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Toyota Motor Corp.

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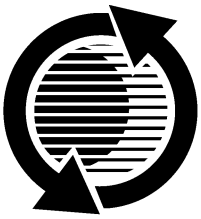

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ABSTRACT

The 2ZZ-GE is a sporty 1.8 liter engine based on the 1ZZ-FE, which is currently being mass produced in Japan, USA, and Canada.

It was designed to fit into the same engine compartment as the base 1ZZ-FE, have equivalent vehicle performance as a 2.2 liter engine, and meet TLEV emission standards.

The main features of the 2ZZ-GE are the Metal Matrix Composite (MMC) reinforced all-aluminum cylinder block and the intelligent Variable Valve Timing and Lift (VVTL-i) system. These features were adopted for size and performance.

Other features such as a reinforced ladder frame, and an intake manifold spacer was utilized for a sporty engine sound.

The 2ZZ-GE delivers maximum power at 7600rpm and maximum torque at 6800rpm.

INTRODUCTION

The 1ZZ-FE, base engine to the 2ZZ-GE, was designed with the following targets.

1. To reduce exhaust emissions and improve fuel economy without extra systems. (i.e. direct injection)
2. To make compact and lightweight

The 2ZZ-GE was designed with the following additional targets.

1. Provide high speed performance
2. Retain low speed flexibility
3. Maintain same bore pitch as base engine
4. This was to keep the same outer dimensions
5. Maintain same emission standard as base engine Target TLEV
6. Achieve best power to weight ratio in the field

SPECIFICATIONS

Table 1 shows basic specifications of the 2ZZ-GE engine, in comparison with the base engine, 1ZZ-FE.

Figure 1 shows the outline of the 2ZZ-GE compared to the 1ZZ-FE. The basic outer dimensions were kept equal while performance was increased.

Table 1. Basic Specifications

	2ZZ-GE	1ZZ-FE
Displacement (cc)	1795	1794
Bore x Stroke (mm)	82 x 85	79 x 91.5
Compression	11.5	10
Valve Train	DOHC 4 Chain Driven VVTL-i	DOHC 4 Chain Driven VVT-i
Aspiration	natural	natural
Cylinder Block	Aluminum w/MMC liner	Aluminum w/Cast iron liner
Bore Pitch (mm)	87.5	87.5
Bore wall (mm)	5.5	8.5
Valve Dia. (mm)	Int 34 Exh 29	Int 32 Exh 27.5
Max Power	135kw/7600rpm	107kw/6400rpm
Max Torque	180Nm/6800rpm	172Nm/4400rpm
Size (LxWxH) (mm)	652 x 608 x 659	639 x 586 x 632
Dry weight	115kg	102kg

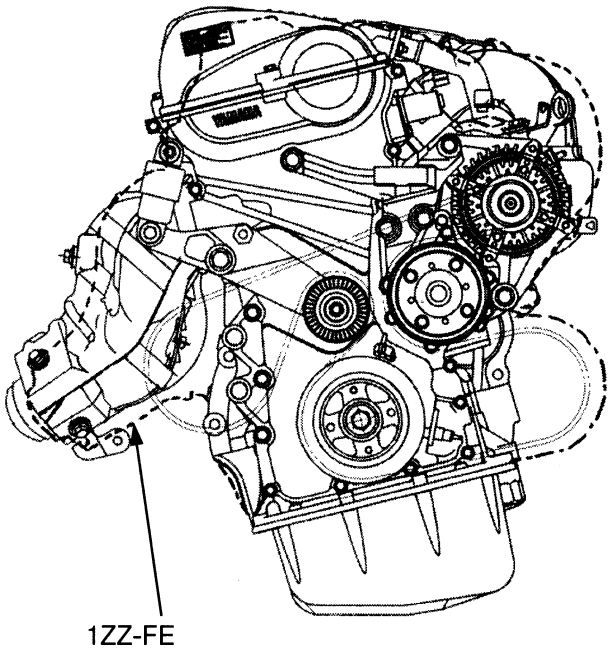


Figure 1. Engine Outline

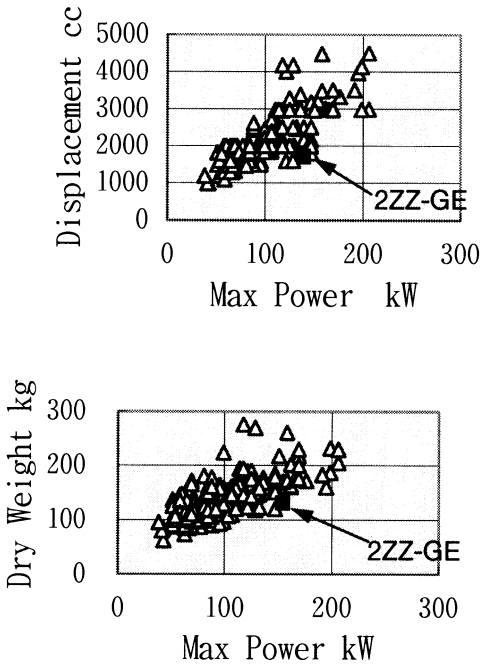


Figure 2. Power to Weight and Power to Displacement Comparisons

Figure 2 shows the Power, weight, and displacement of the engines in the Japanese market. 2ZZ-GE is among the top of all engines.

The MMC all-aluminum cylinder block with a minimum bore to bore wall thickness of 5.5mm made this compactness and low weight possible. The aluminum alloy cylinder bore has been reinforced with ceramic fibers and particles, a combination which we found most favorable amongst thermal spraying, plating, and a cast-wrapped aluminum liner.

Table 2. Comparison of Aluminum Blocks

	Linerless			Cast-wrapped liner	
	MMC	Thermal spray	Plating	Aluminum	Cast iron
Bore temp.	B	B	B	B	D
Bore rigidity	A	B	B	C	C
Bore strength	A	B	B	C	C
Head Gkt seal	A	B	B	B	B

A; excellent B; very good C; good D; poor

The details of the MMC cylinder block will be introduced in a separate paper.

HIGH SPEED PERFORMANCE AND LOW SPEED TORQUE

The 2ZZ-GE adopted a Variable Valve Timing and Lift system called VVTL-i. The system changes valve timing over the entire speed range in accordance to engine speed and load. This feature is also used in the base engine. VVTLi also changes valve lift and event angles at 6000rpm from low to high. Table 2 shows the changes in valve timing and lift.

Table 2. Valve Timing and Lift

	Exhaust			Intake		
	Open BBDC (CA)	Close ATDC (CA)	Lift (mm)	Open BTDC (CA)	Close ABDC (CA)	Lift (mm)
Low	34	14	7.6	-10 to 33	58 to 15	7.6
High	56	40	10.0	15 to 58	97 to 54	11.2

VVTi mechanism allows the valve timing of the intake cam to be changed continuously in the range shown.

VVTL-i MECHANISM – The valve timing change mechanism of the VVTL-i system, VVT-i, has already been introduced in other papers.

Figure 3 shows the schematic drawing of the lift change mechanism of the VVTL-i. Figure 4 shows the detail of the mechanism set inside the rocker arm.

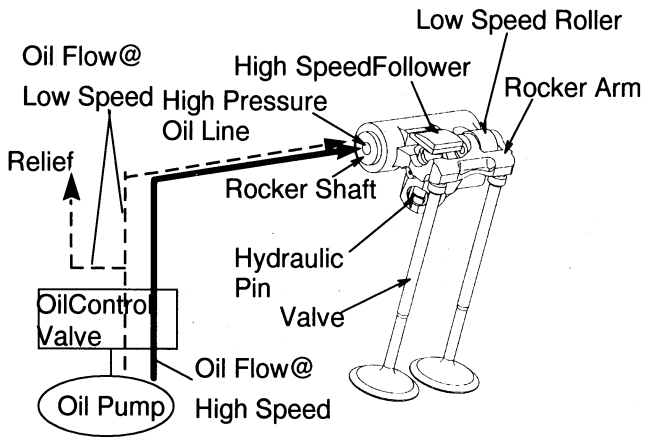


Figure 3. Lift Change Schematic

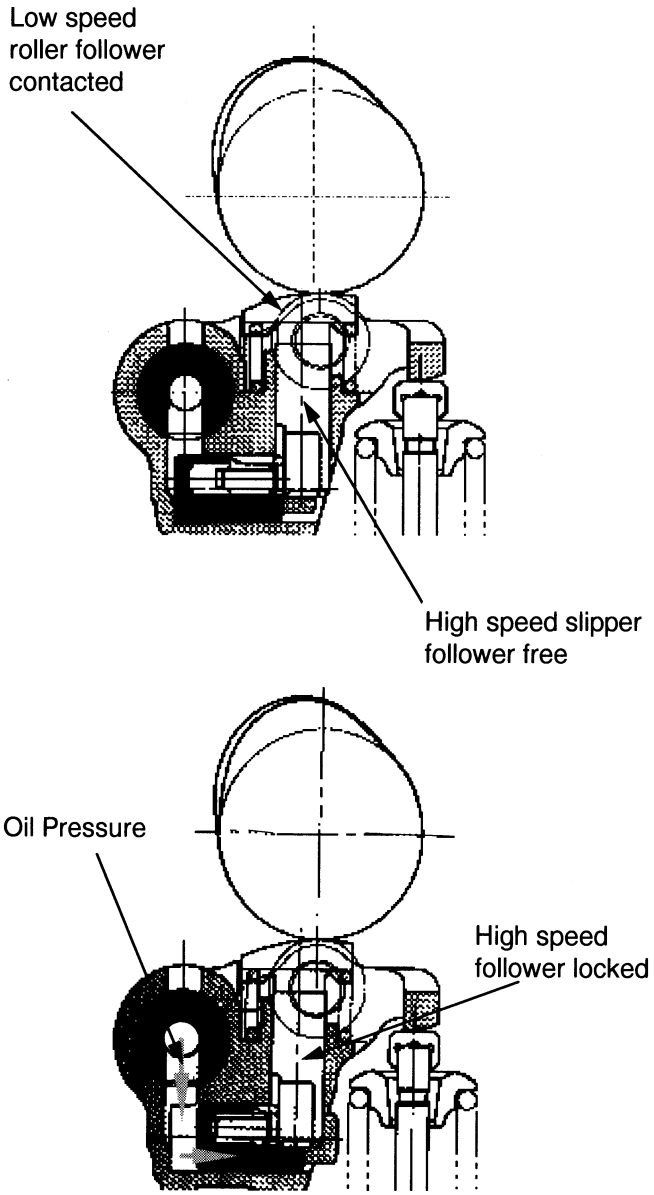


Figure 4. Detail of Mechanism

At engine speeds below 6000rpm, the rocker arm moves according to the low lift roller follower. When engine speed is above 6000rpm, hydraulic pressure is applied to the locking pin, which slides under and locks the high lift slipper follower to the rocker arm. This creates the difference in valve lift, for the rocker arm will now move according to the high lift slipper. When engine speed is below 6000rpm, the return spring pushes the locking pin back, and the high lift slipper is freed.

Choice of Follower – A few considerations were made when choosing a follower which best suited the 2ZZ-GE.

1. To provide high speed performance
2. To have low speed flexibility

These requirements came from the original targets.

Volumetric Efficiency – Angle-lift area of the cam angle to lift curves has a large effect on the volumetric efficiency of an engine. The volumetric efficiency has a large effect on engine maximum performance.

Figure 5 compares angle-lift areas of slipper, direct drive, and roller followers. Throughout the speed range, a slipper shows the largest angle-lift area.

We therefore decided that a rocker arm with a slipper follower would be the best choice to gain high speed performance.

Friction – At low engine speeds, valve train friction accounts for 30% of the total friction of an engine and therefore has a large effect on low speed flexibility of an engine.

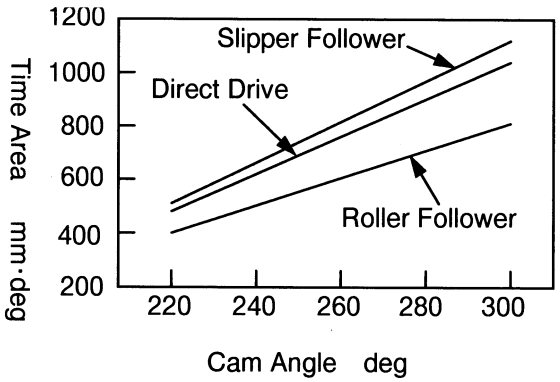


Figure 5. Angle Lift Area

Figure 6 shows friction for slipper, direct drive, and roller followers. Roller shows lowest friction, but at high engine speeds, the difference between followers is substantially smaller.

We therefore decided a rocker arm with a roller follower to be the best choice for low speed flexibility.

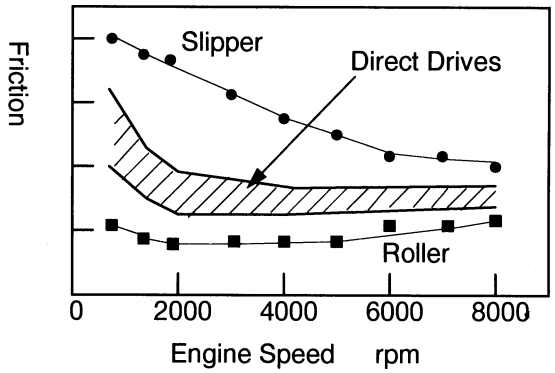


Figure 6. Friction

For the base engine, direct drive mechanism was adopted as the best single choice, but for the 2ZZ-GE, we chose the roller follower for the low speed cam and slipper follower for the high speed cam.

This means two different followers will be set onto one rocker arm.

Technical Problems with Two Different Followers

Material Selection – The roller will be made of hardened steel and the slipper from ferrous sintered metal. For the cam material, ferrous sintered metal was chosen for pitting and scuffing durability.

The cam is brazed to the shaft and sintered simultaneously. Then, two different surface finishes were applied separately to the high and low lift cams.

Special care was taken to control the initial wear of the high speed cam.

Lubrication – Slipper type follower needs to be lubricated for anti-scuff characteristics so shower lines were added to the head cover.

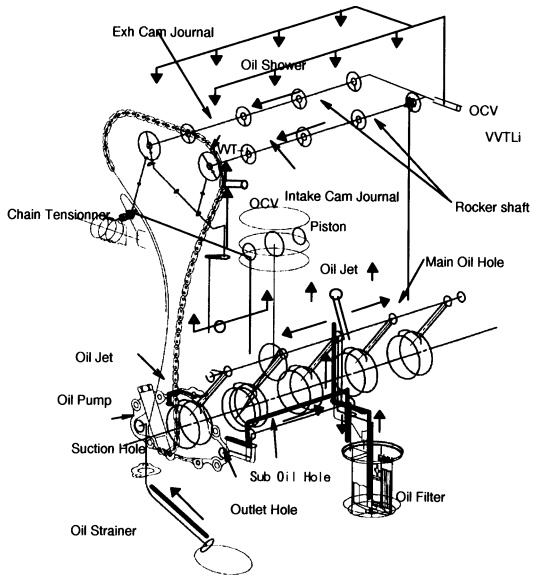


Figure 7. Lubrication System

Figure 7 shows the lubrication system of the 2ZZ-GE.

The hydraulic pressure line which passes through the rocker shaft also lubricates the rocker arms. Oil is fed through this line at all speeds, and at high speeds the oil control valve (OCV) allows additional oil to flow into the pressure line to lock the high speed follower.

Movement of Valve and Spring – Figure 8 shows the actual valve lift curves, before and after improvement of rocker arm rigidity and mass.

Inset shows detail of lift curves at high and low speeds.

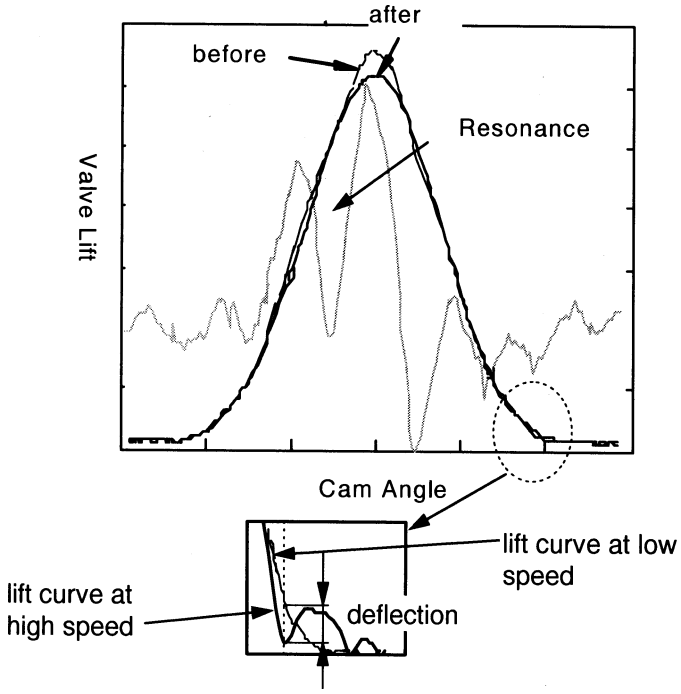


Figure 8. Actual Lift Curves

The original showed a resonance during lift, and a large deflection at valve closing. Resonance affects the reliability of the valve spring, and deflection affects the performance of the engine.

Valve lift acceleration was changed to improve resonance, and rocker arm rigidity was increased to improve deflection.

Lock Pin Durability – The lock pin does not slide under the high speed follower within 1 camshaft revolution. When the overlap of the lock pin and follower is still small, the pin can get kicked back. This will cause a slight wear of the corners of lock pin and follower, increasing the chances for the kick back to occur. When the average of the wears of the lock pin and follower exceeds a given value, the lock pin will always be kicked back, and the valve lift will not switch to high.

We decided the criteria number of low-high cycles based on an actual circuit run, and controlled the wear to an acceptable level. Two main methods were used to control the wear.

- Balancing the wear
  1. The same material and surface finish used for both lock pin and follower
  2. Optimization of corner shapes
- Increasing velocity of lock pin
  1. Increasing available hydraulic pressure
  2. Decreasing lock pin weight

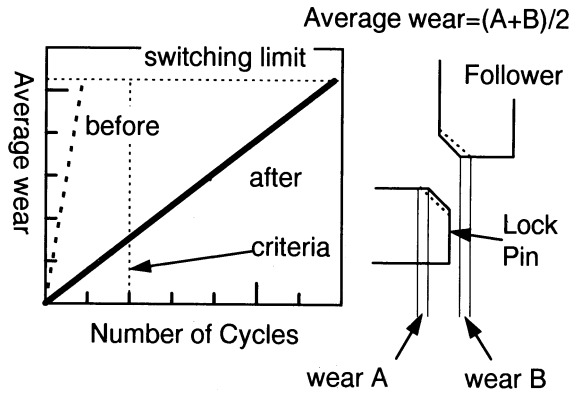


Figure 9. Lock Pin Wear

EFFECT OF VVTL-i – Figure 10 shows the torque curve of the 2ZZ-GE. The torque increase from variable valve timing is approximately 5% below 6000rpm and 2% above 6000rpm. At above 6000rpm, the variable valve lift shows a big torque increase of 22%.

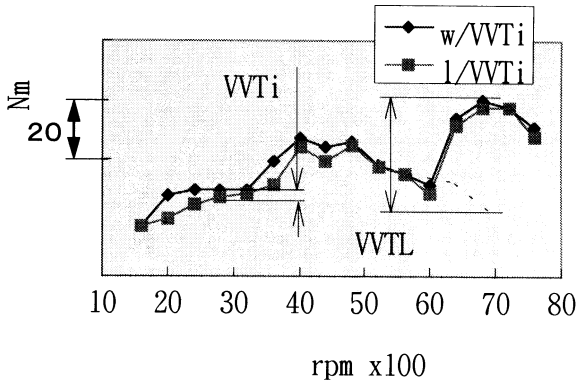


Figure 10. Torque Curve

OTHER FEATURES FOR HIGH SPEED OPERATION

Oil Pan – Figure 11 shows oil pan and baffle plate set on the ladder frame. The oil pan itself is without a baffle. This quickens the return of oil into the oil pan, increasing performance. Air suction was minimized by optimally positioning the suction pipe inlet. The 2ZZ-GE can withstand 1.0G without sucking air.

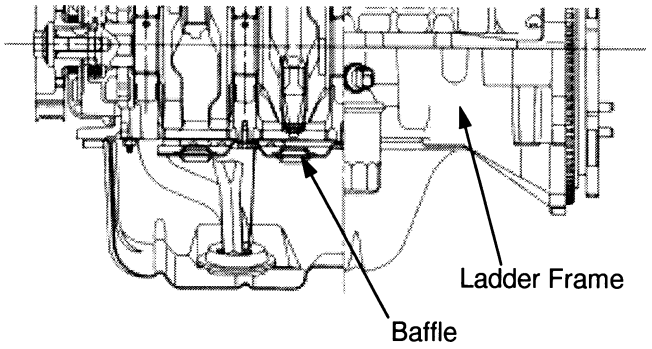


Figure 11. Oil Pan

Crankshaft and Connecting Rod – Table 3 compares the crankshaft dimensions with the base engine. The pin journal diameter was enlarged by 1mm and the stroke was shortened by 6.5mm.

Table 3. Crankshaft Dimensions (mm)

	2ZZ-GE	1ZZ-FE
Main Journal Diameter	48	48
Pin Journal Diameter	45	44
Journal Overlap	4	0.25

As for bearings, the connecting rod uses Kelmet material, the main is aluminum.

Intake Manifold – Figure 12 shows the intake manifold.

A large surge tank (4.5 liters) and intake manifold runners made from aluminum pipes were adopted.

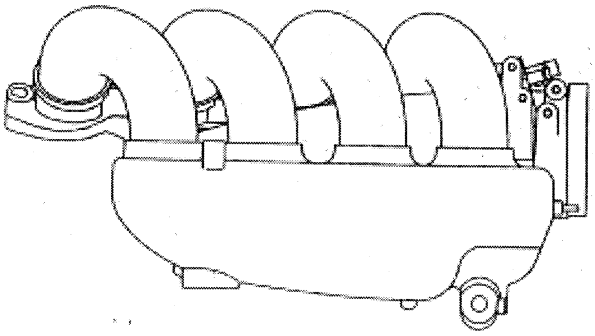


Figure 12. Intake Manifold

Compression Ratio – A high compression ratio of 11.5 was adopted. It was made possible by the adoption of an all-aluminum cylinder block.

EXHAUST EMISSIONS

THETA EXHAUST PIPES – Figure 13 shows the exhaust manifold.

In order to maintain high speed performance while keeping heat loss from the exhaust pipes to a minimum, a cylindrical pipe with a partition wall (theta pipe) was adopted.

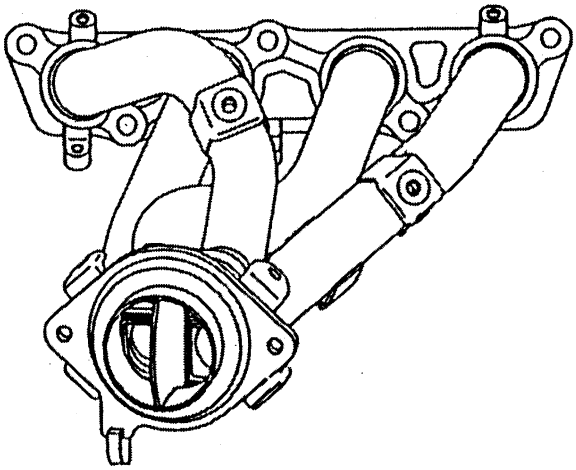


Figure 13. Exhaust Manifold

Emissions and Power – Figure 14 shows catalyst heat-up of dual exhaust pipes and theta pipe.Theta pipe shows quicker heat-up.

In order to meet TLEV standards, the theta pipe without other systems was selected.

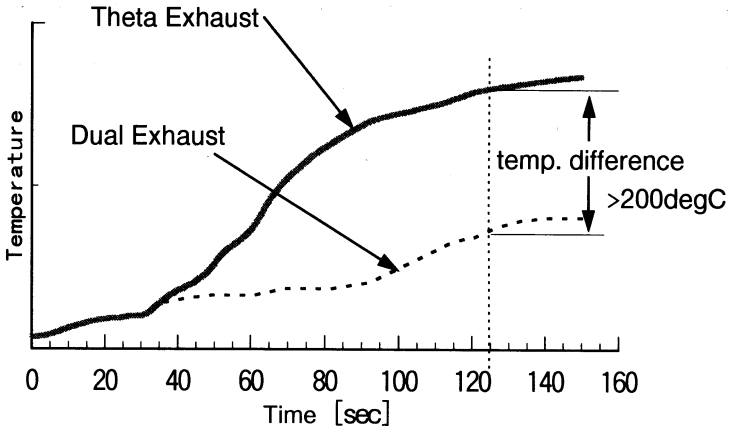


Figure 14. Catalyst Heat-up

Power to Aperture – Figure 15 shows the effect of aperture size between exhaust manifold and front pipe on maximum power. The larger the aperture, the lower the power. The aperture was set to the present level as a compromise between power, manufacturability, and design clearance (heat, vibration, etc).

Maximum power for dual pipe will be at aperture =0.

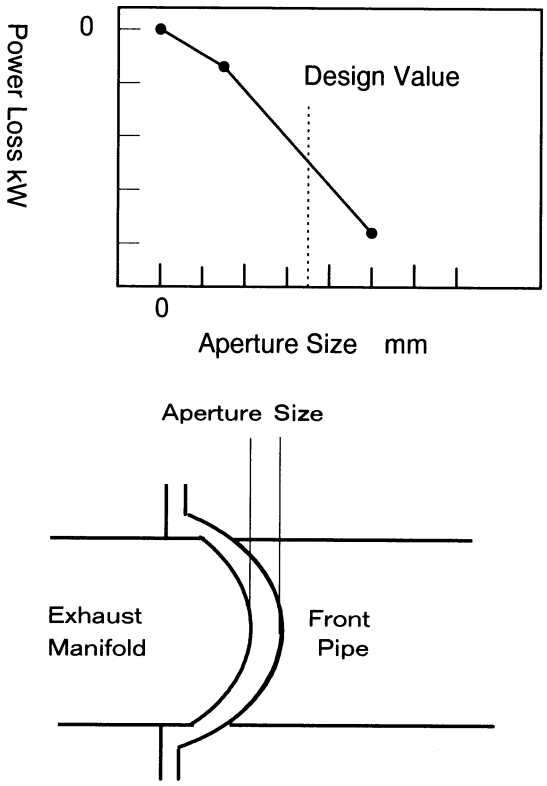


Figure 15. Aperture Size and Power Difference

FUEL ECONOMY

Figure 16 compares maximum power and fuel economy (City and Highway) for engines in the US market. When compared in terms of maximum power, the 2ZZ-GE shows high City fuel economy and is one of the best for Highway fuel economy.

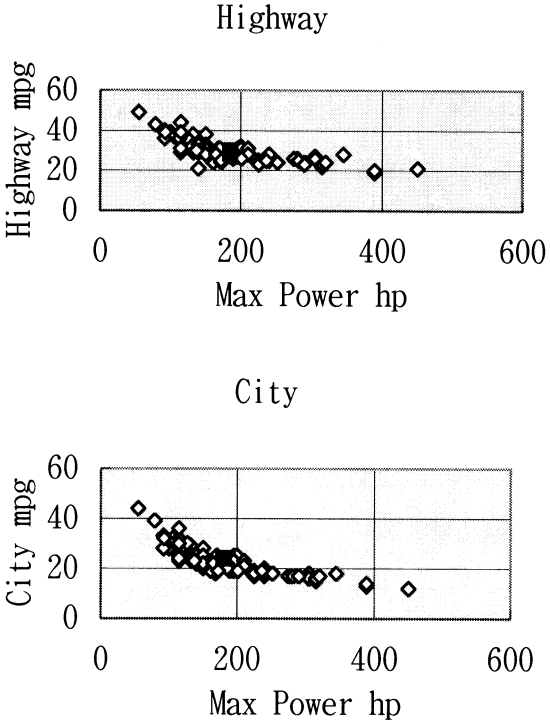


Figure 16. Max Power vs Fuel Economy

ENGINE SOUND

Since 2ZZ-GE is an engine with a high revolution limit, a low final gear ratio of 4.529 was chosen for the manual transmission. Noise suppressing insulation could not be added to the inside of the engine hood, because the hood line was low. Acoustic intensity was measured and a rubber spacer was added between the intake manifold and the block . This filled a volume which was acting as a resonance chamber.

Figure 17 shows the acoustic intensity measurement result.

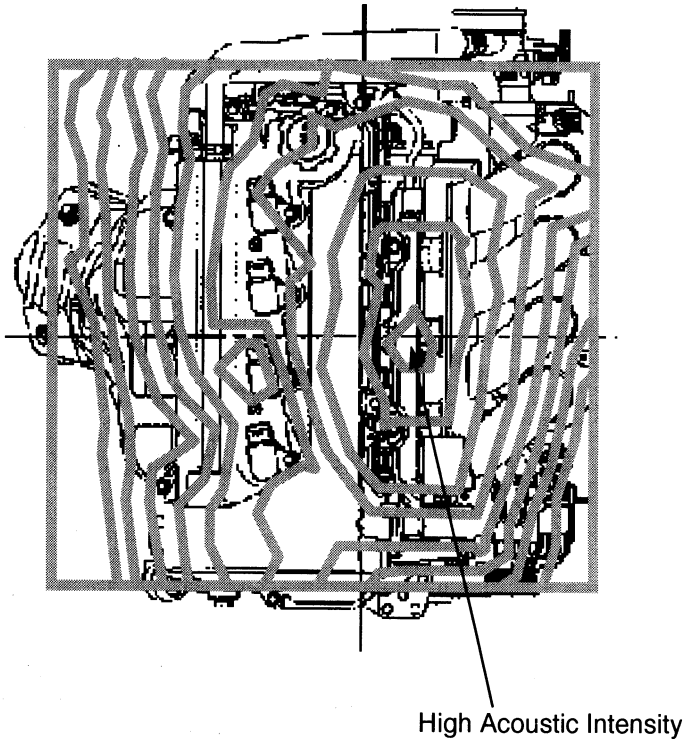


Figure 17. Acoustic Intensity

Improvements were also made to the head cover, timing chain cover, and transmission hole cover using this method.

CONCLUSION

1. A sporty, compact, lightweight, high power, and flexible engine was developed
2. An MMC all-aluminum cylinder block with bore wall thickness of 5.5mm was developed. This contributed to its compactness and low weight.
3. The VVTL-i system, which switches valve lift between low and high, and controls valve timing at the same time, was developed. This contributed to the 2ZZ-GE's high power and flexibility.

ACKNOWLEDGMENTS

The authors would like to thank those both within and outside our company including suppliers for their valuable assistance and advice offered to us. Special thanks to the Yamaha Motor Company for their help in developing this engine.

VALVE CLEARANCE (2ZZ–GE)

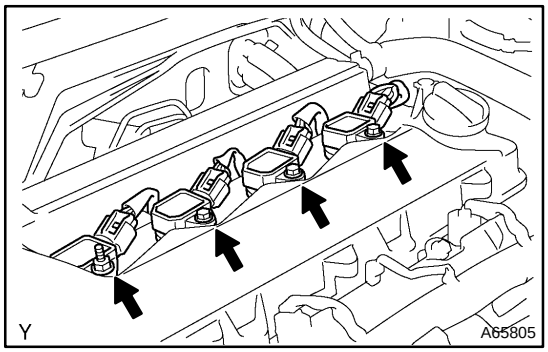
140R6–01

ADJUSTMENT

1. REMOVE ENGINE UNDER COVER RH

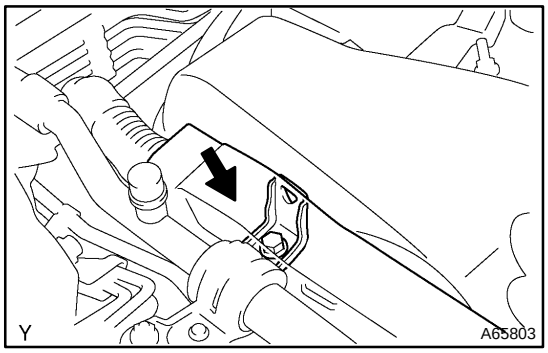
2. REMOVE CYLINDER HEAD COVER NO.2

(a) Remove the 3 bolts, the nut and the cylinder head cover No. 2.



3. REMOVE IGNITION COIL ASSY

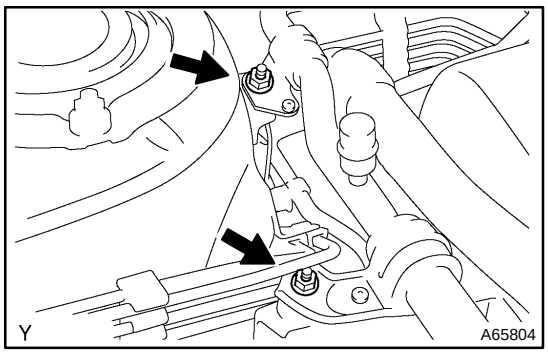
(a) Remove the 3 bolts and the nut, and disconnect the 4 connectors, and remove the 4 ignition coils.



4. REMOVE WIRE HARNESS CLAMP

(a) Disconnect the engine wire harness.

(b) Remove the bolt and wiring harness clamp bracket.



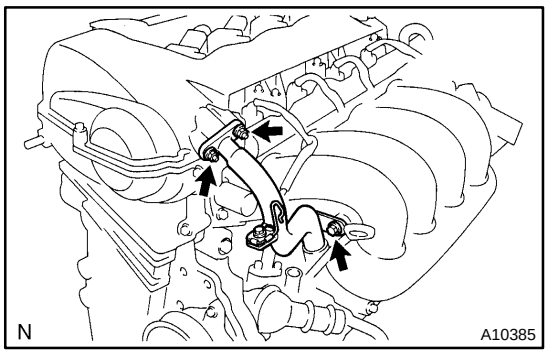
5. DISCONNECT SUCTION HOSE SUB–ASSY

(a) Remove the 2 nuts installing the suction hose sub–assy.

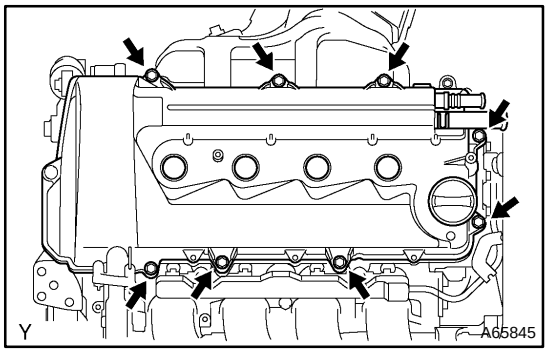
(b) Disconnect the suction hose sub–assy.

6. REMOVE CYLINDER HEAD COVER SUB–ASSY

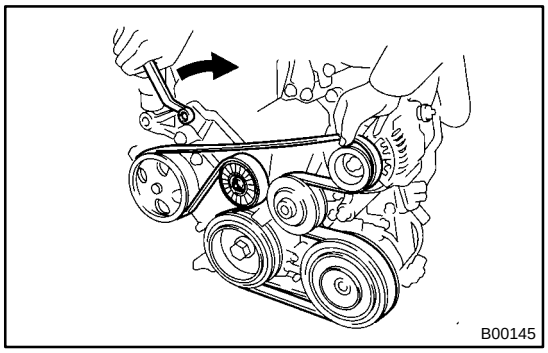
(a) Disconnect the fuel hose clamp and 2 PCV hoses from the cylinder head cover.



(b) Remove the 2 nuts, bolt and disconnect the No. 3 ventilation hose from the No. 1 ventilation pipe.
(c) Disconnect the ventilation No. 1 tube and gasket.

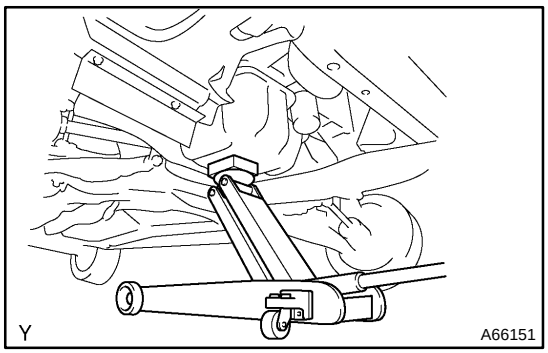


(d) Remove the 8 bolts, wire harness protector, cylinder head cover and gasket.
(e) Remove the O–ring from the cylinder head cover.



7. REMOVE FAN AND GENERATOR V BELT

(a) Turn the drive belt tensioner slowly clockwise and loosen it. Then, remove the drive belt and put back the drive belt tensioner little by little and fix it quietly.

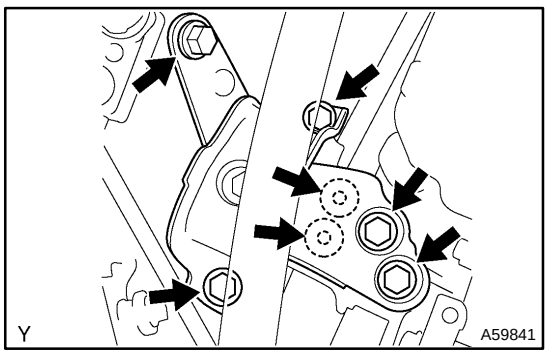


8. REMOVE ENGINE MOUNTING INSULATOR SUB–ASSY RH

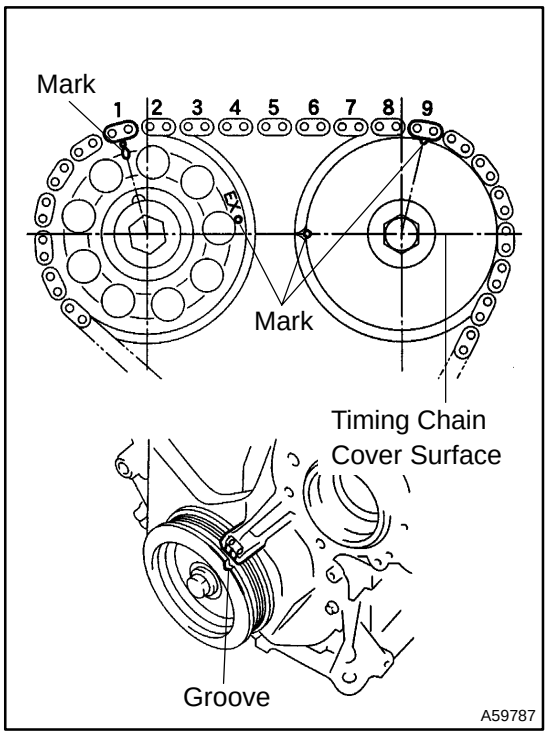
(a) Set the jack to the engine.

HINT:

Place a wooden block between the jack and engine.



(b) Remove the 5 bolts, 2 nuts and engine mounting insulator sub–assy RH.



9. SET NO. 1 CYLINDER TO TDC/COMPRESSION

(a) Turn the crankshaft pulley, and align its groove with timing mark ”0” of the timing chain cover.

(b) Check that the point marks of the camshaft timing sprocket and VVT timing sprocket are in straight line on the timing chain cover surface as shown in the illustration.

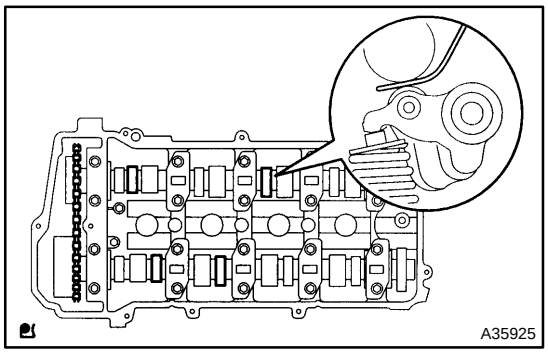
HINT:

If not, turn the crankshaft 1 revolution (360°) and align the marks as above.

10. REMOVE V–RIBBED BELT TENSIONER ASSY

HINT:

Handle a jack up and down to remove the bolt.



11. INSPECT VALVE CLEARANCE

(a) Check only the valves indicated.

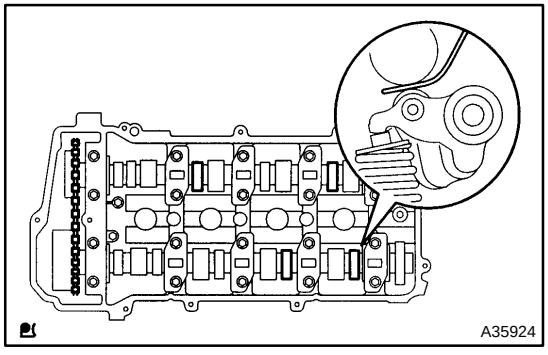
(1) Using a feeler gauge, measure the clearance between the valve rocker arm and camshaft.

(2) Record the out–of specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

Valve clearance (Cold)

Intake	0.08 – 0.18 mm (0.0031 – 0.0071 in.)
Exhaust	0.22 – 0.32 mm (0.0087 – 0.0126 in.)

(b) Turn the crankshaft 1 revolution (360 °) and set No. 4 cylinder to TDC/compression.



(c) Check only the valves indicated.

(1) Using a feeler gauge, measure the clearance between the valve rocker arm and camshaft.

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Valve clearance (Cold)

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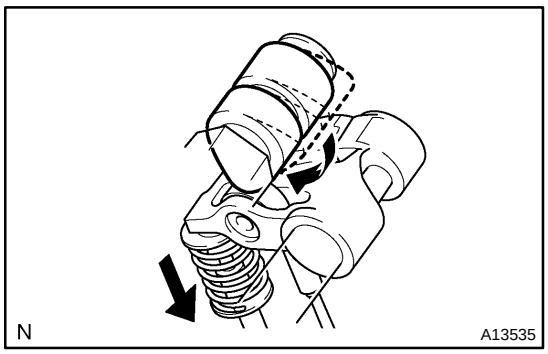


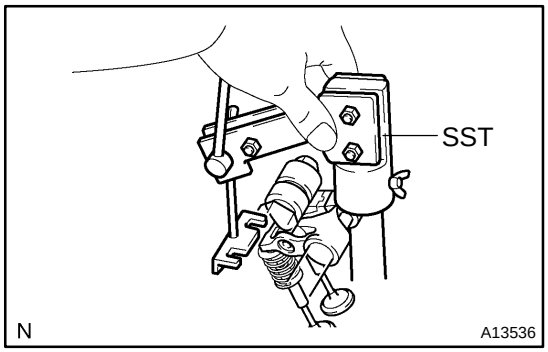
12. ADJUST VALVE CLEARANCE

(a) Set the SST.

(1) Turn the crankshaft so that the related rocker arm,where the valve clearance is adjusted, is fully pushed down.

NOTICE:

Remove the spark plug and take off the compression.

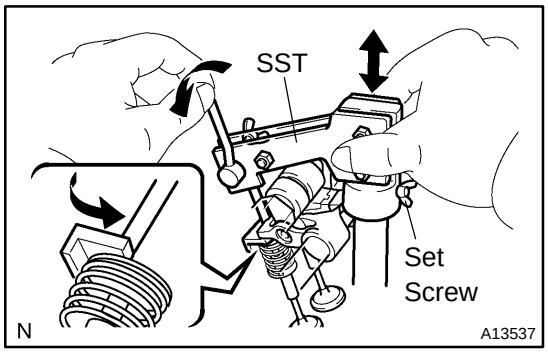


(2) Insert SST into the plug tube.

SST 09248–77010 (09248–07010)

NOTICE:

- **SST cannot be inserted unless the set screw is loosened.**
- **Make sure that the camshaft is in the same condition as step (1).**



(3) Operate the lever so that SST's seat surface comes to contact with the valve retainer and lock them with the set screw.

NOTICE:

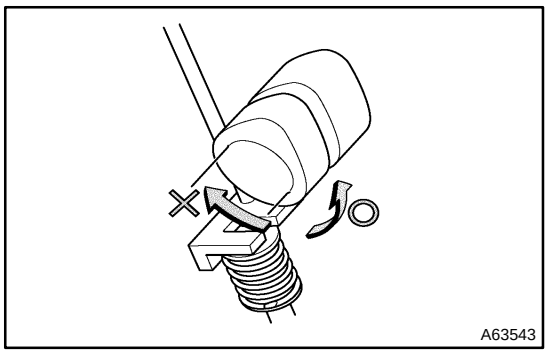
- **Clearance between the valve retainer and SST's seat surface is not allowed.**
- **Care should be taken not to make clearance when inserting SST, since a presence of clearance may unlock the keeper.**

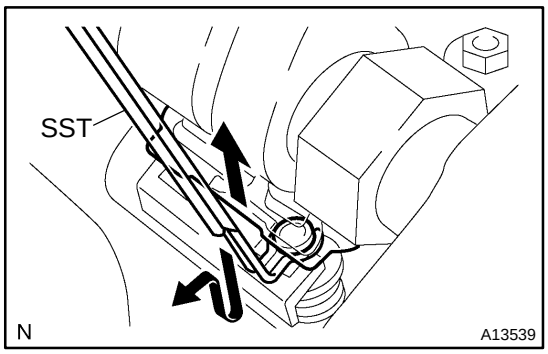
(4) lock the set screw on the plug tube side of SST.

(5) Rotate the crankshaft so that the camshaft is positioned as shown in the illustration.

NOTICE:

- **Pay attention to the direction of the rotation to prevent the nose of the camshaft from interfering with the SST's shaft.**
- **Do not rotate the crankshaft excessively.**





(b) Remove the adjusting shim.

(1) Lift the rocker arm to make a room and remove the adjusting shim using SST.

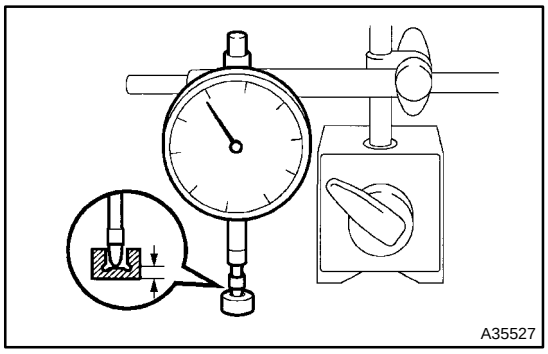
SST 09248–77010 (09248–07010)

NOTICE:

Do not remove SST in the condition that adjusting shim is removed.

HINT:

- Setting SST from the right above makes the removal easy.
- If there is not enough room, reset SST.



(2) Determine the size of the replaced shim according to there Formula or Charts:

- Using a dial indicator, measure the thickness of the removed shim.
- Calculate the thickness of a new shim so that the valve clearance comes within the specified value.

A	Thickness of new shim
B	Thickness of used shim
C	Measured valve clearance

Intake: A = B + (C – 0.13 mm (0.005 in.)) × 1.5

Exhaust: A = B + (C – 0.27 mm (0.011 in.)) × 1.5

HINT:

Shim are available in 41 sizes in increments of 0.020 mm (0.0008 in.), from 2.000 mm (0.0787 in.) to 2.800 mm (0.1102 in.).

2ZZ–GE: Valve Shim Selection Chart (Intake)

Measure clearance mm(in.) \ Installed shim thickness mm(in.)	2.000 (0.0787)	2.020 (0.0795)	2.040 (0.0803)	2.060 (0.0811)	2.080 (0.0819)	2.100 (0.0827)	2.120 (0.0835)	2.140 (0.0843)	2.160 (0.0850)	2.180 (0.0858)	2.190 (0.0862)	2.200 (0.0866)	2.210 (0.0870)	2.220 (0.0874)	2.230 (0.0878)	2.240 (0.0882)	2.250 (0.0886)	2.260 (0.0890)	2.270 (0.0894)	2.280 (0.0898)	2.290 (0.0902)	2.300 (0.0906)	2.310 (0.0909)	2.320 (0.0913)	2.330 (0.0917)	2.340 (0.0921)	2.340 (0.0921)	2.350 (0.0925)	2.360 (0.0929)	2.370 (0.0933)	2.380 (0.0937)	2.390 (0.0941)	2.400 (0.0945)	2.410 (0.0949)	2.420 (0.0953)	2.430 (0.0957)	2.440 (0.0961)	2.450 (0.0965)	2.460 (0.0969)	2.470 (0.0972)	2.480 (0.0976)	2.490 (0.0980)	2.500 (0.0984)	2.510 (0.0988)	2.520 (0.0992)	2.530 (0.0996)	2.540 (0.1000)	2.550 (0.1004)	2.560 (0.1008)	2.580 (0.1016)	2.600 (0.1024)	2.620 (0.1031)	2.640 (0.1039)	2.660 (0.1047)	2.680 (0.1055)	2.700 (0.1063)	2.720 (0.1071)	2.740 (0.1079)	2.760 (0.1087)	2.780 (0.1094)	2.800 (0.1102)
0.000 – 0.030 (0.0000 – 0.0012)										00	02	02	04	04	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	42	44	46	48	50	52	54	56	58	60	62	64
0.031 – 0.050 (0.0012 – 0.0020)								00	02	04	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	46	48	50	52	54	56	58	60	62	64	66	68
0.051 – 0.070 (0.0020 – 0.0028)							00	02	04	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	48	50	52	54	56	58	60	62	64	66	68	70
0.071 – 0.090 (0.0028 – 0.0035)					00	02	04	06	08	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	52	54	56	58	60	62	64	66	68	70	72	74
0.091 – 0.099 (0.0036 – 0.0039)				00	02	04	06	08	10	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	54	56	58	60	62	64	66	68	70	72	74	76
0.100 – 0.160 (0.0039 – 0.0063)																																																													
0.161 – 0.180 (0.0063 – 0.0071)	06	80	10	12	14	16	18	20	22	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	66	68	70	72	74	76	78	80				
0.181 – 0.200 (0.0071 – 0.0079)	10	12	14	16	18	20	22	24	26	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	70	72	74	76	78	80						
0.201 – 0.220 (0.0079 – 0.0087)	12	14	16	18	20	22	24	26	28	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	72	74	76	78	80							
0.221 – 0.240 (0.0087 – 0.0094)	16	18	20	22	24	26	28	30	32	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	76	78	80	82								
0.241 – 0.260 (0.0095 – 0.0102)	18	20	22	24	26	28	30	32	34	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	78	80										
0.261 – 0.280 (0.0103 – 0.0110)	22	24	26	28	30	32	34	36	38	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80												
0.281 – 0.300 (0.0111 – 0.0118)	24	26	28	30	32	34	36	38	40	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80													
0.301 – 0.320 (0.0119 – 0.0126)	28	30	32	34	36	38	40	42	44	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																	
0.321 – 0.340 (0.0126 – 0.0134)	30	32	34	36	38	40	42	44	46	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																			
0.341 – 0.360 (0.0134 – 0.0142)	34	36	38	40	42	44	46	48	50	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																							
0.361 – 0.380 (0.0142 – 0.0150)	36	38	40	42	44	46	48	50	52	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																									
0.381 – 0.400 (0.0150 – 0.0157)	40	42	44	46	48	50	52	54	56	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																													
0.401 – 0.420 (0.0158 – 0.0165)	42	44	46	48	50	52	54	56	58	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																															
0.421 – 0.440 (0.0166 – 0.0173)	46	48	50	52	54	56	58	60	62	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																																			
0.441 – 0.460 (0.0174 – 0.0181)	48	50	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80																																					
0.461 – 0.480 (0.0181 – 0.0189)	52	54	56	58	60	62	64	66	68	70	72	72	74	74	76	76	78	78	80	80																																									
0.481 – 0.500 (0.0189 – 0.0197)	54	56	58	60	62	64	66	68	70	72	74	74	76	76	78	78	80	80																																											
0.501 – 0.520 (0.0197 – 0.0205)	58	60	62	64	66	68	70	72	74	76	78	78	80	80																																															
0.521 – 0.540 (0.0205 – 0.0213)	60	62	64	66	68	70	72	74	76	78	80	80																																																	
0.541 – 0.560 (0.0213 – 0.0220)	64	66	68	70	72	74	76	78	80																																																				
0.561 – 0.580 (0.0221 – 0.0228)	66	68	70	72	74	76	78	80																																																				
0.581 – 0.600 (0.0229 – 0.0236)	70	72	74	76	78	80																																																							
0.601 – 0.620 (0.0237 – 0.0244)	72	74	76	78	80																																																								
0.621 – 0.640 (0.0244 – 0.0252)	76	78	80																																																										
0.641 – 0.660 (0.0252 – 0.0260)	78	80																																																											
0.661 – 0.680 (0.0260 – 0.0268)	80																																																													

New Shim thickness mm (in.)

Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 (0.0787)	28	2.280 (0.0898)	56	2.560 (0.1008)
02	2.020 (0.0795)	30	2.300 (0.0906)	58	2.580 (0.1016)
04	2.040 (0.0803)	32	2.320 (0.0913)	60	2.600 (0.1024)
06	2.060 (0.0811)	34	2.340 (0.0921)	62	2.620 (0.1031)
08	2.080 (0.0819)	36	2.360 (0.0929)	64	2.640 (0.1039)
10	2.100 (0.0827)	38	2.380 (0.0937)	66	2.660 (0.1047)
12	2.120 (0.0835)	40	2.400 (0.0945)	68	2.680 (0.1055)
14	2.140 (0.0843)	42	2.420 (0.0953)	70	2.700 (0.1063)
16	2.160 (0.0850)	44	2.440 (0.0961)	72	2.720 (0.1071)
18	2.180 (0.0858)	46	2.460 (0.0969)	74	2.740 (0.1079)
20	2.200 (0.0866)	48	2.480 (0.0976)	76	2.760 (0.1087)
22	2.220 (0.0874)	50	2.500 (0.0984)	78	2.780 (0.1094)
24	2.240 (0.0882)	52	2.520 (0.0992)	80	2.800 (0.1102)
26	2.260 (0.0890)	54	2.540 (0.1000)		

Intake valve clearance (Cold):
0.08 – 0.18 mm (0.0031 – 0.0071 in.)

EXAMPLE: The 2.200 mm (0.0826 in.) shim is installed, and the measured clearance is 0.400 mm (0.0157 in.).
Replace the 2.600 mm (0.1024 in.) shim with a new No. 60 shim.

A10466

2ZZ–GE: Valve Shim Selection Chart (Exhaust)

Installed shim thickness mm(in.) / Measure clearance mm(in.)

Measure clearance mm(in.) \ Installed shim thickness mm(in.)	2.000 (0.0787)	2.020 (0.0795)	2.040 (0.0803)	2.060 (0.0811)	2.080 (0.0819)	2.100 (0.0827)	2.120 (0.0835)	2.140 (0.0843)	2.160 (0.0850)	2.180 (0.0858)	2.190 (0.0862)	2.200 (0.0866)	2.210 (0.0870)	2.220 (0.0874)	2.230 (0.0878)	2.240 (0.0882)	2.250 (0.0886)	2.260 (0.0890)	2.270 (0.0894)	2.280 (0.0898)	2.290 (0.0902)	2.300 (0.0906)	2.310 (0.0909)	2.320 (0.0913)	2.330 (0.0917)	2.340 (0.0921)	2.340 (0.0921)	2.350 (0.0925)	2.360 (0.0929)	2.370 (0.0933)
0.000 - 0.030 (0.0000 - 0.0012)																														
0.031 - 0.050 (0.0012 - 0.0020)																												00	04	04
0.051 - 0.070 (0.0020 - 0.0028)																								00	02	02	04	04	06	06
0.071 - 0.090 (0.0028 - 0.0035)																					00	00	02	02	04	04	06	06	08	08
0.091 - 0.110 (0.0036 - 0.0043)																		00	02	02	04	04	06	06	08	08	10	10	12	12
0.111 - 0.130 (0.0044 - 0.0051)															00	00	02	02	04	04	06	06	08	08	10	10	12	12	14	14
0.131 - 0.150 (0.0052 - 0.0059)												00	02	02	04	04	06	06	08	08	10	10	12	12	14	14	16	16	18	18
0.151 - 0.170 (0.0059 - 0.0067)										00	02	02	04	04	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20
0.171 - 0.190 (0.0067 - 0.0075)								00	02	04	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24
0.191 - 0.210 (0.0075 - 0.0083)							00	02	04	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26
0.211 - 0.230 (0.0083 - 0.0091)					00	02	04	06	08	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30
0.231 - 0.239 (0.0091 - 0.0094)				00	02	04	06	08	10	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32
0.301 - 0.320 (0.0119 - 0.0126)	06	08	10	12	14	16	18	20	22	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44
0.321 - 0.340 (0.0126 - 0.0134)	08	10	12	14	16	18	20	22	24	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46
0.341 - 0.360 (0.0134 - 0.0142)	12	14	16	18	20	22	24	26	28	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50
0.361 - 0.380 (0.0142 - 0.0150)	16	18	20	22	24	26	28	30	32	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54
0.381 - 0.400 (0.0150 - 0.0157)	18	20	22	24	26	28	30	32	34	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56
0.401 - 0.420 (0.0158 - 0.0165)	22	24	26	28	30	32	34	36	38	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60
0.421 - 0.440 (0.0166 - 0.0173)	24	26	28	30	32	34	36	38	40	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62
0.441 - 0.460 (0.0174 - 0.0181)	28	30	32	34	36	38	40	42	44	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66
0.461 - 0.480 (0.0181 - 0.0189)	30	32	34	36	38	40	42	44	46	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68
0.481 - 0.500 (0.0189 - 0.0197)	34	36	38	40	42	44	46	48	50	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72
0.501 - 0.520 (0.0197 - 0.0205)	36	38	40	42	44	46	48	50	52	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74
0.521 - 0.540 (0.0205 - 0.0213)	40	42	44	46	48	50	52	54	56	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78
0.541 - 0.560 (0.0213 - 0.0220)	42	44	46	48	50	52	54	56	58	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80
0.561 - 0.580 (0.0221 - 0.0228)	46	48	50	52	54	56	58	60	62	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80				
0.581 - 0.600 (0.0229 - 0.0236)	48	50	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80						
0.601 - 0.620 (0.0237 - 0.0244)	52	54	56	58	60	62	64	66	68	70	72	72	74	74	76	76	78	78	80	80										
0.621 - 0.640 (0.0244 - 0.0252)	54	56	58	60	62	64	66	68	70	72	74	74	76	76	78	78	80	80												
0.641 - 0.660 (0.0252 - 0.0260)	58	60	62	64	66	68	70	72	74	76	78	78	80	80																
0.661 - 0.680 (0.0260 - 0.0268)	60	62	64	66	68	70	72	74	76	78	80	80																		
0.681 - 0.700 (0.0268 - 0.0276)	64	66	68	70	72	74	76	78	80																					
0.701 - 0.720 (0.0276 - 0.0283)	66	68	70	72	74	76	78	80																						
0.721 - 0.740 (0.0284 - 0.0291)	70	72	74	76	78	80																								
0.741 - 0.760 (0.0292 - 0.0299)	72	74	76	78	80																									
0.761 - 0.780 (0.0300 - 0.0307)	76	78	80																											
0.781 - 0.800 (0.0307 - 0.0315)	80																													
0.801 - 0.820 (0.0315 - 0.0323)	80																													

Measure clearance mm(in.) \ Installed shim thickness mm(in.)	2.380 (0.0937)	2.390 (0.0941)	2.400 (0.0945)	2.410 (0.0949)	2.420 (0.0953)	2.430 (0.0957)	2.440 (0.0961)	2.450 (0.0965)	2.460 (0.0969)	2.470 (0.0972)	2.480 (0.0976)	2.490 (0.0980)	2.500 (0.0984)	2.510 (0.0988)	2.520 (0.0992)	2.530 (0.0996)	2.540 (0.1000)	2.550 (0.1004)	2.560 (0.1008)	2.580 (0.1016)	2.600 (0.1024)	2.620 (0.1031)	2.640 (0.1039)	2.660 (0.1047)	2.680 (0.1055)	2.700 (0.1063)	2.720 (0.1071)	2.740 (0.1079)	2.760 (0.1087)	2.780 (0.1094)	2.800 (0.1102)
0.000 - 0.030 (0.0000 - 0.0012)	00	00	02	02	04	04	06	06	08	08	10	10	12	12	14	14	16	16	18	20	22	24	26	28	30	32	34	36	38	40	42
0.031 - 0.050 (0.0012 - 0.0020)	06	06	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	26	28	30	32	34	36	38	40	42	44	46	48
0.051 - 0.070 (0.0020 - 0.0028)	08	08	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	28	30	32	34	36	38	40	42	44	46	48	50
0.071 - 0.090 (0.0028 - 0.0035)	10	10	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	30	32	34	36	38	40	42	44	46	48	50	52
0.091 - 0.110 (0.0036 - 0.0043)	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	34	36	38	40	42	44	46	48	50	52	54	56
0.111 - 0.130 (0.0044 - 0.0051)	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	36	38	40	42	44	46	48	50	52	54	56	58
0.131 - 0.150 (0.0052 - 0.0059)	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	40	42	44	46	48	50	52	54	56	58	60	62
0.151 - 0.170 (0.0059 - 0.0067)	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	42	44	46	48	50	52	54	56	58	60	62	64
0.171 - 0.190 (0.0067 - 0.0075)	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	46	48	50	52	54	56	58	60	62	64	66	68
0.191 - 0.210 (0.0075 - 0.0083)	28	28	30	30	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	48	50	52	54	56	58	60	62	64	66	68	70
0.211 - 0.230 (0.0083 - 0.0091)	32	32	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	52	54	56	58	60	62	64	66	68	70	72	74
0.231 - 0.239 (0.0091 - 0.0094)	34	34	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	54	56	58	60	62	64	66	68	70	72	74	76
0.301 - 0.320 (0.0119 - 0.0126)	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	66	68	70	72	74	76	78	80	80			
0.321 - 0.340 (0.0126 - 0.0134)	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	68	70	72	74	76	78	80					
0.341 - 0.360 (0.0134 - 0.0142)	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	72	74	76	78	80							
0.361 - 0.380 (0.0142 - 0.0150)	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	76	78	80									
0.381 - 0.400 (0.0150 - 0.0157)	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	78	80										
0.401 - 0.420 (0.0158 - 0.0165)	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80												
0.421 - 0.440 (0.0166 - 0.0173)	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80													
0.441 - 0.460 (0.0174 - 0.0181)	68	68	70	70	72	72	74	74	76	76	78	78	80	80																	
0.461 - 0.480 (0.0181 - 0.0189)	70	70	72	72	74	74	76	76	78	78	80	80																			
0.481 - 0.500 (0.0189 - 0.0197)	74	74	76	76	78	78	80	80																							
0.501 - 0.520 (0.0197 - 0.0205)	76	76	78	78	80	80																									
0.521 - 0.540 (0.0205 - 0.0213)	80	80																													

New Shim thickness mm (in.)

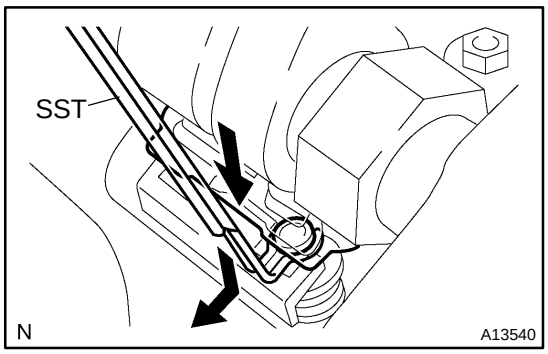
Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 (0.0787)	28	2.280 (0.0898)	56	2.560 (0.1008)
02	2.020 (0.0795)	30	2.300 (0.0906)	58	2.580 (0.1016)
04	2.040 (0.0803)	32	2.320 (0.0913)	60	2.600 (0.1024)
06	2.060 (0.0811)	34	2.340 (0.0921)	62	2.620 (0.1031)
08	2.080 (0.0819)	36	2.360 (0.0929)	64	2.640 (0.1039)
10	2.100 (0.0827)	38	2.380 (0.0937)	66	2.660 (0.1047)
12	2.120 (0.0835)	40	2.400 (0.0945)	68	2.680 (0.1055)
14	2.140 (0.0843)	42	2.420 (0.0953)	70	2.700 (0.1063)
16	2.160 (0.0850)	44	2.440 (0.0961)	72	2.720 (0.1071)
18	2.180 (0.0858)	46	2.460 (0.0969)	74	2.740 (0.1079)
20	2.200 (0.0866)	48	2.480 (0.0976)	76	2.760 (0.1087)
22	2.220 (0.0874)	50	2.500 (0.0984)	78	2.780 (0.1094)
24	2.240 (0.0882)	52	2.520 (0.0992)	80	2.800 (0.1102)
26	2.260 (0.0890)	54	2.540 (0.1000)		

Exhaust valve clearance (Cold):
0.22 – 0.32 mm (0.0087 – 0.0126 in.)

EXAMPLE: The 2.200 mm (0.0862 in.) shim is installed, and the measured clearance is 0.500 mm (0.0197 in.). Replace the 2.540 mm (0.1000 in.) shim with a new No. 54 shim.

A10467

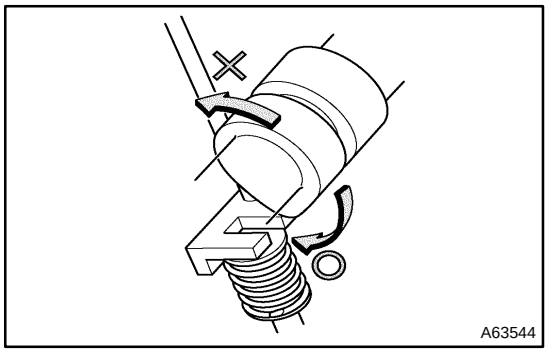
P



(c) Lift the rocker arm to make a room and use SST, install the adjusting shim.

HINT:

- Setting SST from the right above makes the removal easy.
- To remove SST from the adjusting shim, it is advisable to push down the rocker arm.



(d) Turn the crankshaft so that the related rocker arm, where the valve clearance is adjusted, is fully pushed down.

NOTICE:

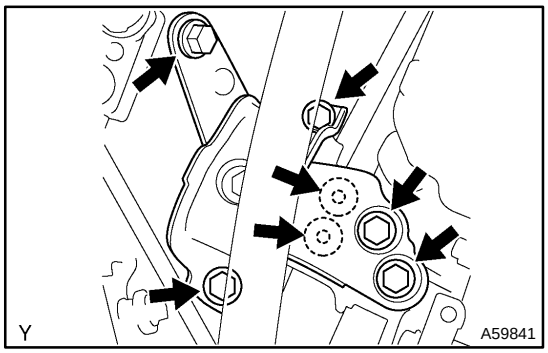
- **Pay attention to the direction of the rotation to prevent the nose of the camshaft from interfering with the SST's shaft.**
- **Do not rotate the crankshaft excessively.**

(e) After loosening the 2 set screws of SST, remove SST itself.

SST 09248–77010(09248–07010)

13. INSTALL V–RIBBED BELT TENSIONER ASSY

Torque:
Nut 29 N·m (296 kgf·cm, 21 ft·lbf)
Bolt 100 N·m (1,020 kgf·cm, 74 ft·lbf)



14. INSTALL ENGINE MOUNTING INSULATOR SUB–ASSY RH

(a) Install the engine mounting insulator sub–assy RH with the 5 bolts and the 2 nuts.

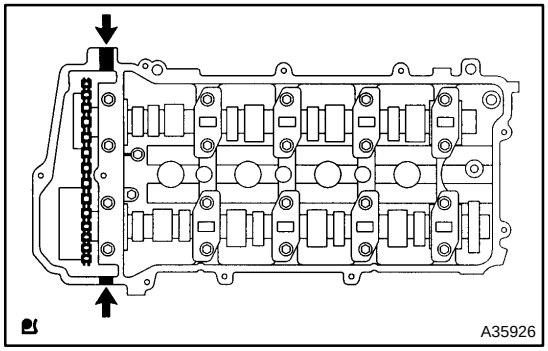
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

15. INSTALL CYLINDER HEAD COVER SUB–ASSY

(a) Remove any old packing (FIPG) material.

HINT:

When FIPG on the head cover gasket side cannot be eliminated completely, replace the gasket.



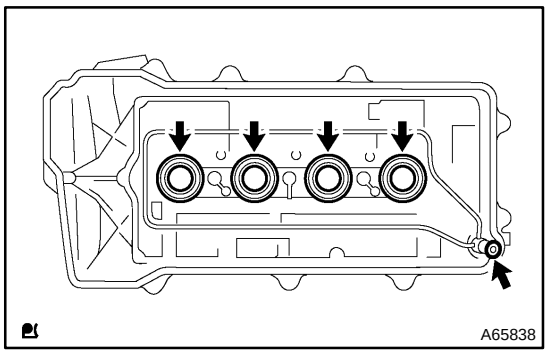
(b) Apply seal packing to 2 locations as shown in the illustration.

Seal packing: Part No. 08826–00080 or equivalent

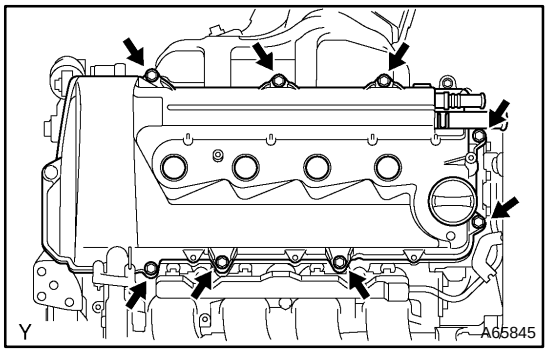
(c) Install the cylinder head cover gasket to the cylinder head cover.

HINT:

Part must be assembled within 3 minutes of application. Otherwise the material must be remove and reapplied.

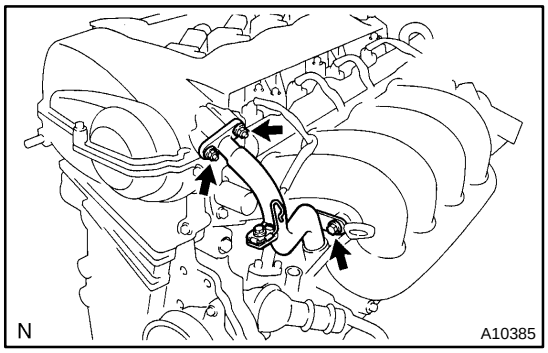


(d) Install the new spark plug tube gasket and a new O–ring to the cylinder head cover.



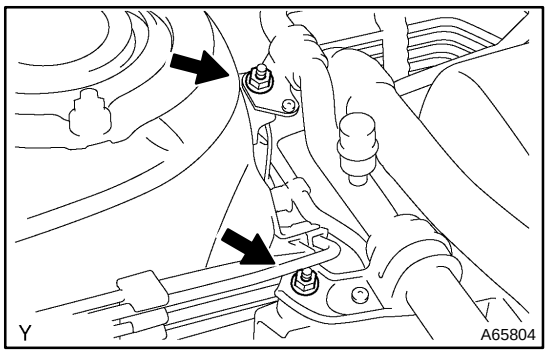
(e) Install the cylinder head cover and wire harness protector with the 8 bolts. Uniformly tighten the bolts, in the several passes, in the sequence shown.
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

(f) Connect the PCV hoses to the cylinder head cover.

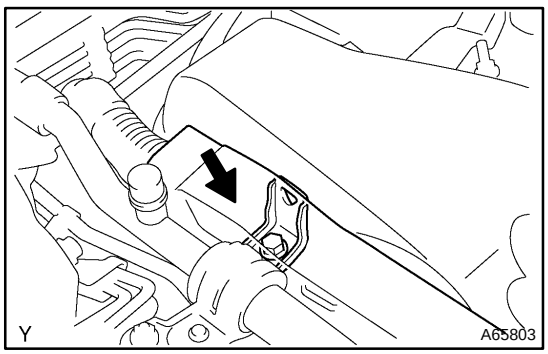


(g) Install a new gasket and No. 1 ventilation pipe with 2 nuts and bolt.
Torque:
Nut 10 N·m (102 kgf·cm, 7 ft·lbf)
Bolt 24 N·m (245 kgf·cm, 18 ft·lbf)

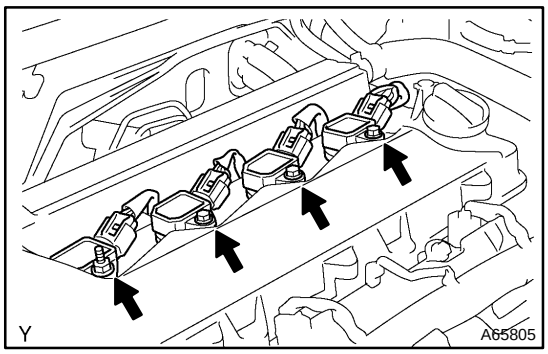
(h) Connect the No. 3 ventilation hose to the No. 1 ventilation pipe.



16. INSTALL SUCTION HOSE SUB–ASSY
Torque: 9.8 N·m (100 kgf·cm, 87 in.·lbf)



17. INSTALL WIRE HARNESS CLAMP
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)



18. INSTALL IGNITION COIL ASSY
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

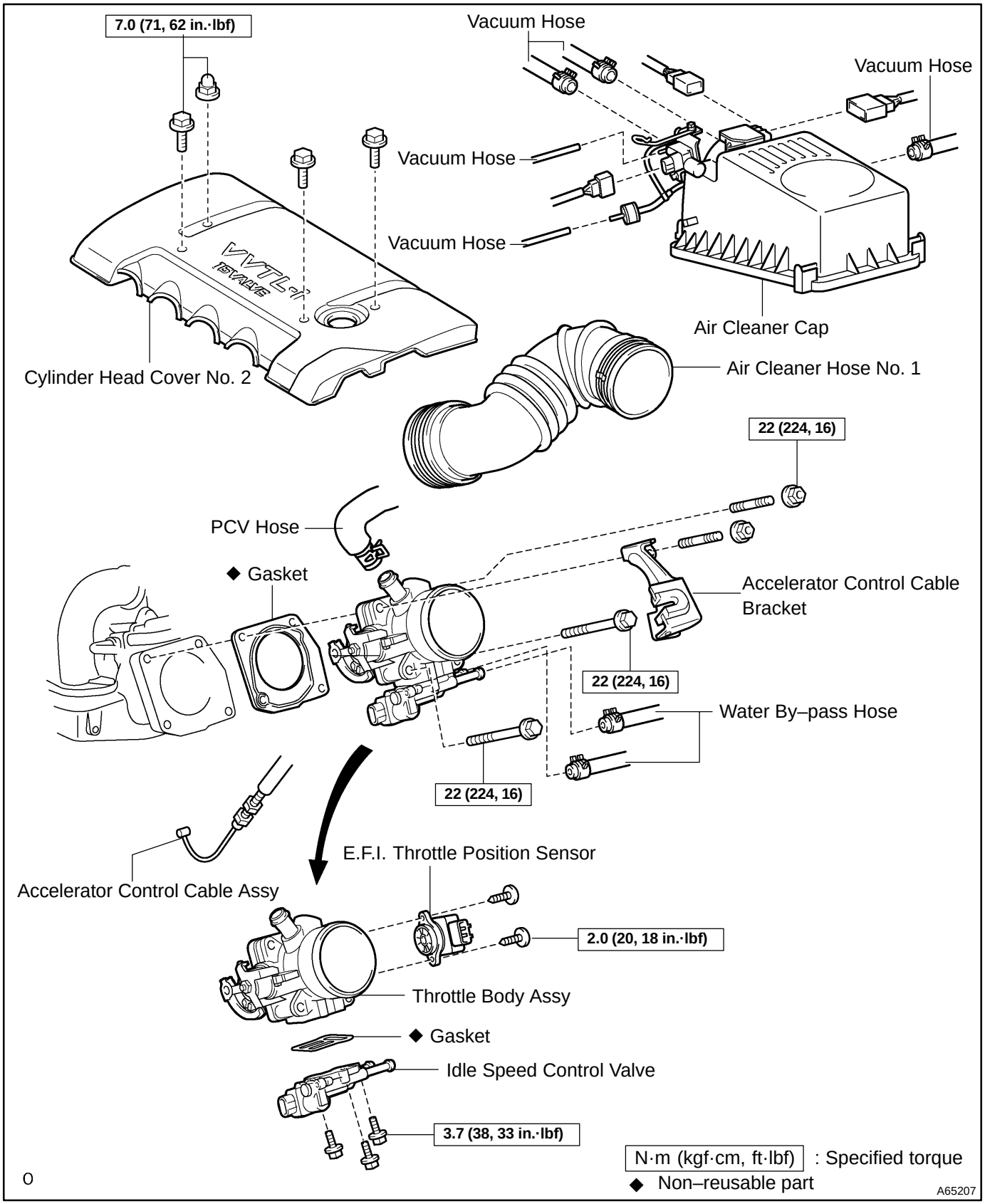
19. INSTALL CYLINDER HEAD COVER NO.2
Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)

20. INSPECT OIL LEAK

THROTTLE BODY ASSY (2ZZ–GE)

COMPONENTS

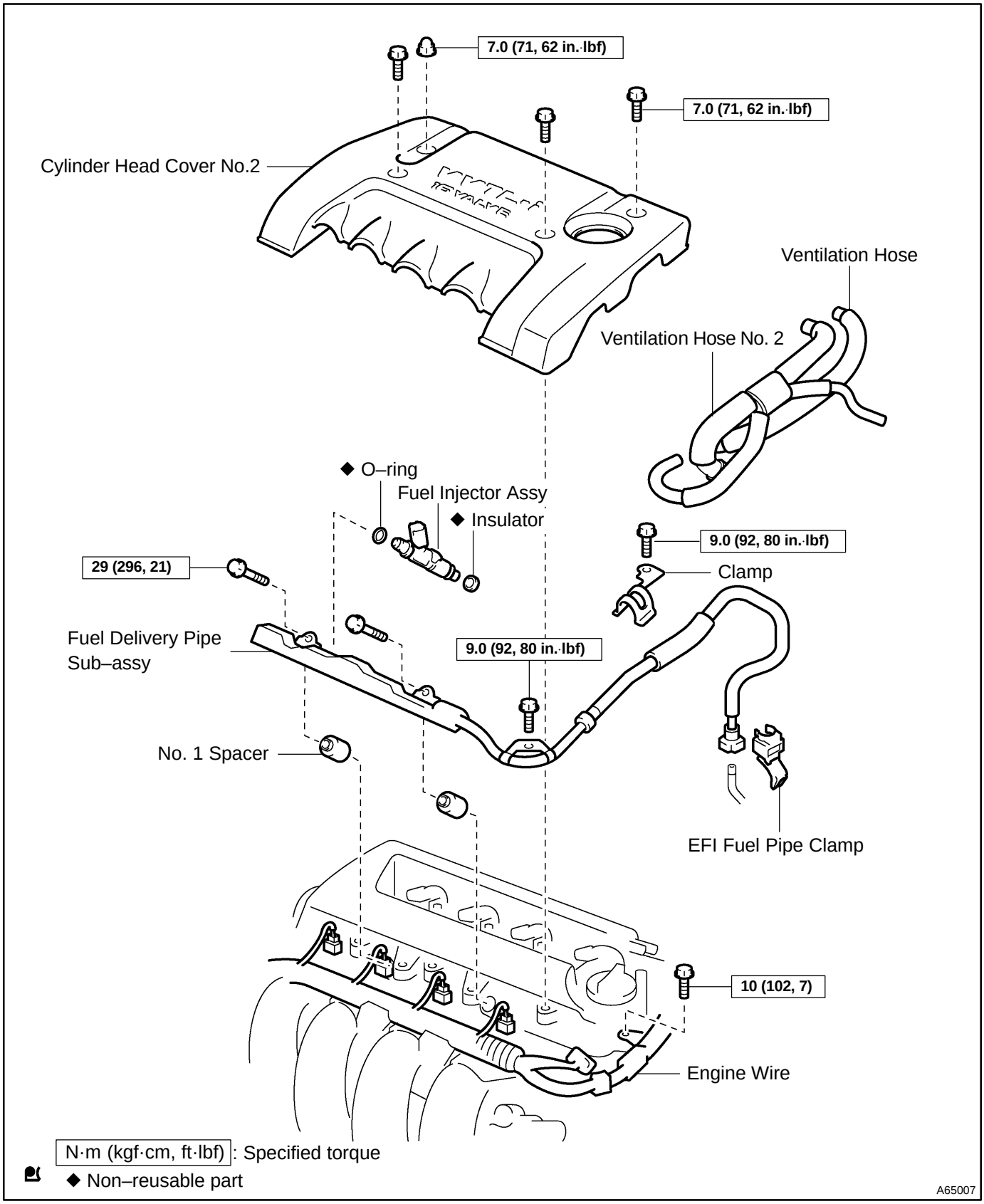
1008O–01



FUEL INJECTOR ASSY (2ZZ–GE)

110F0–01

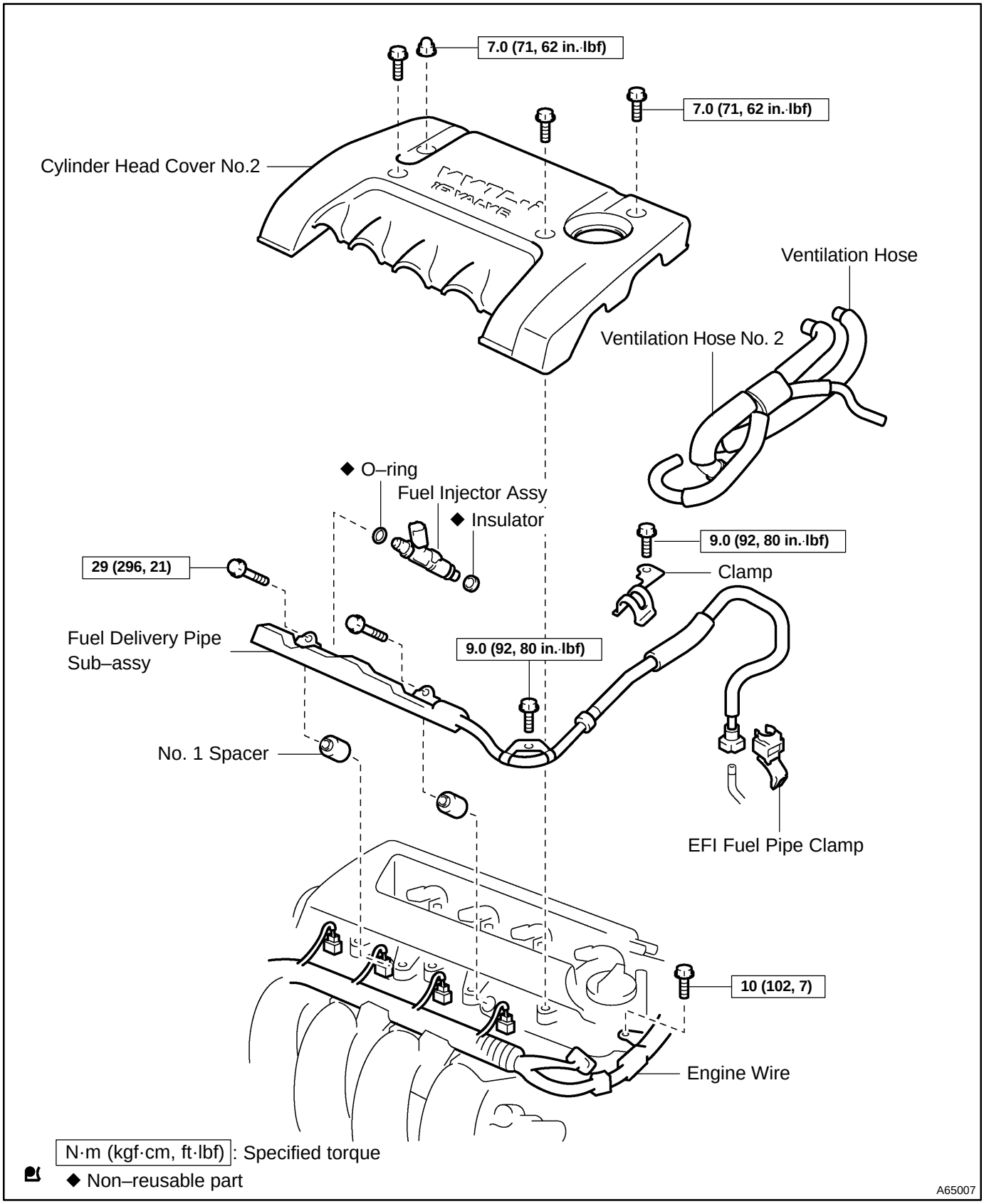
COMPONENTS



FUEL INJECTOR ASSY (2ZZ–GE)

110F0–01

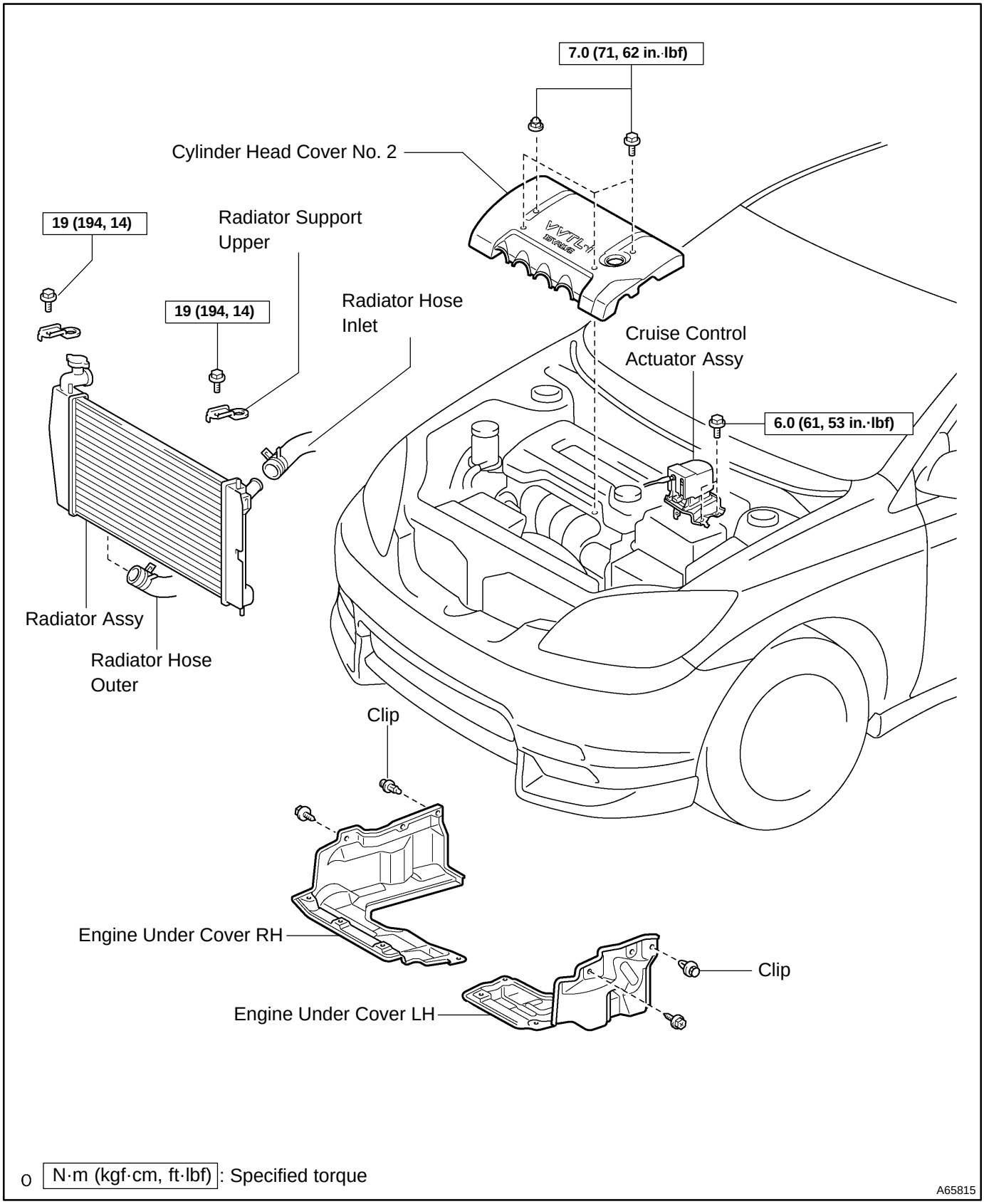
COMPONENTS



PARTIAL ENGINE ASSY (2ZZ–GE)

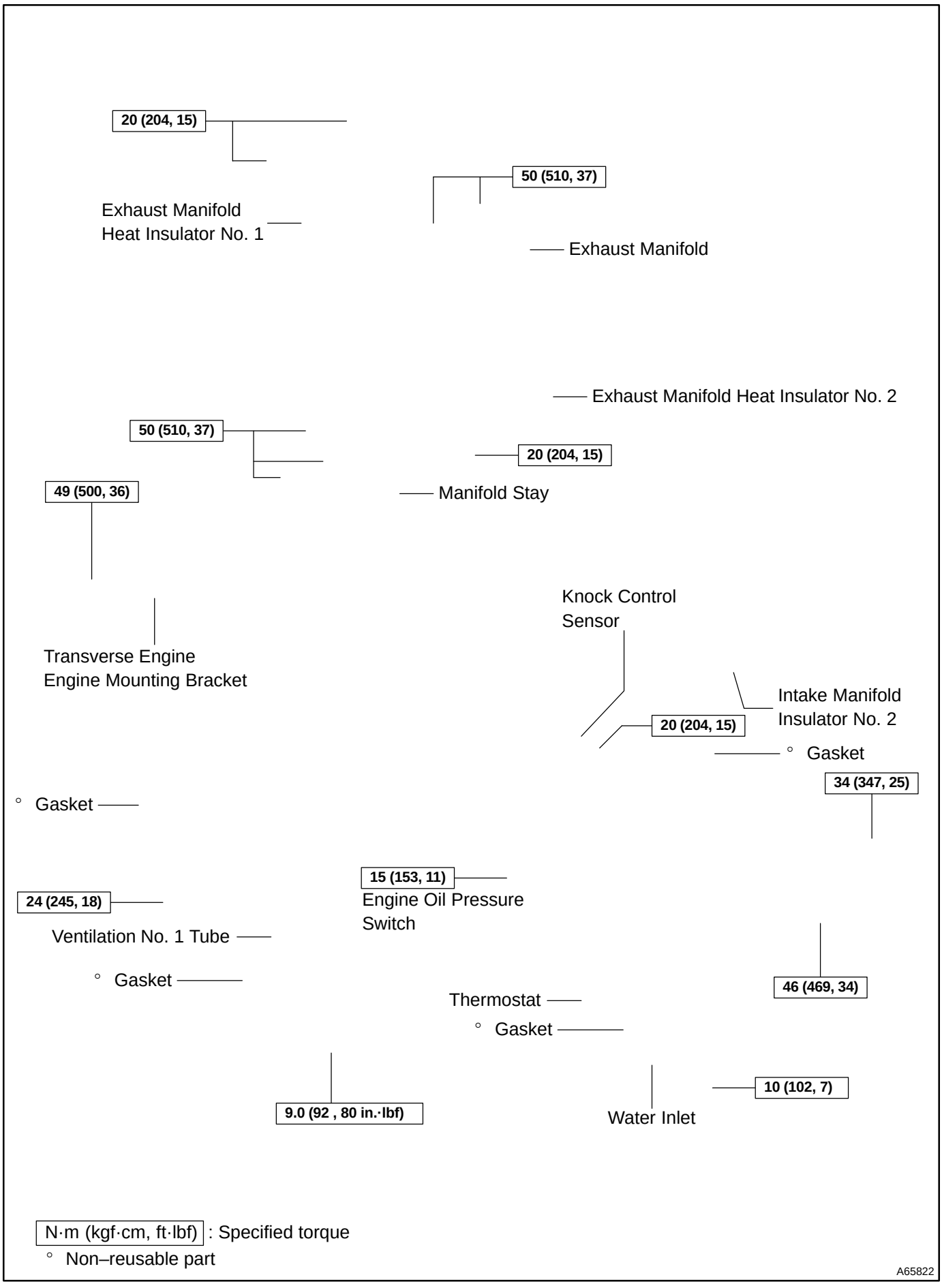
COMPONENTS

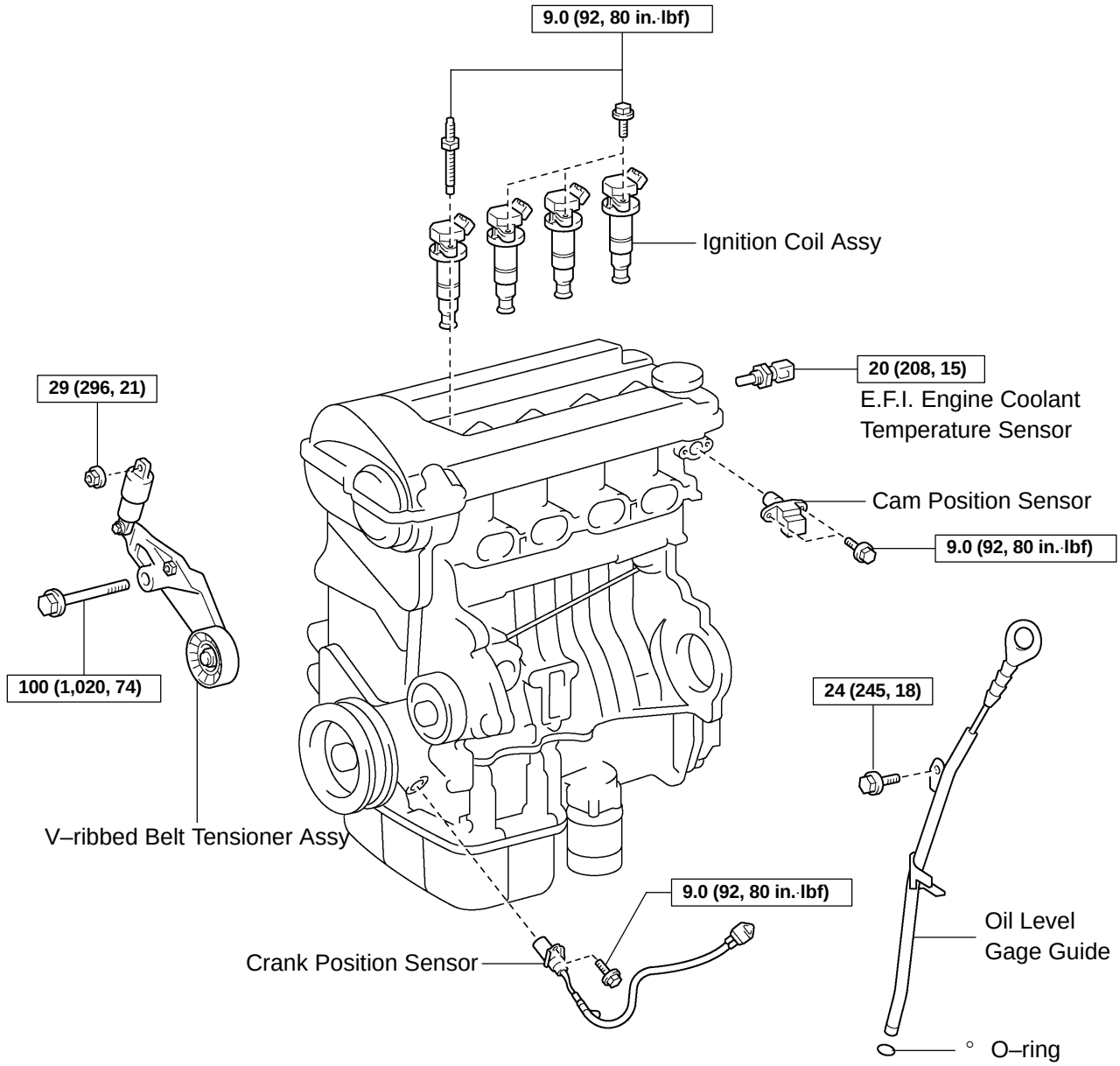
140R7–01



o 7.0 (71, 62 in.·lbf) : Specified torque

A65815

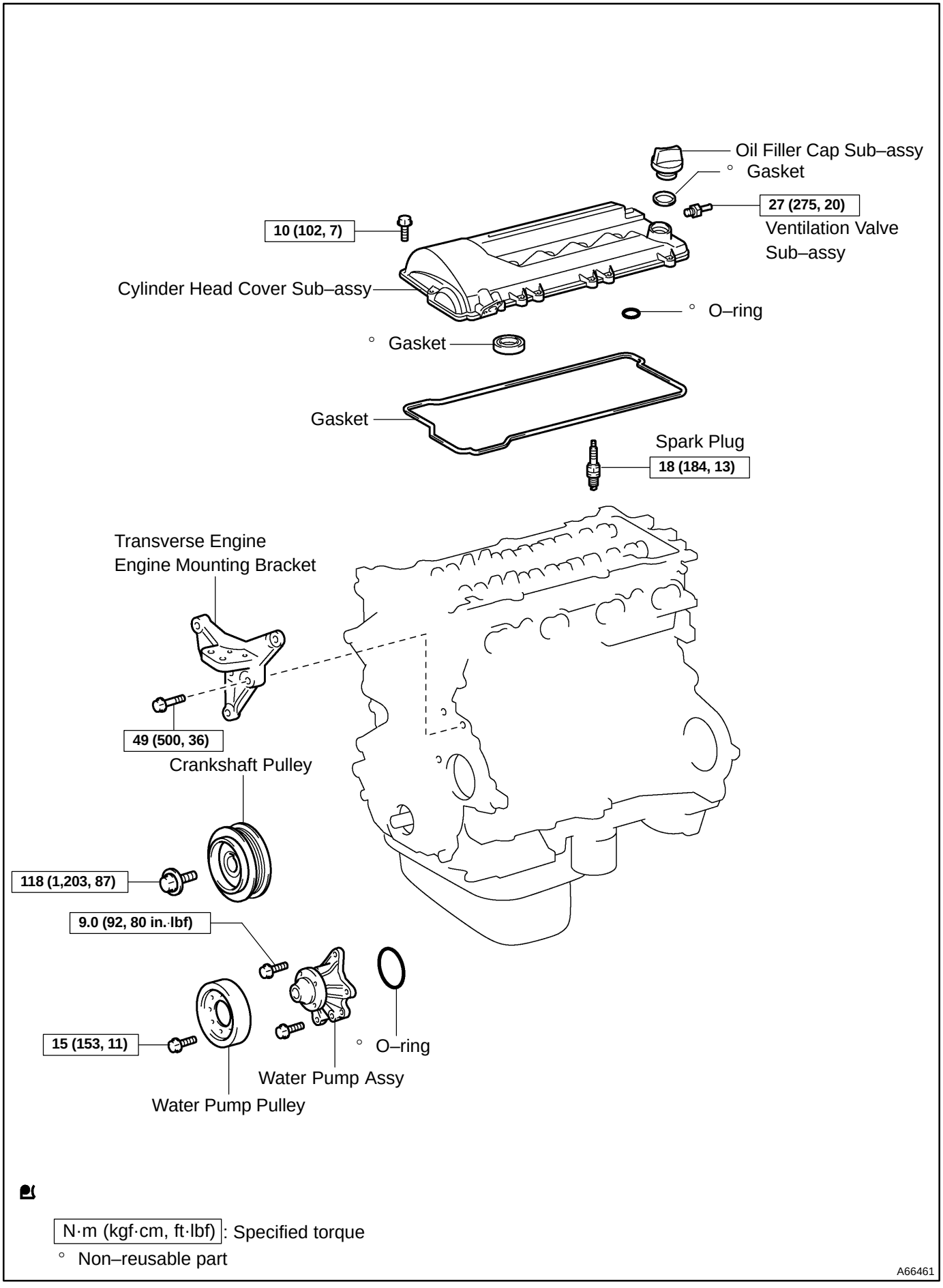

20 (204, 15)
50 (510, 37)
Exhaust Manifold
Heat Insulator No. 1
Exhaust Manifold
Exhaust Manifold Heat Insulator No. 2
50 (510, 37)
20 (204, 15)
49 (500, 36)
Manifold Stay
Knock Control
Sensor
Transverse Engine
Engine Mounting Bracket
Intake Manifold
Insulator No. 2
20 (204, 15)
° Gasket
34 (347, 25)
° Gasket
15 (153, 11)
24 (245, 18)
Engine Oil Pressure
Switch
Ventilation No. 1 Tube
° Gasket
46 (469, 34)
Thermostat
° Gasket
10 (102, 7)
9.0 (92 , 80 in.·lbf)
Water Inlet
N·m (kgf·cm, ft·lbf) : Specified torque
° Non–reusable part
A65822

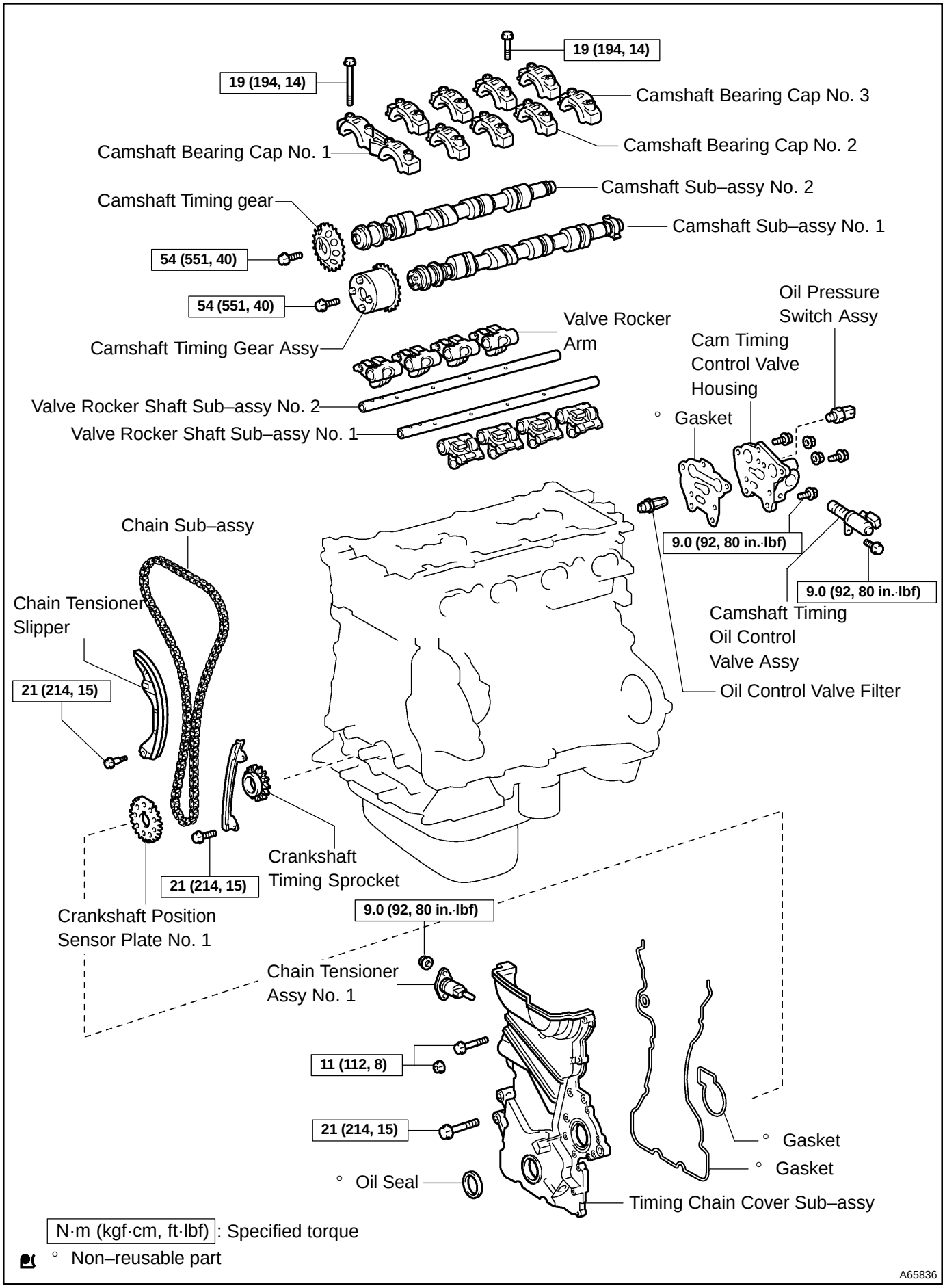


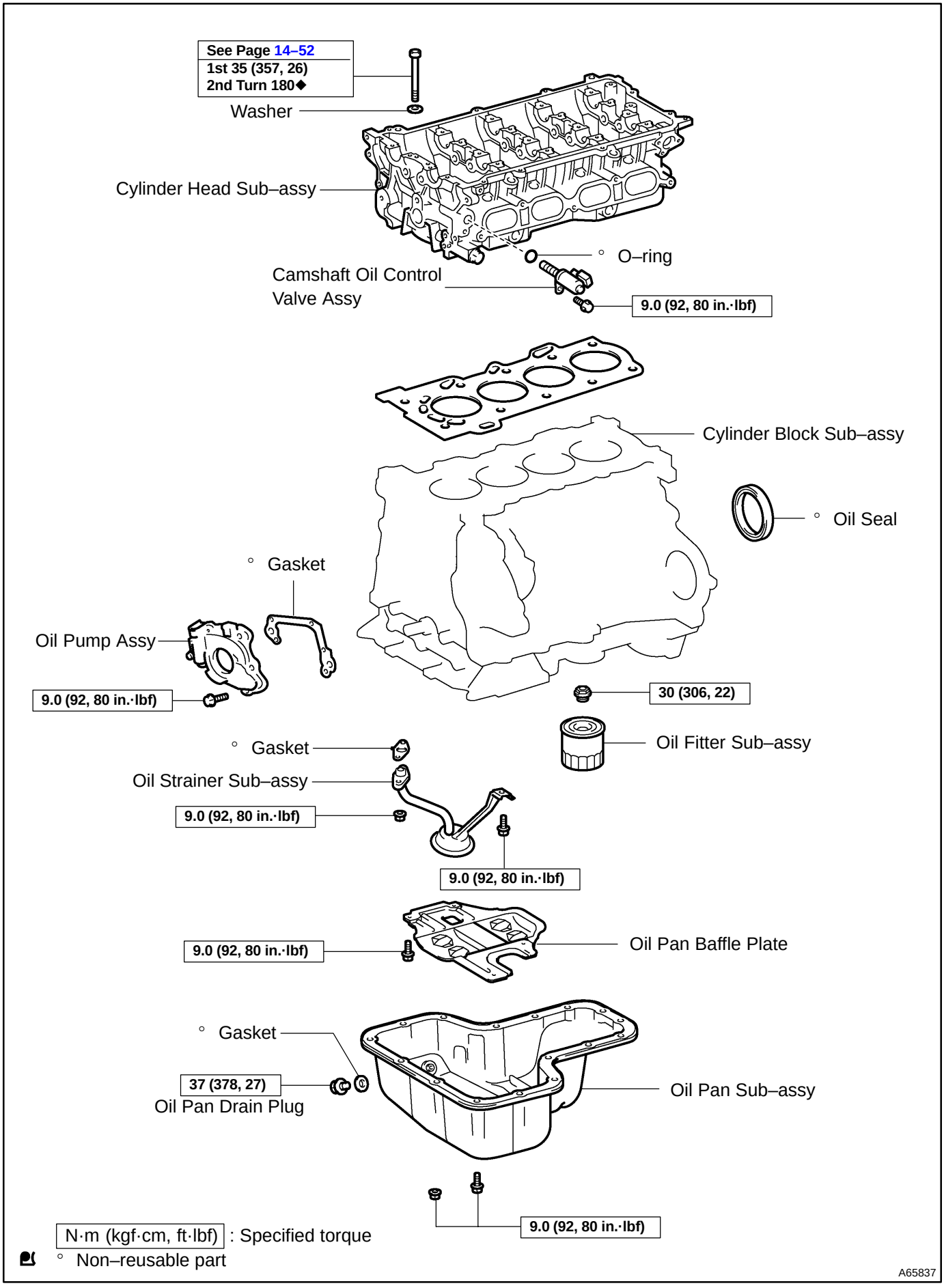
N·m (kgf·cm, ft·lbf) : Specified torque

° Non–reusable part

A65823


Oil Filler Cap Sub–assy
° Gasket
27 (275, 20)
Ventilation Valve Sub–assy
10 (102, 7)
Cylinder Head Cover Sub–assy
° O–ring
° Gasket
Gasket
Spark Plug
18 (184, 13)
Transverse Engine Engine Mounting Bracket
49 (500, 36)
Crankshaft Pulley
118 (1,203, 87)
9.0 (92, 80 in.·lbf)
15 (153, 11)
° O–ring
Water Pump Assy
Water Pump Pulley
N·m (kgf·cm, ft·lbf): Specified torque
° Non–reusable part
A66461

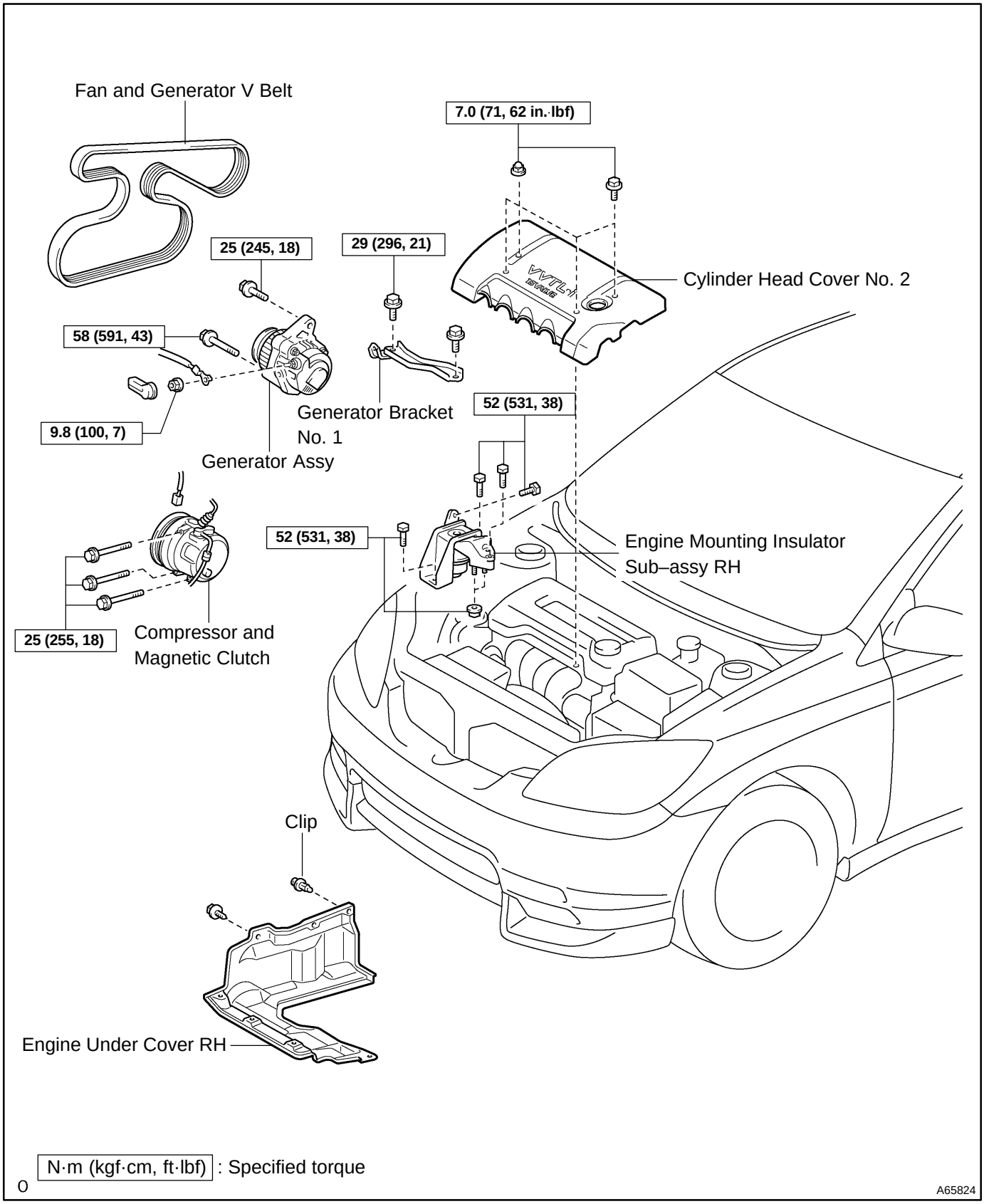

19 (194, 14)
19 (194, 14)
Camshaft Bearing Cap No. 3
Camshaft Bearing Cap No. 2
Camshaft Bearing Cap No. 1
Camshaft Sub–assy No. 2
Camshaft Timing gear
Camshaft Sub–assy No. 1
54 (551, 40)
54 (551, 40)
Oil Pressure Switch Assy
Valve Rocker Arm
Camshaft Timing Gear Assy
Cam Timing Control Valve Housing
Valve Rocker Shaft Sub–assy No. 2
Gasket
Valve Rocker Shaft Sub–assy No. 1
Chain Sub–assy
9.0 (92, 80 in.·lbf)
9.0 (92, 80 in.·lbf)
Chain Tensioner Slipper
Camshaft Timing Oil Control Valve Assy
21 (214, 15)
Oil Control Valve Filter
21 (214, 15)
Crankshaft Timing Sprocket
Crankshaft Position Sensor Plate No. 1
9.0 (92, 80 in.·lbf)
Chain Tensioner Assy No. 1
11 (112, 8)
21 (214, 15)
Gasket
Gasket
Oil Seal
Timing Chain Cover Sub–assy
N·m (kgf·cm, ft·lbf): Specified torque
Non–reusable part
A65836

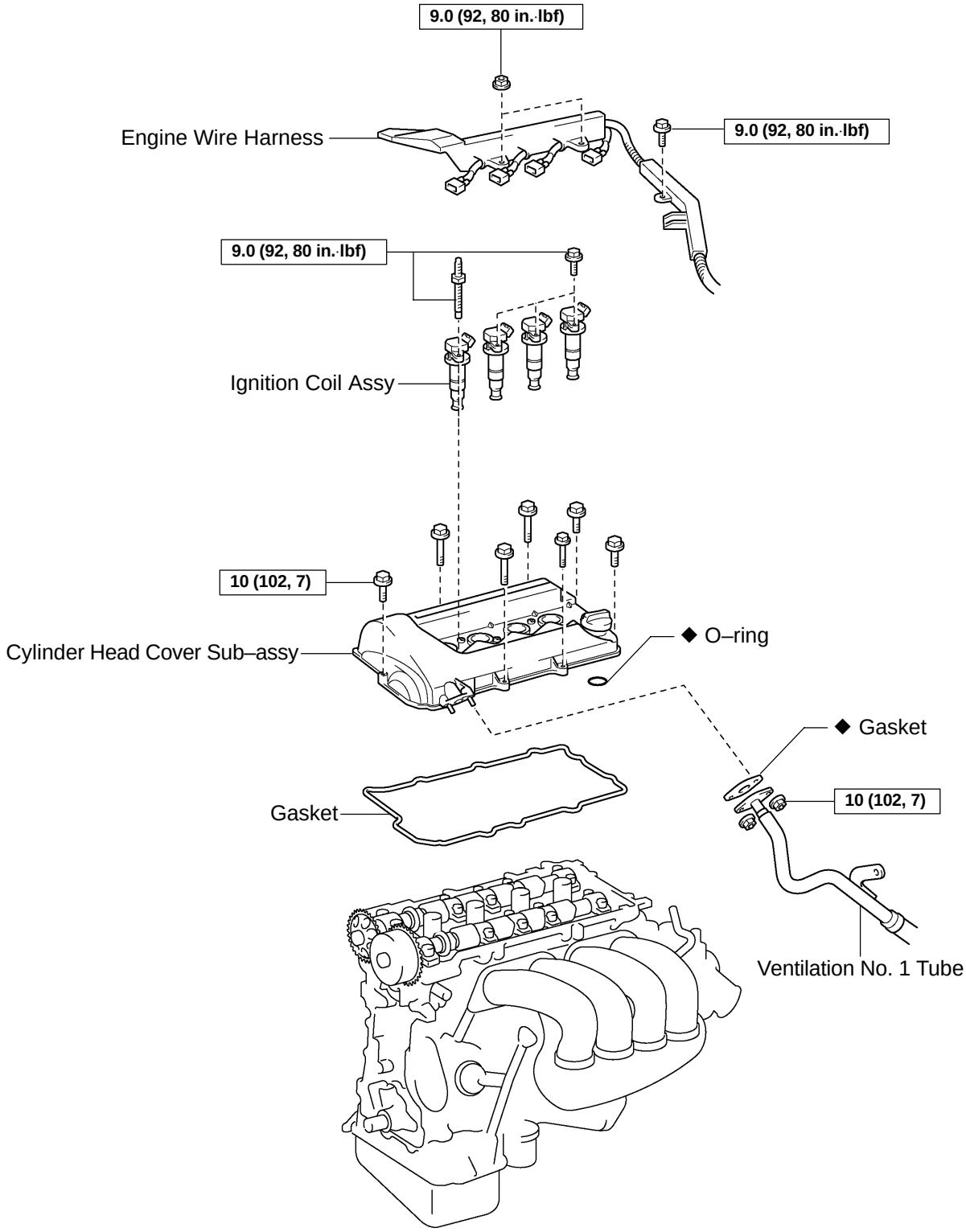

See Page 14–52
1st 35 (357, 26)
2nd Turn 180◆
Washer
Cylinder Head Sub–assy
◦ O–ring
Camshaft Oil Control Valve Assy
9.0 (92, 80 in.·lbf)
Cylinder Block Sub–assy
◦ Oil Seal
◦ Gasket
Oil Pump Assy
9.0 (92, 80 in.·lbf)
30 (306, 22)
Oil Fitter Sub–assy
◦ Gasket
Oil Strainer Sub–assy
9.0 (92, 80 in.·lbf)
9.0 (92, 80 in.·lbf)
9.0 (92, 80 in.·lbf)
Oil Pan Baffle Plate
◦ Gasket
37 (378, 27)
Oil Pan Drain Plug
Oil Pan Sub–assy
9.0 (92, 80 in.·lbf)
N·m (kgf·cm, ft·lbf) : Specified torque
◦ Non–reusable part
A65837

CHAIN SUB–ASSY (2ZZ–GE)

140RA–01

COMPONENTS



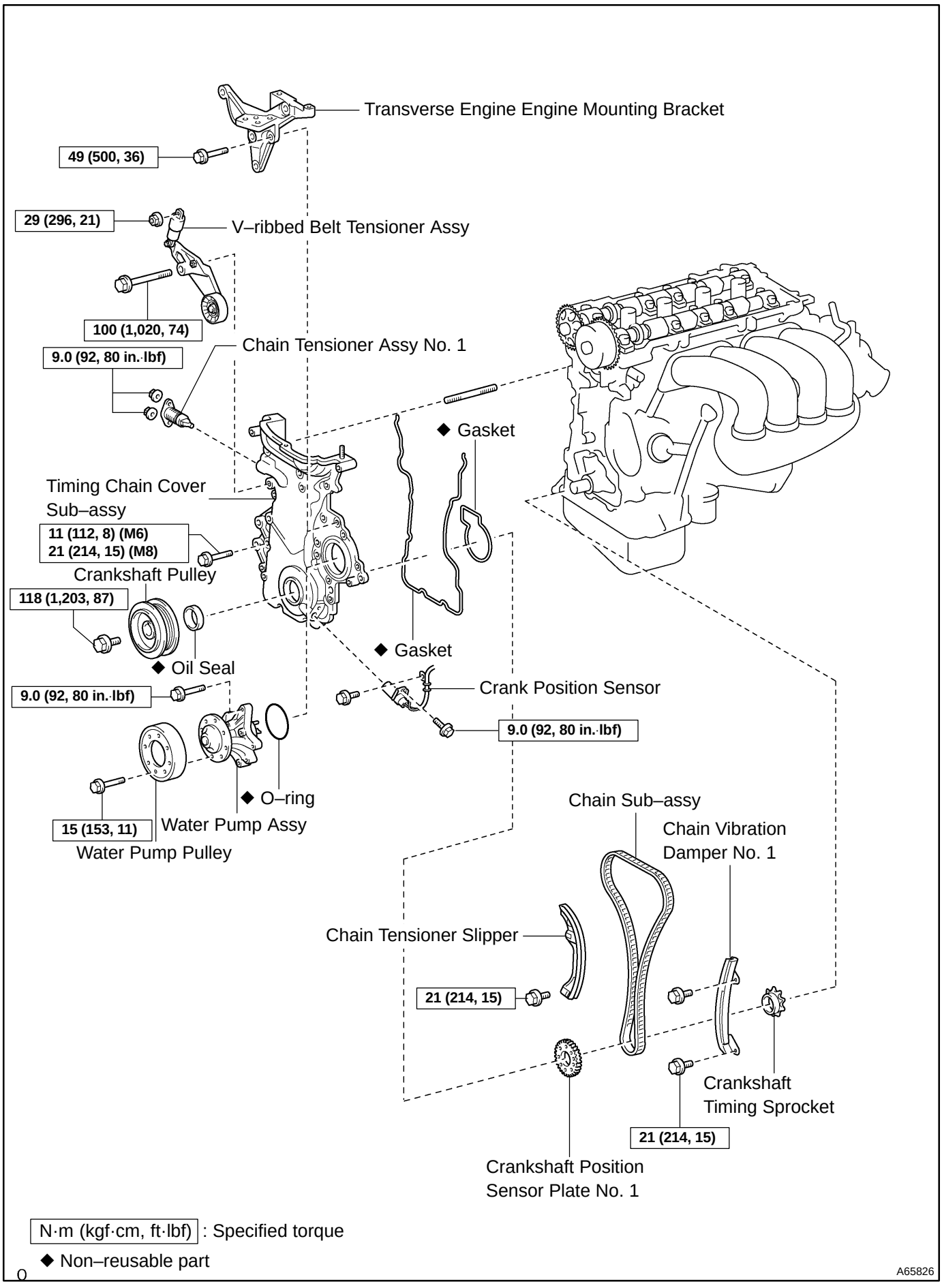


N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non–reusable part

0

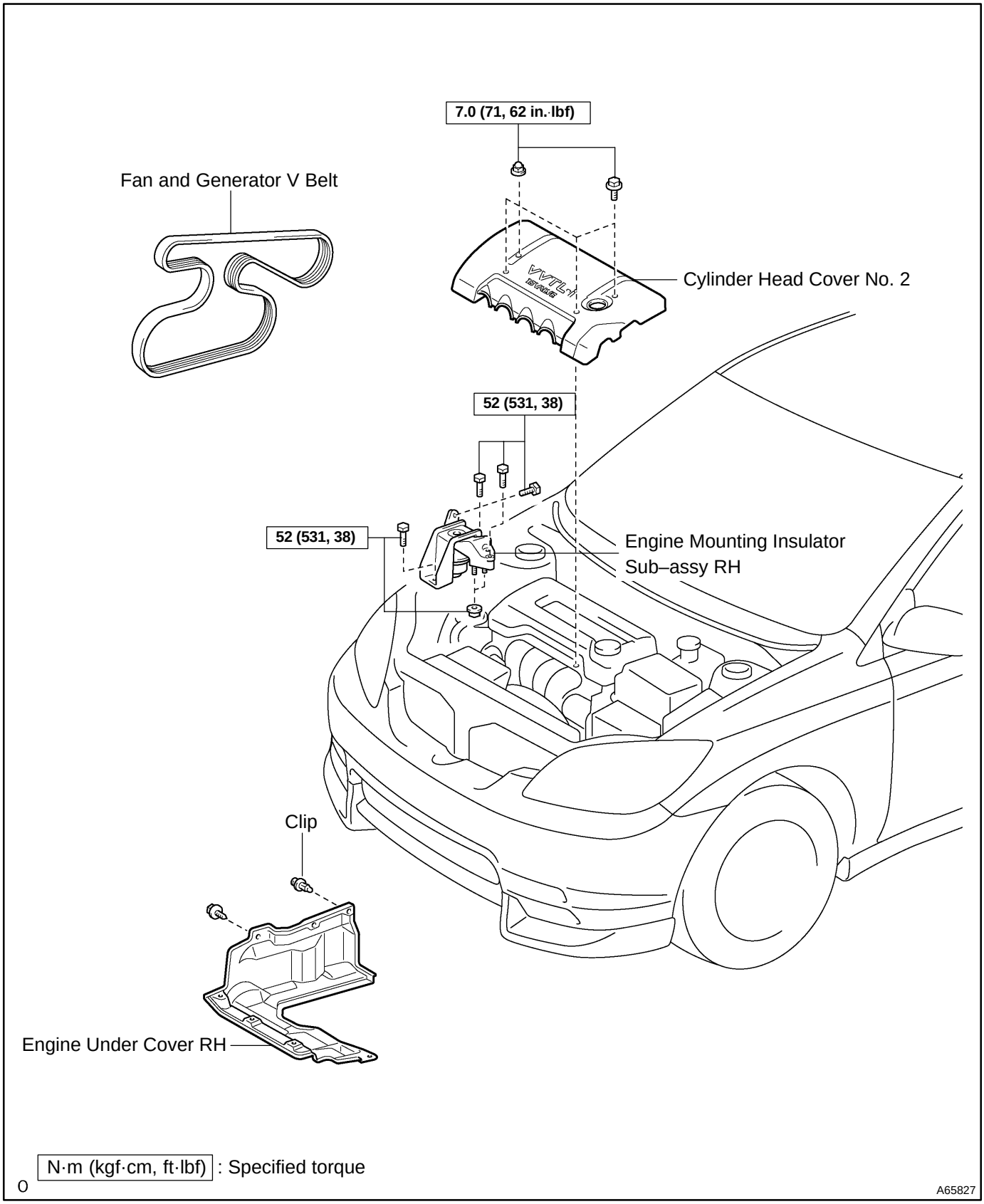
A65825

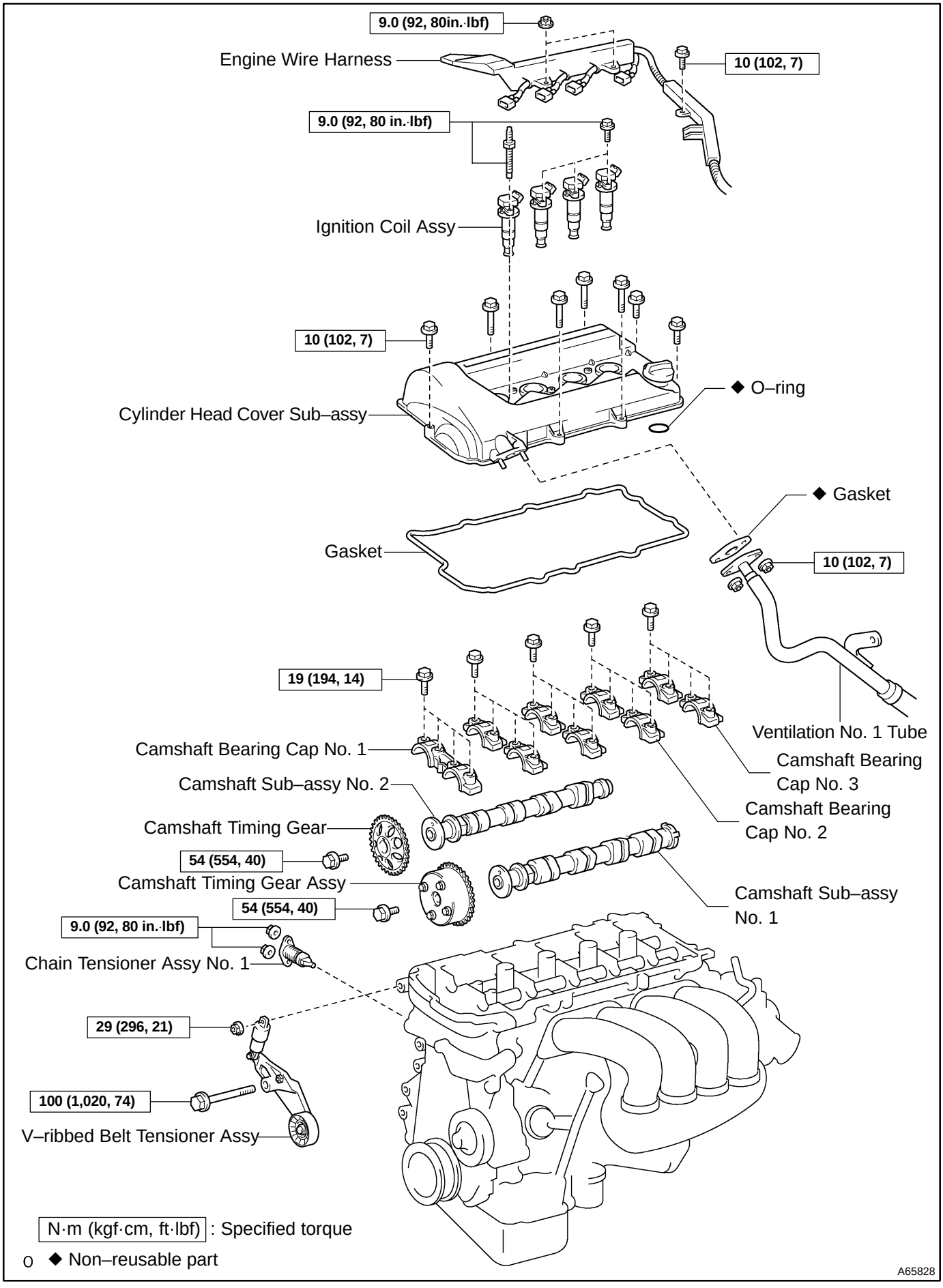

Transverse Engine Engine Mounting Bracket
49 (500, 36)
29 (296, 21)
V–ribbed Belt Tensioner Assy
100 (1,020, 74)
9.0 (92, 80 in.·lbf)
Chain Tensioner Assy No. 1
◆ Gasket
Timing Chain Cover Sub–assy
11 (112, 8) (M6)
21 (214, 15) (M8)
Crankshaft Pulley
118 (1,203, 87)
◆ Oil Seal
◆ Gasket
9.0 (92, 80 in.·lbf)
Crank Position Sensor
9.0 (92, 80 in.·lbf)
◆ O–ring
15 (153, 11)
Water Pump Assy
Water Pump Pulley
Chain Sub–assy
Chain Vibration Damper No. 1
Chain Tensioner Slipper
21 (214, 15)
Crankshaft Timing Sprocket
21 (214, 15)
Crankshaft Position Sensor Plate No. 1
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
A65826

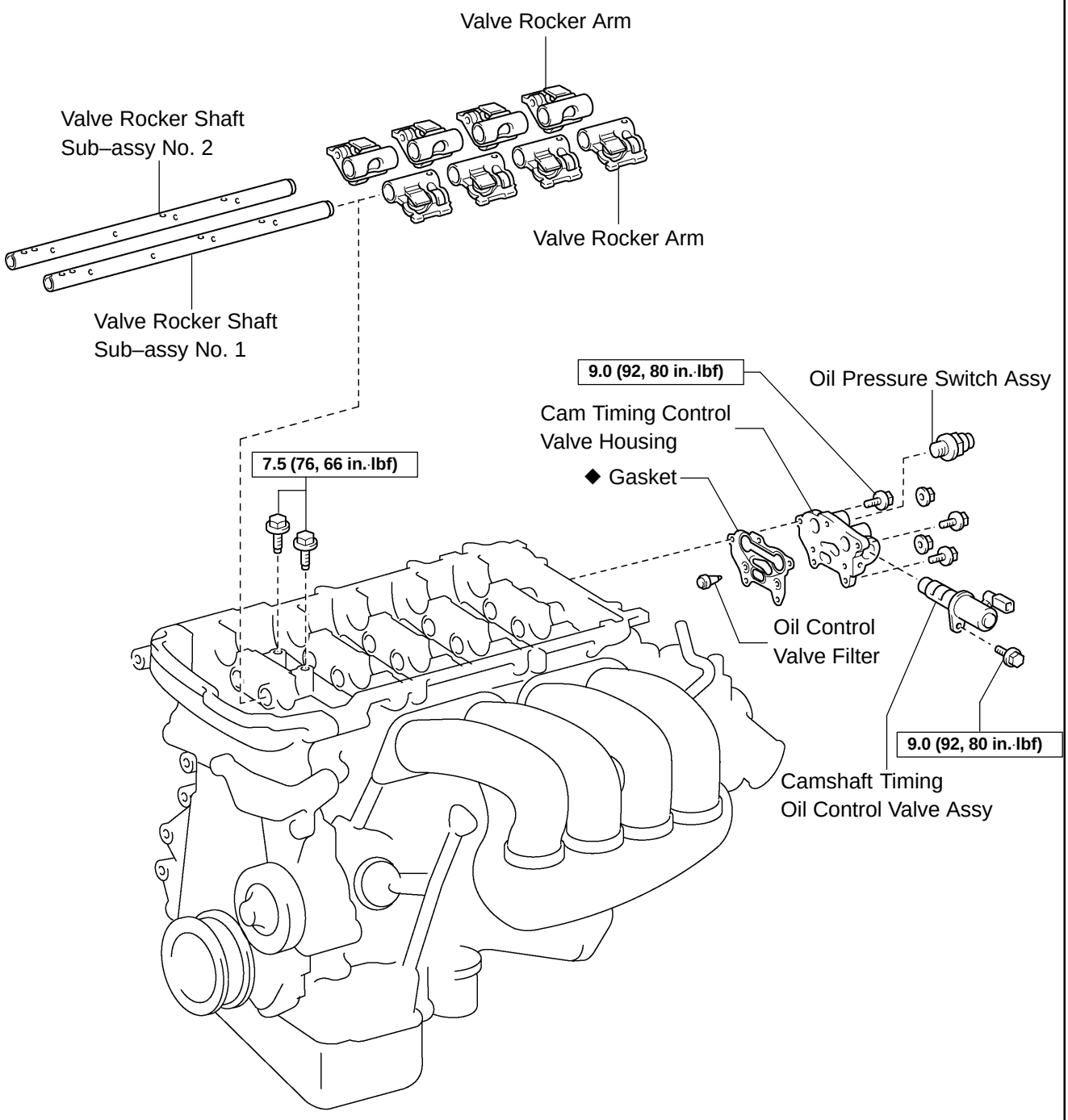
CAMSHAFT (2ZZ–GE)

COMPONENTS

140RC–01



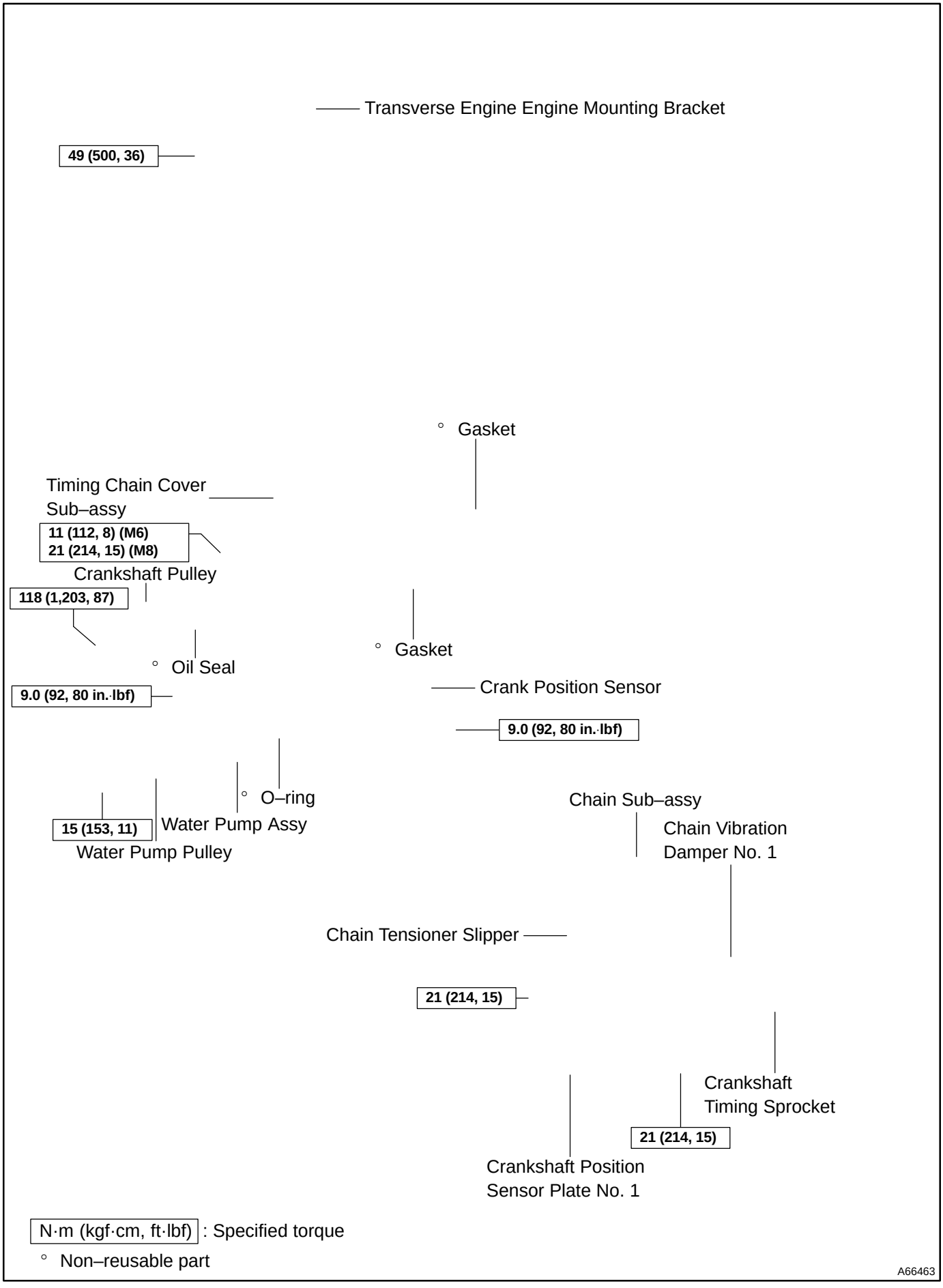

9.0 (92, 80in.·lbf)
Engine Wire Harness
10 (102, 7)
9.0 (92, 80 in.·lbf)
Ignition Coil Assy
10 (102, 7)
◆ O–ring
Cylinder Head Cover Sub–assy
◆ Gasket
Gasket
10 (102, 7)
19 (194, 14)
Ventilation No. 1 Tube
Camshaft Bearing Cap No. 1
Camshaft Bearing Cap No. 3
Camshaft Sub–assy No. 2
Camshaft Bearing Cap No. 2
Camshaft Timing Gear
54 (554, 40)
Camshaft Timing Gear Assy
Camshaft Sub–assy No. 1
54 (554, 40)
9.0 (92, 80 in.·lbf)
Chain Tensioner Assy No. 1
29 (296, 21)
100 (1,020, 74)
V–ribbed Belt Tensioner Assy
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
A65828

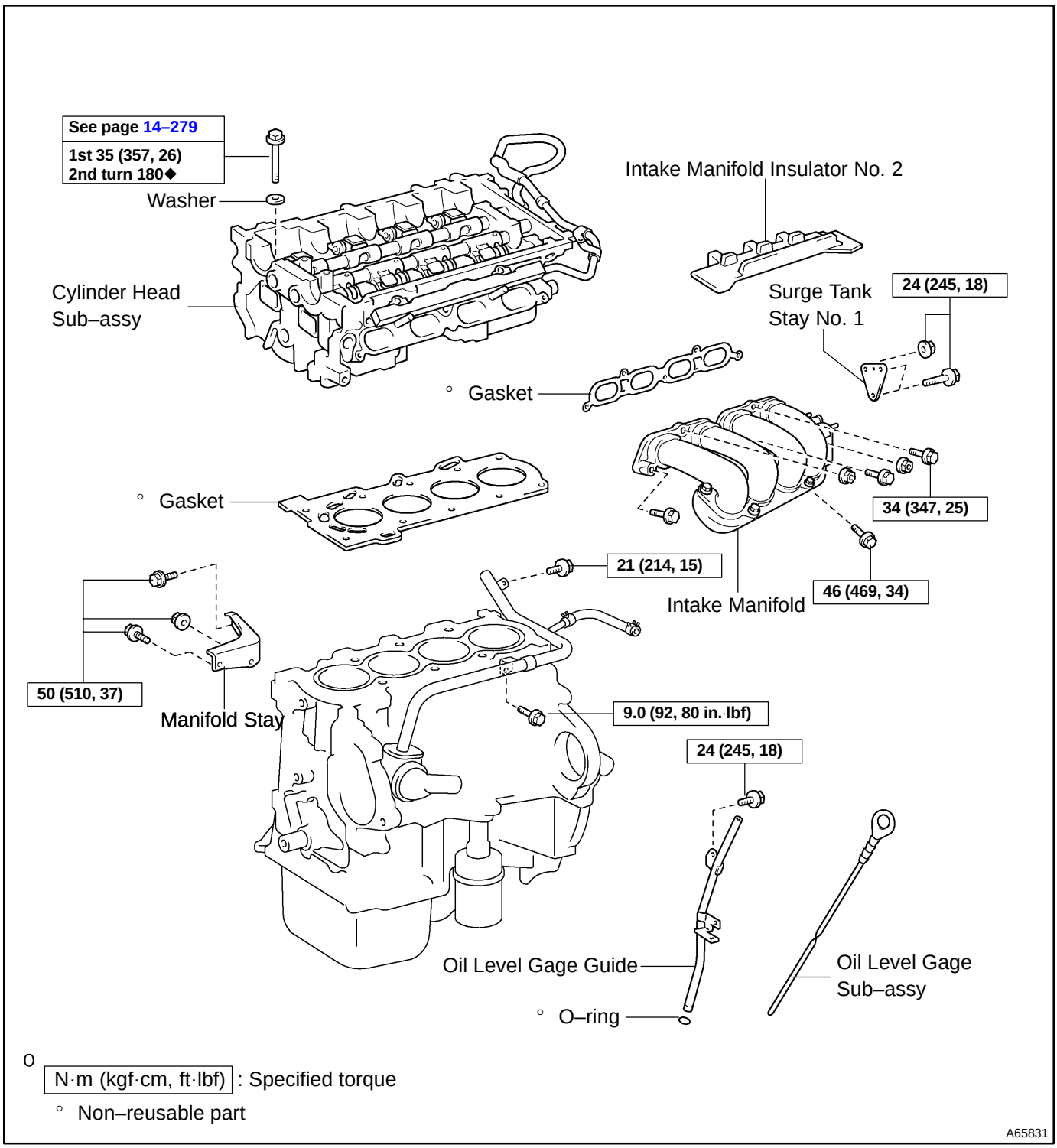


N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non–reusable part

A65829

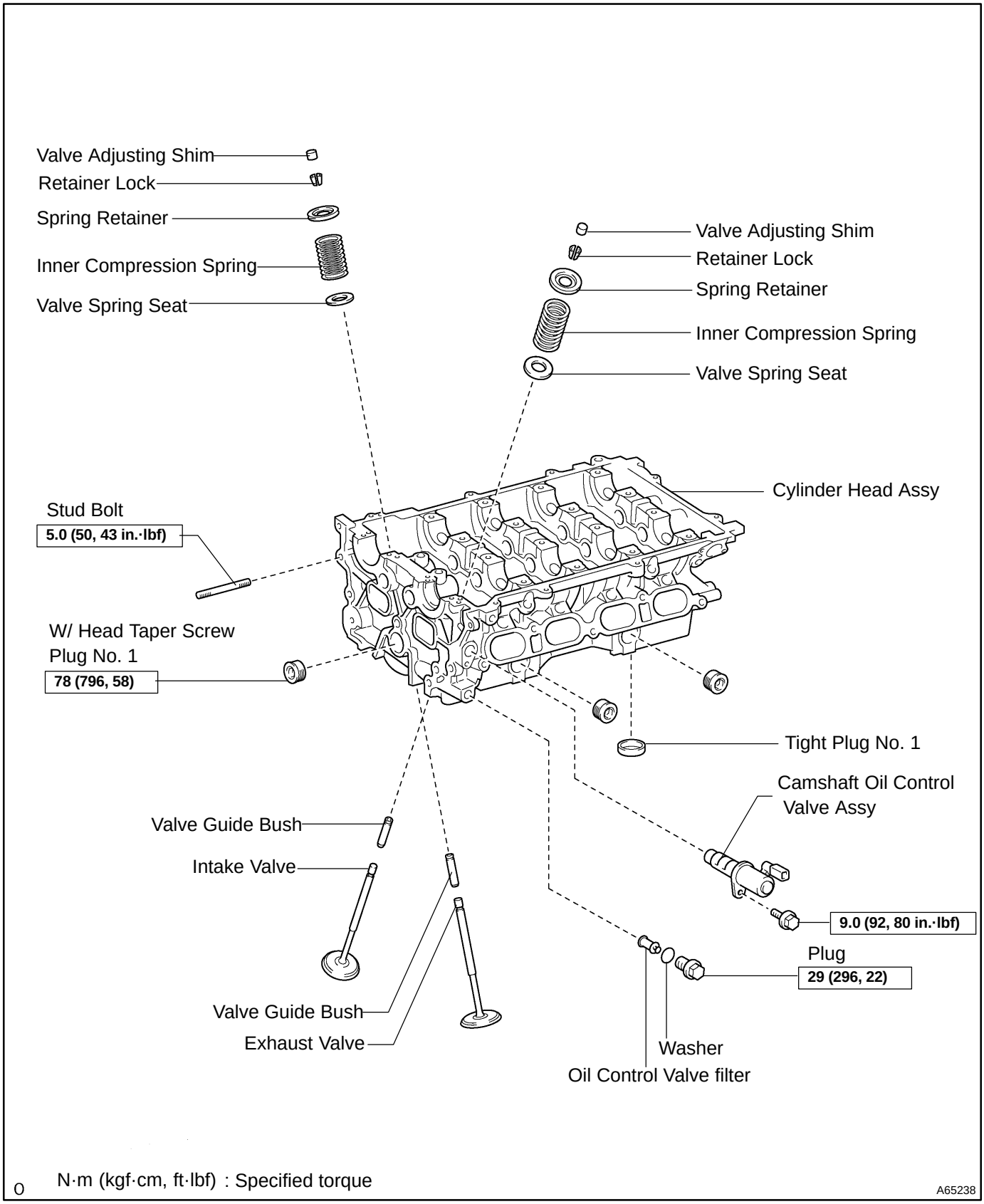

Transverse Engine Engine Mounting Bracket
49 (500, 36)
Gasket
Timing Chain Cover Sub–assy
11 (112, 8) (M6)
21 (214, 15) (M8)
Crankshaft Pulley
118 (1,203, 87)
Gasket
Oil Seal
Crank Position Sensor
9.0 (92, 80 in.·lbf)
9.0 (92, 80 in.·lbf)
O–ring
Chain Sub–assy
15 (153, 11)
Water Pump Assy
Water Pump Pulley
Chain Vibration Damper No. 1
Chain Tensioner Slipper
21 (214, 15)
Crankshaft Timing Sprocket
21 (214, 15)
Crankshaft Position Sensor Plate No. 1
N·m (kgf·cm, ft·lbf) : Specified torque
Non–reusable part
A66463


See page 14–279
1st 35 (357, 26)
2nd turn 180◆
Washer
Cylinder Head Sub–assy
Intake Manifold Insulator No. 2
Surge Tank Stay No. 1
24 (245, 18)
◦ Gasket
◦ Gasket
34 (347, 25)
46 (469, 34)
Intake Manifold
21 (214, 15)
50 (510, 37)
Manifold Stay
9.0 (92, 80 in.·lbf)
24 (245, 18)
Oil Level Gage Guide
◦ O–ring
Oil Level Gage Sub–assy
O N·m (kgf·cm, ft·lbf) : Specified torque
◦ Non–reusable part
A65831

CYLINDER HEAD ASSY (2ZZ–GE)

140RI–01

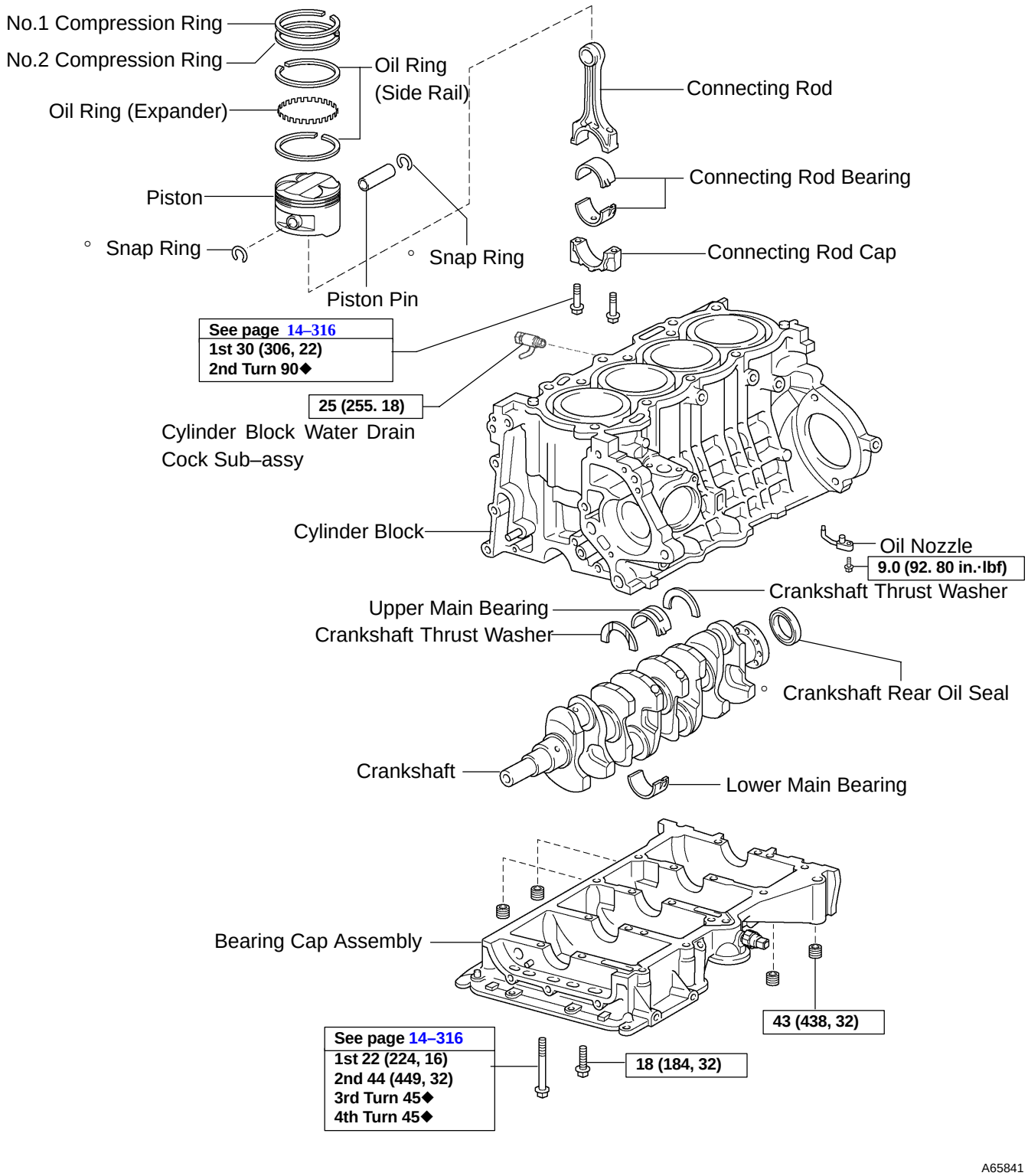
COMPONENTS



CYLINDER BLOCK (2ZZ–GE)

COMPONENTS

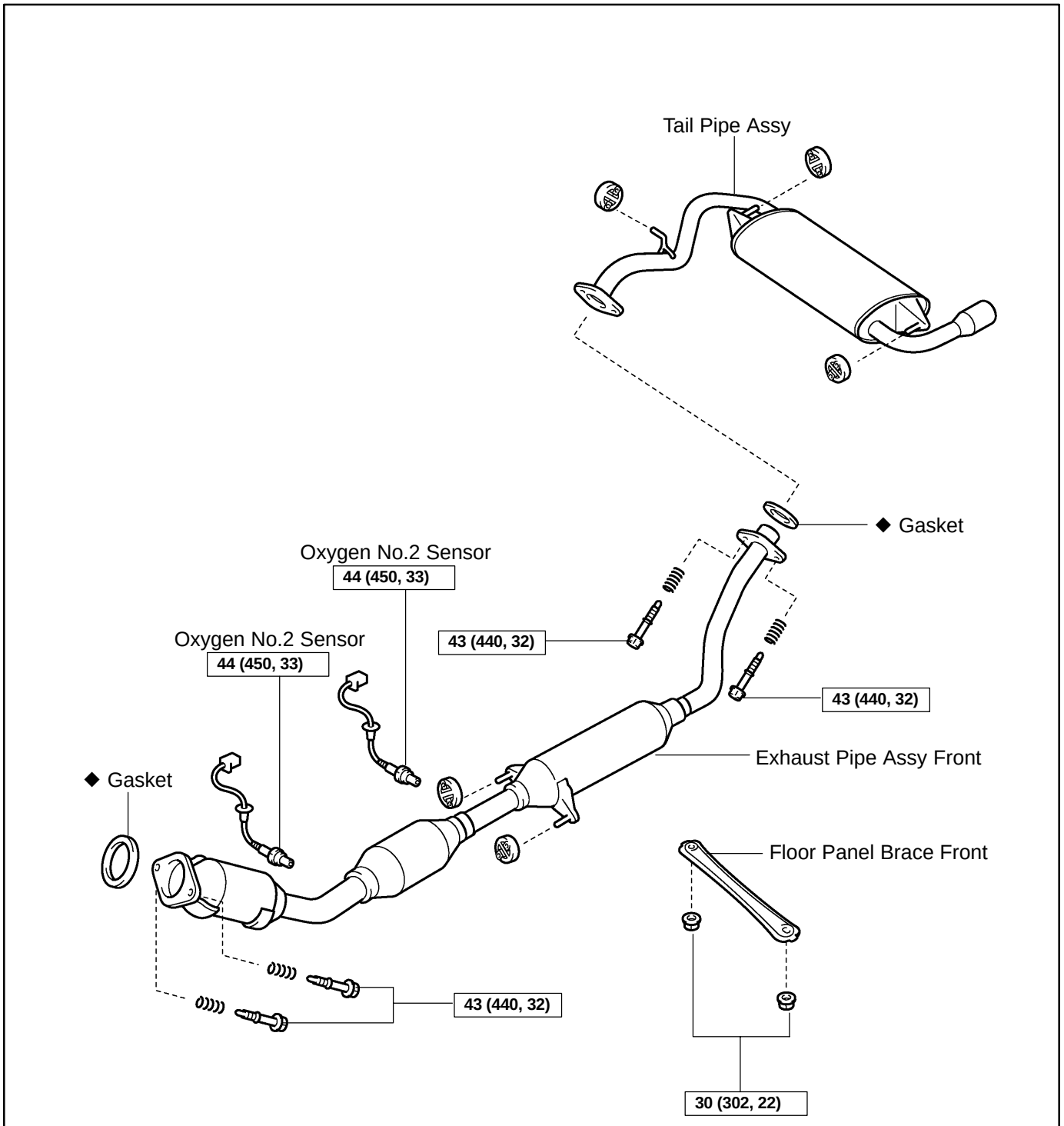
140RK–01



EXHAUST PIPE (2ZZ–GE)

COMPONENTS

1504K–01



ENGINE ASSEMBLY (2ZZ–GE)

140R4–01

INSPECTION

1. **INSPECT COOLANT (See page 16–6)**
2. **INSPECT ENGINE OIL(See page 17–12)**
3. **INSPECT BATTERY(See page 19–12)**
4. **INSPECT AIR CLEANER FILTER ELEMENT SUB–ASSY**
5. **INSPECT SPARK PLUG(See page 18–5)**
6. **INSPECT IGNITION TIMING**

(a) Warm up engine.

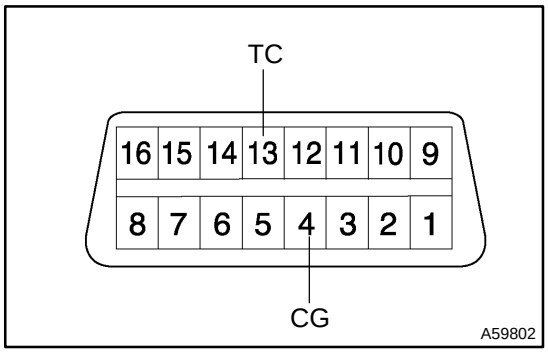
(b) When using hand–held tester or OBDII scan tool.

(1) Connect the hand–held tester or OBDII scan tool to the DLC3.

HINT:

Please refer to the hand–held tester or OBDII scan tool operator's manual for further details.

(c) When not using hand–held tester or OBDII scan tool.

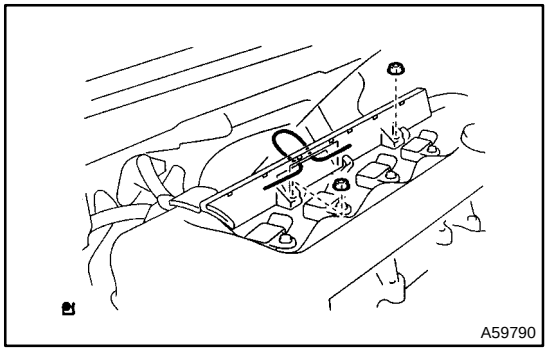


(1) Using SST,connect terminals 13 (TC) and 4 (CG) of DLC3.

SST 09843–18040

NOTICE:

- **Be sure not to connect incorrectly. It causes breakage of the engine.**
- **Turn OFF all electrical systems.**
- **Operate the inspection when the cooling fan motor is turned OFF.**



(2) Remove the 3 bolts, the nut and the cylinder head cover No. 2.

(3) Pull out the wire harness as shown in the illustration.

(4) Connect timing light to engine.

NOTICE:

- **Use a timing light which can detect the first signal.**
- **After checking, be sure to tape the wire harness.**

(5) Inspect ignition timing at idle.

Ignition timing: 8 – 12 BTDC

NOTICE:

When checking the ignition timing, the transmission is at neutral position.

HINT:

After engine rpm is kept at 1,000 – 1,300 rpm for 5 seconds, check that it returns idle speed.

(6) Disconnect the terminal 13 (TC) and 4 (CG) of the DLC3.

(7) Inspect ignition timing at idle.

Ignition timing:

M/T 4 – 12 BTDC

A/T 10 – 18 BTDC

(8) Confirm that ignition timing moves to advanced angle side when the engine rpm is increased.

(9) Remove the timing light.

(10) Install cylinder head cover No. 2 with the 3 bolts and the nut.

Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)

7. INSPECT ENGINE IDLE SPEED

(a) Warm up engine.

(b) When using hand–held tester or OBDII scan tool.

(1) Connect the hand–held tester or OBDII scan tool to the DLC3.

HINT:

Please refer to the hand – held tester or OBDII scan tool operator's manual for further details.

(c) Check the idle speed.

Idle speed:

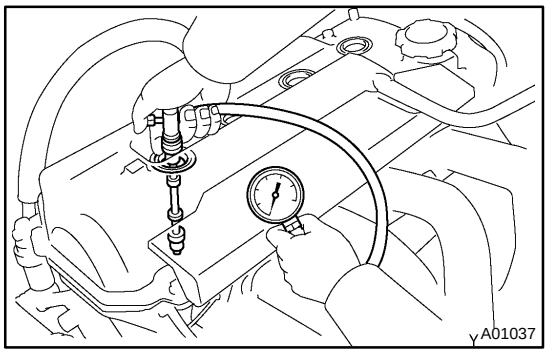
M/T 750 – 850 rpm

A/T 700 – 800 rpm

NOTICE:

- **Check idle speed with cooling fan OFF.**
- **Switch off all accessories and air conditioning.**

SST 09843–18040



8. INSPECT COMPRESSION

(a) Warm up and stop engine.

(b) Remove ignition coil.

(c) Remove spark plugs.

(d) Inspect cylinder compression pressure.

SST 09992–00500

(1) Insert a compression gauge into the spark plug hole.

(2) Fully open the throttle.

(3) While cranking the engine, measure the compression pressure.

NOTICE:

- **Always use a fully charged battery to obtain engine speed of 250 rpm or more.**
- **Check other cylinder's compression pressure in the same way.**
- **This measurement must be done in as short a time as possible.**

Compression pressure:

1,400 kpa (14.3 kgf/cm^2, 203 psi)

Minimum pressure:

1,000 kpa (10.3 kgf/cm^2, 145 psi)

Difference between each cylinder:

110 kpa (1.1 kgf/cm^2, 16 psi)

(4) If the cylinder compression in one more cylinders 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 helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.

9. INSPECT CO/HC

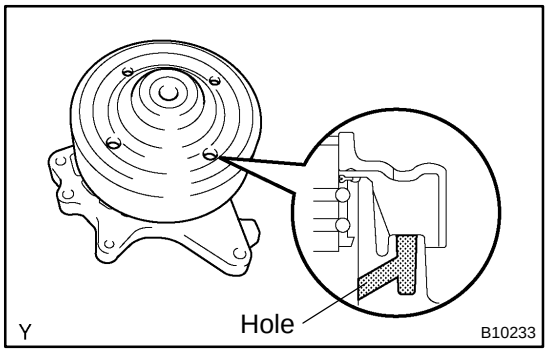
(a) Start engine.
(b) Race engine at 2,500 rpm for approx. 180 seconds.
(c) Insert CO/HC meter testing probe at least 40 cm (1.3 ft) into tailpipe during idling.
(d) Immediately check CO/HC concentration at idle and/or 2,500 rpm.

HINT:
- Complete the measuring within 3 minutes.
- When doing the 2 mode (idle and 2,500 rpm) test, these measuring 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 heated oxygen sensor operation.(See page 12–13)

CO	HC	Problems	Causes
Normal	High	Rough idle	1. Faulty ignitions: ° Incorrect timing ° Fouled, shorted or improperly gapped plugs 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinders
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: ° PCV hoses ° Intake manifold ° Throttle body ° ISC valve ° Brake booster line 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke form exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. Faulty EFI systems: ° Faulty pressure regulator ° Defective water temperature sensor ° DEFECTIVE Air–flow meter ° Faulty ECM ° Faulty injectors ° Faulty throttle position sensor

INSPECTION

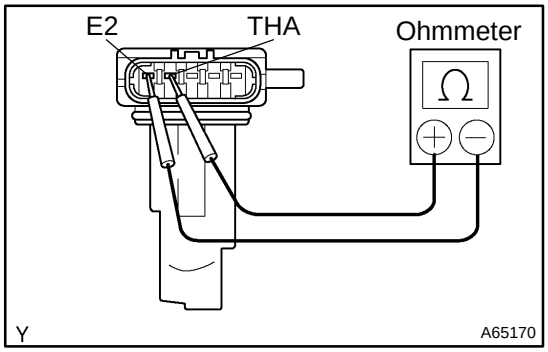


1. INSPECT WATER PUMP ASSY

(a) Visually check the drain hole for coolant leakage.

1008L–01

INSPECTION



1. INTAKE AIR FLOW METER SUB–ASSY

(a) Inspect the intake air flow meter resistance.

(1) Using an ohmmeter, measure the resistance between terminals THA and E2.

Resistance:

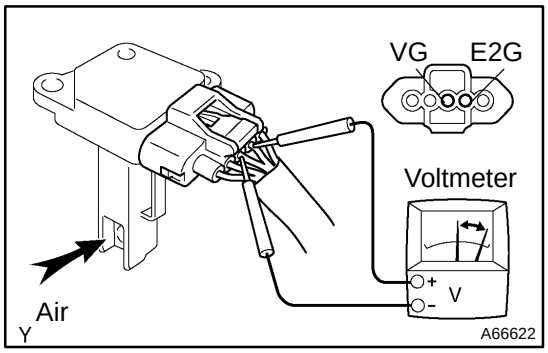
At –20°C (–4°F) 13.6 – 18.4 kΩ

At 20°C (68°F) 2.21 – 2.69 kΩ

At 60°C (140°F) 0.49 – 0.67 kΩ

HINT:

If the resistance is not as specified, replace the intake air flow meter.



(b) Inspect the intake air flow meter operation.

(1) Connect the intake air flow meter connector.

(2) Turn the ignition switch to ON.

(3) Using a voltmeter, connect the positive (+) tester probe to terminal VG, and negative (–) tester probe to terminal E2G.

(4) Blow air into the intake air flow meter, and check that the voltage fluctuates.

HINT:

If operation is not as specified, replace the intake air flow meter.

(5) Turn the ignition switch to LOCK.

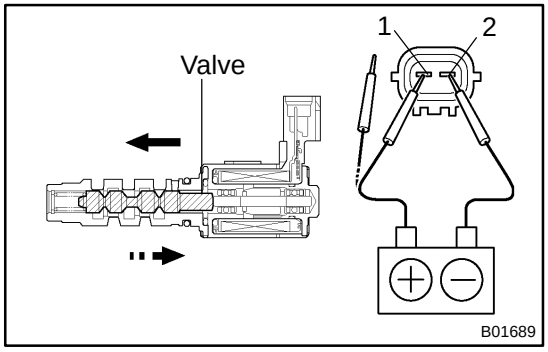
(6) Disconnect the intake air flow meter connector.

2. CAMSHAFT TIMING OIL CONTROL VALVE ASSY

(a) Resistance inspection.

(1) Using an ohmmeter, measure the resistance between the terminals.

Resistance: 6.9 – 7.9 Ω at 20°C (68°F)



(b) Movement inspection.

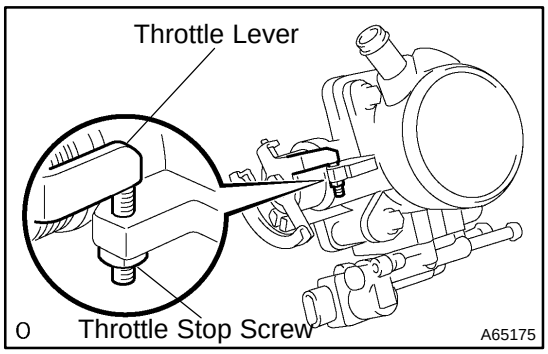
(1) Connect the positive (+) lead from the battery to terminal 1 and negative (–) lead to terminal 2, and check the movement of the valve.

NOTICE:

Confirm the valve does not adhere.

HINT:

Bad returning of the valve by entrance of foreign objects causes subtle pressure leak to the advanced direction. Then, DTC can be detected.

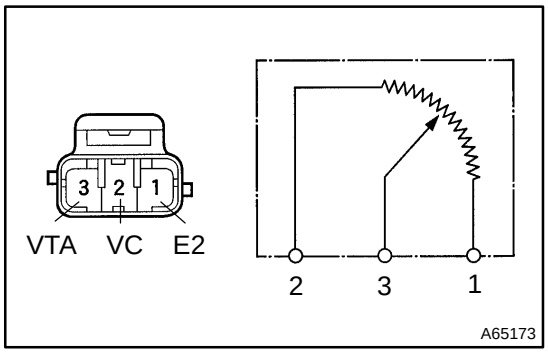


3. THROTTLE BODY ASSY

(a) Check throttle body.
  (1) Check that throttle valve shaft is not rickety.
  (2) Check that each port is not stopped up.
  (3) Check that throttle valve opens and closes smoothly.
  (4) Check that there is no clearance between the throttle stop screw and throttle lever at the throttle closed position.

NOTICE:

Do not adjust the throttle stop screw.



4. E.F.I. THROTTLE POSITION SENSOR

(a) Resistance inspection.
  (1) Disconnect the throttle position sensor connector.
  (2) Using an ohmmeter, measure the resistance between terminals VC and E2.

  Resistance: 2.5 – 6.0 kΩ

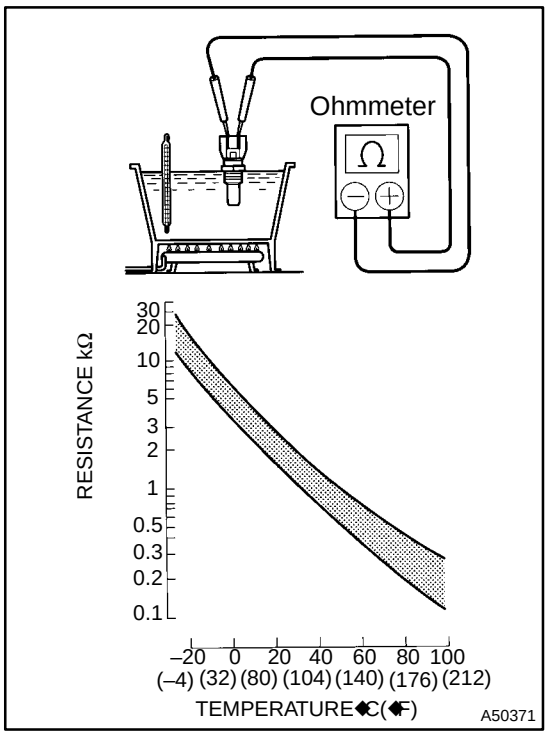
  (3) Check the change of resistance between terminals VTA and E2.

  Change of resistance:

  The resistance value increases in proportion to the throttle lever opening value.

HINT:

Throttle valve	Resistance
Fully open	0.2 – 5.7 kΩ
Fully close	2.0 – 10.2 kΩ



5. E.F.I. ENGINE COOLANT TEMPERATURE SENSOR

(a) Resistance inspection.

(1) Using an ohmmeter, measure the resistance between each terminal.

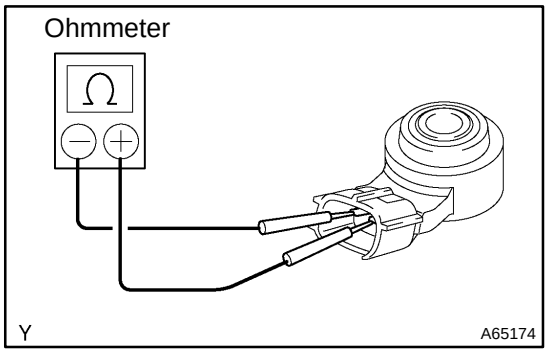
Resistance:

At 20◆C (68◆F) 2.32 – 2.59 kΩ

At 80◆C (176◆F) 0.310 – 0.326 kΩ

NOTICE:

In case of checking the water temperature sensor in the water, be careful not to allow water to go into the terminals, and after checking, wipe out the sensor.



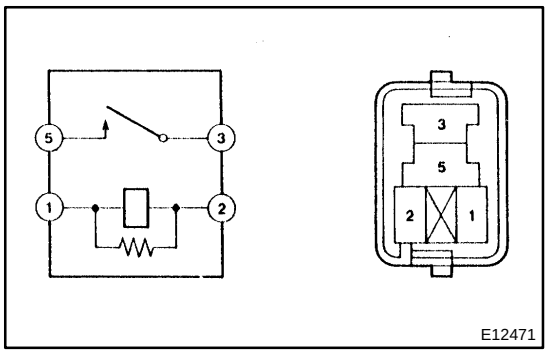
6. KNOCK CONTROL SENSOR

(a) Using an ohmmeter, measure the resistance between terminals.

Resistance: 120 – 280 kΩ at 20◆C (68◆F)

HINT:

If the resistance is not specified, replace the sensor.



7. E.F.I. CIRCUIT OPENING RELAY ASSY

(a) Continuity inspection.

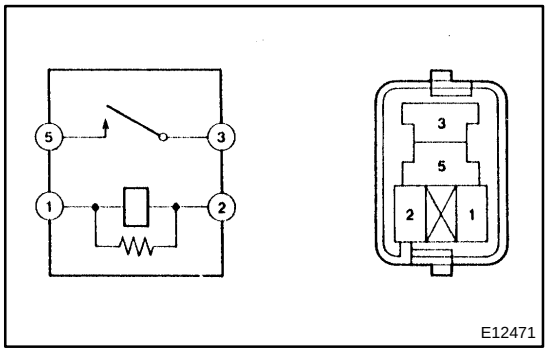
(1) Using an ohmmeter, check that continuity exists between each terminal.

Specified condition:

Between terminals 1 and 2 Continuity

Between terminals 3 and 5 No continuity

(2) Using an ohmmeter, check that continuity exists between terminals 3 and 5 when the battery voltage is applied across terminals 1 and 2.



8. E.F.I ECU RELAY

(a) Continuity inspection.

(1) Using an ohmmeter, check that continuity exists between each terminal.

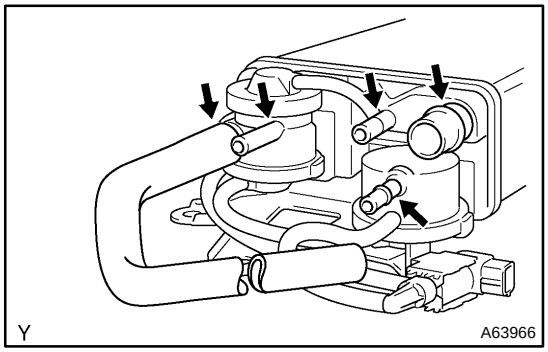
Specified condition:

Between terminals 1 and 2 Continuity

Between terminals 3 and 5 No continuity

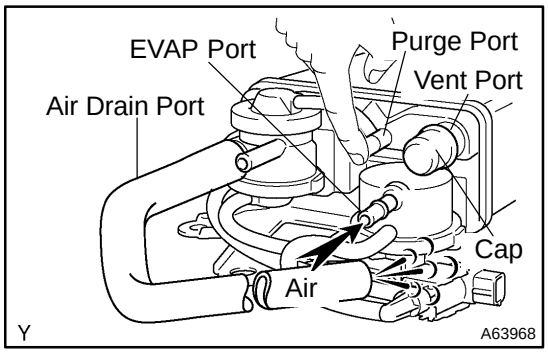
(2) Using an ohmmeter, check that continuity exists between terminals 3 and 5 when the battery voltage is applied across terminals 1 and 2.

INSPECTION



1. CHARCOAL CANISTER ASSY

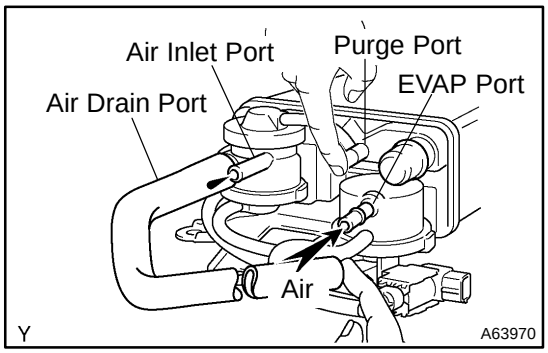
(a) Visually check the charcoal canister for cracks or damage.



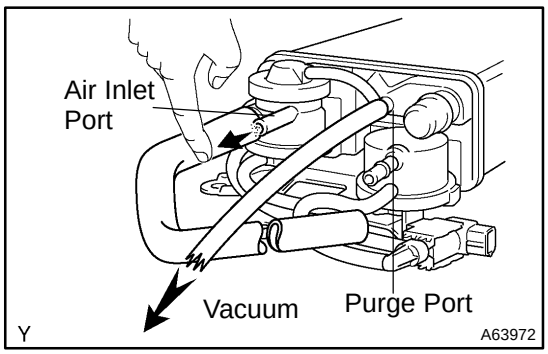
(b) Inspect the charcoal canister operation.

(1) Plug the vent port with the cap.

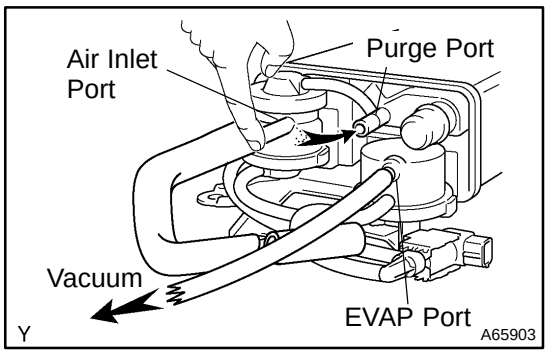
(2) While holding the purge port closed, blow air (1.76 kPa, 18 gf/cm^2, 0.26 psi) into the EVAP port and check that air flows from the air drain port.



(3) While holding the purge port and the air drain port closed, blow air (1.76 kPa, 18 gf/cm^2, 0.26 psi) into the EVAP port and check that air does not flow from the air inlet port.



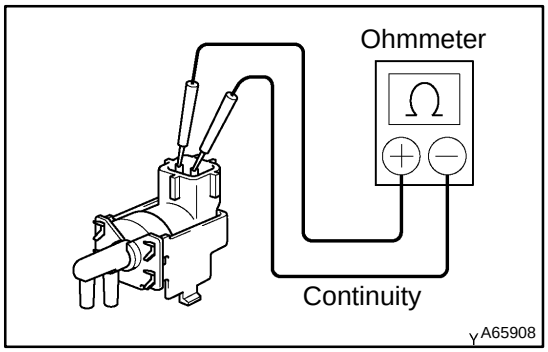
(4) Apply vaccum (3.43 kPa, 25.7 mmHg, 1.01 in.Hg) to the purge port, check that the vacuum dose not decrease when the air inlet port is closed, and check that the vacuum decreases when the air inlet port is released.



(5) While holding the air inlet port closed, apply vacuum (3.43 kPa, 25.7 mmHg, 1.01 in.Hg) to the EVAP port and check that air flows into the purge port.

If operation is not as spacified, replace the charcoal canister.

(6) Remove the hose and cap from vent port.

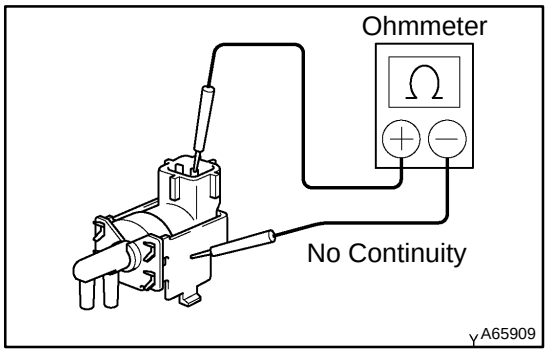


(c) Inspect VSV for Pressure Swiching Valve

(1) Using an ohmmeter, check that there is continuity between the terminals.

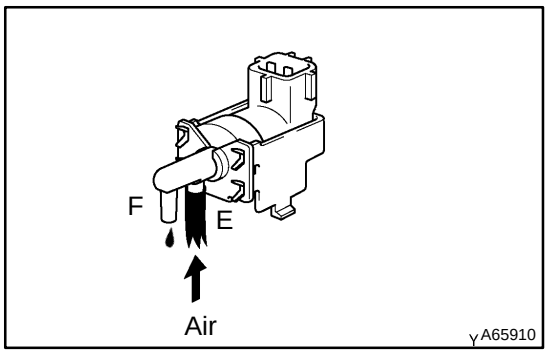
Resistance: 37 – 44 Ω at 20◆C (68◆F)

If there is no continuity, replace the VSV.

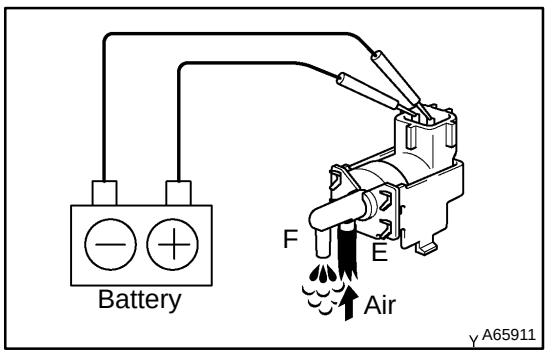


(2) Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.



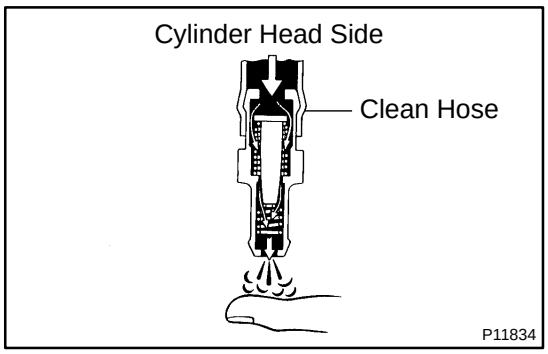
(3) Check that air does not flow from ports E to F.



(4) Apply battery positive voltage across the terminals.

(5) Check that air flows from ports E to F.

If operation is not as specified, replace the VSV.



2. VENTILATION VALVE SUB–ASSY

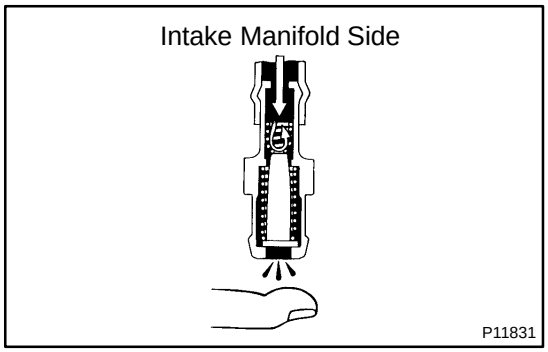
(a) Install clean hose to the PCV valve.

(b) Inspect the PCV valve operation.

(1) Blow air into the cylinder head side, and check that air passes through easily.

CAUTION:

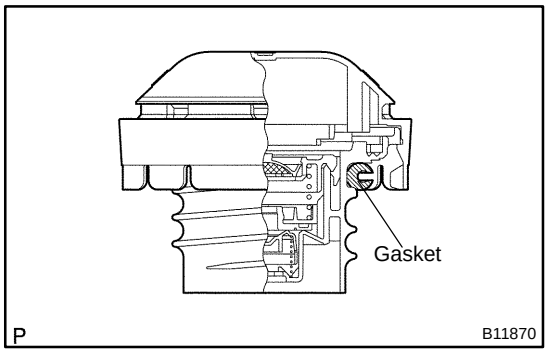
Do not suck air through the valve. Petroleum substances inside the valve air harmful.



(2) Blow air into the intake manifold side, and check that air passes through with difficulty.

If operation is not as specified, replace the PCV valve.

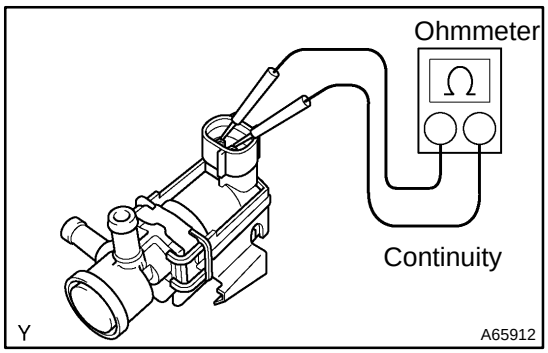
(c) Remove clean hose from the PCV valve.



3. FUEL TANK CAP ASSY

(a) Visually check if cap and/or gasket are deformed or damaged.

If necessary, repair or replace the cap.



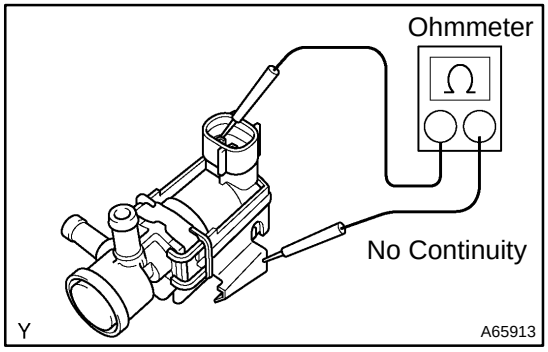
4. VACUUM SWITCHING VALVE NO.1

(a) Inspect VSV for evaporative emission (EVAP).

(1) Using an ohmmeter, check that there is continuity between the terminals.

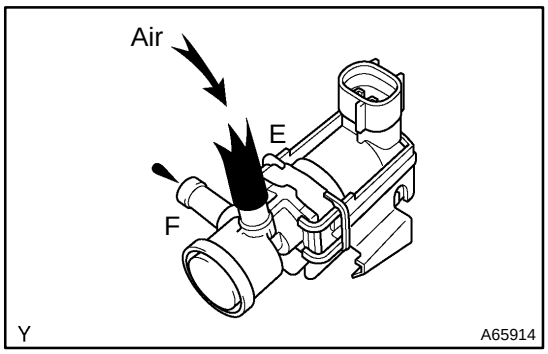
Resistance: 27 – 33 Ω at 20◆C (68◆F)

If there is no continuity, replace the VSV.

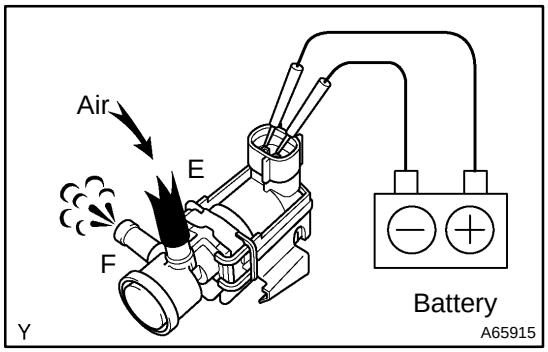


(2) Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.

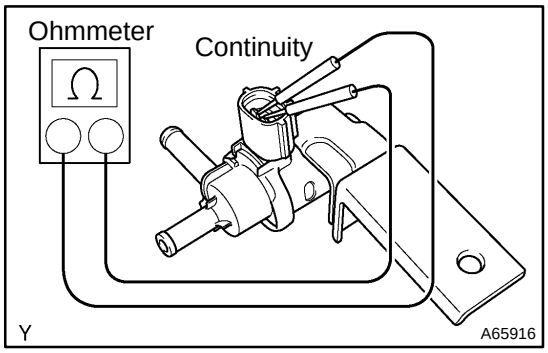


(3) Check that air flows from ports E to F.



(4) Apply battery positive voltage across the terminals.
(5) Check that air does not flow from ports E to F.

If operation is not as specified, replace the VSV.

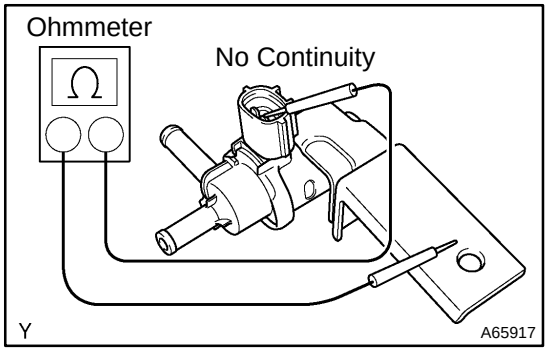


5. VACUUM SWITCHING VALVE ASSY NO.1

(a) Inspect VSV for Canister Closed valve (CCV).
(1) Using an ohmmeter, check that there is continuity between the terminals.

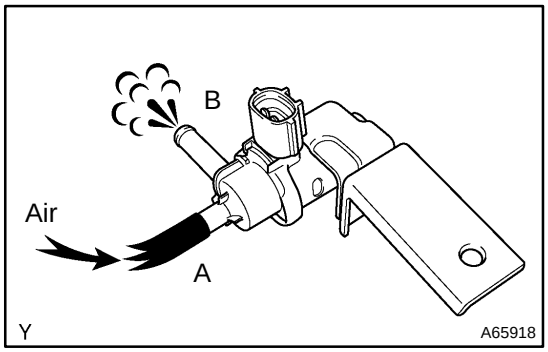
Resistance: 25 – 30 Ω at 20◆C (68◆F)

If there is no continuity, replace the VSV.

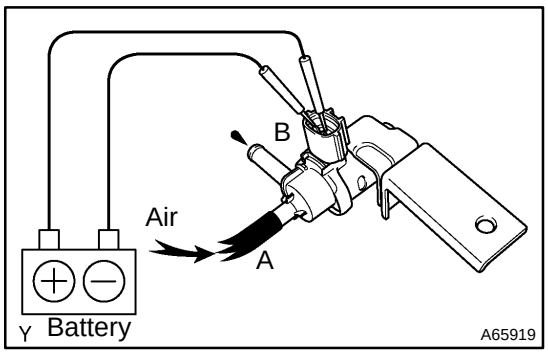


(2) Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.



(3) Check that air flows from ports A to B.



(4) Apply battery positive voltage across the terminals.
(5) Check that air does not flow from ports A to B.

If operation is not as specified, replace the VSV.

EMISSION CONTROL SYSTEM (2ZZ–GE)

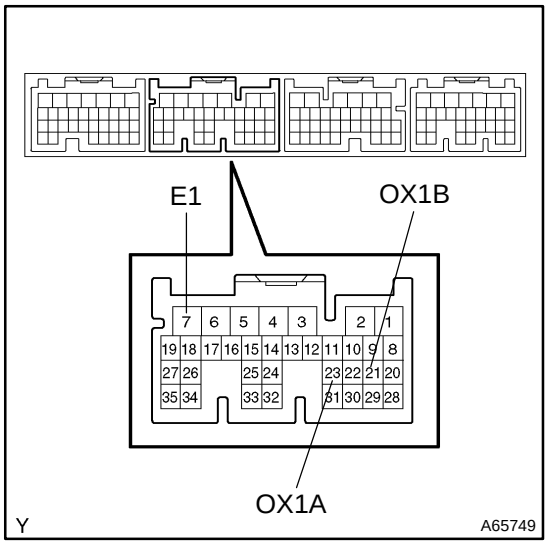
1204D–02

ON–VEHICLE INSPECTION

1. INSPECT AIR–FUEL RATIO COMPENSATION SYSTEM

HINT:

You can also check the system by choosing ”DATA MONITOR”, then ”O_2 SENSOR OUTPUT VOLTAGE” on the monitor of the hand–held tester.



(a) Connect the hand–held tester to the terminal 23 (OX1A) ⇔ 7 (E1) and 21 (OX1B) ⇔ 7 (E1) of the ECM.

CAUTION:

Connect test leads from the back side of the connector with the ECU connected.

(b) Warm up the oxygen sensor with the engine speed at 2,500 rpm for approx. 2 minutes.

(c) Confirm that the voltage changes between 0V to 1V with the engine speed at 2,500 rpm.

OK:

The voltage changes more than 8 times in 10 seconds.

CAUTION:

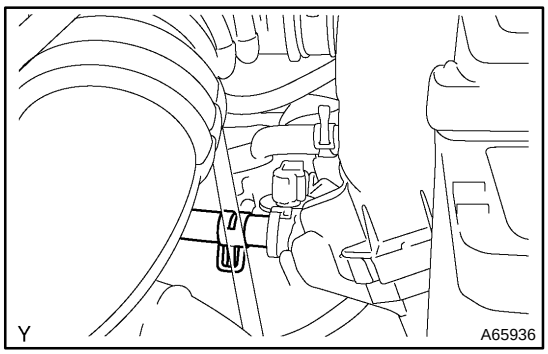
- **Perform the check immediately after the end of the warming up.**
- **If not confirming the change of voltage, warming up the oxygen sensor again.**

2. INSPECT FUEL CUT OFF RPM

(a) Increase the engine speed to at least 3,500 rpm.

(b) Use a sound scope to check for injector operating noise.

(c) Check that when the throttle lever is released, injector operation noise stops momentarily and then resumes.



3. INSPECT EVAPORATIVE EMISSION CONTROL SYSTEM

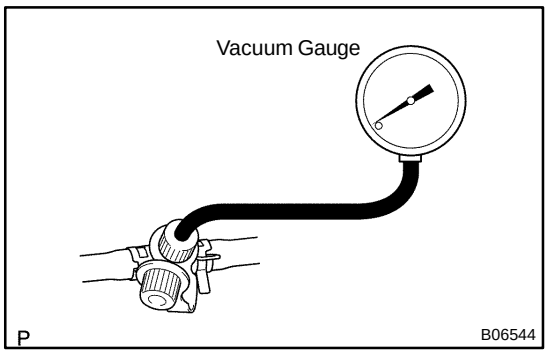
(a) After starting the engine, disconnect the vacuum hose shown in the illustration.

(b) Confirm vacuum occurs at the vsv port, when choosing ”ACTIVE TEST” and ”PURGE VSV” according to the display on hand–held tester.

(c) Finish ”ACTIVE TEST”, then connect the vacuum hose again.

(d) After going to ”ECM DATA MONITOR” on the hand–held tester, choose ”PURGE VSV” to check the operation of the purge VSV.

(e) After warm up the engine and drive the vehicle, confirm the VSV turns on from off.

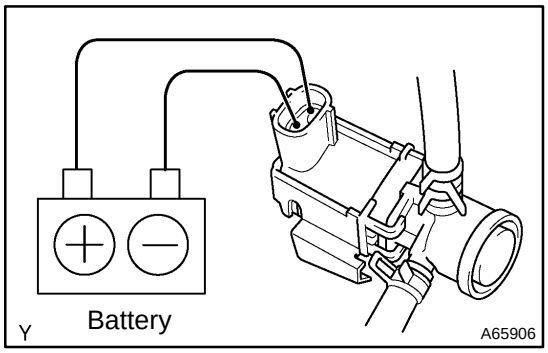


4. INSPECT EVAP SYSTEM LINE

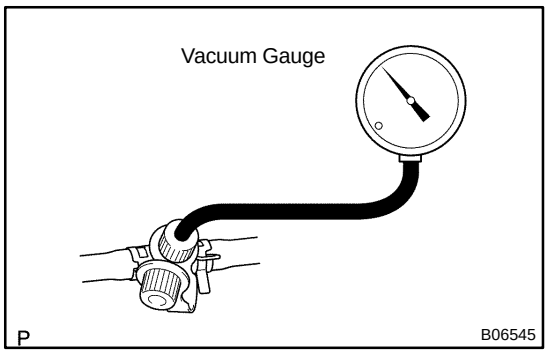
(a) Warm up the engine and stop the engine. Allow the engine to warm up to normal operating temperature.

(b) Install a vacuum gauge (EVAP control system test equipment vacuum gauge) to the EVAP service port on the purge line.

(c) TOYOTA Hand–Held Tester:
Forced driving of the VSV for the EVAP.
(1) Connect a TOYOTA hand–held tester to the DLC3
(2) Start the engine.
(3) Push the TOYOTA hand–held tester main switch ON.
(4) Use the ACTIVE TEST mode on the TOYOTA hand–held tester to operate the VSV for the EVAP.



(d) If you have no TOYOTA Hand–Held Tester:
Forced driving of the VSV for the EVAP.
(1) Disconnect the VSV connector for the EVAP.
(2) Connect the positive (+) and negative (–) leads from the battery to the VSV terminals for the EVAP.
(3) Start the engine.



(e) Check the vacuum at idle
Vacuum:
Maintain at 0.368 – 19.713 in.Hg (5 –268 in.Aq) for over 5 seconds.

HINT:
If the vacuum does not change, you can conclude that the hose connecting the VSV to the service port has come loose or is blocked, or the VSV is malfunctioning.

(f) TOYOTA Hand–Held Tester:
Conclude forced driving of the VSV for the EVAP.
(1) Stop the engine.
(2) Disconnect the TOYOTA hand–held tester from the DLC3.

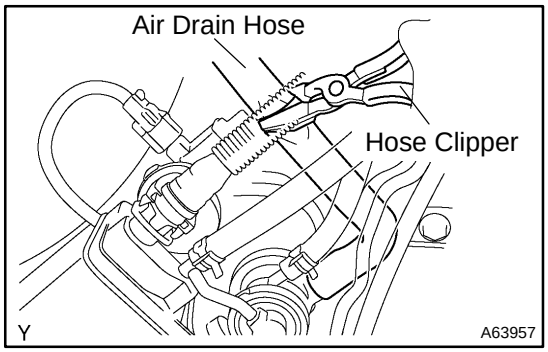
(g) If you have no TOYOTA Hand–Held tester:
Conclude forced driving of the VSV for the EVAP.
(1) Stop the engine.

(2) Disconnect the positive (+) and negative (–) leads from the battery from the VSV terminals for the EVAP.

(3) Connect the VSV connector for the EVAP.

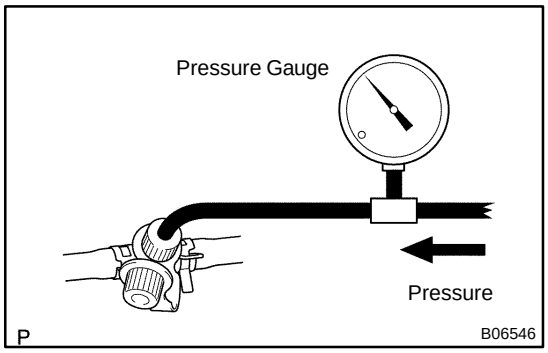
(h) Disconnect the vacuum gauge from the EVAP service port on the purge line.

(i) Connect a pressure gauge to the EVAP service port on the purge line.



(j) Check the pressure.

(1) Close off the air drain hose at the marked position of the canister with a hose clipper or similar instrument.



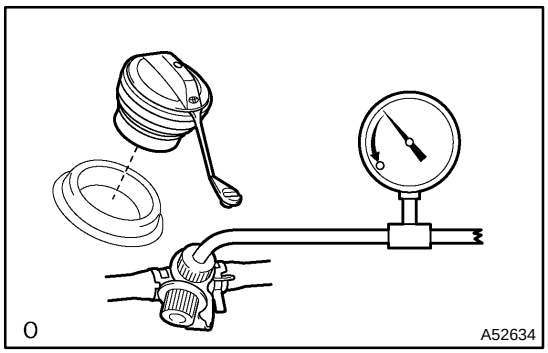
(2) Add the pressure (13.5 – 15.5 in. Aq) from the EVAP service port.

Pressure:

2 minutes after the the pressure is added, the gauge should be over 7.7–8.8 in.Aq.

HINT:

If you can not add pressure, you can conclude that the hose connecting the VSV – canister – fuel tank has slipped off or the VSV is open.

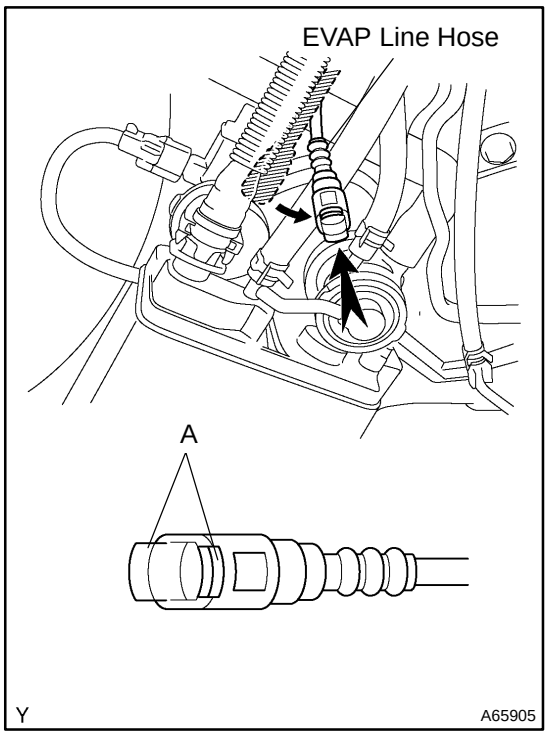


(3) Check if the pressure decreases when the fuel tank cap is removed while adding pressure.

HINT:

If the pressure dose not decrease when the filler cap is removed, then you can conclude that the hose connecting the service port to the fuel tank is blocked, etc.

(k) Disconnect the pressure gauge from the EVAP service port on the purge line.

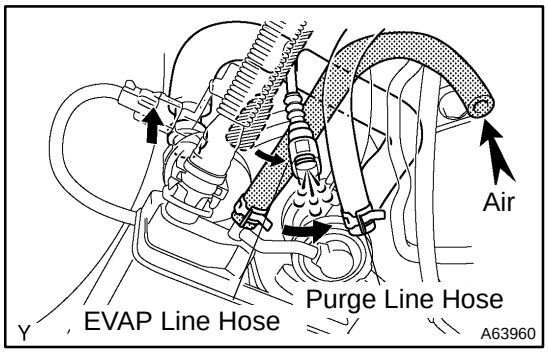


5. CHECK AIRTIGHTNESS IN FUEL TANK AND FILLER PIPE

(a) Disconnect the EVAP line hose from the charcoal canister.
  (1) Pinch portion A.
  (2) Pull out the connector.
(b) Pressurize and make the internal pressure in the fuel tank 4 kPa (41 gf/cm^2, 0.58 psi).
(c) Check that the internal pressure of the fuel tank can be hold for 1 minute.
(d) Check the connected portions of each hose and pipe.
(e) Check the installed parts on the fuel tank.

If there is no abnormality, replace the fuel tank and filler pipe.

(f) Reconnect the EVAP line hose to the charcoal canister.



6. INSPECT FUEL CUT OFF VALVE AND FILL CHECK VALVE

(a) Disconnect the purge line hose and EVAP line hose from the charcoal canister.
(b) Plug the cap to the air drain hose.
(c) Pressurize 4 kPa (41 gf/cm^2, 0.58 psi) to the purge port and check that there is ventilation through the EVAP line hose.

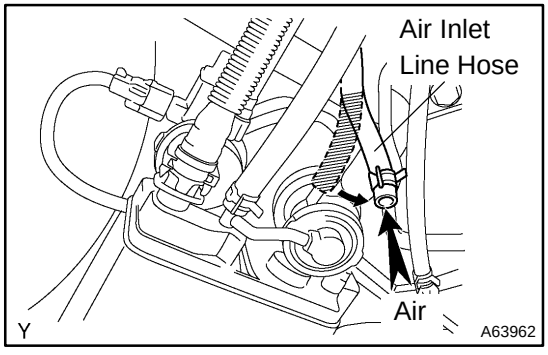
HINT:

In the condition that the fuel is full, as the float value of the fill check valve is closed and has no ventilation, it is necessary to check the fuel amount (volume).

(d) Check if there is anything struck in the vent line hose and EVAP line hose.

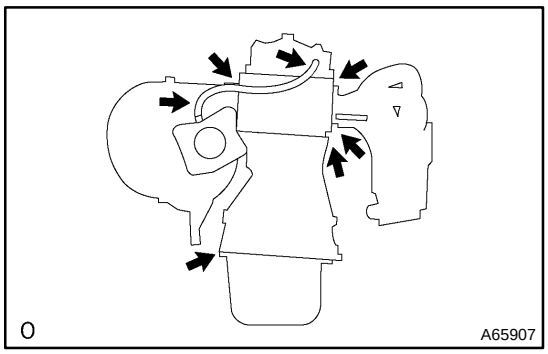
If there is no stuck in hoses, replace the fuel cut off valve and fill check valve.

(e) Reconnect the purge line hose and EVAP line hose to the charcoal canister.



7. CHECK AIR INLET LINE

(a) Disconnect the air inlet line hose from the charcoal canister.
(b) Check that there is ventilation in the air inlet line.
(c) Reconnect the air inlet line hose to the charcoal canister.

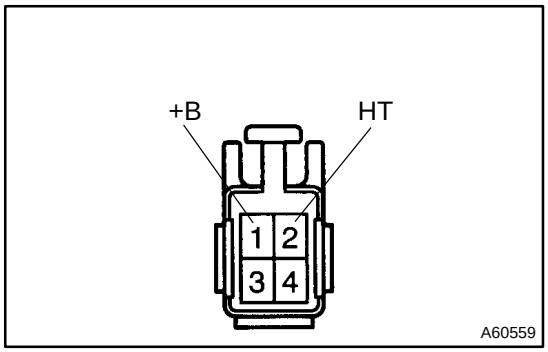


8. VISUALLY INSPECT HOSES, CONNECTIONS AND GASKETS

(a) Check for cracks, leaks or damage.

HINT:

Separation of the engine oil dipstick, oil filler cap, PCV hose, etc. may cause the engine to run out of turn. Disconnection, looseness or cracks in the parts of the air induction system between the throttle body and cylinder head will allow air suction and cause the engine to run out of turn.

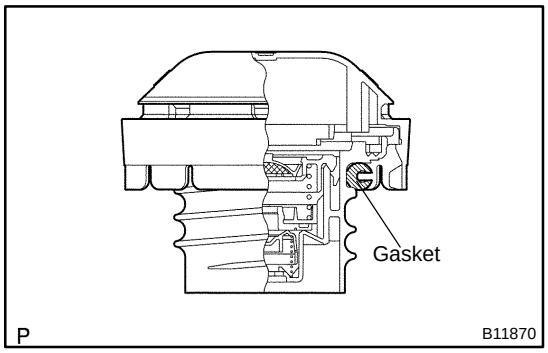


9. INSPECT HEATER RESISTANCE OF HEATED OXYGEN SENSOR

(a) Disconnect the oxygen sensor connector.

(b) Using an ohmmeter, measure the resistance between the terminals HT and +B.

Resistance: 11 – 16 Ω at 20°C (68°F)



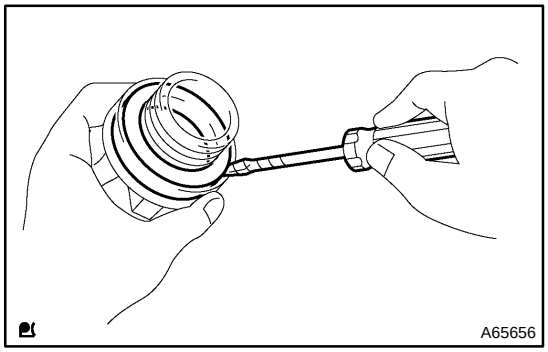
10. INSPECT FUEL TANK CAP

(a) Visually check if the cap and/or gasket are deformed or damaged.

140R9–01

OVERHAUL

1. REMOVE OIL FILLER CAP SUB–ASSY



2. REMOVE OIL FILLER CAP GASKET

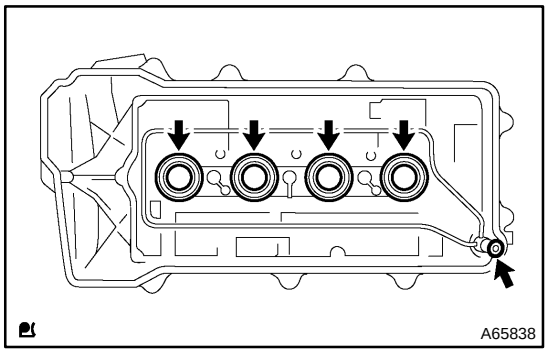
(a) Using a screwdriver, remove the gasket from the oil filter cap.

3. REMOVE VENTILATION VALVE SUB–ASSY

4. REMOVE SPARK PLUG

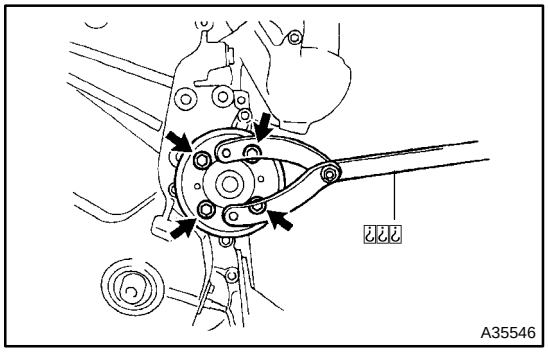
5. REMOVE CYLINDER HEAD COVER SUB–ASSY

(a) Remove the 9 bolts and cylinder head cover.



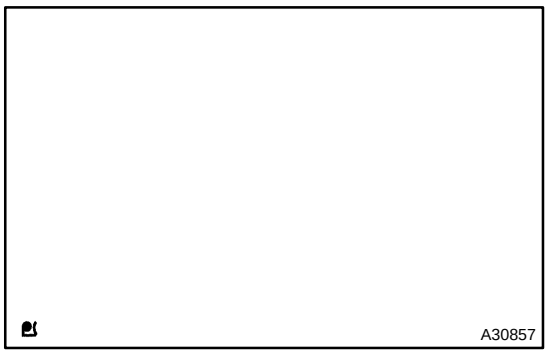
(b) Remove the spark plug tube gasket and O–ring.

6. REMOVE CYLINDER HEAD COVER GASKET



7. REMOVE WATER PUMP PULLEY

(a) Using SST, remove the water pump pulley
SST 09960–10010 (09962–01000, 09963–00600)

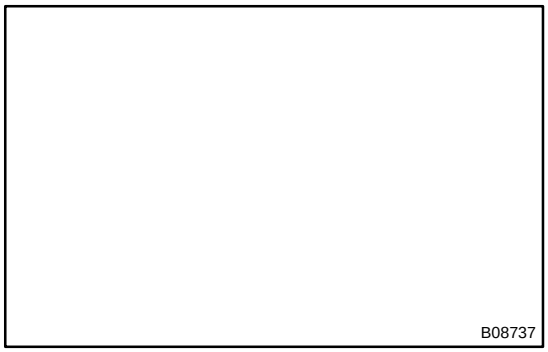


19. REMOVE CHAIN SUB–ASSY

(a) Using screwdrivers, ply out the timing chain with the crankshaft timing gear as shown in the illustration.

NOTICE:

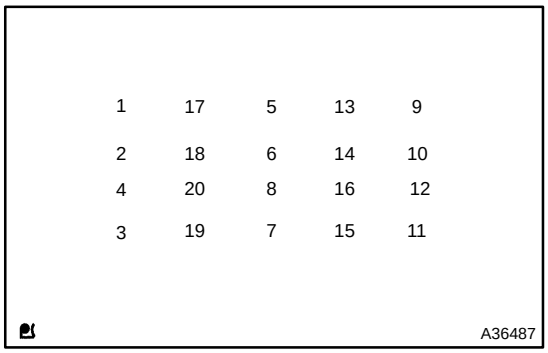
- **Put shop rag to protect the engine.**
- **In case of revolving the camshafts with the chain off the sprockets, turn the crankshaft 1/4 revolution for valves not to touch the pistons.**



20. REMOVE OIL PUMP ASSY

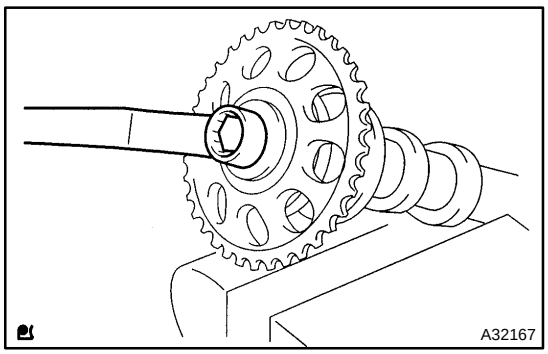
(a) Remove the 5 bolts and oil pump.

21. REMOVE OIL PUMP GASKET



22. REMOVE CAMSHAFT

(a) Uniformly loosen and remove the 20 bearing cap bolts, in several passes, in the sequence shown, and remove the 9 bearing caps, intake and exhaust camshafts.

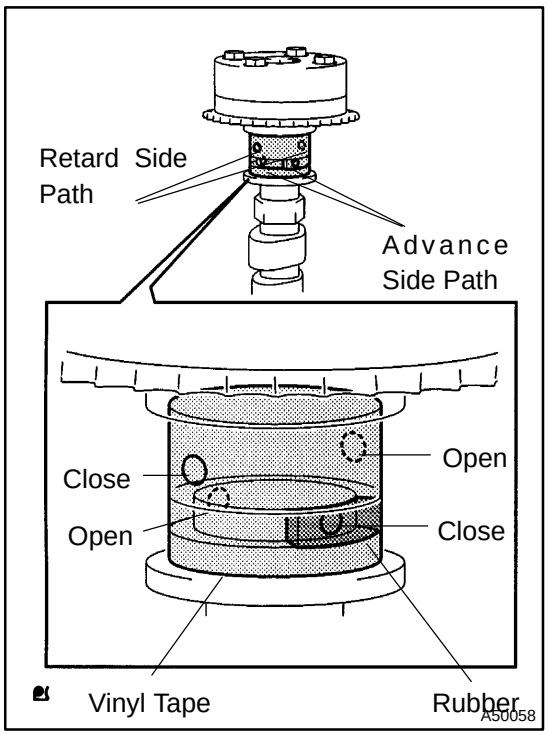


23. REMOVE CAMSHAFT TIMING GEAR OR SPROCKET

(a) Grip the camshaft No.2 with a vice, and remove the camshaft timing gear.

NOTICE:

Be careful not to damage the camshaft.



24. INSPECT CAMSHAFT TIMING GEAR ASSY

(a) Check the lock of camshaft timing gear.

(1) Grip the camshaft with a vice, and confirm the camshaft timing gear is locked.

NOTICE:

Be careful not to damage the camshaft.

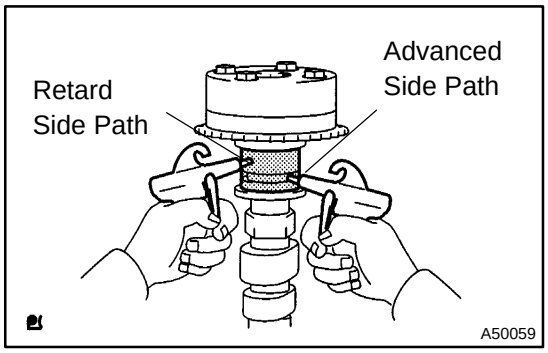
(b) Release lock pin.

(1) Cover 4 oil paths of cam journal with vinyl tape as shown in the illustration.

HINT:

Two advance side paths are provided in the groove of the camshaft. Plug one of the path with a rubber piece.

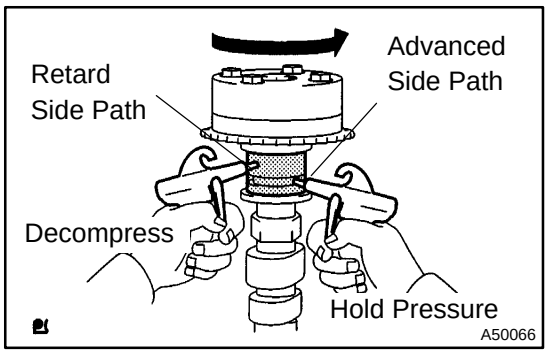
(2) Break through the tapes of the advance side path and the retard side path on the opposite side of the groove.



(3) Put air pressure into two broken paths (the advance side path and the retard side path) with about 150 kPa {1.5 kgf/cm^2}.

CAUTION:

Cover the paths with shop rag to avoid oil splashing.



(4) Confirm if the camshaft timing gear assembly revolves in the timing advance direction when weakening the air pressure of the timing retard path.

HINT:

The lock pin is released, and camshaft timing gear, revolves in the advance direction.

(5) When the camshaft timing gear comes to the most advanced position, take out the air pressure of the timing retard side path, and then, take out that of timing advance side path.

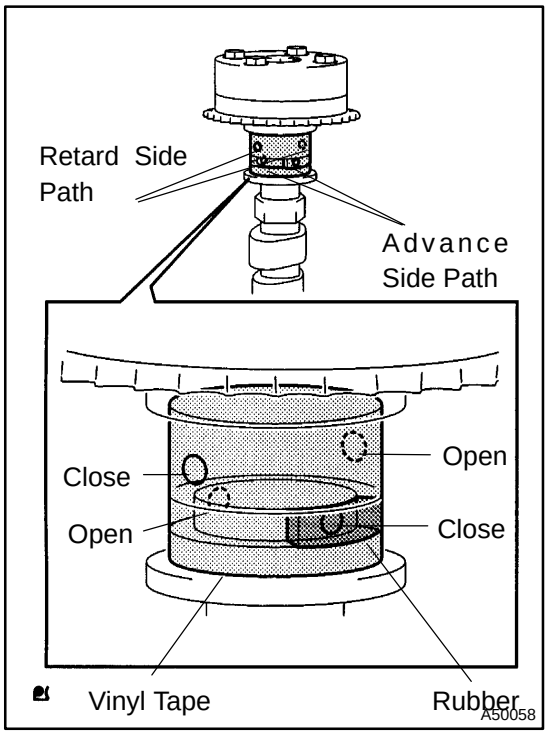
CAUTION:

Camshaft timing assembly gear occasionally shifts to the retard side abruptly, if the air compression of the advanced side path is released before retard side path. It often causes the breakage of the lock pin.

(c) Check smooth revolution
  (1) Revolve the camshaft timing gear assembly within the movable range except for the most retarded position several times, and check the smooth revolution.

CAUTION:
Be sure to perform this check by hand, instead of air pressure.

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



25. REMOVE CAMSHAFT TIMING GEAR ASSY

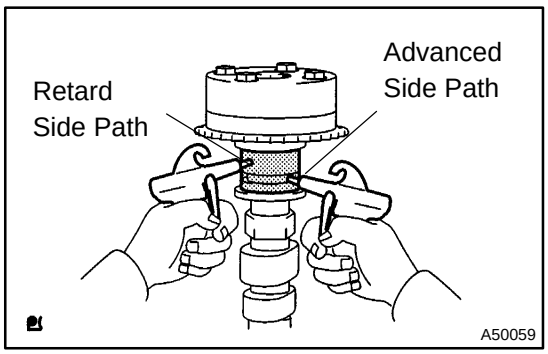
(a) Grip the camshaft with a vice, and confirm that the gear is locked.

CAUTION:
Be careful not to damage the camshaft.

(b) Cover 4 oil paths of cam journal with vinyl tape as shown in the illustration.

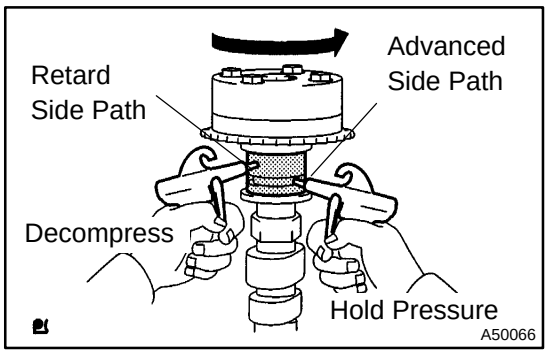
HINT:
Two advance side paths are provided in the groove of the camshaft. Plug one of the path with a rubber piece.

(c) Break through the tapes of the advance side path and the retard side path on the opposite side of the groove.



(d) Put air pressure into two broken paths (the advance side path and the retard side path) with about 150 kPa {1.5 kgf/cm^2}.

CAUTION:
Cover the paths with shop rag to avoid oil splashing.



(e) Confirm if the camshaft timing gear assembly revolves in the timing advance direction when weakening the air pressure of the timing retard path.

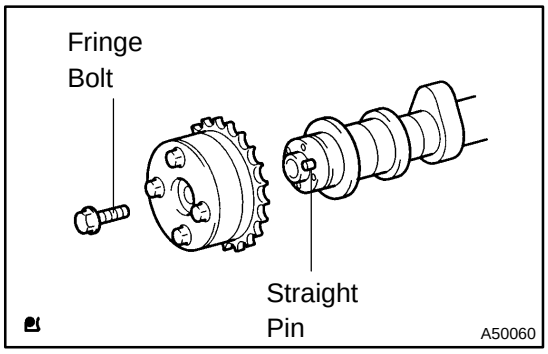
HINT:

The lock pin is released, and camshaft timing gear revolves in the advance direction.

(f) When the camshaft timing gear comes to the most advanced position, take out the air pressure of the timing retard side path, and then, takeout that of timing advance side path.

CAUTION:

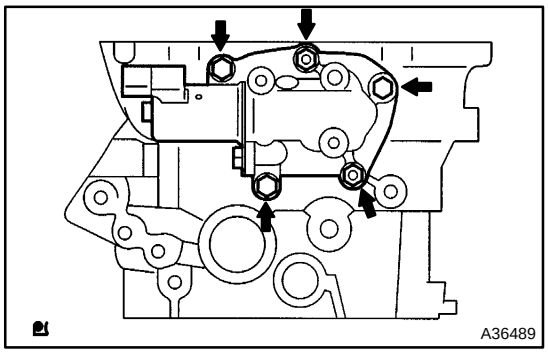
Camshaft timing gear assembly occasionally shifts to the retard side abruptly, if the air compression of the advanced side path is released before retard side paths. It often causes the breakage of the lock pin.



(g) Remove the fringe bolt of camshaft timing gear assembly.

NOTICE:

- **Be sure not to remove the other 4 bolts.**
- **In case of reusing the camshaft timing gear, release the strait pin locking first, and then install the gear.**

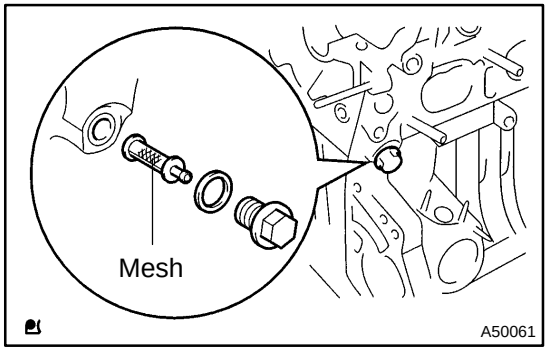


26. REMOVE CAM TIMING CONTROL VALVE HOUSING

(a) Remove the 3 bolts, 2 nuts and cam timing oil control valve housing.

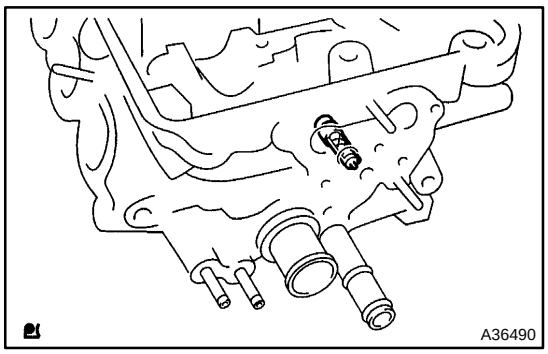
27. REMOVE CAM TIMING OIL CONTROL VALVE HOUSING GASKET

28. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSY

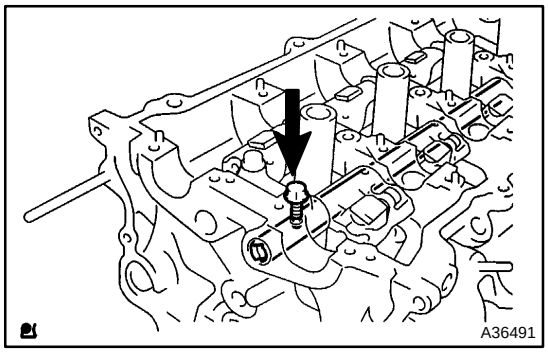


29. REMOVE OIL CONTROL VALVE FILTER

(a) Remove the plug and oil control valve filter.(Front side)



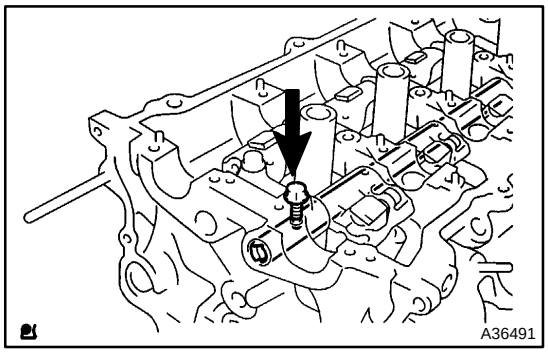
(b) Remove the oil control valve filter.(Rear side)



30. REMOVE VALVE ROCKER SHAFT SUB–ASSY NO.1

(a) Remove the bolt and the rocker shaft No.1.

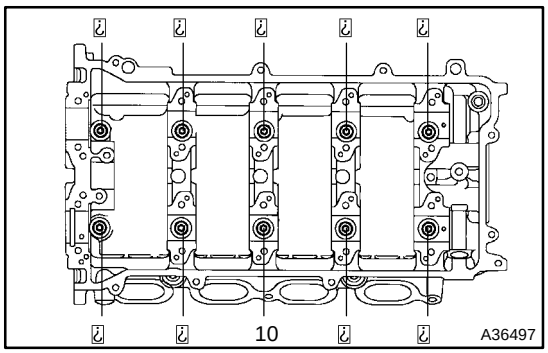
(b) Remove the valve rocker arm.



31. REMOVE VALVE ROCKER SHAFT SUB–ASSY NO.2

(a) Remove the bolt and the rocker shaft No.2.

(b) Remove the valve rocker arm.



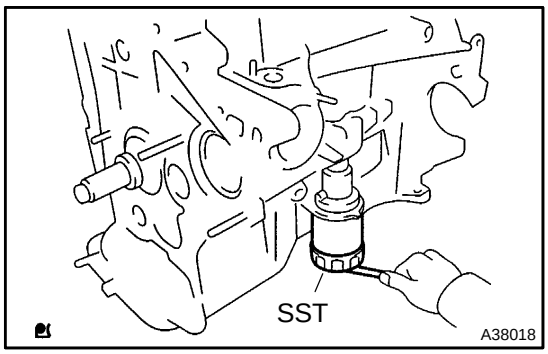
32. REMOVE CYLINDER HEAD SUB–ASSY

(a) Using a 10 mm bi–hexagon wrench, uniformly loosen an remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.

NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in an incorrect order.**

33. REMOVE CYLINDER HEAD GASKET

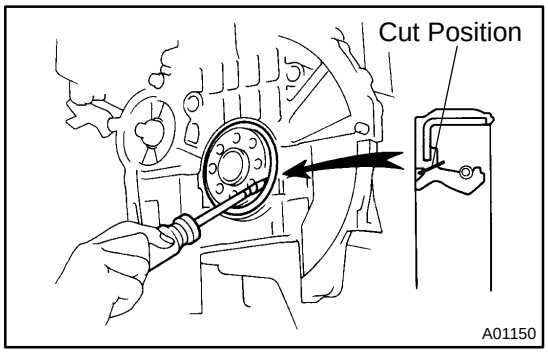


34. REMOVE OIL FILTER SUB–ASSY

(a) Using SST, remove the oil filter.
SST 09228–06501

35. REMOVE OIL FILTER UNION

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



36. REMOVE ENGINE REAR OIL SEAL

(a) Using a knife, cut off the oil seal lip.

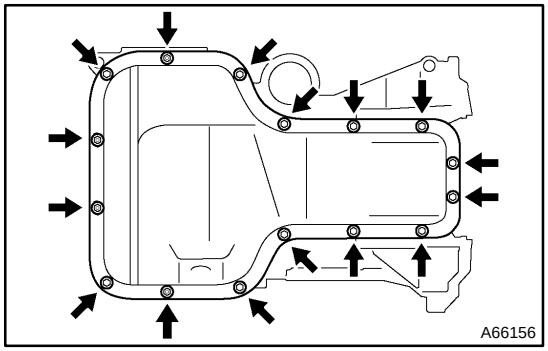
(b) Using a screwdriver with its tip taped, pry out the oil seal.

NOTICE:

After the removal, check if the crankshaft is not damaged. If there is, mend it with a sandpaper (# 400).

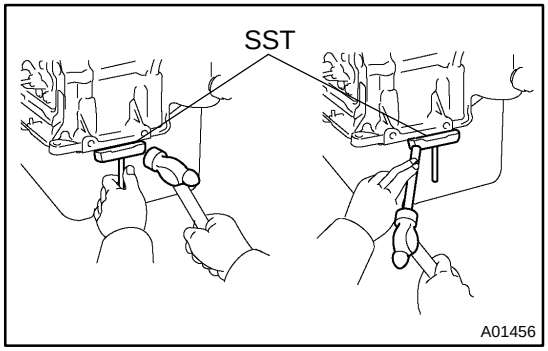
37. REMOVE OIL PAN DRAIN PLUG

38. REMOVE OIL PAN DRAIN PLUG GASKET



39. REMOVE OIL PAN SUB–ASSY

(a) Remove the 12 bolts and 4 nuts.



(b) Insert the blade of SST between the bearing cap sub–assembly and oil pan, and cut off applied sealer and remove the oil pan.
SST 09032–00100

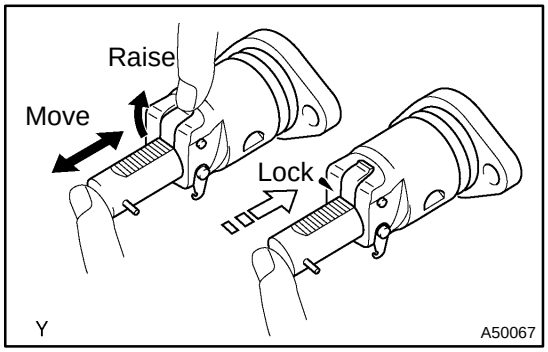
NOTICE:

Be careful not to damage the oil pan contact surface of the bearing cap sub–assembly and the oil pan flange.

40. REMOVE OIL STRAINER SUB–ASSY

41. REMOVE OIL STRAINER FLANGE GASKET

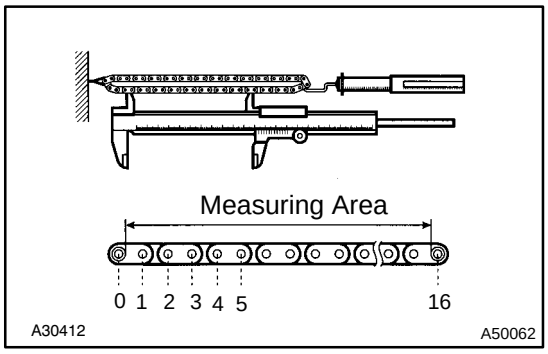
42. REMOVE OIL PAN BAFFLE PLATE



43. INSPECT CHAIN TENSIONER ASSY NO.1

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

(b) Release the ratchet pawl and check that the plunger is locked in place by the ratchet pawl and does not move when pushed with your finger.



44. INSPECT CHAIN SUB–ASSY

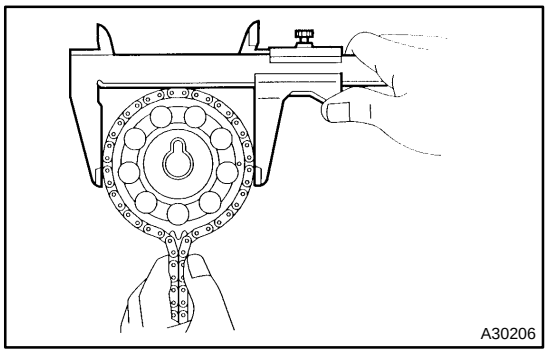
(a) Using a spring scale, pull the timing chain with 140 N (4.3 kgf, 315 lb) and measure the length of it.

Maximum chain elongation : 122.6 mm (4.827 in.)

(b) If the elongation is greater than maximum, replace the chain.

HINT:

Make the same measurements pulling at 3 or more places selected at random.



45. INSPECT CAMSHAFT TIMING GEAR OR SPROCKET

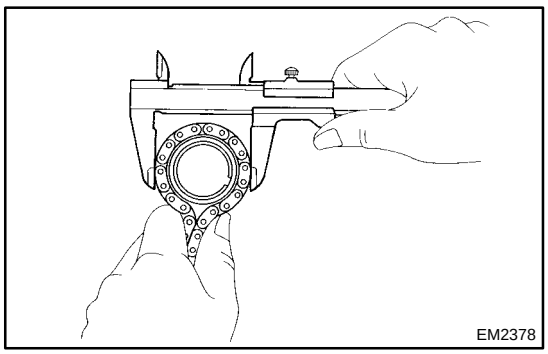
(a) Wrap the chain around the timing sprocket.

(b) Using a vernier calipers, measure the timing sprocket diameter with the chain.

Minimum sprocket diameter (w / chain):
97.3mm (3.831 in.)

NOTICE:

Vernier calipers must contact the chain rollers for measuring.



46. INSPECT CRANKSHAFT TIMING GEAR OR SPROCKET

(a) Wrap the chain around the timing sprocket.

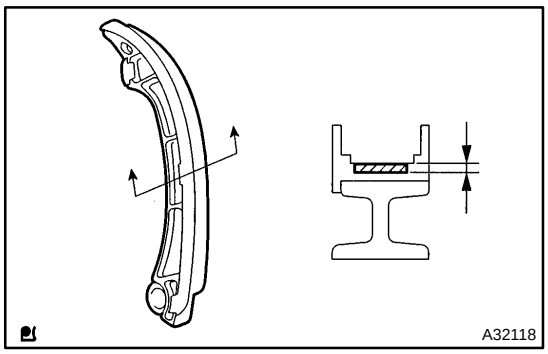
(b) Using a vernier calipers, measure the timing sprocket diameter with the chain.

NOTICE:

Vernier calipers must contact the chain rollers for the measuring.

Minimum sprocket diameter (w / chain):
51.6mm (2.031in.)

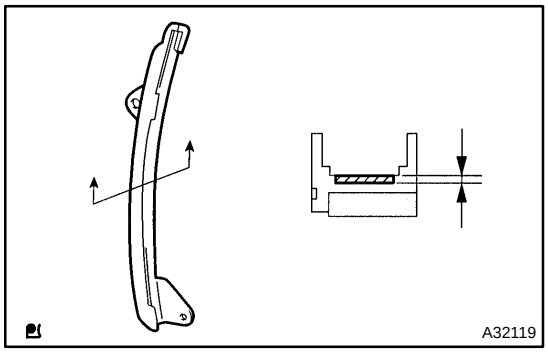
If the diameter is less than minimum, replace the chain and sprockets.



47. INSPECT CHAIN TENSIONER SLIPPER

(a) Measure the chain tensioner slipper wears.
Maximum wear: 1.0 mm (0.039 in.)

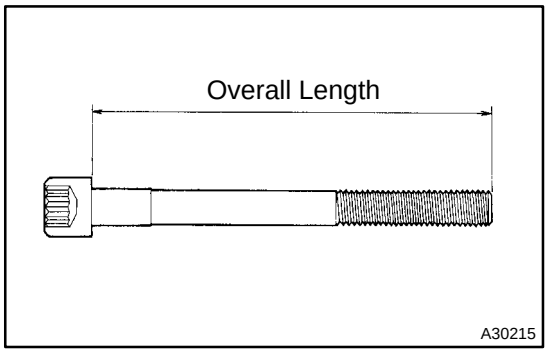
(b) If the wear is greater than maximum, replace the slipper.



48. INSPECT CHAIN VIBRATION DAMPER NO.1

(a) Measure the vibration damper wears.
Maximum wear: 1.0 mm (0.039 in.)

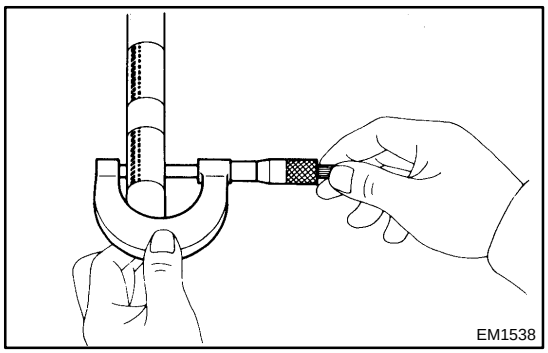
(b) If the wear is greater than maximum, replace the damper.



49. INSPECT CYLINDER HEAD BOLT

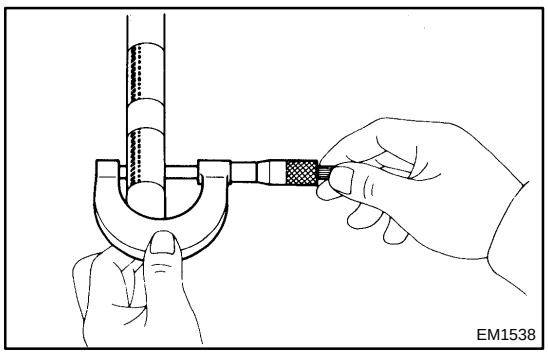
(a) Using vernier calipers, measure the length of head bolts from the seat to the end.
Standard bolt length:
146.8 – 148.2 mm (5.780–5.835 in.)
Maximum bolt length: 148.5 mm(5.846 in.)

(b) If the length surpasses the maximum, replace the bolt.



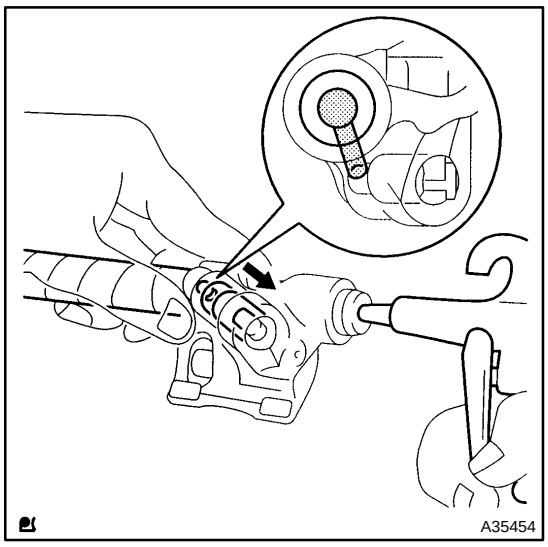
50. INSPECT VALVE ROCKER SHAFT SUB–ASSY NO.1

(a) Using a micrometer, measure the rocker No.1 shaft diameter.
Standard : 15.965 – 15.985 mm (0.6285 – 0.6293 in)



51. INSPECT VALVE ROCKER SHAFT SUB–ASSY NO.2

(a) Using a micrometer, measure the rocker No.2 shaft diameter.
Standard : 15.965 – 15.985 mm (0.6285 – 0.6293 in)

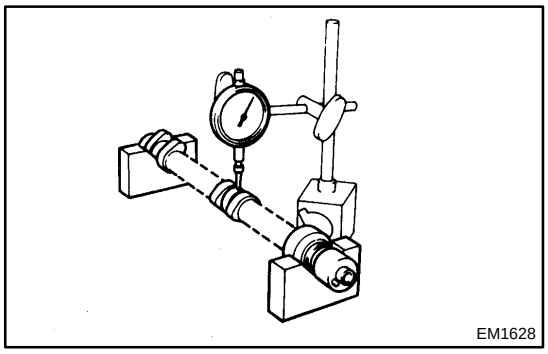


52. INSPECT VALVE ROCKER ARM

(a) Cover oil paths of the rocker arm shaft except 2 paths with vinyl type.

(b) Align the oil path of the rocker arm shaft to the oil path of the rocker arm.

(c) Check that the posfon inside of the rocker arm noves when air pressure 150 kpa {1.5kgf/cm^2 } is put to the oil paths.



53. INSPECT CAMSHAFT

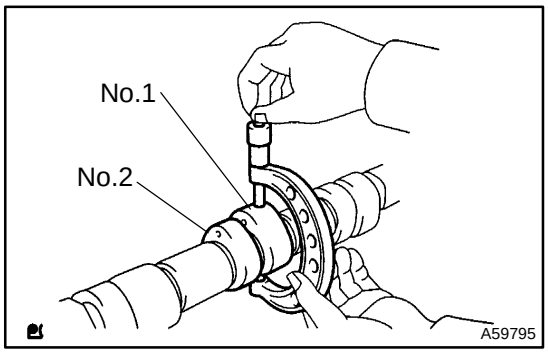
(a) Inspect camshaft for runout.

(1) Place the camshaft on V–blocks.

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

Maximum circle runout: 0.03 mm (0.0012 in.)

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

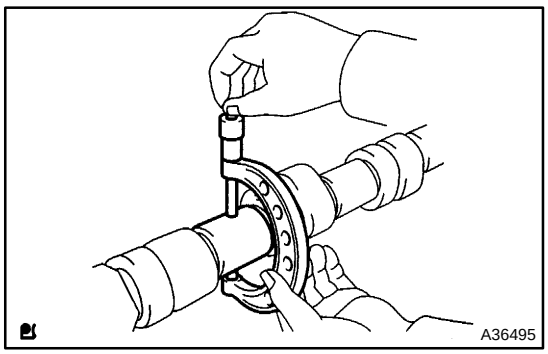


(c) Inspect cam lobes.

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

Standard cam lobe height:
No.1: 40.607 – 40.707 mm (1.5987 – 1.6026 in.)
No.2: 38.769 – 38.869 mm (1.5236 – 1.5303 in.)
Minimum cam lobe height:
No.1: 40.45 mm (1.5925 in.)
No.2: 38.61 mm (1.5201 in.)

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

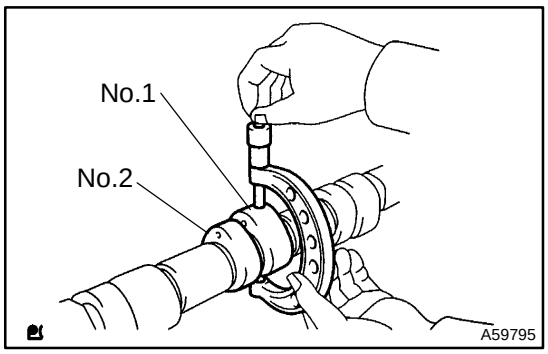


(d) Inspect camshaft journals.

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

No. 1 journal diameter:
34.449 – 34.465 mm (1.3563 – 1.3569 in.)
Others journal diameter:
27.949 – 27.965 mm (1.1004 – 1.1010 in.)

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



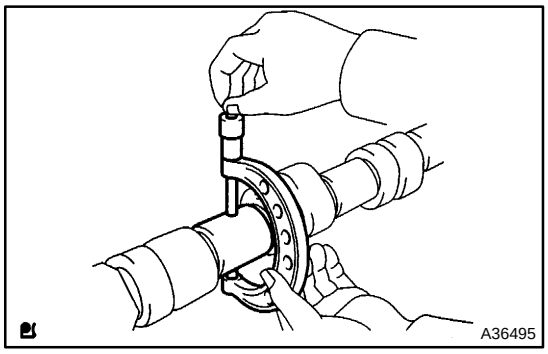
54. INSPECT NO.2 CAMSHAFT

(a) Inspect cam lobes.

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

Standard cam lobe height:
No.1: 40.019 – 40.119 mm (1.5756 – 1.5795 in.)
No.2: 38.863 – 38.963 mm (1.5300 – 1.5340 in.)
Minimum cam lobe height:
No.1: 39.86 mm (1.5693 in.)
No.2: 38.71 mm (1.5240 in.)

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



(b) Inspect camshaft journals.

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

No. 1 journal diameter:
34.449 – 34.465 mm (1.3563 – 1.3569 in.)
Others journal diameter:
27.949 – 27.965 mm (1.1004 – 1.1010 in.)

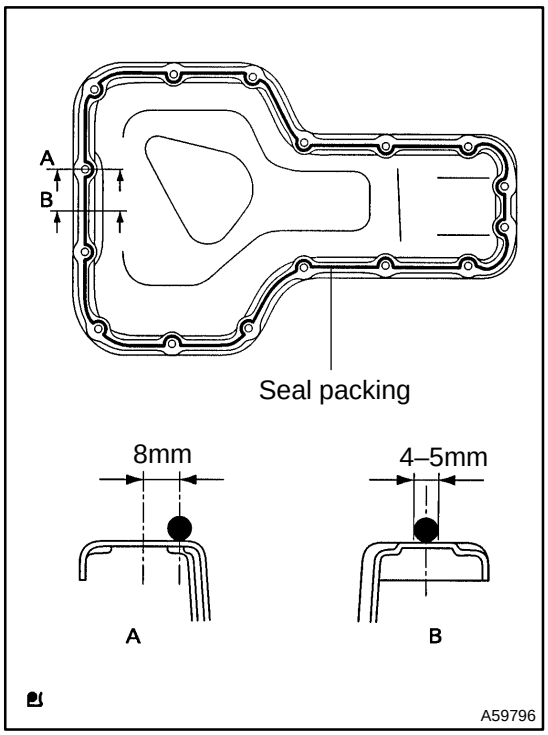
(2) If the journal diameter is not as specified, check the oil clearance.

55. INSTALL OIL PAN BAFFLE PLATE

(a) Install the oil pan baffle plate with the 2 bolts and 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

56. INSTALL OIL STRAINER SUB–ASSY

(a) Install a new gasket and the oil strainer with the 2 nuts and a bolt.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



57. INSTALL OIL PAN SUB–ASSY

(a) Remove any old packing material from the contact surface.

(b) Apply seal packing in the shape of bead (Diameter 3.5 mm – 4.5 mm(0.1379 – 0.177in)) consequently as shown in the illustration.

Seal packing: Part No. 08826–00080 or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes after applying seal packing.**
- **Do not put into engine oil within 2 hours after installing.**

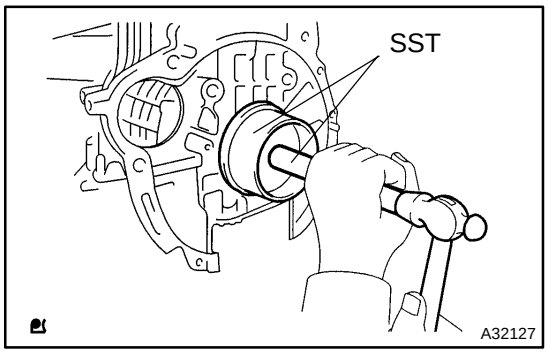
(c) Install the oil pan with the 12 bolts and 2 nuts.

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

58. INSTALL OIL PAN DRAIN PLUG

(a) Place a new gasket on the drain plug and install the oil pan drain plug.

Torque: 37 N·m (378 kgf·cm, 27 ft·lbf)



59. INSTALL ENGINE REAR OIL SEAL

(a) Apply MP grease to a new oil seal lip.

NOTICE:

Keep the lip off foreign materials.

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

SST 09223–15030, 09950–70010 (09951–07100)

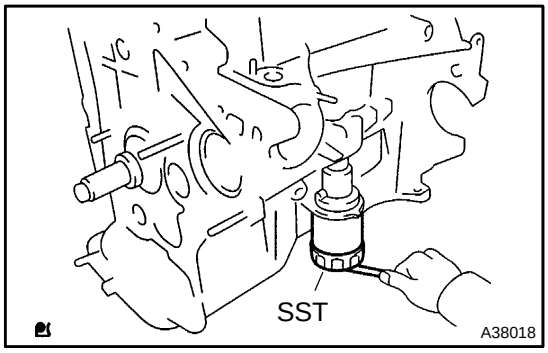
NOTICE:

Wipe off extra grease on the crank shaft.

60. INSTALL OIL FILTER UNION

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

Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)



61. INSTALL OIL FILTER SUB–ASSY

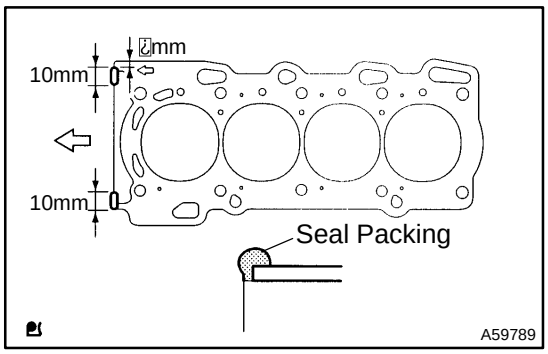
(a) Check and clean the oil filter installation surface.

(b) Apply clean engine oil to the gasket of a new oil filter.

(c) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.

(d) Using SST, tighten it an additional 3/4 turn.

SST 09228–06501



62. INSTALL CYLINDER HEAD GASKET

(a) Place a new cylinder head gasket on the cylinder block surface with the Lot No. stamp upward.

NOTICE:

- **Pay attention to the installation direction.**
- **Place the cylinder head quietly in order not to damage the gasket with the bottom part of the head.**

(b) Apply seal packing to the cylinder head gasket as shown in the illustration.

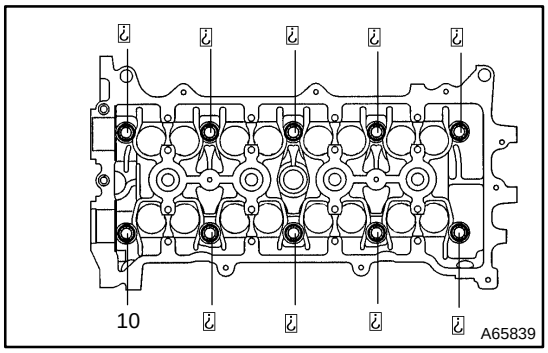
Seal packing:

Part No. 08826–00080 or equivalent

HINT:

avoid applying an excessive amount to the surface.

- Parts must be assembled with in 3 minutes of application. Otherwise the material must be removed and repplied.
- Immediately remove nozzle from the tube and reinstall cap.



63. INSTALL CYLINDER HEAD SUB–ASSY

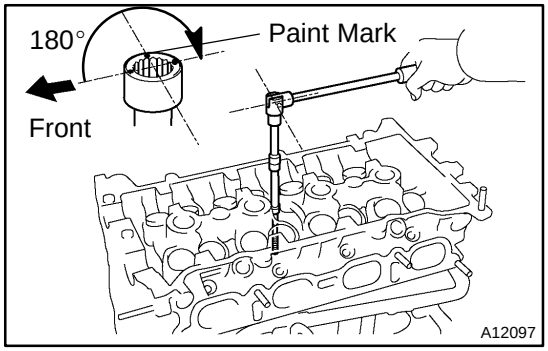
HINT:

The cylinder head bolts are tightened in 2 progressive steps.

(a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.

(b) Using a 10 mm bi–hexagon wrench, install and uniformly tighten the 10 cylinder head bolts with plate washers, in several passes, in the sequence shown.

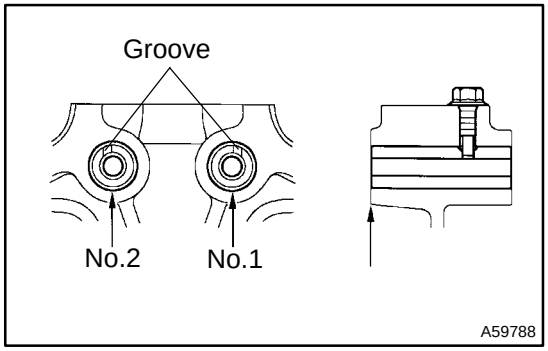
Torque: 35 N·m (357 kgf·cm, 26 ft·lbf)



(c) Mark the front of the cylinder head bolt with paint.

(d) Retighten the cylinder head bolts 180 ° in the numerical order shown.

(e) Check that the point marked bolts are moved at 180 ° angle.

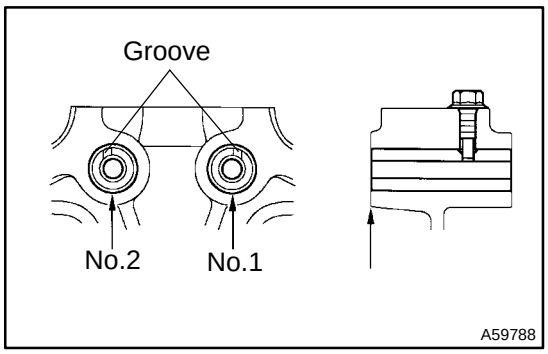


64. INSTALL VALVE ROCKER SHAFT SUB–ASSY NO.2

(a) Put the valve rocker shaft through the cylinder head and the hole of the valve rocker arm, and check the direction of the groove.

(b) Install a bolt to fix the rocker shaft No.2.

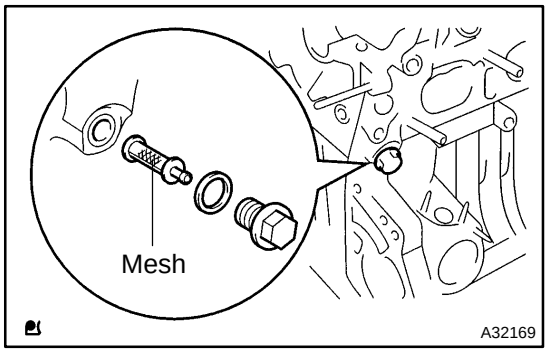
Torque: 9.0 N·m (92 kgf·cm 80 in.·lbf)



65. INSTALL VALVE ROCKER SHAFT SUB–ASSY NO.1

(a) Put the valve rocker shaft through the cylinder head and the hole of the valve rocker arm, and check the direction of the groove.

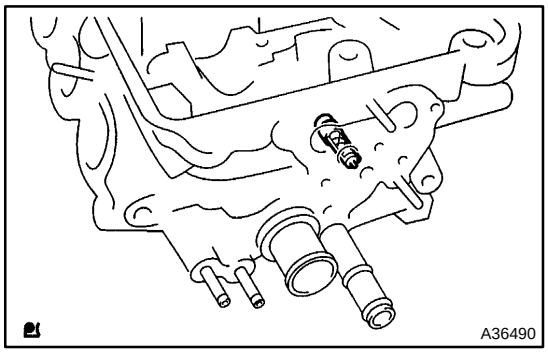
(b) Install a bolt to fix the rocker shaft No.1.
Torque: 9.0 N·m (92 kgf·cm 80 in.·lbf)



66. INSTALL OIL CONTROL VALVE FILTER

(a) Confirm that the filter is clear.

(b) Place a new gasket on the bolt and install the filter.(Front side)
Torque: 29 N·m (296 kgf·cm, 21 ft·lbf)

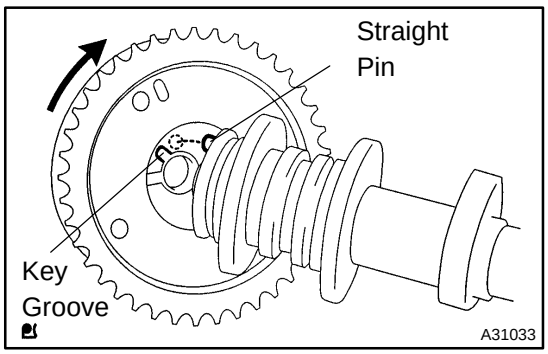


(c) Install the oil control valve filter from the cylinder head.(Rear side)

67. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSY
Torque: 9.0 N·m (92 kgf·cm 80 in.·lbf)

68. INSTALL CAM TIMING CONTROL VALVE HOUSING

(a) Install the cam timing control valve housing with a new gasket.
Torque: 9.0 N·m (92 kgf·cm 80 in.·lbf)



69. INSTALL CAMSHAFT TIMING GEAR ASSY

(a) Put the camshaft timing gear assembly and the camshaft together with the straight pin off the key groove.

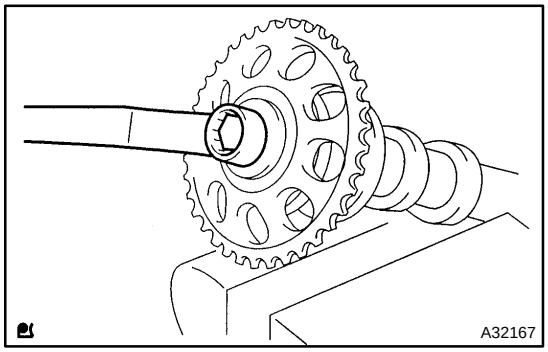
(b) Turn the camshaft timing gear assembly to the left direction (as shown in the illustration) with pushing it lightly against the camshaft. Push further at the position where the pin gets into the groove.

CAUTION:
Be sure not to turn the camshaft timing gear to the retard angle side (to the right angle).

(c) Check that there is no clearance between the gear's fringe and the camshaft.

(d) Tighten the fringe bolt with the camshaft timing gear fixed.
Torque: 54 N·m (551 kgf·cm 40 ft·lbf)

(e) Check that the camshaft timing gear assembly can move to the retard angle side (the right angle), and is locked at the most retarded position.



70. INSTALL CAMSHAFT TIMING GEAR OR SPROCKET

(a) Grip the camshaft with a vice, and install the camshaft timing gear.

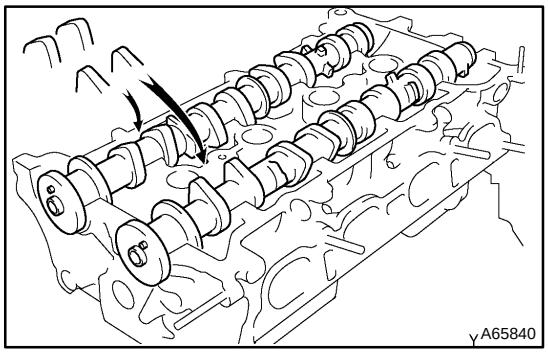
Torque: 54 N·m (551 kgf·cm 40 ft·lbf)

NOTICE:

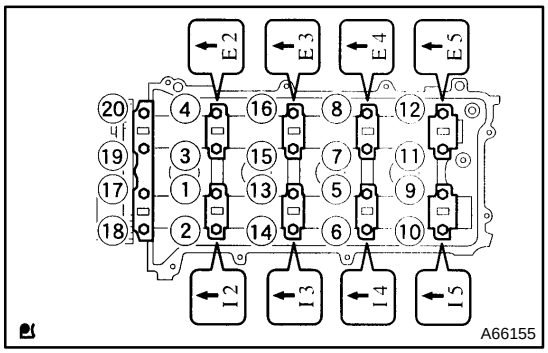
Be careful not to damage the camshaft.

71. INSTALL CAMSHAFT

(a) Apply light coat of engine oil on the camshaft journals.



(b) Place the 2 camshafts on the cylinder head with the No. 1 cam lobes facing as shown the illustration.

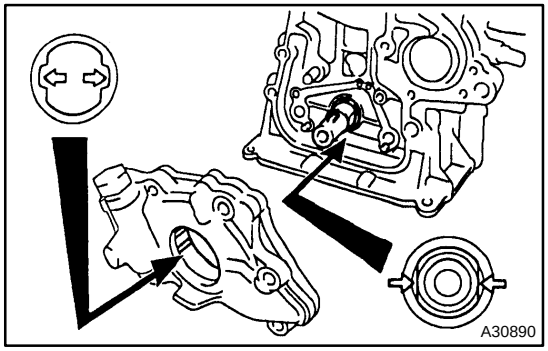


(c) Examine the front marks and numbers and tighten the bolts in the order shown in the illustration.

Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)

72. INSTALL OIL PUMP GASKET

(a) Place a new gasket on the cylinder block.

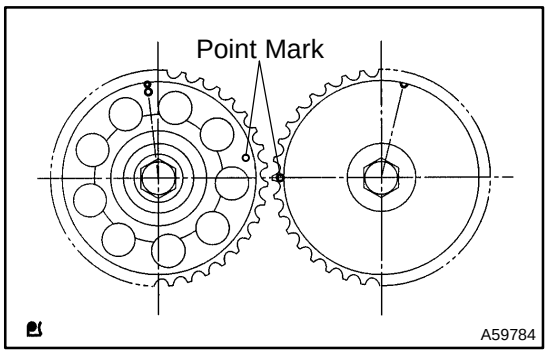


73. INSTALL OIL PUMP ASSY

(a) Engage the spline teeth of the oil pump drive rotor with the large teeth of the crankshaft, and side the oil pump.

(b) Install the oil pump with the 5 bolts.

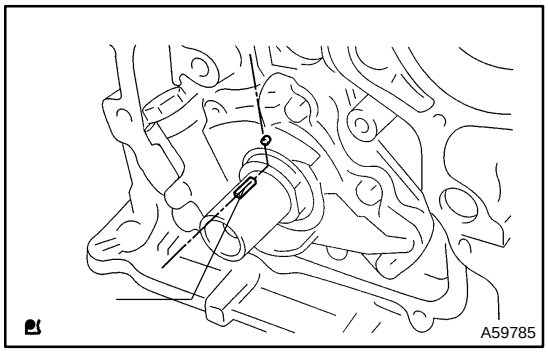
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



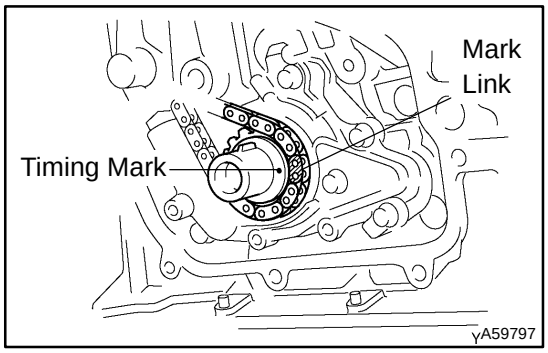
74. INSTALL CHAIN SUB–ASSY

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

(1) Turn the hexagonal wrench head portion of the camshafts, and align the point marks of the camshaft timing sprockets.



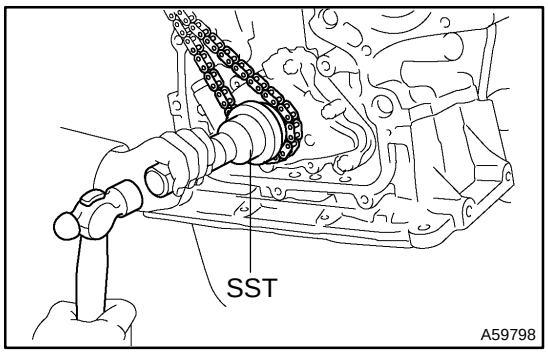
(2) Turn the crankshaft and set the set key on the crankshaft upward.



(b) Install the timing chain on the crankshaft timing sprocket with the mark link (yellow color link) aligned with the timing mark on the crankshaft timing sprocket.

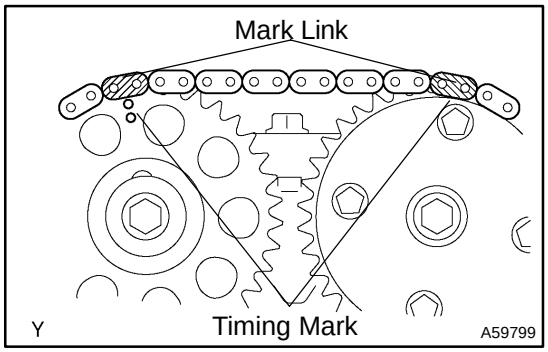
HINT:

A yellow color link and 2 orange color links are on the chain.



(c) Using a SST, install the sprocket.

SST 09223–22010



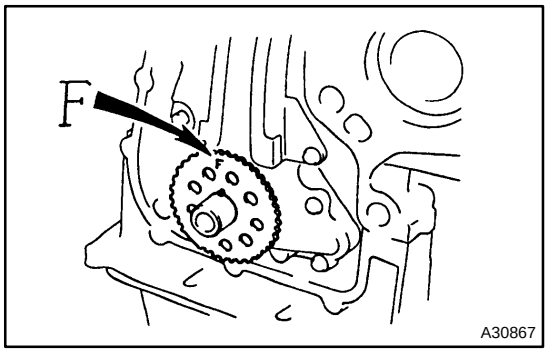
(d) Install the timing chain on the camshaft timing sprockets with the mark link (orange color links) aligned with the timing marks on the camshaft timing sprockets.

75. INSTALL CHAIN VIBRATION DAMPER NO.1

(a) Install the 2 bolts and the chain vibration damper No.1.
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)

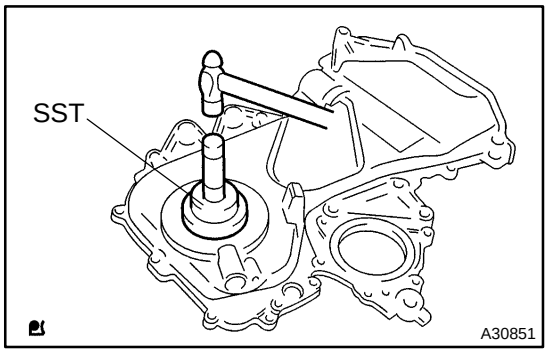
76. INSTALL CHAIN TENSIONER SLIPPER

(a) Install the bolt and the chain tensioner slipper.
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)



77. INSTALL CRANKSHAFT POSITION SENSOR PLATE NO.1

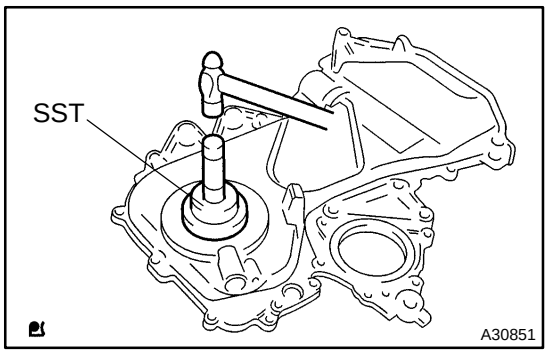
(a) Install the plate with the ”F” mark facing forward.



78. INSTALL TIMING GEAR COVER OIL SEAL

(a) Apply MP grease to the oil seal lip.
(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.
SST 09223–22010

NOTICE:
Keep the lip off foreign materials.



79. INSTALL TIMING CHAIN OR BELT COVER SUB–ASSY

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surface of the timing chain cover, cylinder head and cylinder block.
- Using a razor blade and a gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing grooves.
- Thoroughly clean all components to remove all the loose material.
- Using a non–residue solvent, clean both sealing surfaces.

(b) Apply seal packing to the timing chain cover as shown in the illustration.

Seal packing:

Part No. 08826–00100 or equivalent

- Install a nozzle that has been cut to a 1.5 mm opening.

HINT:

Avoid applying an excessive amount to the surface.

- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

(c) Install the 2 gaskets to the timing chain cover an shown in the illustration.

(d) Apply seal packing to 4 locations an shown in the illustration.

Seal packing:

Part No. 08826–00080 or equivalent

- Install a nozzle that has been cut to a 4 – 5 mm (0.16 – 0.20 in.)opening.

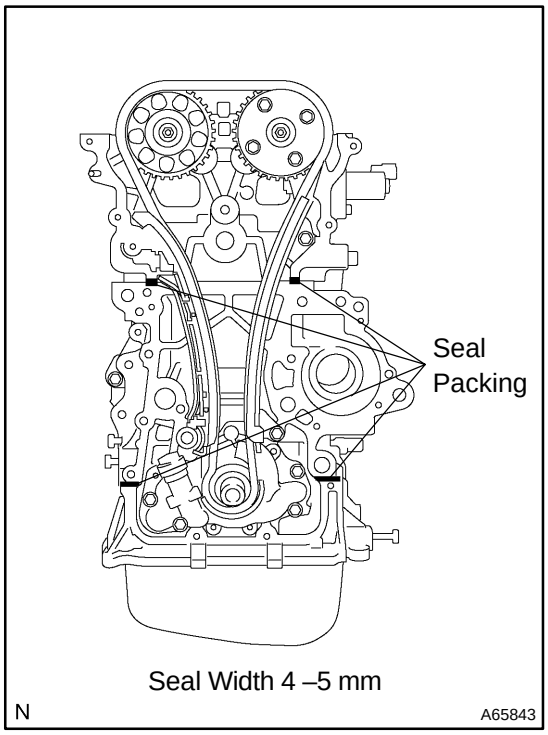
HINT:

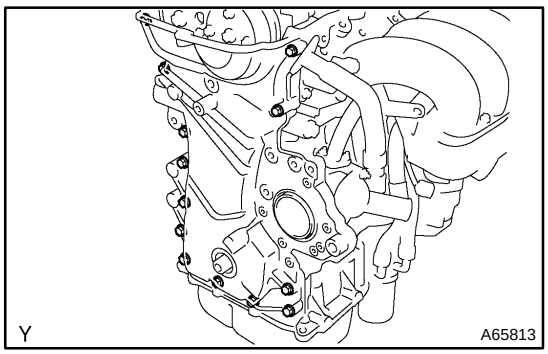
Avoid applying an excessive amount to the surface.

- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

NOTICE:

- **Do not put into engine oil within 2 hours after installing.**





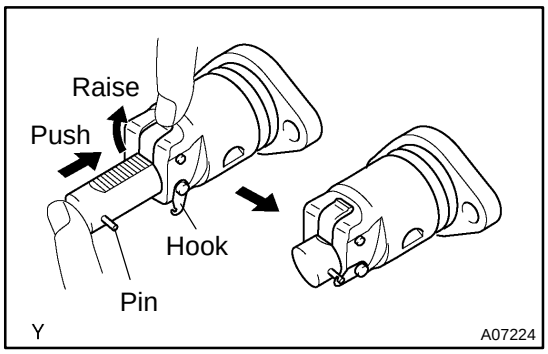
(e) Install the timing chain cover, with the 13 bolts.

Torque:

21 N·m (214 kgf·cm, 15 ft·lbf) (M8)

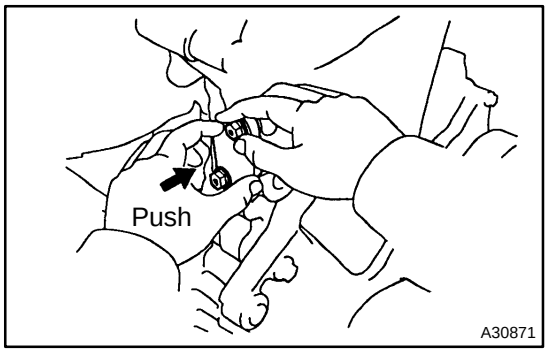
11 N·m (112 kgf·cm, 8 ft·lbf) (M6)

(f) Install the stud bolt.



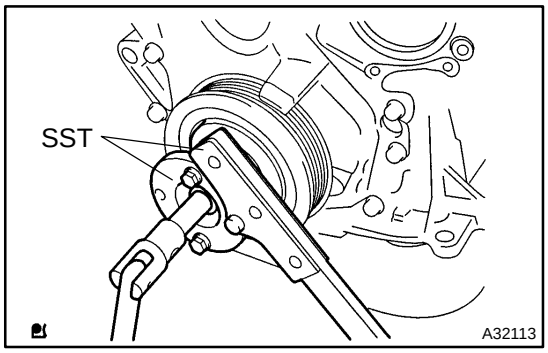
80. INSTALL CHAIN TENSIONER ASSY NO.1

(a) Check the O–ring is clean, and set the hook as shown in the illustration.



(b) Apply engine oil to the chain tensioner and install it.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

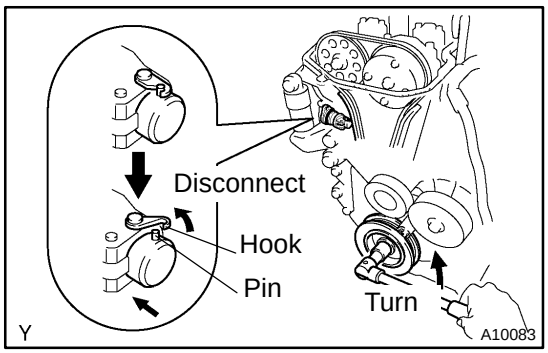
NOTICE:
When installing the tensioner, set the hook again if the hook releases the plunger.



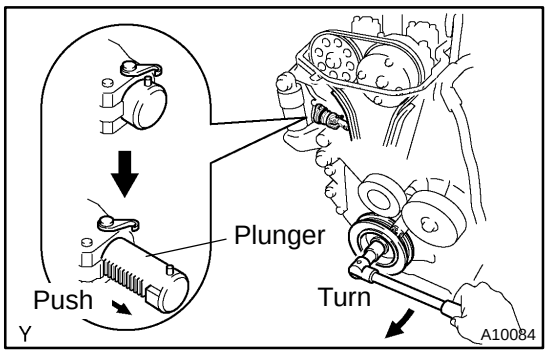
81. INSTALL CRANKSHAFT PULLEY

(a) Align the pulley set key with the key groove of the pulley, and slide on the pulley.

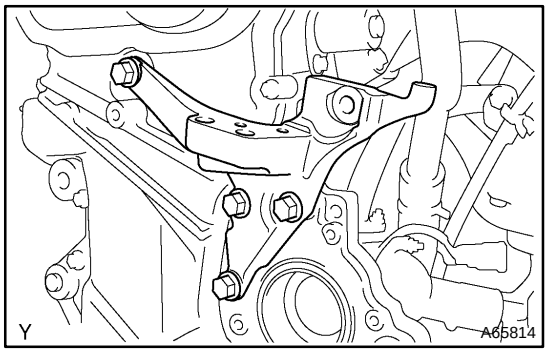
(b) Using SST, install the pulley bolt.
SST 09213–70011(09213 – 70020), 09330–00021
Torque: 118 N·m (1,203 kgf·cm, 87 ft·lbf)



(c) Turn the crankshaft counterclockwise, and disconnect the plunger knock pin from the hook.

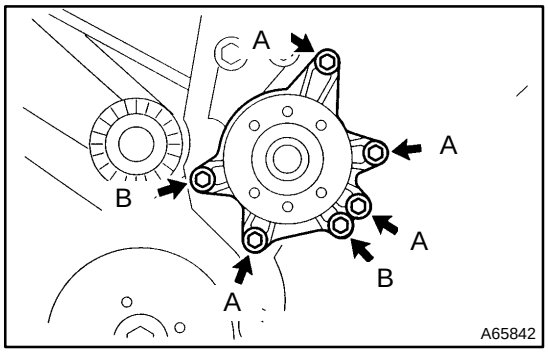


(d) Turn the crankshaft clockwise, and check that the slipper is pushed by the plunger.



82. INSTALL TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)



83. INSTALL WATER PUMP ASSY

(a) Place a new O–ring on the timing chain cover.

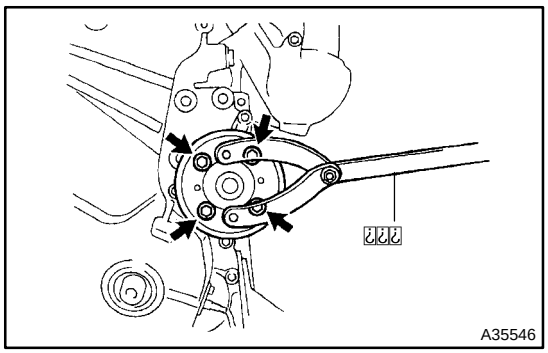
(b) Install the water pump with the 6 bolts.

Torque:9.0 N·m (92 kgf·cm, 80 in·lbf)

HINT:

Each bolt length is indicated in the illustration.

Bolt A	35 mm (1.38 in.)
Bolt B	28 mm (1.10 in.)

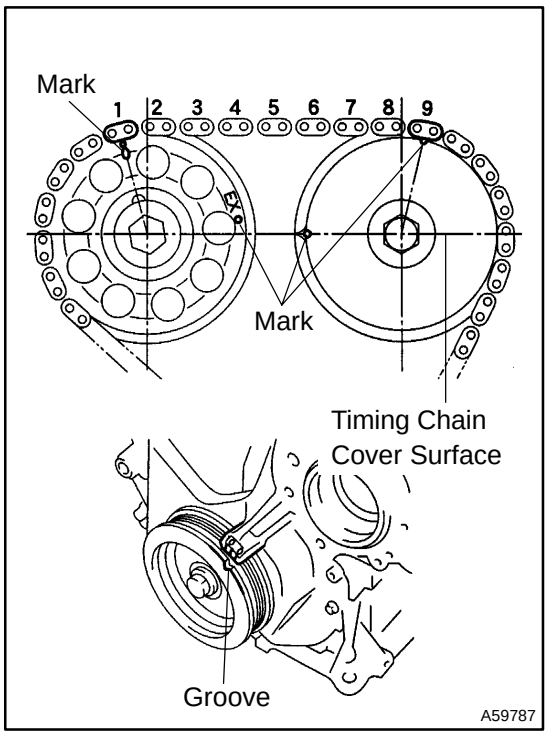


84. INSTALL WATER PUMP PULLEY

(a) Using SST the water pump pulley.

SST 09960–10010 (09962–01000, 09963–00600)

Torque: 15 N·m (153 kgf·cm, 11 ft·lbf)



85. INSPECT VALVE CLEARANCE

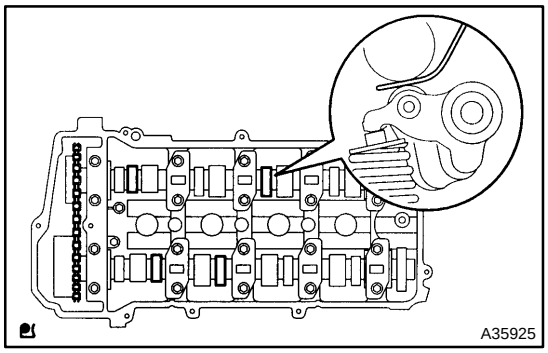
(a) Set No. 1 cylinder to TDC/compression.

(1) Turn the crankshaft pulley, and align its groove with timing mark ”0” of the timing chain cover.

(2) Check that the point marks of the camshaft timing sprocket and VVT timing sprocket are in straight line on the timing chain cover surface as shown in the illustration.

HINT:

If not, turn the crankshaft 1 revolution (360°) and align the marks as above.



(b) Check only the valves indicated.

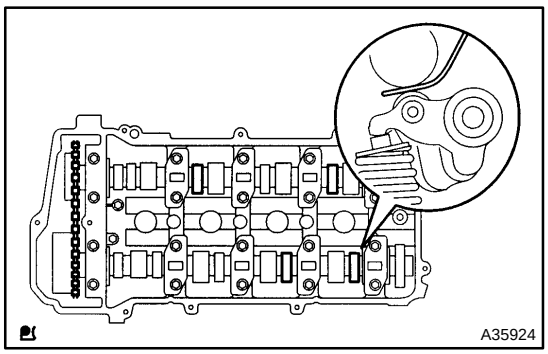
(1) Using a feeler gauge, measure the clearance between the valve rocker arm and camshaft.

(2) Record the out–of specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

Valve clearance (Cold)

Intake	0.08 – 0.18 mm (0.0031 – 0.0070 in.)
Exhaust	0.22 – 0.32 mm (0.0087 – 0.0126 in.)

(c) Turn the crankshaft 1 revolution (360 °) and set No. 4 cylinder to TDC/compression.



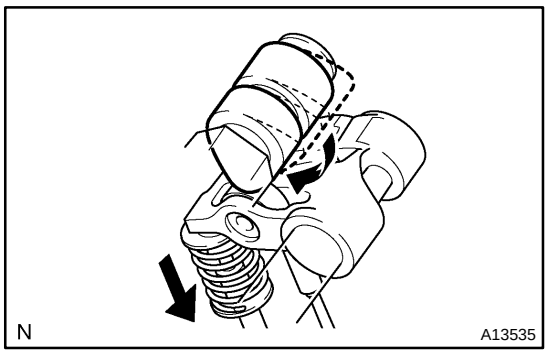
(d) Check only the valves indicated.

(1) Using a feeler gauge, measure the clearance between the valve rocker arm and camshaft.

(2) Record the out–of specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

Valve clearance (Cold)

Intake	0.08 – 0.18 mm (0.0031 – 0.0070 in.)
Exhaust	0.22 – 0.32 mm (0.0087 – 0.0126 in.)

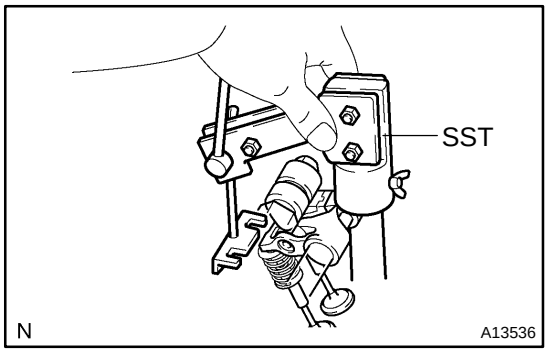


86. ADJUST VALVE CLEARANCE

(a) Set the SST.

NOTICE:

Remove the spark plug and take off the compression.

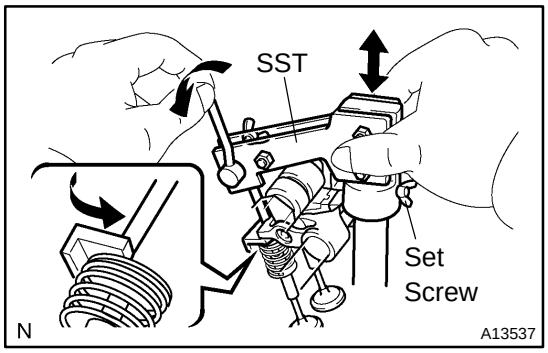


(1) Insert SST into the plug tube.

SST 09248–77010(09248–07010)

NOTICE:

- **SST cannot be inserted unless the set screw is loosened.**
- **Make sure that the camshaft is in the same condition as step (1).**



(2) Operate the lever so that SST's seat surface comes to contact with the valve retainer and lock them with the set screw.

NOTICE:

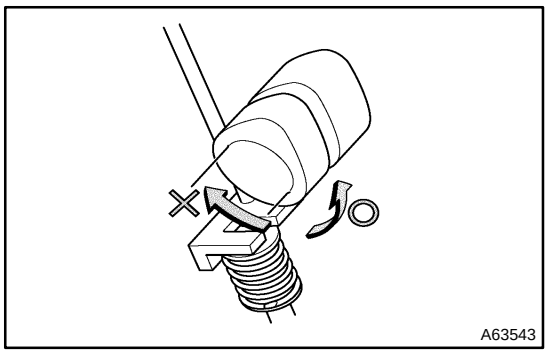
- **Clearance between the valve retainer and SST's seat surface is not allowed.**
- **Care should be taken not to make clearance when inserting SST, since a presence of clearance may unlock the keeper.**

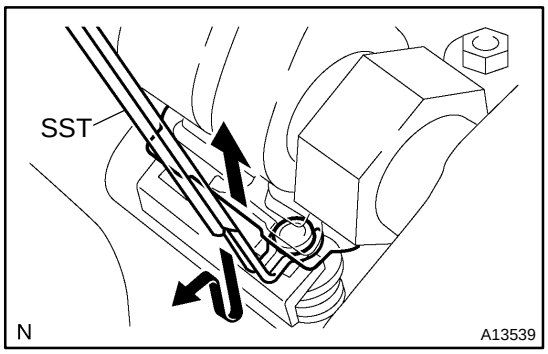
(3) lock the set screw on the plug tube side of SST.

(4) Rotate the crankshaft so that the camshaft is positioned as shown in the illustration.

NOTICE:

- **Pay attention to the direction of the rotation to prevent the nose of the camshaft from interfering with the SST's shaft.**
- **Do not rotate the crankshaft excessively.**





(b) Remove the adjusting shim.

(1) Lift the rocker arm to make a room and remove the adjusting shim using SST.

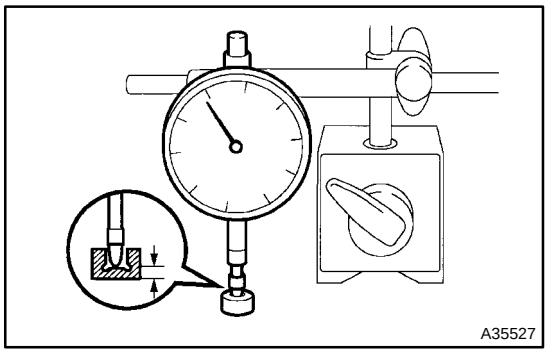
SST 09248–77010(09248–07010)

NOTICE:

Do not remove SST in the condition that adjusting shim is removed.

HINT:

- Setting SST from the right above makes the removal easy.
- If there is not enough room, reset SST.



(2) Determine the size of the replaced shim according to there Formula or Charts:

- Using a dial indicator, measure the thickness of the removed shim.
- Calculate the thickness of a new shim so that the valve clearance comes within the specified value.

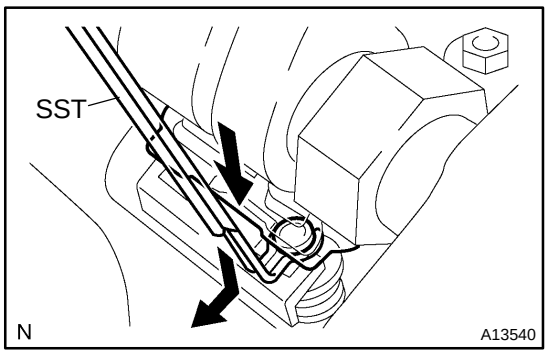
A	Thickness of new shim
B	Thickness of used shim
C	Measured valve clearance

Intake: A = B + (C – 0.13 mm (0.005 in.)) × 1.5

Exhaust: A = B + (C – 0.27 mm (0.011 in.)) × 1.5

HINT:

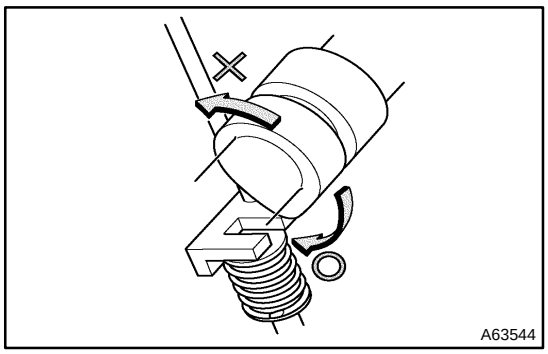
Shim are available in 41 sizes in increments of 0.020 mm (0.0008 in.), from 2.000 mm (0.0787 in.) to 2.800 mm (0.1102 in.).



(c) Lift the rocker arm to make a room and use SST, install the adjusting shim.

HINT:

- Setting SST from the right above makes the removal easy.
- To remove SST from the adjusting shim, it is advisable to push down the rocker arm.



(d) Turn the crankshaft so that the related rocker arm, where the valve clearance is adjusted, is fully pushed down.

NOTICE:

- **Pay attention to the direction of the rotation to prevent the nose of the camshaft from interfering with the SST's shaft.**
- **Do not rotate the crankshaft excessively.**

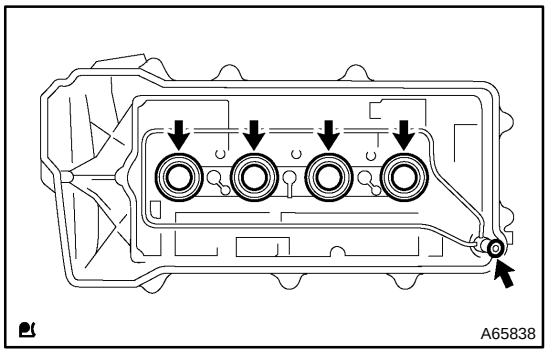
(e) After loosening the 2 set screws of SST, remove SST itself.

SST 09248–77010(09248–07010)

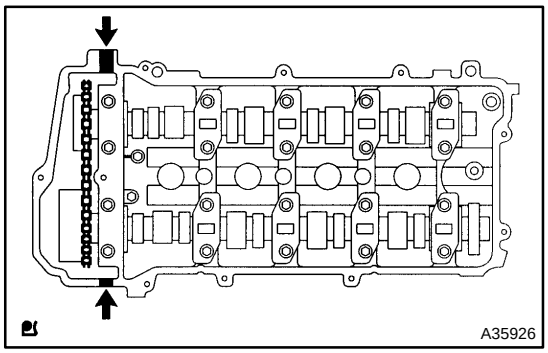
87. INSTALL CYLINDER HEAD COVER SUB–ASSY

(a) Remove any old packing (FIPG) material.

(b) Install the new cylinder head cover gasket to the cylinder head cover.



(c) Install the new spark plug tube gasket and a new O–ring to the cylinder head cover.

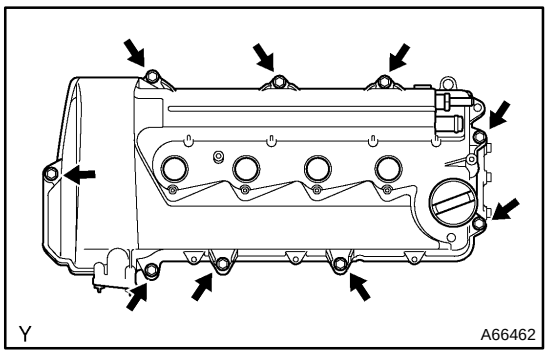


(d) Apply seal packing to 2 locations as shown in the illustration.

Seal packing: Part No. 08826–00080 or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the cylinder head cover within 3 minutes after applying seal packing.**
- **Do not put into engine oil 2 hours after installing.**



(e) Install the cylinder head cover and cable bracket with the 9 bolts.

Uniformly tighten the bolts, in the several passes,in the sequence shown.

Torque: 10 N·m (102 kgf·cm, 89 in.·lbf)

88. INSTALL SPARK PLUG

Torque: 18 N·m (184 kgf·cm, 13 ft·lbf)

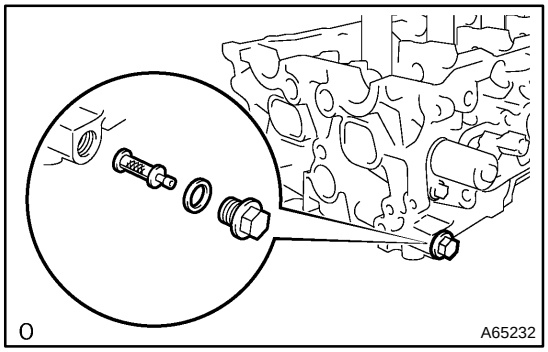
89. INSTALL VENTILATION VALVE SUB–ASSY

Torque: 27 N·m (275 kgf·cm, 20 ft·lbf)

CYLINDER HEAD ASSY (2ZZ–GE)

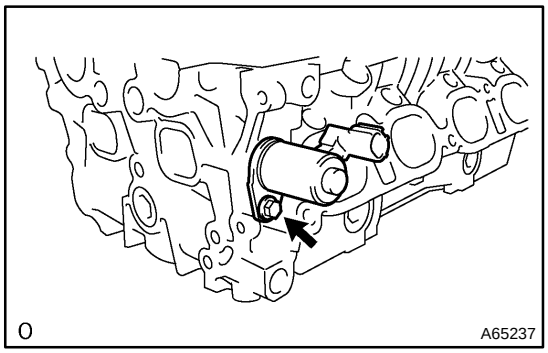
140RJ–01

OVERHAUL



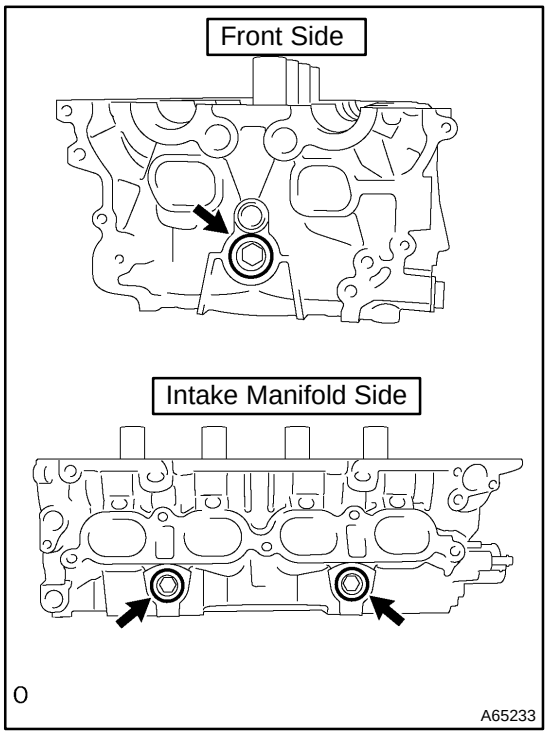
1. REMOVE OIL CONTROL VALVE FILTER

(a) Remove the plug and oil control valve filter.



2. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSY

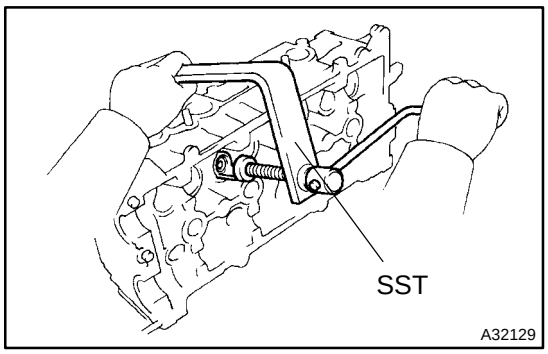
(a) Remove a bolt and oil control valve.



3. REMOVE W/HEAD TAPER SCREW PLUG NO.1

(a) Using hexagon socket wrench (14), remove 3 taper screw plug No.1 as shown in the illustration.

4. REMOVE VALVE ADJUSTING SHIM



5. REMOVE INNER COMPRESSION SPRING

HINT:

Arrange the inner compression spring, spring retainer and retainer lock in the correct order.

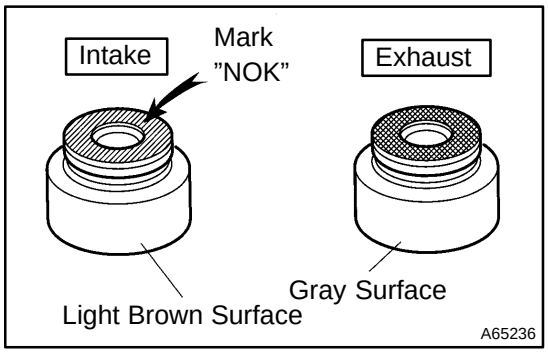
(a) Using SST compress the inner compression spring and remove 2 keepers.
SST 09202–70020

(b) Remove the spring retainer.

(c) Remove the inner compression spring.

6. REMOVE VALVE STEM OIL O SEAL OR RING

(a) Using a needle–nose pliers,remove the valve stem oil o seal or ring.



7. REMOVE VALVE SPRING SEAT

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

HINT:

Arrange the spring seat in the correct order.

8. REMOVE INTAKE VALVE

HINT:.

Arrange the intake valve in the correct order.

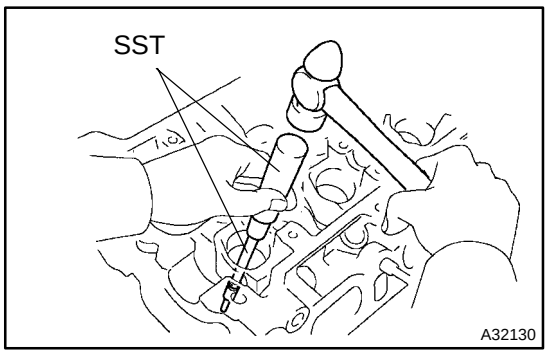
9. REMOVE EXHAUST VALVE

HINT:

Arrange the exhaust valve in the correct order.

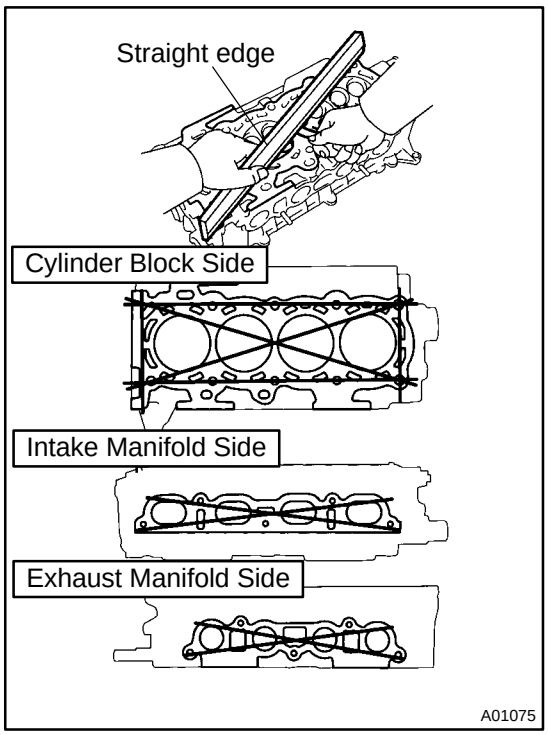
10. REMOVE VALVE GUIDE BUSH

(a) Heat the cylinder head to 110 – 130°C (230 – 266°F).



(b) Using SST and a hammer tap out the valve guide bushing.
SST 09201–10000, 09201–01055, 09950–70010 (09951–07100)

11. REMOVE STUD BOLT

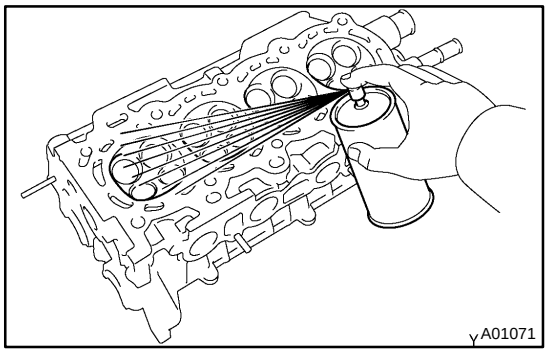


12. INSPECT CYLINDER HEAD FOR FLATNESS

(a) Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder block and the manifolds for warpage.

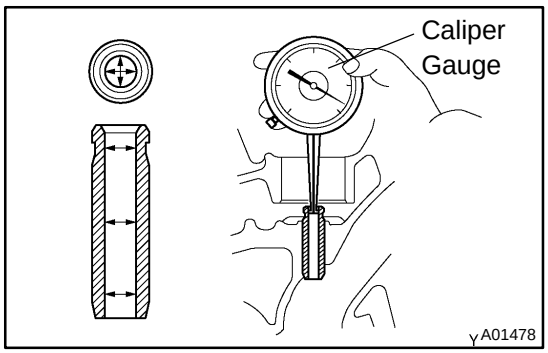
Maximum warpage:

Cylinder block side	0.2 mm (0.0080 in.)
Intake manifold side	0.2 mm (0.0080 in.)
Exhaust manifold side	0.3 mm (0.0120 in.)



13. INSPECT CYLINDER HEAD FOR CRACKS

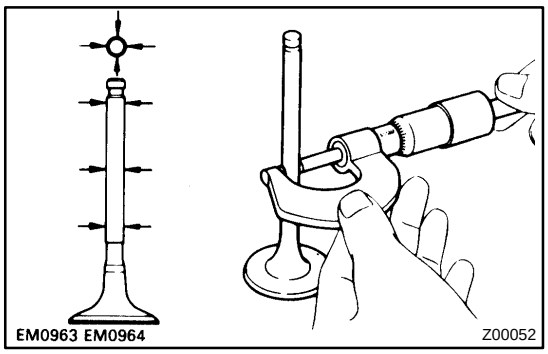
(a) Using a dye penetrate, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.



14. INSPECT VALVE GUIDE BUSHING OIL CLEARANCE

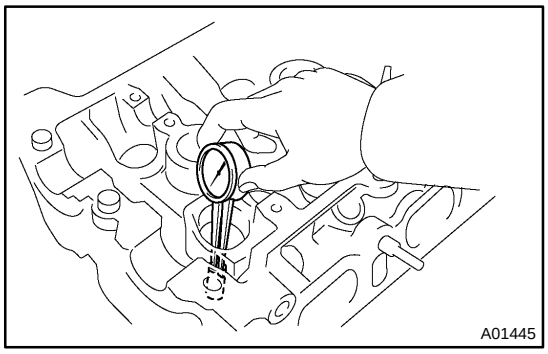
(a) Using a caliper gauge, measure the inside diameter of the guide bushing.

Busing inside diameter:
5.500 – 5.518 mm (0.2165 – 0.2172 in.)



(b) Using a micrometer, measure the diameter of the valve stem.
Valve stem diameter:
Intake 5.460 – 5.475 mm (0.2145 – 0.2156 in.)
Exhaust 5.455 – 5.470 mm (0.2144 – 0.2154 in.)

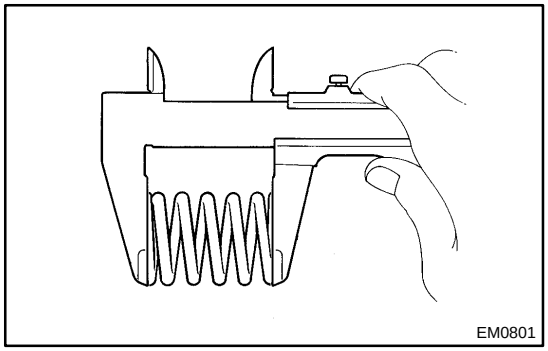
(c) Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.
Standard oil clearance:
Intake 0.025 – 0.058 mm (0.0010 – 0.0023 in.)
Exhaust 0.030 – 0.063 mm (0.0012 – 0.0025 in.)
Maximum oil clearance: 0.10 mm (0.0039 in.)



15. INSPECT VALVE GUIDE BUSH

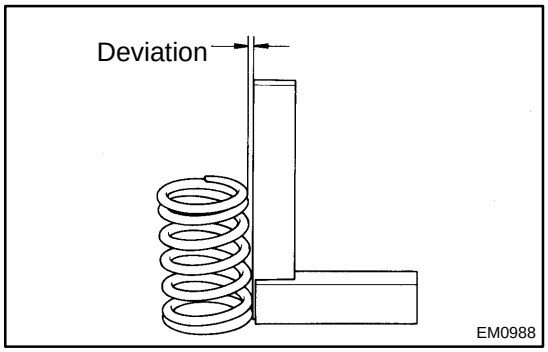
(a) If the busing bore diameter of the cylinder head is greater than 10.506 mm (0.4136 in.), machine the bushing bore to the dimension of 10.538 – 10.556 mm (0.4149 – 0.4156 in.) to install a over size busing.
Bushing bore diameter:
10.538 – 10.556 mm (0.4149 – 0.4156 in.)

bushing size	Bushing bore diameter mm (in.)
Use STD	10.448 – 10.506 (0.4129 – 0.4136)
Use O/S 0.05	10.538 – 10.556 (0.4149 – 0.4156)

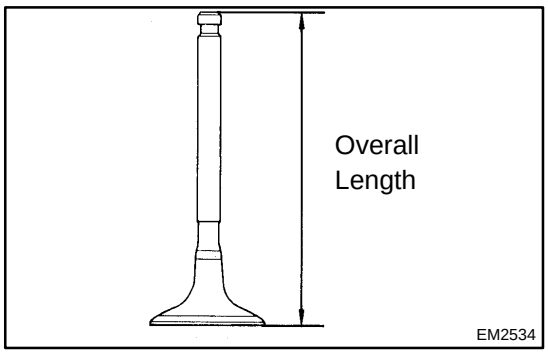


16. INSPECT INNER COMPRESSION SPRING

(a) Using a vernier caliper measure the free length of the valve spring.
Free length:
Intake 46.4 mm (1.827 in.)
Exhaust 46.5 mm (1.831 in.)

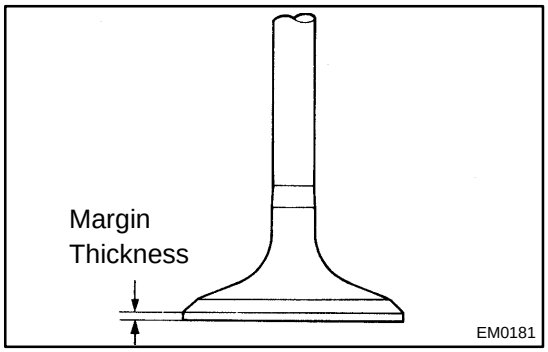


(b) Using a steel square, measure the deviation of the valve spring.
Maximum deviation: 1.6 mm (0.063 in.)
Maximum angle (reference): 2°

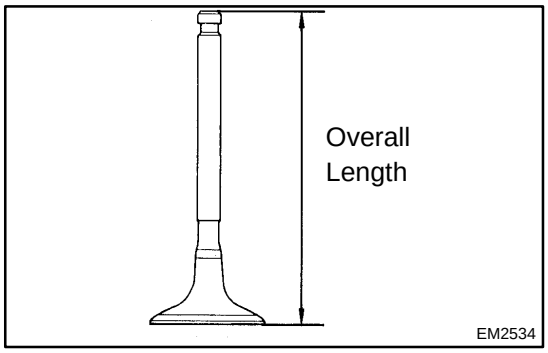


17. INSPECT INTAKE VALVE

(a) Check the valve overall length.
Standard overall length: 111.3 mm (4.382 in.)
Minimum overall length: 110.9 mm (4.366 in.)

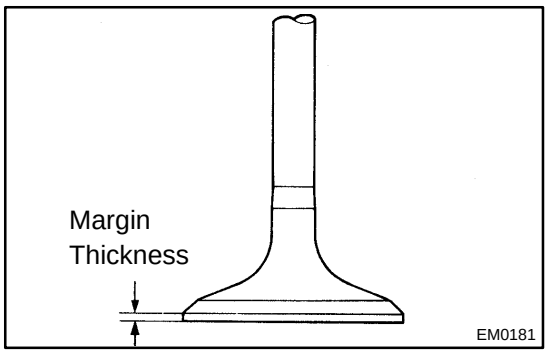


(b) Check the valve head margin thickness.
Standard margin thickness: 1.0 mm (0.039 in.)
Minimum margin thickness: 0.7 mm (0.028 in.)



18. INSPECT EXHAUST VALVE

(a) Check the valve overall length.
Standard overall length: 111.7 mm (4.392 in.)
MInimum overall length: 111.3 mm (4.382 in.)

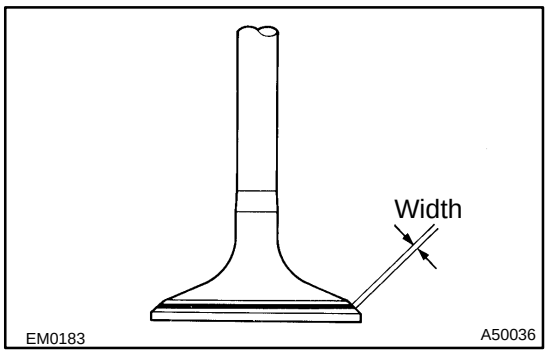


(b) Check the valve head margin thickness.
Standard margin thickness: 1.0 mm (0.039 in.)
MInimum margin thickness: 0.7 mm (0.028 in.)

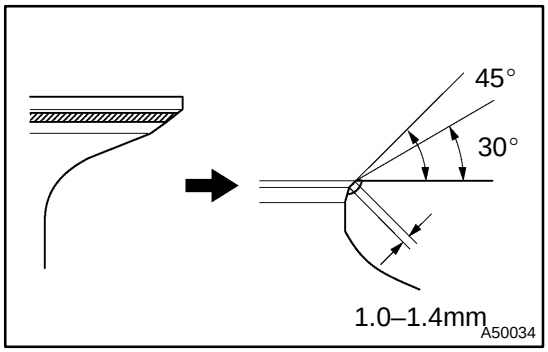
19. INSPECT VALVE SEATS

(a) Apply a light coat of prussian blue (or white lead) to the valve face.

(b) Lightly press the valve against the seat.



(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 blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
  (3) Check that the seat contact is in the middle of the valve face with the width between 1.0 – 1.4 mm (0.039 – 0.055 in.).

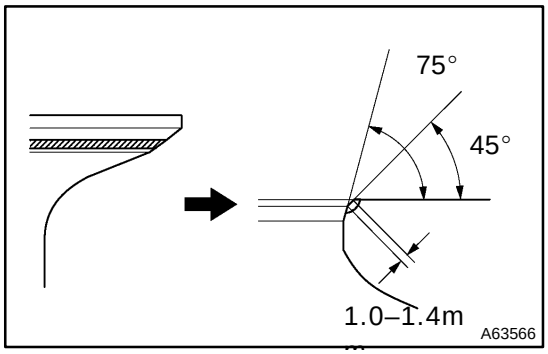


20. REPAIR VALVE SEATS

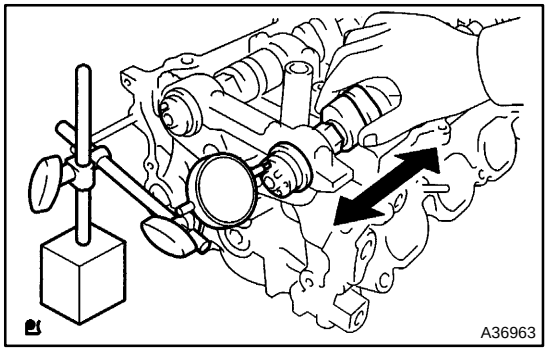
NOTICE:

Take off a cutter gradually to make smooth valve seats.

(a) If the seating is too high on the valve face, use 30° and 45°cutters to correct the seat.



(b) If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.
(c) Hand–lap the valve and valve seat with an abrasive compound.
(d) Check the valve seating position.

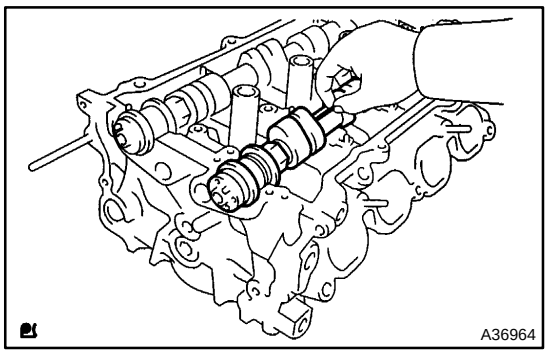


21. INSPECT CAMSHAFT THRUST CLEARANCE

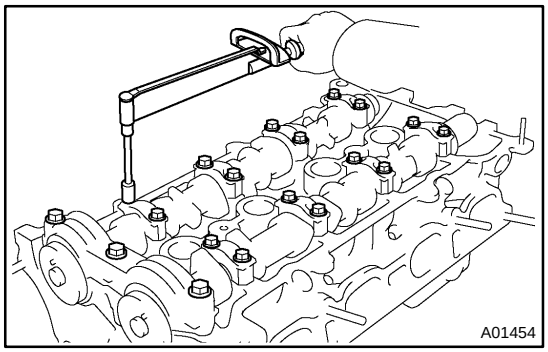
(a) Install the camshafts.
(b) Using a dial indicator measure the thrust clearance while moving the camshaft back and forth.
  Standard thrust clearance:
  0.10 – 0.24 mm (0.0039 – 0.0095 in.)
  Maximum thrust clearance: 0.15 mm (0.0059 in.)
(c) If the thrust clearance is greater than maximum, replace the cylinder head. If damages are found on the camshaft thrust surfaces, the camshaft also has to be replaced.

22. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the bearing caps and camshaft journals.
(b) Place the camshafts on the cylinder head.



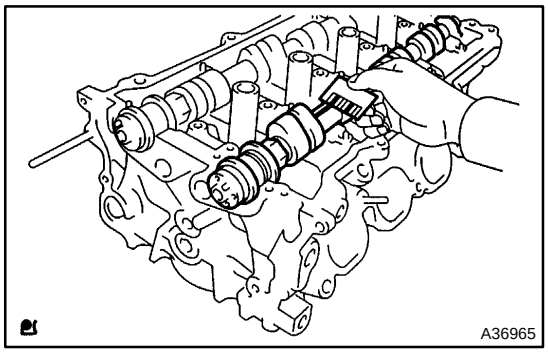
(c) Lay a strip of plastigage across each of the camshaft journal.



(d) Install the bearing caps (See page 14–262).
Torque: 18.5 N·m (189 kgf·cm, 14 ft·lbf)

NOTICE:
Do not turn the camshaft.

(e) Remove the bearing caps.



(f) Measure the plastigage at its widest point.
Standard oil clearance:
0.025 – 0.062 mm (0.0001 – 0.0024 in.)
Maximum oil clearance: 0.062 mm (0.0024 in.)

NOTICE:
Completely remove the plastigage after the measuring.

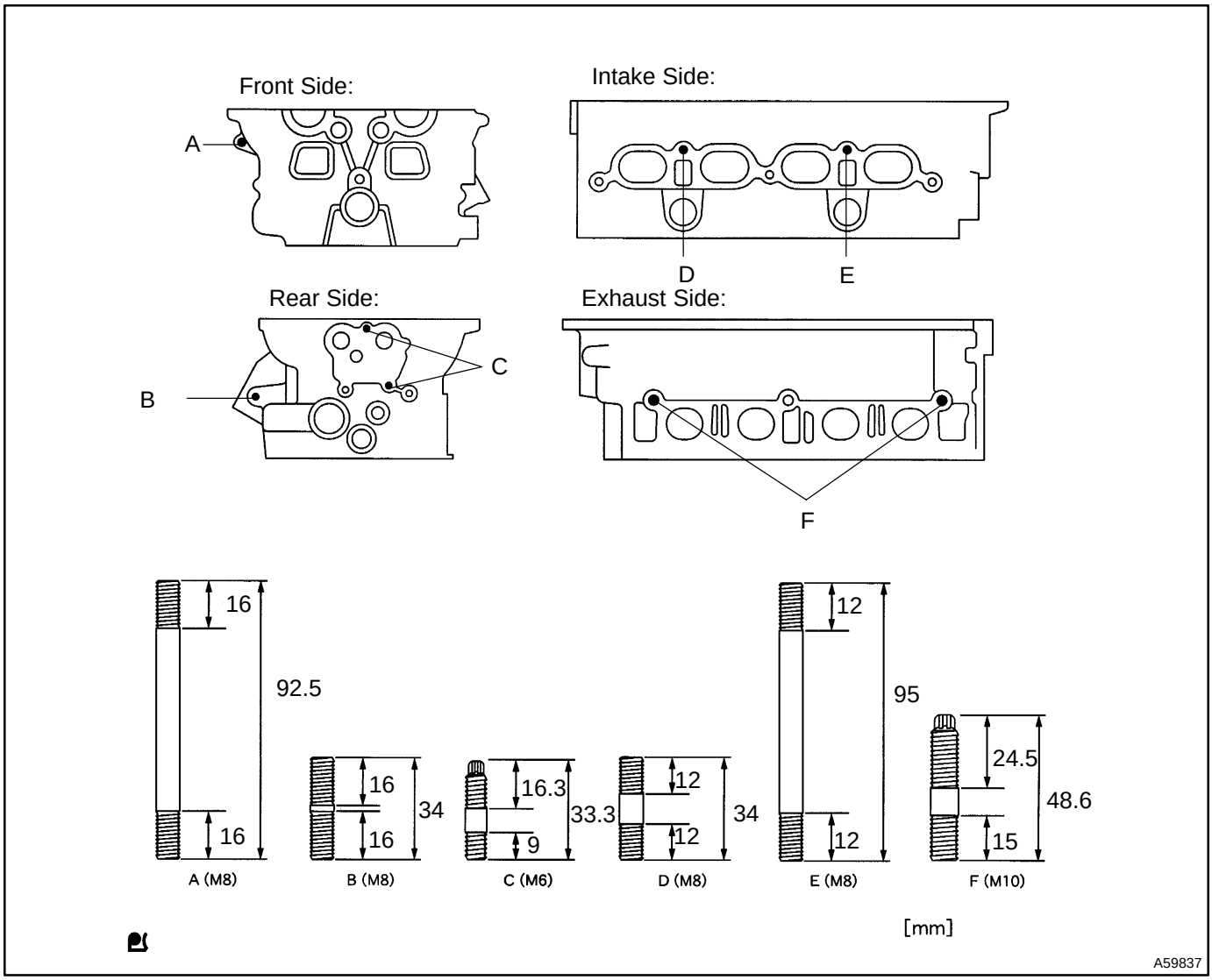
(g) If the oil clearance is greater than maximum, replace the cylinder head.

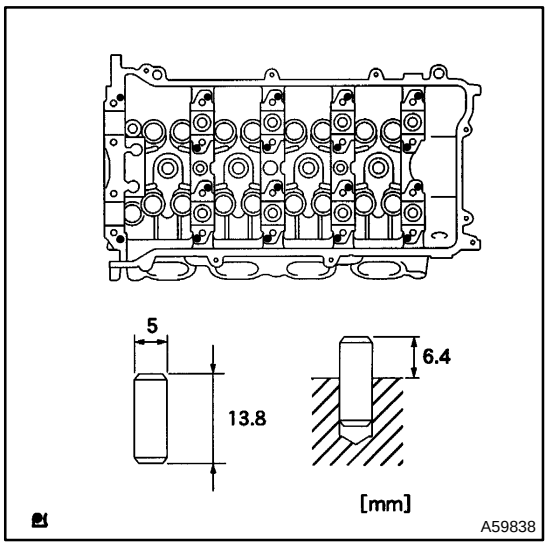
23. INSTALL STUD BOLT

(a) Install the stud bolts as shown in the illustration.

Torque:

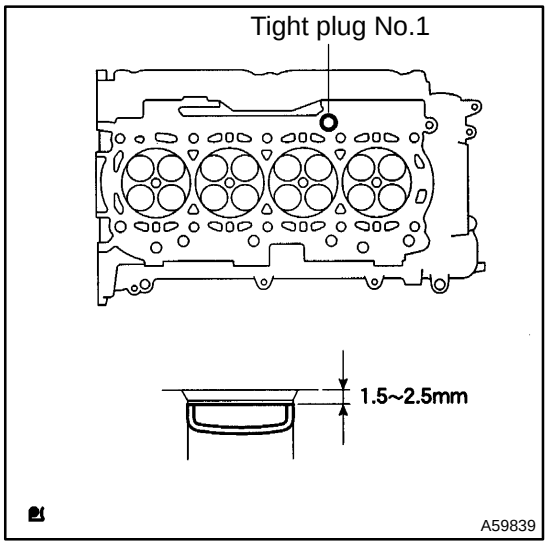
A 9.5 N·m (97 kgf·cm, 84 in.·lbf)
B 9.5 N·m (97 kgf·cm, 84 in.·lbf)
C 5.0 N·m (51 kgf·cm, 44 in.·lbf)
D 9.5 N·m (97 kgf·cm, 84 in.·lbf)
E 9.5 N·m (97 kgf·cm, 84 in.·lbf)
F 19 N·m (194 kgf·cm, 14 ft·lbf)





24. INSTALL RING PIN

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



25. INSTALL TIGHT PLUG NO.1

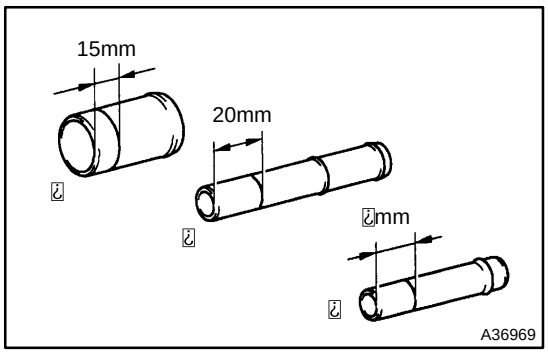
(a) Apply adhesive around tight plugs.

Adhesive:

part No.08833 – 00070, THREE BOND 1324 or equivalent.

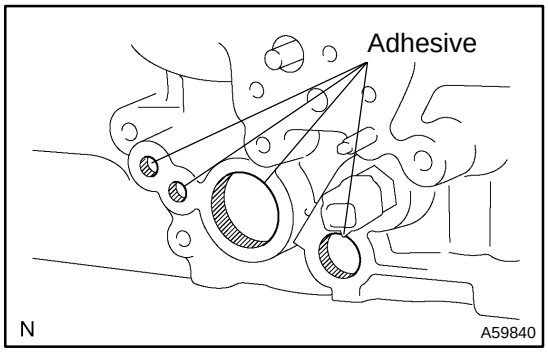
SST 09950–60010 (09951–00350), 09950–70010 (09951–07100)

Standard depth: 1.5 – 2.5 mm (0.0591 – 0.9843 in.)



26. INSTALL UNION

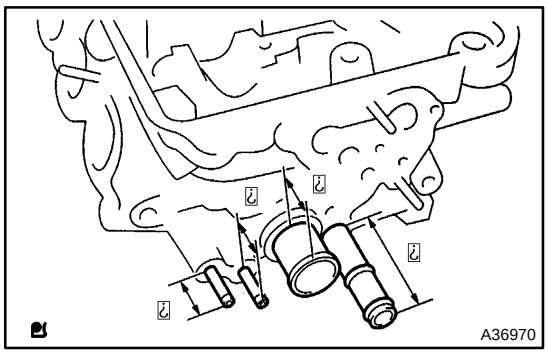
(a) Mark the standard position away from the edge, onto the water hose union as shown in the illustration.



(b) Apply adhesive to the water hose union hole of the cylinder head.

Adhesive:

part No. 08833 – 00070, THREE BOND 1324 or equivalent

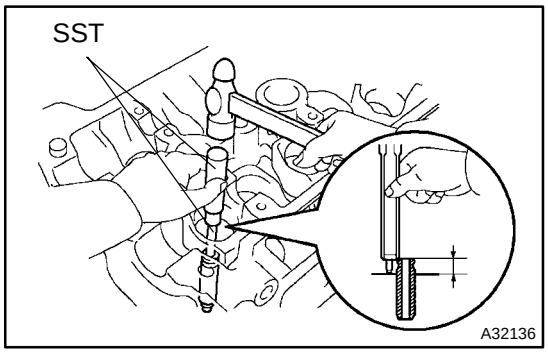


(c) Using a press press in a new water hose union until the standard marks come to the level of the cylinder head surface.

Standard protrusion:
A 29 mm (1.14 in.)
B 69.8 mm (2.748 in.)
C 24 mm (0.95 in.)

NOTICE:

- **Install the water hose union within 3 minutes after applying adhesive.**
- **Do not put into coolant within an hour after installing.**



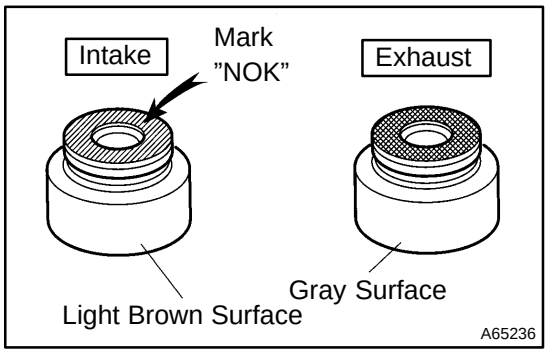
27. INSTALL VALVE GUIDE BUSH

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

(b) Using SST and a hammer, tap in a new guide bushing to the specified protrusion height.

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

Protrusion height: 15.3 – 15.7 mm (0.602 – 0.618 in.)



28. INSTALL VALVE STEM OIL O SEAL OR RING

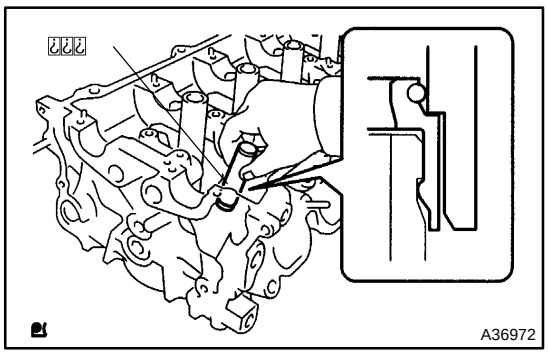
(a) Apply a light coat of engine oil the valve stem seals.

NOTICE:

Be very careful to assemble the oil seal for intake and exhaust. Assembling the wrong one may cause a failure.

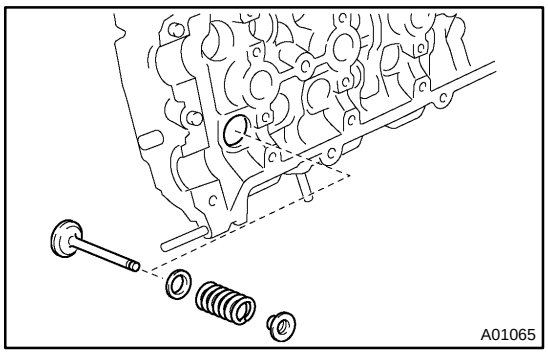
HINT:

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



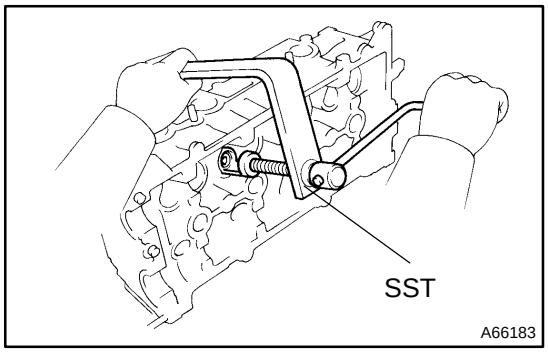
(b) Using SST, push in a new oil seal.

SST 09201–41020

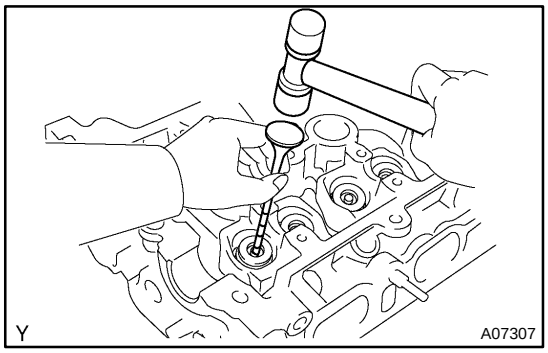


29. INSTALL INNER COMPRESSION SPRING

(a) Install the valve, spring seat, valve spring, and spring retainer.



(b) Using SST, compress the valve spring and place the retainer locks around the valve stem.
SST 09202–70020

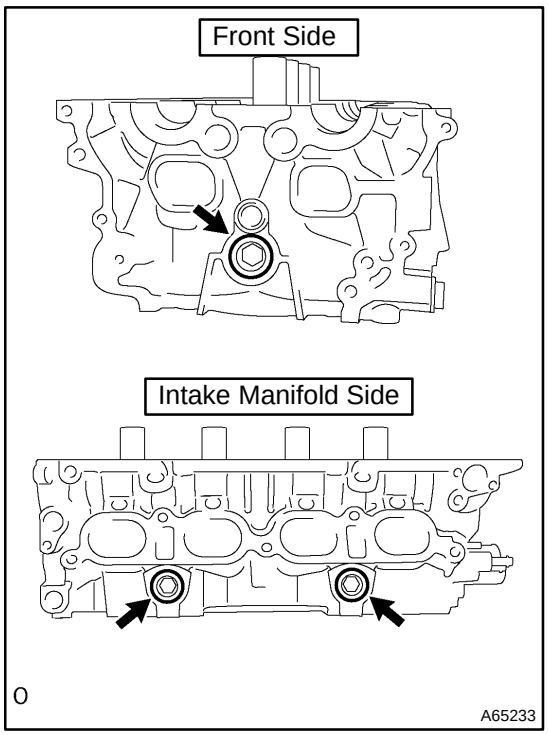


(c) Using a plastic–faced hammer and the valve stem (not in use) tip wound with vinyl tape, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:
Be careful not to damage the valve stem tip.

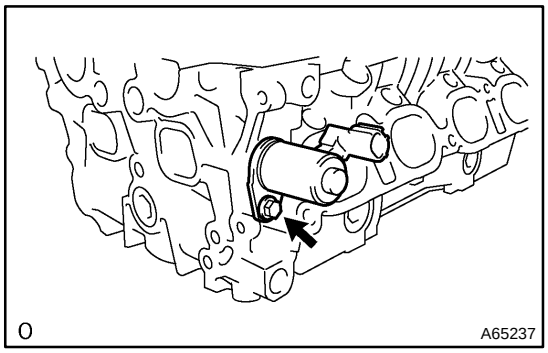
30. INSTALL VALVE ADJUSTING SHIM

(a) Apply a light coat of engine oil on the adjusting shim, install the top of the valve stem.



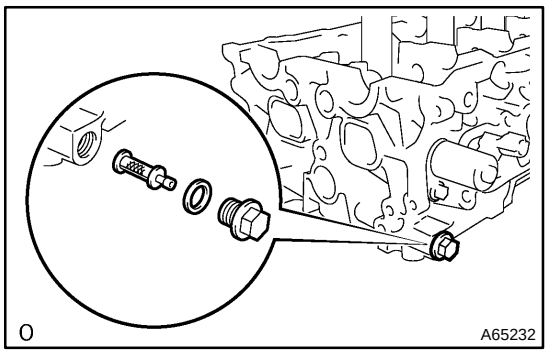
31. INSTALL W/HEAD TAPER SCREW PLUG NO.1

(a) Using hexagon socket wrench (14), install the taper screw plug with a new gasket.
Torque: 78 N·m (796 kgf·cm, 58 ft·lbf)



32. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSY

(a) Install the oil control valve with a bolt.
Torque: 9.0 N·m (92 kgf·cm, 80 ft·lbf)



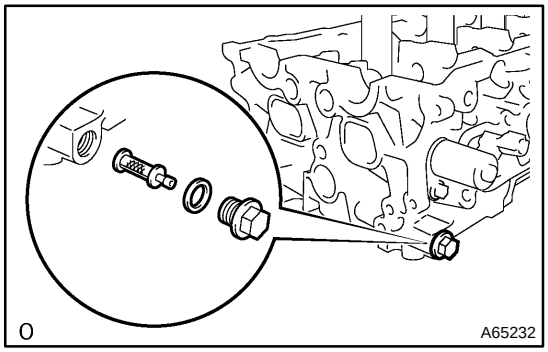
33. INSTALL OIL CONTROL VALVE FILTER

(a) Confirm that the filter is clear.
(b) Place a new gasket on the bolt and install the filter.(Front side)
Torque: 29 N·m (296 kgf·cm, 22 ft·lbf)

CYLINDER HEAD ASSY (2ZZ–GE)

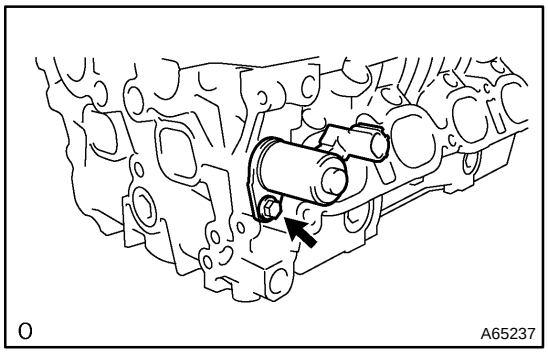
140RJ–01

OVERHAUL



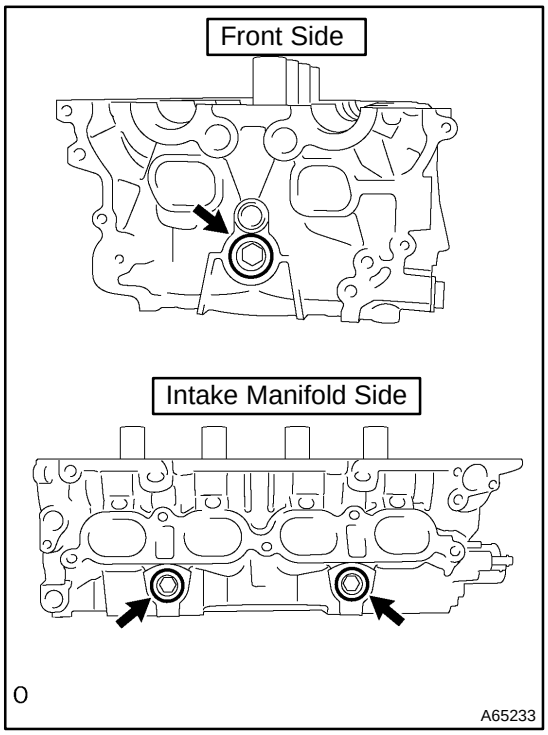
1. REMOVE OIL CONTROL VALVE FILTER

(a) Remove the plug and oil control valve filter.



2. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSY

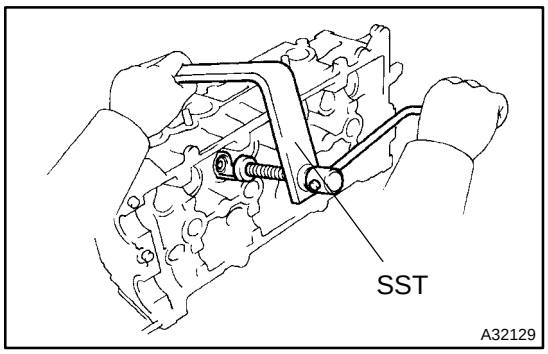
(a) Remove a bolt and oil control valve.



3. REMOVE W/HEAD TAPER SCREW PLUG NO.1

(a) Using hexagon socket wrench (14), remove 3 taper screw plug No.1 as shown in the illustration.

4. REMOVE VALVE ADJUSTING SHIM



5. REMOVE INNER COMPRESSION SPRING

HINT:

Arrange the inner compression spring, spring retainer and retainer lock in the correct order.

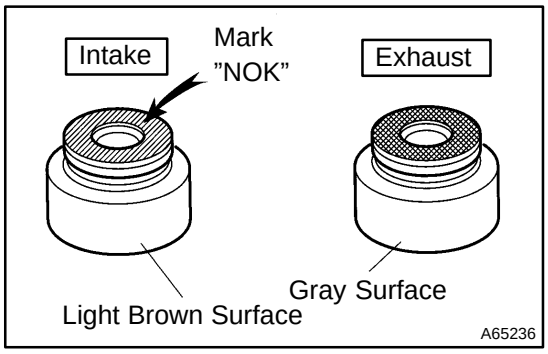
(a) Using SST compress the inner compression spring and remove 2 keepers.
SST 09202–70020

(b) Remove the spring retainer.

(c) Remove the inner compression spring.

6. REMOVE VALVE STEM OIL O SEAL OR RING

(a) Using a needle–nose pliers,remove the valve stem oil o seal or ring.



7. REMOVE VALVE SPRING SEAT

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

HINT:

Arrange the spring seat in the correct order.

8. REMOVE INTAKE VALVE

HINT:.

Arrange the intake valve in the correct order.

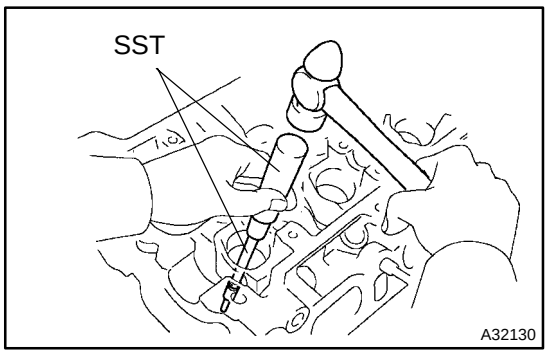
9. REMOVE EXHAUST VALVE

HINT:

Arrange the exhaust valve in the correct order.

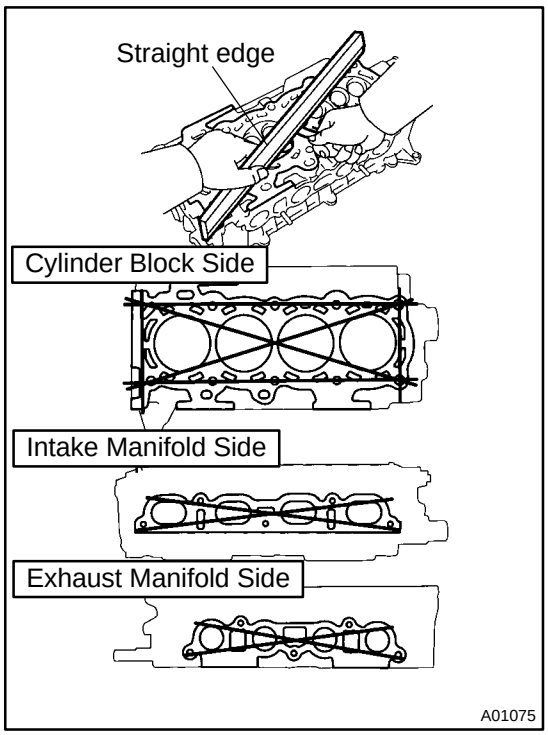
10. REMOVE VALVE GUIDE BUSH

(a) Heat the cylinder head to 110 – 130°C (230 – 266°F).



(b) Using SST and a hammer tap out the valve guide bushing.
SST 09201–10000, 09201–01055, 09950–70010 (09951–07100)

11. REMOVE STUD BOLT

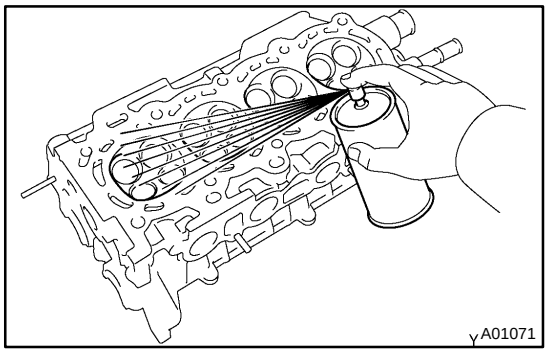


12. INSPECT CYLINDER HEAD FOR FLATNESS

(a) Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder block and the manifolds for warpage.

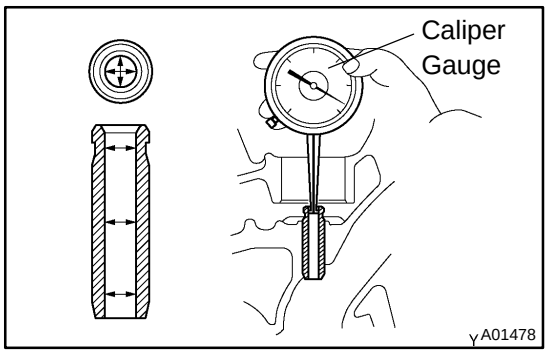
Maximum warpage:

Cylinder block side	0.2 mm (0.0080 in.)
Intake manifold side	0.2 mm (0.0080 in.)
Exhaust manifold side	0.3 mm (0.0120 in.)



13. INSPECT CYLINDER HEAD FOR CRACKS

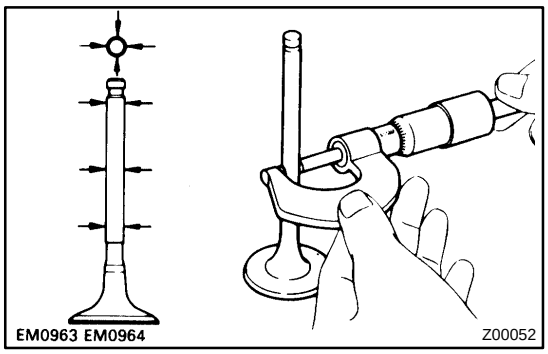
(a) Using a dye penetrate, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.



14. INSPECT VALVE GUIDE BUSHING OIL CLEARANCE

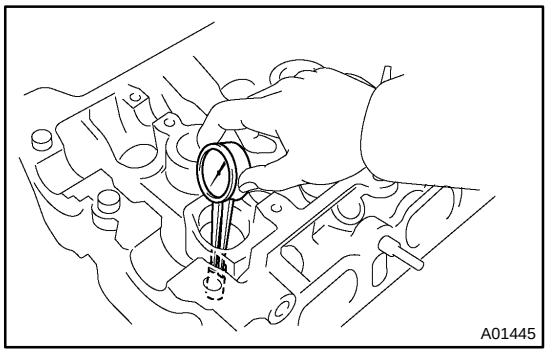
(a) Using a caliper gauge, measure the inside diameter of the guide bushing.

Busing inside diameter:
5.500 – 5.518 mm (0.2165 – 0.2172 in.)



(b) Using a micrometer, measure the diameter of the valve stem.
Valve stem diameter:
Intake 5.460 – 5.475 mm (0.2145 – 0.2156 in.)
Exhaust 5.455 – 5.470 mm (0.2144 – 0.2154 in.)

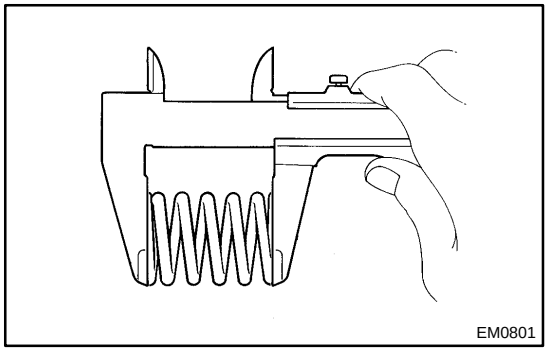
(c) Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.
Standard oil clearance:
Intake 0.025 – 0.058 mm (0.0010 – 0.0023 in.)
Exhaust 0.030 – 0.063 mm (0.0012 – 0.0025 in.)
Maximum oil clearance: 0.10 mm (0.0039 in.)



15. INSPECT VALVE GUIDE BUSH

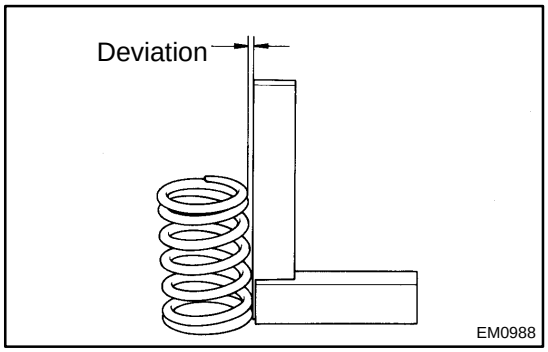
(a) If the busing bore diameter of the cylinder head is greater than 10.506 mm (0.4136 in.), machine the bushing bore to the dimension of 10.538 – 10.556 mm (0.4149 – 0.4156 in.) to install a over size busing.
Bushing bore diameter:
10.538 – 10.556 mm (0.4149 – 0.4156 in.)

bushing size	Bushing bore diameter mm (in.)
Use STD	10.448 – 10.506 (0.4129 – 0.4136)
Use O/S 0.05	10.538 – 10.556 (0.4149 – 0.4156)

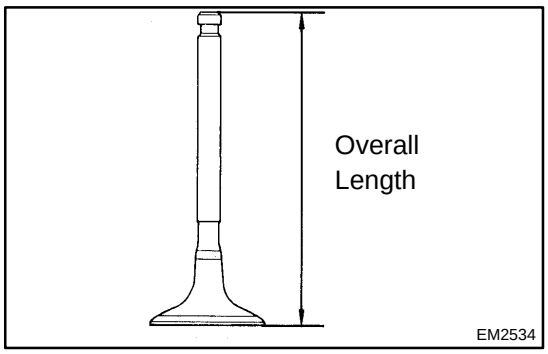


16. INSPECT INNER COMPRESSION SPRING

(a) Using a vernier caliper measure the free length of the valve spring.
Free length:
Intake 46.4 mm (1.827 in.)
Exhaust 46.5 mm (1.831 in.)

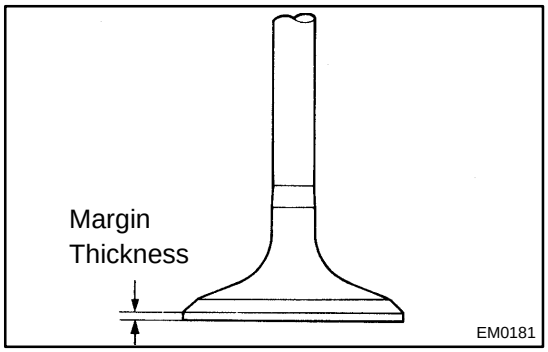


(b) Using a steel square, measure the deviation of the valve spring.
Maximum deviation: 1.6 mm (0.063 in.)
Maximum angle (reference): 2°

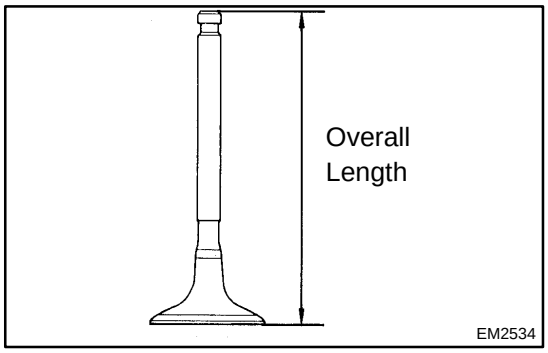


17. INSPECT INTAKE VALVE

(a) Check the valve overall length.
Standard overall length: 111.3 mm (4.382 in.)
Minimum overall length: 110.9 mm (4.366 in.)

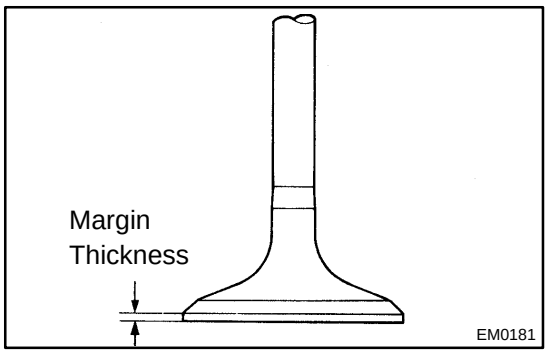


(b) Check the valve head margin thickness.
Standard margin thickness: 1.0 mm (0.039 in.)
Minimum margin thickness: 0.7 mm (0.028 in.)



18. INSPECT EXHAUST VALVE

(a) Check the valve overall length.
Standard overall length: 111.7 mm (4.392 in.)
MInimum overall length: 111.3 mm (4.382 in.)

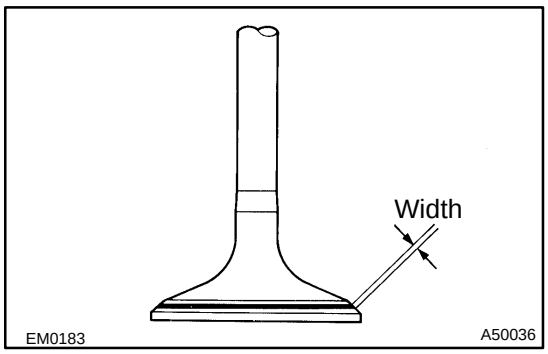


(b) Check the valve head margin thickness.
Standard margin thickness: 1.0 mm (0.039 in.)
MInimum margin thickness: 0.7 mm (0.028 in.)

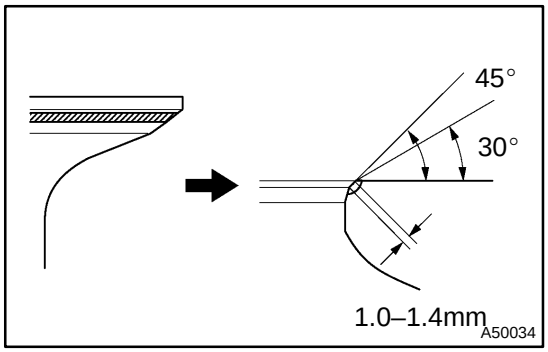
19. INSPECT VALVE SEATS

(a) Apply a light coat of prussian blue (or white lead) to the valve face.

(b) Lightly press the valve against the seat.



(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 blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
  (3) Check that the seat contact is in the middle of the valve face with the width between 1.0 – 1.4 mm (0.039 – 0.055 in.).

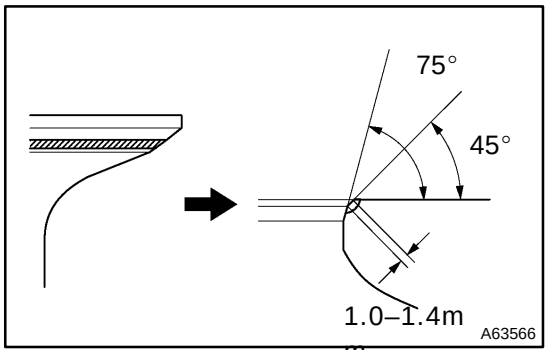


20. REPAIR VALVE SEATS

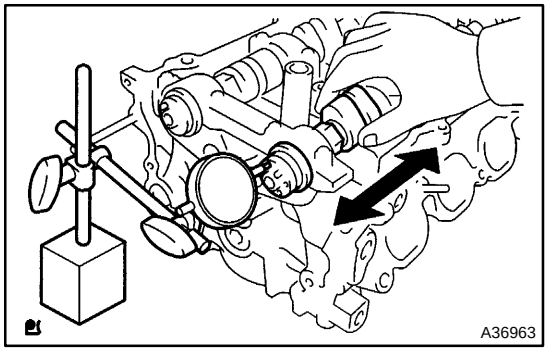
NOTICE:

Take off a cutter gradually to make smooth valve seats.

(a) If the seating is too high on the valve face, use 30° and 45°cutters to correct the seat.



(b) If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.
(c) Hand–lap the valve and valve seat with an abrasive compound.
(d) Check the valve seating position.

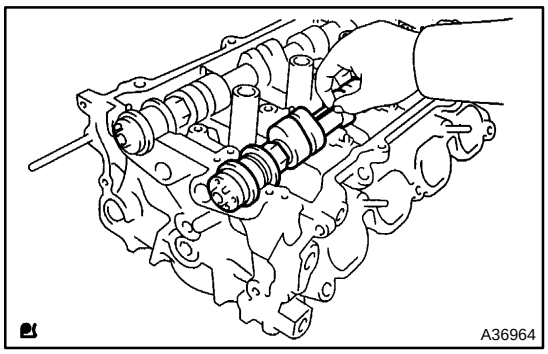


21. INSPECT CAMSHAFT THRUST CLEARANCE

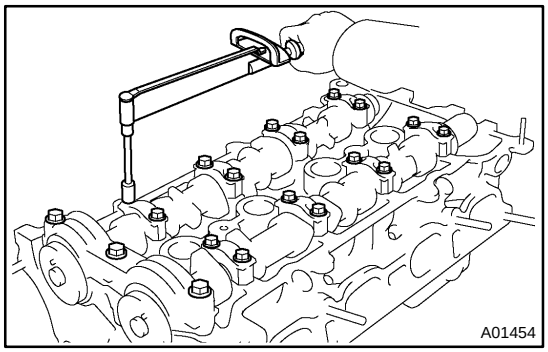
(a) Install the camshafts.
(b) Using a dial indicator measure the thrust clearance while moving the camshaft back and forth.
  Standard thrust clearance:
  0.10 – 0.24 mm (0.0039 – 0.0095 in.)
  Maximum thrust clearance: 0.15 mm (0.0059 in.)
(c) If the thrust clearance is greater than maximum, replace the cylinder head. If damages are found on the camshaft thrust surfaces, the camshaft also has to be replaced.

22. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the bearing caps and camshaft journals.
(b) Place the camshafts on the cylinder head.



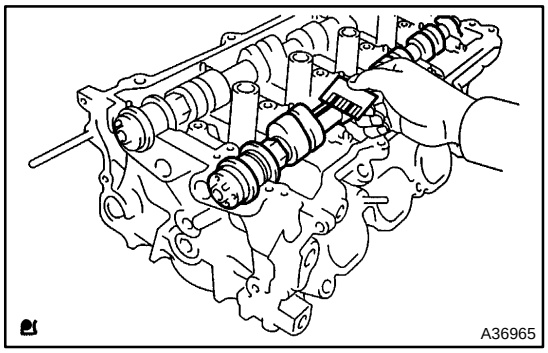
(c) Lay a strip of plastigage across each of the camshaft journal.



(d) Install the bearing caps (See page 14–262).
Torque: 18.5 N·m (189 kgf·cm, 14 ft·lbf)

NOTICE:
Do not turn the camshaft.

(e) Remove the bearing caps.



(f) Measure the plastigage at its widest point.
Standard oil clearance:
0.025 – 0.062 mm (0.0001 – 0.0024 in.)
Maximum oil clearance: 0.062 mm (0.0024 in.)

NOTICE:
Completely remove the plastigage after the measuring.

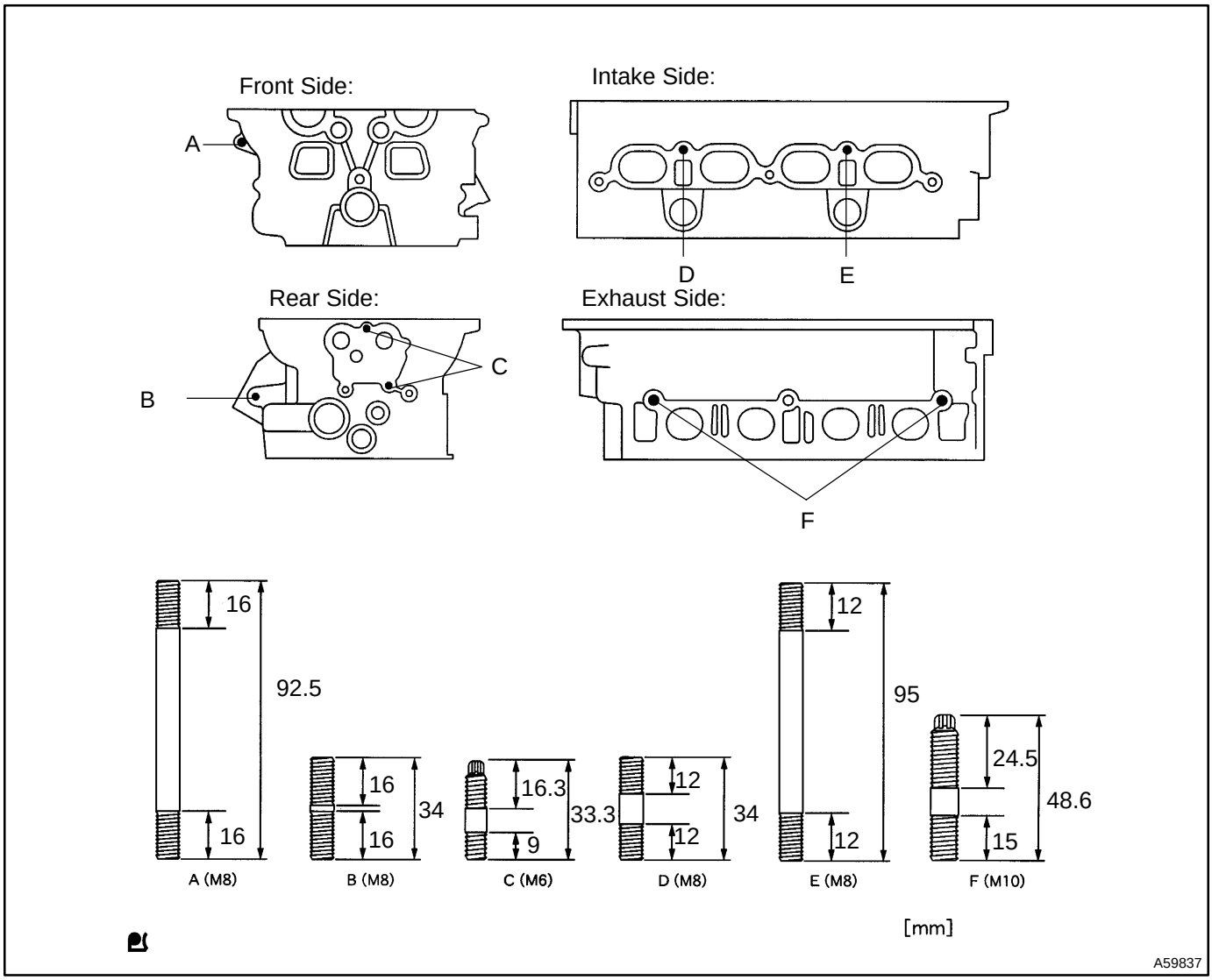
(g) If the oil clearance is greater than maximum, replace the cylinder head.

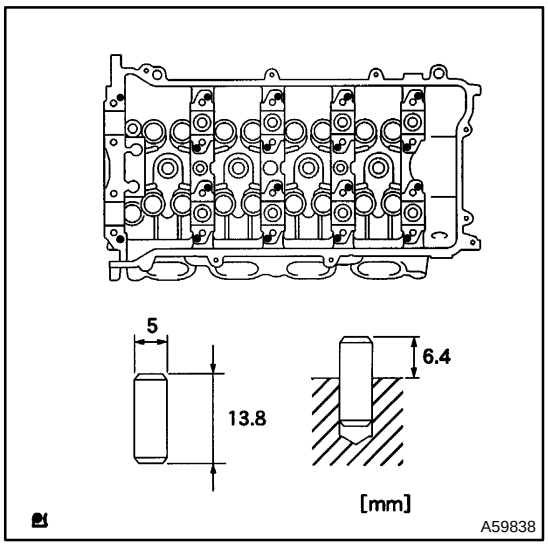
23. INSTALL STUD BOLT

(a) Install the stud bolts as shown in the illustration.

Torque:

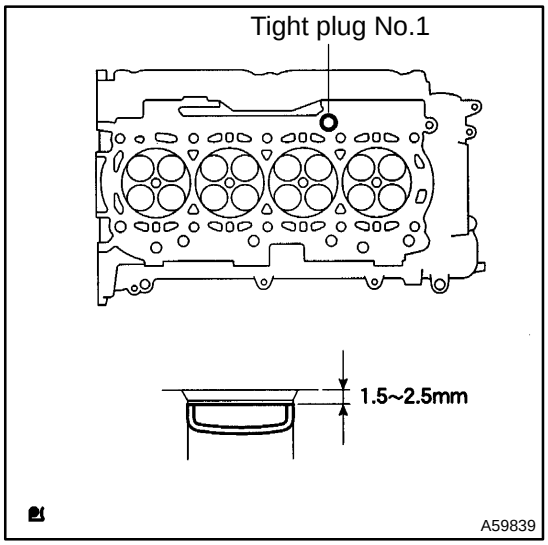
A 9.5 N·m (97 kgf·cm, 84 in.·lbf)
B 9.5 N·m (97 kgf·cm, 84 in.·lbf)
C 5.0 N·m (51 kgf·cm, 44 in.·lbf)
D 9.5 N·m (97 kgf·cm, 84 in.·lbf)
E 9.5 N·m (97 kgf·cm, 84 in.·lbf)
F 19 N·m (194 kgf·cm, 14 ft·lbf)





24. INSTALL RING PIN

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



25. INSTALL TIGHT PLUG NO.1

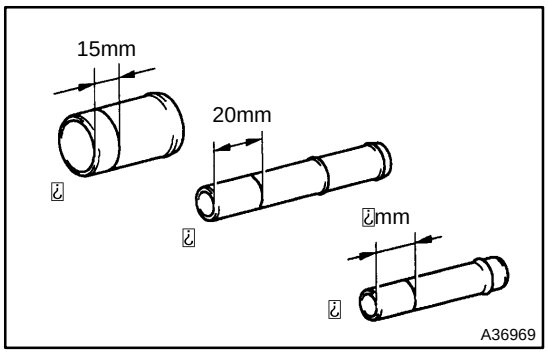
(a) Apply adhesive around tight plugs.

Adhesive:

part No.08833 – 00070, THREE BOND 1324 or equivalent.

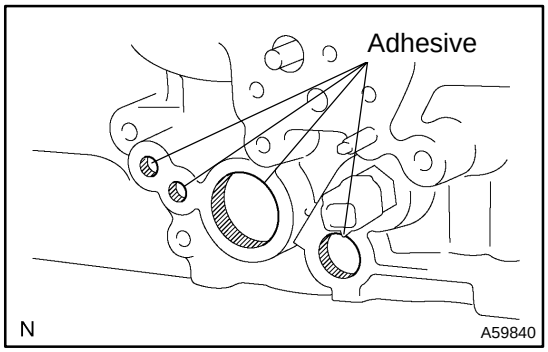
SST 09950–60010 (09951–00350), 09950–70010 (09951–07100)

Standard depth: 1.5 – 2.5 mm (0.0591 – 0.9843 in.)



26. INSTALL UNION

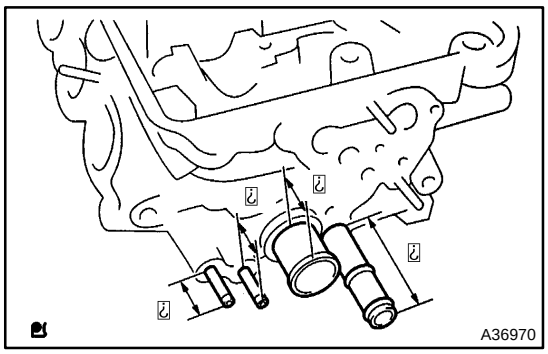
(a) Mark the standard position away from the edge, onto the water hose union as shown in the illustration.



(b) Apply adhesive to the water hose union hole of the cylinder head.

Adhesive:

part No. 08833 – 00070, THREE BOND 1324 or equivalent

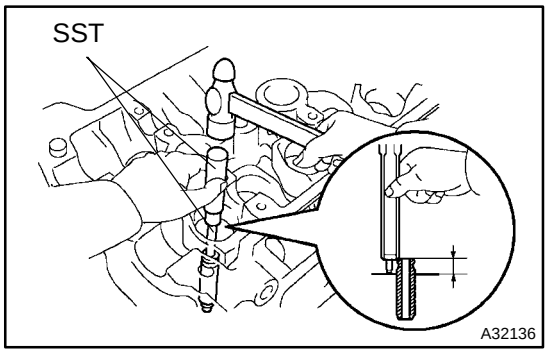


(c) Using a press press in a new water hose union until the standard marks come to the level of the cylinder head surface.

Standard protrusion:
A 29 mm (1.14 in.)
B 69.8 mm (2.748 in.)
C 24 mm (0.95 in.)

NOTICE:

- **Install the water hose union within 3 minutes after applying adhesive.**
- **Do not put into coolant within an hour after installing.**



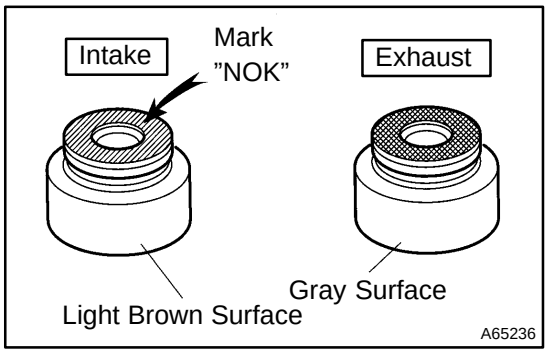
27. INSTALL VALVE GUIDE BUSH

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

(b) Using SST and a hammer, tap in a new guide bushing to the specified protrusion height.

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

Protrusion height: 15.3 – 15.7 mm (0.602 – 0.618 in.)



28. INSTALL VALVE STEM OIL O SEAL OR RING

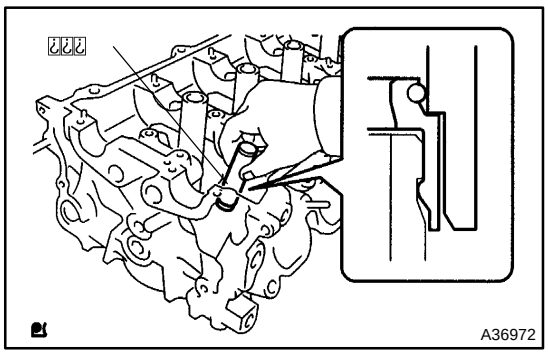
(a) Apply a light coat of engine oil the valve stem seals.

NOTICE:

Be very careful to assemble the oil seal for intake and exhaust. Assembling the wrong one may cause a failure.

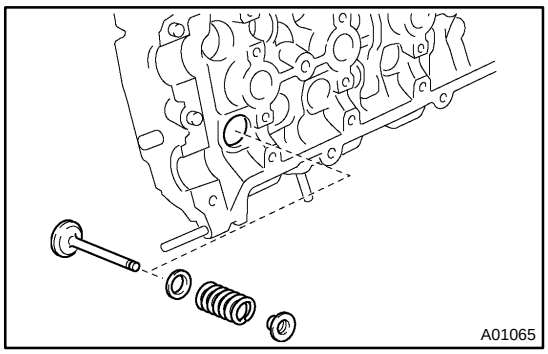
HINT:

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



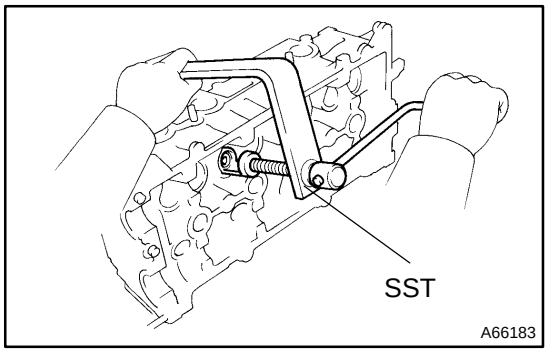
(b) Using SST, push in a new oil seal.

SST 09201–41020

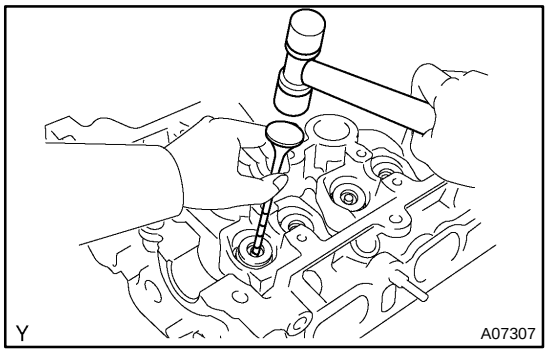


29. INSTALL INNER COMPRESSION SPRING

(a) Install the valve, spring seat, valve spring, and spring retainer.



(b) Using SST, compress the valve spring and place the retainer locks around the valve stem.
SST 09202–70020

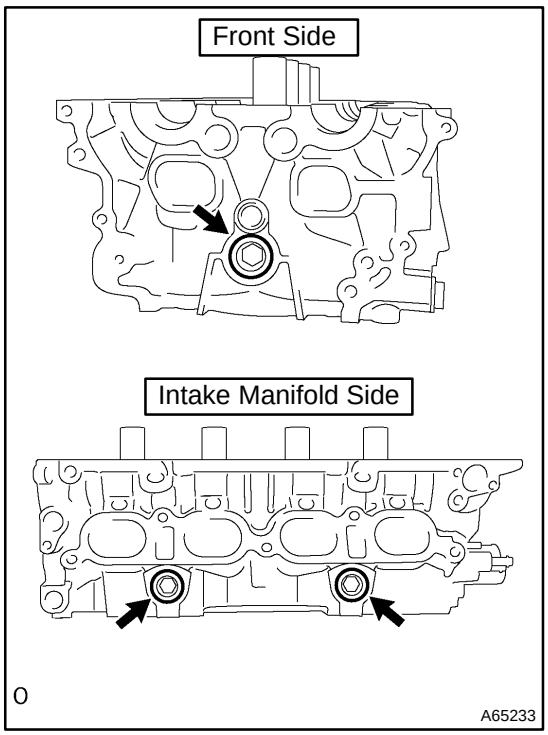


(c) Using a plastic–faced hammer and the valve stem (not in use) tip wound with vinyl tape, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:
Be careful not to damage the valve stem tip.

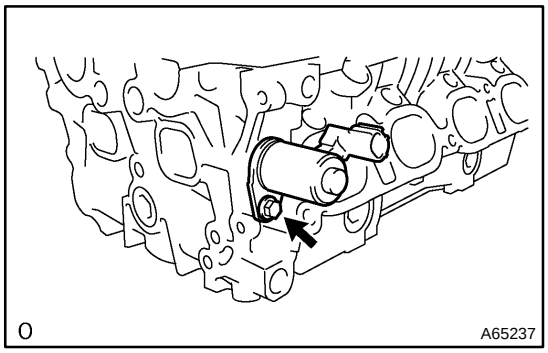
30. INSTALL VALVE ADJUSTING SHIM

(a) Apply a light coat of engine oil on the adjusting shim, install the top of the valve stem.



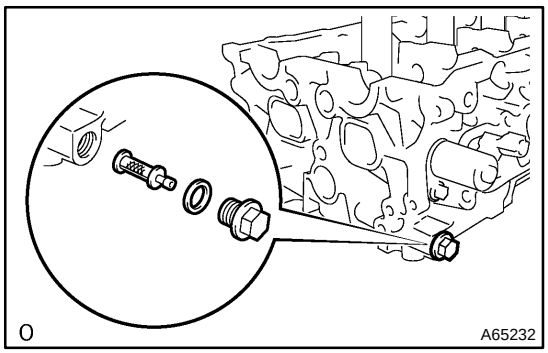
31. INSTALL W/HEAD TAPER SCREW PLUG NO.1

(a) Using hexagon socket wrench (14), install the taper screw plug with a new gasket.
Torque: 78 N·m (796 kgf·cm, 58 ft·lbf)



32. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSY

(a) Install the oil control valve with a bolt.
Torque: 9.0 N·m (92 kgf·cm, 80 ft·lbf)



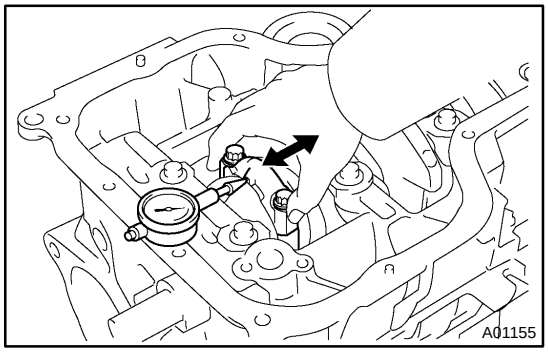
33. INSTALL OIL CONTROL VALVE FILTER

(a) Confirm that the filter is clear.
(b) Place a new gasket on the bolt and install the filter.(Front side)
Torque: 29 N·m (296 kgf·cm, 22 ft·lbf)

140RL–01

OVERHAUL

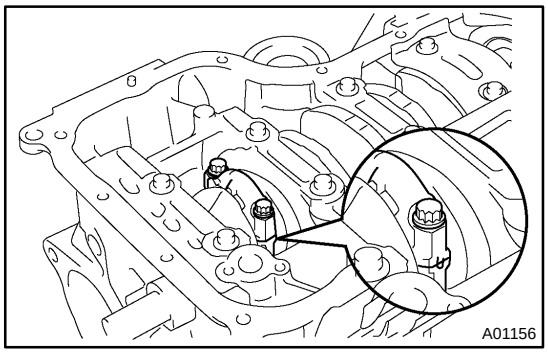
1. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB–ASSY



2. 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:
0.160 – 0.342 mm (0.0063 – 0.0135 in.)
Maximum thrust clearance: 0.342 mm (0.0135 in.)



3. INSPECT CONNECTING ROD BEARING OIL CLEARANCE

NOTICE:

Do not turn the crankshaft.

(a) Using marking paint, write the matched cylinder number on each connecting rod and cap.

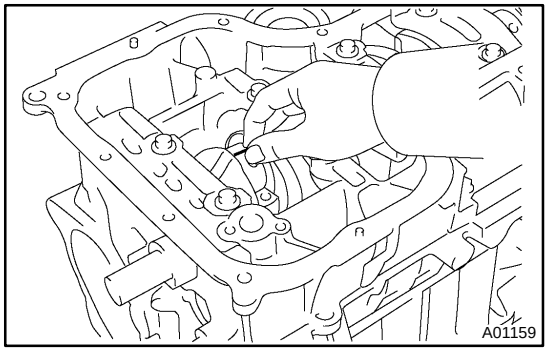
HINT:

The match marks on the connecting rods and caps are for ensuring correct reassembly.

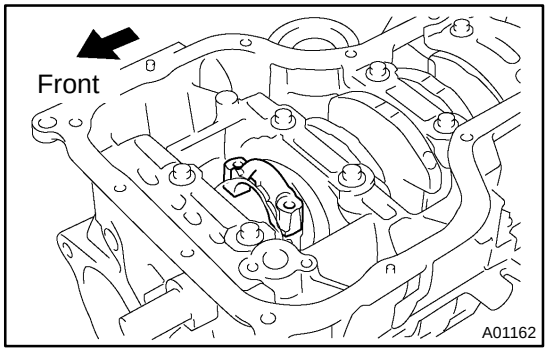
(b) Using SST, remove the 2 connecting rod cap bolts.
SST 09205–16010

(c) Clean the crank pin and bearing.

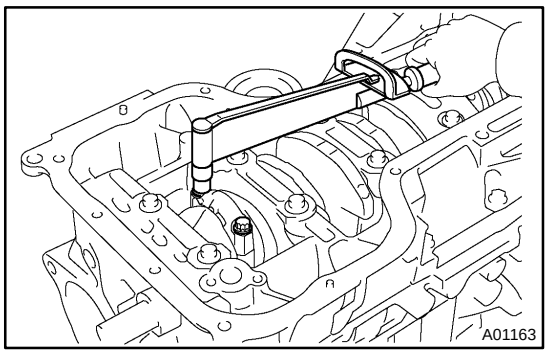
(d) Check the crank pin and bearing for pitting and scratches.



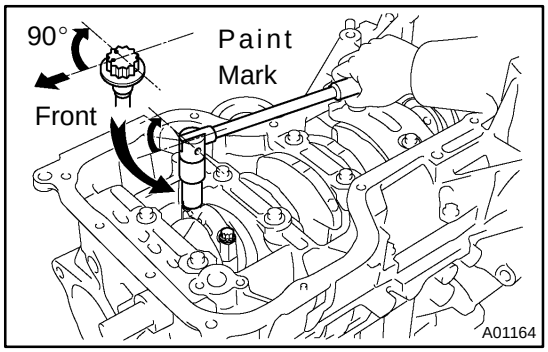
(e) Lay a strip of plastigage across the crank pin.



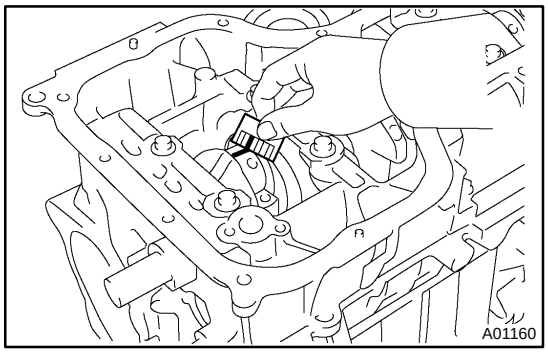
(f) Check that the protrusion of the connecting rod cap is facing in the correct direction.



(g) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.
(h) Using SST, tighten the bolts in several passes by the specified torque.
SST 09205–16010
Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)

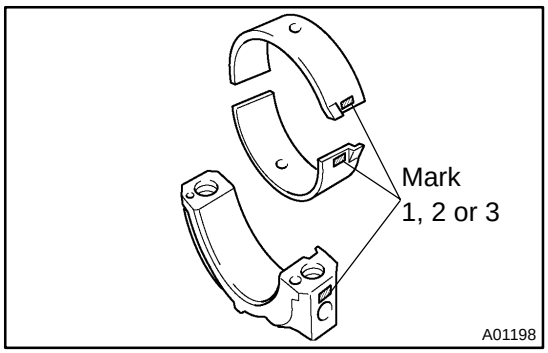


(i) Mark the front of the connecting cap bolts with paint.
(j) Retighten the cap bolts by 90 ° as shown in the illustration.
(k) Check that the crankshaft turns smoothly.
(l) Remove the 2 bolts, connecting rod cap and lower bearing.



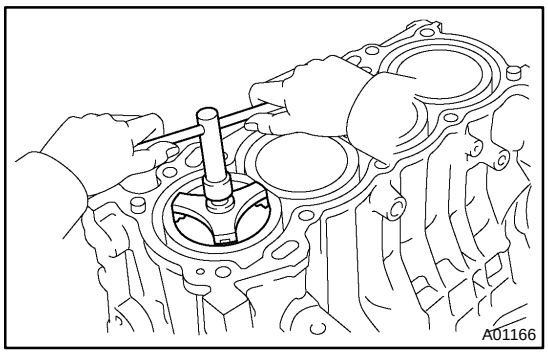
(m) Measure the plastigage at its widest point.
Standard oil clearance:
0.028 – 0.052 mm (0.0011 – 0.0020 in.)
Maximum oil clearance: 0.080 mm (0.0031 in.)

NOTICE:
Remove the plastigage completely after the measurement.



(n) If replacing a bearing, select a new one having the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked ”1”, ”2” and ”3” accordingly.
Reference:
Standard bearing center wall thickness

Item	Mark	mm (in.)
Connecting rod large end bore diameter	1 2 3	48.000 – 48.008 (1.8898 – 1.8901) 48.008 – 48.016 (1.8901 – 1.8904) 48.016 – 48.024 (1.8904 – 1.8907)
Connecting rod bearing thickness	1 2 3	1.482 – 1.486 (0.0583 – 0.0585) 1.486 – 1.490 (0.0585 – 0.0587) 1.490 – 1.494 (0.0587 – 0.0588)
Crankshaft pin outer diameter	–	44.992 – 45.000 (1.7713 – 1.7717)



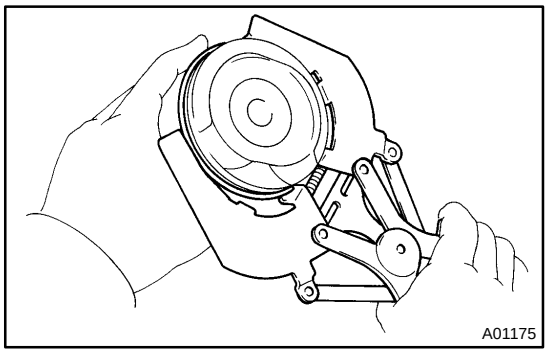
4. REMOVE PISTON SUB–ASSY W/CONNECTING ROD

(a) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

HINT:

- Keep the bearing, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

5. REMOVE CONNECTING ROD BEARING



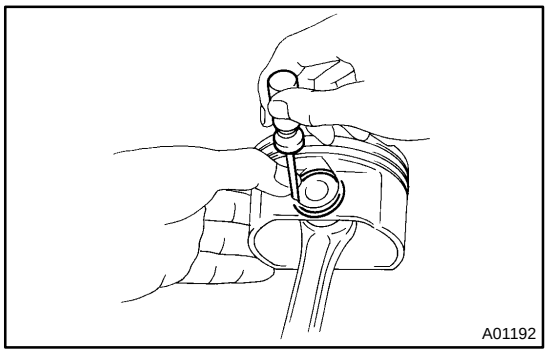
6. REMOVE PISTON RING SET

HINT:

Take care not to misplace the piston rings on both the match with the piston and the direction of the rings.

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

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

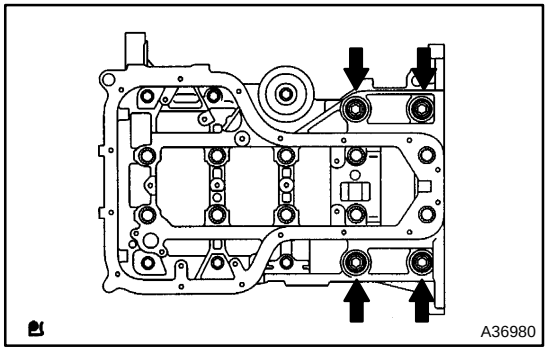


7. REMOVE PISTON PIN HOLE SNAP RING

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

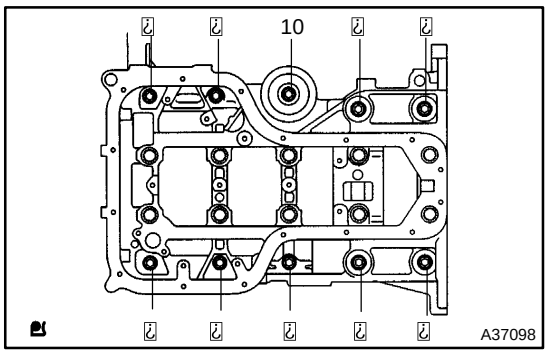
8. REMOVE W/PIN PISTON SUB–ASSY

(a) Remove the pin and connecting rod from the piston.

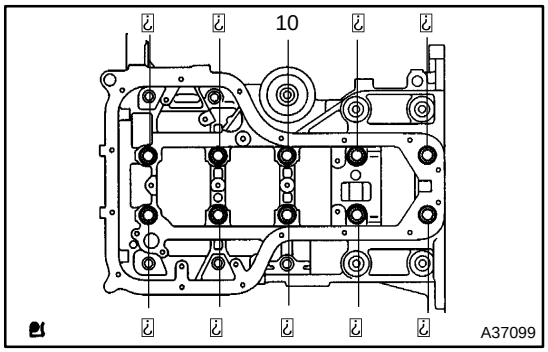


9. REMOVE CRANKSHAFT BEARING CAP SUB–ASSY

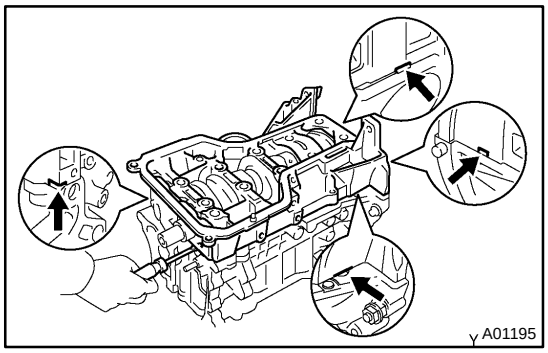
(a) Remove the 4 screws plugs from the bearing cap sub–assembly.



(b) Remove the 10 hexagon head bearing cap sub–assembly bolts.



(c) Uniformly loosen the 10 bearing cap sub–assembly bolts, in several passes, in the sequence shown in the illustration.

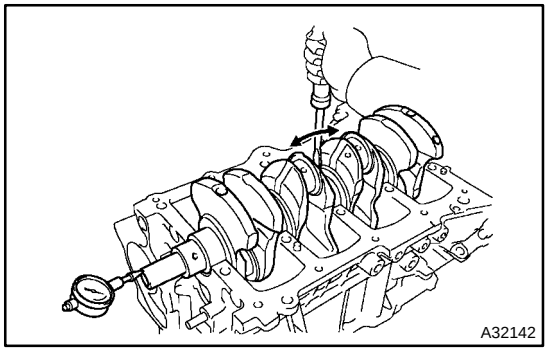


(d) Using a screwdriver, remove the bearing cap sub–assembly by prying the indicated portions between the cylinder block and bearing cap sub–assembly. Remove the 5 lower main bearings.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and bearing cap sub–assembly.

SST 09011–38121



10. 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 – 0.24 mm (0.0016 – 0.0094 in.)
Maximum thrust clearance: 0.24 mm (0.0094 in.)

(b) If the thrust clearance is greater than maximum, measure the thrust washer thickness. If the thickness is not specified, replace the thrust washer.

Thrust washer thickness:
2.430 – 2.480 mm (0.0957 – 0.0976 in.)

11. REMOVE CRANKSHAFT

12. REMOVE CRANKSHAFT THRUST WASHER UPPER

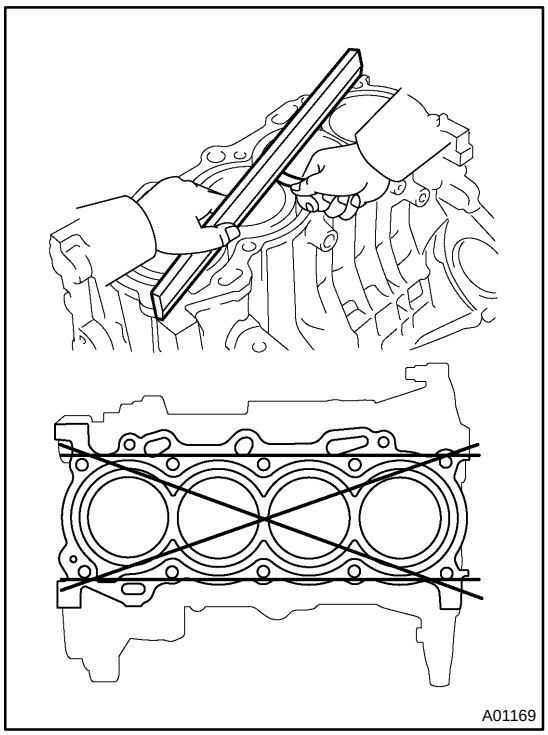
13. REMOVE CRANKSHAFT BEARING

NOTICE:

Arrange the main bearings and thrust washers in the correct order.

14. REMOVE STUD BOLT

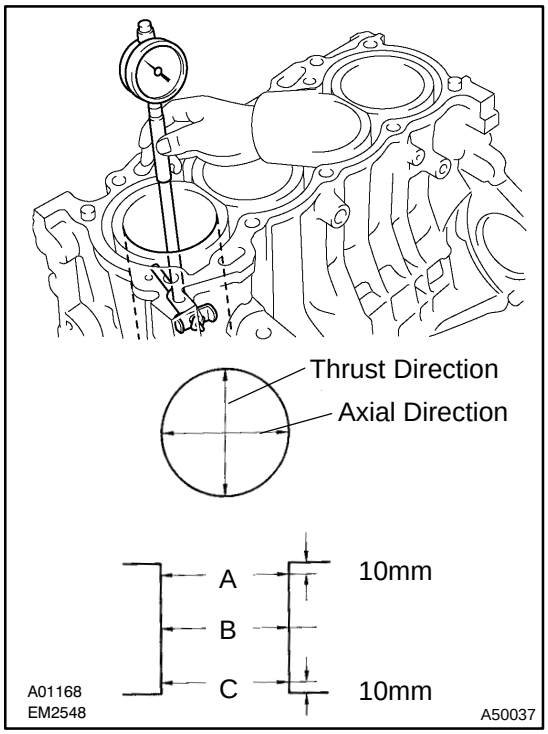
15. REMOVE SUB–ASSY OIL NOZZLE NO.1



16. INSPECT CYLINDER BLOCK FOR FLATNESS

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

Maximum warpage: 0.05 mm (0.0020 in.)

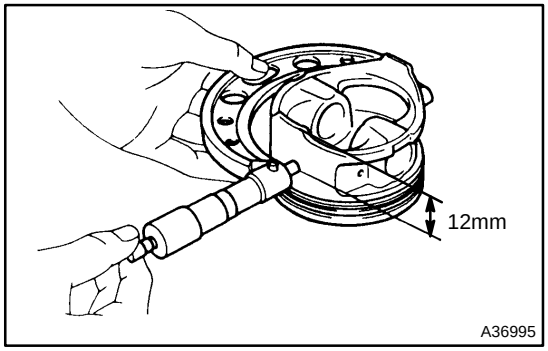


17. INSPECT CYLINDER BORE

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

Standard diameter:
82.000 – 82.013 mm (3.2283 – 3.2289 in.)
Maximum diameter: 82.013 mm (3.2289 in.)

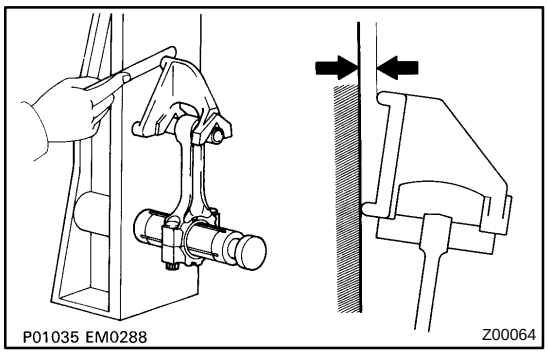
(b) If the diameter is greater than the maximum, replace the cylinder block.



18. INSPECT PISTON DIAMETER

(a) Using a micrometer, measure the piston diameter at a right angle to the piston pin hole, and at the piston of 12 mm (0.472 in.) from the piston skirt.

Piston diameter:
81.975 – 81.993 mm (3.2274 – 3.2281 in.)



19. INSPECT CONNECTING ROD SUB–ASSY

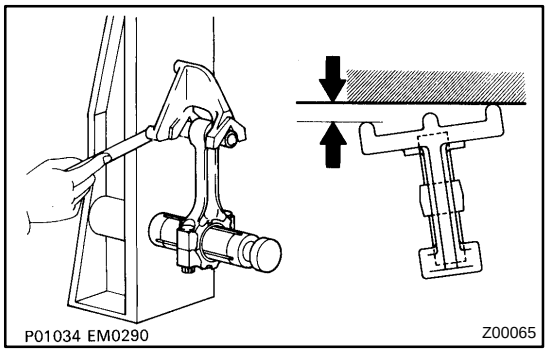
(a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for out–of–alignment.

Maximum out–of alignment:

0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

If out–of alignment is greater than maximum, replace the connecting rod assembly.



(2) Check for twist.

Maximum twist:

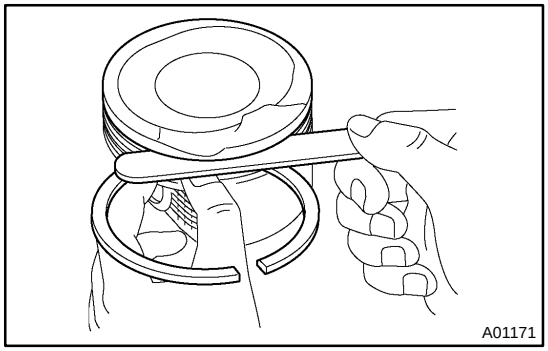
0.05mm (0.0020 in.) per 100 mm (3.94 in.)

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

20. INSPECT PISTON CLEARANCE

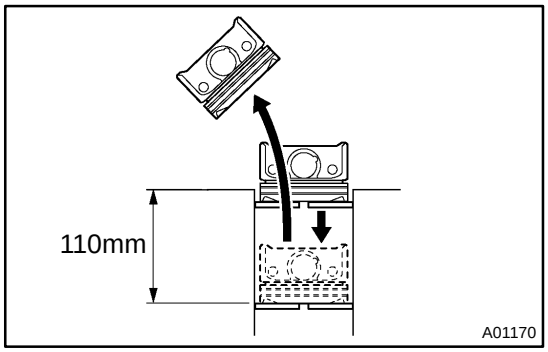
(a) Subtract the piston diameter measurement from the cylinder bore diameter measurement.
Standard oil clearance: 0.007 – 0.038 mm (0.0003 – 0.0015 in.)
Maximum oil clearance: 0.10 mm (0.0039 in.)

(b) If the oil clearance is greater than maximum, replace all the 4 pistons. If necessary, replace the cylinder block.



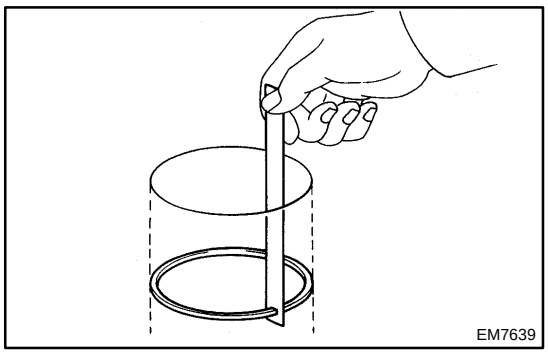
21. INSPECT RING GROOVE CLEARANCE

(a) Using a feeler gauge, measure the clearance between the new piston ring and the wall of the ring groove.
Ring groove clearance:
No.1: 0.020 – 0.070 mm (0.0009 – 0.0028 in.)
No.2: 0.030 – 0.070 mm (0.0012 – 0.0028 in.)

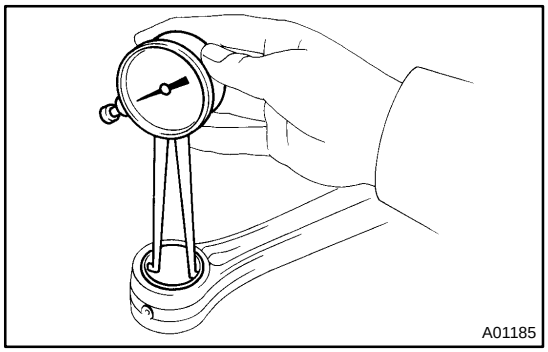


22. INSPECT PISTON RING END GAP

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

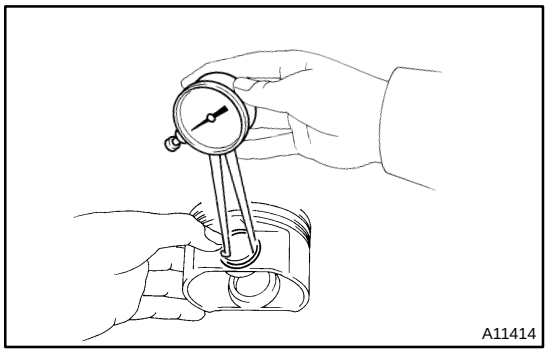


(b) Using a feeler gauge, measure the end gap.
Standard end gap:
No. 1: 0.25 – 0.35 mm (0.0098 – 0.0138 in.)
No. 2: 0.35 – 0.50 mm (0.0138 – 0.0197 in.)
Oil (side rail): 0.15 – 0.40 mm (0.0059 – 0.0157 in.)
Maximum end gap:
No. 1: 1.05 mm (0.0413 in.)
No. 2: 1.20 mm (0.0472 in.)
Oil (side rail): 1.05mm (0.0413 in.)

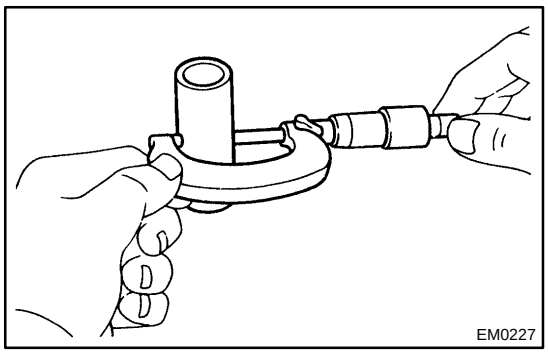


23. INSPECT PISTON PIN

(a) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.
Bushing inside diameter:
20.011–20.023 mm (0.7878 – 0.7883 in.)



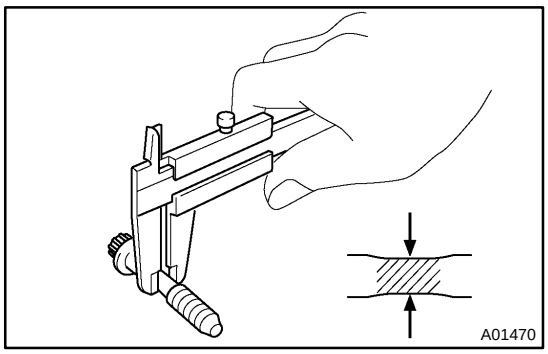
(b) Using a caliper gauge, measure the inside diameter of the piston bushing.
Bushing inside diameter:
20.013–20.025 mm (0.7879 – 0.7884 in.)



(c) Using a micrometer, measure the piston pin diameter.
Piston pin diameter:
20.004 – 20.016 mm (0.7876 – 0.7880 in)

(d) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.
Standard oil clearance:
Piston x Piston pin
0.005 – 0.013 mm (0.0002 – 0.0005 in.)
Piston x Connecting rod
0.005 – 0.009 mm (0.0002 – 0.0004 in.)

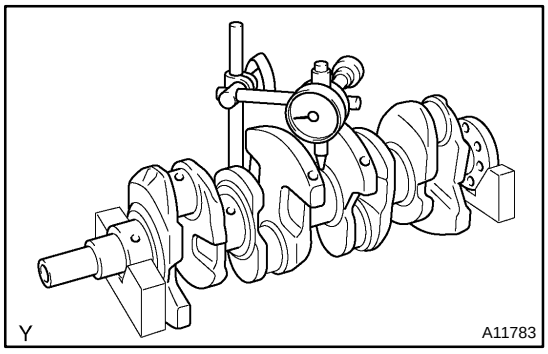
If the oil clearance is greater than maximum. replace the connecting rod assembly. If necessary, replace the piston and piston pin as a set.



24. INSPECT CONNECTING ROD BOLT

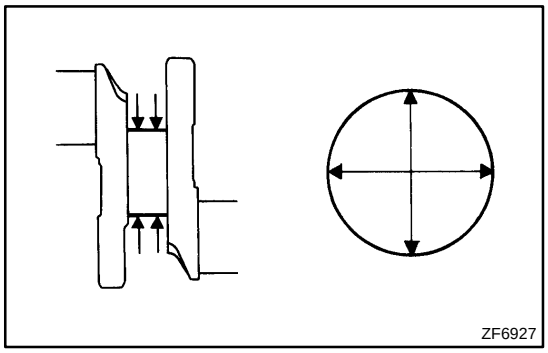
(a) Using a vernier caliper, measure the tension portion diameter of the bolts.
Standard diameter:
6.6 – 6.7 mm (0.260 – 0.264 in.)
Maximum diameter: 6.7 mm (0.263 in.)

(b) If the diameter is less than minimum, replace the bolt.



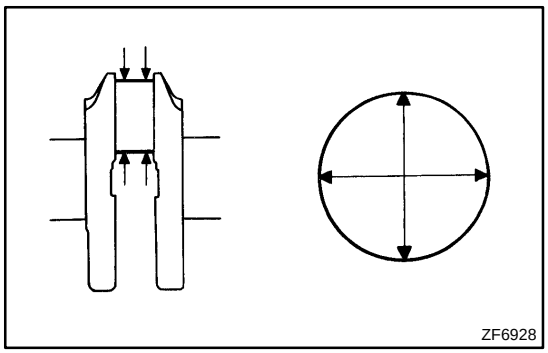
25. INSPECT CRANKSHAFT

(a) Using a dial indicator and V–blocks, measure the circle runout, as shown in the illustration.
Maximum circle runout: 0.03 mm (0.0012 in.)



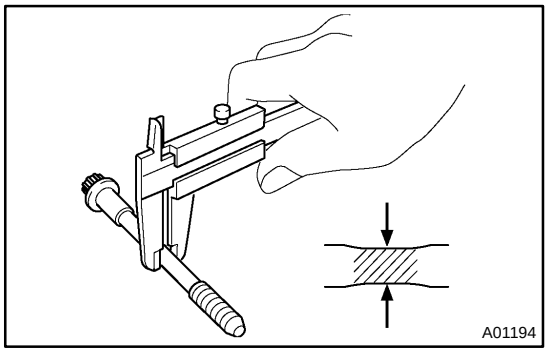
(b) Using a micrometer, measure the diameter of each main journal at the points shown in the illustration.
Diameter: 47.988 – 48.000 mm (1.8893 – 1.8898 in.)

(c) Check each main journal for taper and out–of–round as shown.
Maximum taper and out–of–round:
0.02 mm (0.0008 in.)



(d) Using a micrometer, measure the diameter of each crank pin at the points shown in the illustration.
Diameter: 44.992 – 45.000 mm (1.7713 – 1.7717 in.)

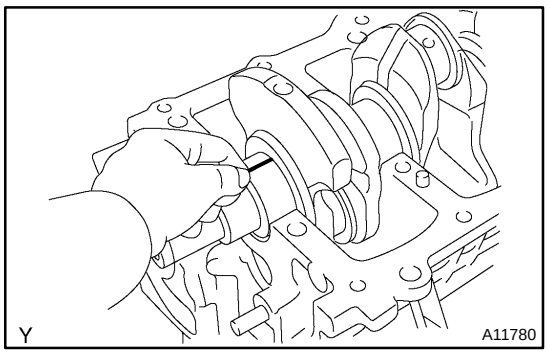
(e) Check each crank pin for taper and out–of–ruond as shown.
Maximum taper and out–of–round:
0.02 mm (0.0008 in.)



26. INSPECT CRANKSHAFT BEARING CAP BOLT

(a) Using vernier caliper, measure the tension portion diameter of the bolts.
Standard diameter: 7.3 – 7.5 mm (0.287 – 0.295 in.)
Minimum diameter: 7.3 mm (0.287 in.)

(b) If the diameter is less than minimum, replace the bolt.

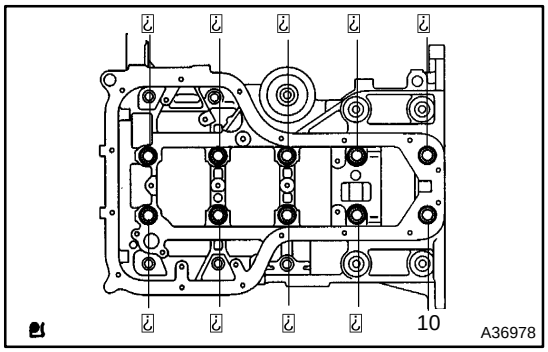


27. INSPECT CRANKSHAFT OIL CLEARANCE

(a) Clean each main journal and bearing.

(b) Place the crankshaft on the cylinder block.

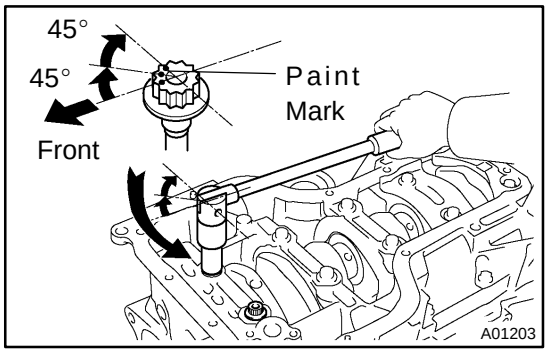
(c) Lay a strip of plastigage across each journal.



(d) Using socket wrench (12), tighten the bolts in several passes, in the sequence shown, by the specified torque.
Torque: 22 N·m (224 kgf·cm, 16 ft·lbf)

(e) Using socket wrench (12), retighten the bolts in several passes, in the sequence shown, by the specified torque.
Torque: 44 N·m (449 kgf·cm, 32 ft·lbf)

(f) Mark the front of the bearing cap sub–assembly bolts with paint.

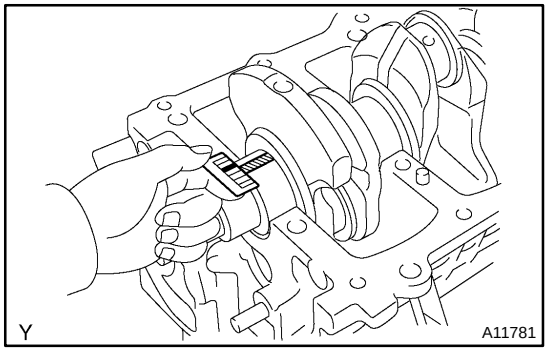


(g) Retighten the bearing cap sub–assembly bolts by 45 ° twice, in the numerical order shown.

(h) Check that the painted mark is now at a 90 ° angle to the front.

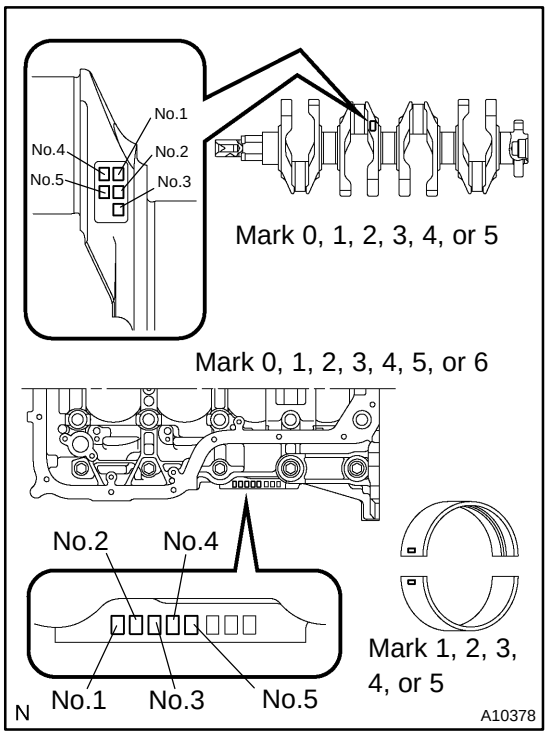
NOTICE:
Do not turn the crankshaft.

(i) Remove the bearing cap sub–assembly.



(j) Measure the plastigage at its widest point.
Standard oil clearance:
0.016 – 0.032 mm (0.0006 – 0.0013 in.)
Maximum oil clearance: 0.08 mm (0.0031 in.)

NOTICE:
Completely remove the plastigage



(k) If using standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, refer to the following table to select bearing.

Standard bearings selection chart

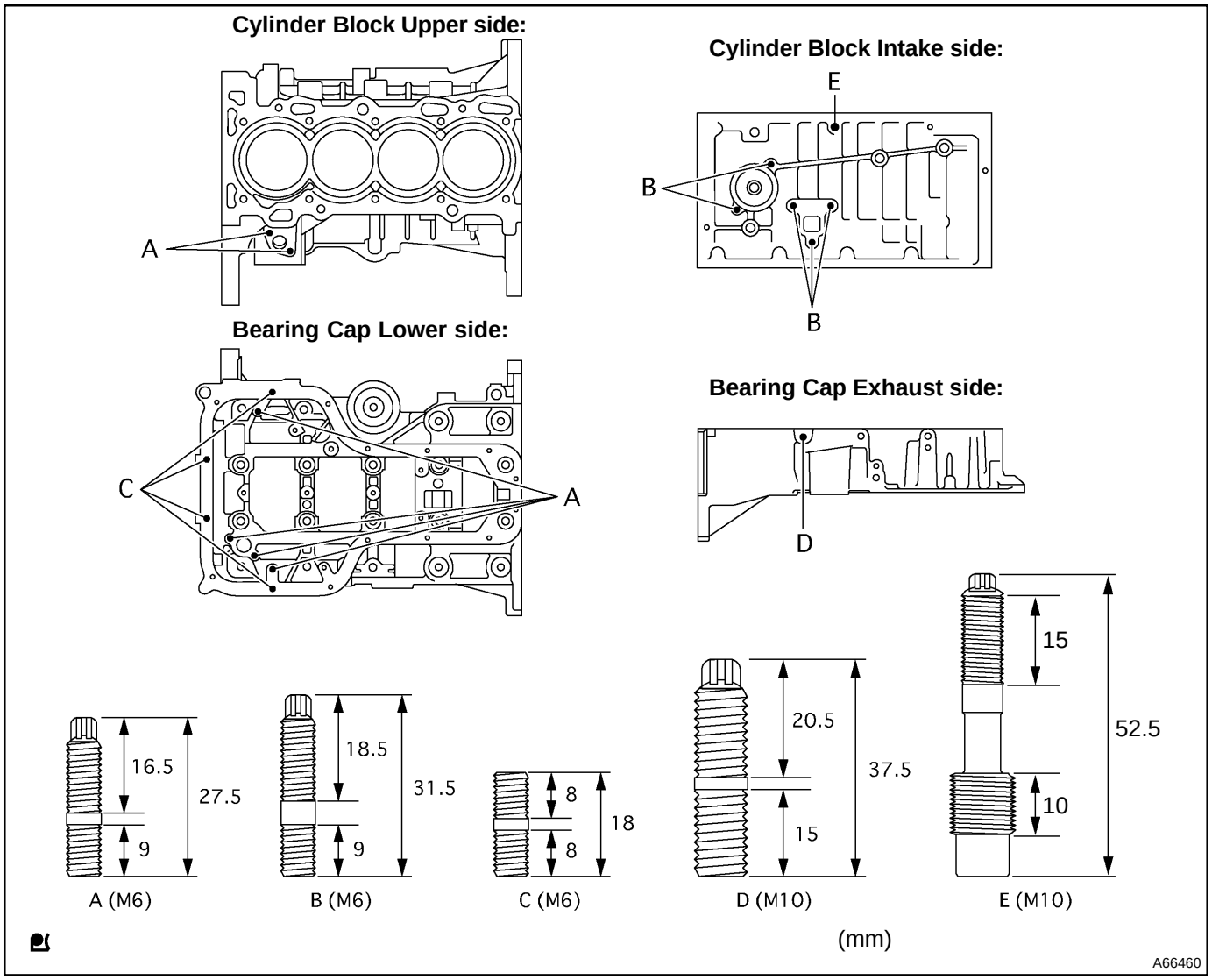
Cylinder block Number mark	Crank shaft number mark					
	0	1	2	3	4	5
0	1	1	1	2	2	2
1	1	1	2	2	2	3
2	1	2	2	2	3	3
3	2	2	2	3	3	3
4	2	3	3	3	4	4
5	3	3	3	4	4	4
6	3	3	4	4	4	5

HINT:
Cylinder block ”4”, Crank shaft ”3”, Use bearing ”3”

Item	Mark	mm (in.)
Cylinder block main journal bore diameter	”0”	52.000 – 52.003 (2.0472 – 2.0473)
	”1”	52.003 – 52.005 (2.0473 – 2.0474)
	”2”	52.005 – 52.007 (2.0474 – 2.0475)
	”3”	52.007 – 52.010 (2.0475 – 2.0476)
	”4”	52.010 – 52.012 (2.0476 – 2.0477)
	”5”	52.012 – 52.014 (2.0477 – 2.0478)
	”6”	52.014 – 52.016 (2.0478 – 2.0479)
Crankshaft main journal diameter	”0”	47.998 – 48.000 (1.8897 – 1.8898)
	”1”	47.996 – 47.998 (1.8896 – 1.8897)
	”2”	47.994 – 47.996 (1.8895 – 1.8896)
	”3”	47.992 – 47.994 (1.8894 – 1.8895)
	”4”	47.990 – 47.992 (1.8893 – 1.8894)
	”5”	47.988 – 47.990 (1.8892 – 1.8893)
Standard bearing center wall thickness	”1”	1.989 – 1.992 (0.0783 – 0.0784)
	”2”	1.992 – 1.995 (0.0784 – 0.0785)
	”3”	1.995 – 1.998 (0.0785 – 0.0787)
	”4”	1.998 – 2.001 (0.0787 – 0.0788)
	”5”	2.001 – 2.004 (0.0788 – 0.0789)

28. INSTALL STUD BOLT

Torque:
A 5.0 N·m (51 kgf·cm, 44 in·lbf)
B 5.0 N·m (51 kgf·cm, 44 in·lbf)
C 5.0 N·m (51 kgf·cm, 44 in·lbf)
D 19.0 N·m (194 kgf·cm, 14 ft·lbf)
E 11N·m (112 kgf·cm, 8 ft·lbf)



29. INSTALL RING PIN

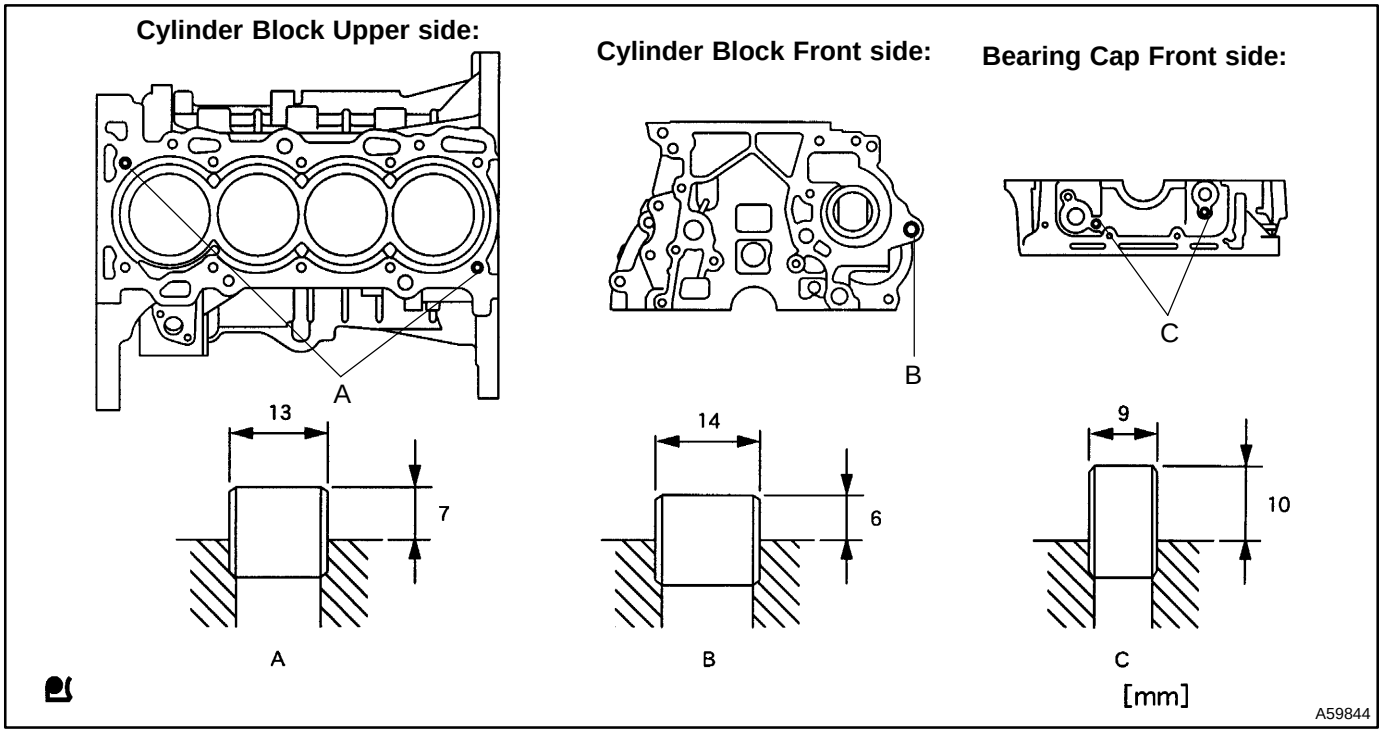
(a) Using a plastic–faced hammer, tap in the new ring pins to the specified protrusion height.

Protrusion height:

A 7 mm (0.2756 in.)

B 6 mm (0.2362 in.)

C 10 mm (0.3973 in.)



30. INSTALL STRAIGHT PIN

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

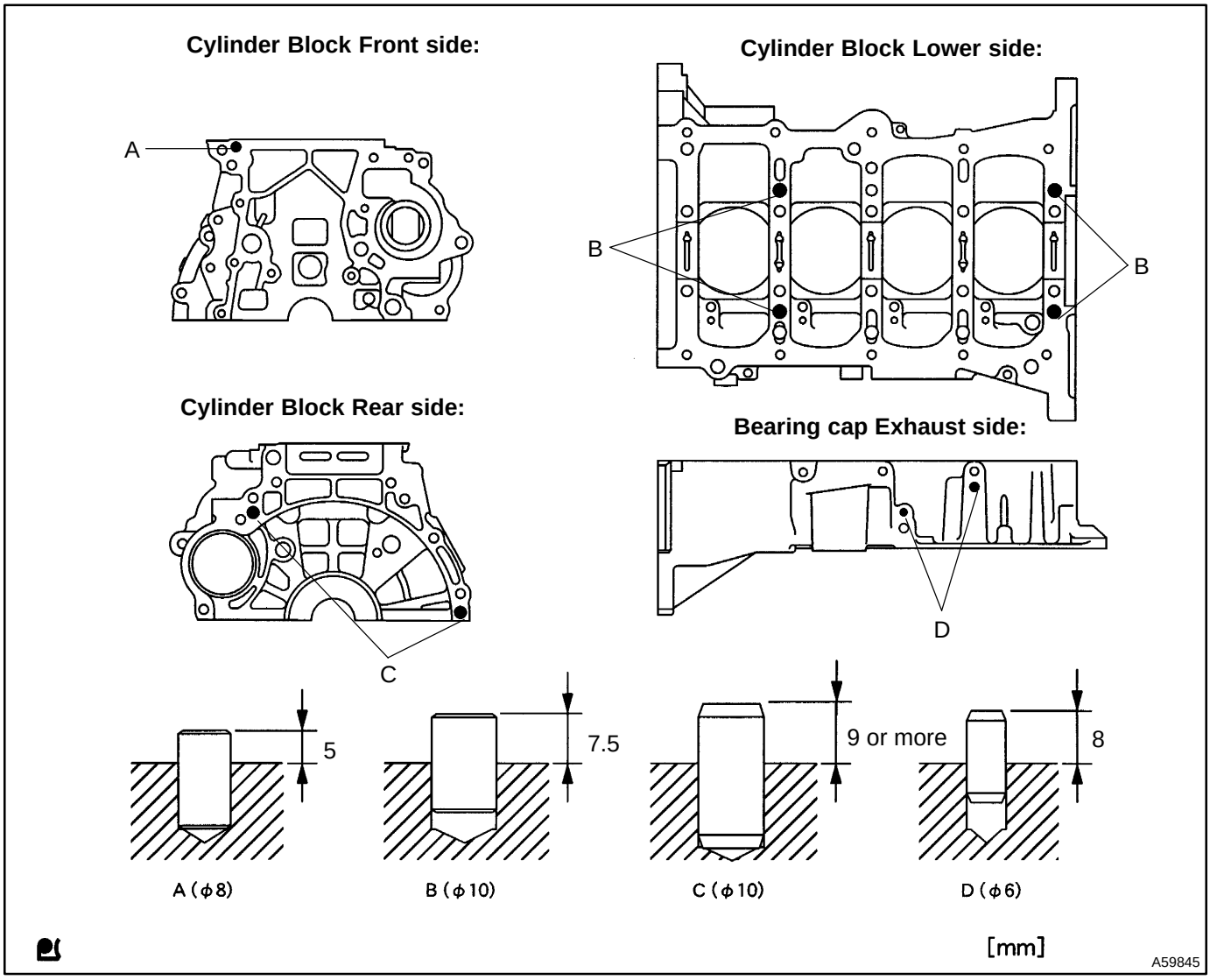
Protrusion height:

A 5 mm (0.1969 in.)

B 7.5 mm (0.2953 in.)

C 9 mm (0.3543 in.) or more

D 8 mm (0.3150 in.)

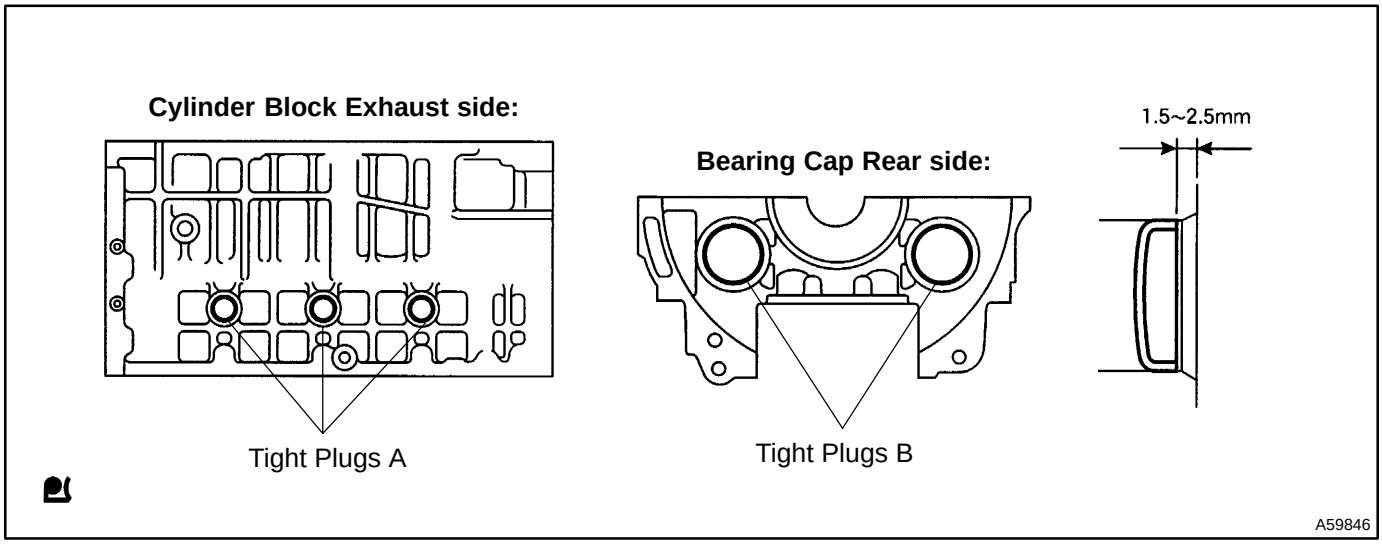


31. INSTALL TIGHT PLUG

(a) Apply adhesive around tight plugs.
Adhesive: Part No. 08833–00070, THREE BOND 1324 or equivalent

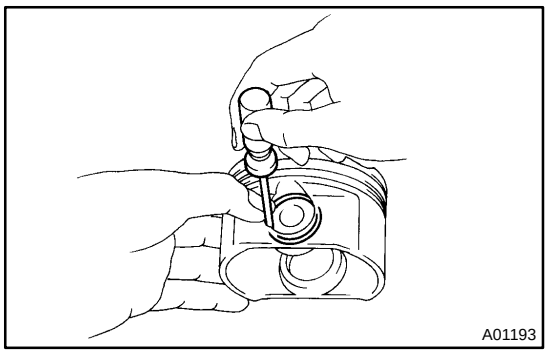
(b) Using SST, tap in the tight plugs A until its surface is flush with the cylinder block.

(c) Using SST, tap in the tight plugs B to the specified protrusion height.
Protrusion height:
B 1.5 – 2.5 mm(0.0591 – 0.0984 in.)
SST 09950–60010 (09951–00250), 09950–70010 (09951–07100, 09951–00450)



32. INSTALL SUB–ASSY OIL NOZZLE NO.1

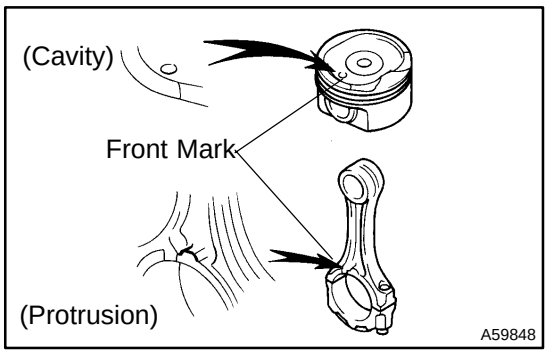
(a) Using a bi–hexagon wrench (5), install the oil nozzle No.1.
Torque: 9.0 N·m (92 kgf·cm, 80 in·lbf)



33. INSTALL PISTON PIN HOLE SNAP RING

(a) Using a small screwdriver, install a new snap ring at one end of the piston pin hole.

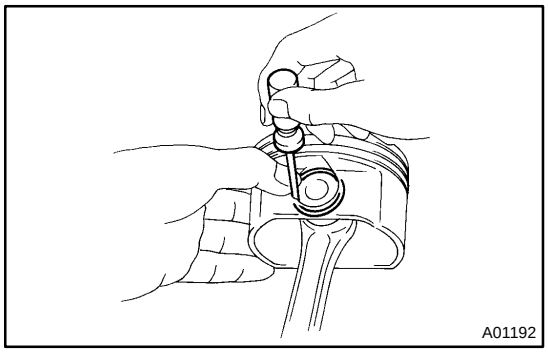
HINT:
Be sure that end gap of the snap ring is aligned with the pin hole cutout portion of the piston.



34. INSTALL W/PIN PISTON SUB–ASSY

(a) Coat the piston pin with engine oil.

(b) Align the front marks on the piston and connecting rod, and push in the piston with your thumb.

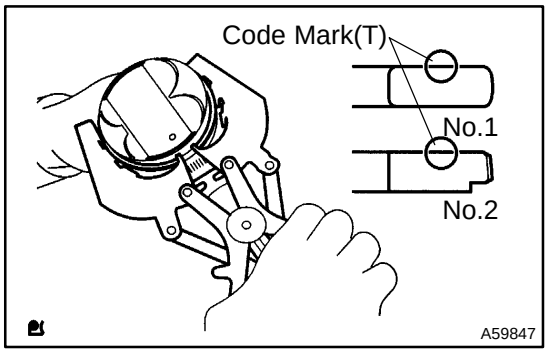


35. INSTALL PISTON PIN HOLE SNAP RING

(a) Using a small screwdriver, install a new snap ring on the other end of the piston pin hole.

HINT:

Be sure that end gap of the snap ring is not as aligned with the pin hole cutout portion of the piston.



36. INSTALL PISTON RING SET

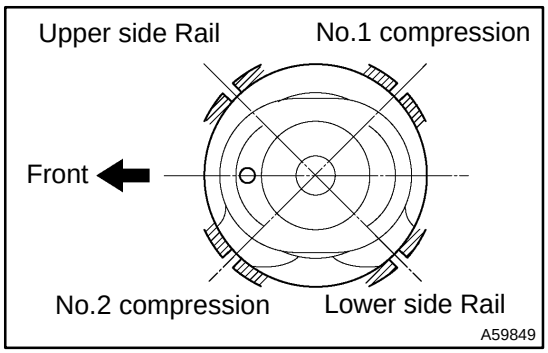
HINT:

In case of reusing the piston rings, install them to the matched pistons with the surfaces faced correctly.

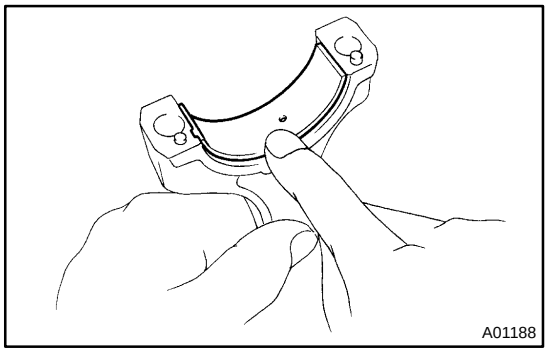
(a) Install the oil ring expander and 2 side rails by hand.

(b) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

Code mark : T



(c) Position the piston rings so that the ring ends are as shown.

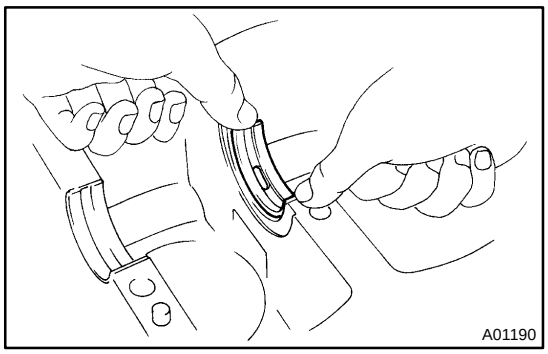


37. INSTALL CONNECTING ROD BEARING

(a) Align the bearing claw with the groove of the connecting rod or connecting cap.

NOTICE:

Clean the backside of the bearing and the bearing surface of the connecting rod and let not stick the oils and fats.

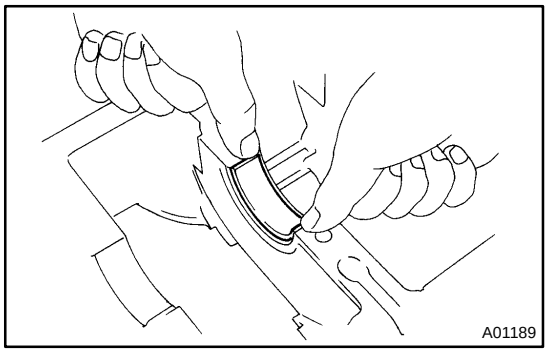


38. INSTALL CRANKSHAFT

(a) Install the upper bearing with an oil groove on cylinder block.

NOTICE:

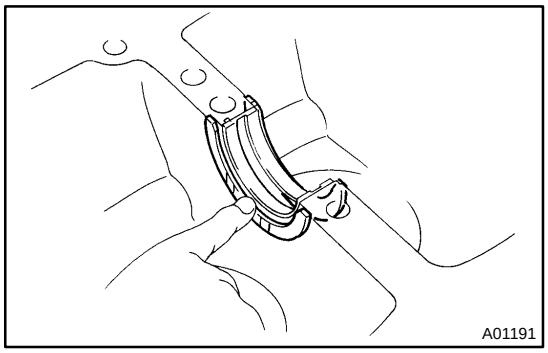
Clean the backside of the bearing and the bearing surface of the bearing cap and let not stick the oils and fats.



(b) Install the lower bearing on the bearing cap sub assembly.

NOTICE:

Clean the backside of the bearing and the bearing surface of the bearing cap and let not stick the oils and fats.



(c) Install the 2 thrust washers upper the No. 3 journal position of the cylinder block with the oil grooves facing outward.

(d) Apply engine oil to upper bearing and install the crankshaft on the cylinder block.

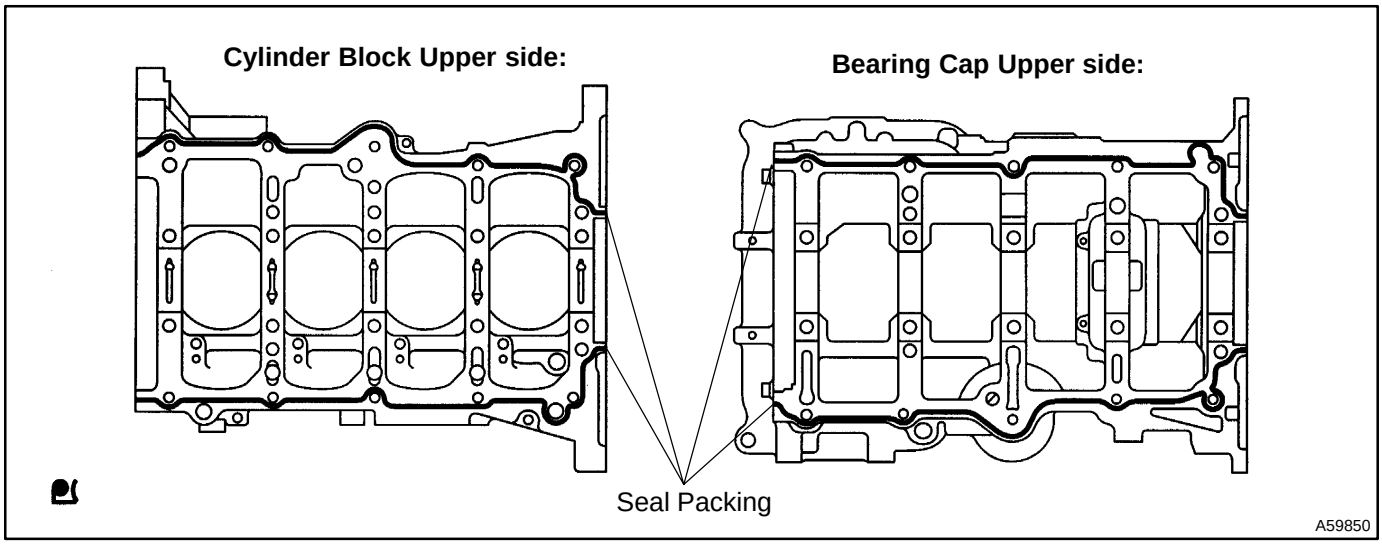
(e) Apply a light coat of engine oil on the bolt threads, the bolt seats, and the bearings of the bearing cap sub assembly.

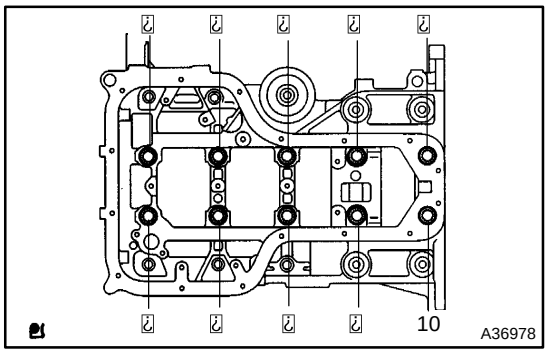
(f) Apply seal packing in the shape of bead (Diameter 2.5 – 3.5 mm (0.08 – 0.12 in.) consequently as shown in the illustration.

Seal packing: Part No. 08826–00080 or equivalent

NOTICE:

- **Remove any oil from the contact surface.**
- **Install the bearing cap sub–assembly within 3 minutes after applying seal packing.**
- **Do not put into engine oil within 2 hours after the installation.**

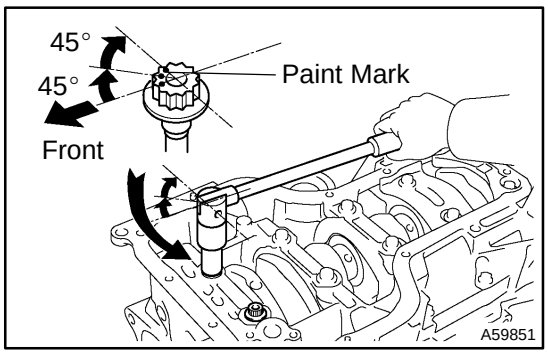




(g) Using socket wrench (12), tighten the bolts in several passes, in the sequence shown, by the specified torque.
Torque: 22 N·m (224 kgf·cm, 16 ft·lbf)

(h) Using socket wrench (12), retighten the bolts in several passes, in the sequence shown, by the specified torque.
Torque: 44 N·m (449 kgf·cm, 32 ft·lbf)

(i) Mark the front of the bearing cap sub–assembly bolts with paint.

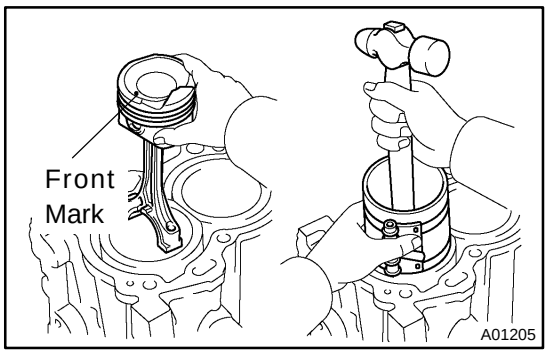


(j) Retighten the bearing cap sub–assembly bolts by 45 ° twice, in the numerical order shown.

(k) Check that the painted mark is now at a 90 ° angle to the front.

(l) Tighten 10 other bolts for the bearing cap.
Torque: 18 N·m (184 kgf·cm, 13 ft·lbf)

(m) apply adhesive to 2 or 3 threads, and install the 4 screw plugs.
Adhesive:
Part No. 08833–0070, THREE BOND 1324, or equivalent
Torque: 43 N·m (438 kgf·cm, 32 ft·lbf)



39. INSTALL CONNECTING ROD SUB–ASSY

(a) Apply engine oil to the cylinder walls, the pistons, and the surfaces of connecting rod bearings.

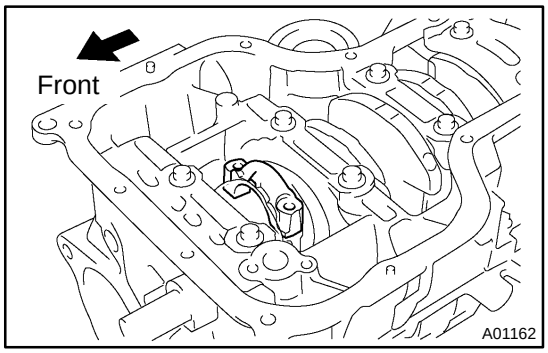
(b) Check the position of the piston ring ends.

(c) Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward.

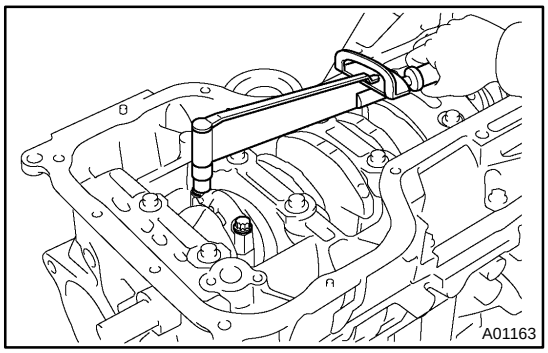
(d) Align the pin dowels of the connecting rod cap with the pins of the connecting rod, and install the connecting rod.

NOTICE:

- **Clean the backside and the surface of the connecting rod cap bearing and let not stick the oils and fats.**
- **Match the numbered connecting rod cap with the same numbered connecting rod.**



(e) Check that the protrusion of the connecting rod cap is facing in the correct direction.

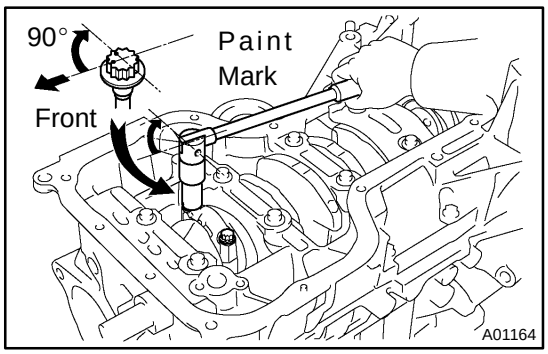


(f) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.

(g) Using SST, tighten the bolts in several passes by the specified torque.

SST 09205–16010

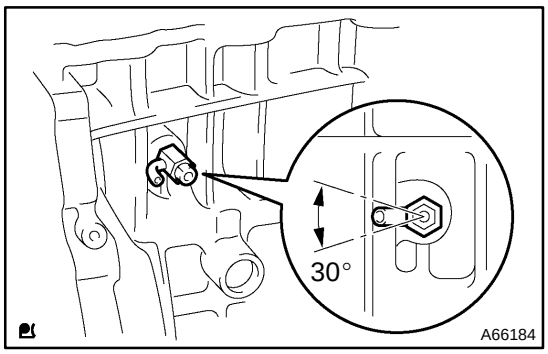
Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)



(h) Mark the front of the connecting cap bolts with paint.

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

(j) Check that the crankshaft turns smoothly.



40. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB–ASSY

(a) Apply two or three threads of adhesive to the drain union, and install it within 3 minutes.

Torque: 25 N·m (255 kgf·cm 18 ft·lbf)

(b) After applying the specified torque, rotate the drain union clockwise until its drain port faces downward.

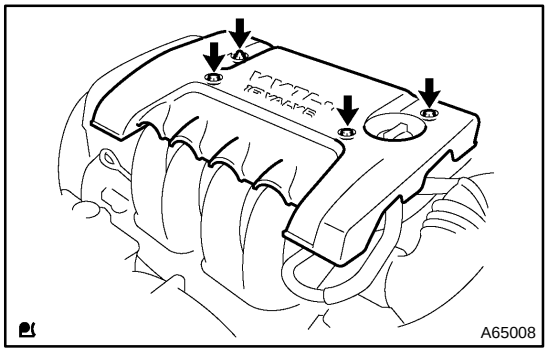
NOTICE:

- **Do not put into coolant in an hour after the installation.**
- **Do not rotate the drain union more than 360 ° in (b), and never loosen it after setting the union correctly.**

1008P–01

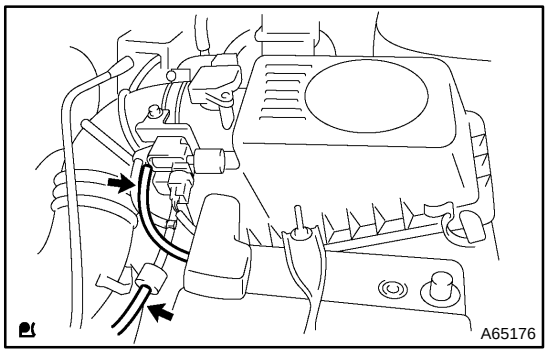
Removal & Installation and Disassembly & Reassembly

1. DRAIN COOLANT(See Page 16–6)



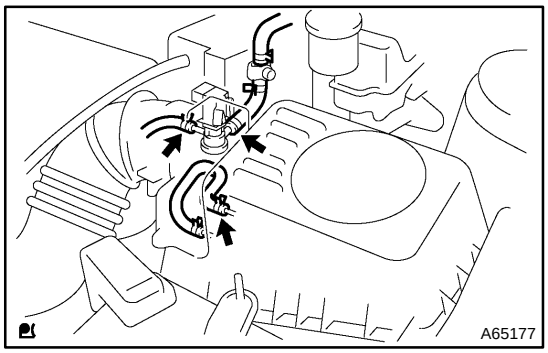
2. REMOVE CYLINDER HEAD COVER NO.2

(a) Remove 3 bolts, nut and cylinder head cover No. 2.



3. REMOVE AIR CLEANER CAP SUB–ASSY

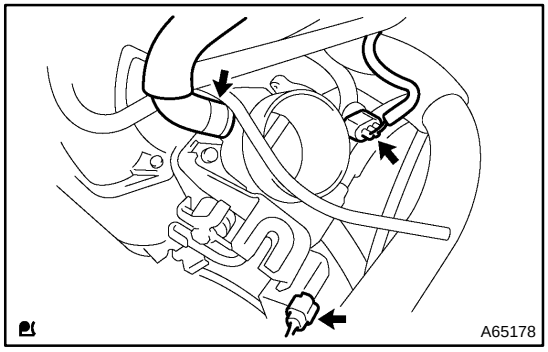
(a) Disconnect 2 vacuum hoses as shown in the illustration.
(b) Disconnect the MAF connector.
(c) Disconnect 2 VSV connectors.



(d) Disconnect 3 vacuum hoses, as shown in the illustration.
(e) Loosen an air cleaner hose clamp and disconnect an air cleaner hose No. 1.
(f) Remove the air cleaner cap.

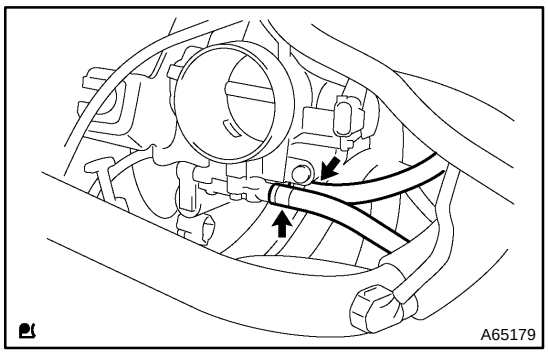
4. REMOVE AIR CLEANER HOSE NO.1

5. SEPARATE ACCELERATOR CONTROL CABLE ASSY

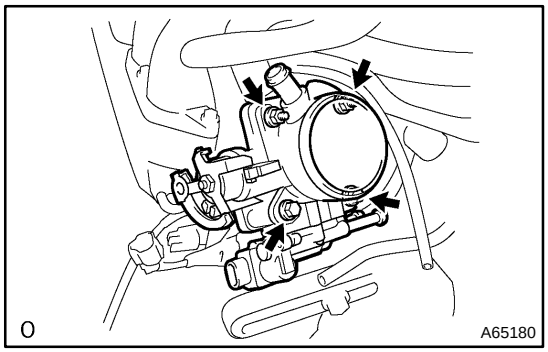


6. REMOVE THROTTLE BODY ASSY

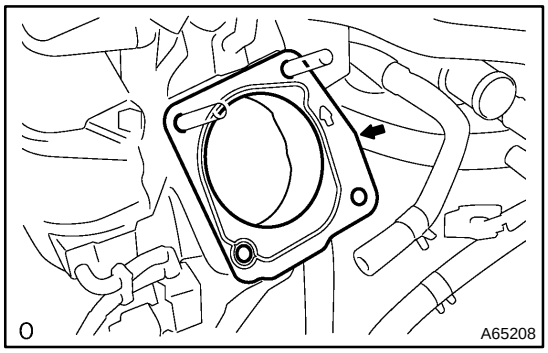
(a) Disconnect an E.F.I. throttle position sensor connector.
(b) Disconnect a throttle body idle speed control valve assy connector.
(c) Disconnect a PCV hose from throttle body.



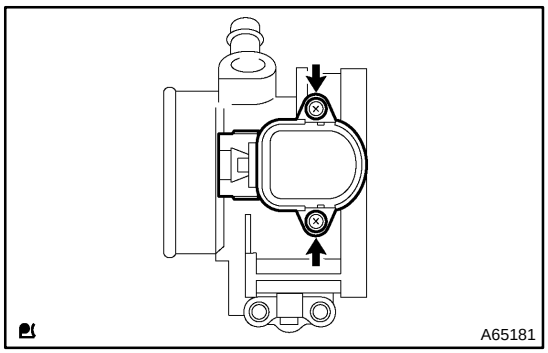
(d) Disconnect 2 water by–pass hoses from the throttle body.



(e) Remove the throttle body and accelerator control cable bracket with 2 bolts and 2 nuts.

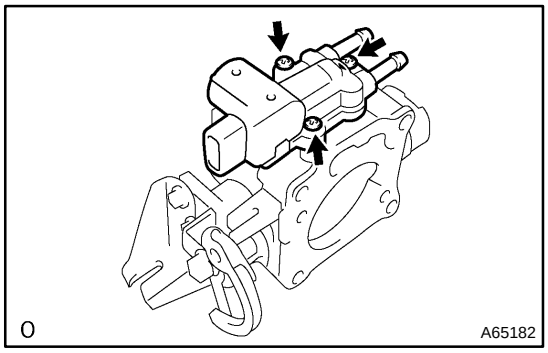


(f) Remove the gasket from the intake manifold.



7. REMOVE E.F.I. THROTTLE POSITION SENSOR

(a) Remove 2 screws and throttle position sensor.



8. REMOVE THLOTTLE BODY IDLE SPEED CONTROL VALVE ASSY

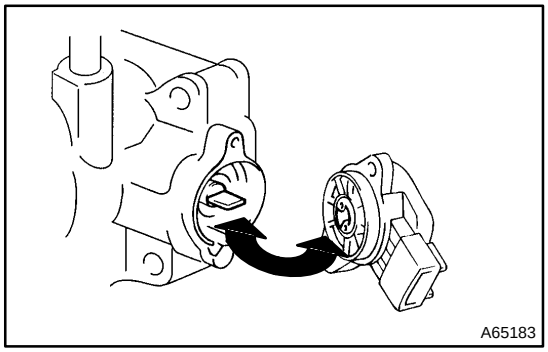
(a) Remove 3 screws and idle speed control valve.

(b) Remove the gasket from the throttle body.

9. INSTALL THLOTTLE BODY IDLE SPEED CONTROL VALVE ASSY

(a) Install a new gasket on the throttle body.

(b) Install the idle speed control valve assy with 3 screws.
Torque: 3.7 N·m (38 kgf·cm, 33 in.·lbf)

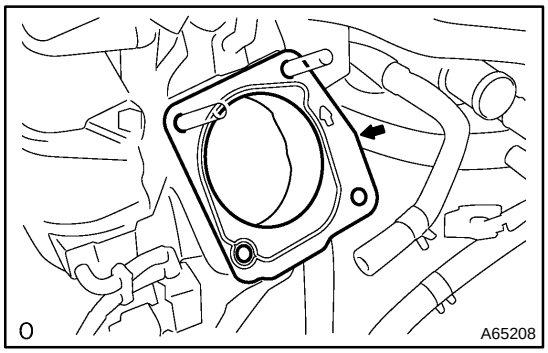


10. INSTALL E.F.I. THROTTLE POSITION SENSOR

(a) Check that the throttle valve is fully close.

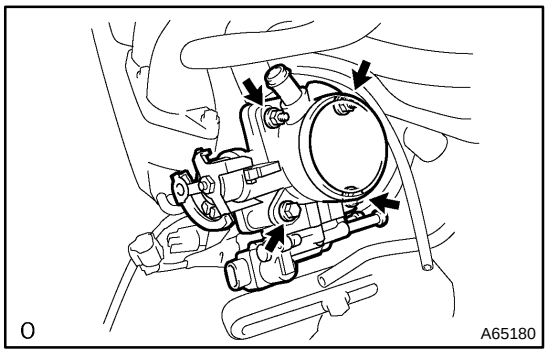
(b) Insert the throttle position sensor to the throttle body with it turned clockwise by 30◆to 90◆against the fully close valve position.

(c) By turning the throttle position sensor clockwise, tighten 2 screws.
Torque: 2.0 N·m (20 kgf·cm, 18 in.·lbf)

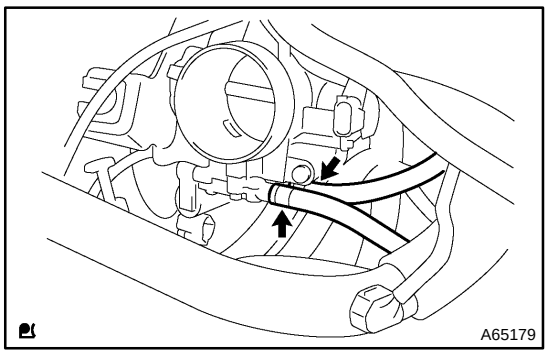


11. INSTALL THROTTLE BODY ASSY

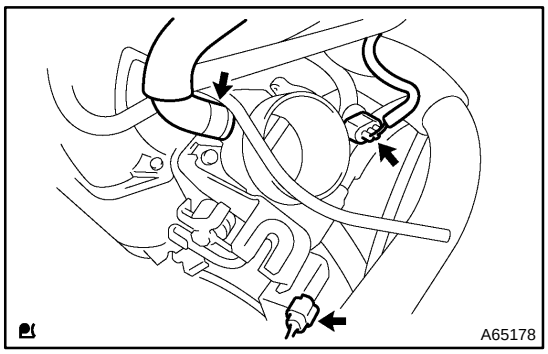
(a) Install a new gasket on the intake manifold, as shown in the illustration.



(b) Install the throttle body and accelerator control cable bracket with 2 bolts and 2 nuts.
Torque: 22 N·m (224 kgf·cm, 16 ft·lbf)



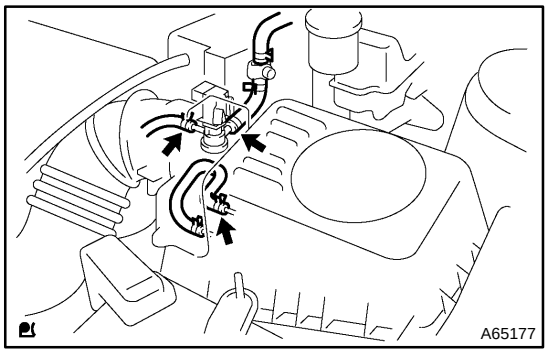
(c) Connect 2 water by–pass hoses to the throttle body.



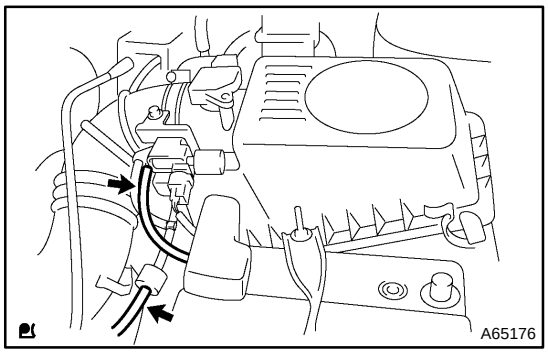
(d) Connect the PCV hose to the throttle body.
(e) Connect the throttle body idle speed control valve assy connector to the throttle body.
(f) Connect the throttle position sensor connector to the throttle body.

12. INSTALL AIR CLEANER CAP SUB–ASSY

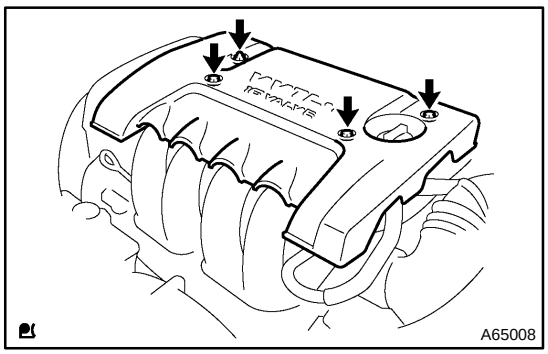
(a) Install the air cleaner cap.
(b) Connect the air cleaner hose No. 1.



(c) Connect 3 vacuum hoses, as shown in the illustration.
(d) Connect 2 VSV connectors.
(e) Connect the MAF connector.



(f) Connect 2 vacuum hoses as shown in the illustration.

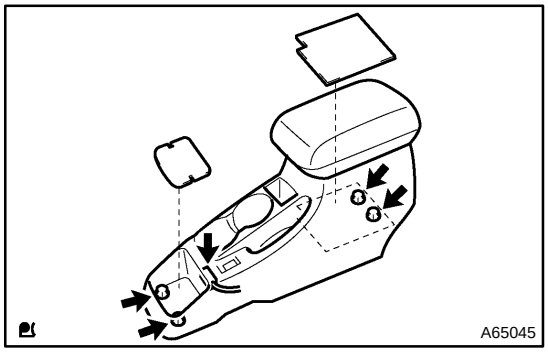


13. INSTALL CYLINDER HEAD COVER NO.2

(a) Install the cylinder head cover No. 2 with 3 bolts and a nut.
Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)

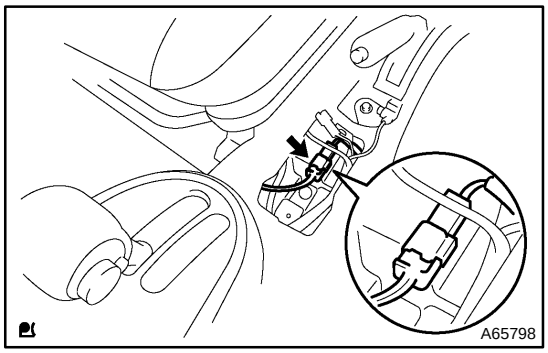
14. ADD COOLANT (See Page 16–6)
15. CHECK ENGINE COOLANT LEAK (See Page 16–1)

Removal & Installation and Disassembly & Reassembly



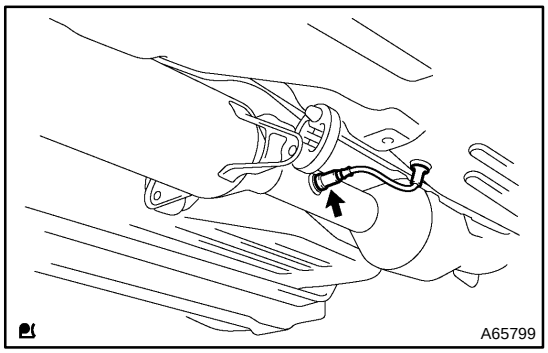
1. REMOVE CONSOLE BOX ASSY REAR

(a) Remove cosole box insert.
(b) Remove console box damper RR.
(c) Remove 4 bolts from the console box assy rear.
(d) Disconnect a connector and remove the console box assy rear.

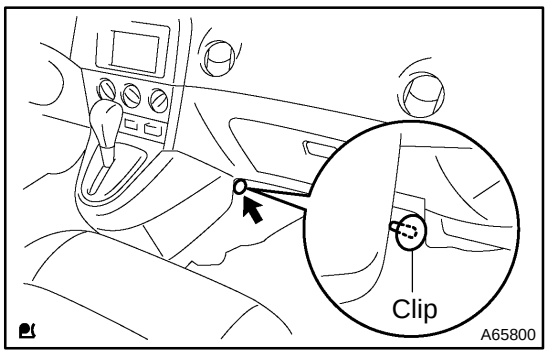


2. REMOVE OXYGEN NO.2 SENSOR (RR POSITION)

(a) Disconnect an oxygen No. 2 sensor connector, as show in the illustration.

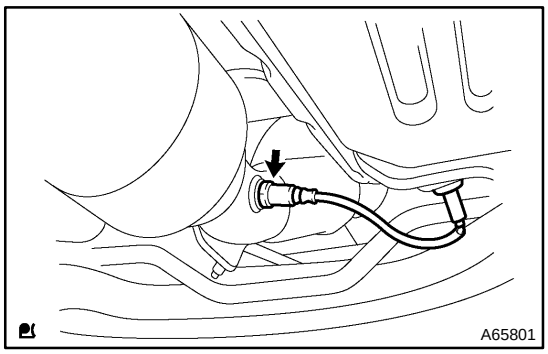


(b) Remove the oxygen No. 2 sensor from the exhaust pipe assy front, as shown in the illustration. 1504L–01



3. REMOVE OXYGEN NO.2 SENSOR (FR POSITION)

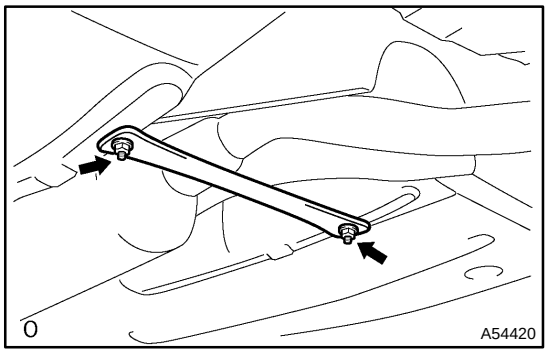
(a) Remove a clip and tear off the floor mat.
(b) Disconnect the oxygen No. 2 sensor connector.



(c) Remove the oxygen No. 2 sensor from the exhaust pipe assy front, as shown in the illustration.

4. REMOVE TAIL PIPE ASSY

(a) Remove the exhaust tail pipe with 2 bolts and 2 springs.



5. REMOVE FLOOR PANEL BRACE FRONT

(a) Remove 2 nuts and the front floor panel brace.

6. REMOVE EXHAUST PIPE ASSY FRONT

(a) Remove 2 bolts, 2 springs and exhaust front pipe.

7. INSTALL EXHAUST PIPE ASSY FRONT

(a) Using a vernier calipers, measure the free length of the compression spring.
Free length: 43 mm (1.693 in.)

HINT:

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

(b) Install a new gasket on the exhaust manifold.

(c) Install the exhaust front pipe with 2 bolts and 2 springs.
Torque: 43 N·m (440 kgf·cm, 32 ft·lbf)

8. INSTALL FLOOR PANEL BRACE FRONT

(a) Install the front floor panel brace with 2 nuts.
Torque: 30 N·m (302 kgf·cm, 22 ft·lbf)

9. INSTALL TAIL PIPE ASSY

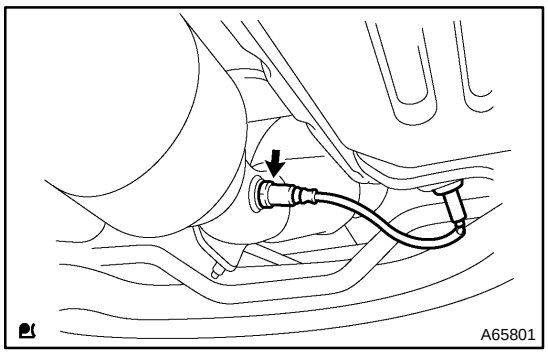
(a) Using a vernier calipers, measure the free length of the compression spring.
Free length: 40 mm (1.575 in.)

HINT:

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

(b) Install a new gasket on the exhaust pipe front.

(c) Install the exhaust tail pipe with 2 bolts and 2 springs.
Torque: 43 N·m (440 kgf·cm, 32 ft·lbf)



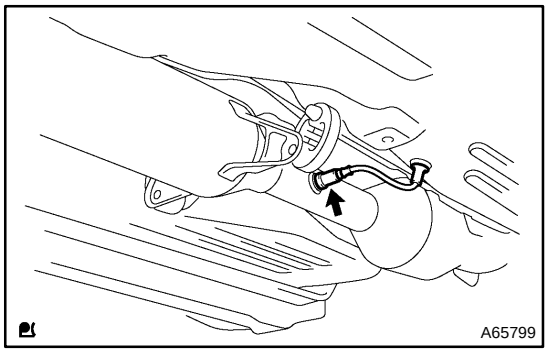
10. INSTALL OXYGEN NO.2 SENSOR (FR POSITION)

(a) Install the oxygen No. 2 sensor to the exhaust pipe front.
Torque: 44 N·m (450 kgf·cm, 33 ft·lbf)

(b) Connect the oxygen No. 2 sensor connector.

HINT:

After installing oxygen No. 2 sensor, check that sensor wire is not twisted. If it is twisted, remove oxygen No. 2 sensor and reinstall it.



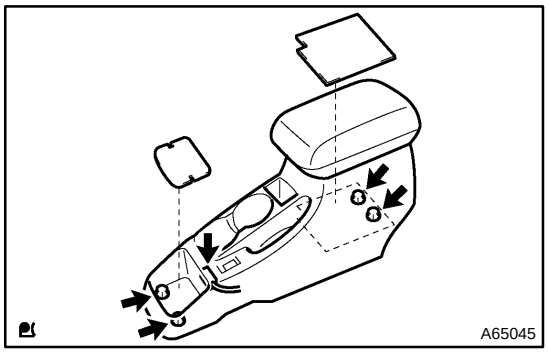
11. INSTALL OXYGEN NO.2 SENSOR (RR POSITION)

(a) Install the oxygen No. 2 sensor to the exhaust pipe front.
Torque: 44 N·m (450 kgf·cm, 33 ft·lbf)

(b) Connect the oxygen No. 2 sensor connector.

HINT:

After installing oxygen No. 2 sensor, check that sensor wire is not twisted. If it is twisted, remove oxygen No. 2 sensor and reinstall it.



12. INSTALL CONSOLE BOX ASSY REAR

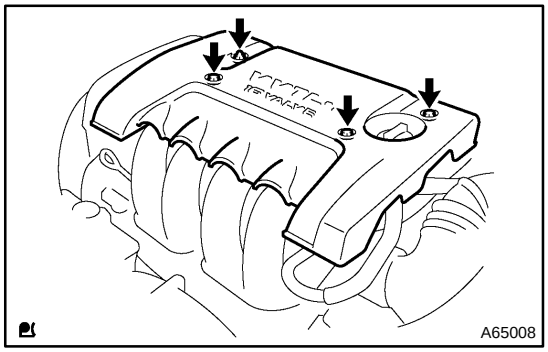
(a) Connect a connector and install the console box assy rear with 4 bolts.

13. CHECK EXHAUST GAS LEAK

110F1–01

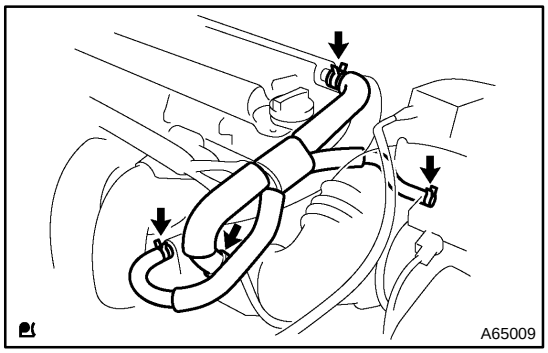
REPLACEMENT

1. WORK FOR PREVENTING GASOLINE FROM SPILLING OUT (See page 11–1)



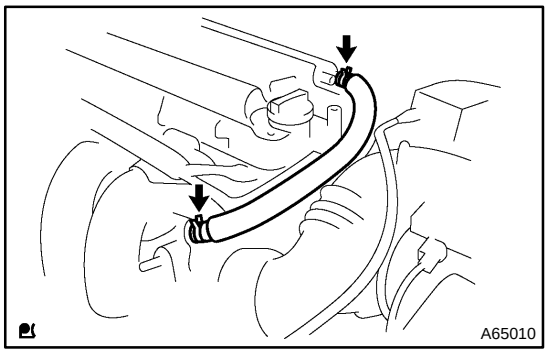
2. REMOVE CYLINDER HEAD COVER NO.2

(a) Remove the 3 bolts, nut and cylinder head cover.



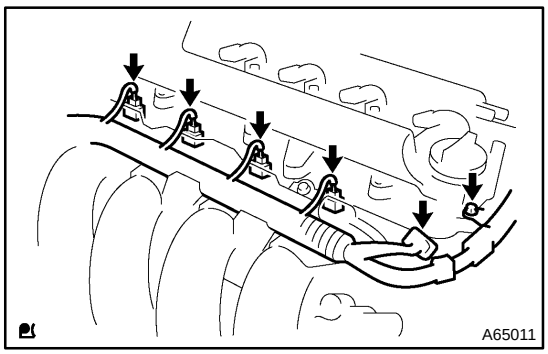
3. REMOVE VENTILATION HOSE NO.2

(a) Remove the ventilation hose.



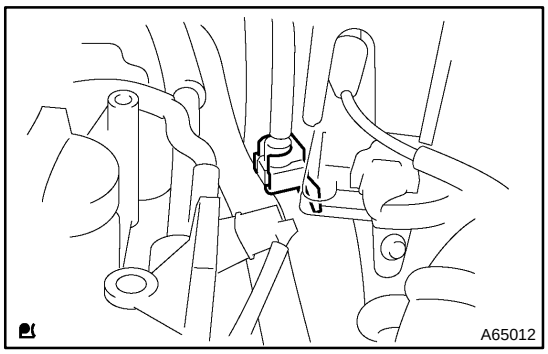
4. REMOVE VENTILATION HOSE

(a) Remove the ventilation hose.



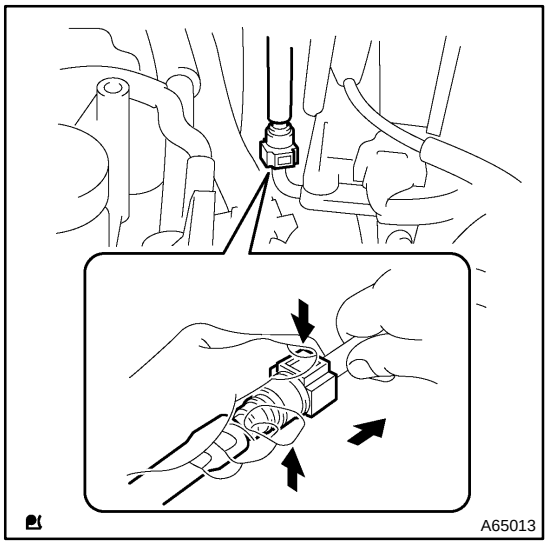
5. DISCONNECT ENGINE WIRE

(a) Remove the bolt.
(b) Disconnect the 4 fuel injector connectors.
(c) Disconnect the cam position sensor connector.



6. REMOVE EFI FUEL PIPE CLAMP

(a) Remove the EFI fuel pipe clamp.

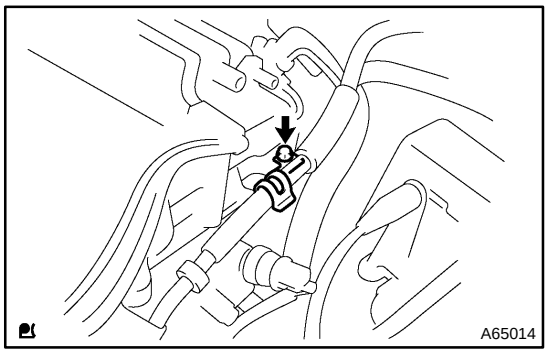


7. REMOVE FUEL DELIVERY PIPE SUB–ASSY

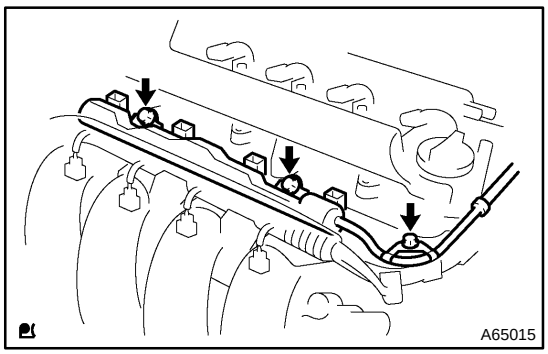
(a) Disconnect the fuel tube (fuel tube connector) from the fuel pipe.

CAUTION:

- **Perform disconnecting operations of the fuel tube connector (quick type) after observing the precautions.**
- **As there is retained pressure in the fuel pipe line, prevent it from splashing inside the engine compartment.**



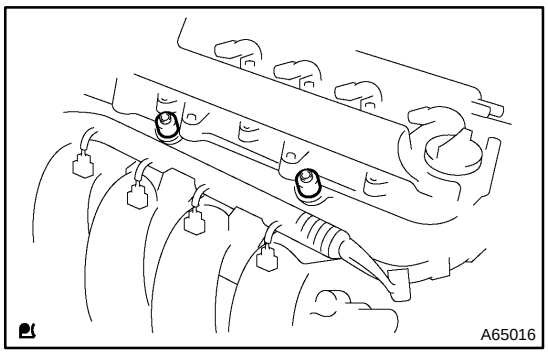
(b) Remove the bolt and clamp.



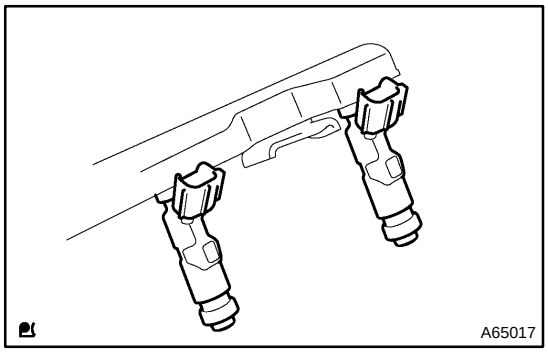
(c) Remove the 3 bolts and fuel delivery pipe together with the 4 fuel injectors and fuel tube.

NOTICE:

Be careful not to drop the fuel injectors when removing the fuel delivery pipe.

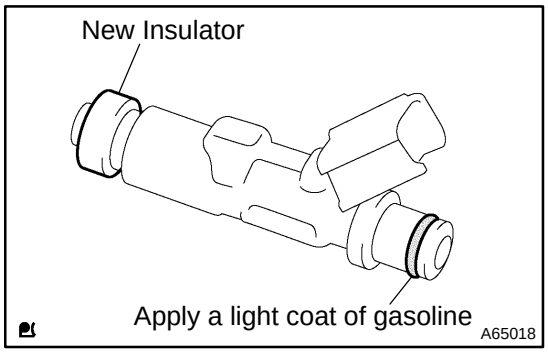


(d) Remove the 2 spacers from the cylinder head.



8. REMOVE FUEL INJECTOR ASSY

(a) Pull out the 4 fuel injectors from the fuel delivery pipe.



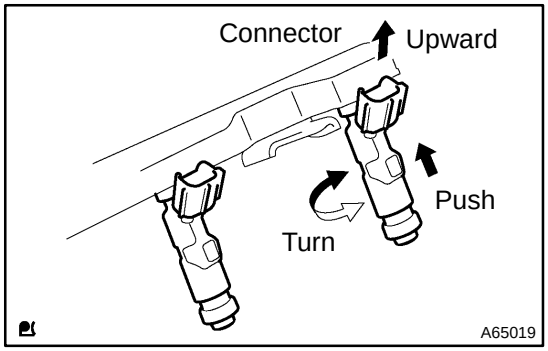
9. INSTALL FUEL INJECTOR ASSY

(a) Install a new insulator to the each fuel injector.

(b) Apply a light coat of spindle oil or gasoline to a new O–ring, and install it to the each fuel injector.

NOTICE:

Never use engine, gear or brake oil.

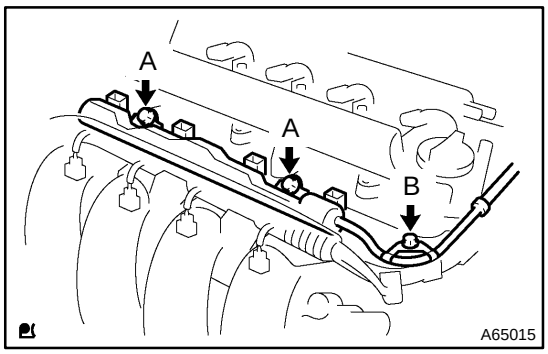


(c) Apply a light coat of spindle oil or gasoline on the place where the fuel delivery pipe touches on O–ring.

(d) While turning the fuel injector clockwise and counter-clockwise, and push it to the fuel delivery pipe.

NOTICE:

- **Be careful not twist the O–ring.**
- **After installing the fuel injectors, check that they turns smoothly. If the fuel injector does not, reinstall it with a new O–ring.**



10. INSTALL FUEL DELIVERY PIPE SUB–ASSY

(a) Install the 2 spacers to the cylinder head.

(b) Install the fuel delivery pipe together with the 4 fuel injectors and fuel tube with the 3 bolts.

Torque:
Bolt A 29 N·m (296 kgf·cm, 21 ft·lbf)
Bolt B 9.0 N·m (92 kgf·cm, 80 in.·lbf)

NOTICE:

- **Be careful not drop the fuel injectors when installing the fuel delivery pipe.**
- **Check that the fuel injectors rotate smoothly after installing the fuel delivery pipe.**

(c) Install the clamp with the bolt.

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

(d) Connect the fuel tube (fuel tube connector) to the fuel pipe.

CAUTION:
Perform connecting operations of the connector (quick type) after observing the precautions.

11. CONNECT ENGINE WIRE

(a) Connect the composition sensor connector.

(b) Connect the 4 fuel injector connectors.

(c) Install the bolt.

Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

12. INSTALL CYLINDER HEAD COVER NO.2

(a) Install the cylinder head cover with the 3 bolts and nut.

Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)

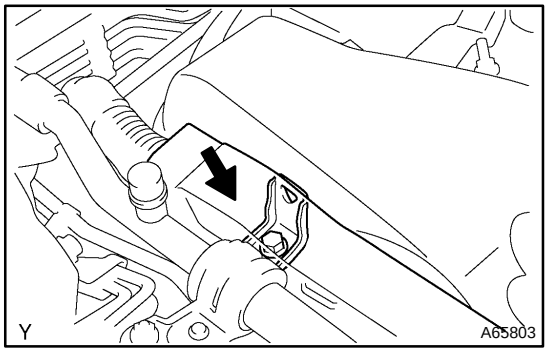
13. CHECK FUEL LEAK (See page 11–1)

FAN AND GENERATOR V BELT (2ZZ–GE)

140R5–01

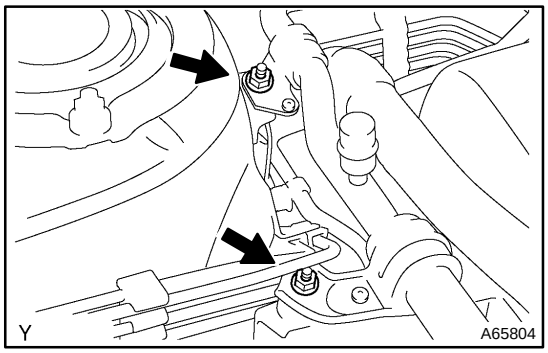
REPLACEMENT

1. REMOVE ENGINE UNDER COVER RH



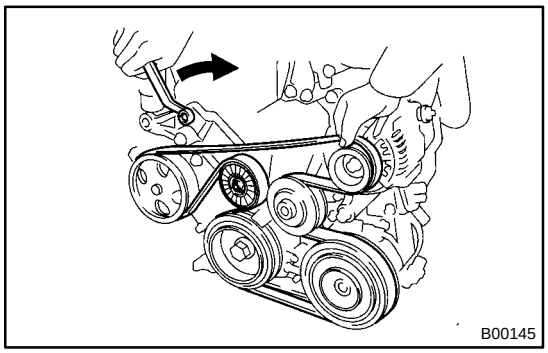
2. REMOVE WIRE HARNESS CLAMP

(a) Disconnect engine wire harness.
(b) Remove the bolt and wiring harness clamp bracket.



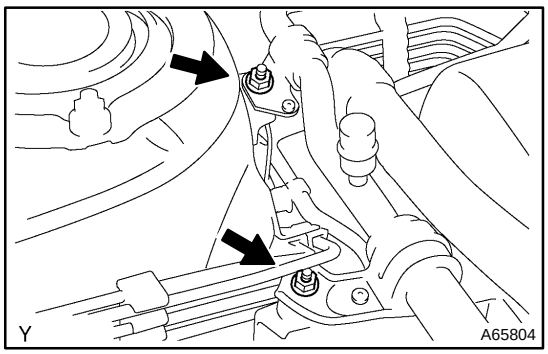
3. DISCONNECT SUCTION HOSE SUB–ASSY

(a) Remove the 2 nuts installing the suction hose sub–assy.
(b) Disconnect the suction hose sub–assy.



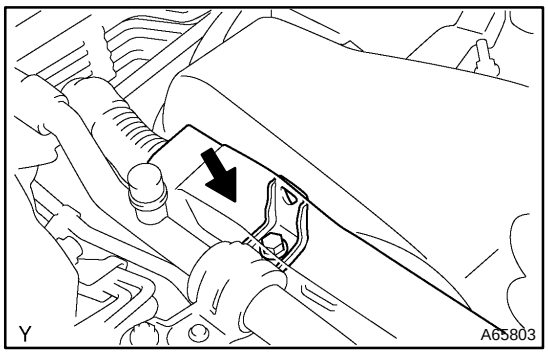
4. REMOVE FAN AND GENERATOR V BELT

(a) Turn the drive belt tensioner slowly clockwise and loosen it. Then, remove the drive belt and put back the drive belt tensioner little by little and fix it quietly.



5. INSTALL SUCTION HOSE SUB–ASSY

Torque: 9.8 N·m (100 kgf·cm, 87 in.·lbf)

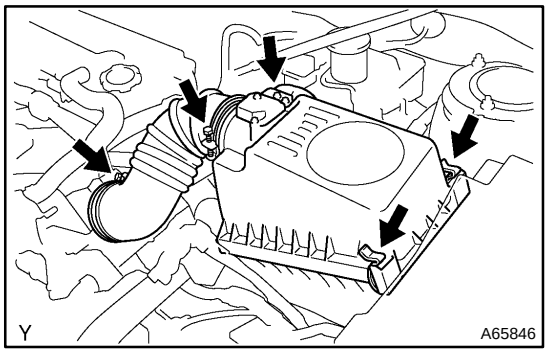


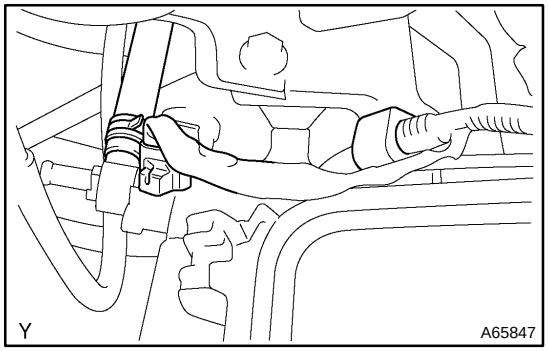
6. INSTALL WIRE HARNESS CLAMP
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

140R8–01

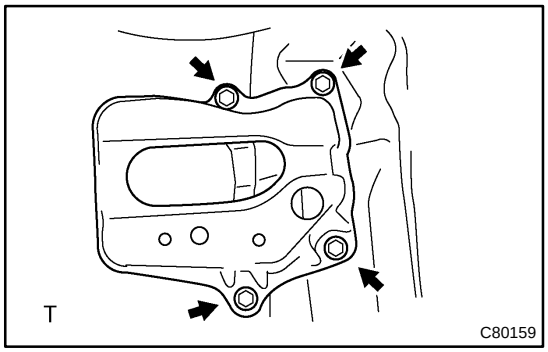
REPLACEMENT

1. WORK FOR PREVENTING GASOLINE FROM SPILLING OUT (See page 11–1)
2. REMOVE FRONT WHEELS
3. REMOVE ENGINE UNDER COVER RH
4. REMOVE ENGINE UNDER COVER LH
5. DRAIN COOLANT (See page 16–6)
6. DRAIN MANUAL TRANSAXLE OIL (M/T TRANSAXLE)
Torque: 39 N·m (398 kgf·cm, 29 ft·lbf)
7. DRAIN AUTOMATIC TRANSAXLE FLUID (A/T TRANSAXLE)
(a) Using a 10 mm hexagon wrench, remove the drain plug and a gasket. Drain automatic transaxle fluid.
(b) Install a new gasket and the drain plug.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)
8. REMOVE CYLINDER HEAD COVER NO.2
(a) Remove the 3 bolts, the nut and the cylinder head cover No. 2.
9. REMOVE BATTERY

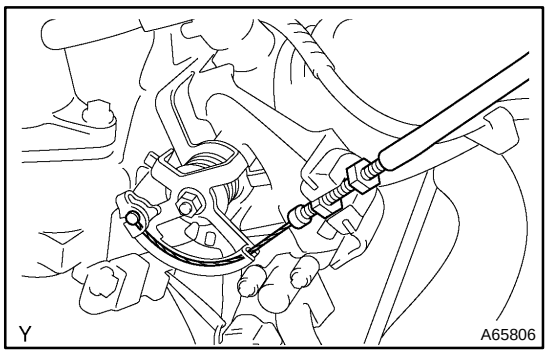




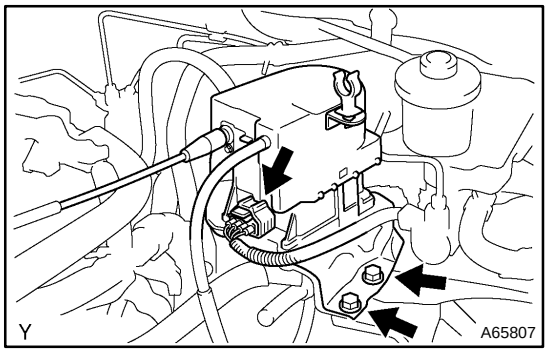
10. REMOVE AIR CLEANER ASSEMBLY WITH HOSE
(a) Disconnect the MAF meter connector.
(b) Place match marks on the vacuum hoses.
(c) Disconnect the 5 vacuum hoses from the air cleaner cap.
(d) Disconnect the 2 clamps, and disconnect the air cleaner cap from the air cleaner case.
(e) Loosen the hose clamp bolt, and disconnect the air cleaner hose from the throttle body.
(f) Remove the air cleaner assembly with hose.
(g) Remove the air filter.
(h) Disconnect the wireharness clamp, connector and hose.
(i) Remove the 3 bolts and the air cleaner case.



11. REMOVE BATTERY CARRIER
(a) Remove the 4 bolts and battery carrier.

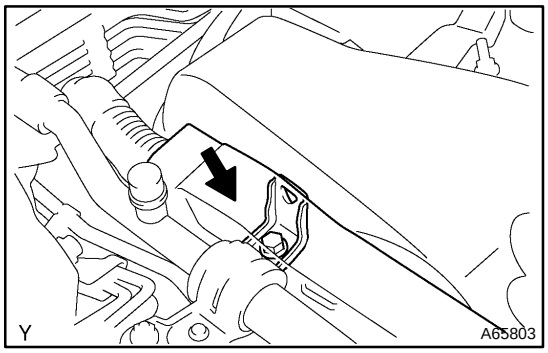


12. SEPARATE ACCELERATOR CONTROL CABLE ASSY



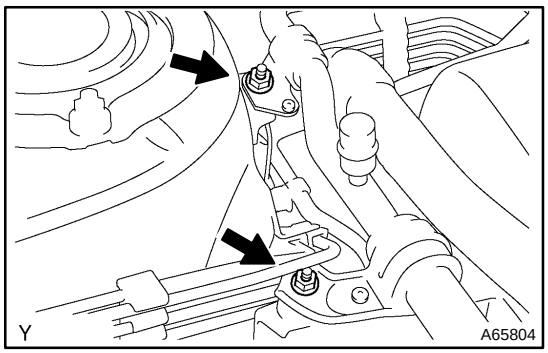
13. REMOVE CRUISE CONTROL ACTUATOR ASSY (W/ CRUISE CONTROL)

(a) Disconnect the actuator connector.
(b) Remove the 2 bolts, and disconnect the actuator from the body.



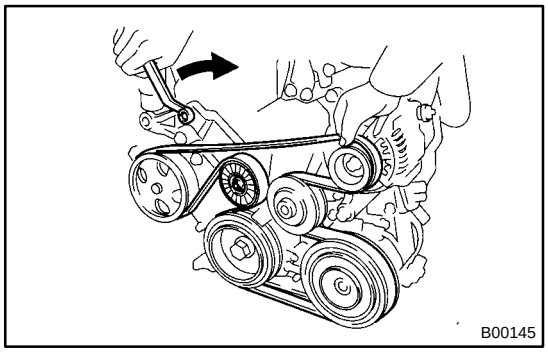
14. REMOVE WIRE HARNESS CLAMP

(a) Disconnect engine wire harness.
(b) Remove the bolt and wiring harness clamp bracket.



15. DISCONNECT SUCTION HOSE SUB–ASSY

(a) Remove the 2 nuts installing the suction hose sub–assy.
(b) Disconnect the suction hose sub–assy.



16. REMOVE FAN AND GENERATOR V BELT

(a) Turn the drive belt tensioner slowly clockwise and loosen it. Then, remove the drive belt and put back the drive belt tensioner little by little and fix it quietly.

17. REMOVE EFI FUEL PIPE CLAMP (See page 11–1)

18. DISCONNECT FUEL TUBE SUB–ASSY (See page 11–1)

19. DISCONNECT RADIATOR HOSE INLET

(a) Disconnect the radiator hose inlet from the radiator.

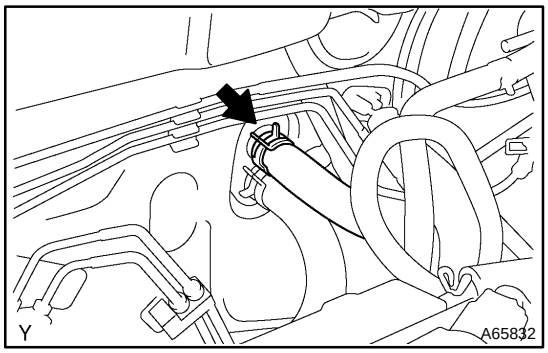
20. DISCONNECT RADIATOR HOSE OUTLET

(a) Disconnect the radiator hose outlet from the radiator.

21. DISCONNECT FLOOR SHIFT CABLE TRANSMISSION CONTROL SHIFT (M/T TRANSAXLE) (See page 41–17)

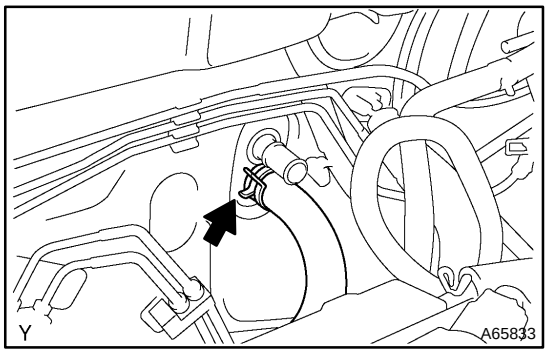
22. DISCONNECT FLOOR SHIFT CABLE TRANSMISSION CONTROL SELECT (M/T TRANSAXLE) (See page 41–17)

23. DISCONNECT FLOOR SHIFT CABLE TRANSMISSION CONTROL SHIFT (A/T TRANSAXLE) (See page 40–25)



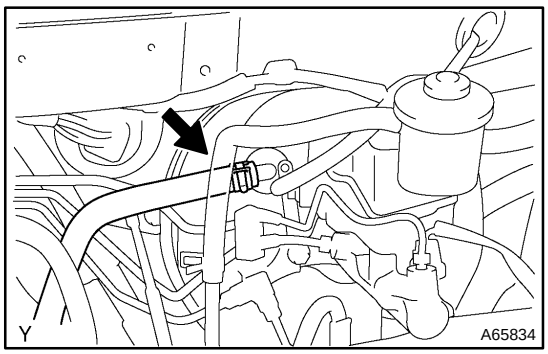
24. DISCONNECT HEATER INLET WATER HOSE

(a) Disconnect the heater inlet water hose from the air conditioner tube.



25. DISCONNECT HEATER OUTLET WATER HOSE

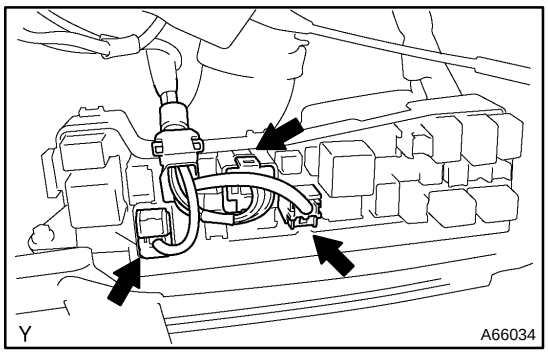
(a) Disconnect the heater outlet water hose from the air conditioner tube.



26. DISCONNECT UNION TO CONNECTOR TUBE HOSE

(a) Disconnect the union to check valve hose from the brake booster.

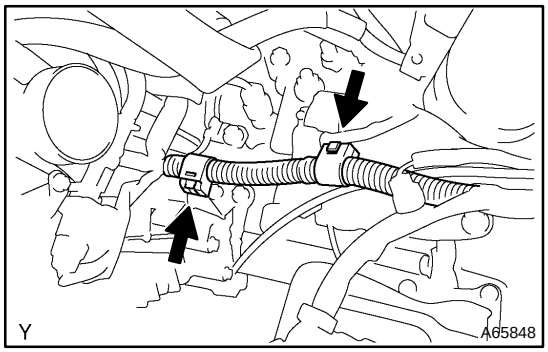
27. REMOVE GLOVE COMPARTMENT DOOR ASSY (See page 71–10)



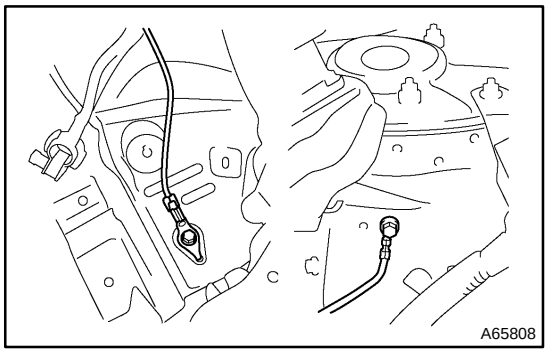
28. DISCONNECT ENGINE WIRE

(a) Remove the engine room relay block cover.

(b) Disconnect the 3 connectors.



(c) Disconnect the 2 wireharness clamps.



(d) Disconnect the 2 ground cables from the vehicle.

(e) Disconnect the 2 ECM connectors.

(f) Disconnect the 3 cowl wire connectors from connectors on bracket.

(g) Pull out the engine wire from the cabin.

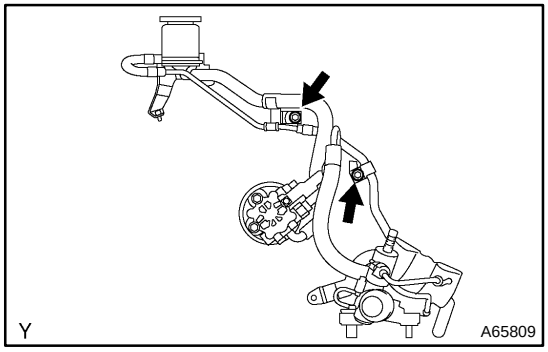
29. REMOVE RADIATOR ASSY (W/ AIR CONDITIONER) (See page 16–15)

30. DISCONNECT CLUTCH RELEASE CYLINDER ASSY (M/T TRANSAXLE) (See page 41–17)

31. REMOVE COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONER) (See page 55–34)

HINT:

Hung up the hoses instead of detaching.



32. SEPARATE RETURN TUBE SUB–ASSY

(a) Remove the 2 clamp bolts, and separate the return tube sub–assy.

33. SEPARATE VANE PUMP OIL RESERVOIR ASSY

(a) Remove the 2 bolts and the oil reservoir assy.

34. REMOVE FLOOR PANEL BRACE FRONT (See page 15–9)

35. REMOVE EXHAUST PIPE ASSY FRONT (See page 15–9)

36. REMOVE STEERING INTERMEDIATE SHAFT (See page 51–22)

37. REMOVE FRONT AXLE HUB LH NUT(See page 30–32)

SST 09930–00010

38. REMOVE FRONT AXLE HUB RH NUT

SST 09930–00010

HINT:

Perform the same procedure as above on the opposite side.

39. SEPARATE TIE ROD END SUB–ASSY LH (See page 51–22)

SST 09628–62011

40. SEPARATE TIE ROD END SUB–ASSY RH

SST 09628–62011

HINT:

Perform the same procedure as above on the opposite side.

41. SEPARATE FRONT STABILIZER LINK ASSY LH (See page 26–22)

42. SEPARATE FRONT STABILIZER LINK ASSY RH

HINT:

Perform the same procedure as above on the opposite side.

43. SEPARATE FRONT SUSPENSION ARM SUB–ASSY LOWER NO.1 LH (See page 26–15)

44. SEPARATE FRONT SUSPENSION ARM SUB–ASSY LOWER NO.1 RH

HINT:

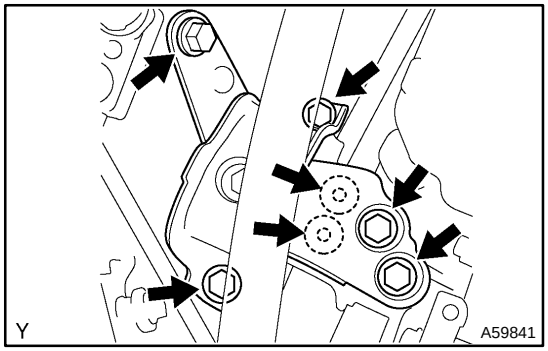
Perform the same procedure as above on the opposite side.

45. SEPARATE FRONT AXLE ASSY LH (See page 30–32)

46. SEPARATE FRONT AXLE ASSY RH

HINT:

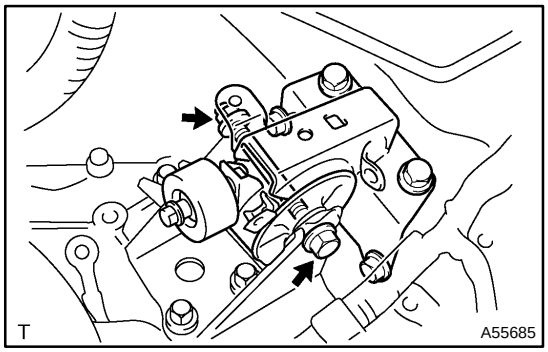
Perform the same procedure as above on the opposite side.



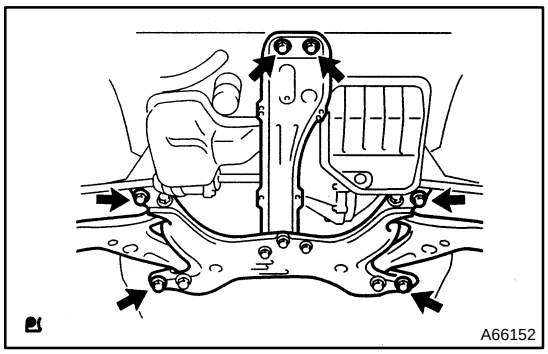
47. REMOVE ENGINE ASSEMBLY WITH TRANSAXLE

(a) Set the engine lifter.

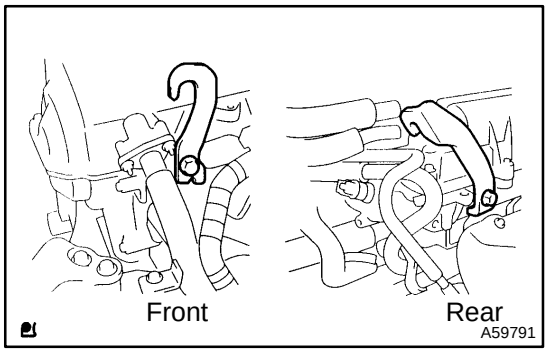
(b) Remove the 5 bolts, 2 nuts and engine mounting insulator RH.



(c) Remove the through bolt and nut, detach the engine mounting insulator LH from the vehicle.



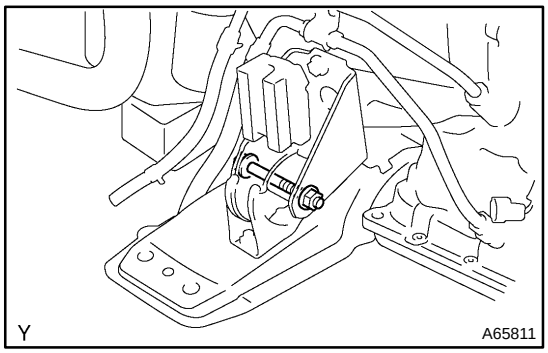
(d) Remove the 6 bolts, as shown in the illustration.
(e) Carefully, remove the engine assembly from the vehicle.



(f) Install the 2 engine hangers as shown in the illustration.
Parts No.:
No. 1 engine hanger 12281–88600
No. 2 engine hanger 12282–88600
Bolt: 91512–61020
Torque: 38 N·m (387 kgf·cm, 28 ft·lbf)

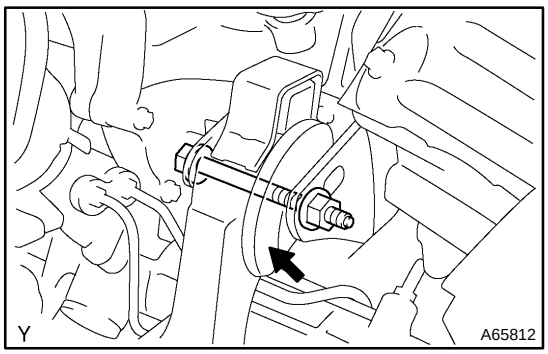
HINT:
Be sure to install engine hanger (12281–88600) to the front side of the engine, and engine hanger (12282–88600) to the rear side.

(g) Using the chain block and engine sling device, hang the engine assembly.



48. REMOVE FRONT SUSPENSION COSSMENBER W/CENTER MENBER

(a) Remove the through bolt and a nut, detach the engine mounting insulator FR from the engine mounting bracket.

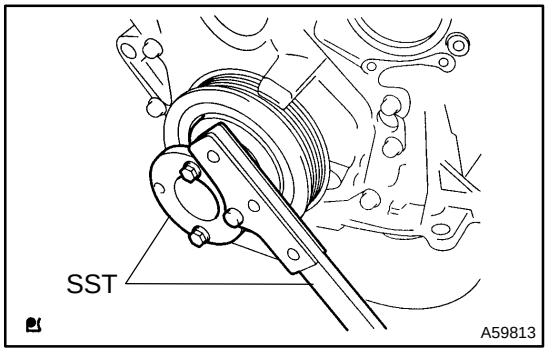


(b) Remove the through bolt, detach the engine mounting insulator RR from the suspension crossmember.
(c) Separate the engine and transaxle assembly from the front suspension crossmember w/center member.

49. REMOVE STARTER ASSY (See page 19–3)
50. REMOVE FRONT DRIVE SHAFT ASSY RH (See page 30–32)
SST 09520–01010, 09520–24010 (09520–32040)
51. SEPARATE MANUAL TRANSAXLE ASSY (M/T TRANSAXLE) (See page 41–17)
52. SEPARATE AUTOMATIC TRANSAXLE ASSY (A/T TRANSAXLE) (See page 40–25)

53. REMOVE CLUTCH COVER ASSY (M/T TRANSAXLE) (See page 42–18)

54. REMOVE CLUTCH DISC ASSY (M/T TRANSAXLE) (See page 42–18)



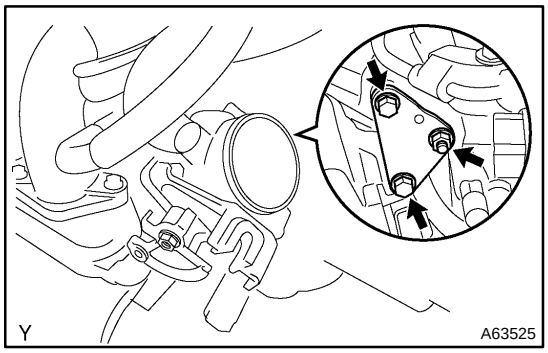
55. REMOVE DRIVE PLATE AND RING GEAR OR FLYWHEEL

(a) Fix the crankshaft with SST, then remove the drive plate and ring gear or the flywheel.
SST 09213–70011 (09213–70020), 09330–00021

56. INSTALL ENGINE STAND

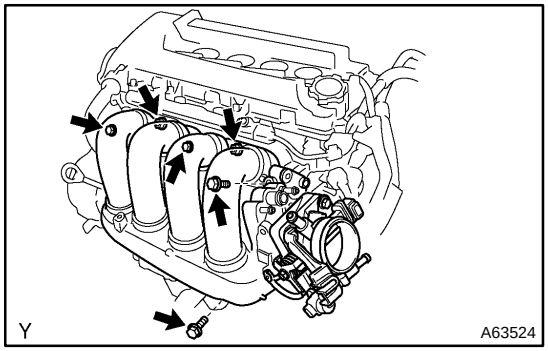
57. REMOVE OIL LEVEL GAGE SUB–ASSY

58. REMOVE OIL LEVEL GAGE GUIDE



59. REMOVE SURGE TANK STAY NO.1

(a) Remove the 2 bolts, the nut and the surge tank stay.

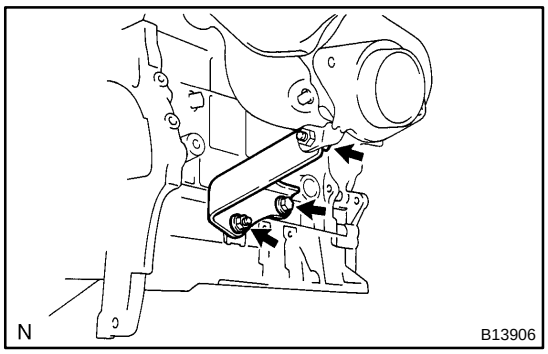


60. REMOVE INTAKE MANIFOLD

(a) Remove the 4 bolts, the 2 nuts, the intake manifold and the gasket.

61. REMOVE V–RIBBED BELT TENSIONER ASSY

(a) Remove the bolt, the nut and the v–ribbed belt tensioner assy.



62. REMOVE MANIFOLD STAY

(a) Remove the 2 bolts, the nut and exhaust manifold stay.

63. REMOVE EXHAUST MANIFOLD HEAT INSULATOR NO.1

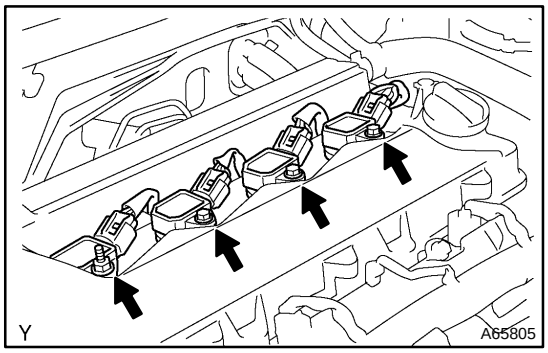
64. REMOVE EXHAUST MANIFOLD

(a) Remove the 3 bolts, 2 nuts, exhaust manifold and gasket.

65. REMOVE GENERATOR BRACKET NO.1 (See page 19–15)

66. REMOVE GENERATOR ASSY (See page 19–15)

67. REMOVE FUEL DELIVERY PIPE SUB–ASSY (See page 11–15)



68. REMOVE IGNITION COIL ASSY

(a) Remove the 3 bolts, the nut and the 4 ignition coils.

69. REMOVE THERMOSTAT (See page 16–13)

70. REMOVE WATER BY–PASS PIPE NO.1

(a) Remove the 2 bolts, the 2 nuts, the water by–pass pipe No. 1 and the gasket.

71. REMOVE ENGINE OIL PRESSURE SWITCH ASSY

(a) Using the SST, remove the oil pressure switch.

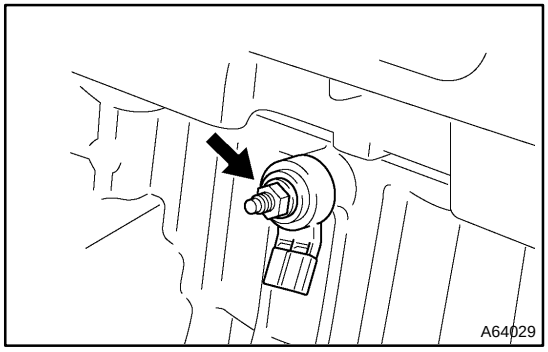
SST 09268–46021

72. REMOVE UNION TO CONNECTOR TUBE HOSE

(a) Remove the clamp and tube.

73. REMOVE CRANK POSITION SENSOR

74. REMOVE CAM POSITION SENSOR



75. REMOVE KNOCK CONTROL SENSOR

(a) Remove the nut and the knock control sensor.

76. REMOVE E.F.I. ENGINE COOLANT TEMPERATURE SENSOR

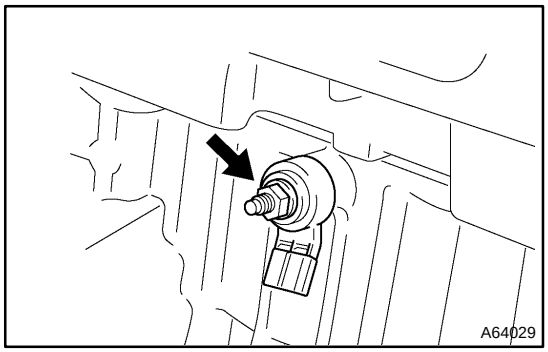
(a) Using a SST, remove the water temperature sensor.
SST 09817–33190

77. REPLACE PARTIAL ENGINE ASSY

78. INSTALL E.F.I. ENGINE COOLANT TEMPERATURE SENSOR

(a) Install a new gasket to the water temperature sensor.

(b) Using a SST, install the water temperature sensor.
SST 09817–33190
Torque: 20 N·m (208 kgf·cm, 15 ft·lbf)



79. INSTALL KNOCK CONTROL SENSOR

(a) install the nut and the knock control sensor.
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)

80. INSTALL CAM POSITION SENSOR
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

81. INSTALL CRANK POSITION SENSOR

(a) Install the crank position sensor and cord wiring clamp.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

82. INSTALL UNION TO CONNECTOR TUBE HOSE
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

83. INSTALL ENGINE OIL PRESSURE SWITCH ASSY

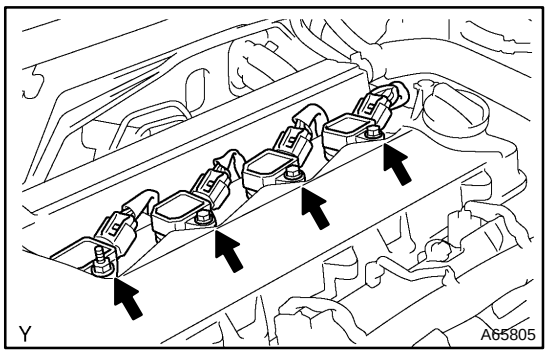
(a) Clean the threads of the oil pressure switch, apply adhesive there.
Adhesive:
Part No. 08833–00080, THREE BOND 1344,

(b) Using a SST, install the oil pressure switch.
SST 09268–46021
Torque: 15 N·m (153 kgf·cm, 11 ft·lbf)

84. INSTALL WATER BY–PASS PIPE NO.1

(a) Install the 2 bolts, the 2 nuts, the new gasket and the water by–pass pipe.
Torque:
8.5 N·m (87 kgf·cm, 75 in.·lbf) for M6
21 N·m (214 kgf·cm, 15 ft·lbf) for M8
10 N·m (102 kgf·cm, 7 ft·lbf) for Nut

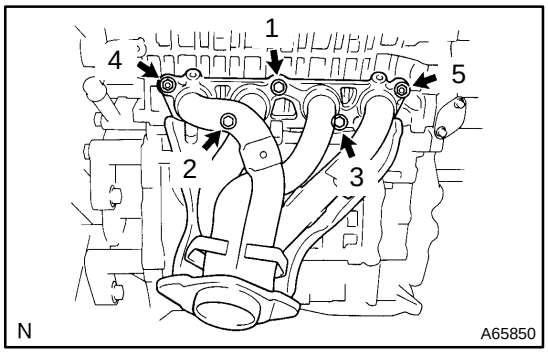
85. INSTALL THERMOSTAT (See page 16–13)



86. INSTALL IGNITION COIL ASSY

(a) Install the 3 bolts, the nut and the 4 ignition coils.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

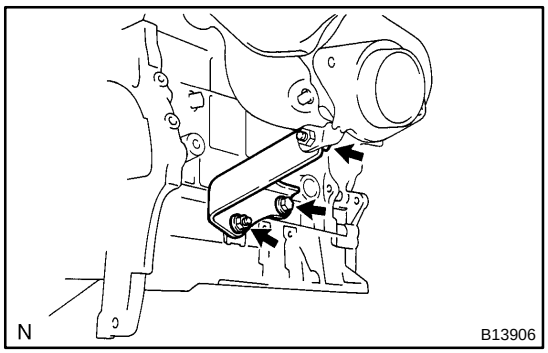
87. INSTALL FUEL DELIVERY PIPE SUB–ASSY (See page 11–15)



88. INSTALL EXHAUST MANIFOLD

(a) Install a new gasket.
(b) Install and uniformly tighten the 3 bolts and 2 nuts in several passes and in the sequence shown.
Torque: 50 N·m (510 kgf·cm, 37 ft·lbf)

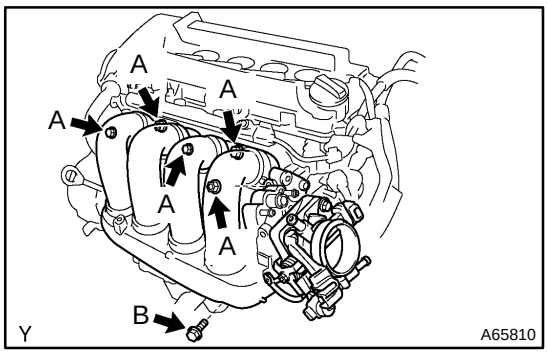
89. INSTALL EXHAUST MANIFOLD HEAT INSULATOR NO.1
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)



90. INSTALL MANIFOLD STAY
Torque: 50 N·m (510 kgf·cm, 37 ft·lbf)

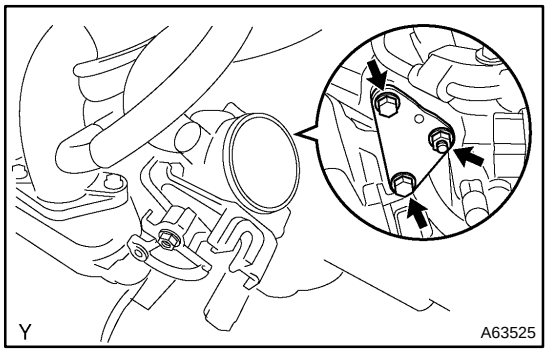
91. INSTALL V–RIBBED BELT TENSIONER ASSY

(a) Install the bolt, the nut and v–ribbed belt tensioner assy.
Torque:
Nut: 29 N·m (296 kgf·cm, 21 ft·lbf)
Bolt: 100 N·m (1,020 kgf·cm, 74 ft·lbf)



92. INSTALL INTAKE MANIFOLD

(a) Install the new gasket, the intake manifold with the 4 bolts and 2 nuts.
Torque:
A: 34 N·m (347 kgf·cm, 25 ft·lbf)
B: 46 N·m (469 kgf·cm, 34 ft·lbf)

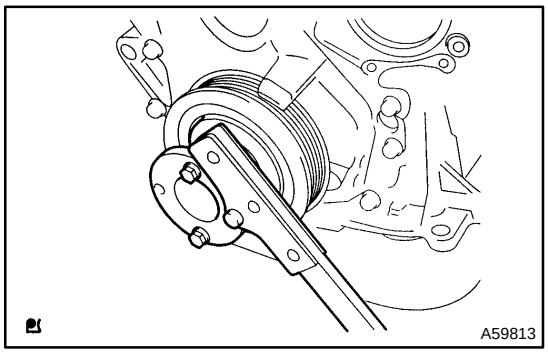


93. INSTALL SURGE TANK STAY NO.1

(a) Install the surge tank stay with the 2 bolts and nut.
Torque:24 N·m (245 kgf·cm, 18 ft·lbf)

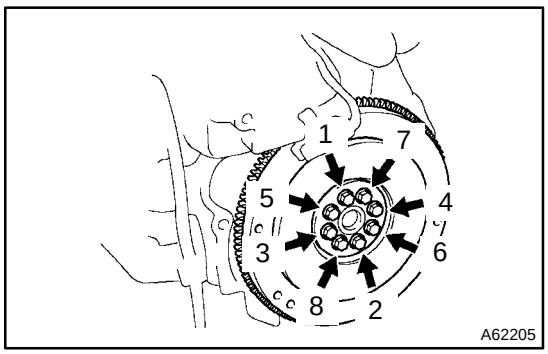
94. INSTALL OIL LEVEL GAGE GUIDE

(a) Apply a light coat of engine oil to a new O–ring, install it to the oil level gage guide.
(b) Install the oil level gage and guide with the bolt.
Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)

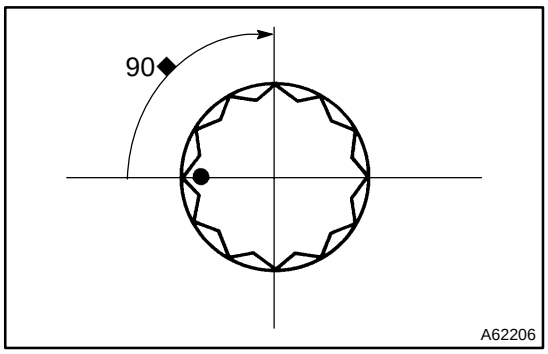


95. INSTALL FLYWHEEL SUB–ASSY (M/T TRANSAXLE)

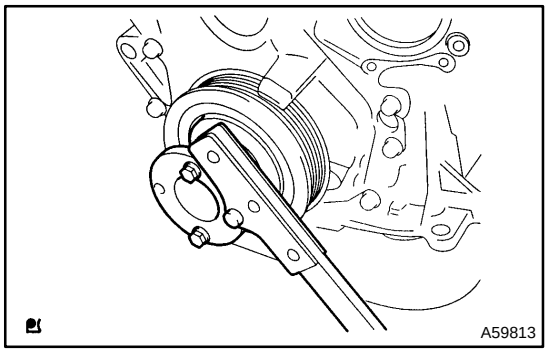
(a) Fix the crankshaft with SST.
SST 09213–70011 (09213–70020), 09330–00021



(b) Clean the bolt and bolt hole.
(c) Apply adhesive to the bolts.
Adhesive:
Part No. 09330–00070, THREE BOND or equivalent.
(d) Install and uniformly tighten the 8 bolts, in several passes, in the sequence shown.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

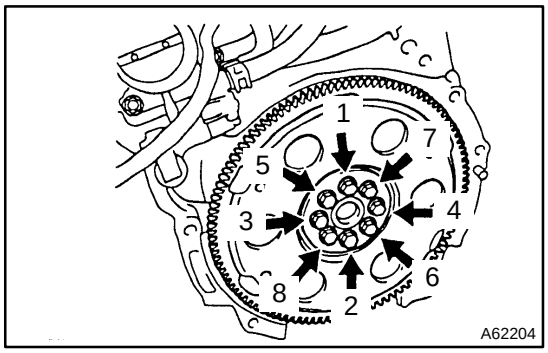


(e) Mark the bolts with paint.
(f) Retighten the bolts by an additional 90◆.
(g) Check that the point marked bolts are moved at 90◆ angle.



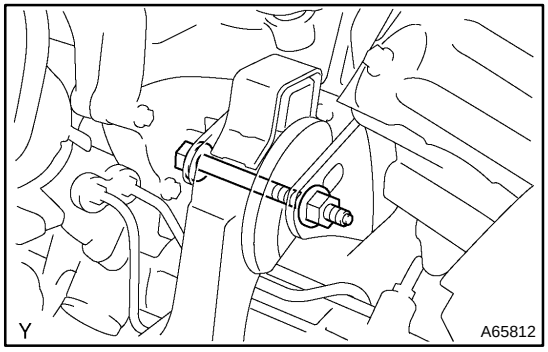
96. INSTALL DRIVE PLATE & RING GEAR SUB–ASSY (A/T TRANSAXLE)

(a) Fix the crankshaft with SST.
SST 09213–70011 (09213–70020), 09330–00021



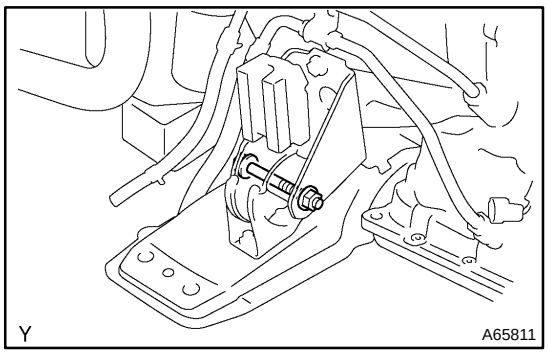
(b) Clean the bolt and bolt hole.
(c) Apply adhesive to the bolts.
Adhesive:
Part No. 09330–00070, THREE BOND or equivalent.
(d) Install and uniformly tighten the 8 bolts, in several passes, in the sequence shown.
Torque: 88 N·m (897 kgf·cm, 65 ft·lbf)

97. INSTALL CLUTCH DISC ASSY (M/T TRANSAXLE) (See page 42–18)
SST 09301–00210
98. INSTALL CLUTCH COVER ASSY (M/T TRANSAXLE) (See page 42–18)
SST 09301–00210
99. INSTALL FRONT DRIVE SHAFT ASSY LH (See page 30–32)
100. INSTALL MANUAL TRANSAXLE ASSY (M/T TRANSAXLE) (See page 41–17)
101. INSTALL AUTOMATIC TRANSAXLE ASSY (A/T TRANSAXLE) (See page 40–25)
102. INSTALL STARTER ASSY (See page 19–3)

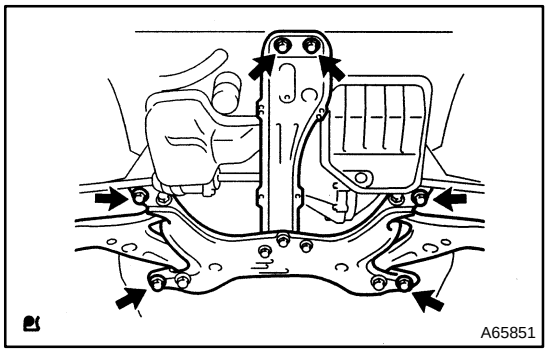


103. INSTALL FRONT SUSPENSION COSSMENBER W/CENTER MENBER

(a) Attach the engine and transaxle assembly to the suspension crossmember w/center member.
(b) Install the bolt holding the rear engine mounting bracket to the mounting insulator.
Torque: 87 N·m (887 kgf·cm, 64 ft·lbf)



(c) Install the bolt holding the front engine mounting bracket to the mounting insulator.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

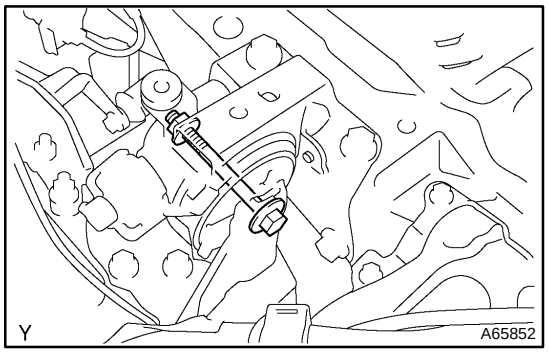


104. INSTALL ENGINE ASSEMBLY WITH TRANSAXLE

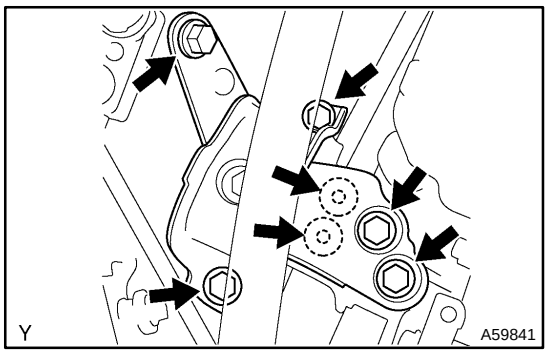
(a) Set the engine assembly with transaxle on the engine lifter.

(b) Install the engine assembly to the vehicle.

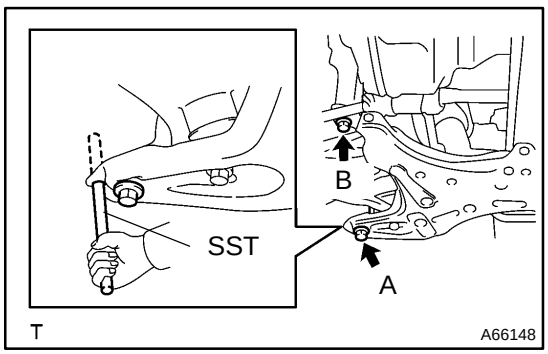
(c) Temporarily, install the suspension crossmember and 6 bolts.



(d) Install the engine mounting insulator LH.
Torque: 80 N·m (816 kgf·cm, 60 ft·lbf)

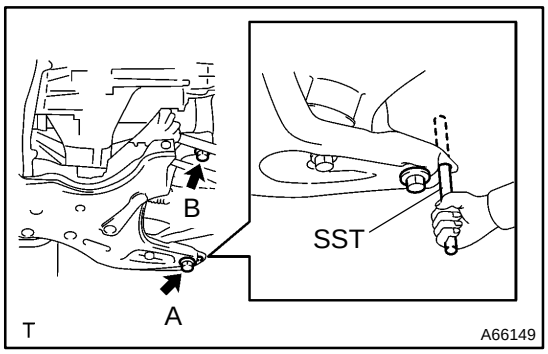


(e) Install the engine mounting insulator RH.
Torque: 52 N·m (531 kgf·cm, 38 ft·lbf)



(f) Insert SST to the positioning holes on the right handle crossmember and on the right–handle of the vehicle.
SST 09670–00010

(g) Temporarily tighten the bolt A first, then bolt B.

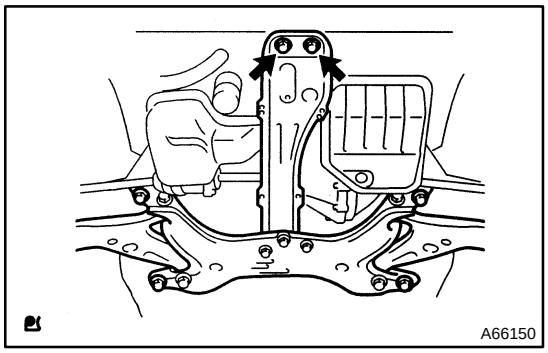


(h) Insert SST to the positioning holes on the left–handle crossmember and on the left–handle of the vehicle.
SST 09670–00010

(i) Temporarily tighten the bolt A first, then bolt B.

(j) Insert SST to the positioning holes on the right–handle crossmember and the right–handle of the vehicle, then the bolts with a specified torque.
SST 09670–00010
Torque:
Bolt A: 157 N·m (1,601 kgf·cm, 116 ft·lbf)
Bolt B: 113 N·m (1,152 kgf·cm, 83 ft·lbf)

(k) Insert SST to the positioning holes on the left–handle crossmember and the left–handle of the vehicle, then tighten the bolts with a specified torque.
SST 09670–00010
Torque:
Bolt A: 157 N·m (1,601 kgf·cm, 116 ft·lbf)
Bolt B: 113 N·m (1,152 kgf·cm, 83 ft·lbf)

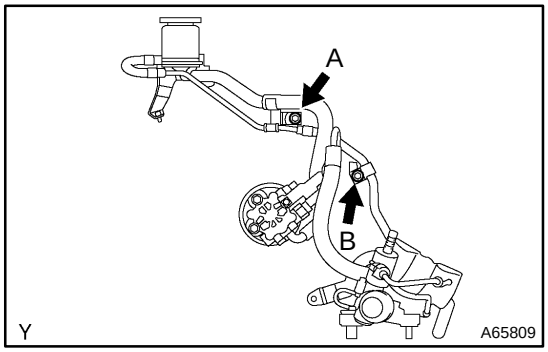


(l) Tighten the 2 bolts as shown in the illustration.
Torque: 39 N·m (398 kgf·cm, 29 ft·lbf)

NOTICE:
After installing the crossmember, check that the positioning holes on the crossmember and the vehicle are aligned with each other.

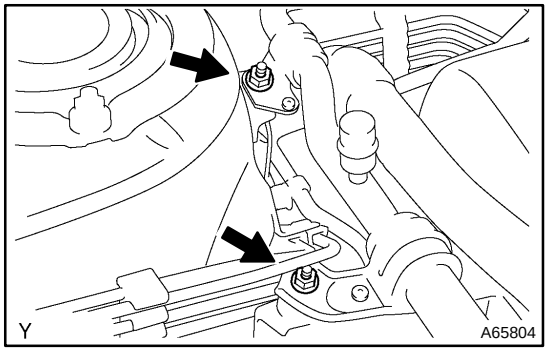
105. INSTALL FRONT AXLE ASSY LH (See page 30–32)
106. INSTALL FRONT AXLE ASSY RH
HINT:
Perform the same procedure as above on the opposite side.
107. INSTALL FRONT SUSPENSION ARM SUB–ASSY LOWER NO.1 LH (See page 26–15)
108. INSTALL FRONT SUSPENSION ARM SUB–ASSY LOWER NO.1 RH
HINT:
Perform the same procedure as above on the opposite side.
109. INSTALL FRONT STABILIZER LINK ASSY LH (See page 26–22)
110. INSTALL FRONT STABILIZER LINK ASSY RH
HINT:
Perform the same procedure as above on the opposite side.
111. INSTALL TIE ROD END SUB–ASSY LH (See page 51–22)
112. INSTALL TIE ROD END SUB–ASSY RH
HINT:
Perform the same procedure as above on the opposite side.
113. INSTALL FRONT AXLE HUB LH NUT (See page 30–32)
114. INSTALL FRONT AXLE HUB RH NUT
HINT:
Perform the same procedure as above on the opposite side.

115. INSTALL STEERING INTERMEDIATE SHAFT (See page 51–22)
116. INSTALL EXHAUST PIPE ASSY FRONT (See page 15–9)
117. INSTALL FLOOR PANEL BRACE FRONT (See page 15–9)

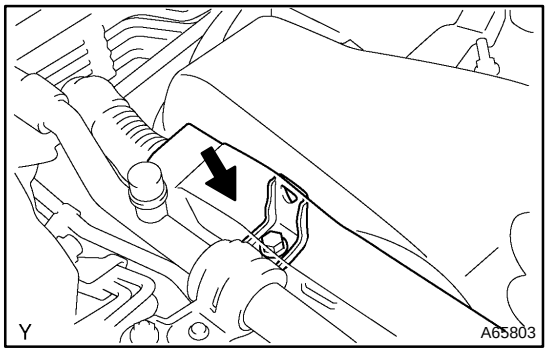


118. INSTALL RETURN TUBE SUB–ASSY
(a) Install the return tube with the 2 bolts.
Torque:
Bolt A: 5.0 N·m (51 kgf·cm, 44 in.·lbf)
Bolt B: 7.8 N·m (80 kgf·cm, 69 in.·lbf)

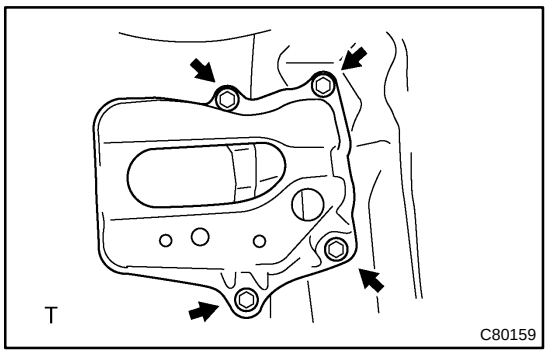
119. INSTALL COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONER) (See page 55–34)
120. INSTALL CLUTCH RELEASE CYLINDER ASSY (M/T TRANSAXLE) (See page 42–15)
121. INSTALL GENERATOR ASSY (See page 19–15)
122. INSTALL GENERATOR BRACKET NO.1(See page 19–15)
123. INSTALL RADIATOR ASSY (W/ AIR CONDITIONER) (See page 16–15)
124. INSTALL GLOVE COMPARTMENT DOOR ASSY (See page 71–10)
125. INSTALL FLOOR SHIFT CABLE TRANSMISSION CONTROL SHIFT (M/T TRANSAXLE) (See page 41–17)
126. INSTALL FLOOR SHIFT CABLE TRANSMISSION CONTROL SELECT (M/T TRANSAXLE) (See page 41–17)
127. INSTALL FLOOR SHIFT CABLE TRANSMISSION CONTROL SHIFT (A/T TRANSAXLE) (See page 40–25)
128. CONNECT FUEL TUBE SUB–ASSY (See page 11–1)
129. INSTALL EFI FUEL PIPE CLAMP (See page 11–1)



130. INSTALL SUCTION HOSE SUB–ASSY
Torque: 9.8 N·m (100 kgf·cm, 7 ft·lbf)

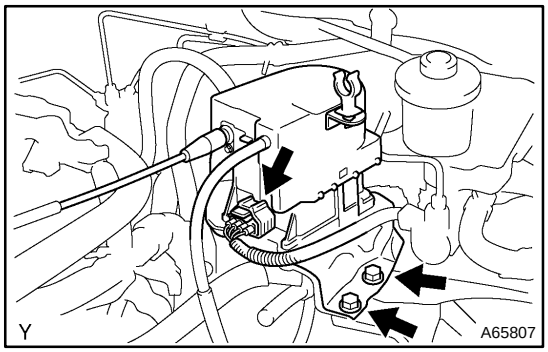


131. INSTALL WIRE HARNESS CLAMP
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)



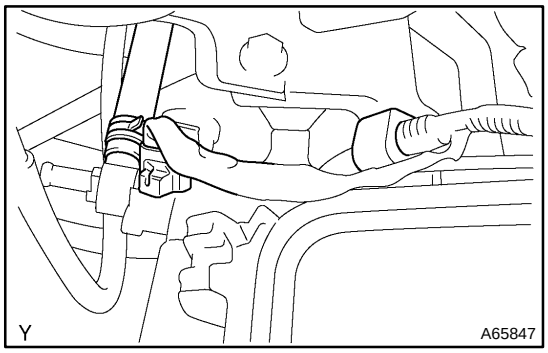
132. INSTALL BATTERY CARRIER

(a) Install the battery carrier with the 4 bolts.
Torque: 13 N·m (132 kgf·cm, 10 ft·lbf)



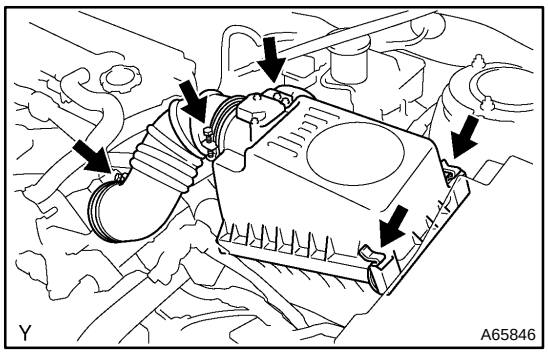
133. INSTALL CRUISE CONTROL ACTUATOR ASSY (W/ CRUISE CONTROL)

(a) Install the actuator with the 2 bolts.
Torque: 6.0 N·m (61 kgf·cm, 53 in.·lbf)
(b) Connect the actuator connector.



134. INSTALL AIR CLEANER ASSEMBLY WITH HOSE

(a) Install the air cleaner case with the 3 bolts.
Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)
(b) Connect the wireharness clamp, connector and hose.
(c) Install the air filter.



(d) Connect the air cleaner hose to the throttle body.
(e) Attach the air cleaner cap to the air cleaner case, and install the 2 clamps.
(f) Tighten the air cleaner hose clamp.
(g) Connect the 5 vacuum hoses for the air cleaner cap.
(h) Connect the MAF meter connector.

135. INSTALL CYLINDER HEAD COVER NO.2
Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)
136. ADD MANUAL TRANSAXLE OIL (M/T TRANSAXLE) (See page 41–17)
137. ADD AUTOMATIC TRANSAXLE FLUID (A/T TRANSAXLE)
138. ADD ENGINE OIL
139. ADD COOLANT (See page 16–6)
140. CHECK ENGINE OIL LEAK
141. CHECK ENGINE COOLANT LEAK (See page 16–6)
142. CHECK FUEL LEAK

143. INSTALL FRONT WHEELS
Torque: 103 N·m (1,050 kgf·cm, 76 ft·lbf)
144. CHECK EXHAUST GAS LEAK
145. INSPECT CHECK IDLE SPEED AND IGNITION TIMING (See page 14–174)
SST 09843–18040
146. INSPECT CO/HC (See page 14–174)
147. INSPECT AND ADJUST FRONT WHEEL ALIGNMENT (See page 26–6)
148. CHECK ABS SPEED SENSOR SIGNAL (See page 05–316)

140RB–01

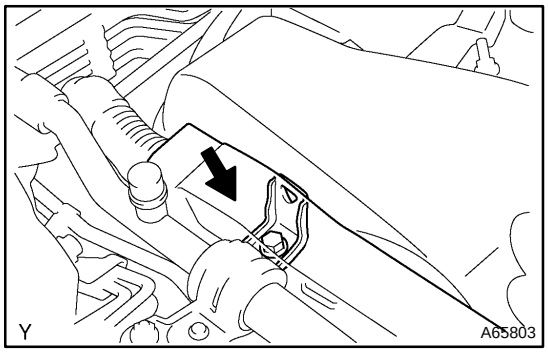
REPLACEMENT

1. REMOVE ENGINE UNDER COVER RH

2. DRAIN COOLANT (See page 16–6)

3. REMOVE CYLINDER HEAD COVER NO.2

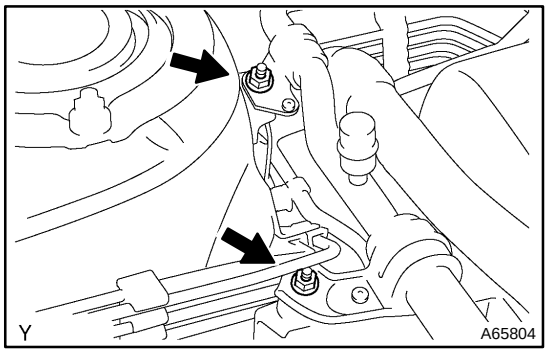
(a) Remove the 3 bolts, the nut and the cylinder head cover No. 2.



4. REMOVE WIRE HARNESS CLAMP

(a) Disconnect engine wire harness.

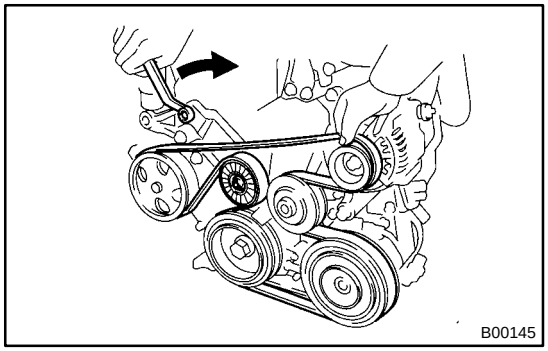
(b) Remove the bolt and wiring harness clamp bracket.



5. DISCONNECT SUCTION HOSE SUB–ASSY

(a) Remove the 2 nuts installing the suction hose sub–assy.

(b) Disconnect the suction hose sub–assy.



6. REMOVE FAN AND GENERATOR V BELT

(a) Turn the drive belt tensioner slowly clockwise and loosen it. Then, remove the drive belt and put back the drive belt tensioner little by little and fix it quietly.

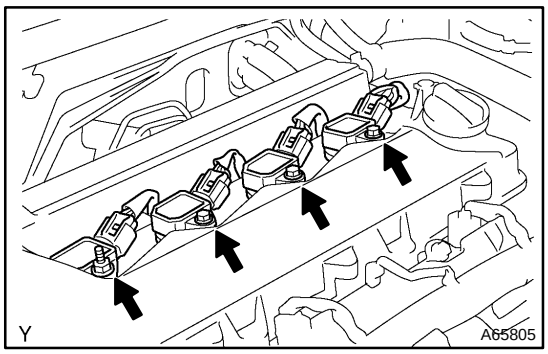
7. REMOVE GENERATOR BRACKET NO.1 (See page 19–15)

8. REMOVE GENERATOR ASSY (See page 19–15)

9. DISCONNECT ENGINE WIRE

(a) Disconnect the ignition coil connectors, oil control valve and crankshaft position sensor connector.

(b) Remove the bolt and nut for the earth and put the engine wiring side.

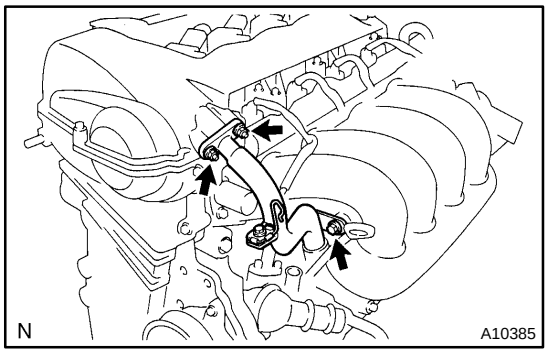


10. REMOVE IGNITION COIL ASSY

(a) Remove the 4 bolts and the 4 ignition coils.

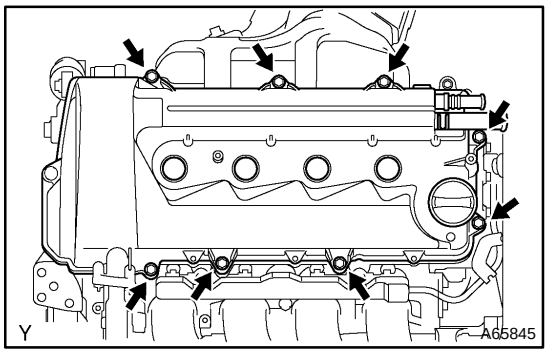
11. REMOVE CYLINDER HEAD COVER SUB–ASSY

(a) Disconnect the fuel hose clamp and 2 PCV hoses from the cylinder head cover.



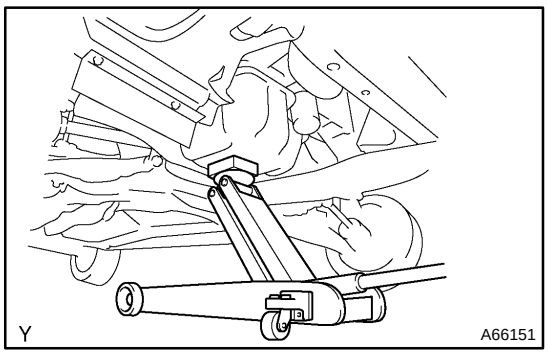
(b) Remove the 2 nuts, bolt and disconnect the No. 3 ventilation hose from the No. 1 ventilation pipe.

(c) Disconnect the ventilation No. 1 tube and gasket.



(d) Remove the 8 bolts, wire harness protector, cylinder head cover and gasket.

(e) Remove the O–ring from the cylinder head cover.

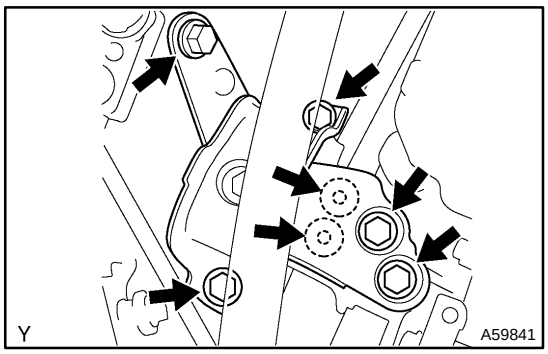


12. REMOVE ENGINE MOUNTING INSULATOR SUB–ASSY RH

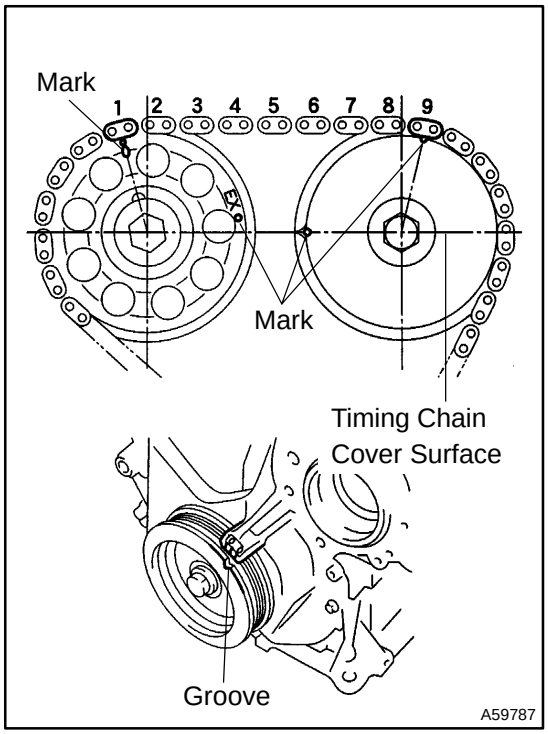
(a) Set the jack to the engine.

HINT:

Place a wooden block between the jack and engine.



(b) Remove the 5 bolts, 2 nuts and engine mounting insulator sub–assy RH.



13. SET NO. 1 CYLINDER TO TDC/COMPRESSION

(a) Turn the crankshaft pulley, and align its groove with timing mark ”0” of the timing chain cover.

(b) Check that the point marks of the camshaft timing sprocket and VVT timing sprocket are in straight line on the timing chain cover surface as shown in the illustration.

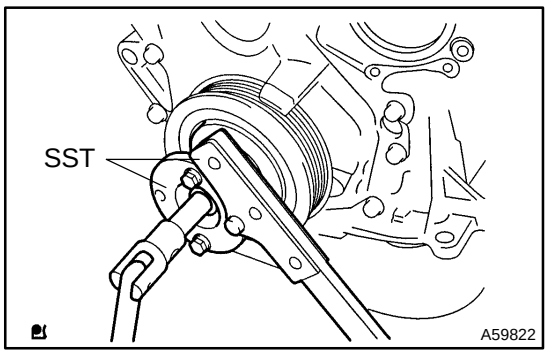
HINT:

If not, turn the crankshaft 1 revolution (360°) and align the marks as above.

14. REMOVE V–RIBBED BELT TENSIONER ASSY

HINT:

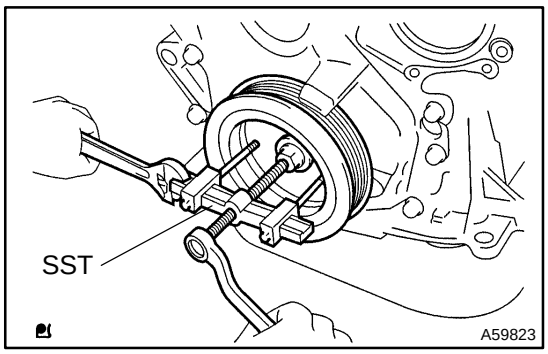
Handle a jack up and down to remove the bolt.



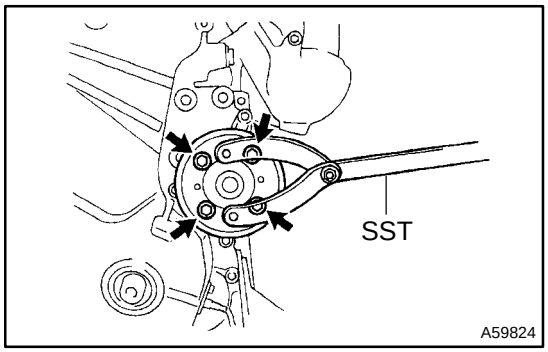
15. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the pulley bolt.

SST 09213–70011 (09213–70020), 09330–00021

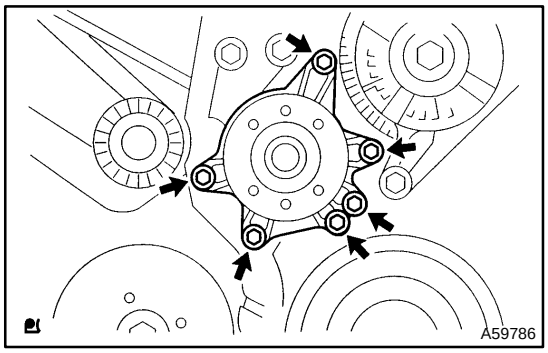


(b) Using SST, remove the crankshaft pulley.
SST 09950–50013 (09951–05010, 09952–05010, 09953–05020, 09954–05021, 09957–04010)



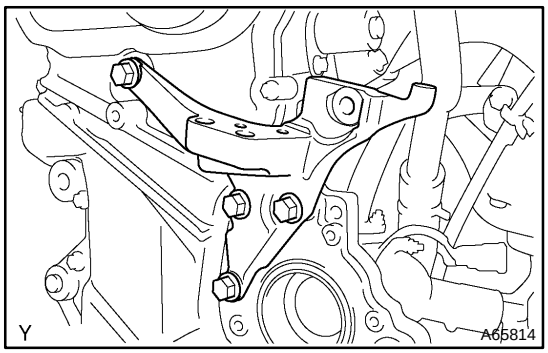
16. REMOVE WATER PUMP PULLEY

(a) Using SST, remove the water pump pulley.
SST 09960–10010



17. REMOVE WATER PUMP ASSY

(a) Remove the 6 bolts and water pump.



18. REMOVE TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

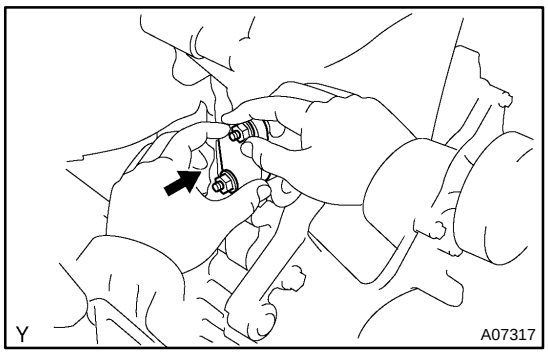
(a) Remove the 4 bolts and the engine mounting bracket.

19. REMOVE COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONER) (See page 55–34)

HINT:

Hung up the hoses instead of detaching.

20. REMOVE CRANK POSITION SENSOR

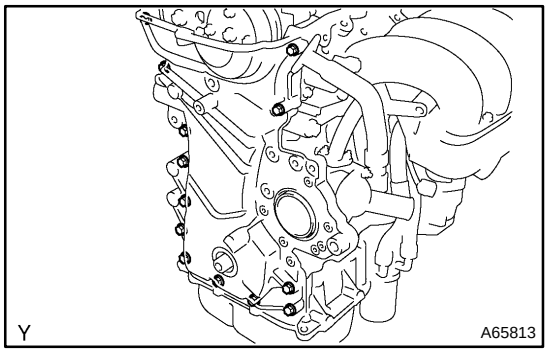


21. REMOVE CHAIN TENSIONER ASSY NO.1

(a) Remove the 2 nuts and chain tensioner assy No. 1.

NOTICE:

Be sure not to revolve the crankshaft without the chain tensioner.



22. REMOVE TIMING CHAIN OR BELT COVER SUB–ASSY

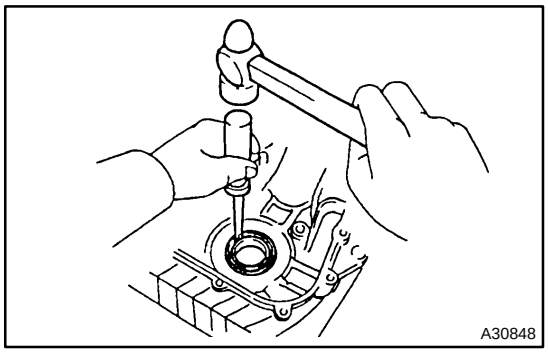
(a) Remove the 12 bolts.

(b) Using a torx wrench socket (E8), remove the stud bolt.

(c) Remove the timing chain cover and 2 gaskets.

NOTICE:

Be careful no tot damage the contact surfaces of the timing chain cover, cylinder head and cylinder block.



23. REMOVE TIMING GEAR COVER OIL SEAL

(a) Using a screwdriver, remove the oil seal.

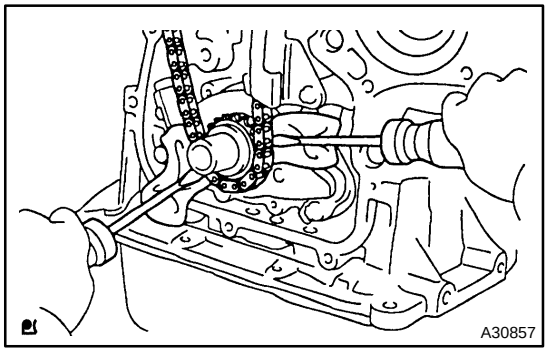
24. REMOVE CRANKSHAFT POSITION SENSOR PLATE NO.1

25. REMOVE CHAIN TENSIONER SLIPPER

(a) Remove the bolt and the chain tensioner slipper.

26. REMOVE CHAIN VIBRATION DAMPER NO.1

(a) Remove the 2 bolts and chain vibration damper No. 1.

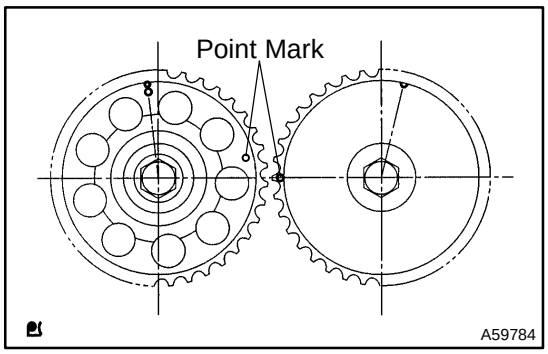


27. REMOVE CHAIN SUB–ASSY

(a) Remove the timing chain with the crankshaft timing gear plying screwdrivers as shown in the illustration.

NOTICE:

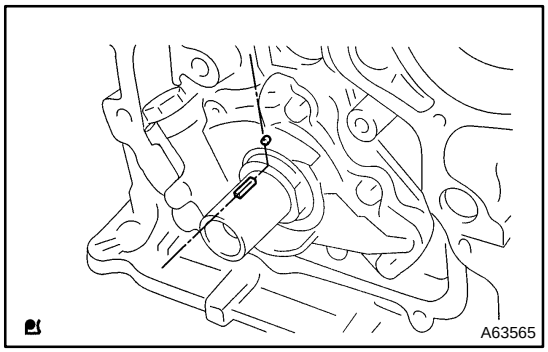
- **Put shop rag to protect the engine.**
- **In case of revolving the camshafts with the chain off the sprockets, turn the crankshaft 1/4 revolution for valves not to touch the pistons.**



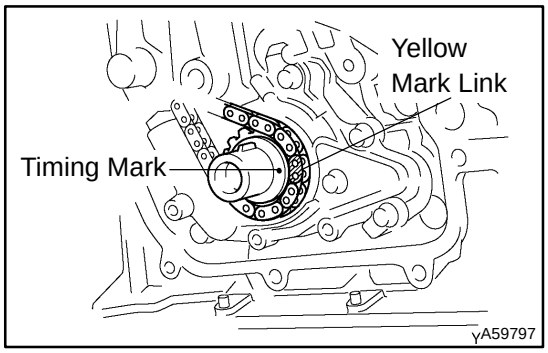
28. INSTALL CHAIN SUB–ASSY

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

(1) Turn the hexagonal wrench head portion of the camshafts, and align the point marks of the camshaft timing sprockets.



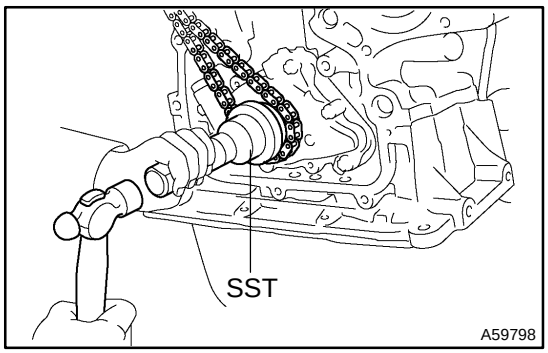
(2) Turn the crankshaft and set the set key on the crankshaft upward.



(b) Install the timing chain on the crankshaft timing sprocket with the yellow mark link aligned with the timing mark on the crankshaft timing sprocket.

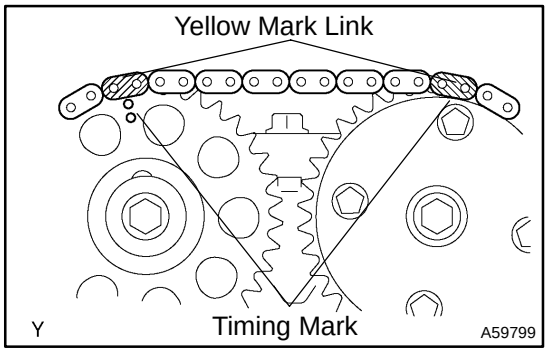
HINT:

Three yellow color links are on the chain.



(c) Using a SST, install the sprocket.

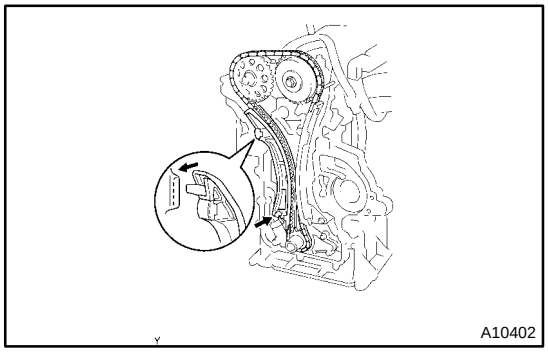
SST 09223–22010



(d) Install the timing chain on the camshaft timing sprockets with the yellow mark links aligned with the timing marks on the camshaft timing sprockets.

29. INSTALL CHAIN VIBRATION DAMPER NO.1

(a) Install the chain vibration damper No. 1 with the 2 bolts.
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)

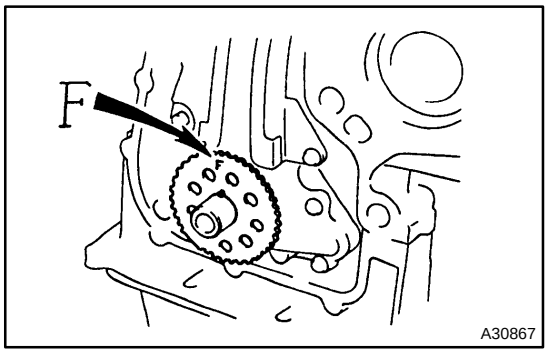


30. INSTALL CHAIN TENSIONER SLIPPER

(a) Install the chain tensioner slipper with the bolt.
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)

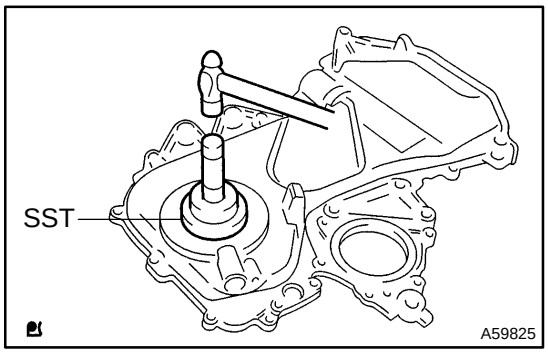
(b) Check that the chain tensioner slipper moves is caught on the cylinder head stopper.

NOTICE:
Do not turn the crankshaft.



31. INSTALL CRANKSHAFT POSITION SENSOR PLATE NO.1

(a) Install the plate with the ”F” mark facing forward.

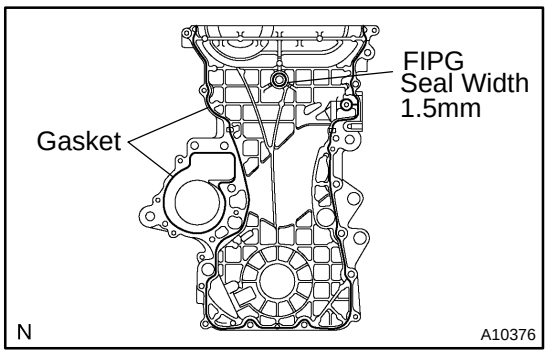


32. INSTALL TIMING GEAR COVER OIL SEAL

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

(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.
SST 09223–22010

NOTICE:
Keep the lip off foreign materials.



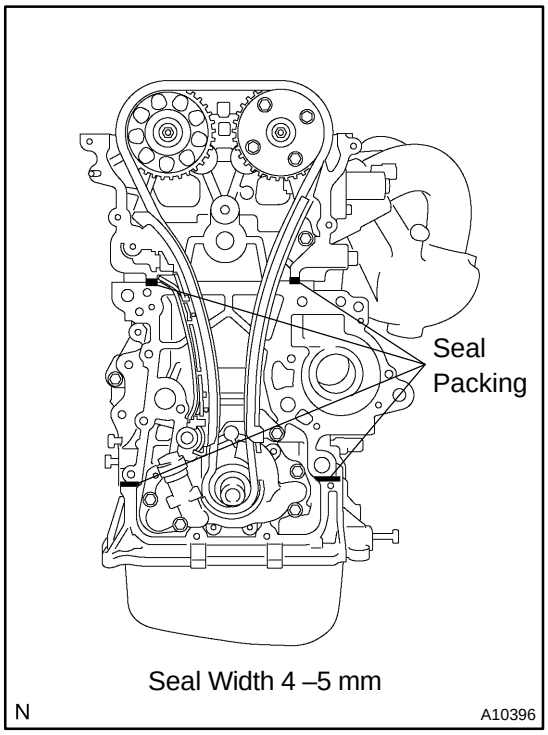
33. INSTALL TIMING CHAIN OR BELT COVER SUB–ASSY

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surface of the timing chain cover, cylinder head and cylinder block.
- Using a razor blade and a gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing grooves.
- Thoroughly clean all components to remove all the loose material.
- Using a non–residue solvent, clean both sealing surfaces.

(b) Apply seal packing to the timing chain cover an shown in the illustration.
Seal packing:
Part No. 08826–00100 or equivalent
- Install a nozzle that has been cut to a 1.5 mm opening.

HINT:
Avoid applying an excessive amount to the surface.
- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

(c) Install the 2 gaskets to the timing chain cover an shown in the illustration.



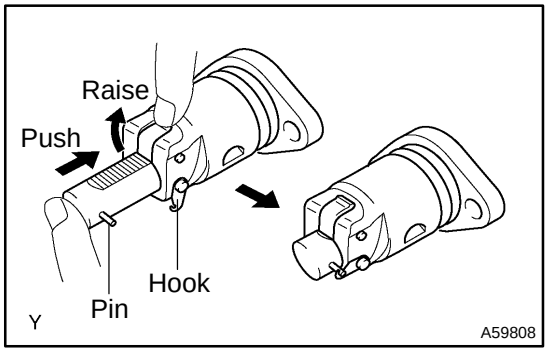
(d) Apply seal packing to 4 locations an shown in the illustration.
Seal packing:
Part No. 08826–00080 or equivalent
- Install a nozzle that has been cut to a 4 – 5 mm (0.16 – 0.20 in.)opening.

HINT:
Avoid applying an excessive amount to the surface.
- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

NOTICE:
Do not put into engine oil within 2 hours after installing.

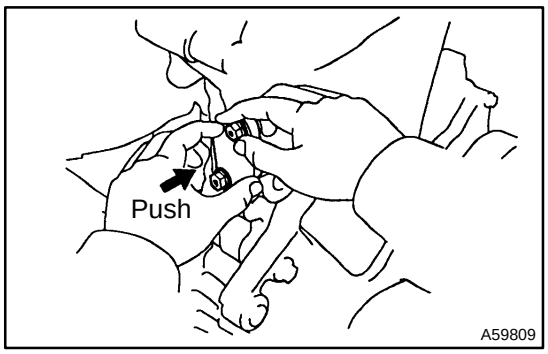
(e) Install the timing chain cover, with the 12 bolts and nut.
Torque:
21 N·m (214 kgf·cm, 15 ft·lbf) (M8)
11 N·m (112 kgf·cm, 8 ft·lbf) (M6)

(f) Install the stud bolt.
Torque: 9.5 N·m (97 kgf·cm, 84 in.·lbf)



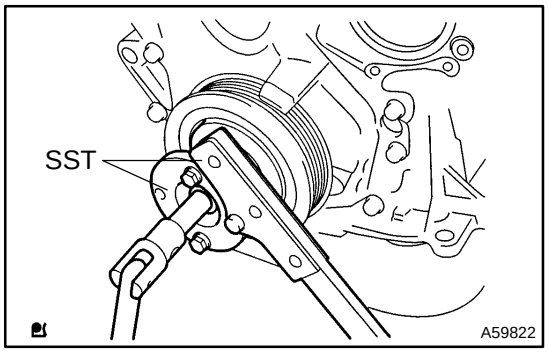
34. INSTALL CHAIN TENSIONER ASSY NO.1

(a) Check the O–ring is clean, and set the hook as shown in the illustration.



(b) Apply engine oil to the chain tensioner and install it.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

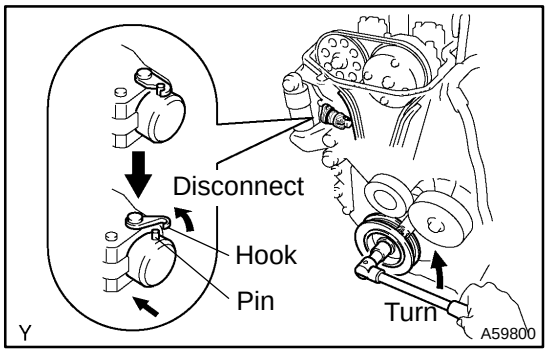
NOTICE:
When installing the tensioner, set the hook again if the hook release the plunger.



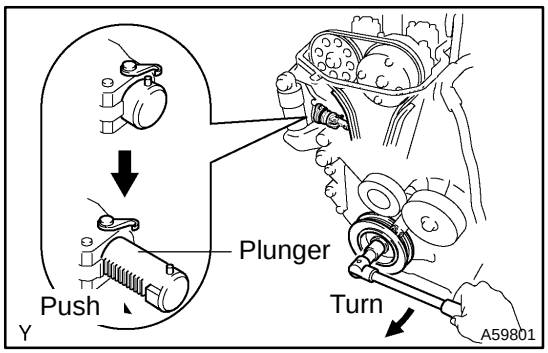
35. INSTALL CRANKSHAFT PULLEY

(a) Align the pulley set key with the key groove of the pulley, and slide on the pulley.

(b) Using SST, install the pulley bolt.
SST 09213–70011 (09213–70020), 09330–00021
Torque: 118 N·m (1,203 kgf·cm, 87 ft·lbf)



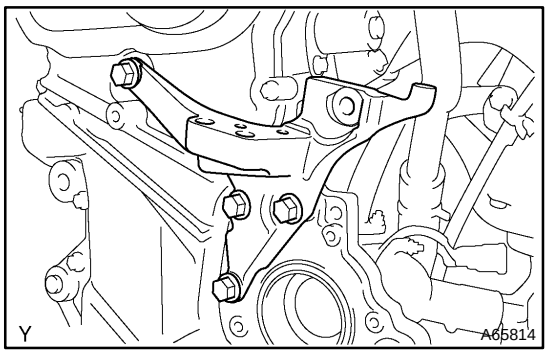
(c) Turn the crankshaft counterclockwise, and disconnect the plunger knock pin form the hook.



(d) Turn the crankshaft clockwise, and check that the slipper is pushed by the plunger.

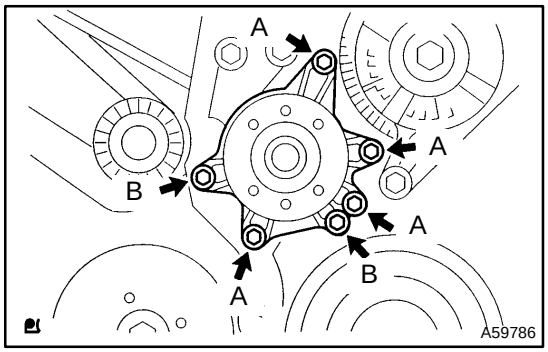
36. INSTALL CRANK POSITION SENSOR
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

37. INSTALL COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONER) (See page 55–34)



38. INSTALL TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

(a) Install the engine mounting bracket with the 4 bolts.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

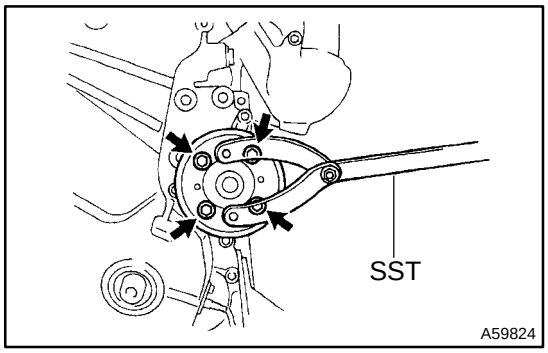


39. INSTALL WATER PUMP ASSY

(a) Place a new O–ring on the timing chain cover.
(b) Install the water pump with the 6 bolts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

HINT:
Each bolt length is indicated in the illustration.

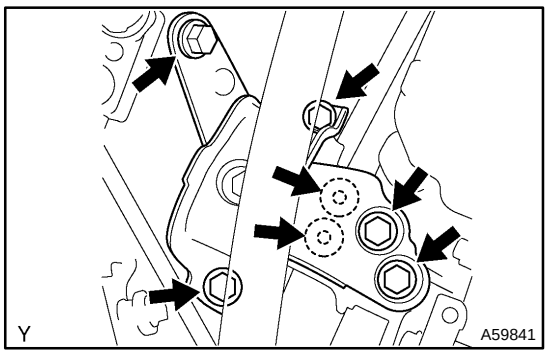
Bolt A	35 mm (1.38 in.)
Bolt B	28 mm (1.10 in.)



40. INSTALL WATER PUMP PULLEY

(a) Using SST, install the water pump pulley.
SST 09960–10010 (09962–01000, 09963–00600)
Torque: 15 N·m (153 kgf·cm, 11 ft·lbf)

41. INSTALL V–RIBBED BELT TENSIONER ASSY
Torque:
Nut: 29 N·m (296 kgf·cm, 21 ft·lbf)
Bolt: 100 N·m (1,020 kgf·cm, 74 ft·lbf)



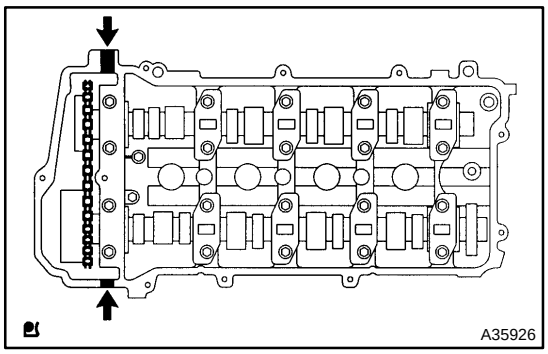
42. INSTALL ENGINE MOUNTING INSULATOR SUB–ASSY RH

(a) Install the engine mounting insulator sub–assy RH with the 5 bolts and the 2 nuts.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

43. INSTALL CYLINDER HEAD COVER SUB–ASSY

(a) Remove any old packing (FIPG) material.

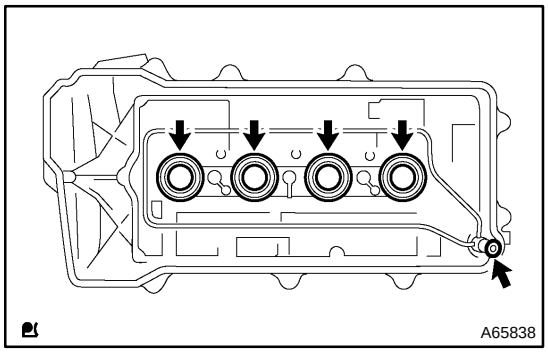
HINT:
When FIPG on the head cover gasket side cannot be eliminated completely, replace the gasket.



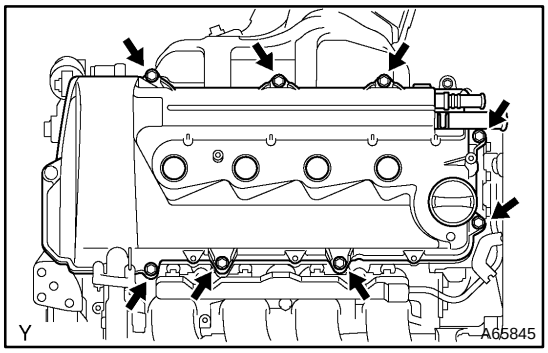
(b) Apply seal packing to 2 locations as shown in the illustration.
Seal packing:
Part No. 08826–00080 or equivalent

(c) Install the cylinder head cover gasket to the cylinder head cover.

HINT:
Part must be assembled within 3 minutes of application. Otherwise the material must be remove and reapplied.

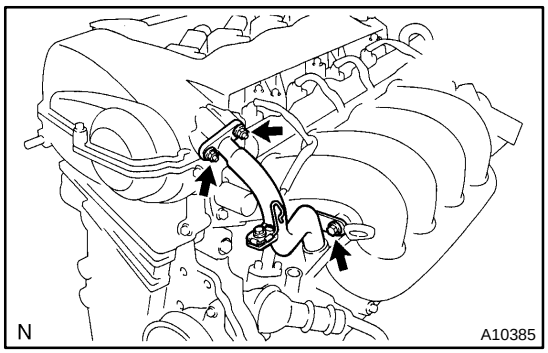


(d) Install the new spark plug tube gasket and a new O–ring to the cylinder head cover.



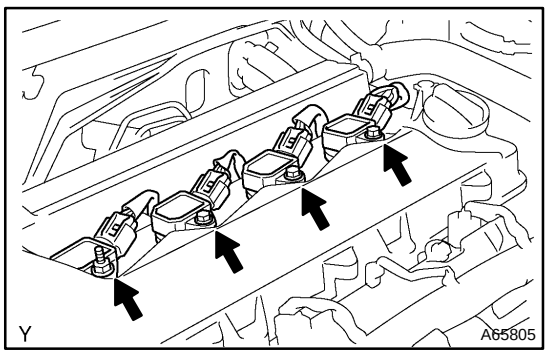
(e) Install the cylinder head cover and wire harness protector with the 9 bolts. Uniformly tighten the bolts, in the several passes, in the sequence shown.
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

(f) Connect the 2 PCV hoses to the cylinder head cover.



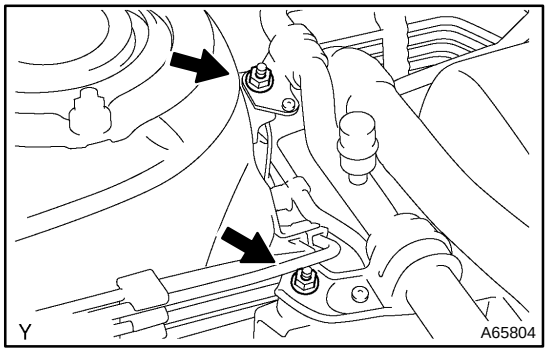
(g) Install a new gasket and No. 1 ventilation pipe with 2 nuts and bolt.
Torque:
Nut 10 N·m (102 kgf·cm, 7 ft·lbf)
Bolt 24 N·m (245 kgf·cm, 18 ft·lbf)

(h) Connect the No. 3 ventilation hose to the No. 1 ventilation pipe.

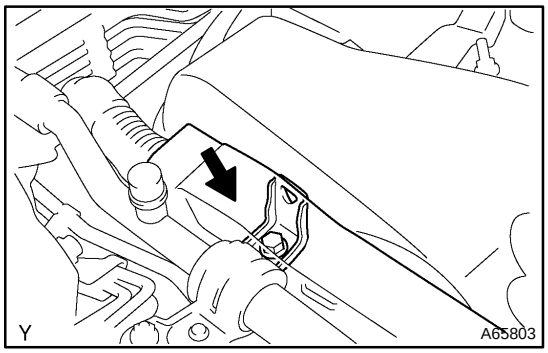


44. INSTALL IGNITION COIL ASSY
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

45. INSTALL GENERATOR ASSY (See page 19–15)
46. INSTALL GENERATOR BRACKET NO.1(See page 19–15)



47. INSTALL SUCTION HOSE SUB–ASSY
Torque: 9.8 N·m (100 kgf·cm, 87 in.·lbf)



48. INSTALL WIRE HARNESS CLAMP
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

49. INSTALL CYLINDER HEAD COVER NO.2
Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)
50. ADD COOLANT (See page 16–6)
51. CHECK ENGINE COOLANT LEAK (See page 16–1)
52. INSPECT OIL LEAK

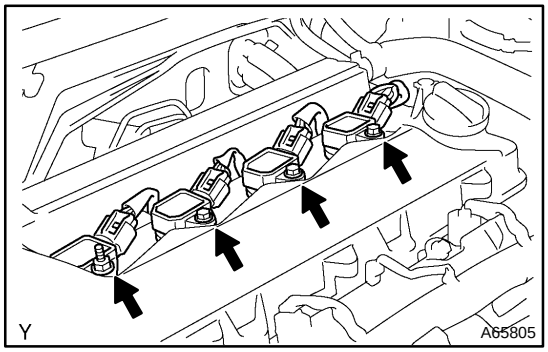
140RD–01

REPLACEMENT

1. REMOVE ENGINE UNDER COVER RH

2. REMOVE CYLINDER HEAD COVER NO.2

(a) Remove the 3 bolts, the nut and the cylinder head cover No. 2.

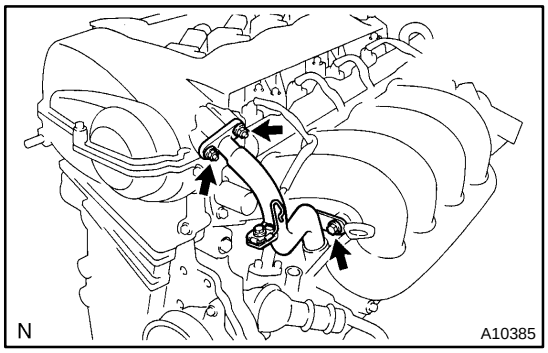


3. REMOVE IGNITION COIL ASSY

(a) Remove the 4 bolts, and disconnect the 4 connectors, and remove the 4 ignition coils.

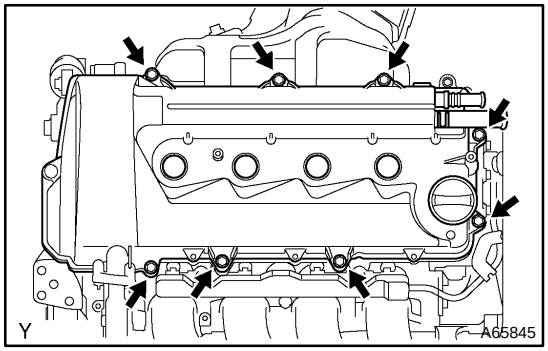
4. REMOVE CYLINDER HEAD COVER SUB–ASSY

(a) Disconnect the fuel hose clamp and 2 PCV hoses from the cylinder head cover.



(b) Remove the 2 nuts, bolt and disconnect the No. 3 ventilation hose from the No. 1 ventilation pipe.

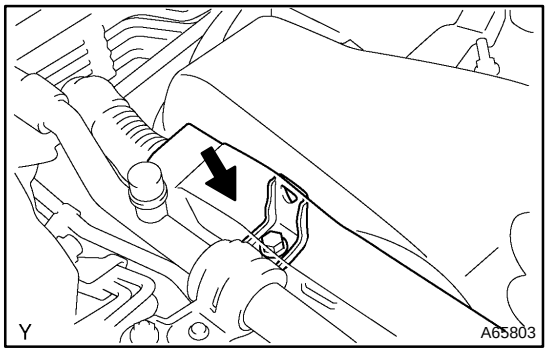
(c) Disconnect the ventilation No. 1 tube and gasket.



(d) Remove the 8 bolts, wire harness protector, cylinder head cover and gasket.

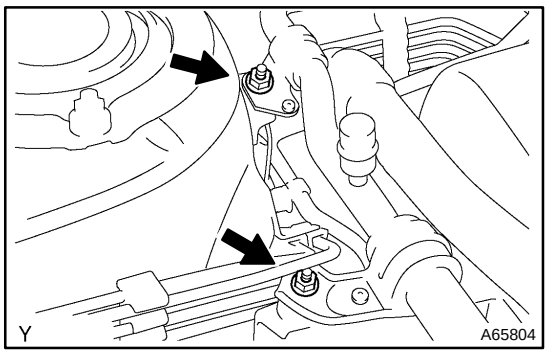
(e) Remove the O–ring from the cylinder head cover.

5. REMOVE WIRE HARNESS CLAMP



(a) Disconnect engine wire harness.

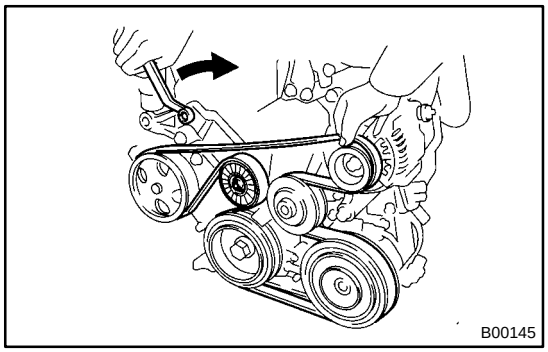
(b) Remove the bolt and wiring harness clamp bracket.



6. DISCONNECT SUCTION HOSE SUB–ASSY

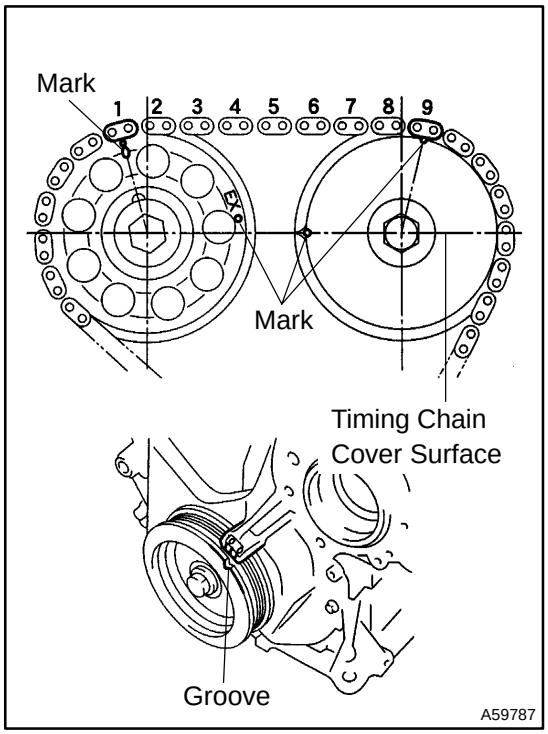
(a) Remove the 2 nuts installing the suction hose sub–assy.

(b) Disconnect the suction hose sub–assy.



7. REMOVE FAN AND GENERATOR V BELT

(a) Turn the drive belt tensioner slowly clockwise and loosen it. Then, remove the drive belt and put back the drive belt tensioner little by little and fix it quietly.



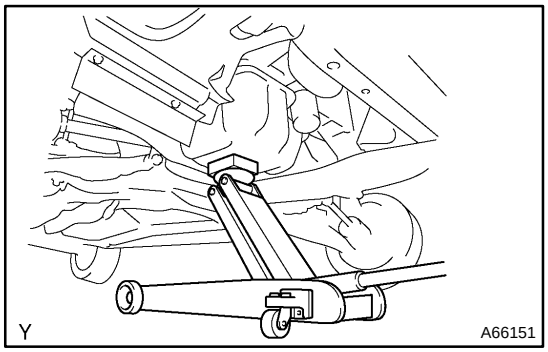
8. SET NO.1 CYLINDER TO TDC/COMPRESSION

(a) Turn the crankshaft pulley, and align its groove with timing mark ”0” of the timing chain cover.

(b) Check that the point marks of the camshaft timing sprocket and VVT timing sprocket are in straight line on the timing chain cover surface as shown in the illustration.

HINT:

If not, turn the crankshaft 1 revolution (360◆) and align the marks as above.

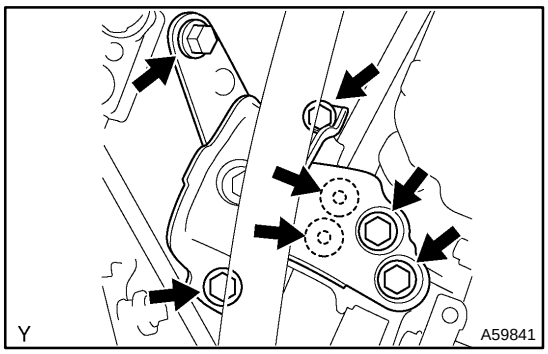


9. REMOVE ENGINE MOUNTING INSULATOR SUB–ASSY RH

(a) Set the jack to the engine.

HINT:

Place a wooden block between the jack and engine.

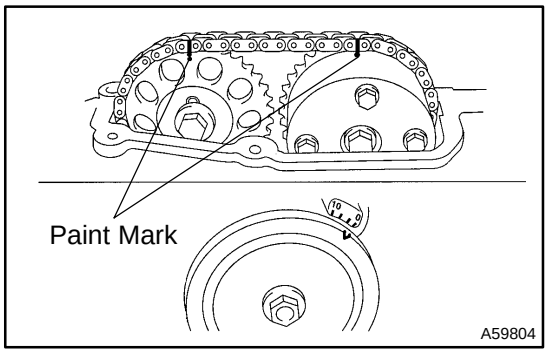


(b) Remove the 5 bolts, 2 nuts and engine mounting insulator sub–assy RH.

10. REMOVE V–RIBBED BELT TENSIONER ASSY

HINT:

Handle a jack up and down to remove the bolt.



11. REMOVE CAMSHAFT

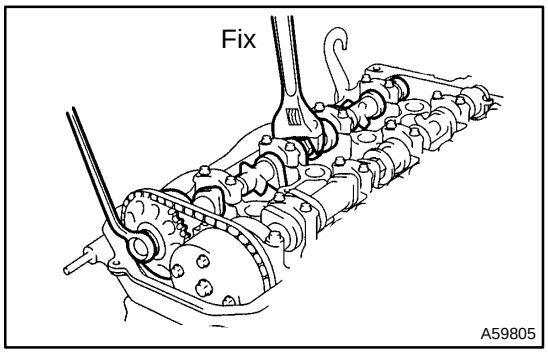
NOTICE:

Be sure not to revolve the crankshaft without the chain tensioner.

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

(b) Place match marks on the timing chain and camshaft timing sprockets.

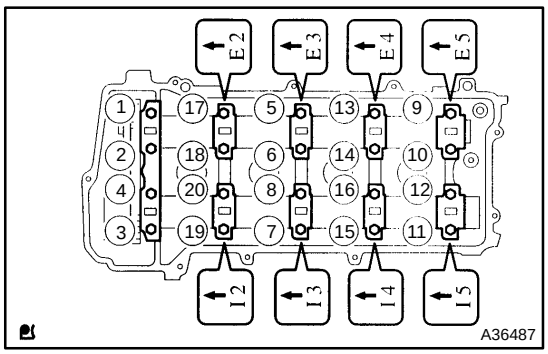
(c) Remove the 2 nuts and the chain tensioner.



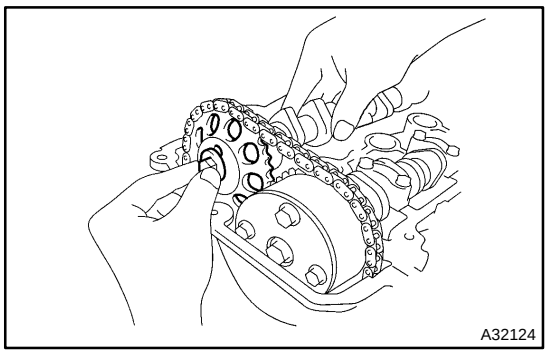
(d) Fix the camshaft with a wrench and so on, then loosen the camshaft timing gear set bolt.

NOTICE:

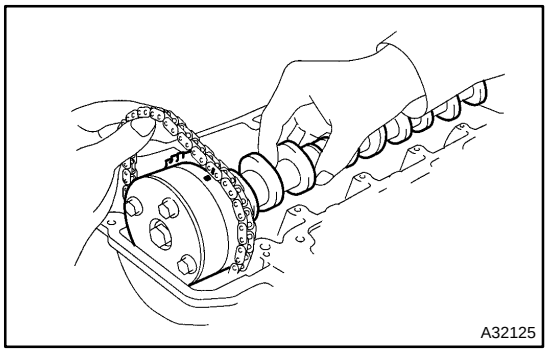
Be careful not to damage the valve lifter.



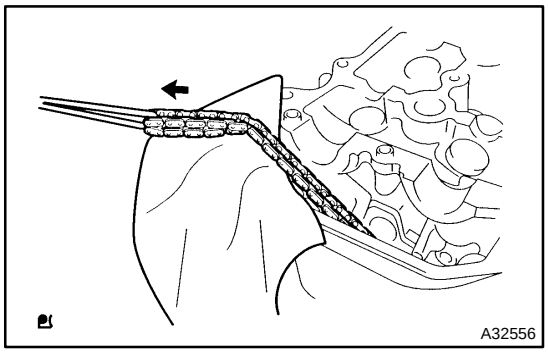
(e) Loosen the camshaft bearing cap bolts on No. 2 camshaft in the order as shown in the illustration in several passes,and remove the caps.



(f) Remove the camshaft timing gear as shown in the illustration.



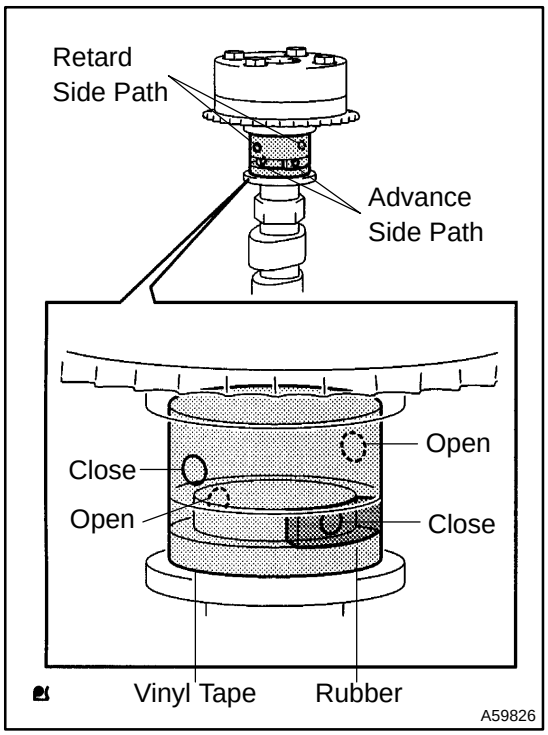
(g) Remove the camshaft with holding the timing chain.



(h) Tie the timing chain with a string as shown in the illustration.

NOTICE:

Be careful not to drop anything inside the timing chain cover.



12. INSPECT CAMSHAFT TIMING GEAR ASSY

(a) Check the lock of camshaft timing gear.

(1) Grip the camshaft with a vice, and confirm the camshaft timing gear is locked.

NOTICE:

Be careful not to damage the camshaft.

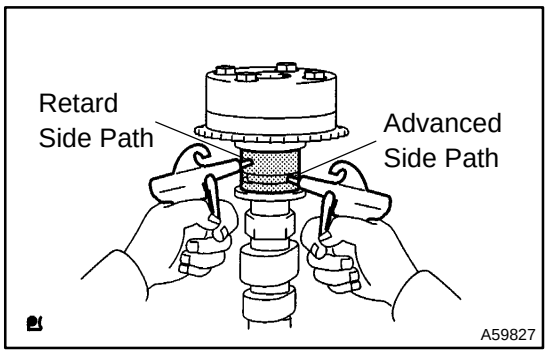
(b) Release lock pin.

(1) Cover 4 oil paths of cam journal with vinyl tape as shown in the illustration.

HINT:

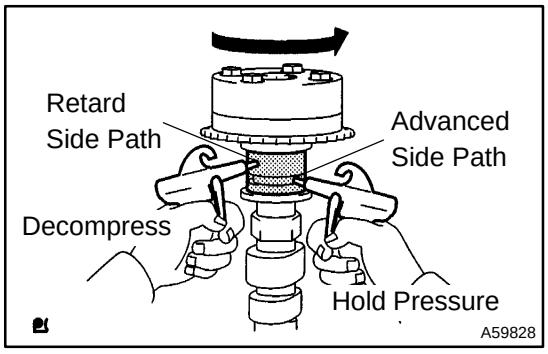
Two advance side paths are provided in the groove of the camshaft. Plug one of the path with a rubber piece.

(2) Break through the tapes of the advance side path and the retard side path on the opposite side of the groove.



(3) Put air pressure into two broken paths (the advance side path and the retard side path) with about 150 kPa {1.5 kgf/cm^2}.

CAUTION:
Cover the paths with shop rag to avoid oil splashing.



(4) Confirm if the camshaft timing gear assembly revolves in the timing advance direction when weakening the air pressure of the timing retard path.

HINT:
The lock pin is released, and camshaft timing gear, revolves in the advance direction.

(5) When the camshaft timing gear comes to the most advanced position, take out the air pressure of the timing retard side path, and then, take out that of timing advance side path.

CAUTION:
Camshaft timing assembly gear occasionally shifts to the retard side abruptly, if the air compression of the advanced side path is released before retard side path. It often causes the breakage of the lock pin.

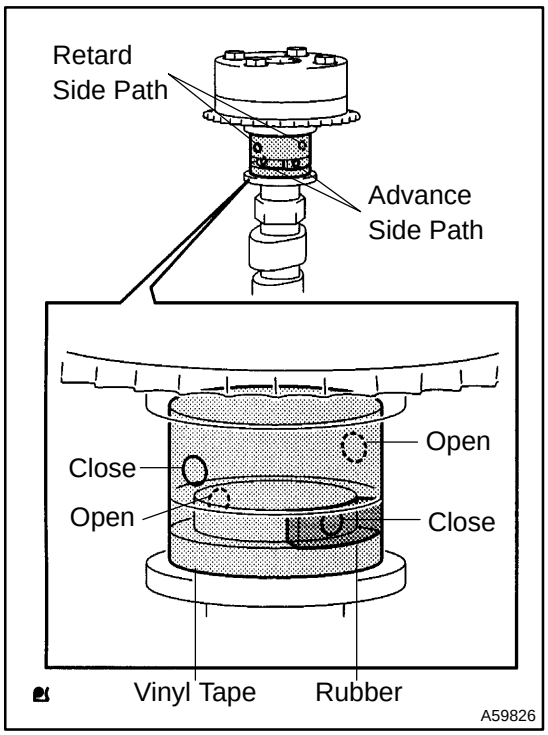
(c) Check smooth revolution

(1) Revolve the camshaft timing gear assembly within the movable range except for the most retarded position several times, and check the smooth revolution.

CAUTION:
Be sure to perform this check by hand, instead of air pressure.

(d) Check the lock in the most retarded position.

(1) Confirm that the camshaft timing gear assembly is locked at the most retarded position.



13. REMOVE CAMSHAFT TIMING GEAR ASSY

(a) Grip the camshaft with a vice, and confirm that the gear is locked.

CAUTION:

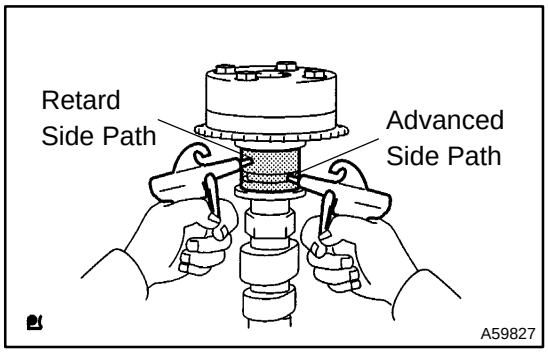
Be careful not to damage the camshaft.

(b) Cover 4 oil paths of cam journal with vinyl tape as shown in the illustration.

HINT:

Two advance side paths are provided in the groove of the camshaft. Plug one of the path with a rubber piece.

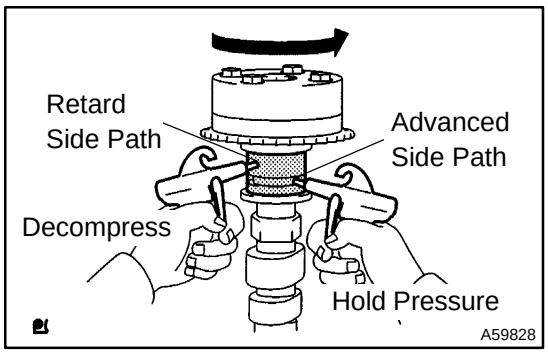
(c) Break through the tapes of the advance side path and the retard side path on the opposite side of the groove.



(d) Put air pressure into two broken paths (the advance side path and the retard side path) with about 150 kPa {1.5 kgf/cm^2}.

CAUTION:

Cover the paths with shop rag to avoid oil splashing.



(e) Confirm if the camshaft timing gear assembly revolves in the timing advance direction when weakening the air pressure of the timing retard path.

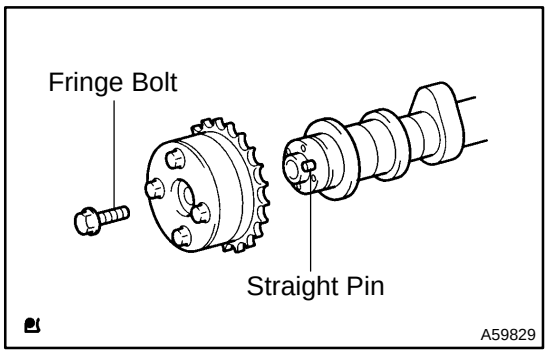
HINT:

The lock pin is released, and camshaft timing gear revolves in the advance direction.

(f) When the camshaft timing gear comes to the most advanced position, take out the air pressure of the timing retard side path, and then, takeout that of timing advance side path.

CAUTION:

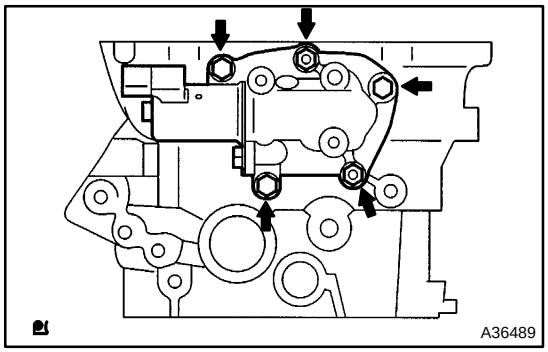
Camshaft timing gear assembly occasionally shifts to the retard side abruptly, if the air compression of the advanced side path is released before retard side paths. It often causes the breakage of the lock pin.



(g) Remove the fringe bolt of camshaft timing gear assembly.

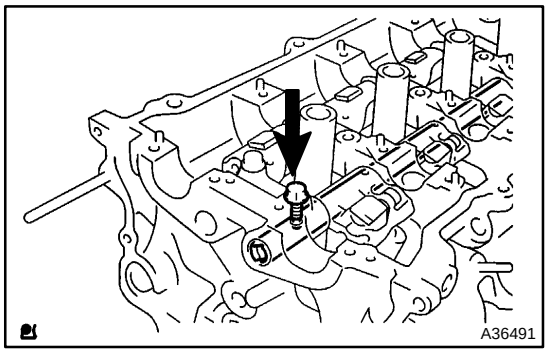
NOTICE:

Be sure not to remove the other 4 bolts.



14. REMOVE CAM TIMING CONTROL VALVE HOUSING

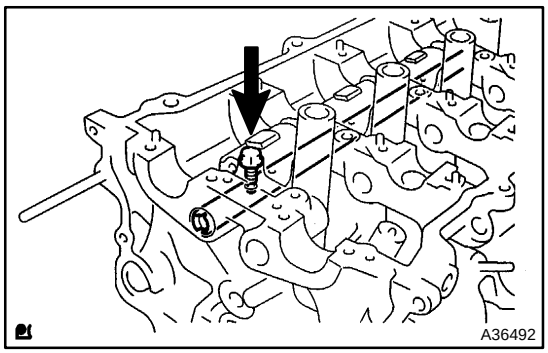
(a) Remove the 3 bolts, 2 nuts and cam timing oil control valve housing.



15. REMOVE VALVE ROCKER SHAFT SUB–ASSY NO.1

(a) Remove the bolt and the rocker shaft No.1.

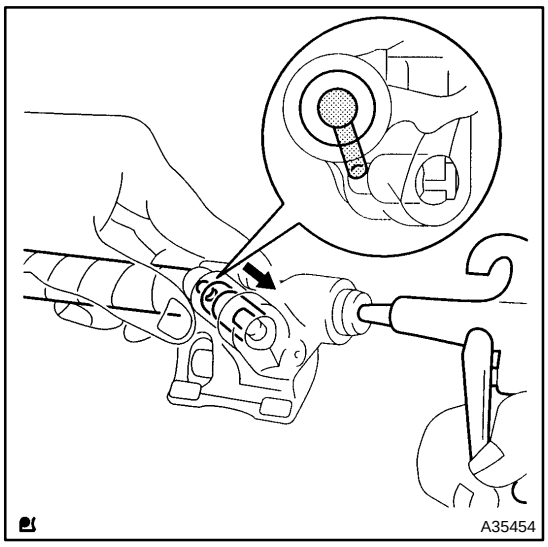
(b) Remove the valve rocker arm.



16. REMOVE VALVE ROCKER SHAFT SUB–ASSY NO.2

(a) Remove the bolt and the rocker shaft No.2

(b) Remove the valve rocker arm.

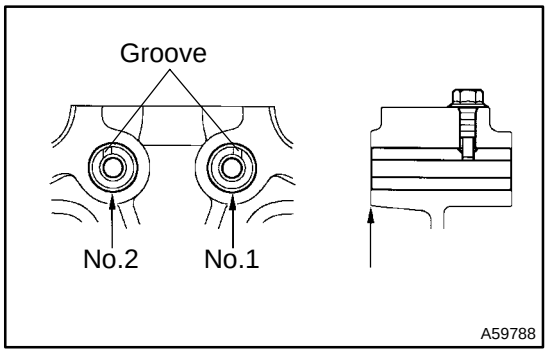


17. INSPECT VALVE ROCKER ARM

(a) Cover oil paths of the rocker arm shaft except 2 paths with vinyl type.

(b) Align the oil path of the rocker arm shaft to the oil path of the rocker arm.

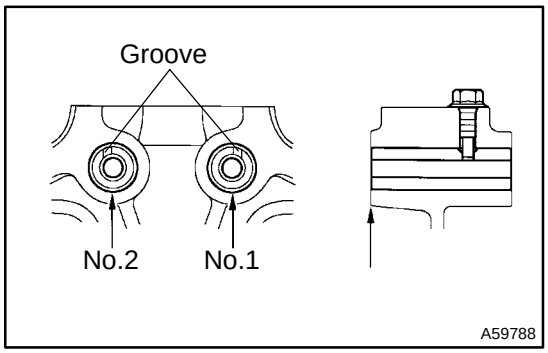
(c) Check that the piston inside of the rocker arm moves when air pressure 150 kpa {1.5kgf/cm^2 } is put to the oil paths.



18. INSTALL VALVE ROCKER SHAFT SUB–ASSY NO.2

(a) Put the valve rocker shaft through the cylinder head and the hole of the valve rocker arm, and check the direction of the groove.

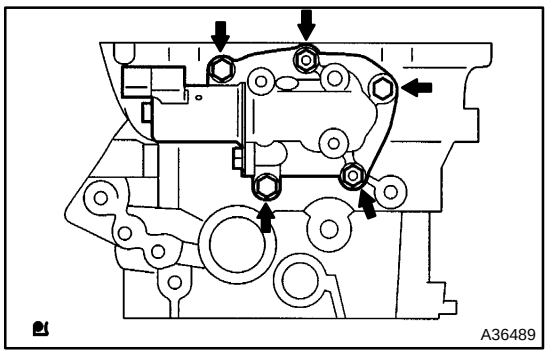
(b) Install a bolt to fix the rocker shaft No.2.
Torque: 7.5 N·m (76 kgf·cm, 66 in·lbf)



19. INSTALL VALVE ROCKER SHAFT SUB–ASSY NO.1

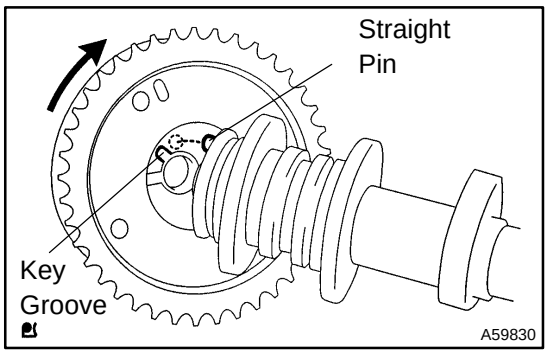
(a) Put the valve rocker shaft through the cylinder head and the hole of the valve rocker arm, and check the direction of the groove.

(b) Install a bolt to fix the rocker shaft No.1.
Torque: 7.5 N·m (76 kgf·cm, 66 in·lbf)



20. INSTALL CAM TIMING CONTROL VALVE HOUSING

(a) Install the new gasket and the oil control valve housing with the 3 bolts and 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



21. INSTALL CAMSHAFT TIMING GEAR ASSY

(a) Put the camshaft timing gear assembly and the camshaft together with the straight pin off the key groove.

(b) Turn the camshaft timing gear assembly to the left direction (as shown in the illustration) with pushing it lightly against the camshaft. Push further at the position where the pin gets into the groove.

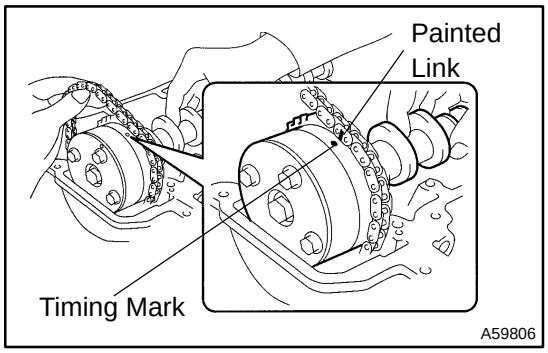
CAUTION:

Be sure not to turn the camshaft timing gear to the retard angle side (to the right angle).

(c) Check that there is no clearance between the gear's fringe and the camshaft.

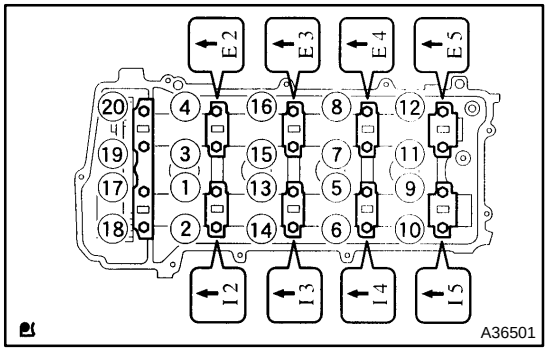
(d) Tighten the fringe bolt with the camshaft timing gear fixed.
Torque: 54 N·m (551 kgf·cm, 40 ft·lbf)

(e) Check that the camshaft timing gear assembly can move to the retard angle side (the right angle), and is locked at the most retarded position.

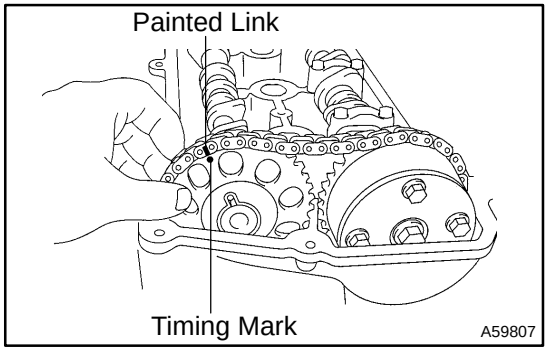


22. INSTALL CAMSHAFT

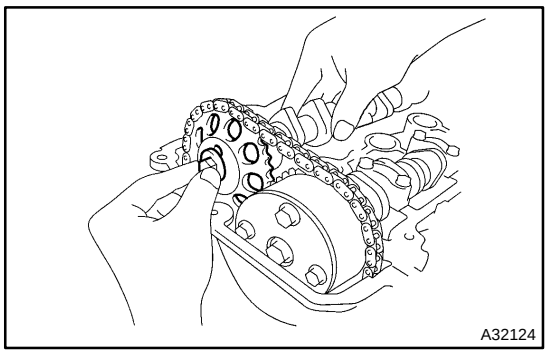
(a) As shown in the illustration, install the timing chain on the camshaft timing gear, with the painted links aligned with the timing marks on the camshaft timing sprockets.



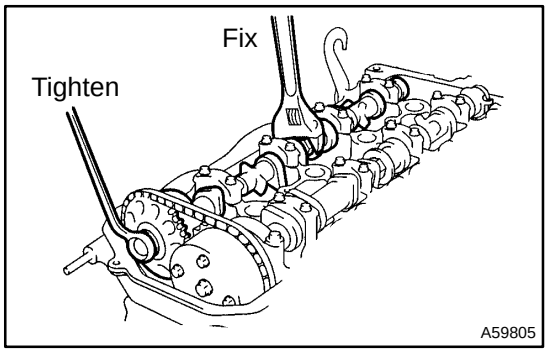
(b) Examine the front marks and numbers and tighten the bolts in the order shown in the illustration.
Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)



(c) Put the camshaft No.2 on the cylinder head with the painted links of the chain aligned with the timing mark on the camshaft timing sprockets.

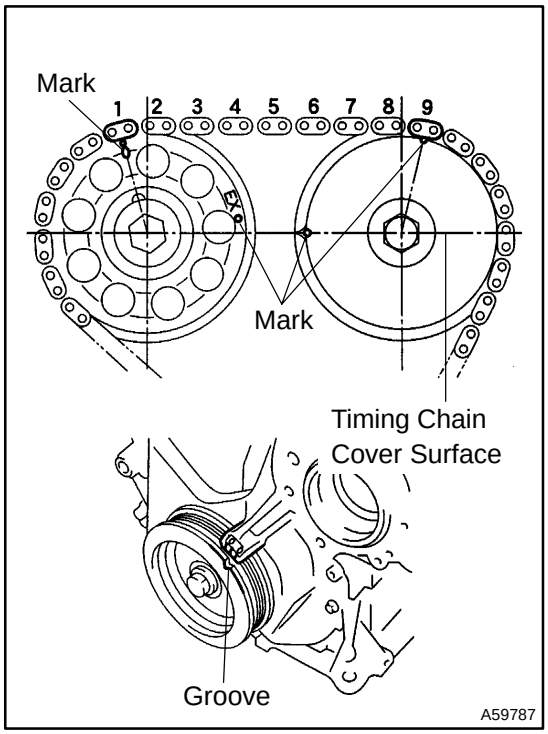


(d) Tighten the set bolt temporarily.

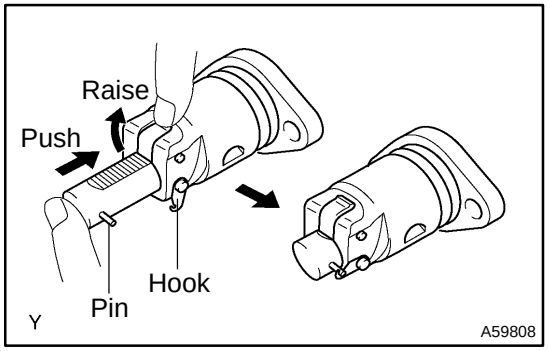


(e) Fix the camshaft with a wrench and so on, then tighten the camshaft timing gear set bolt.
Torque: 54 N·m (551 kgf·cm, 40 ft·lbf)

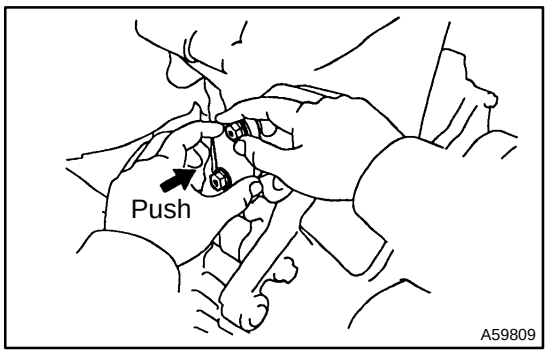
NOTICE:
Be careful not damage the valve lifter.



(f) Check the match marks on the timing chain and camshaft timing sprockets, and then the alignment of the pulley groove with timing mark of the chain cover as shown in the illustration.

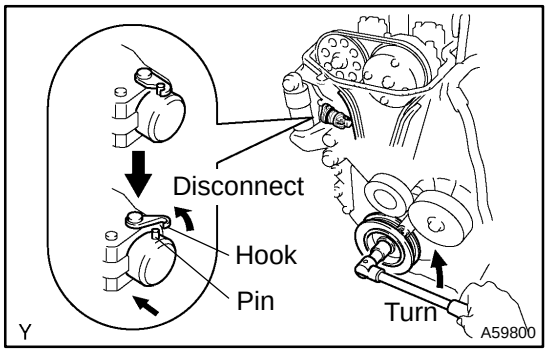


(g) Install chain tensioner.
(1) Check the O–ring is clean, and set the hook as shown in the illustration.

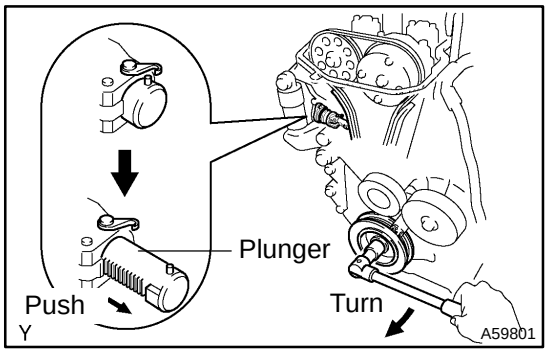


(2) Apply engine oil to the chain tensioner and install it.
Torque: 9.0 N·m (92 kgf·cm, 80 in·lbf)

NOTICE:
When installing the tensioner, set the hook again if the hook release the plunger.

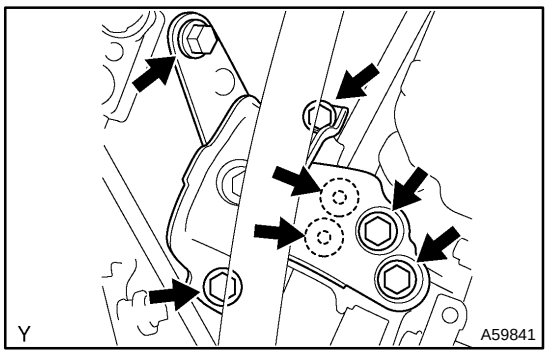


(3) Turn the crankshaft counterclockwise, and disconnect the plunger knock pin from the hook.



(4) Turn the crankshaft clockwise, and check that the slipper is pushed by the plunger.

23. INSTALL V–RIBBED BELT TENSIONER ASSY
Torque:
Nut: 29 N·m (296 kgf·cm, 21 ft·lbf)
Bolt: 100 N·m (1,020 kgf·cm, 74 ft·lbf)



24. INSTALL ENGINE MOUNTING INSULATOR SUB–ASSY RH

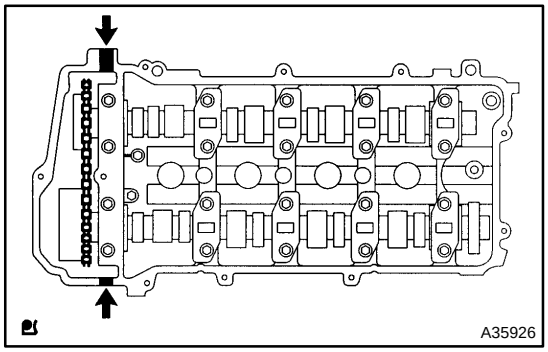
(a) Install the engine mounting insulator sub–assy RH with the 5 bolts and the 2 nuts.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

25. INSTALL CYLINDER HEAD COVER SUB–ASSY

(a) Remove any old packing (FIPG) material.

HINT:

When FIPG on the head cover gasket side cannot be eliminated completely, replace the gasket.



(b) Apply seal packing to 2 locations as shown in the illustration.

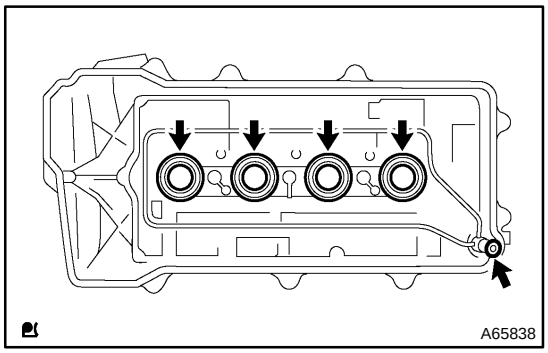
Seal packing:

Part No. 08826–00080 or equivalent

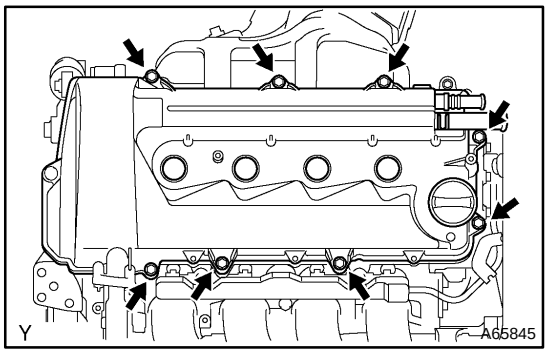
(c) Install the cylinder head cover gasket to the cylinder head cover.

HINT:

Part must be assembled within 3 minutes of application. Otherwise the material must be remove and reapplied.



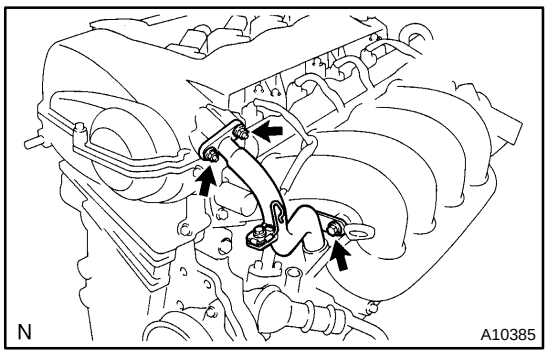
(d) Install the spark plug tube gasket and a new O–ring to the cylinder head cover.



(e) Install the cylinder head cover and wire harness protector with the 8 bolts. Uniformly tighten the bolts, in the several passes, in the sequence shown.

Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

(f) Connect the 2 PCV hoses to the cylinder head cover.



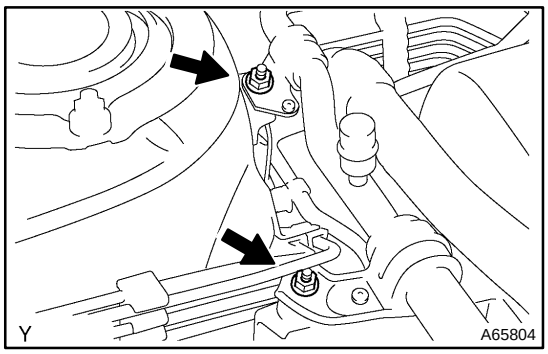
(g) Install a new gasket and No. 1 ventilation pipe with 2 nuts and bolt.

Torque:

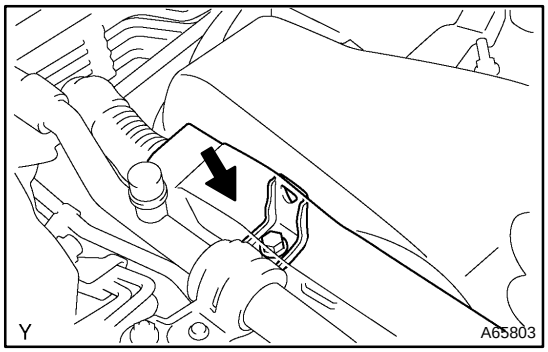
Nut 10 N·m (102 kgf·cm, 7 ft·lbf)

Bolt 24 N·m (245 kgf·cm, 18 ft·lbf)

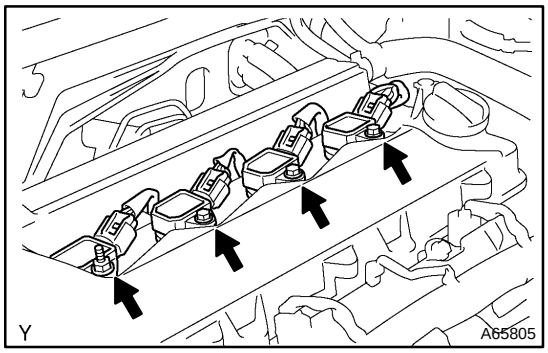
(h) Connect the No. 3 ventilation hose to the No. 1 ventilation pipe.



26. INSTALL SUCTION HOSE SUB–ASSY
Torque: 9.8 N·m (100 kgf·cm, 87 in.·lbf)



27. INSTALL WIRE HARNESS CLAMP
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)



28. INSTALL IGNITION COIL ASSY
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

29. INSTALL CYLINDER HEAD COVER NO.2
Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)

30. CHECK ENGINE OIL LEAK

140RF–01

REPLACEMENT

1. WORK FOR PREVENTING GASOLINE FROM SPILLING OUT (See page 11–1)

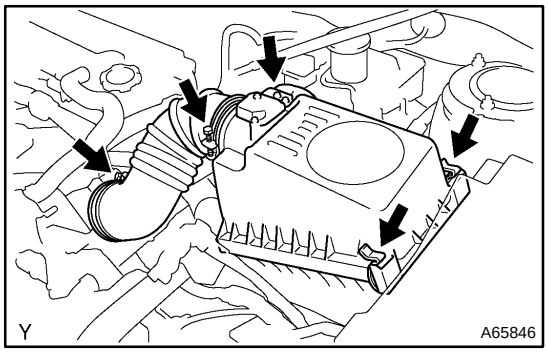
2. REMOVE FRONT WHEEL RH

3. REMOVE ENGINE UNDER COVER RH

4. DRAIN COOLANT(See page 16–6)

5. REMOVE CYLINDER HEAD COVER NO.2

(a) Remove the 3 bolts, the nut and the cylinder head cover No. 2.



6. REMOVE AIR CLEANER ASSEMBLY WITH HOSE

(a) Disconnect the MAF meter connector.

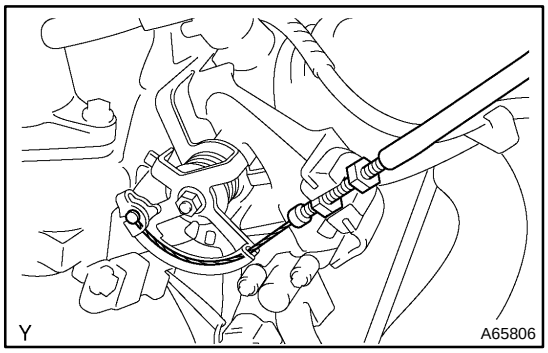
(b) Place match marks on the vacuum hoses.

(c) Disconnect the 5 vacuum hoses from the air cleaner cap.

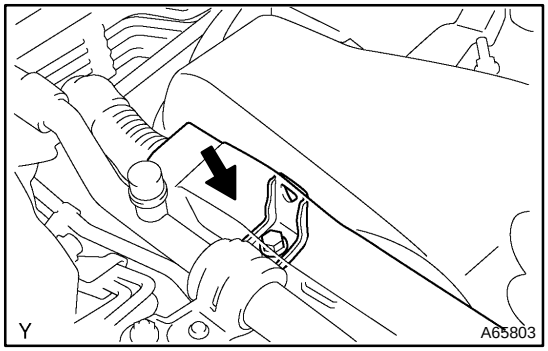
(d) Disconnect the 2 clamps, and disconnect the air cleaner cap from the air cleaner case.

(e) Loosen the hose clamp bolt, and disconnect the air cleaner hose from the throttle body.

(f) Remove the air cleaner assembly with hose.



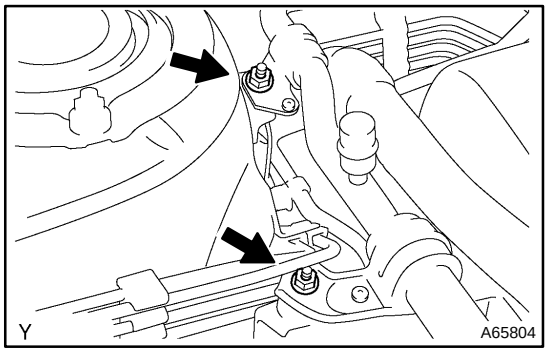
7. DISCONNECT ACCELERATOR CONTROL CABLE ASSY



8. REMOVE WIRE HARNESS CLAMP

(a) Disconnect engine wire harness.

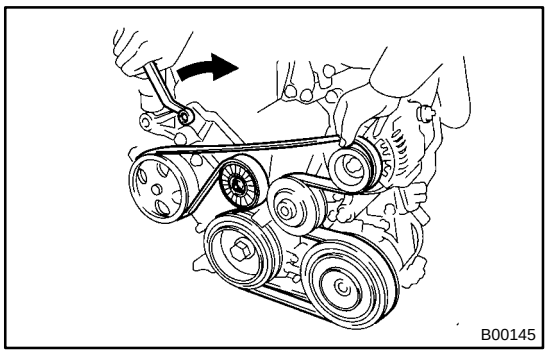
(b) Remove the bolt and wiring harness clamp bracket.



9. DISCONNECT SUCTION HOSE SUB–ASSY

(a) Remove the 2 nuts installing the suction hose sub–assy.

(b) Disconnect the suction hose sub–assy.



10. REMOVE FAN AND GENERATOR V BELT

(a) Turn the drive belt tensioner slowly clockwise and loosen it. Then, remove the drive belt and put back the drive belt tensioner little by little and fix it quietly.

11. REMOVE EFI FUEL PIPE CLAMP (See page 11–1)

12. DISCONNECT FUEL TUBE SUB–ASSY(See page 11–1)

13. SEPARATE RADIATOR HOSE INLET

(a) Disconnect the radiator hose inlet from the radiator.

14. DISCONNECT HEATER INLET WATER HOSE

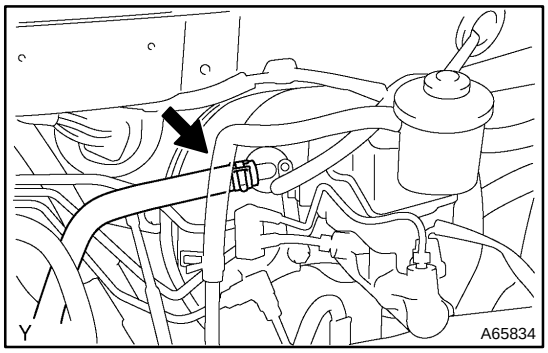
(a) Disconnect the heater inlet water hose from the air conditioner tube.

15. DISCONNECT WATER BY–PASS HOSE NO.2

(a) Disconnect the water by–pass hose No. 2 from the throttle body.

16. DISCONNECT WATER BY–PASS HOSE NO.3

(a) Disconnect the water by–pass hose No. 3 from the throttle body.



17. DISCONNECT UNION TO CONNECTOR TUBE HOSE

(a) Disconnect the union to check valve hose from the brake booster.

18. REMOVE GENERATOR BRACKET NO.1 (See page 19–15)

19. REMOVE GENERATOR ASSY (See page 19–15)

20. SEPARATE COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONER) (See page 55–34)

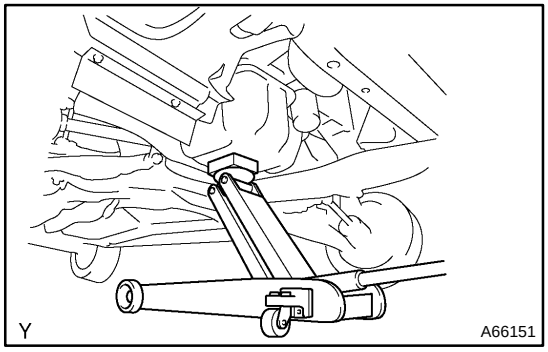
HINT:

Hung up the hoses instead of detaching.

21. DISCONNECT EXHAUST PIPE ASSY FRONT

(a) Remove the 2 bolts and 2 nuts compression springs installing the front side of exhaust pipe.

(b) Remove the gasket.

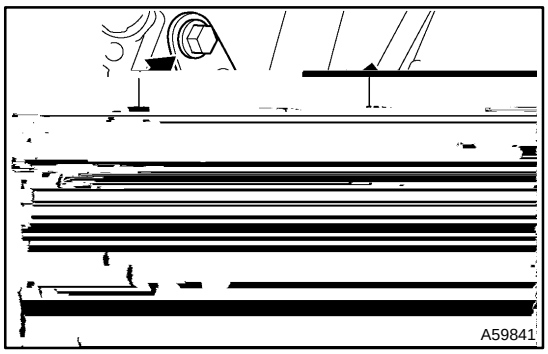


22. REMOVE ENGINE MOUNTING INSULATOR SUB–ASSY RH

(a) Set the jack to the engine.

HINT:

Place a wooden block between the jack and engine.

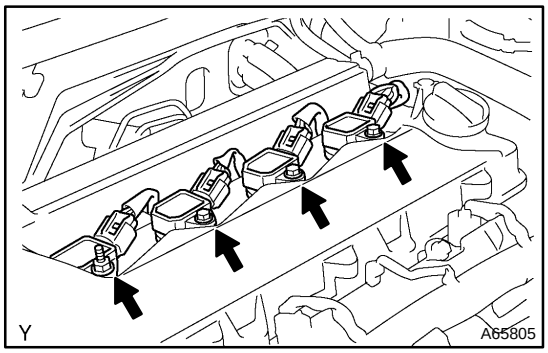


(b) Remove the 5 bolts, 2 nuts and engine mounting insulator sub–assy RH.

23. DISCONNECT ENGINE WIRE

(a) Disconnect the ignition coil connectors, oil control valve connector and crankshaft position sensor connector.

(b) Remove the bolt and nut for the earth and put the engine wiring side.



24. INSTALL IGNITION COIL ASSY

(a) Remove the 4 bolts and the 4 ignition coils.

25. DISCONNECT VENTILATION HOSE

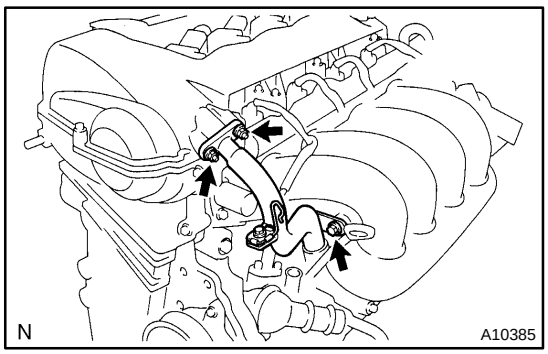
(a) Disconnect the ventilation hose from the cylinder head cover.

26. DISCONNECT VENTILATION HOSE NO.2

(a) Disconnect the ventilation hose from the cylinder head cover.

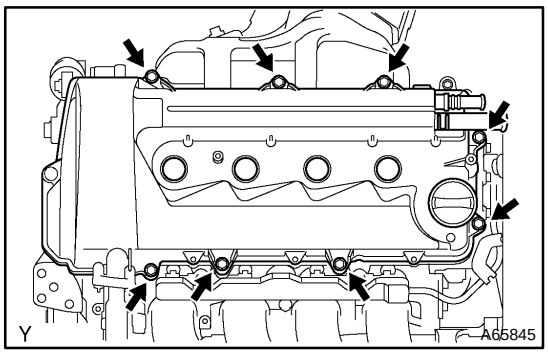
27. REMOVE CYLINDER HEAD COVER SUB–ASSY

(a) Disconnect the fuel hose clamp and 2 PCV hoses from the cylinder head cover.

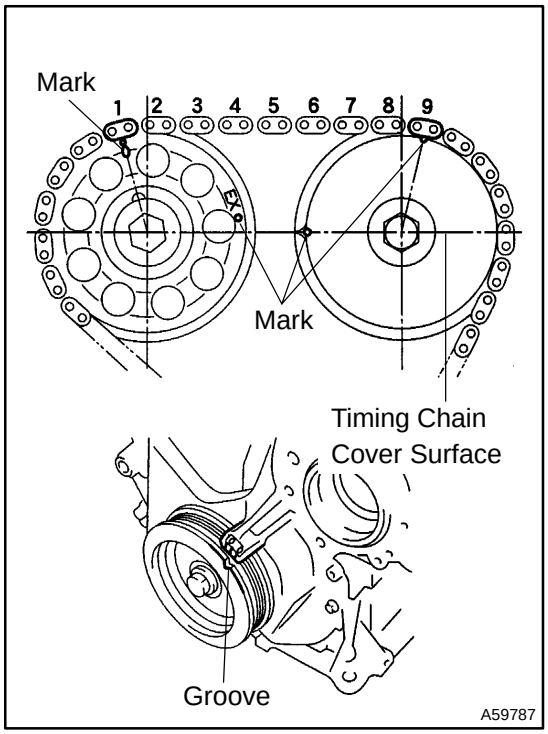


(b) Remove the 2 nuts, bolt and disconnect the No. 3 ventilation hose from the No. 1 ventilation pipe.

(c) Disconnect the ventilation No. 1 tube and gasket.



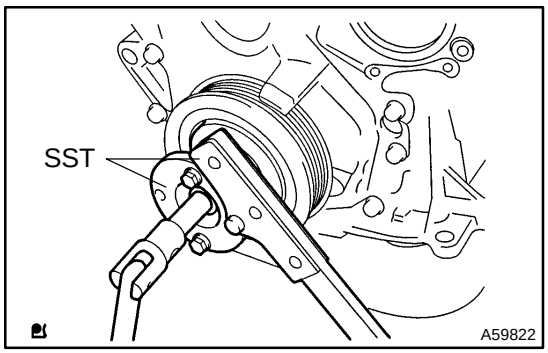
(d) Remove the 8 bolts, wire harness protector, cylinder head cover and gasket.
(e) Remove the O–ring from the cylinder head cover.



28. SET NO.1 CYLINDER TO TDC/COMPRESSION

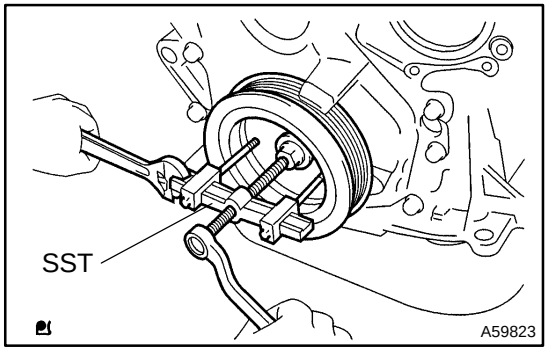
(a) Turn the crankshaft pulley, and align its groove with timing mark ”0” of the timing chain cover.
(b) Check that the point marks of the camshaft timing sprocket and VVT timing sprocket are in straight line on the timing chain cover surface as shown in the illustration.

HINT:
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.



29. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the pulley bolt.
SST 09213–70011 (09213–70020), 09330–00021

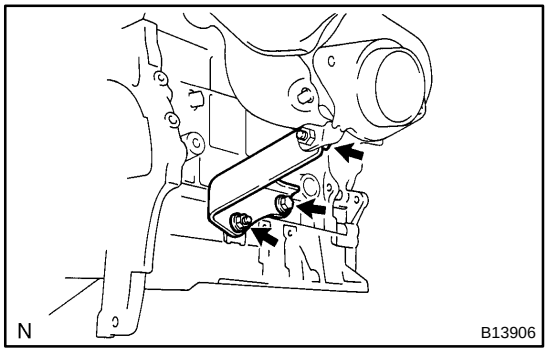


(b) Using SST, remove the crankshaft pulley.
SST 09950–50013 (09951–05010, 09952–05010, 09953–05020, 09954–05021, 09957–04010)

30. REMOVE V–RIBBED BELT TENSIONER ASSY

HINT:

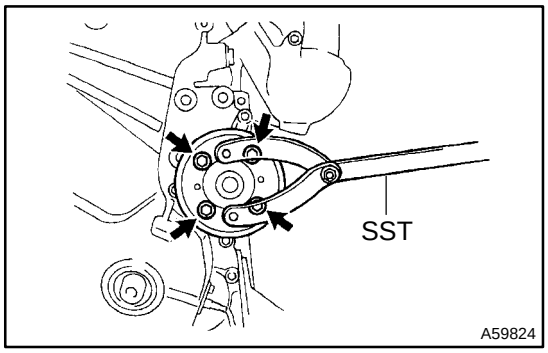
Handle a jack up and down to remove the bolt.



31. REMOVE MANIFOLD STAY

(a) Remove the 2 bolts, nut and exhaust manifold stay.

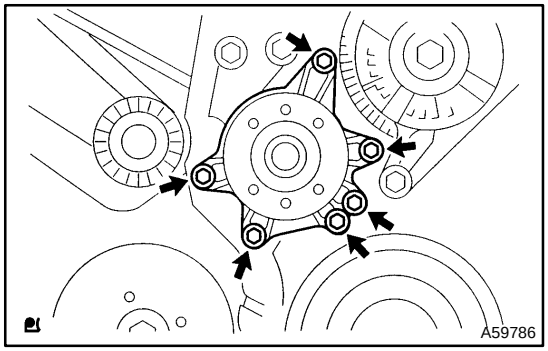
32. REMOVE EXHAUST MANIFOLD HEAT INSULATOR NO.1



33. REMOVE WATER PUMP PULLEY

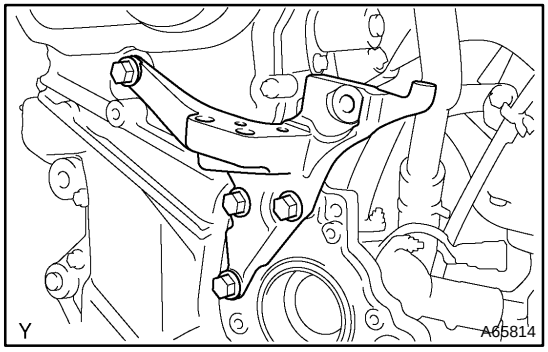
(a) Using SST, remove the water pump pulley.

SST 09960–10010



34. REMOVE WATER PUMP ASSY

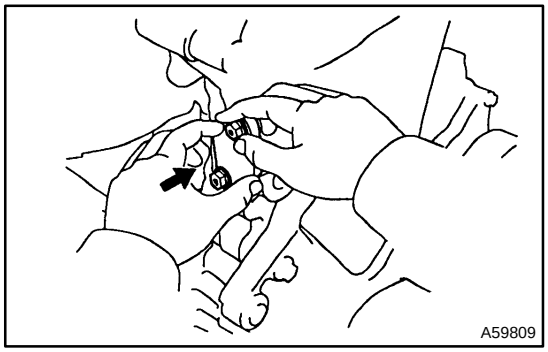
(a) Remove the 6 bolts and water pump.



35. REMOVE TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

(a) Remove the 4 bolts and the engine mounting bracket.

36. REMOVE CRANK POSITION SENSOR

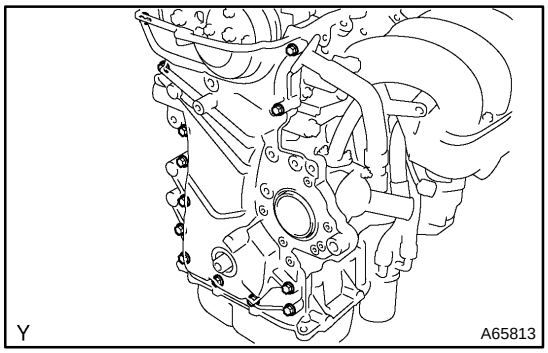


37. REMOVE CHAIN TENSIONER ASSY NO.1

(a) Remove the 2 nuts and the chain tensioner assy No. 1.

NOTICE:

Be sure not to revolve the crankshaft without the chain tensioner.



38. REMOVE TIMING CHAIN OR BELT COVER SUB–ASSY

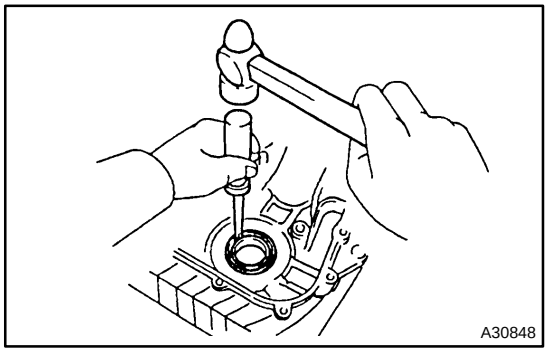
(a) Remove the 12 bolts.

(b) Using a torx wrench socket (E8), remove the stud bolt.

(c) Remove the timing chain cover and 2 gaskets.

NOTICE:

Be careful no tot damage the contact surfaces of the timing chain cover, cylinder head and cylinder block.



39. REMOVE TIMING GEAR COVER OIL SEAL

(a) Using a screwdriver, remove the oil seal.

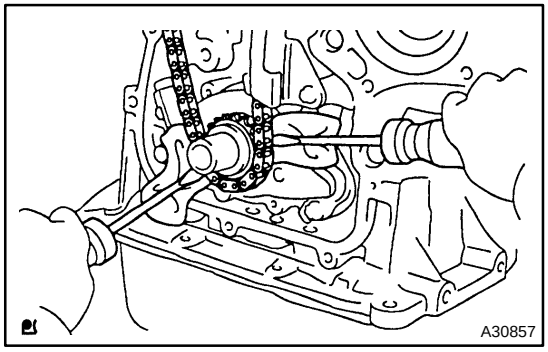
40. REMOVE CRANKSHAFT POSITION SENSOR PLATE NO.1

41. REMOVE CHAIN TENSIONER SLIPPER

(a) Remove the bolt and the chain tensioner slipper.

42. REMOVE CHAIN VIBRATION DAMPER NO.1

(a) Remove the 2 bolts and chain vibration damper No. 1.

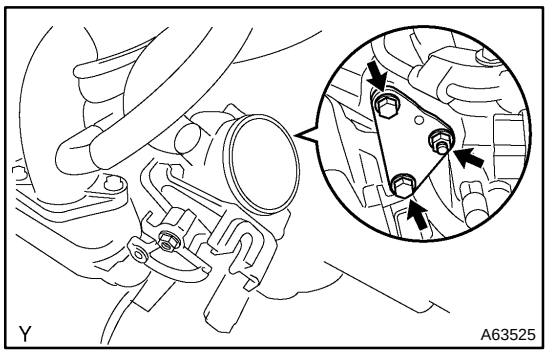


43. REMOVE CHAIN SUB–ASSY

(a) Remove the timing chain with the crankshaft timing gear plying screwdrivers as shown in the illustration.

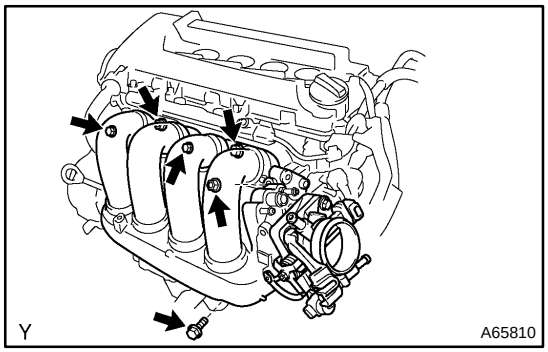
NOTICE:

- **Put shop rag to protect the engine.**
- **In case of revolving the camshafts with the chain off the sprockets, turn the crankshaft 1/4 revolution for valves not to touch the pistons.**



44. REMOVE SURGE TANK STAY NO.1

(a) Remove the 2 bolts, nut and surge tank stay No. 1.

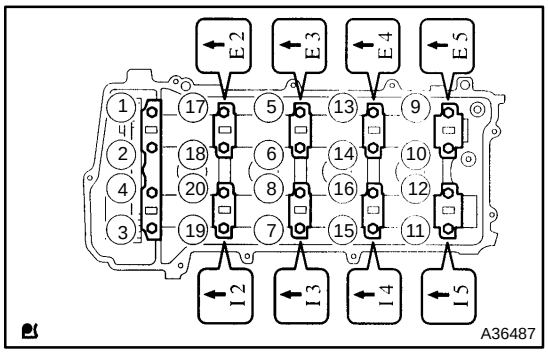


45. REMOVE INTAKE MANIFOLD

(a) Remove the 4 bolts, the 2 nuts, the intake manifold and the gasket.

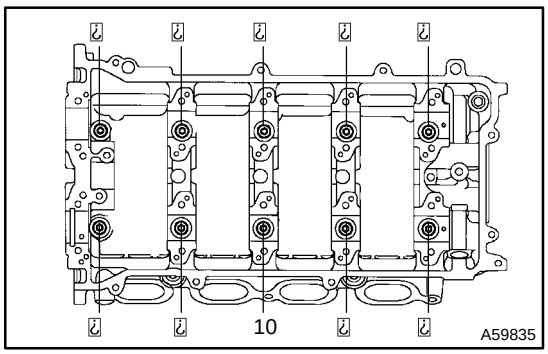
46. REMOVE OIL LEVEL GAGE GUIDE

47. REMOVE OIL LEVEL GAGE SUB–ASSY



48. REMOVE CAMSHAFT

(a) Uniformly loosen and remove the 20 bearing cap bolts, in several passes, in the sequence shown, and remove the 9 bearing caps, of the intake and exhaust camshafts.



49. REMOVE CYLINDER HEAD SUB–ASSY

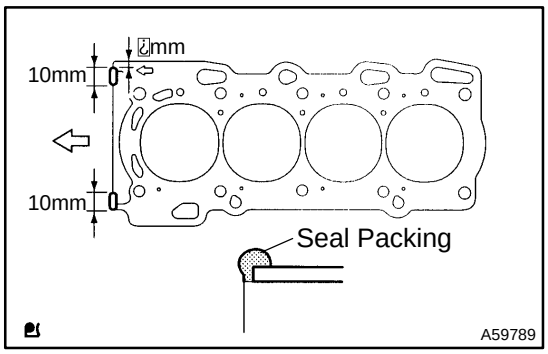
(a) Detach the water by–pass pipe from the cylinder head.

(b) Using a 10 mm bi–hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.

NOTICE:

- **Be careful not to drop washers into the cylinder head.**
- **Head warpage or cracking could result from removing bolts in and incorrect order.**

50. REMOVE CYLINDER HEAD GASKET



51. INSTALL CYLINDER HEAD GASKET

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

NOTICE:

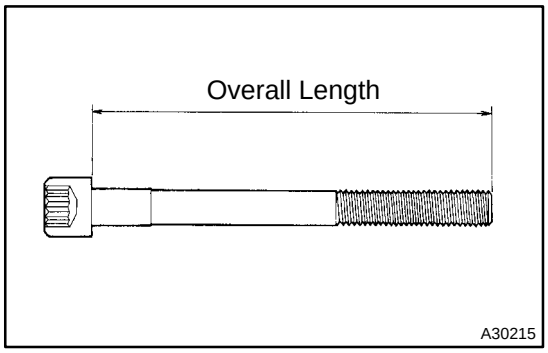
- **Pay attention to the installation direction.**
- **Place the cylinder head quietly in order not to damage the gasket with the bottom part of the head.**

(b) Apply seal packing to the cylinder head gasket as shown in the illustration.

Seal packing:
Part No. 08826–00080 or equivalent

HINT:
avoid applying an excessive amount to the surface.

- Parts must be assembled with in 3 minutes of application. Otherwise the material must be removed and repplied.
- Immediately remove nozzle from the tube and reinstall cap.

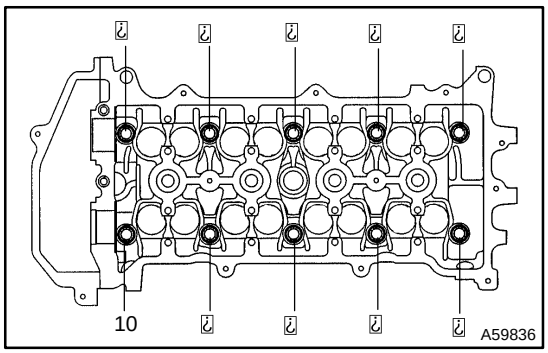


52. INSPECT CYLINDER HEAD SET BOLT

(a) Using vernier calipers, measure the length of head bolts from the seat to the end.

Standard bolt length:
146.0 – 148.2 mm (5.780–5.835 in.)
Maximum bolt length: 148.5 mm(5.846 in.)

(b) If the length surpasses the maximum, replace the bolt.



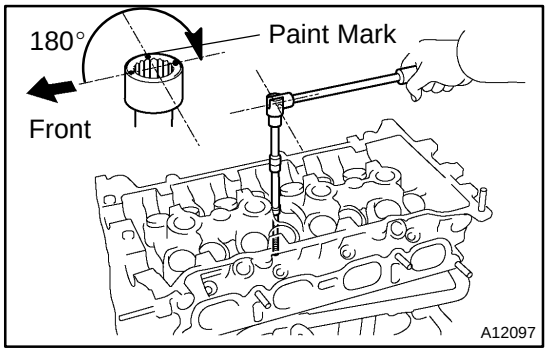
53. INSTALL CYLINDER HEAD SUB–ASSY

HINT:
The cylinder head bolts are tightened in 2 progressive steps.

(a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.

(b) Using a 10 mm bi–hexagon wrench, install and uniformly tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

Torque: 35 N·m (357 kgf·cm, 26 ft·lbf)



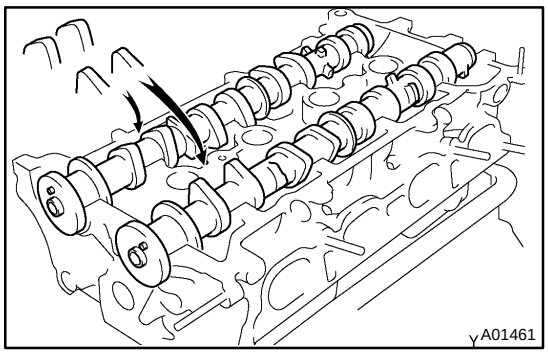
(c) Make the front of the cylinder head bolt with paint.

(d) Retighten the cylinder head bolts 180° in the numerical order shown.

(e) Check that the point marked bolts are moved at 90° angle.

(f) Install the water by–pass pipe.

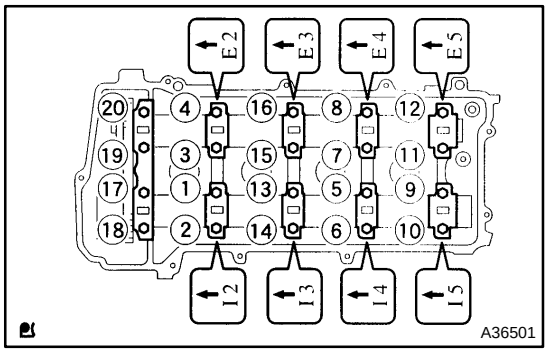
Torque: 21 N·m (214 kgf·cm, 16 ft·lbf)



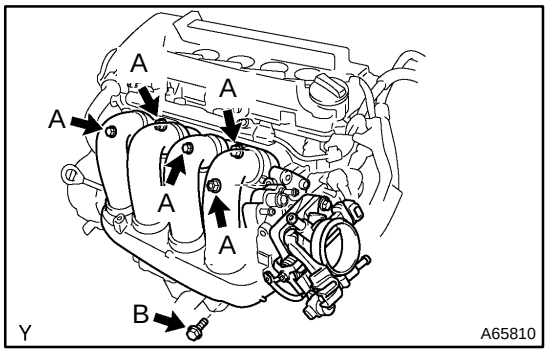
54. INSTALL CAMSHAFT

(a) Apply light coat of engine oil on the camshaft journals.

(b) Place the 2 camshafts on the cylinder head with the No. 1 cam lobes facing as shown the illustration.

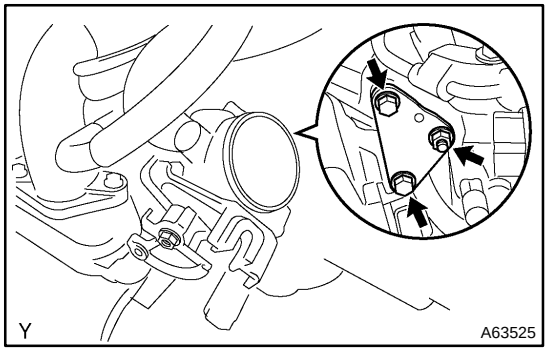


(c) Examine the front marks and numbers and tighten the bolts in the order shown in the illustration.
Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)



55. INSTALL INTAKE MANIFOLD

(a) Install a new gasket, the intake manifold with the 4 bolts and 2 nuts.
Torque:
A: 34 N·m (347 kgf·cm, 25 ft·lbf)
B: 46 N·m (469 kgf·cm, 34 ft·lbf)



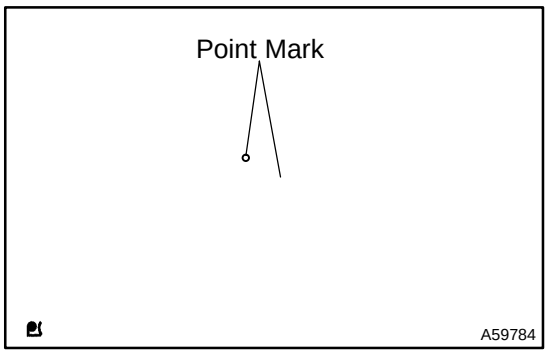
56. INSTALL SURGE TANK STAY NO.1

(a) Install the surge tank stay with the 2 bolts and nut.
Torque:24 N·m (245 kgf·cm, 18 ft·lbf)

57. INSTALL OIL LEVEL GAGE GUIDE

(a) Apply a light coat of engine oil to the new O–ring, install it to the oil level gage guide.

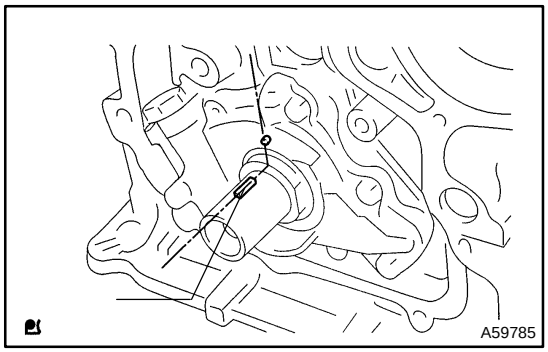
(b) Install the oil level gage and guide with the bolt.
Torque:24 N·m (245 kgf·cm, 18 ft·lbf)



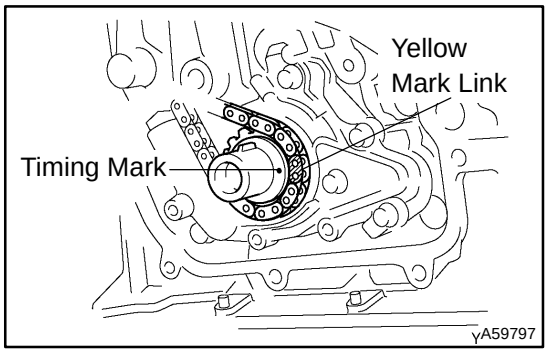
58. INSTALL CHAIN SUB–ASSY

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

(1) Turn the hexagonal wrench head portion of the camshafts, and align the point marks of the camshaft timing sprockets.



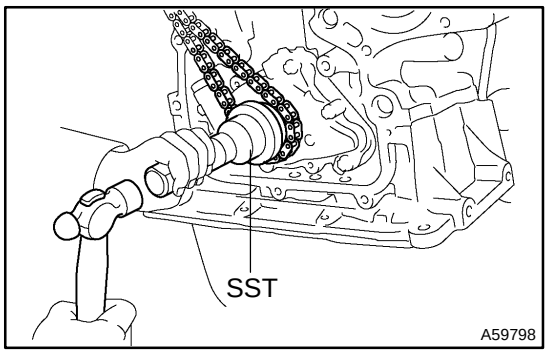
(2) Turn the crankshaft and set the set key on the crankshaft upward.



(b) Install the timing chain on the crankshaft timing sprocket with the yellow mark link aligned with the timing mark on the crankshaft timing sprocket.

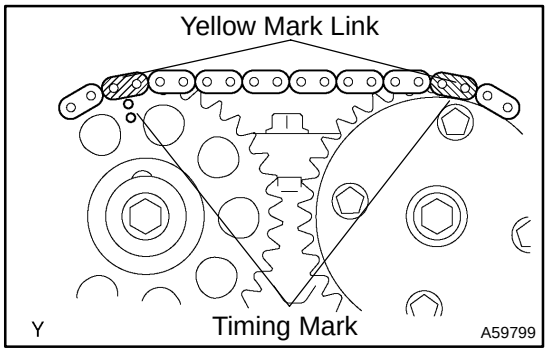
HINT:

Three yellow color links are on the chain.



(c) Using a SST, install the sprocket.

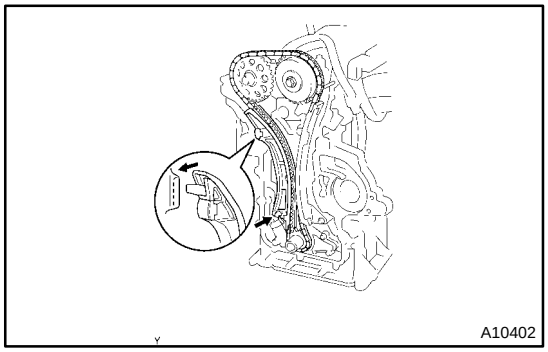
SST 09223–22010



(d) Install the timing chain on the camshaft timing sprockets with the yellow mark links aligned with the timing marks on the camshaft timing sprockets.

59. INSTALL CHAIN VIBRATION DAMPER NO.1

(a) Install the chain vibration damper No, 1 with the 2 bolts.
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)

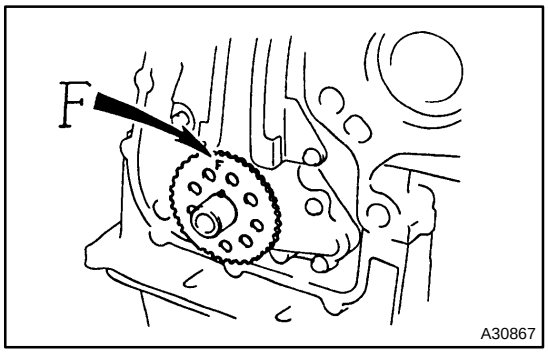


60. INSTALL CHAIN TENSIONER SLIPPER

(a) Install the chain tensioner slipper with the bolt.
Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)

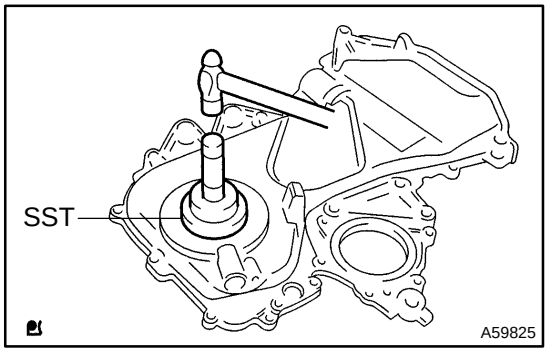
(b) Check that the chain tensioner slipper moves is caught on the cylinder head stopper.

NOTICE:
Do not turn the crankshaft.



61. INSTALL CRANKSHAFT POSITION SENSOR PLATE NO.1

(a) Install the plate with the ”F” mark facing forward.

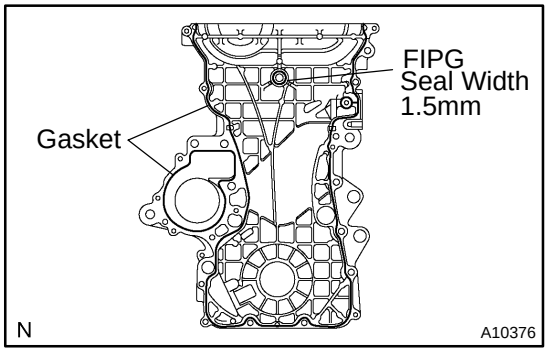


62. INSTALL TIMING GEAR COVER OIL SEAL

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

(b) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.
SST 09223–22010

NOTICE:
Keep the lip off foreign materials.



63. INSTALL TIMING CHAIN OR BELT COVER SUB–ASSY

(a) Remove any old packing (FIPG)material and be careful not to drop any oil on the contact surface of the timing chain cover, cylinder head and cylinder block.
- Using a razor blade and a gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing grooves.
- Thoroughly clean all components to remove all the loose material.
- Using a non–residue solvent, clean both sealing surfaces.

(b) Apply seal packing to the timing chain cover an shown in the illustration.

Seal packing:

Part No. 08826–00100 or equivalent

- Install a nozzle that has been cut to a 1.5 mm opening.

HINT:

Avoid applying an excessive amount to the surface.

- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

(c) Install the 2 gaskets to the timing chain cover an shown in the illustration.

(d) Apply seal packing to 4 locations an shown in the illustration.

Seal packing:

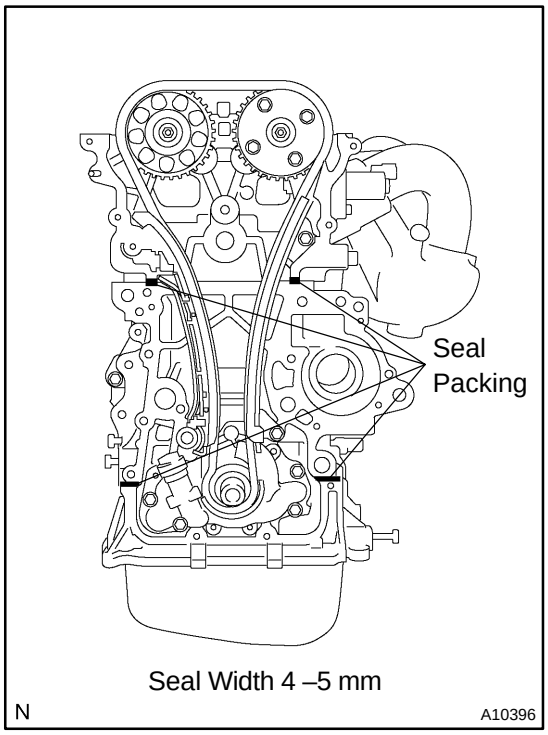
Part No. 08826–00080 or equivalent

- Install a nozzle that has been cut to a 4 – 5 mm (0.16 – 0.20 in.)opening.

HINT:

Avoid applying an excessive amount to the surface.

- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.



NOTICE:

Do not put into engine oil within 2 hours after installing.

(e) Install the timing chain cover, with the 12 bolts and nut.

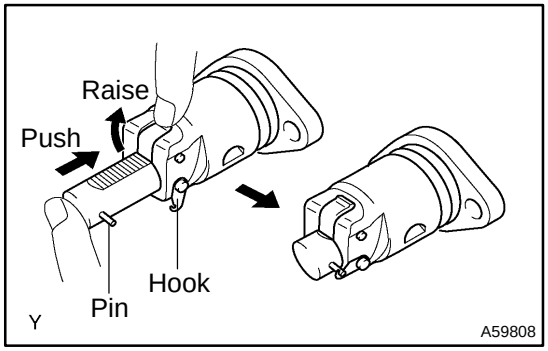
Torque:

21 N·m (214 kgf·cm, 15 ft·lbf) (M8)

11 N·m (112 kgf·cm, 8 ft·lbf) (M6)

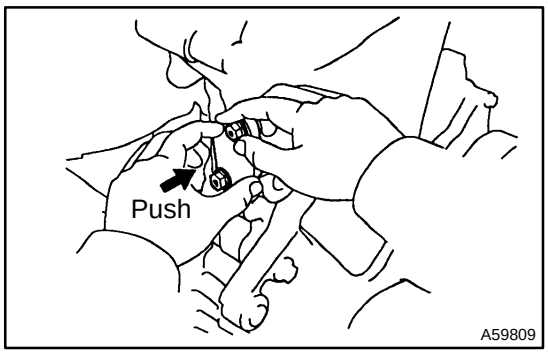
(f) Install the stud bolt.

Torque: 9.5 N·m (97 kgf·cm, 84 in.·lbf)



64. INSTALL CHAIN TENSIONER ASSY NO.1

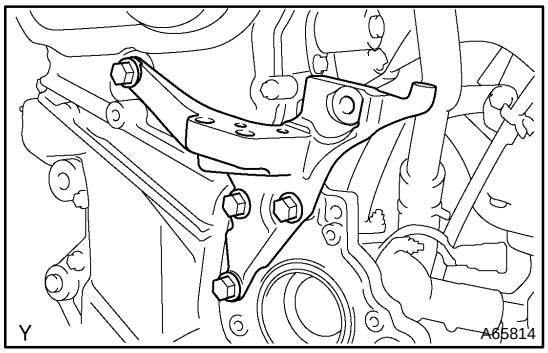
(a) Check the O–ring is clean, and set the hook as shown in the illustration.



(b) Apply engine oil to the chain tensioner and install it.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

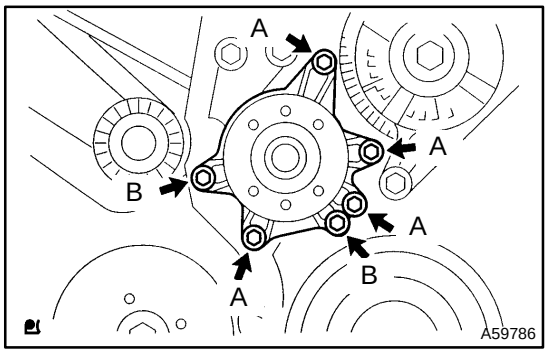
NOTICE:
When installing the tensioner, set the hook again if the hook release the plunger.

65. INSTALL CRANK POSITION SENSOR
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



66. INSTALL TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

(a) Install the engine mounting bracket with the 4 bolts.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

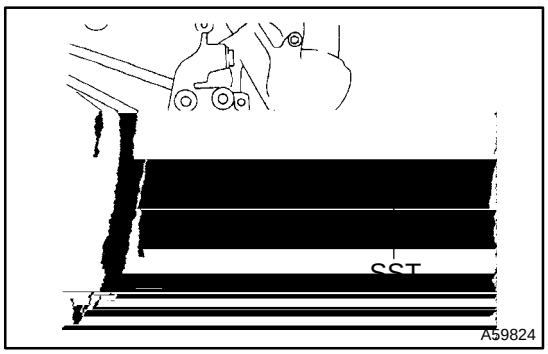


67. INSTALL WATER PUMP ASSY

(a) Place a new O–ring on the timing chain cover.
(b) Install the water pump with the 6 bolts.
Torque:9.0 N·m (92 kgf·cm, 80 in.·lbf)

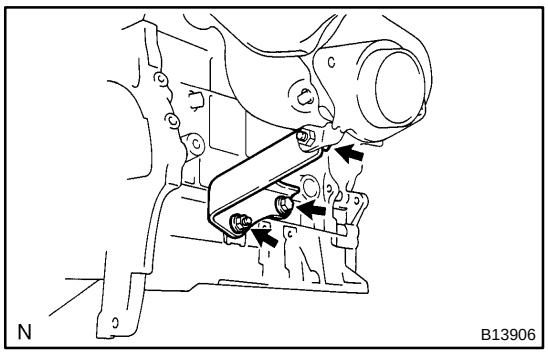
HINT:
Each bolt length is indicated in the illustration.

Bolt A	35 mm (1.38 in.)
Bolt B	28 mm (1.10 in.)



68. INSTALL WATER PUMP PULLEY

(a) Using SST, install the water pump pulley.
Torque: 15 N·m (153 kgf·cm, 11 ft·lbf)
SST 09960–10010



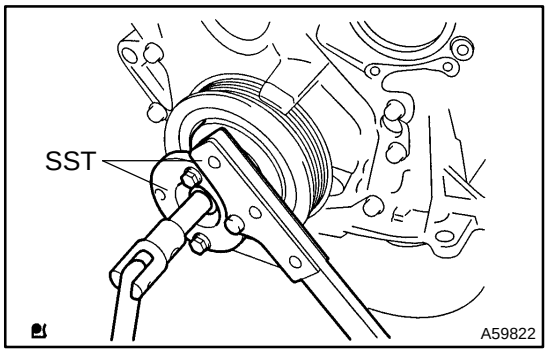
69. INSTALL MANIFOLD STAY

(a) Install the exhaust manifold stay with the 2 bolts and nut
Torque: 50 N·m (510 kgf·cm, 37 ft·lbf)

70. INSTALL EXHAUST MANIFOLD HEAT INSULATOR NO.1
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)

71. INSTALL V–RIBBED BELT TENSIONER ASSY

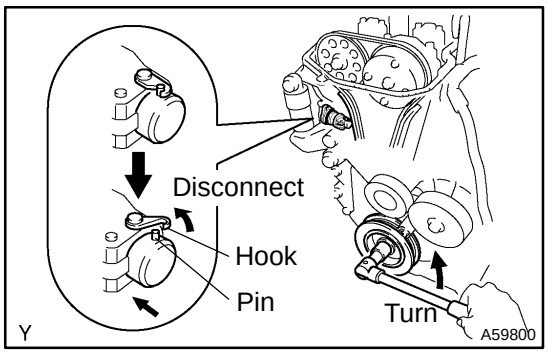
(a) Install the bolt, the nut and v–ribbed belt tensioner assy.
Torque:
Nut 29 N·m (296 kgf·cm, 21 ft·lbf)
Bolt 100 N·m (1,020 kgf·cm, 74 ft·lbf)



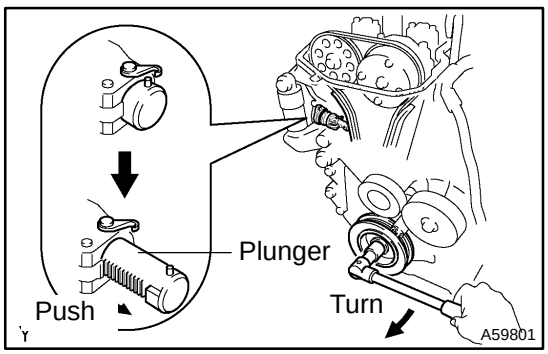
72. INSTALL CRANKSHAFT PULLEY

(a) Align the pulley set key with the key groove of the pulley, and slide on the pulley.

(b) Using SST, install the pulley bolt.
SST 09213–70011 (09213–70020), 09330–00021
Torque: 118 N·m (1,203 kgf·cm, 87 ft·lbf)



(c) Turn the crankshaft counterclockwise, and disconnect the plunger knock pin form the hook.



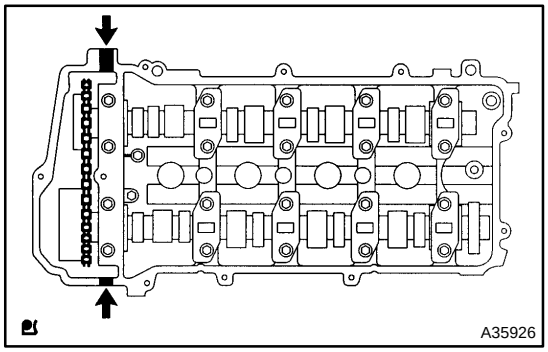
(d) Turn the crankshaft clockwise, and check that the slipper is pushed by the plunger.

73. INSTALL CYLINDER HEAD COVER SUB–ASSY

(a) Remove any old packing (FIPG) material.

HINT:

When FIPG on the head cover gasket side cannot be eliminated completely, replace the gasket.



(b) Apply seal packing to 2 locations as shown in the illustration.

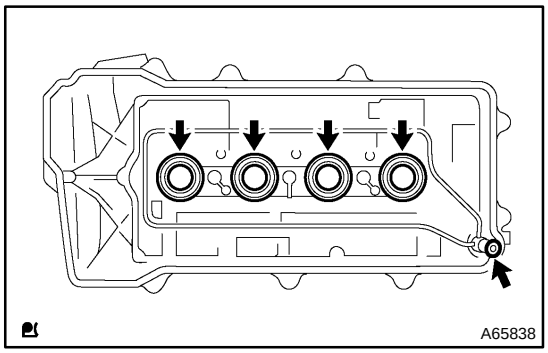
Seal packing:

Part No. 08826–00080 or equivalent

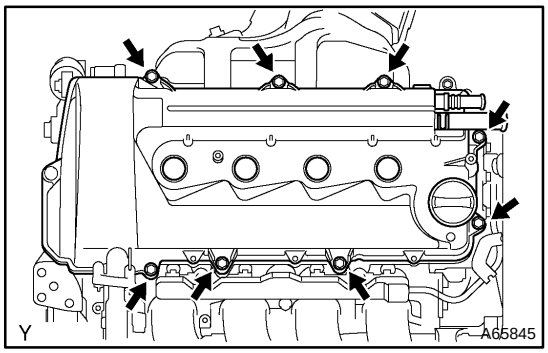
(c) Install the cylinder head cover gasket to the cylinder head cover.

HINT:

Part must be assembled within 3 minutes of application. Otherwise the material must be remove and reapplied.



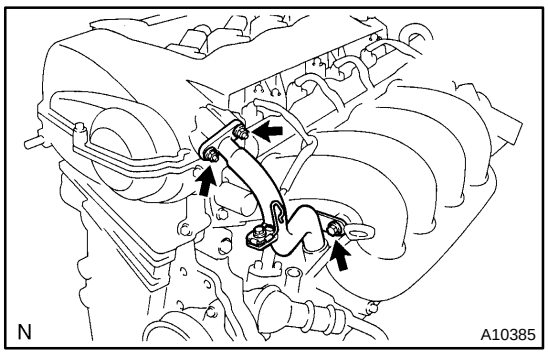
(d) Install the spark plug tube gasket and a new O–ring to the cylinder head cover.



(e) Install the cylinder head cover and wire harness protector with the 8 bolts. Uniformly tighten the bolts, in the several passes, in the sequence shown.

Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

(f) Connect the 2 PCV hoses to the cylinder head cover.



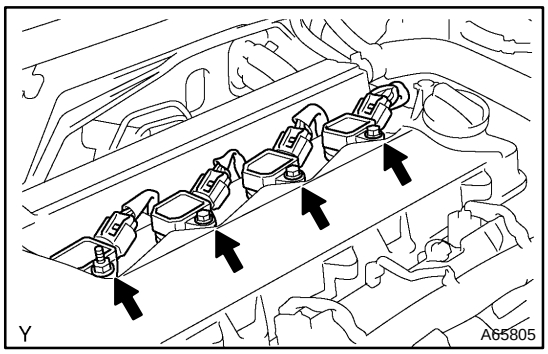
(g) Install a new gasket and No. 1 ventilation pipe with 2 nuts and bolt.

Torque:

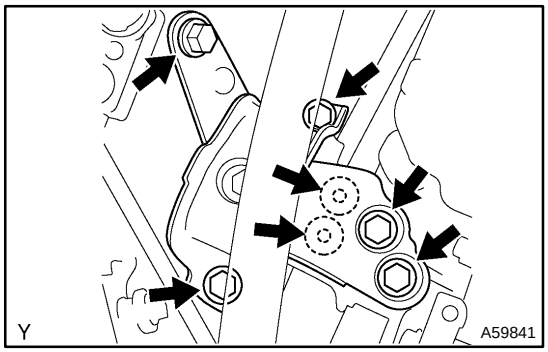
Nut 10 N·m (102 kgf·cm, 7 ft·lbf)

Bolt 24 N·m (245 kgf·cm, 18 ft·lbf)

(h) Connect the No. 3 ventilation hose to the No. 1 ventilation pipe.



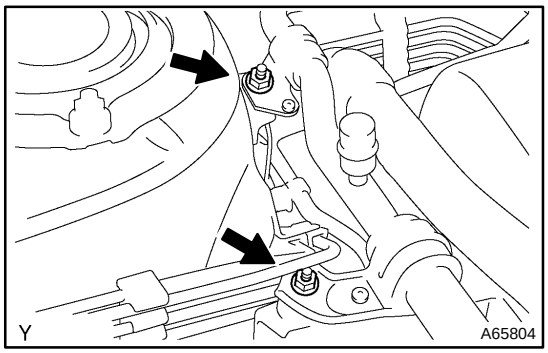
74. INSTALL IGNITION COIL ASSY
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



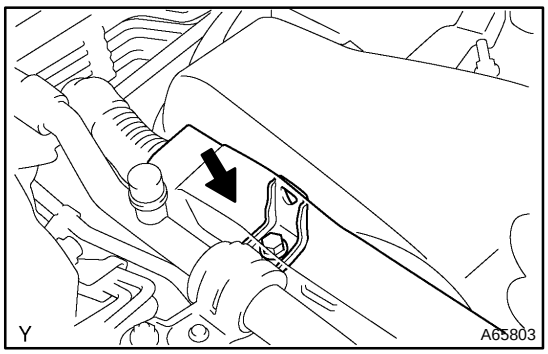
75. INSTALL ENGINE MOUNTING INSULATOR SUB–ASSY RH

(a) Install the engine mounting insulator sub–assy RH with the 5 bolts and the 2 nuts.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

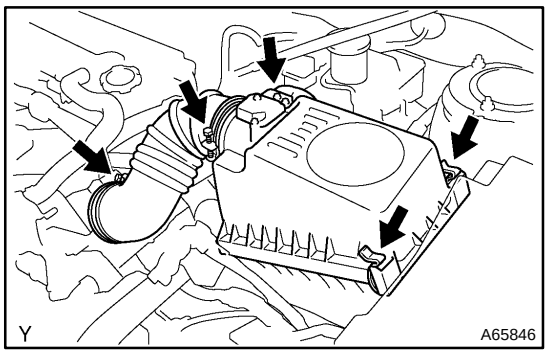
76. INSTALL EXHAUST PIPE ASSY FRONT (See page 15–9)
77. INSTALL COMPRESSOR AND MAGNETIC CLUTCH (W/ AIR CONDITIONER) (See page 55–34)
78. INSTALL GENERATOR ASSY (See page 19–15)
79. INSTALL GENERATOR BRACKET NO.1 (See page 19–15)



80. INSTALL SUCTION HOSE SUB–ASSY
Torque: 9.8 N·m (100 kgf·cm, 87 in.·lbf)



81. INSTALL WIRE HARNESS CLAMP
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)



82. INSTALL AIR CLEANER ASSEMBLY WITH HOSE

(a) Connect the air cleaner hose to the throttle body.
(b) Attach the air cleaner cap to the air cleaner case, and install the 2 clamps.
(c) Tighten the air cleaner hose clamp.
(d) Connect the 5 vacuum hoses for the air cleaner cap.
(e) Connect the MAF meter connector.

83. INSTALL CYLINDER HEAD COVER NO.2
Torque: 7.0 N·m (71 kgf·cm, 62 in.·lbf)

84. INSTALL FRONT WHEEL RH
Torque: 103 N·m (1,050 kgf·cm, 76 ft·lbf)

85. ADD COOLANT (See page 16–6)

86. CHECK ENGINE COOLANT LEAK

87. CHECK ENGINE OIL LEAK

88. CHECK IDLE SPEED AND IGNITION TIMING (See page 14–174)
SST 09843–18040

89. INSPECT COMPRESSION (See page 14–174)
SST 09992–00500

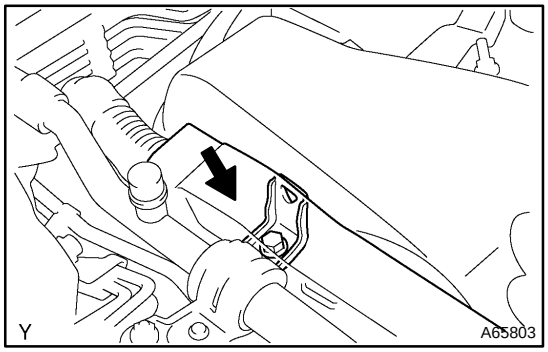
90. INSPECT CO/HC (See page 14–174)

TIMING GEAR COVER OIL SEAL (2ZZ–GE)

140RG–01

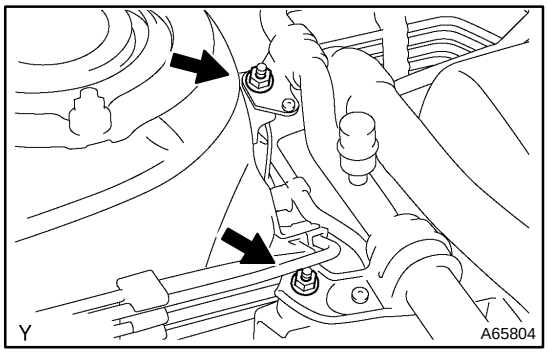
REPLACEMENT

1. REMOVE ENGINE UNDER COVER RH



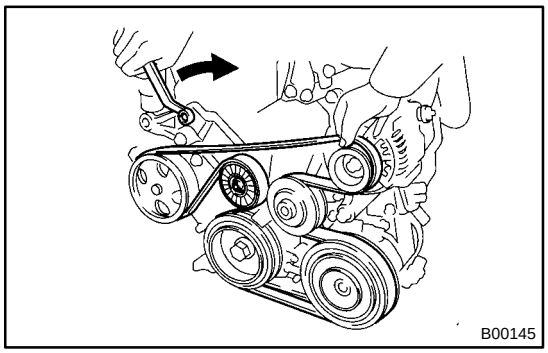
2. REMOVE WIRE HARNESS CLAMP

(a) Disconnect the engine wire harness.
(b) Remove the bolt and wiring harness clamp bracket.



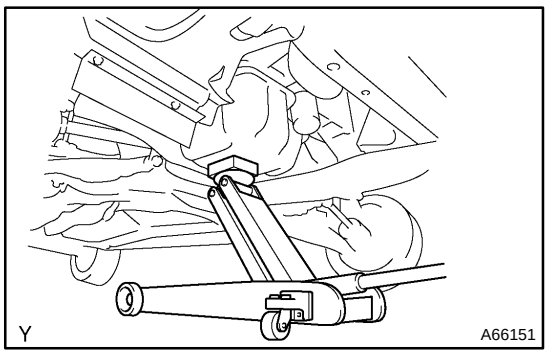
3. DISCONNECT SUCTION HOSE SUB–ASSY

(a) Remove the 2 nuts installing the suction hose sub–assy.
(b) Disconnect the suction hose sub–assy.



4. REMOVE FAN AND GENERATOR V BELT

(a) Turn the drive belt tensioner slowly clockwise and loosen it. Then, remove the drive belt and put back the drive belt tensioner little by little and fix it quietly.

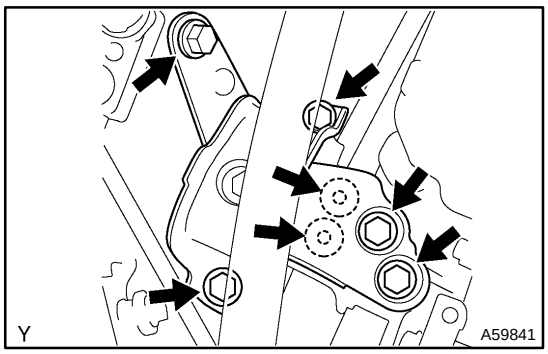


5. REMOVE ENGINE MOUNTING INSULATOR SUB–ASSY RH

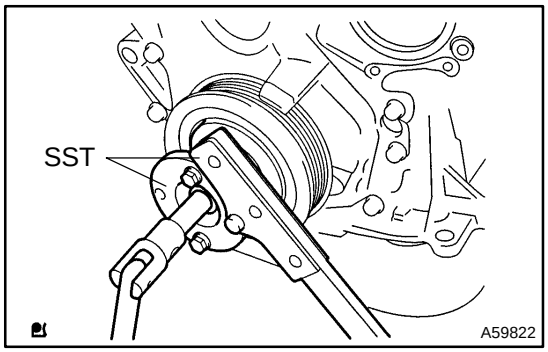
(a) Set the jack to the engine.

HINT:

Place a wooden block between the jack and engine.

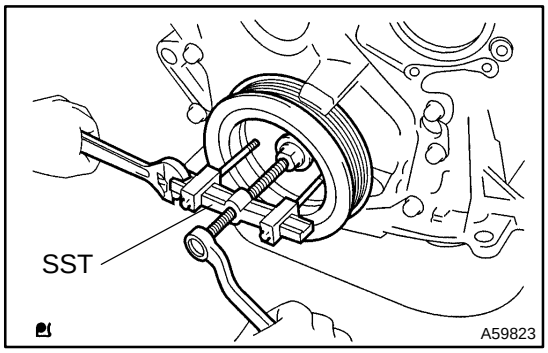


(b) Remove the 5 bolts, 2 nuts and engine mounting insulator sub–assy RH.

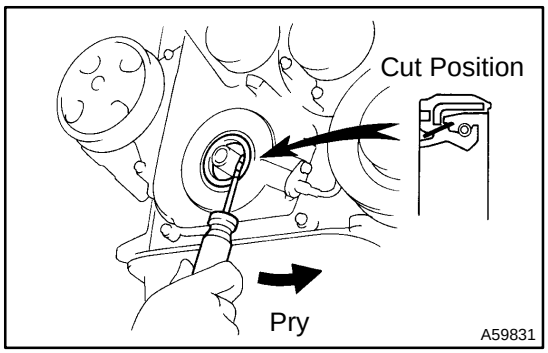


6. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the pulley bolt.
SST 09213–70011 (09213–70020), 09330–00021



(b) Using SST, remove the crankshaft pulley.
SST 09950–50013 (09951–05010, 09952–05010, 09954–05021, 09953–05020, 09957–04010)

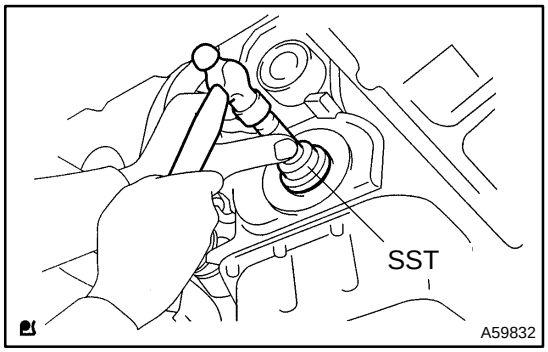


7. REMOVE TIMING GEAR COVER OIL SEAL

(a) Using a knife, cut off the oil seal lip.
(b) Using a screwdriver with taping its tip, pry out the oil seal.

NOTICE:

After the removal, check if the crankshaft is not damaged. If there is, mend it with a sandpaper (#400).



8. INSTALL TIMING GEAR COVER OIL SEAL

(a) Apply MP grease to a new oil seal lip.

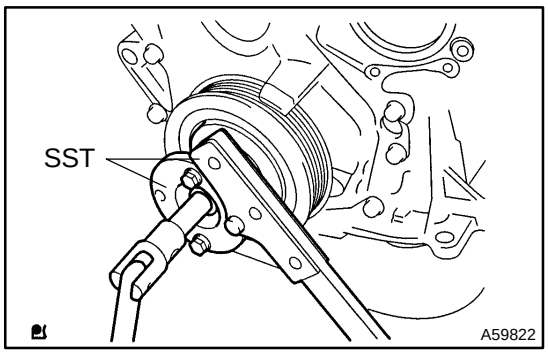
NOTICE:

Keep the lip off foreign materials.

(b) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
SST 09223–22010

NOTICE:

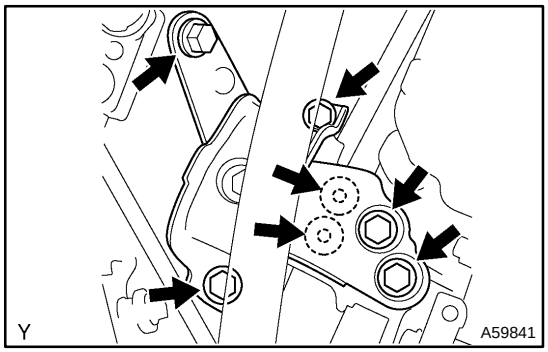
Wipe off extra grease on the crank shaft.



9. INSTALL CRANKSHAFT PULLEY

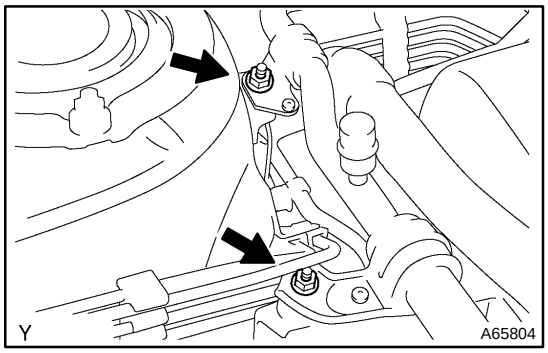
(a) Align the pulley set key with the key groove of the pulley, and slide on the pulley.

(b) Using SST, install the pulley bolt.
Torque: 118 N·m (1,203 kgf·cm, 87 ft·lbf)
SST 09213–70011 (09213–70020), 09330–00021

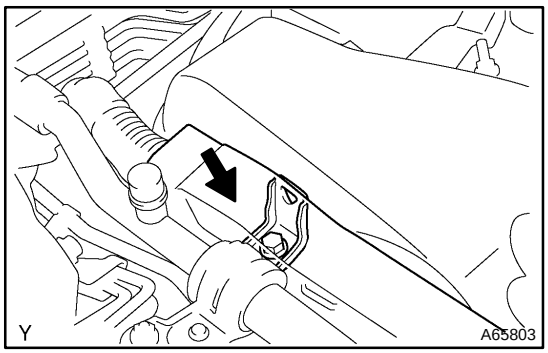


10. INSTALL ENGINE MOUNTING INSULATOR SUB–ASSY RH

(a) Install the engine mounting insulator sub–assy RH with the 5 bolts and the 2 nuts.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)



11. INSTALL SUCTION HOSE SUB–ASSY
Torque: 9.8 N·m (100 kgf·cm, 87 in.·lbf)



12. INSTALL WIRE HARNESS CLAMP
Torque: 10 N·m (102 kgf·cm, 7 ft·lbf)

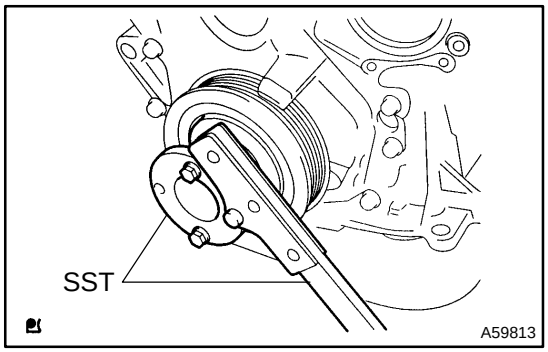
13. CHECK ENGINE OIL LEAK

ENGINE REAR OIL SEAL (2ZZ–GE)

140RH–01

REPLACEMENT

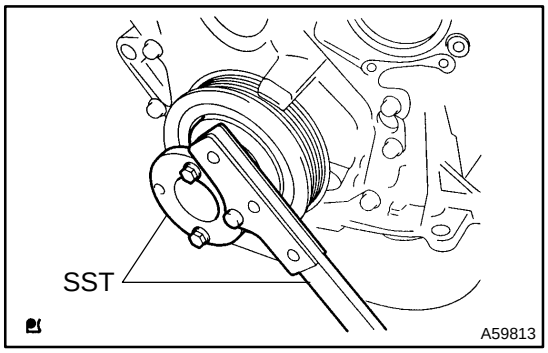
1. SEPARATE MANUAL TRANSAXLE ASSY (M/T TRANSAXLE) (See page 41–17)
2. SEPARATE AUTOMATIC TRANSAXLE ASSY (A/T TRANSAXLE) (See page 40–25)
3. REMOVE CLUTCH COVER ASSY (M/T TRANSAXLE) (See page 42–18)
4. REMOVE CLUTCH DISC ASSY (M/T TRANSAXLE) (See page 42–18)



5. REMOVE FLYWHEEL SUB–ASSY (M/T TRANSAXLE)

(a) Fix the crankshaft with SST, them remove the 8 bolts and flywheel.

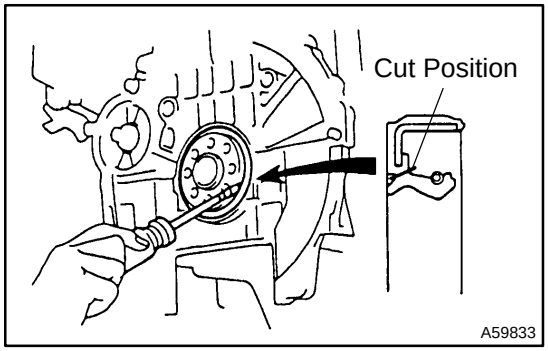
SST 09213–70011 (09213–70020), 09330–00021



6. REMOVE DRIVE PLATE & RING GEAR SUB–ASSY (A/T TRANSAXLE)

(a) Fix the crankshaft with SST, them remove the 8 bolts and drive plate & ring gear.

SST 09213–70011 (09213–70020), 09330–00021



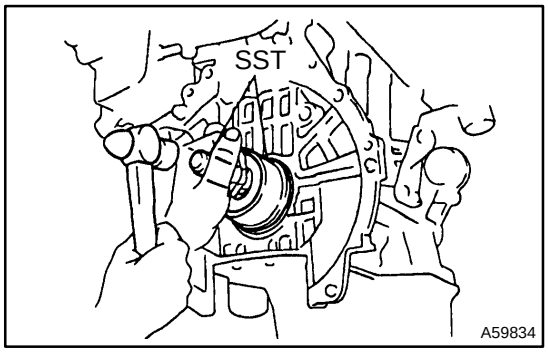
7. REMOVE ENGINE REAR OIL SEAL

(a) Using a knife, cut off the oil seal lip.

(b) Using a screwdriver with taping its tip, pry out the oil seal.

NOTICE:

After the removal, check if the crankshaft is not damaged. If there is, mend it with a sandpaper (#400).



8. INSTALL ENGINE REAR OIL SEAL

(a) Apply MP grease to a new oil seal lip.

NOTICE:

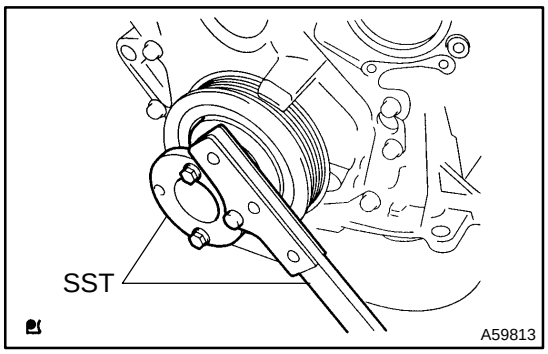
Keep the lip off foreign materials.

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

SST 09223–15030, 09950–70010 (09951–07100)

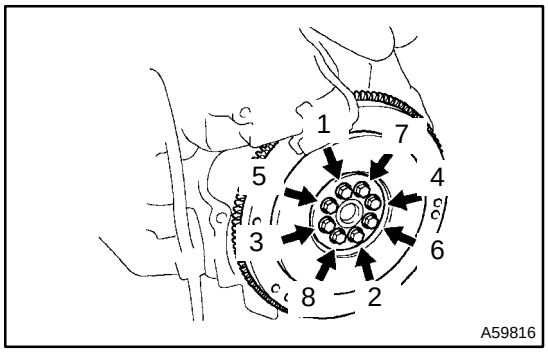
NOTICE:

Wipe off extra grease on the crank shaft.

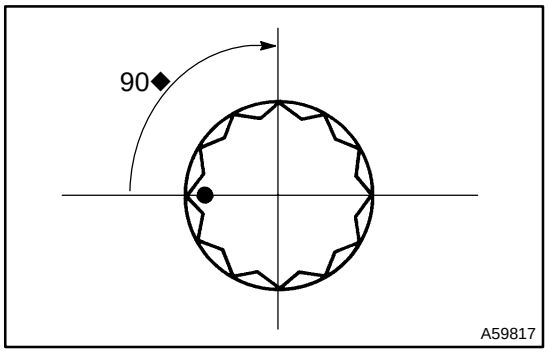


9. INSTALL FLYWHEEL SUB–ASSY (M/T TRANSAXLE)

(a) Fix the crankshaft with SST.
SST 09213–70011 (09213–70020), 09330–00021



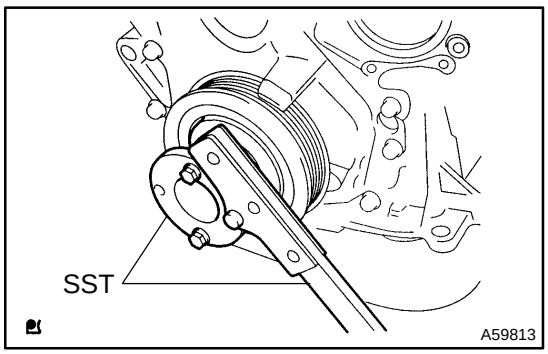
(b) Clean the bolt and the bolt hole.
(c) Apply Adhesive to the bolts.
Adhesive:
Part No. 09330–00070, THREE BOND or equivalent.
(d) Install and uniformly tighten the 8 bolts, in several passes, in the sequence shown.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)



(e) Mark the bolt with paint.
(f) Retighten the bolts by an additional 90◆.
(g) Check that the point marked bolts are moved at 90◆ angle.

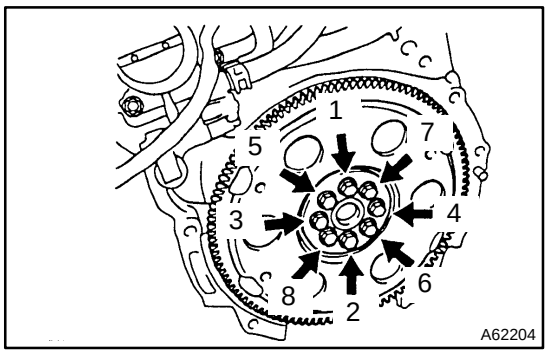
10. INSTALL CLUTCH DISC ASSY (M/T TRANSAXLE) (See page 42–18)
SST 09301–00210

11. INSTALL CLUTCH COVER ASSY (M/T TRANSAXLE) (See page 42–18)
SST 09301–00210



12. INSTALL DRIVE PLATE & RING GEAR SUB–ASSY (A/T TRANSAXLE)

(a) Fix the crankshaft with SST.
SST 09213–70011 (09213–70020), 09330–00021



(b) Clean the bolt and bolt hole.

(c) Apply adhesive to the bolts.
Adhesive:
Part No. 09330–00070, THREE BOND or equivalent.

(d) Install and uniformly tighten the 8 bolts, in several passes, in the sequence shown.

(e) Fix the crankshaft with SST.
Torque: 88 N·m (897 kgf·cm, 65 ft·lbf)

13. INSTALL MANUAL TRANSAXLE ASSY (M/T TRANSAXLE) (See page 41–17)

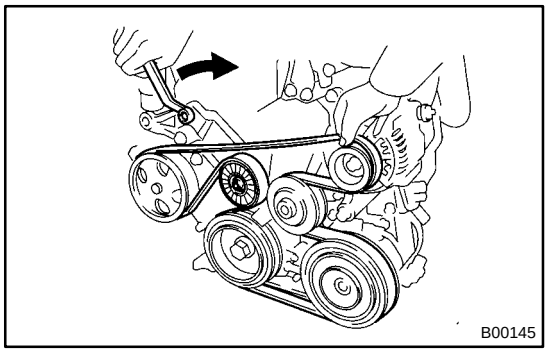
14. INSTALL AUTOMATIC TRANSAXLE ASSY (A/T TRANSAXLE) (See page 40–25)

WATER PUMP ASSY (2ZZ–GE)

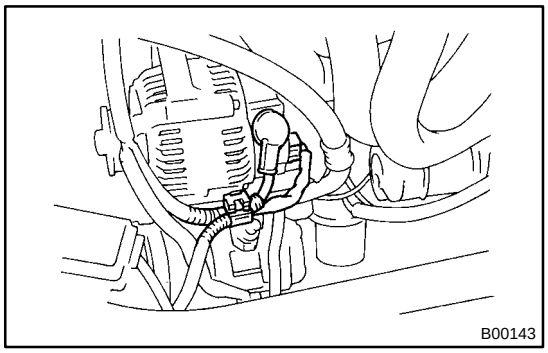
160CZ–01

REPLACEMENT

1. REMOVE ENGINE UNDER COVER RH
2. DRAIN COOLANT (See page 16–6)



3. REMOVE FAN AND GENERATOR V BELT (See page 14–177)

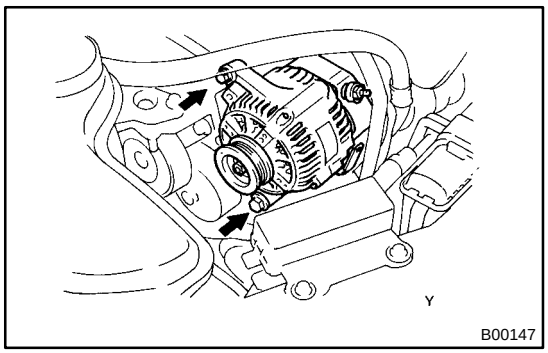


4. REMOVE GENERATOR ASSY

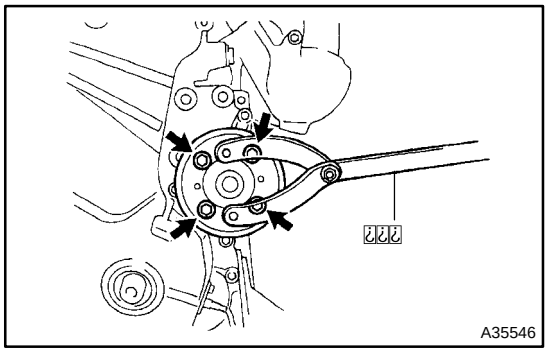
(a) Disconnect the wire clamp from the wire clip on the rectifire end frame.

(b) Remove the rubber cap and nut, and disconnect the alternator wire.

(c) Disconnect the alternator connector.

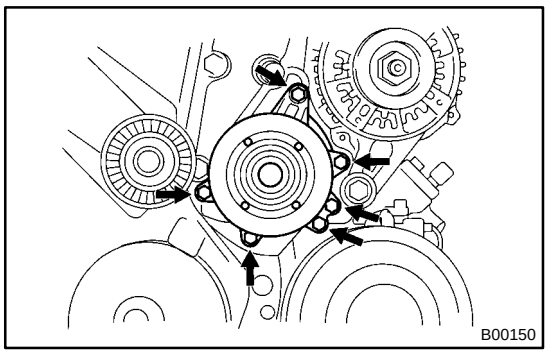


(d) Remove the 2 bolts and alternator.

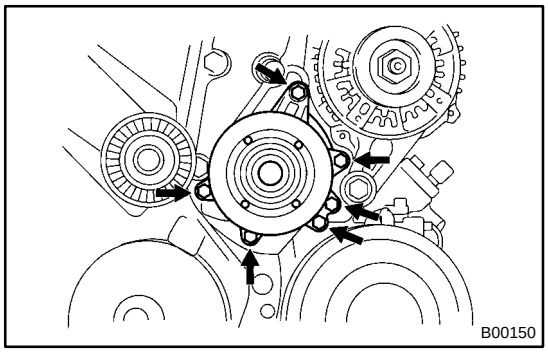


5. REMOVE WATER PUMP ASSY

(a) Using SST, remove 4 bolts and the water pump pulley.
SST 09960–10010 (09962–01000, 09963–00600)



(b) Remove the 6 bolts, water pump and O–ring.

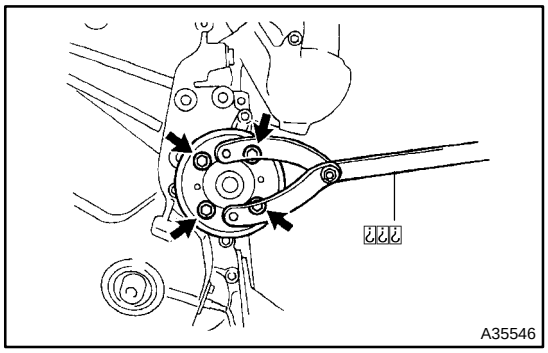


6. INSTALL WATER PUMP ASSY

(a) Place a new O–ring on the timing chain cover.

(b) Install the water pump with the 6 bolts.

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



(c) Using SST, install the water pump pulley.

SST 09960–10010 (09962–01000, 09963–00600)

Torque: 15 N·m (153 kgf·cm, 11 ft·lbf)

7. INSTALL GENERATOR ASSY

Torque:

12 mm head 25 N·m (250 kgf·cm, 18 ft·lbf)

14 mm head 54 N·m (550 kgf·cm, 39 ft·lbf)

8. ADD COOLANT (See page 16–6)

9. CHECK ENGINE COOLANT LEAK (See page 16–6)