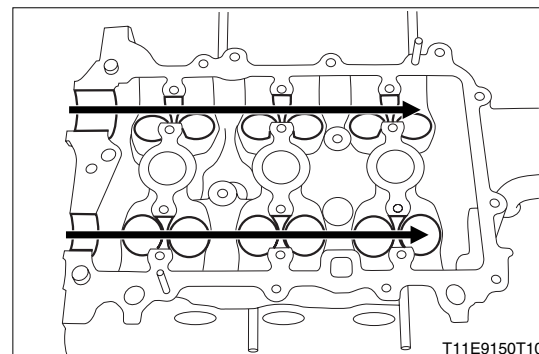
1. Install the No.1/No.2 camshaft.

- (1) Turn the crankshaft about 90 degrees (crank angle) in the engine rotation direction from the top dead center of the cylinder No.1 so that the lifted valve will not interfere with the piston during the installation of the camshaft.

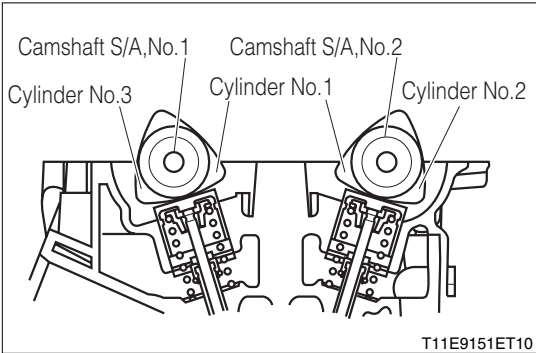


- (2) Apply engine oil to where the cam sections of the No.1 and No.2 camshafts contact with the journal sections.

LUBRICANT: Engine oil



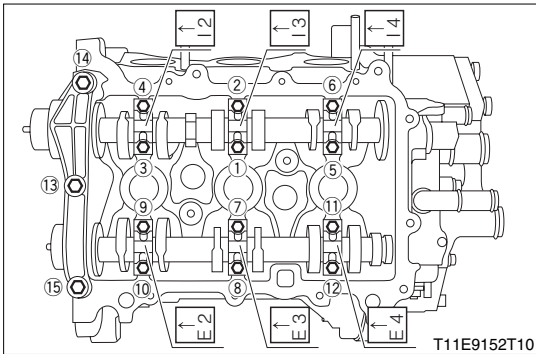
(3) Set the No.1 camshaft Ay so that the cam noses of the No.1 and No.3 cylinders may hold the valve lifters. Also, set the No.2 camshaft Ay (exhaust side) so that the cam noses of the No.1 and No.2 cylinders may hold the valve lifters.



(4) Set the camshaft bearing No.1/No.2 caps, respectively. Tighten the attaching bolts in the sequence shown at the right figure.

**CAUTION**

- During the installation, make sure that the front marks (arrow marks) indicated on the top of each bearing cap face the engine front side.
- As for the installation positions of the stamped number's indicated on the top of the bearing caps, refer to the table below.



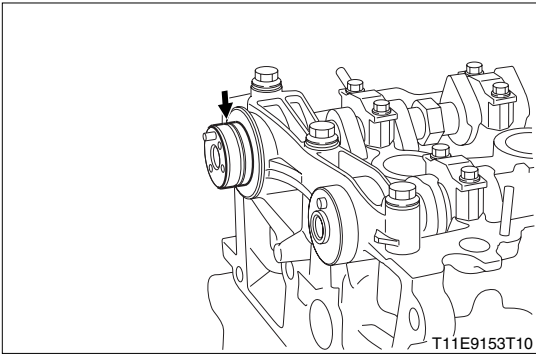
Installation positions of bearing cap No.2

Stamping No.	Installation position	
	Intake/exhaust	Cylinder No.
I2	Intake side	Cylinder No.1
I3		Cylinder No.2
I4		Cylinder No.3
E2	Exhaust side	Cylinder No.1
E3		Cylinder No.2
E4		Cylinder No.3

2. Assemble the camshaft timing sprocket Ay (DVVT controller) and camshaft timing No.2 sprocket.

(1) Apply engine oil to around the installation position of the camshaft timing sprocket Ay of the camshaft.

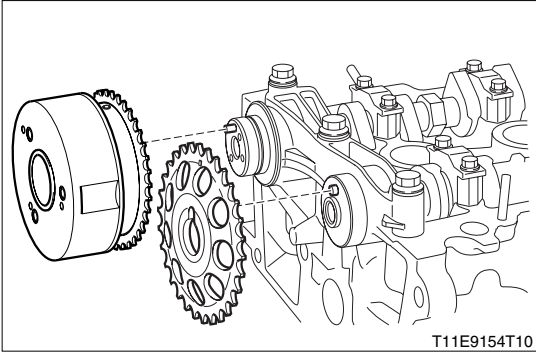
**LUBRICANT:** Engine oil



(2) Insert the knock pin at the forward end of the camshaft into the knock hole of the camshaft timing sprocket Ay.

**CAUTION**

- After the insertion, lightly turn the sprocket to ensure that the knock pin has been completely inserted.
- If the knock pin is not inserted in position and the sprocket is strongly pushed and turned, the sprocket end surface may be damaged. Therefore, utmost care must be exercised in this regard.



(3) Assemble in such a way that the knock pin at the forward end of the camshaft may enter the groove of the camshaft timing No.2 sprocket.

- (4) By utilizing the hexagonal section provided for servicing of the camshaft, tighten the attaching bolt for the camshaft timing sprocket Ay and camshaft timing No.2 sprocket.

3. Check the valve clearances.

#### Specified value

		Valve clearance (mm)
IN	During cold period	0.18 <sup>+0.055</sup> <sub>-0.035</sub>
EX		0.31 <sup>+0.055</sup> <sub>-0.035</sub>

- (1) By utilizing the hexagonal section provided for servicing of the camshaft, set the No.1 and No.2 camshafts in such a way that the mating marks of the sprockets face exactly upward.( Exhaust top dead center)

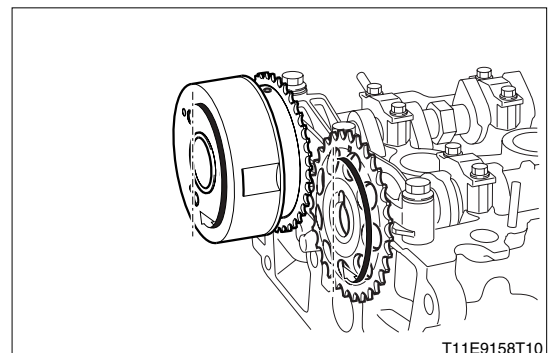
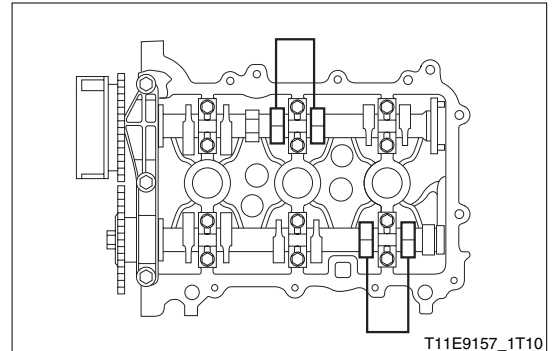
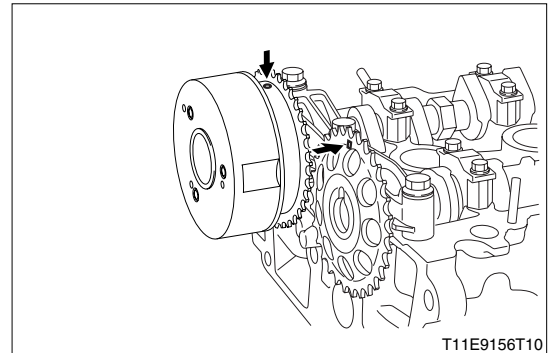
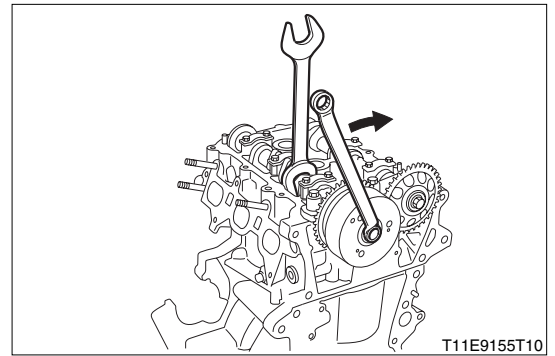
- (2) Using a thickness gauge, check the valve clearances shown in the right figure.

**Valves to be checked when cylinder No.1 is at the top dead center under exhaust stroke**

Cylinder No.1		Cylinder No.2		Cylinder No.3	
IN	EX	IN	EX	IN	EX
—	—	○	—	—	○

#### CAUTION

- The thickness gauge should be inserted from the spark plug side. (central side)
- (3) By utilizing the hexagonal section provided for servicing the camshaft, turn the camshaft 180 degrees. Set the No.1 and No.2 camshafts in such a way that the mating mark of the timing sprocket may face exactly downward.(Compression top dead center)



(4) Using a thickness gauge, check the valve clearances shown in the right figure.

Valves to be checked when cylinder No.1 is at the top dead center under compression stroke

Cylinder No.1		Cylinder No.2		Cylinder No.3	
IN	EX	IN	EX	IN	EX
○	○	—	○	○	—

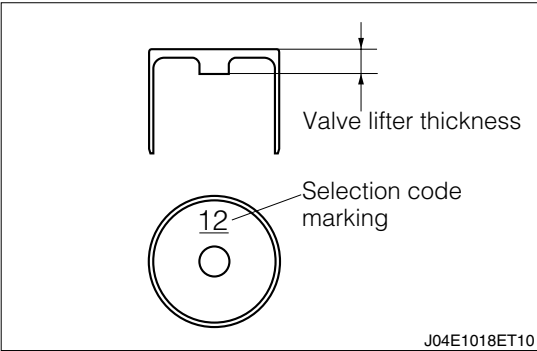
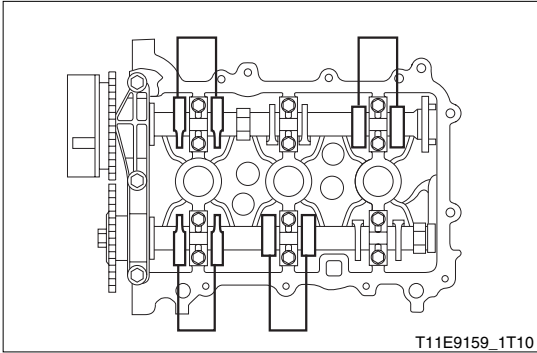
CAUTION

- The thickness gauge should be inserted from the spark plug side. (central side)

4. If the specified value is not obtained, remove the No.1 and No.2 camshafts. Replace the valve lifter as follows, in order to obtain the specified value.

CAUTION

- Record the position of the valve where the clearance deviates from the specification, as well as the their measurement results.



(1) Select the valve lifter, using the following formula given below, so that the valve clearance becomes the specified value.

· Intake side

$$(\text{Thickness of selected lifter}) = (\text{Thickness of removed lifter}) + [(\text{Measurement clearance}) - 0.18\text{mm}]$$

· Exhaust side

$$(\text{Thickness of selected lifter}) = (\text{Thickness of removed lifter}) + [(\text{Measurement clearance}) - 0.31\text{mm}]$$

NOTE

- As for a new valve lifter, identification numbers have been written with indelible ink.

List of valve lifter

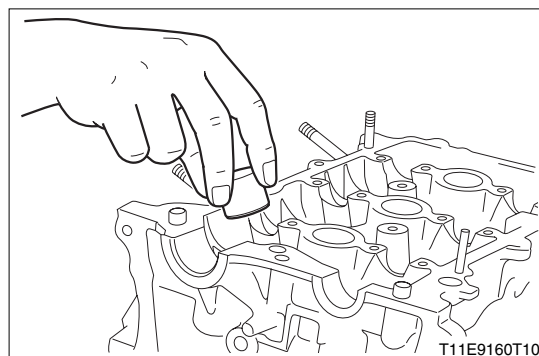
No.	Lifter thickness (mm)	No.	Lifter thickness (mm)	No.	Lifter thickness (mm)	No.	Lifter thickness (mm)
12	5.12	28	5.28	44	5.44	60	5.6
14	5.14	30	5.3	46	5.46	62	5.62
16	5.16	32	5.32	48	5.48	64	5.64
18	5.18	34	5.34	50	5.5	66	5.66
20	5.2	36	5.36	52	5.52	68	5.68
22	5.22	38	5.38	54	5.54	—	—
24	5.24	40	5.4	56	5.56	—	—
26	5.26	42	5.42	58	5.58	—	—

5. Apply engine oil to the circumference of the selected valve lifter. Insert the valve lifter straight into the lifter hole.

LUBRICANT: Engine oil

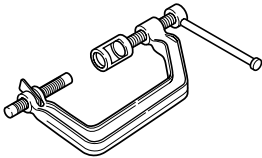
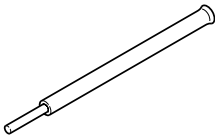
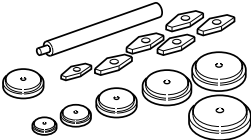
**CAUTION**

- After insertion, ensure that the valve lifter turns smoothly.





4 CYLINDER HEAD AY  
4-1 DISASSEMBLING AND ASSEMBLING  
4-1-1 ARTICLES TO BE PREPARED  
SST

Shape	Part No.	Part name
	09202-87002-000 (09202-87001-000)	Remover & replacer, valve cotter
	09201-87203-000	Remover & replacer, valve guide bush
	09608-87302-000	Tool set, axle hub bearing & drive pinion bearing

Tool

Scraper

Instrument

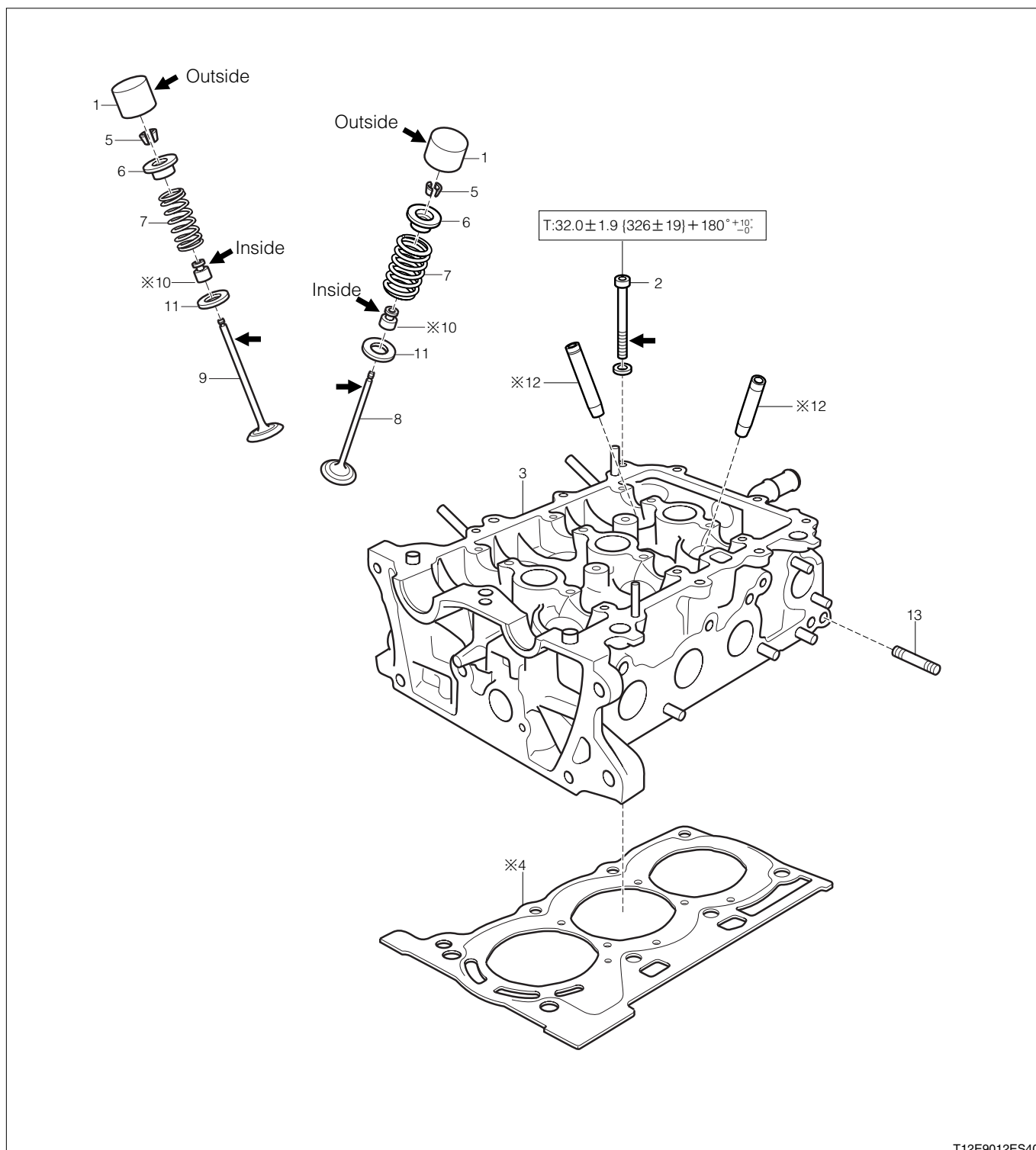
Precision straightedge, Steel square, Vernier calipers, Torque wrench, Micrometer

Lubricant, adhesive, others

Engine oil

## 4-1-2 DISASSEMBLING AND ASSEMBLING

## (1) Components



T12E9012ES40

➔: Engin oil

Unit: N·m{kgf·cm}

※: Non-reusable parts

## (2) Disassembling and assembling procedure

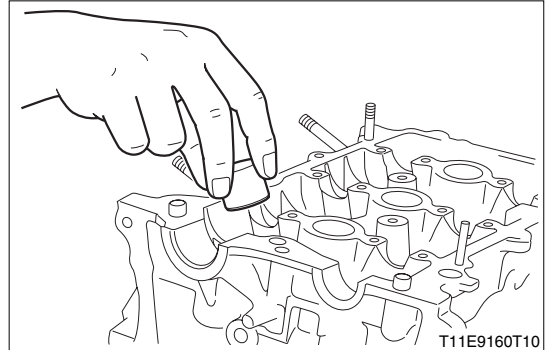
- |   |                             |    |                      |
|---|-----------------------------|----|----------------------|
| 1 | Lifter, valve               | 8  | Valve, exhaust       |
| 2 | Bolt, cylinder head         | 9  | Valve, intake        |
| 3 | Head Ay, cylinder           | 10 | Seal, valve stem oil |
| 4 | Gasket, cylinder head       | 11 | Seat, valve spring   |
| 5 | Lock, valve spring retainer | 12 | Bush, valve guide    |
| 6 | Retainer, valve spring      | 13 | Bolt, stud           |
| 7 | Spring, compression         |    |                      |

### 4-1-3 POINTS OF DISASSEMBLY

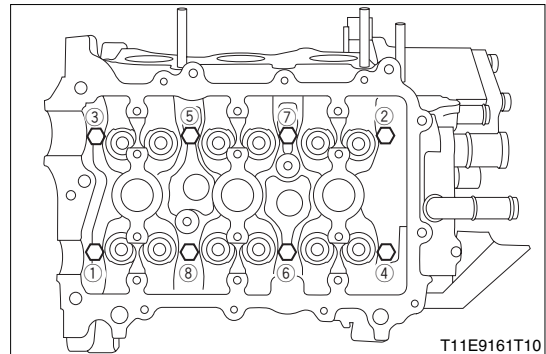
1. Remove the valve Lifter.

#### CAUTION

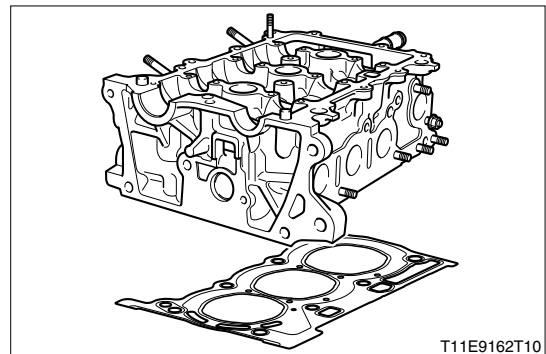
- When removing the valve lifters, record the stamped numbers of the valve lifters for each valve.
- Place the valve lifters in order by the cylinder.



2. Evenly loosen the cylinder head bolts in the sequence shown at the right figure over several stages and remove them.



3. Remove the cylinder head Ay and cylinder head gasket from the cylinder block Ay.

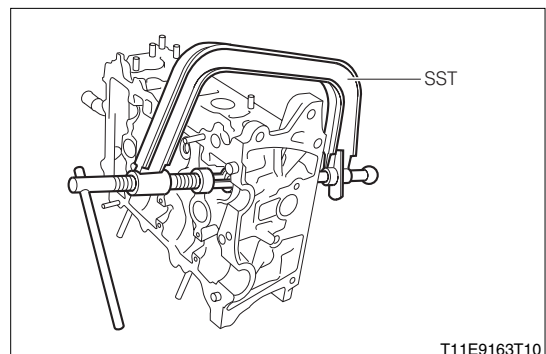


4. Using the SST, remove the valve spring retainer locks at the intake side and exhaust side. Then, remove the valve spring retainer and compression spring progressively.

SST: 09202-87002-000

#### CAUTION

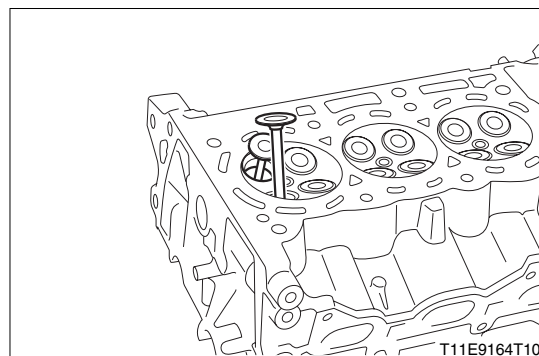
- Place each part in order by the cylinder.



5. Remove the intake valve and exhaust valve.

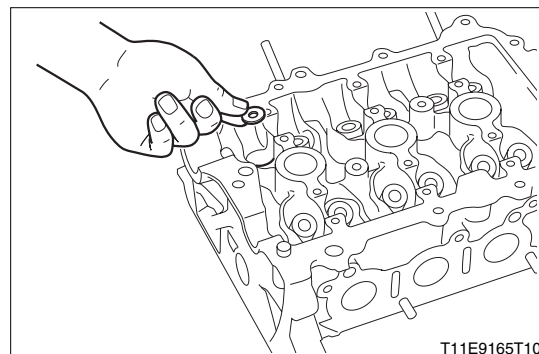
**CAUTION**

- Place each valve in order by the cylinder.



6. Remove the valve stem oil seal and valve spring seat.

7. Heat the cylinder head Ay in hot water or the like to 80–100°C.

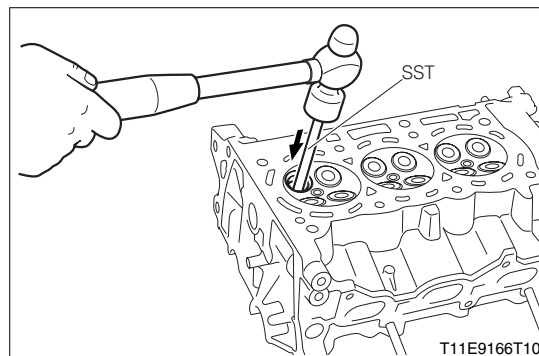


8. Using the SST, drive out the valve guide bush from the combustion chamber side.

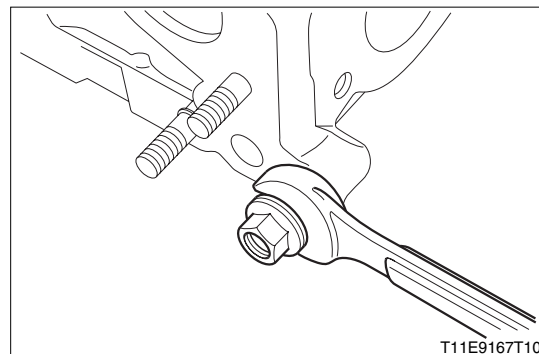
SST: 09201-87203-000

**CAUTION**

- The valve guide bush that has been once removed cannot be used again.



9. Put a double nut to the stud bolt and remove the bolt.



#### 4-1-4 CLEANING

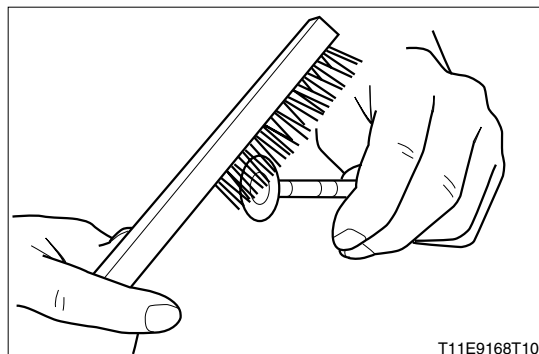
##### (1) Cleaning of valves

1. Remove carbon which gets to each valve.

TOOL: Wire brush

**WARNING**

- Wear safety goggles during the cleaning so as to protect your eyes.



# B-29

## (2) Cleaning of head, cylinder

1. Using a scraper, clean the cylinder block surface and manifold surface of the cylinder head.

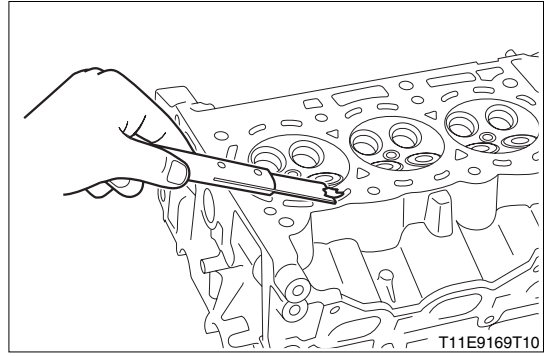
TOOL: Scraper

### WARNING

- Wear safety goggles during the cleaning so as to protect your eyes.

### CAUTION

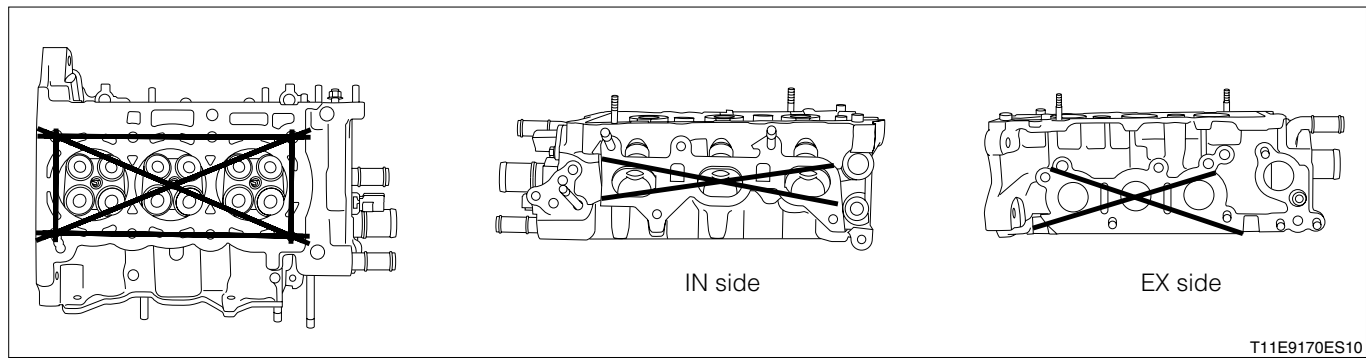
- Be very careful not to damage the cylinder head Ay during the cleaning.
- Be very careful not to allow the cylinder head gasket debris, etc. to fall into the water jacket.



## 4-1-5 CHECK

### (1) Check of head, cylinder

1. Using a straightedge and thickness gauge, perform measurement at sections shown at the figure below.

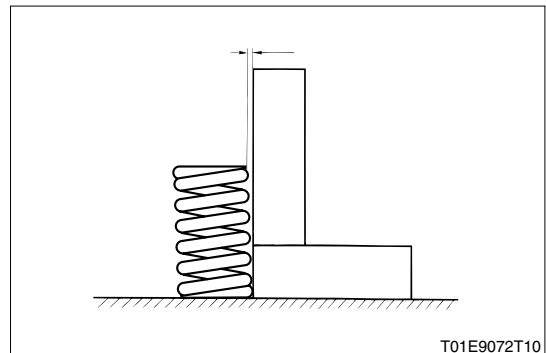


ALLOWABLE LIMIT: 0.05mm

### (2) Check of spring, compression

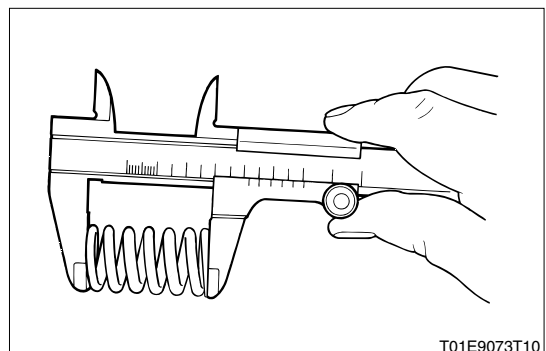
1. Using a straightedge, measure the squareness of the valve spring.

ALLOWABLE LIMIT: 1.5mm



2. Measure the free length of the spring.

ALLOWABLE LIMIT: 51.63mm



### (3) Check of valve

#### ① Unit check of valve

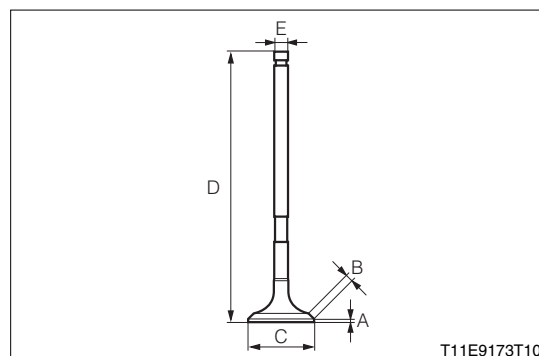
1. Check each valve for deformation and severe wear.

##### Unit check of valve

Detected item		Specified value	Limit value
Stock thickness of valve head section: A (mm)	IN	$1.25 \pm 0.2$	0.7
	EX	$1.30 \pm 0.2$	0.7
Contact width: B (mm)	IN	$1.30^{+0.4}_{-0.1}$	—
	EX	$1.26^{+0.35}_{-0.15}$	—

##### Valve specifications

Detected item	Valve, intake	Valve, exhaust
Valve head diameter: C (mm)	$27.5 \pm 0.15$	$23.6 \pm 0.15$
Overall length: D (mm)	88.39	89.11
Diameter of stem end section: E (mm)	$4.2 \pm 0.3$	$4.2 \pm 0.3$



#### ② Check of clearance between valve guide bush and valve stem

1. Using a caliper gauge, measure the inner diameter of the valve guide bush. Using a micrometer, measure the outer diameter of the valve stem.

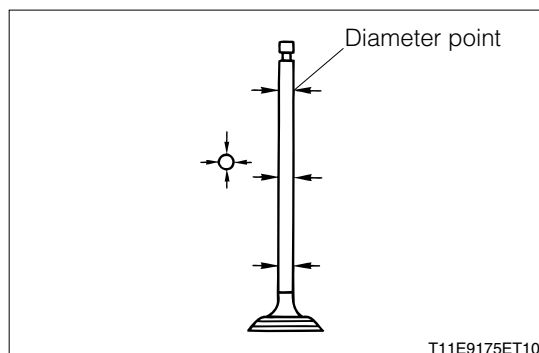
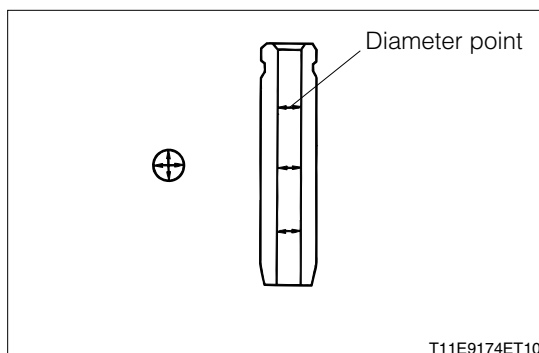
##### CAUTION

- Perform the measurement at several sections. Calculate the clearance at the section where the wear is the greatest.

2. Calculate the difference between the measured values to obtain the clearance.

##### Check of clearance between valve guide bush and valve stem

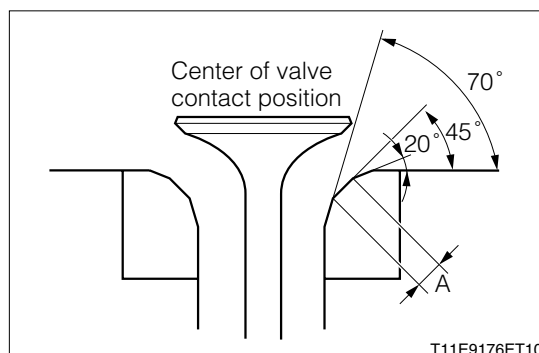
Detected item		Specified value	Limit value
Valve guide bush inner diameter(mm)		5.01—5.03	—
Valve stem outer diameter (mm)	IN	4.970—4.985	—
	EX	4.965—4.980	—
Clearance (mm)	IN	0.025—0.060	0.08
	EX	0.030—0.065	0.1



#### ③ Check of valve contact surface

1. Thinly apply red lead to the valve contact surface. Lightly bring the valve into contact with the valve seat without turning the valve. Check the contact and contact width.

Detected item		Specified value
Contact width: A (mm)	IN	$1.3^{+0.4}_{-0.1}$
	EX	$1.26^{+0.35}_{-0.15}$



## (4) Correction of valve seat

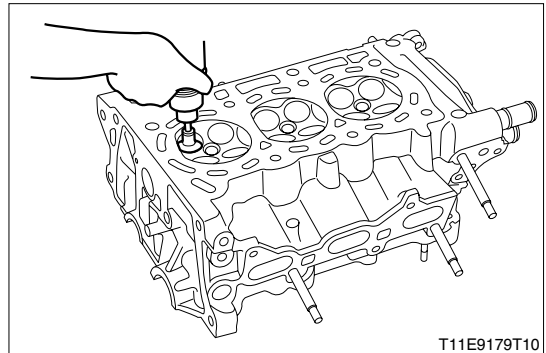
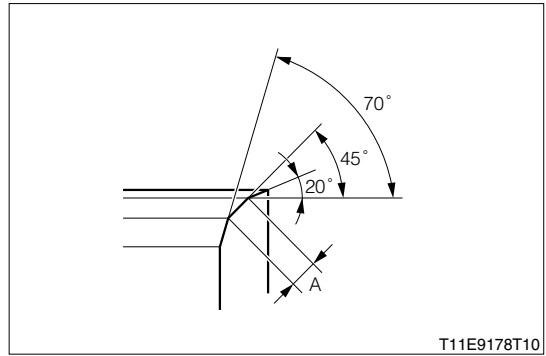
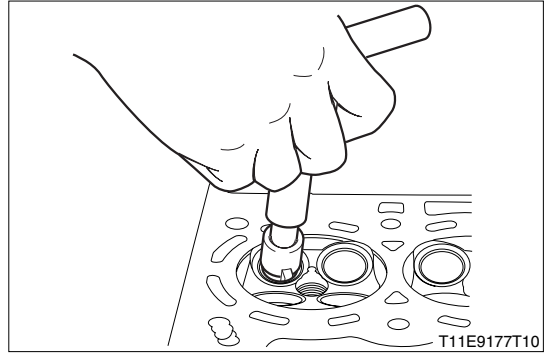
1. With a 45 degrees cutter, grind the seat so that the contact width can become greater than the specified value.

### CAUTION

- Perform the seat correction, always checking the valve contact position.
- Reduce the grinding force gradually as reaching to the end of the grind so that no ridge may be formed at the corrected surface.

2. Check each valve for contact position. Perform grinding with a 45 degrees cutter so that the contact position may come to the center of the valve face.
3. Perform grinding with a 20 degrees or 70 degrees cutter in such a way that the valve contact position comes at the center throughout the circumference and the contact width becomes the specified value.

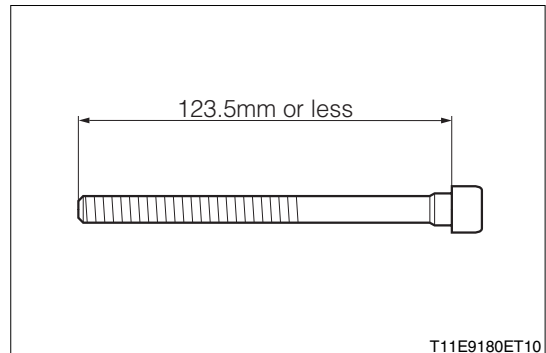
4. Rub the compound to the contact surface.



## (5) Check of bolt, cylinder head

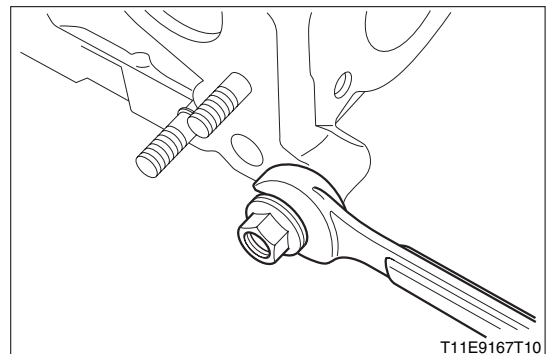
1. Measure the length of the cylinder head bolt.

**ALLOWABLE LIMIT:** Not to exceed 123.5mm



## 4-1-6 POINTS OF ASSEMBLY

1. Install the double nut to the stud bolt.



2. With the SST, drive the new valve guide bush until the protruding amount of it becomes the value indicated in the table.

SST: 09201-87203-000

#### Driving valve guide bush into position

Bush-protruding amount from the driven-in surface (mm)	IN	$10.1 \pm 0.3$
	EX	$9.7 \pm 0.3$

3. Polish the inner diameter with a reamer to bring the clearance into the specified value.

SPECIFIED VALUE: IN :  $0.025 - 0.06\text{mm}$

EX :  $0.03 - 0.065\text{mm}$

4. Install the valve spring seat and valve stem oil seal.

- (1) Apply engine oil to the inside of the new valve stem oil seal. Install the valve stem oil seal by pushing its shoulder section.

#### NOTE

- After press-fitting, ensure that the valve stem oil seal has been press-fit to the specified dimension.

SPECIFIED VALUE: IN :  $10.5 \pm 0.8\text{mm}$

EX :  $10.1 \pm 0.8\text{mm}$

SPECIFIED VALUE: IN :  $10.8 \pm 0.8\text{mm}$

EX :  $10.2 \pm 0.8\text{mm}$

LUBRICANT: Engine oil

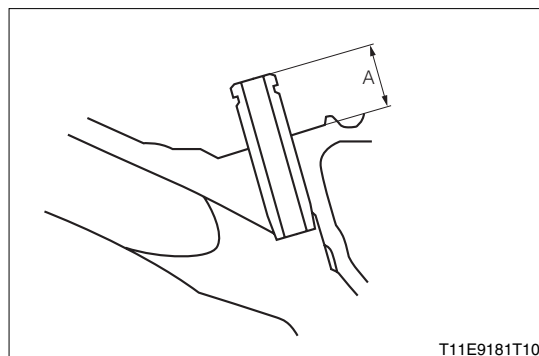
5. Install the exhaust valve and intake valve.

- (1) Apply engine oil to the forward end of each valve over the length of 30 mm or more. Then, install the valve.

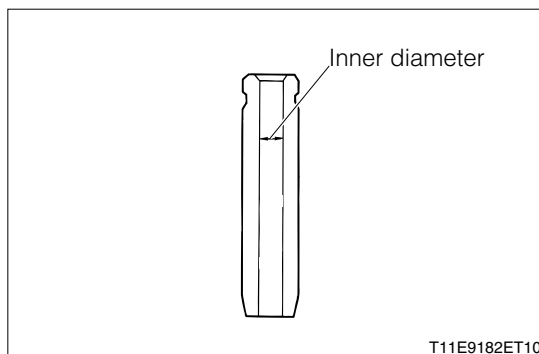
LUBRICANT: Engine oil

- (2) After installing each valve, apply engine oil to the valve guide bush and the lip section of the valve stem oil seal.

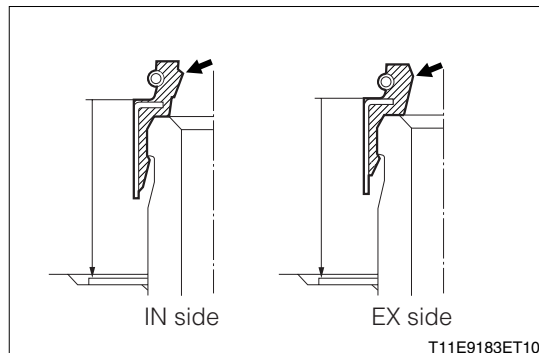
LUBRICANT: Engine oil



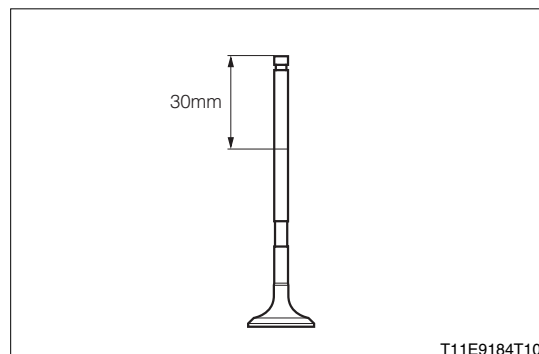
T11E9181T10



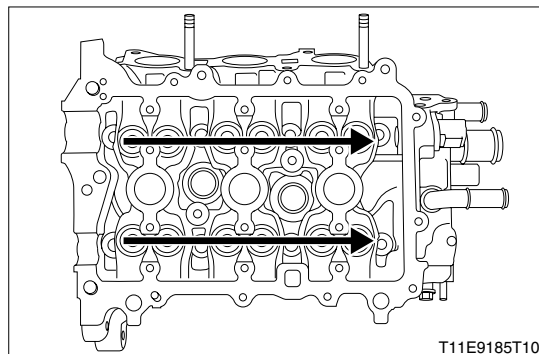
T11E9182ET10



T11E9183ET10



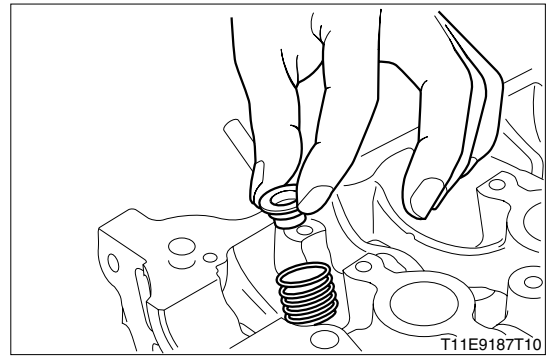
T11E9184T10



T11E9185T10



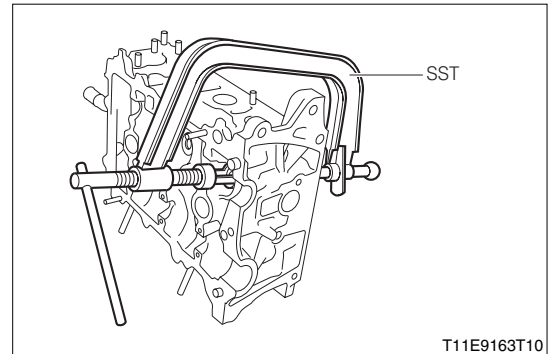
(3) Install the retain valve spring .



(4) Using the SST, install the valve spring retainer lock.  
SST: 09202-87002-000

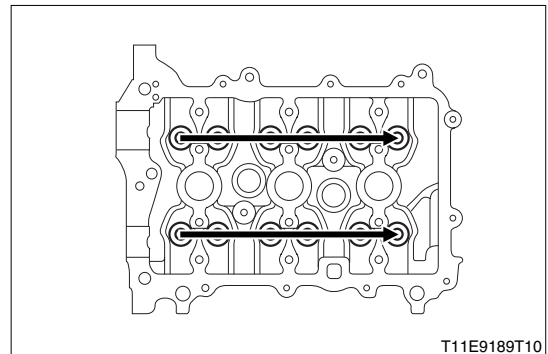
## WARNING

- Wear safety goggles during the operation so as to protect your eyes.
- Be careful not to allow the compression spring, etc. to jump out.



(5) After installing all the compression springs, apply engine oil to the top surface of the valve lifter as shown in the figure.

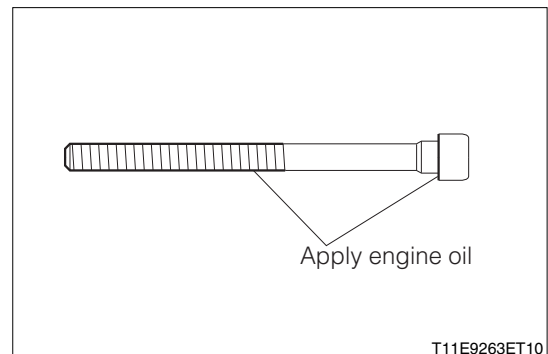
**LUBRICANT:** Engine oil



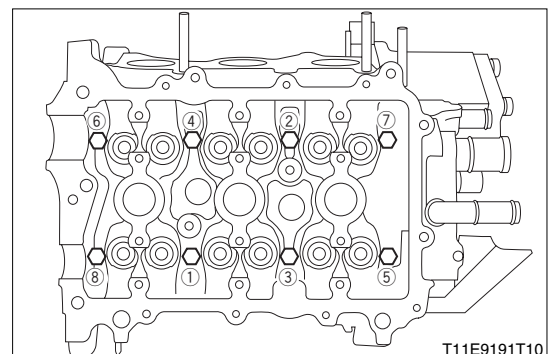
6. Install the cylinder head Ay to the cylinder block Ay.

- (1) Set the cylinder head gasket and cylinder head Ay to the cylinder block Ay.
- (2) Assemble the plate washer to the cylinder head Ay. Apply engine oil to the threaded portion of the bolt and bolt side seat surface. Then, assemble the bolts.

**LUBRICANT:** Engine oil



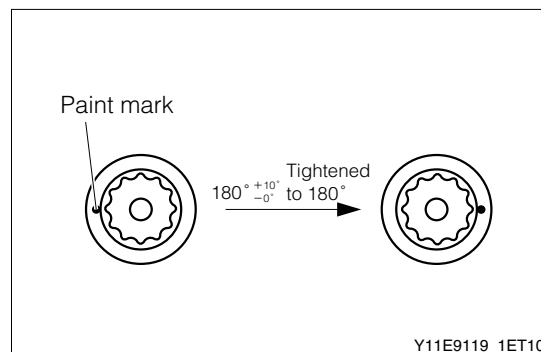
(3) To assemble the cylinder head Ay, tighten the bolts over two or three stages in the sequence shown at the right figure. Then, tighten them to the specified torque.



- (4) After tightening to the specified torque, further tighten each of them  $180^\circ \begin{smallmatrix} +10^\circ \\ -0^\circ \end{smallmatrix}$  in the same sequence.

**NOTE**

- Put a paint mark on the top of each cylinder head bolt in the same direction. After tightening the bolts  $180^\circ$  in the sequence above, ensure that all the bolt marks have been turned  $180^\circ$ .

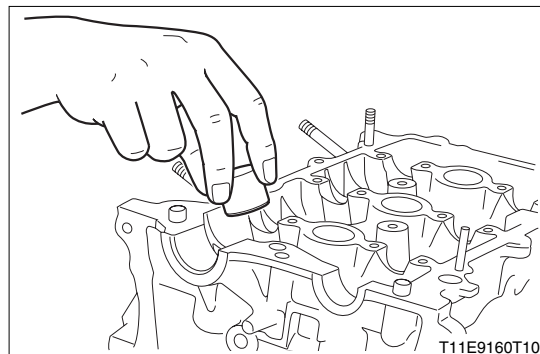


7. Apply engine oil to the circumference of the valve lifter. Insert the valve lifter straight into the lifter hole.

LUBRICANT: Engine oil

**CAUTION**

- Make sure that all the valves are assembled in position with their numbers returned to their original positions.
- After assembling the valve lifter, ensure that the lifter can turn lightly.



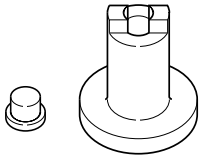
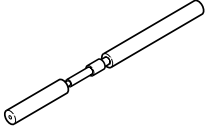
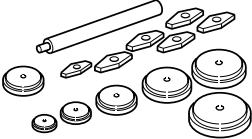
# B-35

## 5 CYLINDER BLOCK AY

### 5-1 DISASSEMBLING AND ASSEMBLING

#### 5-1-1 ARTICLES TO BE PREPARED

SST

Shape	Part No.	Part name
	09221-B1010-000	Remover & replacer
	09221-B1020-000	Remover & replacer
	09608-87302-000	Tool set, axle hub bearing & drive pinion bearing

#### Tool

Scraper

#### Instrument

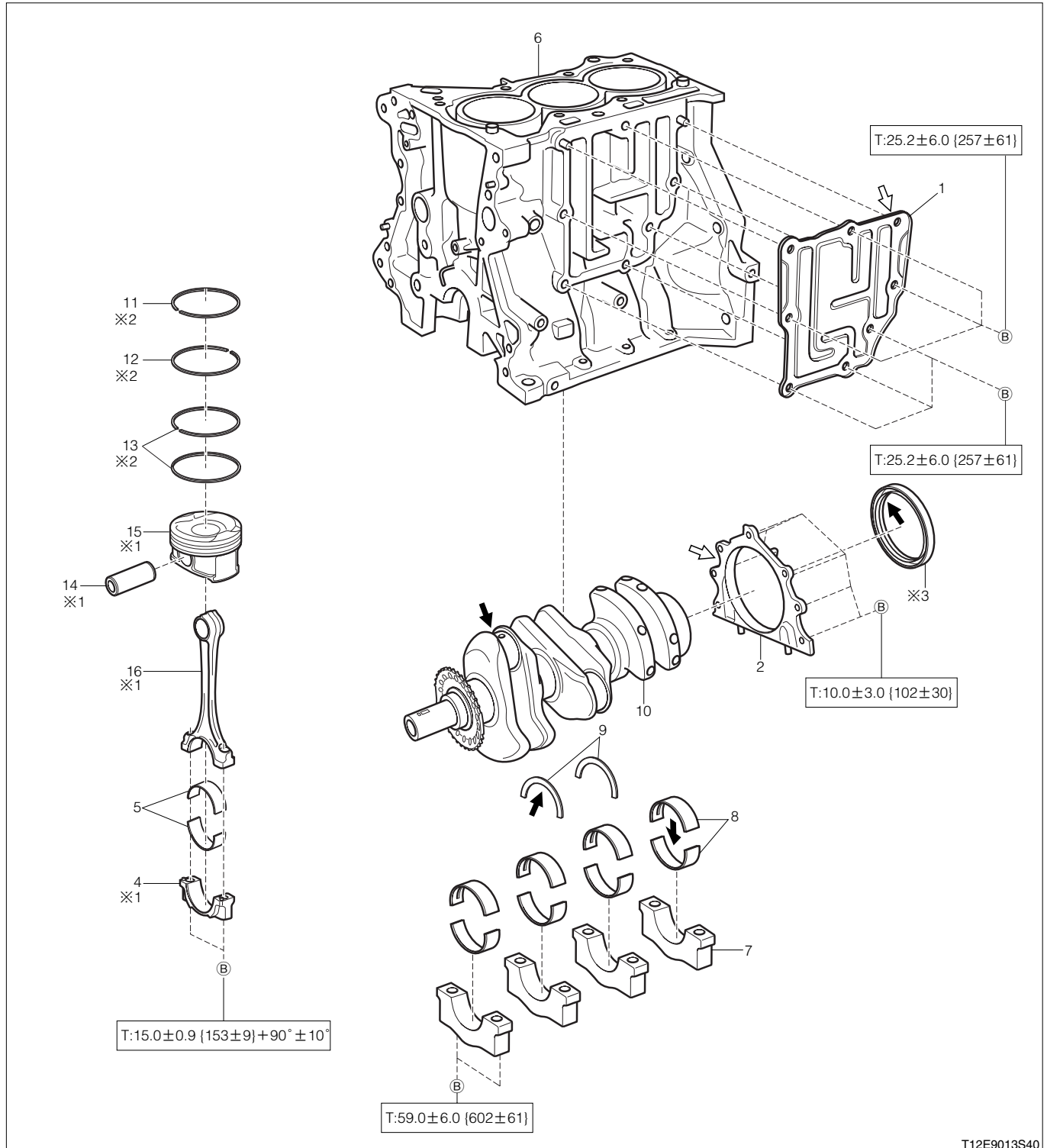
Thickness gauge, Micrometer, Precision straightedge, Steel square, Dial gauge, Vernier calipers, Cylinder gauge, Press gauge, Torque wrench

#### Lubricant, adhesive, others

Engine oil, Three Bond1280E

## 5-1-2 DISASSEMBLING AND ASSEMBLING

### (1) Components



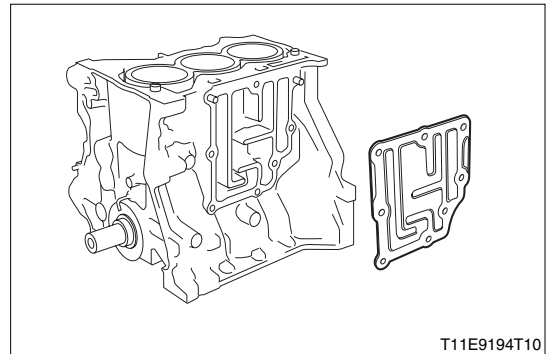
T12E9013S40

## (2) Disassembling and assembling procedure

- |   |                             |    |                           |
|---|-----------------------------|----|---------------------------|
| 1 | Plate, ventilation baffle   | 9  | Washer, crankshaft thrust |
| 2 | Retainer, oil seal          | 10 | Crankshaft                |
| 3 | Seal, type T oil            | 11 | Ring, compression, No.1   |
| 4 | Cap, connecting rod bearing | 12 | Ring, compression, No.2   |
| 5 | Bearing, connecting rod     | 13 | Ring, oil                 |
| 6 | Rod, piston W/ connecting   | 14 | Pin, piston               |
| 7 | Cap, crankshaft bearing     | 15 | Piston                    |
| 8 | Bearing, crankshaft         | 16 | Rod, connecting           |

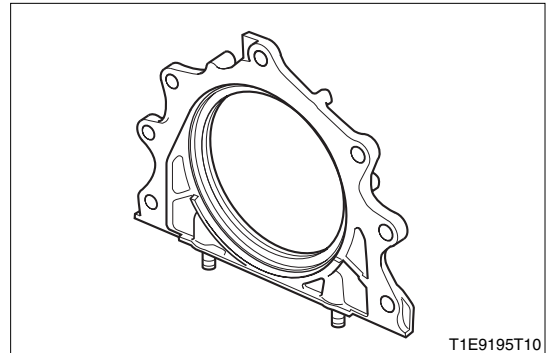
### 5-1-3 POINTS OF DISASSEMBLY

1. Remove the ventilation baffle plate.



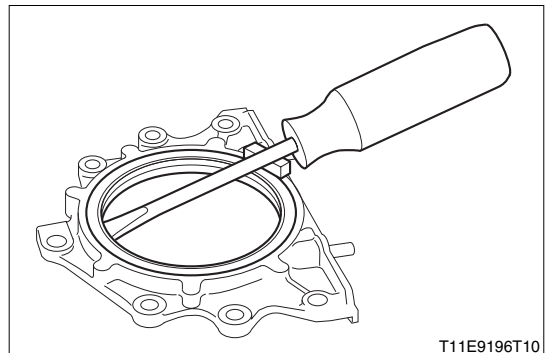
T11E9194T10

2. Remove the oil seal retainer.



T1E9195T10

3. With a flat screwdriver, remove the type T oil seal.



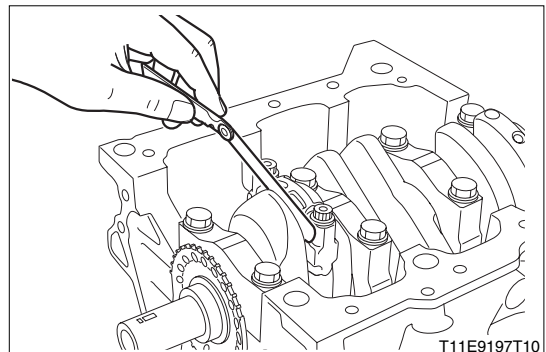
T11E9196T10

4. Check the thrust clearance of the connecting rod.

(1) Using a dial gauge or thickness gauge, measure the thrust clearance.

**SPECIFIED VALUE: 0.1—0.3mm**

**ALLOWABLE LIMIT: 0.35mm**



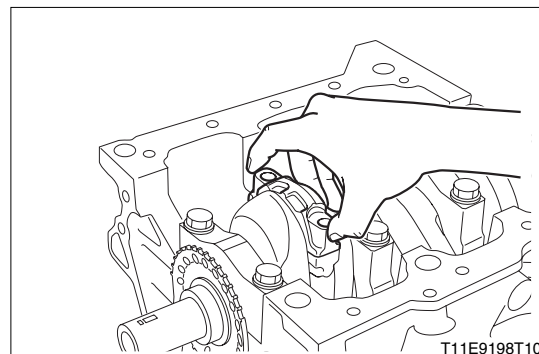
T11E9197T10

5. Check the oil clearance of the connecting rod bearing.

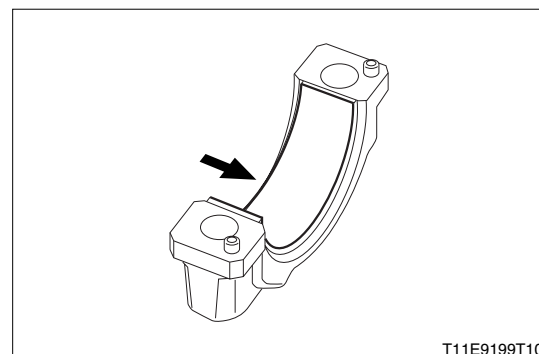
- (1) Remove the connecting rod bearing caps and connecting rod bearings.

**CAUTION**

- Place them in order by the cylinder.



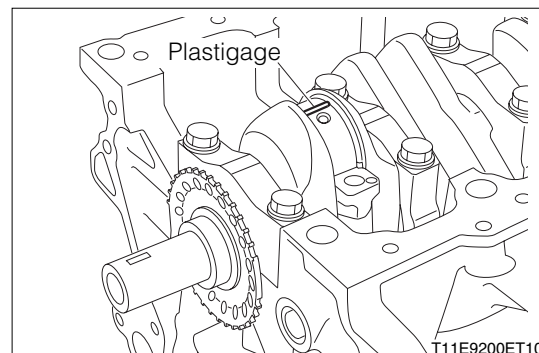
- (2) Clean the connecting rod bearing and crank pin.



- (3) Set the plastigage in the axial direction of the crank pin. Tighten the connecting rod bearing cap to the specified torque.

**CAUTION**

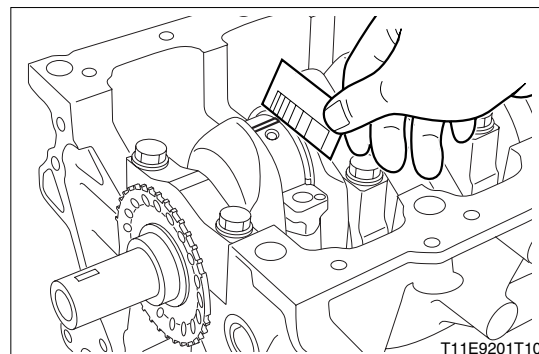
- Do not turn the crankshaft.



- (4) Remove the connecting rod bearing cap. Measure the plastigage at a point where the width is the greatest.

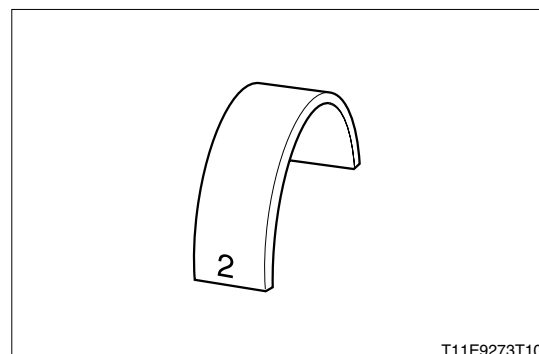
SPECIFIED VALUE: 0.010—0.036mm

ALLOWABLE LIMIT: 0.045mm



**NOTE**

- If the allowable limit is exceeded, install the bearing which has the same number as that indicated on the bearing back surface or connecting rod. (This bearing is supplied together with the connecting rod.) If the limit is still exceeded even after the bearing is replaced, replace the crankshaft.



Specified values

Fitting number	Bore diameter of connecting rod big end (mm Dia)	Central thickness of bearing (mm)	Crankshaft pin diameter (mm Dia)
1	43.000 or more — 43.008 or less	1.492 or more — 1.495 or less	39.992 — 40.000
2	more than 43.008 — 43.016 or less	more than 1.495 — 1.498 or less	
3	more than 43.016 — 43.024 or less	more than 1.498 — 1.501 or less	

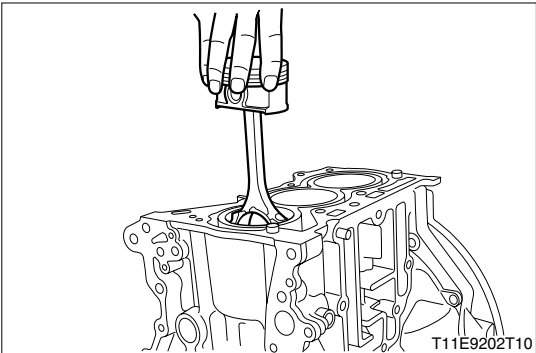
Measurement points for bore diameter of connecting rod big end and central thickness of bearing

6. Remove the connecting rod bearing cap and connecting rod bearing.

7. Remove the piston Ay with the connecting rod by tapping it by the holder of a hammer or the like, being careful not to scratch the cylinder and crankshaft by the end of the connecting rod.

CAUTION

- Place the pistons in order by the cylinder.



8. Check the thrust clearance of the crankshaft.

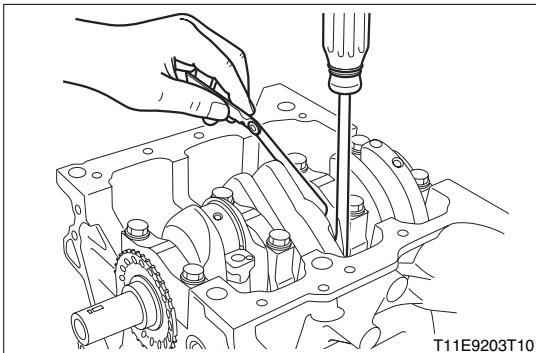
(1) With a thickness gauge, measure the thrust clearance.

SPECIFIED VALUE: 0.02 — 0.22mm

ALLOWABLE LIMIT: 0.30mm

NOTE

- If the thrust clearance exceeds the allowable limit, replace the thrust washer.  
If the clearance exceeds the limit even after the replacement, replace the crankshaft.



9. Check the oil clearance of the crankshaft.

(1) Remove the crankshaft bearing cap and crankshaft bearing.

CAUTION

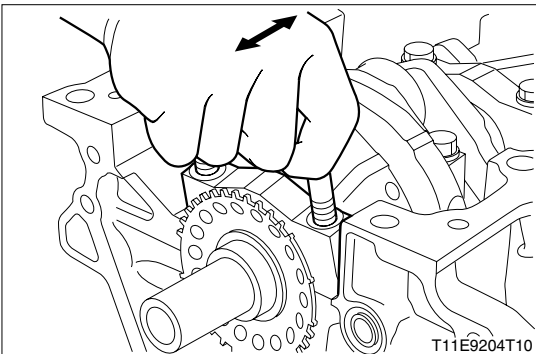
- Place the removed parts in the order of removal.

NOTE

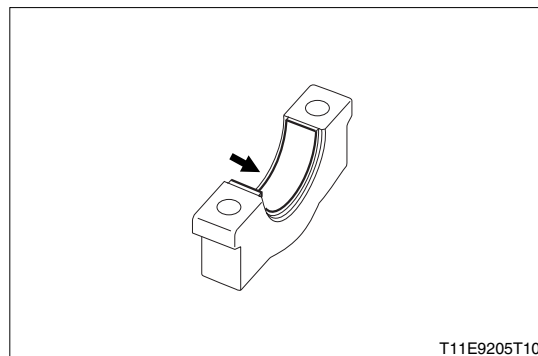
- If any difficulty is encountered in removing the crankshaft bearing cap, remove it by tapping with a plastic hammer.

CAUTION

- Move the upper section of the crankshaft bearing cap along the crankshaft.



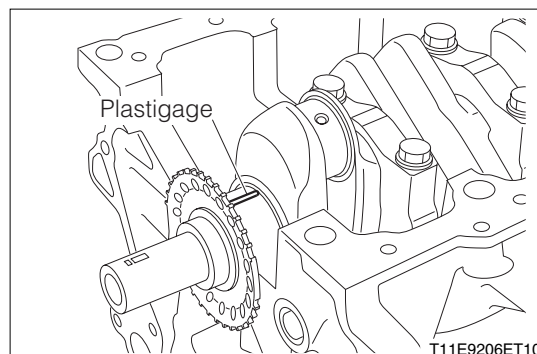
- (2) Clean the inside of the crankshaft bearing, inside of the crankshaft bearing cap, journal section of the cylinder block, and journal section of the crankshaft. Check for severe wear or damage.



- (3) Set the plastigage in the axial direction of the crankshaft journal. Tighten the crankshaft bearing cap to the specified torque.

**CAUTION**

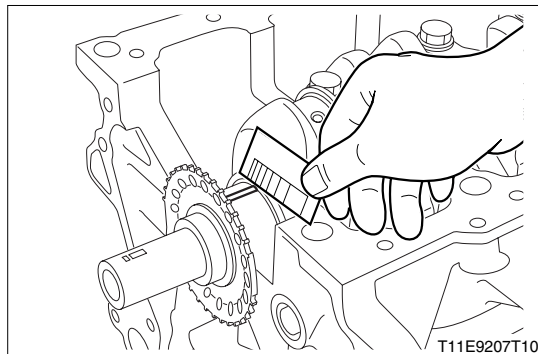
- Do not turn the crankshaft.



- (4) Remove the crankshaft bearing cap. Measure the plastigage at a point where the width is the greatest.

**SPECIFIED VALUE:** 0.010–0.028mm

**ALLOWABLE LIMIT:** 0.046mm





NOTE

- If the oil clearance exceeds the allowable limit, install the bearing which has the same number as that indicated on the back surface of the bearing or crankshaft. If the oil clearance still exceeds the limit even after the bearing is replaced, replace the crankshaft.
- The following indicates the relationship between the crankshaft bearing number, crank journal number and cylinder block journal number.

$$\text{Crankshaft bearing number} = \text{Crank journal number} + \text{Cylinder block journal number}$$

Cylinder block journal hole diameter

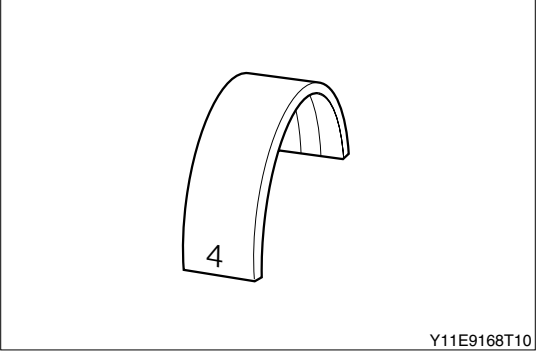
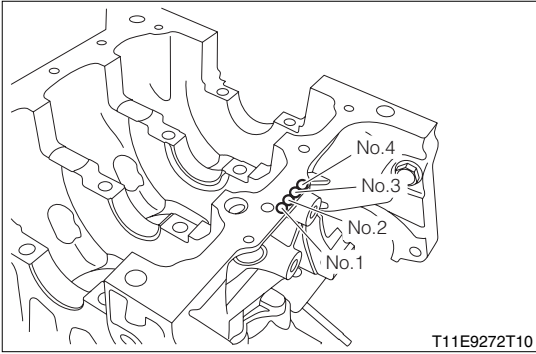
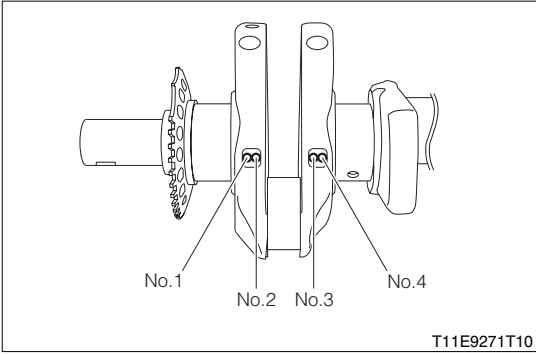
Cylinder block journal hole diameter (mm Dia)	
No.	48 tolerance
1	0 or more +0.006 or less
2	More than +0.006 +0.012 or less
3	More than +0.012 +0.018 or less

Crankshaft journal diameter

Crankshaft journal diameter (mm Dia)	
No.	44 tolerance
2	-0.012 or more -0.006 or less
1	More than -0.006 0 or less

Crankshaft bearing thickness

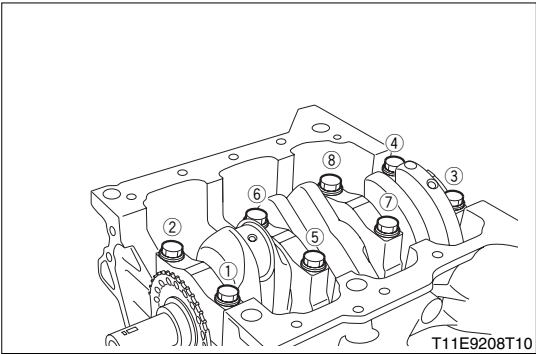
Crankshaft bearing thickness (mm Dia)	
No.	2.0 tolerance
2	More than -0.006 -0.003 or less
3	More than -0.003 -0.000 or less
4	More than -0.000 +0.003 or less
5	More than +0.003 +0.006 or less



10.Remove the crankshaft bearing cap. Remove the crankshaft bearing, crankshaft thrust washer and crankshaft.

CAUTION

- Loosen the bolts of the crankshaft bearing cap over two or three stages in the sequence shown at the right figure.

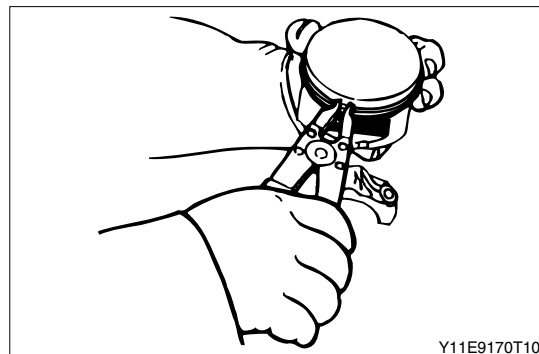


11. Disassemble the piston and connecting rod.

- (1) By using the piston ring tool, No.1 compression ring, No.2 compression ring and oil ring.

**CAUTION**

- Never reuse the removed piston ring.



#### 5-1-4 CLEANING

##### (1) Cleaning of block, cylinder

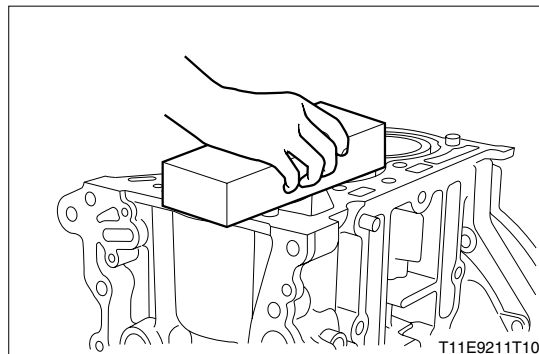
1. With an oil stone or the like, clean the chain cover surface of the cylinder block, cylinder head surface, oil pan S/A and ventilation baffle plate surface.

**WARNING**

- Wear safety goggles during the cleaning so as to protect your eyes.

**CAUTION**

- Be careful not to scratch the cylinder block during the cleaning.
- Be very careful not to allow the cylinder head gasket debris, etc. to fall into the water jacket.



##### (2) Cleaning of piston

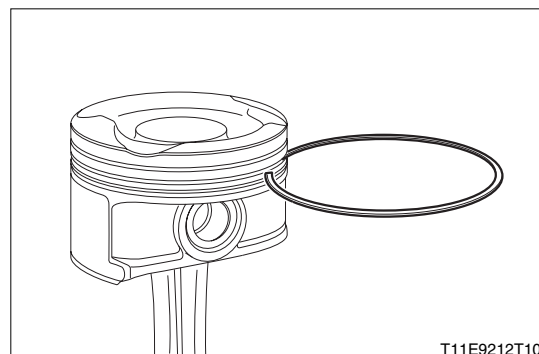
1. Using an old piston ring or the like, remove carbon.

**WARNING**

- Wear safety goggles during the cleaning so as to protect your eyes.

**CAUTION**

- Be careful not to scratch the piston during the cleaning.
2. Remove carbon from various parts using cleaning fluid, etc.

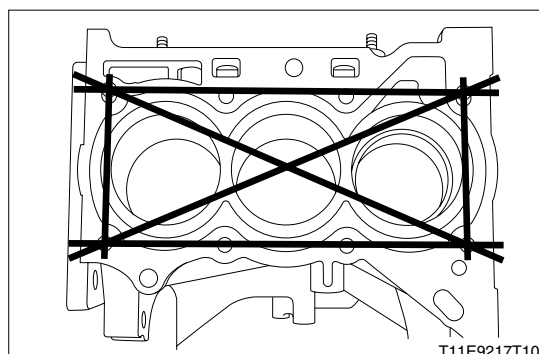


#### 5-1-5 CHECK

##### (1) Check of block, cylinder

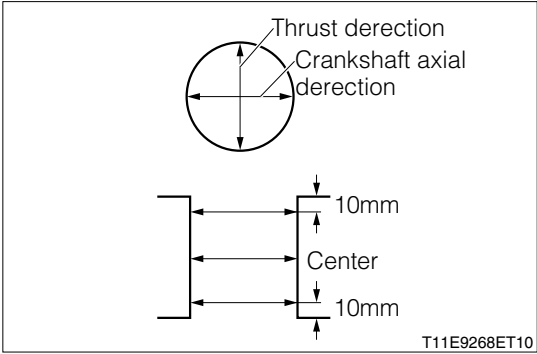
1. Using a straightedge and thickness gauge, perform measurement at sections shown at the right figure.

ALLOWABLE LIMIT: 0.05mm



2. With the cylinder gauge, measure the points shown at the right figure and record them.

**SPECIFIED VALUE:** Specified inner diameter of cylinder block  
71.000—71.013mm  
**ALLOWABLE LIMIT:** 71.013mm

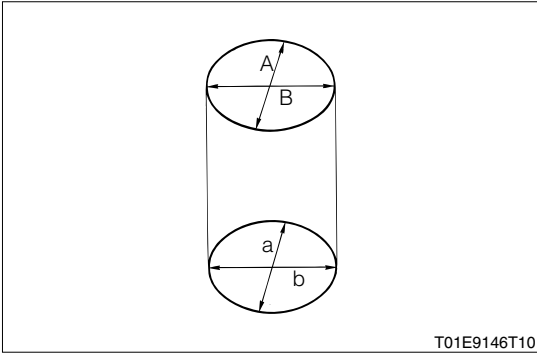


3. Calculate the degree of ellipse and degree of taper.

**ALLOWABLE LIMIT:** 0.02mm

**NOTE**

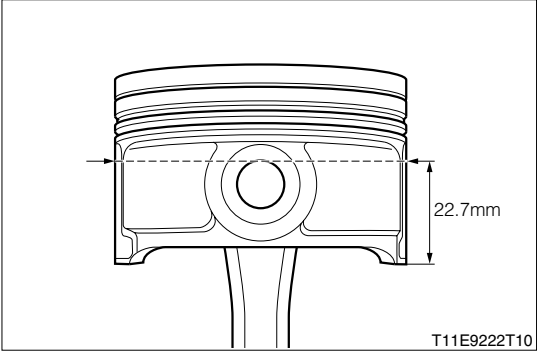
- Degree of ellipse:  $A - B$  or  $a - b$
- Degree of taper:  $A - a$  or  $B - b$



**(2) Check of piston**

1. Measure the outer diameter of the piston.
- (1) At a point 22.7 mm from the lower end of the piston skirt section, measure the outer diameter in a direction vertical to the pin bore.

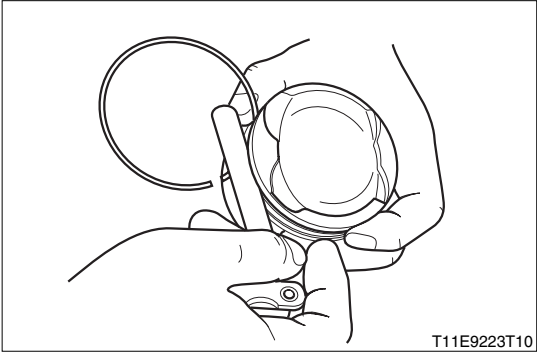
**SPECIFIED VALUE:** 70.921—70.931mm  
**ALLOWABLE LIMIT:** 70.921mm



2. Check the piston ring groove.
- (1) With the thickness gauge and piston ring, check the piston clearance over the entire circumference.

**Ring groove clearance**

Detected item	Specified value	Limit value
No.1	0.02—0.07	0.07
No.2	0.02—0.06	0.06
Oil	0.020—0.065	0.065

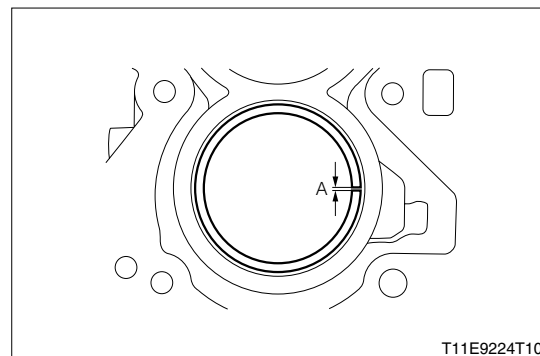


3. Check the clearance between the mating ends of the piston ring.

- (1) Using the piston, push in the piston ring up to the position about 45 mm from the top surface of the cylinder block. With the thickness gauge, measure the clearance between the mating ends.

#### Clearance between mating ends of ring

Detected item	Specified value	Limit value
No.1	0.2–0.3	0.79
No.2	0.4–0.6	0.75
Oil	0.1–0.4	0.69



T11E9224T10

4. Measure the oil clearance between the cylinder and the piston.

- (1) Measure the piston outer diameter and cylinder inner diameter to obtain the oil clearance. If the limit is exceeded, replace the piston or replace the cylinder block.

**SPECIFIED VALUE:** 0.080–0.103mm

**ALLOWABLE LIMIT:** 0.103mm

#### NOTE

- The oil clearance between the piston and the cylinder block is the difference between the minimum inner diameter of the cylinder in the thrust direction and the piston maximum outer diameter. (basic diameter)
- Since there is ridged wear at the upper end of the sliding range of the piston ring, be sure to measure the point with greater wear.

Specified values for cylinder block inner diameter and piston outer diameter

Cylinder block inner diameter (mm Dia)	$71^{+0.013}_{-0}$
Piston outer diameter (mm Dia)	$70.915 \pm 0.05$

- (2) If the piston or cylinder block has been replaced, check the oil clearance once again after the replacement.

#### (3) Check of crankshaft

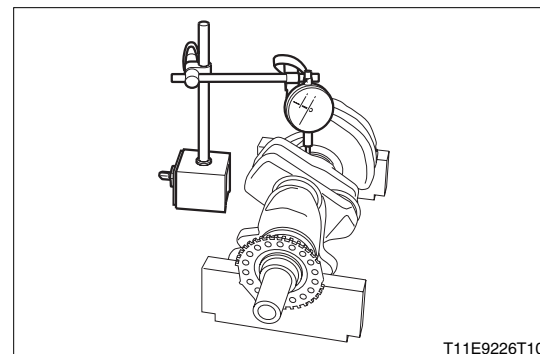
1. Check the crankshaft for bending.

- (1) With a dial gauge, measure the bend of 2J.

**ALLOWABLE LIMIT:** 0.03mm

#### CAUTION

- The bend is a half of the gauge reading (runout) when the crankshaft is turned one turn.



T11E9226T10

# B-45

## 2. Check the crankshaft for wear.

- (1) Calculate the degree of ellipse and degree of taper for the points on the journal shown at the right figure, using a micrometer.

**ALLOWABLE LIMIT:** Crank journal outer diameter  
0.03mm

Degree of ellipse and degree of taper 0.03mm

### NOTE

- Degree of ellipse:  $A - B$  or  $a - b$
  - Degree of taper:  $A - a$  or  $B - b$
- (2) Calculate the degree of ellipse and degree of taper for the points on the pin shown at the right figure, by measuring the outer diameter with a micrometer.

**ALLOWABLE LIMIT:** Crank pin outer diameter 0.03mm

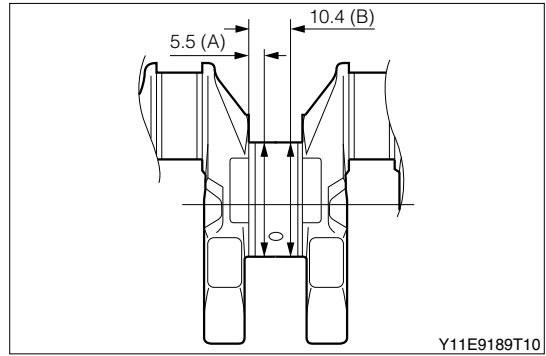
Degree of ellipse and degree of taper 0.03mm

### NOTE

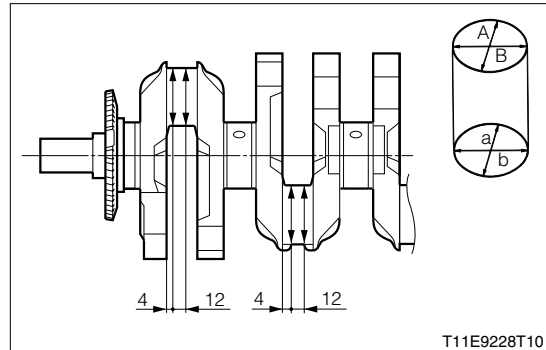
- Degree of ellipse:  $A - B$  or  $a - b$
- Degree of taper:  $A - a$  or  $B - b$

## 3. Measure the thickness of the crankshaft thrust washer.

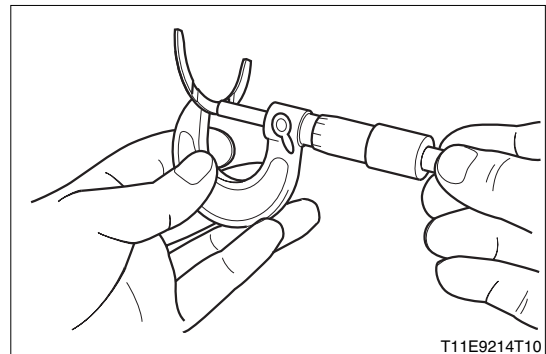
**SPECIFIED VALUE:** 1.94 – 1.99mm



Y11E9189T10



T11E9228T10

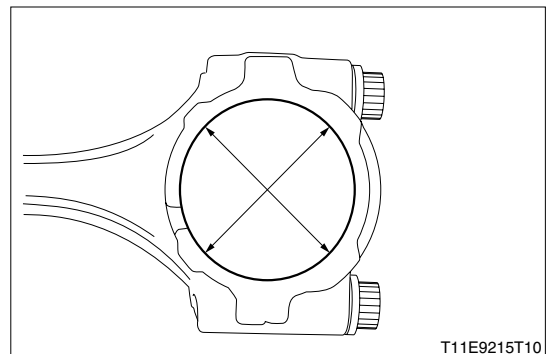


T11E9214T10

## (4) Check of rod, connecting

### 1. Check of oil level.

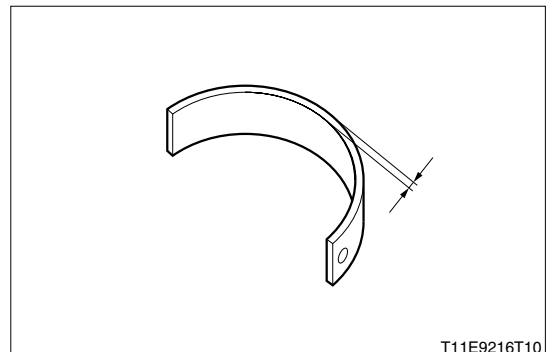
**SPECIFIED VALUE:** 43.000 – 43.024mm



T11E9215T10

### 2. Measure the stock thickness of the connecting rod bearing.

**SPECIFIED VALUE:** 1.492 – 1.501mm

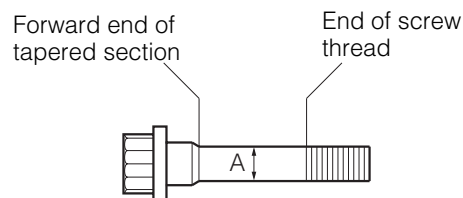


T11E9216T10

**(5) Check of bolt, connecting rod**

1. Measure the outer diameter (A) of the connecting rod bolt at several points.

**ALLOWABLE LIMIT:** Outer diameter: 6.4 mm



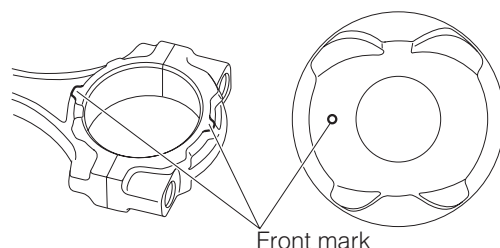
T11E9229ET10

**5-1-6 POINTS OF ASSEMBLY**

1. Assemble the piston, connecting rod and piston pin.

- (1) Apply engine oil to the pin hole of the connecting rod. Temporarily assemble the piston and connecting rod with their front marks aligned with each other.

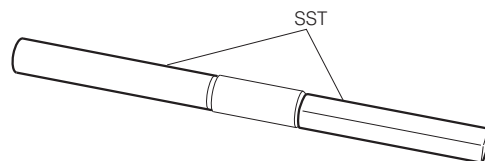
**LUBRICANT:** Engine oil



T11E9231ET10

- (2) Assemble the SST to the piston pin as shown at the right figure.

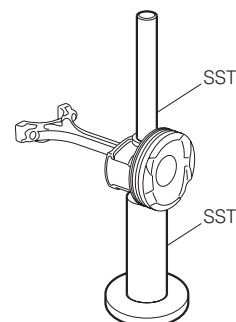
**SST:** 09221-B1020-000



T11E9232T10

- (3) Insert the piston pin assembled with the SST to the piston and connecting rod. Then, set them to the SST.

**SST:** 09221-B1010-000



T11E9210T10

- (4) Heat the piston side of the connecting rod. (Approx. 80–220°C)

**CAUTION**

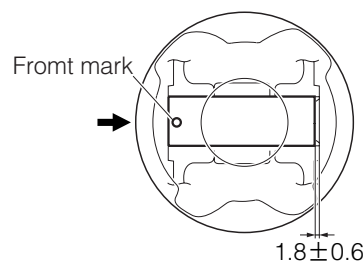
- If the temperature will not rise above 190 °C, apply oil.

- (5) Using a press, assemble the piston pin into the piston and connecting rod.

**SPECIFIED VALUE:**  $1.8 \pm 0.6$  mm

**CAUTION**

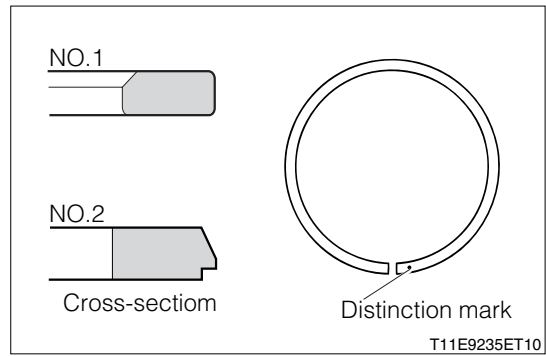
- Press fit the piston pin from the front mark side of the piston.
- During press-fitting, the piston pin should be pushed from exactly above. Never apply the force diagonally.



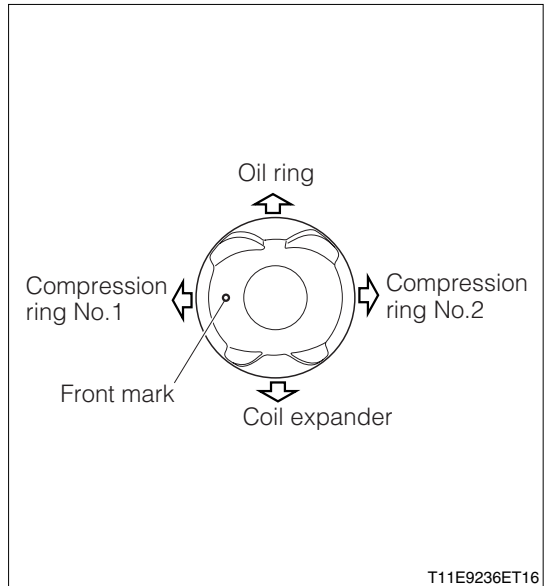
T11E9234ET10

2. Assemble the oil ring, compression ring No.2 and compression ring No.1.

- (1) The compression ring No.2 and compression ring No.1 should be installed using the piston ring tool with the identification mark T facing upward.



- (2) Assemble the rings in such a way that the mating ends of each ring face in the direction indicated in the figure.

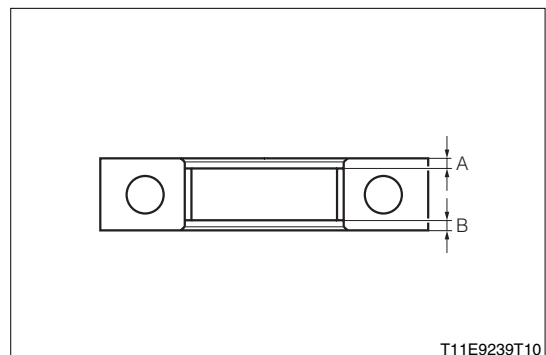


3. Assemble the crankshaft, crankshaft bearing cap, crankshaft bearing and crankshaft thrust washer.

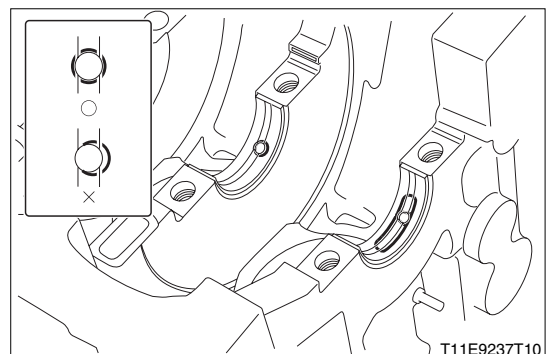
- (1) With the crankshaft (lower) bearing positioned correctly, assemble it to the crankshaft bearing cap.

## NOTE

- Assemble in such a way that the difference between A and B does not exceed 0.8 mm.



- (2) Assemble the crankshaft (upper) bearing, while aligning with the oil hole of the cylinder block.



- (3) Insert and install the crankshaft thrust washer into the No.3 journal at the block side in such a way that the oil groove faces toward the outside. (crank side)

**CAUTION**

- Before assembling, apply engine oil to the oil groove side.

**LUBRICANT: Engine oil**

- (4) After applying engine oil to the crankshaft sliding surface of the crankshaft (upper) bearing, assemble the crankshaft.

**LUBRICANT: Engine oil**

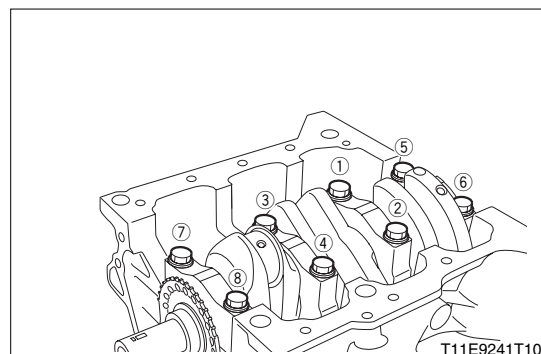
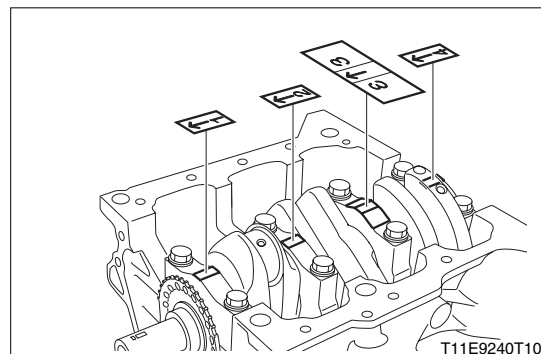
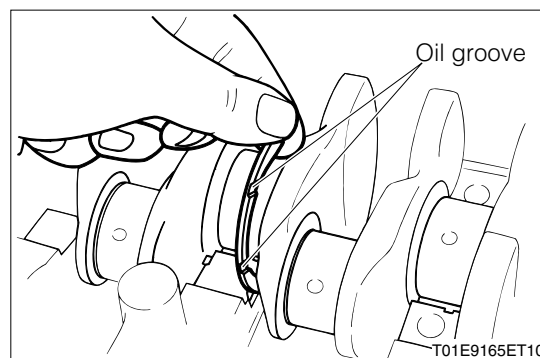
- (5) After applying engine oil to the crankshaft sliding surface of the crankshaft (lower) bearing, assemble the crankshaft bearing cap with its front mark facing to the front.

**LUBRICANT: Engine oil**

- (6) After applying engine oil to the crankshaft bolt, tighten the bolts over two or three stages in the sequence shown at the right figure.

**LUBRICANT: Engine oil**

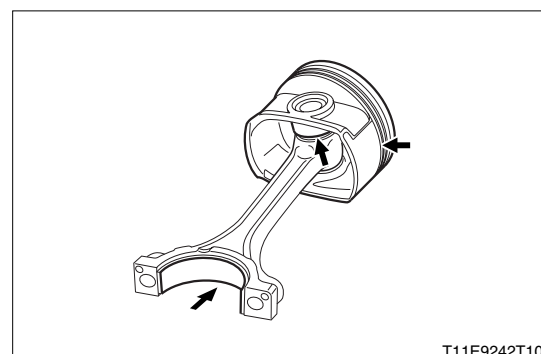
- (7) After assembling, ensure that the crankshaft turns smoothly.



4. Assemble the piston Ay with connecting rod, connecting rod bearing and connecting rod bearing cap.

- (1) Confirm the directions of the mating marks of the compression rings and oil ring.
- (2) Apply engine oil to the sliding surface of the piston and connecting rod.

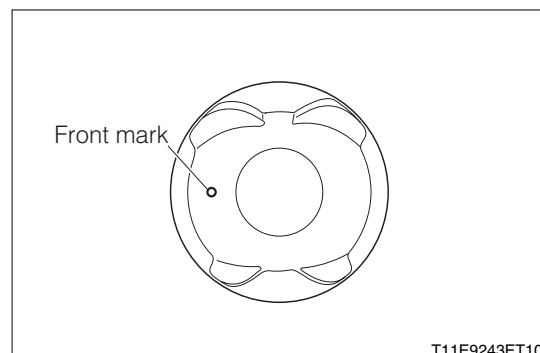
**LUBRICANT: Engine oil**



- (3) With the front mark of the piston facing to the front, insert the piston into the cylinder block using the piston ring tool.

**CAUTION**

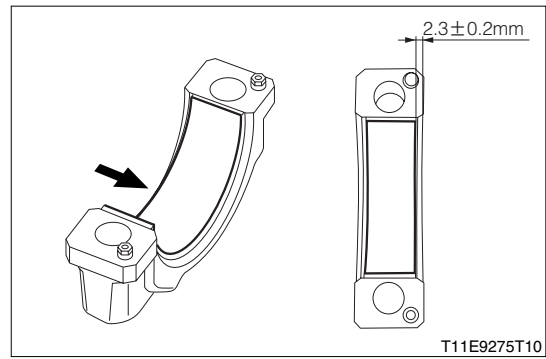
- Assemble the piston and cylinder in the same combination as that before disassembling.





- (4) Assemble the connecting rod bearing to the connecting rod bearing cap at the position shown at the figure. Apply engine oil to the sliding surface of the connecting rod bearing.

LUBRICANT: Engine oil



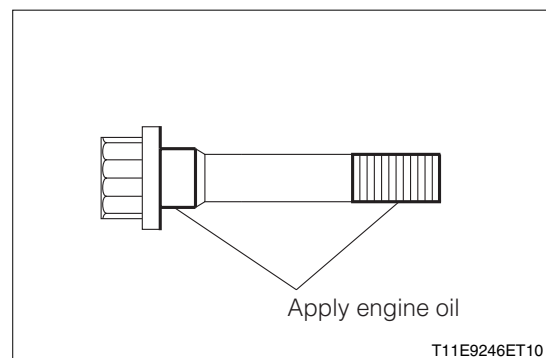
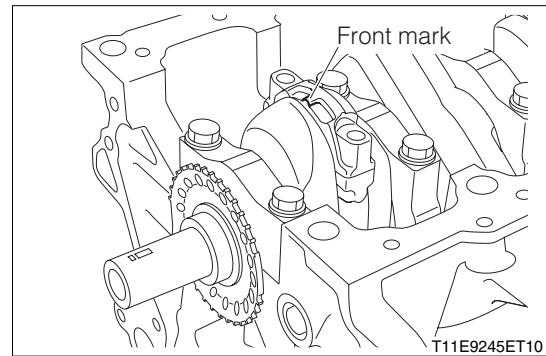
- (5) Assemble the connecting rod to the front mark of the connecting rod bearing cap.

## CAUTION

- Assemble in such a way that the front mark of the connecting rod bearing cap comes at the front direction. Ensure that the knock pin is aligned with the knock hole.
- Assemble the connecting rod and connecting rod bearing cap in the same combination as that before disassembling.

- (6) Apply a thin film of engine oil to the seat surface and threaded portion of the connecting rod bolt and assemble it.

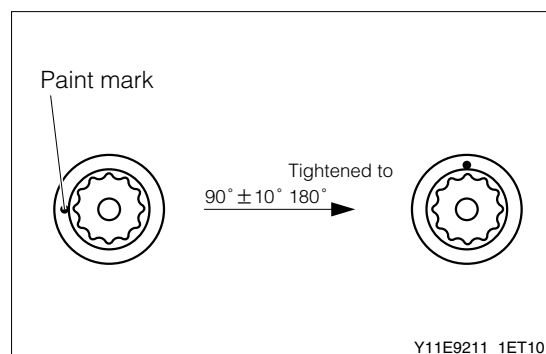
LUBRICANT: Engine oil



- (7) Tighten the connecting rod bolts alternately over two or three stages. Also, retighten each of the bolts about 90 degrees in the same sequence.

## NOTE

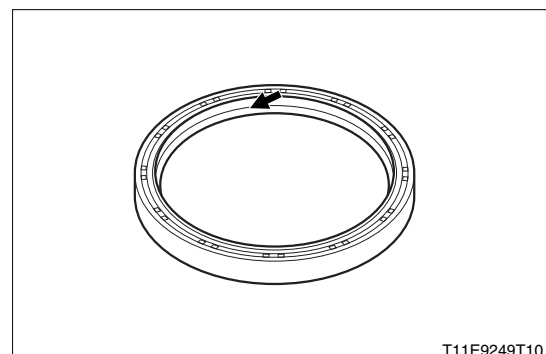
- Put a paint mark on the top of each connecting rod bolt in the same direction. After tightening the bolts 90 degrees in the sequence above, ensure that all the paint marks have been turned 90 degrees.



5. Install the type T oil seal to the oil seal retainer.

- (1) Apply engine oil to the lip section of the type T oil seal.

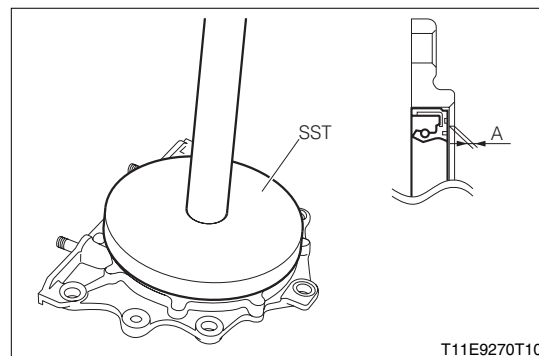
LUBRICANT: Engine oil



- (2) Using the SST, assemble the type T oil seal vertically.

**SPECIFIED VALUE:** Press-fitting amount  
from oil seal retainer  
Protruding amount: within 0.5  
mm  
Press-fitting depth: within 1 mm

SST: 09608-87302-000

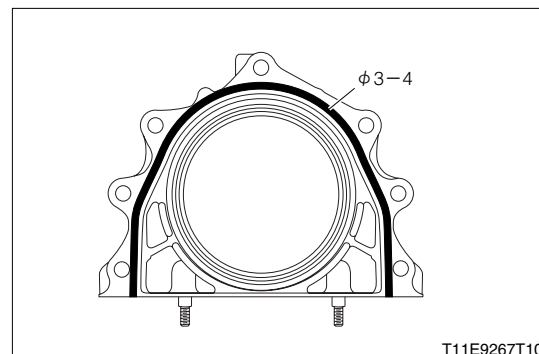


6. Apply liquid gasket to the oil seal retainer. Then, assemble it to the cylinder block Ay.

**CAUTION**

- Perform the assembling within three minutes after application of the liquid gasket.

ADHESIVE: Three Bond1280E

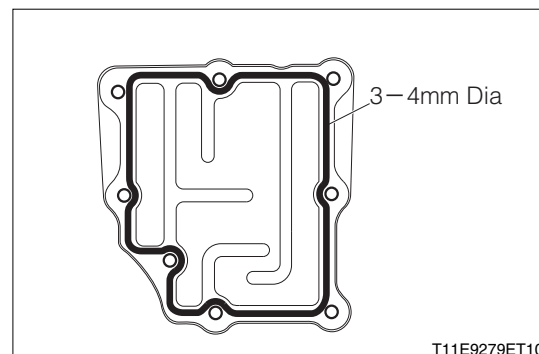


7. Clean the ventilation baffle plate and installation surface. Apply liquid gasket to the ventilation baffle plate.

**CAUTION**

- Assemble the ventilation baffle plate within three minutes after application of the liquid gasket.

ADHESIVE: Three Bond1280E



8. Perform tightening in the sequence shown at the figure.

