

PREPARATION MATERIALS	PREPARATION MATERIALS	PP
ENGINE	ENGINE MECHANICAL	EM
	COOLING	CO

Needs to be rearranged in
numerical order

ENGINE MECHANICAL

LIQUID GASKET APPLYING LOCATION (FA20)	
APPLICATION	EM-1
PARTIAL ENGINE ASSY (FA20)	
EXPLODED VIEW	EM-3
DISASSEMBLY	EM-13
INSPECTION	EM-33
ASSEMBLY	EM-37
CYLINDER HEAD ASSY (FA20)	
EXPLODED VIEW	EM-77
DISASSEMBLY	EM-77
INSPECTION	EM-81
ASSEMBLY	EM-90
CYLINDER BLOCK ASSY (FA20)	
EXPLODED VIEW	EM-100
DISASSEMBLY	EM-101
INSPECTION	EM-106
ASSEMBLY	EM-120



GREASE • OTHER

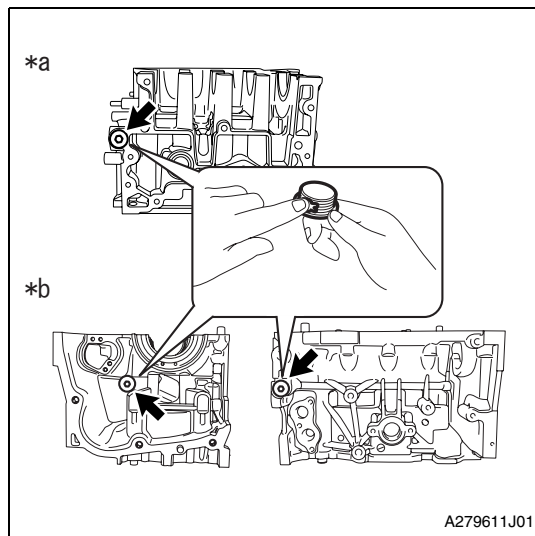
Description	Part number	Used location
Metal wire (approx. 1 mm in diameter)	—	Chain tensioner ASSY No. 2
THREE BOND 1217G	K0877Y0100	• Front camshaft cap, intake rear camshaft cap, and exhaust rear camshaft cap • Camshaft housing SUB-ASSY • Cylinder head gasket No. 2 • Cylinder head cover SUB-ASSY, cylinder head cover SUB-ASSY LH • Timing chain/belt cover SUB-ASSY • Cylinder head plate RR • Vacuum pump ASSY • Oil pan SUB-ASSY • Oil pan SUB-ASSY No. 2 • Pump drive case ASSY • Oil separator cover • Cylinder block
Plastigauge	—	Camshaft, connecting rod, crankshaft
THREE BOND 1324	004403042	Engine oil pressure switch ASSY
THREE BOND 1105	004403010	Cylinder block tight plug No. 1
Red dye	—	Valve
Valve compound	—	Valve
Protective tape	—	• Timing chain/belt cover oil seal • Timing chain/belt cover SUB-ASSY • Engine rear oil seal • Cylinder head cover SUB-ASSY • Camshaft housing SUB-ASSY • Oil pan SUB-ASSY • Piston pin hole snap ring

ASSEMBLY

1. Installation of cylinder block tight plug No. 1

<Caution>

- During the work, stabilize the cylinder block by placing it on a wooden piece wrapped with cloth etc, in this case be careful not to contact the knock pin with the wooden piece.
- Be careful not to scratch the mating surface of cylinder block during work.



- (1) Apply THREE BOND 1105 to the threaded portions of three cylinder block tight plug No. 1s and install to cylinder block (bank 1 side and bank 2 side).

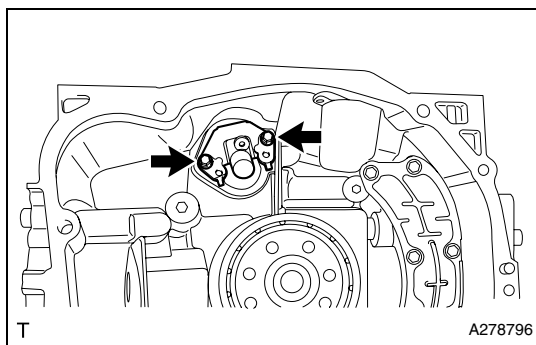
Captions in illustration

*a	Bank 1
*b	Bank 2

Standard value: $T=37N \cdot m$ {377kgf $\cdot$ cm} {27.3ft $\cdot$ lbf}

<Caution>

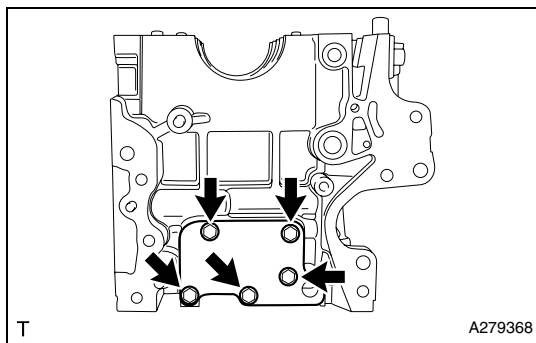
Before applying liquid gasket, degrease the thread holes of the cylinder block and main gallery plug.



2. Installation of crankshaft sensor holder ASSY

- (1) Install the crankshaft sensor holder ASSY to the cylinder block (bank 2 side) with two bolts.

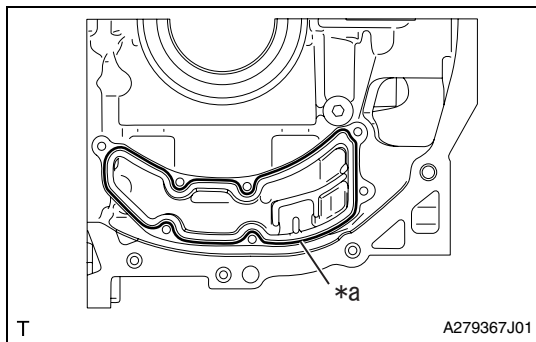
Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7ft·lbf}



3. Installation of cylinder block plate

- (1) Install the cylinder block plate to the cylinder block (bank 2 side) with five bolts.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7ft·lbf}



4. Installation of oil separator cover

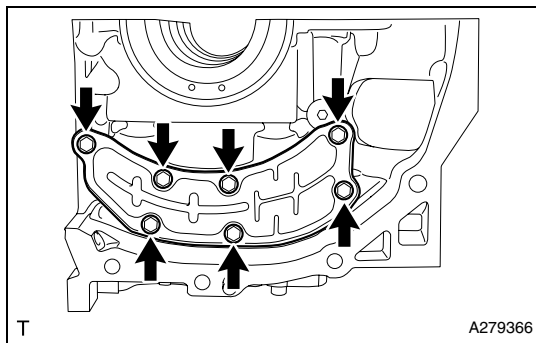
- (1) Apply THREE BOND 1217G to the mating surface of the new oil separator cover.

Captions in illustration

*a	Dia. 3.0 to 5.0mm {0.138 to 0.197in}
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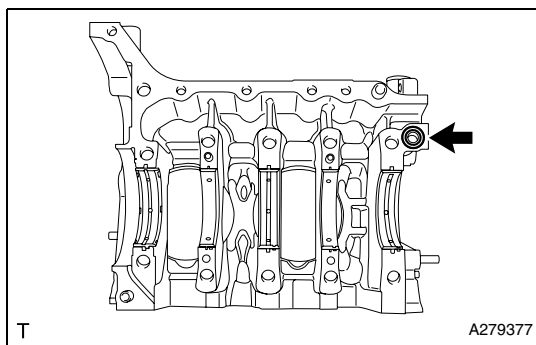
<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.



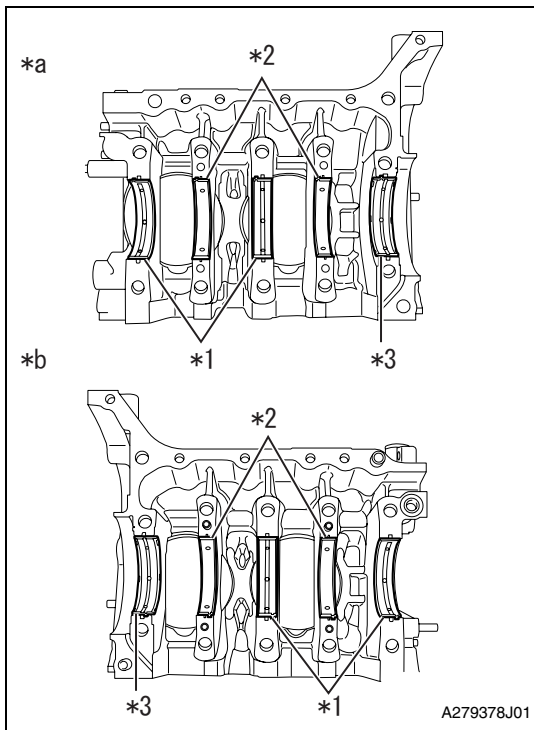
- (2) Tighten seven bolts in order as shown in the figure, and install the oil separator cover to the cylinder block (bank 1 side).

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7ft·lbf}



5. Installation of O-ring

- (1) Install a new O-ring to the cylinder block (bank 2 side).



6. Installation of crankshaft bearing

- (1) Apply engine oil to the ten crankshaft bearing and install to cylinder block (bank 1 side and bank 2 side).

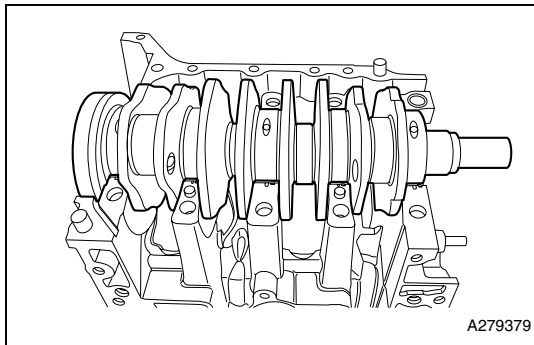
Captions in illustration

*1	Crankshaft bearing No. 1, No. 3 (with groove)
*2	Crankshaft bearing No. 2, No. 4 (without groove)
*3	Crankshaft bearing No. 5
*a	Bank 1
*b	Bank 2

<Caution>

- Be careful not to scratch the mating surface of cylinder block during work.
- Because journal bearings No. 1 and No. 3 differ from No. 2 and No. 4, confirm at assembly.

EM

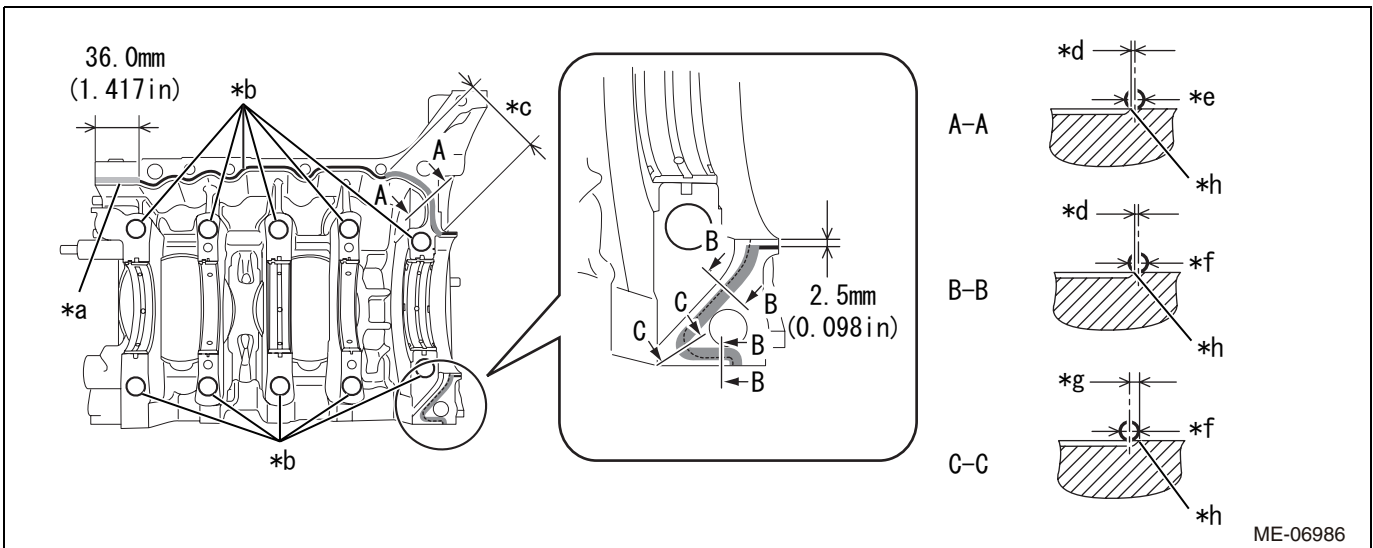


7. Installation of crankshaft

- (1) Apply engine oil to the crankshaft journal, and set to the cylinder block (bank 2 side).

8. Installation of cylinder block SUB-ASSY (bank 1 side)

- (1) Apply THREE BOND 1217G to the mating surface of the cylinder block (bank 1 side) as shown in the figure.



Captions in illustration

*a	Dia. 3.5 to 4.5mm {0.138 to 0.177in}	*b	Dia. 0.5 to 1.5mm {0.0197 to 0.0591in}
*c	Range A-A	*d	Within 1.0mm {0.039in}
*e	Dia. 2.7 to 3.7mm {0.106 to 0.146in}	*f	Dia. 3.5 to 4.5mm {0.138 to 0.177in}

*g	2.0mm {0.079in}	*h	Groove
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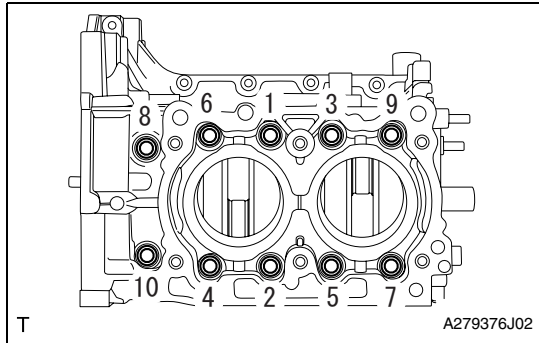
<Caution>

- Do not let the gasket overflow to the oil passage and crankshaft bearing portions, because the engine seizure may result.
- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

- (2) Install the cylinder block (bank 1 side) to the cylinder block (bank 2 side).
- (3) Apply engine oil to the washers and cylinder block mounting bolt threads.

<Caution>

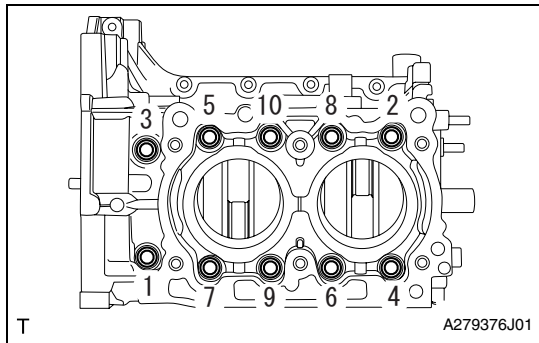
To prevent mixture of engine oil into the water jacket, do not apply a large amount.



- (4) Tighten the ten mounting bolts in the order as shown in the figure.
Standard value: $T=35\text{N}\cdot\text{m}$ {357kgf·cm} {25.8ft·lbf}

<Caution>

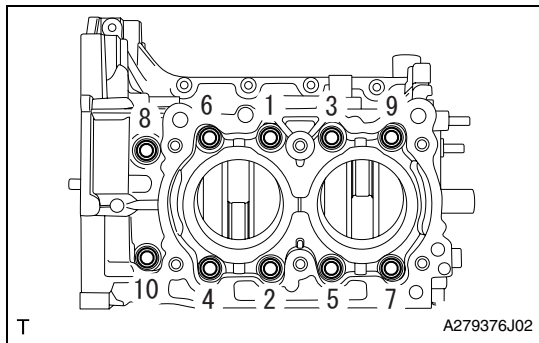
When tightening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.



- (5) Loosen the ten mounting bolts by 180° in the order as shown in the figure.

<Caution>

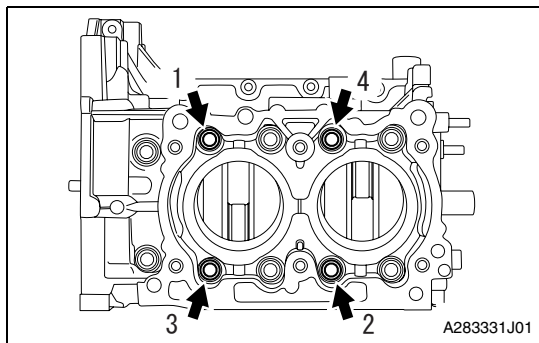
When loosening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.



- (6) Tighten the ten mounting bolts in the order as shown in the figure.
Standard value: $T=35\text{N}\cdot\text{m}$ {357kgf·cm} {25.8ft·lbf}

<Caution>

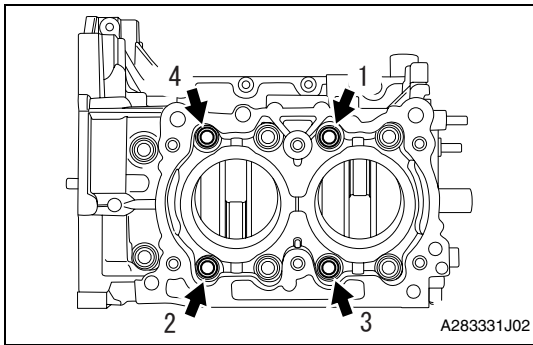
When tightening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.



- (7) Loosen the four bolts by 180° in the order as shown in the figure.

<Caution>

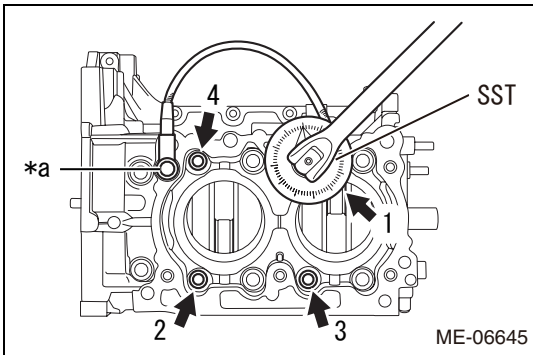
When loosening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.



- (8) Tighten the four mounting bolts in the order as shown in the figure.
Standard value: $T=17\text{N}\cdot\text{m}$ {173kgf·cm} {12.5ft·lbf}

<Caution>

When tightening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.



- (9) Further-tighten the four mounting bolts by 60° in the order as shown in the figure using SST.

SST 18854AA000

Captions in illustration

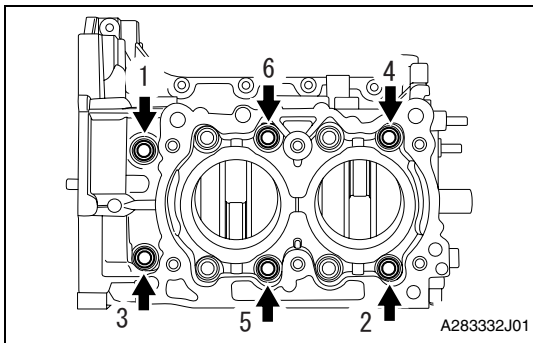
*a	temporary bolt
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<Caution>

When tightening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.

<Reference>

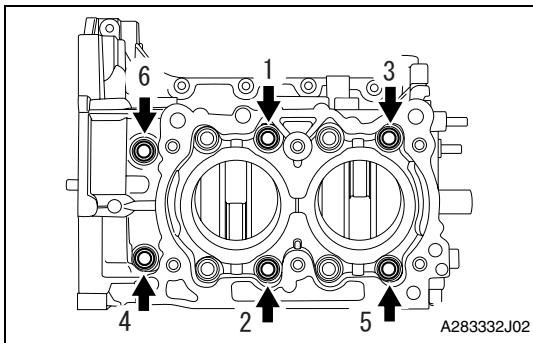
As necessary, attach the temporary bolt to fix SST.



- (10) Loosen the six mounting bolts by 180° in the order as shown in the figure.

<Caution>

When loosening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.

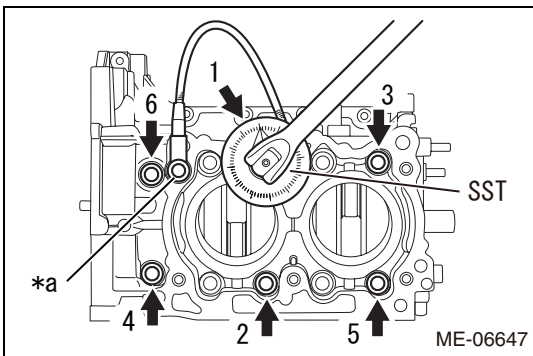


- (11) Tighten the six mounting bolts in the order as shown in the figure.

Standard value: $T=17\text{N}\cdot\text{m}$ {173kgf·cm} {12.5ft·lbf}

<Caution>

When tightening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.



- (12) Further-tighten the six mounting bolts by 60° in the order as shown in the figure using SST.

SST 18854AA000

Captions in illustration

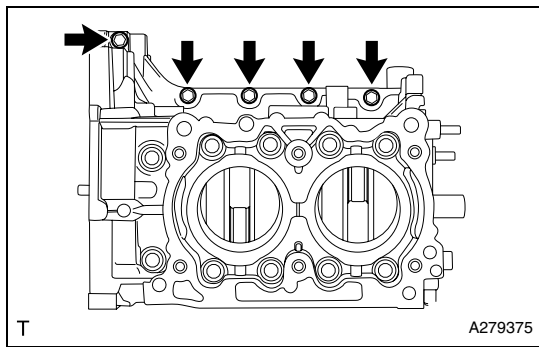
*a	temporary bolt
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<Caution>

When tightening the mounting bolts, hold the cylinder block (bank 2 side) while not holding the cylinder block (bank 1 side) to ensure the joint accuracy of the cylinder block.

<Reference>

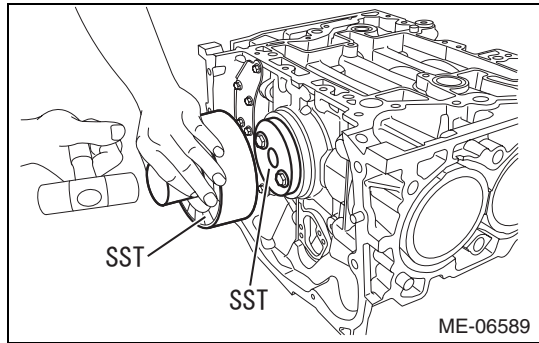
As necessary, attach the temporary bolt to fix SST.



- (13) Install the five bolts shown in the figure.
- Standard value: $T=25\text{N}\cdot\text{m}$ {255kgf·cm} {18.4ft·lbf}
- <Reference>
- After tightening, if the gasket is squeezed out in the seal surface area of the oil pan upper, completely remove any gasket that is squeezed out. However, gasket in the groove should not be removed.

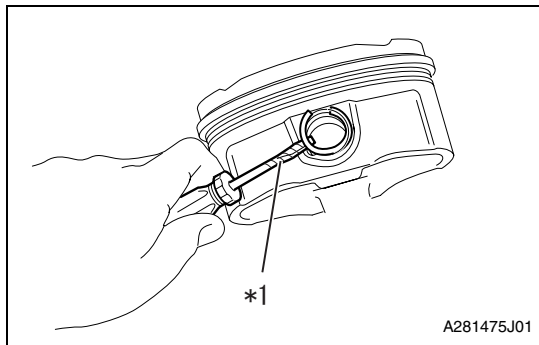
EM

9. Installation of engine rear oil seal

- (1) Apply a little coat of engine oil to the inside and outside of the new engine rear oil seal.
- 
- (2) Using SST, strike in the engine rear oil seal equally flush with the end surface of the cylinder block.
- SST 18671AA020, 18657AA030
- <Caution>
- Do not hammer in the engine rear oil seal obliquely.
 - Wipe off the oil attached to the crankshaft.
 - Do not hammer in the engine rear oil seal too deep.
- <Reference>
- The strike amount of the engine rear oil seal is allowed within 0 to - 1 mm {0 to -0.039 in} from the end surface of the cylinder block.

10. Installation of cylinder block SUB-ASSY

- (1) Mount the cylinder block SUB-ASSY onto the engine stand.



11. Installation of piston with pin
- (1) Install the piston pin hole snap ring to one side of the piston using a screwdriver wrapped with protective tape.

Captions in illustration

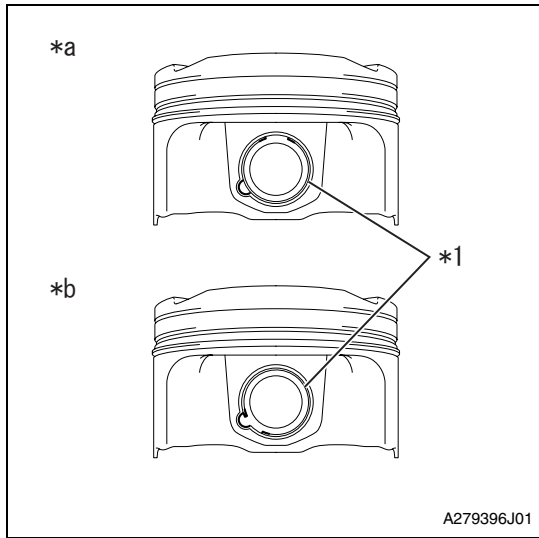
*1	Protective tape
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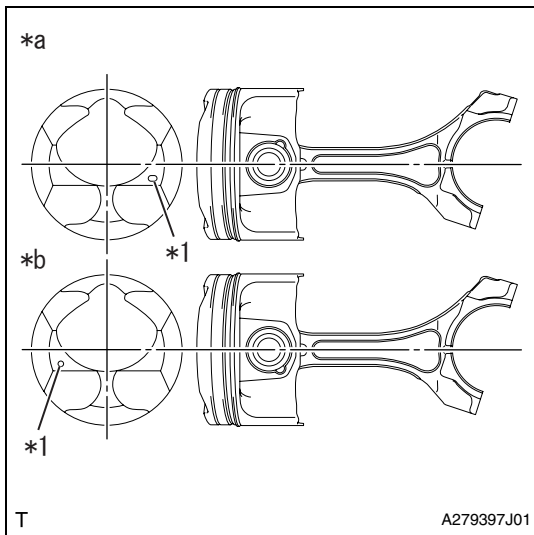
<Reference>

- Make sure the piston pin hole snap ring is firmly inserted into the groove.
- After installing the piston pin hole snap ring, turn the piston pin hole snap ring so that the end and cutout portion of the hole snap ring do not match.

Captions in illustration

*1	Piston pin hole snap ring
*a	OK
*b	NG





- (2) Set the piston to the connecting rod.

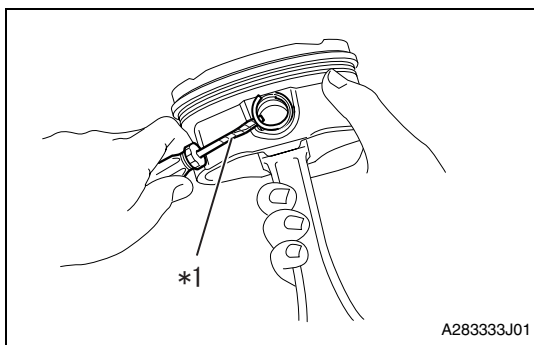
Captions in illustration

*1	Front mark
*a	Bank 1
*b	Bank 2

<Reference>

Align the front mark of piston and the connecting rod direction correctly as shown in the figure.

- (3) Apply engine oil to the piston pin, and attach the piston pin.



- (4) Install the piston pin hole snap ring to the piston using a screwdriver wrapped with protective tape.

Captions in illustration

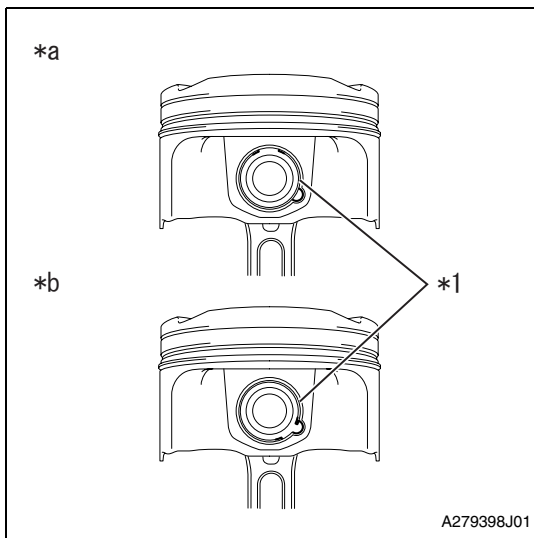
*1	Protective tape
----	-----------------

<Reference>

- Make sure the piston pin hole snap ring is firmly inserted into the groove.
- After installing the piston pin hole snap ring, turn the piston pin hole snap ring so that the end and cutout portion of the hole snap ring do not match.

Captions in illustration

*1	Piston pin hole snap ring
*a	OK
*b	NG



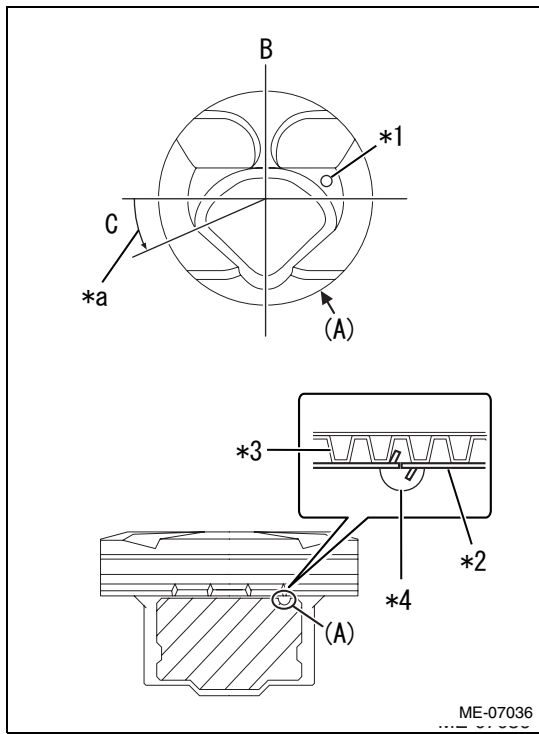
12. Installation of piston ring set

- (1) Install the oil ring in the order of oil ring expander, side rail (lower) and oil ring side rail (upper) by hand.

<Reference>

Oil ring consists of oil ring side rail (upper), oil ring expander and oil ring side rail (lower).

- (2) Set the oil ring expander gap to the position (B) in the figure.

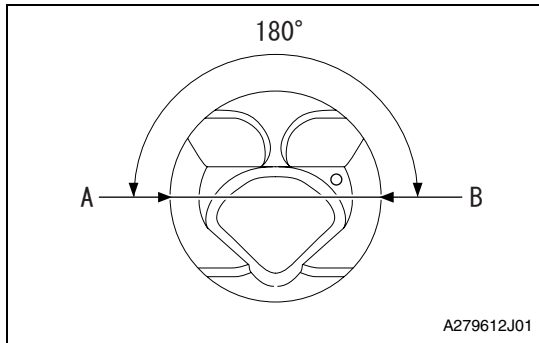


- (3) Engage the lower turn stopper of the oil ring side rail (lower) in the oil notch of the coated piston skirt cutout at the position (A) in the figure and engage the upper turn stopper to the oil ring expander.

Captions in illustration

*1	Front mark
*2	Oil ring side rail (lower)
*3	Oil ring expander
*4	Cutout portion
*a	0 to 20°

- (4) Align the oil ring side rail (upper) gap to position (C) (0 to 20°) in the figure and engage the upper turn stopper to the oil ring expander.
- (5) Using a piston ring tool, install compression ring No. 2 and then, compression ring No. 1 in numerical order with a stamped mark upward.

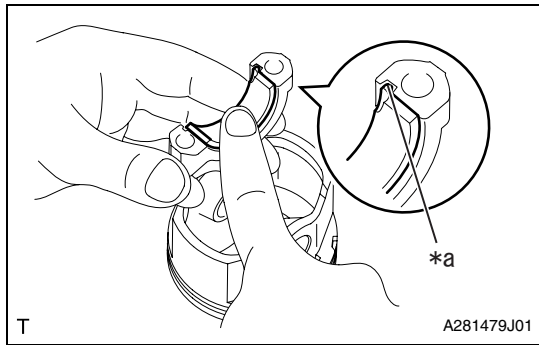


- (6) Set the gap of compression ring No. 1 to the position (A) or (B) in the figure.
- <Reference>
Either (A) or (B) is good for compression ring No. 1 if it points in the piston pin direction.

- (7) Set the gap of compression ring No. 2 to the position (A) or (B), 180° opposite side of compression ring No. 1, in the figure.
- (8) Check that the positions of piston ring and oil ring gap are properly adjusted.

13. Installation of piston with connecting rod

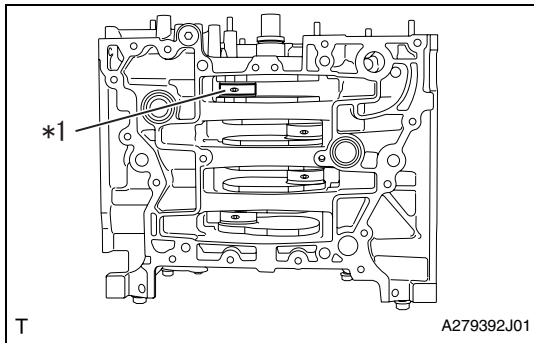
- (1) Move the engine stand to face the oil pan side of the cylinder block upward.



- (2) With the claw aligned in position, assemble the connecting rod bearing with the connecting rod and connecting rod cap.<*1>
- Captions in illustration

*a	Claw position
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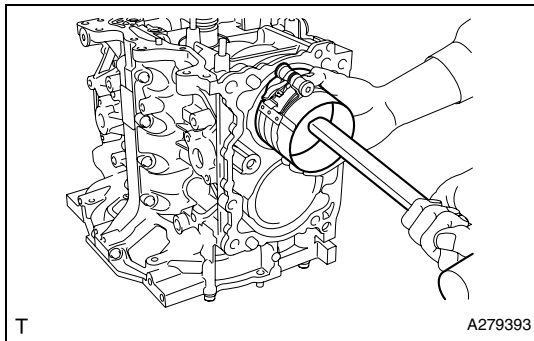
- (3) Check that the positions of piston ring and oil ring gap are properly adjusted.
- (4) Apply engine oil to the outer circumference of each piston, crank pin, and in the cylinder block.



- (5) Turn the crankshaft so that the crankshaft pin position comes to TDC.

Captions in illustration

*1	Crankshaft pin
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- (6) Compress the piston ring using piston ring compressor, and insert the piston with connecting rod into the cylinder block by tapping the piston crown using the handle of a plastic hammer etc.

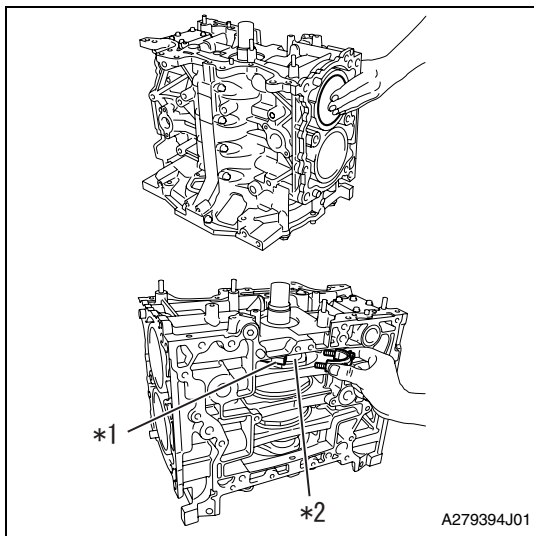
<Caution>

- Be careful not to damage the cylinder liner and crankshaft pin by the connecting rod large end.
- Do not apply strong impact when inserting the piston with connecting rod to prevent connecting rod bearing from falling off.

<Reference>

Face the piston front mark towards the front of the engine.

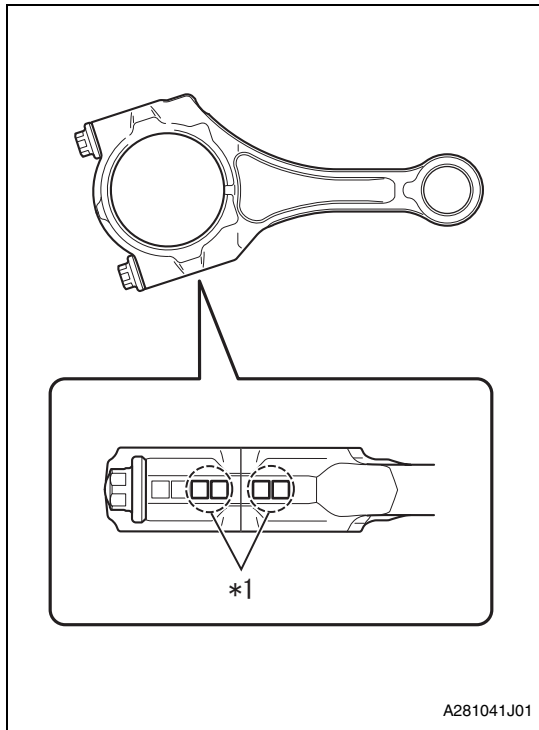
- (7) Apply engine oil to the connecting rod cap seat and the connecting rod cap bolt threads.



- (8) Turn the crankshaft so that the crank pin and the large end of connecting rod are positioned as shown in the figure, while pressing the piston crown, and then install the connecting rod cap using the connecting rod cap bolt.

Captions in illustration

*1	Connecting rod
*2	Crankshaft pin



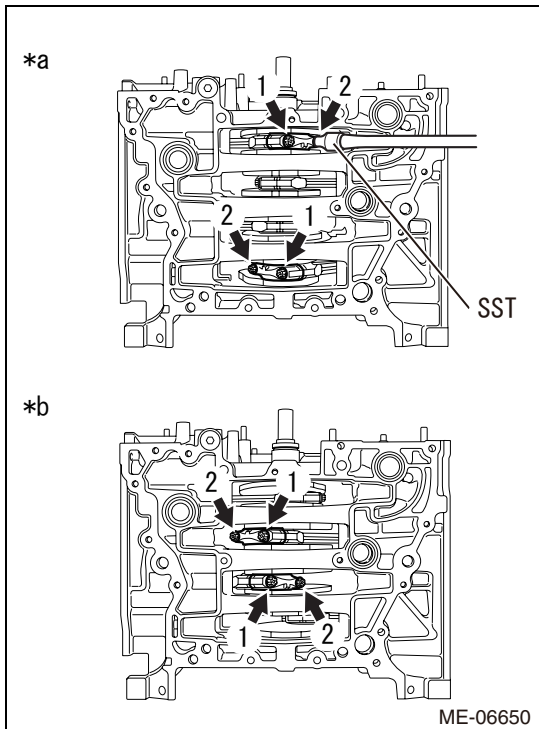
<Reference>

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their identification symbols.

Captions in illustration

*1	Identification symbol
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- Use a new connecting rod cap bolt.
- When installing piston with connecting rod No. 1 and No. 3, turn the crankshaft counter-clockwise, on the other hand, when installing the piston with connecting rod No. 2 and No. 4, turn the crankshaft clockwise.



- (9) Using SST, tighten the two connecting rod cap bolts in the order as shown in the figure.

SST 18270AA020

Captions in illustration

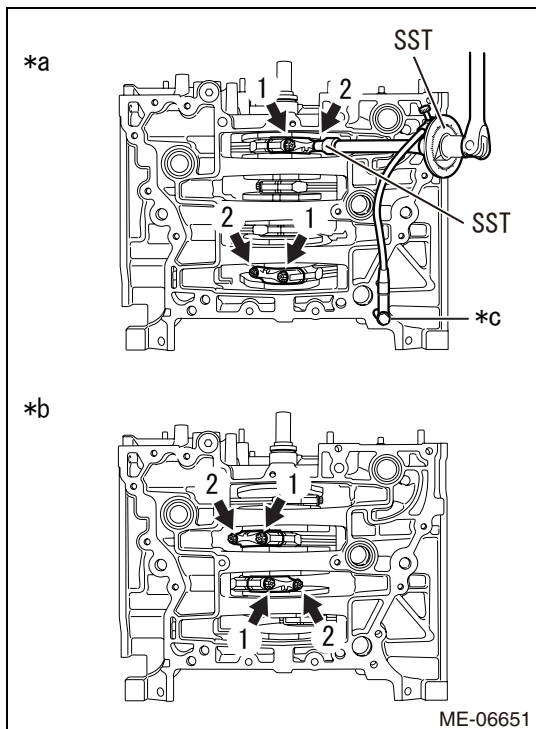
*a	Cylinder No. 1, No. 4
*b	Cylinder No. 2, No. 3

Standard value: $T=10\text{N}\cdot\text{m}$ {102kgf $\cdot\text{cm}$ } {7.4ft $\cdot\text{lb}$ }

- (10) Further-tighten the two bolts in the same order. <*2>

Standard value: $T=25\text{N}\cdot\text{m}$ {255kgf $\cdot\text{cm}$ } {18.4ft $\cdot\text{lb}$ }

- (11) Using steps <*1> through <*2>, assemble the piston with connecting rod No. 2, No.3 and No. 4 as well as No. 1.



(12) Further-tighten the connecting rod cap bolts No. 1 through No. 4 by 92.5° in the order as shown in the figure using SST.

SST 18270AA020, 18854AA000

Captions in illustration

*a	Cylinder No. 1, No. 4
*b	Cylinder No. 2, No. 3
*c	temporary bolt

<Reference>

As necessary, attach the temporary bolt to fix SST.

(13) Make sure that the crankshaft turns smoothly.

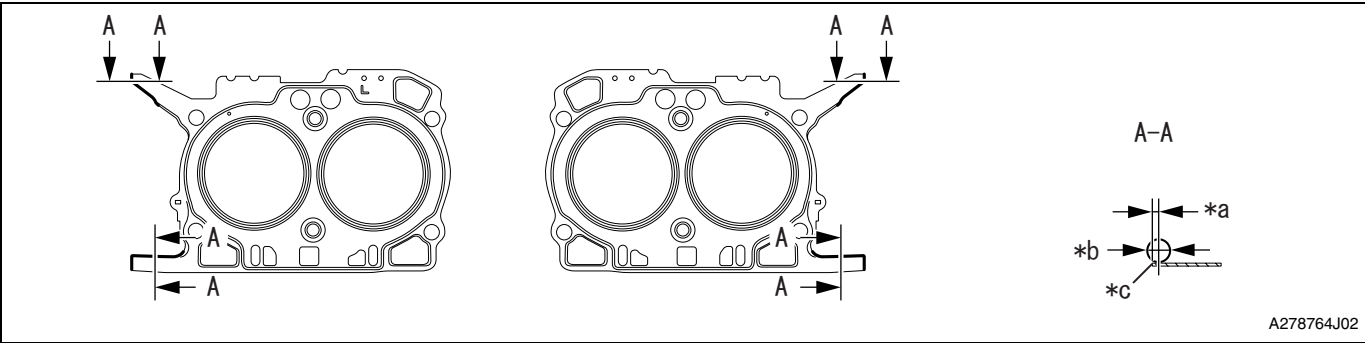
15. Installation of cylinder head gasket No. 2

- (1) Move the engine stand to face the bank 2 side upward.
- (2) Clean the bolt holes in the cylinder block (bank 2 side).

<Caution>

To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.

- (3) Apply THREE BOND 1217G to the mating surface of the new cylinder head gasket No. 2 as shown in the figure.



Captions in illustration

*a	0 to 1.0 mm {0 to 0.039 in}	*b	2.0 to 4.0 mm {0.079 to 0.158 in} in diameter
*c	Gasket end	-	-

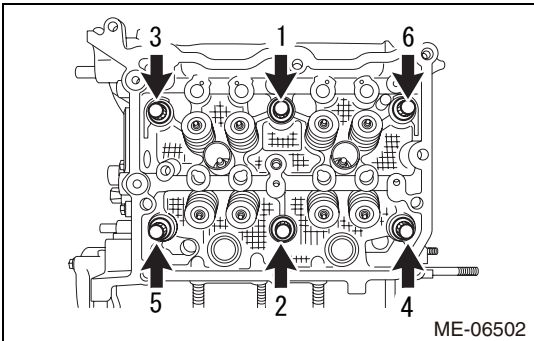
<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

(4) Install the cylinder head gasket No. 2.

16. Installation of cylinder head LH

- (1) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolt threads.
- (2) Set the cylinder head LH to the cylinder block (bank 2 side).



- (3) Tighten the six cylinder head bolts in the order as shown in the figure.

Standard value: $T=20\text{N}\cdot\text{m}$ {204kgf•cm} {14.8 ft•lbf}

- (4) Further-tighten the six cylinder head bolts in the same order.

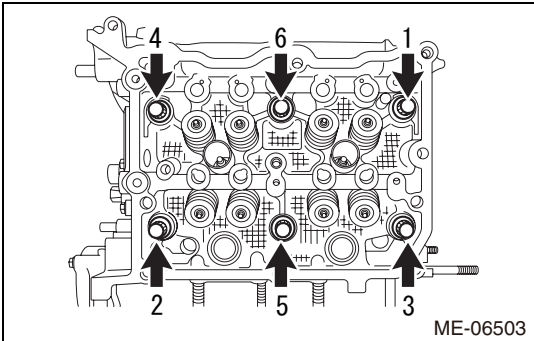
Standard value: $T=100\text{N}\cdot\text{m}$ {102kgf•cm} {73.8 ft•lbf}

<Caution>

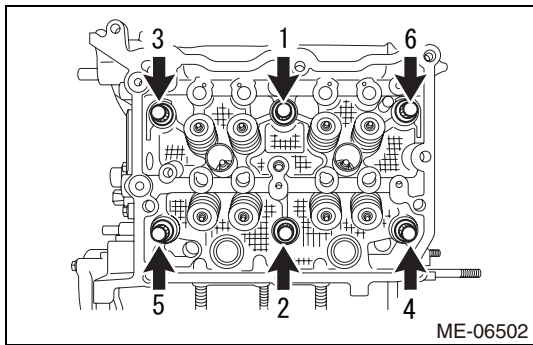
If the bolt makes stick-slip sound during tightening, clean the bolt holes and the fitting surface and wait until it dries, and then repeat the process from the procedure of application of gasket.

<Reference>

If the processes are resumed, the cylinder head gasket can be reused.



- (5) Loosen the six cylinder head bolts by 360° in the order as shown in the figure.

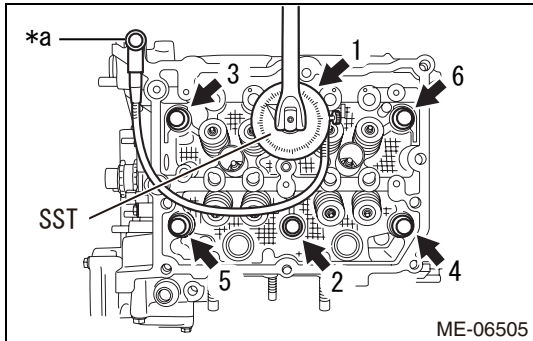


- (6) Tighten the six cylinder head bolts in the order as shown in the figure.

Standard value: $T=20\text{N}\cdot\text{m}$ {204kgf·cm} {14.8 ft·lbf}

- (7) Further-tighten the six cylinder head bolts in the same order.

Standard value: $T=42\text{N}\cdot\text{m}$ {428kgf·cm} {31.0 ft·lbf}



- (8) Further-tighten the six cylinder head bolts by 100° in the order as shown in the figure using SST.

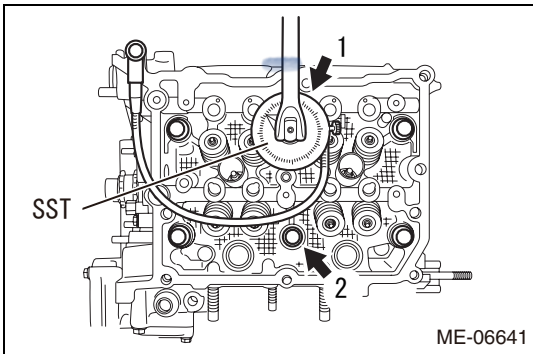
SST 18854AA000

Captions in illustration

*a	Temporary bolt
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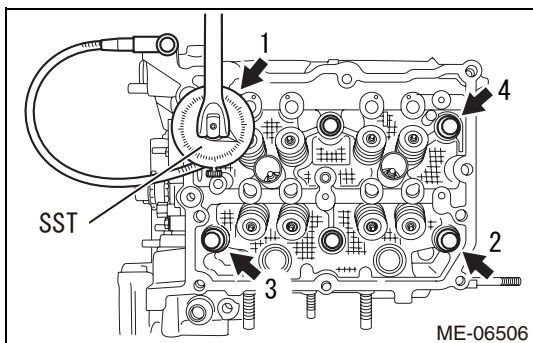
<Reference>

As necessary, attach the temporary bolt to fix SST.



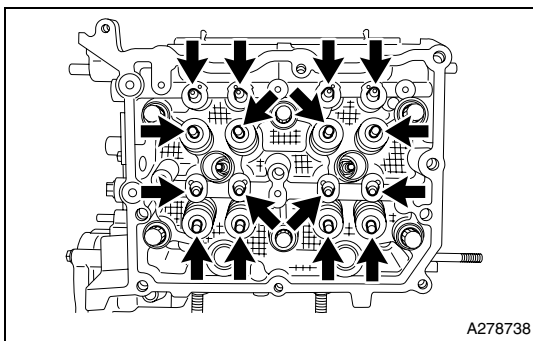
- (9) Further-tighten the two cylinder head bolts by 100° in the order as shown in the figure using SST.

SST 18854AA000



- (10) Further-tighten the four cylinder head bolts by 50° in the order as shown in the figure using SST.

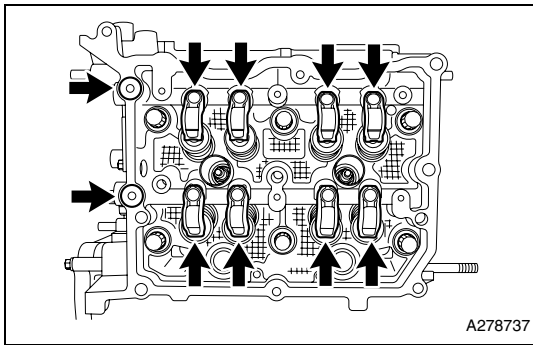
SST 18854AA000



17. Installation of camshaft housing SUB-ASSY LH

- (1) Apply engine oil to the valve adjusting shim and the roller rocker arm pivot, and install to the cylinder head LH.

Don't forget oil
spacer thing
Refer to IPB



- (2) Apply engine oil to the eight sets of the valve rocker arm SUB-ASSY No. 1 and two new O-rings, and install to the cylinder head LH.
- (3) Apply THREE BOND 1217G to the mating surface of the camshaft housing SUB-ASSY LH as shown in the figure.

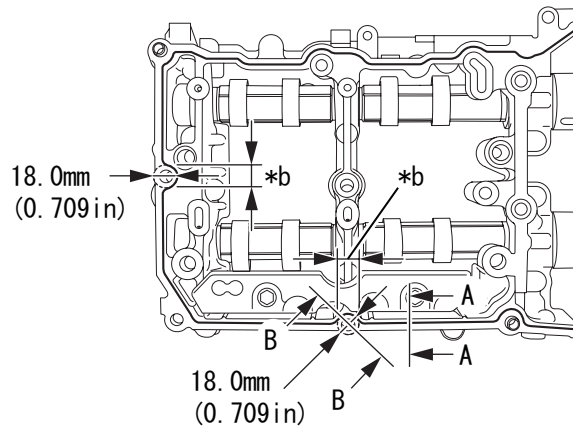
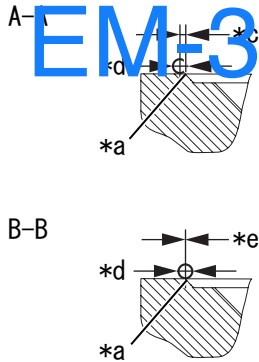
**Don't forget small
strainer filter**

Continue on Page

Refer to IPB

EM

EM-36



Captions in illustration

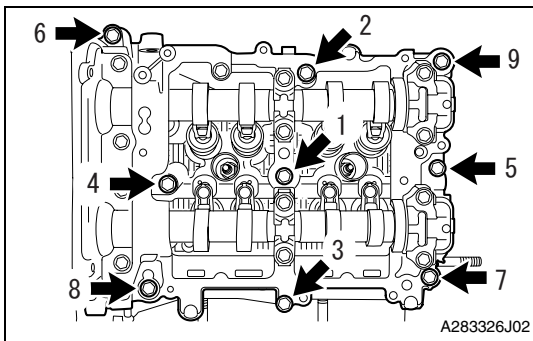
*a	Groove	*b	Range B-B
*c	1.0 mm {0.0394 in} or less	*d	2.5 to 3.5 mm {0.098 to 0.138 in} in diameter
*e	-0.5 to 0.5 mm {-0.0197 to 0.0197 in}	-	-

<Caution>

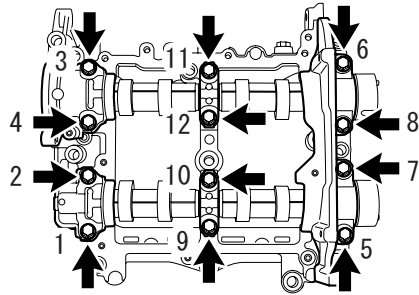
- Clean and degrease the fitting surface.
- Do not apply liquid gasket excessively.
- Install within 5 min. after applying liquid gasket.
- Completely remove any liquid gasket that is squeezed out on the fitting surface of the timing chain/belt cover SUB-ASSY.

- (4) Tighten nine bolts in order as shown in the figure, and install the camshaft housing SUB-ASSY LH.

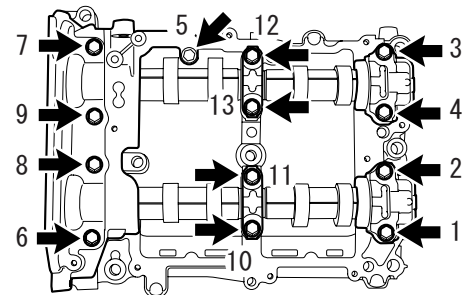
Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf•cm} {13.3 ft•lbf}



*a



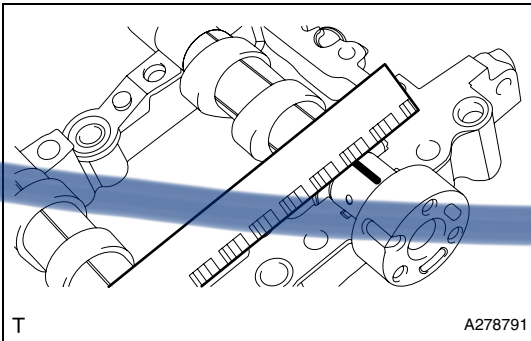
*b



A281476J02

Captions in illustration

*a	Bank 1	*b	Bank 2
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T

A278791

(8) Remove the plastigauge properly.

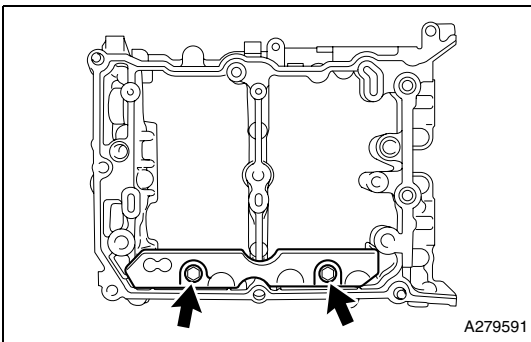
- (7) Obtain the camshaft oil clearance at the widest point of plastigauge on each journal.

Standard value: 0.037 to 0.072 mm {0.00146 to 0.00283 in}

<Reference>

If it is not within the specified value, replace each camshaft cap and camshaft housing SUB-ASSY as a set. If necessary replace the camshaft.

ASSEMBLY

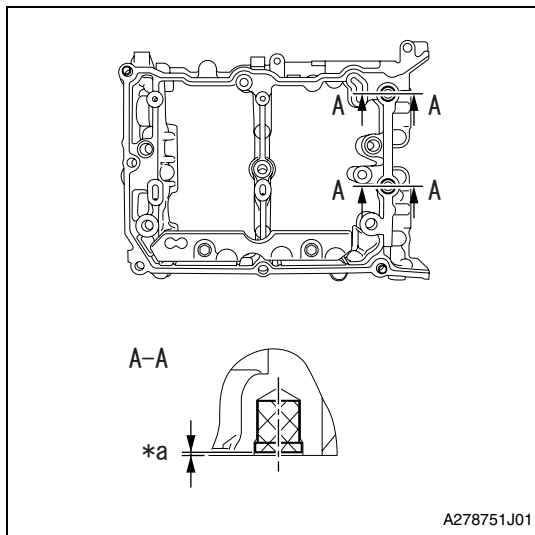


A279591

1. Installation of oil spacer LH

- (1) Install the oil spacer LH with two bolts.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}



2. Installation of oil control valve filter LH

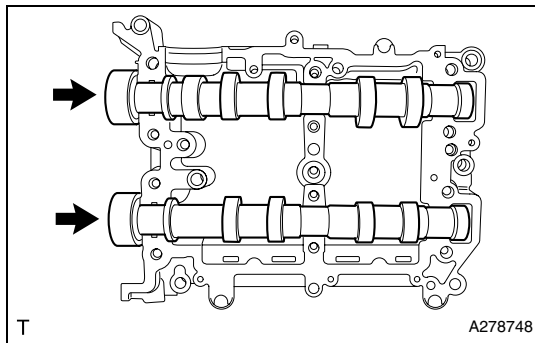
- (1) Install two new oil control valve filters LH to the camshaft housing SUB-ASSY LH.

Captions in illustration

*a	0 to 0.5 mm {0 to 0.0197 in} (from the end surface of camshaft housing SUB-ASSY LH)
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3. Installation of camshaft (bank 2 side)

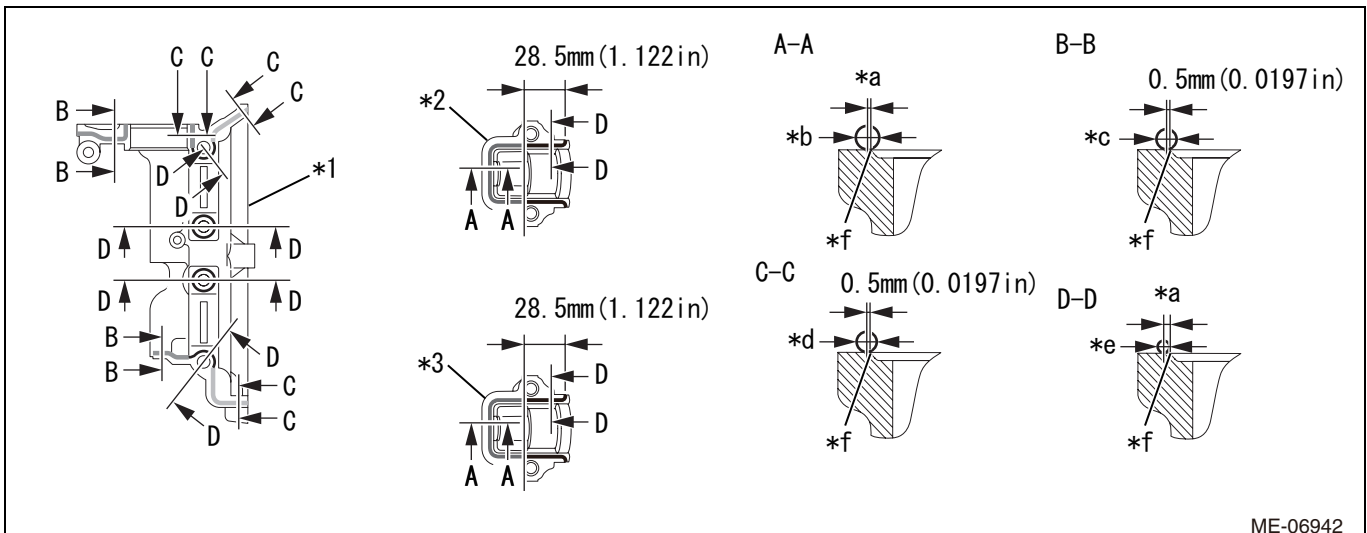
- (1) Apply engine oil to the camshaft housing SUB-ASSY LH journal.



- (2) Install the intake camshaft LH and exhaust camshaft LH to the camshaft housing SUB-ASSY LH.

4. Installation of camshaft cap (bank 2 side)

- (1) Apply THREE BOND 1217G to the mating surface of front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH as shown in the figure.



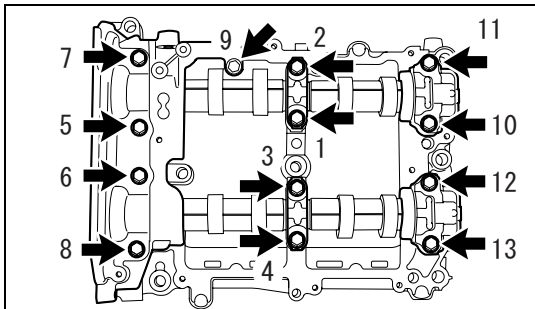
Captions in illustration

*1	Front camshaft cap LH	*2	Intake rear camshaft cap LH
*3	Exhaust rear camshaft cap LH	-	-
*a	1.0 mm {0.0394 in} or less	*b	3.0 to 4.0 mm {0.1181 to 0.1575 in} in dia.
*c	2.5 to 3.5 mm {0.0984 to 0.1378 in} in dia.	*d	2.5 to 4.0 mm {0.0984 to 0.1575 in} in dia.
*e	1.5 to 2.5 mm {0.0591 to 0.0984 in} in dia.	*f	Groove

<Caution>

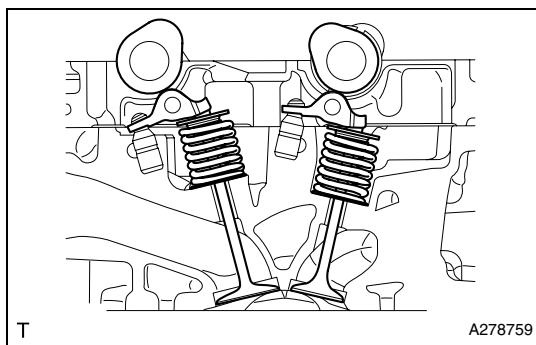
- Clean and degrease the fitting surface.
- Do not apply liquid gasket excessively to avoid engine seizure.
- Do not apply liquid gasket to the intake center camshaft cap LH and exhaust center camshaft cap LH.
- Install within 5 min. after applying liquid gasket.

(2) Apply engine oil to the journals of each camshaft cap and set the camshaft housing SUB-ASSY LH.



(3) Tighten 13 bolts in order as shown in the figure, install the front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH.

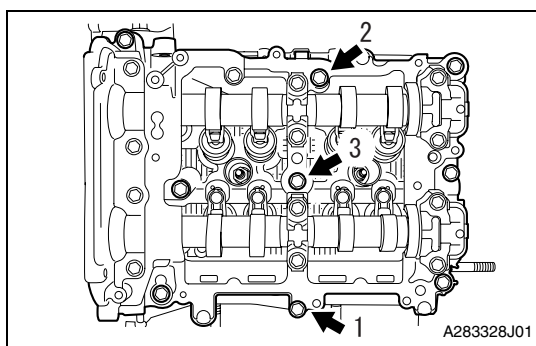
Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}



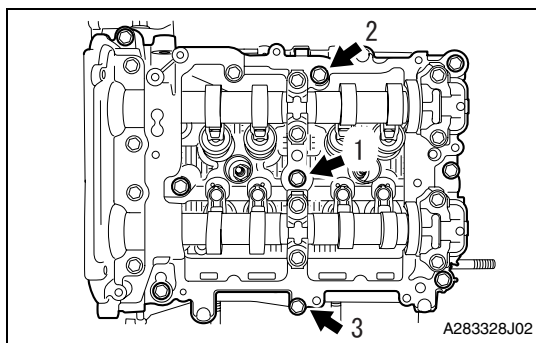
<Reference>

Set the intake camshaft LH and the exhaust camshaft LH to the zero-lift position.

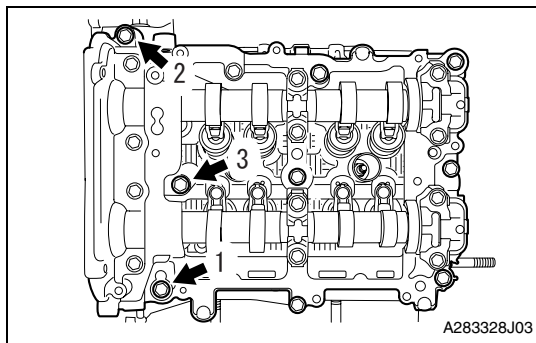
EM



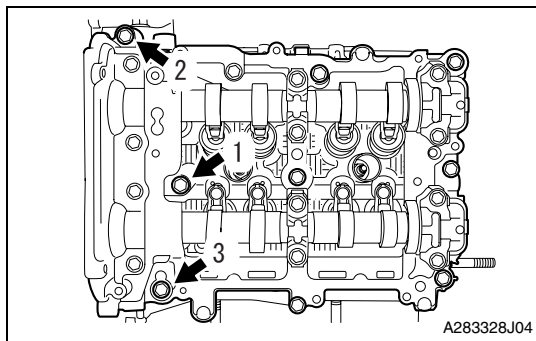
- (5) Loosen the three bolts by 180° in the order as shown in the figure.



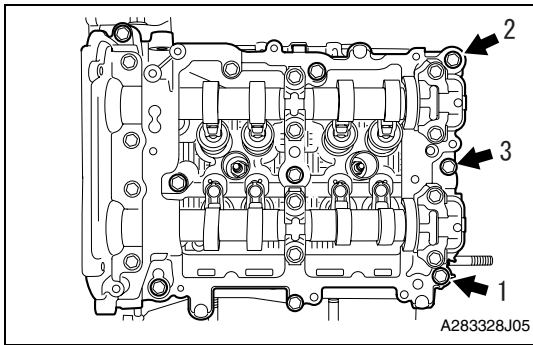
- (6) Tighten the three bolts in the order as shown in the figure.
Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}



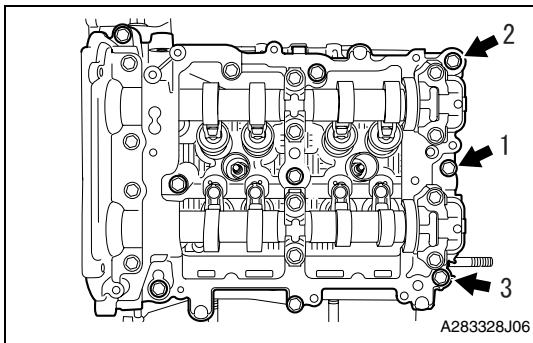
- (7) Loosen the three bolts by 180° in the order as shown in the figure.



- (8) Tighten the three bolts in the order as shown in the figure.
Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}



(9) Loosen the three bolts by 180° in the order as shown in the figure.



(10) Tighten the three bolts in the order as shown in the figure.

Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}

<Reference>

After tightening, if the liquid gasket is squeezed out in the seal surface area of the timing chain/belt cover SUB-ASSY, completely remove any liquid gasket that is squeezed out.

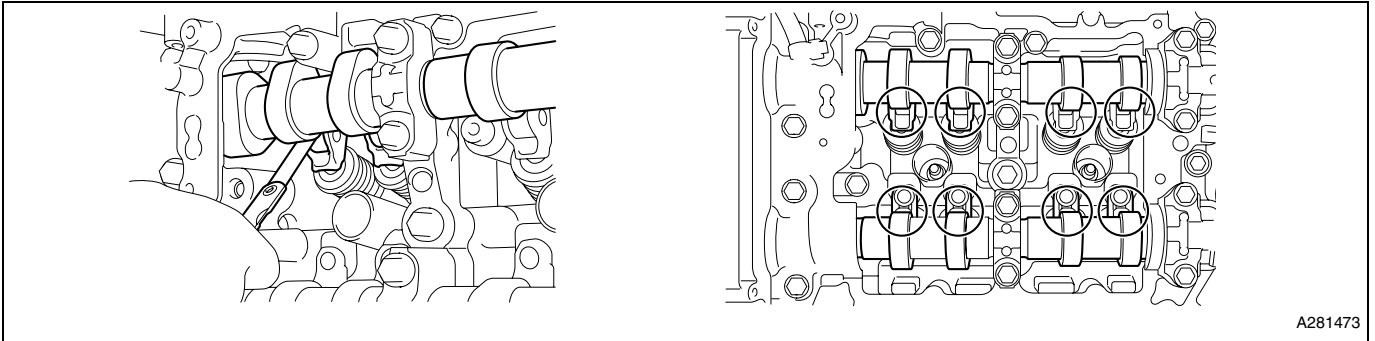
EM

18. Valve clearance check (bank 2 side)

<Caution>

Under the condition that the chain SUB-ASSY (bank 2 side) is detached, the valve heads contact each other and valve stem may bend. Do not turn the intake camshaft LH and exhaust camshaft LH to the outside of range of zero-lift (in range where it can be turned lightly by hand).

(1) Measure the roller surface of cam base circle and valve rocker arm SUB-ASSY No.1 using thickness gauge.



Standard value (when cold): 0.10 to 0.16 mm {0.0039 to 0.0063 in} (intake side)

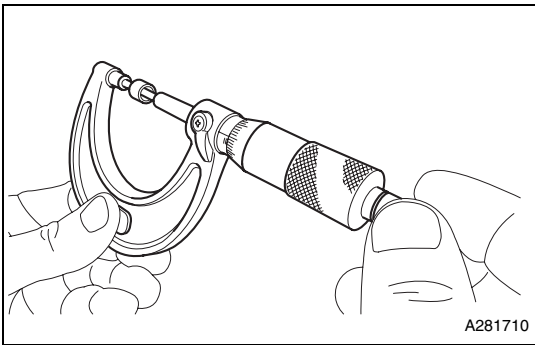
0.21 to 0.27 mm {0.0083 to 0.0106 in} (exhaust side)

<Reference>

- For valve clearance inspection, adjust the cam base circle position so that the thickness gauge can be inserted easily by hand turning the camshaft to be measured.
- If the measured value is out of standard, take notes of the value in order to adjust the valve clearance later on.

19. Valve clearance adjustment (bank 2 side)

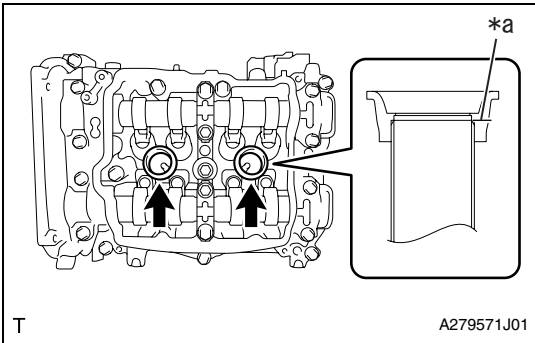
- (1) Remove the camshaft housing SUB-ASSY LH.
- (2) Remove the valve rocker arm SUB-ASSY No. 1.
- (3) Remove the valve adjusting shim.



- (4) Measure the thickness of the removed valve adjusting shim using micrometer.

EM

- (5) Calculate the thickness of the valve adjusting shim so that the valve clearance is within the specified range.
- Standard value: Intake side: (Selected shim thickness) = (removed shim thickness) + [(measured clearance) - 0.13 mm {0.0051 in}] × 1.54
- Exhaust side: (Selected shim thickness) = (removed shim thickness) + [(measured clearance) - 0.24 mm {0.0094 in}] × 1.69
- (6) Apply engine oil to the inner circle area of the selected valve adjusting shim, and install to the valve.
- <Caution>
- Make sure that the valve adjusting shim turns smoothly after inserting.
- (7) Install the valve rocker arm SUB-ASSY No. 1.
- (8) Install the camshaft housing SUB-ASSY LH.



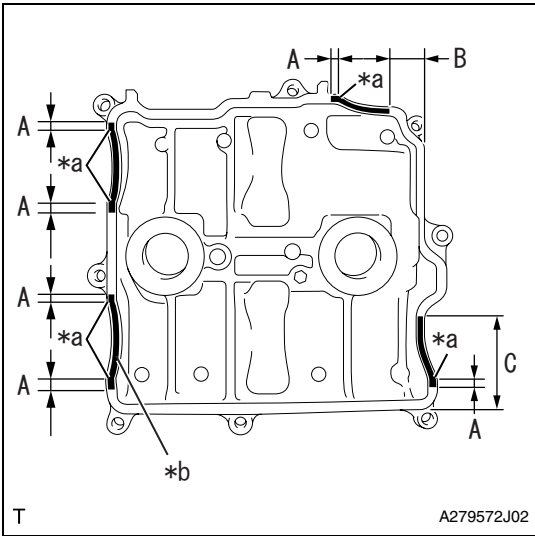
20. Installation of cylinder head cover SUB-ASSY LH

- (1) Apply a light coat of engine oil to the two new spark plug tube gaskets, and insert them up to the spark plug tube end.

Captions in illustration

*a	Spark plug tube end
----	---------------------

- (2) Install the new cylinder head cover gasket No. 2 to the cylinder head cover SUB-ASSY LH.

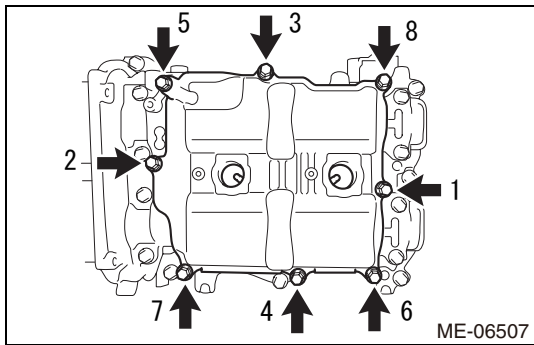


- (3) Apply THREE BOND 1217G to the mating surface of the cylinder head cover SUB-ASSY LH as shown in the figure.

Application area	Application length
A	10.0 mm {0.394 in} or more
B	18.8 mm {0.740 in} or more
C	63.0 mm {2.480 in} or more

Captions in illustration

*a	Arch starting point
*b	2.0 to 4.0 mm {0.079 to 0.158 in} in diameter



- (4) Set the cylinder head cover SUB-ASSY LH, and tighten the eight bolts in the order as shown in the figure.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}

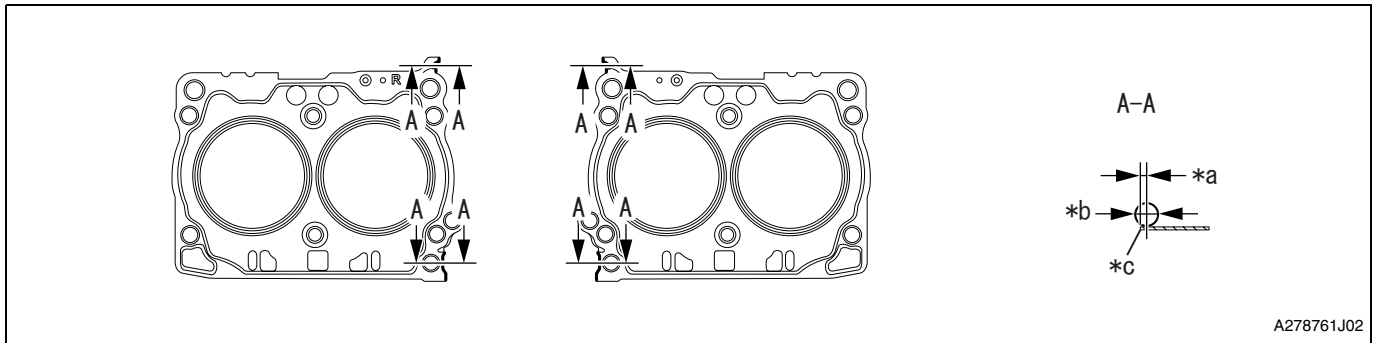
21. Installation of cylinder head gasket

- (1) Move the engine stand to face the bank 1 side upward.
- (2) Clean the bolt holes in the cylinder block (bank 1 side).

<Caution>

To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.

- (3) Apply THREE BOND 1217G to the both surfaces of the cylinder head gasket as shown in the figure.



Captions in illustration

*a	0 to 1.0 mm {0 to 0.039 in}	*b	2.0 to 4.0 mm {0.79 to 0.158 in} in diameter
*c	Gasket end	-	-

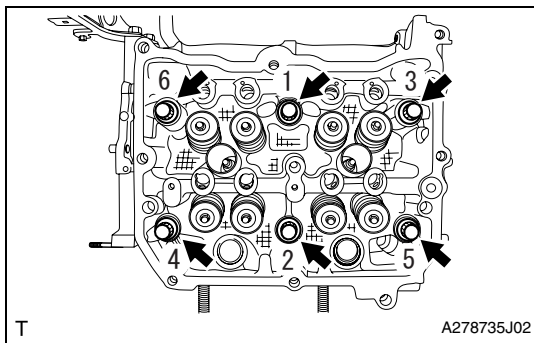
<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

- (4) Attach the cylinder head gasket.

22. Installation of cylinder head SUB-ASSY

- (1) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolt threads.
- (2) Set the cylinder head SUB-ASSY to the cylinder block (bank 1 side).



- (3) Tighten the six cylinder head bolts in the order as shown in the figure.

Standard value: $T=20\text{N}\cdot\text{m}$ {204kgf·cm} {14.8 ft·lbf}

- (4) Further-tighten the six cylinder head bolts in the same order.

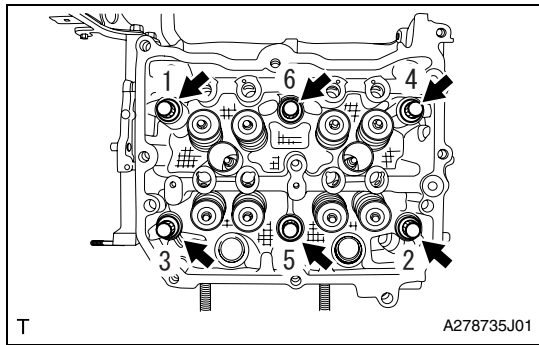
Standard value: $T=100\text{N}\cdot\text{m}$ {102kgf·cm} {73.8 ft·lbf}

<Caution>

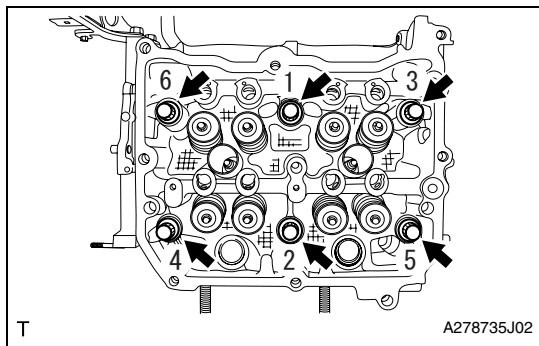
If the bolt makes stick-slip sound during tightening, clean the bolt holes and the fitting surface and wait until it dries, and then repeat the process from the procedure of application of gasket.

<Reference>

If the processes are resumed, the cylinder head gasket can be reused.



(5) Loosen the six cylinder head bolts by 360° in the order as shown in the figure.

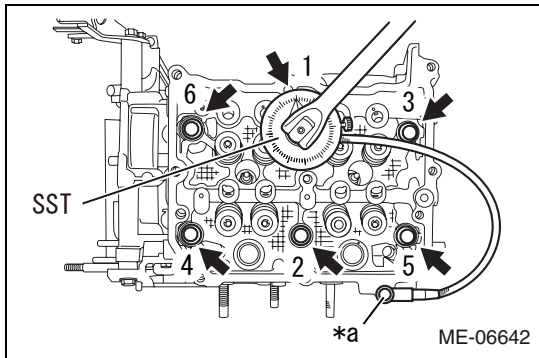


(6) Tighten the six cylinder head bolts in the order as shown in the figure.

Standard value: $T=20N\cdot m$ {204kgf·cm} {14.8 ft·lbf}

(7) Further-tighten the six cylinder head bolts in the same order.

Standard value: $T=42N\cdot m$ {428kgf·cm} {31.0 ft·lbf}



(8) Further-tighten the six cylinder head bolts by 100° in the order as shown in the figure using SST.

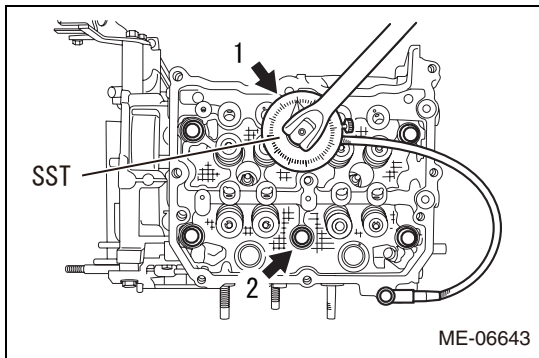
SST 18854AA000

Captions in illustration

*a	Temporary bolt
----	----------------

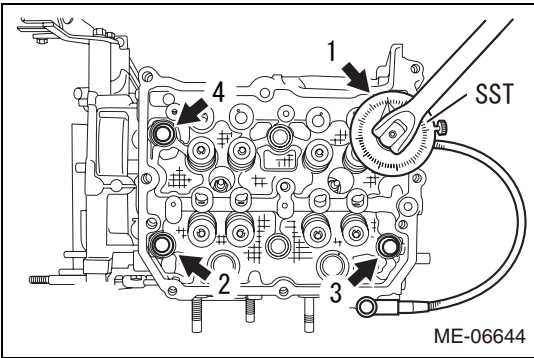
<Reference>

As necessary, attach the temporary bolt to fix SST.

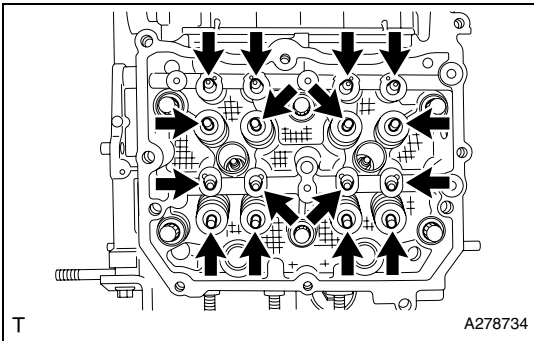


(9) Further-tighten the two cylinder head bolts by 100° in the order as shown in the figure using SST.

SST 18854AA000



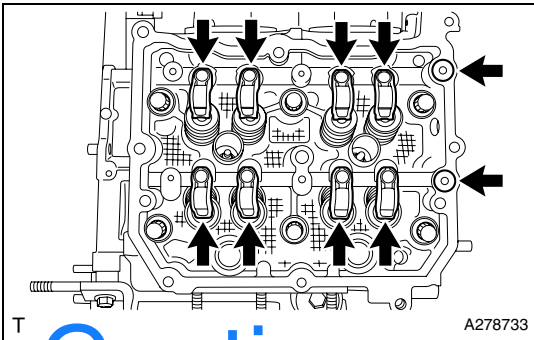
- (10) Further-tighten the four cylinder head bolts by 50° in the order as shown in the figure using SST.
SST 18854AA000



23. Installation of camshaft housing SUB-ASSY RH

- (1) Apply engine oil to the valve adjusting shim and the roller rocker arm pivot, and install to the cylinder head SUB-ASSY.

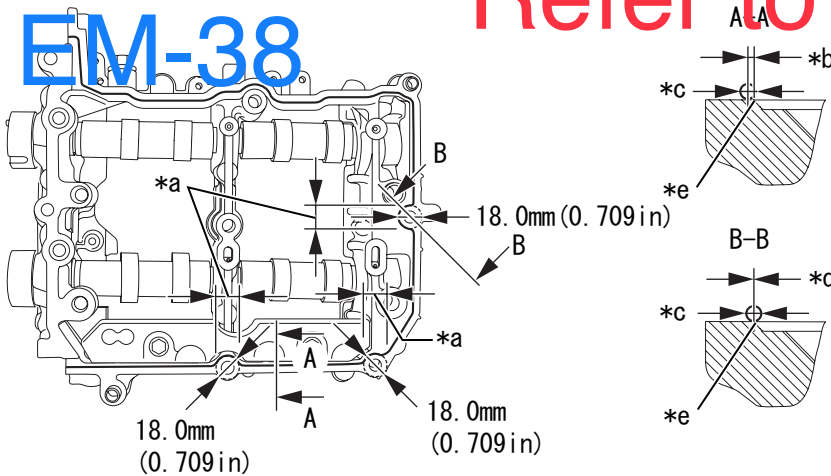
Don't forget oil spacer thing



- (2) Apply engine oil to the eight sets of the valve rocker arm SUB-ASSY No. 1 and two new O-rings, and install to the cylinder head SUB-ASSY.
(3) Apply THREE BOND 1217G to the mating surface of the camshaft housing SUB-ASSY RH as shown in the figure.

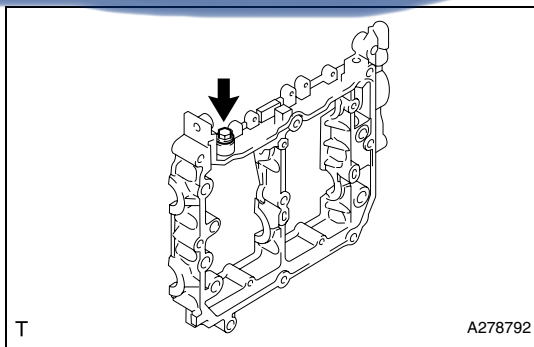
Don't forget small strainer filter
Refer to IPB

Continue on page EM-38



Captions in illustration

*a	Range B-B	*b	0 to 1.0 mm {0 to 0.0394 in}
*c	2.5 to 3.5 mm {0.098 to 0.138 in} in diameter	*d	-0.5 to 0.5 mm {-0.0197 to 0.0197 in}
*e	Groove end	-	-



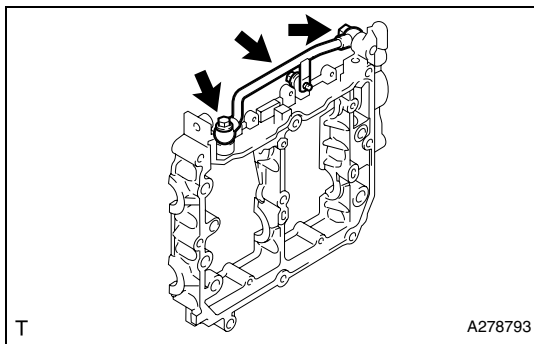
5. Installation of hole plug (transmission M/T)

- (1) Using a new gasket, install the hole plug to the camshaft housing SUB-ASSY RH.

Standard value: $T=25\text{N}\cdot\text{m}$ {225kgf•cm} {18.4 ft•lbf}

6. Installation of camshaft oil field pipe SUB-ASSY (transmission A/T)

- (1) Using two new gaskets, temporarily tighten the camshaft oil field pipe SUB-ASSY with the two union bolts and bolt.

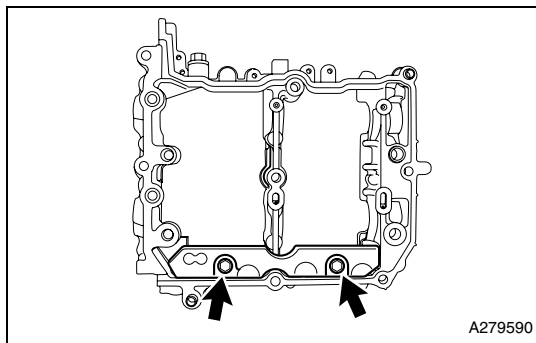


- (2) Tighten the two union bolts to specified torque.

Standard value: $T=31\text{N}\cdot\text{m}$ {316kgf•cm} {22.9 ft•lbf}

- (3) Tighten the bolt to specified torque.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}

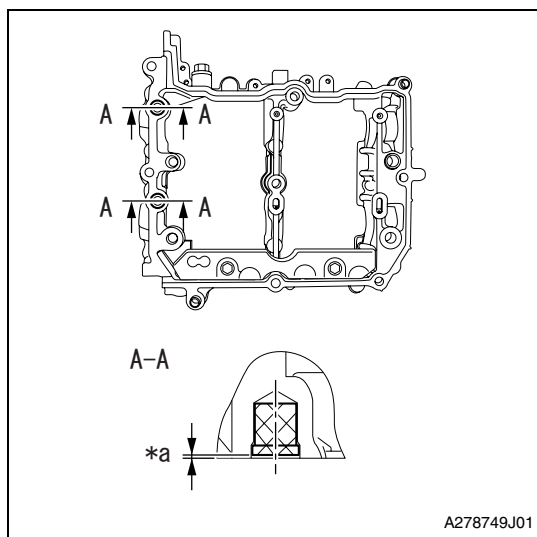


7. Installation of oil spacer RH

- (1) Install the oil spacer RH with two bolts.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}

EM



8. Installation of oil control valve filter RH

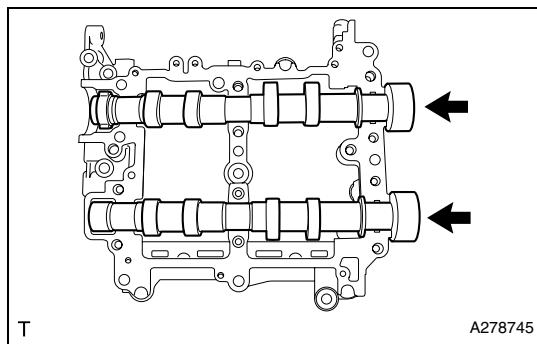
- (1) Install two new oil control valve filters RH to the camshaft housing SUB-ASSY RH as shown in the figure.

Captions in illustration

*a	0 to 0.5 mm {0 to 0.0197 in} (from the end surface of camshaft housing SUB-ASSY RH)
----	---

9. Installation of camshaft (bank 1 side)

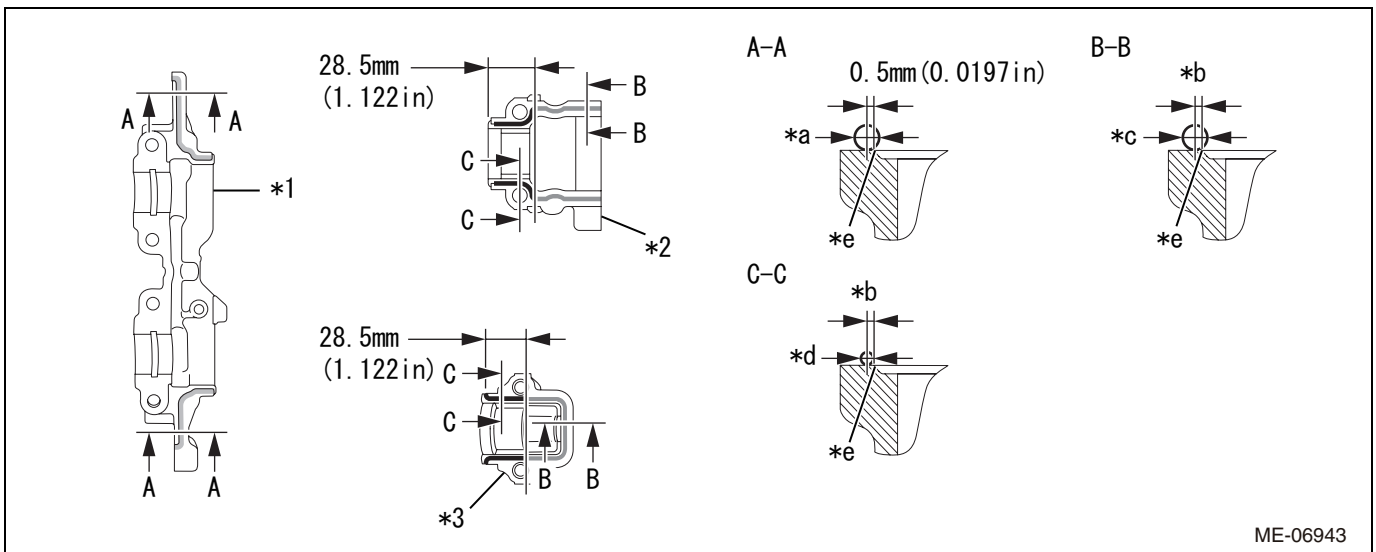
- (1) Apply engine oil to the camshaft housing SUB-ASSY RH journal.



- (2) Install the intake camshaft RH and exhaust camshaft RH to the camshaft housing SUB-ASSY RH.

10. Installation of camshaft cap (bank 1 side)

- (1) Apply THREE BOND 1217G to the mating surface of front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH as shown in the figure.



ME-06943

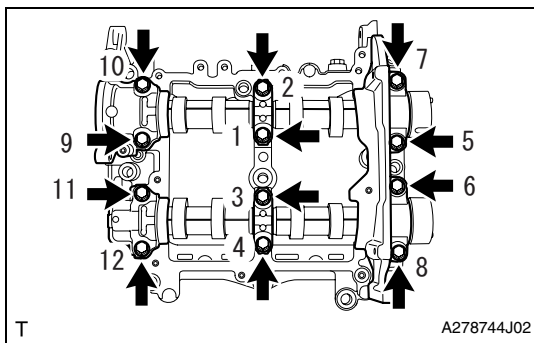
Captions in illustration

*1	Front camshaft cap RH	*2	Intake rear camshaft cap RH
*3	Exhaust rear camshaft cap RH	-	-
*a	2.5 to 4.0 mm {0.0984 to 0.1575 in} in diameter	*b	1.0 mm {0.0394 in} or less
*c	3.0 to 4.0 mm {0.1181 to 0.1575 in} in diameter	*d	1.5 to 2.5 mm {0.0591 to 0.0984 in} in diameter
*e	Groove	-	-

<Caution>

- Clean and degrease the fitting surface.
- Do not apply liquid gasket excessively to avoid engine seizure.
- Do not apply liquid gasket to the intake center camshaft cap RH and exhaust center camshaft cap RH.
- Install within 5 min. after applying liquid gasket.

(2) Apply engine oil to the journals of each camshaft cap and set to the camshaft housing SUB-ASSY RH.



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(3) Tighten 12 bolts in order as shown in the figure, install the front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH.

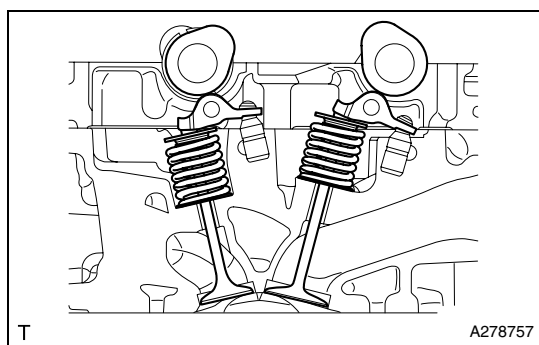
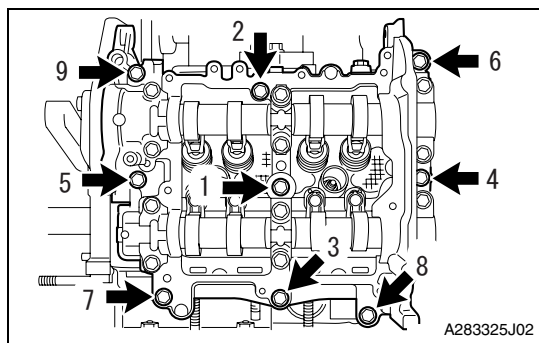
Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}

<Caution>

- Clean and degrease the fitting surface.
- Do not apply liquid gasket excessively.
- Install within 5 min. after applying liquid gasket.
- Completely remove any liquid gasket that is squeezed out on the fitting surface of the timing chain/belt cover SUB-ASSY.

- (4) Tighten nine bolts in order as shown in the figure, and install the camshaft housing SUB-ASSY RH.

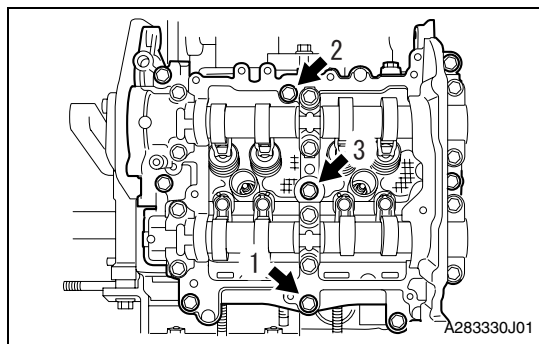
Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf•cm} {13.3 ft•lbf}



<Reference>

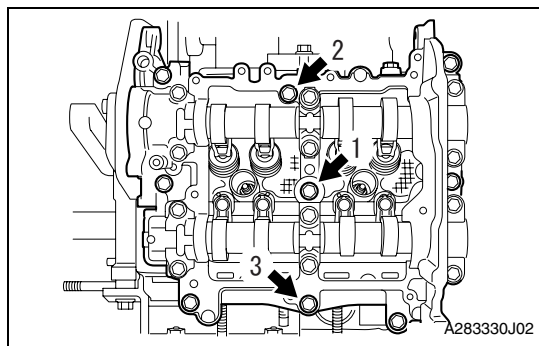
Set the intake camshaft RH and the exhaust camshaft RH to the zero-lift position.

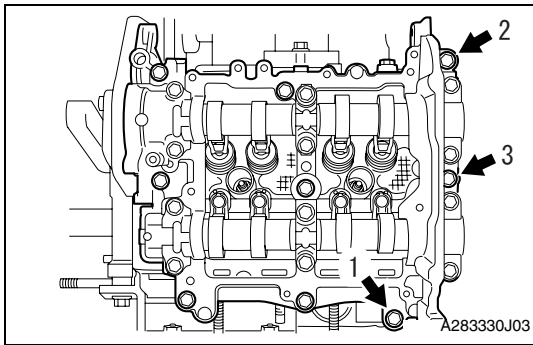
- (5) Loosen the three bolts by 180° in the order as shown in the figure.



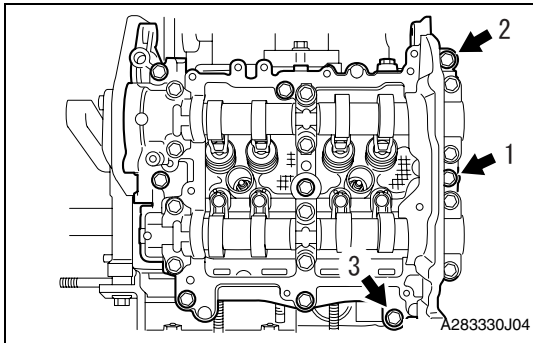
- (6) Tighten the three bolts in the order as shown in the figure.

Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf•cm} {13.3 ft•lbf}



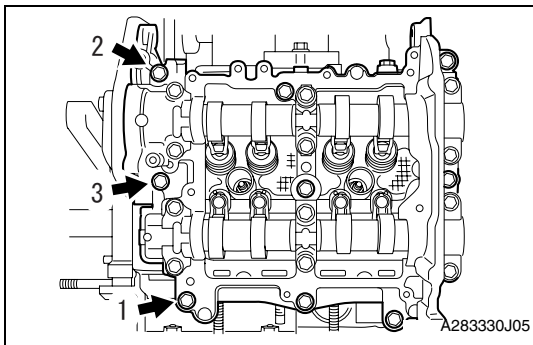


(7) Loosen the three bolts by 180° in the order as shown in the figure.

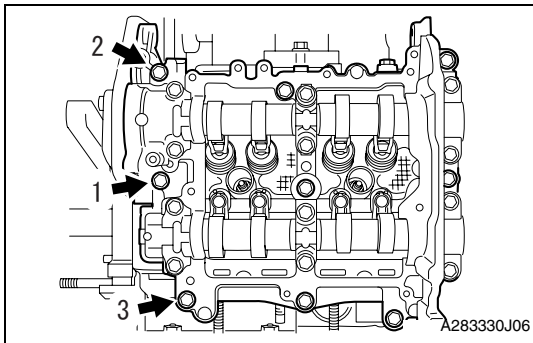


(8) Tighten the three bolts in the order as shown in the figure.
Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}

EM



(9) Loosen the three bolts by 180° in the order as shown in the figure.



(10) Tighten the three bolts in the order as shown in the figure.

Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}

<Reference>

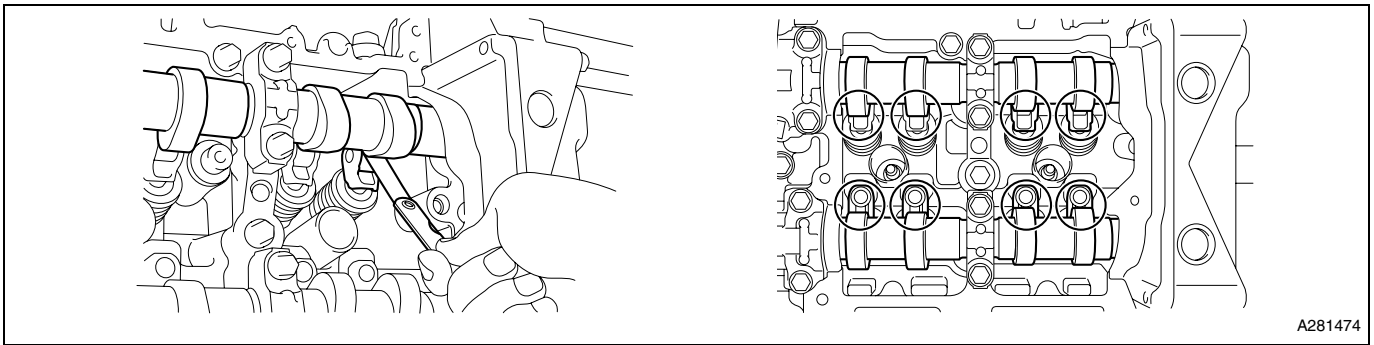
After tightening, if the liquid gasket is squeezed out in the seal surface area of the timing chain/belt cover SUB-ASSY, completely remove any liquid gasket that is squeezed out.

24. Valve clearance check (bank 1 side)

<Caution>

Under the condition that the chain SUB-ASSY (bank 1 side) is detached, the valve heads contact each other and valve stem may bend. Do not turn the intake camshaft RH and exhaust camshaft RH to the outside of range of zero-lift (in range where it can be turned lightly by hand).

(1) Measure the roller surface of cam base circle and valve rocker arm SUB-ASSY No.1 using thickness gauge.



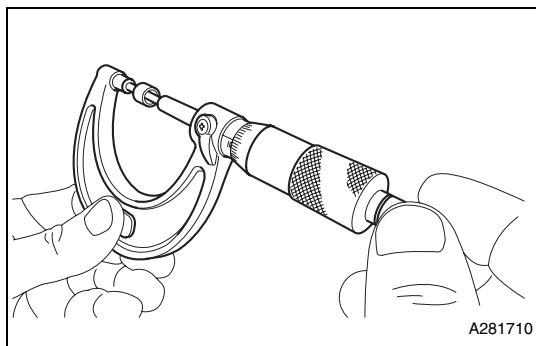
Standard value (when cold): 0.10 to 0.16 mm {0.0039 to 0.0063 in} (intake side)
0.21 to 0.27 mm {0.0083 to 0.0106 in} (exhaust side)

<Reference>

- For valve clearance inspection, adjust the cam base circle position so that the thickness gauge can be inserted easily by hand turning the camshaft to be measured.
- If the measured value is out of standard, take notes of the value in order to adjust the valve clearance later on.

25. Valve clearance adjustment (bank 1 side)

- Remove the camshaft housing SUB-ASSY RH.
- Remove the valve rocker arm SUB-ASSY No. 1.
- Remove the valve adjusting shim.



- Measure the thickness of the removed valve adjusting shim using micrometer.

- Calculate the thickness of the valve adjusting shim so that the valve clearance is within the specified range.

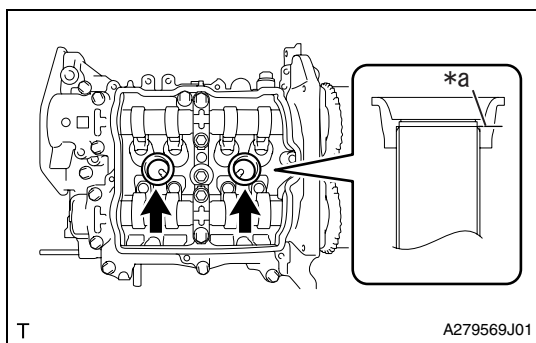
Standard value: Intake side: (Selected shim thickness) = (removed shim thickness) + [(measured clearance) - 0.13 mm {0.0051 in}] × 1.54
Exhaust side: (Selected shim thickness) = (removed shim thickness) + [(measured clearance) - 0.24 mm {0.0094 in}] × 1.69

- Apply engine oil to the inner circle area of the selected valve adjusting shim, and install to the valve.

<Caution>

Make sure that the valve adjusting shim turns smoothly after inserting.

- Install the valve rocker arm SUB-ASSY No. 1.
- Install the camshaft housing SUB-ASSY RH.



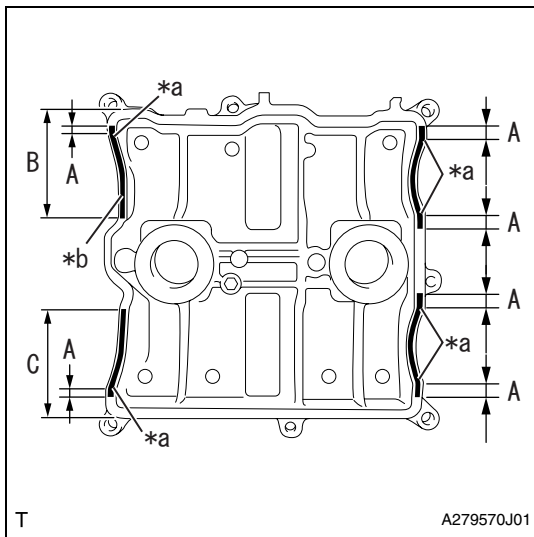
26. Installation of cylinder head cover SUB-ASSY

- Apply a light coat of engine oil to the two new spark plug tube gaskets, and insert them up to the spark plug tube end.

Captions in illustration

*a	Spark plug tube end
----	---------------------

- Install the cylinder head cover gasket to the cylinder head cover SUB-ASSY.



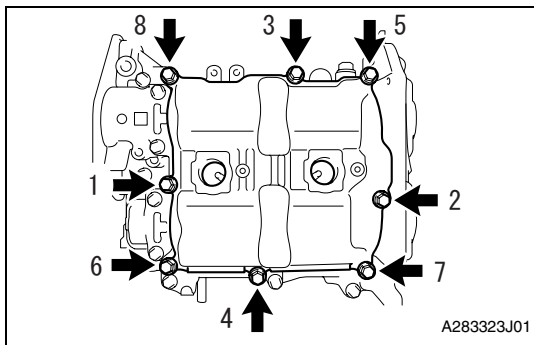
- (3) Apply THREE BOND 1217G to the mating surface of the cylinder head cover SUB-ASSY as shown in the figure.

Application area	Application length
A	10.0 mm {0.394 in} or more
B	68.0 mm {2.677 in} or more
C	70.7 mm {2.784 in} or more

Captions in illustration

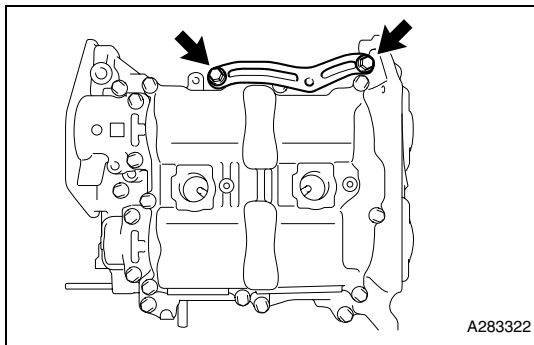
*a	Arch starting point
*b	2.0 to 4.0 mm {0.079 to 0.158 in} in diameter

EM



- (4) Set the cylinder head cover SUB-ASSY, and tighten the eight bolts in the order as shown in the figure.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}



- (5) Install the injector driver bracket using two bolts.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}

27. Installation of spark plug

- (1) Install the four spark plugs.

Standard value: $T=17\text{N}\cdot\text{m}$ {173kgf·cm} {12.5 ft·lbf}

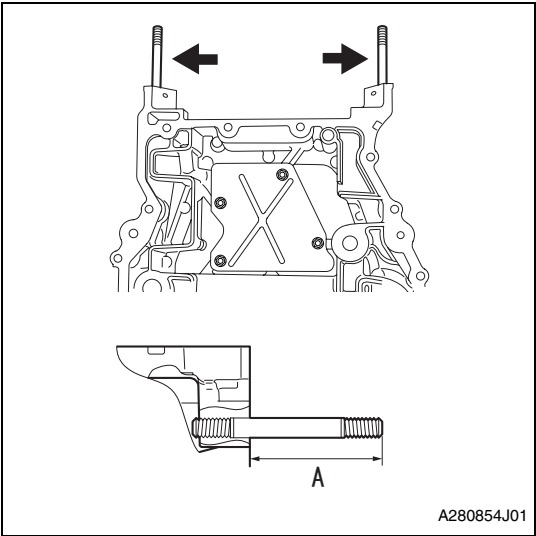
28. Installation of camshaft timing exhaust gear ASSY LH

<Caution>

Before installation, check that there is no foreign matter on the camshaft timing exhaust gear ASSY LH and exhaust camshaft LH.

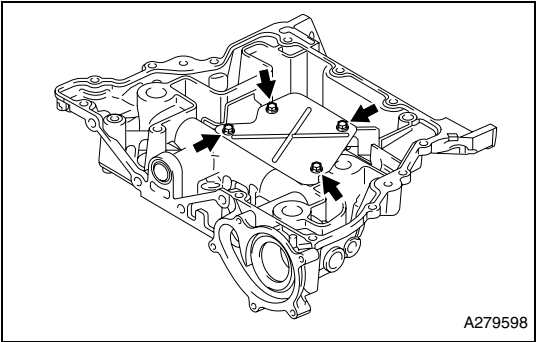
Next step EM-41

EM

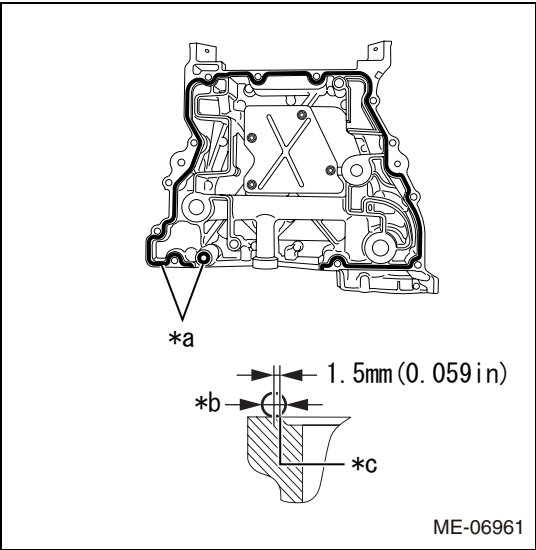


11. Installation of oil pan SUB-ASSY

- (1) Install the two stud bolts to the oil pan SUB-ASSY.
Standard value: $T=10N\cdot m$ {102kgf $\cdot$ cm} {7.4 ft $\cdot$ lbf}
Stud bolt height (A): 70.0 mm {2.756 in}



- (2) Install the baffle plate No. 1 to the oil pan SUB-ASSY with four bolts.
Standard value: $T=6.4N\cdot m$ {65kgf $\cdot$ cm} {4.7 ft $\cdot$ lbf}



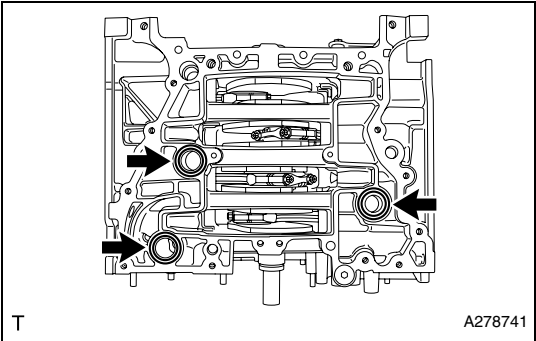
- (3) Apply THREE BOND 1217G to the mating surface of the oil pan SUB-ASSY as shown in the figure.

Captions in illustration

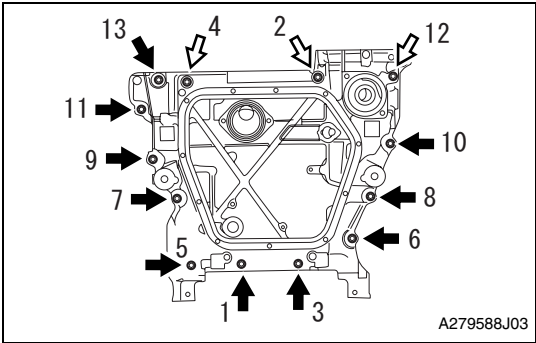
*a	THREE BOND 1217G
*b	4.0 to 6.0 mm {0.158 to 0.236 in} in diameter
*c	Groove

<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.
- Apply liquid gasket 1.5 mm {0.059 in} outside from the groove of the oil pan SUB-ASSY. However, application of liquid gasket around the bolt hole is allowed.



- (4) Install three new O-rings to the cylinder block.



- (5) Tighten 13 bolts (A and B) in order as shown in the figure, and install the oil pan SUB-ASSY to the cylinder block.
- Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf·cm} {13.3 ft·lbf}
- Captions in illustration

	Bolt A
	Bolt B

Bolt type	Bolt length (except for head)
Bolt A	25 mm {0.984 in}
Bolt B	75 mm {2.953 in}

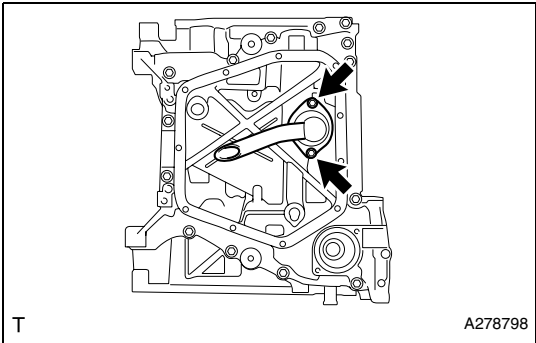
EM

<Reference>

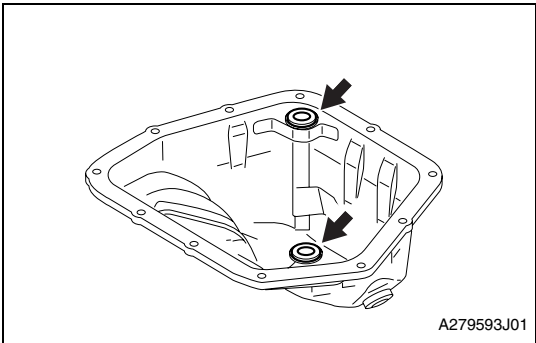
After tightening, if the liquid gasket is squeezed out in the seal surface area of the timing chain/belt cover SUB-ASSY, completely remove any liquid gasket that is squeezed out.

12. Installation of oil strainer SUB-ASSY

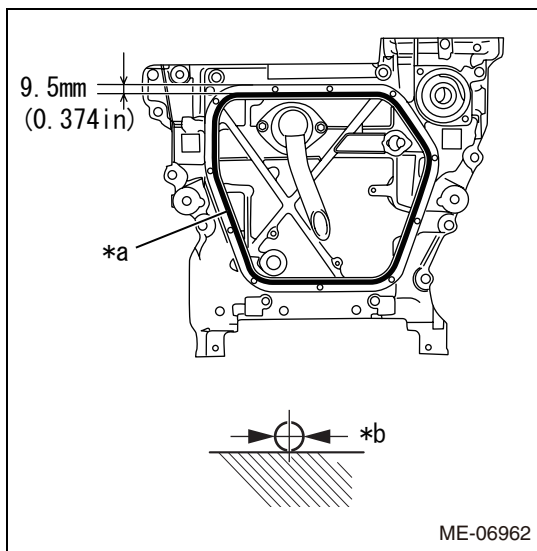
(1) Install a new O-ring.



- (2) Install the oil strainer SUB-ASSY to the oil pan SUB-ASSY with two bolts.
- Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}



13. Installation of oil pan SUB-ASSY No. 2
- (1) Install the two new oil pan seal rings to the oil pan SUB-ASSY No. 2.

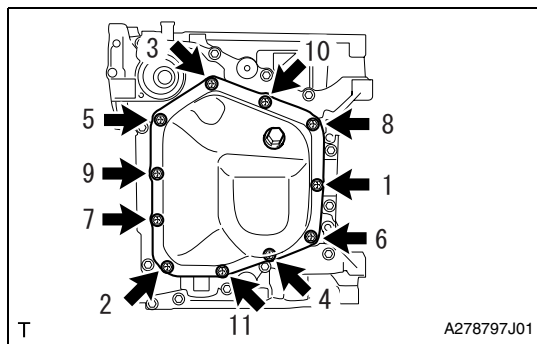


- (2) Apply THREE BOND 1217G to the mating surface of the oil pan SUB-ASSY No. 2 of the oil pan SUB-ASSY as shown in the figure.
Captions in illustration

*a	THREE BOND 1217G
*b	4.0 to 6.0 mm {0.158 to 0.236 in} in diameter

<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

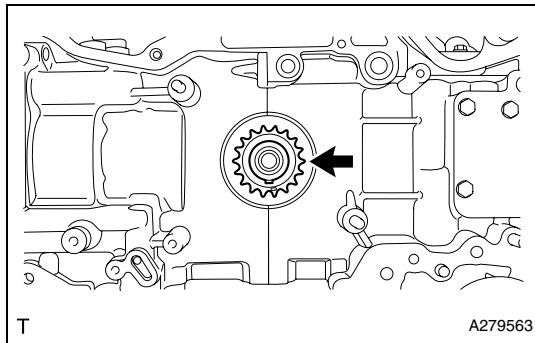


- (3) Tighten 11 bolts in order as shown in the figure, and install the oil pan SUB-ASSY No. 2.
Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}



14. Installation of engine hanger No. 2

- (1) Install the engine hanger No. 2 to the cylinder block (bank 1 side) with two bolts.
Standard value: $T=21\text{N}\cdot\text{m}$ {214kgf•cm} {15.5 ft•lbf}



32. Installation of crankshaft timing gear/sprocket
(1) Install the crankshaft timing gear/sprocket.

EM

33. Installation of chain SUB-ASSY (bank 2 side)

<Caution>

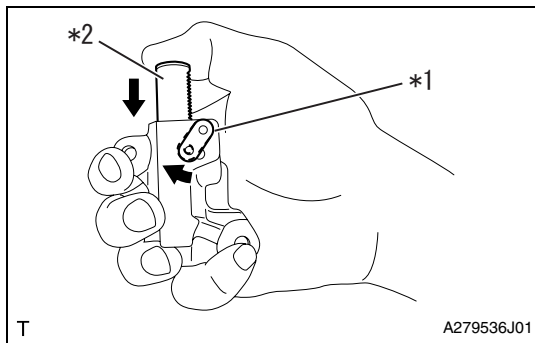
Be careful that the foreign matter is not into or onto the assembled component during installation.

<Reference>

Apply engine oil to all component parts of the chain SUB-ASSY.

- (1) Install the SST to the crankshaft.

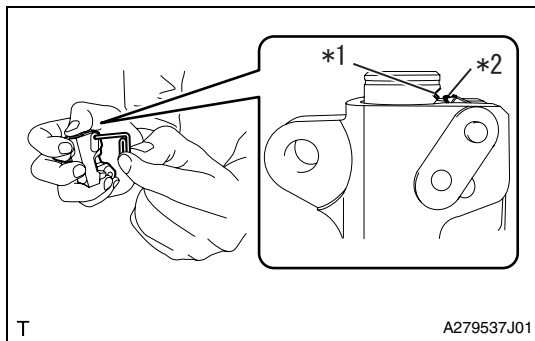
SST 18252AA000



- (2) Move the link plate in the direction of arrow to press in the plunger.

Captions in illustration

*1	Link plate
*2	Plunger



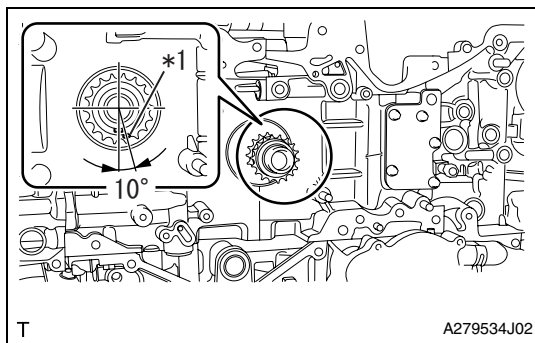
- (3) Insert a piece of metal wire (approx. 1 mm {0.0394 in} dia.) into the stopper pin hole to secure the plunger.

<Reference>

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner ASSY are not aligned, check that the first notch of plunger rack is engaged with the stopper tooth. If not engaged, retract the plunger a little so that the first notch of plunger rack is engaged with the stopper tooth.

Captions in illustration

*1	First notch of rack
*2	Stopper tooth



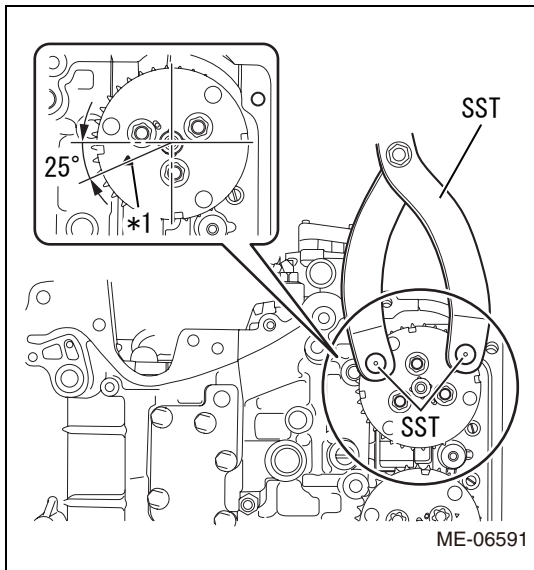
- (4) Check that the crankshaft timing gear/sprocket is located at the position shown in the figure. If not aligned, turn the crankshaft to align the crankshaft timing gear/sprocket alignment mark to the position shown in the figure.

Captions in illustration

*1	Alignment mark
----	----------------

<Caution>

Perform properly to avoid contact of the valve and piston.



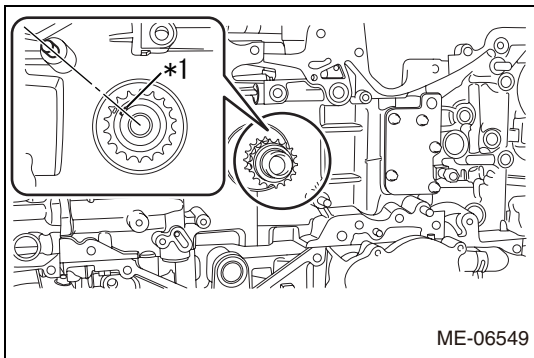
- (5) Using SST and by turning the camshaft timing intake gear ASSY LH, align the alignment mark to the position as shown in the figure.
SST 18355AA000, 18334AA030

<Caution>

The intake valve and exhaust valve contact each other and valve stem may bend. Do not turn the exhaust camshaft LH.

Captions in illustration

*1	Alignment mark
----	----------------



- (6) Using SST and by turning the crankshaft approximately 200° counterclockwise, align the crankshaft timing gear key to the position as shown in the figure.

SST 18252AA000

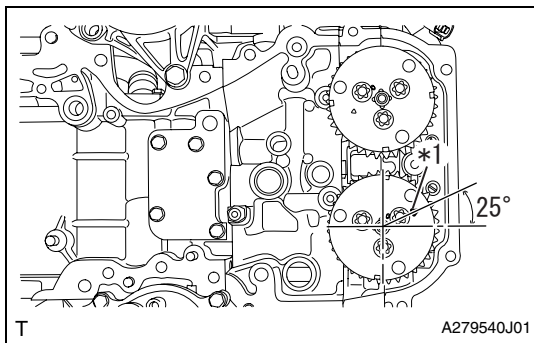
<Caution>

Never turn clockwise because the valve and piston may contact. However, turning clockwise is allowed in case of fine adjustment after aligning the crankshaft timing gear key to the position shown in the figure.

Captions in illustration

*1	Key
----	-----

- (7) Remove SST.



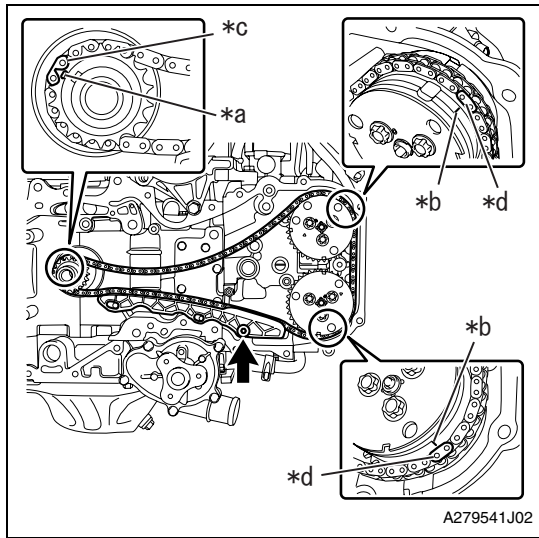
- (8) Using SST and by turning the camshaft timing exhaust gear ASSY LH, align the alignment mark to the position as shown in the figure.
SST 18355AA000, 18334AA030

<Caution>

To prevent valve damage, turn the camshaft timing exhaust gear ASSY LH only within the range of zero-lift (in range where it can be turned lightly by hand).

Captions in illustration

*1	Alignment mark
----	----------------



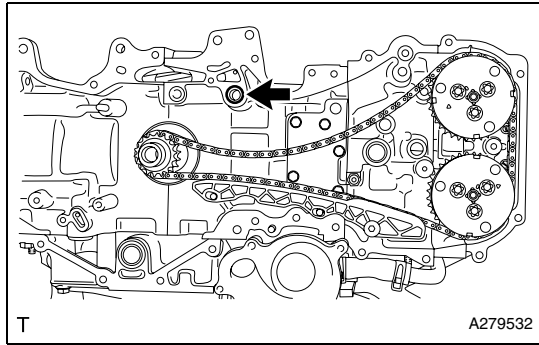
(9) Align the mark plate (blue) of the chain SUB-ASSY to the alignment mark of the crankshaft timing gear/sprocket.

Captions in illustration

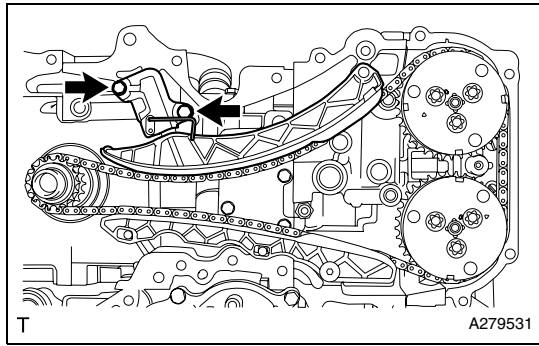
*a	Alignment mark
*b	Timing mark
*c	Mark plate (blue)
*d	Mark plate (pink)

- (10) Align the mark plate (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing intake gear ASSY LH.
(11) Align the mark (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing exhaust gear ASSY LH.
(12) Apply engine oil to the sliding surface of the chain vibration damper No. 1 bolt.
(13) Install the chain vibration damper No. 1 with the bolt.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}

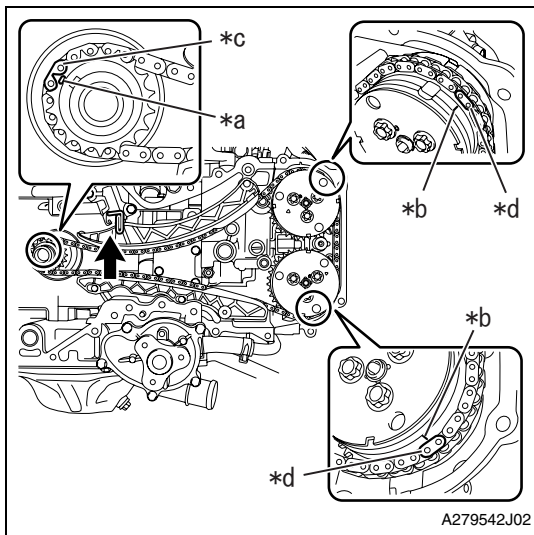


(14) Install a new O-ring to the cylinder block (bank 2 side).



(15) Install the chain tensioner slipper.

- (16) Tighten the two bolts to install the chain tensioner ASSY No. 2.
Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}



(17) Make sure that the chain SUB-ASSY is securely installed.

Captions in illustration

*a	Alignment mark
*b	Timing mark
*c	Mark plate (blue)
*d	Mark plate (pink)

(a) Align the mark (blue) of the chain SUB-ASSY to the alignment mark of the crankshaft timing gear/sprocket.

(b) Align the mark (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing intake gear ASSY LH.

(c) Align the mark (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing exhaust gear ASSY LH.

EM

(18) Pull out the wire from the chain tensioner ASSY No. 2.

<Reference>

Pull out the piece of metal wire, while pushing up the chain tensioner slipper to push in the plunger of the chain tensioner ASSY No. 2.

(19) Install the SST to the crankshaft.

SST 18252AA000

(20) Turn the crankshaft clockwise, and make sure that there is no abnormal condition.

<Caution>

Always perform this check.

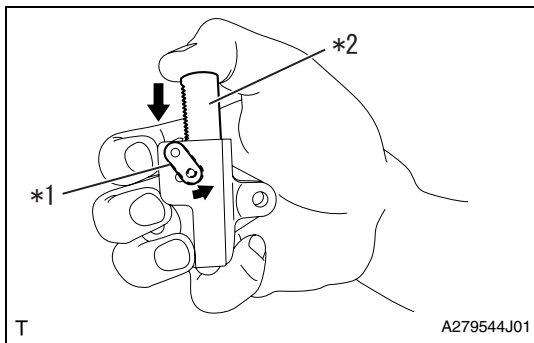
34. Installation of chain SUB-ASSY (bank 1 side)

<Caution>

Be careful that the foreign matter is not into or onto the assembled component during installation.

<Reference>

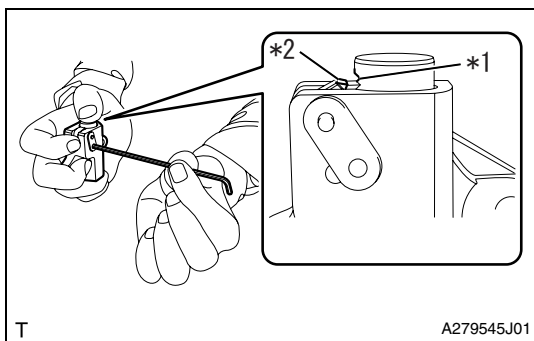
Apply engine oil to all component parts of the chain SUB-ASSY.



(1) Move the link plate in the direction of arrow to press in the plunger.

Captions in illustration

*1	Link plate
*2	Plunger



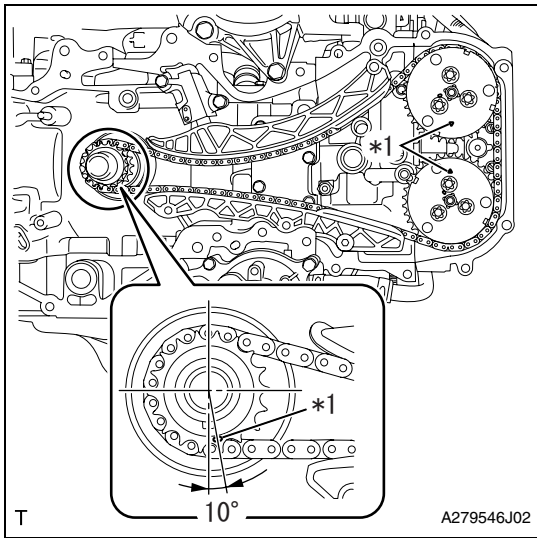
(2) Insert a dia. 2.5 mm {0.098 in} hex wrench into the stopper pin hole to fix the plunger.

Captions in illustration

*1	First notch of rack
*2	Stopper tooth

<Reference>

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner ASSY are not aligned, check that the first notch of plunger rack is engaged with the stopper tooth. If not engaged, retract the plunger a little so that the first notch of plunger rack is engaged with the stopper tooth.



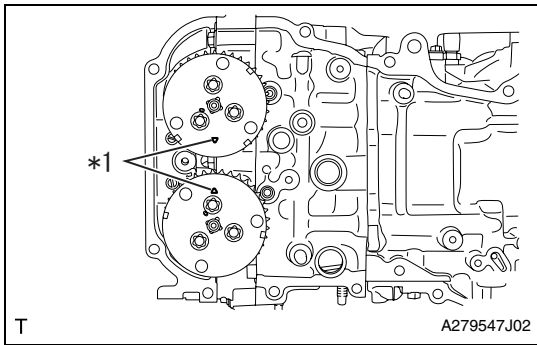
- (3) Using SST and by turning the crankshaft, align the alignment mark of the crankshaft timing gear/sprocket, camshaft timing intake gear ASSY LH and camshaft timing exhaust gear ASSY LH.

Captions in illustration

*1	Alignment mark
----	----------------

<Reference>

When the mark is aligned to the position shown in the figure, the crankshaft timing gear key points downward.



- (4) Using SST, align the alignment mark of the camshaft timing intake gear ASSY RH and camshaft timing exhaust gear ASSY RH to the position as shown in the figure.

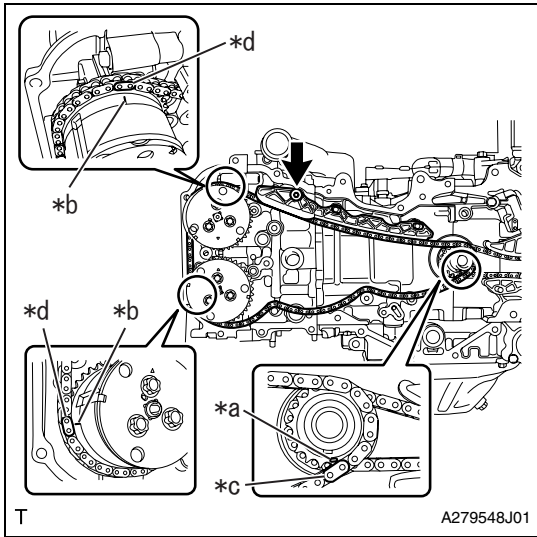
SST 18355AA000, 18334AA030

<Caution>

To prevent valve damage, turn the camshaft timing intake gear ASSY RH and camshaft timing exhaust gear ASSY RH only within the range of zero-lift (in range where it can be turned lightly by hand).

Captions in illustration

*1	Alignment mark
----	----------------

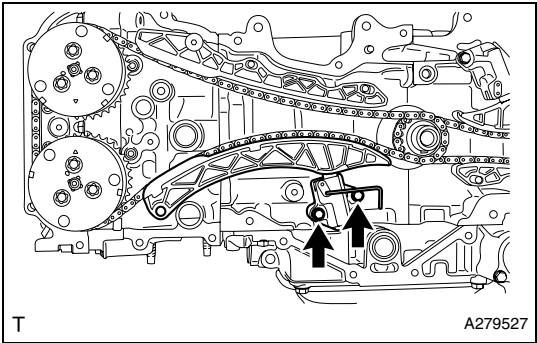


- (5) Align the mark plate (blue) of the chain SUB-ASSY to the alignment mark of the crankshaft timing gear/sprocket.

Captions in illustration

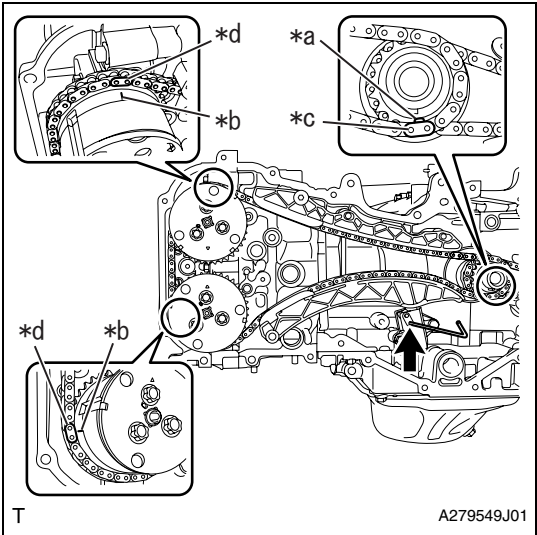
*a	Alignment mark
*b	Timing mark
*c	Mark plate (blue)
*d	Mark plate (pink)

- (6) Align the mark plate (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing intake gear ASSY RH.
- (7) Align the mark plate (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing exhaust gear ASSY RH.
- (8) Apply engine oil to the sliding surface of the chain vibration damper No. 1 bolt.
- (9) Install the chain vibration damper No. 1 with the bolt.
- Standard value: T=6.4N•m {65kgf•cm} {4.7 ft•lbf}



(10) Install the chain tensioner slipper.

(11) Tighten the two bolts to install the chain tensioner ASSY No. 1.
Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}



(12) Make sure that the chain SUB-ASSY is securely installed.

Captions in illustration

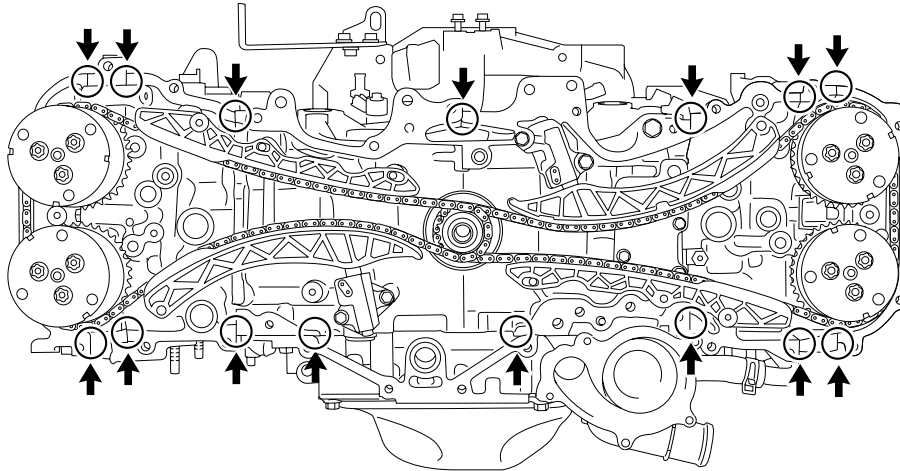
*a	Alignment mark
*b	Timing mark
*c	Mark plate (blue)
*d	Mark plate (pink)

- (a) Align the mark plate (blue) of the chain SUB-ASSY to the alignment mark of the crankshaft timing gear/sprocket.
- (b) Align the mark plate (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing intake gear ASSY RH.
- (c) Align the mark plate (pink) of the chain SUB-ASSY to the timing mark of the camshaft timing exhaust gear ASSY RH.

- (13) Pull out the hex wrench from the chain tensioner ASSY No. 1.
- (14) Turn the crankshaft clockwise, and make sure that there is no abnormal condition.
<Caution>
Always perform this check.
- (15) Remove SST from the crankshaft.

35. Installation of timing chain/belt cover SUB-ASSY

- (1) Apply a little coat of engine oil to four new O-rings and install to the engine.
- (2) Before applying liquid gasket, completely remove the old sealing material attached to the sealing portion.
- (3) If there is a gap at the position shown in the figure, fill in the THREE BOND 1217G.



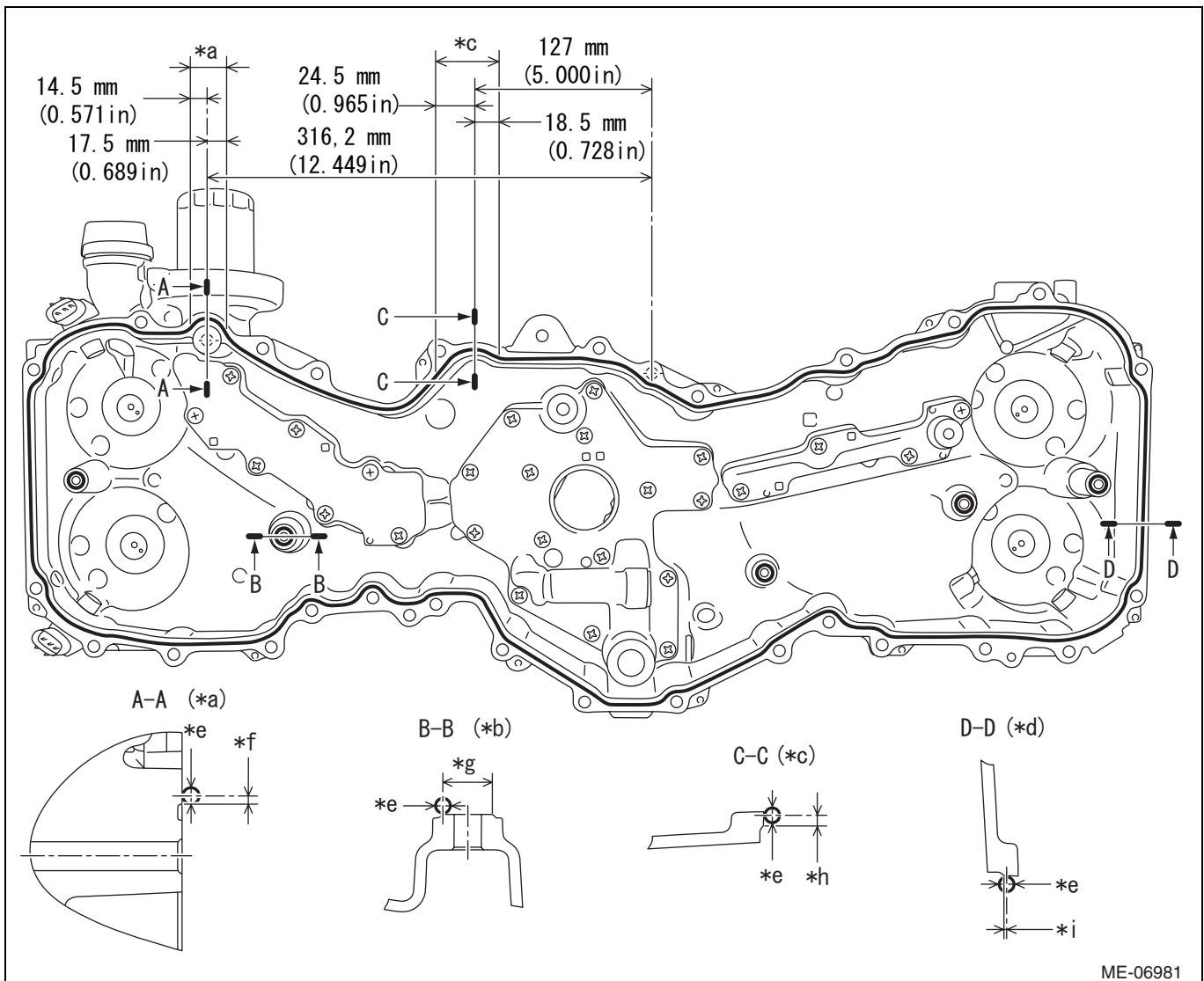
T

A281483

- (4) Apply THREE BOND 1217G to the timing chain/belt cover SUB-ASSY at the position shown in the figure.

Refer to IPB for O ring locations

DO NOT forget oil pump O ring



<Caution>

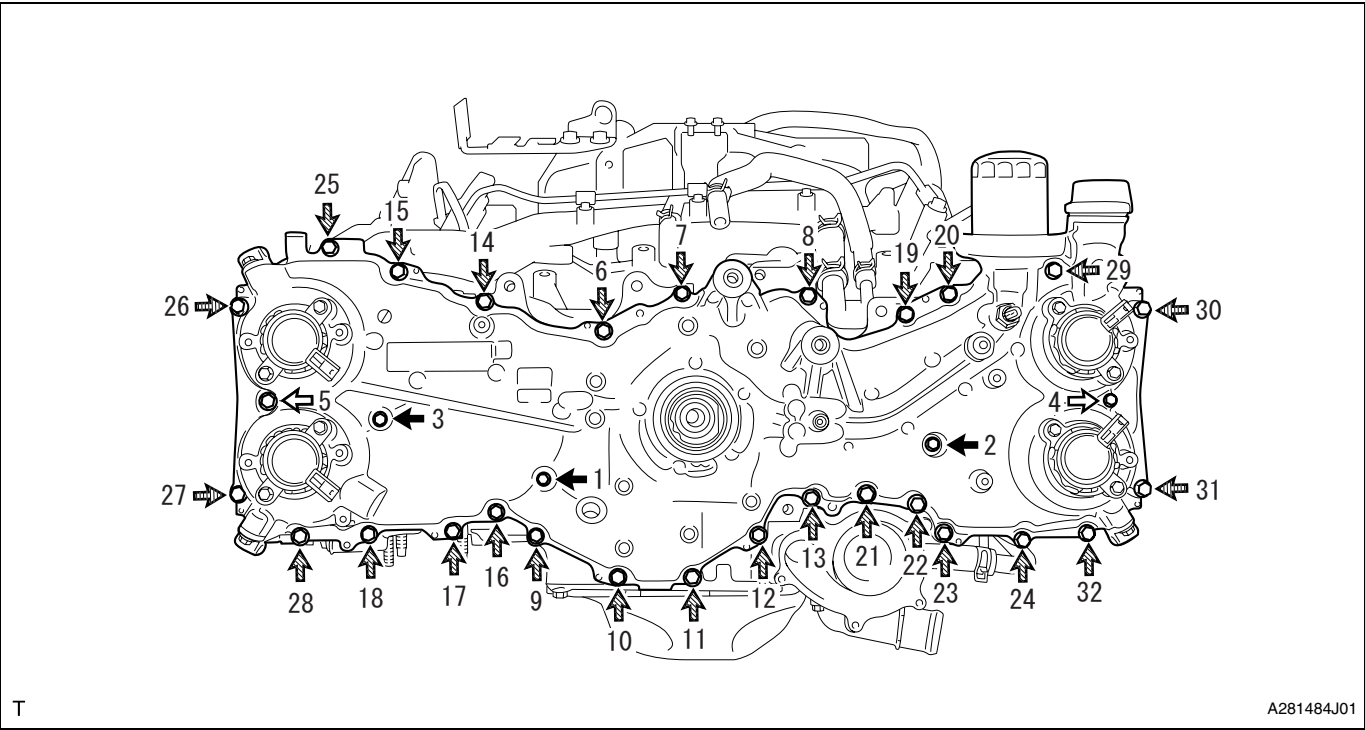
- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

Captions in illustration

*a	Range A	*b	Boss (five locations)
*c	Range B	*d	Other than ranges A and B
*e	3.5 to 4.5 mm {0.138 to 0.177 in} in diameter	*f	2 mm {0.079 in}
*g	12 mm {0.472 in} in diameter	*h	2.5 mm {0.098 in}
*i	0.5 mm {0.0197 in}	-	-

(5) Temporarily install the timing chain/belt cover SUB-ASSY using 32 bolts.

(6) Tighten the 32 bolts in the order as shown in the figure.



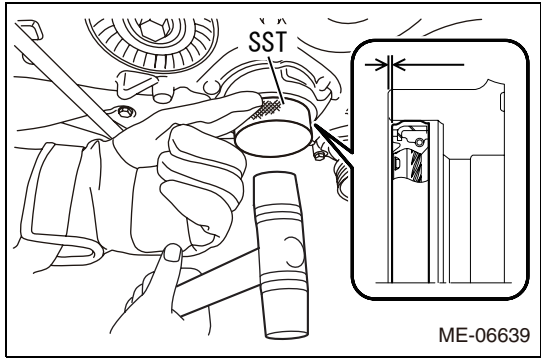
Captions in illustration

	Bolt A		Bolt B
	Bolt C		Bolt D

Standard value: Bolt A, B
T=10N•m {102kgf•cm} {7.4 ft•lbf}
Bolt C, D
T=25N•m {255kgf•cm} {18.4 ft•lbf}

<Reference>

Bolt type	Bolt length (except for head)	Bolt type	Bolt length (except for head)
Bolt A	20 mm {0.787 in}	Bolt B	25 mm {0.984 in}
Bolt C	60 mm {2.362 in}	Bolt D	50 mm {1.969 in}

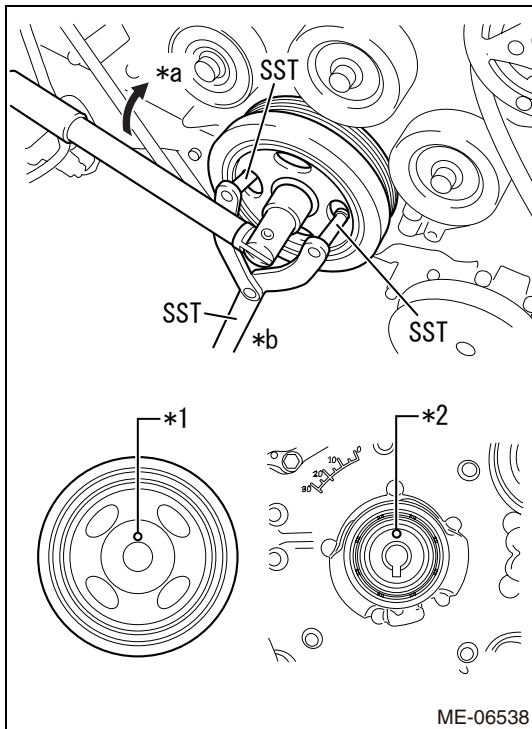


36. Installation of timing chain/belt cover oil seal

- (1) Apply a little coat of engine oil to the inside and outside of the new oil seal.
- <Caution>
- Do not foul the lip.
 - Do not attach engine oil to the dust seal portion.
- (2) Using SST, hammer in the timing chain/belt cover oil seal evenly so that it is aligned to the end surface of the timing chain/belt cover SUB-ASSY.
- SST 398437700
- <Caution>
- Do not hammer in the oil seal obliquely.
 - Be careful not to deform the oil seal.
- <Reference>
- The depth at which the timing chain/belt cover oil seal is hammered in is allowed within 0 to -1.0 mm {0 to -0.0394 in} from the end surface of the timing chain/belt cover SUB-ASSY.

37. Installation of crankshaft pulley

- (1) Install the crankshaft pulley spacer.
- (2) Install a new O-ring to the crankshaft pulley spacer.



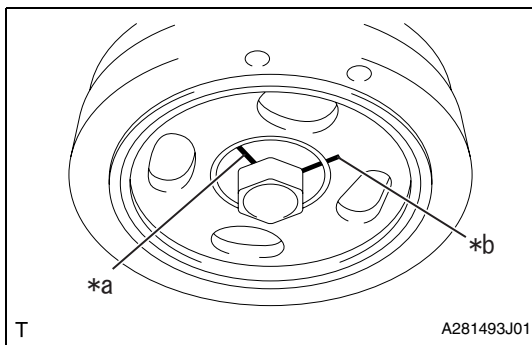
- (3) Install so that the knock hole of the crankshaft pulley and the knock pin of the crankshaft pulley spacer match.

Captions in illustration

*1	Knock hole
*2	Knock pin
*a	Rotate
*b	Hold

- (4) Apply engine oil to the washer and bolt threads of the crankshaft pulley set bolt.
- (5) Use the SST to lock the crankshaft pulley, and tighten the crankshaft pulley set bolt.

SST 18355AA000, 18334AA000

Standard value: $T=20N\cdot m$ {204kgf·cm} {14.8 ft·lbf}

- (6) As shown in the figure, using a marker, draw a reference line (A) on the crankshaft pulley set bolt and end line (B) on the crank pulley at the same level of the line marked on the crankshaft pulley set bolt head portion.

Captions in illustration

*a	Reference line (A)
*b	End line (B)

<Reference>

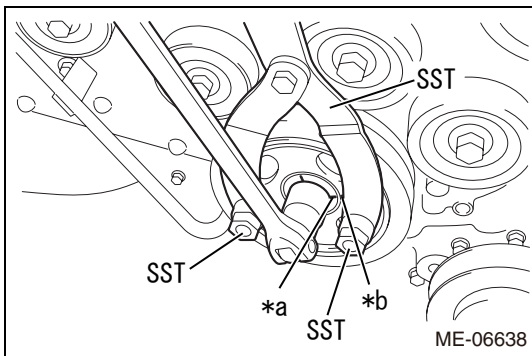
Lines are marked at an interval of 90° on the crankshaft pulley set bolt head portion.

- (7) Use SST to lock the crankshaft pulley, and further-tighten the crankshaft pulley set bolt by 90° to the angle where reference line (A) and end line (B) are aligned.

SST 18355AA000, 18334AA000

Captions in illustration

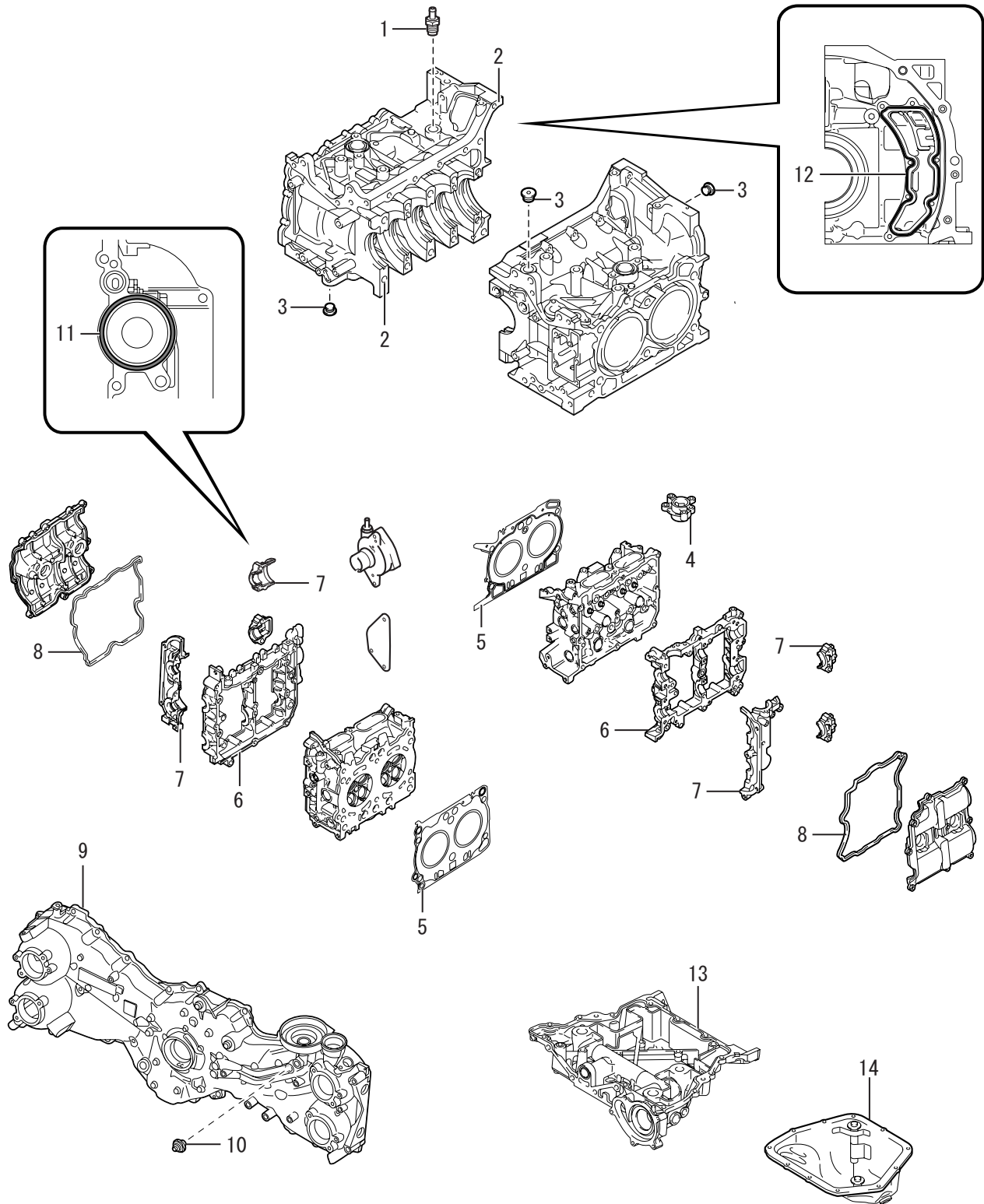
*a	Reference line (A)
*b	End line (B)



38. Installation of thermostat

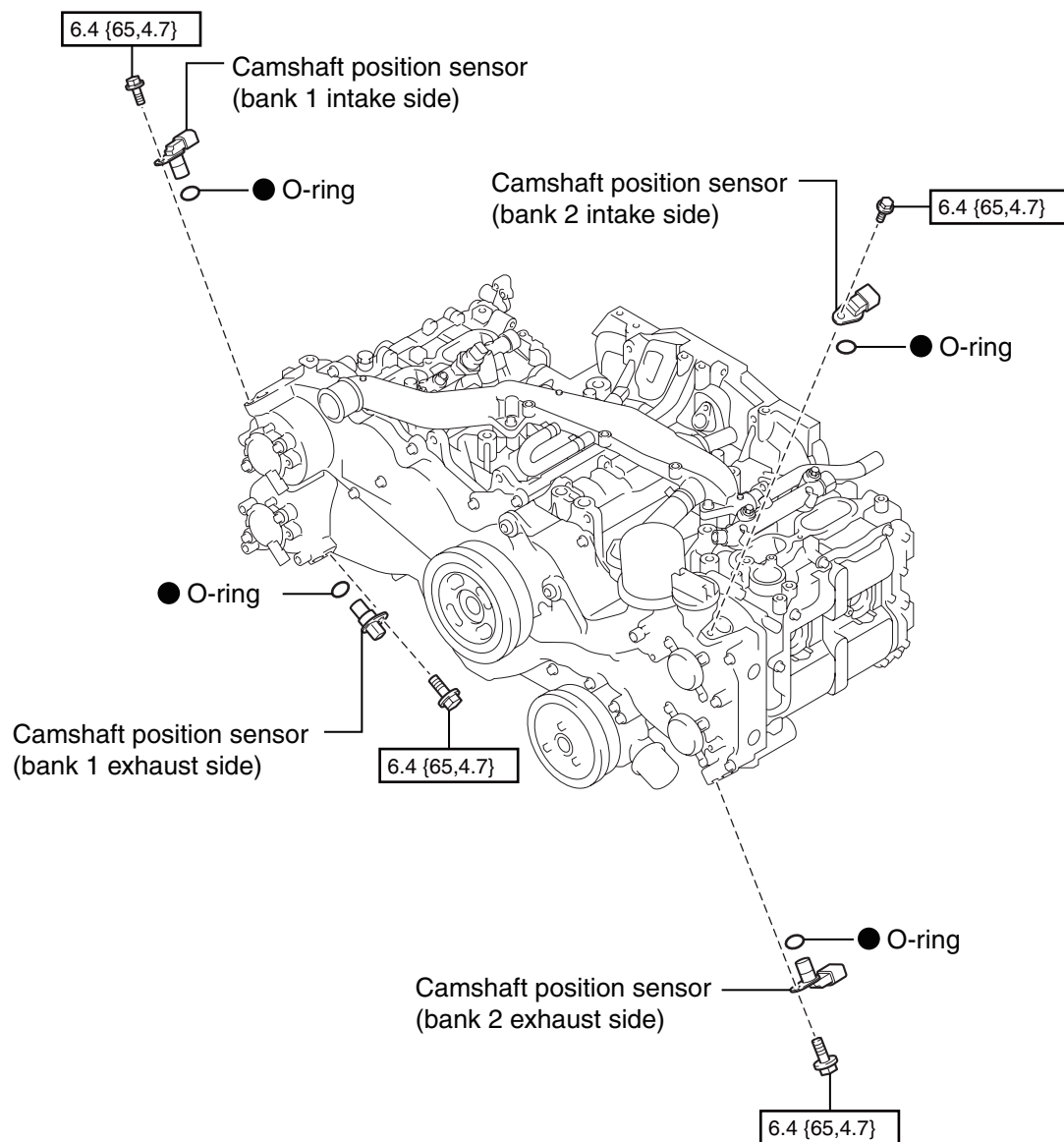
- (1) Install a new gasket to the thermostat.

3. Liquid gasket applying location



PARTIAL ENGINE ASSY (FA20)

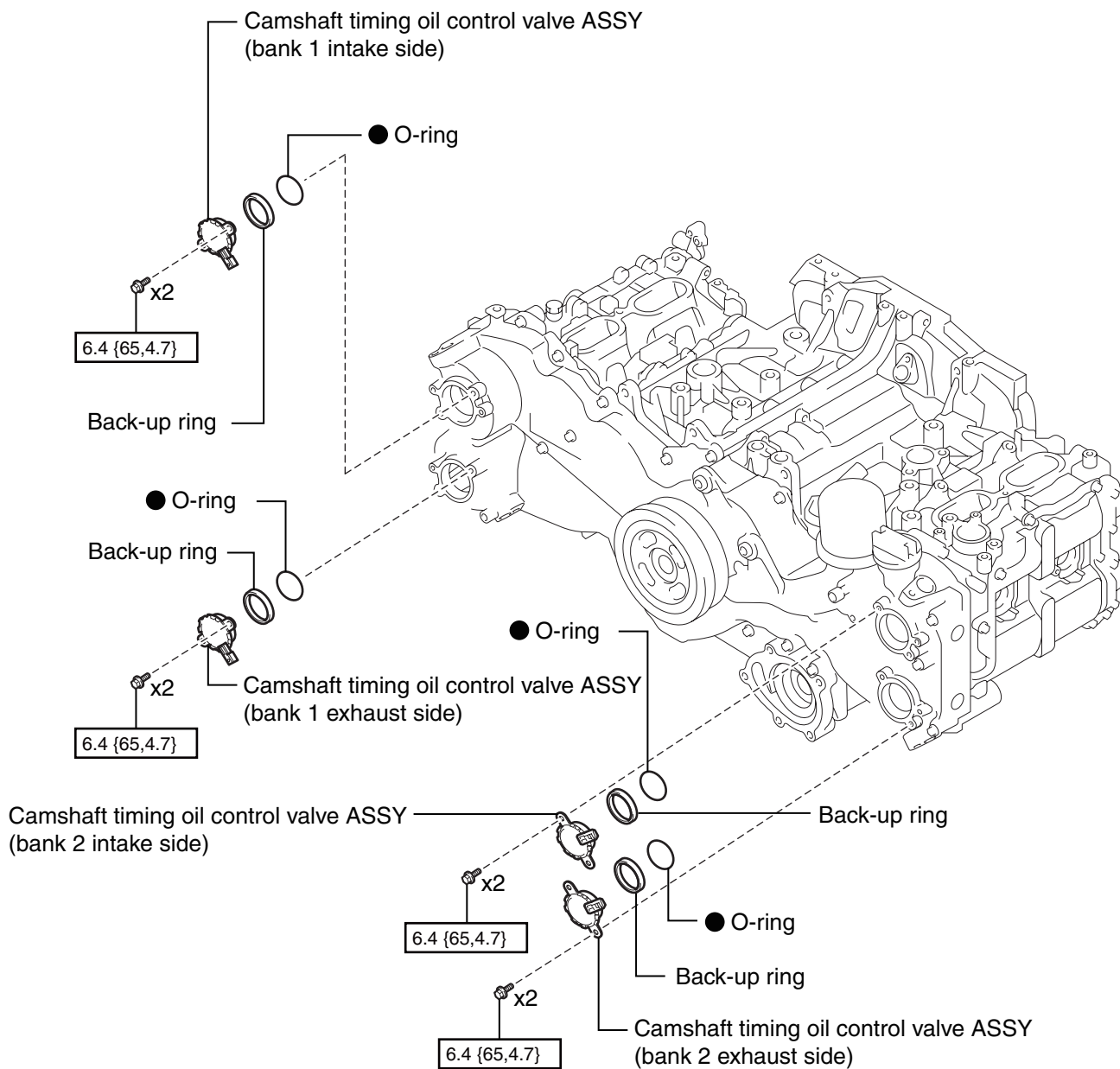
EXPLODED VIEW



$\text{N}\cdot\text{m} \{ \text{kgf}\cdot\text{cm} \} \{ \text{ft}\cdot\text{lbf} \}$: Specified torque

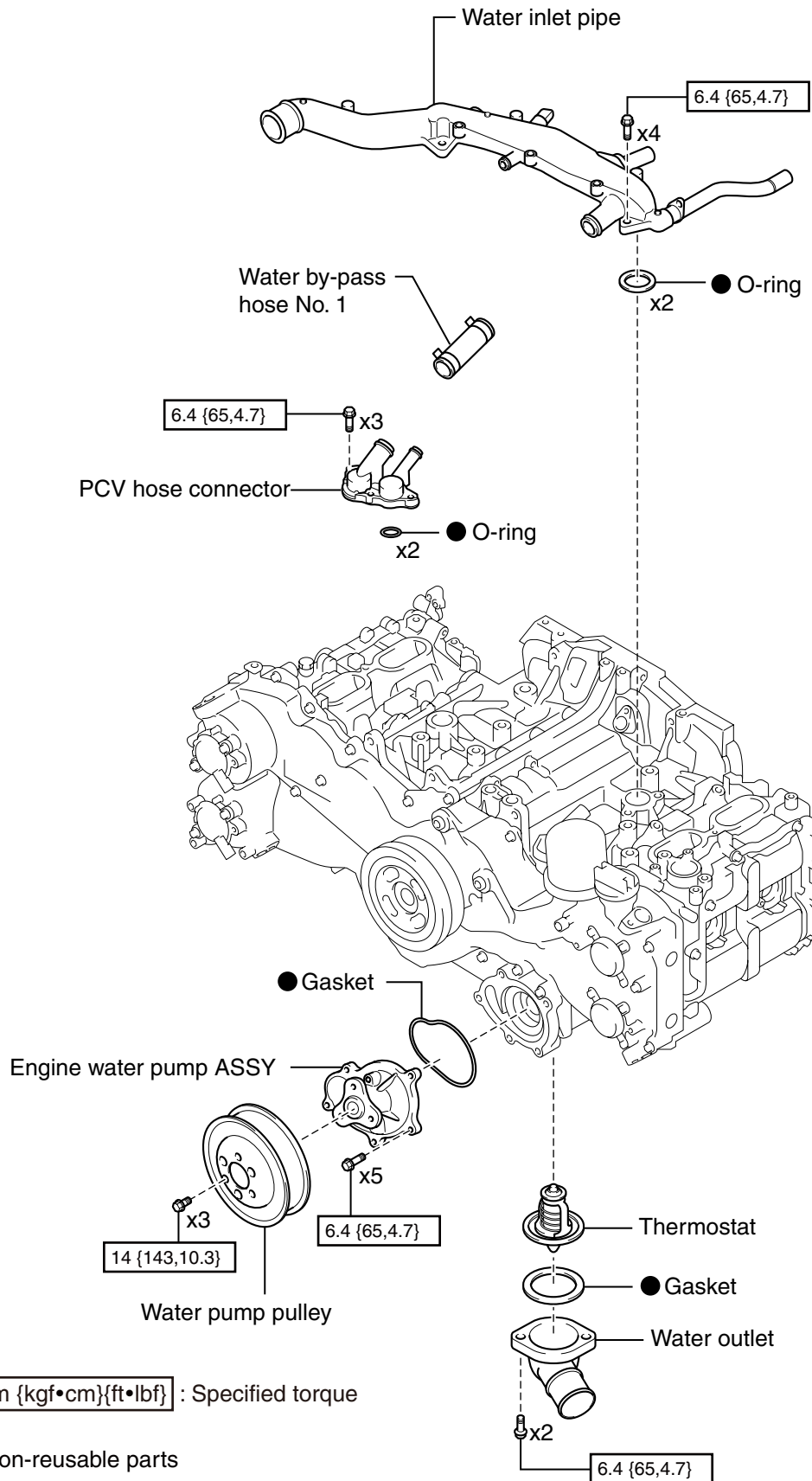
● Non-reusable parts

EM

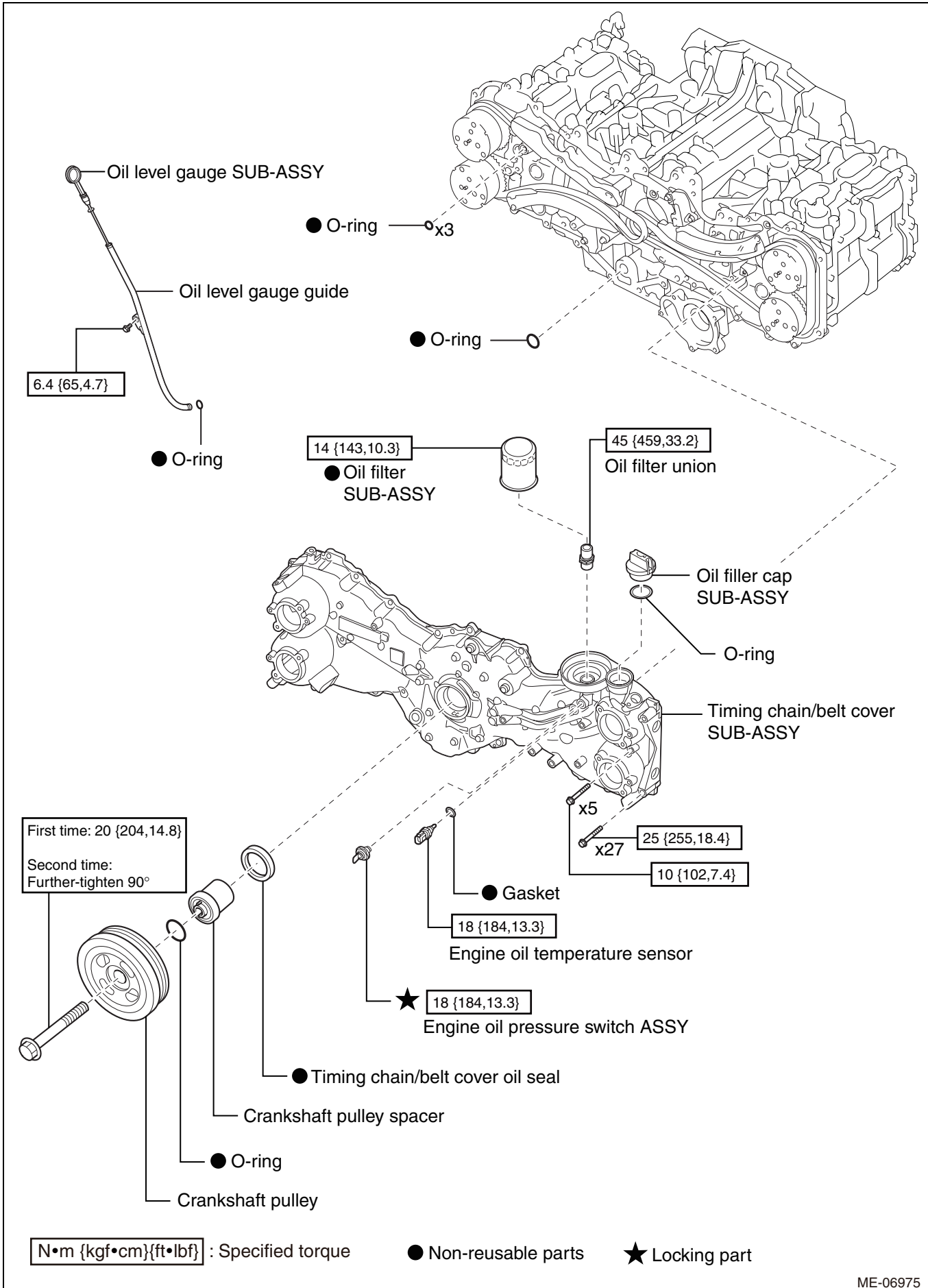


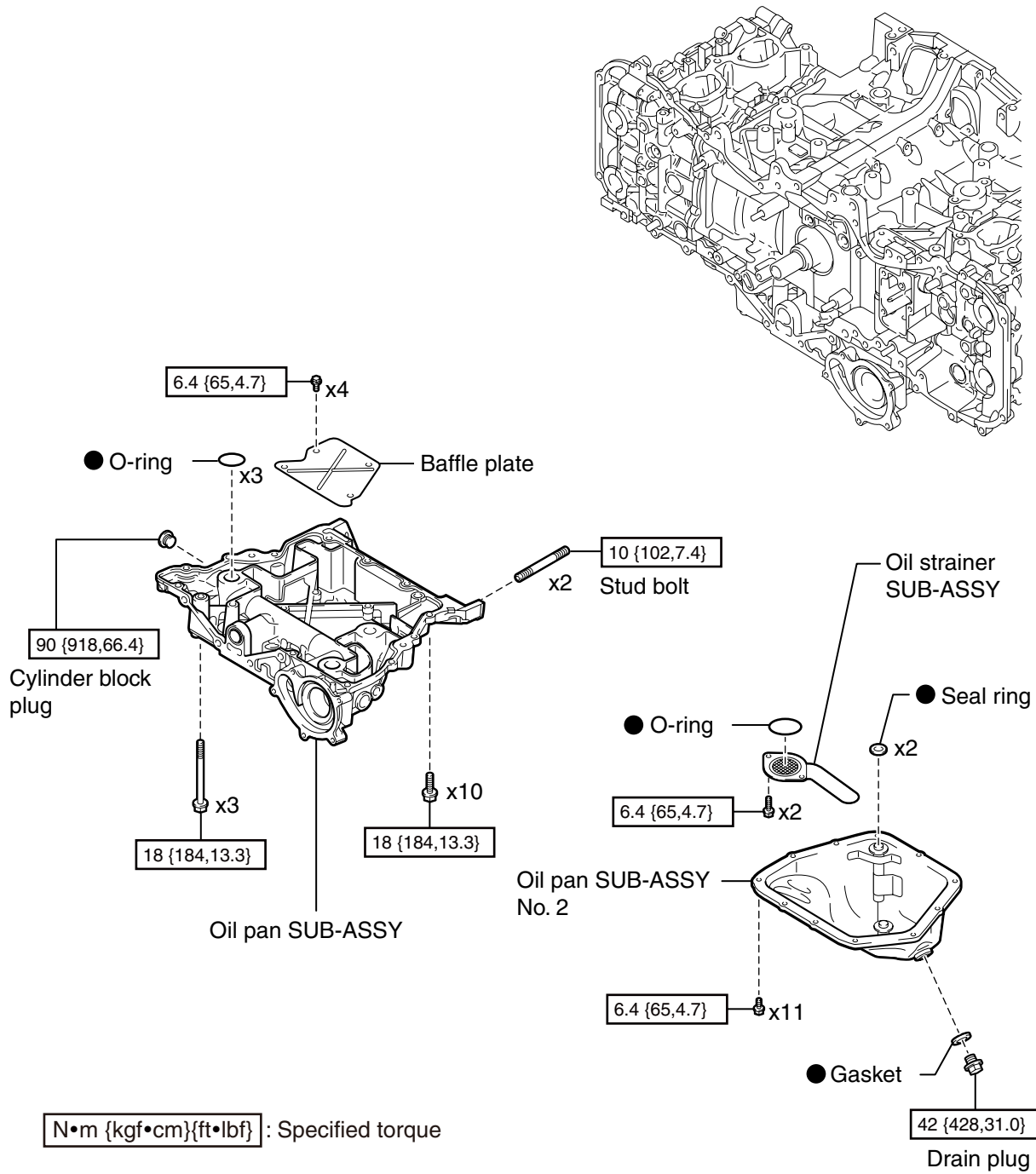
N•m {kgf•cm}{ft•lbf} : Specified torque

● Non-reusable parts



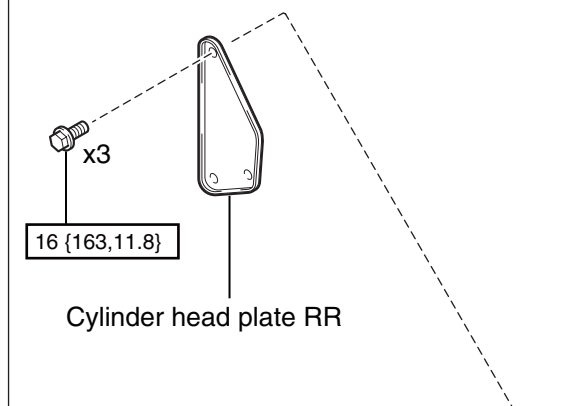
EM



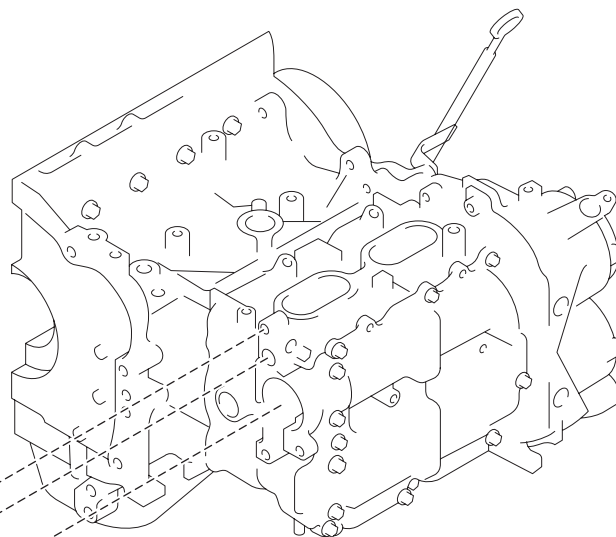
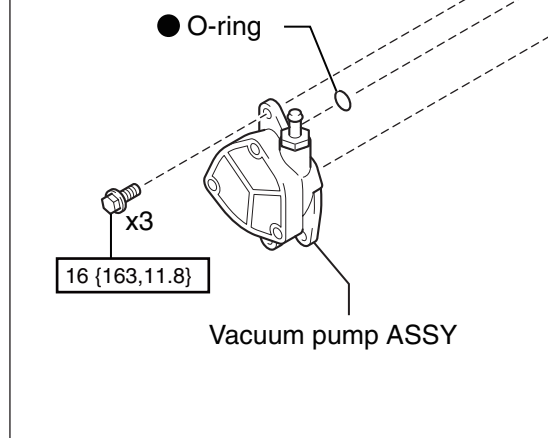


EM

Transmission M/T:

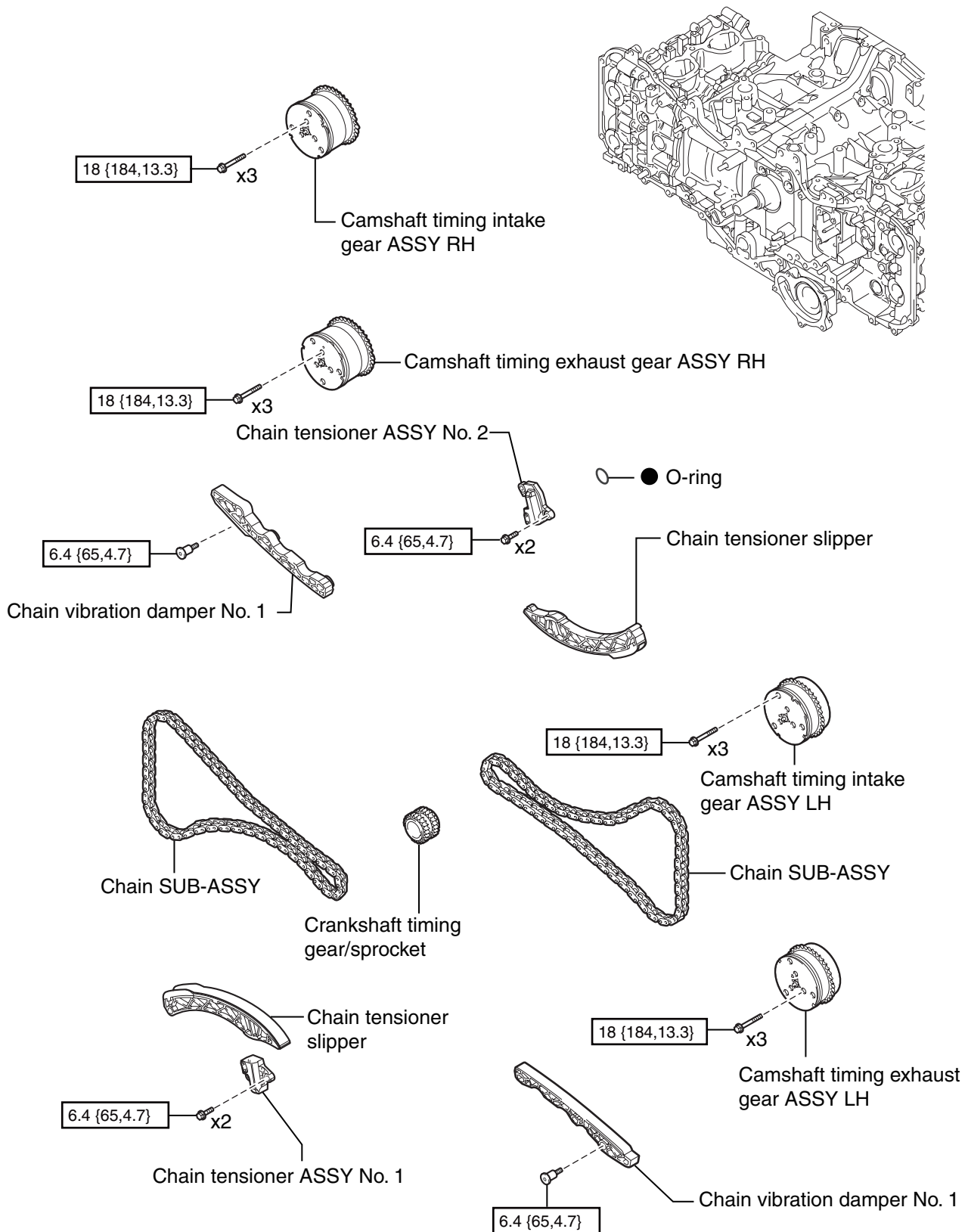


Transmission A/T:



$\boxed{\text{N}\cdot\text{m} \{ \text{kgf}\cdot\text{cm} \} \{ \text{ft}\cdot\text{lbf} \}}$: Specified torque

● Non-reusable parts



N•m {kgf•cm}{ft•lbf} : Specified torque ● Non-reusable parts

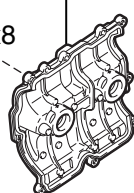
Bank 1:

Injector driver bracket

6.4 {65,4.7}



6.4 {65,4.7}



Cylinder head cover SUB-ASSY

● Cylinder head cover gasket



Transmission A/T:

31 {316,22.9}

x2

6.4 {65,4.7}

x2

● Gasket

Camshaft oil field pipe SUB-ASSY

Intake center camshaft cap RH

Exhaust center camshaft cap RH

Intake rear camshaft cap RH

Exhaust rear camshaft cap RH

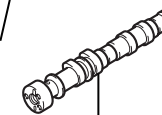
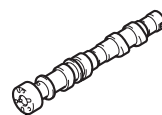
18 {184,13.3}



Front camshaft cap RH

Intake camshaft RH

Exhaust camshaft RH



Transmission M/T:

25 {255,18.4}

Hole plug

● Gasket

Camshaft housing SUB-ASSY RH

x9

First time: 20 {204,14.8}
 Second time: 100 {1020,73.8}
 Third time: Loosen 360°
 Fourth time: 20 {204,14.8}
 Fifth time: 42 {428,31.0}
 Sixth time: Further-tighten 100°
 Seventh time: Further-tighten 100°
 Further-tighten 50°

Cylinder head bolt

x6

First time: 18 {18.4,13.3}

Second time: Loosen 180°

Third time: 18 {18.4,13.3}

● Oil control valve filter RH

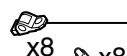
Oil spacer RH

Valve adjusting shim

● Spark plug tube gasket

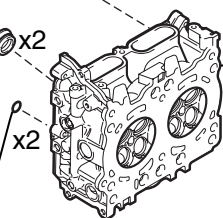
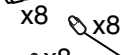
● O-ring

● Cylinder head gasket

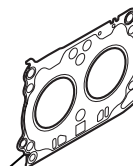


Valve rocker arm SUB-ASSY No. 1

Roller rocker arm pivot



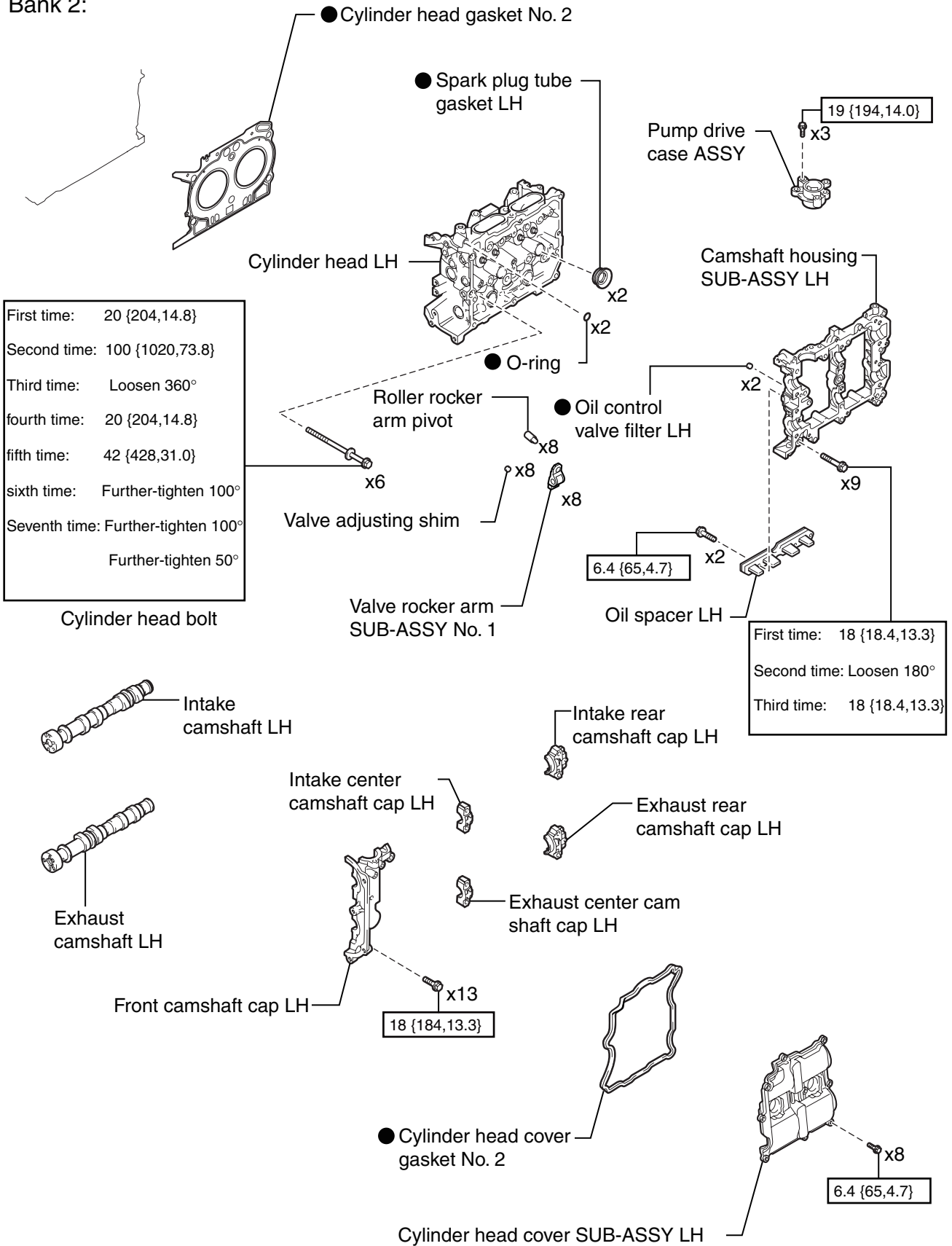
Cylinder head SUB-ASSY



N•m {kgf•cm}{ft•lb} : Specified torque

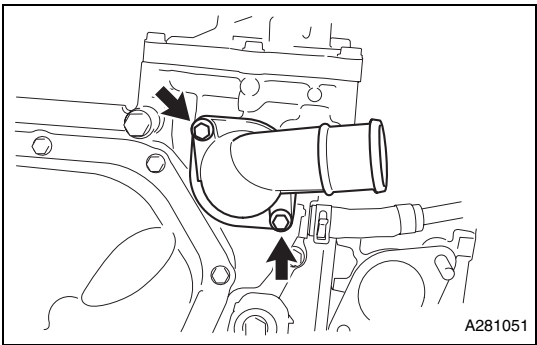
● Non-reusable parts

Bank 2:

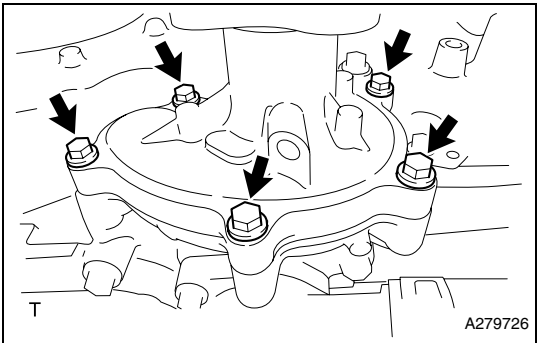


N•m {kgf•cm}{ft•lbf} : Specified torque

● Non-reusable parts



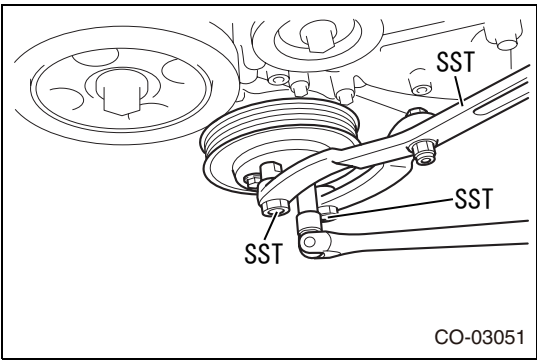
39. Installation of water outlet
- (1) Set the thermostat to the oil pan SUB-ASSY, and install the water outlet with two bolts.
- Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}



40. Installation of engine water pump ASSY
- (1) Using a new gasket, install the water pump ASSY with five bolts.
- Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}

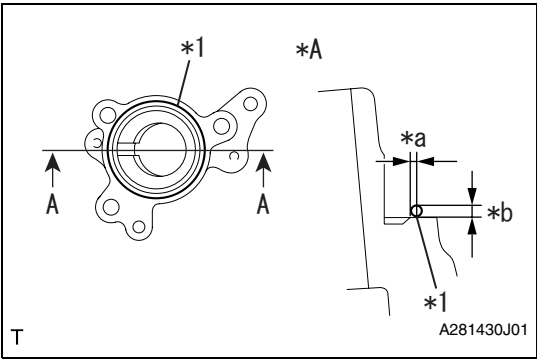
41. Installation of water pump pulley

- (1) Temporarily- tighten the three bolts to the water pump pulley.



- (2) Fix the water pump pulley using SST.
- SST 18355AA000, 18334AA030

- (3) Tighten the three bolts.
- Standard value: $T=14\text{N}\cdot\text{m}$ {143kgf•cm} {10.3 ft•lbf}



42. Installation of pump drive case ASSY

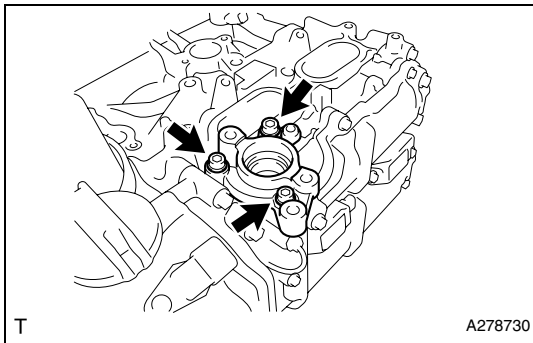
- (1) Apply THREE BOND 1217G to the pump drive case ASSY as shown in the figure.

Captions in illustration

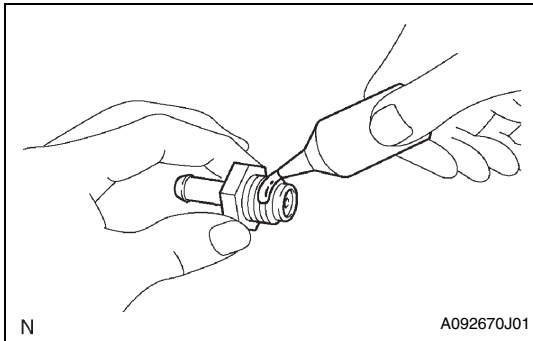
*A	Cross section A - A
*1	THREE BOND 1217G
*a	Application area of liquid gasket: within 1 mm {0.039 in} from edge
*b	Diameter of liquid gasket: 2 to 4 mm {0.079 to 0.158 in}

<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

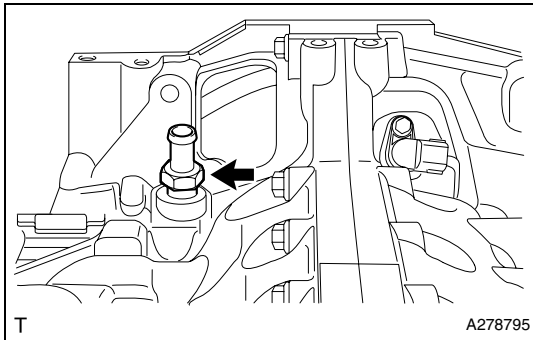


- (2) Tighten the three bolts to install the pump drive case ASSY.
Standard value: $T=19\text{N}\cdot\text{m}$ {194kgf•cm} {14.0 ft•lbf}

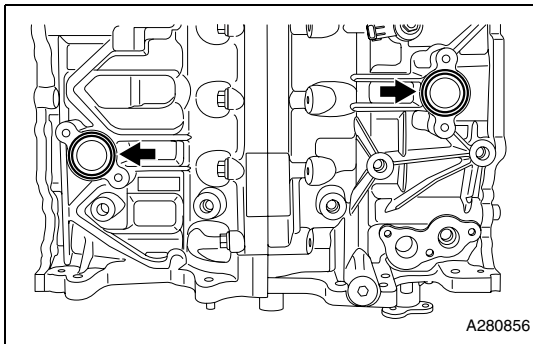


43. Installation of ventilation valve SUB-ASSY

- (1) Apply THREE BOND 1324 to the ventilation valve SUB-ASSY.

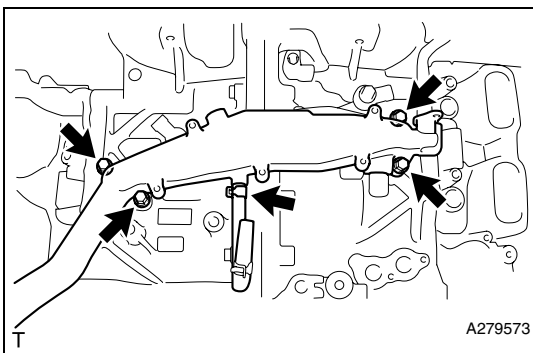


- (2) Install the ventilation valve SUB-ASSY to the cylinder head block.
Standard value: $T=23\text{N}\cdot\text{m}$ {235kgf•cm} {17.0 ft•lbf}



44. Installation of water inlet pipe

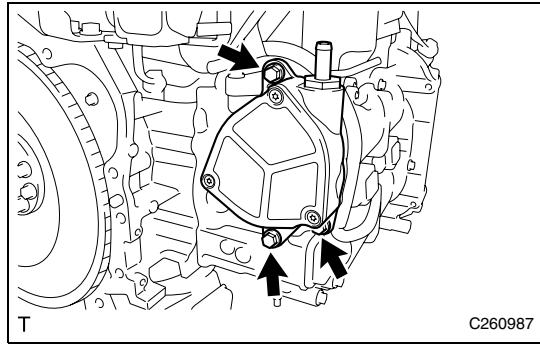
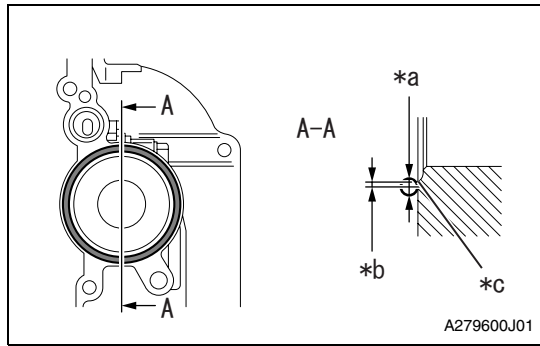
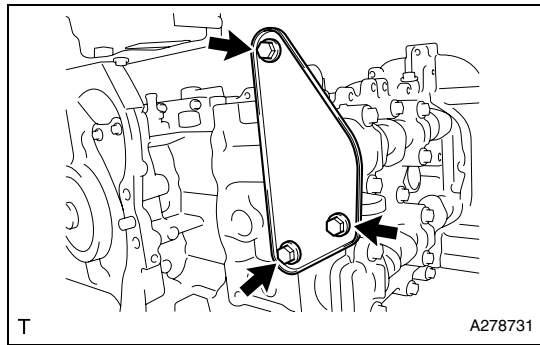
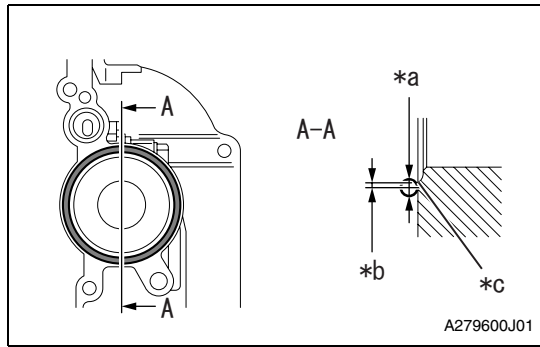
- (1) Install two new O-rings to the cylinder block.



- (2) Install the water inlet pipe with four bolts.
Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}

45. Installation of oil level gauge guide

- (1) Install a new O-ring to the oil level gauge guide.
- (2) Apply engine oil to the O-ring and install the oil level gauge guide with a bolt.
Standard value: $T=6.4N\cdot m$ {65kgf•cm} {4.7 ft•lbf}
- (3) Install the oil level gauge SUB-ASSY.



46. Installation of cylinder head plate RR (transmission M/T)

- (1) Apply THREE BOND 1217G to the camshaft housing SUB-ASSY RH as shown in the figure.

Captions in illustration

*a	2.0 to 4.0 mm {0.079 to 0.158 in} in diameter
*b	1.0 mm {0.0394 in} or less
*c	Groove

<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

- (2) Install the cylinder head plate RR with three bolts.

Standard value: $T=16N\cdot m$ {163kgf•cm} {11.8 ft•lbf}

47. Installation of vacuum pump ASSY (transmission A/T).

- (1) Apply THREE BOND 1217G to the camshaft housing SUB-ASSY RH as shown in the figure.

Captions in illustration

*a	2.0 to 4.0 mm {0.079 to 0.158 in} in diameter
*b	1.0 mm {0.0394 in} or less
*c	Groove

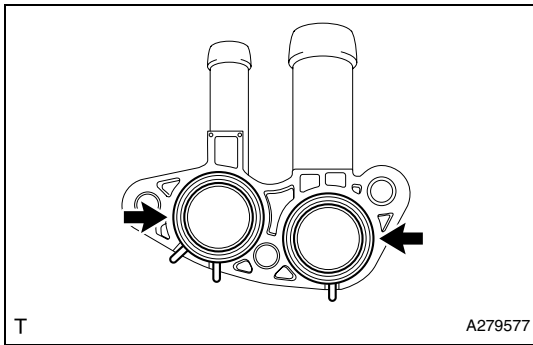
<Caution>

- Clean and degrease the fitting surface.
- Install within 5 min. after applying liquid gasket.

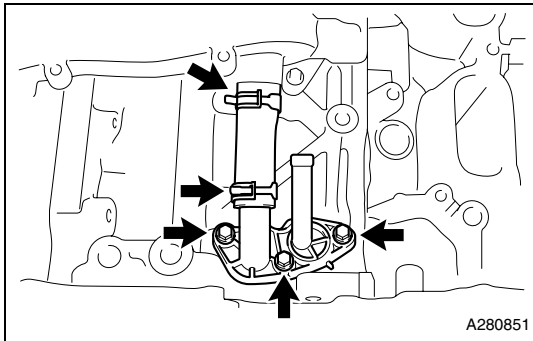
- (2) Install a new O-ring.

- (3) Tighten the three bolts to install the vacuum pump ASSY.

Standard value: $T=16N\cdot m$ {163kgf•cm} {11.8 ft•lbf}



48. Installation of PCV hose connector
- (1) Install two new O-rings to the PCV hose connector.

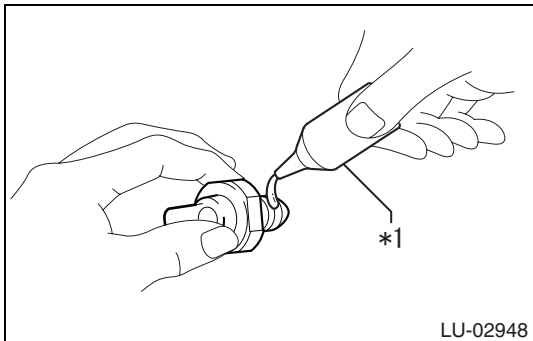


- (2) Connect the water by-pass hose No. 1 to the PCV hose connector and water inlet pipe using hose clamp.
- (3) Install the PCV hose connector with three bolts.
Standard value: $T=6.4\text{N}\cdot\text{m}$ $\{65\text{kgf}\cdot\text{cm}\}$ $\{4.7\text{ft}\cdot\text{lbf}\}$

EM

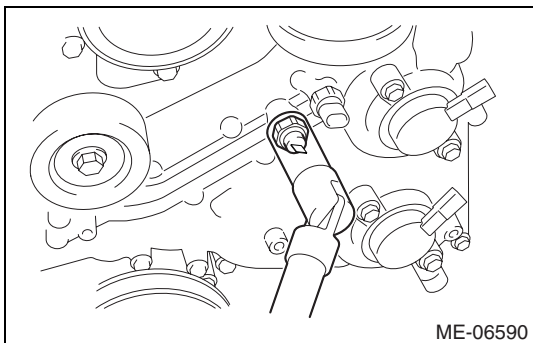
49. Installation of engine oil pressure switch ASSY

- (1) Degrease the threads of the engine oil pressure switch ASSY.



- (2) Apply THREE BOND 1324 to the threads.
<Caution>
Do not attach THREE BOND 1324 to the oil hole.
Captions in illustration

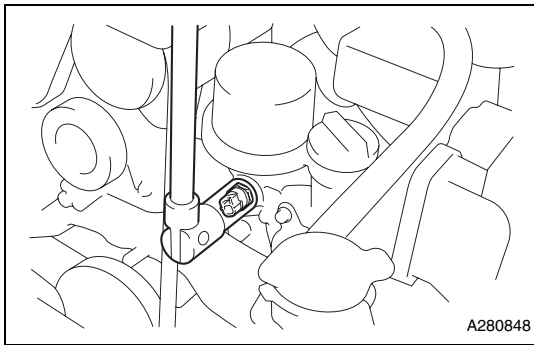
*1	THREE BOND 1324
----	-----------------



- (3) Install the engine oil pressure switch ASSY.
Standard value: $T=18\text{N}\cdot\text{m}$ $\{184\text{kgf}\cdot\text{cm}\}$ $\{13.3\text{ft}\cdot\text{lbf}\}$
<Caution>
After assembly, do not start the engine within one hour.

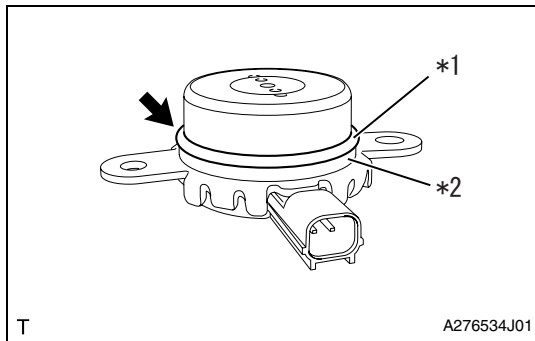
50. Installation of engine oil temperature sensor

- (1) Install a new gasket to the engine oil temperature sensor.



- (2) Install the engine oil temperature sensor.
Standard value: $T=18N\cdot m$ {184kgf·cm} {13.3 ft·lbf}

EM



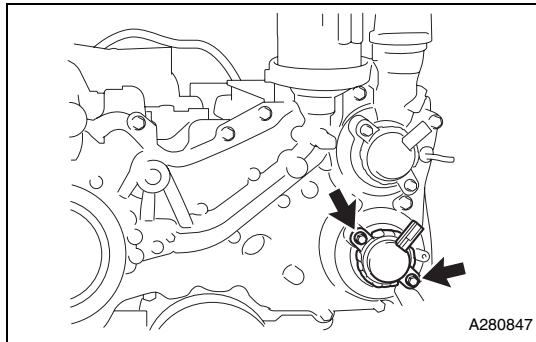
51. Installation of camshaft timing oil control valve ASSY

- (1) Install the back-up ring to the camshaft timing oil control valve ASSY (bank 2 exhaust side).

Captions in illustration

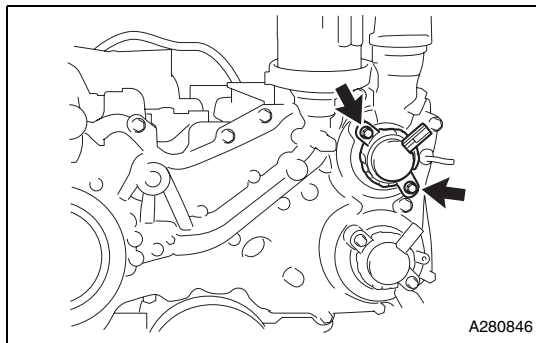
*1	O-ring
*2	Back-up ring

- (2) Install a new O-ring to the camshaft timing oil control valve ASSY (bank 2 exhaust side).
(3) Apply engine oil to O-ring.



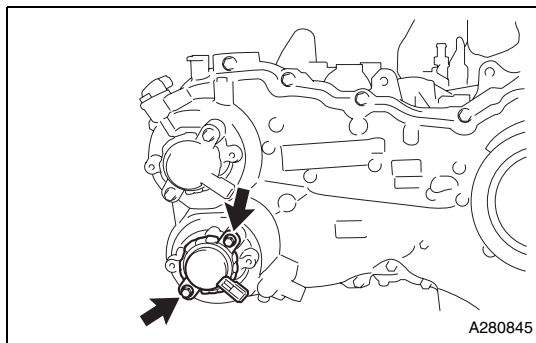
- (4) Install the camshaft timing oil control valve ASSY (bank 2 exhaust side) using two bolts.
Standard value: $T=6.4N\cdot m$ {65kgf·cm} {4.7 ft·lbf}

- (5) Install the back-up ring to the camshaft timing oil control valve ASSY (bank 2 intake side).
(6) Install a new O-ring to the camshaft timing oil control valve ASSY (bank 2 intake side).
(7) Apply engine oil to O-ring.



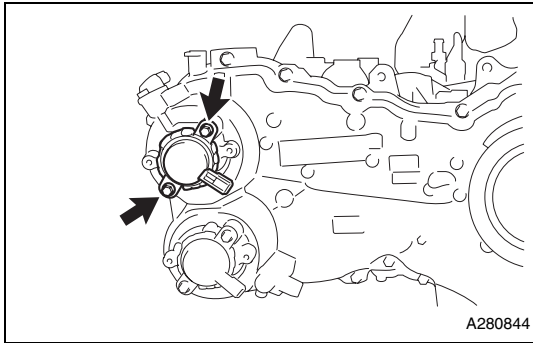
- (8) Install the camshaft timing oil control valve ASSY (bank 2 intake side) using two bolts.
Standard value: $T=6.4N\cdot m$ {65kgf·cm} {4.7 ft·lbf}

- (9) Install the back-up ring to the camshaft timing oil control valve ASSY (bank 1 exhaust side).
(10) Install a new O-ring to the camshaft timing oil control valve ASSY (bank 1 exhaust side).
(11) Apply engine oil to O-ring.



- (12) Install the camshaft timing oil control valve ASSY (bank 1 exhaust side) using two bolts.
Standard value: $T=6.4N\cdot m$ {65kgf·cm} {4.7 ft·lbf}

- (13) Install the back-up ring to the camshaft timing oil control valve ASSY (bank 1 intake side).
(14) Install a new O-ring to the camshaft timing oil control valve ASSY (bank 1 intake side).
(15) Apply engine oil to O-ring.

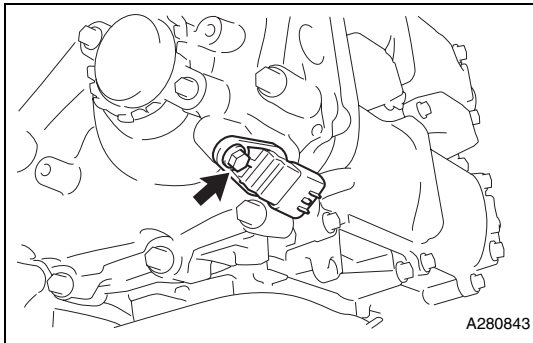


- (16) Install the camshaft timing oil control valve ASSY (bank 1 intake side) using two bolts.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}

52. Installation of camshaft position sensor

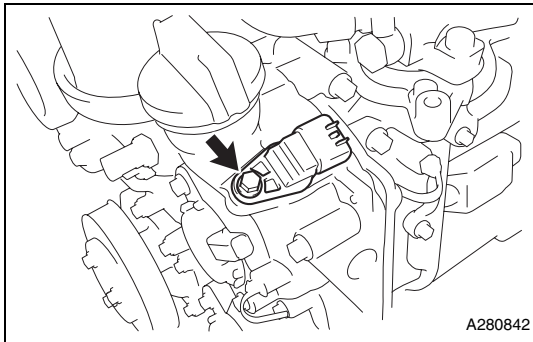
- (1) Install a new O-ring to the camshaft position sensor (bank 2 exhaust side).
- (2) Apply engine oil to O-ring.



- (3) Install the camshaft position sensor (bank 2 exhaust side) using a bolt.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}

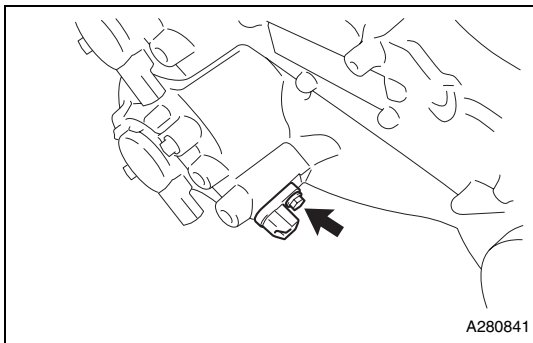
- (4) Install a new O-ring to the camshaft position sensor (bank 2 intake side).
- (5) Apply engine oil to O-ring.



- (6) Install the camshaft position sensor (bank 2 intake side) using a bolt.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}

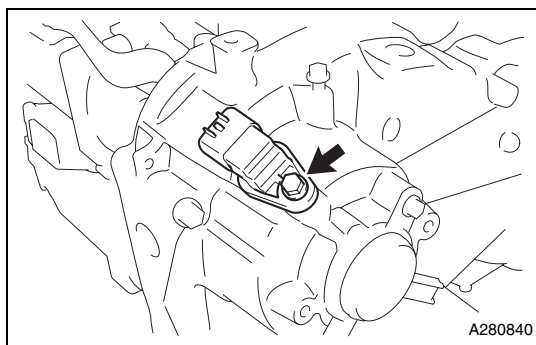
- (7) Install a new O-ring to the camshaft position sensor (bank 1 exhaust side).
- (8) Apply engine oil to O-ring.



- (9) Install the camshaft position sensor (bank 1 exhaust side) using a bolt.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf·cm} {4.7 ft·lbf}

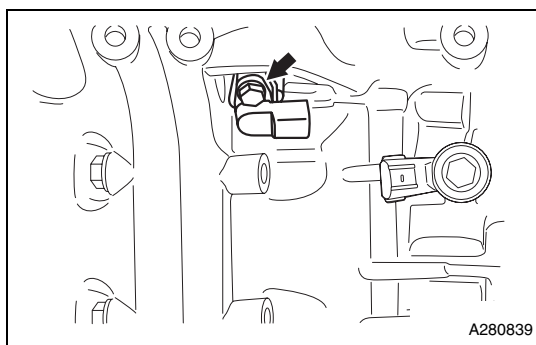
- (10) Install a new O-ring to the camshaft position sensor (bank 1 intake side).
- (11) Apply engine oil to O-ring.



- (12) Install the camshaft position sensor (bank 1 intake side) using a bolt.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}

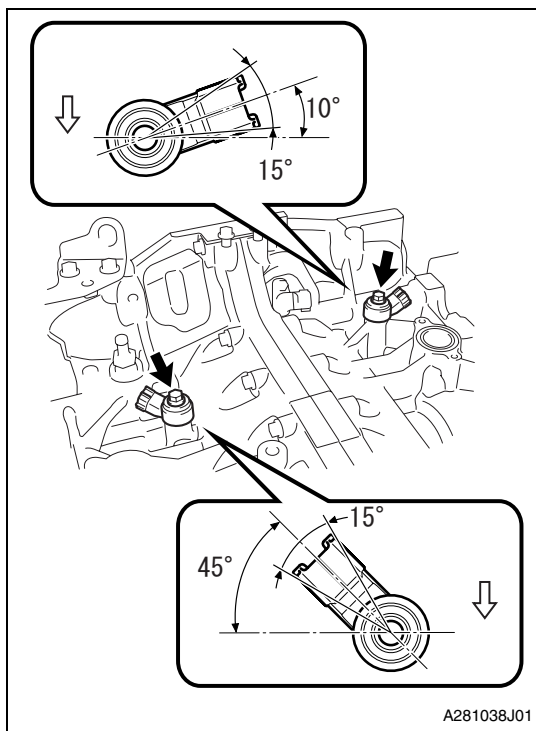
EM



53. Installation of crank position sensor

- (1) Install the crank position sensor using a bolt.

Standard value: $T=6.4\text{N}\cdot\text{m}$ {65kgf•cm} {4.7 ft•lbf}



54. Installation of knock control sensor

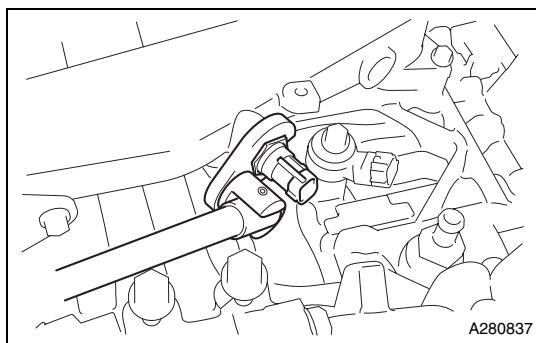
- (1) Install the two knock control sensors in the direction shown in the figure using two bolts.

Standard value: $T=24\text{N}\cdot\text{m}$ {245kgf•cm} {17.7 ft•lbf}

Captions in illustration



Engine front



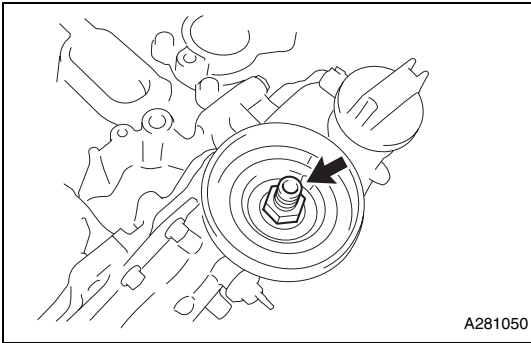
55. Installation of engine water temperature sensor

- (1) Install the engine water temperature sensor, using a new gasket.

Standard value: $T=18\text{N}\cdot\text{m}$ {184kgf•cm} {13.3 ft•lbf}

<Caution>

When a torque wrench extended with a union nut wrench is used, the actual tightening torque becomes over-torque if the part is tightened until the torque wrench reading reaches the specified tightening torque. (For the procedures, refer to IN?5.)



56. Installation of oil filter union

- (1) Install the oil filter union.

Standard value: $T=45\text{N}\cdot\text{m}$ {459kgf•cm} {33.2 ft•lbf}

57. Installation of oil filter SUB-ASSY

- (1) Apply a little coat of engine oil to the seal rubber portion of a new oil filter SUB-ASSY.
- (2) Tighten the oil filter SUB-ASSY by hand.

<Caution>

Be careful not to damage the seal rubber of the oil filter SUB-ASSY.

- (3) Using SST, tighten the oil filter SUB-ASSY.

SST 18332AA020

Standard value: Specified tightening torque

$T=14\text{N}\cdot\text{m}$ {143kgf•cm} {10.3 ft•lbf}

When using SST, calculate the following formula.

Calculation $T2 = L2/(L1 + L2) \times T1$

T1	14 N•m {143 kgf•cm, 10.3 ft•lbf}
T2	Tightening torque
L1	SST length (0.080 m {3.150 in})
L2	Torque wrench length (m)

<Reference>

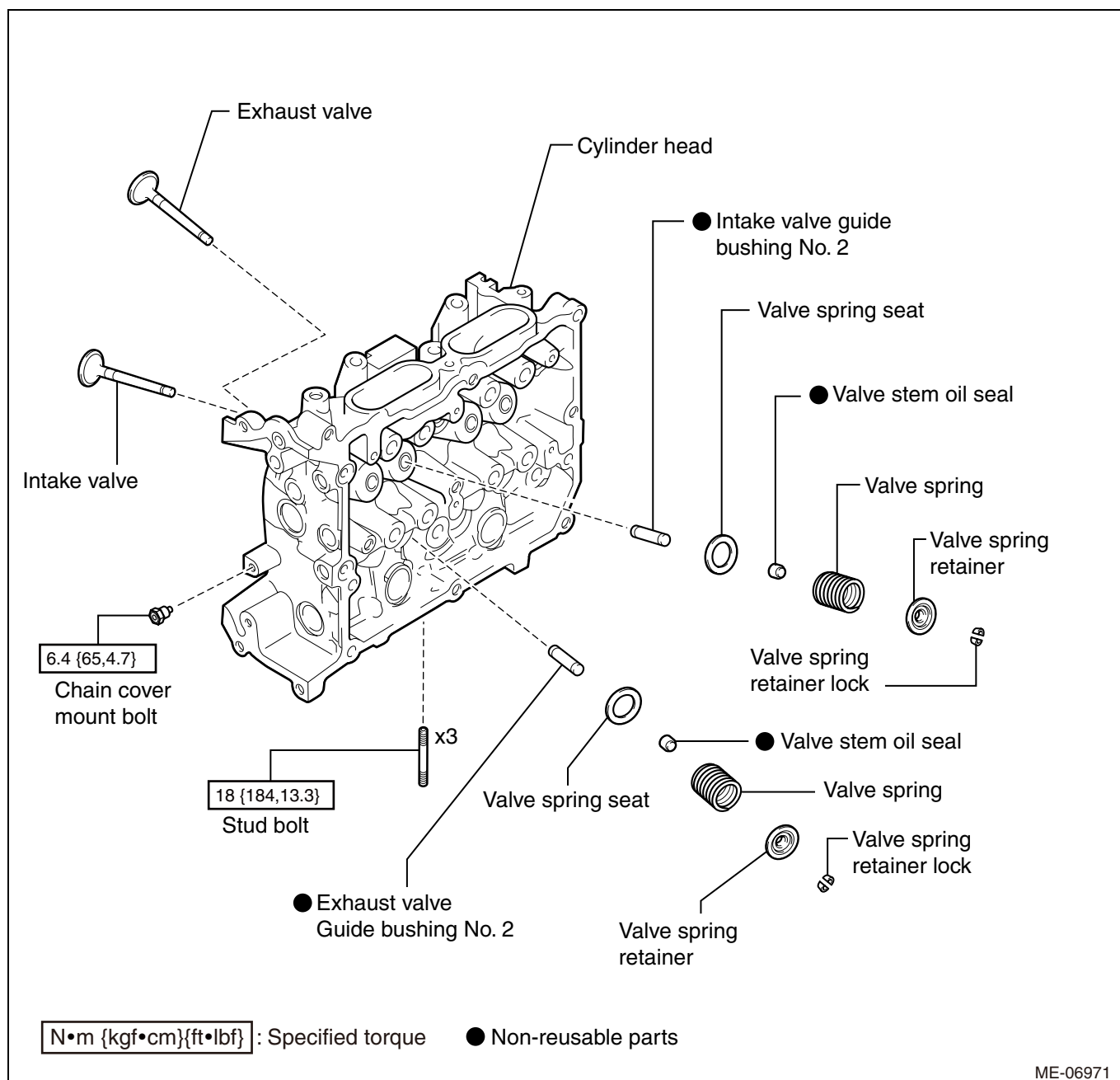
- This torque is valid when SST and a torque wrench are aligned.
- Install SST and a torque wrench so that they are aligned.

58. Installation of oil filler cap SUB-ASSY

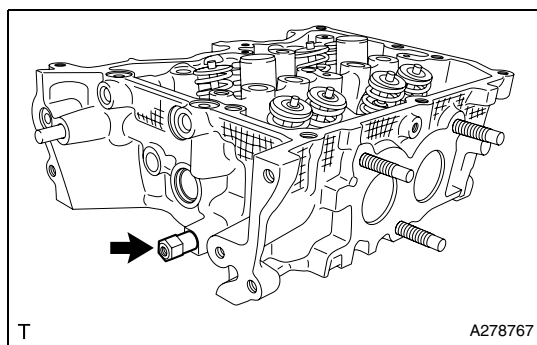
- (1) Install the oil filler cap SUB-ASSY.

CYLINDER HEAD ASSY (FA20)

EXPLODED VIEW



DISASSEMBLY



1. Removal of chain cover mount bolt
 - (1) Remove the chain cover mount bolt from the cylinder head.

EM

First time: 35 {357,25.8}

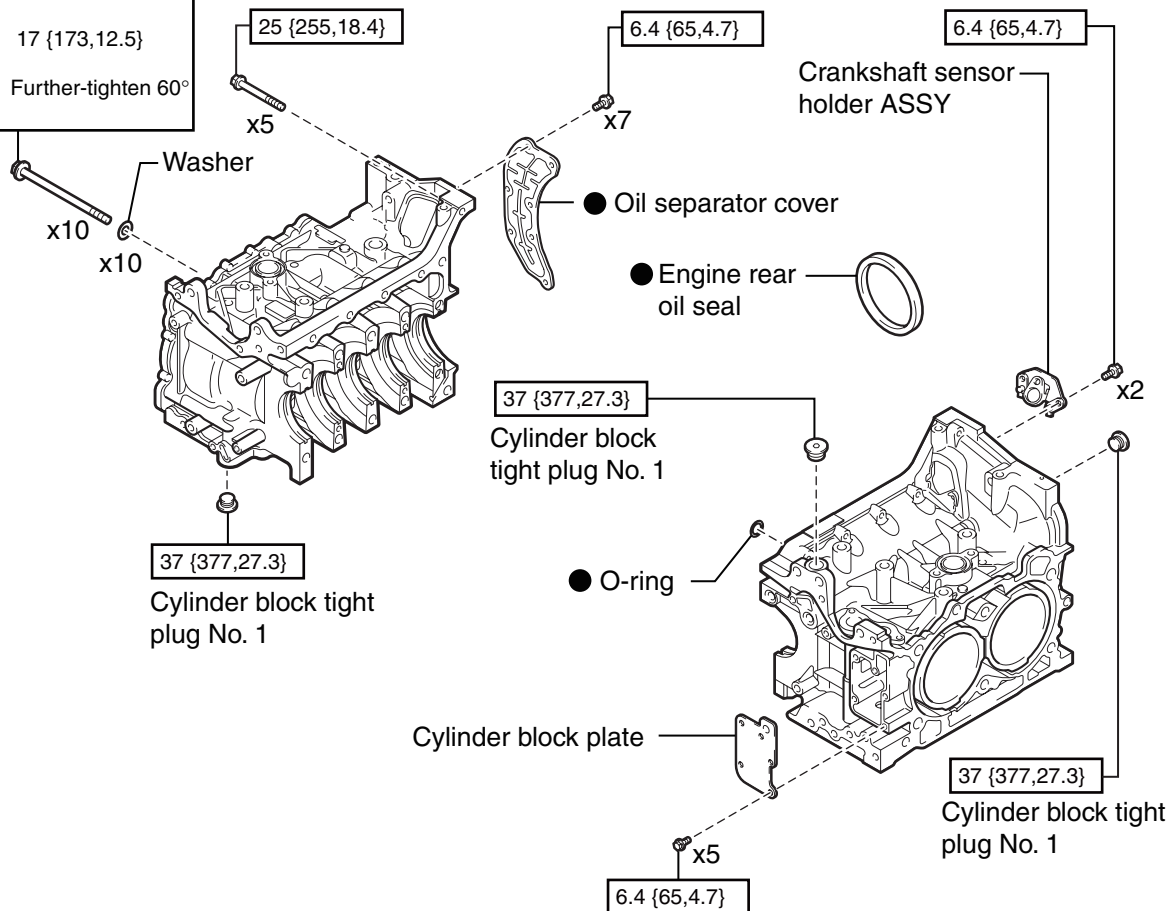
Second time: Loosen 180°

Third time: 35 {357,25.8}

Fourth time: Loosen 180°

Fifth time: 17 {173,12.5}

Sixth time: Further-tighten 60°



N•m {kgf•cm}{ft•lbf} : Specified torque

● Non-reusable parts

ME-06973

DISASSEMBLY

1. Removal of piston with connecting rod

- (1) Mark each connecting rod cap and piston with a cylinder number.
- (2) Turn the crankshaft to the position where the connecting rod cap bolt can be removed.