ENGINE

ON-VEHICLE INSPECTION

1. **INSPECT ENGINE COOLANT (See page CO-2)**
2. **INSPECT ENGINE OIL (See page LU-2)**
3. **INSPECT BATTERY (See page CH-4)**
4. **INSPECT AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY**
5. **INSPECT SPARK PLUG (See page IG-5)**
6. **INSPECT FAN AND GENERATOR V BELT (See page EM-6)**
7. **INSPECT IGNITION TIMING**

NOTICE:

- **Turn all the electrical systems OFF.**
- **Conduct the inspection when the cooling fan motor is turned OFF.**

(a) Warm up the engine.

(b) When using the intelligent tester:

(1) Connect the intelligent tester to the DLC3.

(2) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / IGN ADVANCE.

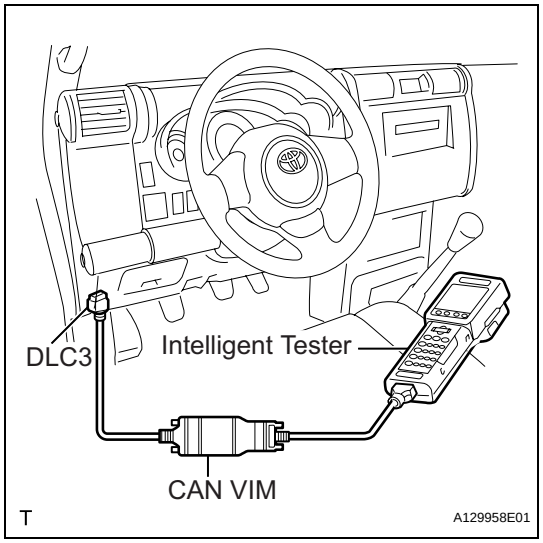
(3) Inspect the ignition timing during idling.

Ignition timing:

7 to 24°CA BTDC during idling

(Transmission in neutral position)

(4) Check that the ignition timing advances immediately when the engine speed is increased.



(c) When not using intelligent tester:

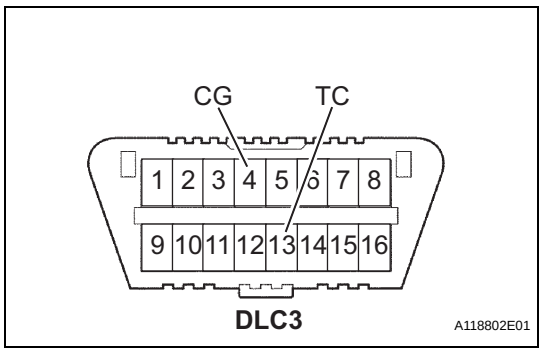
(1) Using SST, connect the terminals 13 (TC) and 4 (CG) of the DLC3.

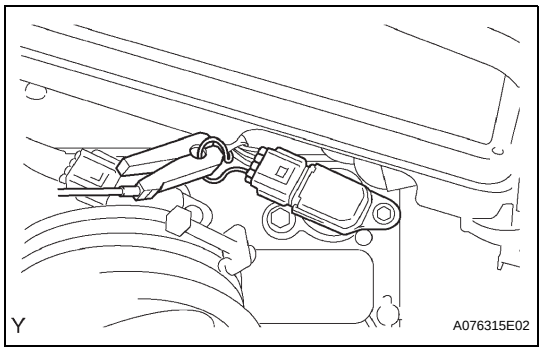
SST 09843-18040

NOTICE:

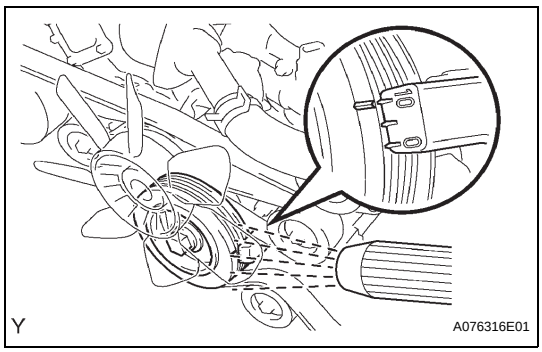
Do not connect the terminals incorrectly as it causes breakage of the engine.

(2) Remove the air cleaner.





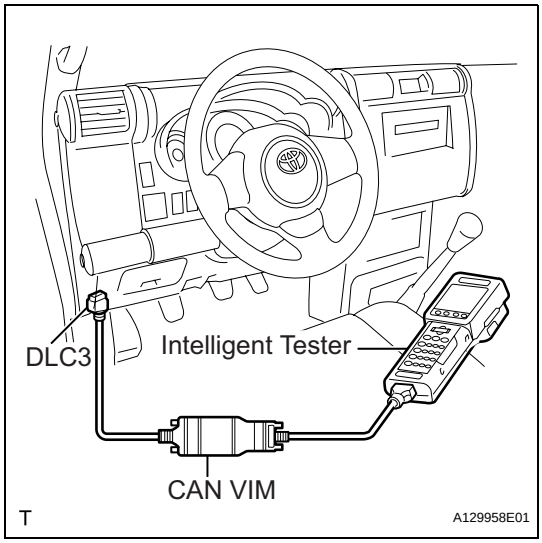
(3) Pull out the wire harness shown in the illustration.
(4) Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.
NOTICE:
- **Use timing light that detects the first signal.**
- **After checking, wrap the wire harness with tape.**



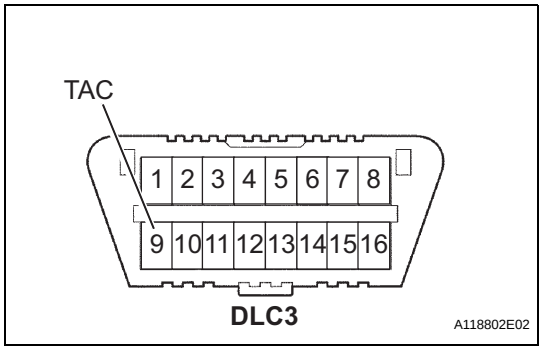
(5) Inspect the ignition timing during idling.
Ignition timing:
8 to 12°CA BTDC during idling (Transmission in neutral position)
(6) Remove SST from the DLC3.
(7) Inspect the ignition timing during idling.
Ignition timing:
7 to 24°CA BTDC during idling (Transmission in neutral position)
(8) Install the air cleaner.

8. INSPECT ENGINE IDLING SPEED
NOTICE:
- **Turn all the electrical systems OFF.**
- **Operate the inspection when the cooling fan motor is turned OFF.**

(a) Warm up the engine.



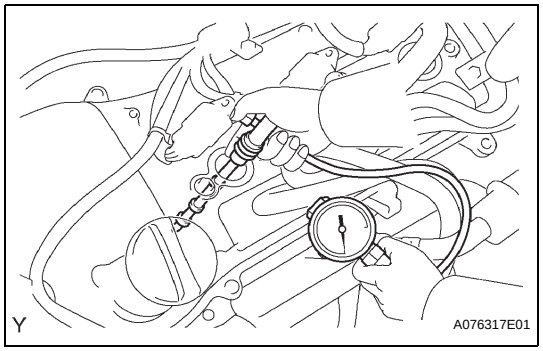
(b) When using the intelligent tester:
(1) Connect the intelligent tester to the DLC3.
(2) Select the following menu items: DIAGNOSIS / ENHANCED OBD ll / DATA LIST / PRIMARY / ENGINE SPD.
(3) Inspect the engine idling speed.
Idling speed:
650 to 750 rpm (Transmission in neutral position)



(c) When not using the intelligent tester:
(1) Using SST, connect the terminal 8 (TAC) of the DLC3.
SST 09843-18030
(2) Race the engine speed at 2,500 rpm for approximately 90 seconds.
(3) Inspect the engine idling speed.
Idling speed:
650 to 750 rpm (Transmission in neutral position)

9. INSPECT COMPRESSION

(a) Warm up and stop the engine.
(b) Remove the circuit opening relay (See page ES-443).
(c) Remove the V-bank cover (See page ES-414).
(d) Remove the air cleaner assembly (See page ES-429).
(e) Remove the throttle body bracket (See page FU-11).
(f) Remove the oil baffle plate (See page FU-11).
(g) Remove the No. 1 surge tank stay (See page FU-11).
(h) Remove the No. 2 surge tank stay (See page FU-12).
(i) Remove the ignition coils (See page IG-8).
(j) Remove the spark plugs.



(k) Inspect the cylinder compression pressure.
(1) Insert a compression gauge into the spark plug hole. (*1)
SST 09992-00500
(2) Fully open the throttle. (*2)
(3) While cranking the engine, measure the compression pressure. (*3)
Compression pressure:
1,300 kPa (13.3 kgf/cm^2, 189 psi)
Minimum pressure:
1,000 kPa (10.2 kgf/cm^2, 145 psi)
Difference between cylinders:
100 kPa (1.0 kgf/cm^2, 15 psi)
NOTICE:
- **Use a fully-charged battery so the engine speed can be increased to 2,500 rpm or more.**
- **Inspect the other cylinders in the same way.**
- **Measure the compression in as short a time as possible.**

(4) If the cylinder compression is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (*1) through (*3) for cylinders with low compression.
- If adding oil increases the compression, the piston rings and/or cylinder bore may be worn or damaged.
- If the pressure stays low, a valve may be stuck or seated improperly, or there may be leakage from the gasket.

10. INSPECT CO/HC

(a) Start the engine.
(b) Run the engine at 2,500 rpm for approximately 180 seconds.
(c) Insert the CO/HC meter testing probe at least 40 cm (1.3 ft) into the tailpipe during idling.

EM

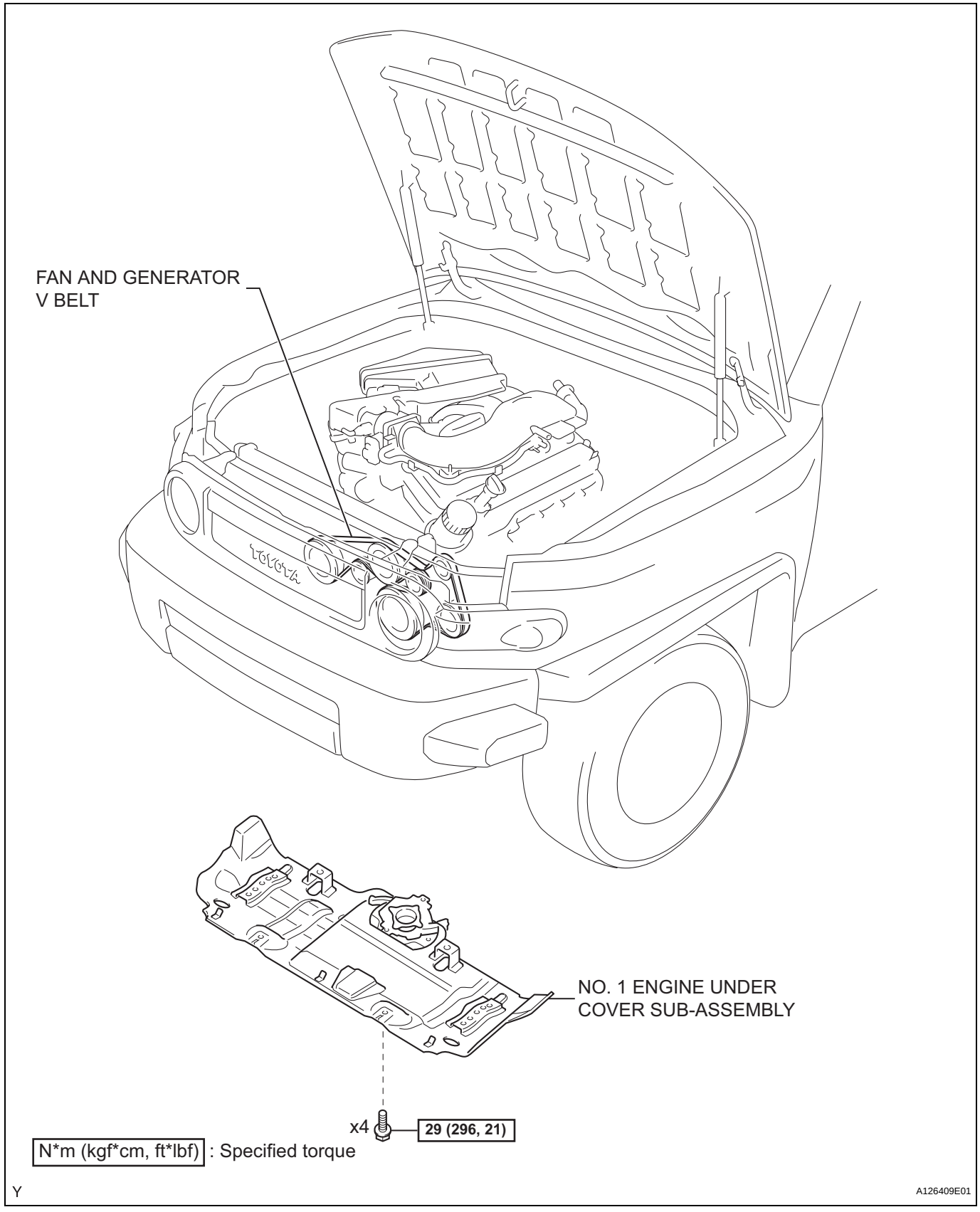
(d) Immediately check the CO/HC concentration during idling and/or while running at 2,500 rpm.
HINT:
- Complete the measurement within 3 minutes.
- When carrying out the 2 mode (with the engine idling/running at 2,500 rpm) test, the measurement orders are prescribed by the applicable local regulations.

(e) If the CO/HC concentration does not comply with regulations, troubleshoot in the order given below.
(1) Check the heated oxygen sensor operation.

CO	HC	Problems	Causes
Normal	High	Rough idling	1. Faulty ignition: – Incorrect timing – Fouled, shorted or improperly gapped plugs 2. Incorrect valve clearance 3. Leaking intake and exhaust valves 4. Leaking cylinders
Low	High	Rough idling (Fluctuating HC reading)	1. Vacuum leaks: – PCV hoses – Intake manifold – Throttle body – IAC valve – Brake booster line 2. Lean mixture causing misfire
High	High	Rough idling (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. Faulty EFI systems: – Faulty pressure regulator – Faulty engine coolant temperature sensor – Faulty mass air flow meter – Faulty ECM – Faulty injectors – Faulty throttle position sensor

DRIVE BELT

COMPONENTS



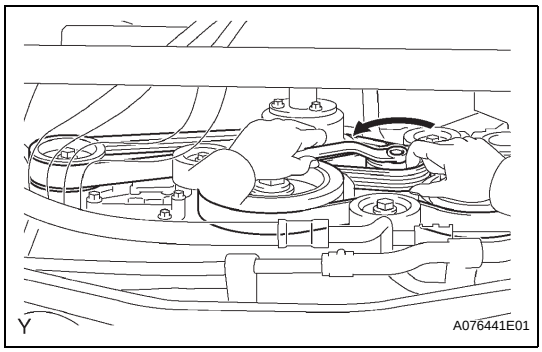
REMOVAL

1. REMOVE NO.1 ENGINE UNDER COVER SUB-ASSEMBLY

(a) Remove the 4 bolts, then remove the No. 1 engine under cover.

2. REMOVE FAN AND GENERATOR V BELT

(a) While releasing the belt tension by turning the belt tensioner counterclockwise, remove the V-ribbed belt from the belt tensioner.



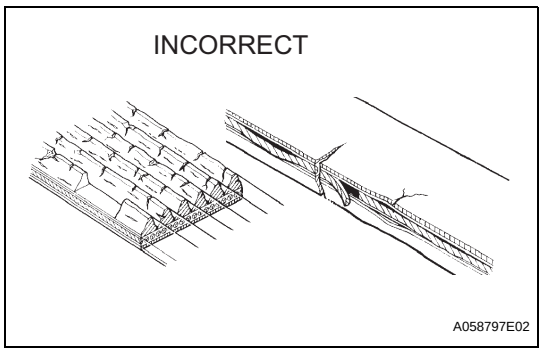
INSPECTION

1. INSPECT FAN AND GENERATOR V BELT

(a) Visually check the driver belt for excessive wear, frayed cords, etc. If any defect is found, replace the drive belt.

HINT:

Cracks on the rib side of the drive belt are considered acceptable. If the drive belt has chunks missing from the ribs, it should be replaced.



INSTALLATION

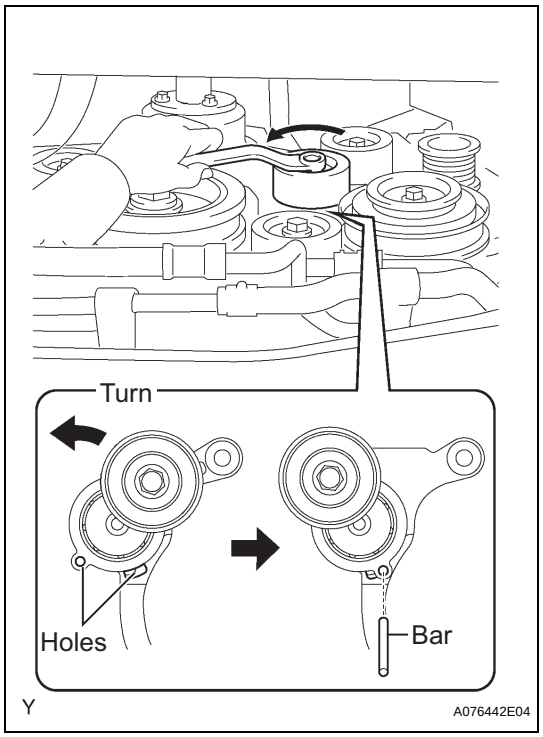
1. INSPECT V-RIBBED BELT TENSIONER ASSEMBLY

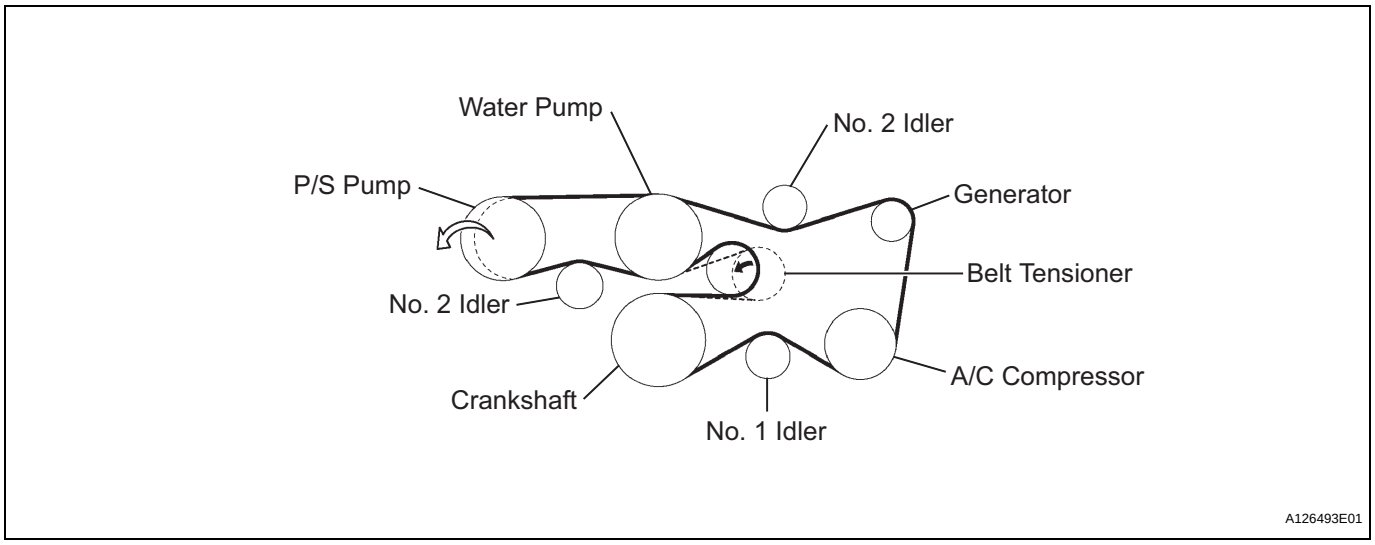
(a) Check that nothing gets caught in the tensioner by turning it clockwise and counterclockwise.
If a malfunction exists, replace the tensioner.

2. INSTALL FAN AND GENERATOR V BELT

(a) While turning the belt tensioner counterclockwise, align the holes as shown, and then insert a bar of 6 mm (0.24 in.) into the holes to fix the belt tensioner.

(b) Install the V-ribbed belt.





(c) While turning the belt tensioner counterclockwise, remove the bar.

(d) If it is hard to install the V-ribbed belt, perform the following procedure:

(1) Put the V-ribbed belt on all parts except the P/S pump, as shown in the illustration.

(2) While releasing the belt tension by turning the belt tensioner counterclockwise, put the V-ribbed belt on the P/S pump.

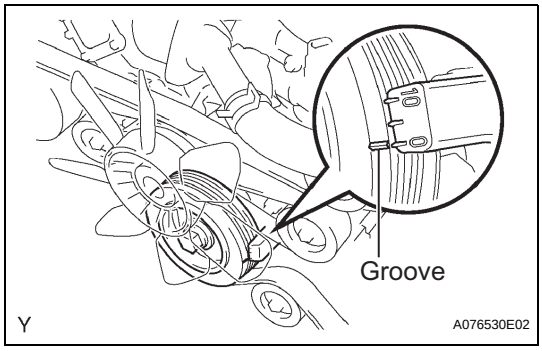
3. INSTALL NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY

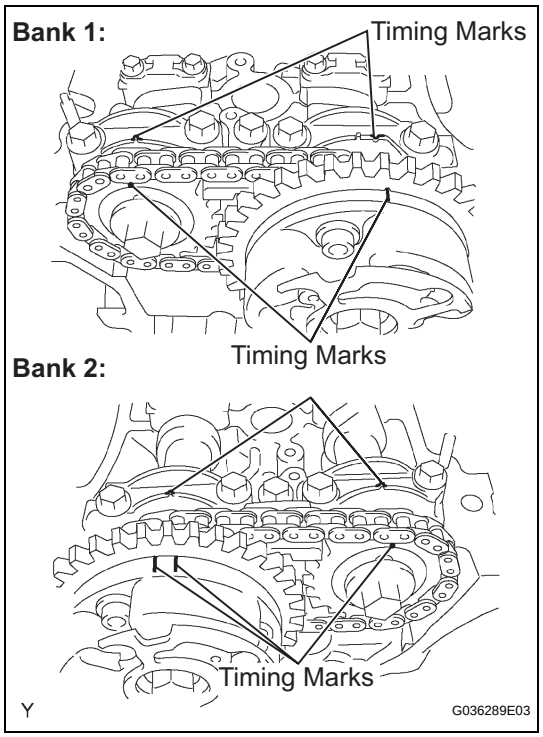
(a) Install the No. 1 engine under cover with the 4 bolts.
Torque: 29 N*m (296 kgf*cm, 21 ft.*lbf)

VALVE CLEARANCE

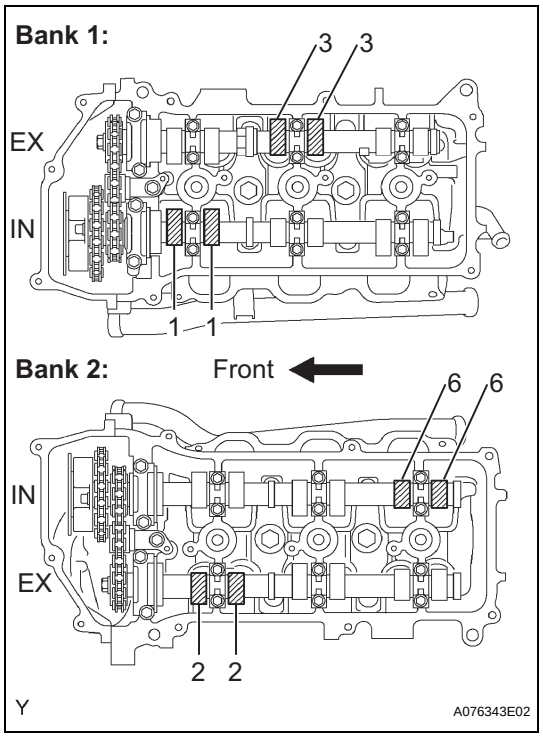
ADJUSTMENT

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **DRAIN ENGINE COOLANT (See page CO-3)**
3. **REMOVE V-BANK COVER (See page ES-428)**
4. **REMOVE AIR CLEANER ASSEMBLY (See page ES-429)**
5. **REMOVE THROTTLE BODY BRACKET (See page FU-11)**
6. **REMOVE OIL BAFFLE PLATE (See page FU-11)**
7. **REMOVE NO. 1 SURGE TANK STAY (See page FU-11)**
8. **REMOVE NO. 2 SURGE TANK STAY (See page FU-12)**
9. **REMOVE INTAKE AIR SURGE TANK (See page FU-12)**
10. **REMOVE IGNITION COIL ASSEMBLY (See page IG-8)**
11. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-40)**
12. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH (See page EM-40)**
13. **SET NO. 1 CYLINDER TO TDC/COMPRESSION**
    (a) Turn the crankshaft pulley until its groove and the "0" timing mark of the timing chain cover are aligned.





(b) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing caps as shown in the illustration.
If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks above.



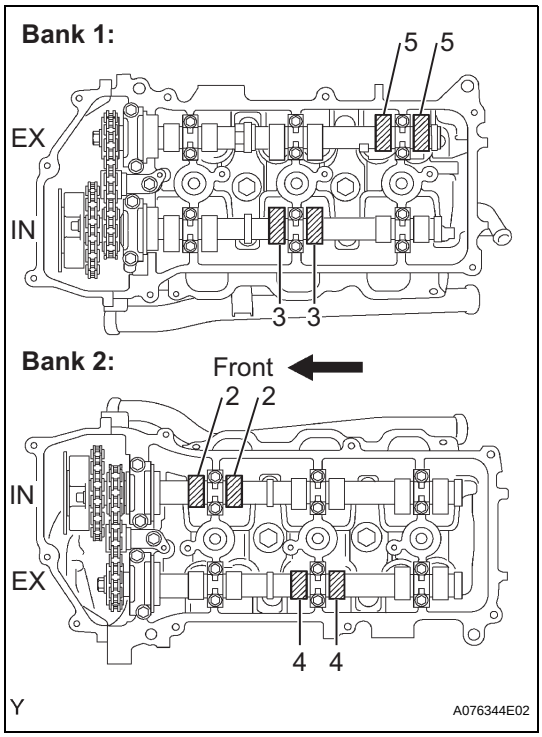
14. INSPECT VALVE CLEARANCE

(a) Check the valves indicated in the illustration.

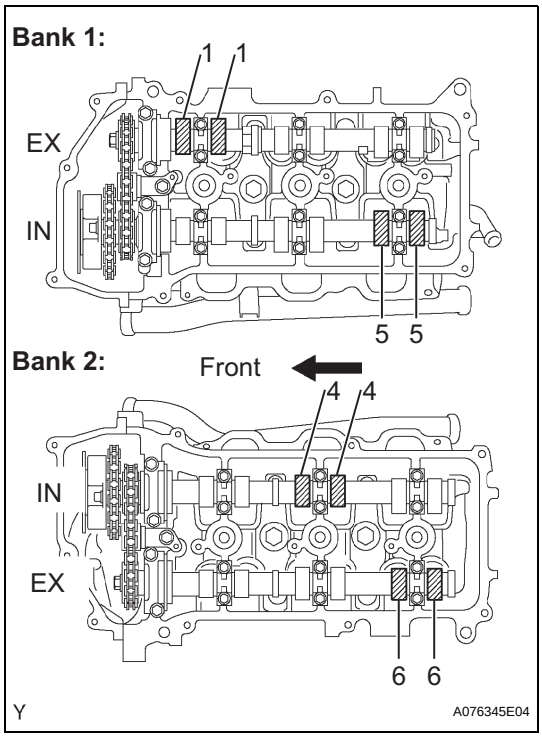
(1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
Valve clearance (Cold):
Intake 0.15 to 0.25 mm (0.006 to 0.010 in.)
Exhaust 0.29 to 0.39 mm (0.011 to 0.015 in.)

(2) Record any out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.

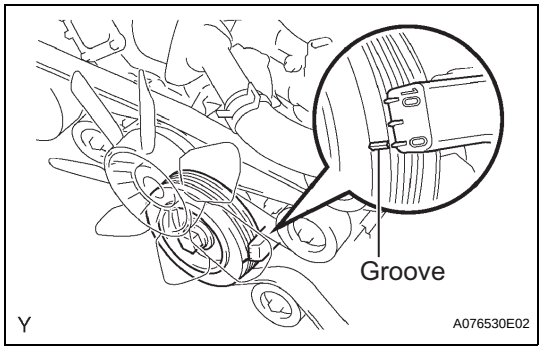
EM



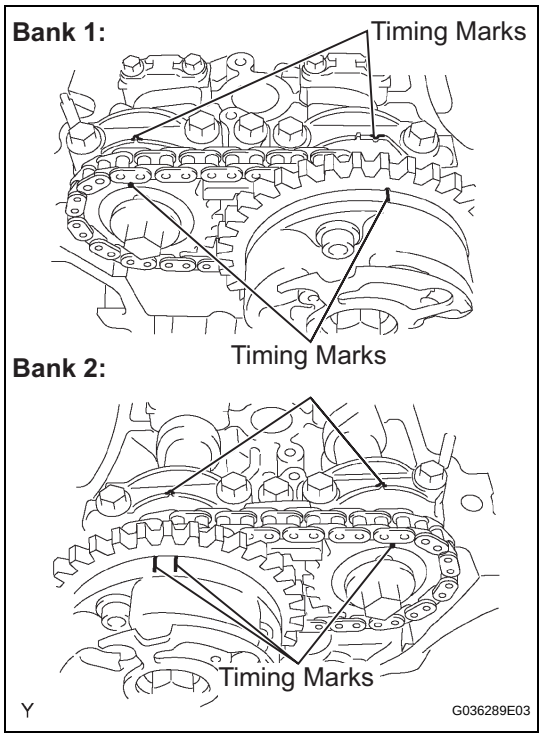
(b) Turn the crankshaft 240° clockwise, and check the valves indicated in the illustration.
(1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
Valve clearance (Cold):
Intake 0.15 to 0.25 mm (0.006 to 0.010 in.)
Exhaust 0.29 to 0.39 mm (0.011 to 0.015 in.)
(2) Record any out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.



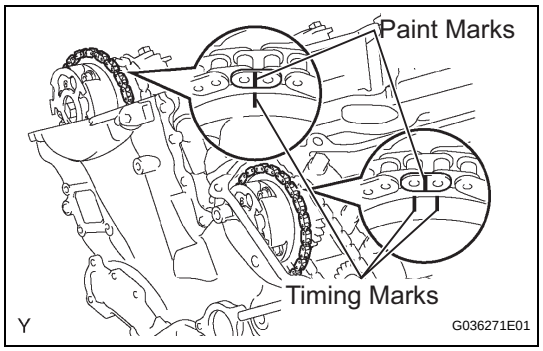
(c) Turn the crankshaft 240° clockwise, and check the valves indicated in the illustration.
(1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
(2) Valve clearance (Cold):
Intake 0.15 to 0.25 mm (0.006 to 0.010 in.)
Exhaust 0.29 to 0.39 mm (0.011 to 0.015 in.)
Record any out-of-specification valve clearance measurements. They will be used later to determine the required replacement valve lifter.



15. ADJUST VALVE CLEARANCE
(a) Set the No. 1 cylinder to TDC/compression.
(1) Turn the crankshaft pulley until its groove and the "0" timing mark of the timing chain cover are aligned.

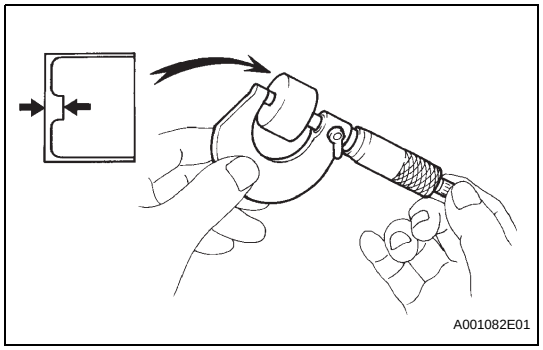


(2) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing caps as shown in the illustration. If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



(3) Place paint marks on the No. 1 chain links corresponding to the timing marks of the camshaft timing gears.

(b) Remove the No. 1 chain tensioner assembly.
(c) Remove the No. 2 camshaft.
(d) Remove the No. 2 chain tensioner assembly.
(e) Remove the camshaft.
(f) Remove the No. 4 camshaft sub-assembly.
(g) Remove the No. 3 chain tensioner assembly.
(h) Remove the No. 3 camshaft sub-assembly.
(i) Remove the valve lifters.



(j) Determine the replacement valve lifter size according to the following formulas and charts:
(1) Using a micrometer, measure the thickness of the removed lifter.
(2) Calculate the thickness of a new lifter so that the valve clearance comes within the specified value.

T:
Thickness of removed lifter
A:
Measured valve clearance
N:
Thickness of new lifter
Intake:
N = T + (A - 0.20 mm (0.008 in.))
Exhaust:
N = T + (A - 0.34 mm (0.013 in.))

EM

(3) Select a new lifter with a thickness as close as possible to the calculated value.
HINT:
Lifters are available in 35 sizes in increments of 0.020 mm (0.0008 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).

Valve Lifter Selection Chart (Intake)

Installed Lifter Thickness mm(in.) \ Measured Clearance mm(in.)	0.000 - 0.020 (0.0000 - 0.0008)	0.021 - 0.040 (0.0008 - 0.0016)	0.041 - 0.060 (0.0016 - 0.0024)	0.061 - 0.080 (0.0024 - 0.0031)	0.081 - 0.100 (0.0032 - 0.0039)	0.101 - 0.120 (0.0040 - 0.0047)	0.121 - 0.140 (0.0048 - 0.0055)	0.141 - 0.149 (0.0056 - 0.0059)	0.251 - 0.270 (0.0099 - 0.0106)	0.271 - 0.290 (0.0107 - 0.0114)	0.291 - 0.310 (0.0115 - 0.0122)	0.311 - 0.330 (0.0122 - 0.0130)	0.331 - 0.350 (0.0130 - 0.0138)	0.351 - 0.370 (0.0138 - 0.0146)	0.371 - 0.390 (0.0146 - 0.0154)	0.391 - 0.410 (0.0154 - 0.0161)	0.411 - 0.430 (0.0162 - 0.0169)	0.431 - 0.450 (0.0170 - 0.0177)	0.451 - 0.470 (0.0178 - 0.0185)	0.471 - 0.490 (0.0185 - 0.0193)	0.491 - 0.510 (0.0193 - 0.0201)	0.511 - 0.530 (0.0201 - 0.0209)	0.531 - 0.550 (0.0209 - 0.0217)	0.551 - 0.570 (0.0217 - 0.0224)	0.571 - 0.590 (0.0225 - 0.0232)	0.591 - 0.610 (0.0233 - 0.0240)	0.611 - 0.630 (0.0241 - 0.0248)	0.631 - 0.650 (0.0248 - 0.0256)	0.651 - 0.670 (0.0256 - 0.0264)	0.671 - 0.690 (0.0264 - 0.0272)	0.691 - 0.710 (0.0272 - 0.0280)	0.711 - 0.730 (0.0280 - 0.0287)	0.731 - 0.750 (0.0288 - 0.0295)	0.751 - 0.770 (0.0296 - 0.0303)	0.771 - 0.790 (0.0304 - 0.0311)	0.791 - 0.810 (0.0311 - 0.0319)	0.811 - 0.830 (0.0319 - 0.0327)	0.831 - 0.850 (0.0327 - 0.0335)	0.851 - 0.870 (0.0335 - 0.0343)
5.060 (0.1992)									12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72
5.080 (0.2000)									14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	
5.100 (0.2008)									16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72		
5.120 (0.2016)								6	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72			
5.140 (0.2024)							8	8	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72				
5.160 (0.2031)						8	10	10	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72					
5.180 (0.2039)					8	10	12	12	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72						
5.200 (0.2047)				8	10	12	14	14	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72							
5.210 (0.2051)			6	8	10	12	14	16	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74							
5.220 (0.2055)			8	10	12	14	16	16	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72								
5.230 (0.2059)		6	8	10	12	14	16	18	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74								
5.240 (0.2063)		8	10	12	14	16	18	18	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72									
5.250 (0.2067)	6	8	10	12	14	16	18	20	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74									
5.260 (0.2071)	8	10	12	14	16	18	20	20	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72										
5.270 (0.2075)	8	10	12	14	16	18	20	22	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74										
5.280 (0.2079)	10	12	14	16	18	20	22	22	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72											
5.290 (0.2083)	10	12	14	16	18	20	22	24	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74											
5.300 (0.2087)	12	14	16	18	20	22	24	24	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72												
5.310 (0.2091)	12	14	16	18	20	22	24	26	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74												
5.320 (0.2094)	14	16	18	20	22	24	26	26	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72													
5.330 (0.2098)	14	16	18	20	22	24	26	28	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74													
5.340 (0.2102)	16	18	20	22	24	26	28	28	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72														
5.350 (0.2106)	16	18	20	22	24	26	28	30	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74														
5.360 (0.2110)	18	20	22	24	26	28	30	30	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72															
5.370 (0.2114)	18	20	22	24	26	28	30	32	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74															
5.380 (0.2118)	20	22	24	26	28	30	32	32	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72																
5.390 (0.2122)	20	22	24	26	28	30	32	34	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74																
5.400 (0.2126)	22	24	26	28	30	32	34	34	46	48	50	52	54	56	58	60	62	64	66	68	70	72																	
5.410 (0.2130)	22	24	26	28	30	32	34	36	48	50	52	54	56	58	60	62	64	66	68	70	72	74																	
5.420 (0.2134)	24	26	28	30	32	34	36	36	48	50	52	54	56	58	60	62	64	66	68	70	72																		
5.430 (0.2138)	24	26	28	30	32	34	36	38	50	52	54	56	58	60	62	64	66	68	70	72	74																		
5.440 (0.2142)	26	28	30	32	34	36	38	38	50	52	54	56	58	60	62	64	66	68	70	72																			
5.450 (0.2146)	26	28	30	32	34	36	38	40	52	54	56	58	60	62	64	66	68	70	72	74																			
5.460 (0.2150)	28	30	32	34	36	38	40	40	52	54	56	58	60	62	64	66	68	70	72																				
5.470 (0.2154)	28	30	32	34	36	38	40	42	54	56	58	60	62	64	66	68	70	72	74																				
5.480 (0.2157)	30	32	34	36	38	40	42	42	54	56	58	60	62	64	66	68	70	72																					
5.490 (0.2161)	30	32	34	36	38	40	42	44	56	58	60	62	64	66	68	70	72	74																					
5.500 (0.2165)	32	34	36	38	40	42	44	44	56	58	60	62	64	66	68	70	72																						
5.510 (0.2169)	32	34	36	38	40	42	44	46	58	60	62	64	66	68	70	72	74																						
5.520 (0.2173)	34	36	38	40	42	44	46	46	58	60	62	64	66	68	70	72																							
5.530 (0.2177)	34	36	38	40	42	44	46	48	60	62	64	66	68	70	72	74																							
5.540 (0.2181)	36	38	40	42	44	46	48	48	60	62	64	66	68	70	72																								
5.550 (0.2185)	36	38	40	42	44	46	48	50	62	64	66	68	70	72	74																								
5.560 (0.2189)	38	40	42	44	46	48	50	50	62	64	66	68	70	72																									
5.580 (0.2197)	40	42	44	46	48	50	52	52	64	66	68	70	72																										
5.600 (0.2205)	42	44	46	48	50	52	54	54	66	68	70	72																											
5.620 (0.2213)	44	46	48	50	52	54	56	56	68	70	72																												
5.640 (0.2220)	46	48	50	52	54	56	58	58	70	72																													
5.660 (0.2228)	48	50	52	54	56	58	60	60	72																														
5.680 (0.2236)	50	52	54	56	58	60	62	62																															
5.700 (0.2244)	52	54	56	58	60	62	64	64																															
5.720 (0.2252)	54	56	58	60	62	64	66	66																															
5.740 (0.2260)	56	58	60	62	64	66	68	68																															

EM

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Valve Lifter Selection Chart (Exhaust)

Installed Lifter Thickness mm(in.) \ Measured Clearance mm(in.)	0.000 - 0.020 (0.0000 - 0.0008)	0.021 - 0.040 (0.0008 - 0.0016)	0.041 - 0.060 (0.0016 - 0.0024)	0.061 - 0.080 (0.0024 - 0.0031)	0.081 - 0.100 (0.0032 - 0.0039)	0.101 - 0.120 (0.0040 - 0.0047)	0.121 - 0.140 (0.0048 - 0.0055)	0.141 - 0.160 (0.0056 - 0.0063)	0.161 - 0.180 (0.0063 - 0.0071)	0.181 - 0.200 (0.0071 - 0.0079)	0.201 - 0.220 (0.0079 - 0.0087)	0.221 - 0.240 (0.0087 - 0.0094)	0.241 - 0.260 (0.0095 - 0.0102)	0.261 - 0.280 (0.0103 - 0.0110)	0.281 - 0.289 (0.0111 - 0.0114)	0.391 - 0.410 (0.0154 - 0.0161)	0.411 - 0.430 (0.0162 - 0.0169)	0.431 - 0.450 (0.0170 - 0.0177)	0.451 - 0.470 (0.0178 - 0.0185)	0.471 - 0.490 (0.0185 - 0.0193)	0.491 - 0.510 (0.0193 - 0.0201)	0.511 - 0.530 (0.0201 - 0.0209)	0.531 - 0.550 (0.0209 - 0.0217)	0.551 - 0.570 (0.0217 - 0.0224)	0.571 - 0.590 (0.0225 - 0.0232)	0.591 - 0.610 (0.0233 - 0.0240)	0.611 - 0.630 (0.0241 - 0.0248)	0.631 - 0.650 (0.0248 - 0.0256)	0.651 - 0.670 (0.0256 - 0.0264)	0.671 - 0.690 (0.0264 - 0.0272)	0.691 - 0.710 (0.0272 - 0.0280)	0.711 - 0.730 (0.0280 - 0.0287)	0.731 - 0.750 (0.0288 - 0.0295)	0.751 - 0.770 (0.0296 - 0.0303)	0.771 - 0.790 (0.0304 - 0.0311)	0.791 - 0.810 (0.0311 - 0.0319)	0.811 - 0.830 (0.0319 - 0.0327)	0.831 - 0.850 (0.0327 - 0.0335)	0.851 - 0.870 (0.0335 - 0.0343)	0.871 - 0.890 (0.0343 - 0.0350)	0.891 - 0.910 (0.0351 - 0.0358)	0.911 - 0.930 (0.0359 - 0.0366)	0.931 - 0.950 (0.0367 - 0.0374)	0.951 - 0.970 (0.0374 - 0.0382)	0.971 - 0.990 (0.0382 - 0.0390)	0.991 - 1.010 (0.0390 - 0.0398)
5.060 (0.1992)																12	14	16	18	20	22	24	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72
5.080 (0.2000)																14	16	18	20	22	24	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	
5.100 (0.2008)																16	18	20	22	24	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72		
5.120 (0.2016)															6	18	20	22	24	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72			
5.140 (0.2024)														8	8	20	22	24	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72				
5.160 (0.2031)													8	10	10	22	24	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72					
5.180 (0.2039)												8	10	12	12	24	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72						
5.200 (0.2047)											8	10	12	14	14	56	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72							
5.210 (0.2051)										6	8	10	12	14	16	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74						
5.220 (0.2055)										8	10	12	14	16	16	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72							
5.230 (0.2059)									6	8	10	12	14	16	18	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74						
5.240 (0.2063)									8	10	12	14	16	18	18	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72							
5.250 (0.2067)								6	8	10	12	14	16	18	20	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74						
5.260 (0.2071)								8	10	12	14	16	18	20	20	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72							
5.270 (0.2075)							6	8	10	12	14	16	18	20	22	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74						
5.280 (0.2079)							8	10	12	14	16	18	20	22	22	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72							
5.290 (0.2083)						6	8	10	12	14	16	18	20	22	24	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74							
5.300 (0.2087)						8	10	12	14	16	18	20	22	24	24	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72								
5.310 (0.2091)					6	8	10	12	14	16	18	20	22	24	26	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74								
5.320 (0.2094)					8	10	12	14	16	18	20	22	24	26	26	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72									
5.330 (0.2098)				6	8	10	12	14	16	18	20	22	24	56	28	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74									
5.340 (0.2102)				8	10	12	14	16	18	20	22	24	26	28	28	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72										
5.350 (0.2106)			6	8	10	12	14	16	18	20	22	24	56	28	30	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74										
5.360 (0.2110)			8	10	12	14	16	18	20	22	24	26	28	30	30	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72											
5.370 (0.2114)		6	8	10	12	14	16	18	20	22	24	56	28	30	32	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74											
5.380 (0.2118)		8	10	12	14	16	18	20	22	24	26	28	30	32	32	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72												
5.390 (0.2122)	6	8	10	12	14	16	18	20	22	24	56	28	30	32	34	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74												
5.400 (0.2126)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	34	46	48	50	52	54	56	58	60	62	64	66	68	70	72													
5.410 (0.2130)	8	10	12	14	16	18	20	22	24	56	28	30	32	34	36	48	50	52	54	56	58	60	62	64	66	68	70	72	74													
5.420 (0.2134)	10	12	14	16	18	20	22	24	26	28	30	32	34	36	36	48	50	52	54	56	58	60	62	64	66	68	70	72														
5.430 (0.2138)	10	12	14	16	18	20	22	24	56	28	30	32	34	36	38	50	52	54	56	58	60	62	64	66	68	70	72	74														
5.440 (0.2142)	12	14	16	18	20	22	24	26	28	30	32	34	36	38	38	50	52	54	56	58	60	62	64	66	68	70	72															
5.450 (0.2146)	12	14	16	18	20	22	24	56	28	30	32	34	36	38	40	52	54	56	58	60	62	64	66	68	70	72	74															
5.460 (0.2150)	14	16	18	20	22	24	26	28	30	32	34	36	38	40	40	52	54	56	58	60	62	64	66	68	70	72																
5.470 (0.2154)	14	16	18	20	22	24	56	28	30	32	34	36	38	40	42	54	56	58	60	62	64	66	68	70	72	74																
5.480 (0.2157)	16	18	20	22	24	26	28	30	32	34	36	38	40	42	42	54	56	58	60	62	64	66	68	70	72																	
5.490 (0.2161)	16	18	20	22	24	56	28	30	32	34	36	38	40	42	44	56	58	60	62	64	66	68	70	72	74																	
5.500 (0.2165)	18	20	22	24	26	28	30	32	34	36	38	40	42	44	44	56	58	60	62	64	66	68	70	72																		
5.510 (0.2169)	18	20	22	24	56	28	30	32	34	36	38	40	42	44	46	58	60	62	64	66	68	70	72	74																		
5.520 (0.2173)	20	22	24	26	28	30	32	34	36	38	40	42	44	46	46	58	60	62	64	66	68	70	72																			
5.530 (0.2177)	20	22	24	56	28	30	32	34	36	38	40	42	44	46	48	60	62	64	66	68	70	72	74																			
5.540 (0.2181)	22	24	26	28	30	32	34	36	38	40	42	44	46	48	48	60	62	64	66	68	70	72																				
5.550 (0.2185)	22	24	56	28	30	32	34	36	38	40	42	44	46	48	50	62	64	66	68	70	72	74																				
5.560 (0.2189)	24	26	28	30	32	34	36	38	40	42	44	46	48	50	50	62	64	66	68	70	72																					
5.580 (0.2197)	26	28	30	32	34	36	38	40	42	44	46	48	50	52	52	64	66	68	70	72																						
5.600 (0.2205)	28	30	32	34	36	38	40	42	44	46	48	50	52	54	54	66	68	70	72																							
5.620 (0.2213)	30	32	34	36	38	40	42	44	46	48	50	52	54	56	56	68	70	72																								
5.640 (0.2220)	32	34	36	38	40	42	44	46	48	50	52	54	56	58	58	70	72																									
5.660 (0.2228)	34	36	38	40	42	44	46	48	50	52	54	56	58	60	60	72																										
5.680 (0.2236)	36	38	40	42	44	46	48	50	52	54	56	58	60	62	62																											
5.700 (0.2244)	38	40	42	44	46	48	50	52	54	56	58	60	62	64	64																											
5.720 (0.2252)	40	42	44	46	48	50	52	54	56	58	60	62	64	66	66																											
5.740 (0.2260)	42	44	46	48	50	52	54	56	58	60	62	64	66	68	68																											

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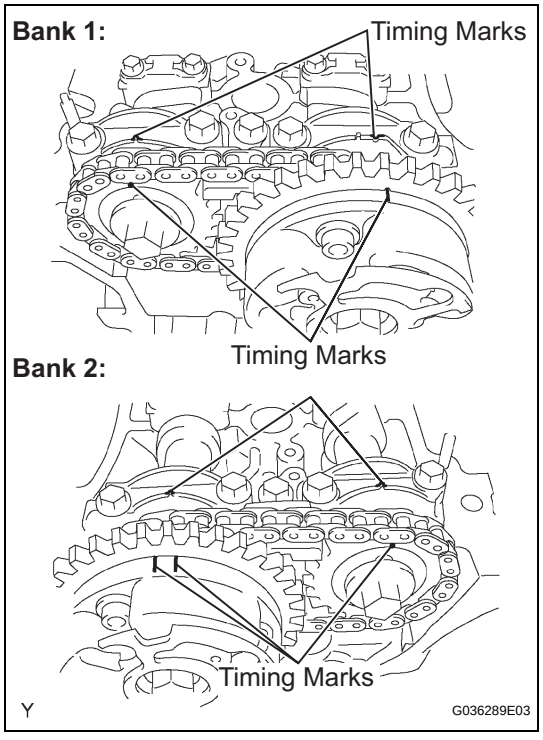
HINT:
New lifter thickness [mm (in.)]

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 (0.1992)	30	5.300 (0.2087)	54	5.540 (0.2181)
08	5.080 (0.2000)	32	5.320 (0.2094)	56	5.560 (0.2189)
10	5.100 (0.2008)	34	5.340 (0.2102)	58	5.580 (0.2197)
12	5.120 (0.2016)	36	5.360 (0.2110)	60	5.600 (0.2205)
14	5.140 (0.2024)	38	5.380 (0.2118)	62	5.620 (0.2213)
16	5.160 (0.2031)	40	5.400 (0.2126)	64	5.640 (0.2220)
18	5.180 (0.2039)	42	5.420 (0.2134)	66	5.660 (0.2228)
20	5.200 (0.2047)	44	5.440 (0.2142)	68	5.680 (0.2236)
22	5.220 (0.2055)	46	5.460 (0.2150)	70	5.700 (0.2244)
24	5.240 (0.2063)	48	5.480 (0.2157)	72	5.720 (0.2252)
26	5.260 (0.2071)	50	5.500 (0.2165)	74	5.740 (0.2260)
28	5.280 (0.2079)	52	5.520 (0.2173)		

(k) Install the No. 3 camshaft sub-assembly.
(l) Install the No. 3 chain tensioner assembly.
(m) Install the No. 4 camshaft sub-assembly.
(n) Install the camshaft.
(o) Install the No. 2 chain tensioner assembly.
(p) Install the No. 2 camshaft.
(q) Install the No. 1 chain tensioner assembly.
(1) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.



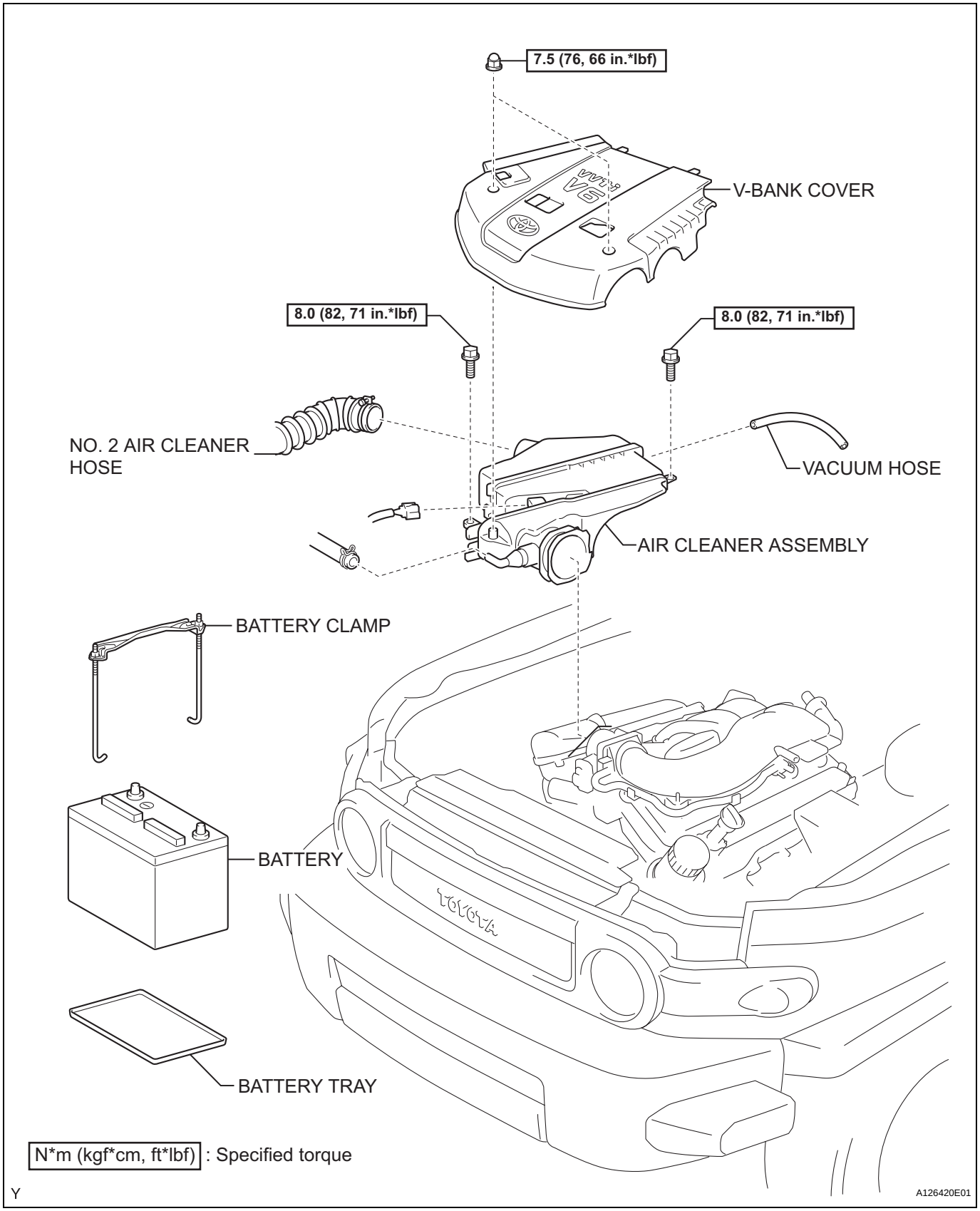
16. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH (See page EM-57)**
17. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-58)**
18. **INSTALL IGNITION COIL ASSEMBLY (See page IG-8)**
19. **INSTALL INTAKE AIR SURGE TANK (See page FU-17)**
20. **INSTALL NO. 2 SURGE TANK STAY (See page FU-19)**
21. **INSTALL NO. 1 SURGE TANK STAY (See page FU-19)**
22. **INSTALL OIL BAFFLE PLATE (See page FU-19)**
23. **INSTALL THROTTLE BODY BRACKET (See page FU-19)**
24. **INSTALL AIR CLEANER ASSEMBLY (See page ES-431)**
25. **ADD ENGINE COOLANT (See page CO-3)**
26. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)
27. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**

EM

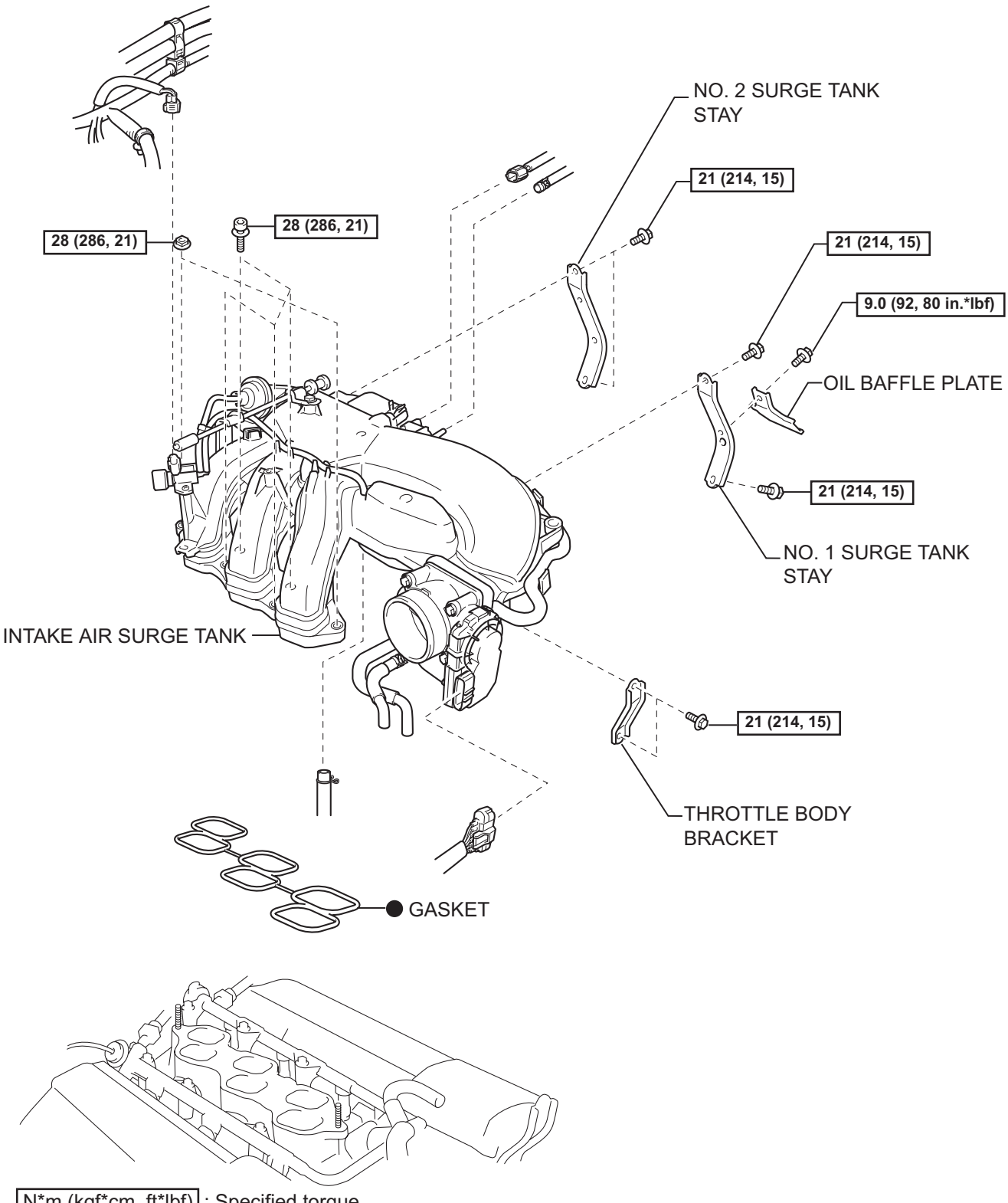
28. **INSPECT IGNITION TIMING (See page EM-1)**
29. **INSTALL V-BANK COVER (See page ES-431)**

TIMING CHAIN

COMPONENTS



EM



N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

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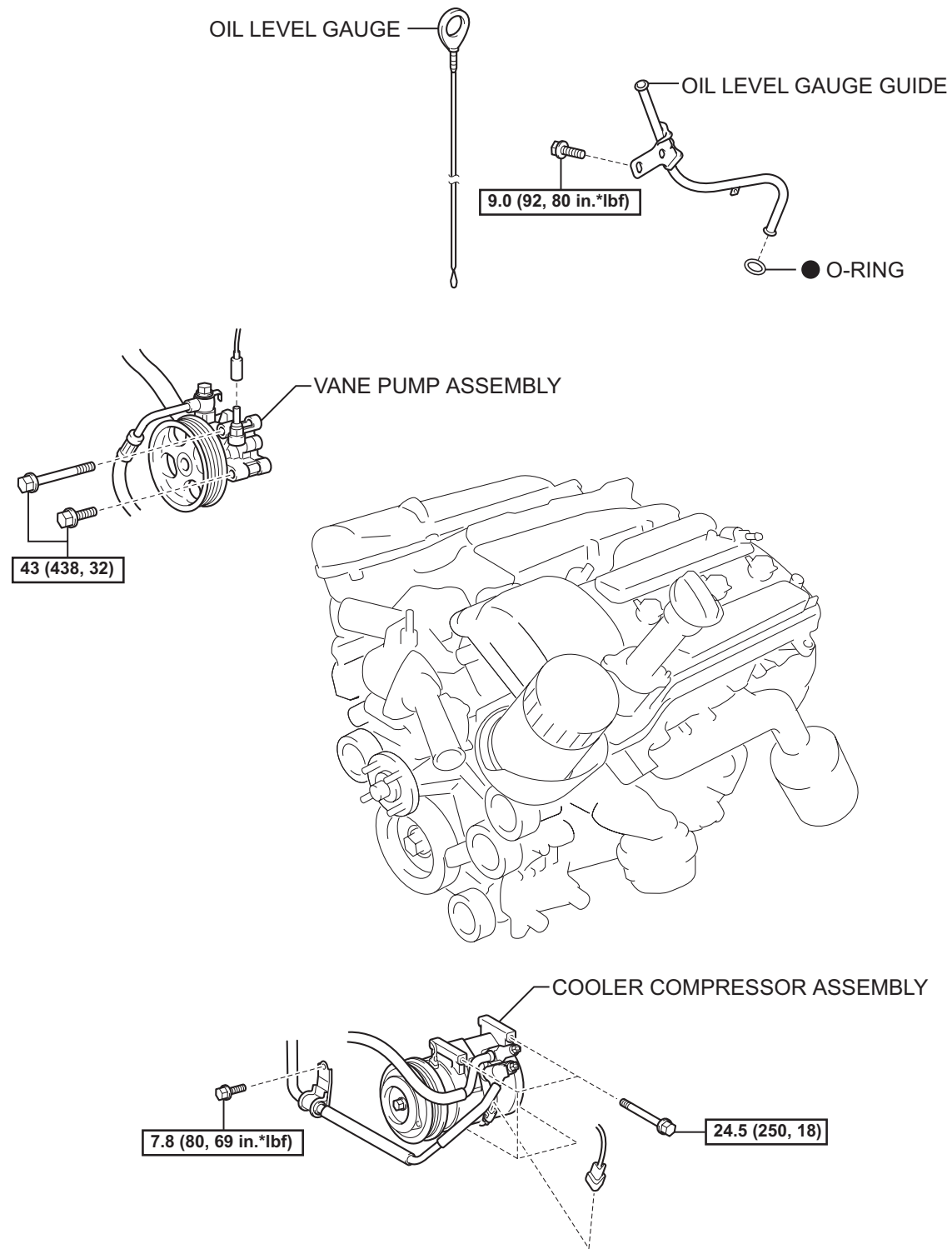

EM

N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

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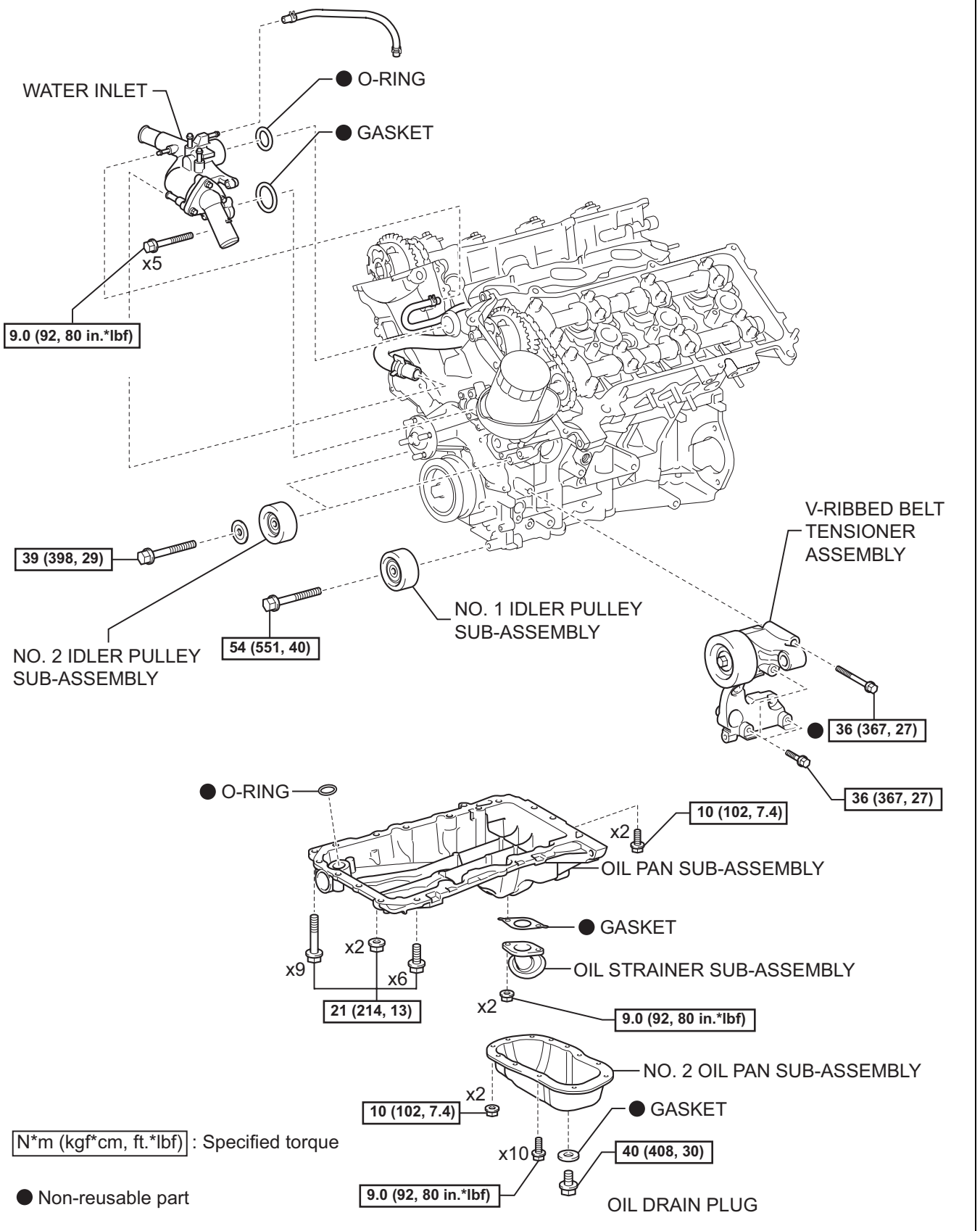
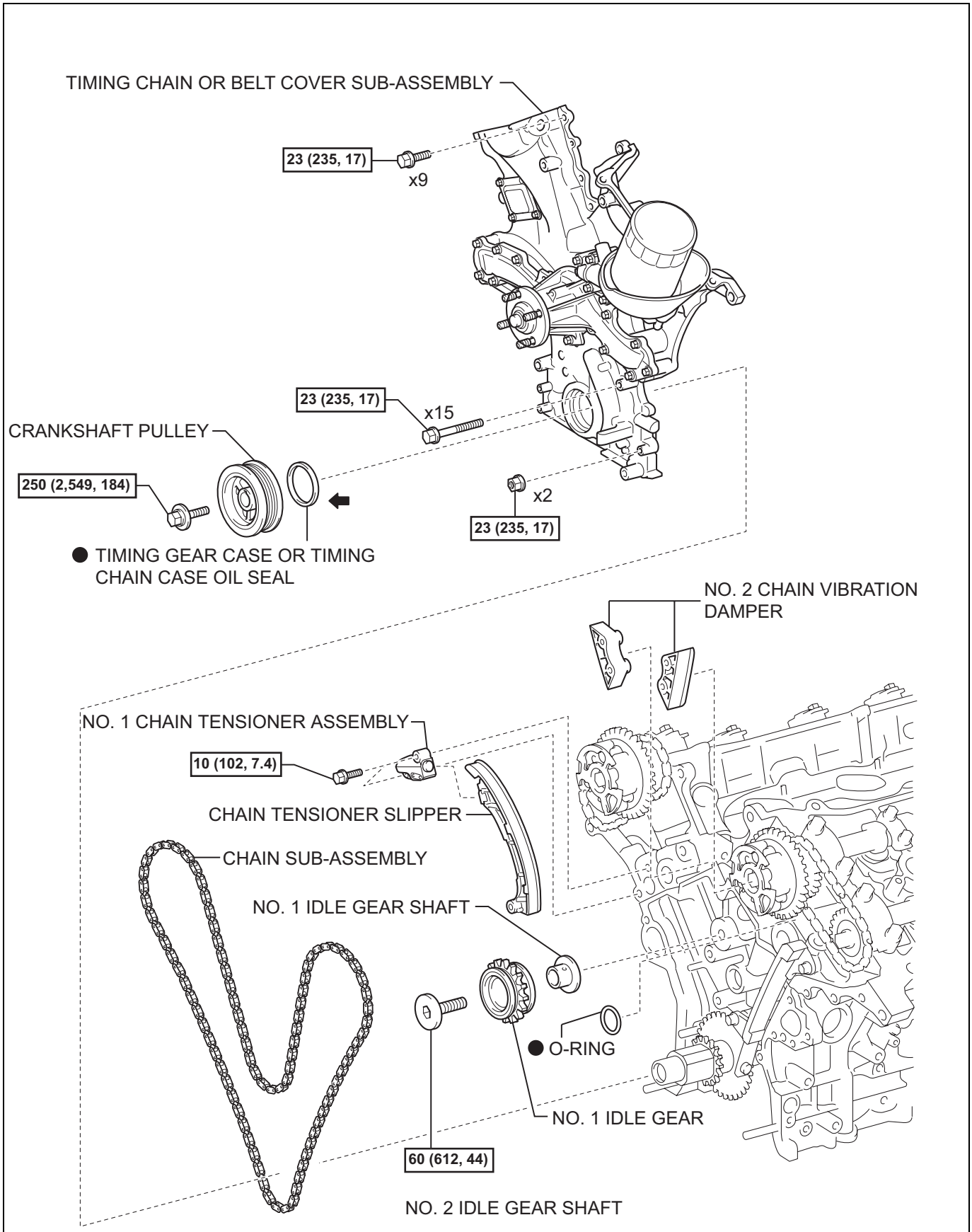
EM


WATER INLET
O-RING
GASKET
x5
9.0 (92, 80 in.*lbf)
39 (398, 29)
NO. 2 IDLER PULLEY SUB-ASSEMBLY
54 (551, 40)
NO. 1 IDLER PULLEY SUB-ASSEMBLY
V-RIBBED BELT TENSIONER ASSEMBLY
36 (367, 27)
36 (367, 27)
O-RING
10 (102, 7.4)
x2
OIL PAN SUB-ASSEMBLY
GASKET
x9
x2
x6
21 (214, 13)
OIL STRAINER SUB-ASSEMBLY
x2
9.0 (92, 80 in.*lbf)
NO. 2 OIL PAN SUB-ASSEMBLY
x2
10 (102, 7.4)
GASKET
x10
40 (408, 30)
9.0 (92, 80 in.*lbf)
OIL DRAIN PLUG
N*m (kgf*cm, ft.*lbf) : Specified torque
Non-reusable part
Y
A126506E01



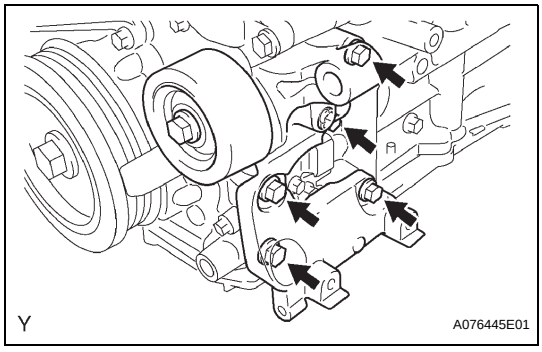
N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part ⬅ Apply MP grease

Y

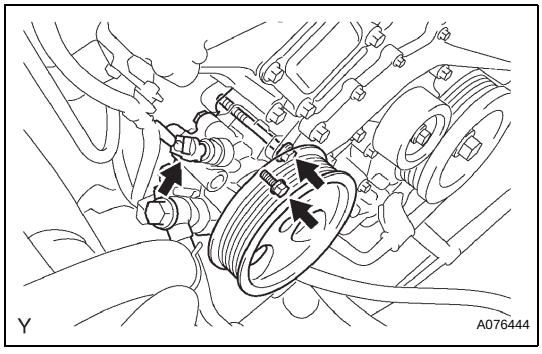
A113591E02

REMOVAL

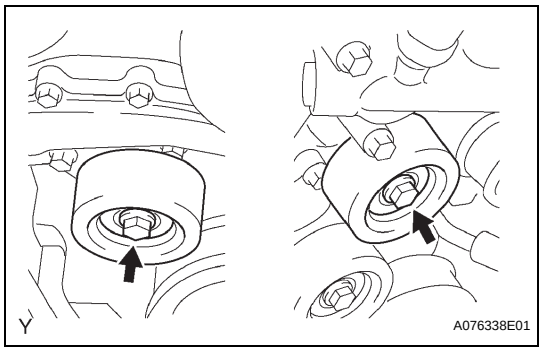
1. **REMOVE BATTERY**
2. **DRAIN ENGINE COOLANT (See page CO-3)**
3. **DRAIN ENGINE OIL (See page LU-4)**
4. **REMOVE POWER STEERING LINK ASSEMBLY (for 2WD)**
   Refer to the procedures up to "REMOVE POWER STEERING LINK ASSEMBLY" (See page PS-18).
5. **REMOVE POWER STEERING LINK ASSEMBLY (for 4WD)**
   Refer to the procedures up to "REMOVE POWER STEERING LINK ASSEMBLY" (See page PS-37).
6. **REMOVE FRONT DIFFERENTIAL CARRIER ASSEMBLY (for 4WD)**
   Refer to the procedures up to "REMOVE FRONT DIFFERENTIAL CARRIER ASSEMBLY" (See page DF-20).
7. **REMOVE FAN**
   Refer to the procedures up to "REMOVE FAN PULLEY" (See page CO-17).
8. **REMOVE GENERATOR ASSEMBLY**
   Refer to the procedures up to "REMOVE GENERATOR ASSEMBLY" (See page CH-9)
9. **SEPARATE COOLER COMPRESSOR ASSEMBLY (See page ES-420)**
10. **REMOVE V-RIBBED BELT TENSIONER ASSEMBLY**
    (a) Remove the 5 bolts, then remove the V-ribbed belt tensioner.



11. **REMOVE OIL LEVEL GAUGE GUIDE**
    (a) Remove the oil level gauge.
    (b) Remove the bolt and pull out the oil level gauge guide.
    (c) Remove the O-ring from the oil level gauge guide.

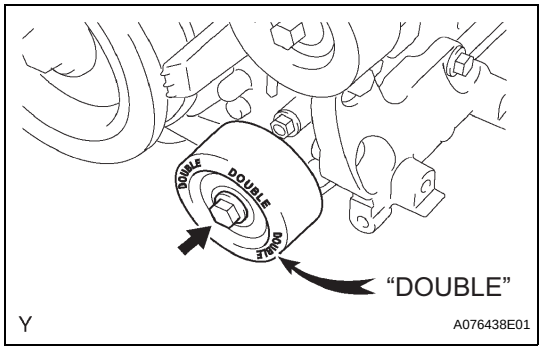


12. **SEPARATE VANE PUMP ASSEMBLY**
    (a) Disconnect the power steering pressure switch connector.
    (b) Remove the 2 bolts, then separate the vane pump.
    NOTICE:
    Do not hit the pulley with other parts when separating the vane pump.
    HINT:
    The vane pump is suspended securely.



13. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

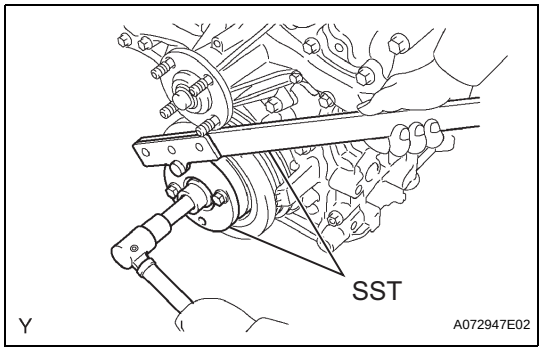
(a) Remove the 2 bolts, then remove the No. 2 idler pulleys.



14. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

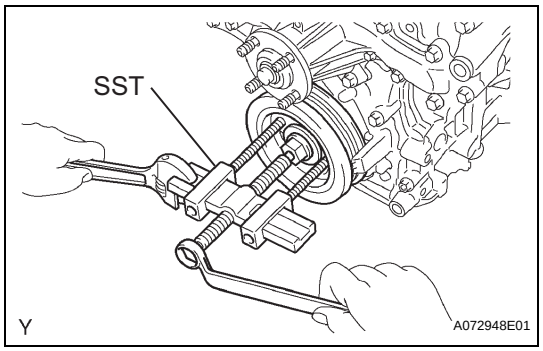
(a) Remove the bolt, then remove the No. 1 idler pulley.

EM

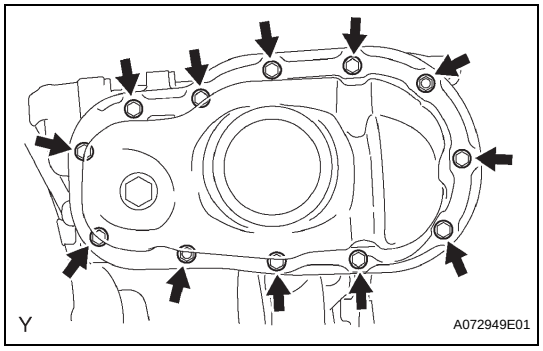


15. REMOVE CRANKSHAFT PULLEY

(a) Using SST, hold the crankshaft pulley and loosen the pulley set bolt.
SST 09213-54015 (91651-60855), 09330-00021

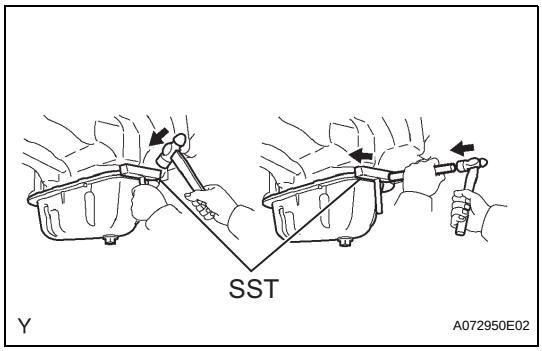


(b) Using the pulley set bolt and SST, remove the crankshaft pulley.
SST 09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05030)

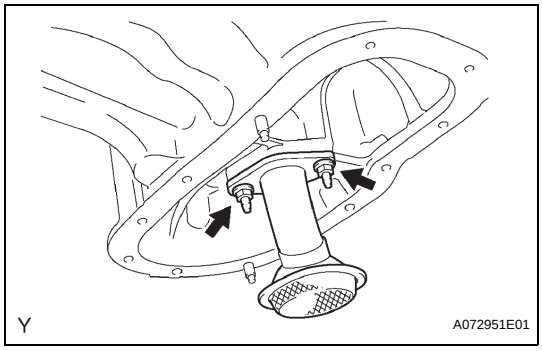


16. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

(a) Remove the 10 bolts and 2 nuts.

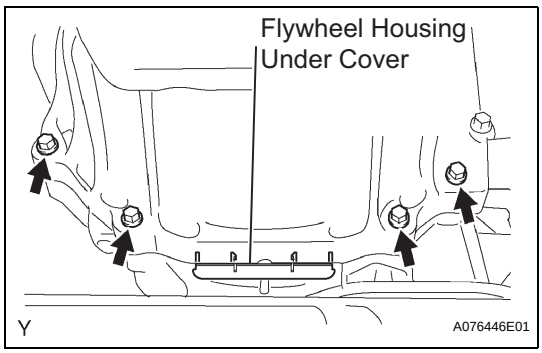


(b) Insert the blade of SST between the oil pan and No. 2 oil pan, cut off applied sealer and remove the No. 2 oil pan.
SST 09032-00100
NOTICE:
- **Be careful not to damage the contact surfaces of the oil pan and No. 2 oil pan.**
- **Be careful not to damage the No. 2 oil pan flange.**



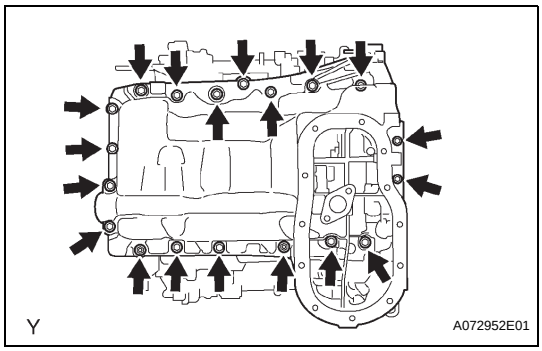
17. REMOVE OIL STRAINER SUB-ASSEMBLY

(a) Remove the 2 nuts, then remove the oil strainer and gasket.

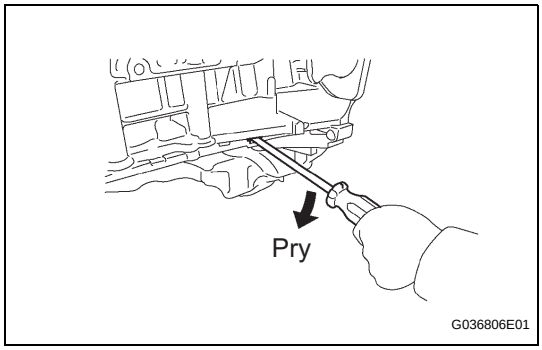


18. REMOVE OIL PAN SUB-ASSEMBLY

(a) Remove the 4 housing bolts.
(b) Remove the flywheel housing under cover.



(c) Remove the 17 bolts and 2 nuts.

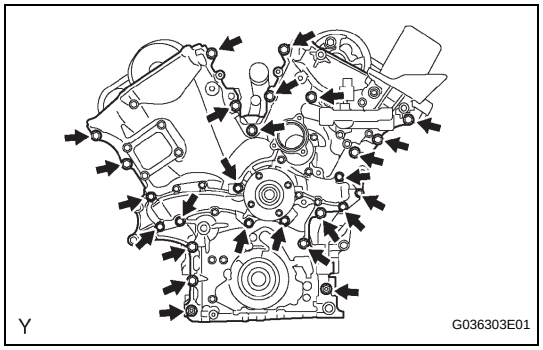


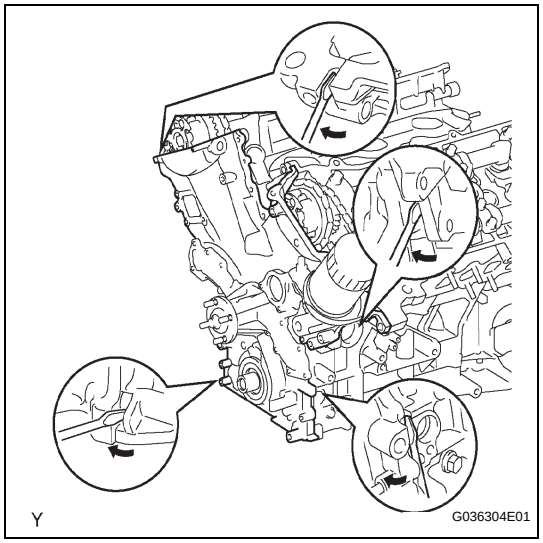
(d) Using a screwdriver, remove the oil pan by prying between the oil pan and cylinder block.
NOTICE:
Be careful not to damage the contact surfaces of the cylinder block and oil pan.
(e) Remove the O-ring from the oil pump.

19. REMOVE AIR CLEANER ASSEMBLY (See page ES-429)

20. REMOVE THROTTLE BODY BRACKET (See page FU-11)

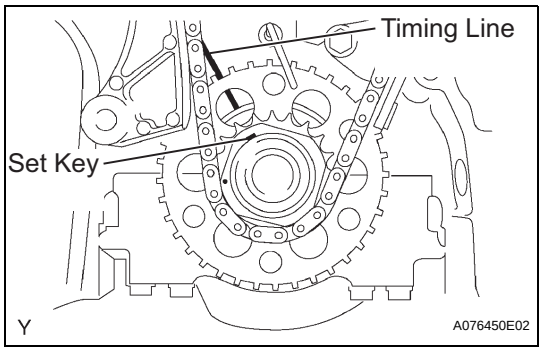
21. **REMOVE OIL BAFFLE PLATE (See page FU-11)**
22. **REMOVE NO. 1 SURGE TANK STAY (See page FU-11)**
23. **REMOVE NO. 2 SURGE TANK STAY (See page FU-12)**
24. **REMOVE INTAKE AIR SURGE TANK (See page FU-12)**
25. **REMOVE IGNITION COIL ASSEMBLY (See page IG-8)**
26. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (See page ES-414)**
27. **REMOVE VVT SENSOR (See page ES-417)**
28. **REMOVE WATER INLET (See page CO-8)**
29. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-40)**
30. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH (See page EM-40)**
31. **REMOVE TIMING CHAIN OR BELT COVER SUB-ASSEMBLY**
    (a) Remove the 24 bolts and 2 nuts.





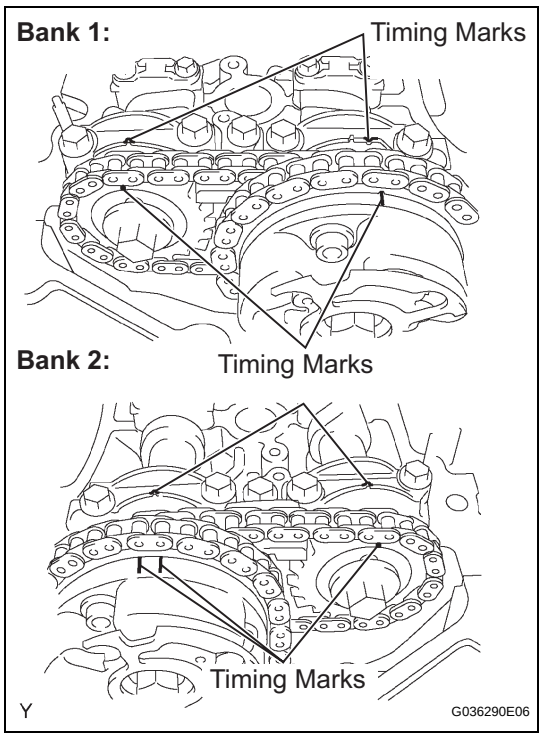
    (b) Remove the timing chain cover by prying between the timing chain cover, cylinder head or cylinder block with a screwdriver.
    NOTICE:
    Be careful not to damage the contact surfaces of the timing chain cover, cylinder block and cylinder head.
    (c) Remove the O-ring from the LH cylinder head.
32. **REMOVE TIMING GEAR CASE OR TIMING CHAIN CASE OIL SEAL (See page EM-163)**

EM



33. SET NO. 1 COMPRESSION TO TDC/COMPRESSION

(a) Using the crankshaft pulley set bolt, turn the crankshaft to align the crankshaft set key with the timing line of the cylinder block.

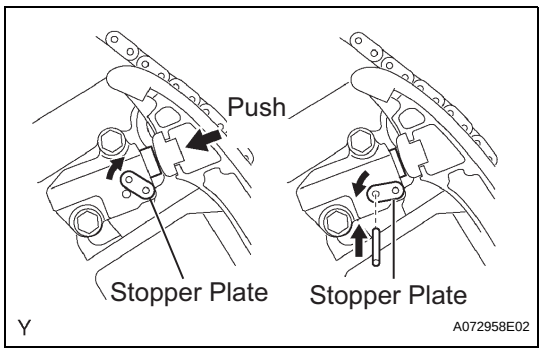


(b) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing caps as shown in the illustration.
If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.

34. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

NOTICE:

- **Never rotate the crankshaft with the chain tensioner removed.**
- **When rotating the camshaft with the timing chain removed, rotate the crankshaft counterclockwise 40° from the TDC first.**



(a) While turning the stopper plate of the tensioner upward, push in the plunger of the chain tensioner as shown in the illustration.

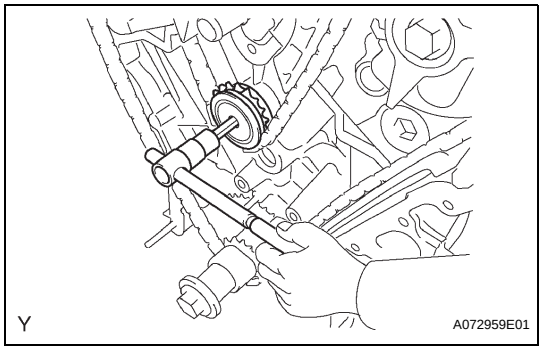
(b) While turning the stopper plate of the tensioner downward, insert a bar of ϕ 3.5 mm (0.138) into the holes in the stopper plate and tensioner to fix the stopper plate.

(c) Remove the 2 bolts, then remove the chain tensioner.

35. REMOVE CHAIN TENSIONER SLIPPER

36. REMOVE IDLE SPROCKET ASSEMBLY

(a) Using a 10 mm hexagon wrench, remove the No. 2 idle gear shaft, No. 1 idle gear and No. 1 idle gear shaft.



37. REMOVE NO. 2 CHAIN VIBRATION DAMPER

(a) Remove the 2 No. 2 chain vibration dampers.

38. REMOVE CHAIN SUB-ASSEMBLY

INSTALLATION

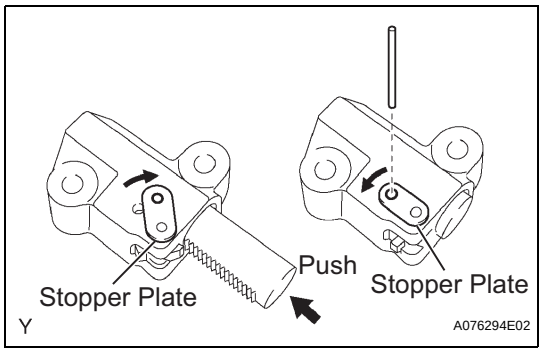
1. INSTALL CHAIN TENSIONER SLIPPER

2. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

(a) While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

(b) While turning the stopper plate of the tensioner counterclockwise, insert a bar of ϕ 35 mm (0.138 in.) into the holes in the stopper plate and tensioner to fix the stopper plate.

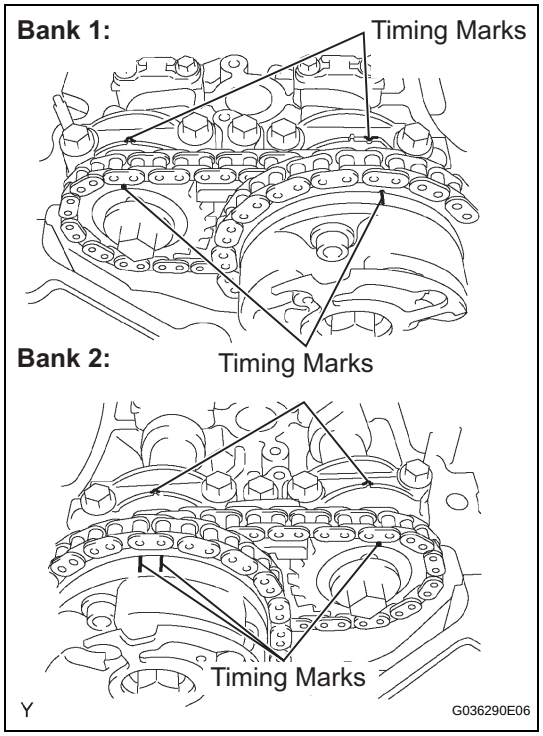
(c) Install the chain tensioner with the 2 bolts.
Torque: 10 N*m (102 kgf*cm, 7.4 ft.*lbf)



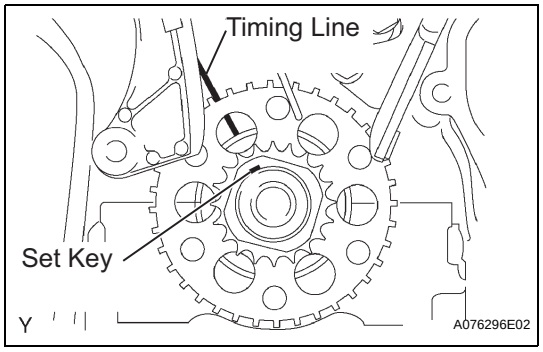
3. INSTALL CHAIN SUB-ASSEMBLY

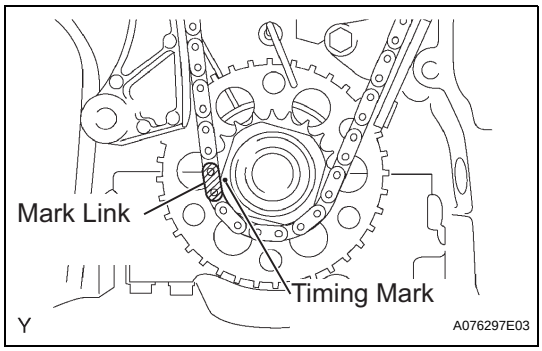
(a) Set the No. 1 cylinder to TDC/ compression.

(1) Align the timing marks of the camshaft timing gears and bearing caps.

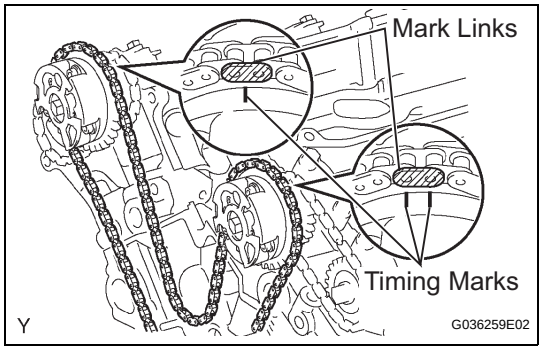


(2) Using the crankshaft pulley set bolt, turn the crankshaft to align the crankshaft set key with the timing line of the cylinder block.





(b) Align the yellow mark link with the timing mark of the crankshaft timing link.



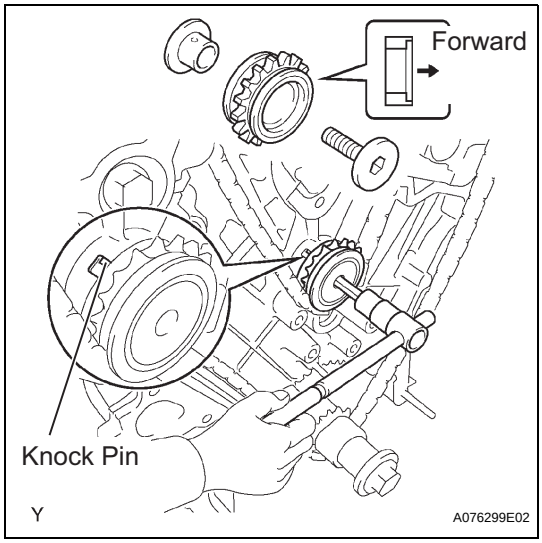
(c) Align the orange mark links with the timing marks of the camshaft timing gears, and install the chain.

4. INSTALL NO. 2 CHAIN VIBRATION DAMPER

(a) Install the 2 No. 2 chain vibration dampers.

5. INSTALL IDLE SPROCKET ASSEMBLY

(a) Apply a light coat of engine oil to rotating surface of the No. 1 idle gear shaft.



(b) Temporarily install the No. 1 idle gear shaft together with the No. 2 idle gear shaft with the knock pin of the No. 1 idle gear shaft and the knock pin groove of the cylinder block are aligned.
NOTICE:
Orient the idle gear shafts correctly.

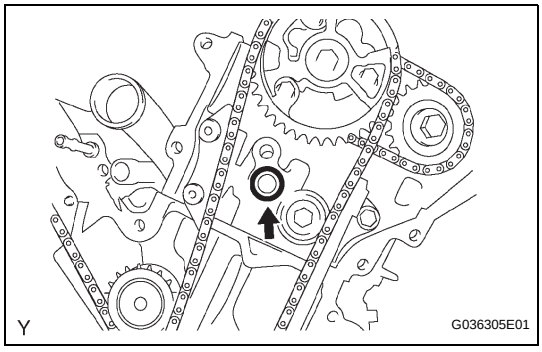
(c) Using a 10 mm hexagon wrench, tighten the No. 2 idle gear shaft.
Torque: 60 N*m (612 kgf*cm, 44 ft.*lbf)

(d) Remove the bar from the chain tensioner.

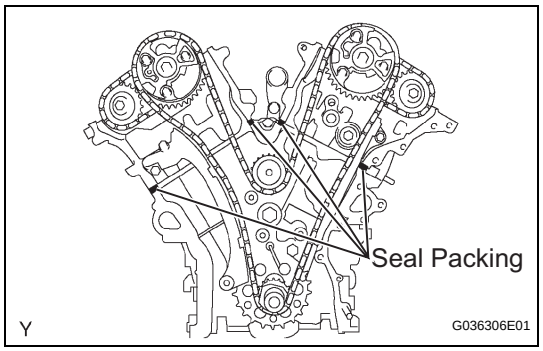
6. INSTALL TIMING GEAR CASE OR TIMING CHAIN CASE OIL SEAL (See page EM-163)

7. INSTALL TIMING CHAIN OR BELT COVER SUB-ASSEMBLY

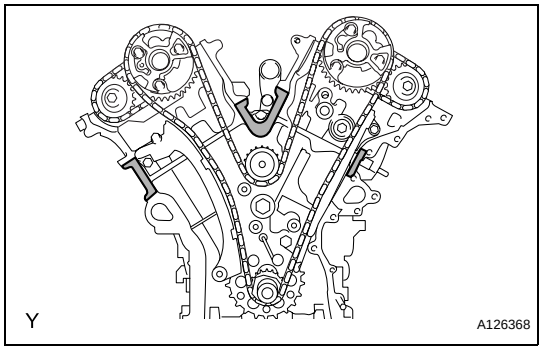
(a) Remove any old packing (FIPG) material.
HINT:
Do not drop any oil on the contact surfaces of the timing chain cover, cylinder head and cylinder block.



(b) Install a new O-ring onto the bank 2 cylinder head as shown in the illustration.

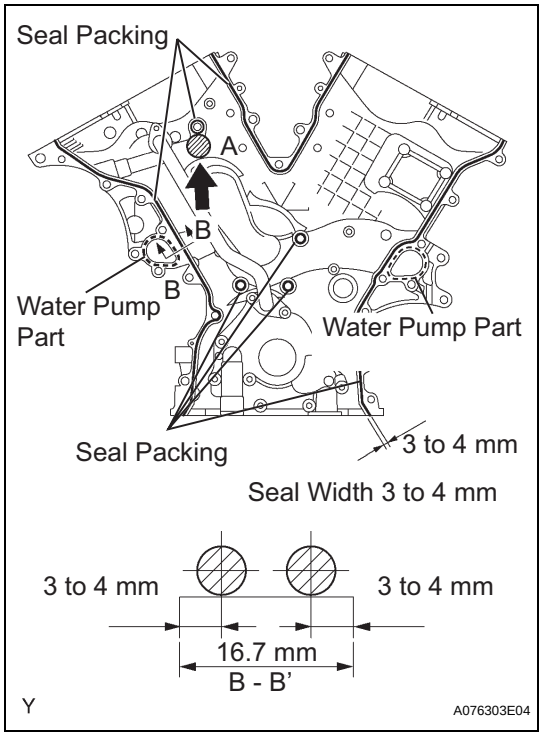


(c) Apply continuous beads of seal packing (diameter 3 to 4 mm (0.12 to 0.16 in.)) to the 4 locations shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent

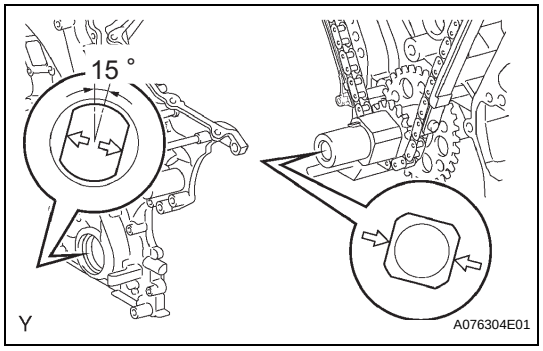


(d) Keep the seal surface between the cylinder block and the cylinder head shown in the illustration free of oil before installing the chain cover.

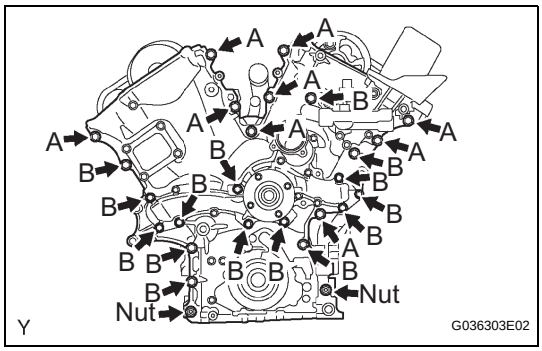
EM



(e) Apply continuous beads of seal packing (diameter 3 to 4 mm (0.12 to 0.16 in.)) to the timing chain cover as shown in the illustration.
Seal packing:
Water pump part:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or the equivalent
Other parts:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
- **Install the timing chain cover within 3 minutes of applying the seal packing. The timing chain cover bolts and nuts must be tightened within 15 minutes of the installation. Otherwise the seal packing must be removed and reapplied.**
- **Do not apply seal packing to portion A shown in the illustration.**



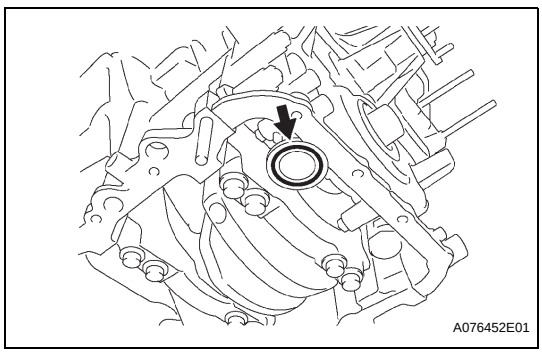
(f) Align the key way of the oil pump drive rotor with the rectangular portion of the crankshaft timing gear, and slide the timing chain cover into place.

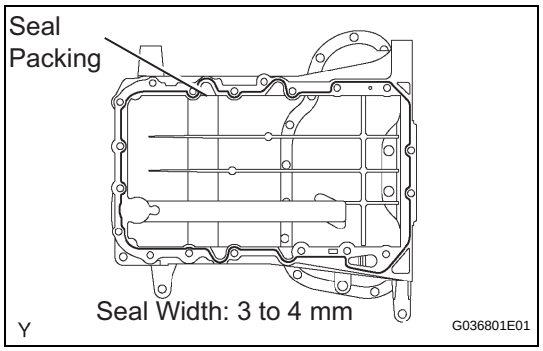


(g) Install the timing chain cover with the 24 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.
Torque: 23 N*m (235 kgf*cm, 17 ft.*lbf)
NOTICE:
Pay attention not to wrap the chain and slipper over the timing chain cover seal line.
Each bolt length is as follows

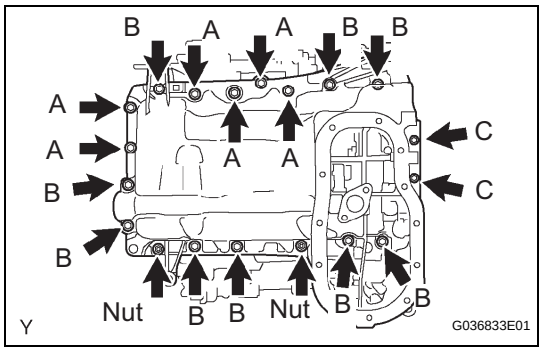
Bolt	Length
A	25 mm (0.98 in.)
B	55 mm (2.17 in.)

8. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH (See page EM-57)**
9. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-58)**
10. **INSTALL WATER INLET (See page CO-9)**
11. **INSTALL VVT SENSOR (See page ES-417)**
12. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (See page ES-415)**
13. **INSTALL IGNITION COIL ASSEMBLY (See page IG-8)**
14. **INSTALL INTAKE AIR SURGE TANK (See page FU-17)**
15. **INSTALL NO. 2 SURGE TANK STAY (See page FU-19)**
16. **INSTALL NO. 1 SURGE TANK STAY (See page FU-19)**
17. **INSTALL OIL BAFFLE PLATE (See page FU-19)**
18. **INSTALL THROTTLE BODY BRACKET (See page FU-19)**
19. **INSTALL AIR CLEANER ASSEMBLY (See page ES-431)**
20. **INSTALL OIL PAN SUB-ASSEMBLY**
    (a) Remove any old packing (FIPG) material.
    HINT:
    Do not drop any oil on the contact surfaces of the cylinder block, rear oil seal and oil pan.
    (b) Install a new O-ring onto the oil pump.



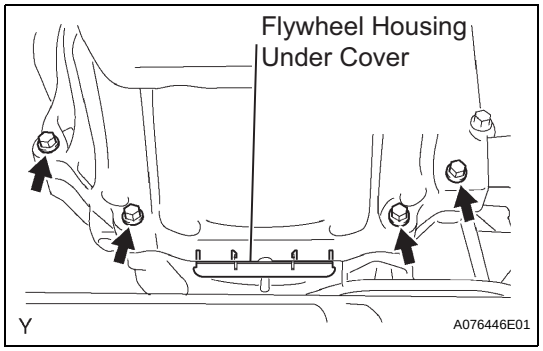


(c) Apply a continuous bead of seal packing (diameter 3 to 4 mm (0.12 to 0.16 in.)) to the oil pan as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the oil pan within 3 minutes of applying the seal packing. Tighten the oil pan bolts and nuts within 15 minutes of installing the oil pan. Otherwise, the seal packing must be removed and reapplied.

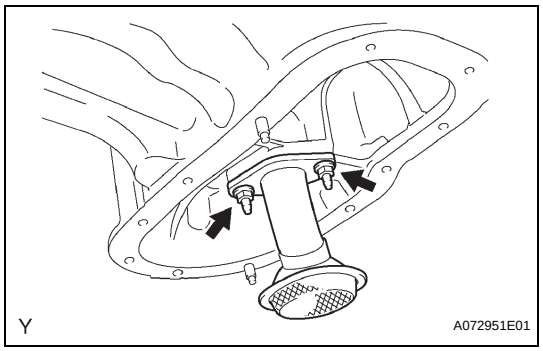


(d) Install the oil pan with the 17 bolts and 2 nuts, and tighten the bolts and nuts uniformly in several steps.
Torque: 10 mm (0.39 in.) head
10 N*m (102 kgf*cm, 7.4 ft.*lbf)
12 mm (0.47 in.) head
21 N*m (214 kgf*cm, 16 ft.*lbf)
Nut
21 N*m (1,214 kgf*cm, 16 ft.*lbf)
HINT:
Each bolt length is as follows:

Bolt	Length
A	25 mm (0.98 in.)
B	45 mm (1.77 in.)
C	14 mm (0.55 in.)

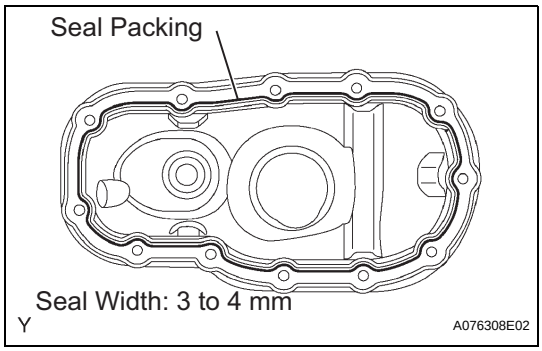


(e) Install the 4 housing bolts.
Torque: 37 N*m (377 kgf*cm, 27 ft.*lbf)
(f) Install the flywheel housing under cover.

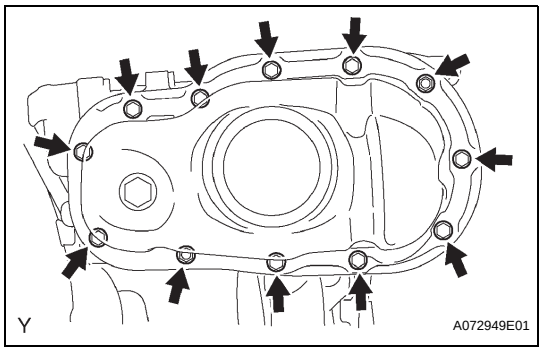


21. INSTALL OIL STRAINER SUB-ASSEMBLY
(a) Install a new gasket and the oil strainer with the 2 nuts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

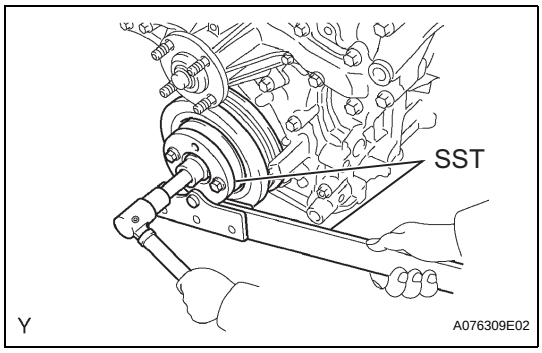
22. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY
(a) Remove any old packing (FIPG) material.
HINT:
Do not drop any oil on the contact surfaces of the oil pan and No. 2 oil pan.



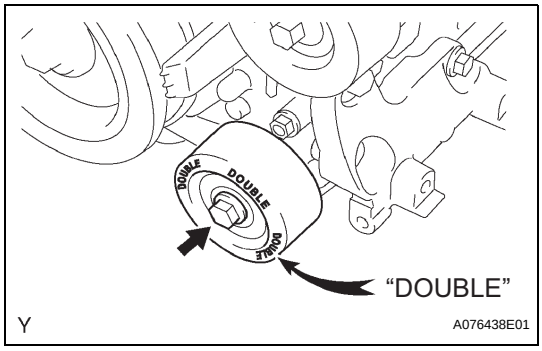
(b) Apply a continuous bead of seal packing (diameter 3 to 4 mm (0.12 to 0.16 in.)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the No. 2 oil pan within 3 minutes of applying the seal packing. Tighten the No. 2 oil pan bolts and nuts within 15 minutes of installing the No. 2 oil pan. Otherwise, the seal packing must be removed and reapplied.



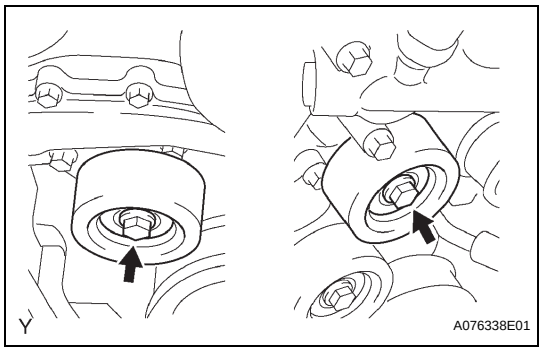
(c) Install the No. 2 oil pan with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.
Torque: Bolt
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Nut
10 N*m (102 kgf*cm, 7.4 in.*lbf)



23. INSTALL CRANKSHAFT PULLEY
(a) Using SST, install the pulley set bolt.
SST 09213-54015 (91651-60855), 09330-00021
Torque: 250 N*m (2,549 kgf*cm, 184 ft.*lbf)

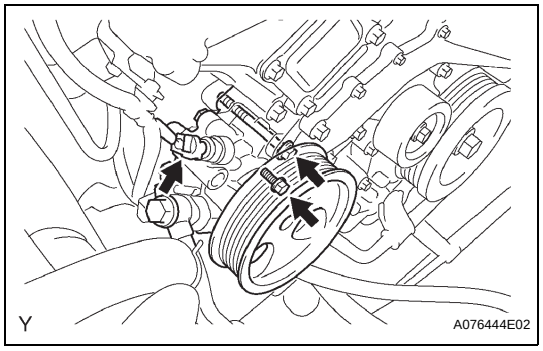


24. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY
(a) Install the idler pulley with the bolt.
Torque: 39 N*m (398 kgf*cm, 29 ft.*lbf)
HINT:
DOUBLE is marked on the No. 1 idler pulley to distinguish it from the No. 2 idler pulley.



25. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY

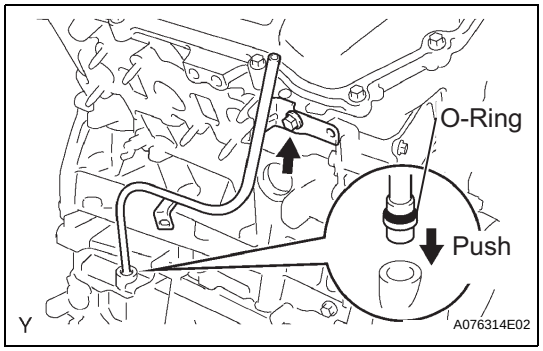
(a) Install the 2 No. 2 idler pulleys with the 2 bolts.
Torque: 54 N*m (551 kgf*cm, 40 ft.*lbf)



26. INSTALL VANE PUMP ASSEMBLY

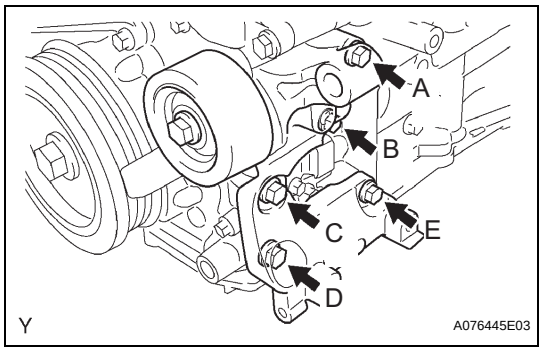
(a) Install the vane pump with the 2 bolts.
Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)
NOTICE:
Do not hit the pulley with other parts when installing the vane pump.

(b) Connect the power steering pressure switch connector.



27. INSTALL OIL LEVEL GAUGE GUIDE

(a) Install a new O-ring onto the oil level gauge guide.
(b) Apply a light coat of engine oil to the O-ring.
(c) Push the oil level gauge guide end into the guide hole in the oil pan.
(d) Install the oil level gauge guide with the bolt.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
(e) Install the oil level gauge guide.



28. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY
NOTICE:
The bolt in position A is not reusable.
HINT:
Each bolt length is as follows:

Position	Length
A	70 mm (2.76 in.)
B, C, D and E	33 mm (1.30 in.)

(a) Use a new bolt in position A.
(b) Finger-tighten the bolts in positions A and E and install the bracket.
(c) Tighten the bolts in positions A and E.
Torque: 36 N*m (267 kgf*cm, 27 ft.*lbf)
(d) Tighten the bolts in positions B, C and D.
Torque: 36 N*m (267 kgf*cm, 27 ft.*lbf)

29. INSTALL COOLER COMPRESSOR ASSEMBLY (See page ES-421)

30. INSTALL GENERATOR ASSEMBLY
Refer to the procedures up to "INSTALL GENERATOR ASSEMBLY" (See page CH-17)

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31. **INSTALL FAN**
Refer to the procedures up to "INSTALL FAN PULLEY" (See page CO-17).

32. **INSTALL FRONT DIFFERENTIAL CARRIER ASSEMBLY (for 4WD)**
Refer to the procedures up to "INSTALL FRONT DIFFERENTIAL CARRIER ASSEMBLY" (See page DF-42).

33. **INSTALL POWER STEERING LINK ASSEMBLY (for 2WD)**
Refer to the procedures up to "INSTALL POWER STEERING LINK ASSEMBLY" (See page PS-30).

34. **INSTALL POWER STEERING LINK ASSEMBLY (for 4WD)**
Refer to the procedures up to "INSTALL POWER STEERING LINK ASSEMBLY" (See page PS-49).

35. **INSTALL BATTERY**

36. **ADD ENGINE COOLANT (See page CO-3)**

37. **ADD ENGINE OIL (See page LU-5)**

38. **ADD POWER STEERING FLUID**

39. **BLEED POWER STEERING FLUID (See page PS-2)**

40. **ADD DIFFERENTIAL OIL (for 4WD)**

41. **INSPECT DIFFERENTIAL OIL (for 4WD) (See page DF-3)**

42. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**

43. **CHECK FOR ENGINE OIL LEAKAGE**

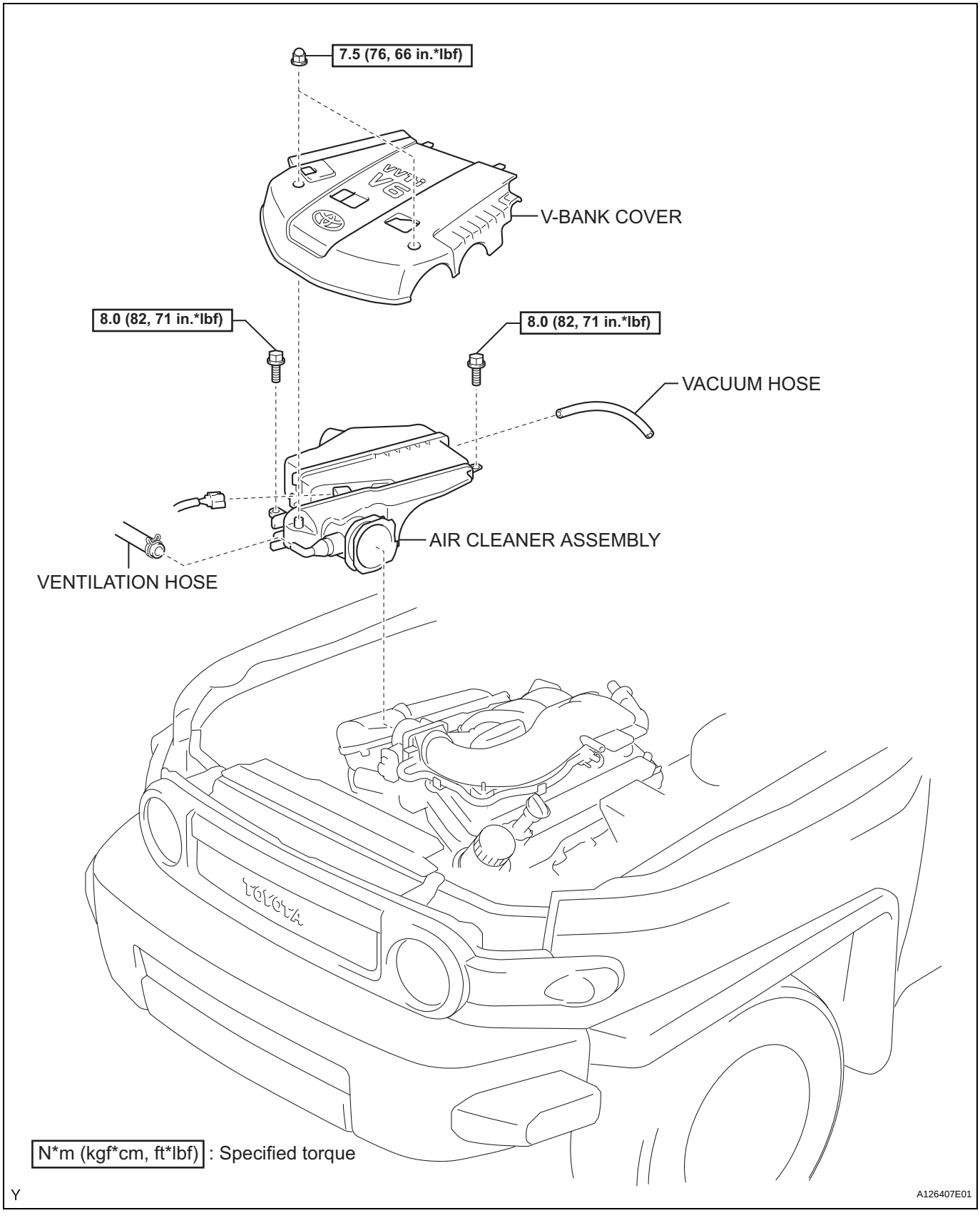
44. **CHECK FOR POWER STEERING FLUID LEAKAGE**

45. **CHECK FOR DIFFERENTIAL OIL LEAKAGE**

46. **INSPECT AND ADJUST FRONT WHEEL ALIGNMENT** (See page SP-2)

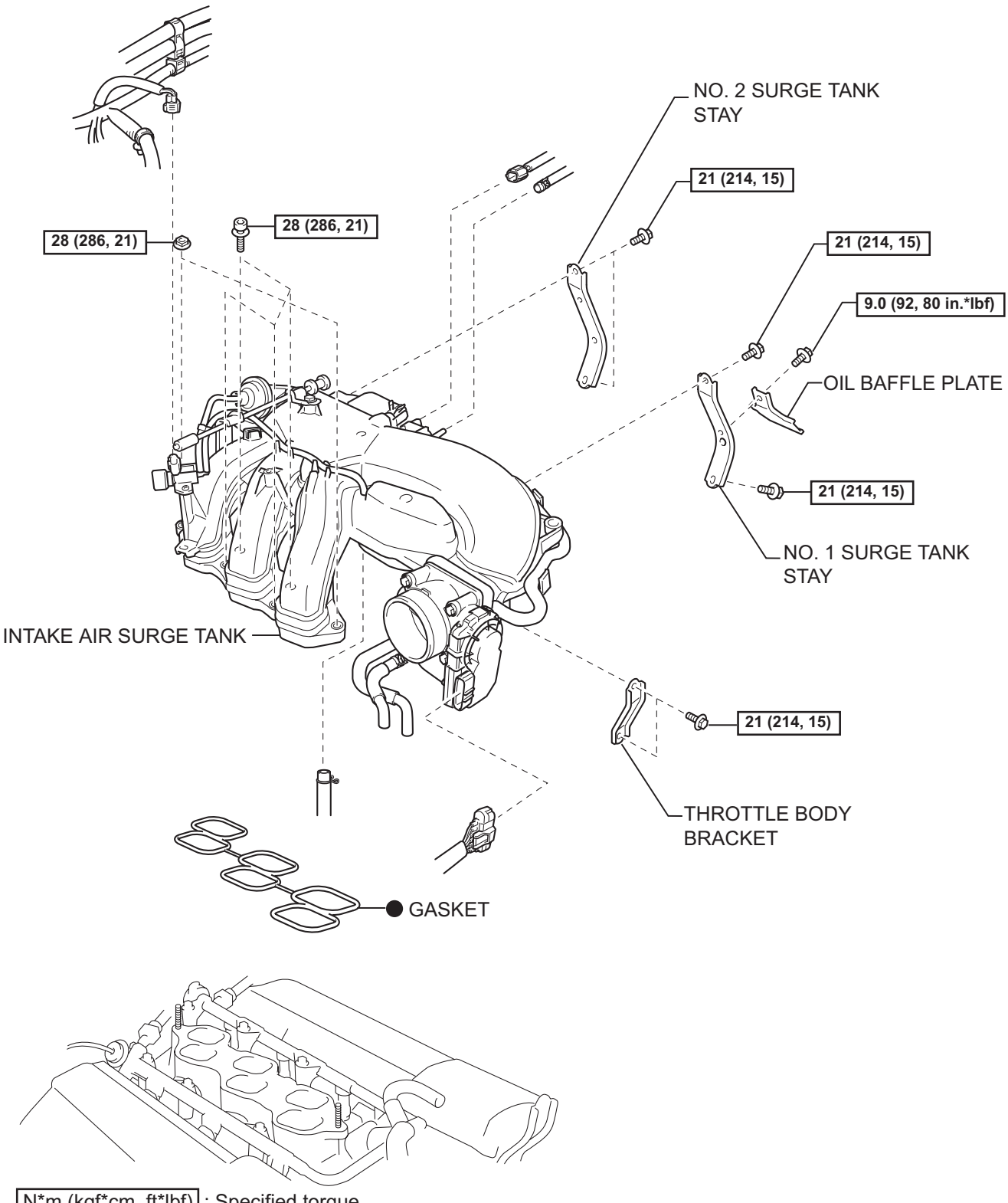
CAMSHAFT

COMPONENTS



EM

EM

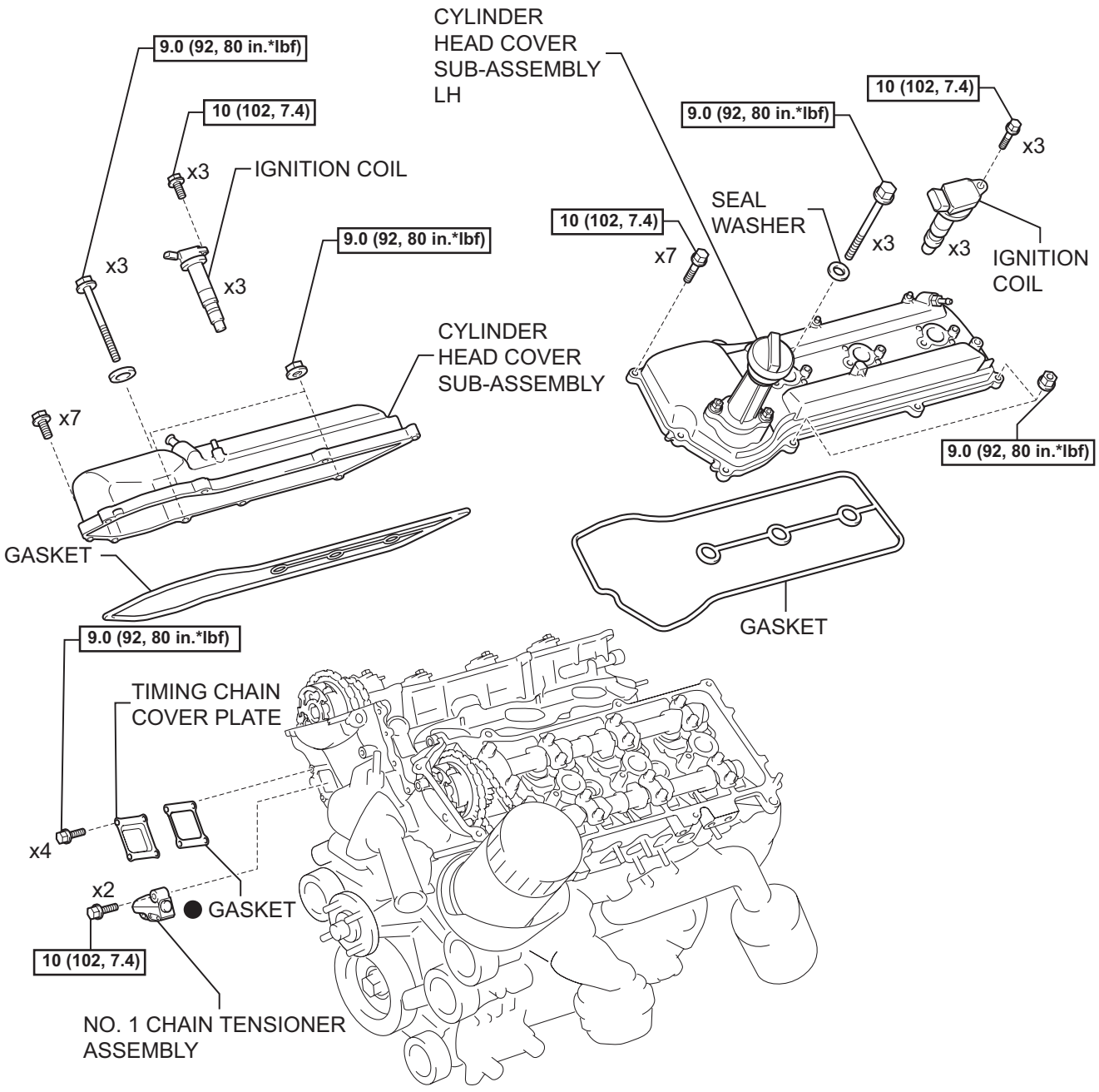


N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

A126476E01



N*m (kgf*cm, ft*lbf) : Specified torque

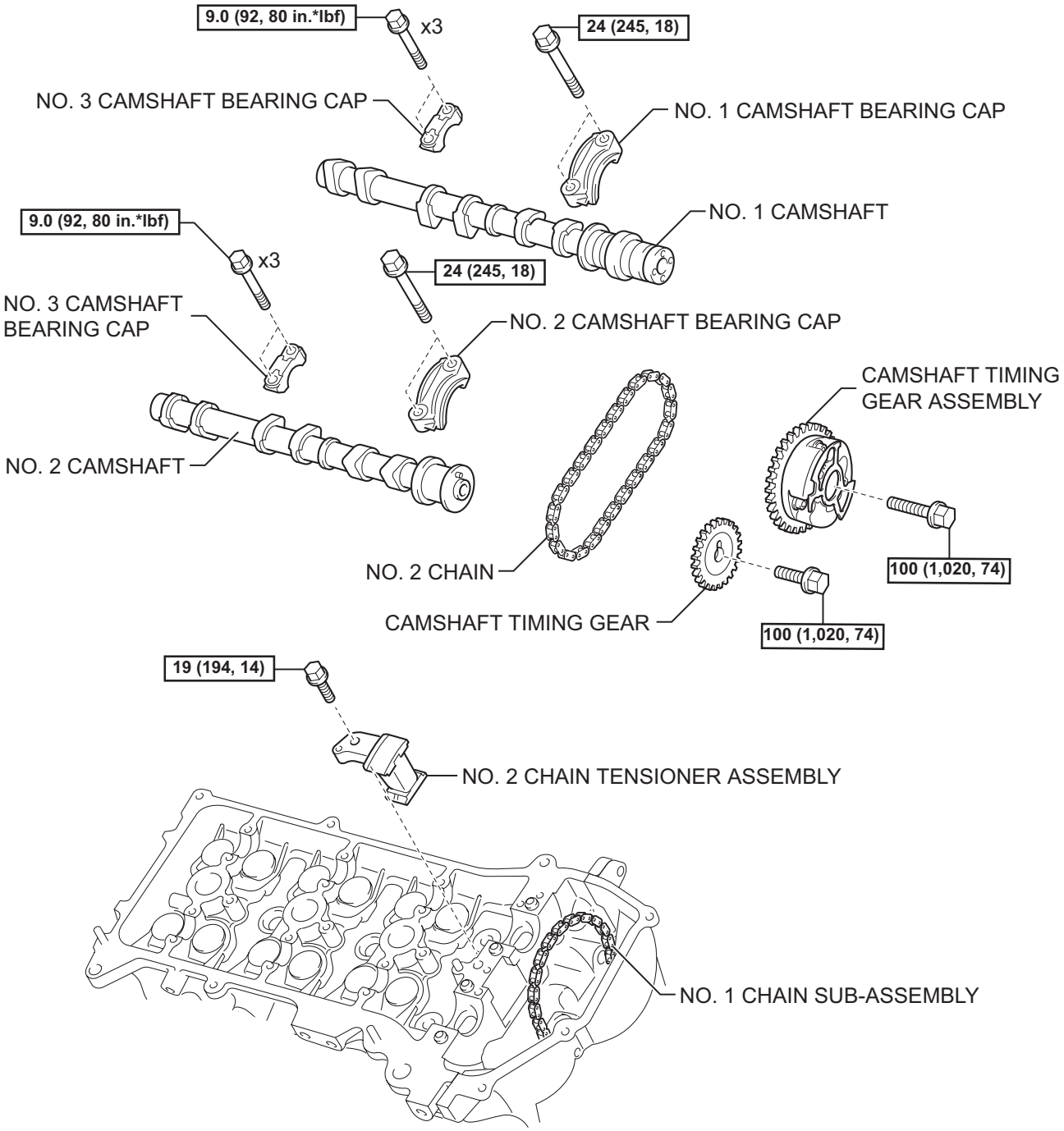
● Non-reusable part

Y

A126426E01

EM

For Bank 1:

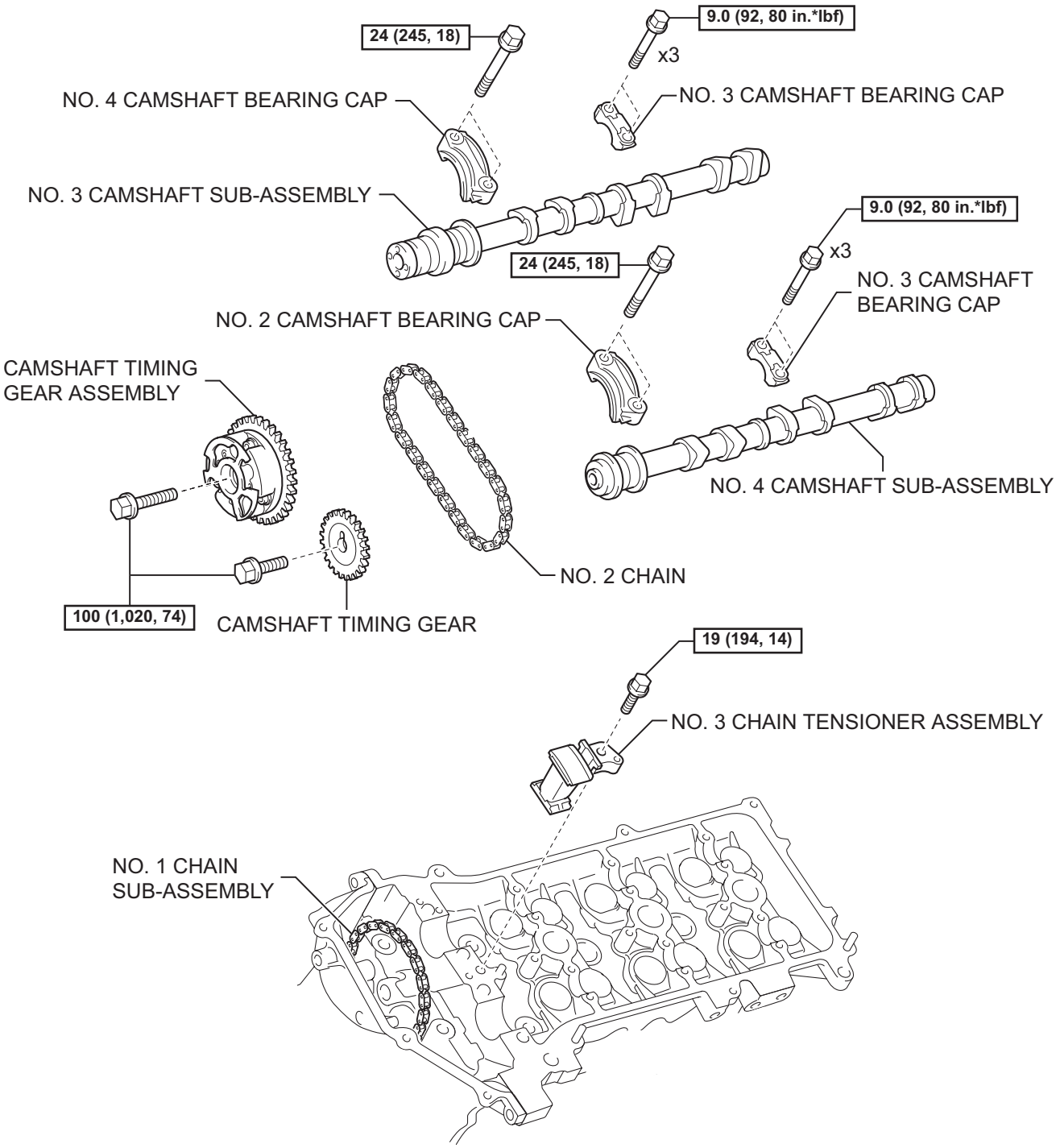


N*m (kgf*cm, ft*lbf) : Specified torque

Y

A126427E01

For Bank 2:



N*m (kgf*cm, ft*lbf) : Specified torque

Y

A126428E01

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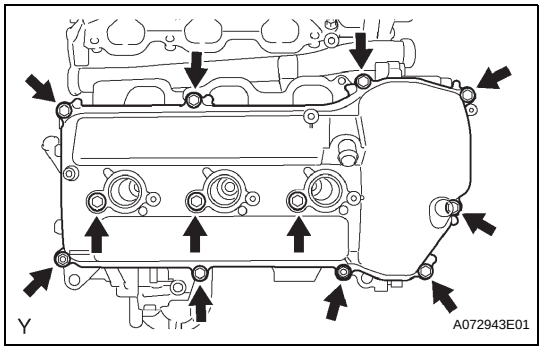
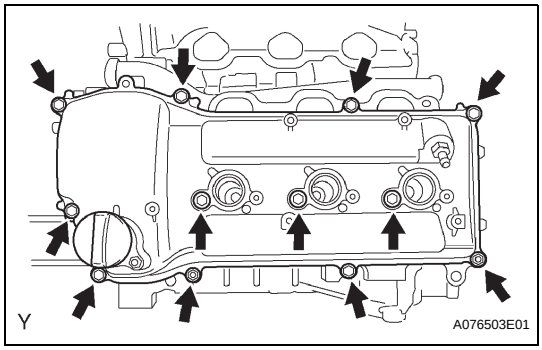
REMOVAL

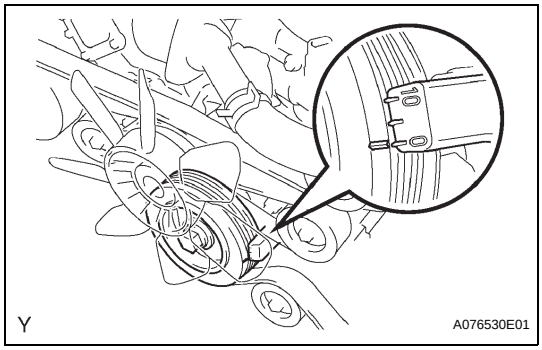
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **DRAIN ENGINE COOLANT (See page CO-3)**
3. **REMOVE V-BANK COVER (See page ES-428)**
4. **REMOVE AIR CLEANER ASSEMBLY (See page ES-429)**
5. **REMOVE THROTTLE BODY BRACKET (See page FU-11)**
6. **REMOVE OIL BAFFLE PLATE (See page FU-11)**
7. **REMOVE NO. 1 SURGE TANK STAY (See page FU-11)**
8. **REMOVE NO. 2 SURGE TANK STAY (See page FU-12)**
9. **REMOVE INTAKE AIR SURGE TANK (See page FU-12)**
10. **REMOVE IGNITION COIL ASSEMBLY (See page IG-8)**
11. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY**
    (a) Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.

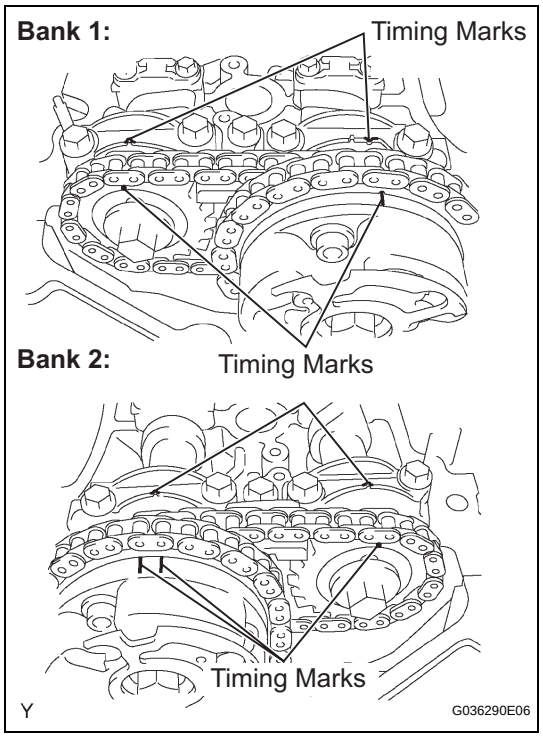


12. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH**
    (a) Remove the 10 bolts, 3 seal washers, 2 nuts, cylinder head cover and gasket.

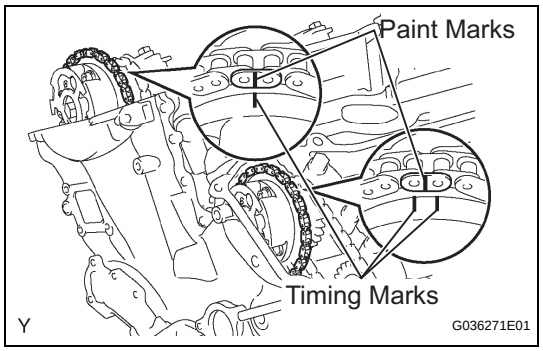


13. **SET NO. 1 CYLINDER TO TDC/COMPRESSION**
    (a) Turn the crankshaft pulley until its groove and the "0" timing mark of the timing chain cover are aligned.





(b) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing caps as shown in the illustration.
If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks above.

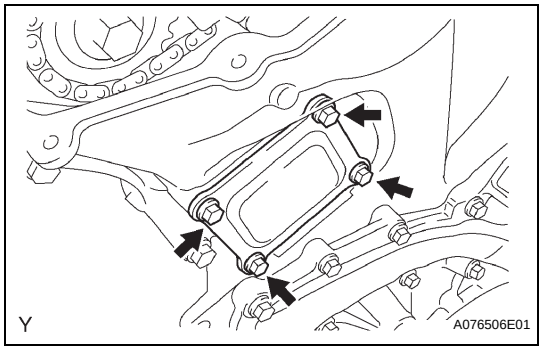


(c) Place paint marks on the No. 1 chain links corresponding to the timing marks of the camshaft timing gears.

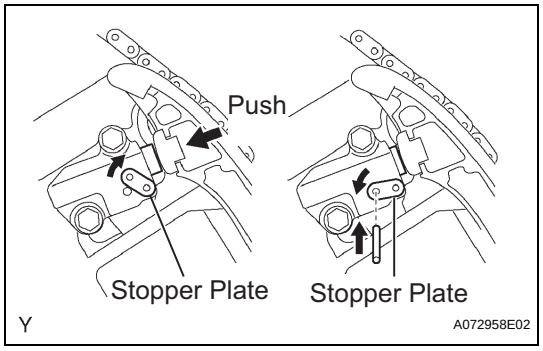
14. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

NOTICE:

- **Never rotate the crankshaft with the chain tensioner removed.**
- **When rotating the camshaft with the timing chain removed, rotate the crankshaft counterclockwise 40° from the TDC first.**



(a) Remove the 4 bolts, then remove the timing chain cover plate and gasket.



(b) While turning the stopper plate of the tensioner upward, push in the plunger of the chain tensioner as shown in the illustration.

(c) While turning the stopper plate of the tensioner downward, insert a bar of ϕ3.5 mm (0.138 in.) into the holes in the stopper plate and tensioner to fix the stopper plate.

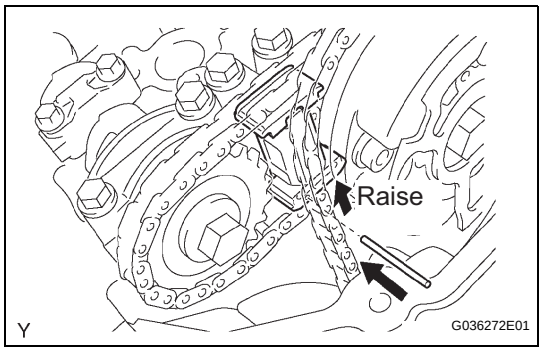
(d) Remove the 2 bolts, then remove the chain tensioner.

15. REMOVE NO. 2 CAMSHAFT

NOTICE:

Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

(a) While raising the chain tensioner No. 2, insert a pin of ϕ1.0 mm (0.039 in.) into the hole to fix it.

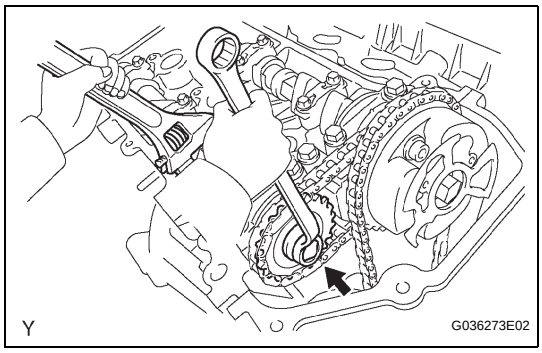


(b) Hold the hexagonal portion of the No. 2 camshaft with a wrench, and remove the camshaft timing gear set bolt.

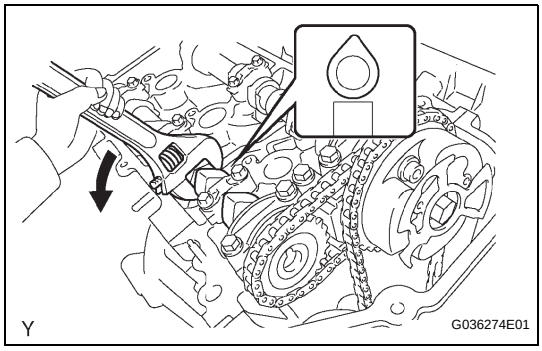
NOTICE:

Be careful not to damage the cylinder head or valve lifter with the wrench.

(c) Separate the camshaft timing gear from the No. 2 camshaft.

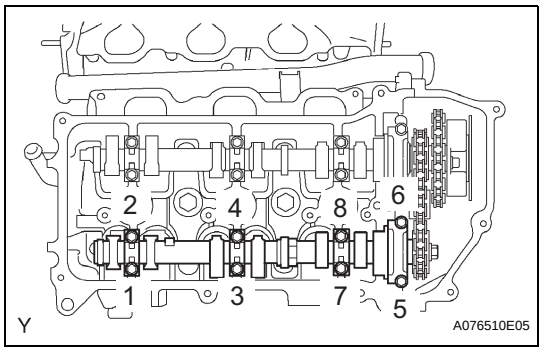


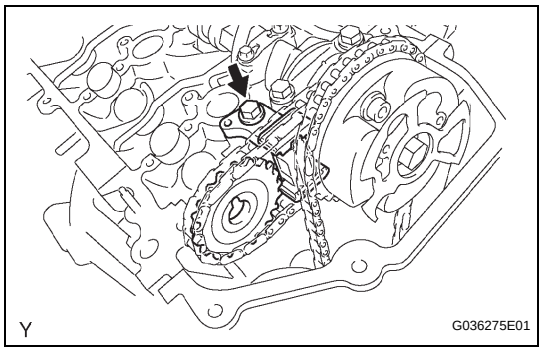
(d) Rotate the camshaft counterclockwise using the wrench so that the cam lobes of No. 1 cylinder face upward as shown in the illustration.



(e) Using several steps, uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

(f) Remove the 4 bearing caps and No. 2 camshaft.





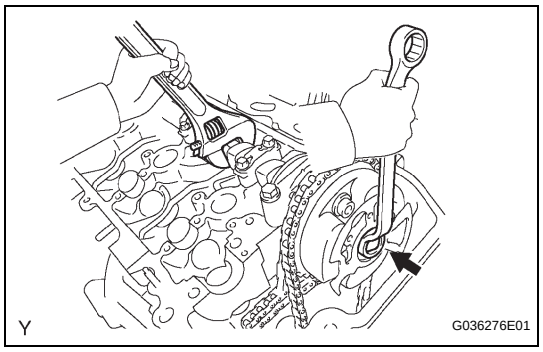
16. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

(a) Remove the No. 2 chain tensioner bolt, then remove the No. 2 chain tensioner and camshaft timing gear.

17. REMOVE CAMSHAFT

NOTICE:

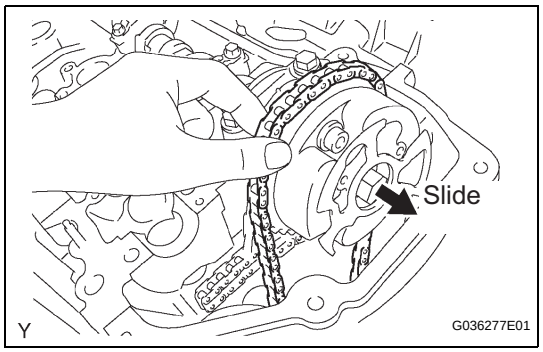
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.



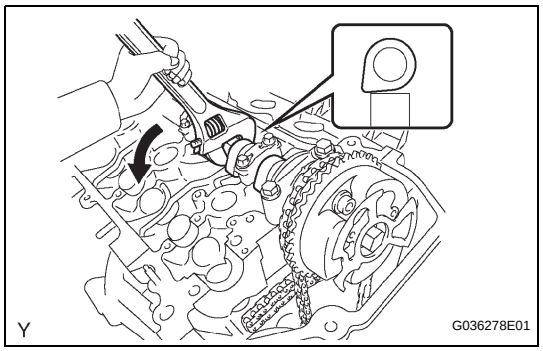
(a) Hold the hexagonal portion of the No. 1 camshaft with a wrench, and loosen the camshaft timing gear set bolt.

NOTICE:

- **Be careful not to damage the cylinder head or valve lifter with the wrench.**
- **Do not disassemble the camshaft timing gear assembly.**



(b) Slide the camshaft timing gear and separate the No. 1 chain from the camshaft timing gear.



(c) Rotate the No. 1 camshaft counterclockwise using the wrench so that the cam lobes of No. 1 cylinder face downward as shown in the illustration.

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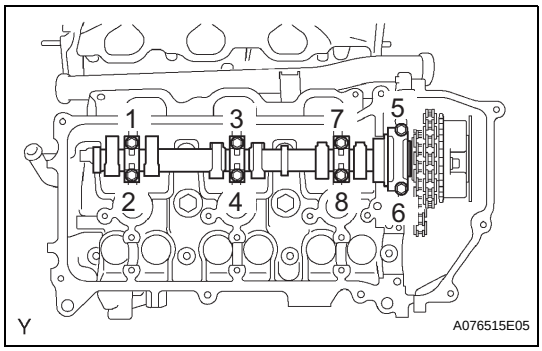
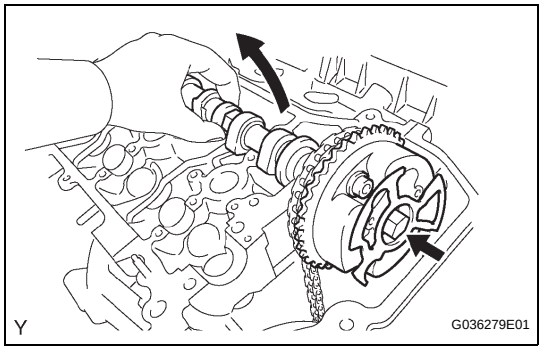
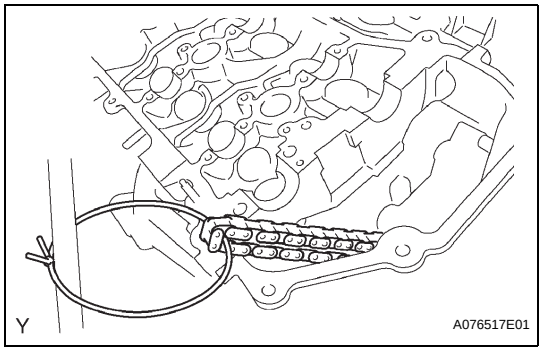


(d) Using several steps, loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.
(e) Remove the 4 bearing caps.

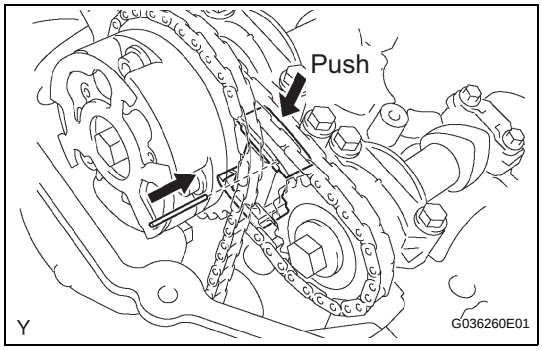


(f) Remove the camshaft timing gear set bolt with the No. 1 camshaft lifted up, then remove the No. 1 camshaft and camshaft timing gear with No. 2 chain.

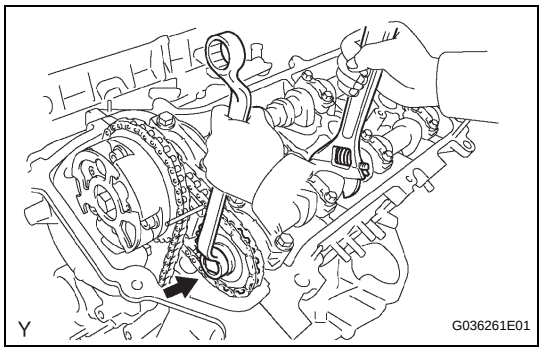


(g) Tie the No. 1 chain with a piece of string as shown in the illustration.
NOTICE:
Be careful not to drop anything inside the timing chain cover.

18. REMOVE NO. 4 CAMSHAFT SUB-ASSEMBLY
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

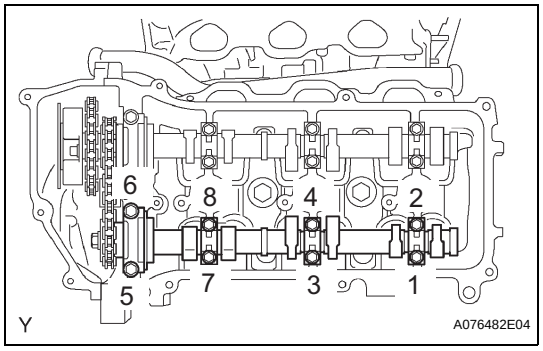


(a) While pushing down the No. 3 chain tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.



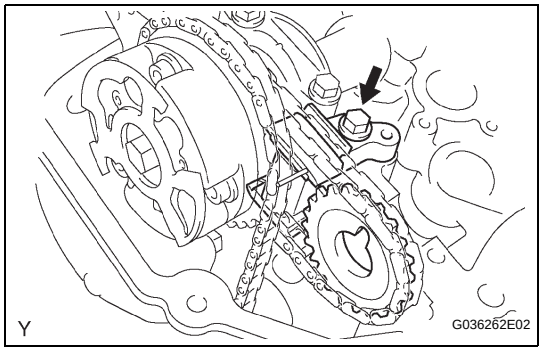
(b) Hold the hexagonal portion of the No. 4 camshaft with a wrench, and remove the camshaft timing gear set bolt.
NOTICE:
Be careful not to damage the cylinder head or valve lifter with the wrench.

(c) Separate the camshaft timing gear from the No. 4 camshaft.



(d) Using several steps, uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

(e) Remove the 4 bearing caps and No. 4 camshaft.



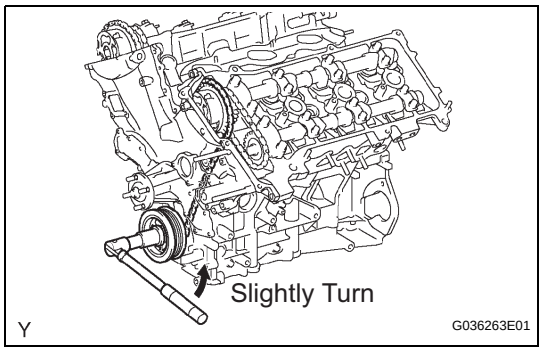
19. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

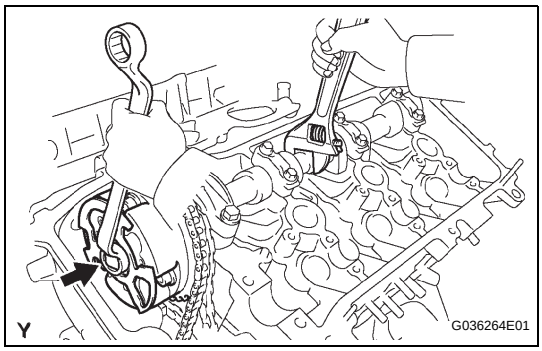
(a) Remove the No. 3 chain tensioner bolt, then remove the No. 3 chain tensioner and camshaft timing gear.

20. REMOVE NO. 3 CAMSHAFT SUB-ASSEMBLY

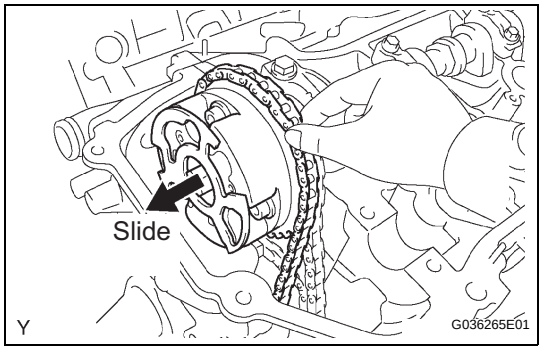
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

(a) Release the chain tension between the camshaft timing gear (bank 2) and crankshaft timing gear by turning the crankshaft pulley counterclockwise slightly.

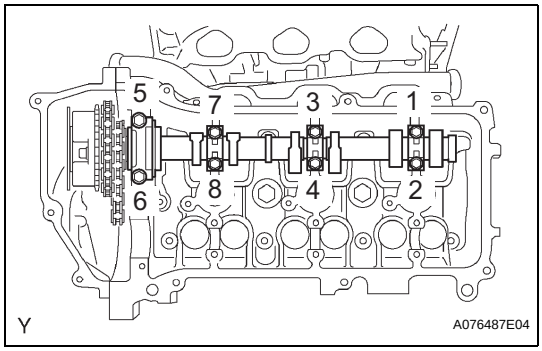




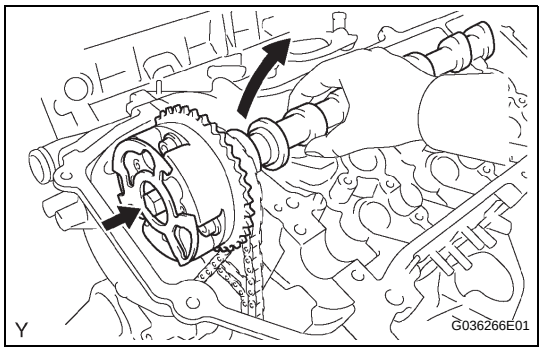
(b) Hold the hexagonal portion of the No. 3 camshaft with a wrench, then loosen the camshaft timing gear set bolt.
NOTICE:
- **Be careful not to damage the cylinder head or valve lifter with the wrench.**
- **Do not disassemble the camshaft timing gear assembly.**



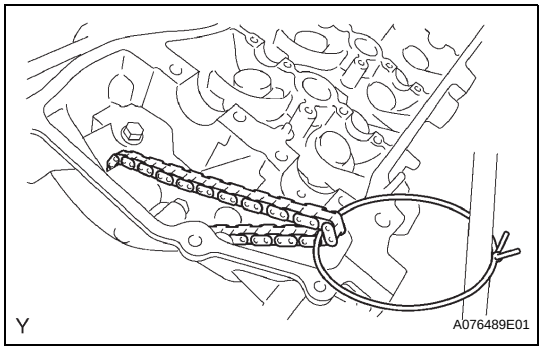
(c) Slide the camshaft timing gear and separate the No. 1 chain from the camshaft timing gear.



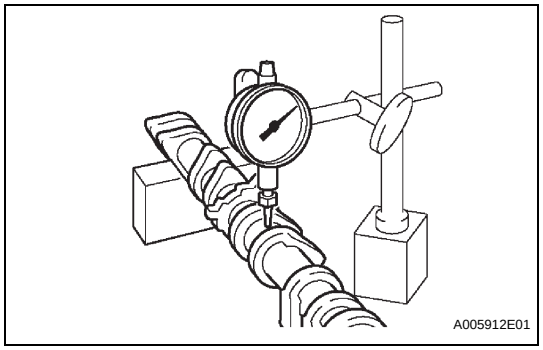
(d) Using several steps, uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.
(e) Remove the 4 bearing caps.

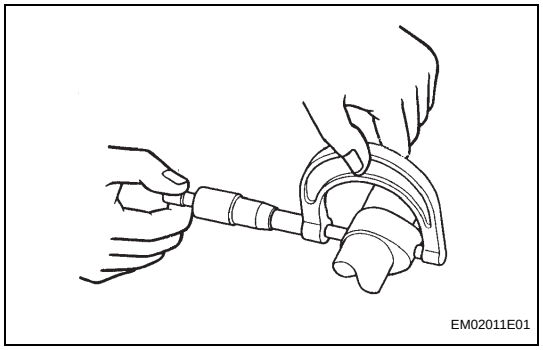


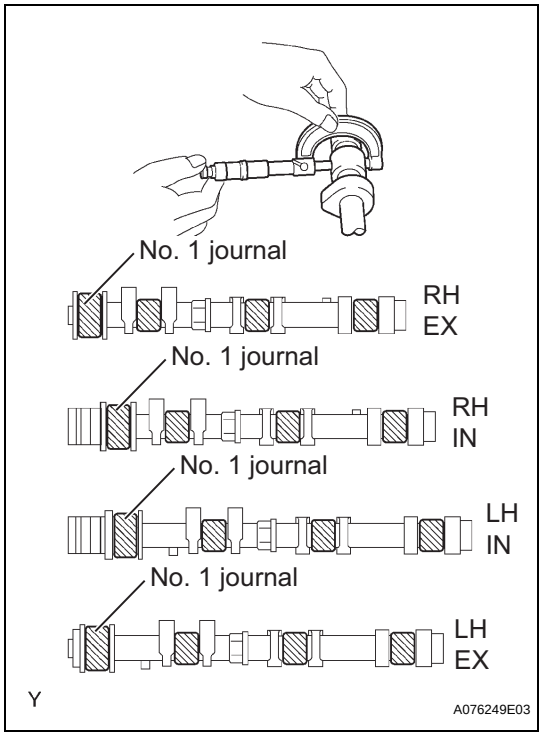
(f) Remove the camshaft timing gear set bolt with the No. 3 camshaft lifted up, then remove the No. 3 camshaft and camshaft timing gear with No. 2 chain.



(g) Tie the No. 1 chain with a piece of string as shown in the illustration.
NOTICE:
Be careful not to drop anything inside the timing chain cover.







INSPECTION

1. INSPECT CAMSHAFTS

(a) Inspect the camshaft for runout.

(1) Place the camshaft on V-blocks.

(2) Using a dial indicator, measure the circle runout at the center journal.

Maximum runout:
0.06 mm (0.0024 in.)

If the circle runout is greater than the maximum, replace the camshaft.

(b) Inspect the cam lobes.

(1) Using a micrometer, measure the cam lobe height.

Standard cam lobe height:
Intake:
44.168 to 44.268 mm (1.7389 to 1.7428 in.)
Exhaust:
44.580 to 44.680 mm (1.7551 to 1.7591 in.)
Minimum cam lobe height:
Intake:
44.018 mm (1.7330 in.)
Exhaust:
44.430 mm (1.7492 in.)

If the cam lobe height is less than the minimum, replace the camshaft.

(c) Inspect the camshaft journals.

(1) Using a micrometer, measure the journal diameter.

No. 1 journal diameter:
35.971 to 35.985 mm (1.4162 to 1.4167 in.)
Other journal diameters:
22.959 to 22.975 mm (0.9039 to 0.9045 in.)

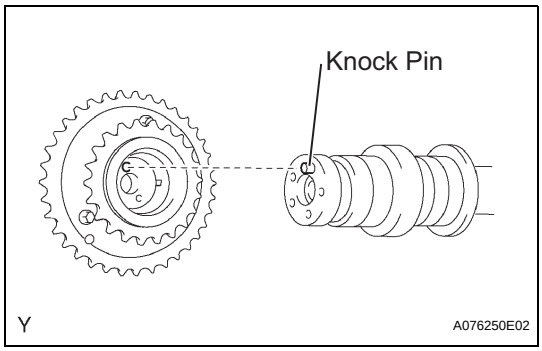
If the journal diameter is not as specified, check the oil clearance.

2. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

(a) Fix the intake camshaft in a vise.

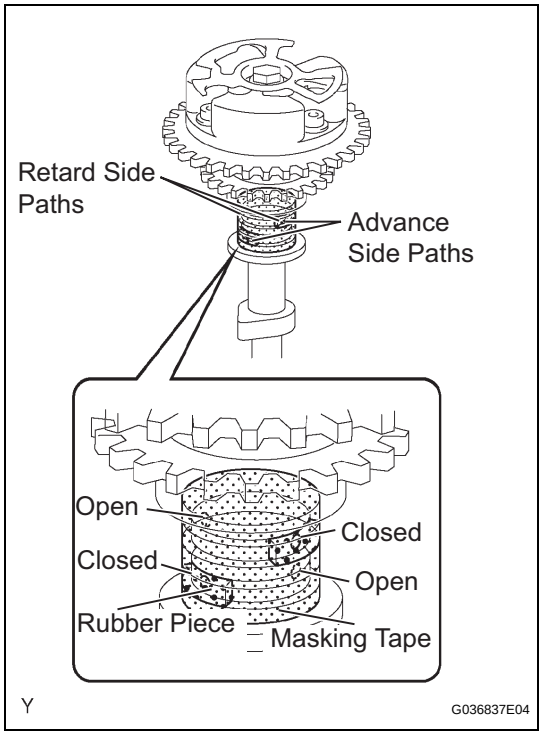
NOTICE:
Be careful not to damage the camshaft.

EM



(b) Align the knock pin hole in the camshaft timing gear assembly with the knock pin of the camshaft, and install the camshaft timing gear assembly with the bolt.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

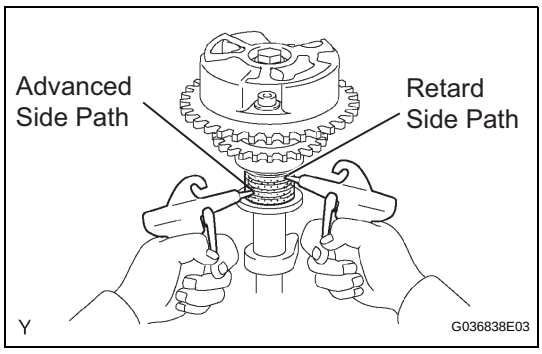
(c) Confirm that the camshaft timing gear assembly is locked.



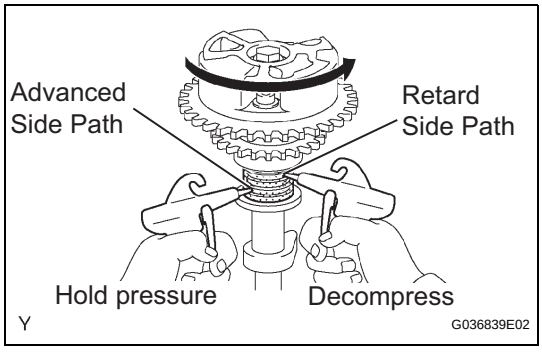
(d) Release that lock pin.

(1) Cover the 4 oil paths of the cam journal with masking tape as shown in the illustration.
HINT:
One of the 2 grooves on the cam journal is for the retard side path (upper) and the other is for the advance side path (lower). Each groove has 2 oil paths. Plug one of the oil paths for each groove with a piece of rubber before wrapping the cam journal with tape.

(2) Puncture the tape covering the advance oil path and retard oil path on the opposite side of the groove as shown in the illustration.



(3) Apply compressed air at 200 kPa (2.0 kgf/cm^2) into the 2 broken paths (the advance side path and the retard side path).
NOTICE:
Cover the paths with a shop rag or piece of cloth to avoid oil splashes.

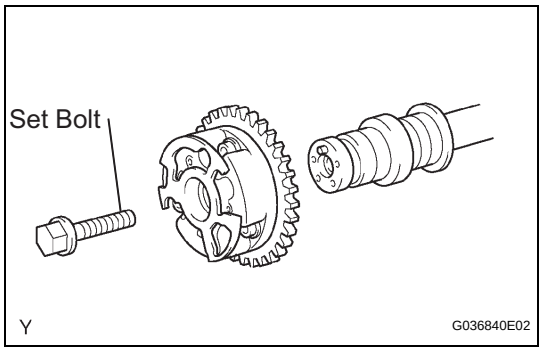


(4) Confirm that the camshaft timing gear assembly rotates in the timing advance direction when reducing the compressed air on the timing retard path.
HINT:
When the lock pin is released, the camshaft timing gear rotates in the advance direction.

(5) When the camshaft timing gear comes to the most advanced position, release the compressed air on the timing retard side path, and release that on the timing advance side path.
NOTICE:
Camshaft timing assembly gear occasionally shifts to the retard side abruptly if the air compression on the advanced side path is released first. This often causes breakage of the lock pin.

(e) Check the smooth revolution.
(1) Rotate the camshaft timing gear several times within the movable range except for the most retarded position and check it rotates smoothly.
Standard:
Moves smoothly in a range of about 31°
NOTICE:
Be sure to perform this check by hand, instead of using compressed air.

(f) Check that the lock is in the most retarded position.
(1) Confirm that the camshaft timing gear assembly is locked in the most retarded position.



(g) Remove the set bolt, then remove the camshaft timing gear assembly.
NOTICE:
Do not remove the other 3 bolts.

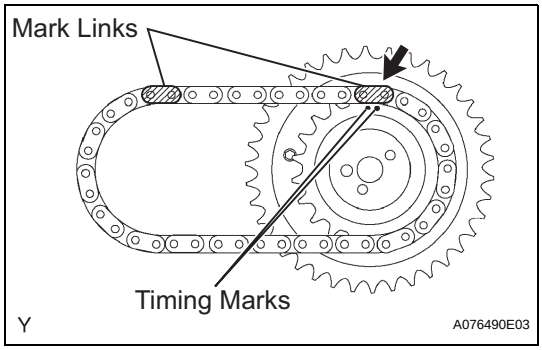
EM

INSTALLATION

1. INSTALL NO. 3 CAMSHAFT SUB-ASSEMBLY

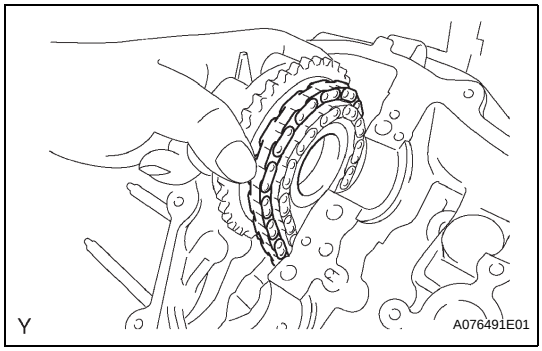
NOTICE:

Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

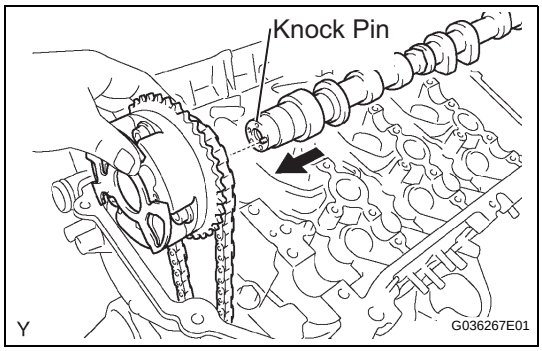


(a) Align the yellow mark link with the timing mark (2 dot marks) of the camshaft timing gear as shown in the illustration.

(b) Apply new engine oil to the thrust portion and journal of the camshafts.

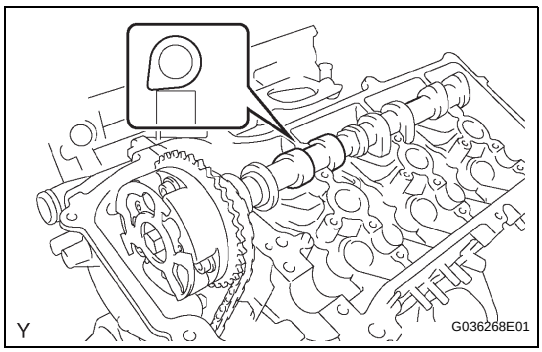


(c) Temporarily put the No. 1 chain on the No. 2 chain of the camshaft timing gear.

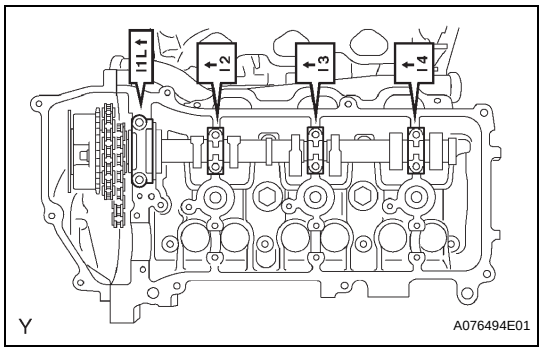


(d) Align the knock pin hole in the camshaft timing gear with the knock pin of the No. 3 camshaft, and insert the No. 3 camshaft into the camshaft timing gear.

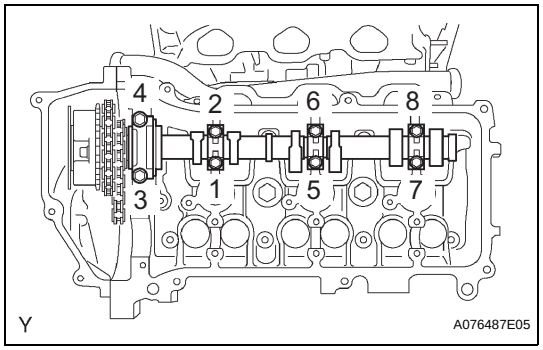
(e) Temporarily install the camshaft timing gear set bolt.



(f) Set the No. 3 camshaft onto the bank 2 cylinder head with the cam lobes of the No. 2 cylinder facing downward as shown in the illustration.

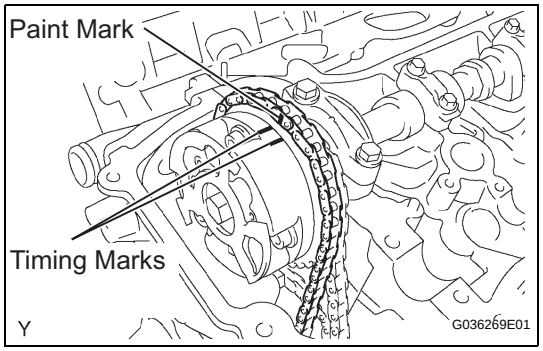


(g) Install the 4 bearing caps in the proper locations as shown.
(h) Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.

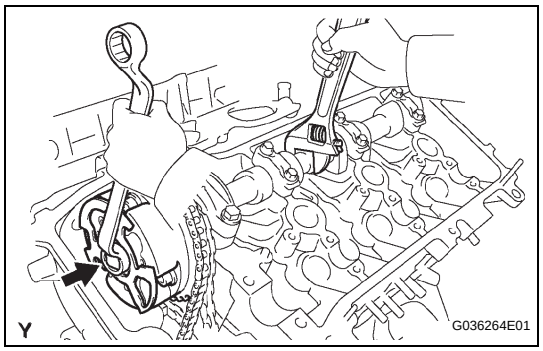


(i) Using several steps, uniformly install and tighten the 8 bearing cap bolts in the sequence shown in the illustration.
Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)

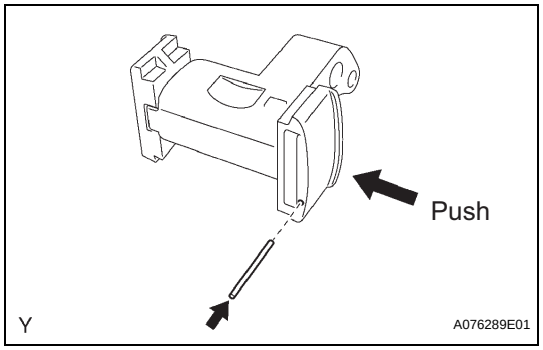
EM



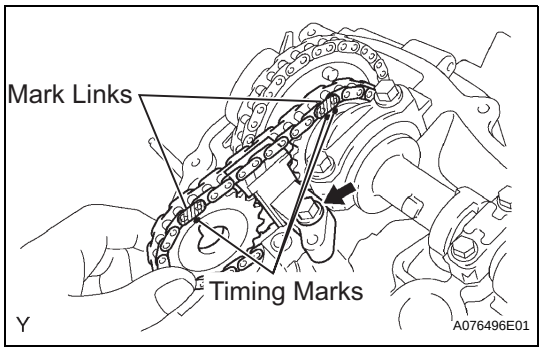
(j) Align the paint mark of the No. 1 chain with the timing marks of the camshaft timing gear.



(k) Hold the hexagonal portion of the No. 3 camshaft with a wrench, and tighten the camshaft timing gear set bolt.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

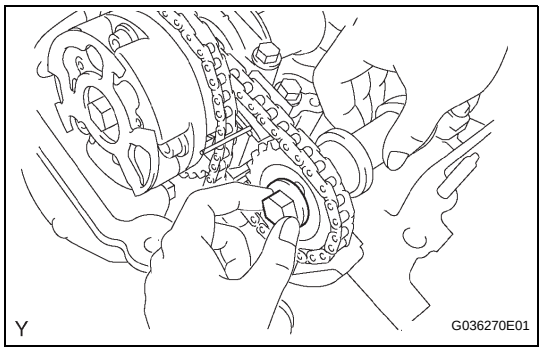


2. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY
(a) While pushing in the tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to hold it.

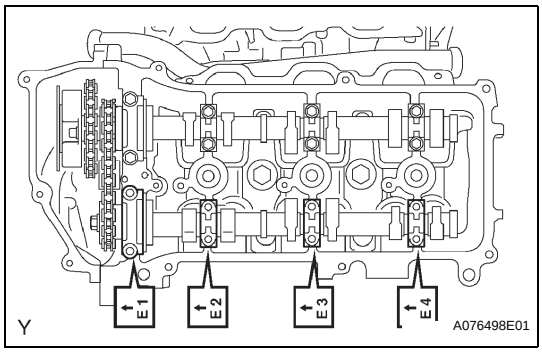


(b) Temporarily install the camshaft timing gear and No. 3 chain tensioner and align the yellow mark links with the timing marks (1 dot mark and 2 dot marks) of the camshaft timing gears.
(c) Tighten the No. 3 chain tensioner bolt.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)

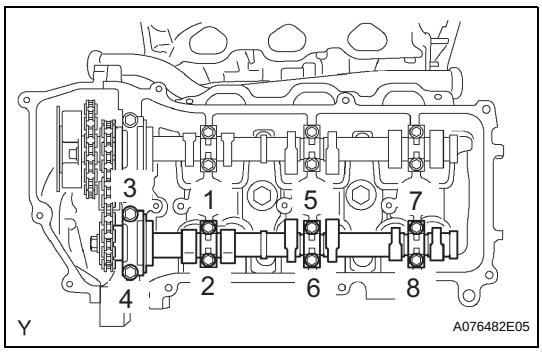
3. INSTALL NO. 4 CAMSHAFT SUB-ASSEMBLY
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.



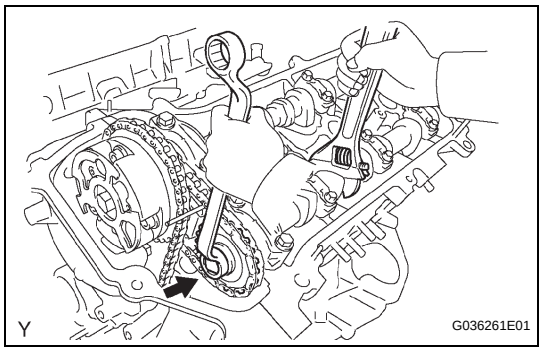
(a) Align the knock pin hole in the camshaft timing gear with the knock pin of the No. 4 camshaft, and insert the No. 4 camshaft into the camshaft timing gear.
(b) Temporarily install the camshaft timing gear set bolt.



(c) Install the 4 bearing caps in the proper locations as shown.
(d) Apply a light coat of engine oil to the threads of the bearing cap bolts.

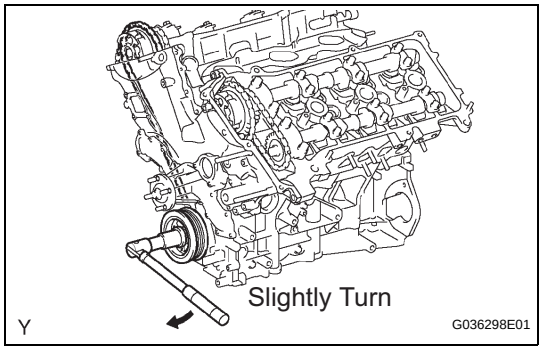


(e) Using several steps, uniformly install and tighten the 8 bearing cap bolts in the sequence shown in the illustration.
Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)



(f) Hold the hexagonal portion of the No. 4 camshaft with a wrench, and tighten the camshaft timing gear set bolt.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

(g) Remove the pin from the No. 3 chain tensioner.

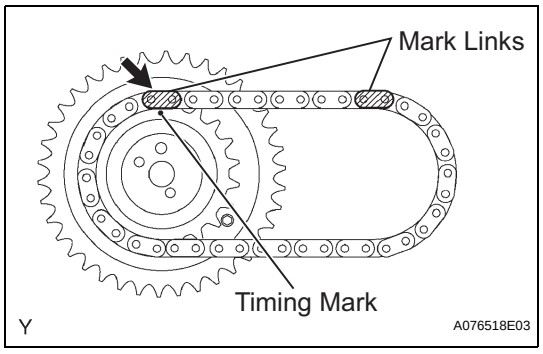


(h) Release the chain tension between the camshaft timing gear (bank 1) and crankshaft timing gear by turning the crankshaft pulley clockwise slightly.

4. INSTALL CAMSHAFT

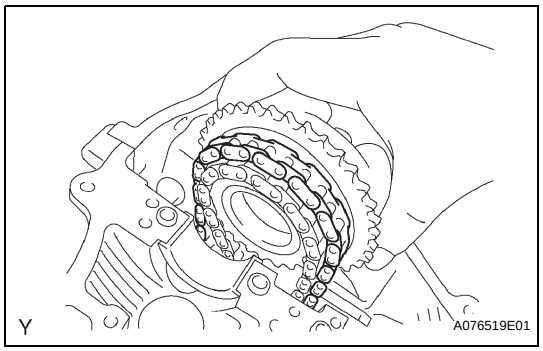
NOTICE:

Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

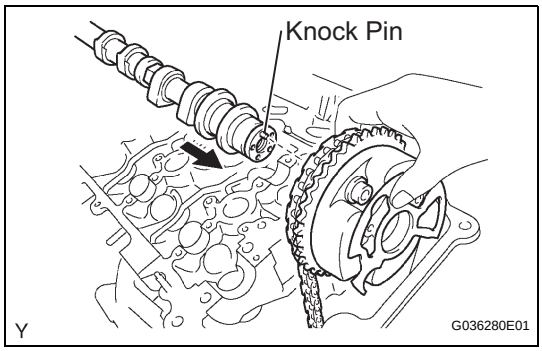


(a) Align the yellow mark link with the timing mark (1 dot mark) of the camshaft timing gear as shown in the illustration.

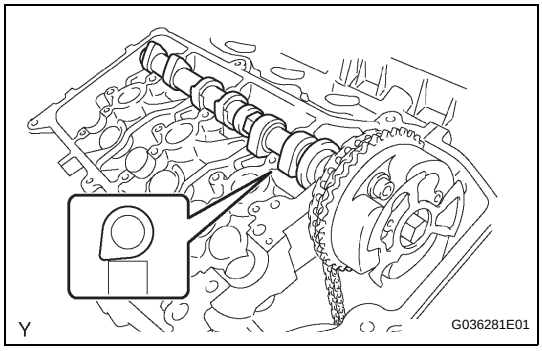
(b) Apply new engine oil to the thrust portion and journal of the camshafts.



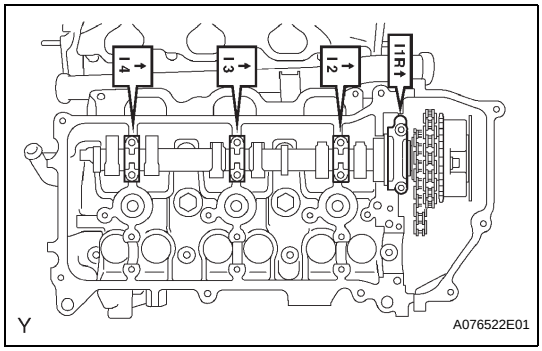
(c) Temporarily install the No. 1 chain onto the No. 2 chain of the camshaft timing gear.



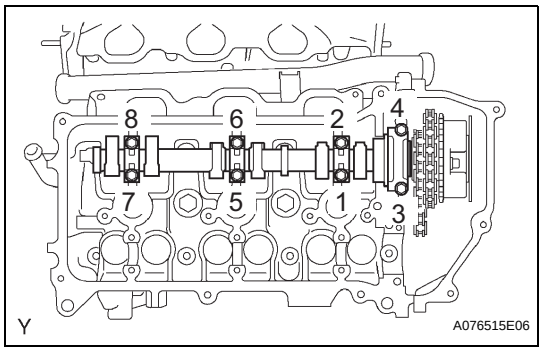
(d) Align the knock pin hole in the camshaft timing gear with the knock pin of the No. 1 camshaft, and insert the No. 1 camshaft into the camshaft timing gear.
(e) Temporarily install the camshaft timing gear set bolt.



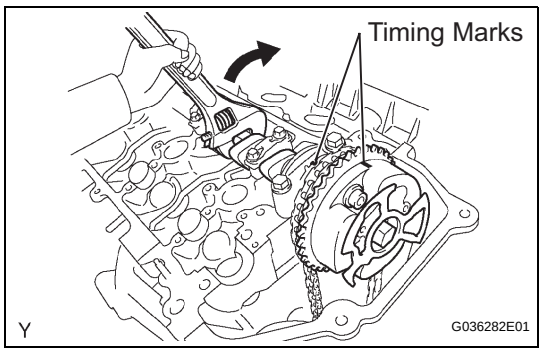
(f) Install the No. 1 camshaft onto the bank 1 cylinder head with the cam lobes of the No. 1 cylinder facing downward as shown in the illustration.



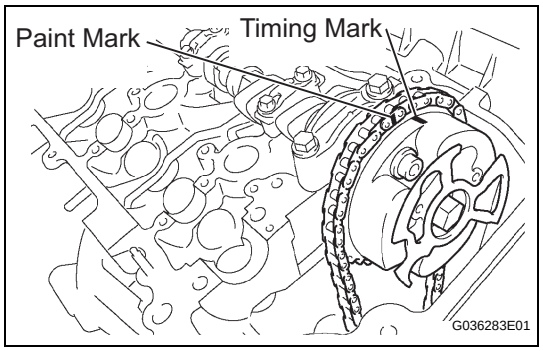
(g) Install the 4 bearing caps in the proper locations as shown.
(h) Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.



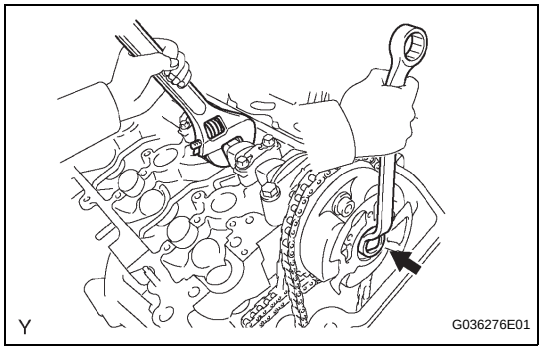
(i) Using several steps, uniformly install and tighten the 8 bearing cap bolts in the sequence shown in the illustration.
Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)



(j) Rotate the No. 1 camshaft clockwise using a wrench so that the timing mark of the camshaft timing gear is aligned with the timing mark of the camshaft bearing cap.

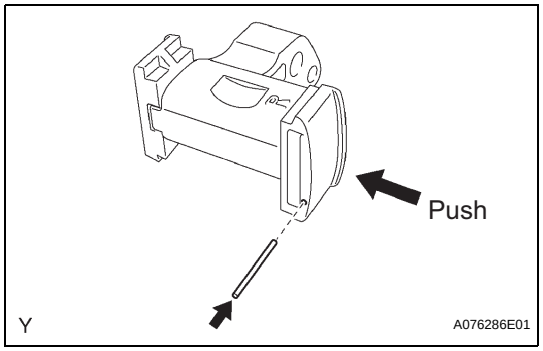


(k) Align the paint mark of the No. 1 chain with the timing mark of the camshaft timing gear.



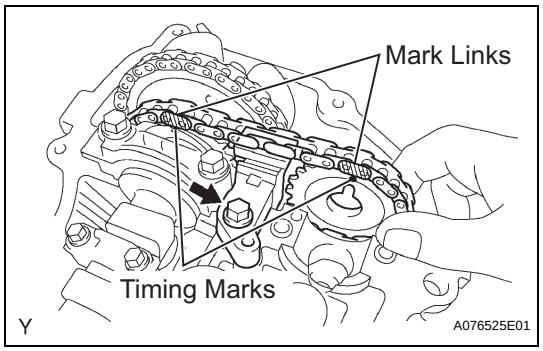
(l) Hold the hexagonal portion of the No. 1 camshaft with a wrench, and tighten the camshaft timing gear set bolt.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

EM



5. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

(a) While pushing in the tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.

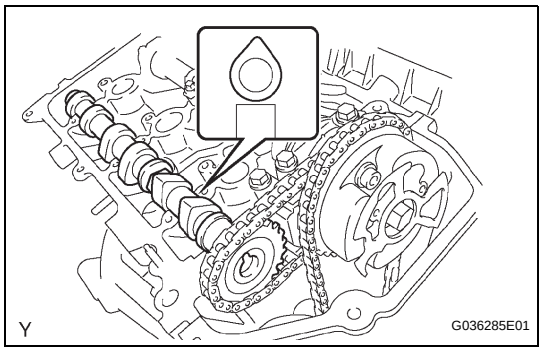


(b) Temporarily install the camshaft timing gear and No. 2 chain tensioner and align the yellow mark links with the timing marks (1 dot mark) of the camshaft timing gears.

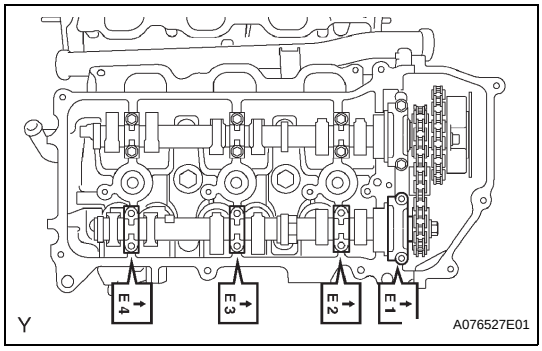
(c) Tighten the No. 2 chain tensioner bolt.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)

6. INSTALL NO. 2 CAMSHAFT

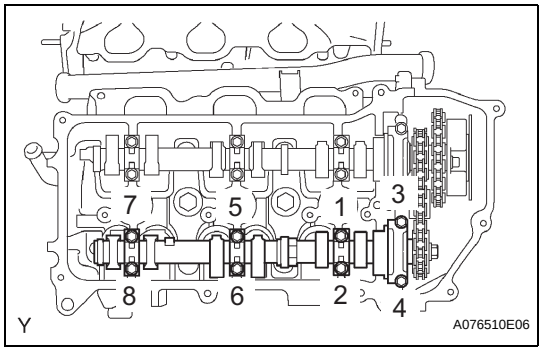
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.



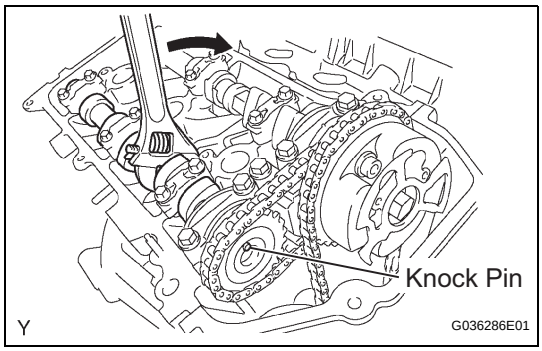
(a) Install the No. 2 camshaft onto the bank 1 cylinder head with the cam lobes of No. 1 cylinder facing upward as shown in the illustration.



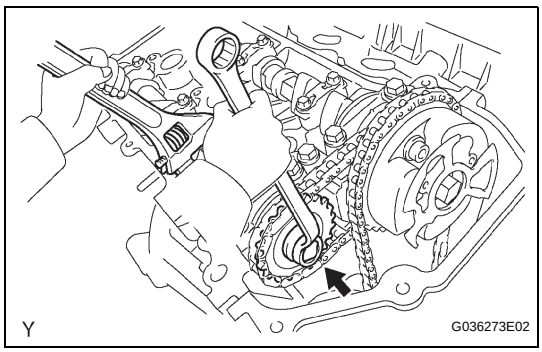
(b) Install the 4 bearing caps in the proper locations as shown.
(c) Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.



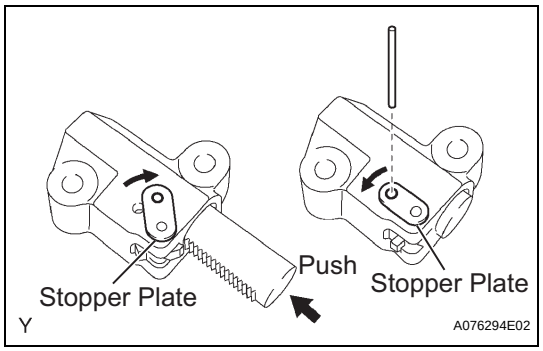
(d) Using several steps, uniformly install and tighten the 8 bearing cap bolts in the sequence shown in the illustration.
Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)



(e) Rotate the No. 2 camshaft clockwise using a wrench so that the knock pin of the No. 2 camshaft is aligned with the knock pin hole in the camshaft timing gear.



(f) Hold the hexagonal portion of the No. 2 camshaft with a wrench, and install the camshaft timing gear set bolt.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)
(g) Remove the pin from the No. 2 chain tensioner.



7. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

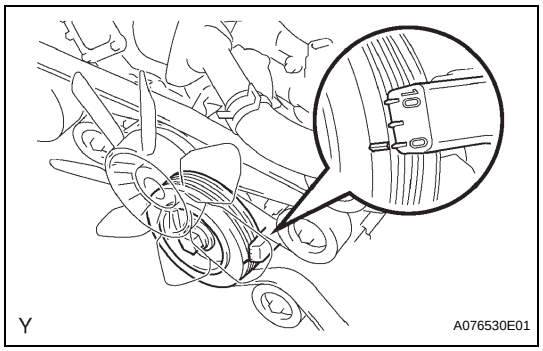
(a) While turning the stopper plate of the No. 1 chain tensioner clockwise, push in the plunger of the No. 1 chain tensioner as shown in the illustration.

(b) While turning the stopper plate of the tensioner counterclockwise, insert a bar of ϕ 3.5 mm (0.138 in.) into the holes in the stopper plate and No. 1 chain tensioner to fix the stopper plate.

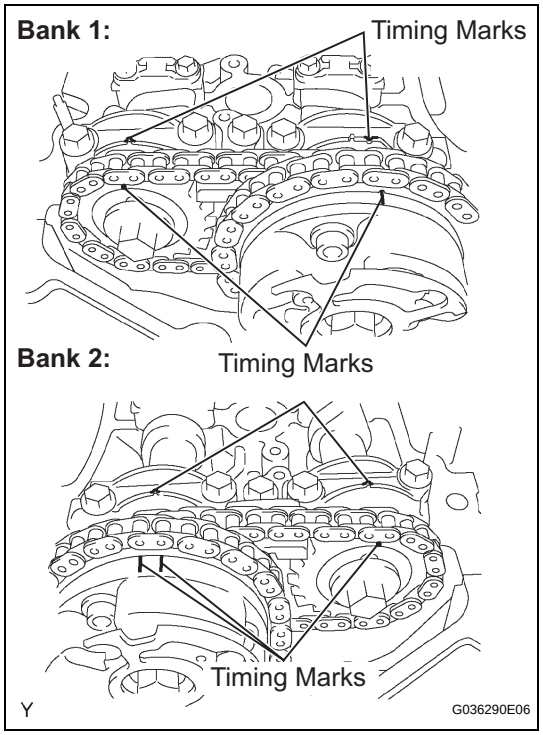
(c) Install the No. 1 chain tensioner with the 2 bolts.
Torque: 10 N*m (102 kgf*cm, 7.4 ft.*lbf)

(d) Remove the bar from the No. 1 chain tensioner.

(e) Install a new gasket and the timing chain cover plate with the 4 bolts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)



(f) Turn the crankshaft pulley 2 complete revolutions slowly until its groove and the "0" timing mark of the timing chain cover are aligned.



(g) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration.

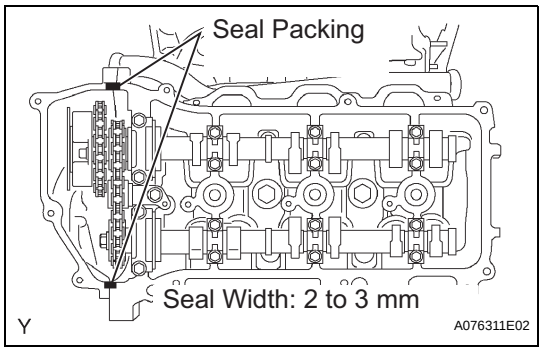
8. SET CYLINDER TO TDC/COMPRESSION (See page EM-8)

9. INSPECT VALVE CLEARANCE (See page EM-9)

10. ADJUST VALVE CLEARANCE (See page EM-10)

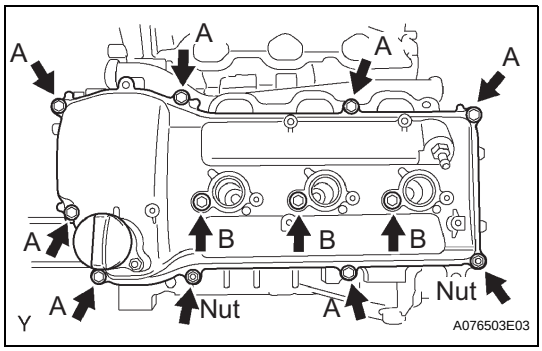
11. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

(a) Remove any old packing (FIPG) material.
HINT:
Do not drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.



(b) Apply a continuous bead of seal packing (diameter 2 to 3 mm (0.08 to 0.12 in.)) to the cylinder head and timing chain cover as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head cover within 3 minutes of applying the seal packing. Tighten the cylinder head cover bolts and nuts within 15 minutes of installing the cylinder head cover. Otherwise, the seal packing must be removed and reapplied.

(c) Install the seal washers onto the bolts.

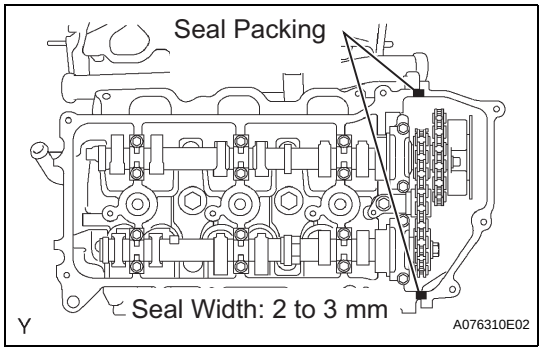


(d) Install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.
Torque: Bolt A
10 N*m (102 kgf*cm, 7.4 ft.*lbf)
Bolt B
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Nut
9.0 N*m (92 kgf*cm, 80 in.*lbf)
HINT:
Each bolt length is as follows.

Bolt	Length
A	25 mm (0.98 in.)
B	60 mm (2.36 in.)

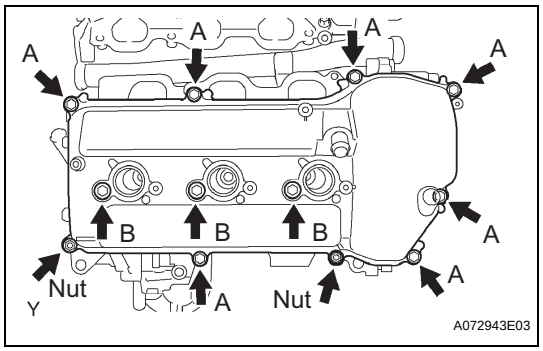
12. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Remove any old packing (FIPG) material.
HINT:
Do not drop any oil on the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.



(b) Apply a continuous bead of seal packing (diameter 2 to 3 mm (0.08 to 0.12 in.)) to the cylinder head and timing chain cover as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head cover within 3 minutes of applying the seal packing. Tighten the cylinder head cover bolts and nuts within 15 minutes of installing the cylinder head cover. Otherwise, the seal packing must be removed and reapplied.

(c) Install the seal washers onto the bolts.



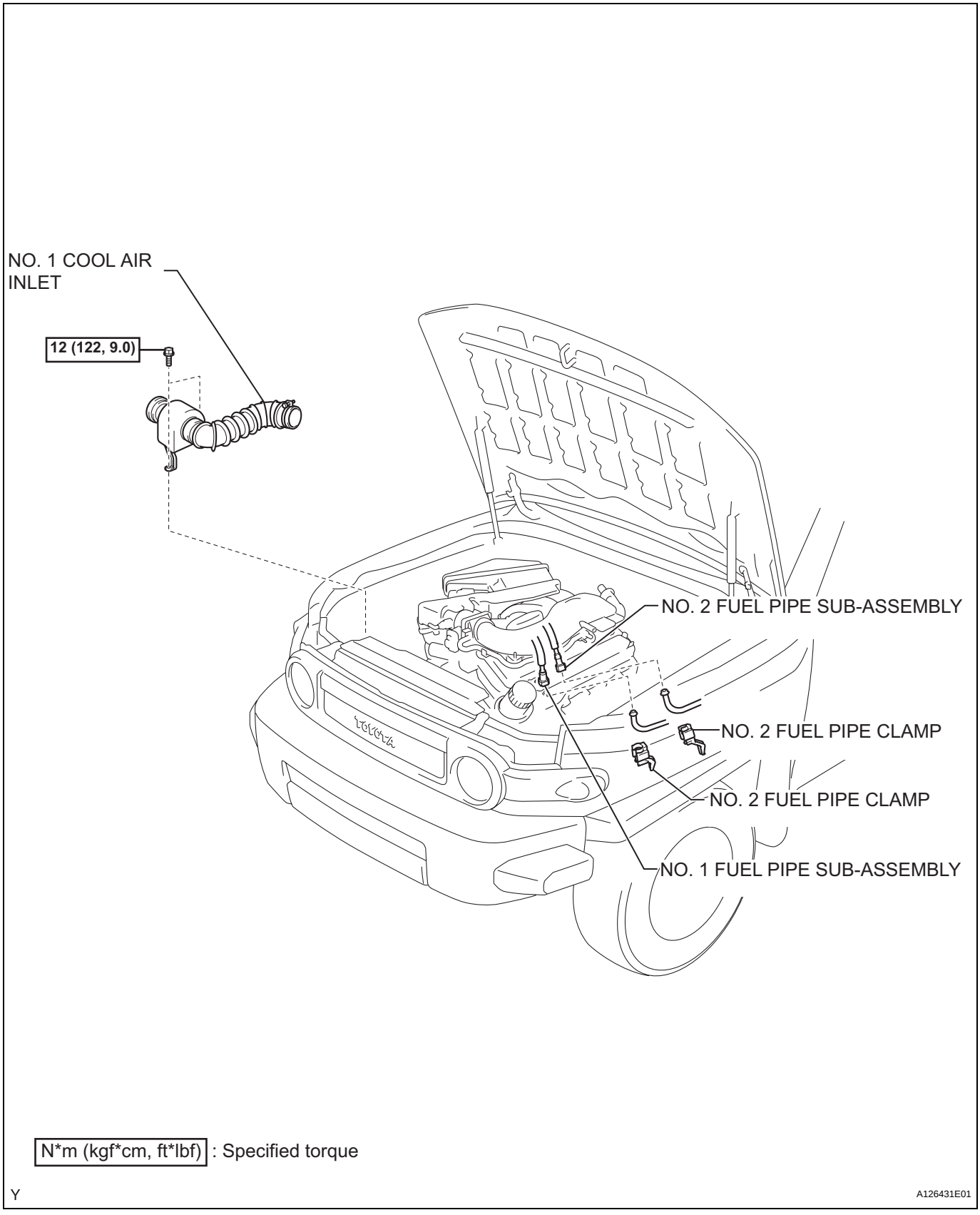
(d) Install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.
Torque: Bolt A
10 N*m (102 kgf*cm, 7.4 ft.*lbf)
Bolt B
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Nut
9.0 N*m (92 kgf*cm, 80 in.*lbf)
HINT:
Each bolt length is as follows.

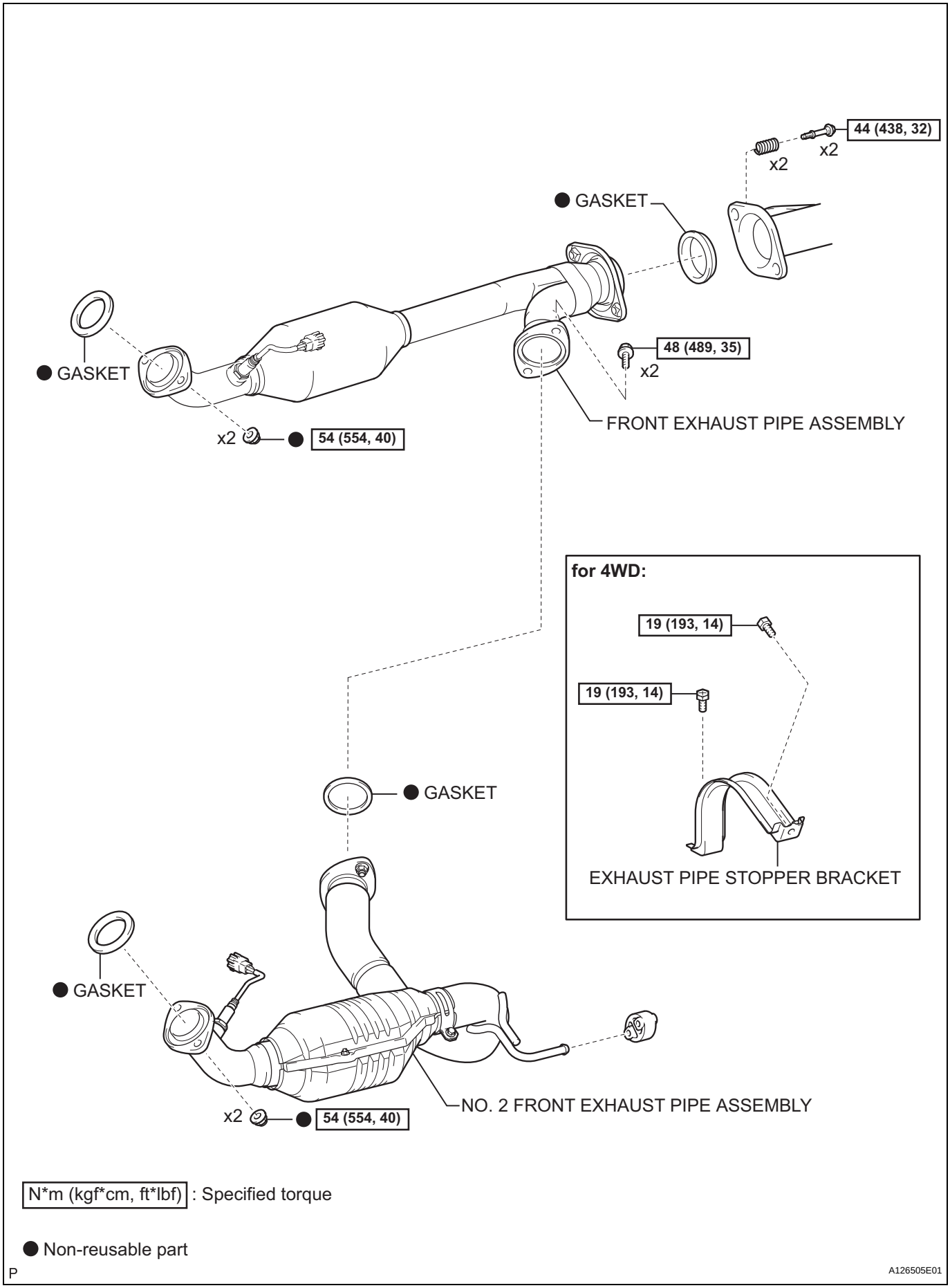
Bolt	Length
A	25 mm (0.98 in.)
B	60 mm (2.36 in.)

13. **INSTALL IGNITION COIL ASSEMBLY (See page IG-8)**
14. **INSTALL INTAKE AIR SURGE TANK (See page FU-17)**
15. **INSTALL NO. 2 SURGE TANK STAY (See page FU-19)**
16. **INSTALL NO. 1 SURGE TANK STAY (See page FU-19)**
17. **INSTALL OIL BAFFLE PLATE (See page FU-19)**
18. **INSTALL THROTTLE BODY BRACKET (See page FU-19)**
19. **INSTALL AIR CLEANER ASSEMBLY (See page ES-431)**
20. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)
21. **ADD ENGINE COOLANT (See page CO-3)**
22. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**
23. **CHECK FOR ENGINE OIL LEAKAGE**
24. **INSPECT IGNITION TIMING (See page EM-1)**
25. **INSTALL V-BANK COVER (See page ES-431)**

CYLINDER HEAD

COMPONENTS

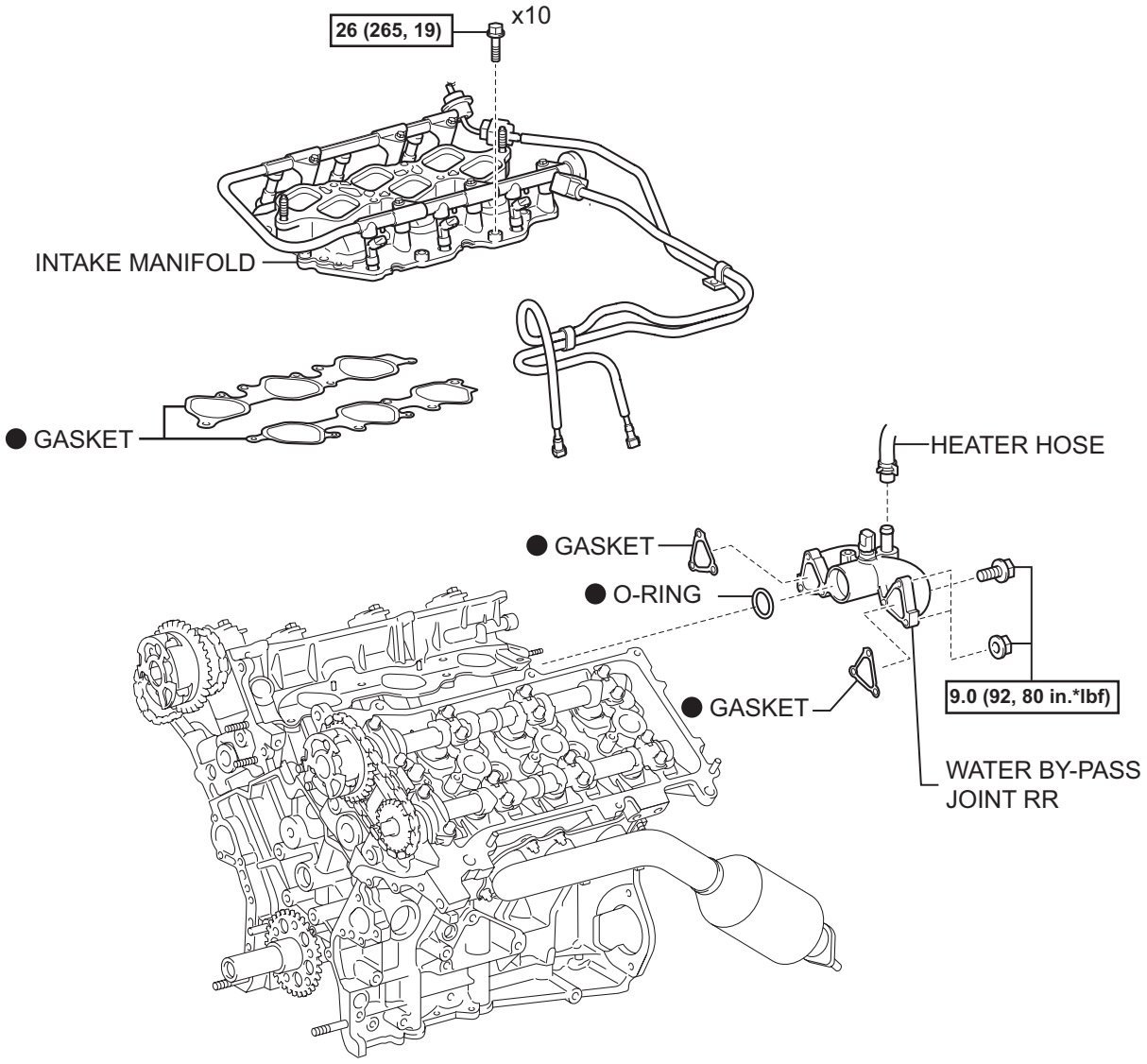



44 (438, 32)
x2
x2
GASKET
48 (489, 35)
x2
GASKET
x2
54 (554, 40)
FRONT EXHAUST PIPE ASSEMBLY
for 4WD:
19 (193, 14)
19 (193, 14)
EXHAUST PIPE STOPPER BRACKET
GASKET
GASKET
x2
54 (554, 40)
NO. 2 FRONT EXHAUST PIPE ASSEMBLY
N*m (kgf*cm, ft*lbf) : Specified torque
Non-reusable part
A126505E01

EM

P

EM

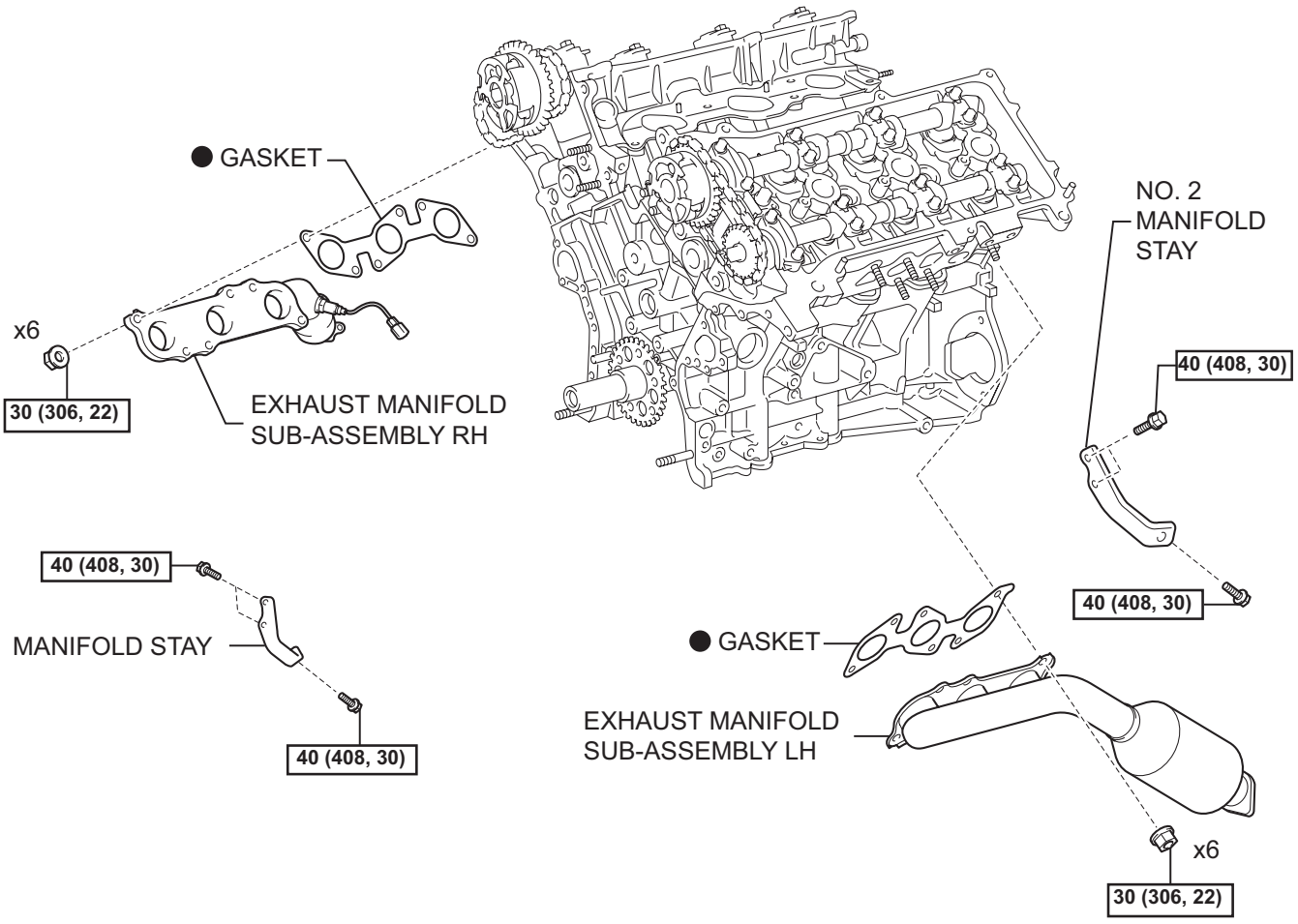


N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

A126432E01



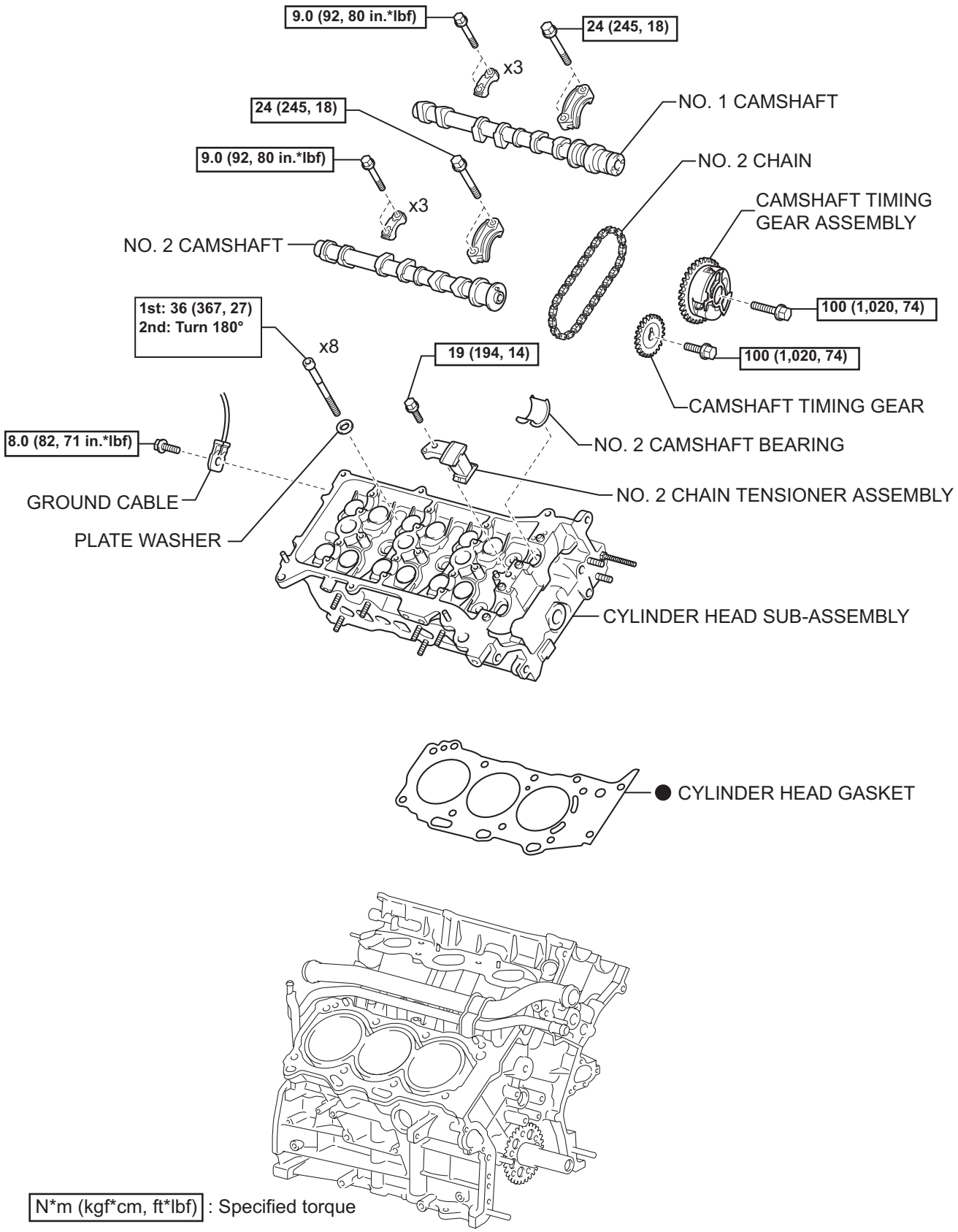
N*m (kgf*cm, ft*lbf) : Specified torque

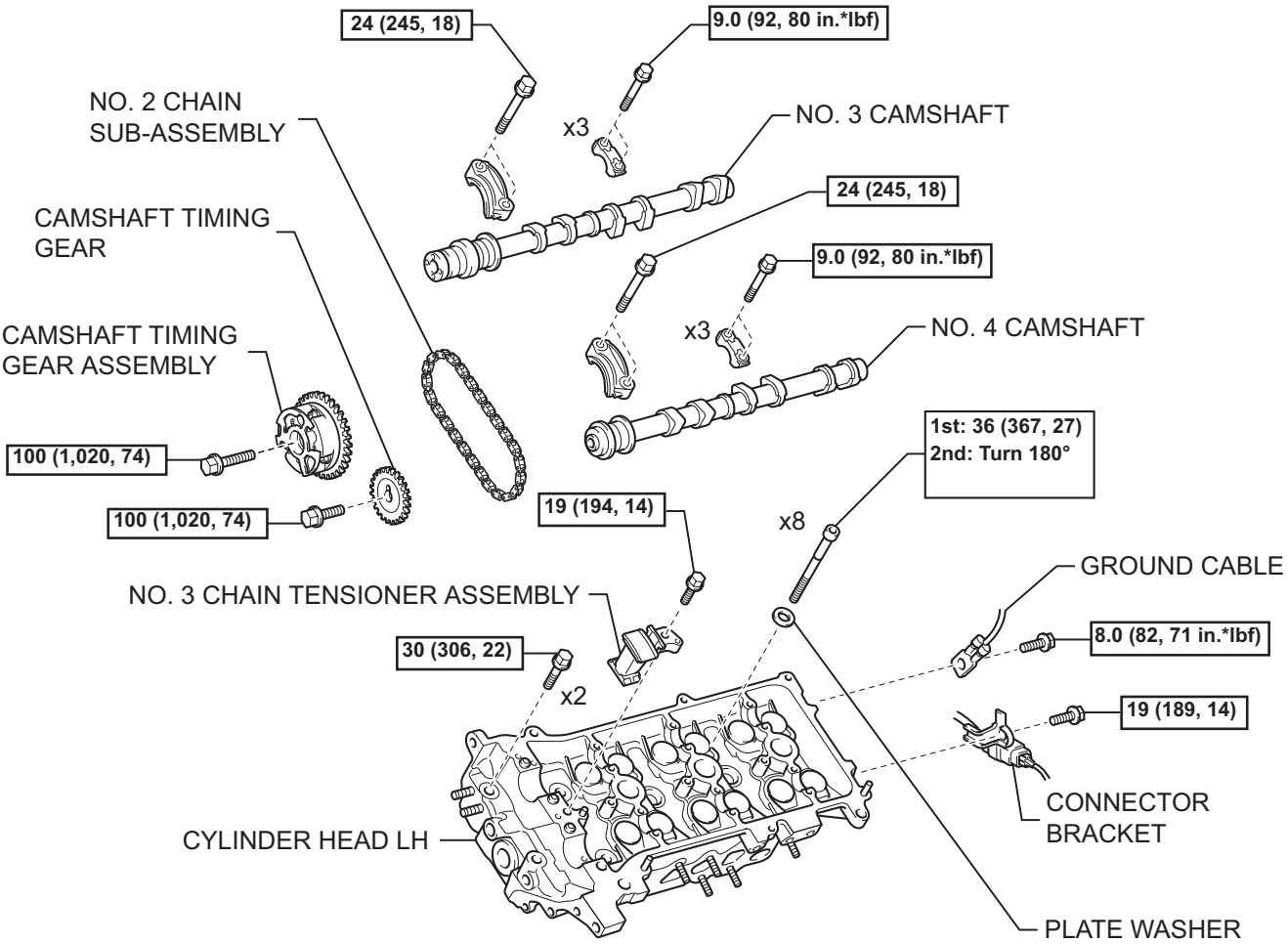
● Non-reusable part

Y

A126433E01

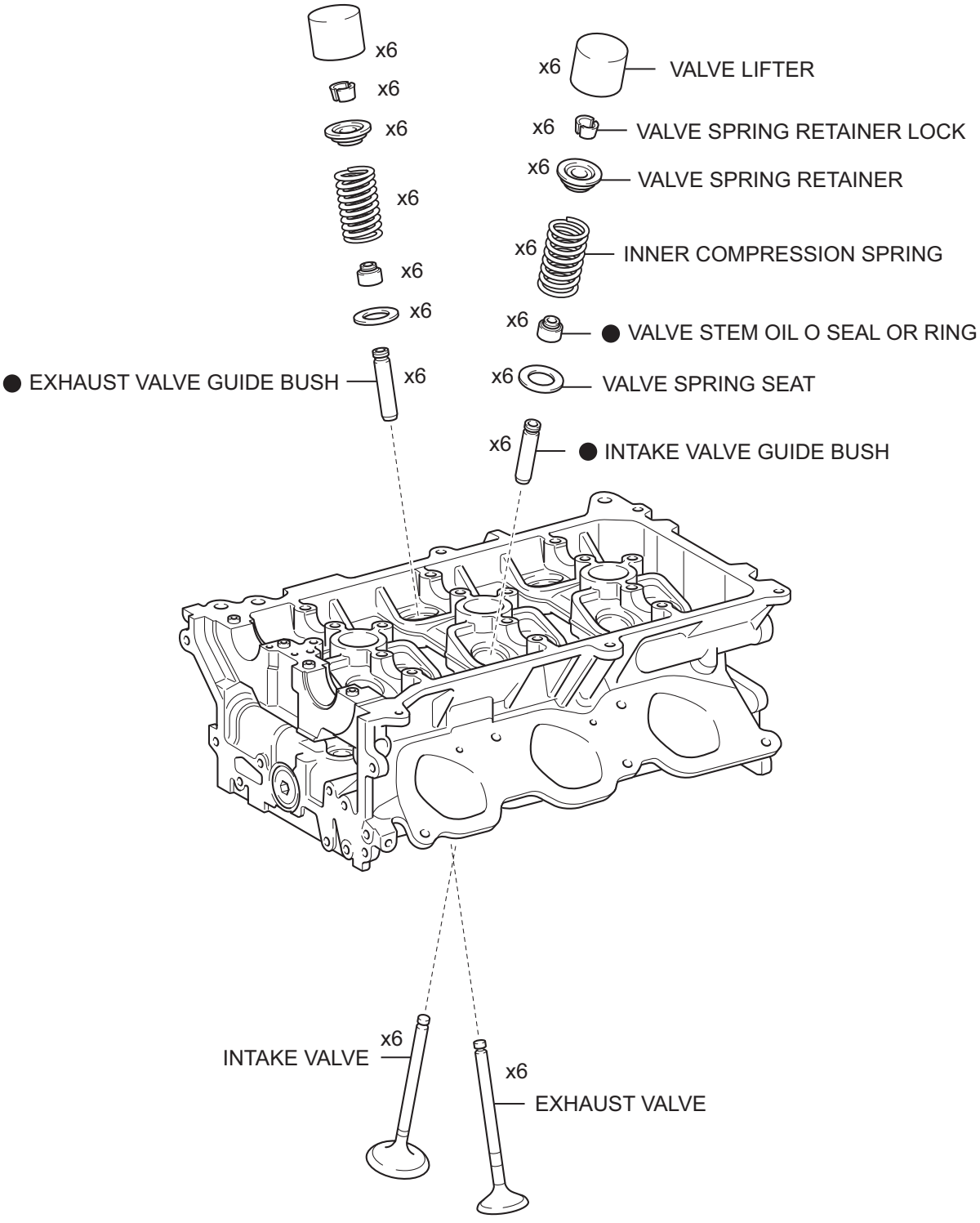
EM


9.0 (92, 80 in.*lbf)
x3
24 (245, 18)
NO. 1 CAMSHAFT
24 (245, 18)
9.0 (92, 80 in.*lbf)
x3
NO. 2 CAMSHAFT
NO. 2 CHAIN
CAMSHAFT TIMING GEAR ASSEMBLY
100 (1,020, 74)
100 (1,020, 74)
CAMSHAFT TIMING GEAR
1st: 36 (367, 27)
2nd: Turn 180°
x8
19 (194, 14)
NO. 2 CAMSHAFT BEARING
8.0 (82, 71 in.*lbf)
GROUND CABLE
PLATE WASHER
NO. 2 CHAIN TENSIONER ASSEMBLY
CYLINDER HEAD SUB-ASSEMBLY
● CYLINDER HEAD GASKET
N*m (kgf*cm, ft*lbf) : Specified torque
● Non-reusable part
Y
A126434E01


24 (245, 18)
9.0 (92, 80 in.*lbf)
x3
NO. 2 CHAIN SUB-ASSEMBLY
NO. 3 CAMSHAFT
24 (245, 18)
CAMSHAFT TIMING GEAR
9.0 (92, 80 in.*lbf)
x3
CAMSHAFT TIMING GEAR ASSEMBLY
NO. 4 CAMSHAFT
100 (1,020, 74)
1st: 36 (367, 27)
2nd: Turn 180°
19 (194, 14)
x8
100 (1,020, 74)
GROUND CABLE
NO. 3 CHAIN TENSIONER ASSEMBLY
8.0 (82, 71 in.*lbf)
30 (306, 22)
x2
19 (189, 14)
CONNECTOR BRACKET
CYLINDER HEAD LH
PLATE WASHER
● NO. 2 CYLINDER HEAD GASKET
N*m (kgf*cm, ft*lbf) : Specified torque
● Non-reusable part
Y
A126435E01

EM

EM



● Non-reusable part

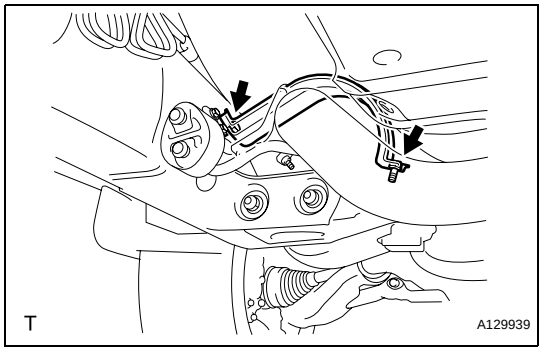
A126376E01

REMOVAL

1. **DISCHARGE FUEL SYSTEM PRESSURE**
   (See page FU-1)

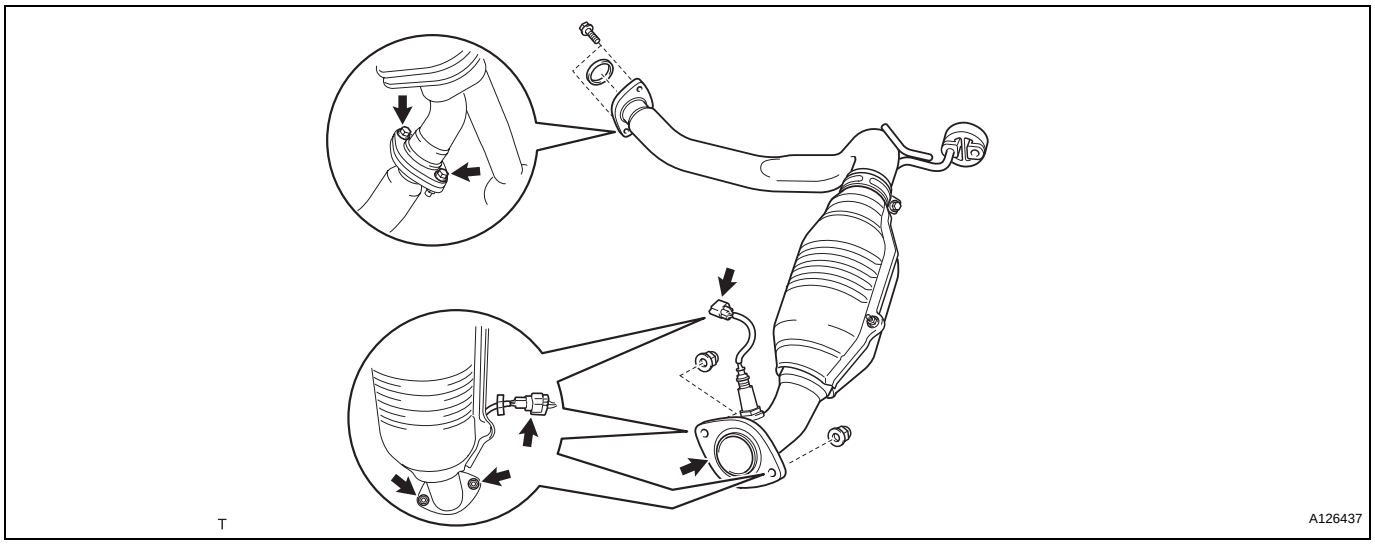
2. **REMOVE CHAIN SUB-ASSEMBLY**
   Refer to the procedures up to "REMOVE CHAIN SUB-ASSEMBLY" (See page EM-22).

3. **REMOVE NO. 1 COOL AIR INLET**
   (a) Remove the 2 bolts and the No. 1 cool air inlet.



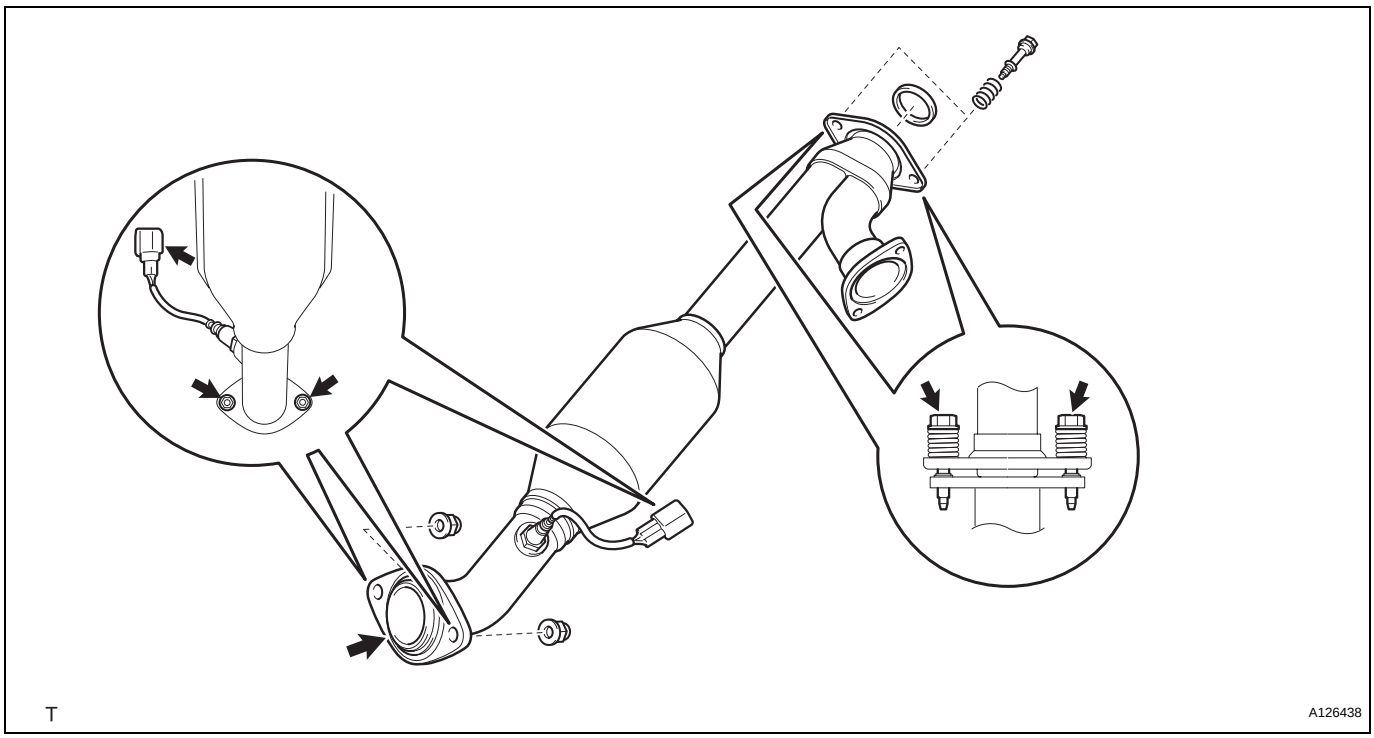
4. **REMOVE EXHAUST PIPE STOPPER BRACKET (for 4WD)**
   (a) Remove the 2 bolts, then remove the exhaust pipe stopper bracket.

5. **REMOVE NO. 2 FRONT EXHAUST PIPE ASSEMBLY**



   (a) Disconnect the oxygen sensor connector.
   (b) Remove the 2 bolts and 2 nuts.
   (c) Disengage the support and remove the front exhaust pipe and 2 gaskets.

6. REMOVE FRONT EXHAUST PIPE ASSEMBLY



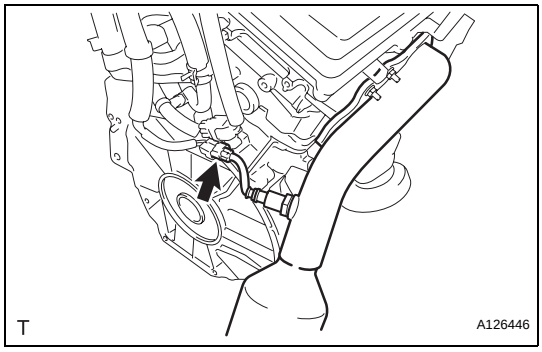
(a) Disconnect the oxygen sensor connector.
(b) Remove the 2 bolts, 2 springs and 2 nuts, then separate the front exhaust pipe from the exhaust manifold RH.

7. REMOVE MANIFOLD STAY

(a) Remove the 3 bolts and manifold stay.

8. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

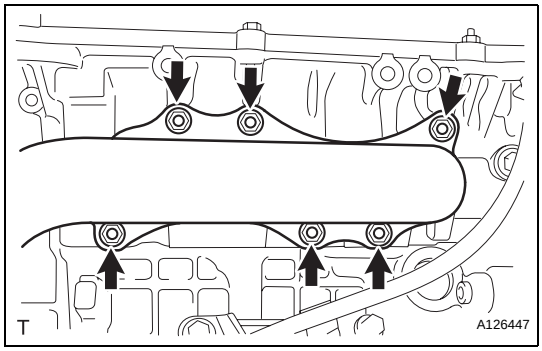
(a) Disconnect the air fuel ratio sensor connector.

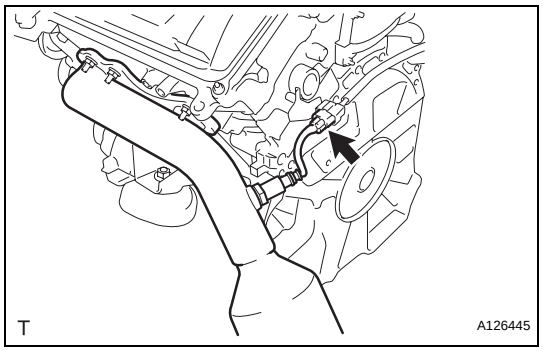


(b) Remove the 6 nuts and exhaust manifold.
(c) Remove the gasket.

9. REMOVE NO. 2 MANIFOLD STAY

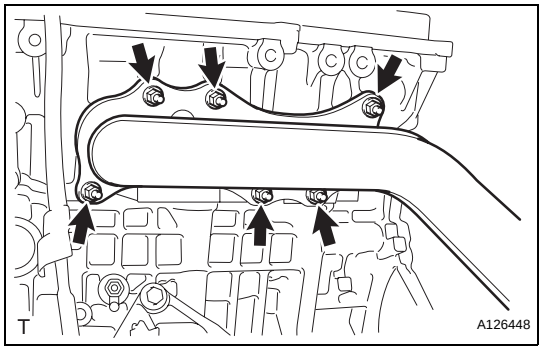
(a) Remove the 3 bolts and the No. 2 manifold stay.





10. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH

(a) Disconnect the air fuel ratio sensor connector.



(b) Remove the 6 nuts and the exhaust manifold.

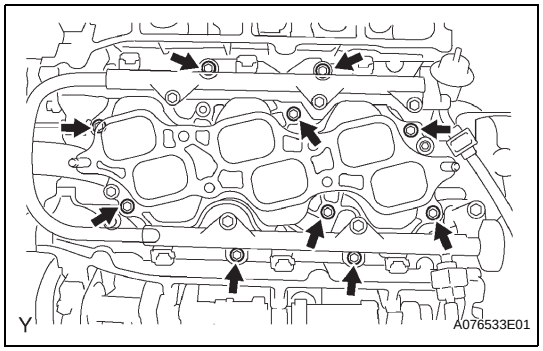
(c) Remove the gasket.

11. DISCONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY (See page FU-13)

12. DISCONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY (See page FU-14)

13. REMOVE INTAKE MANIFOLD

(a) Disconnect the 6 fuel injector connectors.

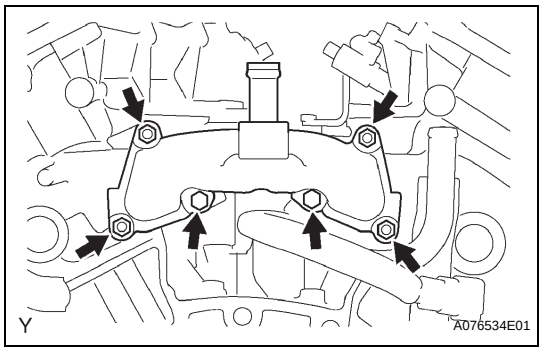


(b) Remove the 10 bolts, then remove the intake manifold and gasket.

14. REMOVE WATER BY-PASS JOINT RR

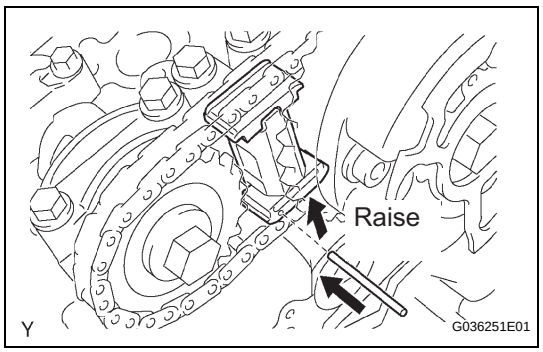
(a) Disconnect the engine coolant temperature sensor connector.

(b) Disconnect the heater hose.



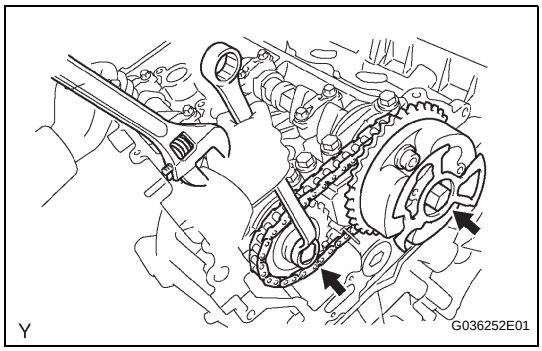
(c) Remove the 2 bolts and 4 nuts, then remove the water by-pass joint RR and 2 gaskets.

(d) Remove the O-ring from the water outlet hose.



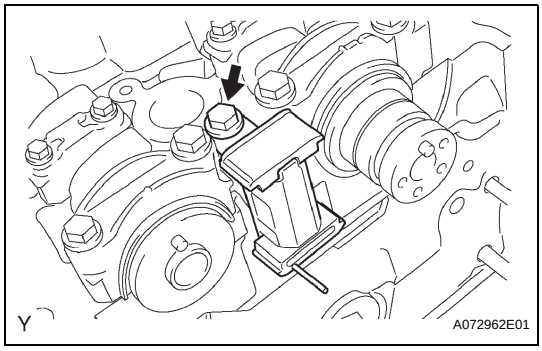
15. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

(a) While raising the No. 2 chain tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.



(b) Hold the hexagonal portion of the camshaft with a wrench.
NOTICE:
Be careful not to damage the cylinder head and valve lifter with the wrench.

(c) Remove the 2 bolts, then remove the camshaft timing gear, camshaft timing gear assembly and No. 2 timing chain.
NOTICE:
Do not disassemble the camshaft timing gear assembly.

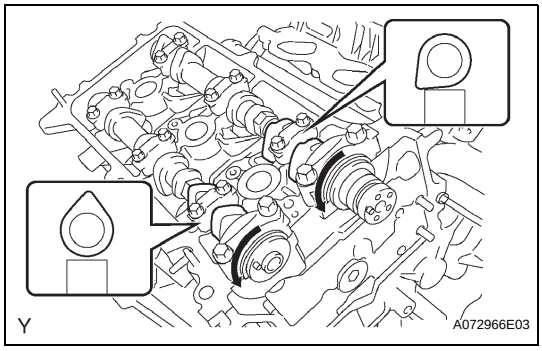


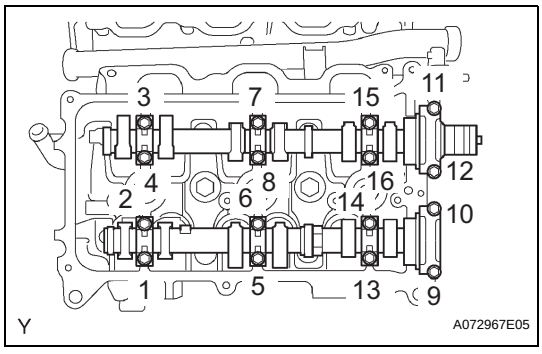
16. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

(a) Remove the bolt, then remove the No. 2 chain tensioner.

17. REMOVE CAMSHAFTS (for Bank 1)
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

(a) Rotate the camshafts counterclockwise using a wrench so that the cam lobes of No. 1 cylinder face in the directions shown in the illustration.





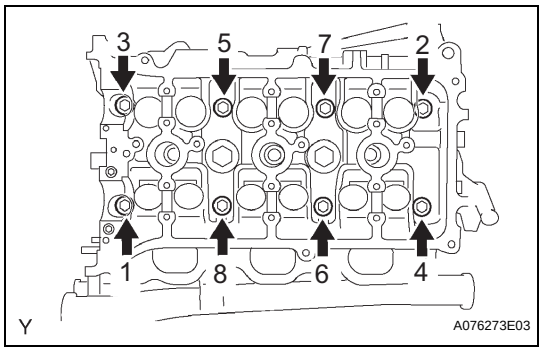
(b) Using several steps, loosen and remove the 16 bearing cap bolts uniformly in the sequence shown in the illustration.

(c) Remove the 8 bearing caps and 2 camshafts.

18. REMOVE NO. 2 CAMSHAFT BEARING

19. REMOVE CYLINDER HEAD SUB-ASSEMBLY

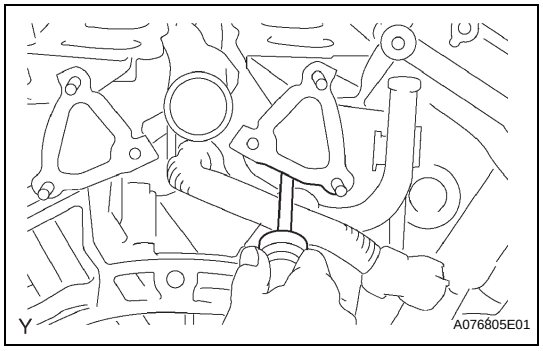
(a) Remove the bolt and separate the ground cable.



(b) Using several steps, loosen the 8 cylinder head bolts on the cylinder head uniformly with a 10 mm bi-hexagon wrench in the sequence shown in the illustration. Remove the 8 cylinder head bolts and 8 plate washers.

NOTICE:

- **Be careful not to drop the plate washers into the cylinder head.**
- **Cylinder head warpage or cracking could result from removing the bolts in the wrong order.**



(c) Lift the cylinder head from the dowels on the cylinder block, and place the cylinder head on wooden blocks on a bench.

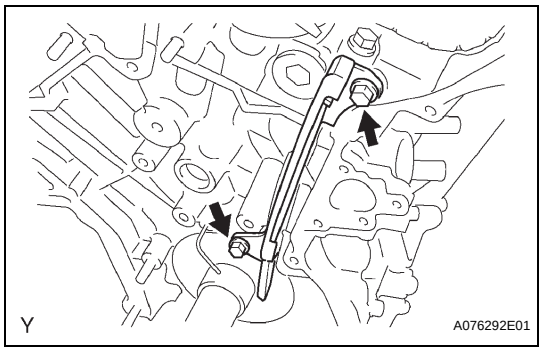
NOTICE:

Be careful not to drop the plate washers into the cylinder head.

If the cylinder head is difficult to lift off, pry between the cylinder head and cylinder block with a screwdriver.

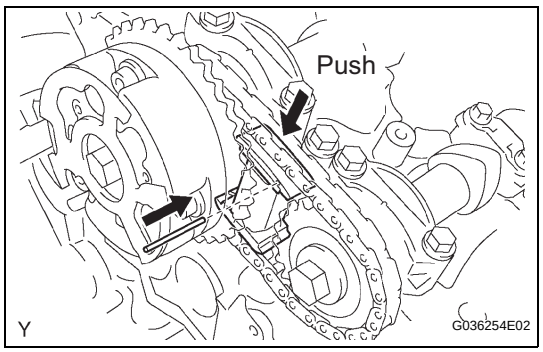
20. REMOVE CYLINDER HEAD GASKET

21. REMOVE NO. 1 CHAIN VIBRATION DAMPER

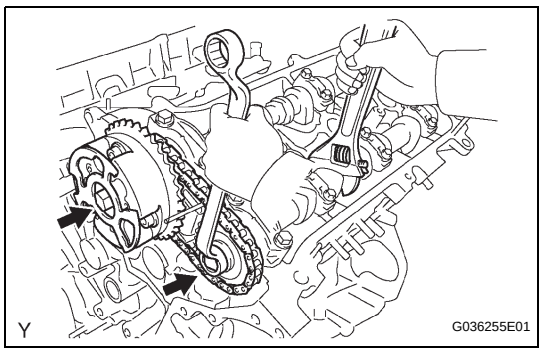


(a) Remove the 2 bolts, then remove the No. 1 chain vibration damper.

22. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)



(a) While pushing down the No. 2 chain tensioner, insert a pin of ϕ 10 mm (0.039 in.) into the hole to fix it.

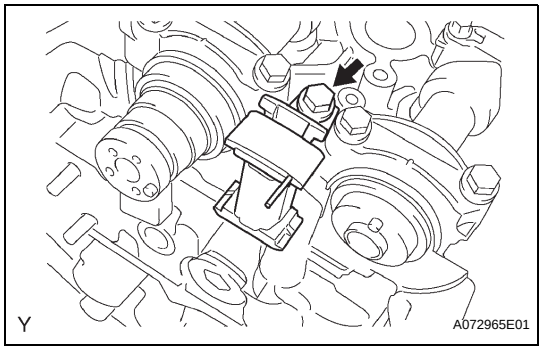


(b) Hold the hexagonal portion of the camshaft with a wrench.

NOTICE:

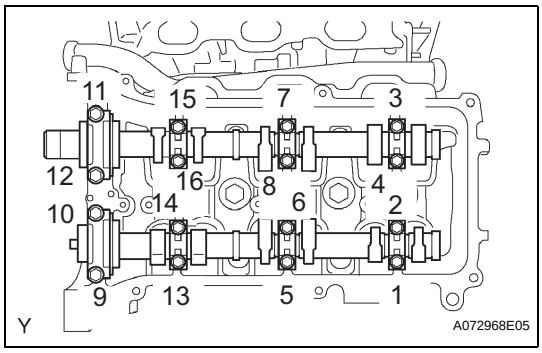
Be careful not to damage the cylinder head and valve lifter with the wrench.

(c) Remove the 2 bolts, then remove the camshaft timing gear, camshaft timing gear assembly and No. 2 timing chain.
NOTICE:
Do not disassemble the camshaft timing gear assembly.



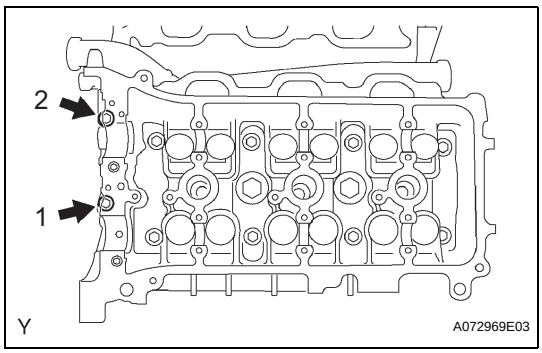
23. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY
(a) Remove the bolt, then remove the No. 3 chain tensioner.

24. REMOVE CAMSHAFTS (for Bank 2)
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

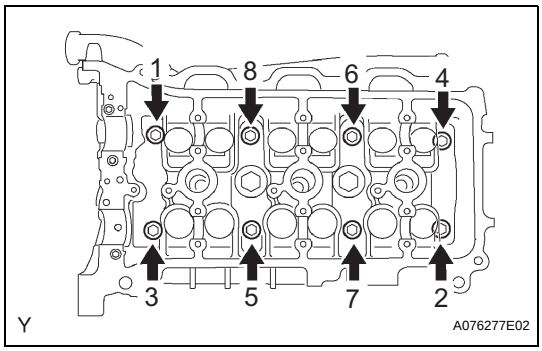


(a) Using several steps, loosen and remove the 16 bearing cap bolts uniformly in the sequence shown in the illustration.
(b) Remove the 8 bearing caps and 2 camshafts.

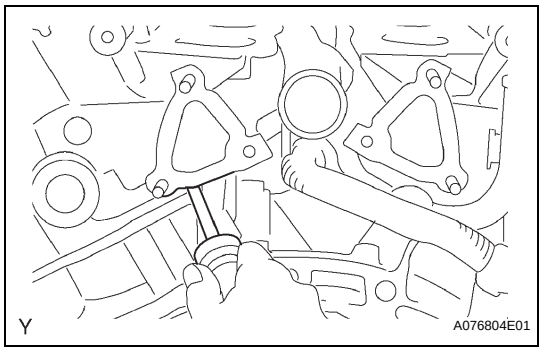
25. REMOVE CYLINDER HEAD LH
(a) Remove the bolt, then separate the ground cable.
(b) Remove the bolt, then separate the air fuel ratio connector bracket.



(c) Using several steps, remove the 2 cylinder head bolts from the cylinder head in the sequence shown in the illustration.



(d) Using several steps, uniformly loosen the 8 cylinder head bolts on the cylinder head with a 10 mm bi-hexagon wrench in the sequence shown in the illustration. Remove the 8 cylinder head bolts and 8 plate washers.
NOTICE:
- **Be careful not to drop the plate washers into the cylinder head.**
- **Cylinder head warpage or cracking could result form removing the bolts in the wrong order.**

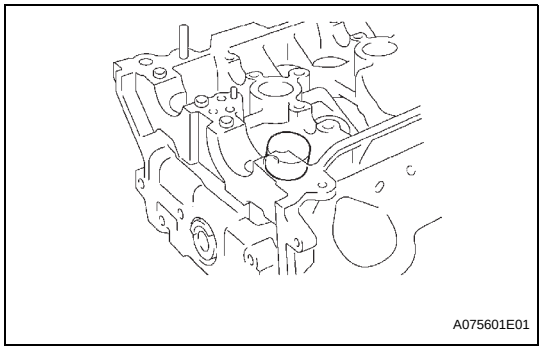


(e) Lift the cylinder head from the dowels on the cylinder block, and place the cylinder head on wooden blocks on a bench.
NOTICE:
Be careful not to drop the plate washers into the cylinder head.
If the cylinder head is difficult to remove, pry between the cylinder head and cylinder block with a screwdriver.

26. REMOVE NO. 2 CYLINDER HEAD GASKET

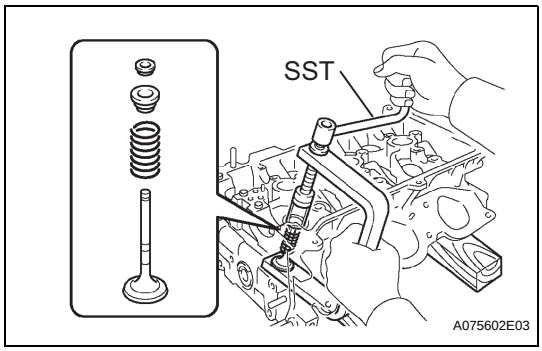
DISASSEMBLY

HINT:
- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.



1. REMOVE VALVE LIFTER

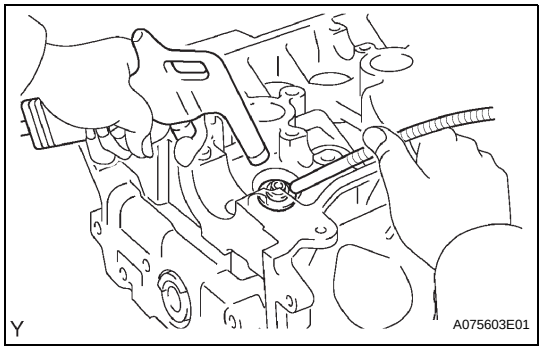
HINT:
Arrange the valve lifter in the correct order.



2. REMOVE VALVE

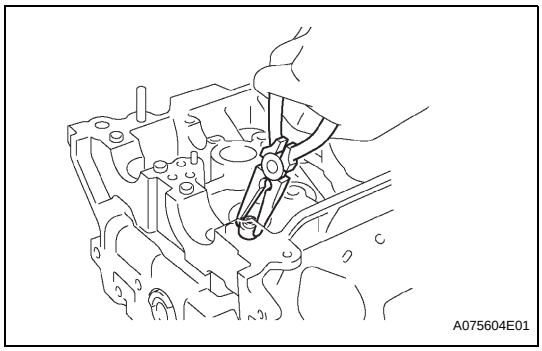
HINT:
Arrange the valves, inner compression springs, valve spring retainers and valve spring retainer locks in the correct order.

(a) Place the cylinder head on a wooden block.
(b) Using SST, compress the inner compression spring and remove the 2 valve spring retainer locks.
SST 09202-70020 (09202-00010)
(c) Remove the valve, inner compression spring and valve spring retainer.



3. REMOVE VALVE SPRING SEAT

(a) Using compressed air and a magnetic finger, remove the valve spring seat by applying compressed air.



4. REMOVE VALVE STEM OIL O SEAL OR RING

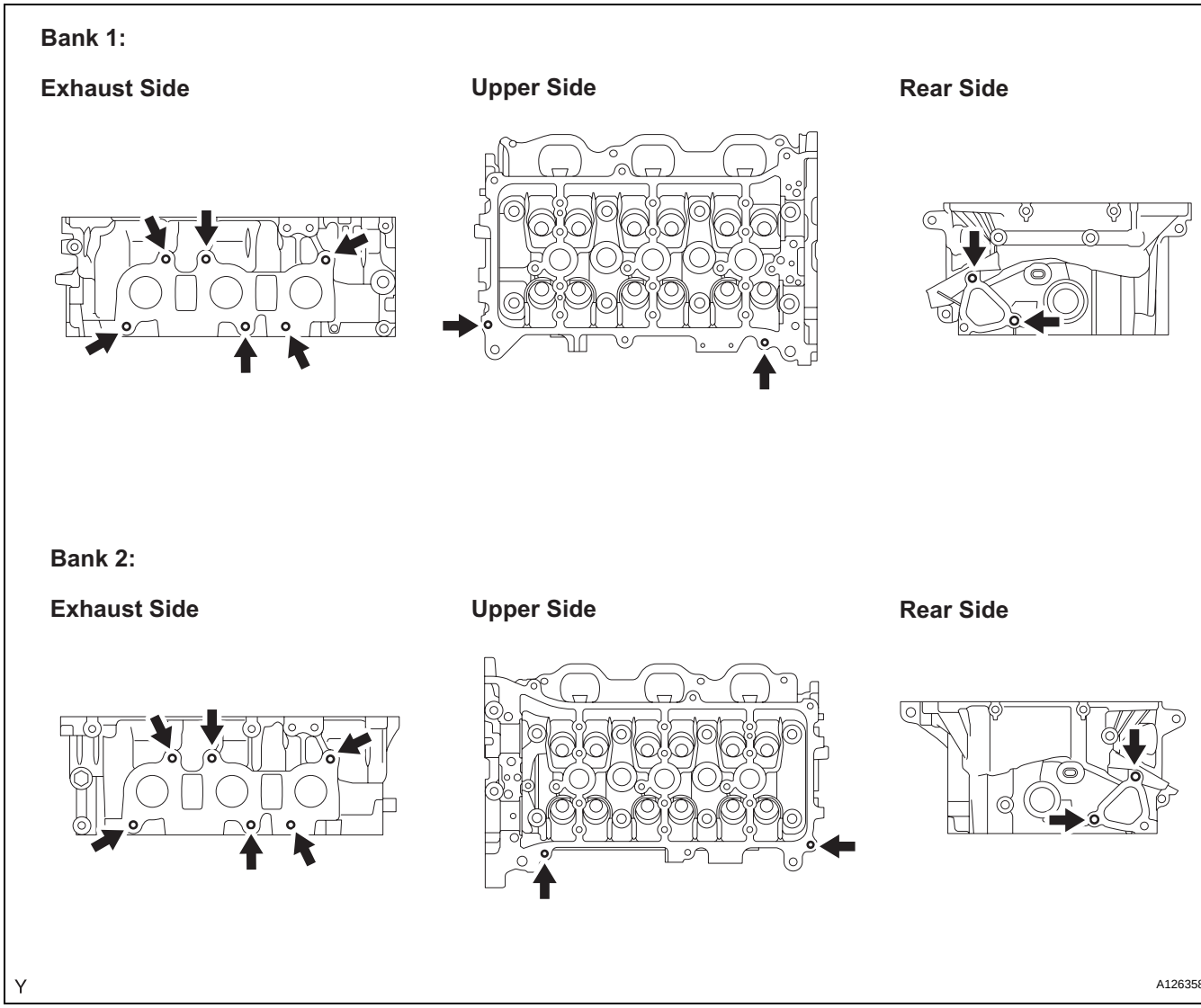
(a) Using needle-nose pliers, remove the valve stem oil seal.

5. REMOVE STRAIGHT PIN NO.1

(a) Remove the 10 knock pins from bank 1 and bank 2 cylinder heads.

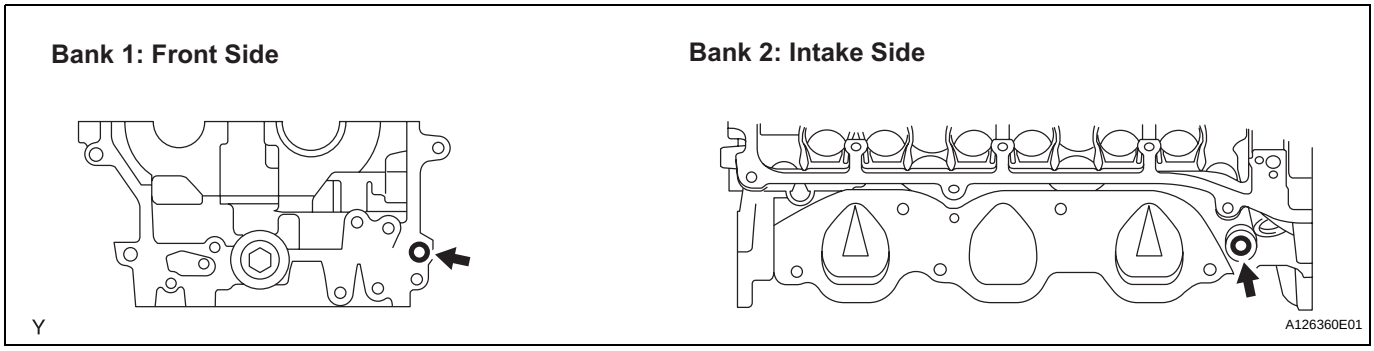
6. REMOVE EXHAUST MANIFOLD, RH STUD BOLT

(a) Remove the 20 stud bolts from bank 1 and bank 2 cylinder heads.



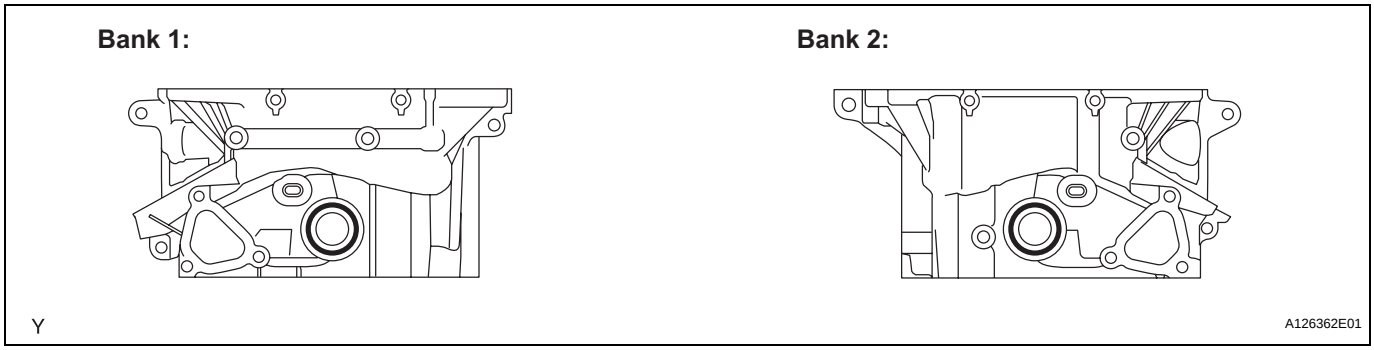
7. REMOVE UNION

(a) Remove the 2 unions from bank 1 and bank 2 cylinder heads.



8. REMOVE TIGHT PLUG

(a) Remove the 2 tight plugs from bank 1 and bank 2 cylinder heads.



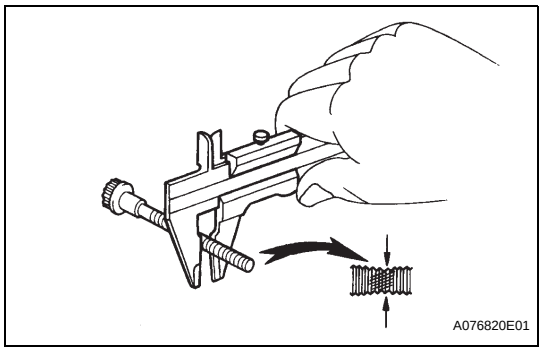
INSPECTION

1. INSPECT CYLINDER HEAD SET BOLT

(a) Using vernier calipers, measure the outer diameter of the cylinder head set bolt thread.

Standard outer diameter:
10.85 to 11.00 mm (0.4272 to 0.4331 in.)
Minimum outer diameter:
10.7 mm (0.421 in.)

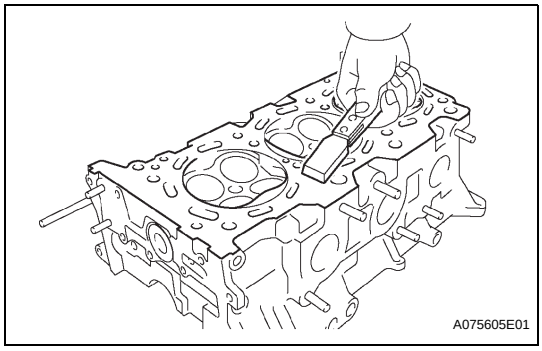
If the outer diameter is less than the minimum, replace the cylinder head set bolt.



2. CLEAN CYLINDER HEAD SUB-ASSEMBLY

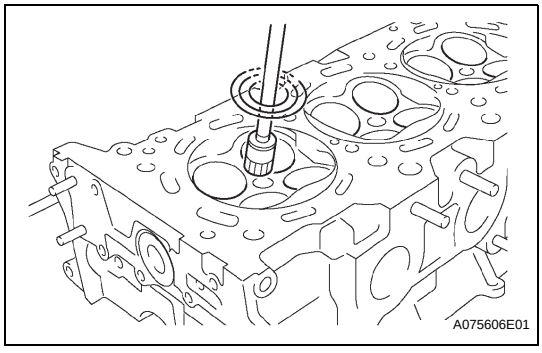
(a) Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

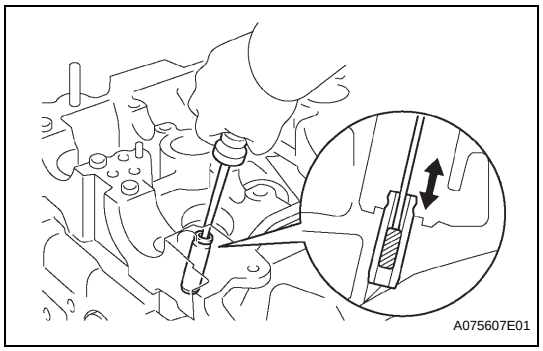
NOTICE:
Be careful not to scratch the cylinder block contact surface.



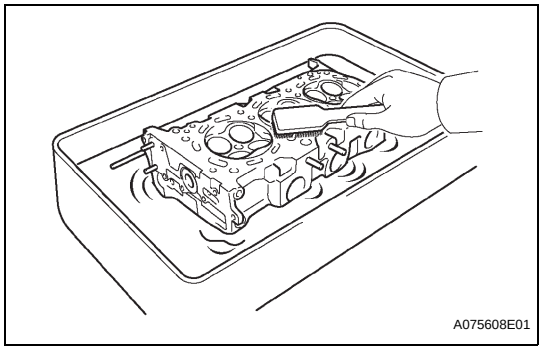
(b) Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE:
Be careful not to scratch the combustion chambers.

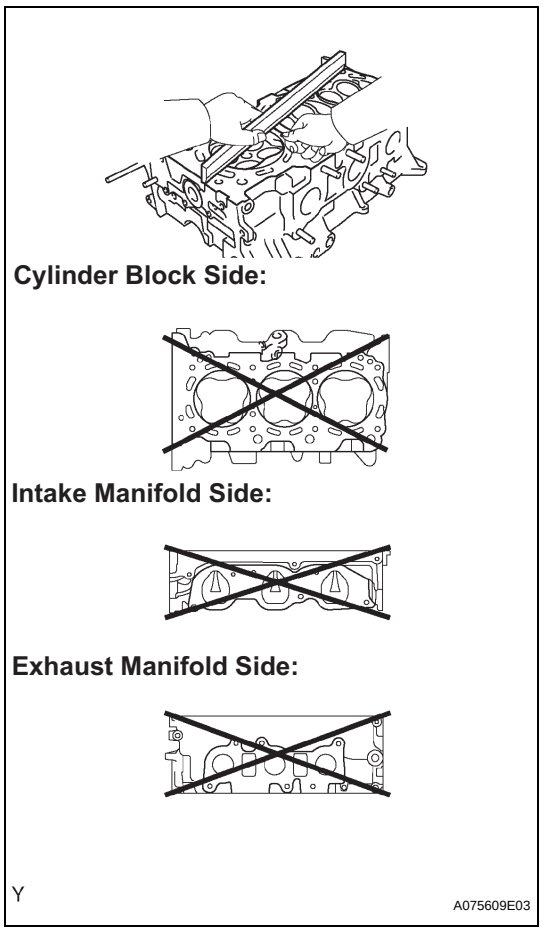




(c) Using a valve guide bushing brush and solvent, clean all the valve guide bushes.



(d) Using a soft brush and solvent, thoroughly clean the cylinder head.



3. INSPECT CYLINDER HEAD SUB-ASSEMBLY

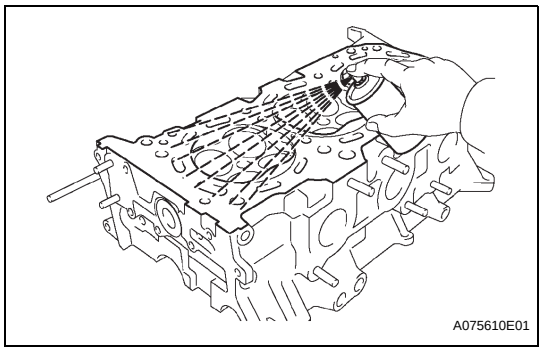
(a) Inspect the cylinder head for warpage.

(1) Using a precision straight edge and feeler gauge, measure the warpage on the cylinder block side and the intake and exhaust sides.

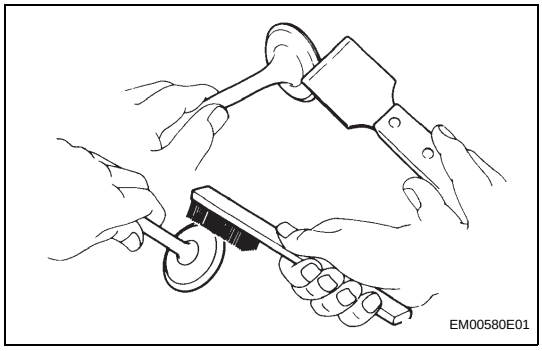
Maximum warpage:

0.10 mm (0.0039 in.)

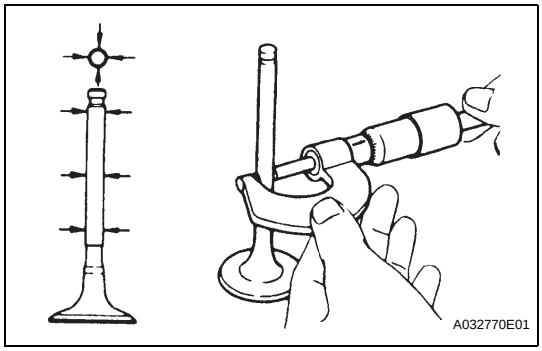
If the warpage is greater than the maximum, replace the cylinder head.


A075610E01

(b) Inspect the cylinder head for cracks.
(1) Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.
If cracked, replace the cylinder head.

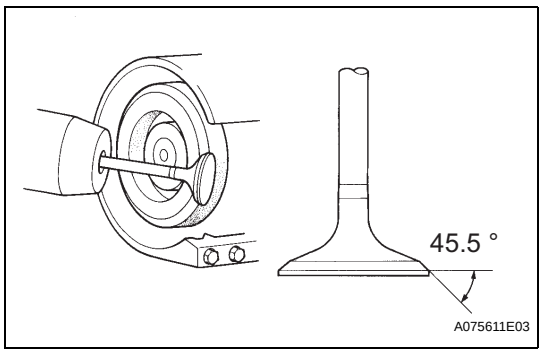

EM00580E01

4. CLEAN VALVE
(a) Using a gasket scraper, chip off any carbon from the valve head.
(b) Using a wire brush, thoroughly clean the valve.


A032770E01

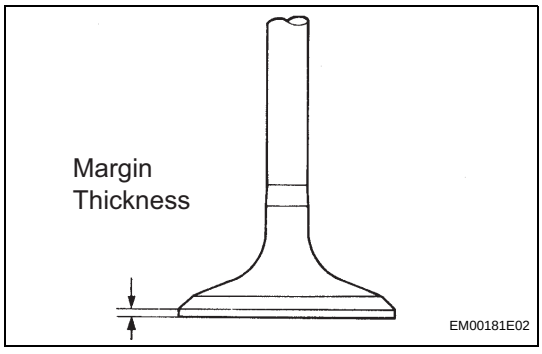
5. INSPECT VALVE
(a) Inspect the valve stem diameter.
(1) Using a micrometer, measure the diameter of the valve stem.
Valve stem diameter

Valve Stem	Specification
Intake	5.470 to 5.485 mm (0.2154 to 0.2159 in.)
Exhaust	5.465 to 5.480 mm (0.2152 to 0.2158 in.)



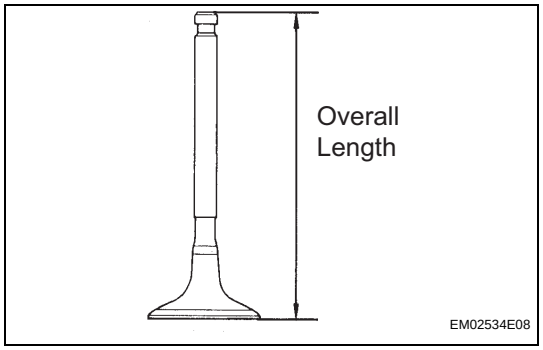
A075611E03

(b) Inspect the valve face angle.
(1) Grind the valve enough to remove any pits and carbon.
(2) Check that the valve is ground to the correct valve face angle.
Valve face angle:
45.5°



EM00181E02

(c) Inspect the valve head margin thickness.
(1) Using vernier calipers, check the valve head margin thickness.
Standard margin thickness:
1.0 mm (0.039 in.)
Minimum margin thickness:
0.5 mm (0.020 in.)
If the margin thickness is less than the minimum, replace the valve.



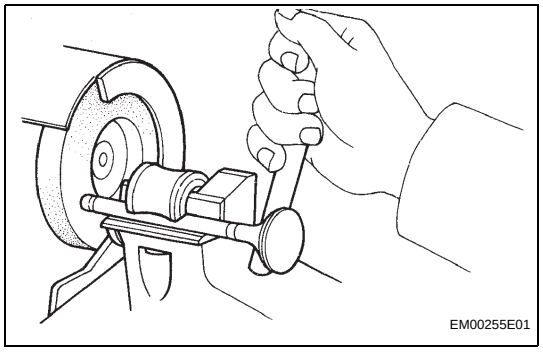
(d) Inspect the overall length.
(1) Using vernier calipers, check the overall length.
Standard overall length

Valve	Specification
Intake	106.95 mm (4.2106 in.)
Exhaust	105.80 mm (4.1654 in.)

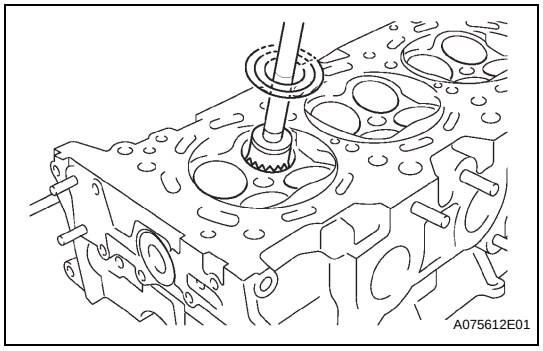
Minimum overall length

Valve	Specification
Intake	106.70 mm (4.2008 in.)
Exhaust	105.55 mm (4.1555 in.)

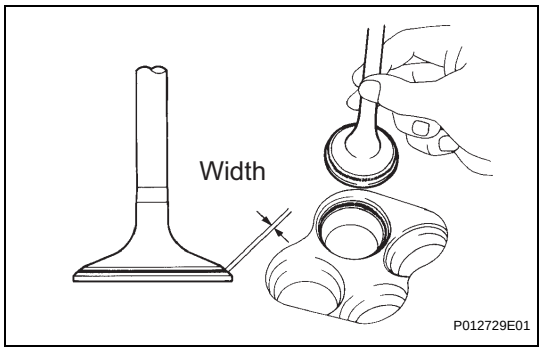
If the overall length is less than the minimum, replace the valve.



(e) Inspect the valve stem tip.
(1) Check the surface of the valve stem tip for wear.
NOTICE:
Do not grind to less than the minimum length.
If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

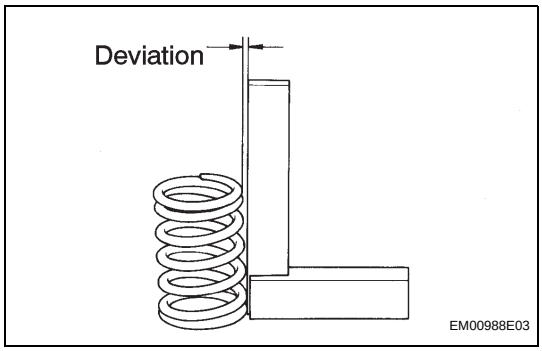


6. CLEAN VALVE SEAT
(a) Using a 45° carbide cutter, resurface the valve seats.
(b) Clean the valve seats.



7. INSPECT VALVE SEAT
(a) Apply a light coat of prussian blue to the valve face.
(b) Lightly press the valve against the valve seat.
NOTICE:
Do not rotate the valve.
(c) Check the valve face and seat according to the following procedure.
(1) If blue appears 360° around the face, the valve is concentric.
If not, replace the valve.
(2) If the blue appears 360° around the valve seat, the guide and face are concentric.
If not, resurface the valve seat.
(3) Check that the seat is in contact with the middle of the valve face with the following width.
Standard width:
1.0 to 1.4 mm (0.039 to 0.055 in.)

EM



8. INSPECT INNER COMPRESSION SPRING

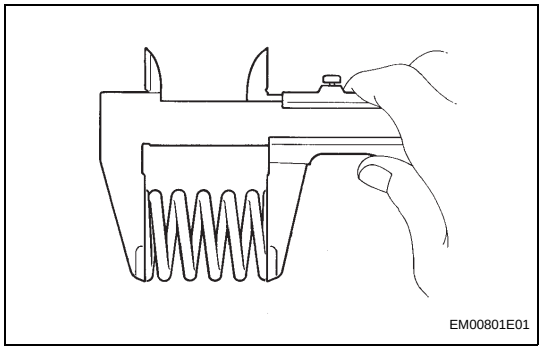
(a) Inspect the deviation.

(1) Using steel squares, measure the deviation of the inner compression spring.

Maximum deviation:

2.0 mm (0.079 in.)

If the deviation is greater than the maximum, replace the inner compression spring.



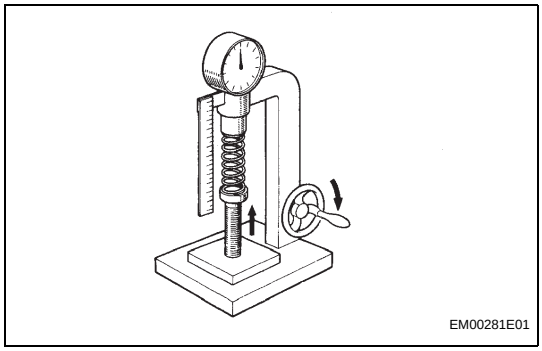
(b) Inspect the free length.

(1) Using vernier calipers, measure the free length of the inner compression spring.

Free length:

47.80 mm (1.8819 in.)

If the free length is not as specified, replace the inner compression spring.



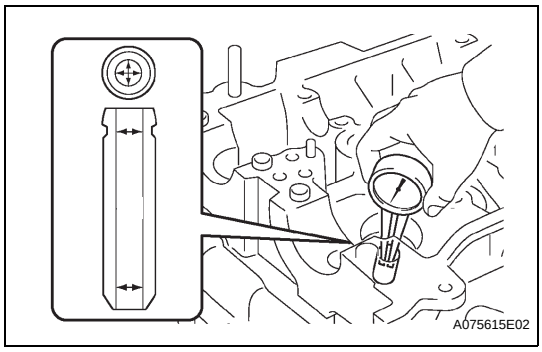
(c) Inspect the tension.

(1) Using a spring tester, measure the tension of the inner compression spring at the specified installed length.

Installed tension

Installed Length	Specification
33.3 mm (1.311 in.)	186.2 to 205.8 N (19.0 to 21.0 kgf, 41.9 to 46.3 lbf)

If the installed tension is not as specified, replace the inner compression spring.



9. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

(a) Using a caliper gauge, measure the internal diameter of the valve guide bush.

Inside diameter:

5.51 to 5.53 mm (0.2169 to 0.2177 in.)

(b) Subtract the valve stem diameter measurement from the valve guide bush internal diameter measurement.

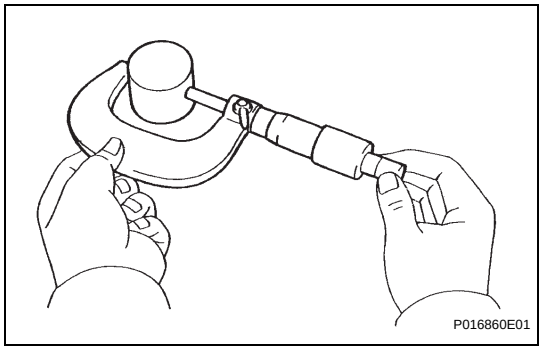
Standard oil clearance

Valve Guide Bush	Specification
Intake	0.025 to 0.060 mm (0.0010 to 0.0024 in.)
Exhaust	0.030 to 0.065 mm (0.0012 to 0.0026 in.)

Maximum oil clearance

Valve Guide Bush	Specification
Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in..)

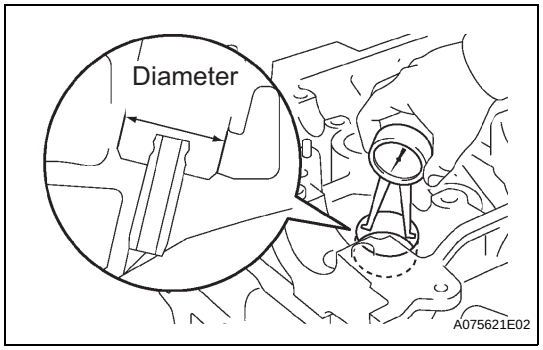
If the oil clearance is greater than the maximum, replace the valve and valve guide bush.



10. INSPECT VALVE LIFTER

(a) Using a micrometer, measure the valve lifter diameter.

Valve lifter diameter:
30.966 to 30.976 mm (1.2191 to 1.2195 in.)



11. INSPECT VALVE LIFTER OIL CLEARANCE

(a) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

Lifter bore diameter:
31.009 to 31.025 mm (1.2208 to 1.2215 in.)

(b) Subtract the valve lifter diameter measurement (Step 16) from the lifter bore diameter measurement.

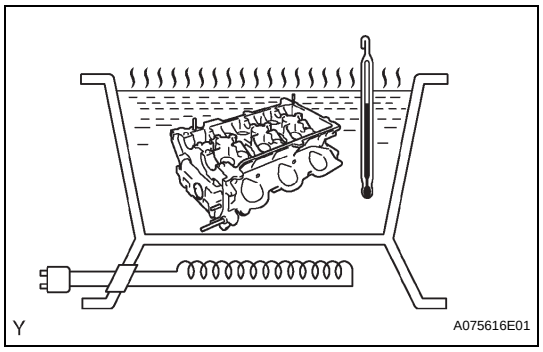
Standard oil clearance:
0.033 to 0.059 mm (0.0013 to 0.0023 in.)
Maximum oil clearance:
0.08 mm (0.0031 in.)

If the oil clearance is greater than the maximum, replace the valve lifter.

If necessary, replace the cylinder head.

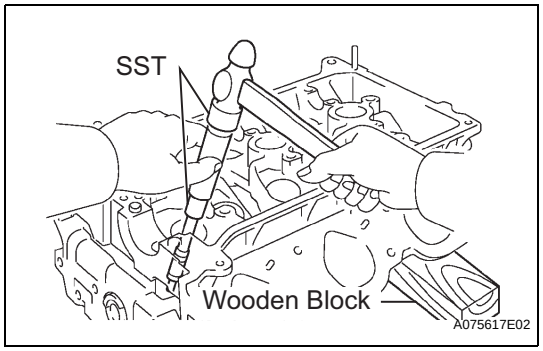
EM

REPLACEMENT



1. REMOVE VALVE GUIDE BUSH

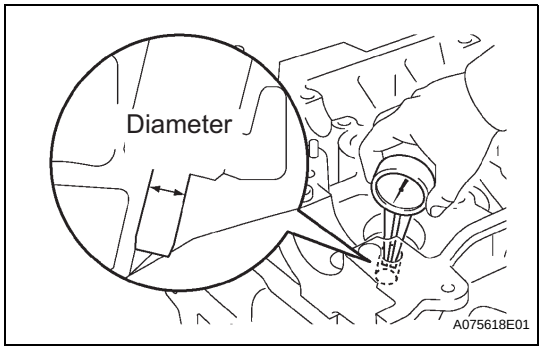
(a) Gradually heat the cylinder head to 80 to 100°C (176 to 212°F).



(b) Place the cylinder head on a wooden block.

(c) Using SST, tap out the valve guide bush.

SST 09201-10000, 09201-01055, 09950-70010 (09951-07100)



2. INSTALL VALVE GUIDE BUSH

(a) Using a caliper gauge, measure the bush bore diameter of the cylinder head.

Bush bore diameter:

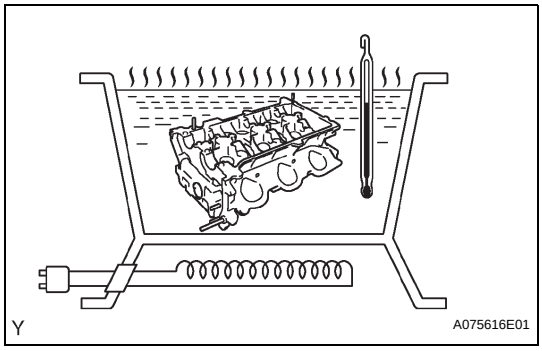
10.295 to 10.315 mm (0.4053 to 0.4061 in.)

If the bush bore diameter of the cylinder head is greater than 10.315 mm (0.4061 in.), machine the bush bore to the dimension of 10.345 to 10.365 mm (0.4073 to 0.4081 in.).

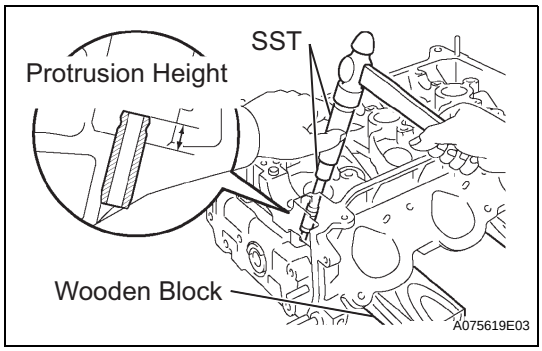
Valve guide bush diameter

Item	mm (in.)
STD	10.333 to 10.344 (0.4068 to 0.4072)
O/S 0.05	10.383 to 10.394 (0.4088 to 0.4092)

EM



(b) Gradually heat the cylinder head to 80 to 100°C (176 to 212°F).



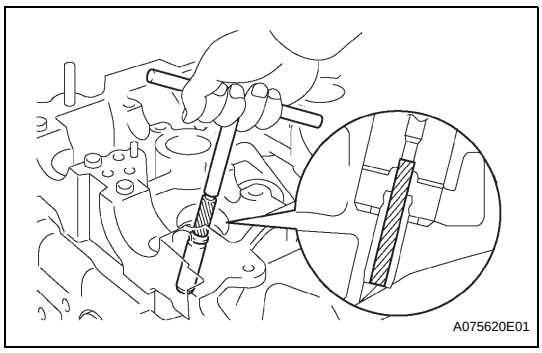
(c) Place the cylinder head on a wooden block.

(d) Using SST, tap in a new valve guide bush to the specified protrusion height.

SST 09201-10000, 09201-01055, 09950-70010 (09951-07100)

Protrusion height:

9.3 to 9.7 mm (0.366 to 0.382 in.)



(e) Using a sharp 5.5 mm reamer, ream the valve guide bush to the standard specified clearance between the valve guide bush and valve stem.

Standard oil clearance:

Value guide	Specification
Intake	0.025 to 0.060 mm (0.0010 to 0.0024 in.)
Exhaust	0.030 to 0.065 mm (0.0012 to 0.0026 in.)

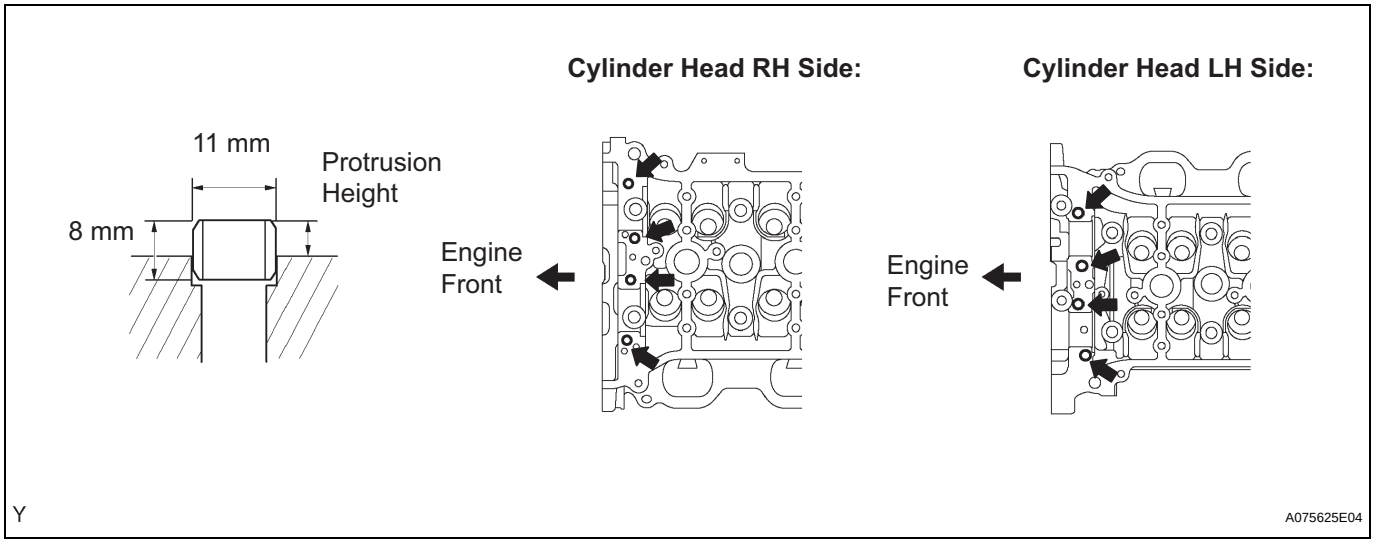
REASSEMBLY

1. INSTALL RING PIN

(a) Using a plastic-faced hammer, tap in new ring pins to the specified protrusion height.

Specified protrusion height:

2.7 to 3.3 mm (0.106 to 0.130 in.)



2. INSTALL STRAIGHT PIN

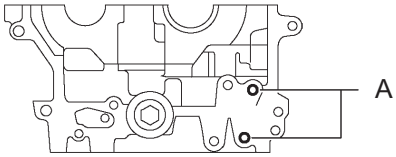
(a) Using a plastic-faced hammer, tap in new straight pins to the specified protrusion height.

Specified protrusion height

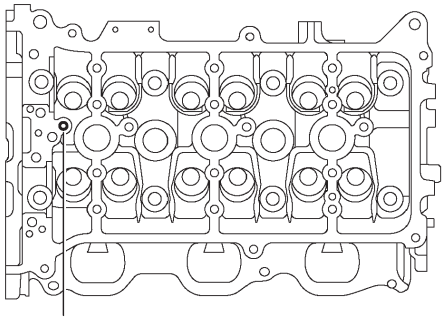
Pin	Specification
A	17.5 to 19.5 mm (0.689 to 0.768 in.)
B	7.5 to 8.5 mm (0.295 to 0.335 in.)
C	7.0 to 9.0 mm (0.276 to 0.354 in.)

Cylinder Head RH Side:

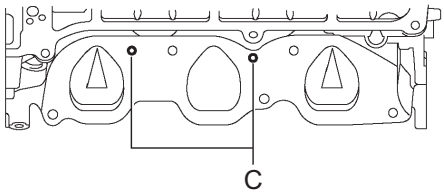
Front Side:



Upper Side:

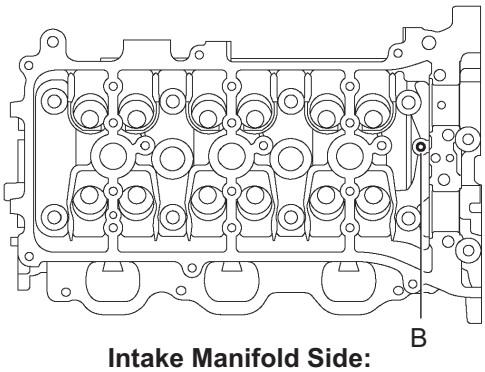


Intake Manifold Side:

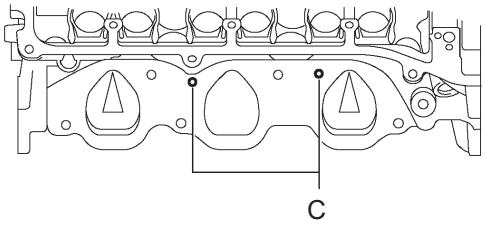


Cylinder Head LH Side:

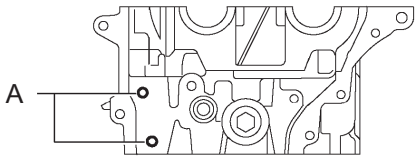
Upper Side:

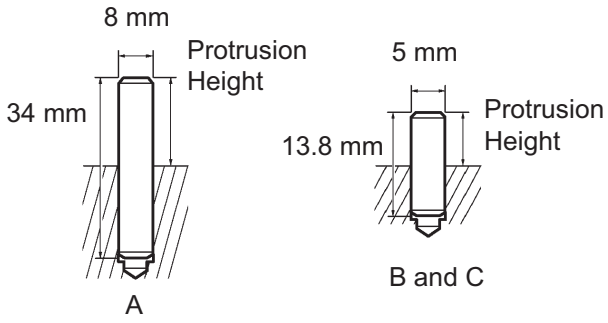


Intake Manifold Side:



Front Side:





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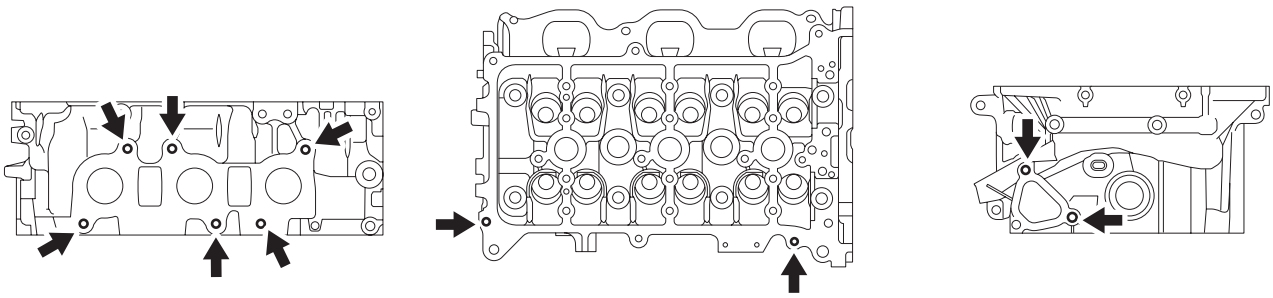
3. INSTALL STUD BOLT

(a) Using "Torx" socket wrench E5 and E7, install the stud bolts.

Torque: Stud bolt A
4.0 N*m (41 kgf*cm, 35 in.*lbf)
Stud bolt B
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Stud bolt C
4.0 N*m (41 kgf*cm, 35 in.*lbf)

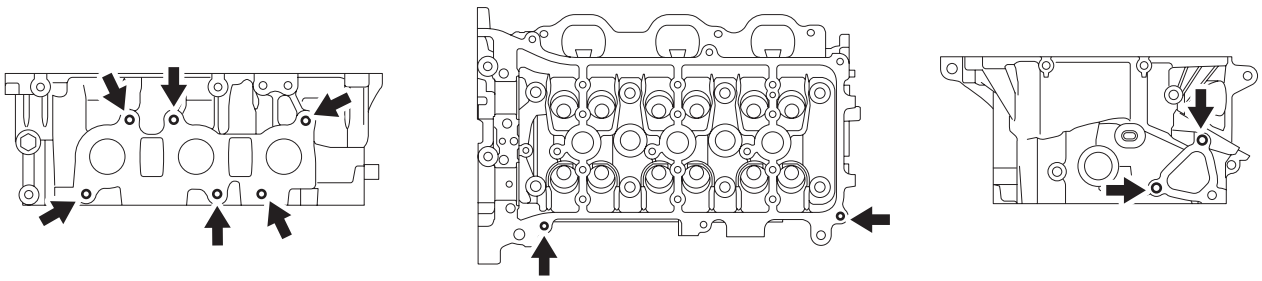
Bank 1:

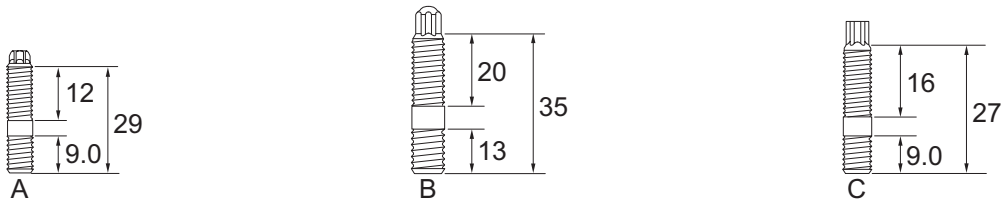
Exhaust Side **Upper Side** **Rear Side**



Bank 2:

Exhaust Side **Upper Side** **Rear Side**





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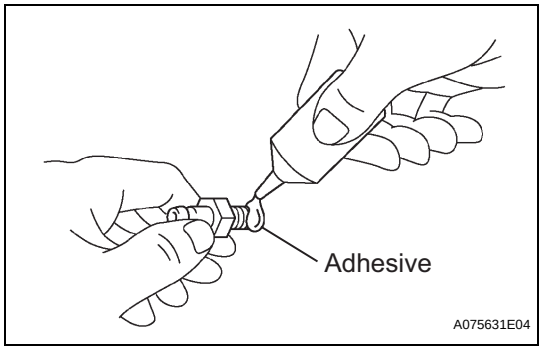
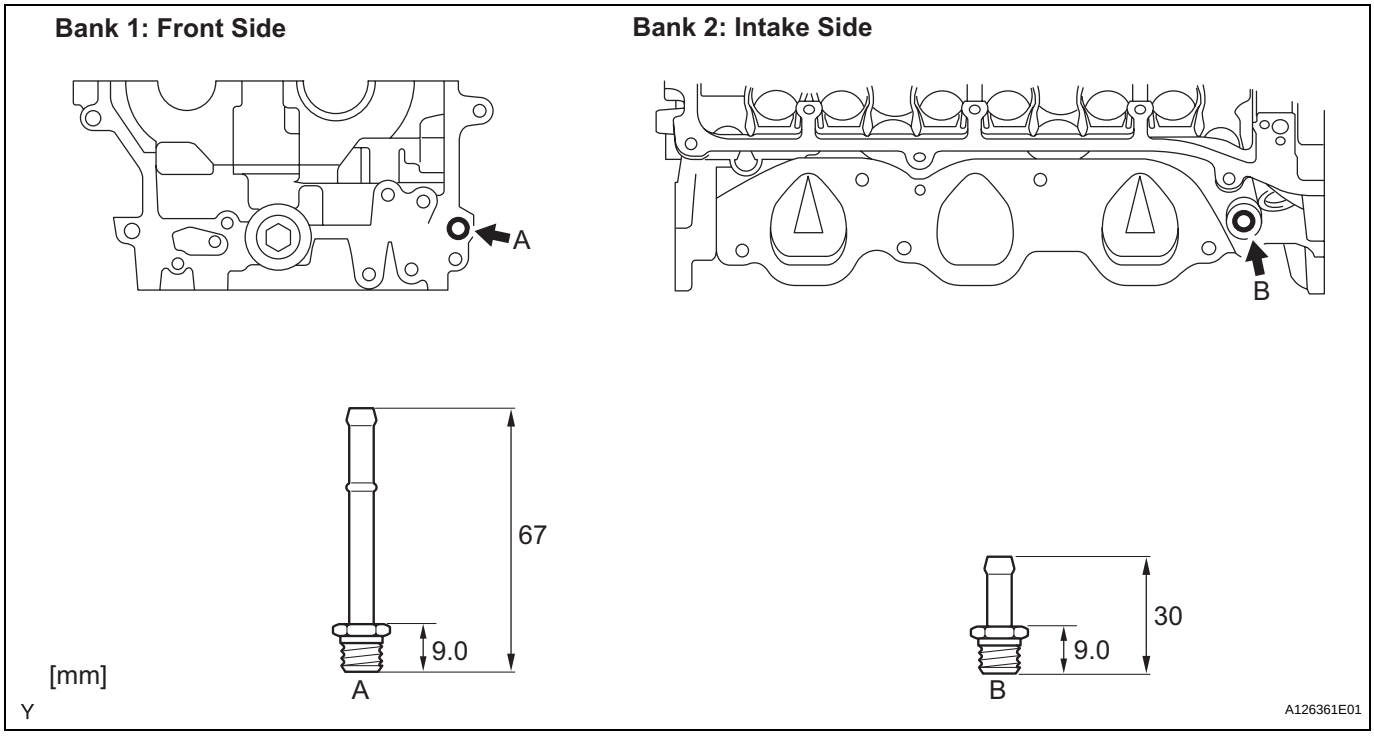
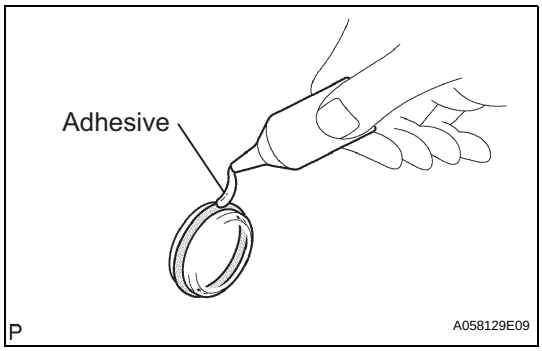


4. INSTALL UNION

(a) Apply adhesive to 2 or 3 threads of the bolt end.
Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or the equivalent

(b) Using a deep socket wrench 12, install the unions.
Torque: 15 N*m (150 kgf*cm, 11 ft.*lbf)





5. INSTALL TIGHT PLUG

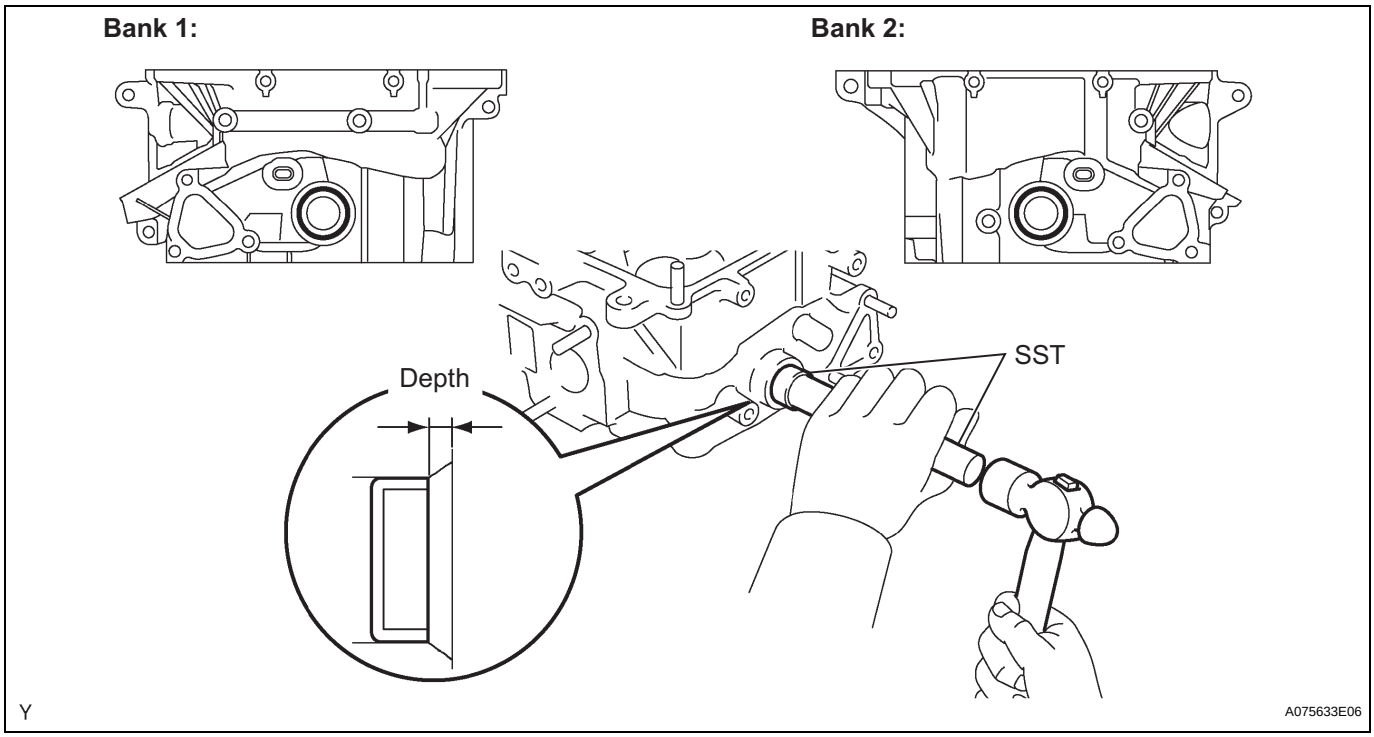
(a) Apply adhesive around the new tight plugs.

(b) Using SST, tap in the tight plugs to the specified depth.

SST 09950-60010 (09951-00250), 09950-70010 (09951-07150)

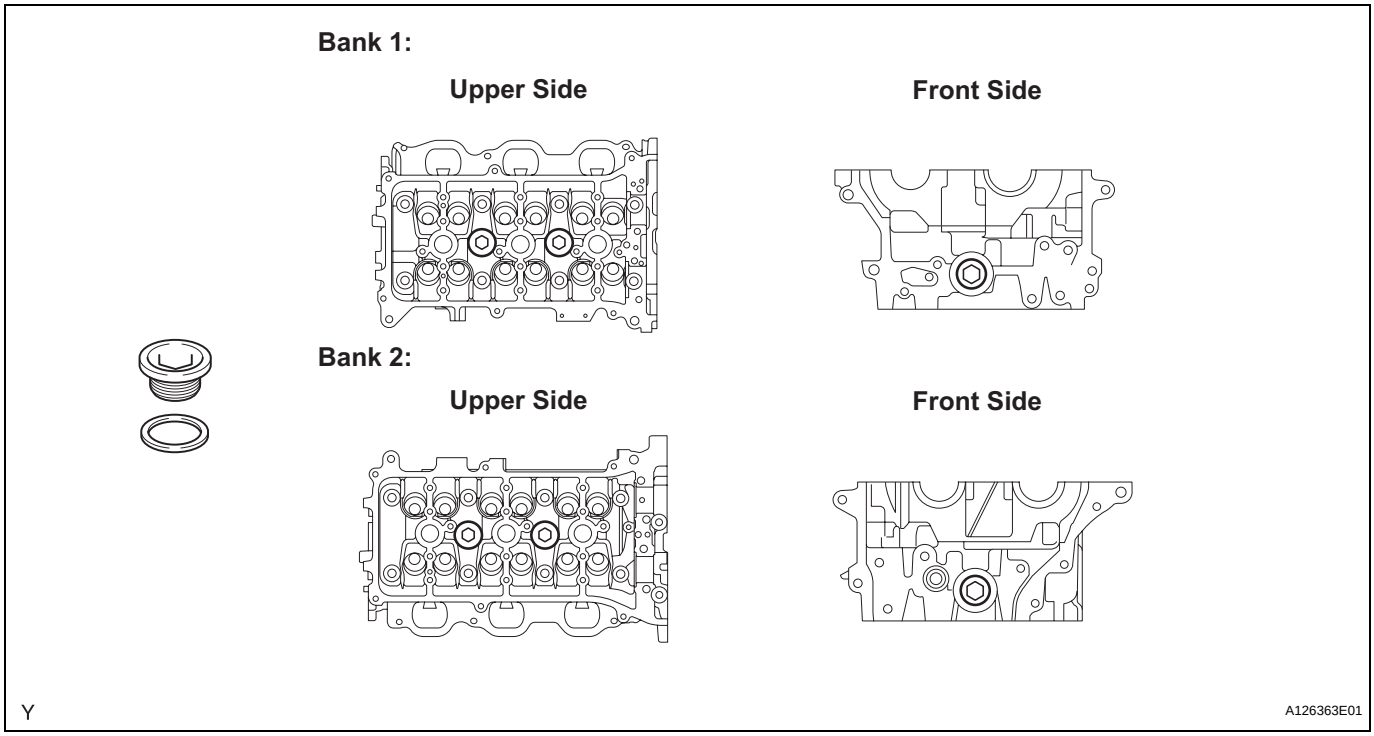
Specified depth:

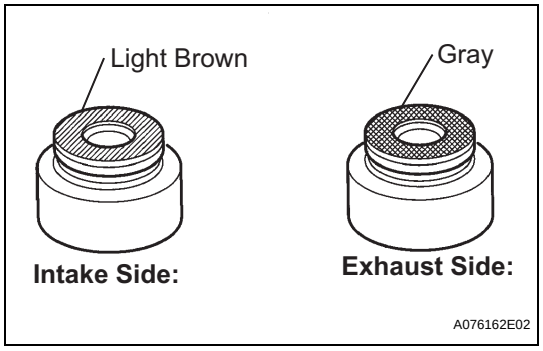
1.5 mm (0.059 in.)



6. INSTALL WITH HEAD STRAIGHT SCREW PLUG

(a) Using a straight hexagon wrench 14, install a new gasket and straight screw plug.
Torque: 80 N*m (816 kgf*cm, 59 ft.*lbf)

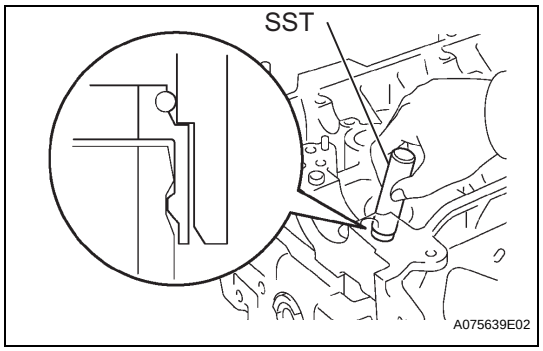




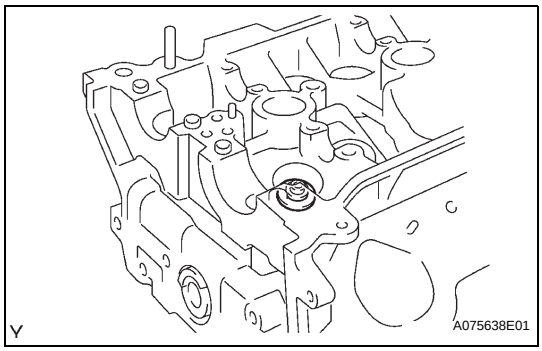
7. INSTALL VALVE STEM OIL SEAL OR RING

HINT:
The intake valve stem oil seal is light brown and the exhaust valve stem oil seal is gray.

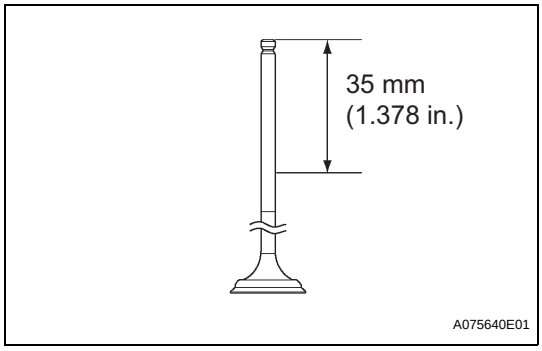
(a) Apply a light coat of engine oil to the valve guide bush.



(b) Using SST, push in a new valve stem oil seal.
SST 09201-41020

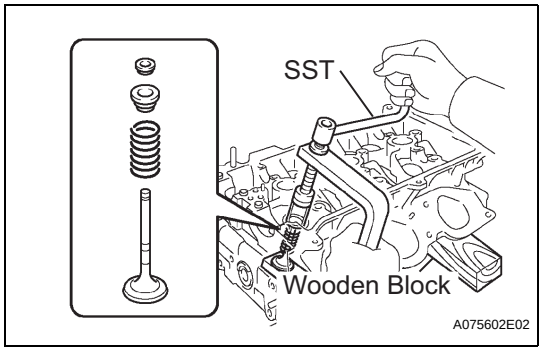


8. INSTALL VALVE SPRING SEAT

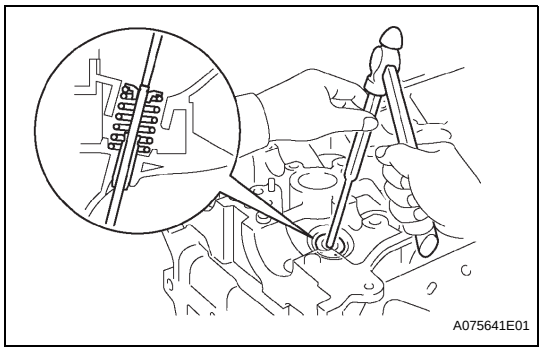


9. INSTALL VALVE

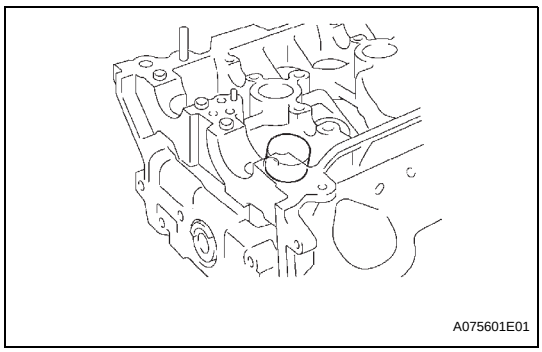
(a) Apply engine oil to the valve as shown in the illustration.



(b) Place the cylinder head on a wooden block.
(c) Install the valve, inner compression spring and valve spring retainer.
(d) Using SST, compress the inner compression spring and place the 2 valve spring retainer locks around the valve stem.
SST 09202-70020 (09202-00010)



(e) Using a pin punch 5, lightly tap the valve stem tip to ensure a proper fit.
NOTICE:
Be careful not to damage the valve stem tip.



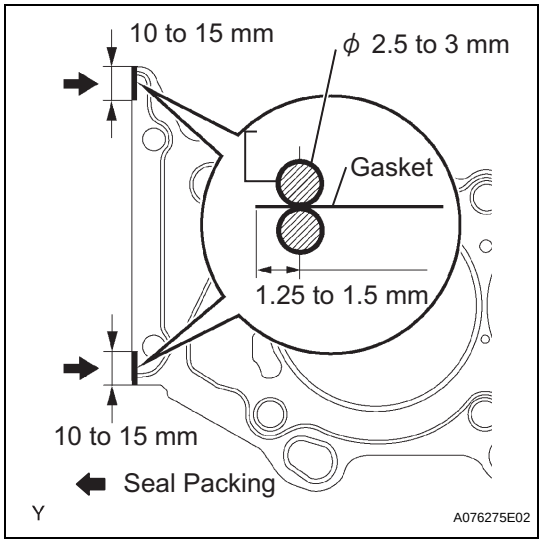
10. INSTALL VALVE LIFTER

(a) Apply engine oil to the valve stem end and valve lifter, and install the valve lifter onto the valve stem.
(b) Check that the valve lifter rotates smoothly by hand.

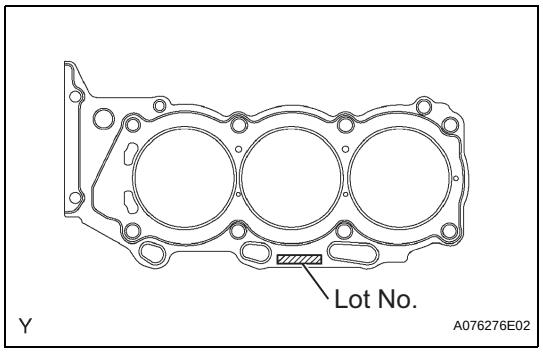
INSTALLATION

1. INSTALL NO. 2 CYLINDER HEAD GASKET

(a) Remove any old packing (FIPG) material.
HINT:
Do not drop any oil on the contact surface of the cylinder head and cylinder block.



(b) Apply a continuous bead of seal packing (diameter 2.5 to 3.0 mm (0.098 to 0.118 in.)) to a new cylinder head gasket as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head within 3 minutes of applying the seal packing. Tighten the cylinder head bolts within 15 minutes of installing the cylinder head. Otherwise, the seal packing must be removed and reapplied.

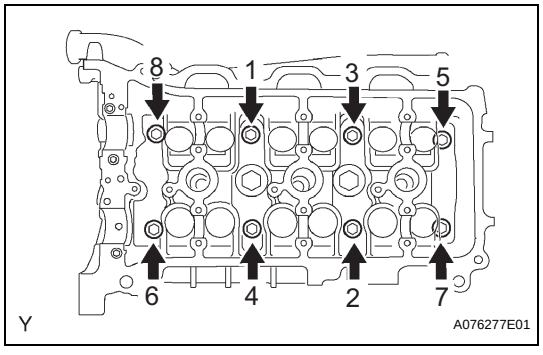


(c) Place the cylinder head gasket on the cylinder block surface with the Lot No. stamp facing upward.
NOTICE:
- **Orient the cylinder head gasket correctly.**
- **Place the cylinder head carefully in order not to damage the gasket with the bottom part of the head.**

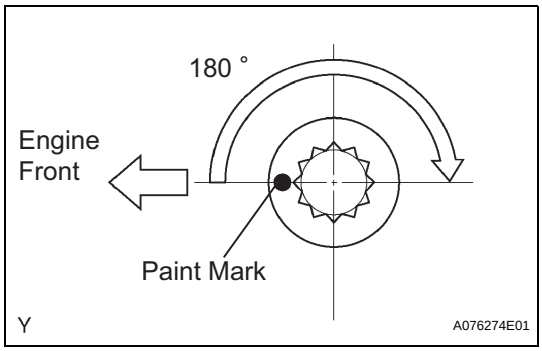
2. INSTALL CYLINDER HEAD LH

(a) Place the cylinder head on the cylinder head gasket.
(b) Install the 8 cylinder head bolts.
HINT:
- The cylinder head bolts are tightened in 2 successive steps (steps (*1) and (*2)).
- If any cylinder head bolts are broken or deformed, replace them.

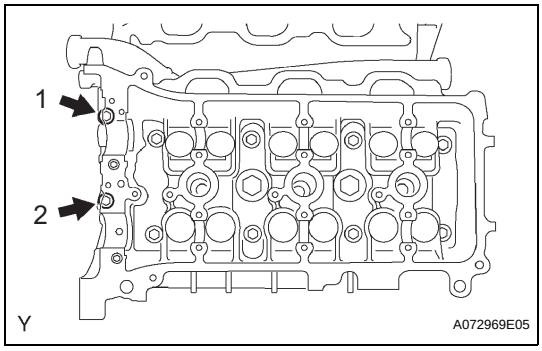
(1) Apply a light coat of engine oil to the threads of the cylinder head bolts.
(2) Install the plate washer onto the cylinder head bolt.



(3) Using several steps, uniformly tighten each bolt with a 10 mm bi-hexagon wrench in the sequence shown in the illustration. (*1)
Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)
If any cylinder head bolts do not meet the torque specification, replace them.
NOTICE:
Do not drop the washers into the cylinder head.

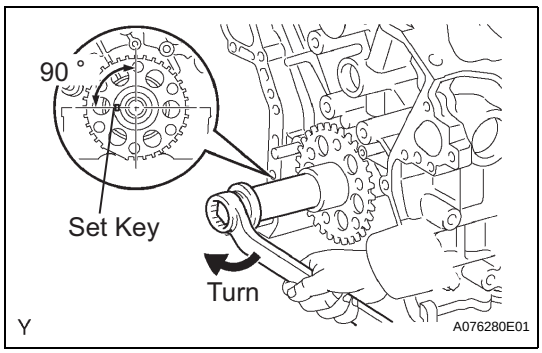


(4) Mark the front side of each cylinder head bolt with paint.
(5) Retighten the cylinder head bolts 180° as shown. (*2)
(6) Check that the painted marks are now at 180° from the engine front.

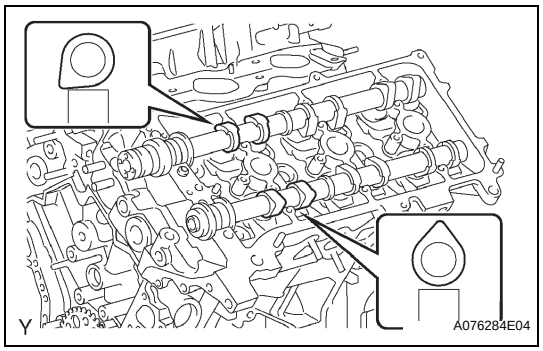


(c) Install the 2 cylinder head bolts.
(1) Apply a light coat of engine oil to the threads of the cylinder head bolts.
(2) Using several steps, uniformly install and tighten the 2 cylinder head bolts in the sequence shown in the illustration.
Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)
(d) Install the ground cable with the bolt.
Torque: 8.0 N*m (82 kgf*cm, 71 ft.*lbf)
(e) Install the air fuel ratio sensor connector bracket with bolt.
Torque: 19 N*m (189 kgf*cm, 14 ft.*lbf)

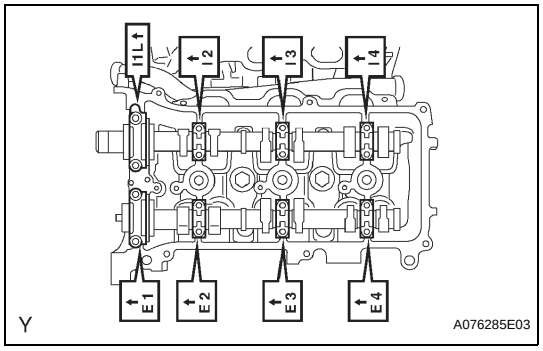
3. INSTALL CAMSHAFTS (for Bank 2)
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.



(a) Set the crankshaft position.
(1) Using the crankshaft pulley set bolt, turn the crankshaft, and set the crankshaft set key in the left horizontal position.
NOTICE:
Installing the crankshaft at the wrong angle could cause the piston head and valve head to come into contact with each other when installing the camshaft. This could cause damage, so always set the crankshaft at the correct angle.
(b) Apply new engine oil to the thrust portion and journal of the camshafts.

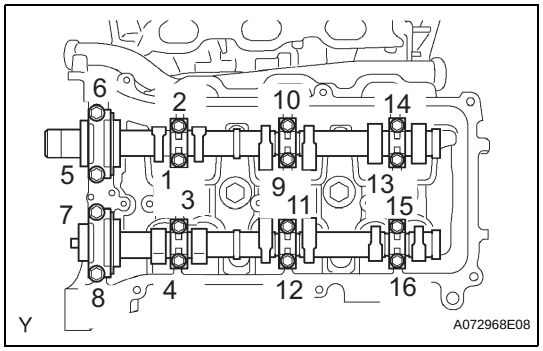


(c) Place the 2 camshafts onto the cylinder head with the cam lobes of No. 1 cylinder facing in the directions shown in the illustration.



(d) Install the 8 bearing caps in the proper locations as shown.

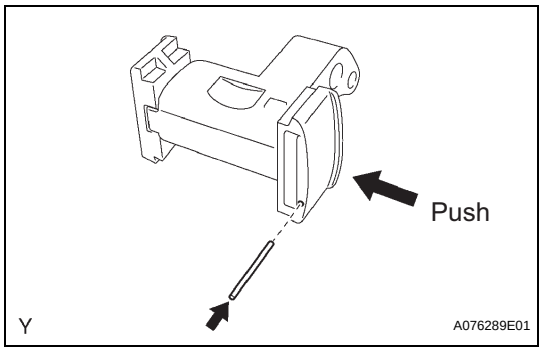
(e) Apply a light coat of engine oil to the threads and under the leads of the bearing cap bolts.



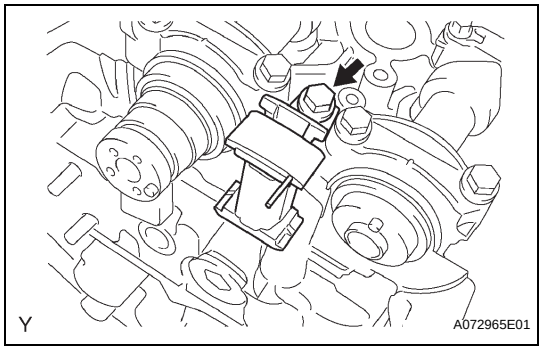
(f) Using several steps, uniformly install and tighten the 16 bearing cap bolts in the sequence shown in the illustration.

Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)

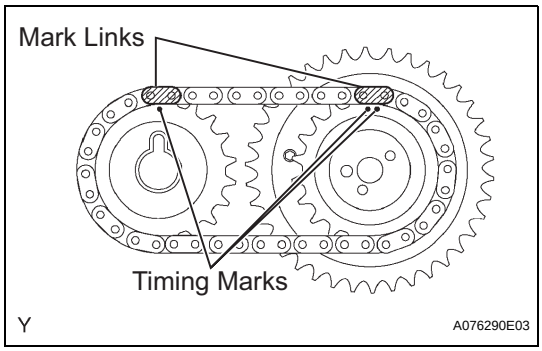
4. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY



(a) While pushing in the tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.

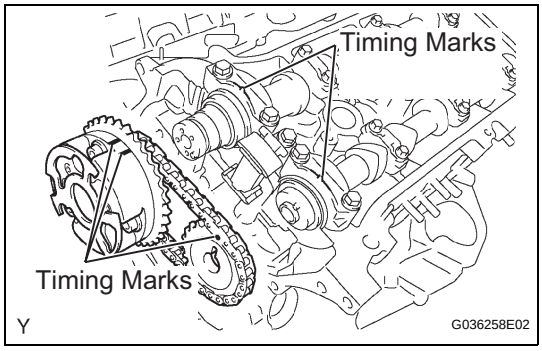


(b) Install the No. 2 chain tensioner with the bolt.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)



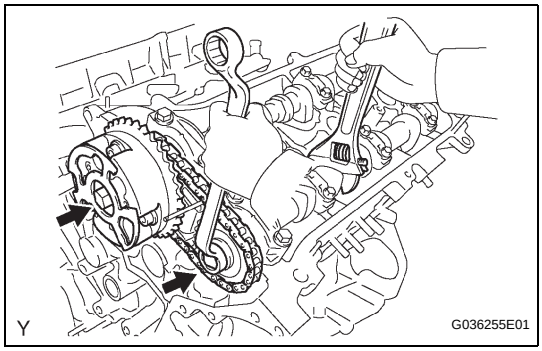
5. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)

(a) Align the yellow mark links with the timing marks (1 dot mark and 2 dot marks) of the camshaft timing gears as shown in the illustration.



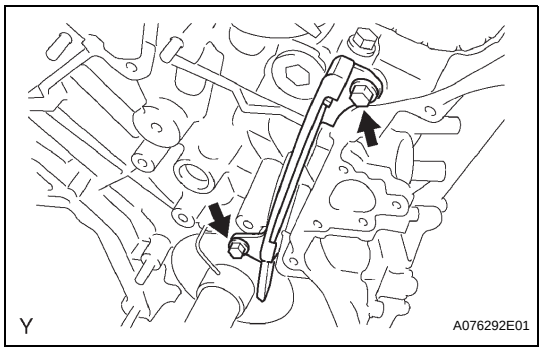
(b) Align the timing marks on the camshaft timing gears with the timing marks on the bearing caps, and install the camshaft timing gears with the chain onto the LH camshafts.

(c) Temporarily install the 2 camshaft timing gear bolts.
NOTICE:
Do not push the camshaft timing gear assembly against the camshaft forcibly when installing it.



(d) Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

(e) Remove the pin from tensioner No. 2.

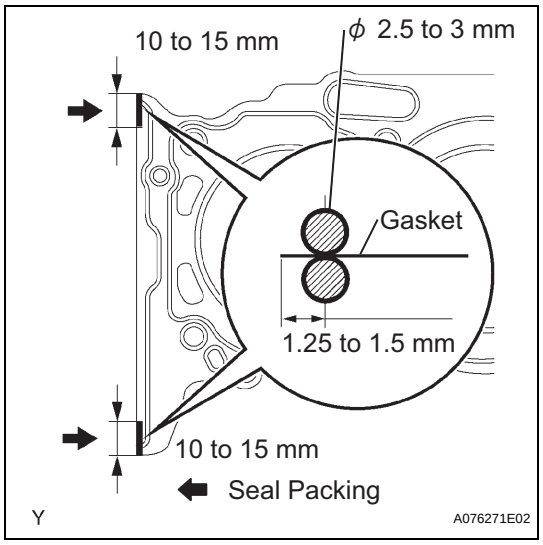


6. INSTALL NO. 1 CHAIN VIBRATION DAMPER

(a) Install the chain vibration damper with the 2 bolts.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)

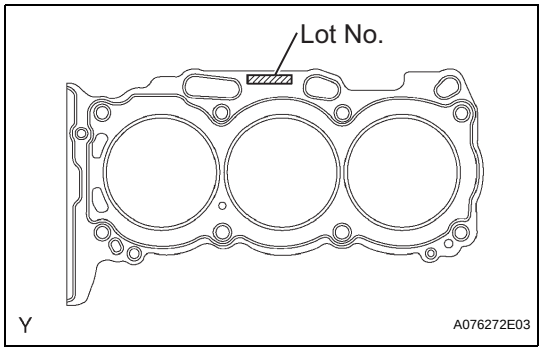
7. INSTALL CYLINDER HEAD GASKET

(a) Remove any old packing (FIPG) material.
HINT:
Do not drop any oil on the contact surfaces of the cylinder head and cylinder block.



(b) Apply a continuous bead of seal packing (diameter 2.5 to 3 mm (0.098 to 0.118 in.)) to a new cylinder head gasket as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head within 3 minutes of applying the seal packing. Tighten the cylinder head bolts within 15 minutes of installing the cylinder head. Otherwise, the seal packing must be removed and reapplied.

EM



(c) Place the cylinder head gasket on the cylinder block surface with the Lot No. stamp facing upward.
NOTICE:
- **Orient the cylinder head gasket correctly.**
- **Place the cylinder head carefully in order not to damage the gasket.**

8. INSTALL CYLINDER HEAD SUB-ASSEMBLY

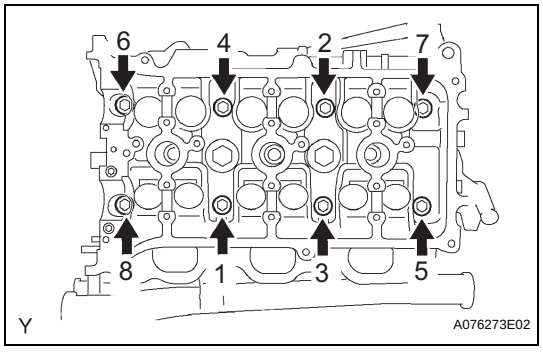
(a) Place the cylinder head on the cylinder head gasket.

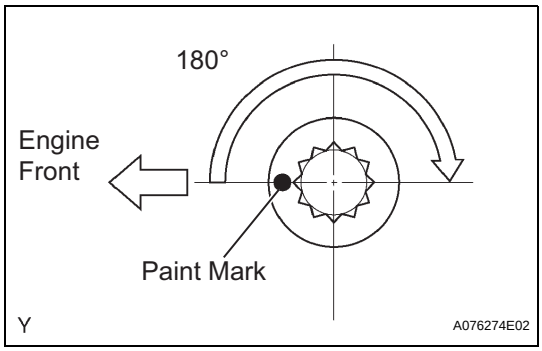
(b) Install the 8 cylinder head bolts.
HINT:
- The cylinder head bolts are tightened in 2 successive steps (steps (*1) and (*2)).
- If any cylinder head bolts are broken or deformed, replace them.

(1) Apply a light coat of engine oil to the threads of the cylinder head bolts.

(2) Install the plate washer onto the cylinder head bolt.

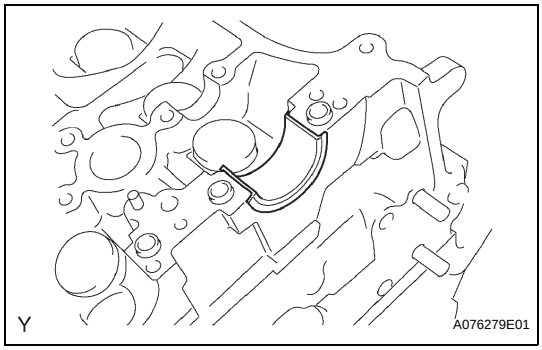
(3) Using several steps, tighten each bolt uniformly with a 10 mm bi-hexagon wrench in the sequence shown in the illustration. (*1)
Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)
If any cylinder head bolts do not meet the torque specification, replace them.
NOTICE:
Do not drop the washers into the cylinder head.





(4) Mark the front side of each cylinder head bolt with paint.
(5) Retighten the cylinder head bolts 180° as shown. (*2)
(6) Check that the painted marks are now at 180° from the engine front.

(c) Install the ground cable with the bolt.
Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

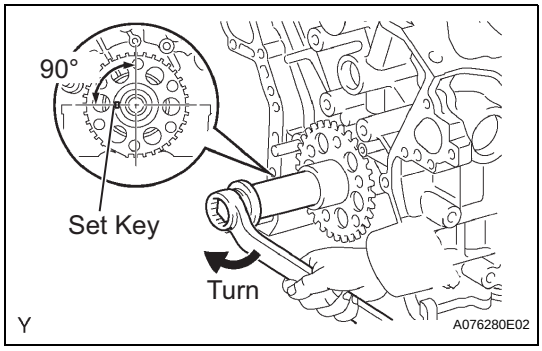


9. INSTALL NO. 2 CAMSHAFT BEARING

(a) Install the No. 2 camshaft bearing onto the cylinder head.
NOTICE:
Clean the installation planes of the back side of the bearing and cylinder head and keep them free of oil.

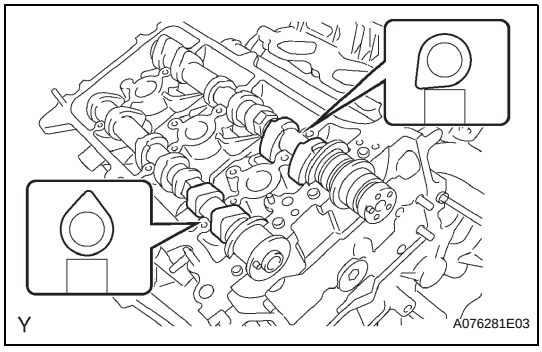
10. INSTALL CAMSHAFTS (for Bank 1)
NOTICE:
Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

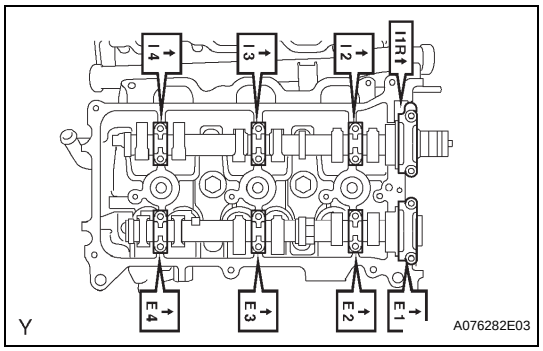
(a) Set the crankshaft position.
(1) Using the crankshaft pulley set bolt, turn the crankshaft, and set the crankshaft set key in the left horizontal position.
NOTICE:
Installing the crankshaft at the wrong angle could cause the piston head and valve head to come into contact with each other when installing the camshaft. This could cause damage, so always set the crankshaft at the correct angle.



(b) Apply new engine oil to the thrust portion and journal of the camshafts.

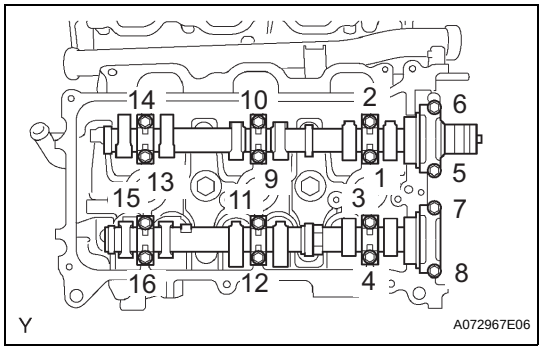
(c) Place the 2 camshafts onto the cylinder head with the cam lobes of No. 1 cylinder facing in the directions shown in the illustration.





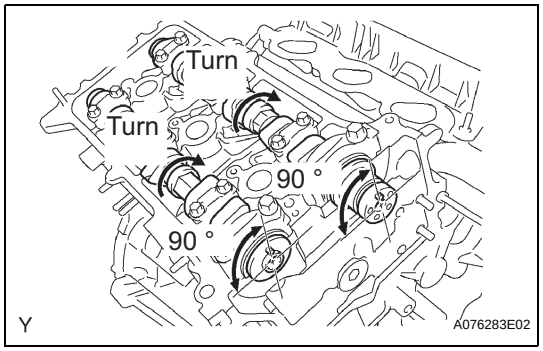
(d) Install the 8 bearing caps in the proper locations as shown.

(e) Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.



(f) Using several steps, uniformly install and tighten the 16 bearing cap bolts in the sequence shown in the illustration.

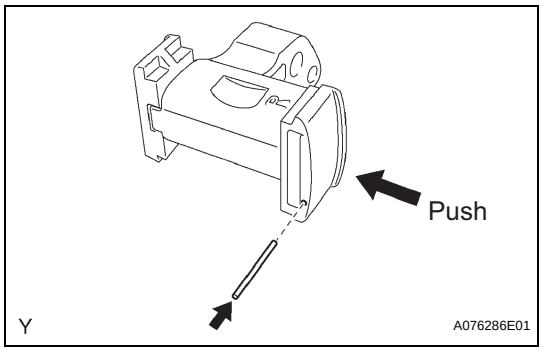
Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)

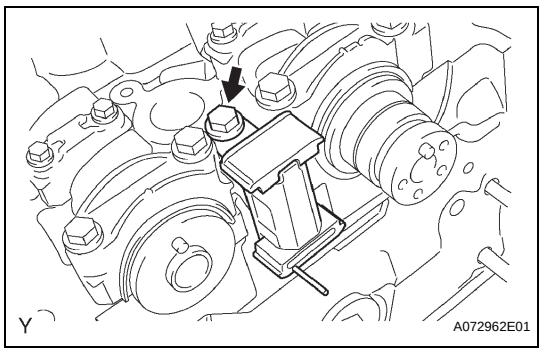


(g) Turn the camshafts clockwise until the knock pin comes to a position 90° to the cylinder head.

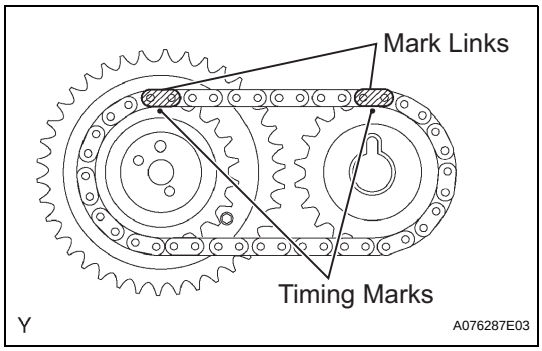
11. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

(a) While pushing in the tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.



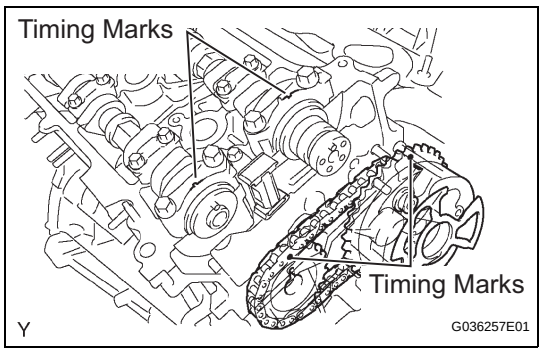


(b) Install the No. 2 chain tensioner with the bolt.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)



12. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

(a) Align the yellow mark links with the timing marks (1 dot mark) of the camshaft timing gears as shown in the illustration.

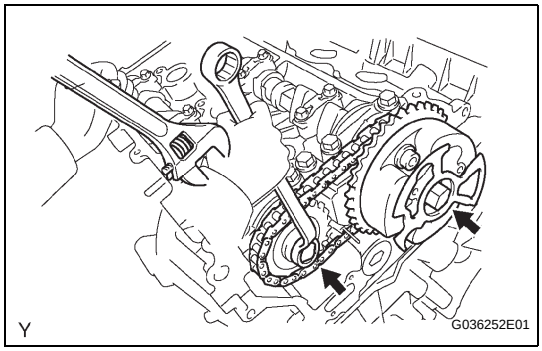


(b) Align the timing marks on the camshaft timing gears with the timing marks on the bearing caps, and install the camshaft timing gears with the chain onto the RH camshafts.

(c) Temporarily install the 2 camshaft timing gear bolts.

NOTICE:

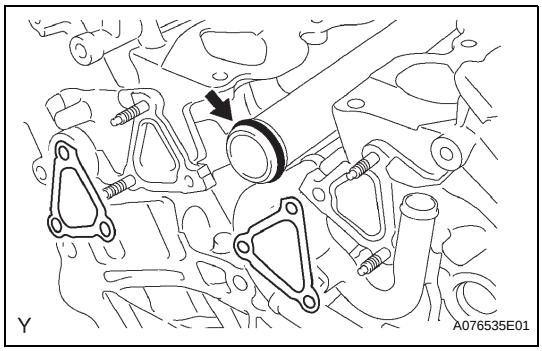
Do not push the camshaft timing gear assembly against the camshaft forcibly when installing it.



(d) Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.

Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

(e) Remove the No. 2 pin from the tensioner.



13. INSTALL WATER BY-PASS JOINT RR

(a) Install a new O-ring onto the water outlet pipe.

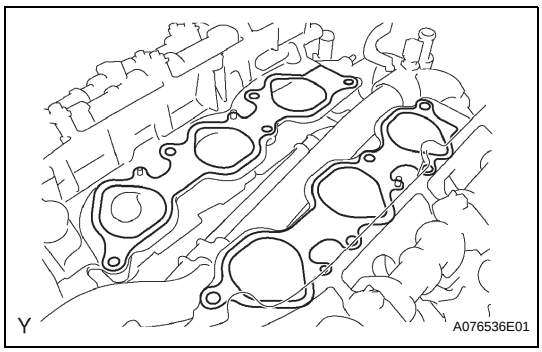
(b) Apply soapy water to the O-ring.

(c) Install 2 new gaskets and water by-pass joint rear with the 2 bolts and 4 nuts.

Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

(d) Connect the heater hose.

(e) Connect the engine coolant temperature sensor connector.



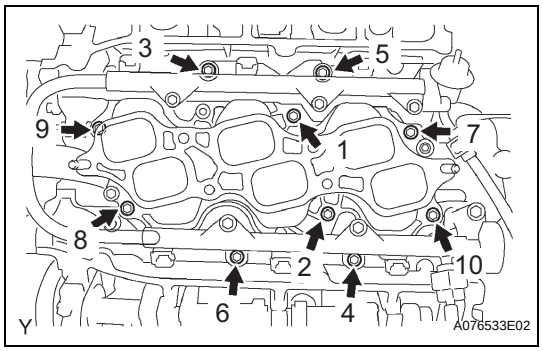
14. INSTALL INTAKE MANIFOLD

(a) Set a new gasket on each cylinder head.

NOTICE:

- **Align the port holes of the gasket and cylinder head.**
- **Orient the gasket correctly.**

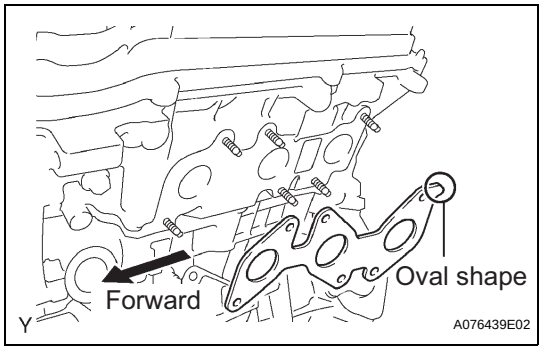
(b) Set the intake manifold on the cylinder heads.



(c) Install and tighten the 10 bolts uniformly in several steps.
Torque: 26 N*m (265 kgf*cm, 19 ft.*lbf)
(d) Connect the 6 fuel injector connectors.

15. CONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY (See page FU-19)

16. CONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY (See page FU-17)



17. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH
(a) Set a new gasket to the bank 2 cylinder head with the oval shape facing forward.
NOTICE:
Orient the new gasket correctly.

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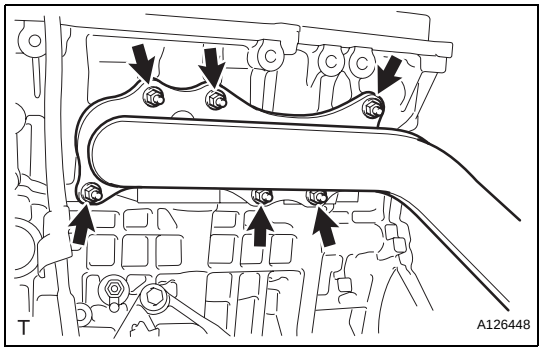
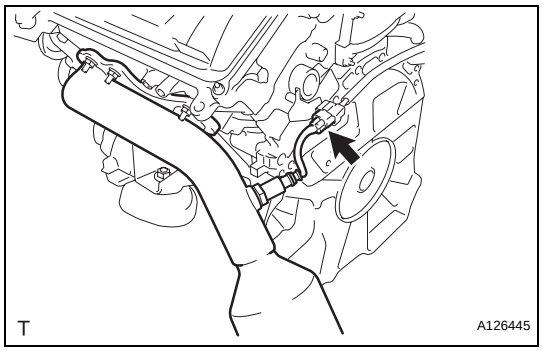
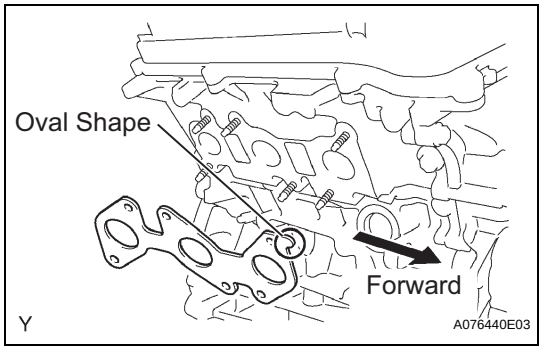


(b) Install the exhaust manifold with the 6 nuts.
Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)

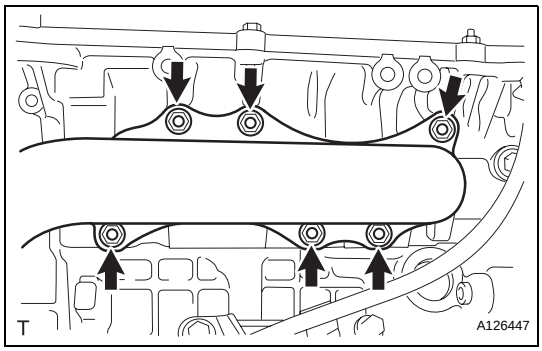


(c) Connect the air fuel ratio sensor connector.

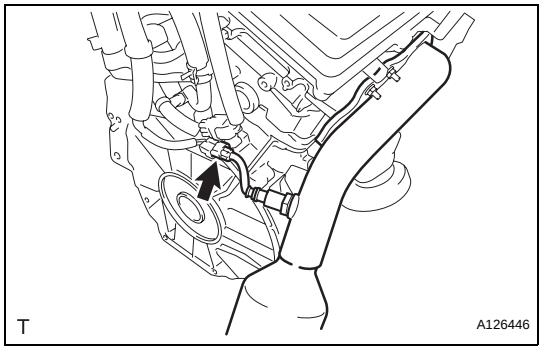
18. INSTALL NO. 2 MANIFOLD STAY
(a) Install the No. 2 manifold stay with the 3 bolts.
Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)



19. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH
(a) Set a new gasket to the bank 1 cylinder head with the oval shape facing forward.
NOTICE:
Orient the new gasket correctly.



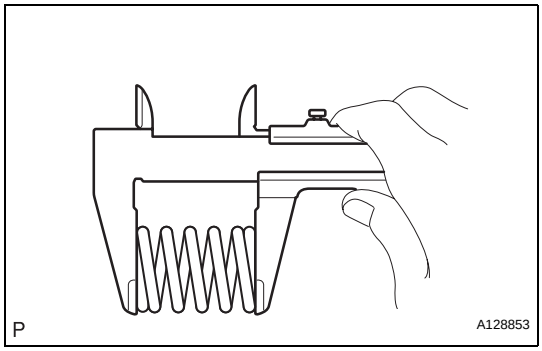
(b) Install the exhaust manifold with the 6 nuts.
Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)



(c) Connect the air fuel ratio sensor connector.

20. INSTALL MANIFOLD STAY

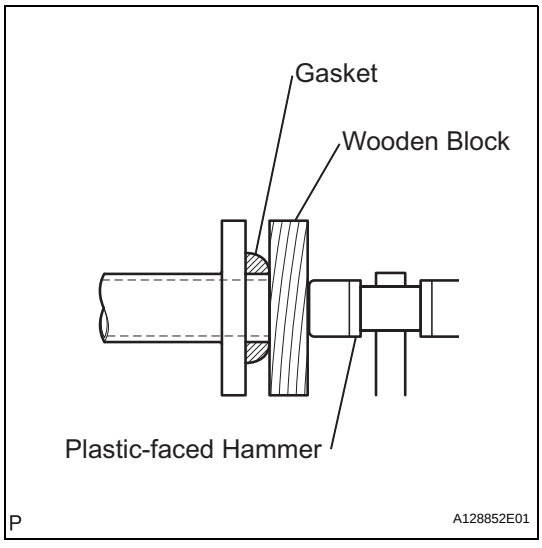
(a) Install the manifold stay with the 3 bolts.
Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)



21. INSTALL FRONT EXHAUST PIPE ASSEMBLY

(a) Check the free length.
(1) Using vernier calipers, measure the free length of the compression spring.
Minimum:
40.5mm (1.594 in.)
If the free length is less that the minimum, replace the compression spring.

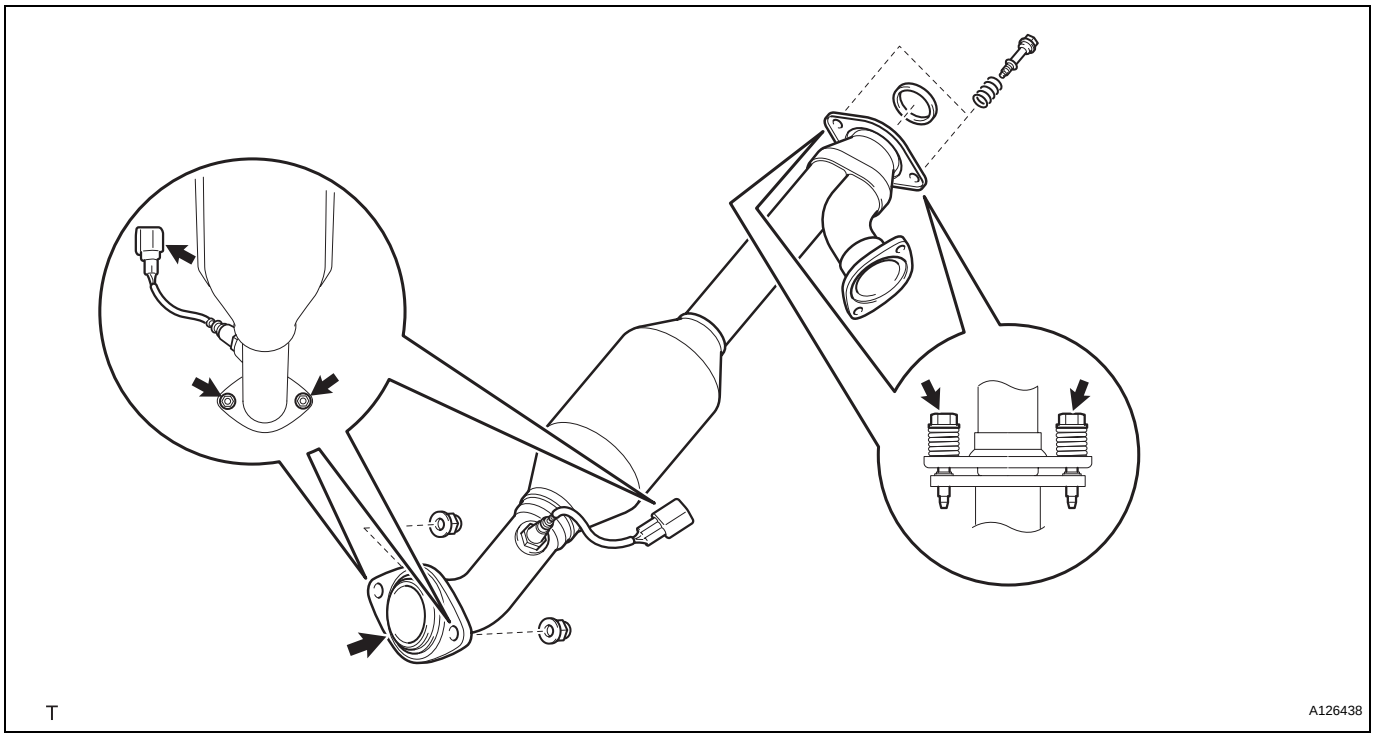
(b) Install a new gasket onto the exhaust manifold RH.



(c) Install a new gasket onto the exhaust front pipe.
(1) Using a wooden block and plastic-faced hammer, tap in the new gasket until it is flush with the exhaust front pipe.
NOTICE:
- **Make sure that the gasket is in the correct direction when installing.**
- **Do not reuse the removed gasket.**

(d) Install the exhaust front pipe with new 2 nuts.
Torque: 54 N*m (554 kgf*cm, 40 ft.*lbf)

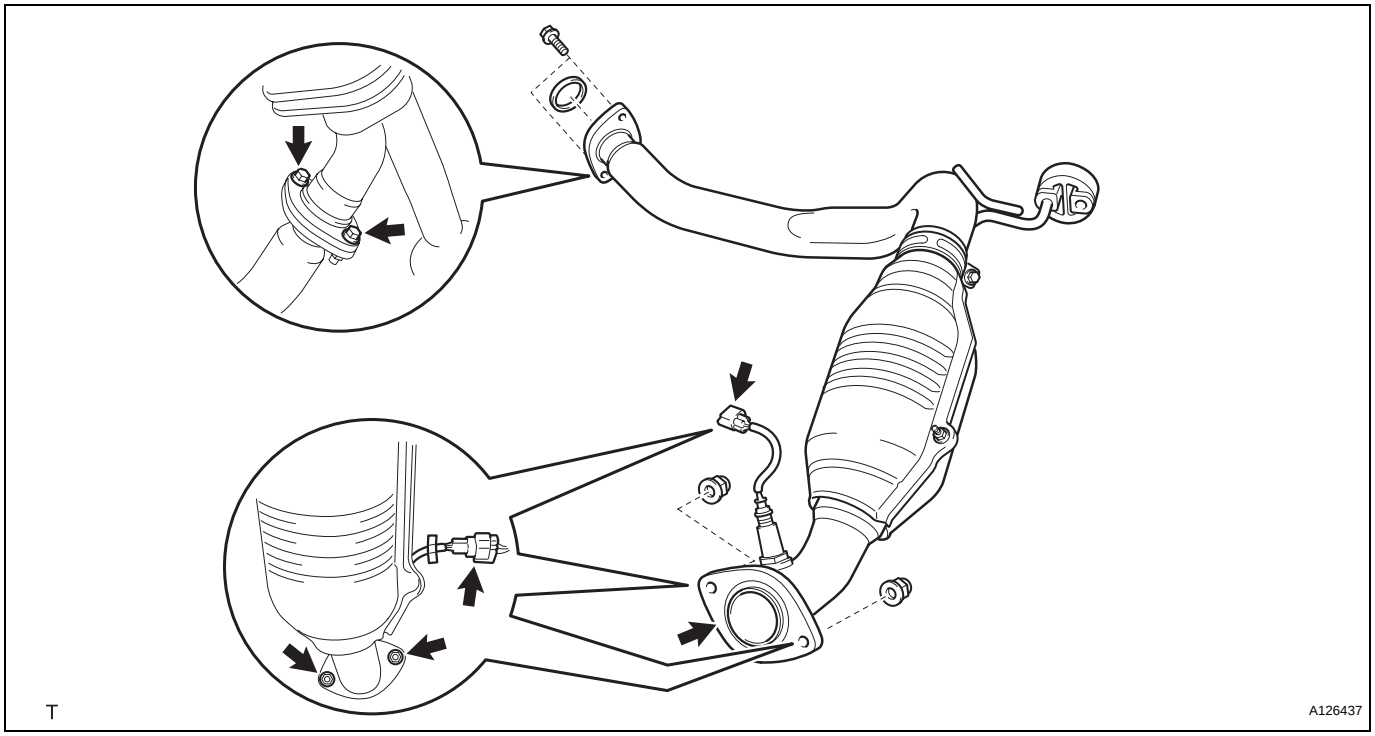
(e) Install the exhaust center pipe onto the front exhaust pipe with the 2 bolts and 2 springs.



Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

(f) Connect the oxygen sensor connector.

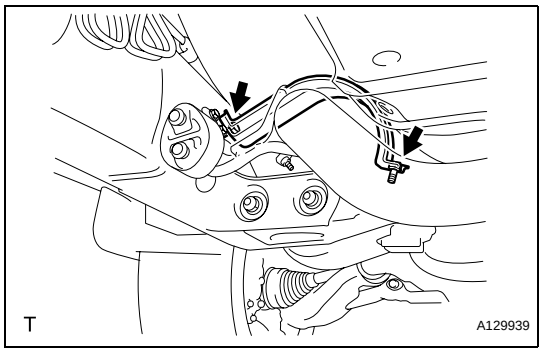
22. INSTALL NO. 2 FRONT EXHAUST PIPE ASSEMBLY



(a) Install a new gasket onto the exhaust manifold LH.

(b) Install a new gasket onto the No. 2 front exhaust pipe.

(c) Install the No. 2 front exhaust pipe with the 2 new nuts and 2 bolts.
Torque: Nut
54 N*m (554 kgf*cm, 40 ft.*lbf)
Bolt
48 N*m (489 kgf*cm, 35 ft.*lbf)
(d) Connect the oxygen sensor connector.



23. INSTALL EXHAUST PIPE STOPPER BRACKET (for 4WD)
(a) Install the exhaust pipe stopper bracket with the 2 bolts.
Torque: 19 N*m (193 kgf*cm, 14 ft.*lbf)

24. INSTALL NO. 1 COOL AIR INLET
(a) Install the cool air inlet with the 2 bolts.
Torque: 12 N*m (122 kgf*cm, 9.0 ft.*lbf)

25. INSTALL CHAIN SUB-ASSEMBLY
Refer to the procedures up to "INSTALL CHAIN TENSIONER SLIPPER" (See page EM-27).

26. CHECK FOR FUEL LEAKAGE

27. CHECK FOR EXHAUST GAS LEAKAGE

28. INSPECT IGNITION TIMING (See page EM-1)

29. INSPECT ENGINE IDLING SPEED (See page EM-2)

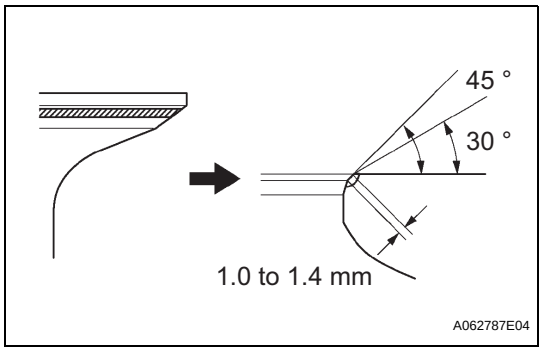
30. REMOVE COMPRESSION (See page EM-3)

31. INSPECT CO/HC (See page EM-3)

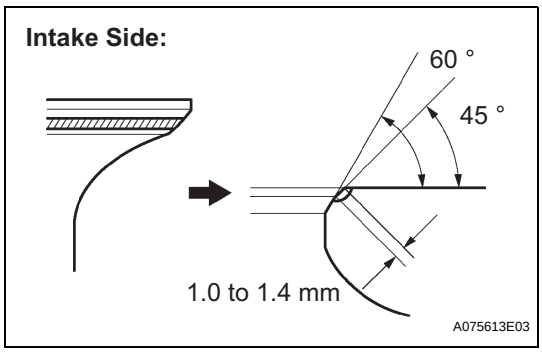
32. INSPECT AND ADJUST FRONT WHEEL ALIGNMENT (See page SP-2)

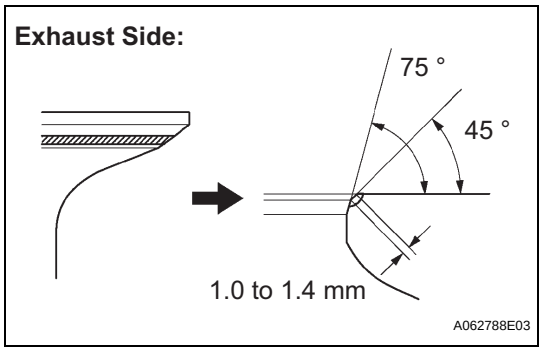
REPAIR

1. REPAIR VALVE SEAT
NOTICE:
Use a cutter to gradually smooth the intake valve seat.
(a) If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

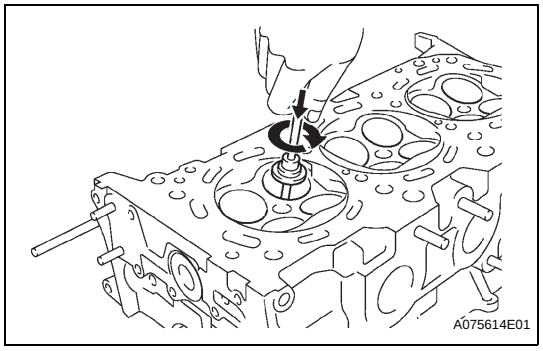


(b) Intake side:
If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.





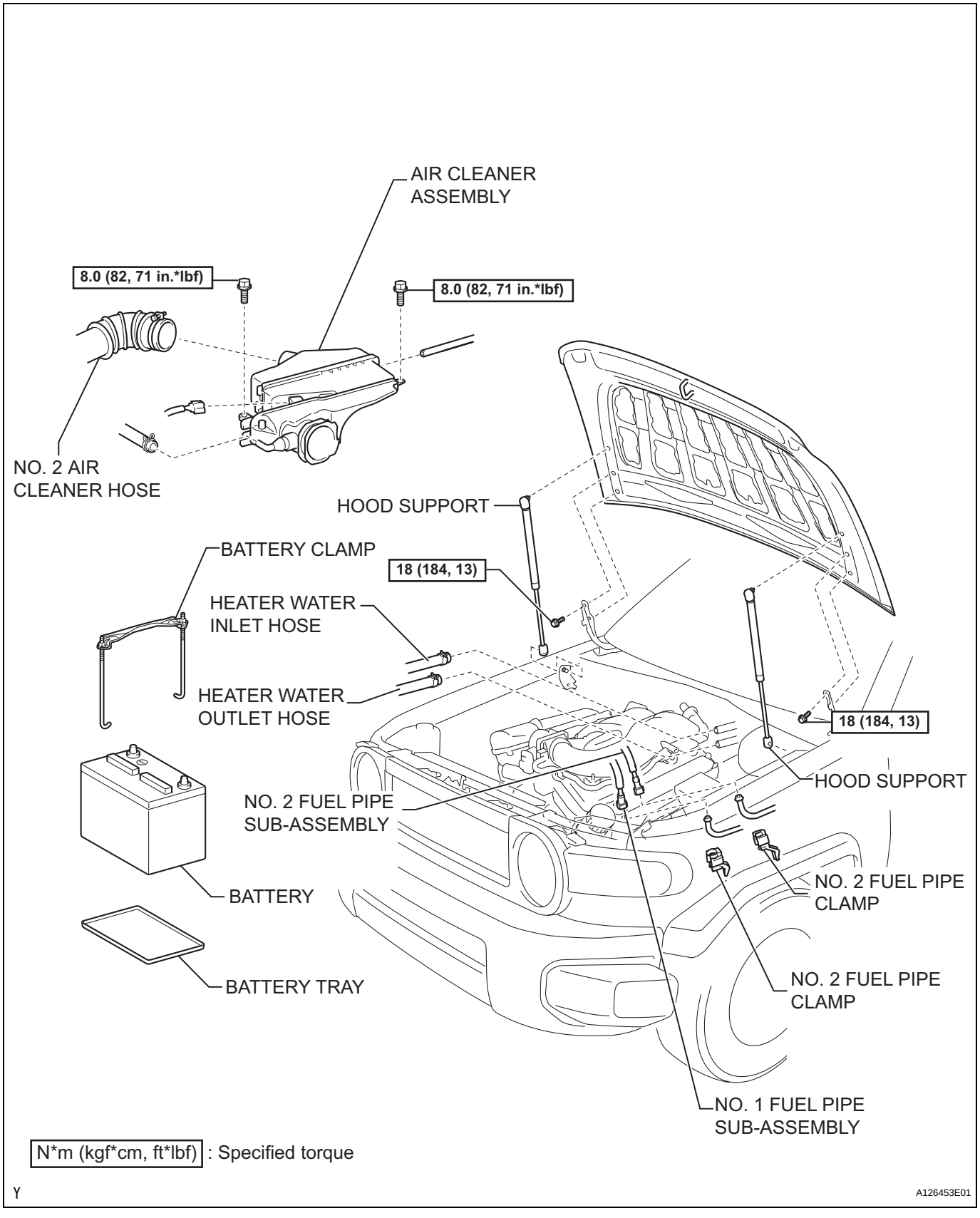
(c) Exhaust side:
If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.

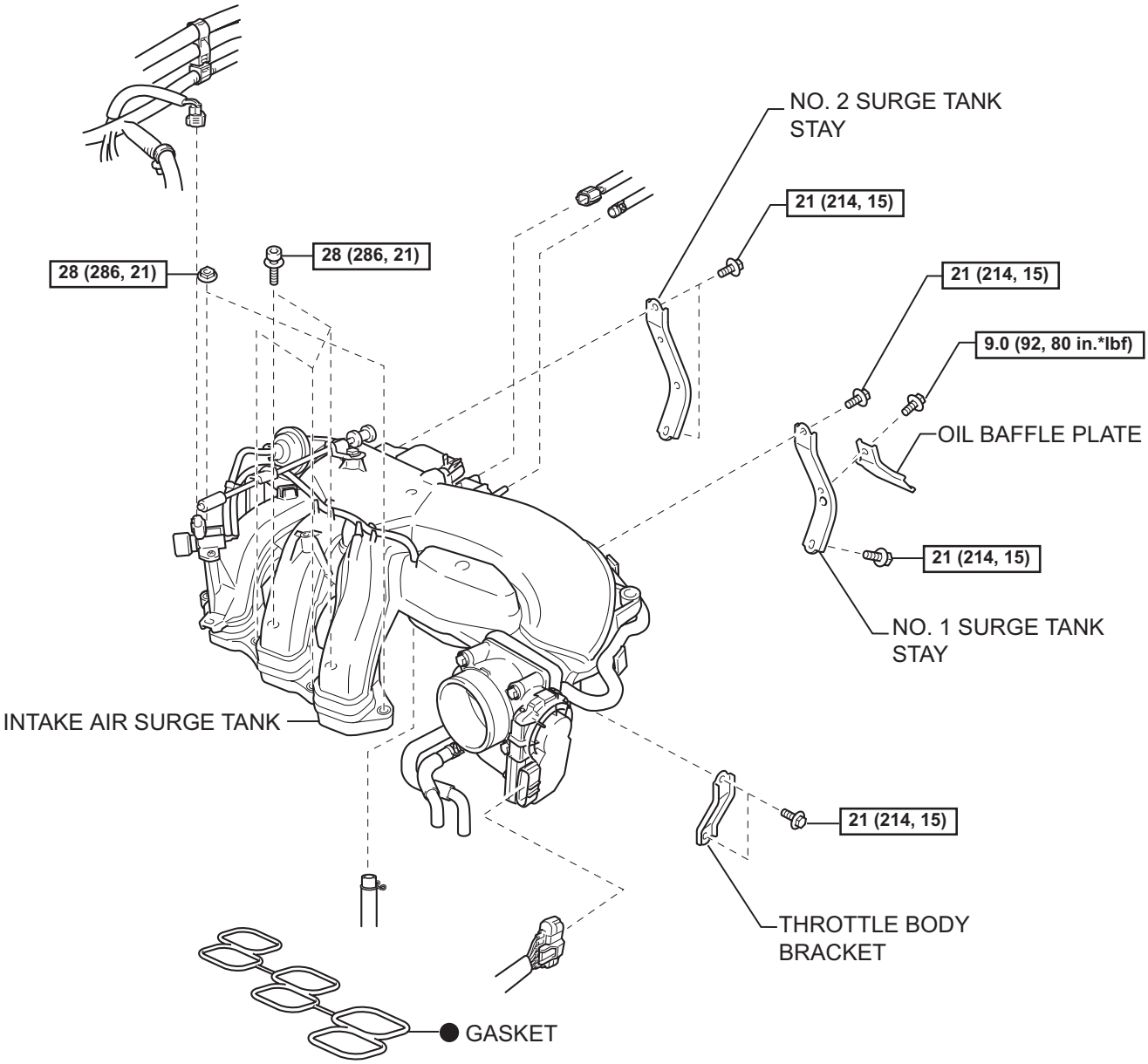


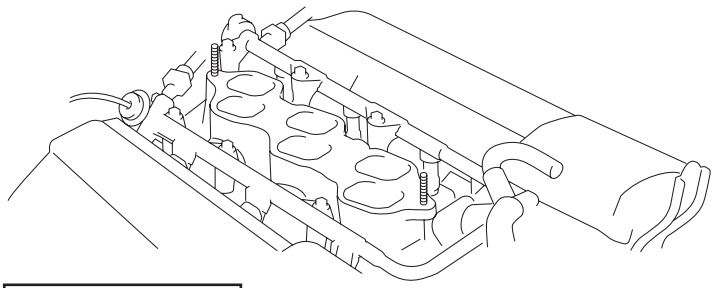
(d) Lap the valve and valve seat with an abrasive compound by hand.
(e) After lapping, clean the valve and valve seat.

ENGINE ASSEMBLY

COMPONENTS





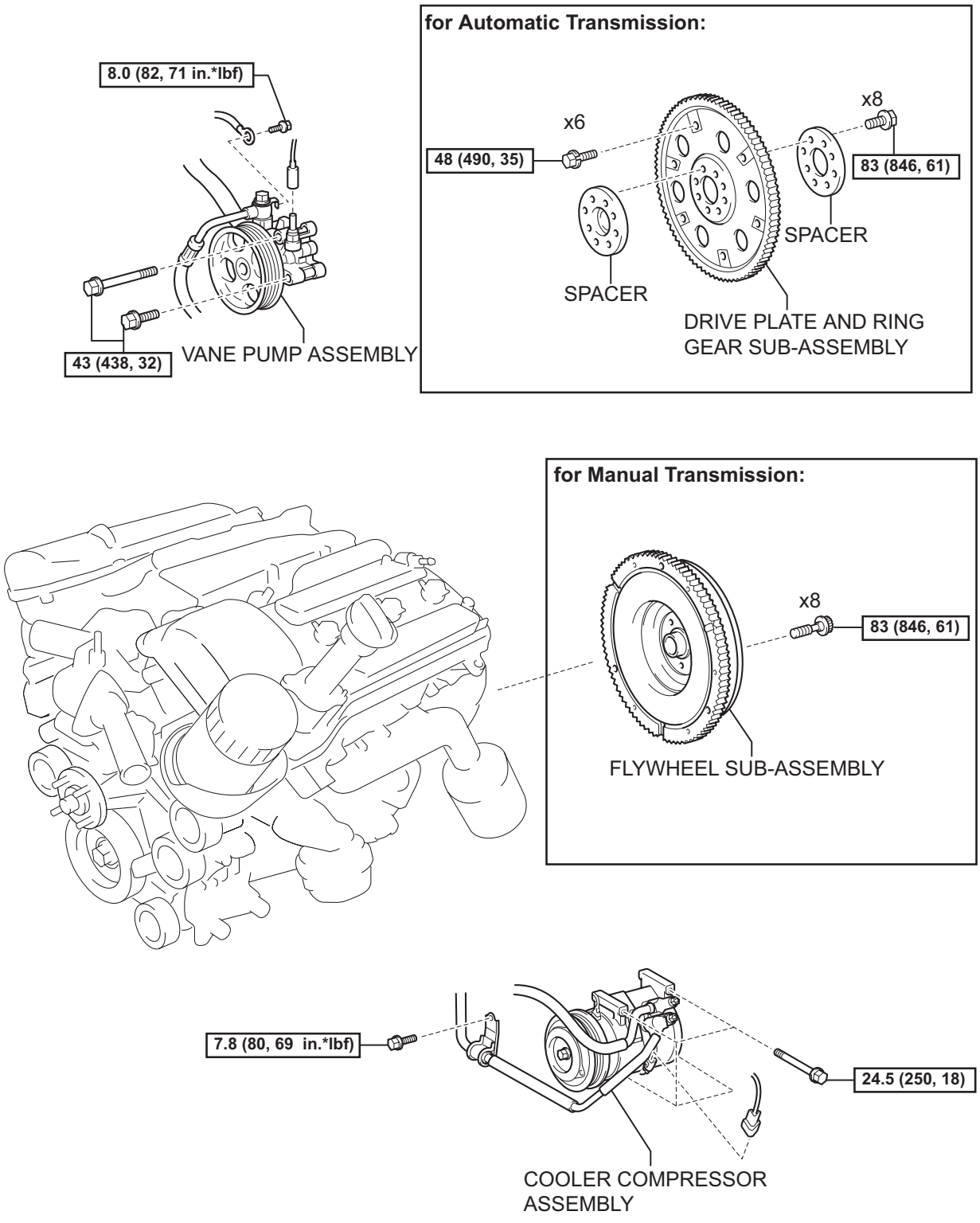


N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

A126476E01



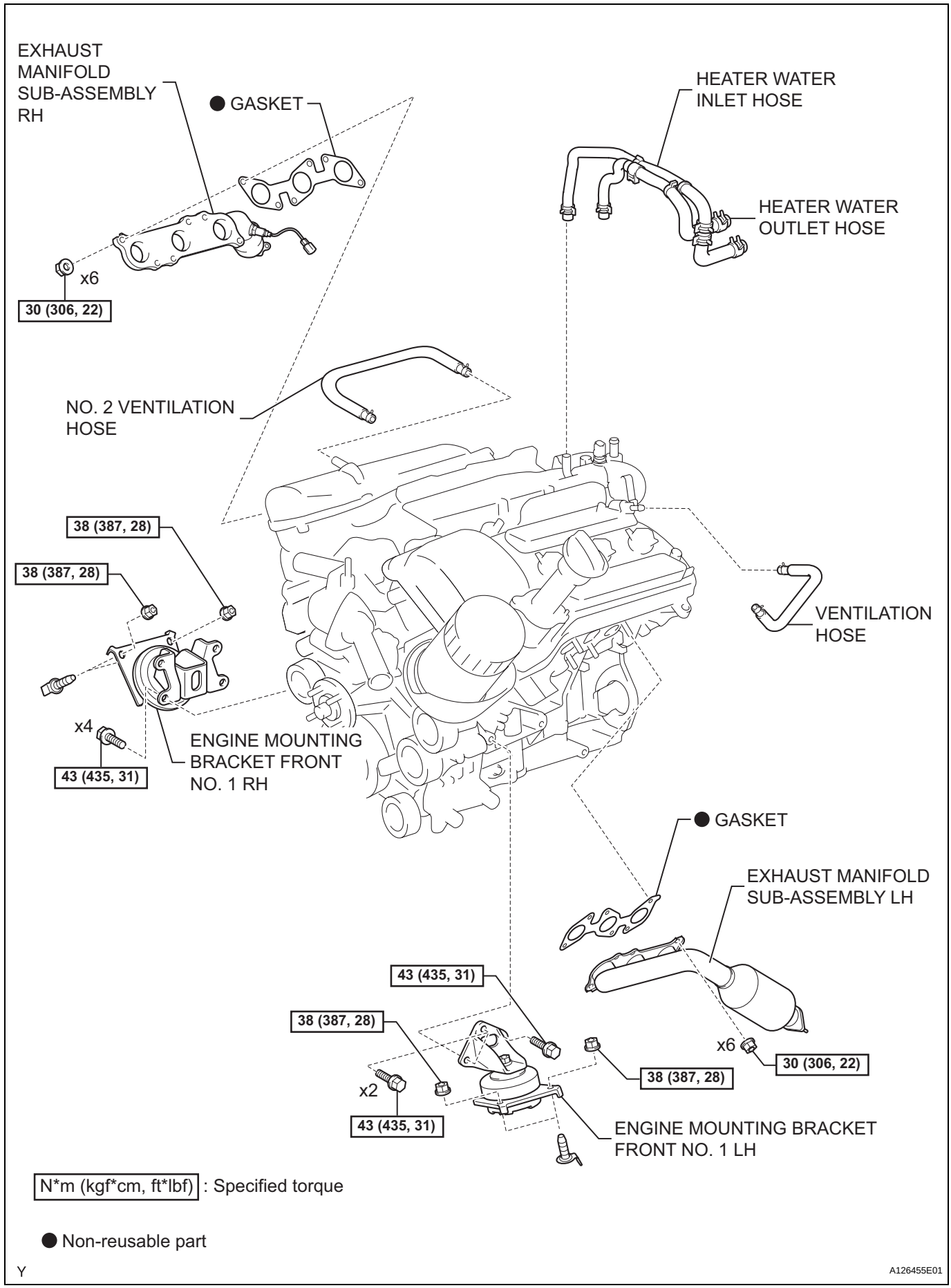
EM

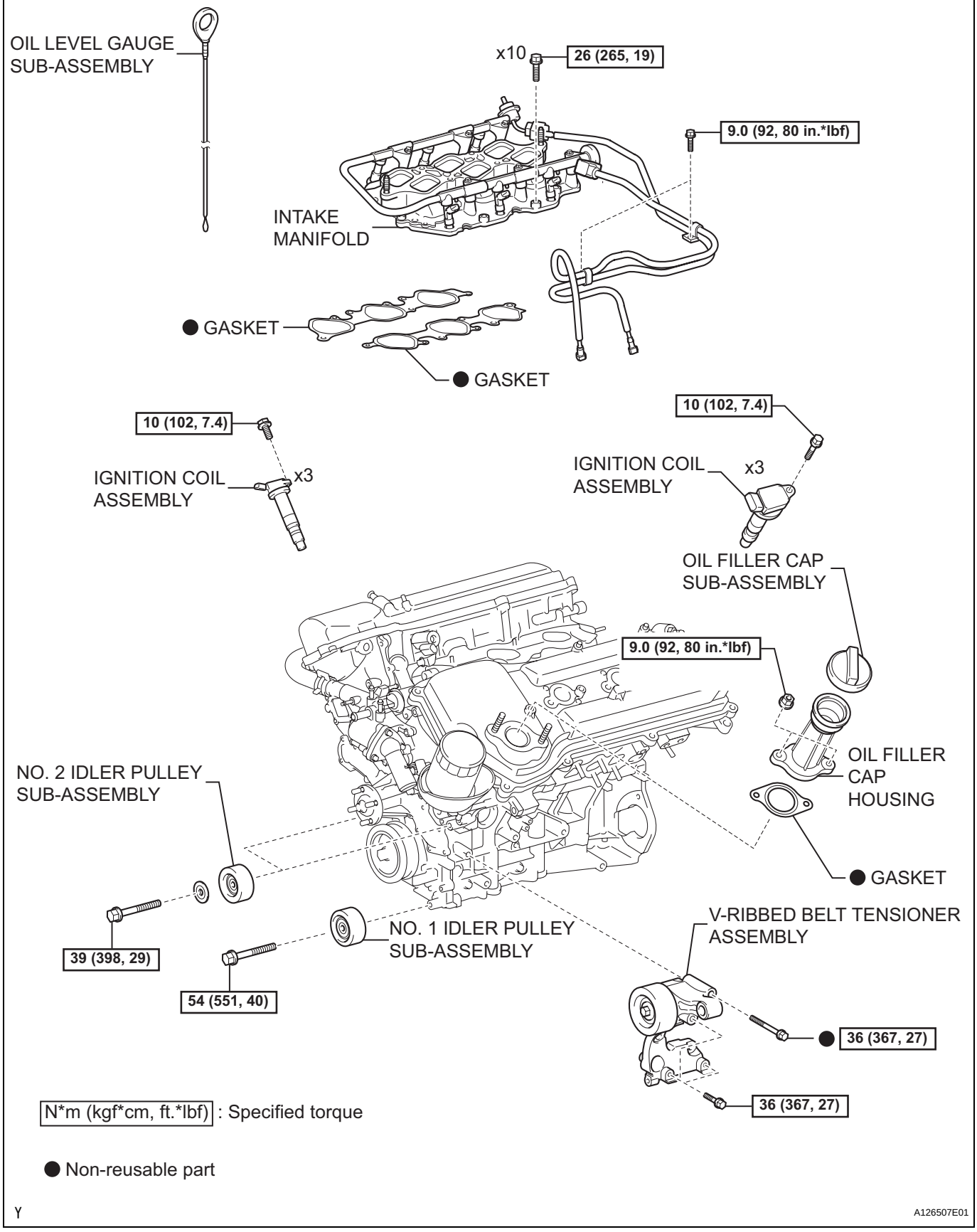
N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

A126454E01


EXHAUST MANIFOLD SUB-ASSEMBLY RH
● GASKET
x6
30 (306, 22)
HEATER WATER INLET HOSE
HEATER WATER OUTLET HOSE
NO. 2 VENTILATION HOSE
38 (387, 28)
38 (387, 28)
VENTILATION HOSE
x4
43 (435, 31)
ENGINE MOUNTING BRACKET FRONT NO. 1 RH
● GASKET
EXHAUST MANIFOLD SUB-ASSEMBLY LH
43 (435, 31)
38 (387, 28)
x6
30 (306, 22)
38 (387, 28)
x2
43 (435, 31)
ENGINE MOUNTING BRACKET FRONT NO. 1 LH
N*m (kgf*cm, ft*lbf) : Specified torque
● Non-reusable part
Y
A126455E01

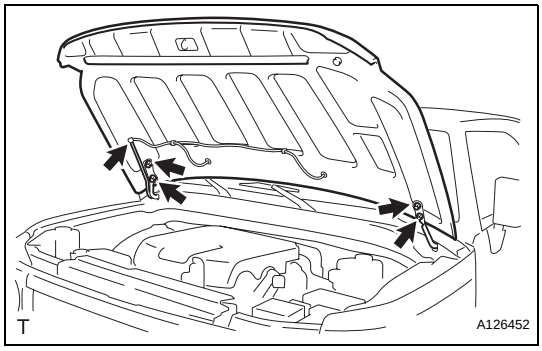

OIL LEVEL GAUGE SUB-ASSEMBLY
x10
26 (265, 19)
9.0 (92, 80 in.*lbf)
INTAKE MANIFOLD
● GASKET
● GASKET
10 (102, 7.4)
IGNITION COIL ASSEMBLY
x3
10 (102, 7.4)
IGNITION COIL ASSEMBLY
x3
OIL FILLER CAP SUB-ASSEMBLY
9.0 (92, 80 in.*lbf)
OIL FILLER CAP HOUSING
● GASKET
NO. 2 IDLER PULLEY SUB-ASSEMBLY
39 (398, 29)
NO. 1 IDLER PULLEY SUB-ASSEMBLY
54 (551, 40)
V-RIBBED BELT TENSIONER ASSEMBLY
● 36 (367, 27)
36 (367, 27)
N*m (kgf*cm, ft.*lbf) : Specified torque
● Non-reusable part
A126507E01

EM

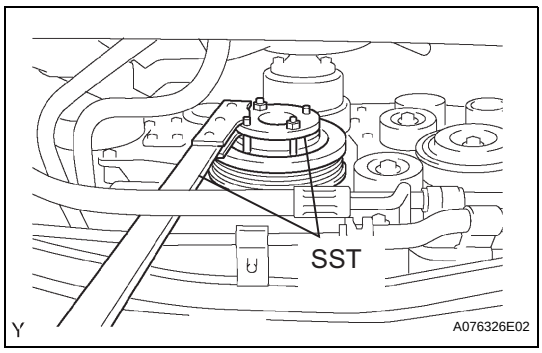
EM

REMOVAL

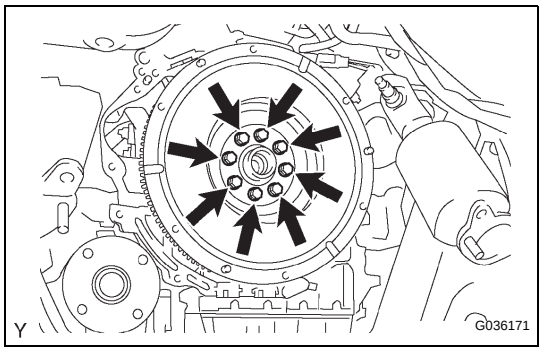
1. **DISCHARGE FUEL SYSTEM PRESSURE**
   (See page FU-1)
2. **REMOVE BATTERY**
3. **DRAIN ENGINE COOLANT (See page CO-3)**
4. **DRAIN ENGINE OIL (See page LU-4)**
5. **REMOVE HOOD SUPPORT (See page ED-5)**
6. **REMOVE HOOD SUB-ASSEMBLY**
   (a) Disconnect the windshield washer hose.
   (b) Remove the 4 bolts, then remove the hood.

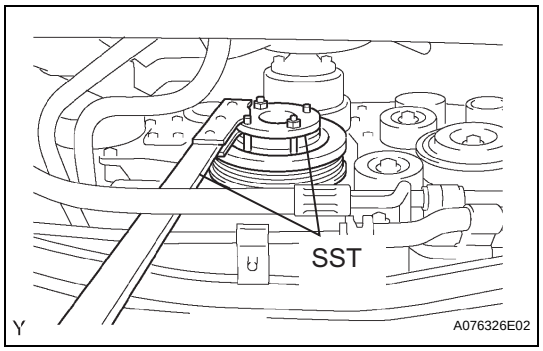


7. **REMOVE RADIATOR ASSEMBLY**
   Refer to the procedures up to " REMOVE RADIATOR ASSEMBLY" (See page CO-22).
8. **REMOVE MANUAL TRANSMISSION UNIT ASSEMBLY (for Manual Transmission)**
   Refer to the procedures up to " REMOVE MANUAL TRANSMISSION UNIT ASSEMBLY" (See page MT-8).
9. **REMOVE AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)**
   Refer to the procedures up to " REMOVE AUTOMATIC TRANSMISSION ASSEMBLY" (See page AT-172 or AT-178).
10. **REMOVE CLUTCH DISC ASSEMBLY (for Manual Transmission)**
    Refer to the procedures up to " REMOVE CLUTCH DISC ASSEMBLY" (See page CL-21).
11. **REMOVE FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)**
    (a) Using SST, hold the crankshaft.
    SST 09213-54015 (91651-60855), 09330-00021



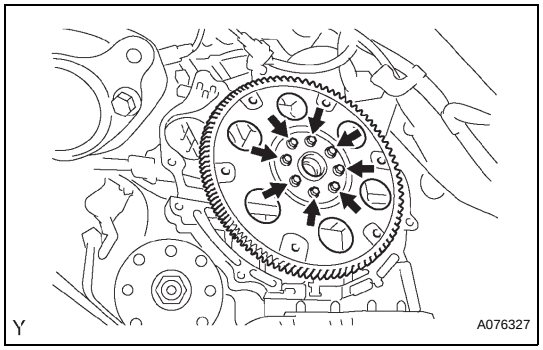
(b) Remove the 8 bolts, then remove the flywheel and 2 spacers.





12. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

(a) Using SST, hold the crankshaft.
SST 09213-54015 (91651-60855), 09330-00021



(b) Remove the 8 bolts, then remove the drive plate and 2 spacers.

13. REMOVE THROTTLE BODY BRACKET (See page FU-11)

14. REMOVE OIL BAFFLE PLATE (See page FU-11)

15. REMOVE NO. 1 SURGE TANK STAY (See page FU-11)

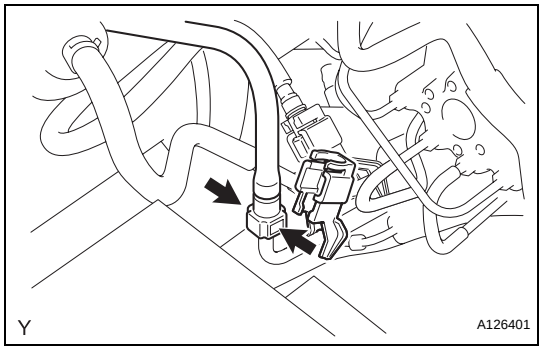
16. REMOVE NO. 2 SURGE TANK STAY (See page FU-12)

17. REMOVE INTAKE AIR SURGE TANK (See page FU-12)

18. REMOVE GENERATOR ASSEMBLY (See page CH-10)

19. SEPARATE COOLER COMPRESSOR ASSEMBLY (See page ES-420)

20. REMOVE VANE PUMP ASSEMBLY (See page PS-8)



21. DISCONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY

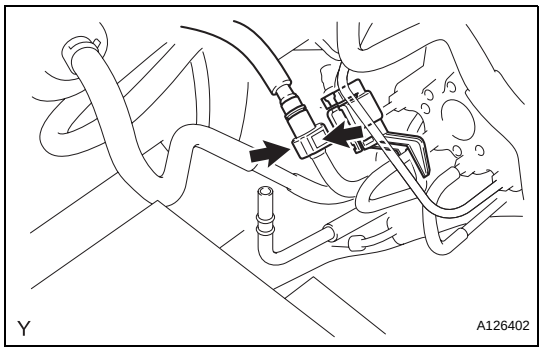
(a) Remove the No. 2 fuel pipe clamp.

(b) Pinch the retainer as illustrated, then pull the fuel tube connector out of the pipe.

NOTICE:

- **Remove any dirt and foreign matter from the fuel tube connector before performing this work.**
- **Do not allow any scratches or foreign matter onto the parts when disconnecting, as the fuel tube connector has the O-rings that seals the pipe.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a vinyl bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**

EM



22. DISCONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY

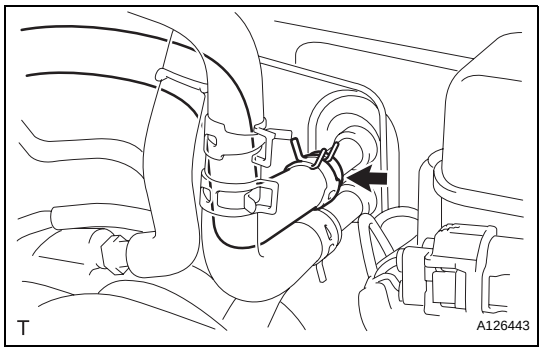
(a) Remove the No. 2 fuel pipe clamp.

(b) Pinch the retainer as illustrated, then pull the fuel tube connector out of the pipe.

NOTICE:

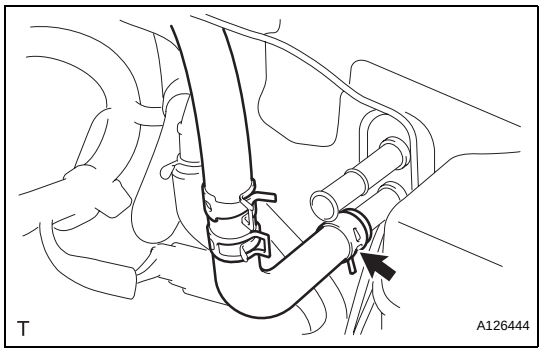
- **Remove any dirt and foreign matter from the fuel tube connector before performing this work.**
- **Do not allow any scratches or foreign matter onto the parts when disconnecting, as the fuel tube connector has the O-rings that seals the pipe.**
- **Perform this work by hand. Do not use any tools.**
- **Do not forcibly bend, twist or turn the nylon tube.**
- **Protect the disconnected part by covering it with a vinyl bag after disconnecting the fuel tube.**
- **If the fuel tube connector and pipe are stuck, push and pull to release them.**

EM



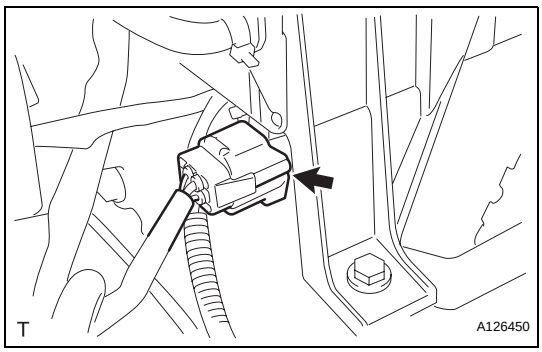
23. DISCONNECT HEATER INLET WATER HOSE

(a) Disconnect the heater inlet water hose shown in the illustration.



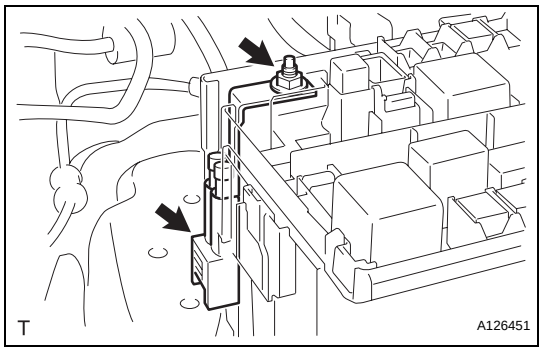
24. DISCONNECT HEATER WATER OUTLET HOSE A (FROM HEATER UNIT)

(a) Disconnect the heater outlet water hose shown in the illustration.

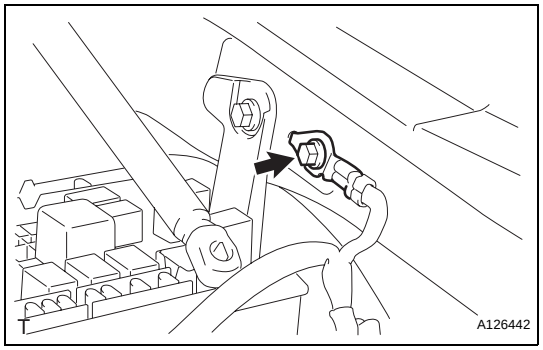


25. REMOVE NO. 2 ENGINE WIRE

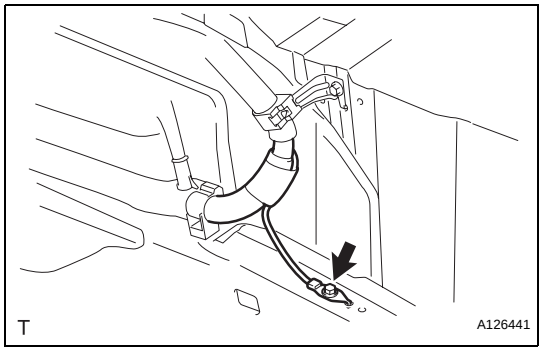
(a) Disconnect the connector from the engine room relay block.



(b) Remove the nut and separate the engine wire from the engine room relay block.



(c) Remove the bolt and separate the ground wire from body.



(d) Remove the bolt and separate the ground wire from the frame.

26. SEPARATE ENGINE WIRE

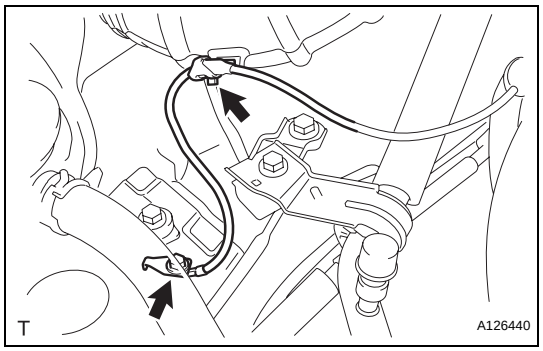
(a) Remove the glove compartment door (see page IP-15)

(b) Disconnect the connector from the four wheel drive ECU (for Automatic Transmission 4WD).

(c) Disconnect the 3 connectors from the ECM.

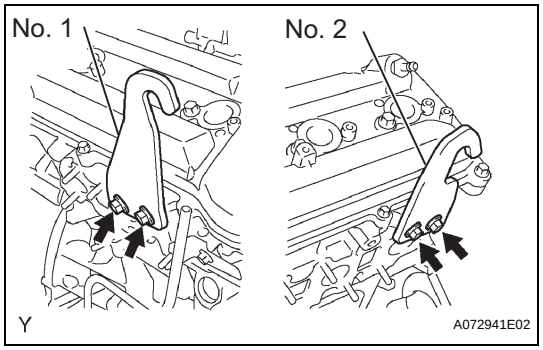
(d) Disconnect the 2 connectors from the A/C unit.

(e) Pull the wire harness into the engine room.



(f) Remove the bolt and disengage the clamp, then separate the ground wire from the body.

(g) Disconnect the front differential connector (for Automatic Transmission 4WD).



27. REMOVE ENGINE ASSEMBLY

(a) Install the 2 engine hangers with the 4 bolts as shown in the illustration.

Part No:

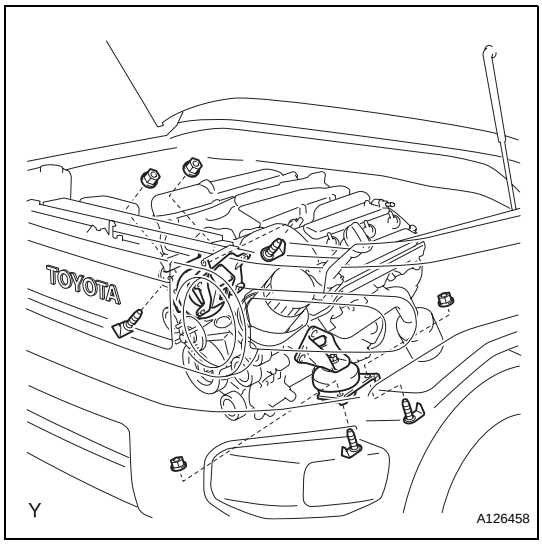
Engine hanger No. 1 12281-31070

Engine hanger No. 2 12282-31050

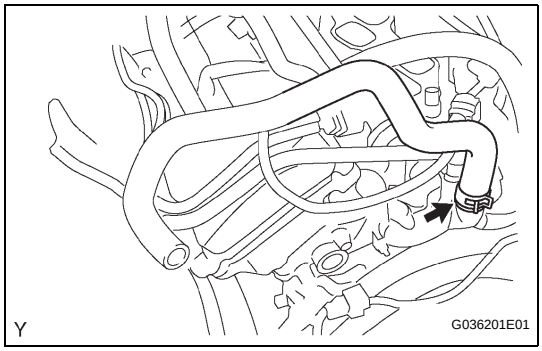
Bolt 90119-08177

Torque: 33 N*m (336 kgf*cm, 24 ft.*lbf)

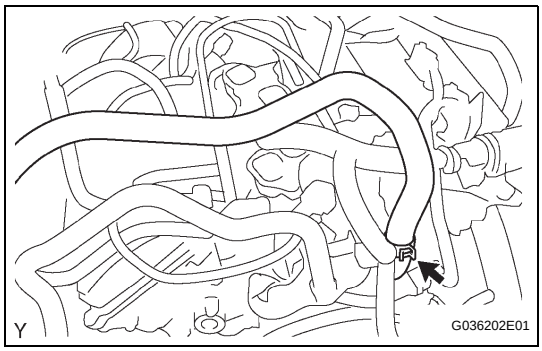
(b) Attach the engine sling device and hang the engine with a chain block.



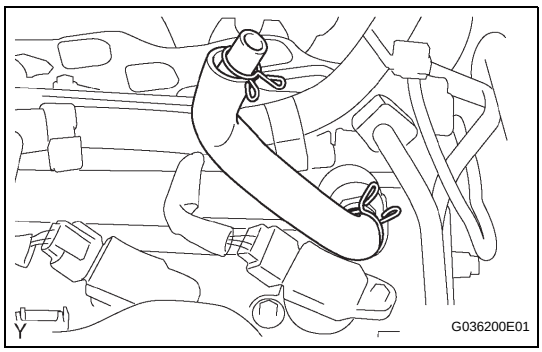
(c) Remove the 4 bolts and 4 nuts, and separate the engine mounting brackets from the frame brackets.
(d) Lift the engine out of the vehicle carefully.
NOTICE:
Make sure that the engine is clear of all wiring and hoses.
(e) Place the engine on a work bench.



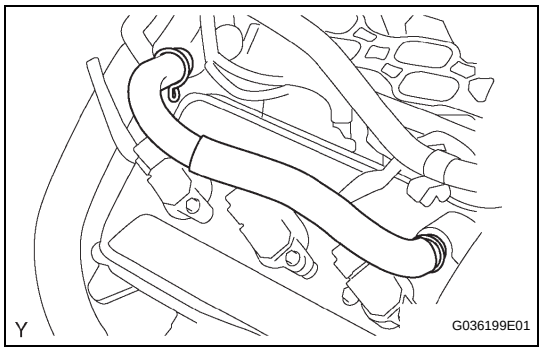
28. REMOVE HEATER INLET WATER HOSE



29. REMOVE HEATER OUTLET WATER HOSE
(a) Disconnect and remove the heater outlet water hose with heater water outlet hose A.



30. REMOVE VENTILATION HOSE



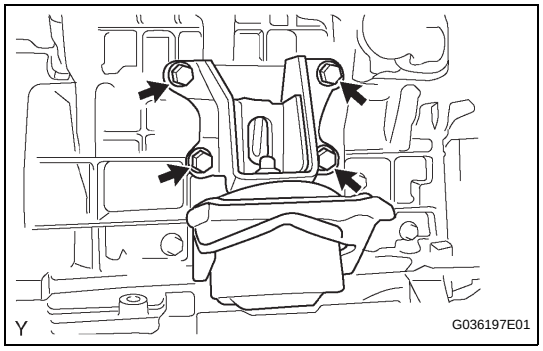
31. REMOVE NO. 2 VENTILATION HOSE

32. REMOVE MANIFOLD STAY (See page EM-68)

33. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH (See page EM-68)

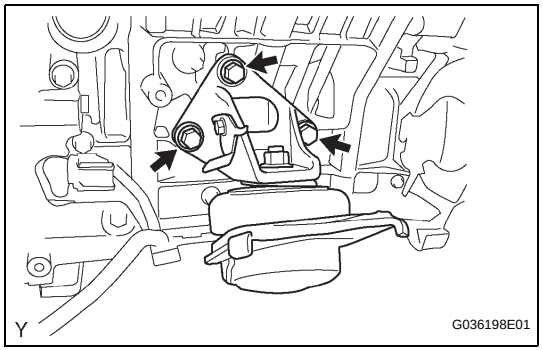
34. REMOVE NO. 2 MANIFOLD STAY (See page EM-68)

35. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH (See page EM-69)



36. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET RH

(a) Remove the 4 bolts, then remove the engine mounting bracket RH.



37. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET LH

(a) Remove the 3 bolts, then remove the engine mounting bracket LH.

38. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY (See page EM-22)

39. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY (See page EM-23)

40. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY (See page EM-23)

41. REMOVE INTAKE MANIFOLD (See page EM-69)

42. REMOVE IGNITION COIL ASSEMBLY (See page IG-8)

43. REMOVE OIL FILLER CAP SUB-ASSEMBLY

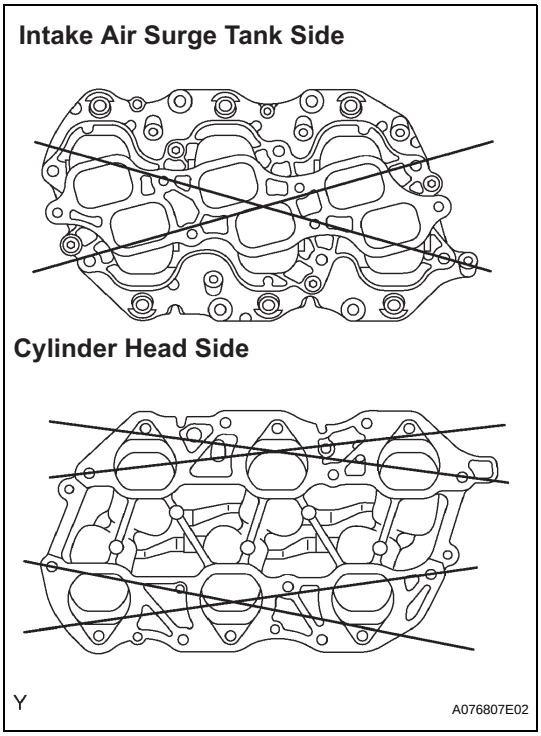
44. REMOVE OIL FILLER CAP HOUSING

(a) Remove the 2 nuts, oil filler cap housing and gasket.

45. REMOVE OIL LEVEL GAUGE SUB-ASSEMBLY

46. REMOVE ENGINE WIRE

(a) Remove the bolt and separate the ground wire from the bank 1 cylinder head.
(b) Remove the bolt and separate the ground wire from the bank 2 cylinder head.
(c) Disconnect the connector from the knock sensor sub wire.
(d) Disconnect all connectors from the engine.
(e) Disengage all clamps and remove the engine wire.



INSPECTION

1. INSPECT INTAKE MANIFOLD FOR WARPAGE

(a) Using a precision straight edge and feeler gauge, measure the warpage of the contact surfaces of the cylinder head and intake air surge tank.

Maximum warpage:

Intake air surge tank side:

0.8 mm (0.031 in.)

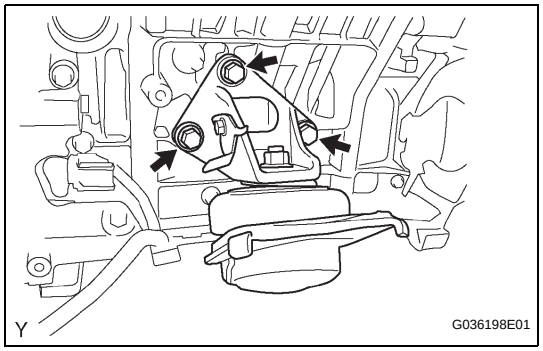
Cylinder head side:

0.2 mm (0.008 in.)

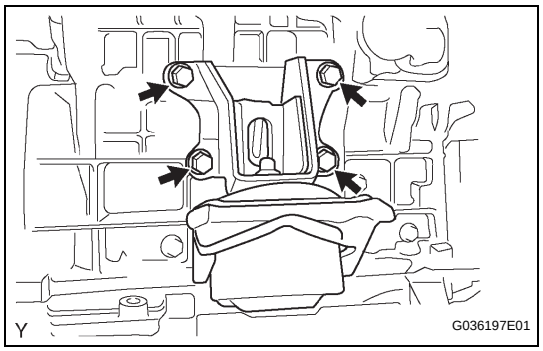
If the warpage is greater than the maximum, replace the intake manifold.

INSTALLATION

1. **INSTALL ENGINE WIRE**
   (a) Connect the connectors to the engine.
   (b) Engage the clamps to the engine.
   (c) Connect the connector to the knock sensor sub wire.
   (d) Install the ground wire onto the bank 2 cylinder head with the bolt.
   Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)
   (e) Install the ground wire onto the bank 1 cylinder head with the bolt.
   Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)
2. **INSTALL OIL LEVEL GAUGE SUB-ASSEMBLY**
3. **INSTALL OIL FILLER CAP HOUSING**
   (a) Install a new gasket.
   (b) Install the oil filler cap housing with the 2 nuts.
   Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
4. **INSTALL OIL FILLER CAP SUB-ASSEMBLY**
5. **INSTALL IGNITION COIL ASSEMBLY (See page IG-8)**
6. **INSTALL INTAKE MANIFOLD (See page EM-96)**
7. **INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY (See page EM-32)**
8. **INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY (See page EM-33)**
9. **INSTALL V-RIBBED BELT TENSIONER ASSEMBLY (See page EM-33)**
10. **INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET LH**
    (a) Install the engine mounting bracket with engine mounting insulator with the 3 bolts.
    Torque: 43 N*m (435 kgf*cm, 31 ft.*lbf)



11. **INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET RH**
    (a) Install the engine mounting bracket with engine mounting insulator with the 4 bolts.
    Torque: 43 N*m (435 kgf*cm, 31 ft.*lbf)
12. **INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH (See page EM-96)**
13. **INSTALL NO. 2 MANIFOLD STAY (See page EM-96)**
14. **INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH (See page EM-97)**
15. **INSTALL MANIFOLD STAY (See page EM-97)**



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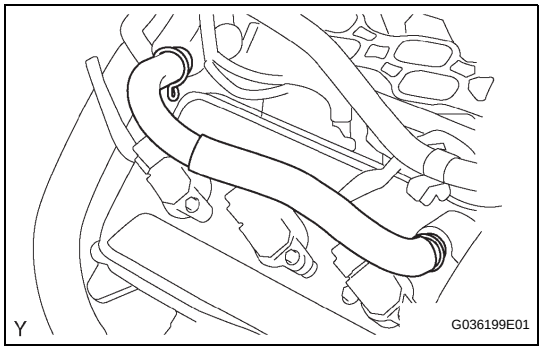
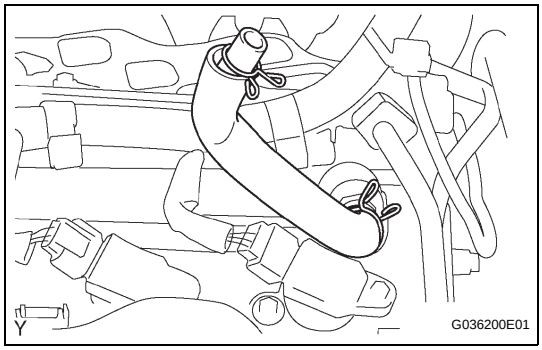
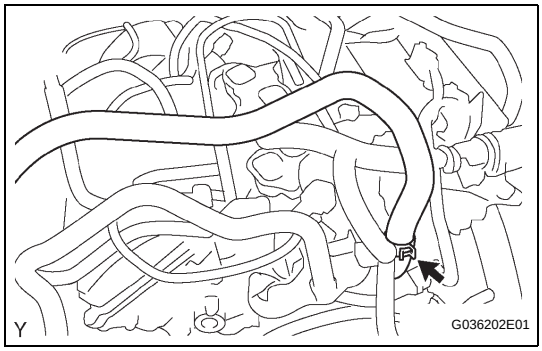


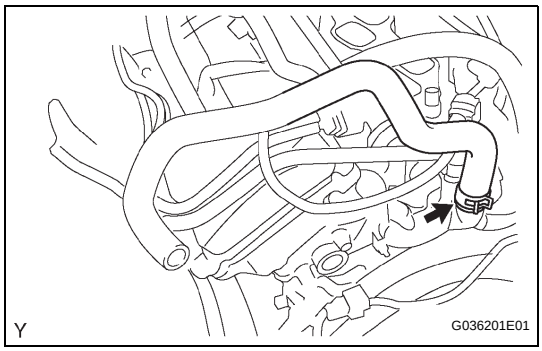
16. INSTALL NO. 2 VENTILATION HOSE



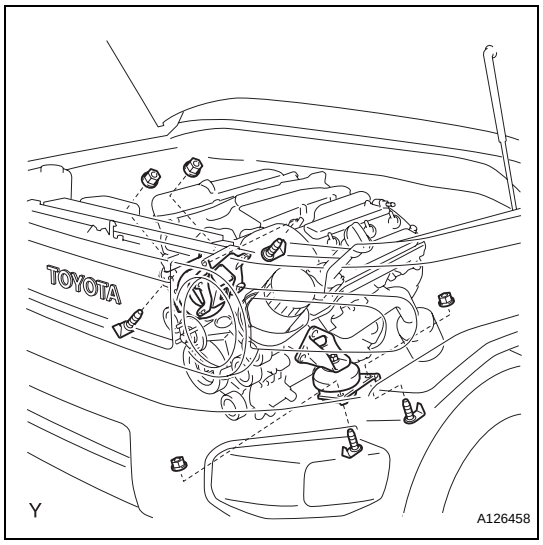
17. INSTALL VENTILATION HOSE



18. INSTALL HEATER OUTLET WATER HOSE



19. INSTALL HEATER INLET WATER HOSE



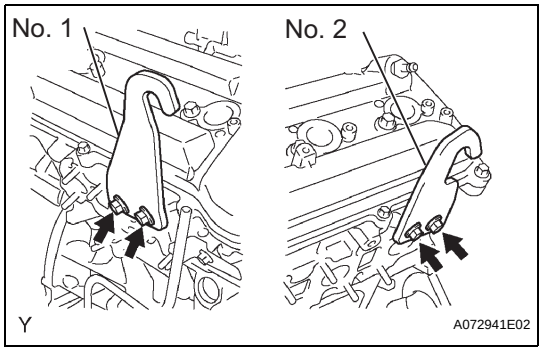
20. INSTALL ENGINE ASSEMBLY

(a) Attach the engine sling device and hang the engine with a chain block.

(b) Lower the engine into the engine compartment carefully.

(c) Attach the engine mounting brackets to the frame brackets.

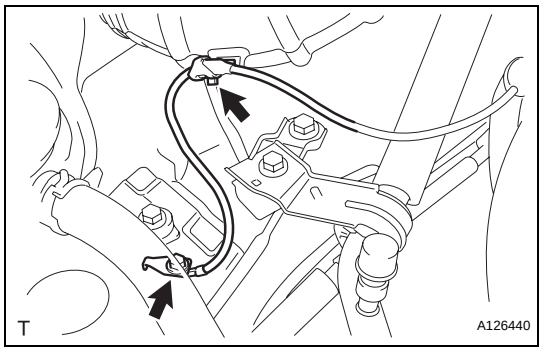
(d) Install the engine mounting brackets onto the frame brackets with the 4 bolts and 4 nuts.
Torque: 38 N*m (387 kgf*cm, 28 ft.*lbf)



(e) Remove the 4 bolts and 2 engine hangers.

21. INSTALL ENGINE WIRE

(a) Connect the front differential connector (for Automatic Transmission 4WD).



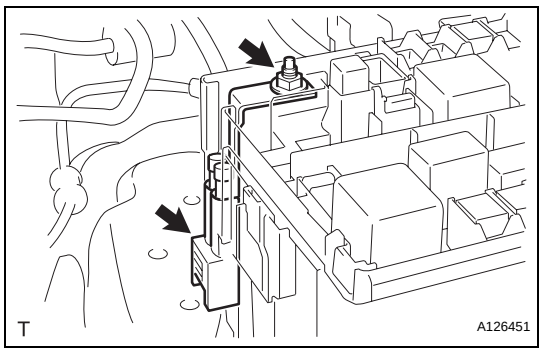
(b) Install the ground wire with the bolt and engage the clamp.
Torque: 8.4 N*m (85 kgf*cm, 74 in.*lbf)

(c) Connect the 2 connectors to the A/C unit.

(d) Connect the 3 connectors to the ECM.

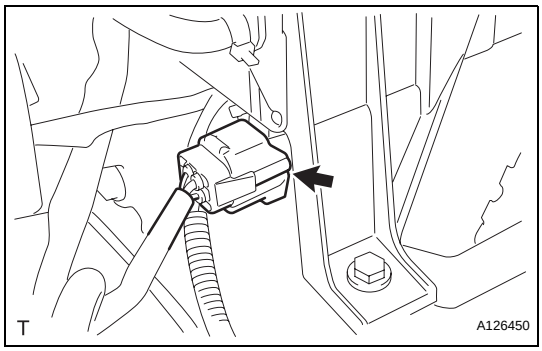
(e) Connect the connector to the four wheel drive ECU (for Automatic Transmission 4WD).

(f) Install the glove compartment door (see page IP-28).

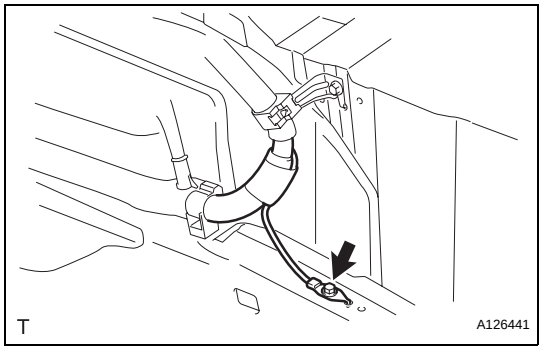


22. INSTALL NO. 2 ENGINE WIRE

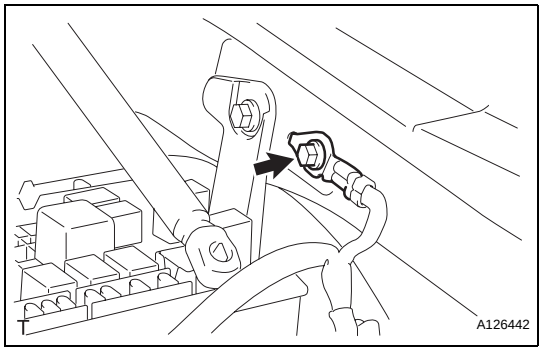
(a) Install the engine wire onto the engine room relay block with the nut.
Torque: 10 N*m (102 kgf*cm, 7.4 ft.*lbf)



(b) Connect the connector to the engine room relay block.

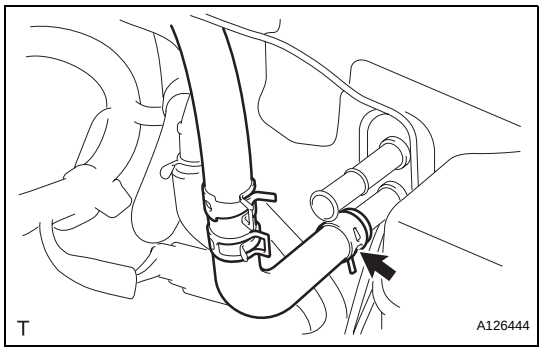


(c) Install the ground wire onto the frame with the bolt.
Torque: 19 N*m (195 kgf*cm, 14 ft.*lbf)

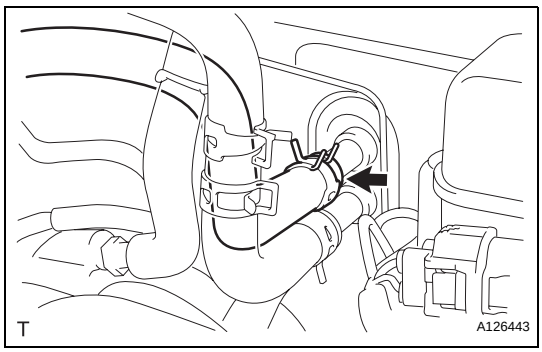


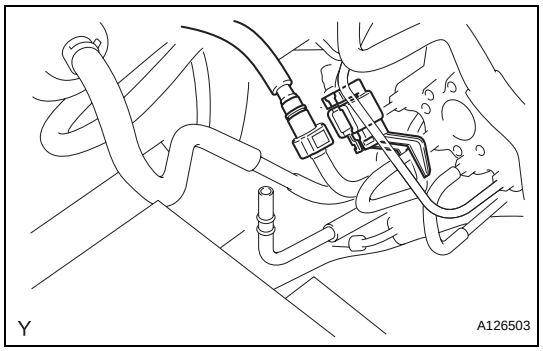
(d) Install the ground wire onto the body with the bolt.
Torque: 8.4 N*m (85 kgf*cm, 7.4 in.*lbf)

23. CONNECT HEATER WATER OUTLET HOSE A (FROM HEATER UNIT)

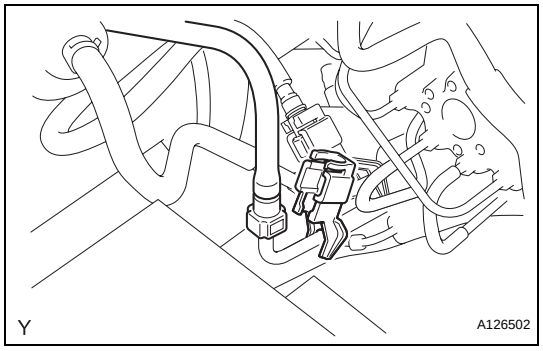


24. CONNECT HEATER INLET WATER HOSE





25. **CONNECT NO. 2 FUEL PIPE SUB-ASSEMBLY**
    (a) Connect the No. 2 fuel tube connector and fuel pipe, and install the No. 2 fuel pipe clamp.
    NOTICE:
    Align the fuel tube connector with the pipe, then push the fuel tube connector in until the retainer makes a click sound. If the connection is tight, apply a small amount of engine oil to the tip of the pipe. After connecting, pull the pipe and connector to make sure that they are securely connected.



26. **CONNECT NO. 1 FUEL PIPE SUB-ASSEMBLY**
    (a) Connect the No. 1 fuel tube connector and fuel pipe, and install the No. 2 fuel pipe clamp.
    NOTICE:
    Align the fuel tube connector with the pipe, then push the fuel tube connector in until the retainer makes a click sound. If the connection is tight, apply a small amount of engine oil to the tip of the pipe. After connecting, pull the pipe and connector to make sure that they are securely connected.

27. **INSTALL VANE PUMP ASSEMBLY (See page PS-14)**

28. **INSTALL COOLER COMPRESSOR ASSEMBLY (See page ES-421)**

29. **INSTALL GENERATOR ASSEMBLY (See page CH-17)**

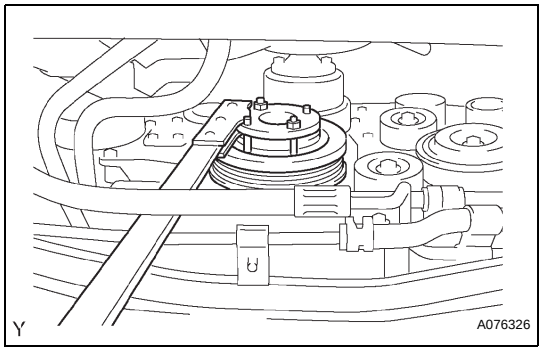
30. **INSTALL INTAKE AIR SURGE TANK (See page FU-17)**

31. **INSTALL NO. 2 SURGE TANK STAY (See page FU-19)**

32. **INSTALL NO. 1 SURGE TANK STAY (See page FU-19)**

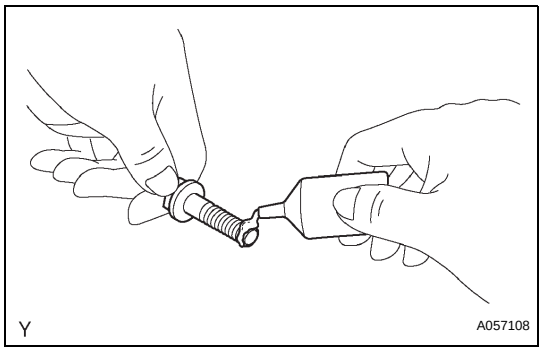
33. **INSTALL OIL BAFFLE PLATE (See page FU-19)**

34. **INSTALL THROTTLE BODY BRACKET (See page FU-19)**

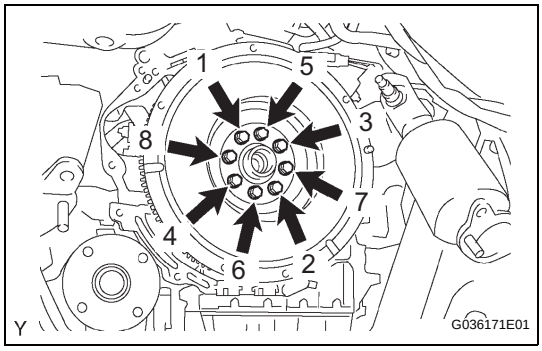


35. **INSTALL FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)**
    (a) Using SST, hold the crankshaft.
    SST 09213-54015 (91651-60855), 09330-00021

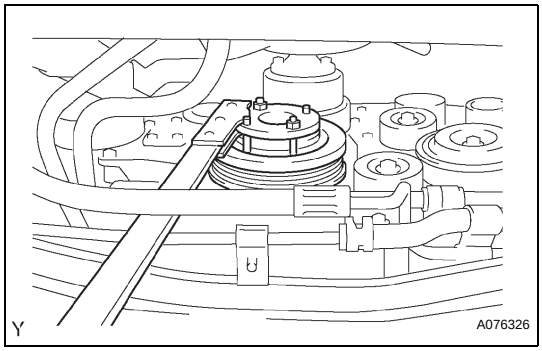
EM



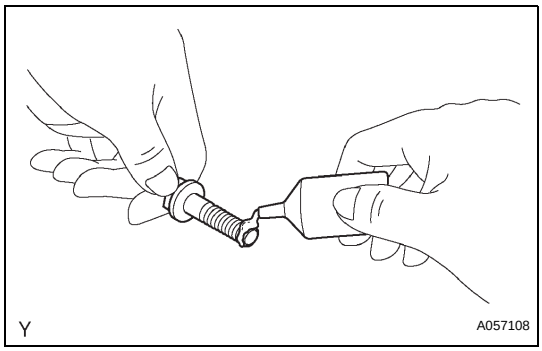
(b) Apply adhesive to the 2 or 3 end threads of the bolts.
Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or the equivalent.



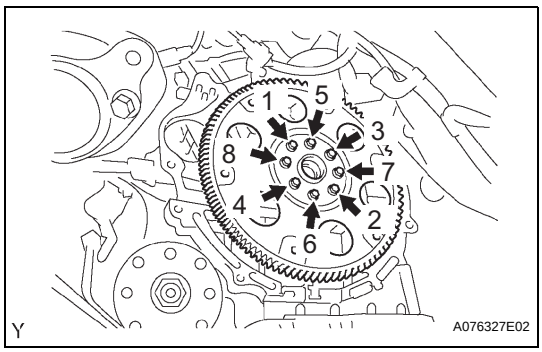
(c) Install the flywheel and 2 spacers onto the crankshaft.
(d) Install the flywheel with the 6 bolts in the order shown in the illustration.
Torque: 83 N*m (846 kgf*cm, 61 ft.*lbf)



36. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)
(a) Using SST, hold the crankshaft.
SST 09213-54015 (91651-60855), 09330-00021



(b) Apply adhesive to the 2 or 3 end threads of the bolts.
Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or the equivalent.



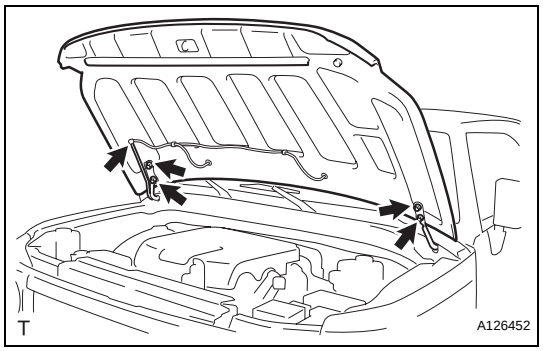
(c) Install the drive plate and 2 spacers onto the crankshaft.
(d) Install the drive plate with the 6 bolts in the order shown in the illustration.
Torque: 83 N*m (846 kgf*cm, 61 ft.*lbf)

37. INSTALL CLUTCH DISC ASSEMBLY (for Manual Transmission)
Refer to the procedures up to "INSTALL CLUTCH DISC ASSEMBLY" (See page CL-23).

38. **INSTALL MANUAL TRANSMISSION UNIT ASSEMBLY (for Manual Transmission)**
Refer to the procedures up to "INSTALL MANUAL TRANSMISSION" (See page MT-11).

39. **INSTALL AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)**
Refer to the procedures up to "INSTALL AUTOMATIC TRANSMISSION" (See page AT-175 or AT-181).

40. **INSTALL RADIATOR ASSEMBLY**
Refer to the procedures up to "INSTALL RADIATOR ASSEMBLY" (See page CO-28).



41. **INSTALL HOOD SUB-ASSEMBLY**
(a) Install the hood with the 4 bolts.
(b) Connect the windshield washer hose.

42. **INSTALL HOOD SUPPORT (See page ED-5)**

43. **INSTALL BATTERY**

44. **ADD ENGINE COOLANT (See page CO-3)**

45. **ADD ENGINE OIL (See page LU-5)**

46. **PERFORM INITIALIZATION (for Automatic Transmission)**
(See page AT-19 or AT-19

47. **CHECK FOR ENGINE COOLANT LEAKAGE (See page CO-4)**

48. **CHECK FOR ENGINE OIL LEAKAGE**

49. **CHECK FOR FUEL LEAKAGE**

50. **CHECK FOR EXHAUST GAS LEAKAGE**

51. **INSPECT IGNITION TIMING (See page EM-1)**

52. **INSPECT ENGINE IDLING SPEED (See page EM-2)**

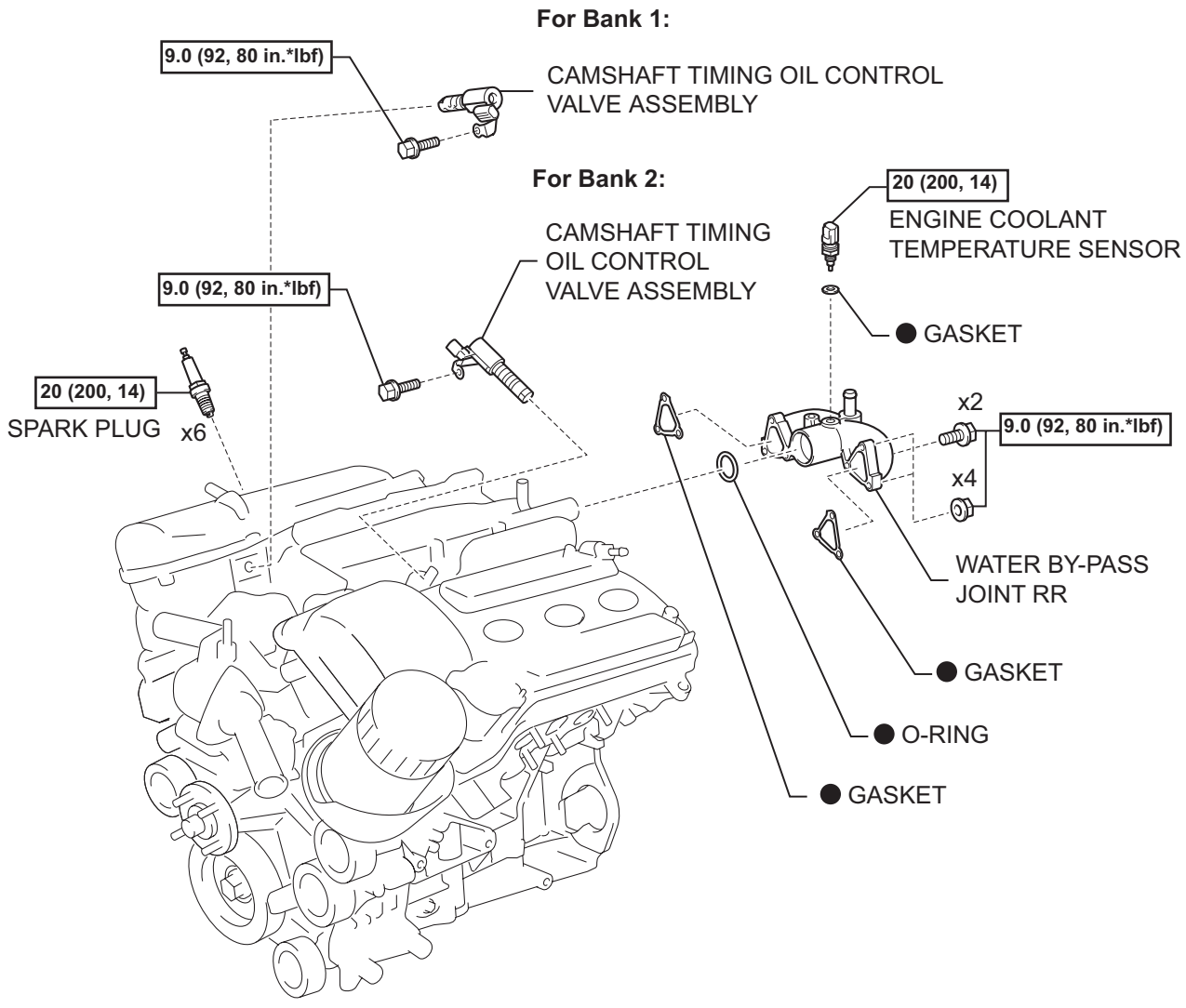
53. **INSPECT COMPRESSION (See page EM-3)**

54. **INSPECT CO/HC (See page EM-3)**

55. **INSPECT AND ADJUST FRONT WHEEL ALIGNMENT**
Refer to the procedures up to "INSPECT AND ADJUST FRONT WHEEL ALIGNMENT" (See page SP-2).

ENGINE UNIT

COMPONENTS

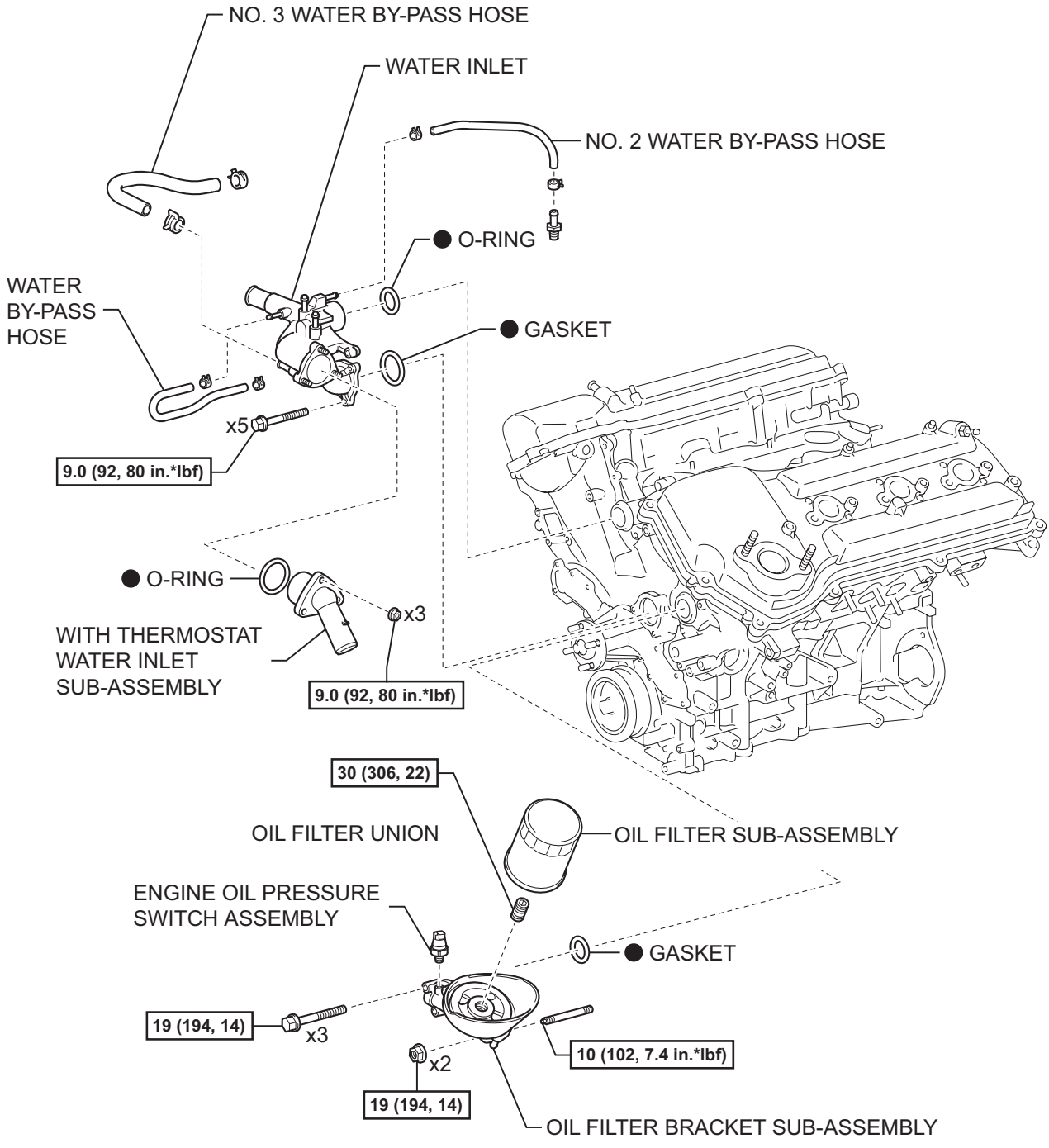


N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

A126337E01

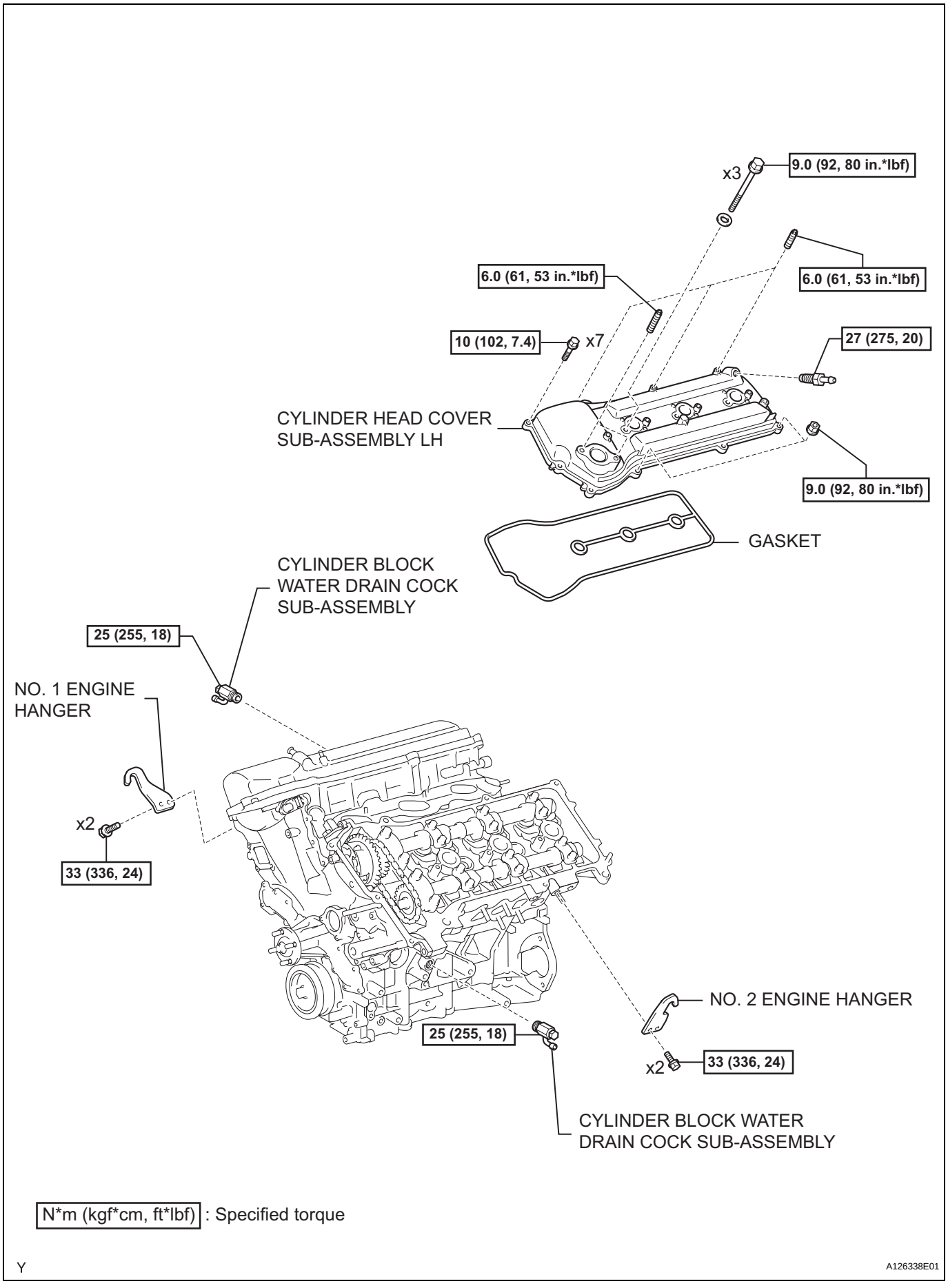
EM



Y N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

A126336E01



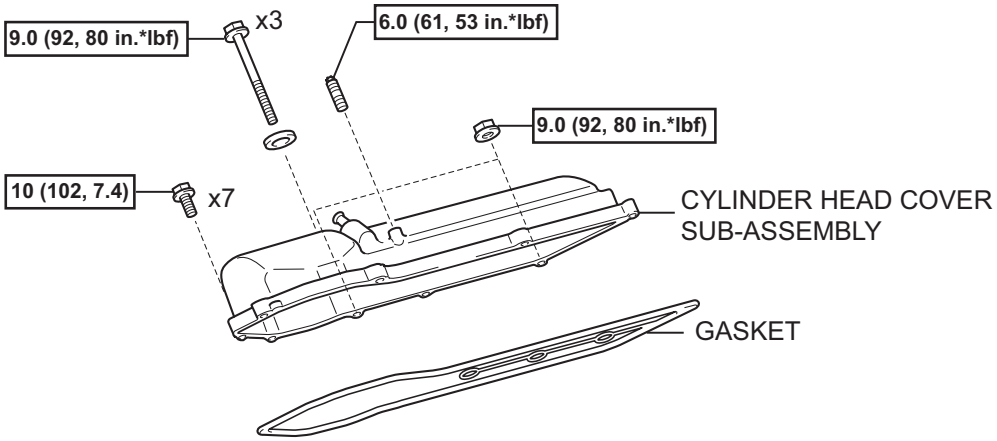
N*m (kgf*cm, ft*lbf) : Specified torque

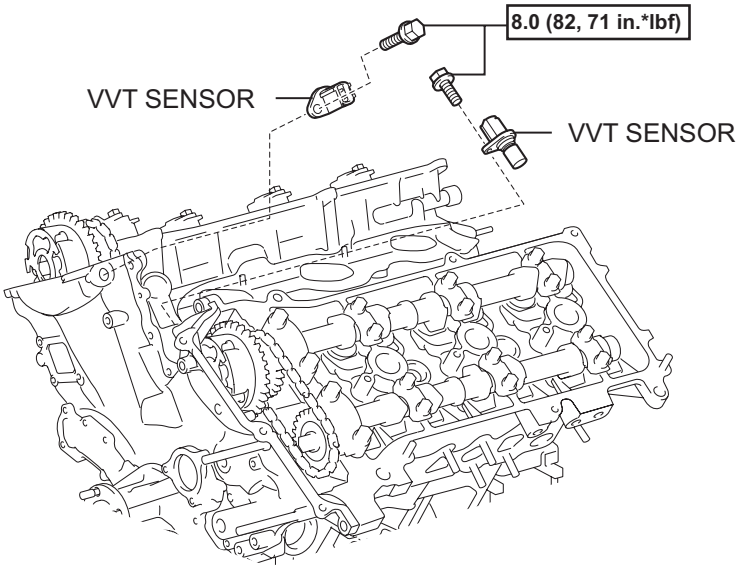
Y

A126338E01

EM

EM



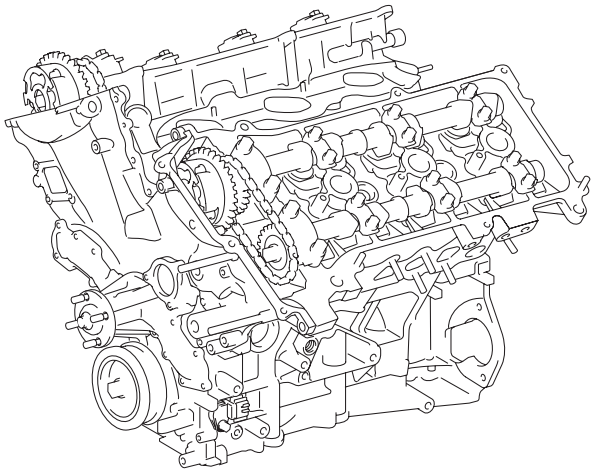


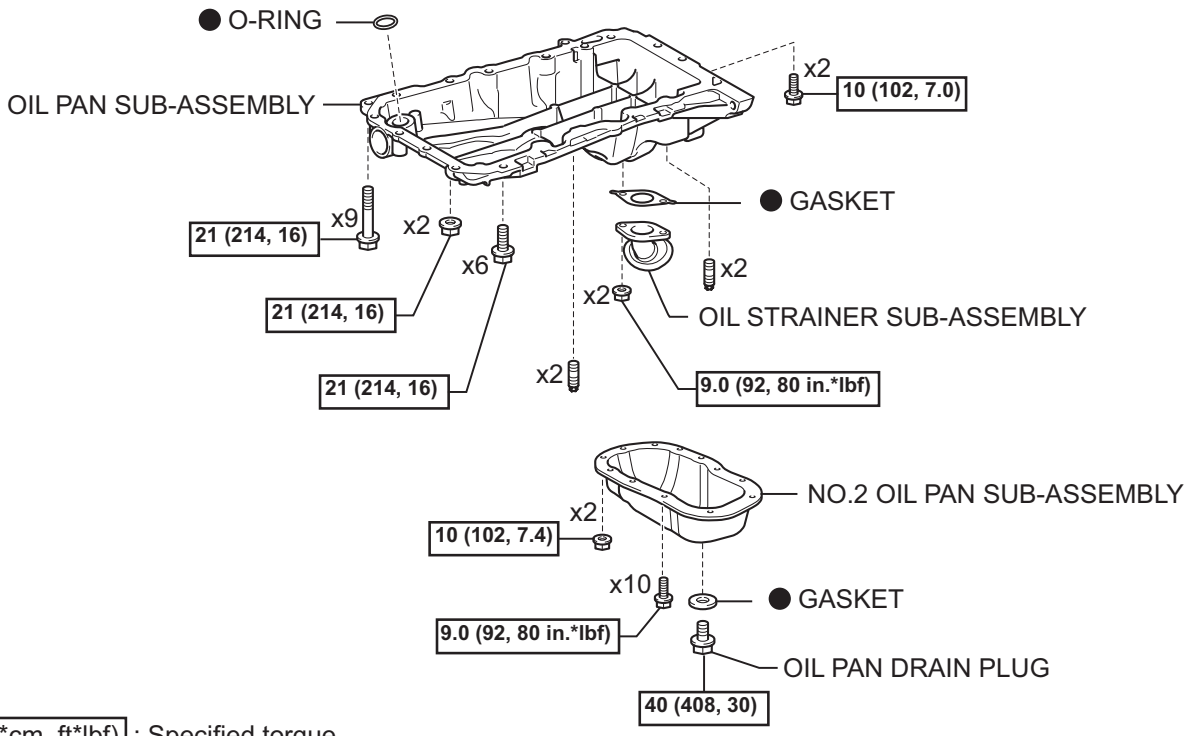
N*m (kgf*cm, ft*lbf) : Specified torque

Y

A126339E01

EM



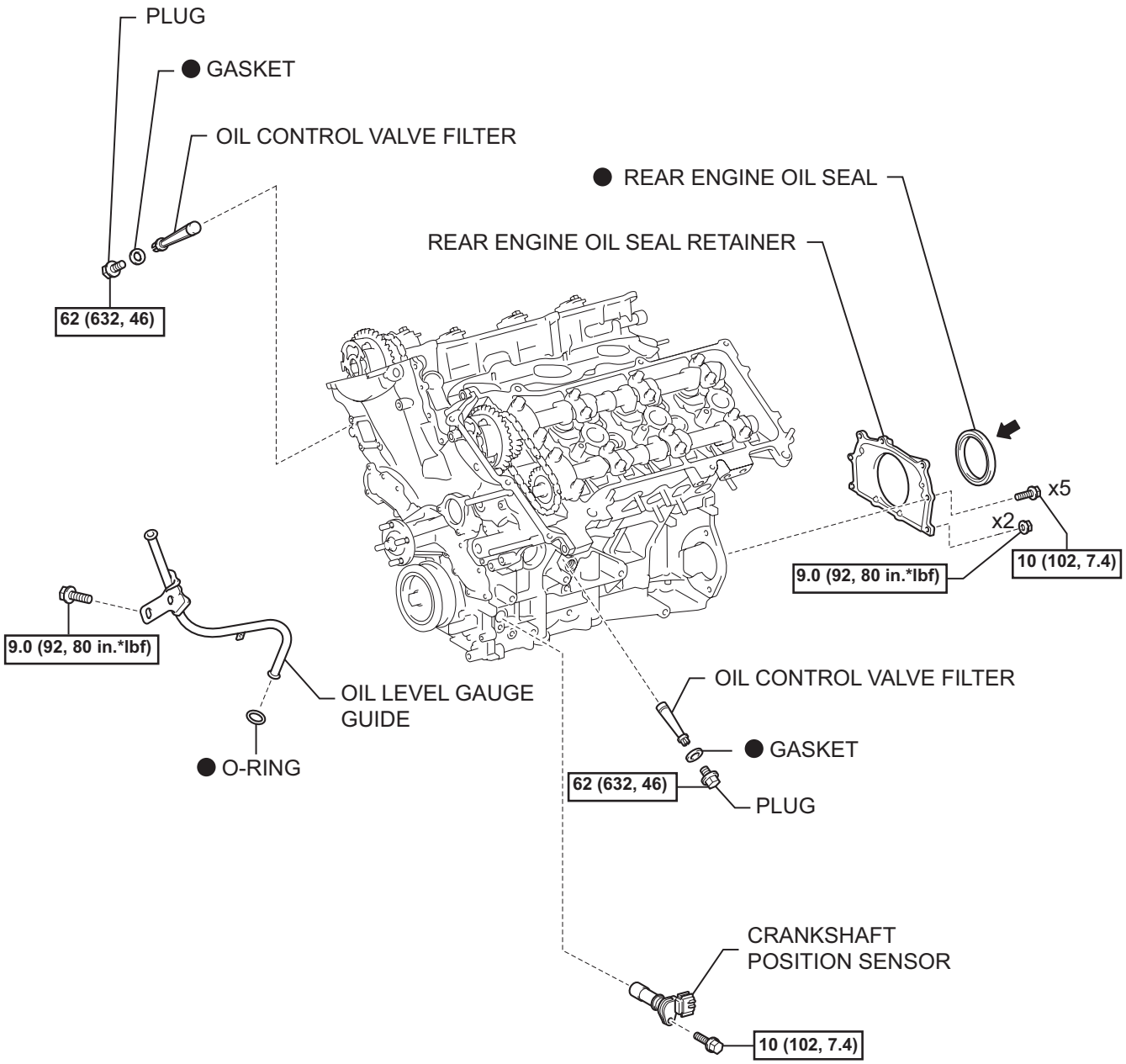


N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

A126340E01

EM

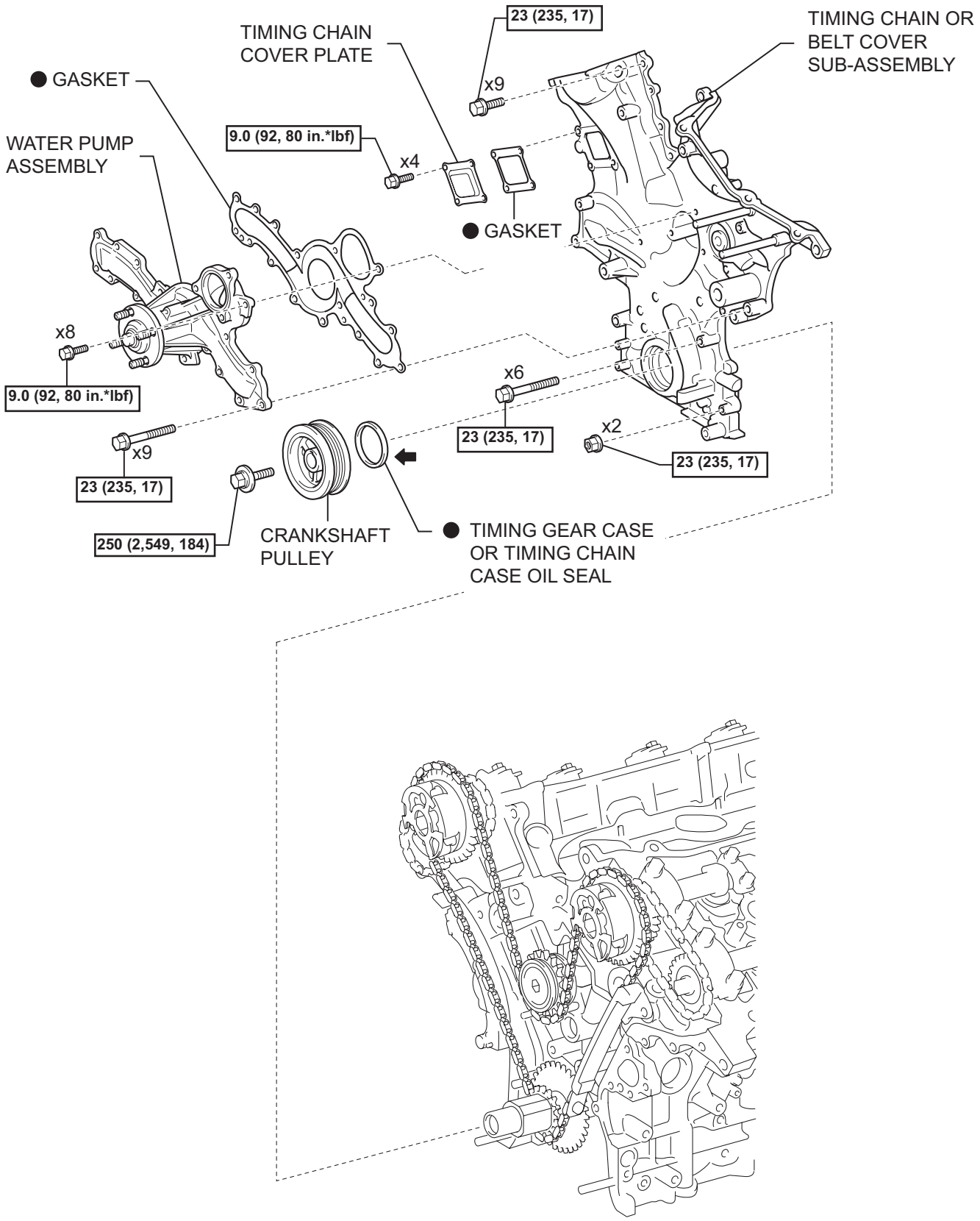


N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part ⬅ Apply MP grease

Y

A126341E01



N*m (kgf*cm, ft*lbf) : Specified torque

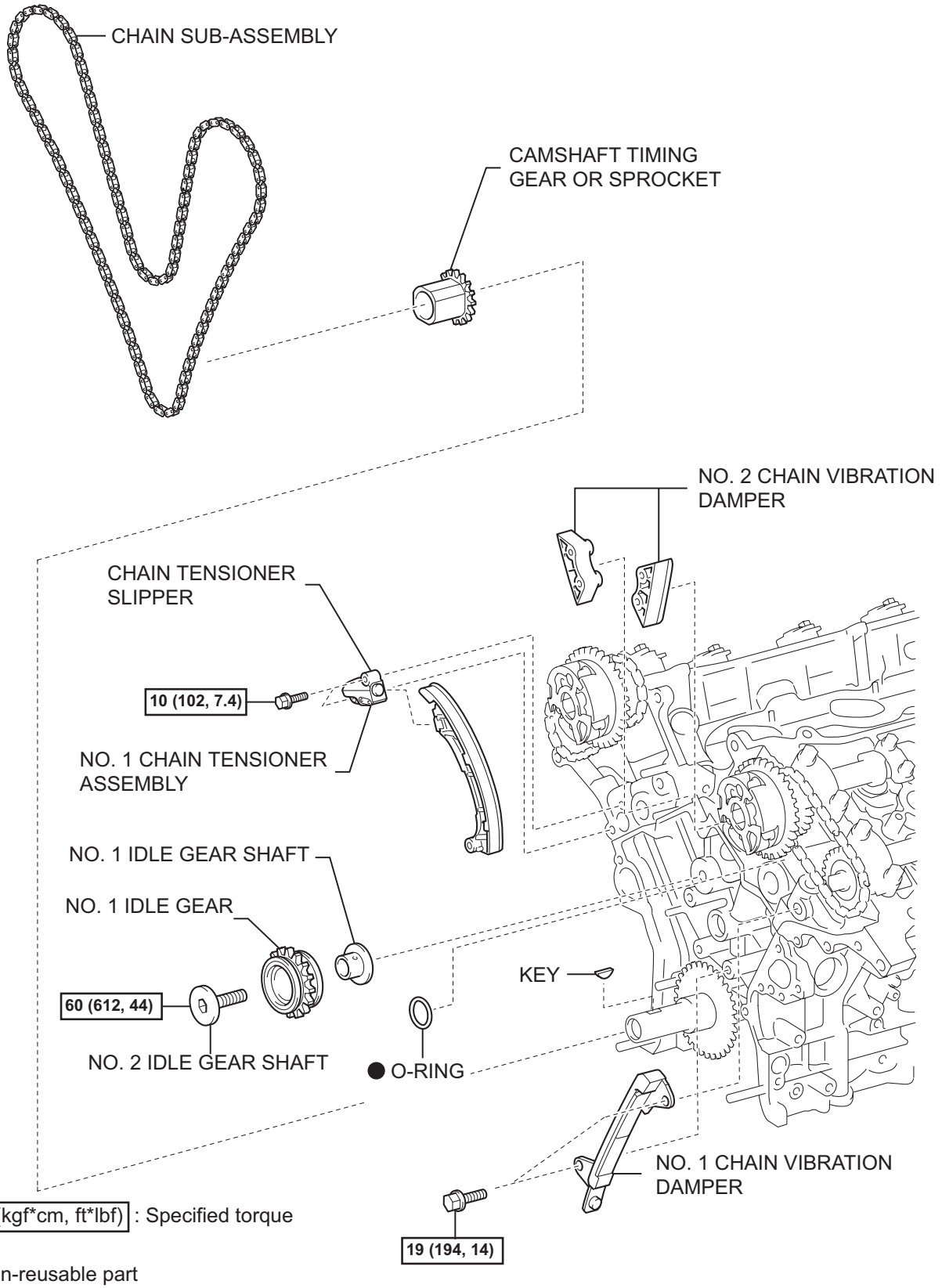
● Non-reusable part ⬅ Apply MP grease

Y

A126342E01

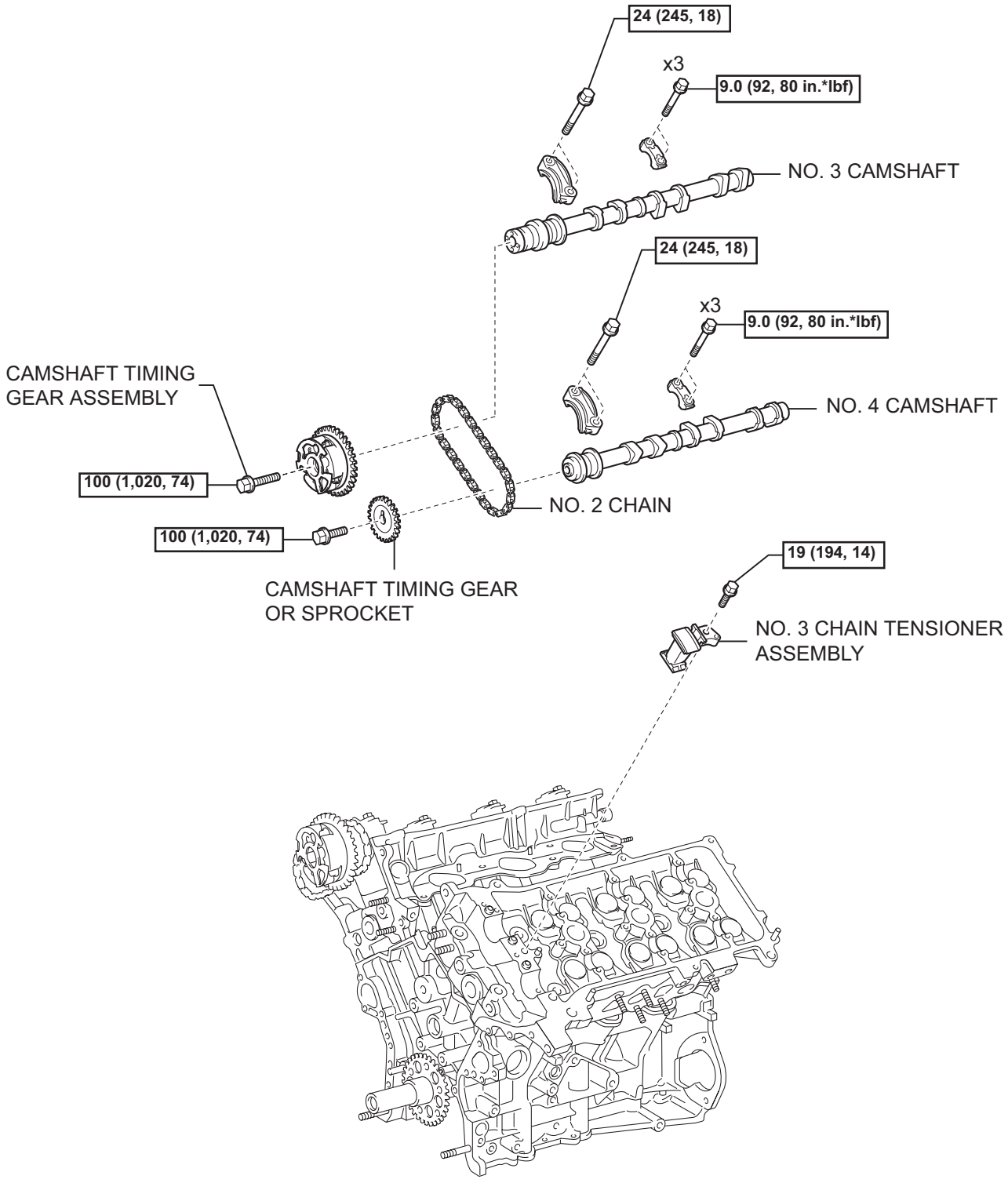
EM

EM



Y

A126343E01



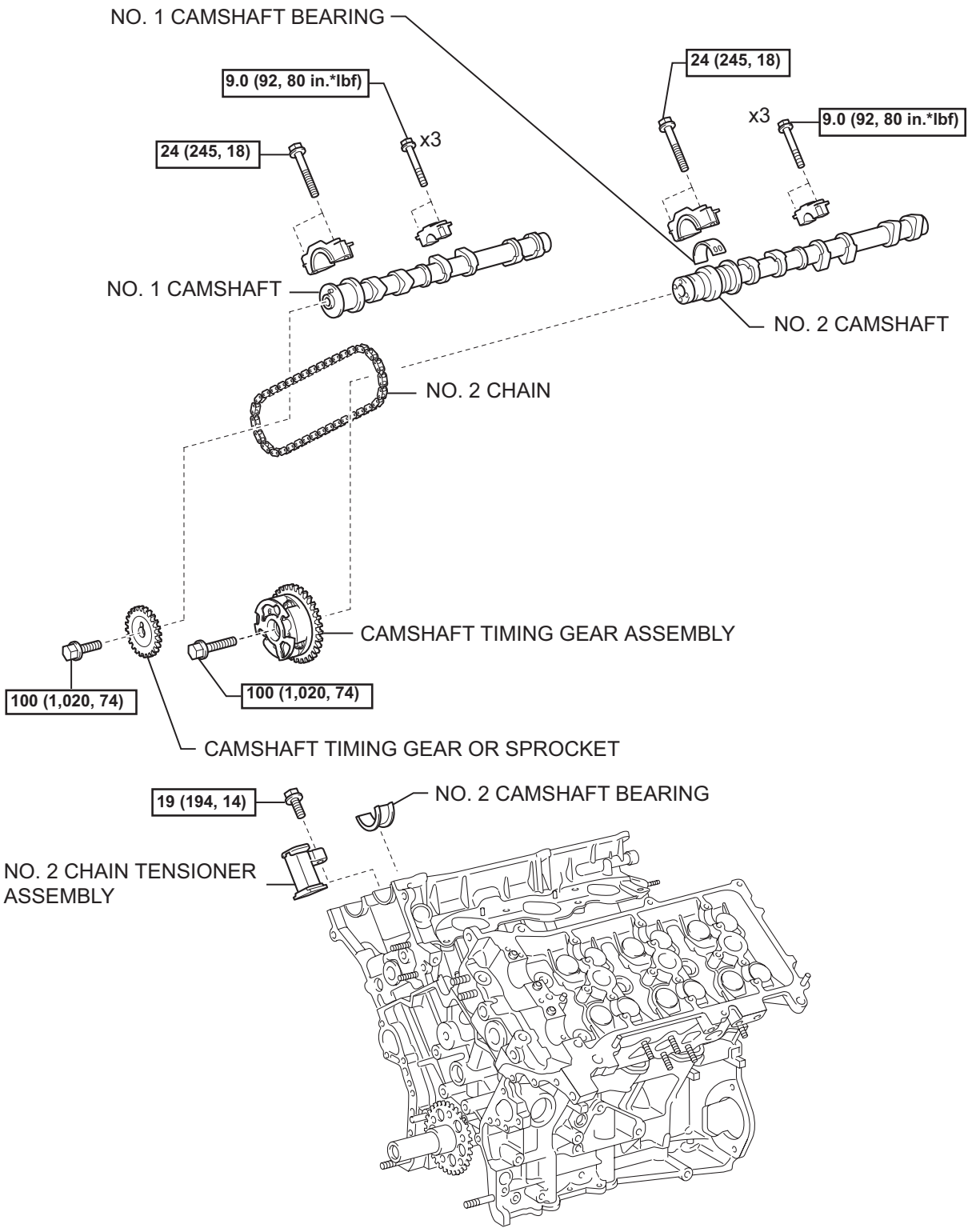
N*m (kgf*cm, ft*lbf) : Specified torque

Y

A126345E01

EM

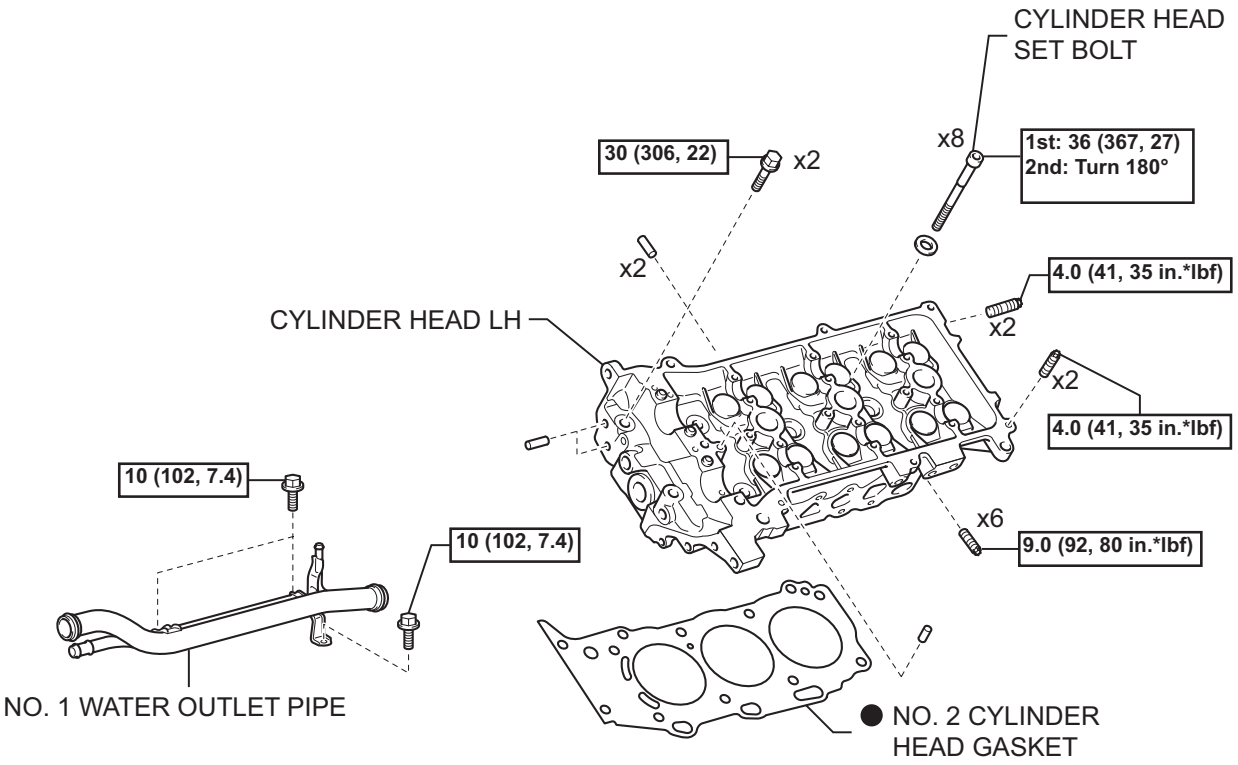
EM

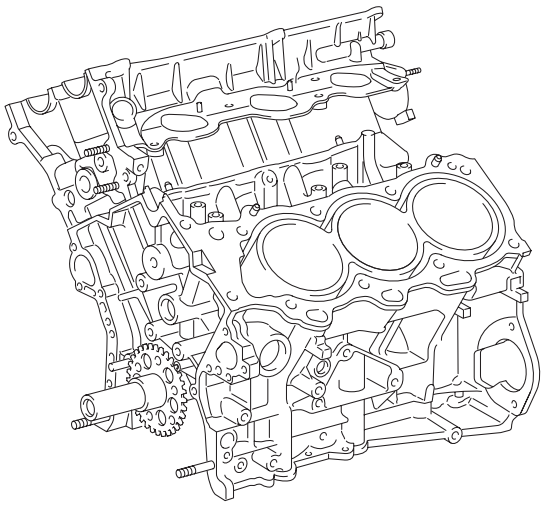


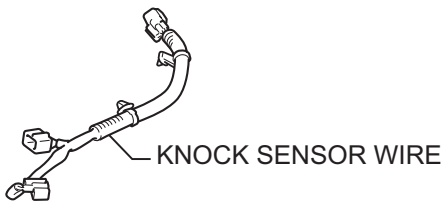
N*m (kgf*cm, ft*lbf) : Specified torque

Y

A126344E01







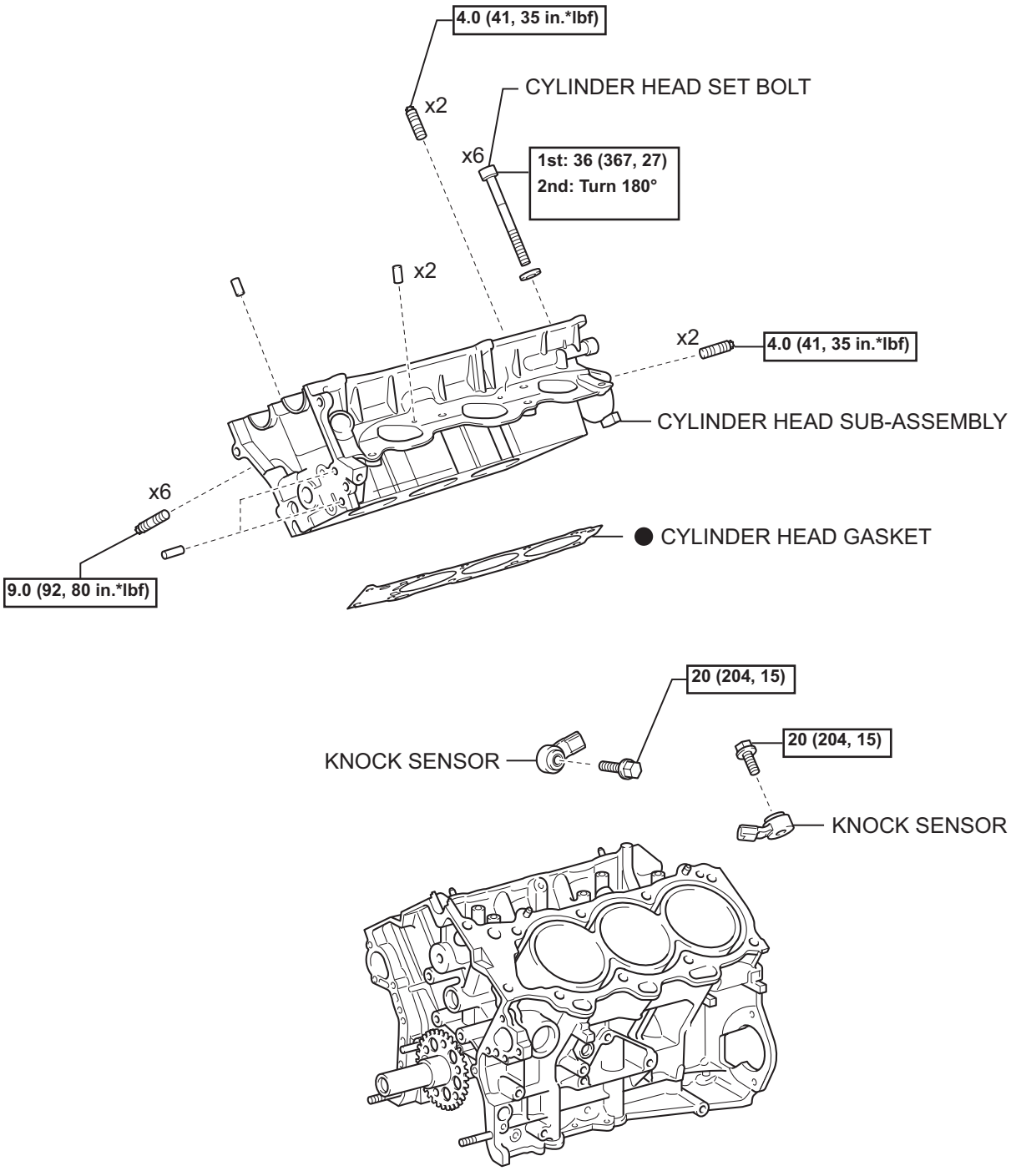
N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

A126346E01

EM

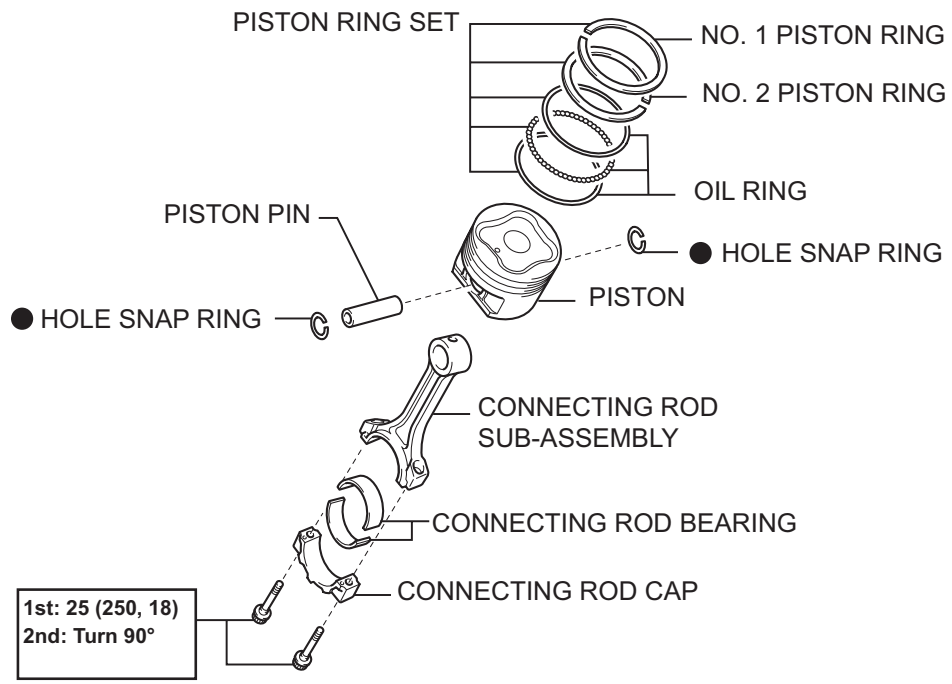


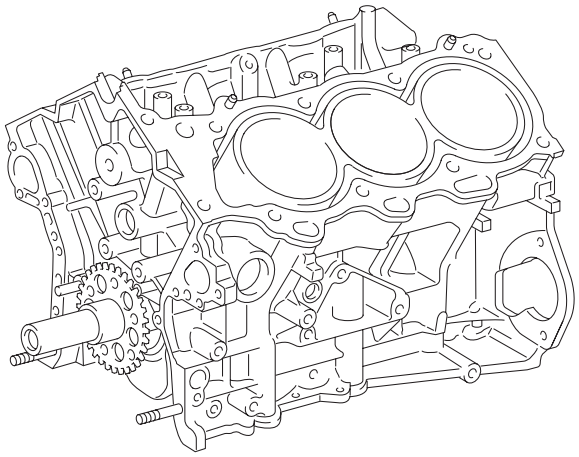
N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

A126347E01





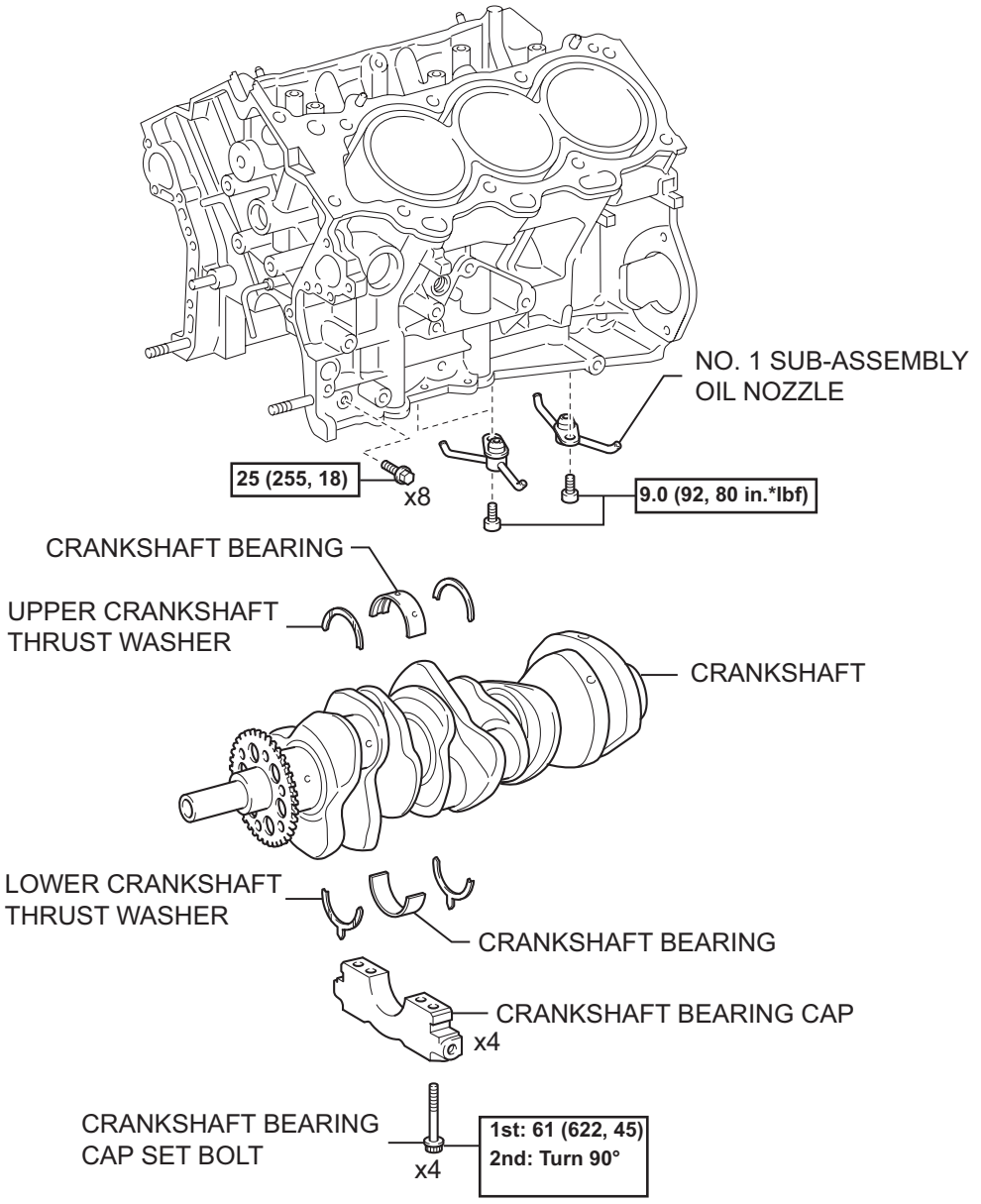
N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

Y

A126348E01

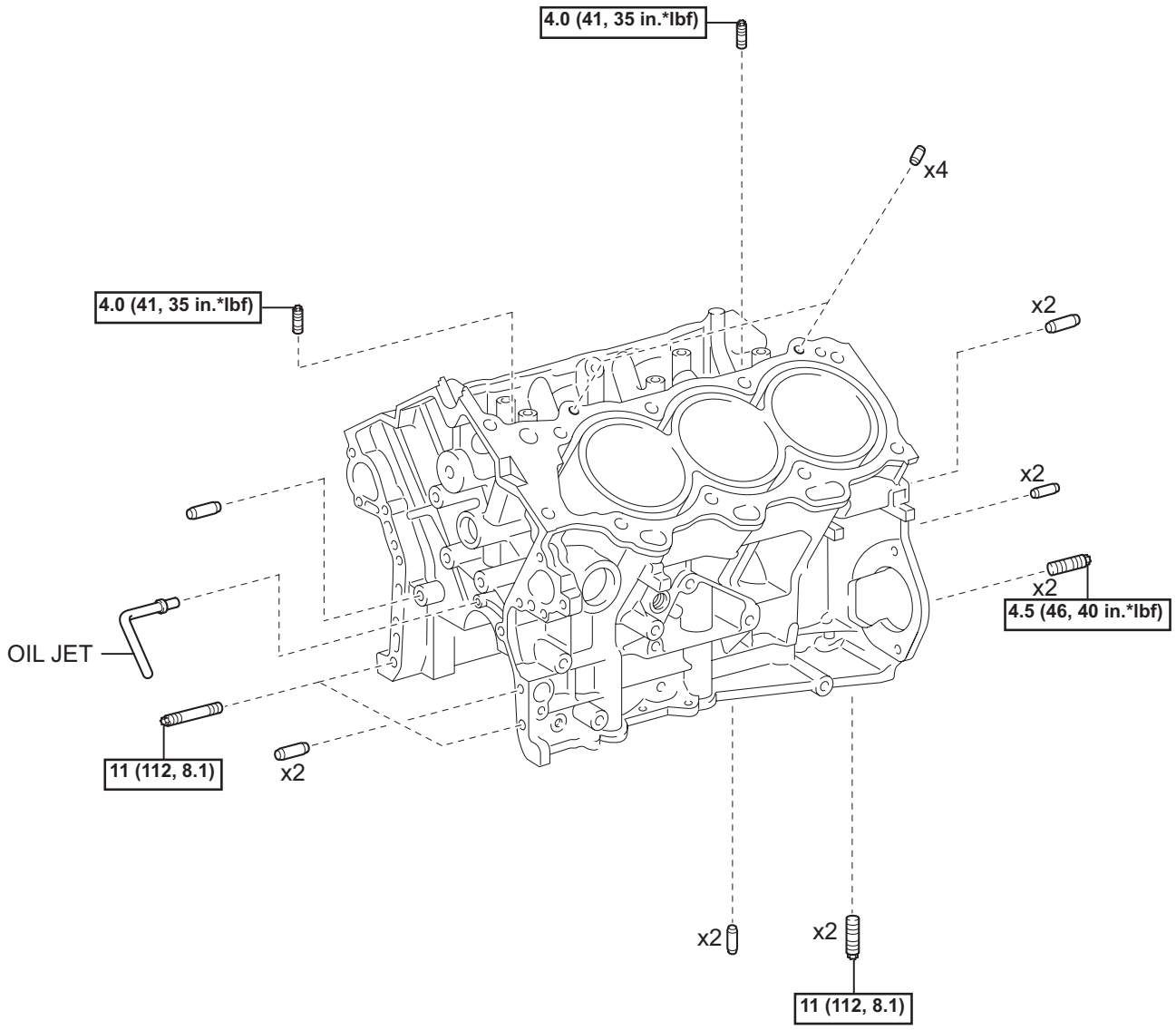
EM



N*m (kgf*cm, ft*lbf) : Specified torque

Y

A126349E01



N*m (kgf*cm, ft*lbf) : Specified torque

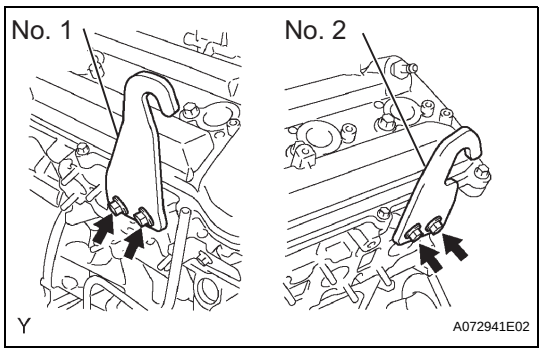
Y

A126350E01

DISASSEMBLY

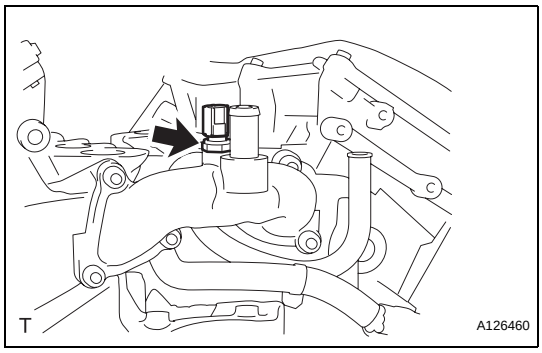
HINT:

- Thoroughly clean all the disassembled parts before reassembly.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets, O-rings and oil seals with new parts.



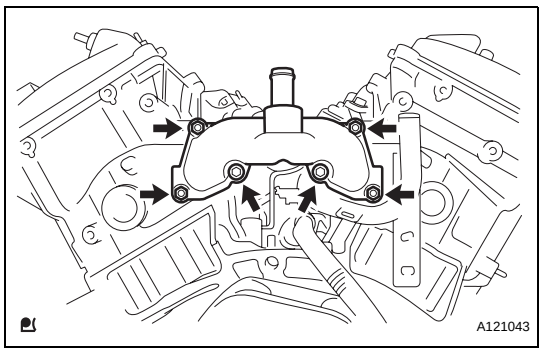
1. REMOVE ENGINE HANGERS

(a) Remove the 2 bolts and No. 1 engine hanger.
(b) Remove the 2 bolts and No. 2 engine hanger.



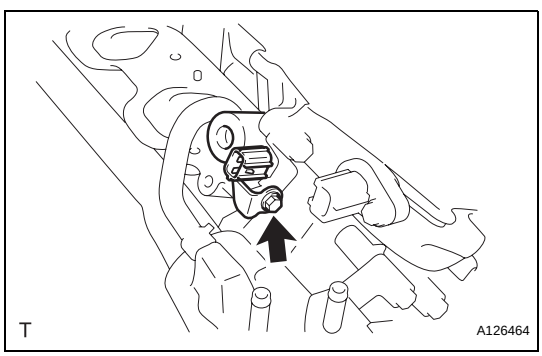
2. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

(a) Remove the engine coolant temperature sensor and gasket.



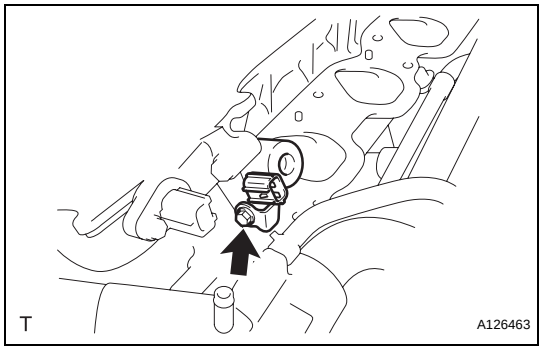
3. REMOVE WATER BY-PASS JOINT RR

(a) Remove the 2 bolts, 4 nuts and the water by-pass rear joint.
(b) Remove the 2 gaskets from the cylinder head.
(c) Remove the O-ring from the outlet pipe.



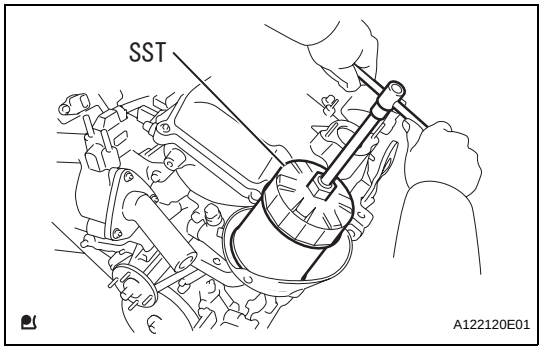
4. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 1)

(a) Remove the bolt and camshaft timing oil control valve.



5. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 2)

(a) Remove the bolt and camshaft timing oil control valve.



6. REMOVE OIL FILTER SUB-ASSEMBLY

(a) Remove the drain pipe cap.

(b) While removing the oil filter with SST, catch the oil from the oil filter with a container.

SST 09228-07501

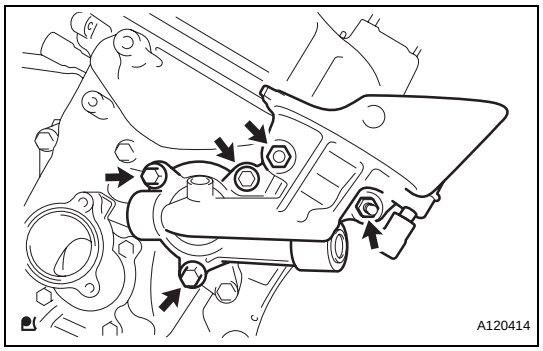
(c) Install the drain pipe cap.

7. REMOVE OIL FILTER UNION

(a) Using a 12 mm hexagon wrench, remove the oil filter union.

8. REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY

(a) Using a 24 mm deep socket wrench, remove the oil pressure switch.

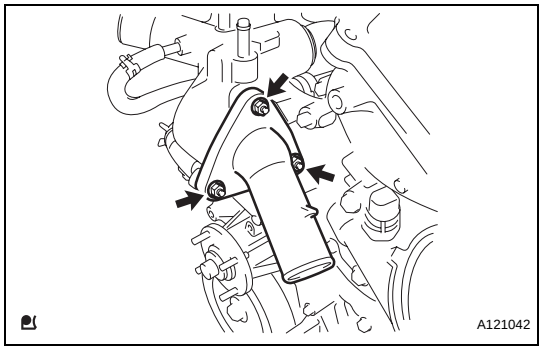


9. REMOVE OIL FILTER BRACKET SUB-ASSEMBLY

(a) Remove the 3 bolts, 2 nuts and the oil filter bracket.

(b) Remove the gasket.

(c) Remove the 2 stud bolts.



10. REMOVE WITH THERMOSTAT WATER INLET SUB-ASSEMBLY

(a) Remove the 3 nuts and the water inlet with thermostat.

(b) Remove the O-ring.

11. REMOVE NO. 3 WATER BY-PASS HOSE

(a) Loosen the 2 clamps and remove the No. 3 water by-pass hose.

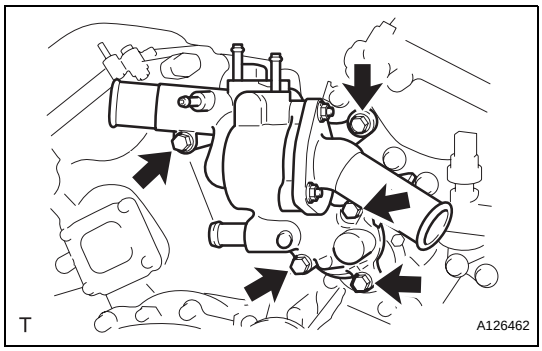
12. REMOVE NO. 2 WATER BY-PASS HOSE

(a) Loosen the 2 clamps and remove the No. 2 water by-pass hose.

13. REMOVE WATER BY-PASS HOSE

(a) Loosen the 2 clamps and remove the water by-pass hose.

EM



14. REMOVE WATER INLET

(a) Remove the 5 bolts and water inlet.
(b) Remove the O-ring from the outlet pipe.
(c) Remove the gasket.

15. REMOVE SPARK PLUG

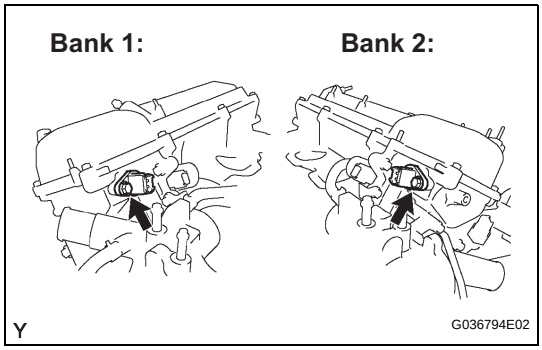
(a) Using a spark plug wrench, remove the 6 spark plugs.

16. REMOVE OIL LEVEL GAUGE GUIDE

(a) Remove the bolt, then pull out the oil level gauge guide.
(b) Remove the O-ring from the oil level gauge guide.

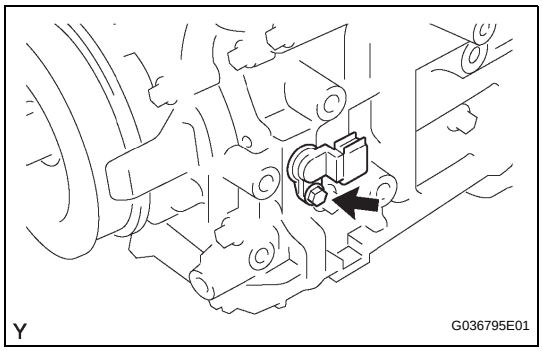
17. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

(a) Remove the 2 water drain cocks.



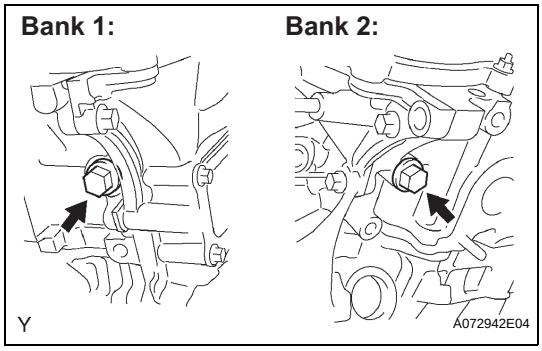
18. REMOVE VVT SENSOR

(a) Remove the 2 bolts, then remove the 2 VVT sensors.



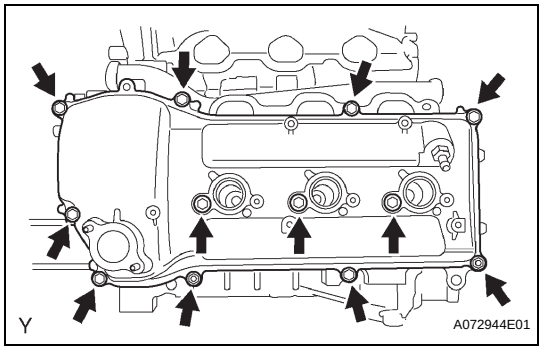
19. REMOVE CRANKSHAFT POSITION SENSOR

(a) Remove the bolt, then remove the crankshaft position sensor.



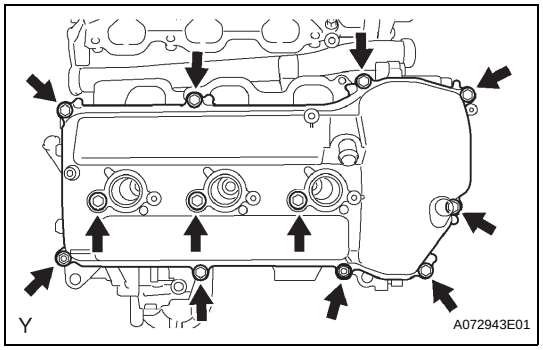
20. REMOVE OIL CONTROL VALVE FILTER

(a) Remove the plug and filter, then remove the gasket from each cylinder head.



21. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

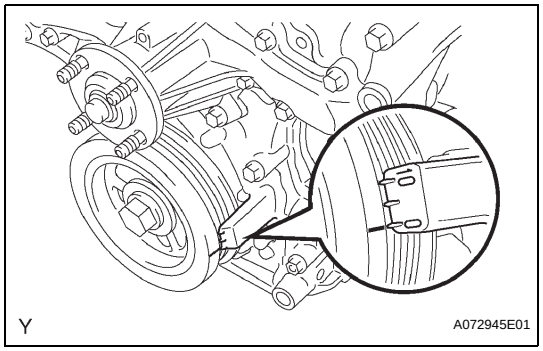
(a) Remove the 10 bolts, 3 seal washers and 2 nuts, then remove the cylinder head cover.
(b) Remove the gasket from the cylinder head cover.
(c) Remove the ventilation valve from the cylinder head cover.



22. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

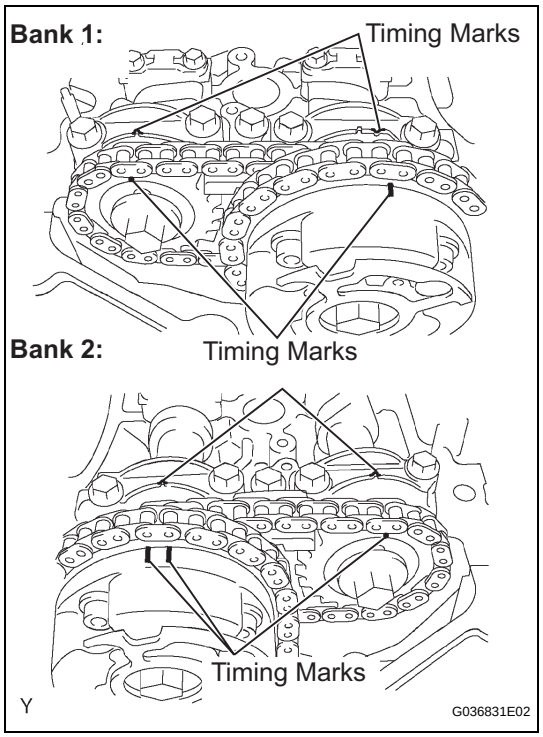
(a) Remove the 10 bolts, 3 seal washers and 2 nuts, then remove the cylinder head cover.
(b) Remove the gasket from the cylinder head cover.

EM

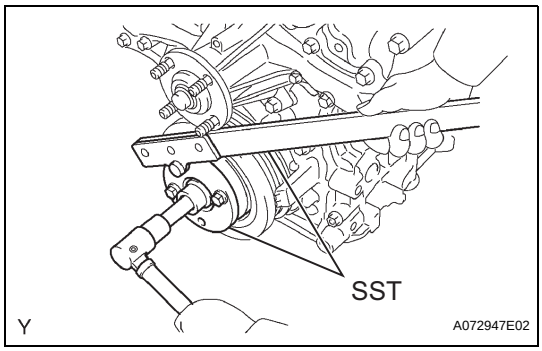


23. REMOVE CRANKSHAFT PULLEY

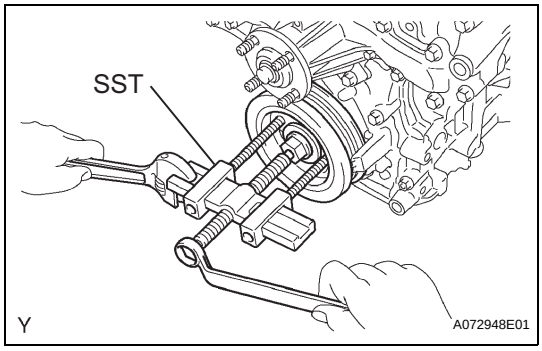
(a) Turn the crankshaft pulley until its groove and the "0" timing mark of the timing chain cover are aligned.



(b) Check that the timing marks of the camshaft timing gears are aligned with the timing marks located on the No. 1 and No. 2 bearing caps as shown in the illustration.
If not, turn the crankshaft 1 complete revolution (360°) and align the timing marks as above.



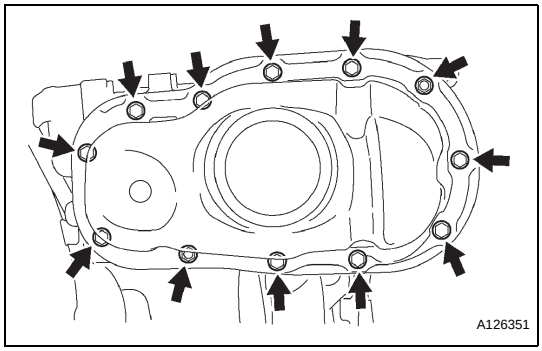
(c) Using SST, fix the pulley and loosen the pulley bolt.
SST 09213-54015 (91651-60855), 09330-00021



(d) Using the pulley set bolt and SST, remove the crankshaft pulley.
SST 09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05030)

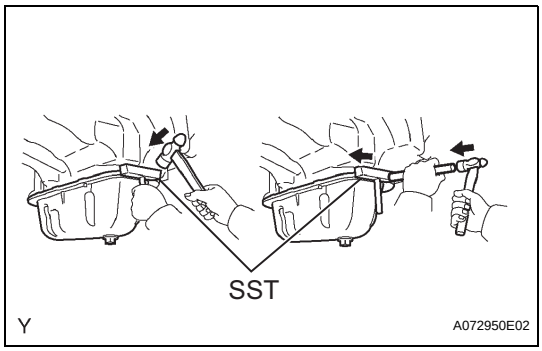
24. REMOVE OIL PAN DRAIN PLUG

(a) Remove the drain plug and gasket.

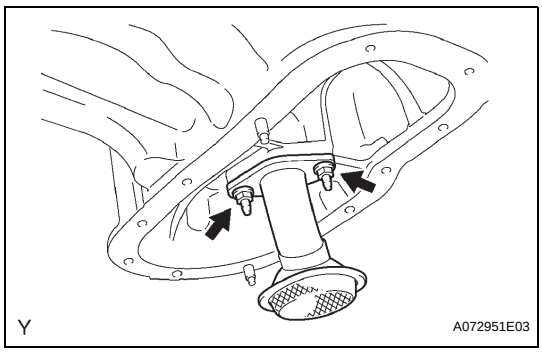


25. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

(a) Remove the 10 bolts and 2 nuts.

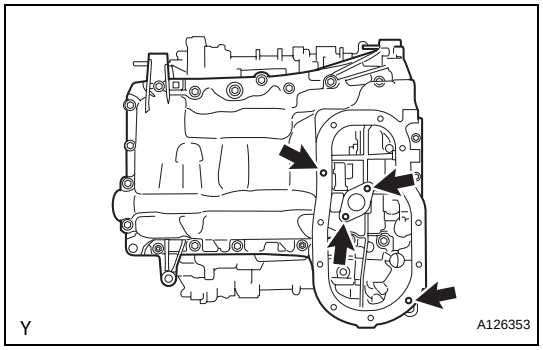


(b) Insert the blade of SST between the oil pan and oil pan No. 2, then cut off applied sealer and remove oil pan No. 2.
SST 09032-00100
NOTICE:
- **Be careful not to damage the contact surface of the oil pan and oil pan No. 2.**
- **Be careful not to damage the oil pan No. 2 flange.**



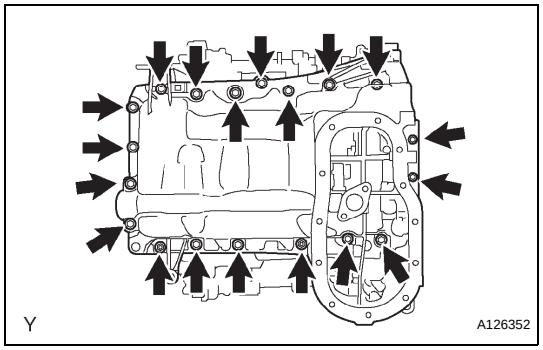
26. REMOVE OIL STRAINER SUB-ASSEMBLY

(a) Remove the 2 nuts, then remove the oil strainer and gasket.

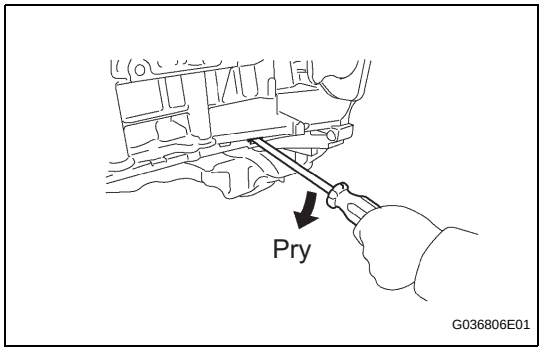


27. REMOVE OIL PAN SUB-ASSEMBLY

(a) Remove the 4 stud bolts from the oil pan.



(b) Remove the 17 bolts and 2 nuts.

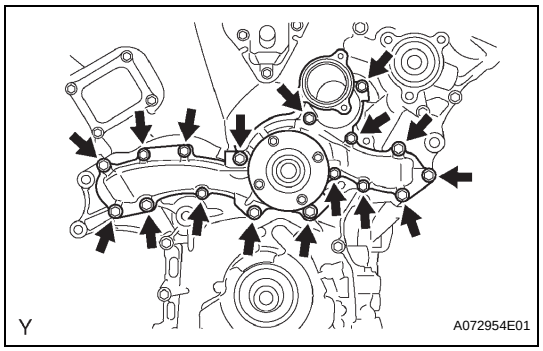


(c) Using a screwdriver, remove the oil pan by prying between the oil pan and cylinder block in the sequence shown.

NOTICE:

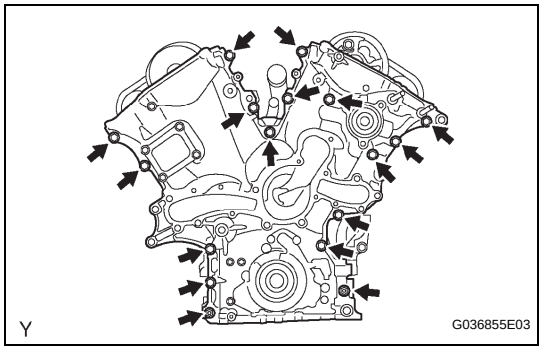
Be careful not to damage the contact surfaces of the cylinder block and oil pan.

(d) Remove the O-ring from the oil pump.



28. REMOVE WATER PUMP ASSEMBLY

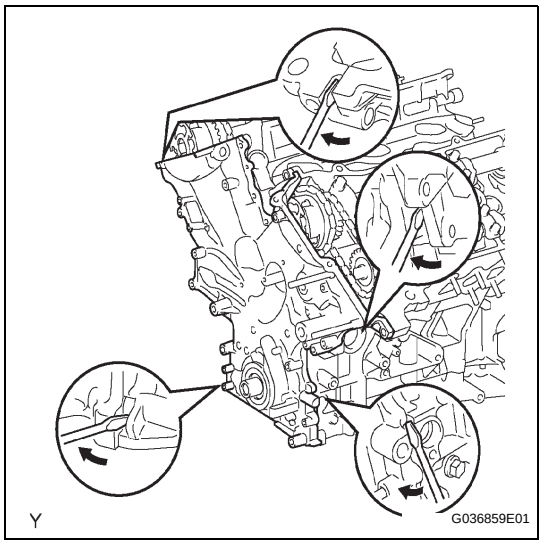
(a) Remove the 17 bolts, then remove the water pump and gasket.



29. REMOVE TIMING CHAIN OR BELT COVER SUB-ASSEMBLY

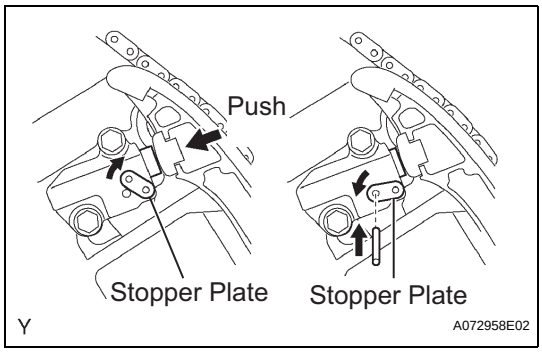
(a) Remove the 15 bolts and 2 nuts.

EM



(b) Remove the timing chain cover by prying between the timing chain cover, cylinder head and cylinder block with a screwdriver.
NOTICE:
Be careful not to damage the contact surfaces of the timing chain cover, cylinder block and cylinder head.
(c) Remove the 4 bolts and timing chain cover plate.
(d) Remove the O-ring from the cylinder head LH.

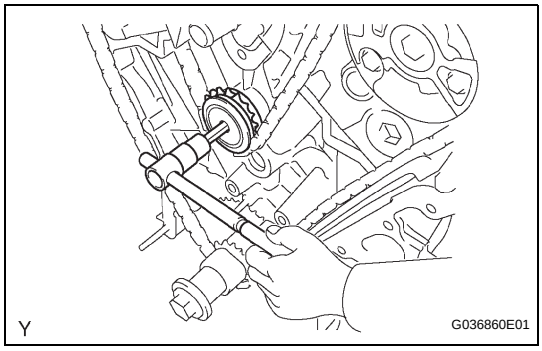
30. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY
NOTICE:
- **Never rotate the crankshaft with the chain tensioner removed.**
- **When rotating the camshaft with the timing chain removed, rotate the crankshaft counterclockwise 40° from the TDC first.**

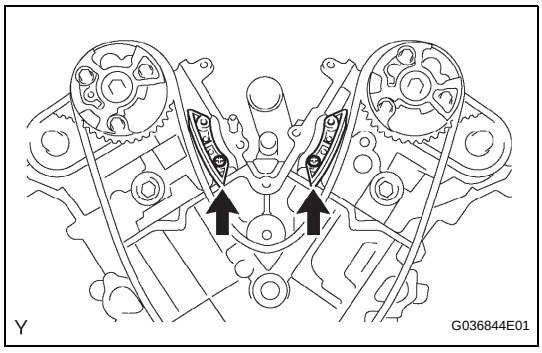


(a) While turning the stopper plate of the tensioner upward, push in the plunger of the chain tensioner as shown in the illustration.
(b) While turning the stopper plate of the tensioner downward, insert a bar of ϕ 3.5 mm (0.138 in.) into the holes in the stopper plate and tensioner to fix the stopper plate.
(c) Remove the 2 bolts, then remove the chain tensioner.

31. REMOVE CHAIN TENSIONER SLIPPER

32. REMOVE IDLE SPROCKET ASSEMBLY
(a) Using a 10 mm hexagon wrench, remove the No. 2 idle gear shaft, No. 1 idle gear and No. 1 idle gear shaft.

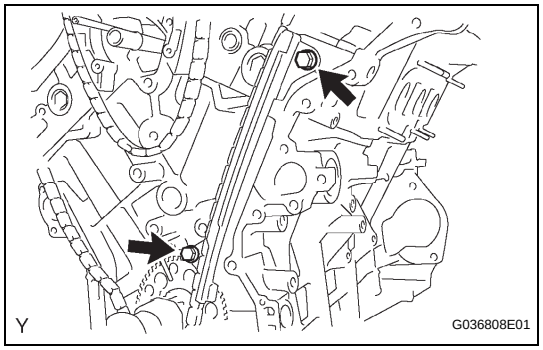




33. REMOVE NO. 2 CHAIN VIBRATION DAMPER
(a) Remove the 2 No. 2 chain vibration dampers.

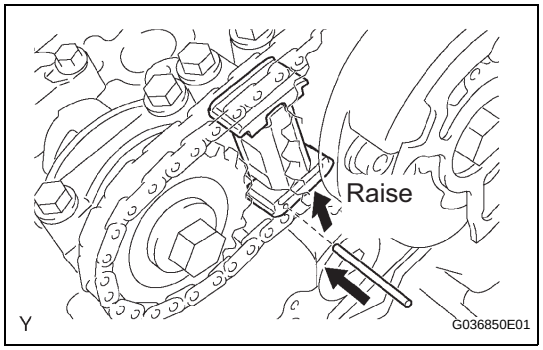
34. REMOVE CHAIN SUB-ASSEMBLY

35. REMOVE CRANKSHAFT TIMING GEAR OR SPROCKET



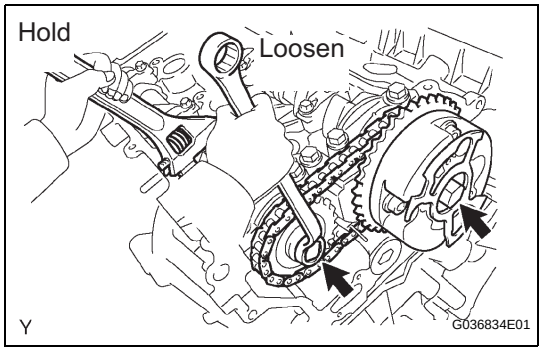
36. REMOVE NO. 1 CHAIN VIBRATION DAMPER

(a) Remove the 2 bolts, then remove the No. 1 chain vibration damper.



37. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

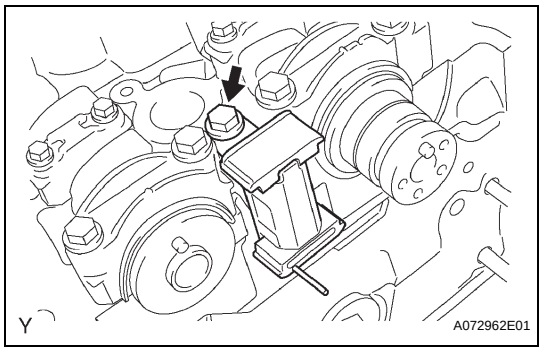
(a) While raising chain tensioner No. 2 upward, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.



(b) Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts, camshaft timing gear, camshaft timing gear assembly and No. 2 timing chain.

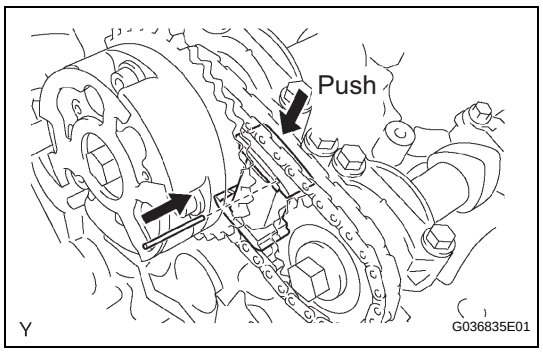
NOTICE:

- **Be careful not to damage the cylinder head and valve lifter with the wrench.**
- **Do not disassemble the camshaft timing gear assembly.**



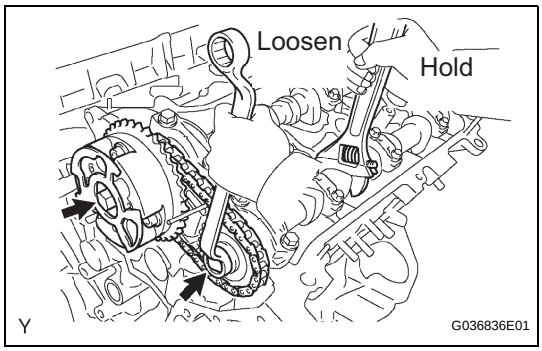
38. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

(a) Remove the bolt, then remove the No. 2 chain tensioner.



39. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)

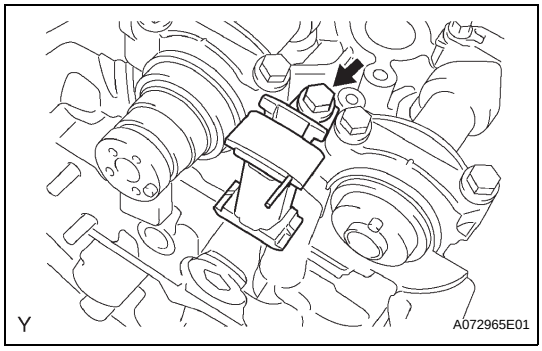
(a) While pushing down the No. 3 chain tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.



(b) Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts, camshaft timing gear, camshaft timing gear assembly and No. 2 timing chain.

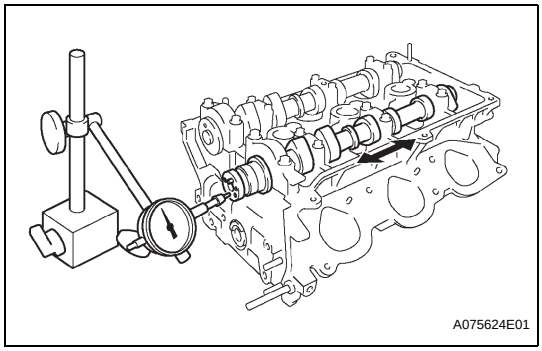
NOTICE:

- **Be careful not to damage the cylinder head and valve lifter with the wrench.**
- **Do not disassemble the camshaft timing gear assembly.**



40. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

(a) Remove the bolt, then remove the No. 3 chain tensioner.



41. INSPECT CAMSHAFT THRUST CLEARANCE

(a) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.04 to 0.09 mm (0.016 to 0.035 in.)
Maximum thrust clearance:
0.11 mm (0.0043 in.)

If the thrust clearance is greater than the maximum, replace the camshafts.

If necessary, replace the camshaft bearing caps and cylinder head as a set.

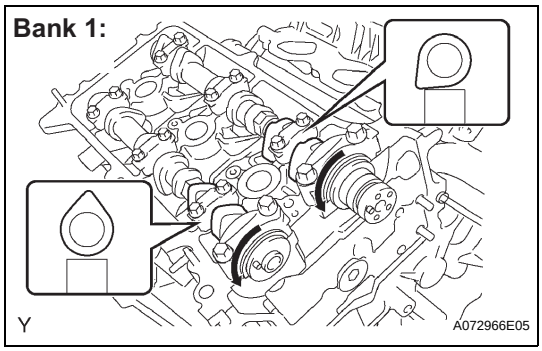
42. REMOVE CAMSHAFTS

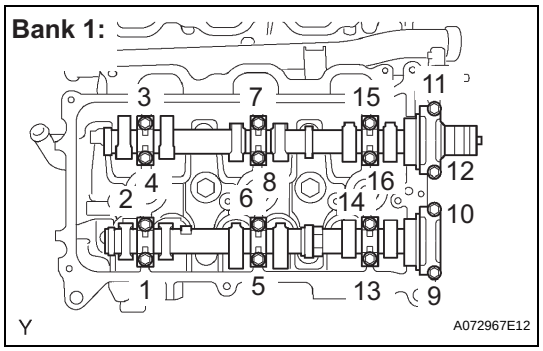
NOTICE:

Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.

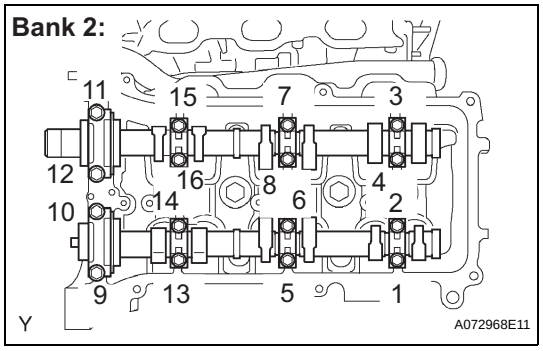
(a) Remove the camshafts of bank 1.

(1) Rotate the camshafts counterclockwise using a wrench so that cam lobes of No. 1 cylinder face in the directions as shown in the illustration.





(2) Using several steps, uniformly loosen and remove the 16 bearing cap bolts in the sequence shown in the illustration.
(3) Remove the 8 bearing caps, then remove the 2 camshafts.



(b) Remove the camshafts of bank 2.
(1) Using several steps, uniformly loosen and remove the 16 bearing cap bolts in the sequence shown in the illustration.
(2) Remove the 8 bearing caps, then remove the 2 camshafts.

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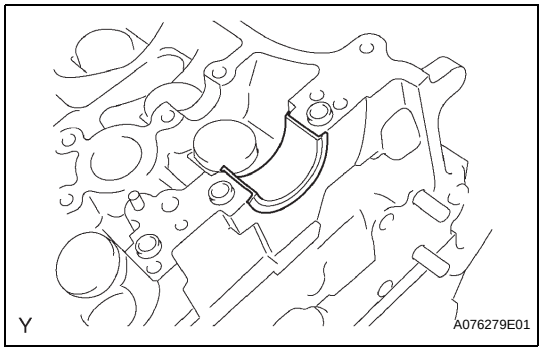
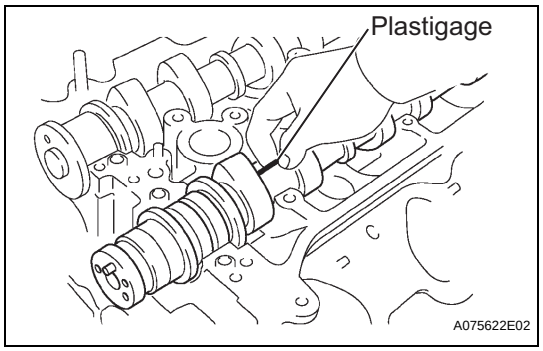
43. REMOVE NO. 1 CAMSHAFT BEARING

(a) Remove the No. 1 camshaft bearing from the No. 1 camshaft bearing cap.



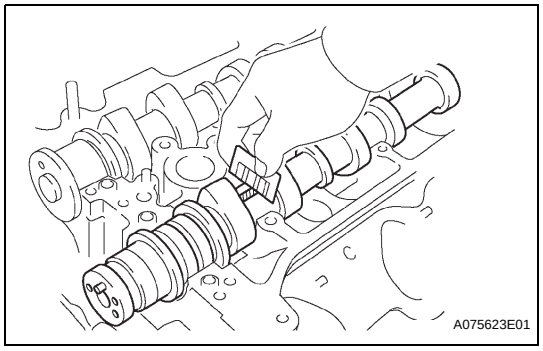
44. REMOVE NO. 2 CAMSHAFT BEARING

(a) Remove the No. 2 camshaft bearing from the cylinder head for bank 1.



45. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the camshaft bearing caps, camshaft bearings and camshaft journals.
(b) Install the camshaft bearing.
(c) Place the camshaft on the cylinder head.
(d) Lay a strip of Plastigage across each camshaft journal.
(e) Install the camshaft bearing caps.
NOTICE:
Do not turn the camshafts.
(f) Remove the camshaft bearing caps.
(g) Measure the Plastigage at its widest point.
Standard oil clearance (Bank 1)



Camshaft Bearing Cap	Specification
No. 1 (Intake)	0.008 to 0.038 mm (0.0003 to 0.0015 in.)
No. 1 (Exhaust)	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Others	0.025 to 0.062 mm (0.0010 to 0.0024 in.)

Standard oil clearance (Bank 2)

Camshaft Bearing Cap	Specification
No. 1	0.040 to 0.079 mm (0.0016 to 0.0031 in.)

Camshaft Bearing Cap	Specification
Others	0.025 to 0.062 mm (0.0010 to 0.0024 in.)

Maximum oil clearance (Bank 1)

Camshaft Bearing Cap	Specification
No. 1 (Intake)	0.07 mm (0.0028 in.)
Others	0.10 mm (0.0039 in.)

Maximum oil clearance (Bank 2):
0.10 mm (0.0039 in.)

If the oil clearance is greater than the maximum, replace the camshaft bearings and/or camshafts. If necessary, replace the camshaft bearing caps and cylinder head together.

Reference

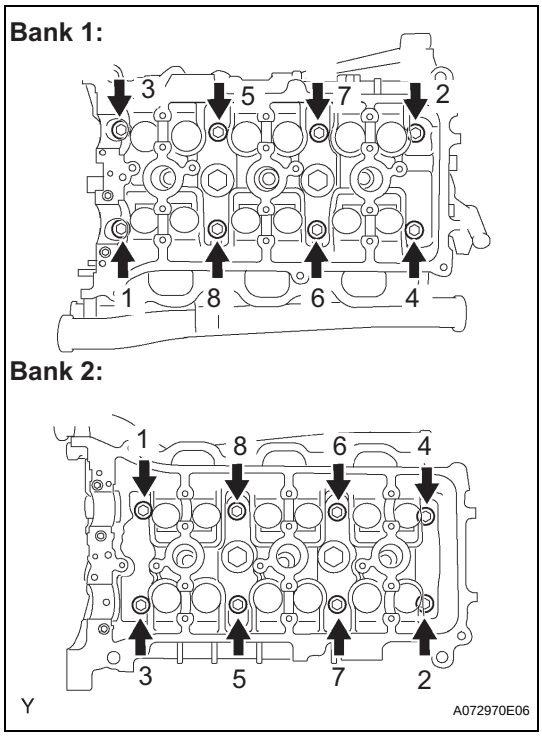
Cylinder head journal bore diameter	40.009 to 40.017 mm (1.5752 to 1.5755 in.)
Camshaft bearing center wall thickness (Mark "2")	2.004 to 2.008 mm (0.0789 to 0.0791 in.)
Camshaft journal diameter	35.971 to 35.985 mm (1.4165 to 1.4167 in.)

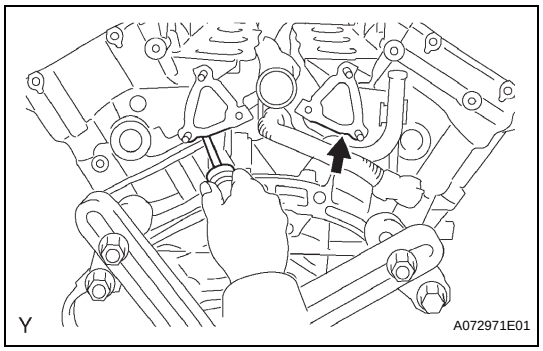
(h) Remove the Plastigage completely.
(i) Remove the camshafts.
(j) Remove the camshaft bearing.

46. REMOVE CYLINDER HEADS

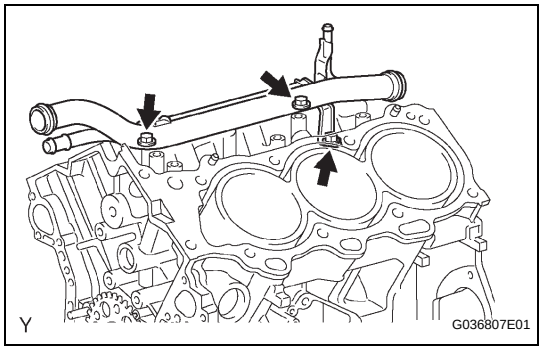
(a) Using several steps, loosen the 8 cylinder head bolts on each cylinder head with a 10 mm bi-hexagon wrench in the sequence shown in the illustration. Remove the 16 cylinder head bolts, then remove the plate washers.

NOTICE:
- **Be careful not to drop the plate washers into the cylinder head.**
- **Cylinder head warpage or cracking could result from removing the bolts in the wrong order.**



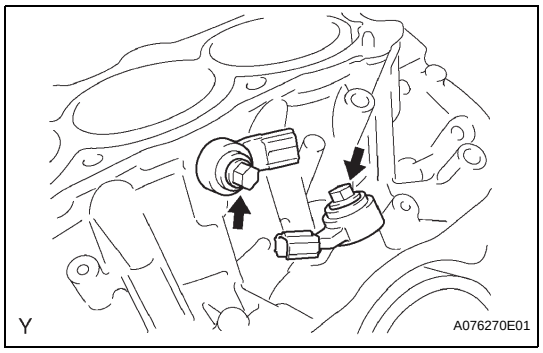


(b) Lift the cylinder head from the dowels on the cylinder block, and place the 2 cylinder heads on wooden blocks on a bench.
NOTICE:
Be careful not to damage the contact surfaces of the cylinder head and cylinder block.
HINT:
If the cylinder head is difficult to remove, pry between the cylinder head and cylinder block with a screwdriver.
(c) Remove the bank 1 and bank 2 cylinder head gaskets.

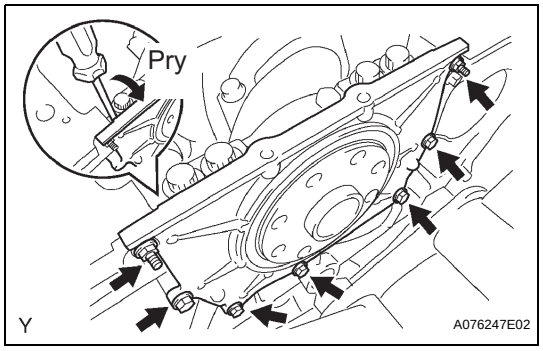


47. REMOVE NO. 1 WATER OUTLET PIPE
(a) Separate the knock sensor wire.
(b) Remove the 3 bolts, then remove the water outlet pipe.

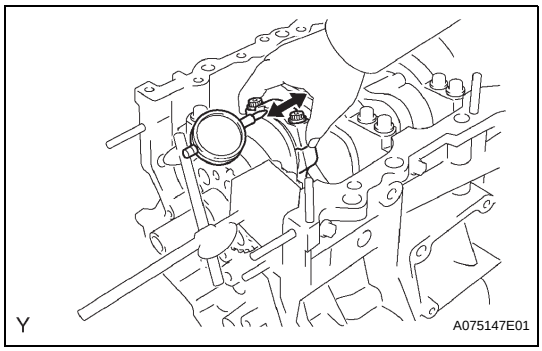
EM



48. REMOVE KNOCK SENSOR
(a) Disconnect the 2 knock sensor connectors.
(b) Remove the 2 bolts, then remove the 2 knock sensors.



49. REMOVE REAR ENGINE OIL SEAL RETAINER
(a) Remove the 5 bolts and 2 nuts.
(b) Using a screwdriver, remove the oil seal retainer by prying between the oil seal retainer and crankshaft bearing cap.

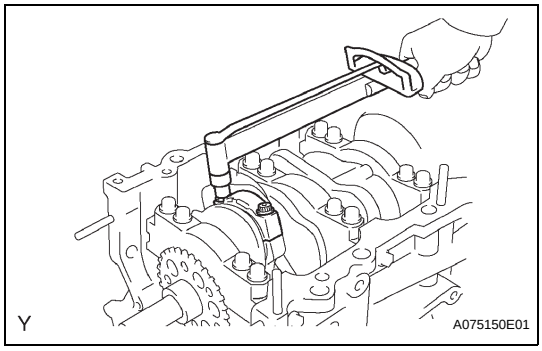


50. INSPECT CONNECTING ROD THRUST CLEARANCE

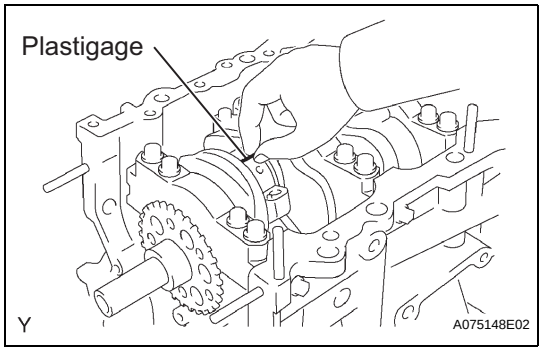
(a) Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.
Standard thrust clearance:
0.15 to 0.30 mm (0.0059 to 0.0118 in.)
Maximum thrust clearance:
0.35 mm (0.0138 in.)

51. INSPECT CONNECTING ROD OIL CLEARANCE

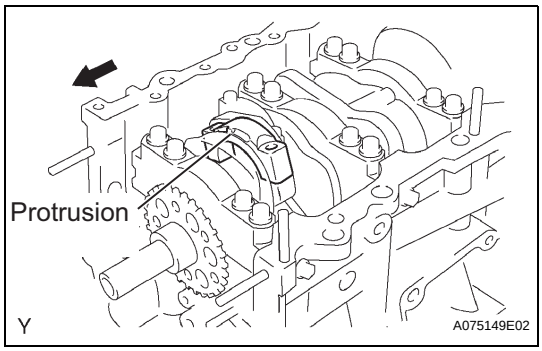
(a) Check the matchmarks on the connecting rod and cap are aligned to ensure correct assembly.



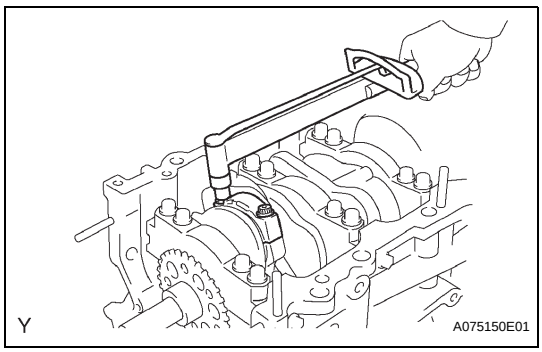
(b) Remove the 2 connecting rod cap bolts.
(c) Clean the crank pin, bearing and connecting rod.
(d) Check the crank pin and bearing for any pits and scratches.



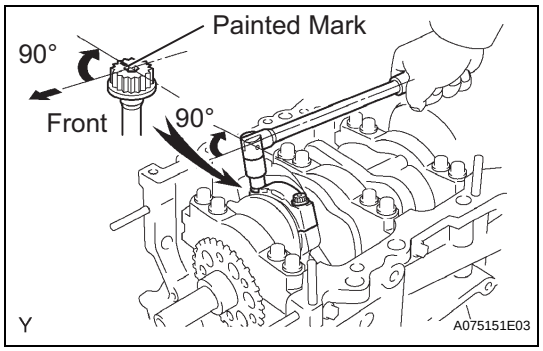
(e) Lay a strip of plastigage across the crank pin.



(f) Check that the protrusion of the connecting rod cap is facing in the correct direction.
(g) Apply a light coat of engine oil to the threads of the connecting rod cap bolts.



(h) Tighten the bolts alternately to the specified torque.
Torque: 25 N*m (250 kgf*cm, 18 ft.*lbf)



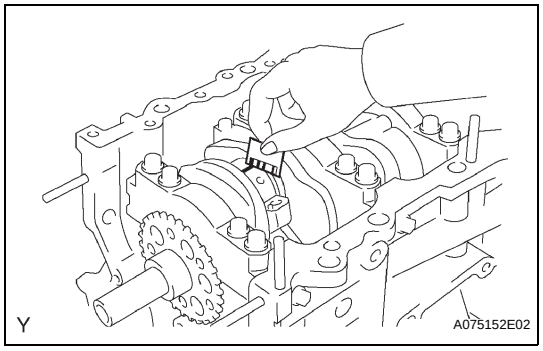
(i) Mark the front side of the each connecting cap bolt with paint.

(j) Retighten the cap bolts 90° as shown in the illustration.

NOTICE:

Do not turn the crankshaft.

(k) Remove the 2 bolts, connecting rod cap and lower bearing.



(l) Measure the plastigage at its widest point.

Standard oil clearance:

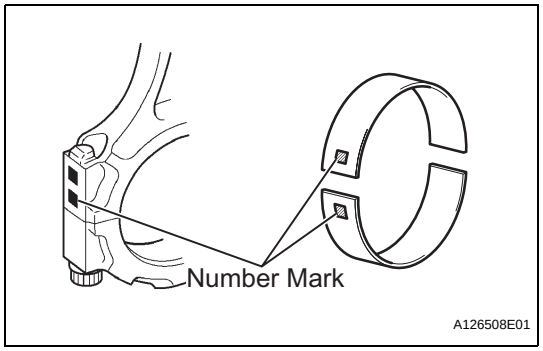
0.026 to 0.046 mm (0.0010 to 0.0018 in.)

Maximum oil clearance:

0.066 mm (0.0025 in.)

NOTICE:

Completely remove the plastigage.

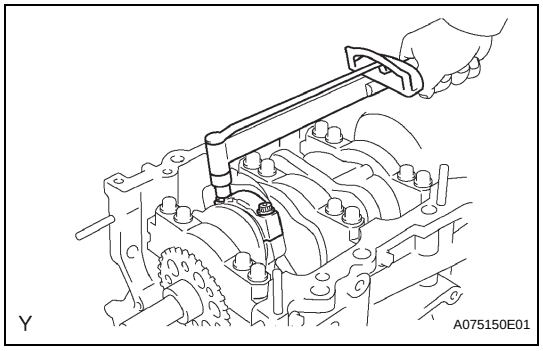


(m) When replacing the bearing, replace it with one with the same number as marked on the connecting rod. There are 4 sizes of standard bearings, marked "1", "2", "3" and "4".

HINT:

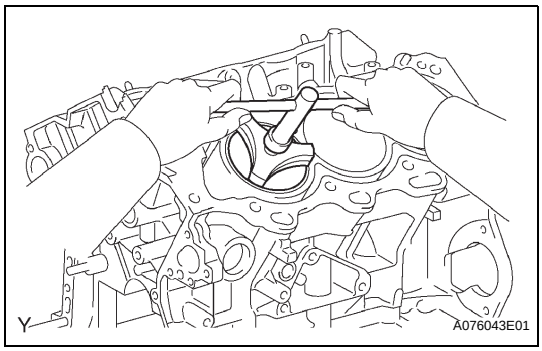
Standard bearing center wall thickness

Mark	mm (in.)
"1"	1.484 to 1.487 (0.0584 to 0.0585)
"2"	1.487 to 1.490 (0.0585 to 0.0587)
"3"	1.490 to 1.493 (0.0587 to 0.0588)
"4"	1.493 to 1.496 (0.0588 to 0.0589)



(n) Remove the 2 connecting rod cap bolts.

EM

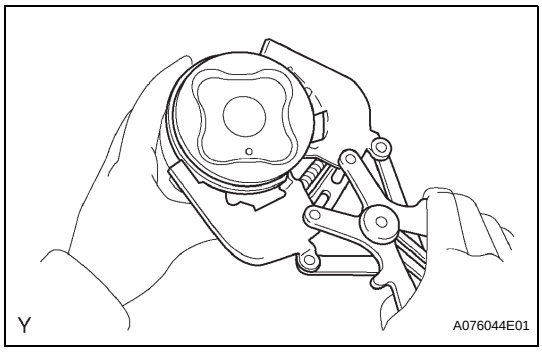


52. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

(a) Using a ridge reamer, remove all the carbon from the top of the cylinder.

(b) Push in the piston, connecting rod assembly and upper bearing through the top of the cylinder block.
HINT:
- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod in the correct order.

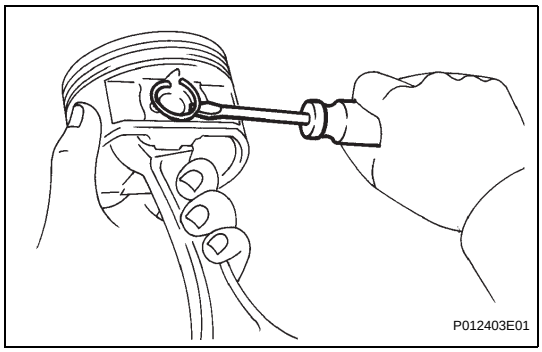
53. REMOVE CONNECTING ROD BEARING



54. REMOVE PISTON RING SET

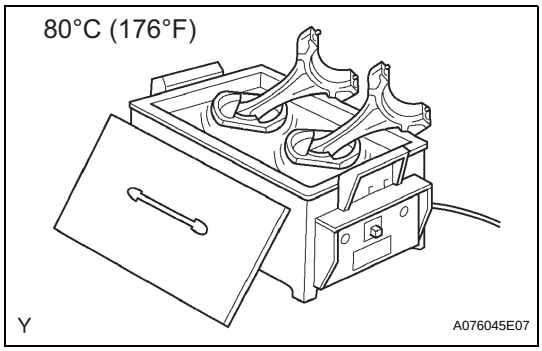
(a) Using a piston ring expander, remove the 2 compression rings.

(b) Remove the 2 side rails and oil ring by hand.



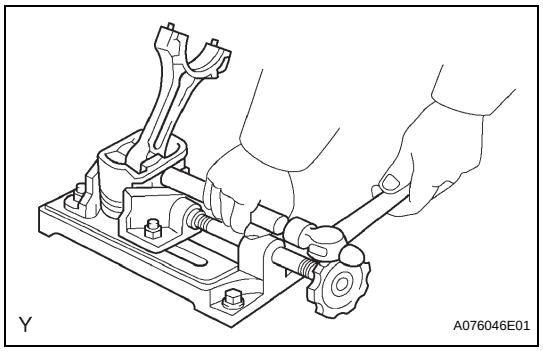
55. REMOVE HOLE SNAP RING

(a) Using a small screwdriver, pry out the 2 snap rings.

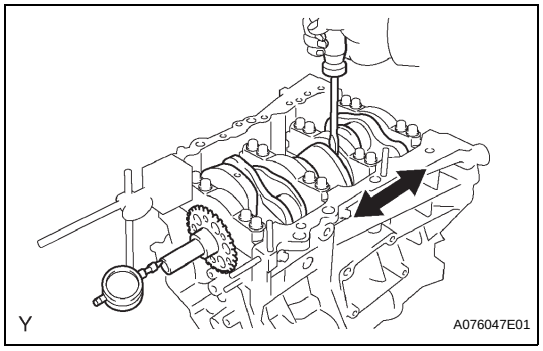


56. REMOVE WITH PISTON SUB-ASSEMBLY

(a) Gradually heat the piston to approximately 80°C (176°F).

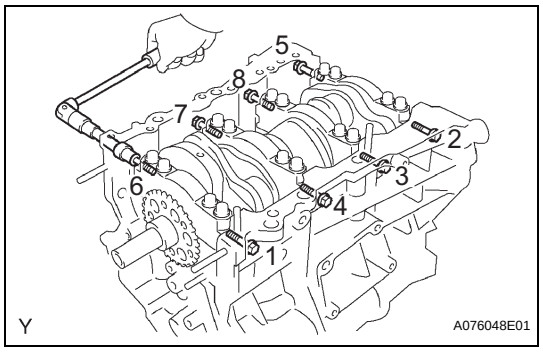


(b) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.
HINT:
- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.



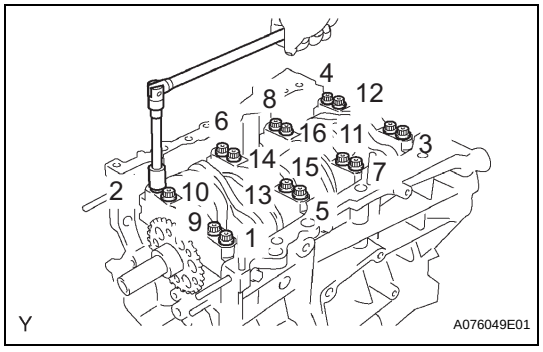
57. INSPECT CRANKSHAFT THRUST CLEARANCE

(a) Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.
Standard thrust clearance:
0.04 to 0.24 mm (0.0016 to 0.0094 in.)
Maximum thrust clearance:
0.30 mm (0.0118 in.)
If the thrust clearance is greater than the maximum, replace the pair of the thrust washers or crankshaft.
HINT:
Thrust washer thickness:
1.93 to 1.98 mm (0.0760 to 0.0780 in.)

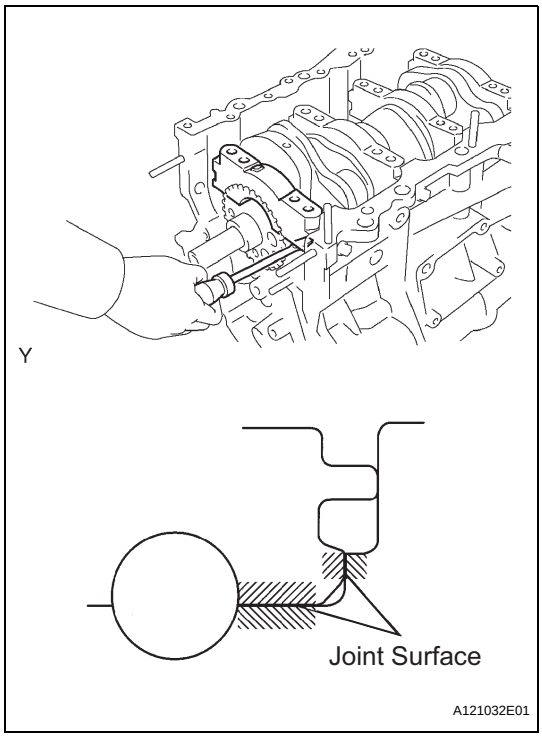


58. INSPECT CRANKSHAFT OIL CLEARANCE

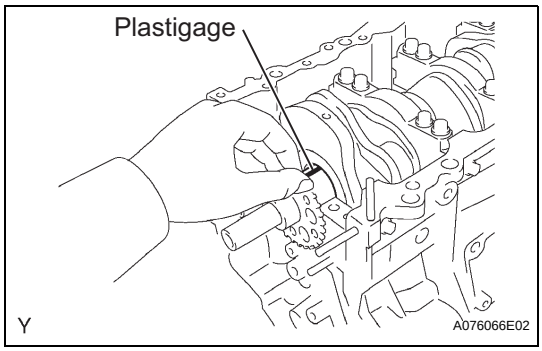
(a) Using several steps, uniformly loosen and remove the 8 main bearing cap bolts and seal washers in the sequence shown in the illustration.



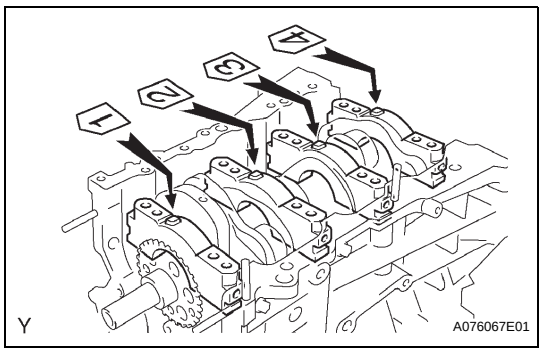
(b) Using several steps, uniformly loosen and remove the 16 main bearing cap bolts in the sequence shown in the illustration.



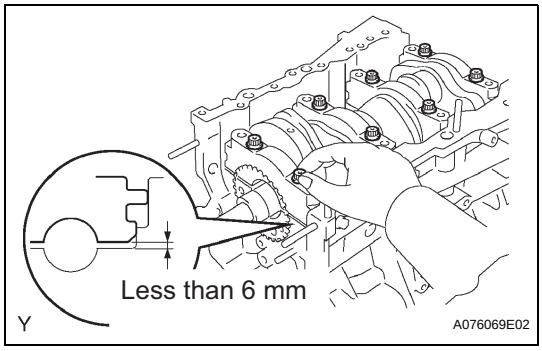
(c) Using a screwdriver, pry out the main bearing caps. Remove the 4 main bearing caps and lower bearings.
NOTICE:
- **Pull up the main bearing cap by turning it to the right and left little by little.**
- **Be careful not to damage the joint surfaces of the cylinder block and the main bearing cap.**



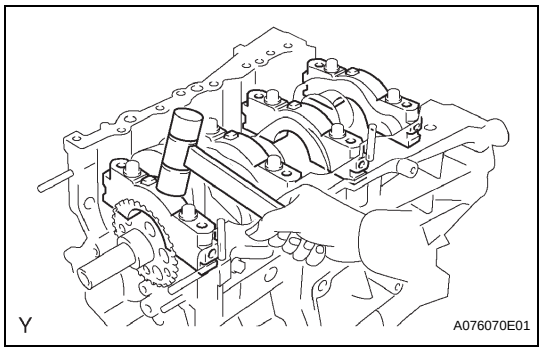
(d) Lay a strip of plastigage across each journal.



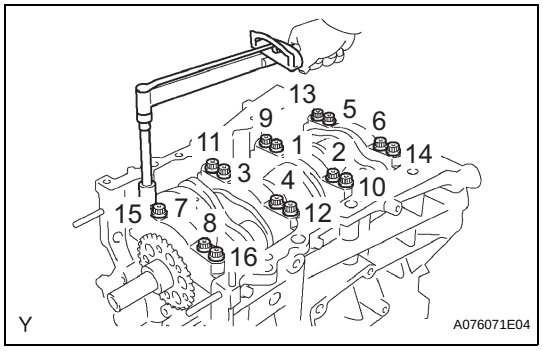
(e) Examine the front marks and numbers, check the sequence order is as shown and install the bearing caps onto the cylinder block.
(f) Apply a light coat of engine oil to the threads of bearing cap bolts.
(g) Temporarily install the 8 main bearing cap bolts in the inside positions.



(h) Install the main bearing caps. Tighten the 2 bolts for each bearing cap until the clearance between the bearing cap and the cylinder block is under 6 mm (0.23 in.).

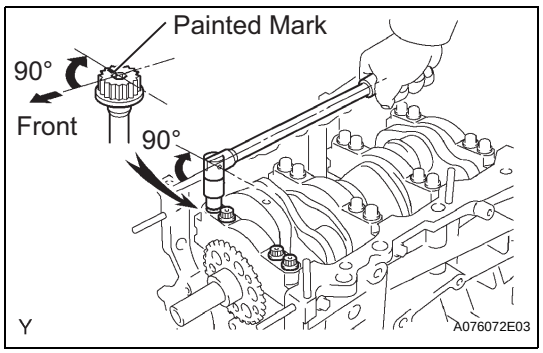


(i) Using a plastic-faced hammer, lightly tap the bearing cap to ensure a proper fit.
(j) Apply a light coat of engine oil to the threads of main bearing cap bolts.

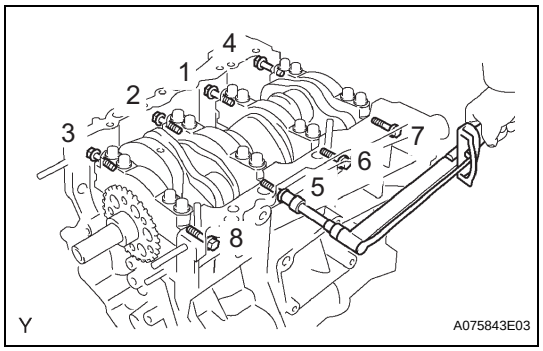


(k) Install the 16 main bearing cap bolts. Using several steps, tighten the bolts uniformly in the sequence shown in the illustration.
Torque: 61 N*m (622 kgf*cm, 45 ft.*lbf)

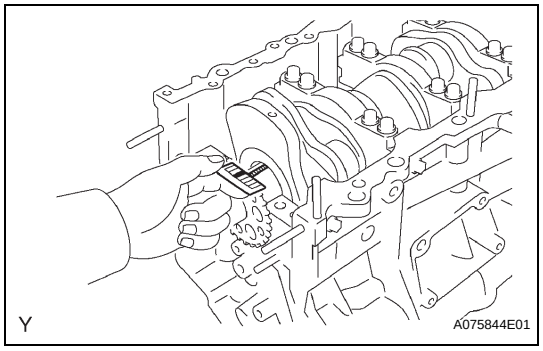
EM



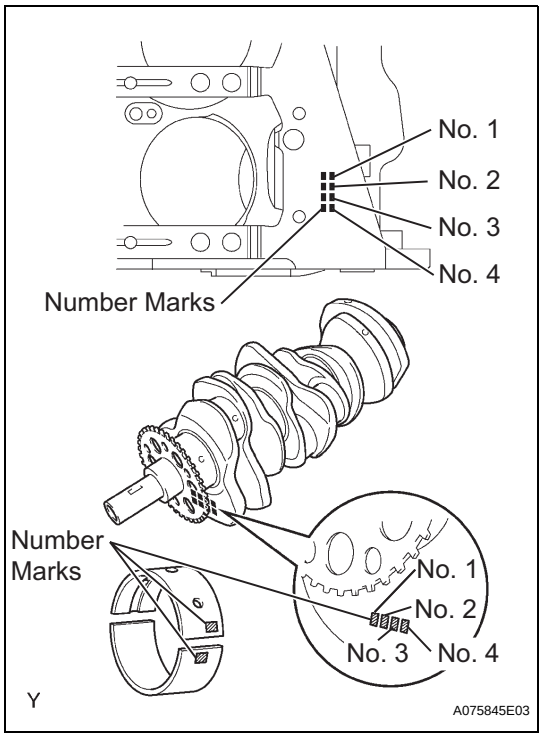
(l) Mark the front side of the bearing cap bolts with paint.
(m) Retighten the bearing cap bolts 90° in the sequence as shown.
(n) Check that the painted mark is now at a 90° angle from the front.
NOTICE:
Do not turn the crankshaft.



(o) Install the 8 main bearing cap bolts. Using several steps, tighten the bolts uniformly in the sequence shown in the illustration.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)
(p) Remove the main bearing caps.



(q) Measure the Plastigage at its widest point.
Standard oil clearance:
0.018 to 0.030 mm (0.0007 to 0.0012 in.)
Maximum clearance:
0.046 mm (0.0018 in.)
If the oil clearance is greater than the maximum, replace the bearings. If necessary, replace the crankshaft.
NOTICE:
Completely remove the plastigage.



(r) Replace the bearing with the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. There are 5 size of standard bearings, marked "1", "2", "3", "4" and "5".

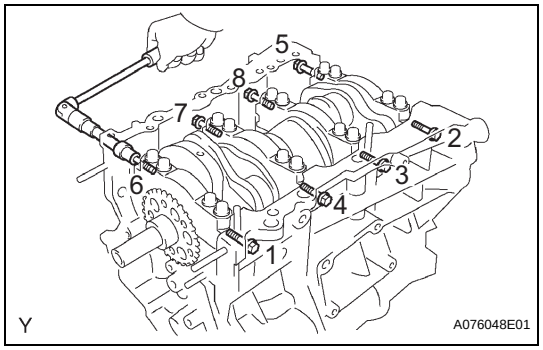
Journal bearing

Cylinder block (A) + Crankshaft	0 -5	6 -11	12 -17	18 - 23	24 - 28
Use Bearing	"1"	"2"	"3"	"4"	"5"

HINT:
EXAMPLE
Cylinder block "11" (A) + Crankshaft "06" (B)
=Total number 17 (Use bearing "3")

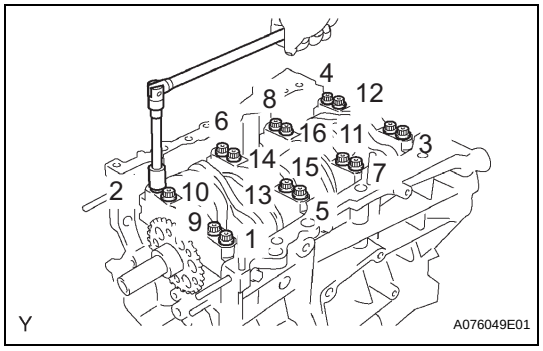
Item	Mark	mm (in.)
Cylinder block main journal bore diameter (A)	"00"	77.000 (3.0315)
	"01"	77.001 (3.0315)
	"02"	77.002 (3.0316)
	"03"	77.003 (3.0316)
	"04"	77.004 (3.0317)
	"05"	77.005 (3.0317)
	"06"	77.006 (3.0317)
	"07"	77.007 (3.0318)
	"08"	77.008 (3.0318)
	"09"	77.009 (3.0319)
	"10"	77.010 (3.0319)
	"11"	77.011 (3.0319)
	"12"	77.012 (3.0320)
	"13"	77.013 (3.0320)
	"14"	77.014 (3.0320)
	"15"	77.015 (3.0321)
	"16"	77.016 (3.0321)
Crankshaft main journal diameter (B)	"00"	71.999 to 72.000 (2.8346 to 2.8346)
	"01"	71.998 to 71.999 (2.8346 to 2.8346)
	"02"	71.997 to 71.998 (2.8345 to 2.8346)
	"03"	71.996 to 71.997 (2.8345 to 2.8346)
	"04"	71.995 to 71.996 (2.8344 to 2.8345)
	"05"	71.994 to 71.995 (2.8344 to 2.8344)
	"06"	71.993 to 71.994 (2.8343 to 2.8344)
	"07"	71.992 to 71.993 (2.8343 to 2.8343)
	"08"	71.991 to 71.992 (2.8343 to 2.8343)
	"09"	71.990 to 71.991 (2.8343 to 2.8343)
	"10"	71.989 to 71.990 (2.8342 to 2.8343)
	"11"	71.988 to 71.989 (2.8342 to 2.8342)

Item	Mark	mm (in.)
Standard bearing center wall thickness	"1"	2.488 to 2.491 (0.0980 to 0.0981)
	"2"	2.491 to 2.494 (0.0981 to 0.0982)
	"3"	2.494 to 2.497 (0.0982 to 0.0983)
	"4"	2.497 to 2.500 (0.0982 to 0.0984)
	"5"	2.500 to 2.503 (0.0984 to 0.0985)

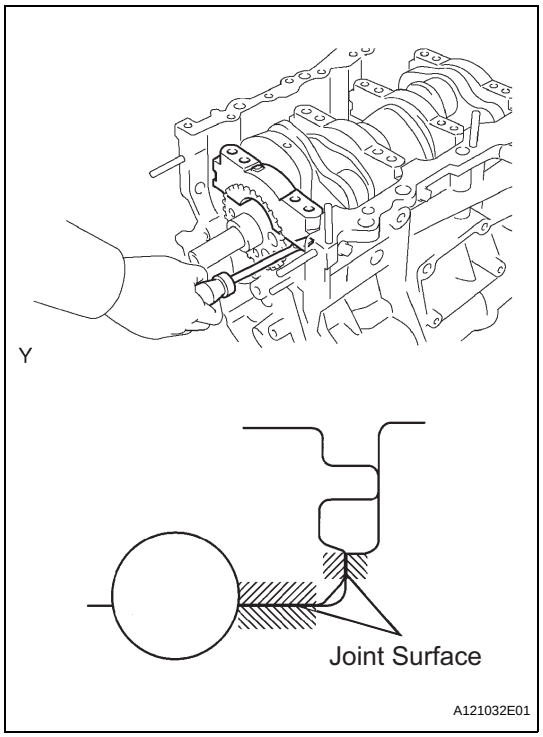


59. REMOVE CRANKSHAFT

(a) Using several steps, uniformly loosen and remove the 8 main bearing cap bolts and seal washers in the sequence shown in the illustration.



(b) Using several steps, uniformly loosen and remove the 16 main bearing cap bolts in the sequence shown in the illustration.



(c) Using a screwdriver, pry out the main bearing caps. Remove the 4 main bearing caps and lower bearings.

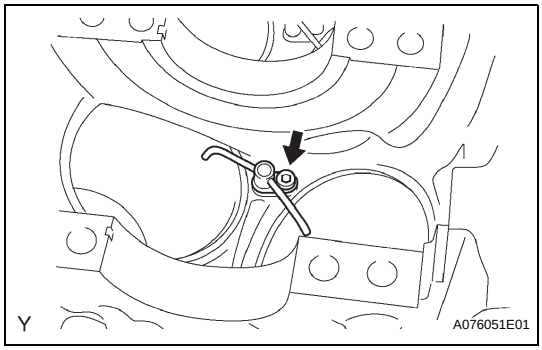
NOTICE:

- **Pull up the main bearing cap by turning it to the right and left little by little.**
- **Be careful not to damage the joint surfaces of the cylinder block and the main bearing cap.**

(d) Remove the crankshaft.

60. REMOVE CRANKSHAFT THRUST WASHER SET

61. REMOVE CRANKSHAFT BEARING



62. REMOVE NO. 1 SUB-ASSEMBLY OIL NOZZLE

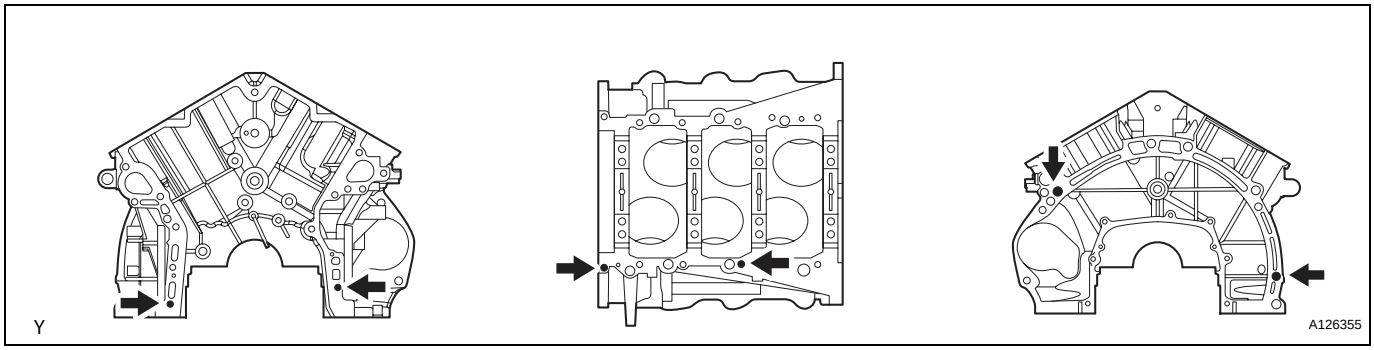
(a) Using a 5 mm socket hexagon wrench, remove the 3 hexagon cap head blots and the 3 oil nozzles.

63. REMOVE OIL JET

64. REMOVE TIGHT PLUG

65. REMOVE STRAIGHT PIN

66. REMOVE STUD BOLT

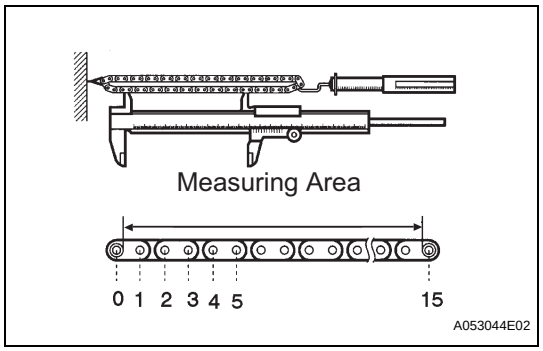


67. DISASSEMBLY CYLINDER HEAD SUB-ASSEMBLY

Refer to the procedures up to "DISASSEMBLY CYLINDER HEAD" (See page EM-73).

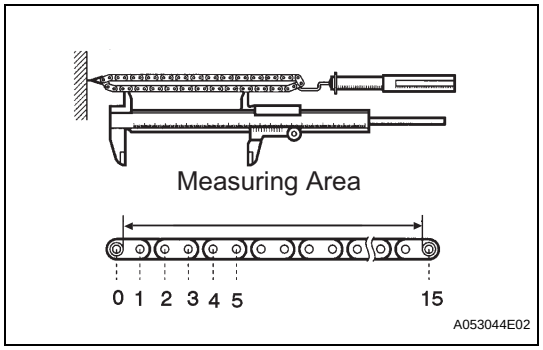
INSPECTION

1. **INSPECT CAMSHAFTS (See page EM-47)**
2. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY (See page EM-47)**
3. **INSPECT CYLINDER HEAD SET BOLT (See page EM-75)**
4. **INSPECT CHAIN SUB-ASSEMBLY**



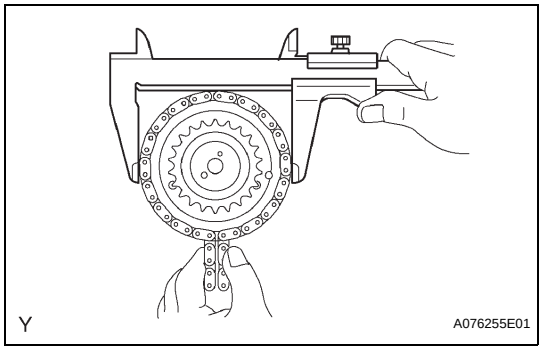
(a) Using a spring scale, apply 147 N (15.0 kgf, 33.1 lbf) to the chain and measure the length.
Maximum chain length:
146.8 mm (5.780 in.)
NOTICE:
Measure the length in at least 3 places and calculate the average length.
If the chain length is greater than the maximum, replace the chain.

5. **INSPECT NO. 2 CHAIN SUB-ASSEMBLY**

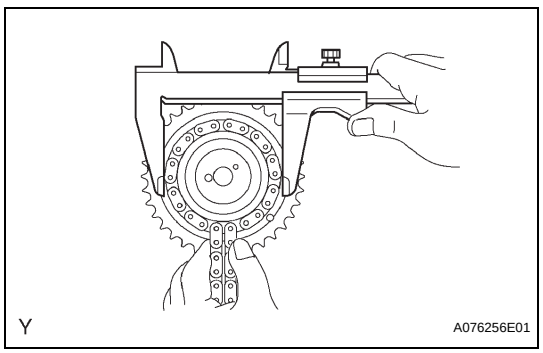


(a) Using a spring scale, apply 147 N (15.0 kgf, 33.1 lbf) to the chain and measure the length.
Maximum chain length:
146.8 mm (5.780 in.)
NOTICE:
Measure the length in at least 3 places and calculate the average length.
If the chain length is greater than the maximum, replace the chain.

6. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY**



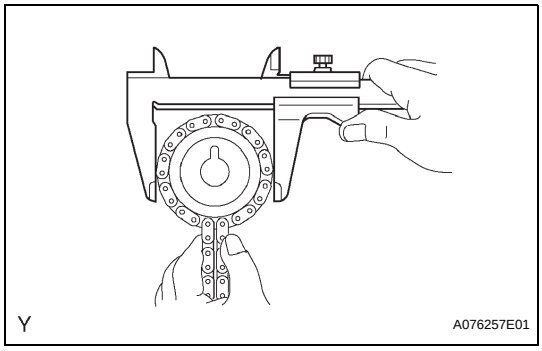
(a) Wrap the chain sub-assembly around the larger gear of the timing gear assembly.
(b) Using vernier calipers, measure the timing gear with the chain wrapped.
Minimum gear diameter (with chain):
115.5 mm (4.547 in.)
NOTICE:
The vernier calipers must be in contact with the chain rollers when measuring.
If the gear diameter is less than the minimum, replace the chain sub-assembly and the camshaft timing gear assembly.



(c) Wrap the No. 2 chain around the smaller gear of timing gear assembly.
(d) Using vernier calipers, measure the timing gear with the chain wrapped.
Minimum gear diameter (with chain):
73.1 mm (2.878 in.)
NOTICE:
The vernier calipers must be in contact the chain rollers when measuring.

EM

If the gear diameter is less than the minimum, replace the No. 2 chain and the camshaft timing gear assembly.



7. INSPECT CAMSHAFT TIMING GEAR OR SPROCKET

(a) Wrap the No. 2 chain around the timing gear.

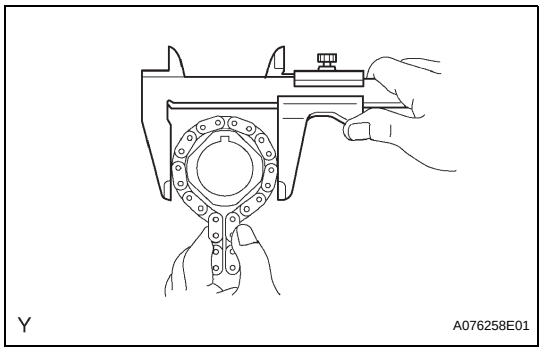
(b) Using vernier calipers, measure the camshaft timing gear diameter with the chain wrapped.

Minimum gear diameter (with chain):
73.1 mm (2.878 in.)

NOTICE:
The vernier calipers must be in contact the chain rollers when measuring.

If the gear diameter is less than the minimum, replace the No. 2 chain and camshaft timing gear.

EM



8. INSPECT CRANKSHAFT TIMING GEAR OR SPROCKET

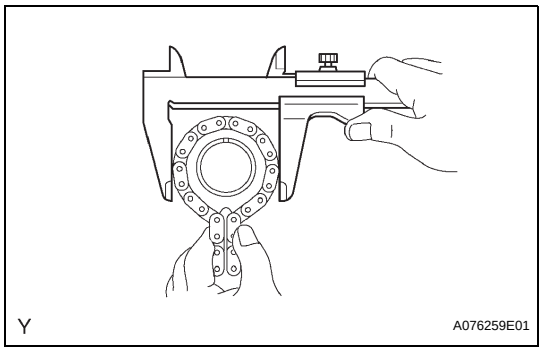
(a) Wrap the chain sub-assembly around the timing gear.

(b) Using vernier calipers, measure the timing gear diameter with the chain wrapped.

Minimum gear diameter (with chain):
61.0 mm (2.402 in.)

NOTICE:
The vernier calipers must be in contact with the chain rollers when measuring.

If the gear diameter is less than the minimum, replace the chain sub-assembly and the crankshaft timing gear.



9. INSPECT IDLE SPROCKET ASSEMBLY

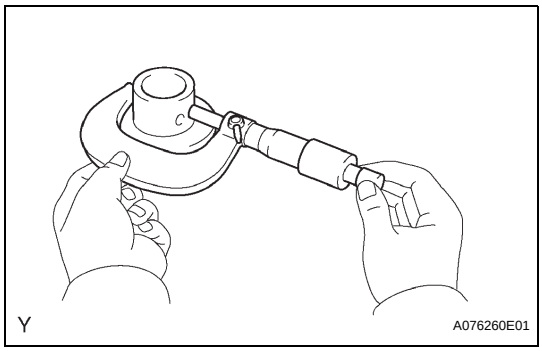
(a) Wrap the chain sub-assembly around the idle sprocket.

(b) Using vernier calipers, measure the idle sprocket with the chain wrapped.

Minimum gear diameter (with chain):
61.0 mm (2.402 in.)

NOTICE:
The vernier calipers must be in contact with the chain rollers when measuring.

If the gear diameter is less than the minimum, replace the chain sub-assembly and idle sprocket.

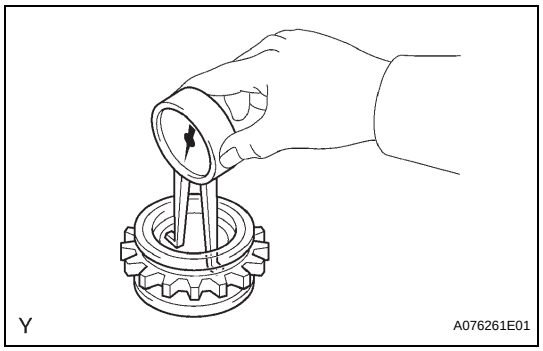


10. INSPECT NO. 1 IDLE GEAR SHAFT

(a) Using a micrometer, measure the idle gear shaft diameter.

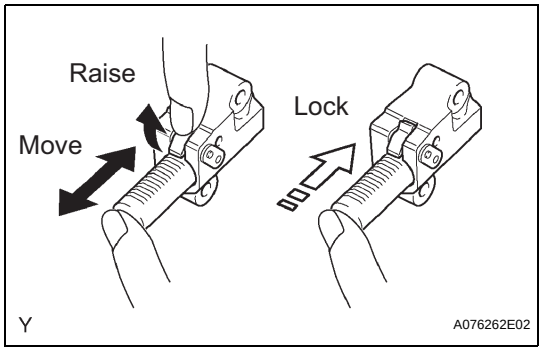
Idle gear shaft diameter:
22.987 to 23.000 mm (0.9050 to 0.9055 in.)

If the result is not as specified, replace the idle gear shaft.



(b) Using a caliper gauge, measure the internal diameter of the idle gear.
Idle gear internal diameter:
23.02 to 23.03 mm (0.9063 to 0.9067 in.)
If the result is not as specified, replace the idle gear.

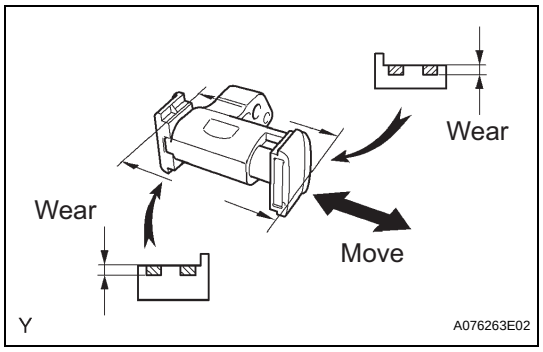
(c) Subtract the idle gear shaft diameter measurement from the idle gear internal diameter measurement.
Standard oil clearance:
0.020 to 0.043 mm (0.0008 to 0.0017 in.)
Maximum oil clearance:
0.093 mm (0.0037 in.)
If the oil clearance is greater than the maximum, replace the idle gear or gear shaft.



11. INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

(a) Check that the plunger moves smoothly when the ratchet pawl is raised with finger.

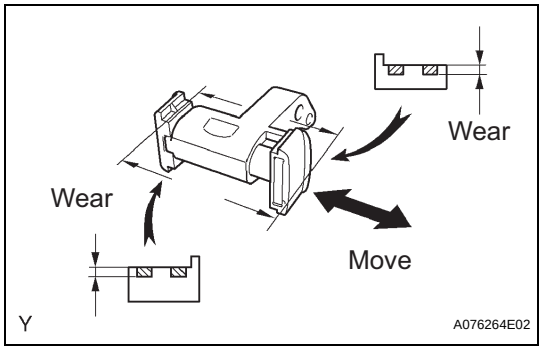
(b) Release the ratchet pawl, then check that the plunger is locked in place by the ratchet pawl and does not move when pushing it with finger.
If the results are not as specified, replace the No. 1 chain tensioner assembly.



12. INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY

(a) Check that the plunger moves smoothly.

(b) Measure the wear of the chain tensioner slipper.
Maximum wear:
1.0 mm (0.039 in.)
If the wear is greater than the maximum, replace chain tensioner No. 2.

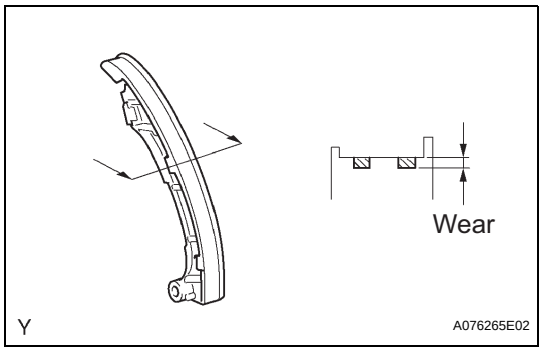


13. INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY

(a) Check that the plunger moves smoothly.

(b) Measure the wear of the chain tensioner slipper.
Maximum wear:
1.0 mm (0.039 in.)
If the wear is greater than the maximum, replace chain tensioner No. 3.

EM



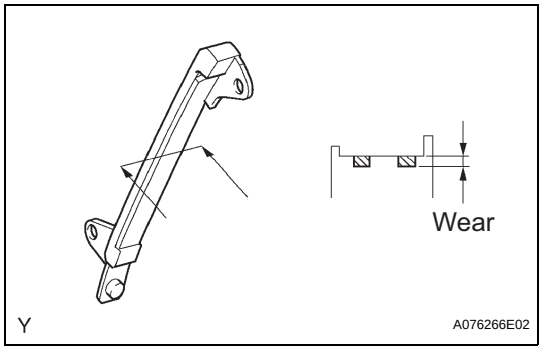
14. INSPECT CHAIN TENSIONER SLIPPER

(a) Measure the wear of the tensioner slipper.

Maximum wear:

1.0 mm (0.039 in.)

If the thickness is greater than the maximum, replace the tensioner slipper.



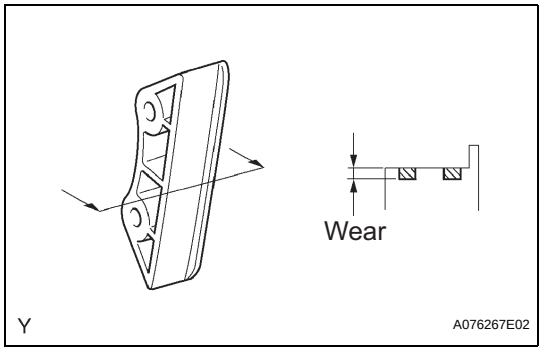
15. INSPECT NO. 1 CHAIN VIBRATION DAMPER

(a) Measure the wear of the vibration damper No. 1.

Maximum wear:

1.0 mm (0.039 in.)

If the thickness is greater than the maximum, replace vibration damper No. 1.



16. INSPECT NO. 2 CHAIN VIBRATION DAMPER

(a) Measure the wear of the vibration damper No. 2 .

Maximum wear:

1.0 mm (0.039 in.)

If the thickness is greater than the maximum, replace vibration damper No. 2.

17. CLEAN CYLINDER HEAD SUB-ASSEMBLY (See page EM-75)

18. INSPECT CYLINDER HEAD SUB-ASSEMBLY (See page EM-77)

19. CLEAN VALVE (See page EM-77)

20. INSPECT VALVE (See page EM-78)

21. CLEAN VALVE SEAT (See page EM-79)

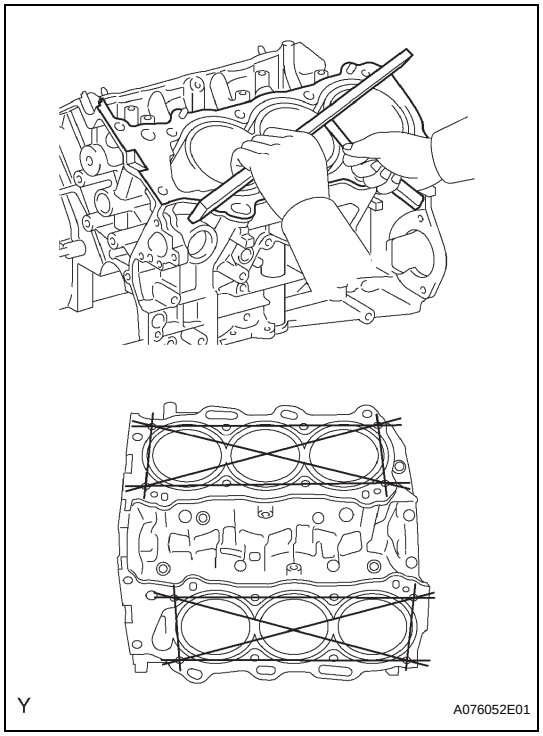
22. INSPECT VALVE SEAT (See page EM-79)

23. INSPECT INNER COMPRESSION SPRING (See page EM-79)

24. INSPECT VALVE GUIDE BUSH OIL CLEARANCE (See page EM-80)

25. INSPECT VALVE LIFTER (See page EM-80)

26. INSPECT VALVE LIFTER OIL CLEARANCE (See page EM-81)



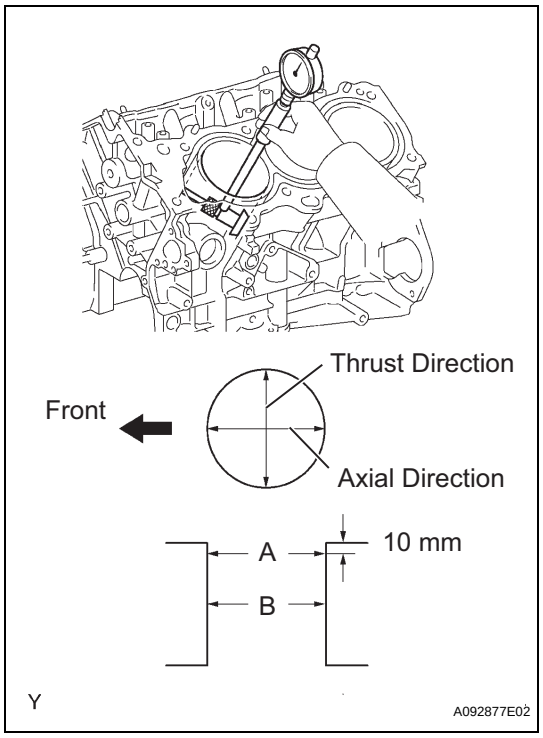
27. CHECK CYLINDER BLOCK FOR WARPAGE

(a) Using a precision straight edge and feeler gauge, measure the warpage of the contact surface of the cylinder head gasket.

Maximum warpage:

0.05 mm (0.0020 in.)

If the warpage is greater than the maximum, replace the cylinder block.



28. INSPECT CYLINDER BORE

(a) Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

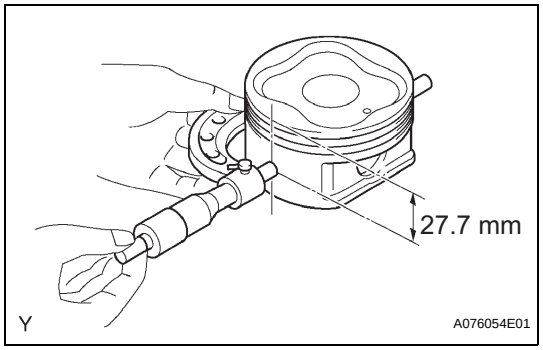
Standard diameter:

94.000 to 94.012 mm (3.7008 to 3.7013 in.)

Maximum diameter:

94.132mm (3.7060 in.)

If the average diameter of the 4 positions is greater than the maximum, replace the cylinder block.



29. INSPECT WITH PISTON SUB-ASSEMBLY

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 27.7 mm (1.091 in.) from the piston head.

Piston diameter:

93.910 to 93.940 mm (3.6972 to 3.6984 in.)

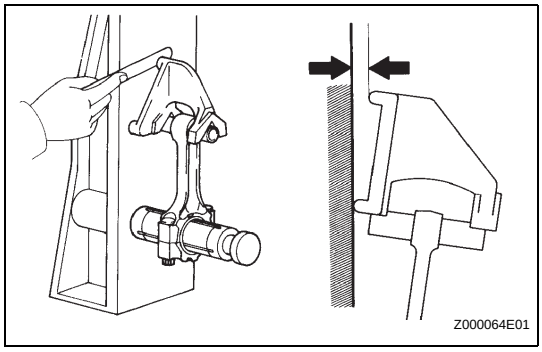
If the result is not as specified, replace the with piston sub-assembly.

30. INSPECT PISTON OIL CLEARANCE

(a) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:
0.060 to 0.102 mm (0.0031 to 0.0040 in.)
Maximum oil clearance:
0.13 mm (0.0051 in.)

If the oil clearance is greater than the maximum, replace all the 6 pistons. If necessary, replace the cylinder block.



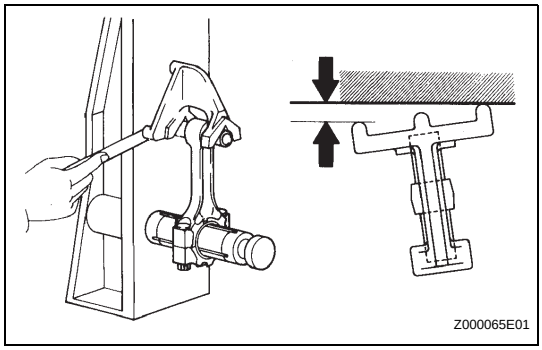
31. INSPECT CONNECTING ROD SUB-ASSEMBLY

(a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for misalignment.

Maximum misalignment:
0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

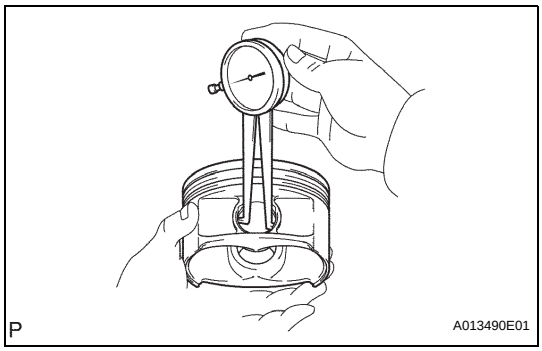
If misalignment is greater than the maximum, replace the connecting rod assembly.



(2) Check the twist.

Maximum twist:
0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

If the twist is greater than the maximum, replace the connecting rod assembly.

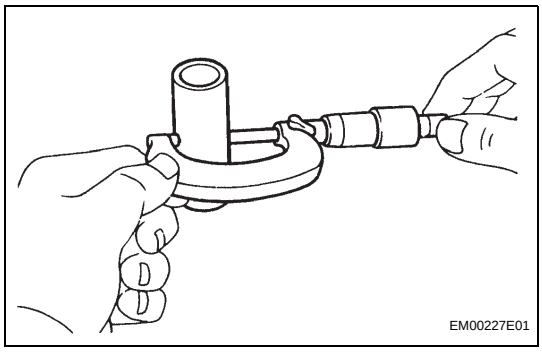


32. INSPECT PISTON PIN OIL CLEARANCE

(a) Using a caliper gauge, measure the internal diameter of the piston pin hole.

Piston pin hole internal diameter:
22.001 to 22.010 mm (0.8662 to 0.8665 in.)
Piston pin hole inside diameter

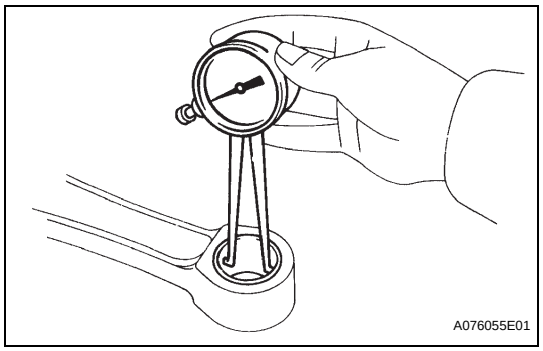
Mark	mm (in.)
A	22.001 to 22.004 (0.8662 to 0.8663)
B	22.005 to 22.007 (0.8663 to 0.8664)
C	22.008 to 22.010 (0.8665 to 0.8665)



(b) Using a micrometer, measure the piston pin diameter.

Piston pin diameter:
21.997 to 22.006 mm (0.8660 to 0.8664 in.)
Piston pin diameter

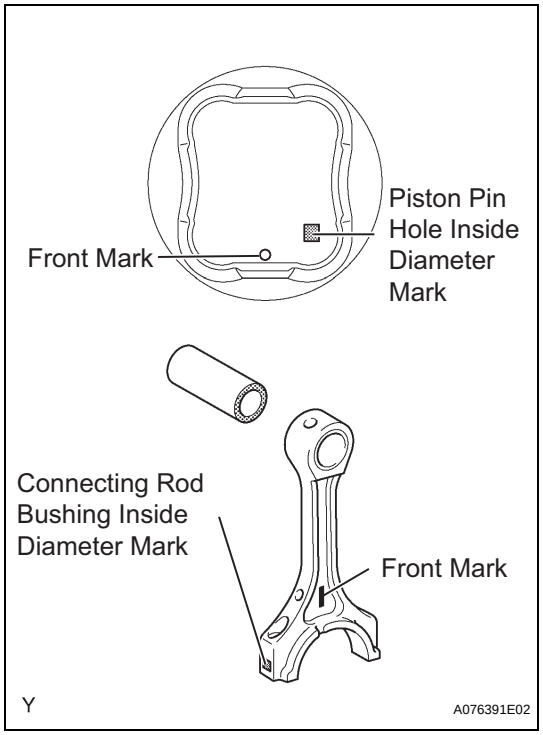
Mark	mm (in.)
A	21.997 to 22.000 (0.8660 to 0.8661)
B	22.001 to 22.003 (0.8661 to 0.8663)
C	22.004 to 22.006 (0.8663 to 0.8664)



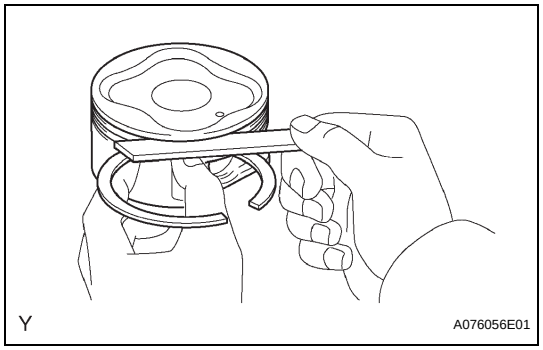
(c) Using a caliper gauge, measure the internal diameter of the connecting rod bushing.
Bushing internal diameter:
22.005 to 22.014 mm (0.8663 to 0.8667 in.)
Bushing internal diameter

Mark	mm (in.)
A	22.005 to 22.008 (0.8663 to 0.8665)
B	22.009 to 22.011 (0.8665 to 0.8666)
C	22.012 to 22.014 (0.8666 to 0.8667)

(d) Subtract the piston pin diameter measurement from the piton pin hole diameter measurement.
Standard oil clearance:
0.001 to 0.007 mm (0.00004 to 0.00028 in.)
Maximum oil clearance:
0.040 mm (0.0016 in.)



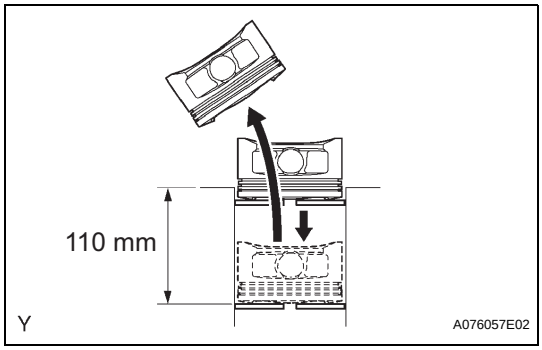
(e) If the oil clearance is greater than the maximum, replace the bushing. If necessary, replace the piston and piston pin together.
(f) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.
Standard oil clearance:
0.005 to 0.011 mm (0.0002 to 0.0004 in.)
Maximum oil clearance:
0.050 mm (0.0020 in.)
(g) If the oil clearance is greater than the maximum, replace the bushing. If necessary, replace the connecting rod and piston pin together.



33. INSPECT RING GROOVE CLEARANCE

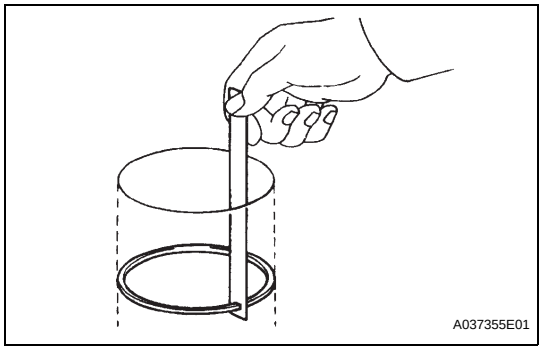
(a) Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.
Ring groove clearance

Piston ring	Specification
No. 1	0.02 to 0.07 mm (0.0008 to 0.0028 in.)
No. 2	0.02 to 0.06 mm (0.0008 to 0.0024 in.)
Oil	0.07 to 0.15 mm (0.0028 to 0.0060 in.)



34. INSPECT PISTON RING END GAP

(a) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.



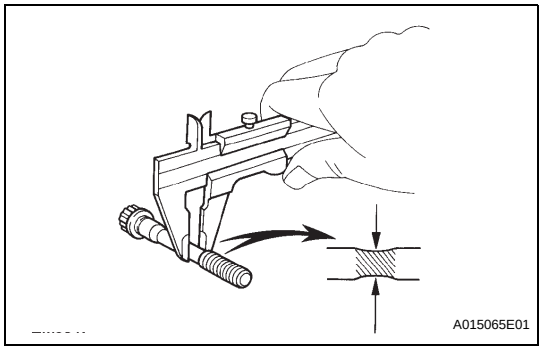
(b) Using a feeler gauge, measure the end gap.

Standard end gap

Piston ring	Specification
No. 1	0.30 to 0.40 mm (0.0118 to 0.0157 in.)
No. 2	0.40 to 0.50 mm (0.0157 to 0.0197 in.)
Oil (Side rail)	0.10 to 0.40 mm (0.0039 to 0.0157 in.)

Maximum end gap

Piston ring	Specification
No. 1	1.0 mm (0.039 in.)
No. 2	1.1 mm (0.043 in.)
Oil (Side rail)	1.0 mm (0.039 in.)



35. INSPECT CONNECTING ROD BOLT

(a) Using vernier calipers, measure the diameter of the elongated portion of the bolt.

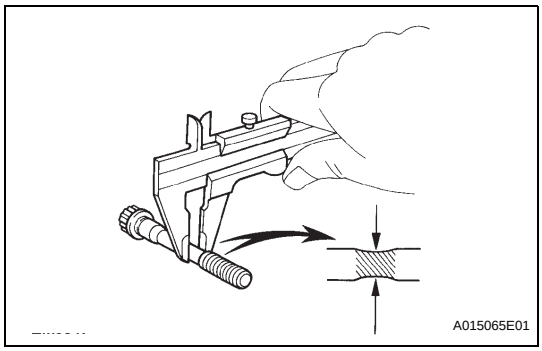
Standard diameter:

7.2 to 7.3 mm (0.283 to 0.287 in.)

Minimum diameter:

7.0 mm (0.276 in.)

If the diameter is less than the minimum, replace the bolt.



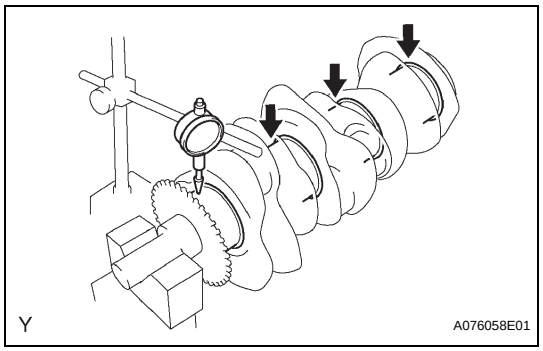
36. INSPECT CRANKSHAFT BEARING CAP SET BOLT

(a) Using vernier calipers, measure the diameter of the elongated portion of the bolt.

Standard diameter:

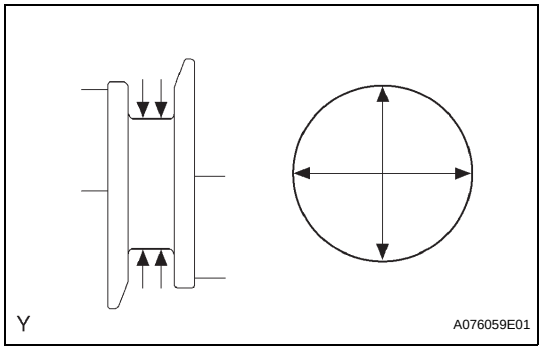
10.0 to 10.2 mm (0.393 to 0.402 in.)

If the diameter is less than the minimum, replace the bolt.



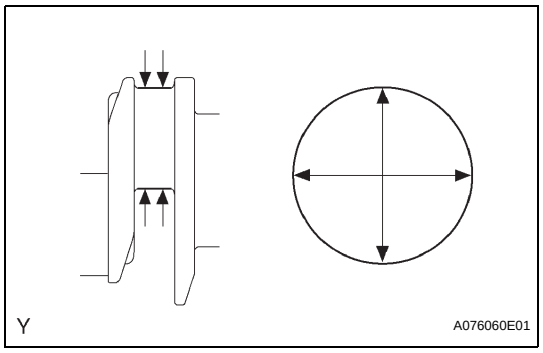
37. INSPECT CRANKSHAFT

(a) Using a dial indicator and V-blocks, measure the runout as shown in the illustration.
Maximum circle runout:
0.06 mm (0.0024 in.)
If the result is not as specified, replace the crankshaft.



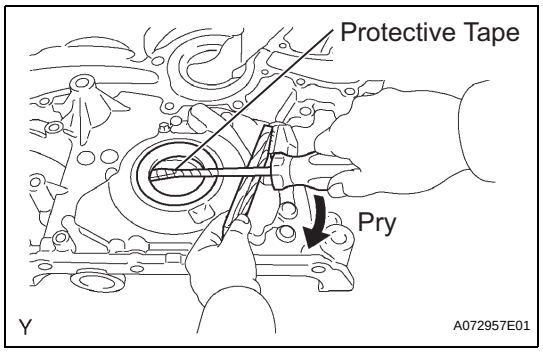
(b) Using a micrometer, measure the diameter of each main journal.
Standard Diameter:
71.988 to 72.000 mm (2.8342 to 2.8346 in.)
If the result is not as specified, replace the crankshaft.

(c) Check each main journal for taper and out-of-roundness as shown.
Maximum taper and out-of-roundness:
0.02 mm (0.0008 in.)
If the result is not as specified, replace the crankshaft.



(d) Using a micrometer, measure the diameter of each crank pin.
Standard diameter:
55.992 to 56.000 mm (2.2044 to 2.2047 in.)
If the result is not as specified, replace the crankshaft.

(e) Check each crank pin for taper and out-of-roundness as shown.
Maximum taper and out-of-roundness:
0.02 mm (0.0008 in.)
If the result is not as specified, replace the crankshaft.

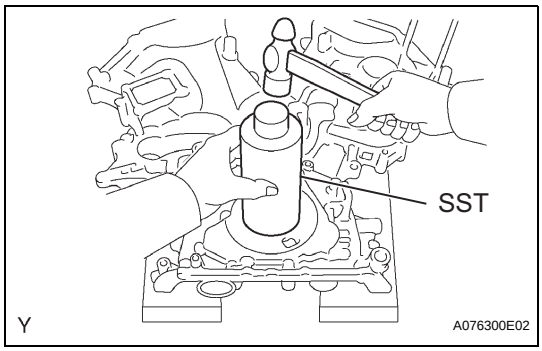


REPLACEMENT

1. REMOVE TIMING GEAR CASE OR TIMING CHAIN CASE OIL SEAL

(a) Using a screwdriver with its tip wrapped in protective tape, pry out the oil seal.
NOTICE:
Do not damage the oil pump assembly.

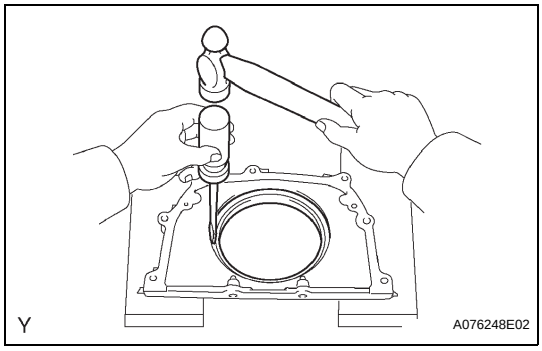
EM



2. INSTALL TIMING GEAR CASE OR TIMING CHAIN CASE OIL SEAL

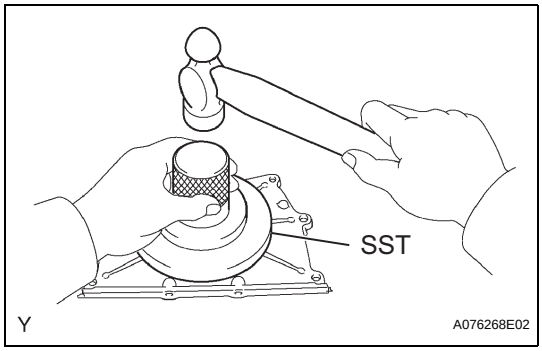
(a) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.
SST 09226-10010

(b) Apply MP grease to the oil seal lip.



3. REMOVE REAR ENGINE OIL SEAL

(a) Using a screwdriver and hammer, tap the oil seal out.



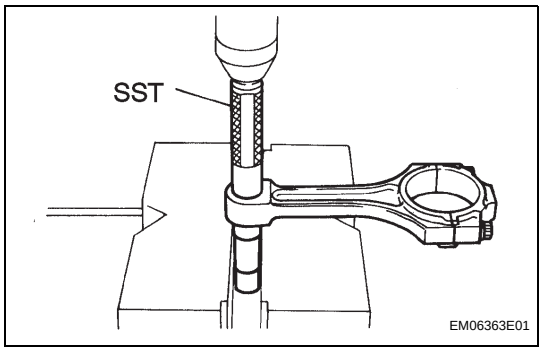
4. INSTALL REAR ENGINE OIL SEAL

(a) Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.
SST 09223-78010

(b) Apply MP grease to the oil seal lip.

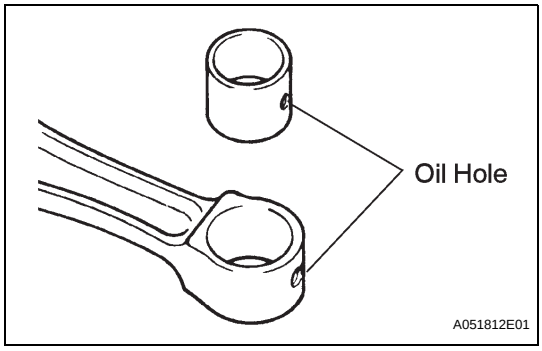
5. REMOVE VALVE GUIDE BUSH (See page EM-81)

6. INSTALL VALVE GUIDE BUSH (See page EM-81)



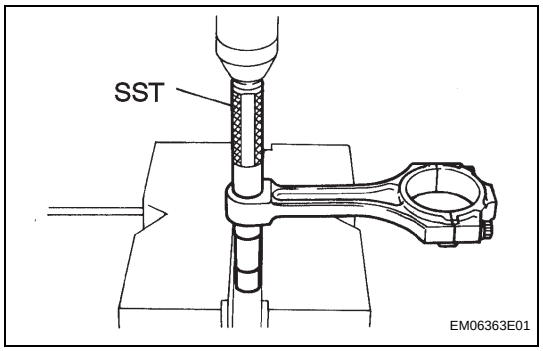
7. REMOVE CONNECTING ROD SMALL END BUSH

(a) Using SST and a press, press out the bushing.
SST 09222-30010

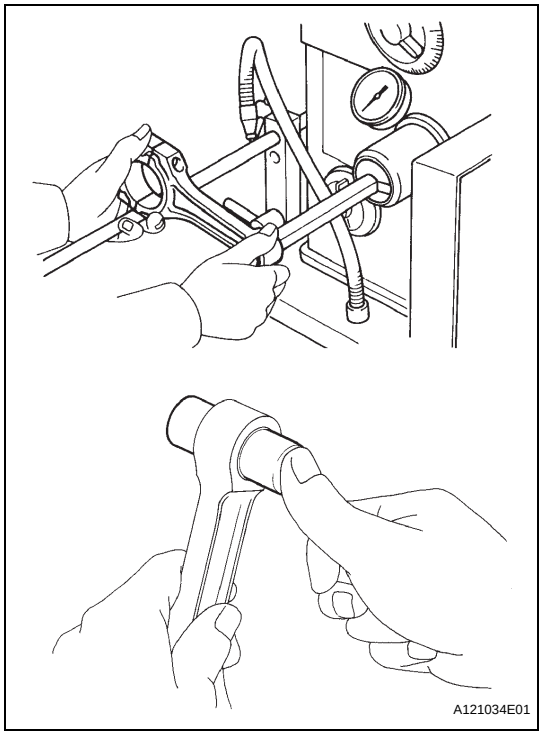


8. INSTALL CONNECTING ROD SMALL END BUSH

(a) Align the oil holes of a new bushing and the connecting rod.



(b) Using SST and a press, press in the bushing.
SST 09222-30010



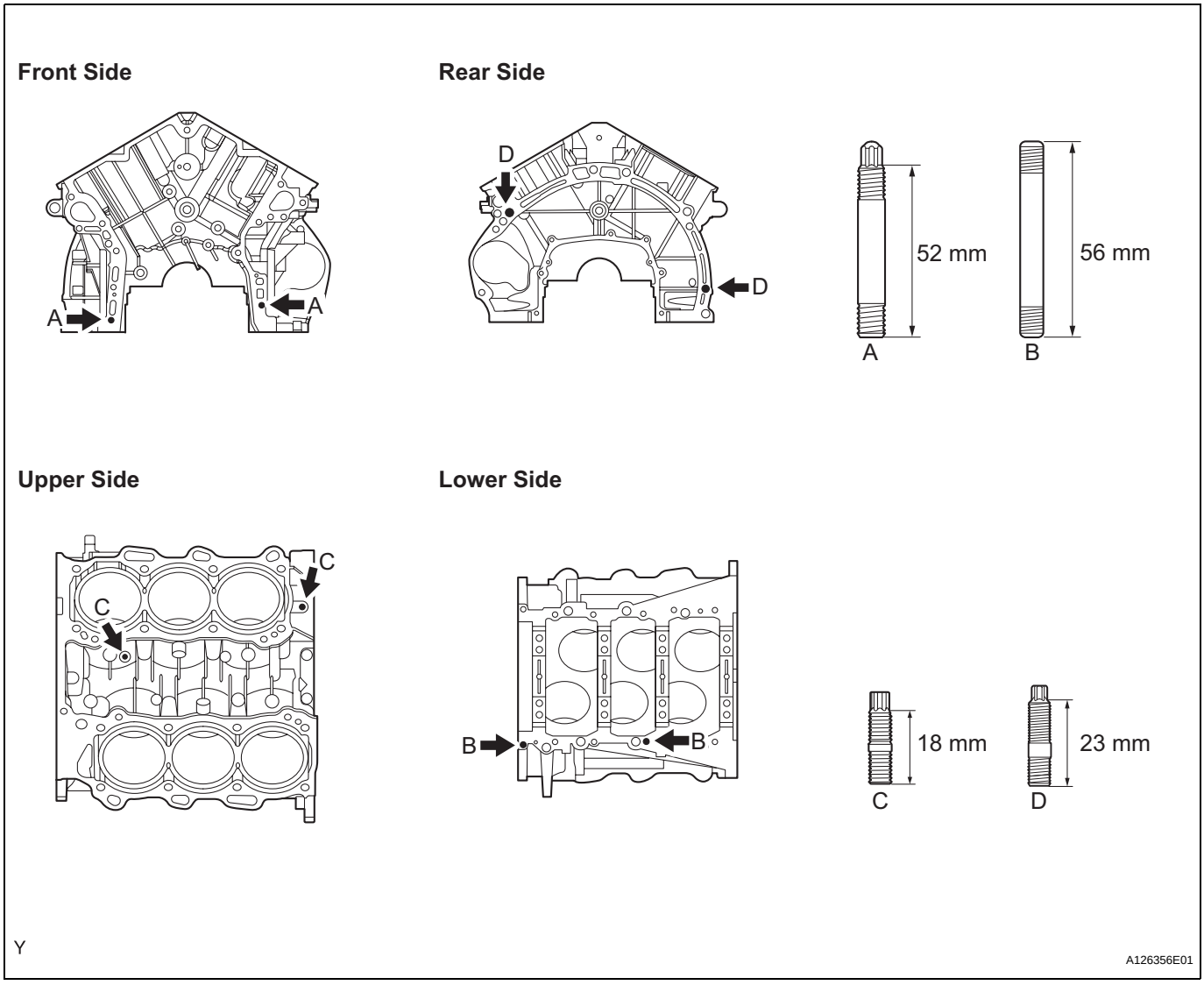
(c) Using a pin hole grinder, hone the bushing to bring the clearance between the bushing and piston pin to the specified value.
Standard oil clearance:
0.005 to 0.011 mm (0.0002 to 0.0004 in.)
HINT:
Check the measurement at room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with a thumb.

EM

REASSEMBLY

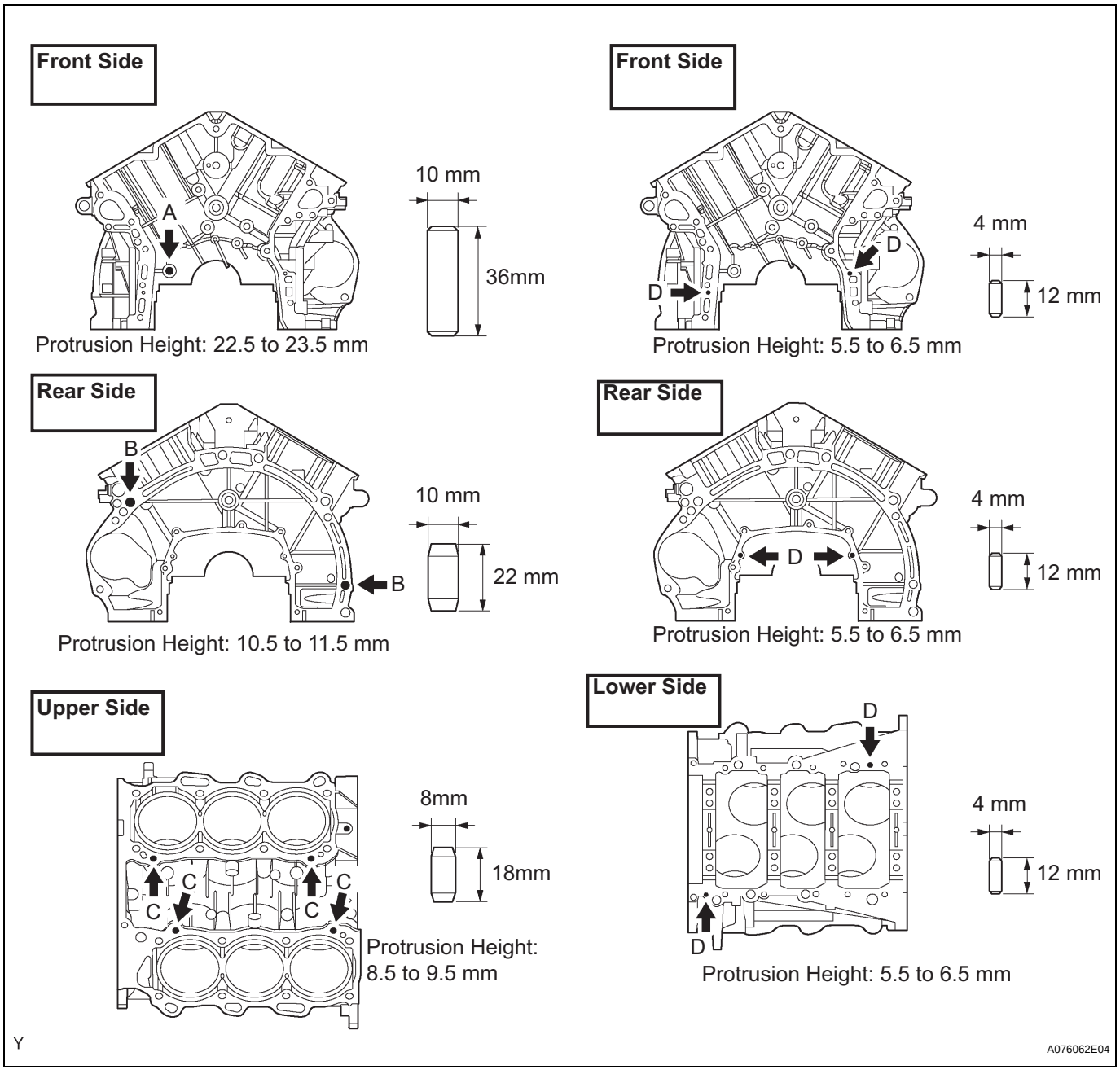
1. **REASSEMBLY CYLINDER HEAD SUB-ASSEMBLY**
   Refer to the procedures up to "REASSEMBLY CYLINDER HEAD" (See page EM-82).

2. **INSTALL STUD BOLT**
   (a) Install the stud bolts as shown in the illustration.
   Torque: Stud bolt A
   11 N*m (112 kgf*cm, 8.1 ft.*lbf)
   Stud bolt B
   4.5 N*m (46 kgf*cm, 40 in.*lbf)
   Stud bolt C
   4.0 N*m (41 kgf*cm, 35 in.*lbf)
   Stud bolt D
   4.0 N*m (41 kgf*cm, 35 in.*lbf)



3. **INSTALL STRAIGHT PIN**
   (a) Using a plastic-faced hammer, tap in a new straight pin.
   Standard protrusion:
   Pin A:
   22.5 to 23.5 mm (0.886 to 0.925 in.)

Pin B:
10.5 to 11.5 mm (0.413 to 0.453 in.)
Pin C:
8.5 to 9.5 mm (0.335 to 0.374 in.)
Pin D:
5.5 to 6.5 mm (0.217 to 0.256 in.)

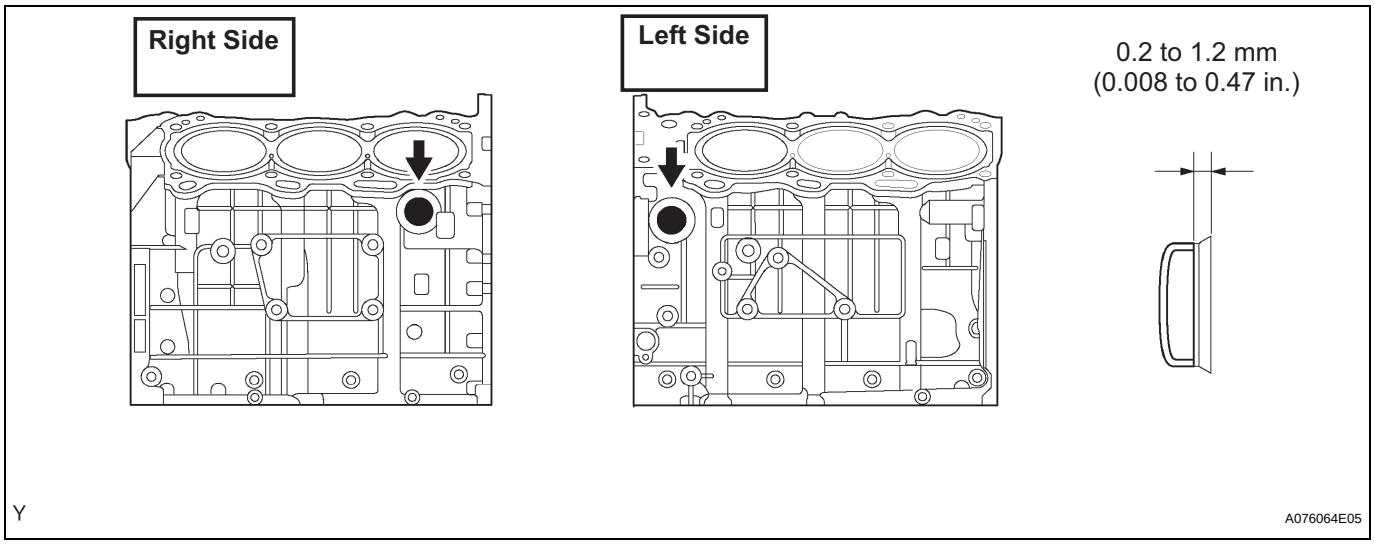


4. INSTALL TIGHT PLUG

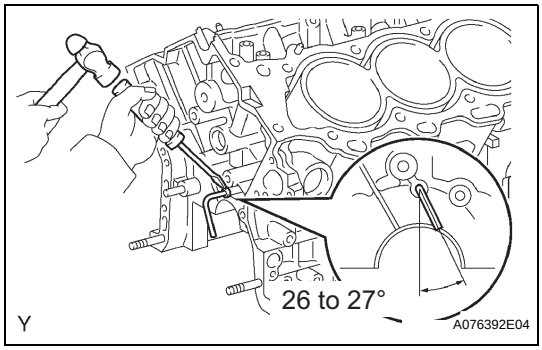
(a) Apply adhesive around new tight plugs.
Adhesive:
Toyota Genuine Adhesive 1324, Three Bond 1324 or the equivalent

(b) Using SST, install the tight plugs as shown in the illustration.
SST 09550-60010 (09951-00350), 09950-70010 (09951-07150)

Standard depth:
0.2 to 1.2 mm (0.008 to 0.047 in.)

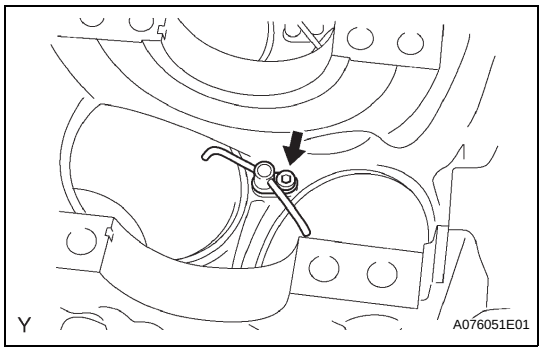


EM



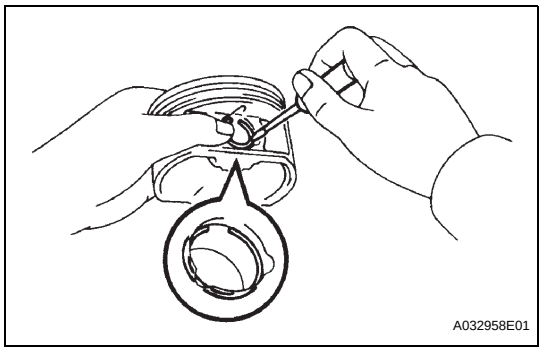
5. INSTALL OIL JET

(a) Using a screw driver and hammer, tap in the oil jet.



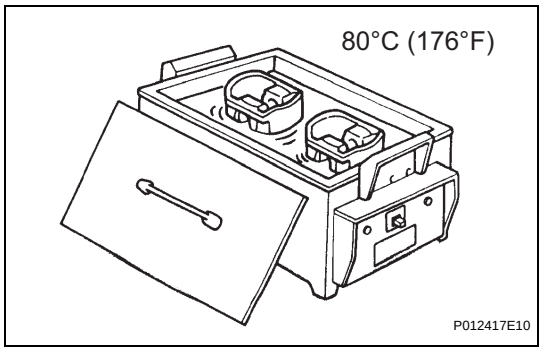
6. INSTALL NO. 1 SUB-ASSEMBLY OIL NOZZLE

(a) Using a 5 mm socket hexagon wrench, install the 3 oil nozzles.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)



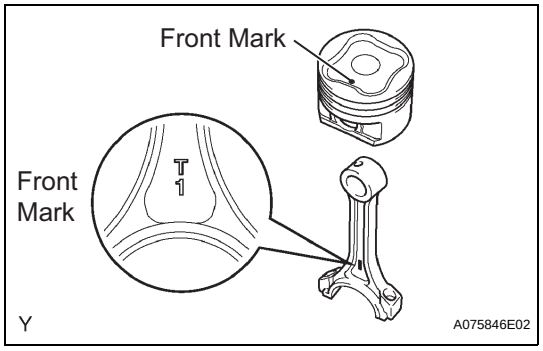
7. INSTALL HOLE SNAP RING

(a) Using a small screwdriver, install a new snap ring onto the side of the piston pin hole.
HINT:
Check that the end gap of the snap ring does not overlap with the pin hole cutout portion of the piston.



8. INSTALL WITH PIN PISTON SUB-ASSEMBLY

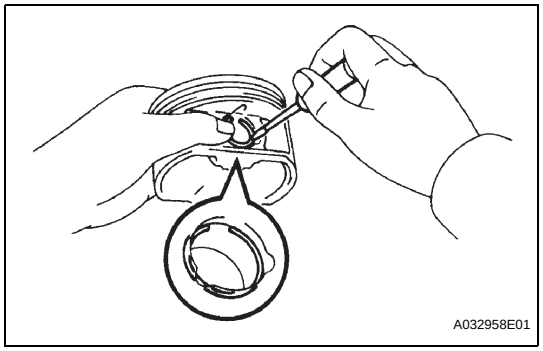
(a) Gradually heat the piston to about 80°C (176°F).



(b) Coat the piston pin with engine oil.

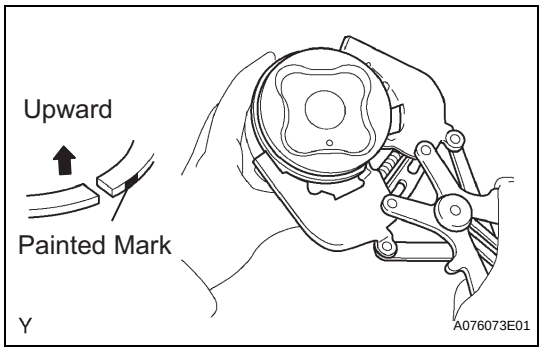
(c) Align the front marks of the piston and connecting rod, and push in the piston pin with a thumb.

EM



9. INSTALL HOLE SNAP RING

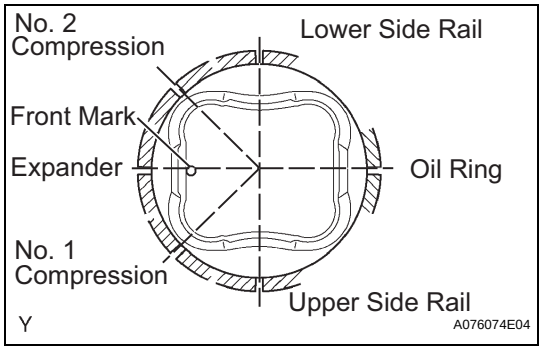
(a) Using a small screwdriver, install a new snap ring onto the other side of the piston pin hole.
HINT:
Make sure that the gap in the snap ring does not overlap with the pin hole cutout portion of the piston.



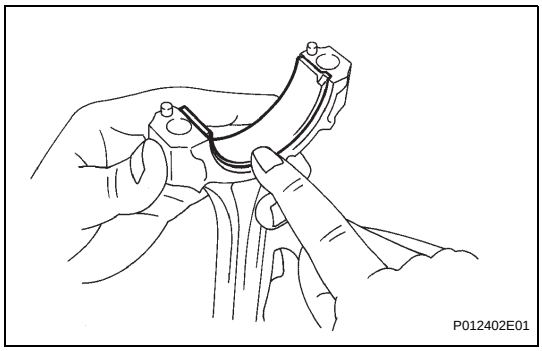
10. INSTALL PISTON RING SET

(a) Install the oil ring expander and 2 side rails by hand.

(b) Using a piston ring expander, install the 2 compression rings.
NOTICE:
Install compression ring No. 2 with the painted mark facing upward.



(c) Position the piston rings so that the ring ends are as shown.

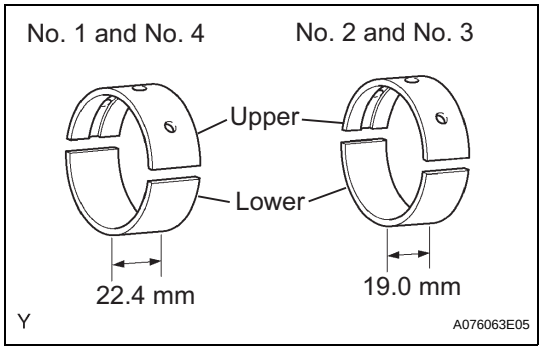


11. INSTALL CONNECTING ROD BEARING

(a) Align the bearing claw with the groove of the connecting rod or connecting cap.

NOTICE:

Clean the back side of the bearing and the bearing surface of the connecting rod and keep them free of oil.

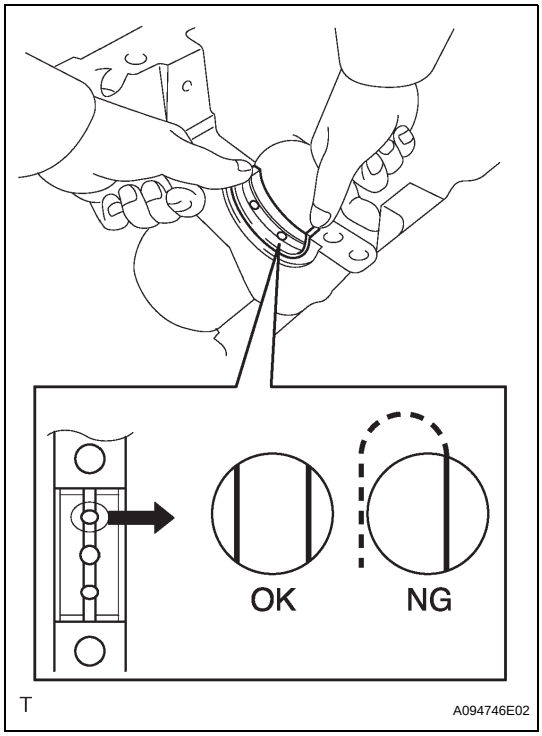


12. INSTALL CRANKSHAFT BEARING

HINT:

There are 2 types of main bearings with different widths (19.0 mm (0.748 in.) and 22.4 mm (0.882 in.)) for use in the inspection. Install the 22.4mm (0.882 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing cap. Install the 19.0 mm (0.748 in.) bearings in the No. 2 and No. 3 positions.

(a) Clean each main journal and bearing.

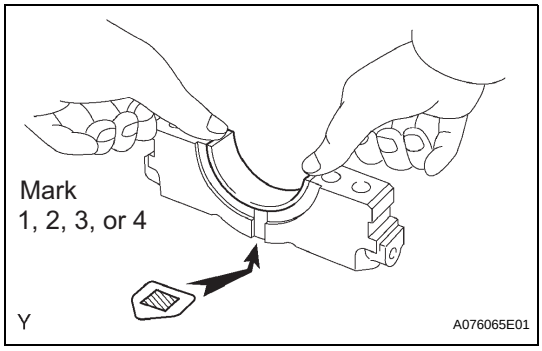


(b) Install the 4 upper bearings.

(1) Install the upper bearings near the center of the cylinder block.

NOTICE:

- **The widths of the No. 1 and No. 4 journal bearings are different from those of the No. 2 and No. 3 journal bearings. Therefore, confirm the identity of each journal bearing prior to installation.**
- **Do not apply engine oil to the bearing installation surfaces of the cylinder block and the back side of the bearings.**
- **Check that the oil groove on the cylinder block can be seen through the oil supply holes of the upper bearing.**



(c) Install the 4 lower bearings.

(1) Install the lower bearings near the center of the cylinder block.

NOTICE:

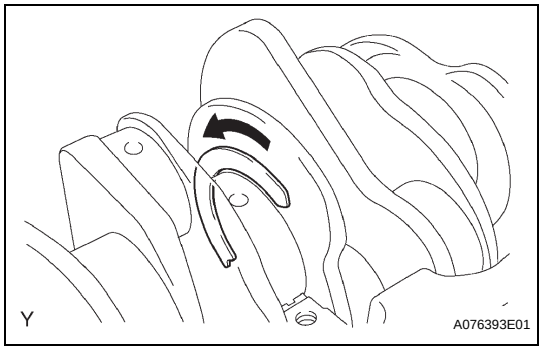
Do not apply engine oil to the bearing or its contact surface.

HINT:

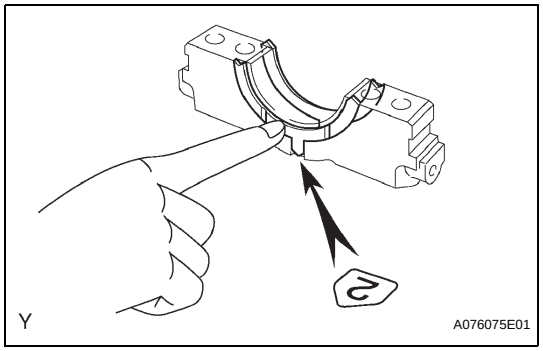
The number marked on each main bearing cap indicates the installation position.

13. INSTALL CRANKSHAFT

(a) Apply engine oil to the upper bearing and install the crankshaft onto the cylinder block.

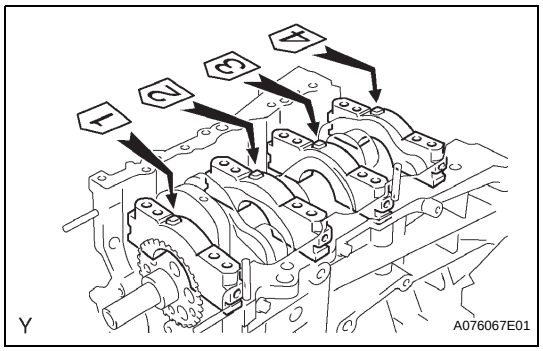


(b) Install the 2 upper thrust washers onto the No. 2 journal position of the cylinder block.
  (1) Push the crankshaft toward the front (rear) side.
  (2) Install the 2 upper thrust washers with the oil grooves facing outward.

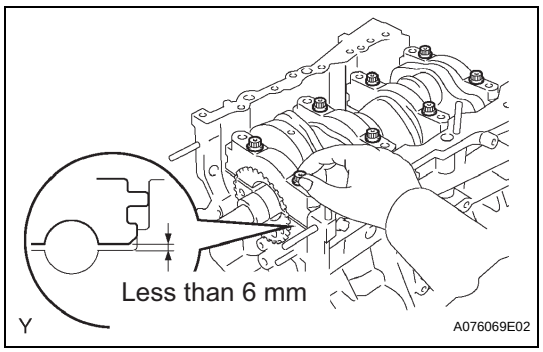


(c) Install the 2 lower thrust washers onto the No. 2 bearing cap with the grooves facing outward.

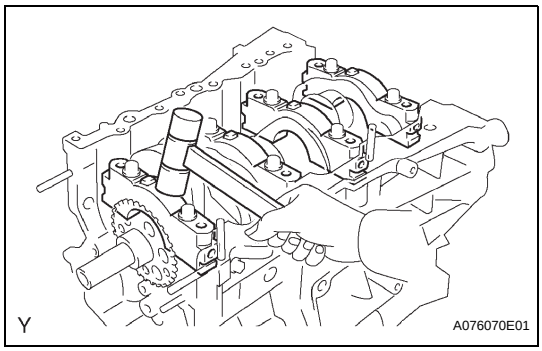
EM



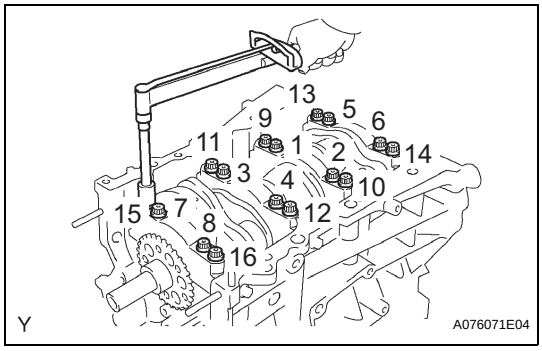
(d) Examine the front marks and numbers, check the sequence number is as shown in the illustration and install the bearing caps on the cylinder block.
(e) Apply a light coat of engine oil to the threads of the bearing cap bolts.
(f) Temporarily install the 8 main bearing cap bolts in the inside positions.



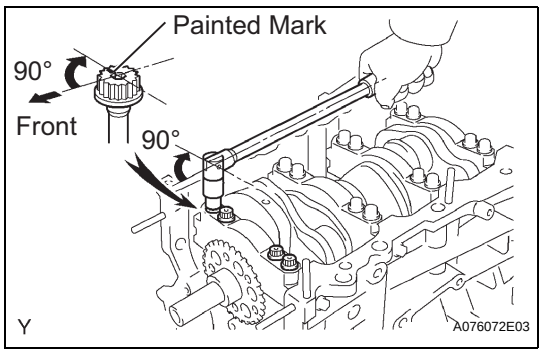
(g) Install the main bearing caps. Tighten the 2 bolts for each bearing cap until the clearance between the bearing cap and the cylinder block is under 6 mm (0.23 in.).



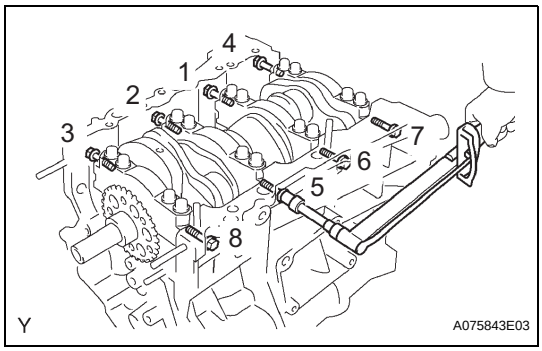
(h) Using a plastic-faced hammer, lightly tap the bearing cap to ensure a proper fit.
(i) Apply a light coat of engine oil to the threads of the main bearing cap bolts.



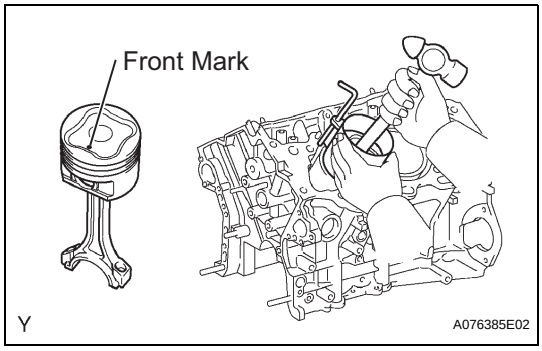
(j) Install the 16 main bearing cap bolts. Using several steps, tighten the bolts uniformly in the sequence shown in the illustration.
Torque: 61 N*m (622 kgf*cm, 45 ft.*lbf)



(k) Mark the front side of the bearing cap bolts with paint.
(l) Retighten the bearing cap bolts 90° in the sequence as shown.
(m) Check that the painted marks are now at a 90° angle from the front.
(n) Check that the crankshaft turns smoothly.



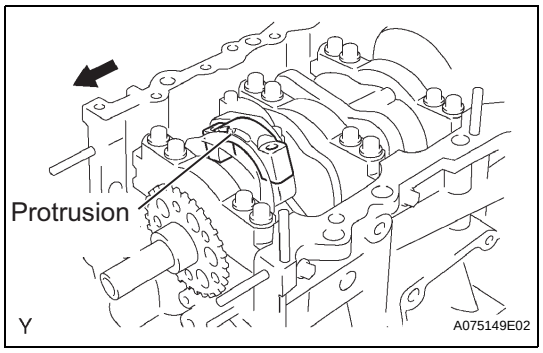
(o) Using several steps, tighten the 8 main bearing cap bolts uniformly in the sequence shown in the illustration.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)



14. INSTALL PISTON SUB-ASSEMBLY WITH CONNECTIONG ROD

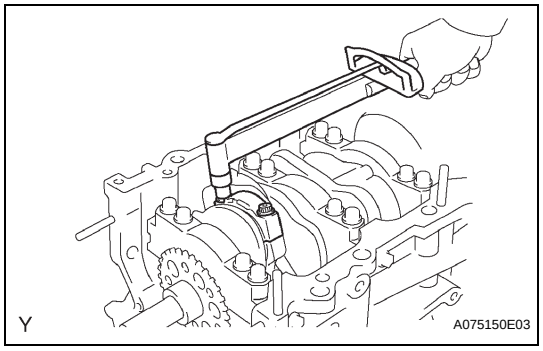
(a) Apply engine oil to the cylinder walls, pistons, and surfaces of connecting rod bearings.
(b) Check the position of the piston ring ends.

(c) Using a piston ring compressor, push the correct number piston and connecting rod into each cylinder with the front mark of the piston facing forward.
NOTICE:
- **Clean the back side of the bearing and the bearing surface of the connecting rod cap and keep them free of oil.**
- **Match the numbered connecting rod cap with the connecting rod.**

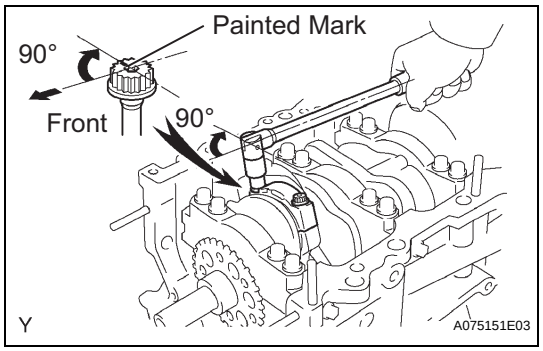


(d) Check that the protrusion of the connecting rod cap is facing in the correct direction.

(e) Apply a light coat of engine oil to the threads of the connecting rod cap bolts.



(f) Tighten the bolts alternately to the specified torque.
Torque: 25 N*m (250 kgf*cm, 18 ft.*lbf)



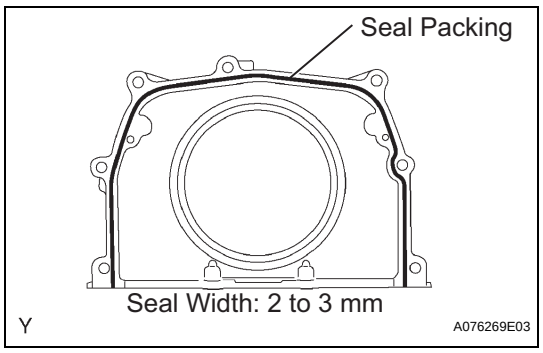
(g) Mark the front side of the each connecting cap bolt with paint.

(h) Retighten the cap bolts 90° as shown.

(i) Check that the crankshaft turns smoothly.

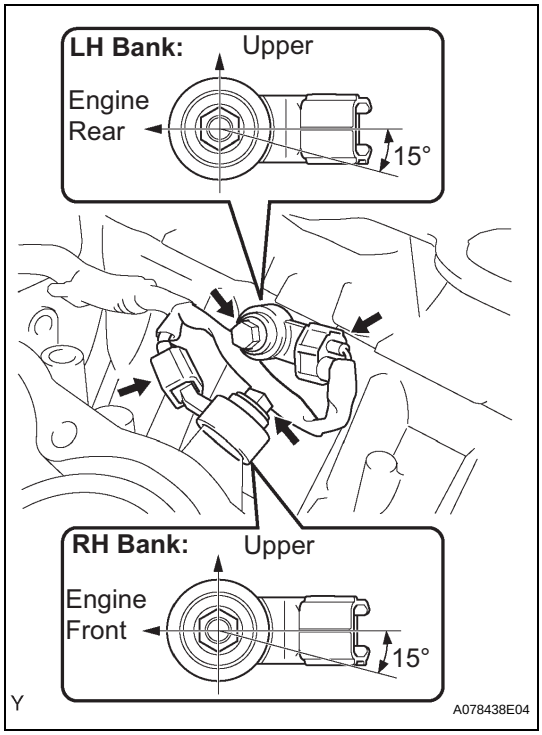
15. INSTALL REAR ENGINE OIL SEAL RETAINER

(a) Remove any old packing material and oil from the contact surfaces of the oil seal retainer and cylinder block.

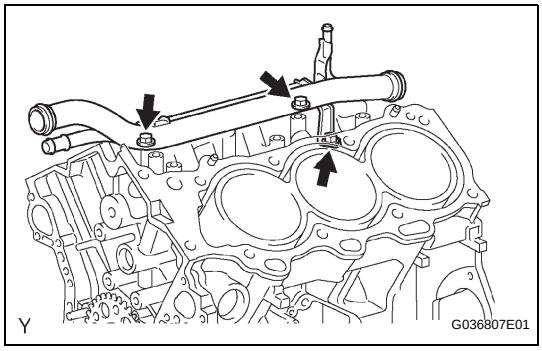


(b) Apply a continuous bead of seal packing (diameter 2 to 3 mm (0.08 to 0.12 in.)) to the oil seal retainer as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Parts must be assembled within 3 minutes of application. Otherwise, the seal packing must be removed and reapplied.

(c) Install the oil seal retainer with the 5 bolts and 2 nuts.
Torque: Nut
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Bolt
10 N*m (102 kgf*cm, 7.4 ft.*lbf)

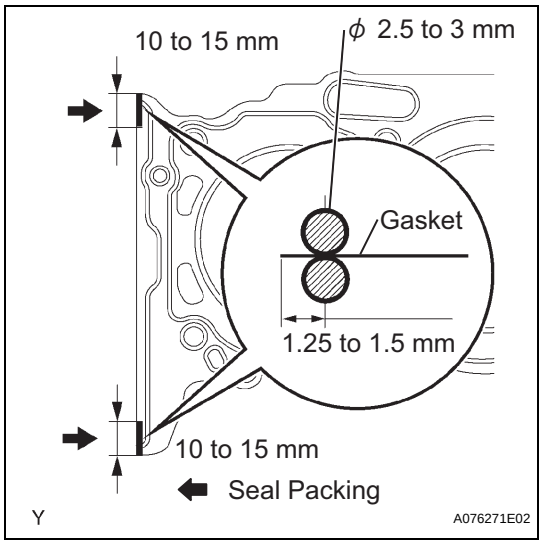


16. INSTALL KNOCK SENSOR
(a) Install the 2 knock sensors with the 2 bolts as shown in the illustration.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)
(b) Connect the knock sensor connectors.
(c) Install the knock sensor wire.



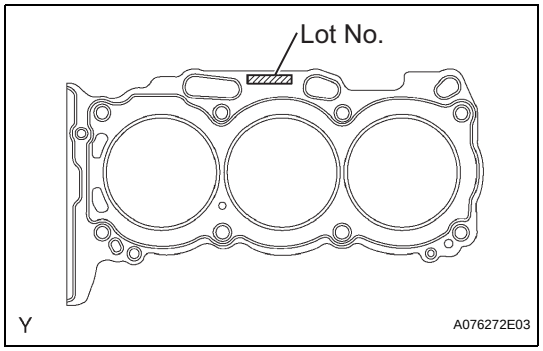
17. INSTALL NO. 1 WATER OUTLET PIPE
(a) Install the water outlet pipe with the 3 bolts.
Torque: 10 N*m (102 kgf*cm, 7.4 ft.*lbf)

18. INSTALL CYLINDER HEAD GASKET
(a) Remove any old packing material and oil from the contact surfaces of the cylinder head and cylinder block.



(b) Apply a continuous bead of seal packing (diameter 2.5 to 3 mm (0.098 to 0.118 in.)) to a new cylinder head gasket as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head within 3 minutes of applying the seal packing. After installation, cylinder head bolts must be tightened within 15 minutes. Otherwise, the seal packing must be removed and reapplied.

EM



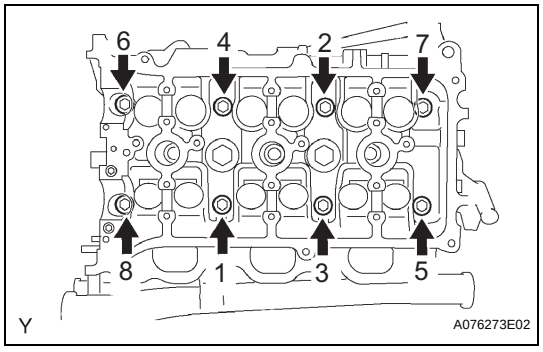
(c) Place the cylinder head gasket on the cylinder block surface with the Lot No. stamp upward.
NOTICE:
- **Install the cylinder head gasket in the correct direction.**
- **Place the cylinder head carefully in order not to damage the gasket with the bottom part of the head.**

19. INSTALL CYLINDER HEAD SUB-ASSEMBLY

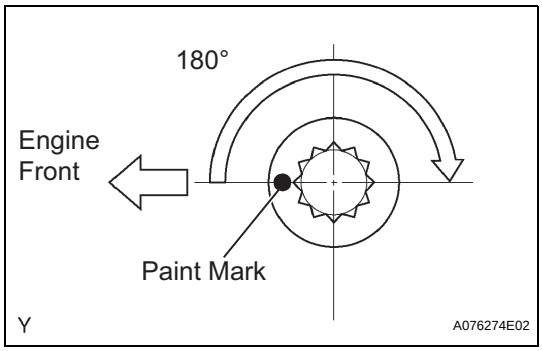
(a) Place the cylinder head RH on the cylinder head gasket.

(b) Install the 8 cylinder head bolts.
HINT:
- The cylinder head bolts are tightened in 2 successive steps (steps (*1), (*2) and (*3)).
- If any cylinder head bolts are broken or deformed, replace them.

(1) Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.



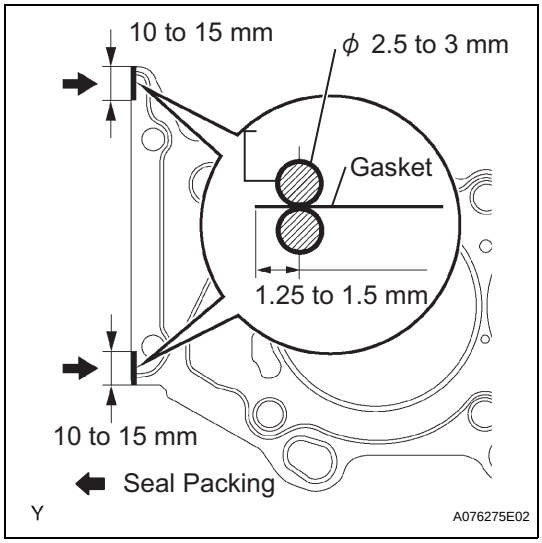
(2) Using several steps, uniformly install and tighten the 10 cylinder head bolts and plate washers with a bi-hexagon wrench 10 mm in the sequence shown in the illustration.
Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)
If any cylinder head bolts do not meet the torque specification, replace them.
NOTICE:
Do not drop the washers into the cylinder head.



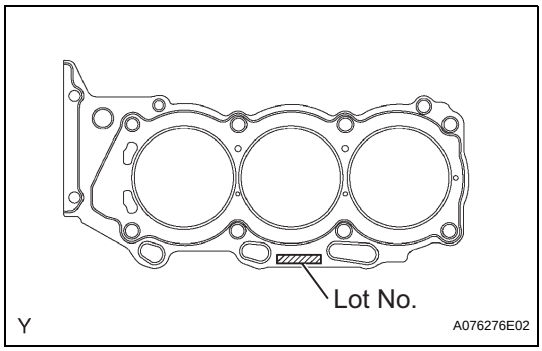
(3) Mark the front of the cylinder head bolt with paint. (*1)
(4) Retighten the cylinder head bolts by 180° as shown. (*2)
(5) Check that the painted marks are now at 180° from the engine front. (*3)

20. INSTALL NO. 2 CYLINDER HEAD GASKET

(a) Remove any old packing material and oil from the contact surfaces of the cylinder head and cylinder block.



(b) Apply a continuous bead of seal packing (Diameter 2.5 to 3 mm (0.098 to 0.118 in.)) to a new cylinder head gasket as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head within 3 minutes of applying the seal packing. After installation, cylinder head bolts must be tightened within 15 minutes. Otherwise, the seal packing must be removed and reapplied.

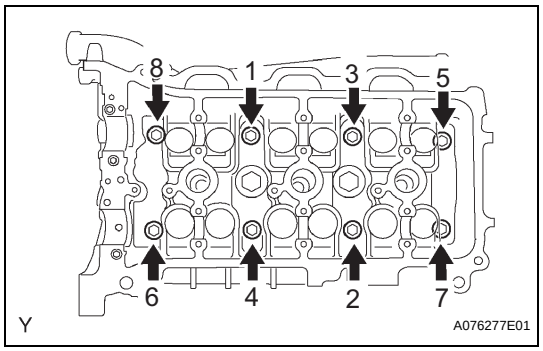


(c) Place the cylinder head gasket on the cylinder block surface with the Lot No. stamp upward.
NOTICE:
- **Be careful of the installation direction.**
- **Place the cylinder head carefully in order not to damage the gasket with the bottom part of the head.**

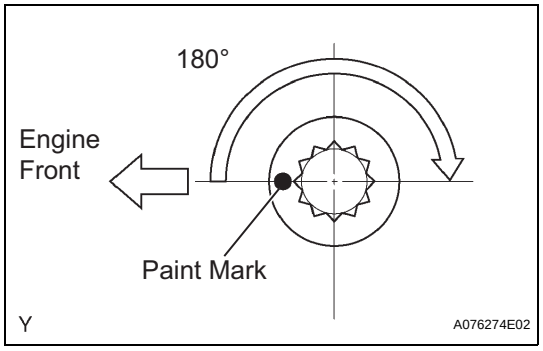
21. INSTALL CYLINDER HEAD LH

(a) Place the cylinder head LH on the cylinder head gasket.
(b) Install the 8 cylinder head bolts.
HINT:
- The cylinder head bolts are tightened in 2 successive steps (steps (*4), (*5) and (*6)).
- If any cylinder head bolts are broken or deformed, replace them.

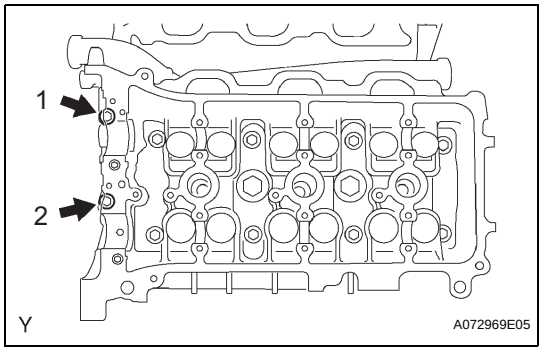
(1) Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.



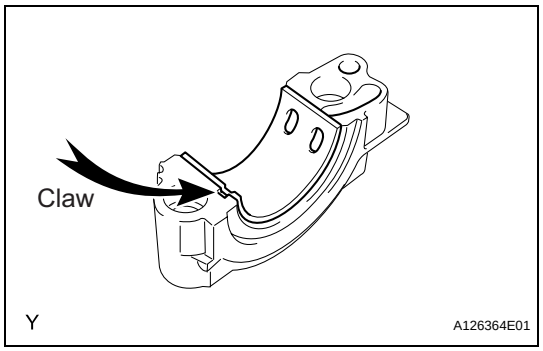
(2) Using several steps, uniformly install and tighten the 8 cylinder head bolts and plate washers with a bi-hexagon wrench 10 mm in the sequence shown in the illustration.
Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)
If any cylinder head bolts do not meet the torque specification, replace them.
NOTICE:
Do not drop the washers into the cylinder head.



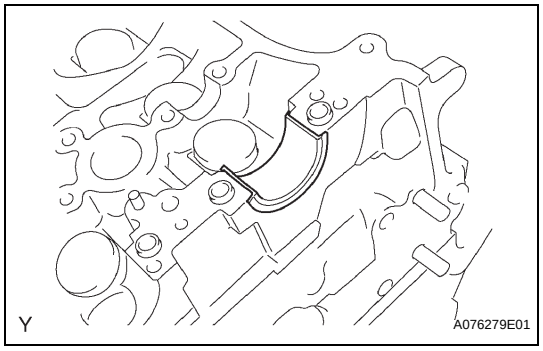
(3) Mark the front of the cylinder head bolt with paint. (*4)
(4) Retighten the cylinder head bolts by 180° as shown. (*5)
(5) Check that the painted marks are now at 180° from the engine front. (*6)



(c) Install the 2 cylinder head bolts.
(1) Apply a light coat of engine oil to the threads of the cylinder head bolts.
(2) Using several steps, uniformly install and tighten the 10 cylinder head bolts and plate washers with a bi-hexagon wrench 10 mm in the sequence shown in the illustration.
Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)



22. INSTALL NO. 1 CAMSHAFT BEARING
(a) Align the bearing claw with the claw groove of the bearing cap, and push in the camshaft bearing.
NOTICE:
- **Install the bearing while aligning it with the oil hole in the bearing cap.**
- **Clean the back side of the bearing and the surface of the bearing cap and keep them free of oil.**



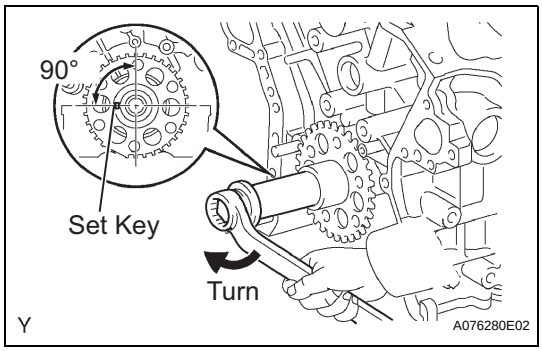
23. INSTALL NO. 2 CAMSHAFT BEARING
(a) Install the No. 2 camshaft bearing onto the cylinder head.
NOTICE:
Clean the back side of the bearing and the bearing surface of the cylinder head and keep them free of oil.

EM

24. INSTALL CAMSHAFTS

NOTICE:

Keep the camshaft level while it is being removed. The camshaft thrust clearance is very small and failing to keep it level could crack or damage the cylinder head journal surface, which receives the thrust force. This could subsequently lead the camshaft to seize or break. Perform the following steps to avoid such problems.



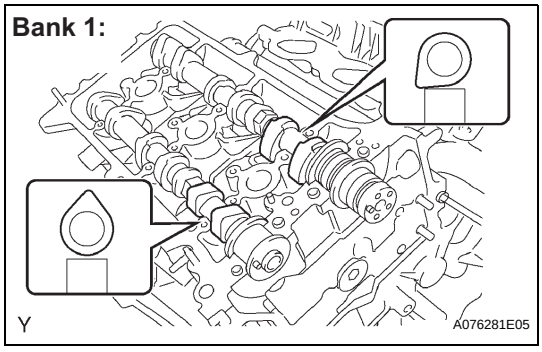
(a) Set the crankshaft position.

(1) Using the crankshaft pulley set bolt, turn the crankshaft, and set the crankshaft set key in the left horizontal position as indicated.

NOTICE:

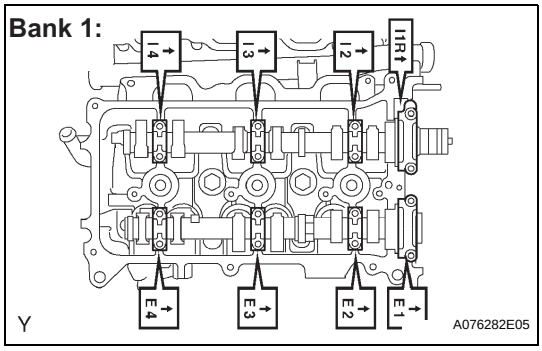
Setting the crankshaft at the wrong angle could cause the piston head and valve head to come into contact with each other when the camshaft is installed. This could cause damage, so always set the camshaft at the correct angle.

(b) Apply new engine oil to the thrust portion and journal of the camshafts.



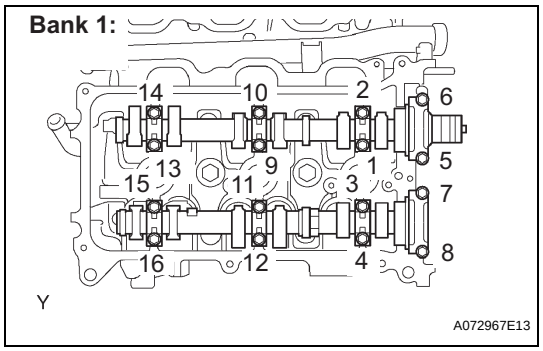
(c) Install the camshafts of bank 1.

(1) Place the 2 camshafts on the cylinder head RH with the No. 1 cam lobes facing as shown the illustration.



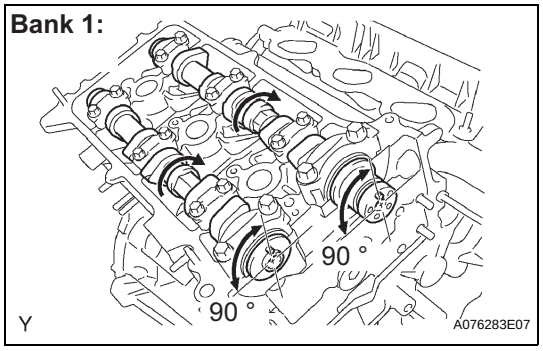
(2) Install the 8 bearing caps in their correct locations.

(3) Apply a light coat of engine oil to the threads of the bearing cap bolts.



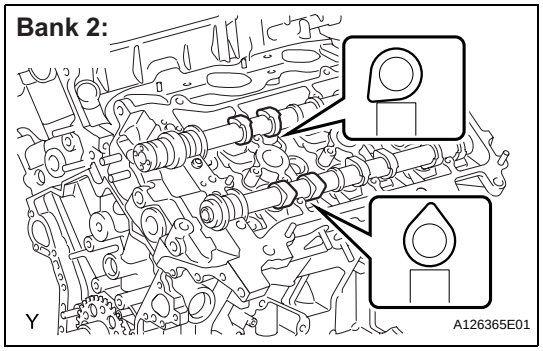
(4) Using several steps, uniformly tighten the 16 bearing cap bolts in the sequence shown in the illustration.

Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)



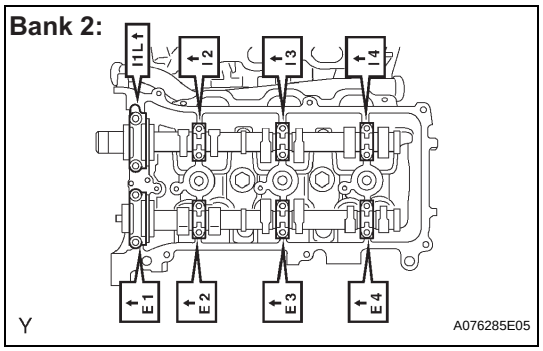
(5) Using a wrench, turn the camshafts clockwise until each camshaft knock pin comes to a position 90° to the cylinder head.

EM



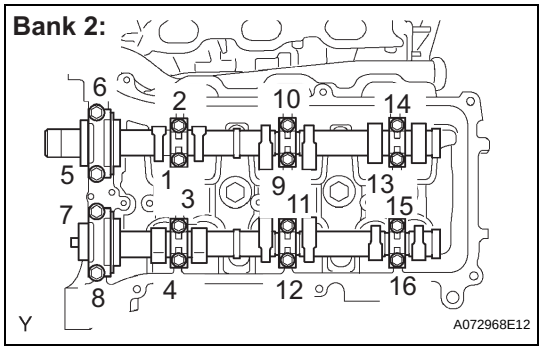
(d) Install the camshafts of bank 2.

(1) Place the 2 camshafts on the cylinder head LH with the No.1 cam lobes facing as shown the illustration.



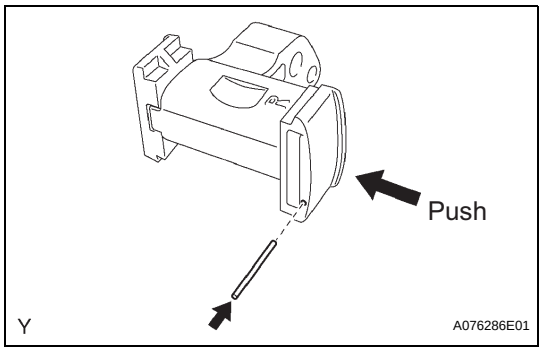
(2) Install the 8 bearing caps in the correct locations as shown.

(3) Apply a light coat of engine oil to the threads and under the heads of the bearing cap bolts.



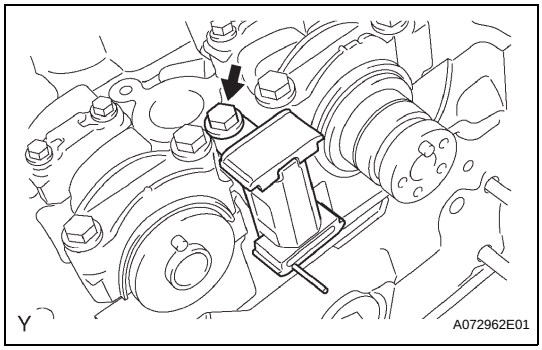
(4) Using several steps, uniformly tighten the 16 bearing cap bolts in the sequence shown in the illustration.

Torque: 10 mm (0.39 in.) head
9.0 N*m (92 kgf*cm, 80 in.*lbf)
12 mm (0.47 in.) head
24 N*m (245 kgf*cm, 18 ft.*lbf)

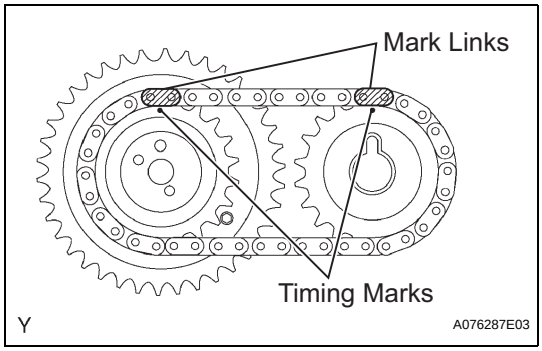


25. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

(a) While pushing in the tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to fix it.

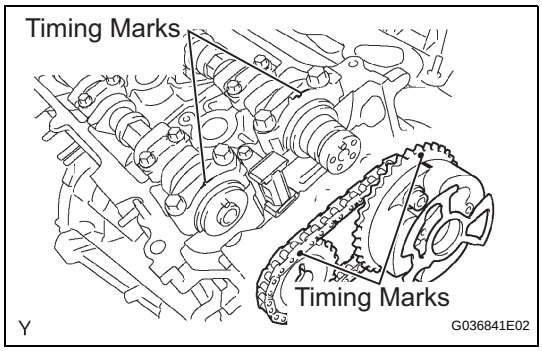


(b) Install chain tensioner No. 2 with the bolt.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)



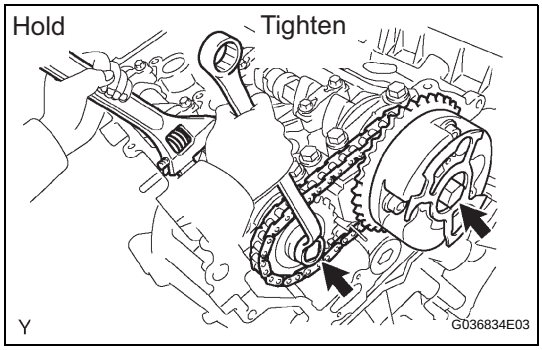
26. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

(a) Align the yellow mark links with the timing marks (1 dot mark) of camshaft timing gears as shown in the illustration.



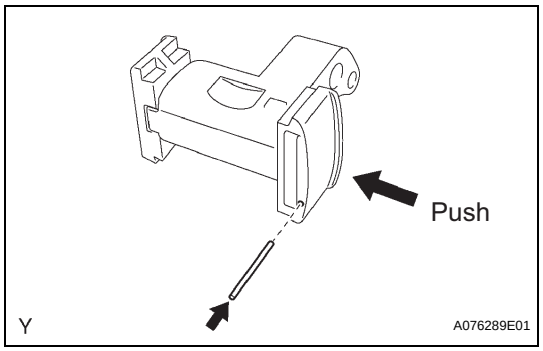
(b) Align the timing marks on the camshaft timing gears with the timing marks on the bearing caps, and install the camshaft timing gears with the chain onto the bank 1 camshafts.

(c) Temporarily install the 2 camshaft timing gear bolts.
NOTICE:
Do not push the camshaft timing gear assembly onto the camshaft forcibly when installing it.



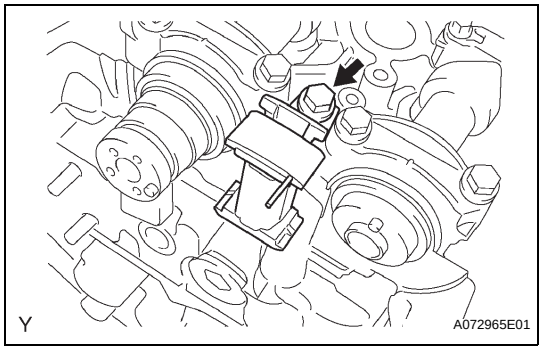
(d) Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

(e) Remove the pin from chain tensioner No. 2.



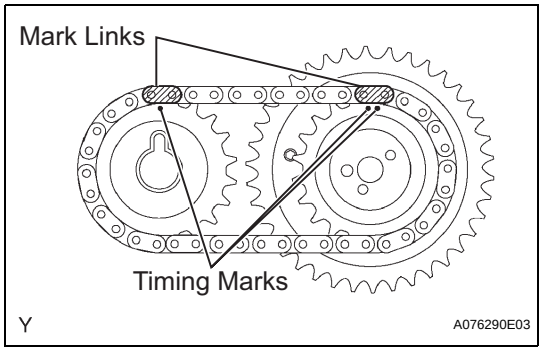
27. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY

(a) While pushing in the tensioner, insert a pin of ϕ 1.0 mm (0.039 in.) into the hole to hold it.



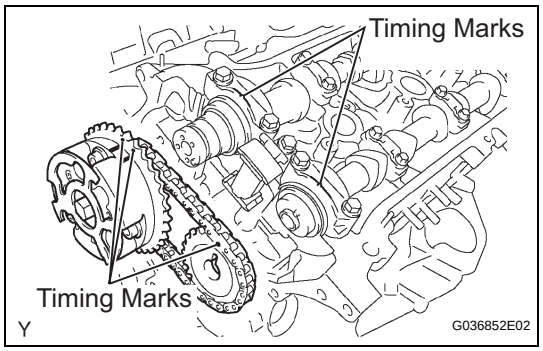
(b) Install chain tensioner No. 3 with the bolt.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)

EM



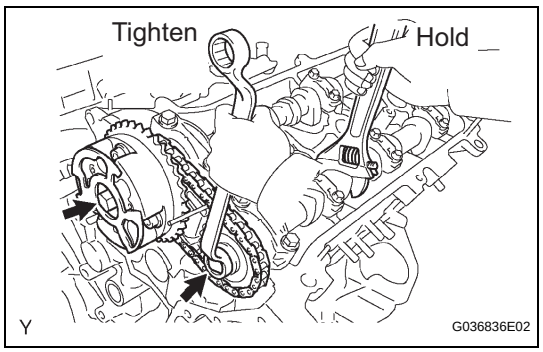
28. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)

(a) Align the yellow mark links with the timing marks (1 dot mark and 2 dot marks) on the camshaft timing gears as shown in the illustration.



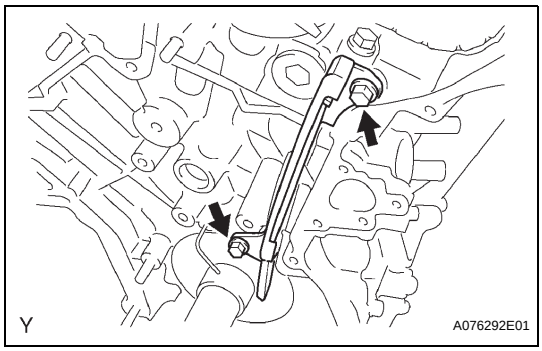
(b) Align the timing marks on the camshaft timing gears with the timing marks on the bearing caps, and install the camshaft timing gears with the chain onto the bank 2 camshafts.

(c) Temporarily install the 2 camshaft timing gear bolts.
NOTICE:
Do not push the camshaft timing gear assembly onto the camshaft forcibly when installing it.



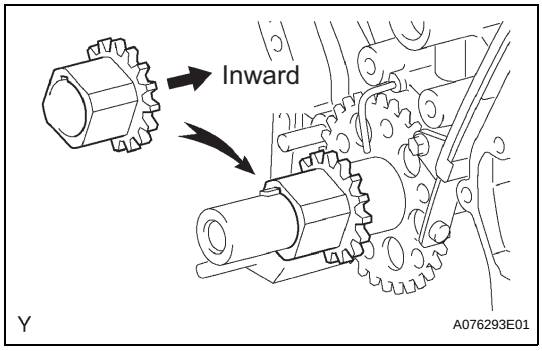
(d) Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

(e) Remove the pin from chain tensioner No. 3.



29. INSTALL NO. 1 CHAIN VIBRATION DAMPER

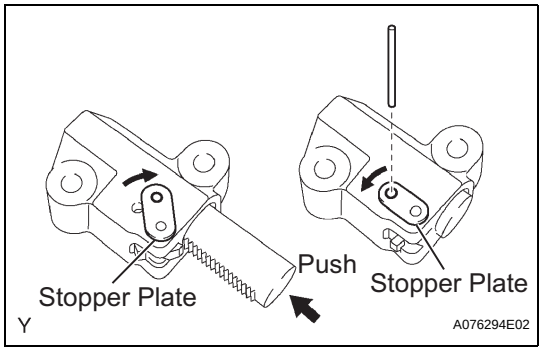
(a) Install chain vibration damper No. 1 with the 2 bolts.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)



30. INSTALL CRANKSHAFT TIMING GEAR OR SPROCKET

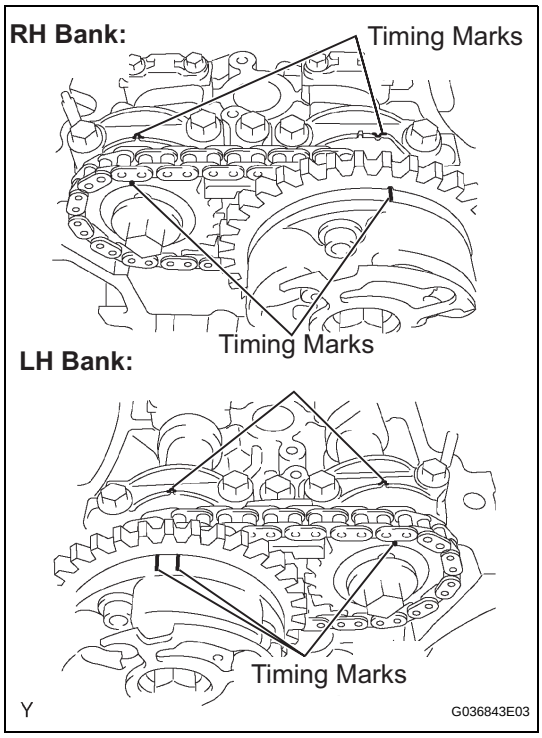
(a) Align the timing gear set key with the key groove of the timing gear.
(b) Install the timing gear onto the crankshaft with the gear side facing inward.

31. INSTALL CHAIN TENSIONER SLIPPER



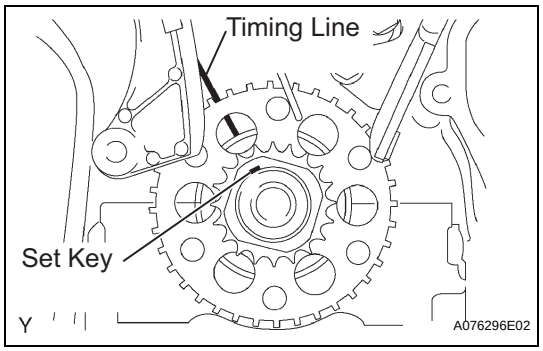
32. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

(a) While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.
(b) While turning the stopper plate of the tensioner counterclockwise, insert a bar of ϕ 3.5 mm (0.138 in.) into the holes in the stopper plate and tensioner to fix the stopper plate.
(c) Install the chain tensioner with the 2 bolts.
Torque: 10 N*m (102 kgf*cm, 7.4 ft.*lbf)

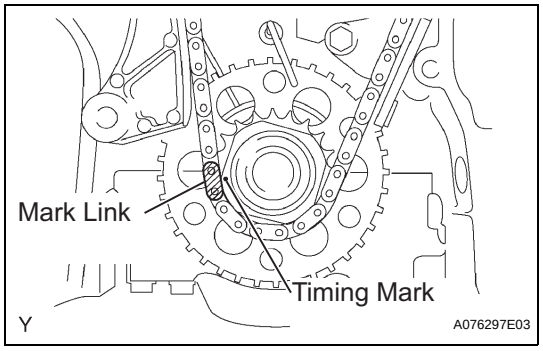


33. INSTALL CHAIN SUB-ASSEMBLY

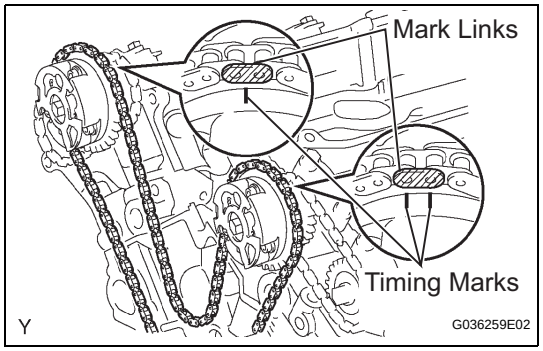
(a) Set the No. 1 cylinder to TDC/ compression.
(1) Align the timing marks of the camshaft timing gears and bearing caps.



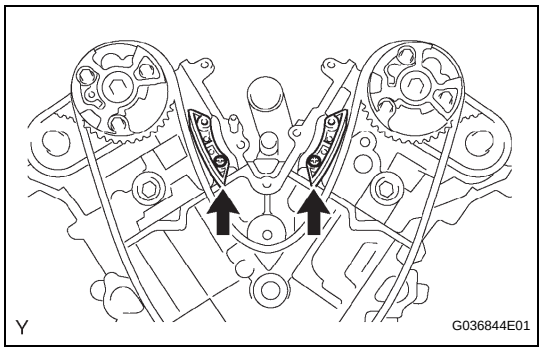
(2) Using the crankshaft pulley set bolt, turn the crankshaft to align the crankshaft set key with the timing line of the cylinder block.



(b) Align the yellow mark link with the timing mark of the crankshaft timing gear.



(c) Align the orange mark links with the timing marks of the camshaft timing gears, and install the chain.



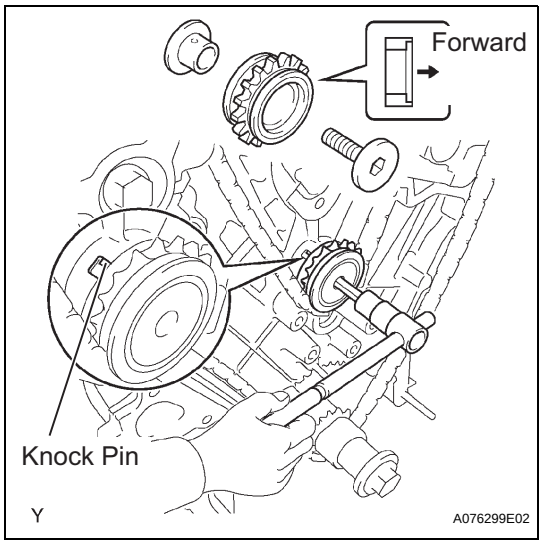
34. INSTALL NO. 2 CHAIN VIBRATION DAMPER

(a) Instal the 2 No. 2 chain vibration dampers.

35. INSTALL IDLE SPROCKET ASSEMBLY

(a) Apply a light coat of engine oil to the rotating surface of idle gear shaft No. 1.

EM



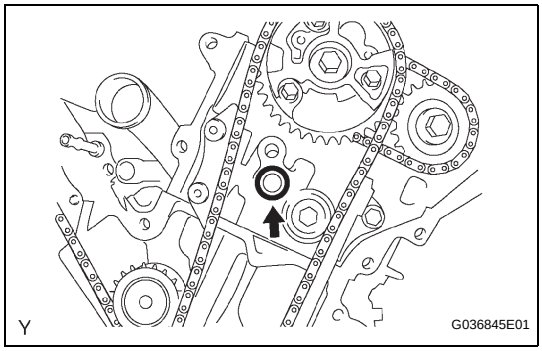
(b) Temporarily install idle gear shaft No. 1 together with idle gear shaft No. 2 while aligning the knock pin of idle gear shaft No. 1 with the knock pin groove of the cylinder block.
NOTICE:
Install the idle gear in the correct direction.

(c) Using a 10 mm hexagon wrench, tighten idle gear shaft No. 2.
Torque: 60 N*m (612 kgf*cm, 44 ft.*lbf)

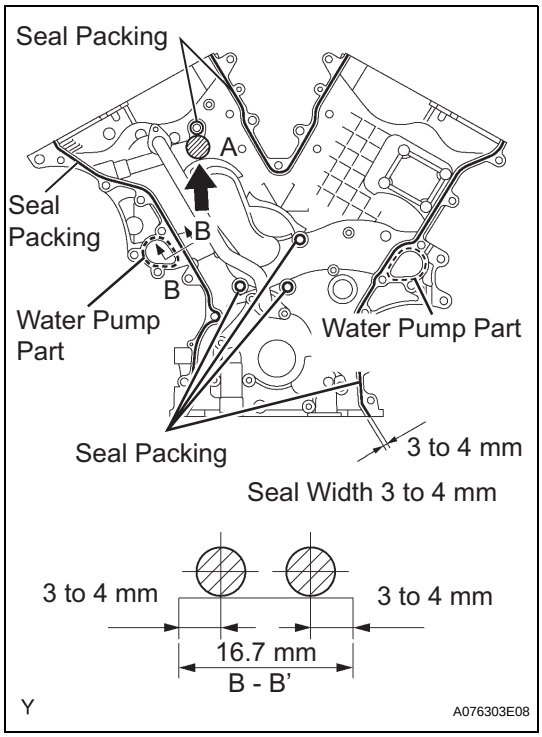
(d) Remove the bar from the chain tensioner.

36. INSTALL TIMING CHAIN OR BELT COVER SUB-ASSEMBLY

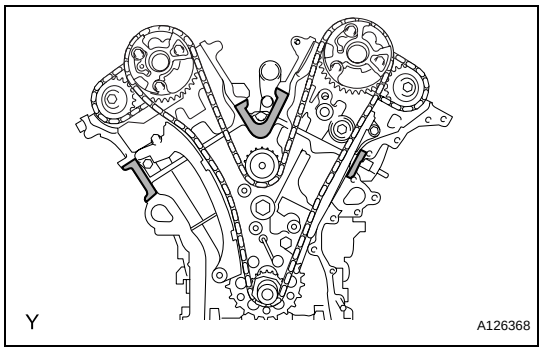
(a) Remove any old packing material and oil from the contact surfaces of the timing chain cover, cylinder head and cylinder block.



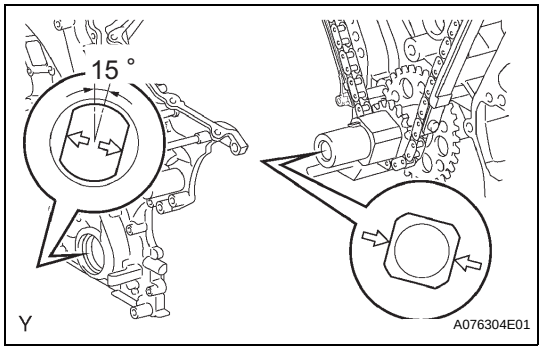
(b) Install a new O-ring onto the cylinder head LH as shown in the illustration.



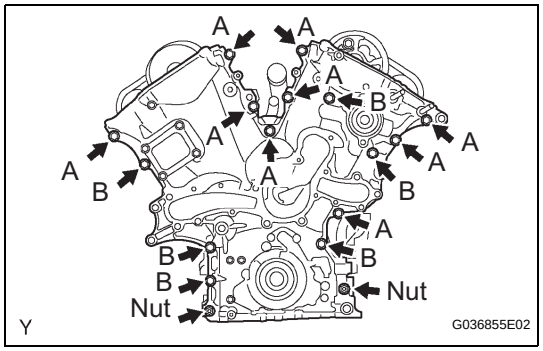
(c) Apply a continuous bead of seal packing (diameter 3 to 4 mm (0.12 to 0.16 in.)) to the timing chain cover as shown in the illustration.
Seal packing:
Water pump part:
Toyota Genuine Seal Packing 1282B, Three Bond 1282B or the equivalent
Other parts:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
- **Install the timing chain cover within 3 minutes of applying the seal packing. After installation, the timing chain cover bolts and nuts must be tightened within 15 minutes. Otherwise, the seal packing must be removed and reapplied.**
- **Do not apply seal packing to A as shown in the illustration.**



(d) Keep the seal surface between the cylinder block and the cylinder head shown in the illustration free of oil before installing the chain cover.



(e) Align the key way of the oil pump drive rotor with the rectangular portion of the crankshaft timing gear, and slide the timing chain cover into place.

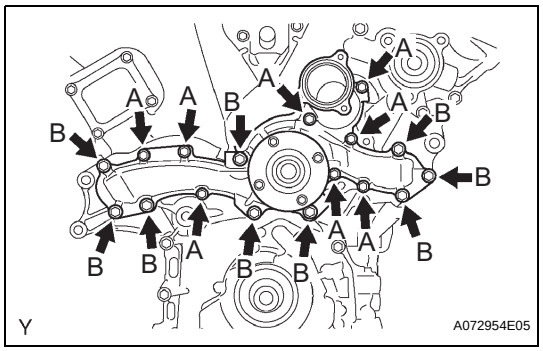


(f) Install the timing chain cover with the 15 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.
Torque: 23 N*m (235 kgf*cm, 17 ft.*lbf)
NOTICE:
- **Do not wrap the chain and slipper beyond the timing chain cover seal line.**
- **After installing the timing chain cover, install the water pump within 15 minutes.**

HINT:
Each bolt length is as follows:

Bolt	length
A	25 mm (0.98 in.)
B	55 mm (2.17 in.)

(g) Install the timing chain cover plate with the 4 bolts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

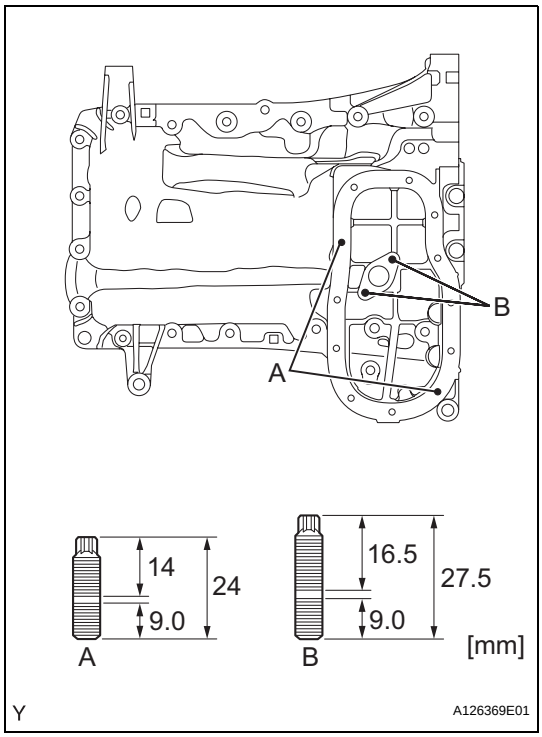


37. INSTALL WATER PUMP ASSEMBLY

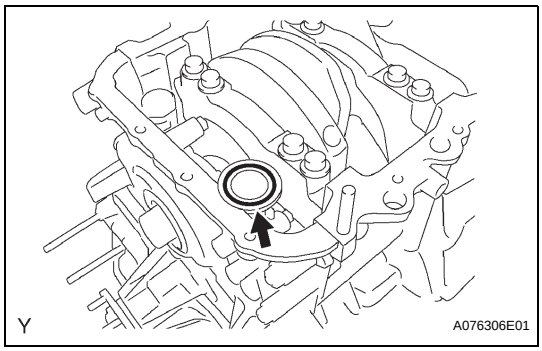
(a) Install a new gasket and the water pump with the 17 bolts.
Torque: Bolt A
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Bolt B
23 N*m (235 kgf*cm, 17 ft.*lbf)

38. INSTALL OIL PAN SUB-ASSEMBLY

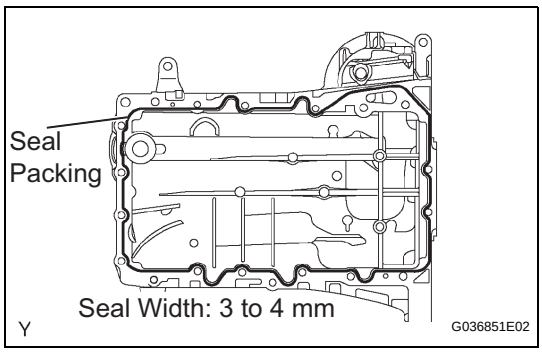
(a) Remove any old packing material and oil from the contact surfaces of the cylinder block, rear oil seal retainer and oil pan.



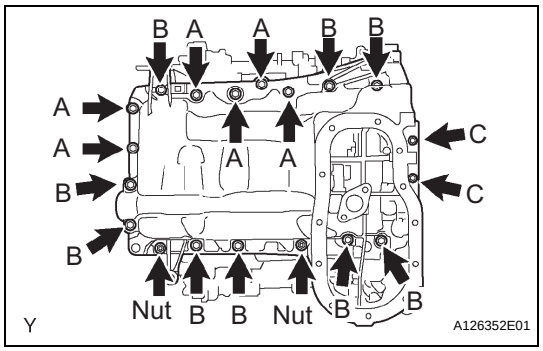
(b) Install the 4 stud bolts.
Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)



(c) Install a new O-ring onto the oil pump.



(d) Apply a continuous bead of seal packing (diameter 3 to 4 mm (0.12 to 0.16 in.)) to the oil pan as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the oil pan within 3 minutes of applying the seal packing. After installation, the oil pan bolts and nuts must be tightened within 15 minutes. Otherwise, the seal packing must be removed and reapplied.

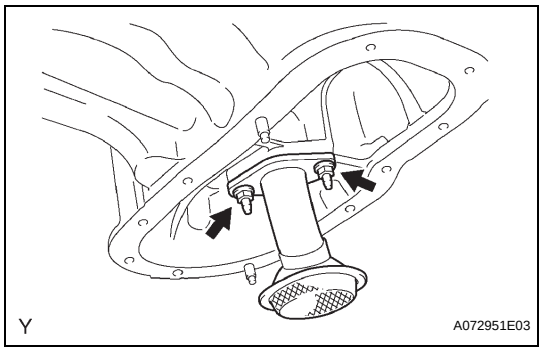


(e) Install the oil pan with the 17 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

Torque: 10 mm (0.39 in.) head
10 N*m (102 kgf*cm, 7 ft.*lbf)
12 mm (0.47 in.) head
21 N*m (214 kgf*cm, 16 ft.*lbf)

HINT:
Each bolt length is as follows:

Bolt	length
A	25 mm (0.98 in.)
B	45 mm (1.77 in.)
C	14 mm (0.55 in.)



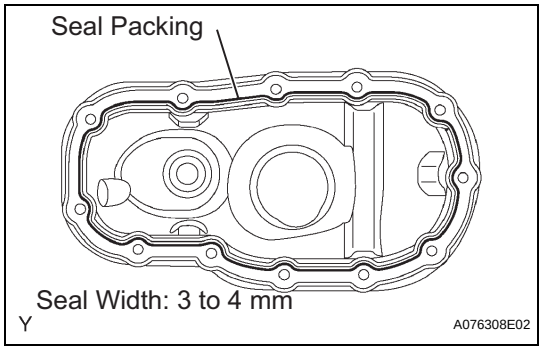
39. INSTALL OIL STRAINER SUB-ASSEMBLY

(a) Install a new gasket, then install the oil strainer with the 2 nuts.

Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

40. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

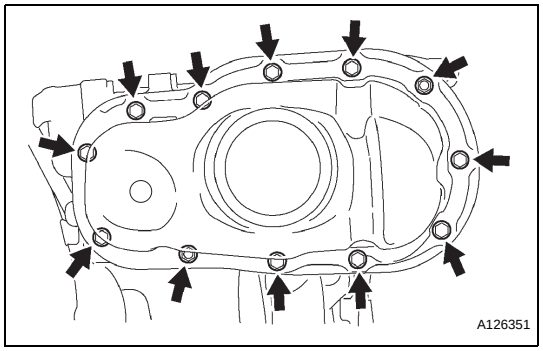
(a) Remove any old packing material and be careful not to drop any oil on the No. 2 contact surfaces of the oil pan and oil pan.



(b) Apply a continuous bead of seal packing (diameter 3 to 4 mm (0.12 to 0.16 in.)) as shown in the illustration.

Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent

NOTICE:
Install the No. 2 oil pan within 3 minutes of applying the seal packing. After installation, the No. 2 oil pan bolts and nuts must be tightened within 15 minutes. Otherwise, the seal packing must be removed and reapplied.



(c) Install the No. 2 oil pan with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.

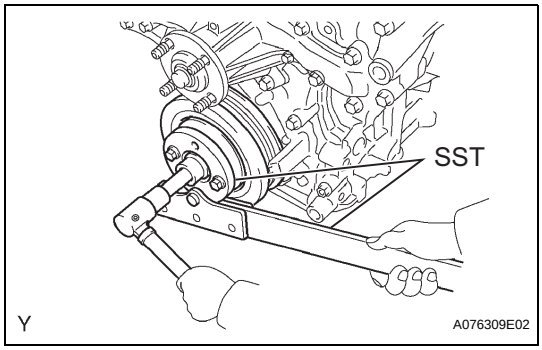
Torque: Bolt
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Nut
10 N*m (102 kgf*cm, 7.4 ft.*lbf)

41. INSTALL OIL PAN DRAIN PLUG

(a) Install the drain plug with a new gasket.

Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)

EM



42. INSTALL CRANKSHAFT PULLEY

(a) Using SST, fix the pulley and tighten the bolt.
SST 09213-54015 (91651-60855), 09330-00021
Torque: 250 N*m (2,549 kgf*cm, 185 ft.*lbf)

43. SET NO. 1 CYLINDER TO TDC/COMPRESSION

44. INSPECT VALVE CLEARANCE

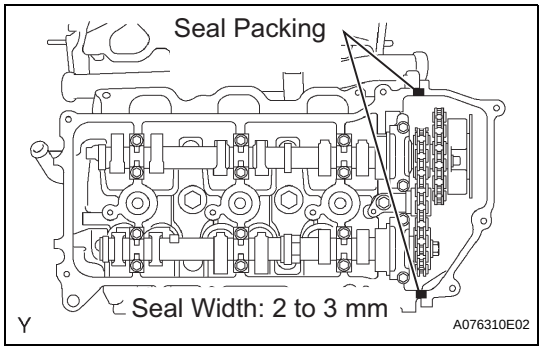
45. ADJUST VALVE CLEARANCE

46. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Remove any old packing material and oil from the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

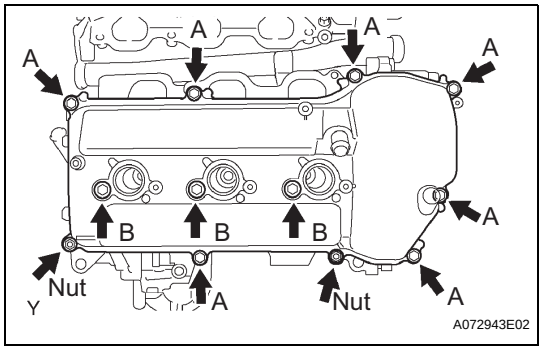
(b) Install the gasket onto the cylinder head cover.

EM



(c) Apply a continuous bead of seal packing (diameter 2 to 3 mm (0.08 to 0.12 in.)) to the cylinder head and timing chain cover as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head cover within 3 minutes of applying the seal packing. After installation, the cylinder head cover bolts and nuts must be tightened within 15 minutes. Otherwise the seal packing must be removed and reapplied.

(d) Install the seal washers onto the bolts.



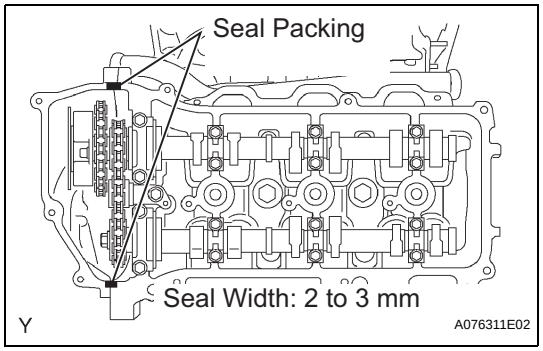
(e) Install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.
Torque: Bolt A
10 N*m (102 kgf*cm, 7.4 ft.*lbf)
Bolt B
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Nut
9.0 N*m (92 kgf*cm, 80 in.*lbf)
HINT:
Each bolt length is as follows:

Bolt	length
A	25 mm (0.98 in.)
B	60 mm (2.36 in.)

47. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

(a) Remove any old packing material and oil from the contact surfaces of the cylinder head, timing chain cover and cylinder head cover.

(b) Apply adhesive to the threads of the ventilation valve.
Adhesive:
Part No. 08833-00070, THREE BOND 1324 or the equivalent

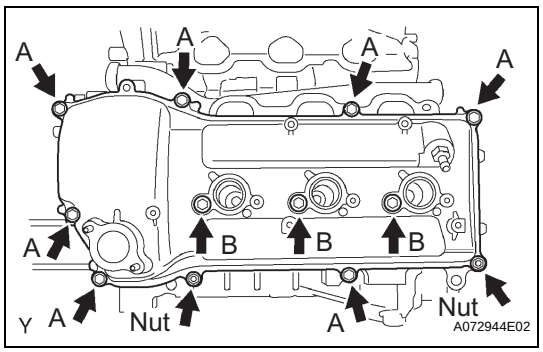


(c) Install the ventilation valve onto the cylinder head cover.
Torque: 27 N*m (275 kgf*cm, 20 ft.*lbf)

(d) Install the gasket onto the cylinder head cover.

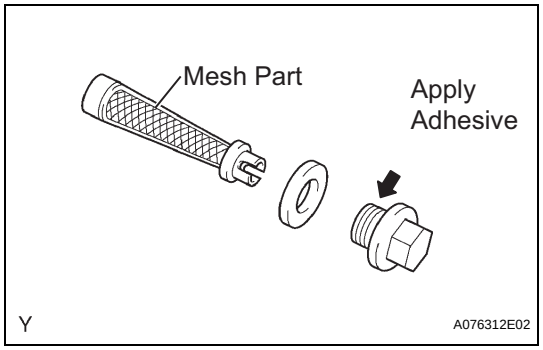
(e) Apply a continuous bead of seal packing (diameter 2 to 3 mm (0.08 to 0.12 in.)) to the cylinder head and timing chain cover as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or the equivalent
NOTICE:
Install the cylinder head cover of 3 minutes of applying the seal packing. After installation, the cylinder head cover bolts and nuts must be tightened within 15 minutes. Otherwise, the seal packing must be removed and reapplied.

(f) Install the seal washers onto the bolts.



(g) Install the cylinder head cover with the 10 bolts and 2 nuts. Tighten the bolts and nuts uniformly in several steps.
Torque: Bolt A
10 N*m (102 kgf*cm, 7.4 ft.*lbf)
Bolt B
9.0 N*m (92 kgf*cm, 80 in.*lbf)
Nut
9.0 N*m (92 kgf*cm, 80 in.*lbf)
HINT:
Each bolt length is as follows:

Bolt	length
A	25 mm (0.98 in.)
B	60 mm (2.36 in.)



48. INSTALL OIL CONTROL VALVE FILTER

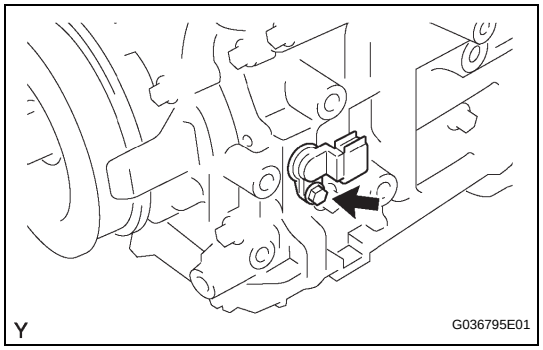
(a) Check that no foreign objects on the mesh part of the 2 filters.

(b) Install a new gasket onto each new plug.

(c) Insert the filters into the plugs.

(d) Apply adhesive to 2 or 3 threads of the plugs.
Adhesive:
Part No. 08833-00080, THREE BOND 1344 LOCTITE 242 or the equivalent

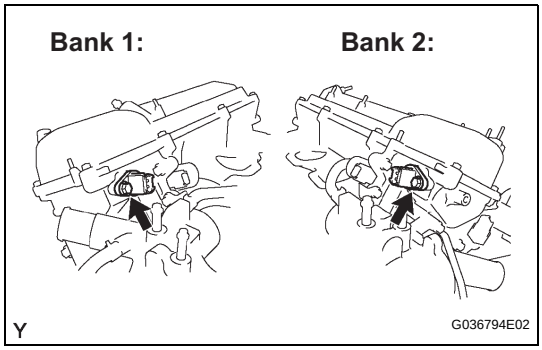
(e) Install the plugs onto each cylinder head.
Torque: 62 N*m (632 kgf*cm, 46 ft.*lbf)



49. INSTALL CRANKSHAFT POSITION SENSOR

(a) Install the crankshaft position sensor with the bolt.
Torque: 10 N*m (102 kgf*cm, 7.4 ft.*lbf)

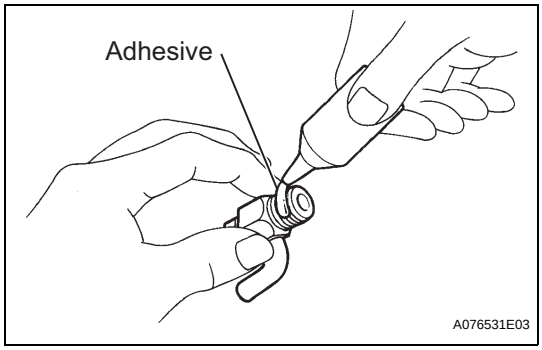
EM



50. INSTALL VVT SENSOR

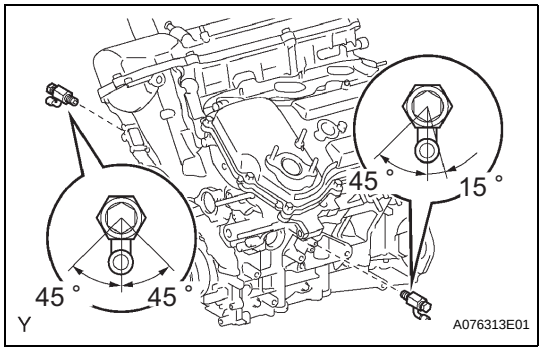
(a) Apply a light coat of engine oil to the O-ring of each VVT sensor.

(b) Install the 2 VVT sensors with the 2 bolts.
Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

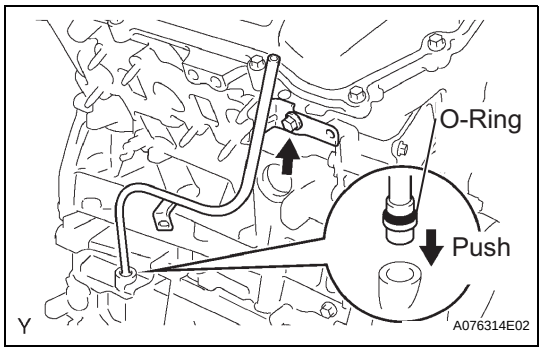


51. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

(a) Apply adhesive to 2 or 3 threads of the drain cock ends.
Adhesive:
Part No. 08833-00070, THREE BOND 1324 or the equivalent



(b) Tighten the drain cocks to the specified torque, and rotate them clockwise as shown in the illustration.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)
NOTICE:
- **Do not rotate the drain cocks more than 1 complete revolution (360°) after tightening the drain cocks to the specified torque.**
- **Do not loosen the drain cocks after setting them correctly.**



52. INSTALL OIL LEVEL GAUGE GUIDE

(a) Install a new O-ring onto the oil level gauge guide.

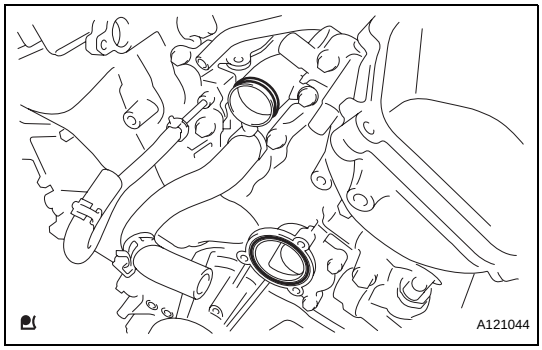
(b) Apply a light coat of engine oil to the O-ring.

(c) Push the oil level gauge guide end into the guide hole of the oil pan.

(d) Install the oil level gauge guide with the bolt.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

53. INSTALL SPARK PLUG

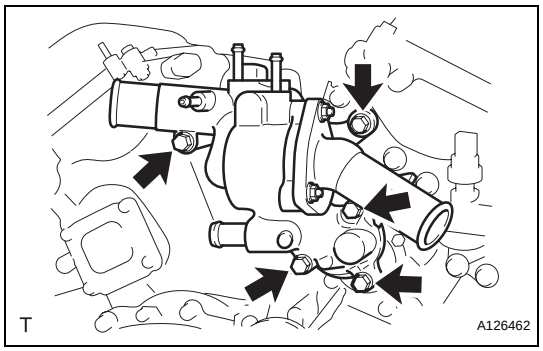
(a) Using a spark plug wrench, install the 6 spark plugs.
Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)



54. INSTALL WATER INLET

(a) Install a new gasket onto the timing chain cover.

(b) Install a new O-ring onto the water by-pass outlet pipe.



(c) Install the water inlet with the 5 bolts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

55. INSTALL WATER BY-PASS HOSE

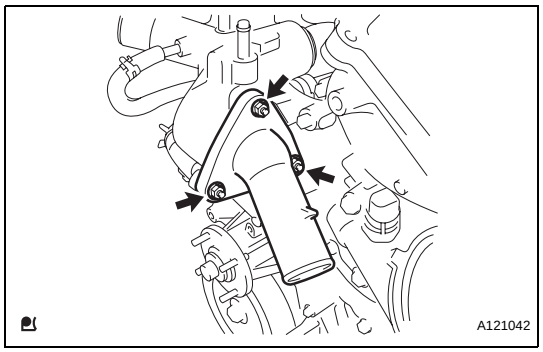
(a) Install the water by-pass hose with the 2 clamps.

56. INSTALL NO. 2 WATER BY-PASS HOSE

(a) Install the No. 2 water by-pass hose with the 2 clamps.

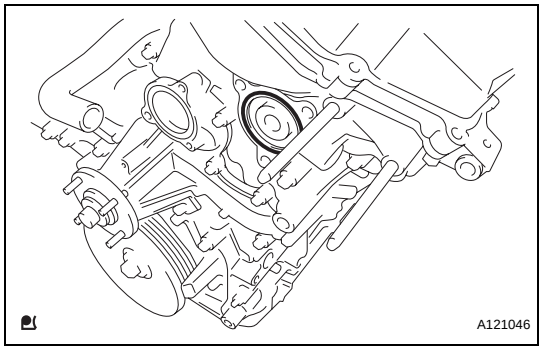
57. INSTALL NO. 3 WATER BY-PASS HOSE

(a) Install the No. 3 water by-pass hose with the 2 clamps.



58. INSTALL WITH THERMOSTAT WATER INLET SUB-ASSEMBLY

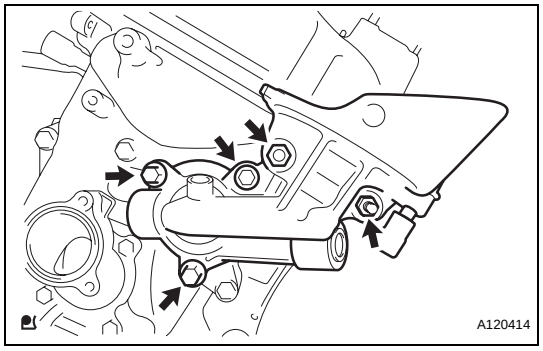
(a) Install a new O-ring and the water inlet with thermostat with the 3 nuts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)



59. INSTALL OIL FILTER BRACKET SUB-ASSEMBLY

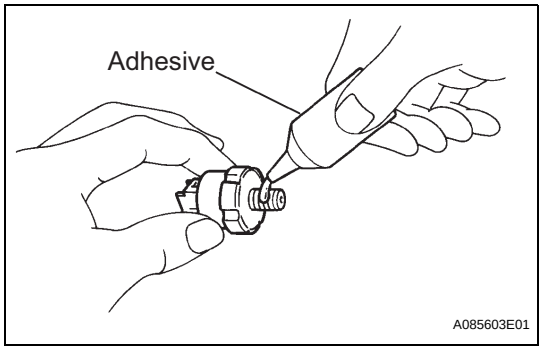
(a) Install the 2 stud bolts.
Torque: 10 N*m (102 kgf*cm, 7.4 ft.*lbf)

(b) Install a new gasket.



(c) Install the oil filter bracket with the 3 bolts and 2 nuts.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)

EM



60. INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY

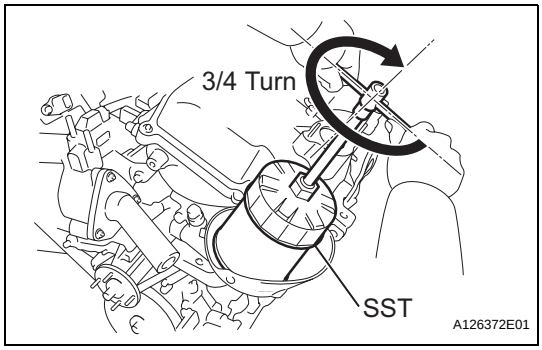
(a) Apply adhesive to 2 or 3 threads of the oil pressure switch.
Adhesive:
Part No. 08833-00080, THREE BOND 1344, LOCTITE 242 or the equivalent.

(b) Using a 24 mm deep socket wrench, install the oil pressure switch.
Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)

61. INSTALL OIL FILTER UNION

(a) Using a 12 mm hexagon wrench, install the oil filter union.
Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)

EM



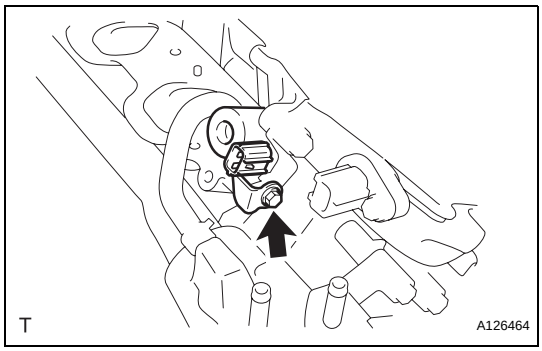
62. INSTALL OIL FILTER SUB-ASSEMBLY

(a) Clean the oil filter contact surface on the oil filter bracket.

(b) Apply clean engine oil to the rubber gasket of a new oil filter.

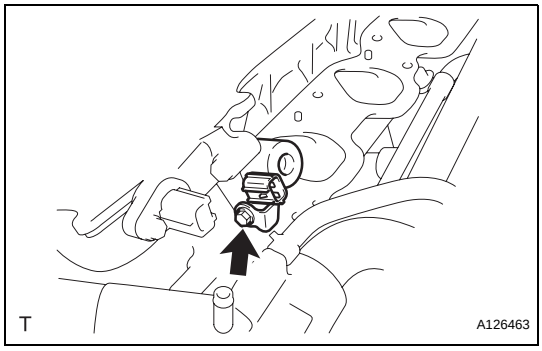
(c) Tighten the oil filter by hand until the rubber gasket comes into contact with the seat of the filter bracket.

(d) Using SST, tighten it an additional 3/4 turn to set the oil filter.
SST 09228-07501
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)



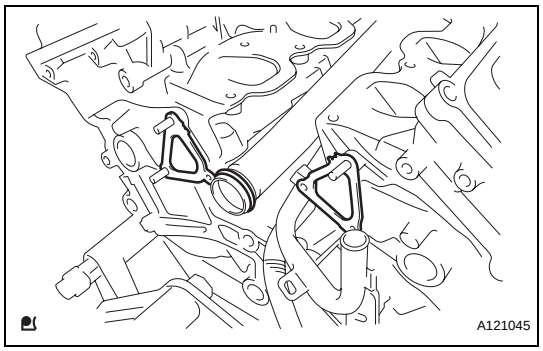
63. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 2)

(a) Install the camshaft timing oil control valve bank 2 with the bolt.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)



64. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY (for Bank 1)

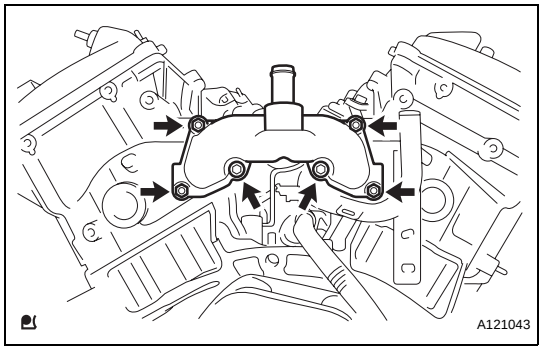
(a) Install the camshaft timing oil control valve bank 1 with the bolt.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)



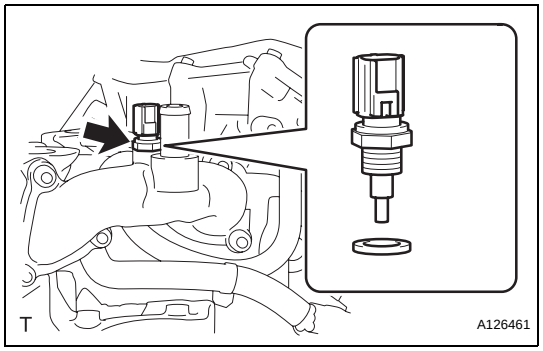
65. INSTALL WATER BY-PASS JOINT RR

(a) Install a new O-ring onto the water outlet pipe.

(b) Install the 2 gaskets onto the bank 1 and bank 2 cylinder heads.

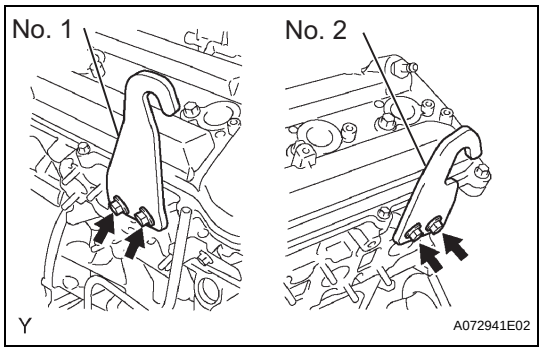


(c) Install the water by-pass rear joint with the 2 bolts and 4 nuts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)



66. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

(a) Install the engine coolant temperature sensor with a new gasket.
Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)



67. INSTALL ENGINE HANGERS

(a) Install engine hanger No. 1 with the 2 bolts.
Torque: 33 N*m (336 kgf*cm, 24 ft.*lbf)

(b) Install engine hanger No. 2 with the 2 bolts.
Torque: 33 N*m (336 kgf*cm, 24 ft.*lbf)