CO/HC

EM05J–22

INSPECTION

HINT:

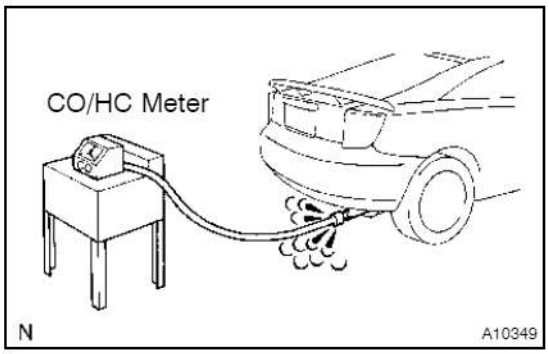
This check is used only to determine whether or not the idle CO/HC complies with regulations.

1. INSTALL CONDITIONS

(a) Engine at normal operating temperature
(b) Air cleaner installed
(c) Air pipes and hoses of air induction system connected
(d) All accessories switched OFF
(e) All vacuum lines properly connected
(f) SFI system wiring connectors fully plugged
(g) Ignition timing check correctly
(h) Transmission in neutral position
(i) Tachometer and CO/HC meter calibrated by hand

2. START ENGINE

3. RACE ENGINE AT 2,500 RPM FOR APPROX. 180 SECONDS



4. INSERT CO/HC METER TESTING PROBE AT LEAST 40 cm (1.3 ft) INTO TAILPIPE DURING IDLING

5. IMMEDIATELY CHECK CO/HC CONCENTRATION AT IDLE AND/OR 2,500 RPM

Complete the measuring with 3 minutes.

HINT:

When doing the 2 mode (idle and 2,500 rpm) test, these measurement order prescribed by the applicable local regulations.

If the CO/HC concentration does not comply with regulations, troubleshoot in the order given below.

- Check heated oxygen sensor operation (See page DI–112 or DI–411).
- See the table below for possible causes, and then inspect and correct the applicable causes if necessary.

CO	HC	Problems	Causes
Normal	High	Rough idle	4. Faulty ignitions: • Incorrect timing • Fouled, shorted or improperly gapped plugs • Open or crossed high–tension cords 5. Incorrect valve clearance 6. Leaky intake and exhaust valves 7. Leaky cylinders
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: • PCV hoses • Intake manifold • Throttle body • IAC valve • Brake booster line 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. Faulty SFI systems: • Faulty pressure regulator • Defective ECT sensor • Defective IAT sensor • Faulty ECM • Faulty injectors • Faulty throttle position sensor

COMPRESSION

INSPECTION

EM05K–18

HINT:

If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

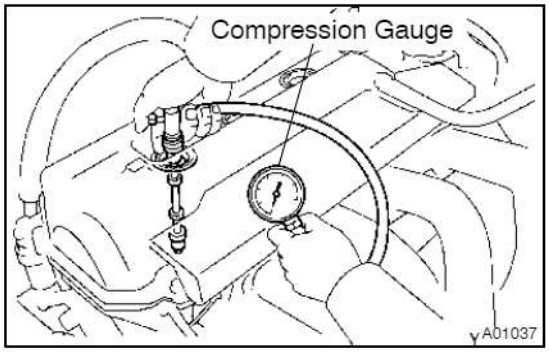
1. WARM UP AND STOP ENGINE

Allow the engine to warm up to normal operating temperature.

2. REMOVE IGNITION COIL (See page IG–6)

3. REMOVE SPARK PLUGS

4. INSPECT CYLINDER COMPRESSION PRESSURE



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

(b) Fully open the throttle.

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

HINT:

Always use a fully charged battery to obtain engine speed of 250 rpm or more.

(d) Repeat steps (a) through (c) for each cylinder.

NOTICE:

This measurement must be done in as short a time as possible.

Compression pressure:
1ZZ–FE 1,500 kPa (15.3 kgf/cm^2, 218 psi)
2ZZ–GE 1,400 kPa (14.3 kgf/cm^2, 203 psi) or more
Minimum pressure:
1ZZ–FE 1,000 kPa (10.2 kgf/cm^2, 145 psi)
2ZZ–GE 1,000 kPa (10.2 kgf/cm^2, 145 psi)
Difference between each cylinder:
1ZZ–FE 100 kPa (1.0 kgf/cm^2, 15 psi) or less
2ZZ–GE 110 kPa (1.1 kgf/cm^2, 16 psi) or less

(e) 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 (a) through (c) 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.

5. REINSTALL SPARK PLUGS

6. INSTALL IGNITION COIL (See page IG–7)

VALVE CLEARANCE

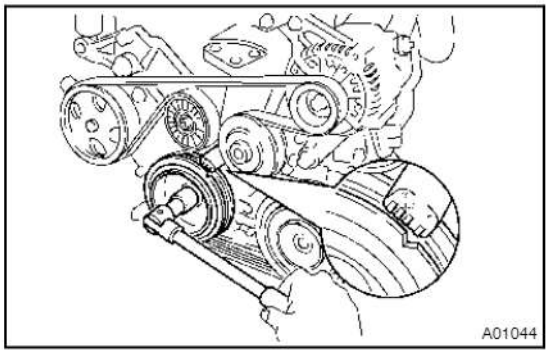
ADJUSTMENT

EM15Q–06

HINT:

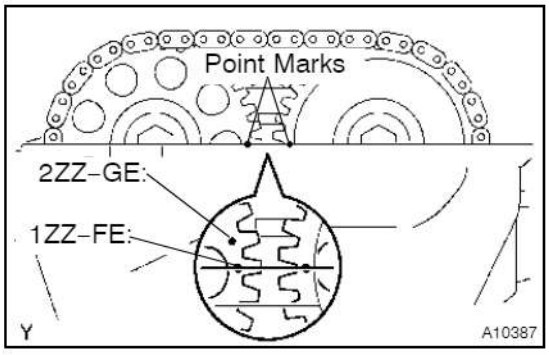
Inspect and adjust the valve clearance when the engine is cold.

1. REMOVE CYLINDER HEAD COVER (See page EM–19)



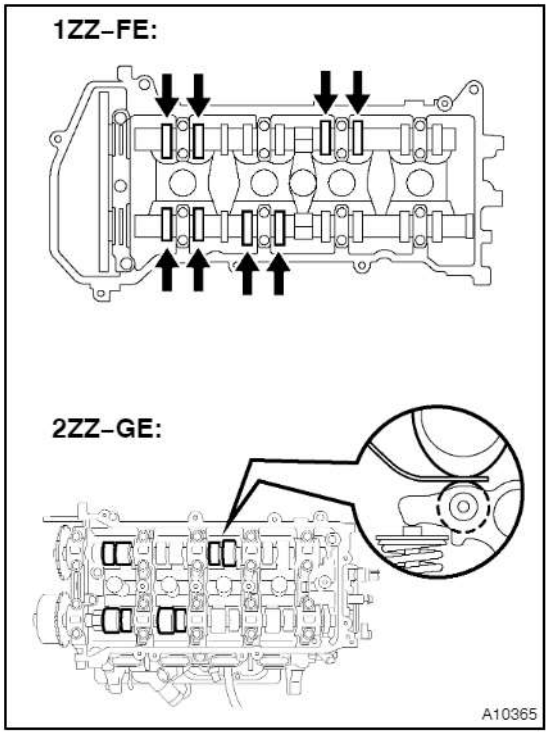
2. SET NO. 1 CYLINDER TO TDC/COMPRESSION

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



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

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



3. INSPECT VALVE CLEARANCE

(a) Check only the valves indicated.

- Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
- Record the out–of–specification valve clearance measurements. They will be used later to determine the required replacement of adjusting shim.

Valve clearance (Cold):

1ZZ–FE:

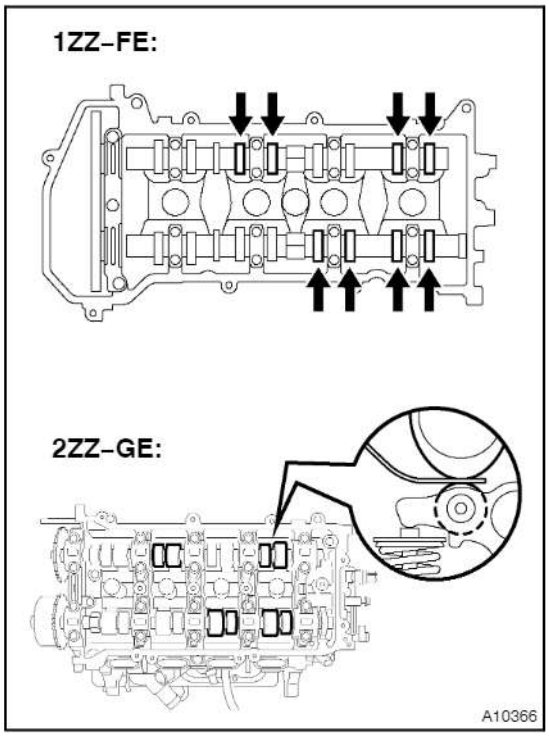
Intake 0.15 – 0.25 mm (0.006 – 0.010 in.)

Exhaust 0.25 – 0.35 mm (0.010 – 0.014 in.)

2ZZ–GE:

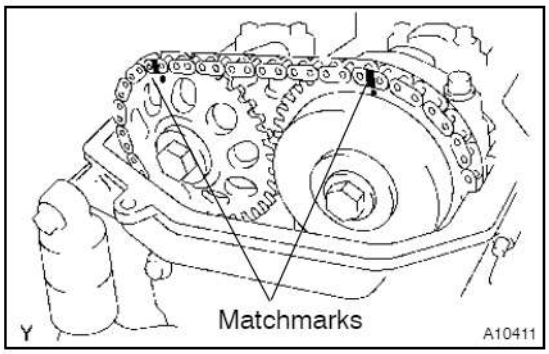
Intake 0.08 – 0.18 mm (0.0031 – 0.0071 in.)

Exhaust 0.22 – 0.32 mm (0.0087 – 0.0126 in.)



(b) Turn the crankshaft 1 revolution (360°) and align the mark as above (See procedure in step 2).

(c) Check only the valves indicated as shown. Measure the valve clearance (See procedure in step (a)).



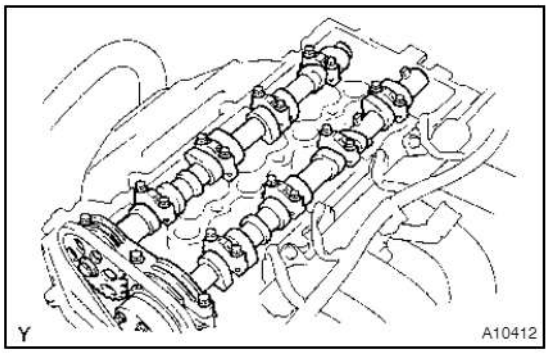
4. 1ZZ–FE:

ADJUST VALVE CLEARANCE

(a) Set the No. 1 cylinder to the TDC/compression (See procedure in step 2).

(b) Place matchmarks on the timing chain and camshaft timing sprockets.

(c) Remove the 2 bolts and chain tensioner.



(d) Remove the camshaft and timing sprocket assemblies (See page EM–44).

(1) 19 camshaft bearing cap bolts

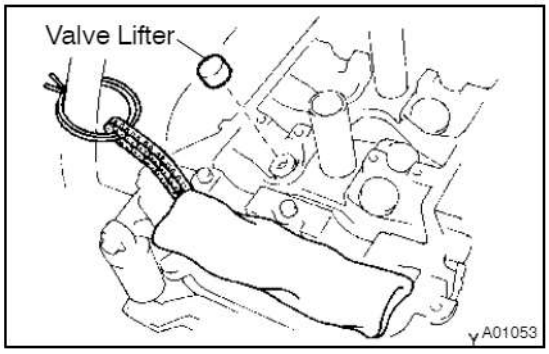
(2) 9 camshaft bearing caps (No. 1 & No. 3)

(3) Exhaust camshaft and timing sprocket assembly

(4) Intake camshaft and timing sprocket assembly

HINT:

When holding the timing chain, disconnect the timing chain from the camshaft timing sprocket.

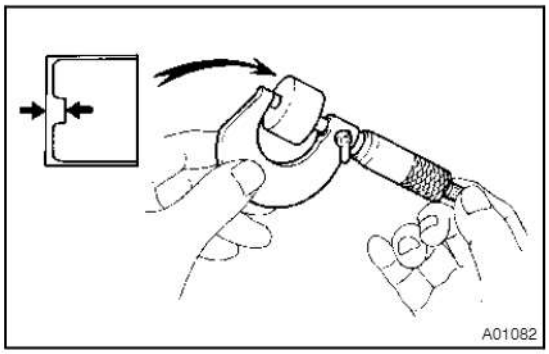


(e) Tie the timing chain with a string as shown in the illustration.

NOTICE:

- **Be careful not to drop anything inside the timing chain cover.**
- **Do not allow the chain to come into contact with water or dust.**

(f) Remove the valve lifters.



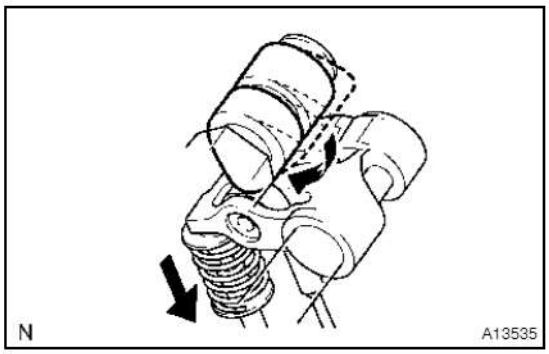
(g) Determine the size of the replaced valve lifter according to these Formula or Charts:

- Using a micrometer, measure the thickness of the removed lifter.
- Calculate the thickness of a new lifter so the valve clearance comes within the specified value.

T..... Thickness of used lifter
A..... Measured valve clearance
N..... Thickness of new lifter
Intake: N = T + (A – 0.20 mm (0.008 in.))
Exhaust: N = T + (A – 0.30 mm (0.012 in.))

- Select a new lifter with a thickness as close as possible to the calculated values.

HINT:
Lifter are available in 35 sizes in increments of 0.020 mm (0.0008 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).

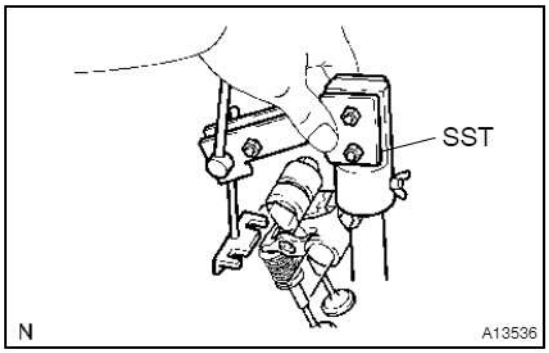


5. 2ZZ–GE:
ADJUST VALVE CLEARANCE

(a) Set the SST.

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

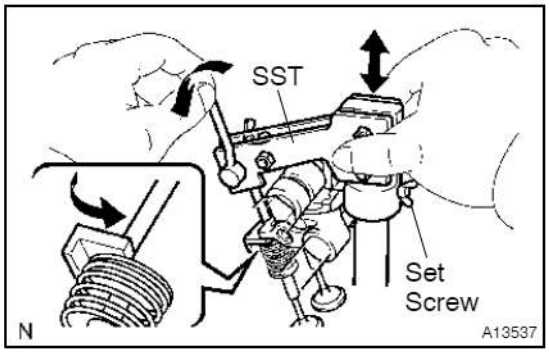
NOTICE:
Remove the spark plug and take off the compression.



(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).**

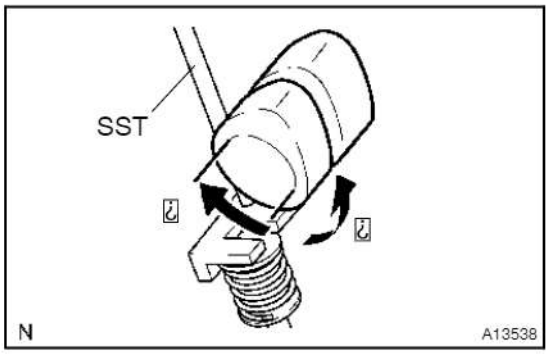


(3) Operate the lever so that SST's seat surface comes to contact with the valve retainer and lock them with the set screw.

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.**

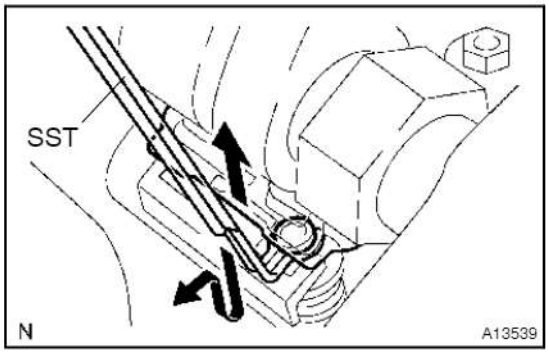
(4) Lock the set screw on the plug tube side of SST.



(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.

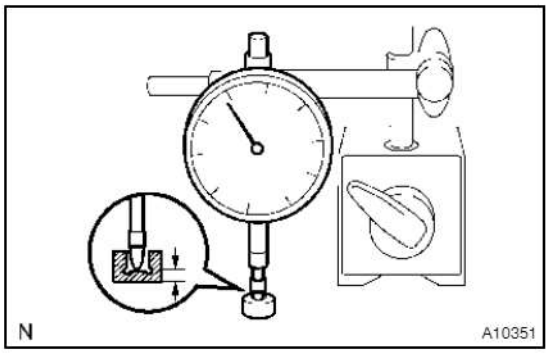
SST 09248–77010 (09248–07020)

NOTICE:

Do not remove SST in the condition that the 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 these Formula or Charts:

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

T..... Thickness of used shim

A..... Measured valve clearance

N..... Thickness of new shim

Intake: N = T+ (A – 0.13 mm (0.0051 in.)) x 1.5

Exhaust: N = T+ (A – 0.27 mm (0.0106 in.)) x 1.5

- Select a new shim with a thickness as close as possible to the calculated values.

HINT:

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

1ZZ–FE: Valve Lifter Selection Chart (Intake)

Measured clearance mm (in.) \ Installed lifter thickness mm (in.)	5.060 (0.1992)	5.080 (0.2000)	5.100 (0.2008)	5.120 (0.2016)	5.140 (0.2024)	5.160 (0.2031)	5.180 (0.2039)	5.200 (0.2047)	5.210 (0.2051)	5.220 (0.2055)	5.230 (0.2059)	5.240 (0.2063)	5.250 (0.2067)	5.260 (0.2071)	5.270 (0.2075)	5.280 (0.2079)	5.290 (0.2083)	5.300 (0.2087)	5.310 (0.2091)	5.320 (0.2094)	5.330 (0.2098)	5.340 (0.2102)	5.350 (0.2106)	5.360 (0.2110)	5.370 (0.2114)	5.380 (0.2118)	5.390 (0.2122)	5.400 (0.2126)	5.410 (0.2130)	5.420 (0.2134)	5.430 (0.2138)	5.440 (0.2142)	5.450 (0.2146)	5.460 (0.2150)	5.470 (0.2154)	5.480 (0.2157)	5.490 (0.2161)	5.500 (0.2165)	5.510 (0.2169)	5.520 (0.2173)	5.530 (0.2177)	5.540 (0.2181)	5.550 (0.2185)	5.560 (0.2189)	5.570 (0.2193)	5.580 (0.2197)	5.590 (0.2201)	5.600 (0.2205)	5.620 (0.2213)	5.640 (0.2220)	5.660 (0.2228)	5.680 (0.2236)	5.700 (0.2244)	5.720 (0.2252)	5.740 (0.2260)
0.000 – 0.030 (0.0000 – 0.0012)									06	06	06	06	06	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
0.031 – 0.050 (0.0012 – 0.0020)							06	06	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	44	46	48	50	52	54	56	58
0.051 – 0.070 (0.0020 – 0.0028)						06	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	44	46	46	48	50	52	54	56	58	60
0.071 – 0.090 (0.0028 – 0.0035)					06	06	06	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	46	48	48	50	52	54	56	58	60	62
0.091 – 0.110 (0.0036 – 0.0043)				06	06	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	50	52	54	56	58	60	62	64
0.111 – 0.130 (0.0044 – 0.0051)			06	06	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	52	54	56	58	60	62	64	66
0.131 – 0.149 (0.0052 – 0.0059)		06	06	06	08	10	12	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	52	54	54	56	58	60	62	64	66	68
0.150 – 0.250 (0.0059 – 0.0098)																																																								
0.251 – 0.270 (0.0099 – 0.0106)	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	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	70	72	74	74	74
0.271 – 0.290 (0.0107 – 0.0114)	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	68	70	72	74	74	74	
0.291 – 0.310 (0.0115 – 0.0122)	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	70	72	74	74	74		
0.311 – 0.330 (0.0122 – 0.0130)	18	20	22	24	26	28	30	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	70	72	72	74	74	74			
0.331 – 0.350 (0.0130 – 0.0138)	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	74	74					
0.351 – 0.370 (0.0138 – 0.0146)	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	74	74						
0.371 – 0.390 (0.0146 – 0.0154)	24	26	28	30	32	34	36	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	74	74	74	74						
0.391 – 0.410 (0.0154 – 0.0161)	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	74	74	74	74	74							
0.411 – 0.430 (0.0162 – 0.0169)	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	74	74	74	74										
0.431 – 0.450 (0.0170 – 0.0177)	30	32	34	36	38	40	42	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	74	74	74	74												
0.451 – 0.470 (0.0178 – 0.0185)	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	74	74	74															
0.471 – 0.490 (0.0185 – 0.0193)	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	74	74	74	74																
0.491 – 0.510 (0.0193 – 0.0201)	36	38	40	42	44	46	48	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	74	74	74	74																		
0.511 – 0.530 (0.0201 – 0.0209)	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	74	74	74	74																			
0.531 – 0.550 (0.0209 – 0.0217)	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	74	74	74	74																				
0.551 – 0.570 (0.0217 – 0.0224)	42	44	46	48	50	52	54	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																					
0.571 – 0.590 (0.0225 – 0.0232)	44	46	48	50	52	54	56	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																					
0.591 – 0.610 (0.0233 – 0.0240)	46	48	50	52	54	56	58	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																					
0.611 – 0.630 (0.0241 – 0.0248)	48	50	52	54	56	58	60	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74	74	74																					
0.631 – 0.650 (0.0248 – 0.0256)	50	52	54	56	58	60	62	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74	74	74																					
0.651 – 0.670 (0.0256 – 0.0264)	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	74	74	74	74	74	74																					
0.671 – 0.690 (0.0264 – 0.0272)	54	56	58	60	62	64	66	68	70	70	72	72	74	74	74	74	74	74	74	74																					
0.691 – 0.710 (0.0272 – 0.0280)	56	58	60	62	64	66	68	70	72	72	74	74	74	74	74	74	74	74																					
0.711 – 0.730 (0.0280 – 0.0287)	58	60	62	64	66	68	70	72	74	74	74	74	74	74	74	74																					
0.731 – 0.750 (0.0288 – 0.0295)	60	62	64	66	68	70	72	74	74	74	74	74	74																								
0.751 – 0.770 (0.0296 – 0.0303)	62	64	66	68	70	72	74	74	74	74	74																								
0.771 – 0.790 (0.0304 – 0.0311)	64	66	68	70	72	74	74	74	74																										
0.791 – 0.810 (0.0311 – 0.0319)	66	68	70	72	74	74	74																												
0.811 – 0.830 (0.0319 – 0.0327)	68	70	72	74	74	74																													
0.831 – 0.850 (0.0327 – 0.0335)	70	72	74	74	74																														
0.851 – 0.870 (0.0335 – 0.0343)	72	74	74	74																															
0.871 – 0.890 (0.0343 – 0.0350)	74	74	74																																
0.891 – 0.910 (0.0351 – 0.0358)	74	74																																	
0.911 – 0.930 (0.0359 – 0.0366)	74																																		

Intake valve clearance (Cold):
0.15 – 0.25 mm (0.006 – 0.010 in.)

EXAMPLE: The 5.250 mm (0.2067 in.) lifter is installed, and the measured clearance is 0.400 mm (0.0157 in.).
Replace the 5.250 mm (0.2067 in.) lifter with a new No. 48 lifter.

New lifter thickness mm (in.)

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

A01234

1ZZ–FE: Valve Lifter Selection Chart (Exhaust)

Measured clearance mm (in.) \ Installed lifter thickness mm (in.)	5.060 (0.1992)	5.080 (0.2000)	5.100 (0.2008)	5.120 (0.2016)	5.140 (0.2024)	5.160 (0.2031)	5.180 (0.2039)	5.200 (0.2047)	5.210 (0.2051)	5.220 (0.2055)	5.230 (0.2059)	5.240 (0.2063)	5.250 (0.2067)	5.260 (0.2071)	5.270 (0.2075)	5.280 (0.2079)	5.290 (0.2083)	5.300 (0.2087)	5.310 (0.2091)	5.320 (0.2094)	5.330 (0.2098)	5.340 (0.2102)	5.350 (0.2106)	5.360 (0.2110)	5.370 (0.2114)	5.380 (0.2118)	5.390 (0.2122)	5.400 (0.2126)	5.410 (0.2130)	5.420 (0.2134)	5.430 (0.2138)	5.440 (0.2142)	5.450 (0.2146)	5.460 (0.2150)	5.470 (0.2154)	5.480 (0.2157)	5.490 (0.2161)	5.500 (0.2165)	5.510 (0.2169)	5.520 (0.2173)	5.530 (0.2177)	5.540 (0.2181)	5.550 (0.2185)	5.560 (0.2189)	5.570 (0.2193)	5.580 (0.2197)	5.590 (0.2201)	5.600 (0.2205)	5.620 (0.2213)	5.640 (0.2220)	5.660 (0.2228)	5.680 (0.2236)	5.700 (0.2244)	5.720 (0.2252)	5.740 (0.2260)
0.000 – 0.030 (0.0000 – 0.0012)																			06	06	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	36	38	40	42	44	46
0.031 – 0.050 (0.0012 – 0.0020)																06	06	06	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	38	40	42	44	46	48
0.051 – 0.070 (0.0020 – 0.0028)													06	06	06	06	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	40	42	44	46	48	50
0.071 – 0.090 (0.0028 – 0.0035)												06	06	06	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
0.091 – 0.110 (0.0036 – 0.0043)										06	06	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	44	46	48	50	52	54
0.111 – 0.130 (0.0044 – 0.0051)									06	06	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
0.131 – 0.150 (0.0052 – 0.0059)								06	06	06	06	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
0.151 – 0.170 (0.0059 – 0.0067)						06	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	44	46	46	48	50	52	54	56	58	60
0.171 – 0.190 (0.0067 – 0.0075)				06	06	06	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	46	48	48	50	52	54	56	58	60	62
0.191 – 0.210 (0.0075 – 0.0083)			06	06	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	50	52	54	56	58	60	62	64
0.211 – 0.230 (0.0083 – 0.0091)		06	06	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	52	54	56	58	60	62	64	66
0.231 – 0.249 (0.0091 – 0.0098)	06	06	06	08	10	12	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	52	54	54	56	58	60	62	64	66	68
0.250 – 0.350 (0.0098 – 0.0138)																																																									
0.351 – 0.370 (0.0138 – 0.0146)	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	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	70	72	74	74	74
0.371 – 0.390 (0.0146 – 0.0154)	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	68	70	72	74	74	74	
0.391 – 0.410 (0.0154 – 0.0161)	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	70	72	74	74	74		
0.411 – 0.430 (0.0162 – 0.0169)	18	20	22	24	26	28	30	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	70	72	72	74	74	74			
0.431 – 0.450 (0.0170 – 0.0177)	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	74	74	74	74			
0.451 – 0.470 (0.0178 – 0.0185)	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	74	74	74					
0.471 – 0.490 (0.0185 – 0.0193)	24	26	28	30	32	34	36	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	74	74	74	74	74					
0.491 – 0.510 (0.0193 – 0.0201)	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	74	74	74	74	74							
0.511 – 0.530 (0.0201 – 0.0209)	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	74	74	74	74	74									
0.531 – 0.550 (0.0209 – 0.0217)	30	32	34	36	38	40	42	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	74	74	74	74	74											
0.551 – 0.570 (0.0217 – 0.0224)	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	74	74	74	74														
0.571 – 0.590 (0.0225 – 0.0232)	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	74	74	74	74																
0.591 – 0.610 (0.0233 – 0.0240)	36	38	40	42	44	46	48	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	74	74	74	74																		
0.611 – 0.630 (0.0241 – 0.0248)	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	74	74	74	74																				
0.631 – 0.650 (0.0248 – 0.0256)	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	74	74	74	74																						
0.651 – 0.670 (0.0256 – 0.0264)	42	44	46	48	50	52	54	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																								
0.671 – 0.690 (0.0264 – 0.0272)	44	46	48	50	52	54	56	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.691 – 0.710 (0.0272 – 0.0280)	46	48	50	52	54	56	58	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.711 – 0.730 (0.0280 – 0.0287)	48	50	52	54	56	58	60	62	64	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.731 – 0.750 (0.0288 – 0.0295)	50	52	54	56	58	60	62	64	66	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.751 – 0.770 (0.0296 – 0.0303)	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	74	74	74	74																									
0.771 – 0.790 (0.0304 – 0.0311)	54	56	58	60	62	64	66	68	70	70	72	72	74	74	74	74	74	74																											
0.791 – 0.810 (0.0311 – 0.0319)	56	58	60	62	64	66	68	70	72	72	74	74	74	74	74	74																											
0.811 – 0.830 (0.0319 – 0.0327)	58	60	62	64	66	68	70	72	74	74	74	74	74	74																											
0.831 – 0.850 (0.0327 – 0.0335)	60	62	64	66	68	70	72	74	74	74	74	74																											
0.851 – 0.870 (0.0335 – 0.0343)	62	64	66	68	70	72	74	74	74	74																											
0.871 – 0.890 (0.0343 – 0.0350)	64	66	68	70	72	74	74	74																													
0.891 – 0.910 (0.0351 – 0.0358)	66	68	70	72	74	74	74																														
0.911 – 0.930 (0.0359 – 0.0366)	68	70	72	74	74	74																															
0.931 – 0.950 (0.0367 – 0.0374)	70	72	74	74	74																																
0.951 – 0.970 (0.0374 – 0.0382)	72	74	74	74																																	
0.971 – 0.990 (0.0382 – 0.0390)	74	74	74																																		
0.991 – 1.010 (0.0390 – 0.0398)	74	74																																			
1.011 – 1.030 (0.0398 – 0.0406)	74																																				

Exhaust valve clearance (Cold):

0.25 – 0.35 mm (0.010 – 0.014 in.)

EXAMPLE: The 5.340 mm (0.2102 in.) lifter is installed, and the measured clearance is 0.440 mm (0.0173 in.).

Replace the 5.340 mm (0.2102 in.) lifter with a new No. 48 lifter.

New lifter thickness mm (in.)

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

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 (0.0872)	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)
0.000 - 0.030 (0.0000 - 0.0012)										00	02	02	04	04	06	06	08	08	10	10
0.031 - 0.050 (0.0012 - 0.0020)								00	02	04	06	06	08	08	10	10	12	12	14	14
0.051 - 0.070 (0.0020 - 0.0028)							00	02	04	06	08	08	10	10	12	12	14	14	16	16
0.071 - 0.079 (0.0028 - 0.0031)					00	02	04	06	08	10	12	12	14	14	16	16	18	18	20	20
0.080 - 0.180 (0.0031 - 0.0071)																				
0.181 - 0.200 (0.0071 - 0.0079)	06	08	10	12	14	16	18	20	22	24	26	26	28	28	30	30	32	32	34	34
0.201 - 0.220 (0.0097 - 0.0087)	10	12	14	16	18	20	22	24	26	28	30	30	32	32	34	34	36	36	38	38
0.221 - 0.240 (0.0087 - 0.0094)	12	14	16	18	20	22	24	26	28	30	32	32	34	34	36	36	38	38	40	40
0.241 - 0.260 (0.0095 - 0.0102)	16	18	20	22	24	26	28	30	32	34	36	36	38	38	40	40	42	42	44	44
0.261 - 0.280 (0.0103 - 0.0110)	18	20	22	24	26	28	30	32	34	36	38	38	40	40	42	42	44	44	46	46
0.281 - 0.300 (0.0111 - 0.0118)	22	24	26	28	30	32	34	36	38	40	42	42	44	44	46	46	48	48	50	50
0.301 - 0.320 (0.0119 - 0.0126)	24	26	28	30	32	34	36	38	40	42	44	44	46	46	48	48	50	50	52	52
0.321 - 0.340 (0.0126 - 0.0134)	28	30	32	34	36	38	40	42	44	46	48	48	50	50	52	52	54	54	56	56
0.341 - 0.360 (0.0134 - 0.0142)	30	32	34	36	38	40	42	44	46	48	50	50	52	52	54	54	56	56	58	58
0.361 - 0.380 (0.0142 - 0.0150)	34	36	38	40	42	44	46	48	50	52	54	54	56	56	58	58	60	60	62	62
0.381 - 0.400 (0.0150 - 0.0157)	36	38	40	42	44	46	48	50	52	54	56	56	58	58	60	60	62	62	64	64
0.401 - 0.420 (0.0158 - 0.0165)	40	42	44	46	48	50	52	54	56	58	60	60	62	62	64	64	66	66	68	68
0.421 - 0.440 (0.0166 - 0.0173)	42	44	46	48	50	52	54	56	58	60	62	62	64	64	66	66	68	68	70	70
0.441 - 0.460 (0.0174 - 0.0181)	46	48	50	52	54	56	58	60	62	64	66	66	68	68	70	70	72	72	74	74
0.461 - 0.480 (0.0181 - 0.0189)	48	50	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	76	76
0.481 - 0.500 (0.0189 - 0.0197)	52	54	56	58	60	62	64	66	68	70	72	72	74	74	76	76	78	78	80	80
0.501 - 0.520 (0.0197 - 0.0205)	54	56	58	60	62	64	66	68	70	72	74	74	76	76	78	78	80	80		
0.521 - 0.540 (0.0205 - 0.0213)	58	60	62	64	66	68	70	72	74	76	78	78	80	80						
0.541 - 0.560 (0.0213 - 0.0220)	60	62	64	66	68	70	72	74	76	78	80	80								
0.561 - 0.580 (0.0221 - 0.0228)	64	66	68	70	72	74	76	78	80											
0.581 - 0.600 (0.0229 - 0.0236)	66	68	70	72	74	76	78	80												
0.601 - 0.620 (0.0237 - 0.0244)	70	72	74	76	78	80														
0.621 - 0.640 (0.0244 - 0.0252)	72	74	76	78	80															
0.641 - 0.660 (0.0252 - 0.0260)	76	78	80																	
0.661 - 0.680 (0.0260 - 0.0268)	78	80																		
0.681 - 0.700 (0.0268 - 0.0276)	80																			

Measure clearance mm(in.) / Installed shim thickness mm(in.)	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)
0.000 - 0.030 (0.0000 - 0.0012)	12	12	14	14	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30
0.031 - 0.050 (0.0012 - 0.0020)	16	16	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34
0.051 - 0.070 (0.0020 - 0.0028)	18	18	20	20	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36
0.071 - 0.079 (0.0028 - 0.0031)	22	22	24	24	26	26	28	28	30	30	32	32	34	34	36	36	38	38	40	40
0.080 - 0.180 (0.0031 - 0.0071)																				
0.181 - 0.200 (0.0071 - 0.0079)	36	36	38	38	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54
0.201 - 0.220 (0.0097 - 0.0087)	40	40	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58
0.221 - 0.240 (0.0087 - 0.0094)	42	42	44	44	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60
0.241 - 0.260 (0.0095 - 0.0102)	46	46	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64
0.261 - 0.280 (0.0103 - 0.0110)	48	48	50	50	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66
0.281 - 0.300 (0.0111 - 0.0118)	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70
0.301 - 0.320 (0.0119 - 0.0126)	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72
0.321 - 0.340 (0.0126 - 0.0134)	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76
0.341 - 0.360 (0.0134 - 0.0142)	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78
0.361 - 0.380 (0.0142 - 0.0150)	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)	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80				
0.401 - 0.420 (0.0158 - 0.0165)	70	70	72	72	74	74	76	76	78	78	80	80								
0.421 - 0.440 (0.0166 - 0.0173)	72	72	74	74	76	76	78	78	80	80										
0.441 - 0.460 (0.0174 - 0.0181)	76	76	78	78	80	80														
0.461 - 0.480 (0.0181 - 0.0189)	78	78	80	80																

Measure clearance mm(in.) / Installed shim thickness mm(in.)	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)	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)	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)	38	38	40	40	42	42	44	44	46	48	50	52	54	56	58	60	62	64	66	68	70
0.071 - 0.079 (0.0028 - 0.0031)	42	42	44	44	46	46	48	48	50	52	54	56	58	60	62	64	66	68	70	72	74
0.080 - 0.180 (0.0031 - 0.0071)																					
0.181 - 0.200 (0.0071 - 0.0079)	56	56	58	58	60	60	62	62	64	66	68	70	72	74	76	78	80				
0.201 - 0.220 (0.0097 - 0.0087)	60	60	62	62	64	64	66	66	68	70	72	74	76	78	80						
0.221 - 0.240 (0.0087 - 0.0094)	62	62	64	64	66	66	68	68	70	72	74	76	78	80							
0.241 - 0.260 (0.0095 - 0.0102)	66	66	68	68	70	70	72	72	74	76	78	80	82								
0.261 - 0.280 (0.0103 - 0.0110)	68	68	70	70	72	72	74	74	76	78	80										
0.281 - 0.300 (0.0111 - 0.0118)	72	72	74	74	76	76	78	78	80												
0.301 - 0.320 (0.0119 - 0.0126)	74	74	76	76	78	78	80	80													
0.321 - 0.340 (0.0126 - 0.0134)	78	78	80	80																	
0.341 - 0.360 (0.0134 - 0.0142)	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)		

Intake valve clearance (Cold):
0.10 – 0.16 mm (0.0039 – 0.0063 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)

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 (0.0872)	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
0.221 - 0.219 (0.0083 - 0.0086)					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
0.220 - 0.320 (0.0087 - 0.0126)																														
0.321 - 0.340 (0.0126 - 0.0134)	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
0.341 - 0.360 (0.0134 - 0.0142)	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
0.361 - 0.380 (0.0142 - 0.0150)	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
0.381 - 0.400 (0.0150 - 0.0157)	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
0.401 - 0.420 (0.0158 - 0.0165)	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
0.421 - 0.440 (0.0166 - 0.0173)	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
0.441 - 0.460 (0.0174 - 0.0181)	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
0.461 - 0.480 (0.0181 - 0.0189)	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
0.481 - 0.500 (0.0189 - 0.0197)	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
0.501 - 0.520 (0.0197 - 0.0205)	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
0.521 - 0.540 (0.0205 - 0.0213)	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
0.541 - 0.560 (0.0213 - 0.0220)	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
0.561 - 0.580 (0.0221 - 0.0228)	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
0.581 - 0.600 (0.0229 - 0.0236)	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				
0.601 - 0.620 (0.0237 - 0.0244)	48	50	52	54	56	58	60	62	64	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80						
0.621 - 0.640 (0.0244 - 0.0252)	52	54	56	58	60	62	64	66	68	70	72	72	74	74	76	76	78	78	80	80										
0.641 - 0.660 (0.0252 - 0.0260)	54	56	58	60	62	64	66	68	70	72	74	74	76	76	78	78	80	80												
0.661 - 0.680 (0.0260 - 0.0268)	58	60	62	64	66	68	70	72	74	76	78	78	80	80																
0.681 - 0.700 (0.0268 - 0.0276)	60	62	64	66	68	70	72	74	76	78	80	80																		
0.701 - 0.720 (0.0276 - 0.0283)	64	66	68	70	72	74	76	78	80																					
0.721 - 0.740 (0.0284 - 0.0291)	66	68	70	72	74	76	78	80																						
0.741 - 0.760 (0.0292 - 0.0299)	70	72	74	76	78	80																								
0.761 - 0.780 (0.0300 - 0.0307)	72	74	76	78	80																									
0.781 - 0.800 (0.0307 - 0.0315)	76	78	80																											
0.801 - 0.820 (0.0315 - 0.0323)	80																													
0.821 - 0.840 (0.0323 - 0.0331)	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
0.221 - 0.219 (0.0083 - 0.0086)	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
0.220 - 0.320 (0.0087 - 0.0126)																															
0.321 - 0.340 (0.0126 - 0.0134)	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			
0.341 - 0.360 (0.0134 - 0.0142)	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					
0.361 - 0.380 (0.0142 - 0.0150)	52	52	54	54	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	72	74	76	78	80							
0.381 - 0.400 (0.0150 - 0.0157)	56	56	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	76	78	80									
0.401 - 0.420 (0.0158 - 0.0165)	58	58	60	60	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	78	80										
0.421 - 0.440 (0.0166 - 0.0173)	62	62	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80												
0.441 - 0.460 (0.0174 - 0.0181)	64	64	66	66	68	68	70	70	72	72	74	74	76	76	78	78	80	80													
0.461 - 0.480 (0.0181 - 0.0189)	68	68	70	70	72	72	74	74	76	76	78	78	80	80																	
0.481 - 0.500 (0.0189 - 0.0197)	70	70	72	72	74	74	76	76	78	78	80	80																			
0.501 - 0.520 (0.0197 - 0.0205)	74	74	76	76	78	78	80	80																							
0.521 - 0.540 (0.0205 - 0.0213)	76	76	78	78	80	80																									
0.541 - 0.560 (0.0213 - 0.0220)	80	80																													
0.561 - 0.580 (0.0221 - 0.0228)																															
0.581 - 0.600 (0.0229 - 0.0236)																															
0.601 - 0.620 (0.0237 - 0.0244)																															
0.621 - 0.640 (0.0244 - 0.0252)																															
0.641 - 0.660 (0.0252 - 0.0260)																															
0.661 - 0.680 (0.0260 - 0.0268)																															
0.681 - 0.700 (0.0268 - 0.0276)																															
0.701 - 0.720 (0.0276 - 0.0283)																															
0.721 - 0.740 (0.0284 - 0.0291)																															
0.741 - 0.760 (0.0292 - 0.0299)																															
0.761 - 0.780 (0.0300 - 0.0307)																															
0.781 - 0.800 (0.0307 - 0.0315)																															
0.801 - 0.820 (0.0315 - 0.0323)																															
0.821 - 0.840 (0.0323 - 0.0331)																															

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)		

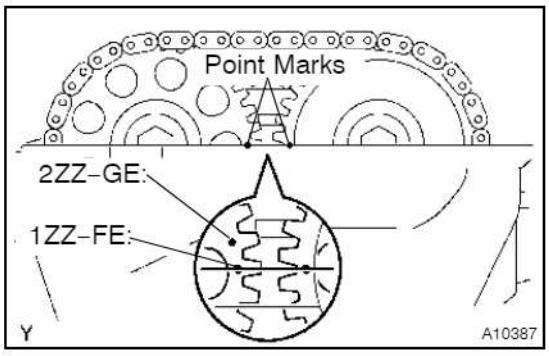
Exhaust valve clearance (Cold):
0.24 – 0.30 mm (0.0094 – 0.0118 in.)

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.

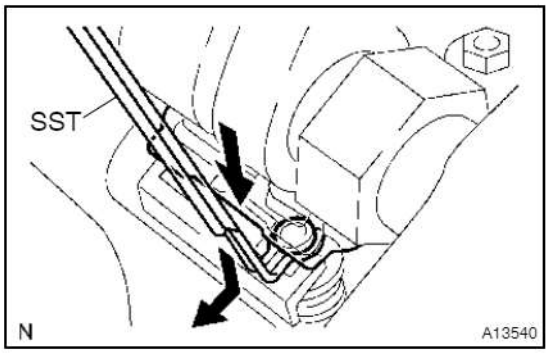
A10467

6. 1ZZ–FE:
REINSTALL CAMSHAFT

(a) Reinstall the valve lifters (See page EM–63).
(b) Align the crankshaft pulley groove with the timing mark "0" of the timing chain cover.
(c) Hold the timing chain, and place the intake camshaft and timing sprocket assembly.
(d) Align the matchmarks on the timing chain and camshaft timing sprocket.
(e) Reinstall the camshaft and timing sprocket assemblies (See page EM–67).



(f) Check that the point marks of the camshaft timing sprockets are in straight line on the timing chain cover surface as shown in the illustration.
(g) Check that the matchmarks are on the timing chain and camshaft timing sprockets.
(h) Install the chain tensioner (See page EM–26).
(i) Recheck the valve clearance (See procedure in step 3).
(j) Check the valve timing (See page EM–26).

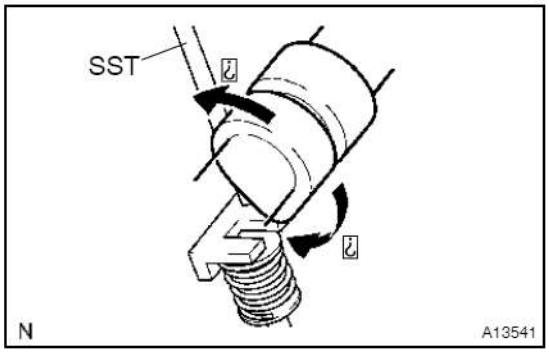


7. 2ZZ–GE:
REINSTALL ADJUSTING SHIM

(a) 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.



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

NOTICE:

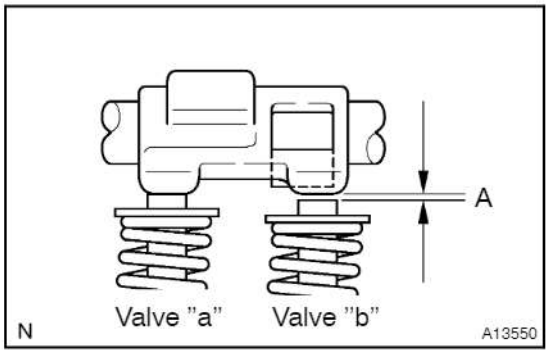
- **Pay attention to the direction of the rotation to prevent the nose of the camshaft from interfering with the SST's shaft.**
- **Do not rotate the crankshaft excessively.**

(c) After loosening the 2 set screws of SST, remove SST itself.
SST 09248–77010 (09248–07010)

8. REINSTALL CYLINDER HEAD COVER
(See page EM–26)

9. IF VALVE OR ROCKER ARM IS REPLACED, REPLACE SHIM AS FOLLOWS

(a) Install a standard shim of 2.400 mm (0.0945 in.) thickness at low temperature and install the rocker arm.



(b) While pressing the rocker arm, measure the clearance "A" of valve "b" in the condition that a clearance of the other value is 0mm (0 in.).

(c) To adjust the valve hight, replace a shim of valve "b" with a shim that has thickness of t_1.

t_1 = A + 2.400

(d) After adjusting the valve hight, adjust the clearance as described from step 3.

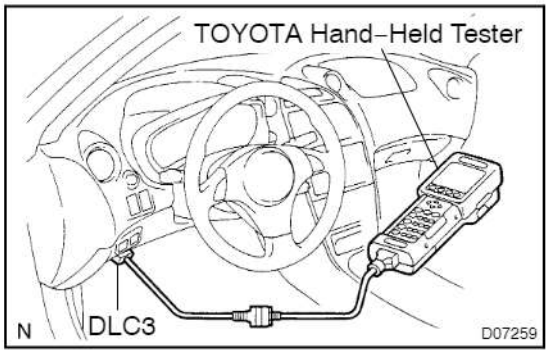
IGNITION TIMING

EM15P–06

INSPECTION

1. WARM UP ENGINE

Allow the engine to warm up to normal operating temperature.

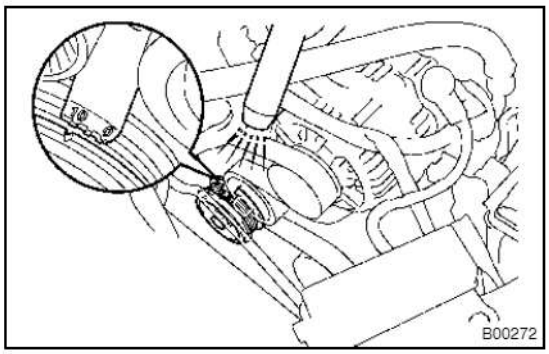


2. CONNECT TOYOTA HAND–HELD TESTER OR OBDII SCAN TOOL

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

(b) Please refer to the TOYOTA hand–held tester or OBDII scan tool operator's for further details.

3. CONNECT TIMING LIGHT TO ENGINE



4. INSPECT IGNITION TIMING

Using a timing light, check the ignition timing.

Ignition timing:
1ZZ–FE:
10 – 18° BTDC @ idle
2ZZ–GE:
8 – 12° BTDC @ idle
(Transmission in neutral position)

HINT:

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

5. DISCONNECT TIMING LIGHT FROM ENGINE

6. DISCONNECT TOYOTA HAND–HELD TESTER OR OBDII SCAN TOOL

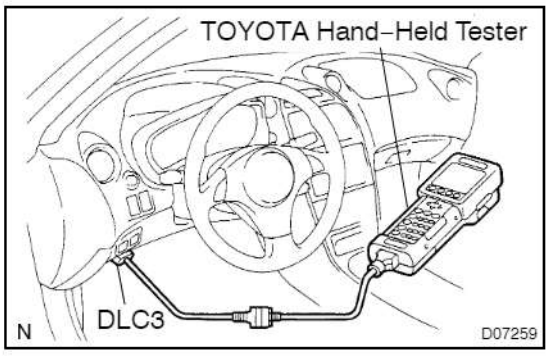
IDLE SPEED

EM05N–09

INSPECTION

1. INSTALL CONDITIONS

(a) Engine at normal operating temperature
(b) Air cleaner installed
(c) All pipes and hoses of air induction system connected
(d) All vacuum lines properly connected
(e) SFI system wiring connectors fully plugged
(f) All operating accessories switched OFF
(g) Ignition timing check correctly
(h) Transmission in neutral position
(i) Air conditioning switched OFF



2. CONNECT TOYOTA HAND–HELD TESTER OR OBDII SCAN TOOL

(a) Connect the TOYOTA hand–held tester or OBDII scan tool to the DLC3.
(b) Please refer to the TOYOTA hand–held tester or OBDII scan tool operator's manual for further details.

3. INSPECT IDLE SPEED

(a) Race the engine at 2,500 rpm for approx. 90 seconds.
(b) Check the idle speed.

Idle speed (w/ Cooling fan OFF):
1ZZ–FE
M/T 700 ± 50 rpm
A/T 750 ± 50 rpm
2ZZ–GE
M/T 800 ± 50 rpm
A/T 750 ± 50 rpm

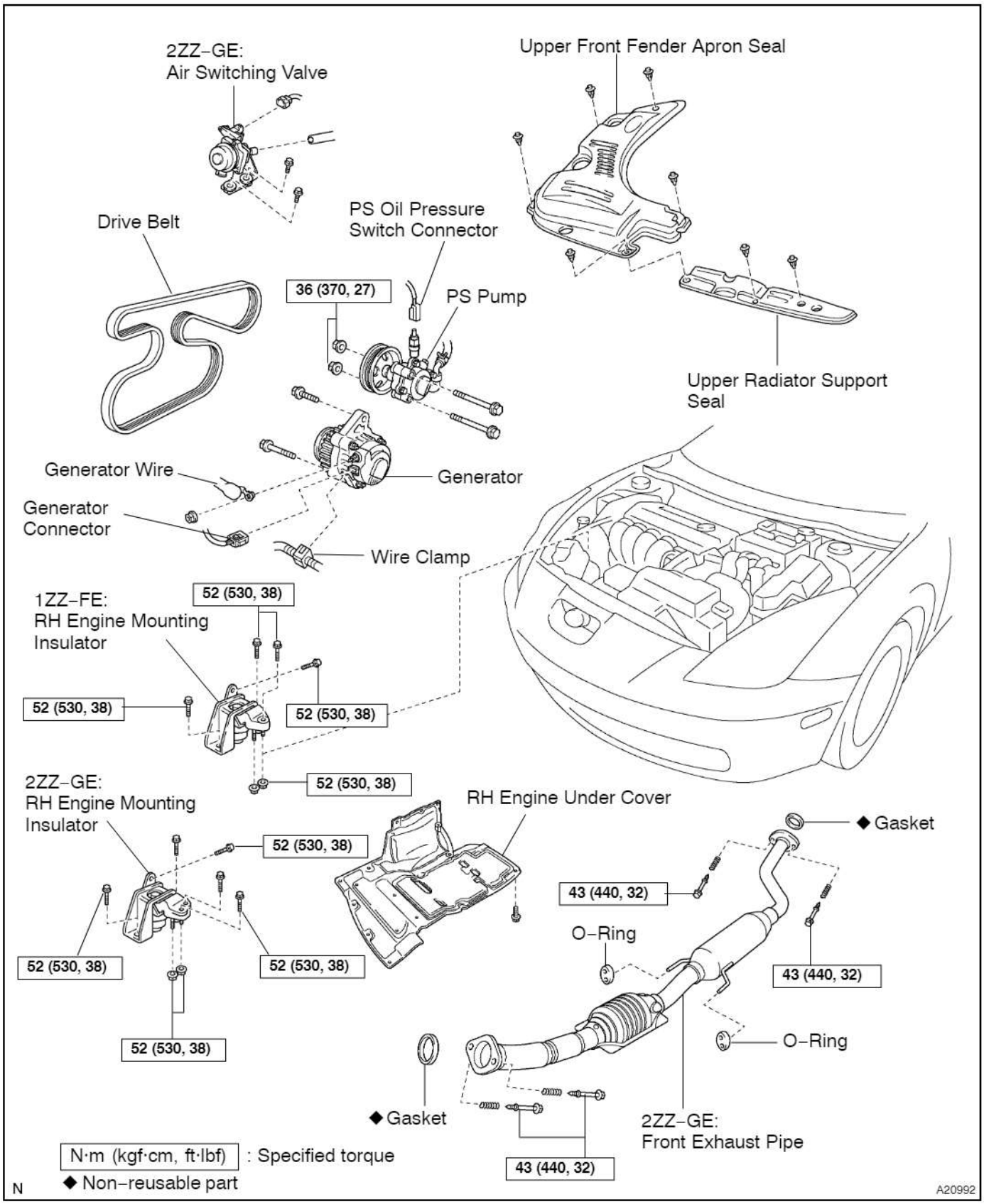
If the idle speed is not as specified, check the IAC valve and air intake system.

4. DISCONNECT TOYOTA HAND–HELD TESTER OR OBDII SCAN TOOL

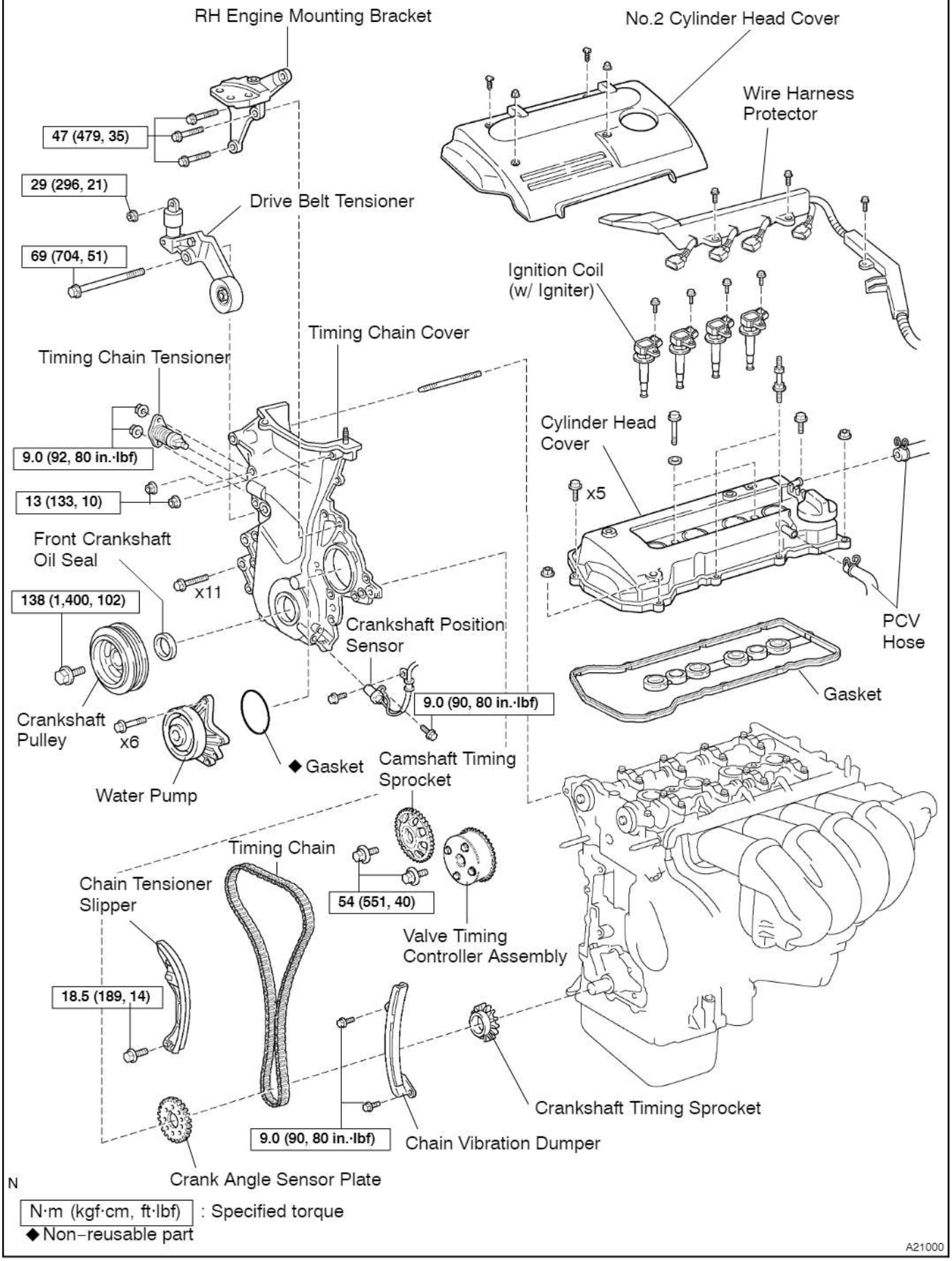
TIMING CHAIN

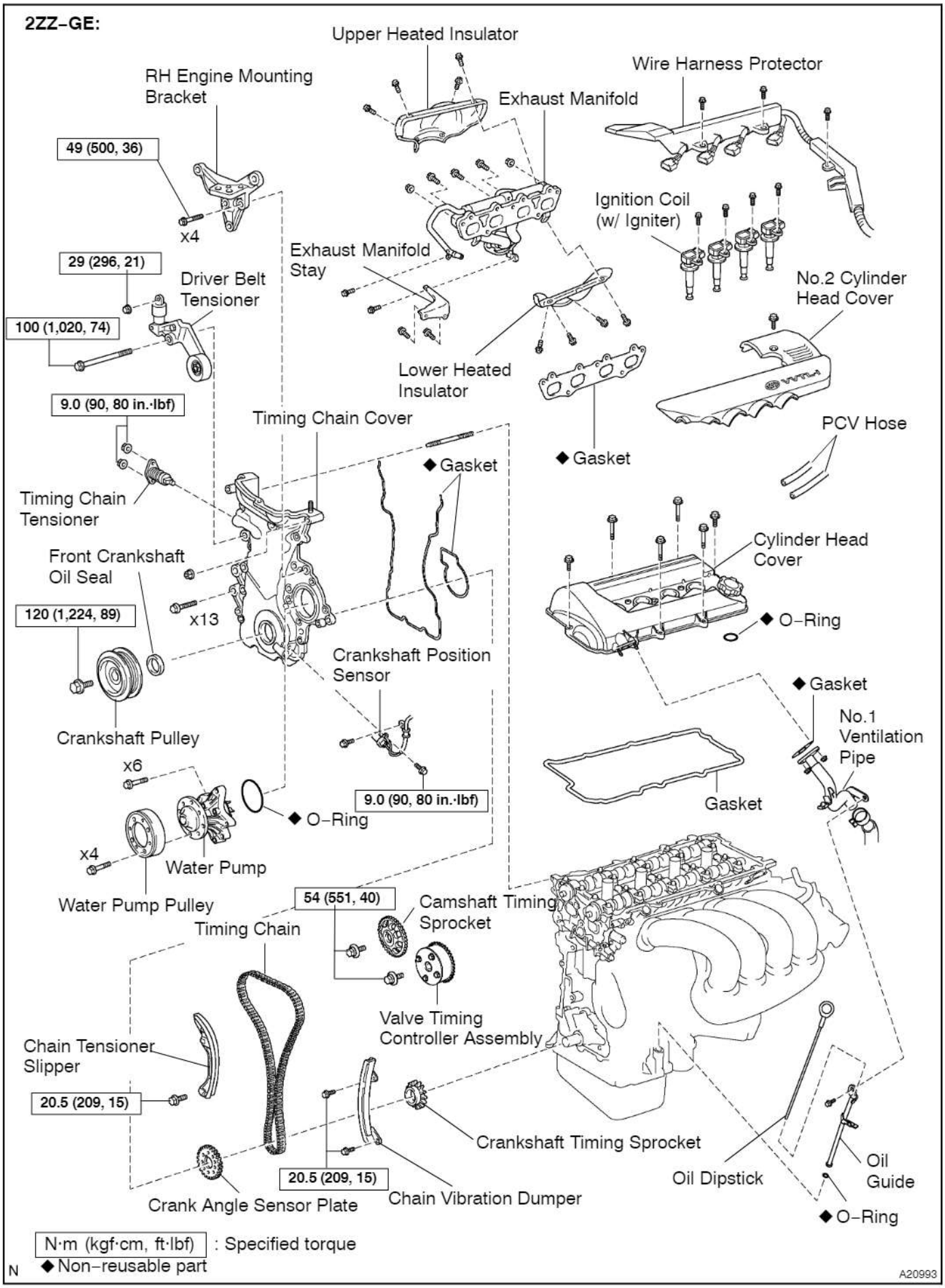
COMPONENTS

EM15R–06



1ZZ–FE:


RH Engine Mounting Bracket
No.2 Cylinder Head Cover
Wire Harness Protector
47 (479, 35)
29 (296, 21)
Drive Belt Tensioner
69 (704, 51)
Ignition Coil (w/ Igniter)
Timing Chain Cover
Timing Chain Tensioner
9.0 (92, 80 in.·lbf)
13 (133, 10)
Cylinder Head Cover
x5
Front Crankshaft Oil Seal
x11
138 (1,400, 102)
Crankshaft Position Sensor
PCV Hose
Gasket
9.0 (90, 80 in.·lbf)
Crankshaft Pulley
x6
◆ Gasket
Camshaft Timing Sprocket
Water Pump
Timing Chain
Chain Tensioner Slipper
54 (551, 40)
Valve Timing Controller Assembly
18.5 (189, 14)
Crankshaft Timing Sprocket
9.0 (90, 80 in.·lbf)
Chain Vibration Dumper
Crank Angle Sensor Plate
N
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
A21000


2ZZ–GE:
Upper Heated Insulator
RH Engine Mounting Bracket
Wire Harness Protector
Exhaust Manifold
49 (500, 36)
x4
Ignition Coil (w/ Igniter)
Exhaust Manifold Stay
29 (296, 21)
Driver Belt Tensioner
No.2 Cylinder Head Cover
100 (1,020, 74)
Lower Heated Insulator
◆ Gasket
9.0 (90, 80 in.·lbf)
Timing Chain Cover
PCV Hose
◆ Gasket
Timing Chain Tensioner
Front Crankshaft Oil Seal
Cylinder Head Cover
x13
◆ O–Ring
120 (1,224, 89)
Crankshaft Position Sensor
◆ Gasket
No.1 Ventilation Pipe
Crankshaft Pulley
x6
9.0 (90, 80 in.·lbf)
Gasket
◆ O–Ring
x4
Water Pump
Water Pump Pulley
54 (551, 40)
Camshaft Timing Sprocket
Timing Chain
Valve Timing Controller Assembly
Chain Tensioner Slipper
20.5 (209, 15)
Crankshaft Timing Sprocket
Oil Dipstick
Oil Guide
20.5 (209, 15)
Chain Vibration Dumper
Crank Angle Sensor Plate
◆ O–Ring
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
N
A20993

EM1W6–04

REMOVAL

1. REMOVE UPPER FRONT FENDER APRON SEAL AND UPPER RADIATOR SUPPORT SEAL

2. DRAIN ENGINE COOLANT

3. REMOVE RH FRONT WHEEL

4. REMOVE RH ENGINE UNDER COVER

5. 2ZZ–GE:
REMOVE AIR SWITCHING VALVE (See page EC–15)

6. REMOVE DRIVE BELT AND GENERATOR (See page CH–7)

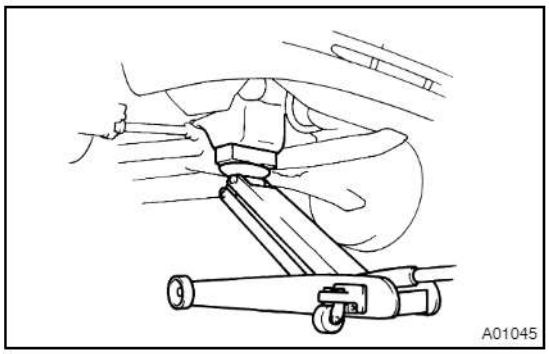
7. DISCONNECT PS PUMP FROM ENGINE

(a) Disconnect the PS oil pressure switch connector.

(b) Remove the 2 nuts and through bolts, and disconnect the PS pump from the engine (See page SR–26).

HINT:

Put aside the pump and suspend it to the cowl with a string.

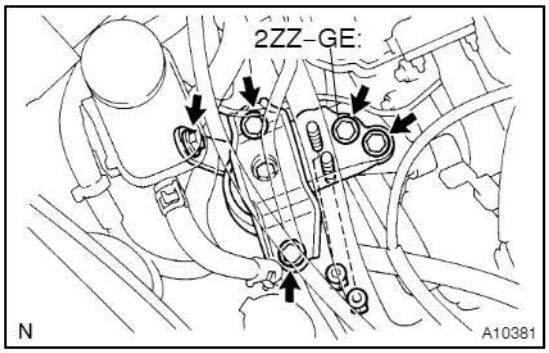


8. REMOVE RH ENGINE MOUNTING INSULATOR

(a) Set the jack to the engine.

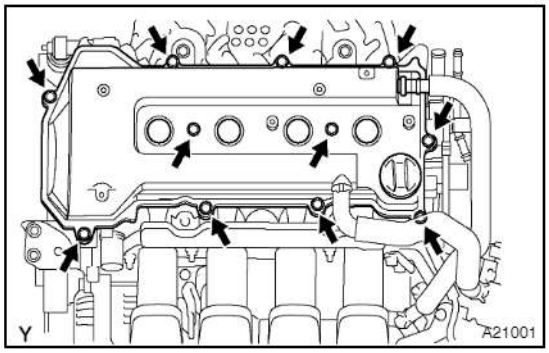
HINT:

Place a wooden block between the jack and engine.



(b) 1ZZ–FE:
Remove the 4 bolts, 2 nuts and RH engine mounting insulator.

(c) 2ZZ–GE:
Remove the 5 bolts, 2 nuts and RH engine mounting insulator.



9. 1ZZ–FE:
REMOVE CYLINDER HEAD COVER

(a) Remove the 2 nuts, 2 clips and No. 2 cylinder head cover.

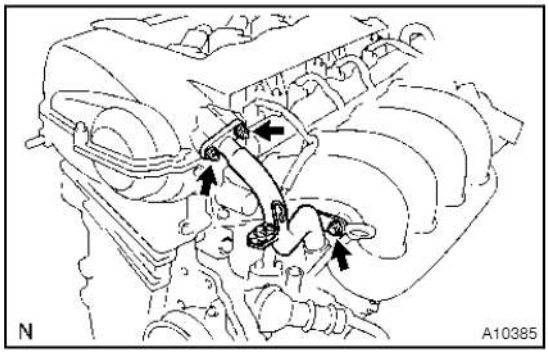
(b) Remove the 4 ignition coils (See page IG–6).

(c) Disconnect the 2 PCV hoses from the cylinder head.

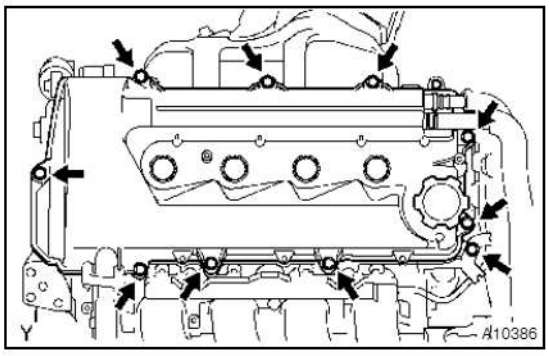
(d) Remove the 9 bolts, 2 seal washers, 2 nuts, cylinder head cover and gasket.

10. 2ZZ–GE:
REMOVE CYLINDER HEAD COVER

(a) Remove the 4 bolts and No. 2 cylinder head cover.
(b) Remove the ignition coils (See page IG–6).
(c) Disconnect the 2 PCV hoses from the cylinder head cover.



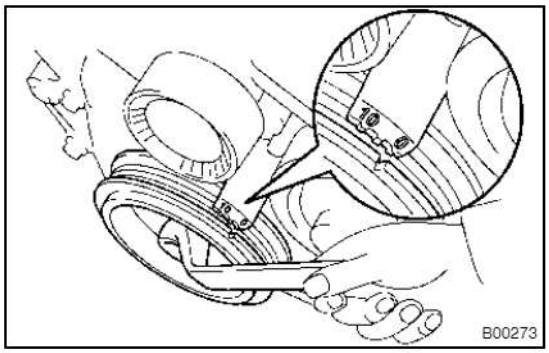
(d) Remove the 2 nuts, bolt and disconnect the No. 3 ventilation hose from the No. 1 ventilation pipe.
(e) Remove the No. 1 ventilation pipe and gasket.

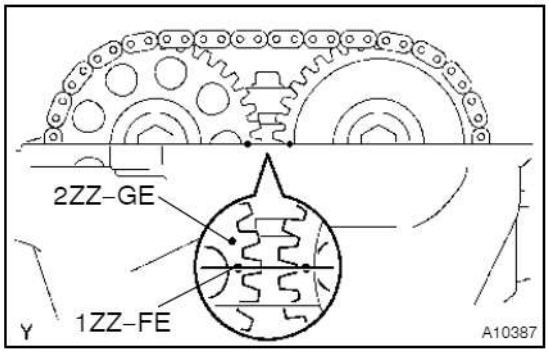


(f) Remove the 9 bolts, wire harness protector, cylinder head cover and gasket.
(g) Remove the O–ring from the cylinder head cover.

11. SET NO.1 CYLINDER TO TDC/COMPRESSION

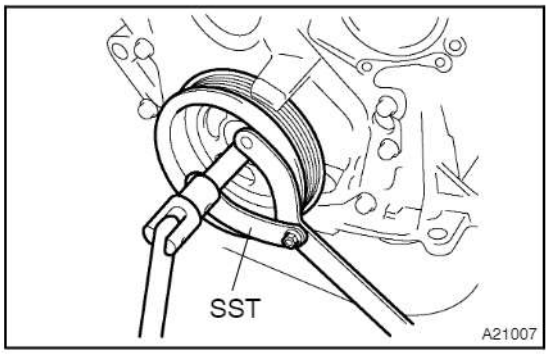
(a) Turn the crankshaft pulley, and align its groove with timing mark "0" of the timing chain cover.





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

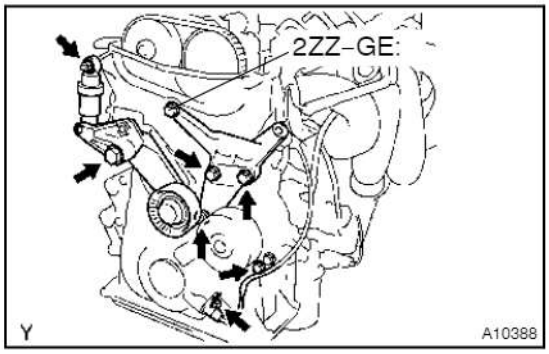
If not, turn the crankshaft 1 revolution (360°) and align the marks as above.



12. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the pulley bolt.
SST 09960–10010 (09962–01000, 09963–01000)

(b) Remove the crankshaft pulley from the crankshaft.



13. DISCONNECT CRANKSHAFT POSITION SENSOR FROM TIMING CHAIN COVER

Remove the 2 bolts and crankshaft position sensor.

14. REMOVE DRIVE BELT TENSIONER

Remove the bolt, nut and drive belt tensioner.

15. REMOVE RH ENGINE MOUNTING BRACKET

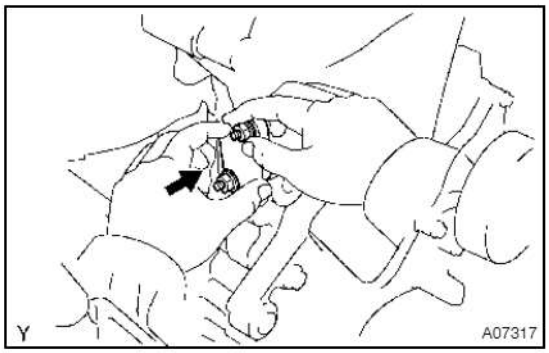
(a) 1ZZ–FE:
Remove the 3 bolts and mounting bracket.

(b) 2ZZ–GE:
Remove the 4 bolts and mounting bracket.

16. 2ZZ–GE:
REMOVE FRONT EXHAUST PIPE (See page EM–44)

17. 2ZZ–GE:
REMOVE EXHAUST MANIFOLD STAY
(See page EM–44)

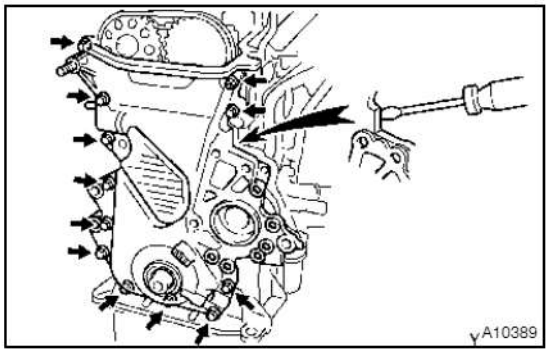
18. 2ZZ–FE:
REMOVE EXHAUST MANIFOLD (See page EM–44)



19. REMOVE CHAIN TENSIONER

Remove the 2 nuts and chain tensioner.

20. REMOVE WATER PUMP (See page CO–5)



21. 1ZZ–FE:
REMOVE TIMING CHAIN COVER

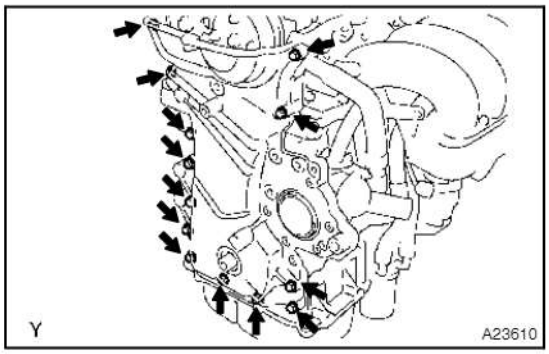
(a) Remove the 11 bolts and nut.

(b) Using a torx® wrench socket (E8), remove the stud bolt.

(c) Remove the timing chain cover by prying the portions between the cylinder head and cylinder block with a screwdriver.

NOTICE:

Be careful not to damage the contact surfaces of the timing chain cover, cylinder head and cylinder block.



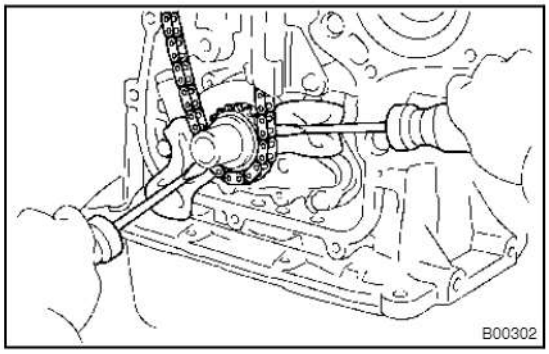
22. 2ZZ–GE:
REMOVE TIMING CHAIN COVER

(a) Remove the 13 bolts.
(b) Using a torx® wrench socket (E8), remove the stud bolt.
(c) Remove the timing chain cover and 2 gaskets.

23. REMOVE CRANK ANGLE SENSOR PLATE

24. REMOVE CHAIN TENSIONER SLIPPER

Remove the bolt and slipper.



25. REMOVE TIMING CHAIN AND CRANKSHAFT TIMING SPROCKET

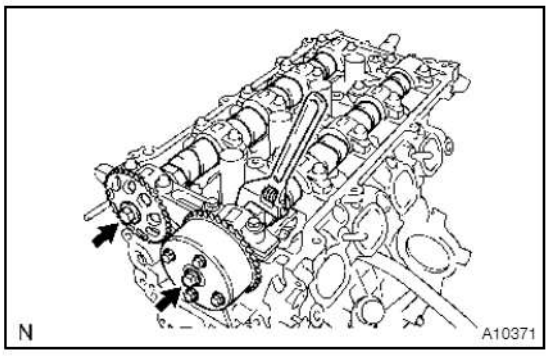
If the crankshaft timing sprocket cannot be removed by hand, use 2 screwdrivers.

NOTICE:

Position shop rags as shown to prevent damage.

26. REMOVE CHAIN VIBRATION DAMPER

Remove the 2 bolts and damper.



27. REMOVE VALVE TIMING CONTROL ASSEMBLY AND CAMSHAFT TIMING SPROCKET

Hold the hexagonal head wrench portion of the camshaft with a wrench, and remove the bolt, valve timing controller assembly and timing sprocket.

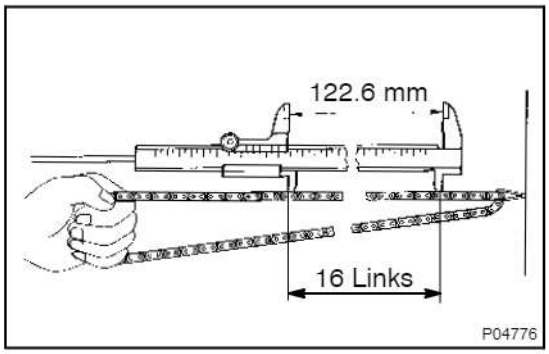
NOTICE:

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

EM05Q-13

INSPECTION

1. INSPECT TIMING CHAIN AND TIMING SPROCKETS



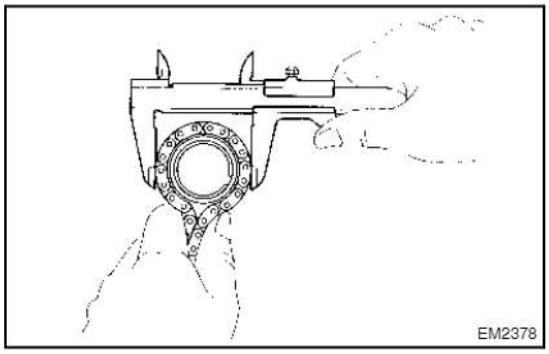
(a) Using a vernier calipers, measure the length of 16 links with the chain dully stretched.

Maximum chain elongation: 122.6 mm (4.827 in.)

If the elongation is greater than maximum, replace the chain.

HINT:

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



(b) Wrap the chain around the timing sprocket.

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

NOTICE:

Vernier calipers must contact the chain rollers for measuring.

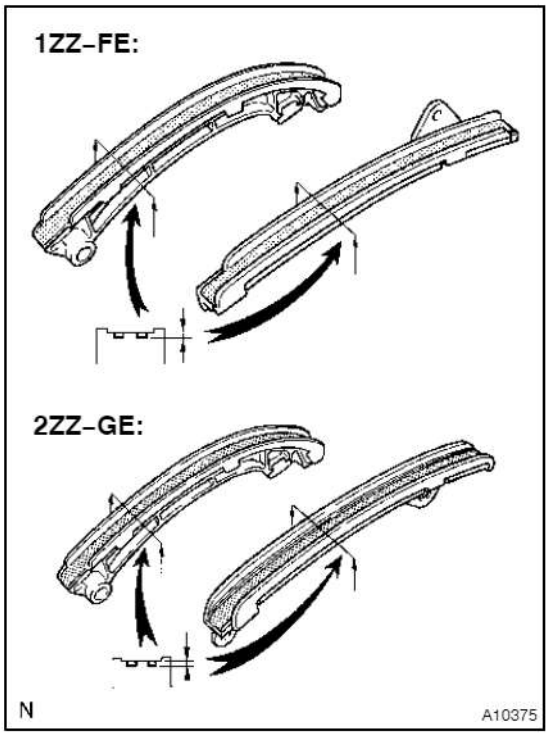
Minimum sprocket diameter (w/ Chain):

Camshaft 97.3 mm (3.831 in.)

Crankshaft 51.6 mm (2.031 in.)

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

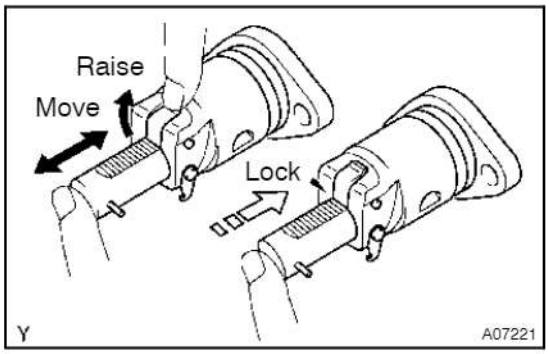
2. INSPECT CHAIN TENSIONER SLIPPER AND VIBRATION DAMPER



Measure the chain tensioner slipper and vibration damper wears.

Maximum wear: 1.0 mm (0.039 in.)

If the wear is greater than maximum, replace the slipper and/or damper.



3. INSPECT CHAIN TENSIONER

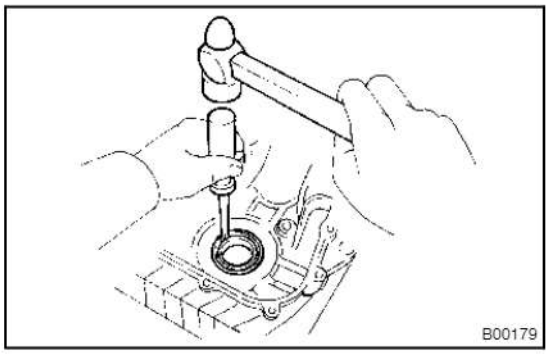
(a) Check that the plunger moves smoothly when the ratchet pawl is raised with your finger.

(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.

4. INSPECT OIL JET (See page LU–11)

EM05R–10

REPLACEMENT



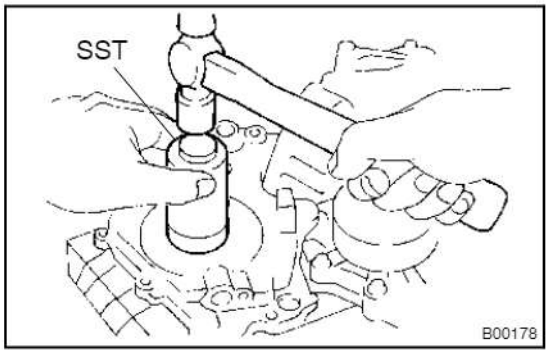
HINT:

There are 2 methods ((a) and (b)) to replace the oil seal as follows:

REPLACE CRANKSHAFT FRONT OIL SEAL

(a) If timing chain cover is removed from cylinder block.

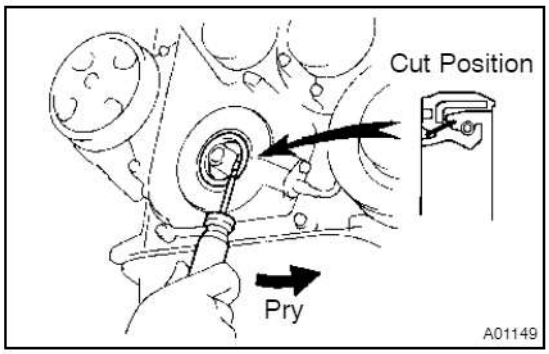
(1) Using a screwdriver and a hammer, tap out the oil seal.



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

SST 09309–37010

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



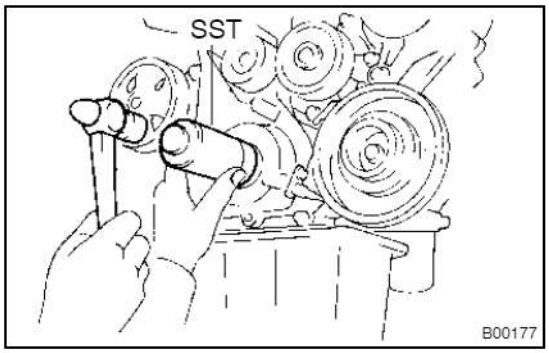
(b) If timing chain cover is installed to the cylinder block.

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

(2) Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft. Tape the screwdriver tip.

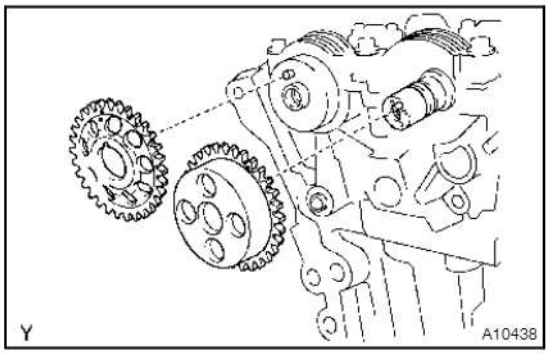


(3) Using SST and a hammer, tap in the oil seal until its surface is flush with the timing chain cover edge.

SST 09309–37010

EM15S–08

INSTALLATION



1. INSTALL VALVE TIMING CONTROLLER ASSEMBLY AND CAMSHAFT TIMING SPROCKET

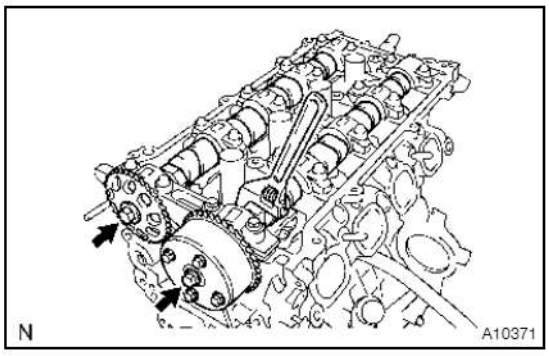
(a) Apply engine oil in the range from the tip of the intake camshaft to 16 mm from that tip.

(b) Align the timing mark on the value timing controller assembly with the knock pin, and install the value timing controller assembly to the camshaft.

NOTICE:

Do not push valve timing controller assembly to the camshaft forcibly when installing it.

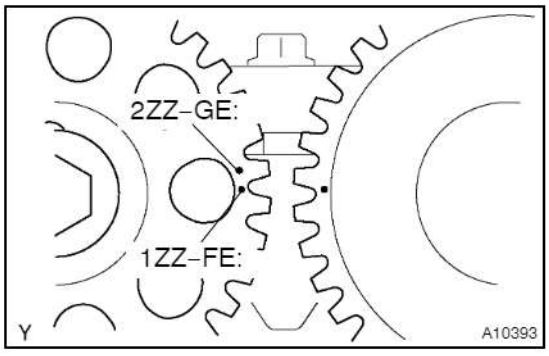
(c) Align the knock pin hole in the camshaft timing sprocket with the knock pin of the camshaft, and exhaust the sprocket to the camshaft.



(d) Temporarily install the timing sprocket bolt.

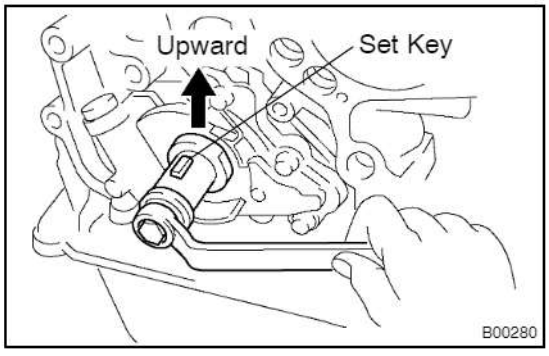
(e) Hold the hexagon wrench head portion of the camshaft with a wrench, and tighten the timing sprocket bolt.

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

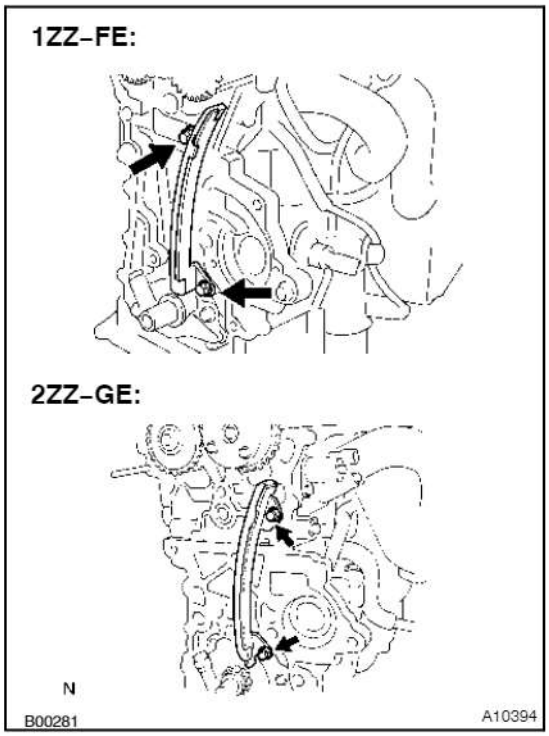


2. SET NO. 1 CYLINDER TO TDC/COMPRESSION

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



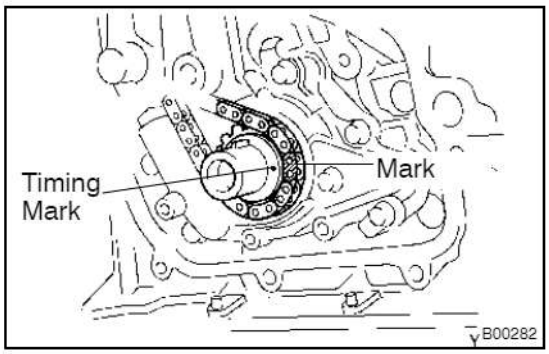
(b) Using a crankshaft pulley bolt, turn the crankshaft and set the set key on the crankshaft upward.



3. INSTALL CHAIN VIBRATION DAMPER

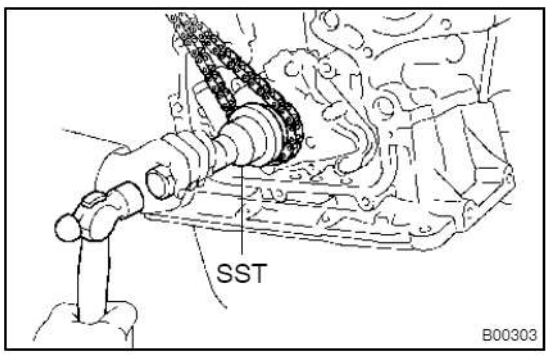
Install the damper with the 2 bolts.

Torque:
1ZZ–FE 9.0 N·m (92 kgf·cm, 80 in.·lbf)
2ZZ–GE 20.5 N·m (209 kgf·cm, 15 ft·lbf)

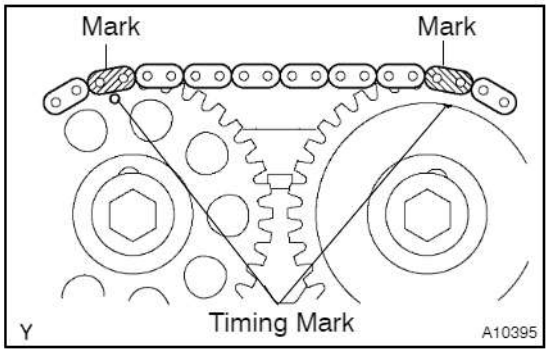


4. INSTALL TIMING CHAIN AND CRANKSHAFT TIMING SPROCKET

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

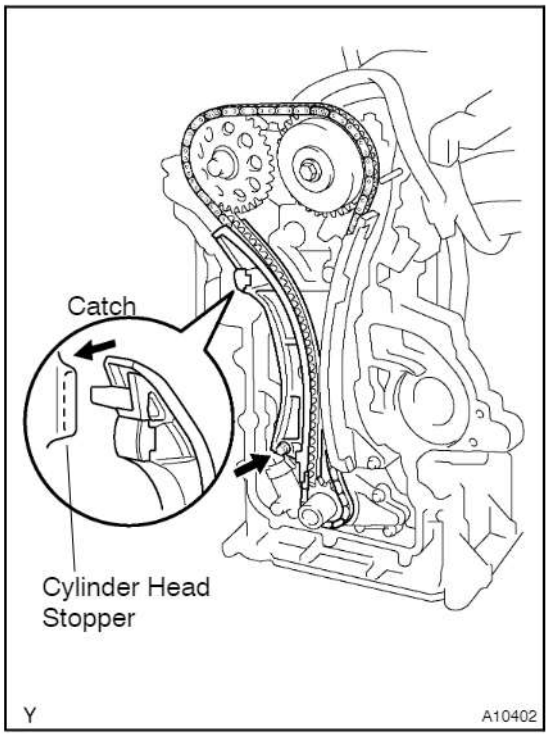


HINT:
If necessary, install the sprocket with SST.
SST 09223–22010



(b) 1ZZ–FE:
Install the timing chain on the camshaft timing sprockets with the yellow color links aligned with the timing marks on the camshaft timing sprockets.

(c) 2ZZ–GE:
Install the timing chain on the camshaft timing sprockets with the orange color links aligned with the timing marks on the camshaft timing sprockets.



(d) Check that the tension between the intake camshaft timing sprocket and crankshaft timing sprocket.

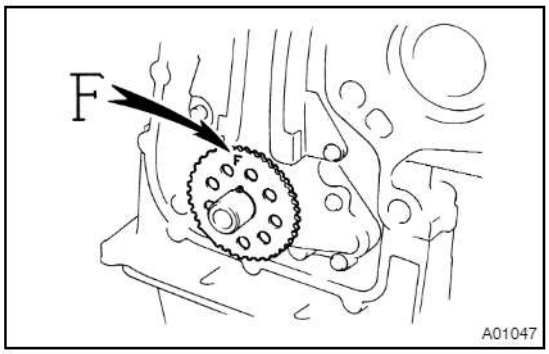
5. INSTALL CHAIN TENSIONER SLIPPER

(a) Install the slipper with the bolt.

Torque:
1ZZ–FE 18.5 N·m (189 kgf·cm, 14 ft·lbf)
2ZZ–GE 20.5 N·m (209 kgf·cm, 15 ft·lbf)

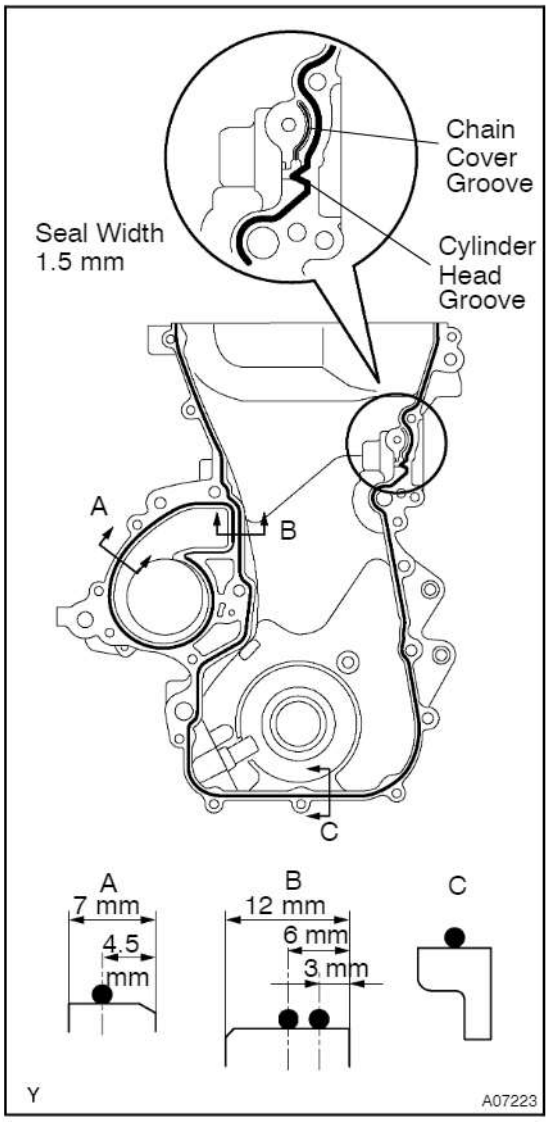
(b) Check that the slipper moves is caught on the cylinder head stopper.

NOTICE:
DO not turn the crankshaft.



6. INSTALL CRANK ANGLE SENSOR PLATE

Install the plate with the "F" mark facing forward.



7. 1ZZ–FE:

INSTALL TIMING CHAIN COVER AND WATER PUMP

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces 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:

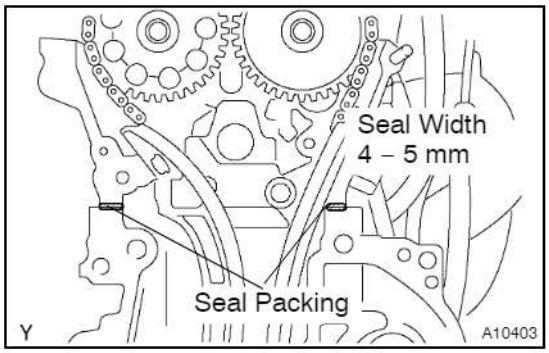
Part No. 08826 – 00100 or equivalent

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



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

Seal packing:

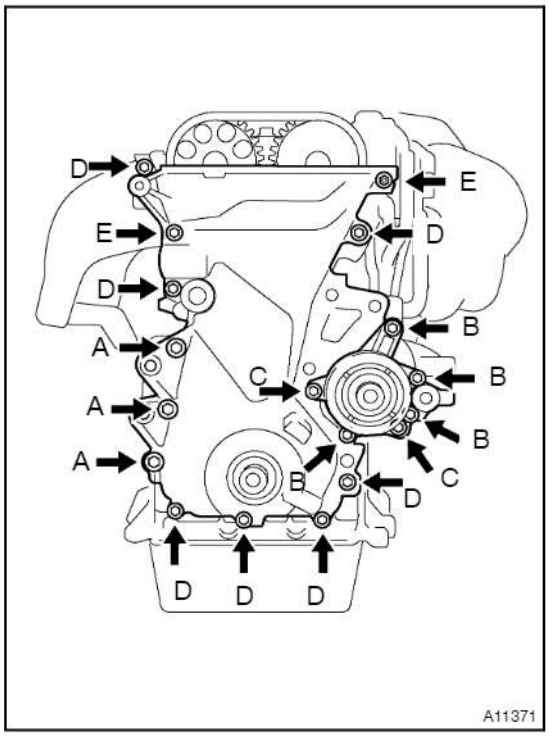
Part No. 08826 – 00080 or equivalent

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



(d) Install the timing chain cover, O–ring and water pump with the 16 bolts and 2 nuts. Uniformly tighten the bolts and nut in several passes.

Torque:
10 mm head:
9 N·m (92 kgf·cm, 80 in.·lbf) for C
13 N·m (133 kgf·cm, 10 ft·lbf) for D and E
11 N·m (113 kgf·cm, 8 ft·lbf) for B
12 mm head:
18.5 N·m (189 kgf·cm, 14 ft·lbf) for A

NOTICE:

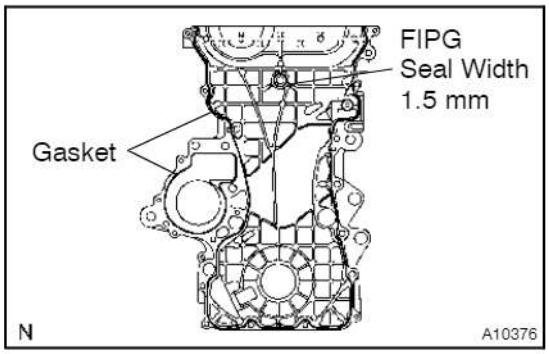
- **Pay attention not to wrap the chain and slipper over the chain cover seal line.**
- **After installing the chain cover, must install the mounting bracket and water pump within 15 minutes.**

HINT:

Each bolt length in indicated in the illustration.

A 45 mm (1.77 in.)
B 35 mm (1.38 in.)
C 22 mm (0.87 in.)
D 25 mm (0.98 in.)

(e) Using a torx® wench socket (E8), install the stud bolt.
Torque: 9.3 N·m (95 kgf·cm, 82 in.·lbf)



8. 2ZZ–GE:

INSTALL TIMING CHAIN COVER AND WATER PUMP

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces 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

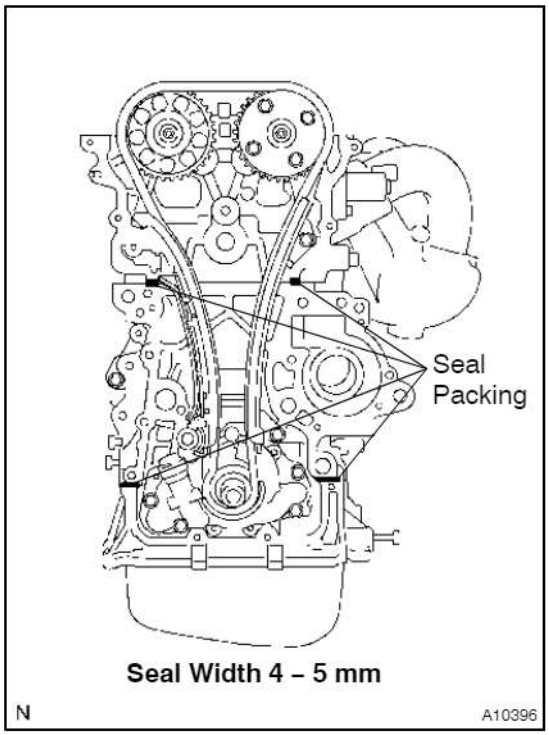
- Install a nozzle that has been cut to a 1.5 mm opening.

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 gasket to the timing chain cover as shown in the illustration.



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

Seal packing:

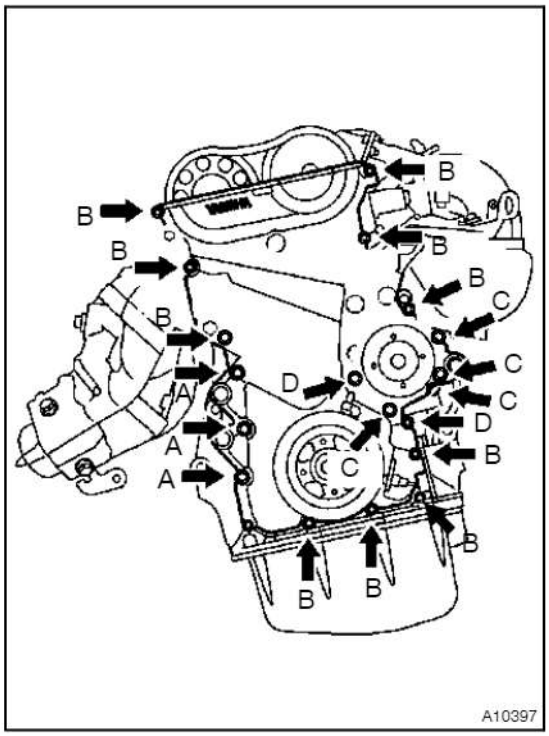
Part No. 08826–00080 or equivalent

- 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.



(e) Install the timing chain cover, O–ring and water pump with the 19 bolts. Uniformly tighten the bolts in several passes.
Torque:
A: 21 N·m (214 kgf·cm, 15 ft·lbf)
B: 11 N·m (113 kgf·cm, 8 ft·lbf)
C: 9.0 N·m (92 kgf·cm, 80 in.·lbf)
D: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

NOTICE:

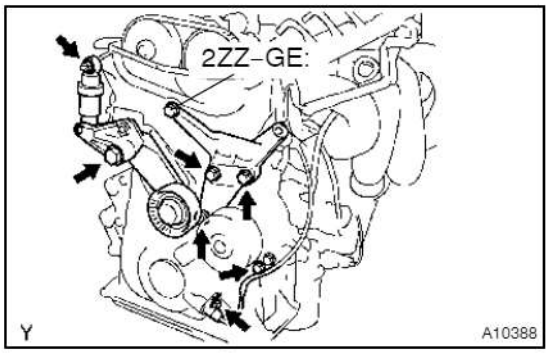
- **Pay attention not to wrap the chain and slipper over the chain cover seal line.**
- **After install the chain cover, must install the mounting bracket and water pump within 15 minutes.**

(f) Using a torx® wrench socket (E8), install the stud bolt.
Torque: 9.3 N·m (95 kgf·cm, 82 in.·lbf)

9. 2ZZ–GE:
INSTALL EXHAUST MANIFOLD (See page EM–67)

10. 2ZZ–GE:
INSTALL EXHAUST MANIFOLD STAY
(See page EM–67)

11. 2ZZ–GE:
INSTALL FRONT EXHAUST PIPE (See page EM–67)



12. 1ZZ–FE:
INSTALL RH ENGINE MOUNTING BRACKET

(a) Apply seal packing to threads of the mounting bolt.
Seal packing:
Part No. 08826 – 00080 or equivalent

HINT:
Do not apply seal packing to 2 or 3 threads of the bolt end.

(b) Install the mounting bracket with the 3 bolts.
Torque: 47 N·m (479 kgf·cm, 35 ft·lbf)

13. 2ZZ–GE:
INSTALL RH ENGINE MOUNTING BRACKET

Install the mounting bracket with the 4 bolts.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

14. INSTALL DRIVE BELT TENSIONER

(a) Check the appearance before installing the drive belt tensioner.

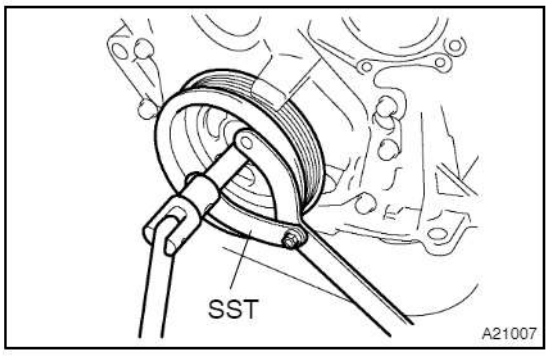
If in case of having the oil leakage, crack, and etc., replace the drive belt tensioner.

(b) Install the drive belt tensioner.
Torque:
Bolt
1ZZ–FE 69 N·m (704 kgf·cm, 51 ft·lbf)
2ZZ–GE 100 N·m (1,020 kgf·cm, 74 ft·lbf)
Nut 29 N·m (296 kgf·cm, 21 ft·lbf)

(c) Hook the tool on the hexagonal portion of the drive belt tensioner bracket and operate drive belt tensioner 3 times with full stroke.

HINT:
Take 3 seconds or more for 1 full stroke.

15. INSTALL CRANKSHAFT POSITION SENSOR
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

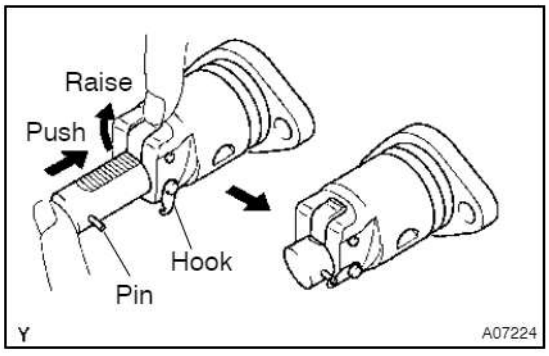


16. INSTALL CRANKSHAFT PULLEY

(a) Clean the crankshaft pulley inside.

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

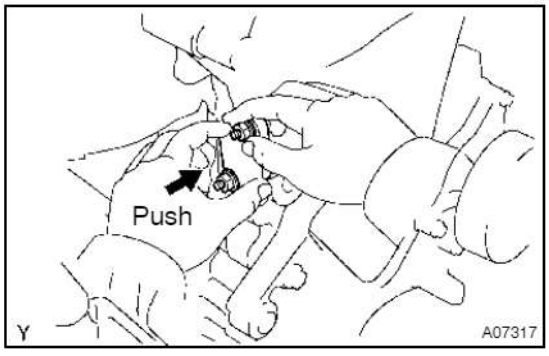
(c) Using SST, install the pulley bolt.
SST 09960–10010 (09962–01000, 09963–01000)
Torque:
1ZZ–FE 138 N·m (1,409 kgf·cm, 102 ft·lbf)
2ZZ–GE 120 N·m (1,224 kgf·cm, 89 ft·lbf)



17. INSTALL CHAIN TENSIONER

(a) Check the chain tensioner.
(See page EM–16)

(b) Release the ratchet pawl, fully push in the plunger and apply the hook to the pin so that the plunger cannot spring out.

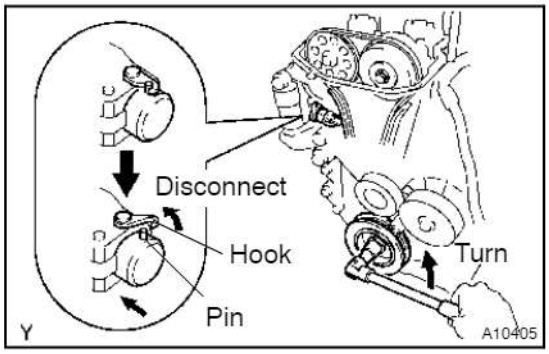


(c) Insert the O–ring with your hand until it reaches to the chamfering position and install nut temporally. Then, by tightening the nut, insert the chain tensioner to the installation position.

HINT:

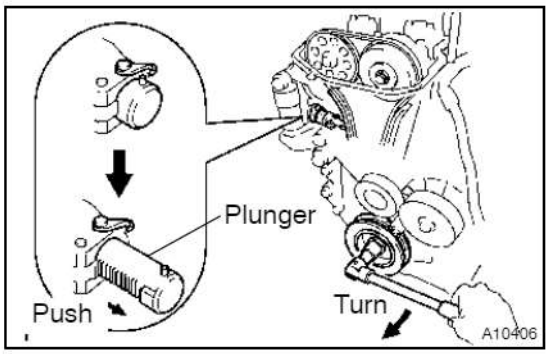
- In the case that the hook is released while pushing in, apply the hook again and push the tensioner in.
- Pay attention not to catch the O–ring as it is built in the chain tensioner previously.

(d) Tighten the 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

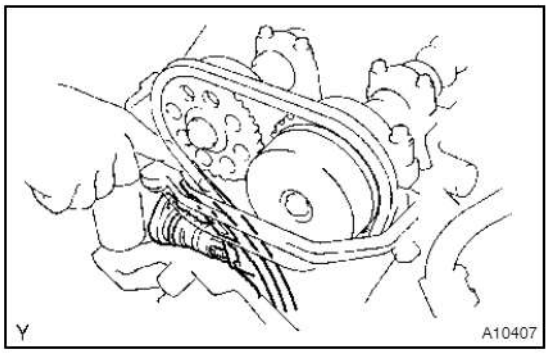


18. SET CHAIN TENSION

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



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

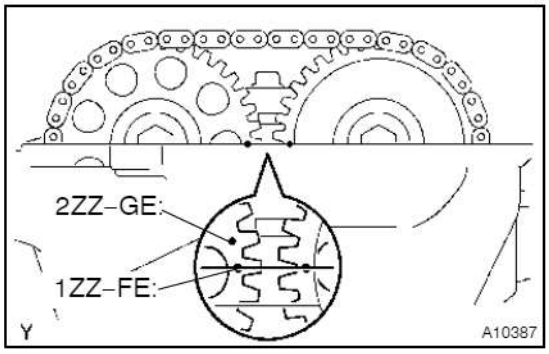


HINT:
If the plunger does not spring out, press the slipper into the chain tensioner with a screwdriver or your finger so that the hook is released from the knock pin and the plunger springs out.

19. CHECK VALVE TIMING

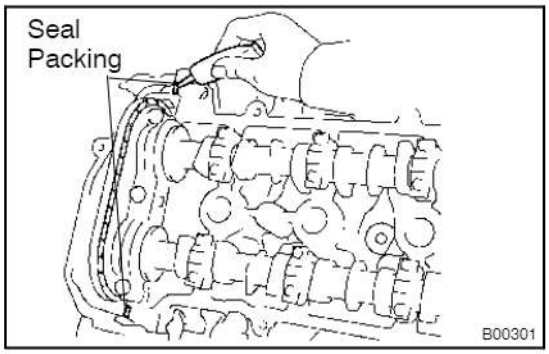
(a) Turn the crankshaft pulley, and align its groove with timing mark "0" of the timing chain cover.

NOTICE:
Always turn the crankshaft clockwise.



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

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



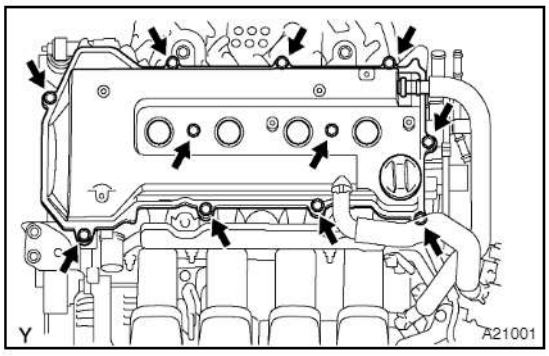
20. 1ZZ–FE:
INSTALL CYLINDER HEAD COVER

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

(b) Apply seal packing to 2 locations as shown in the illustration.
Seal packing:
Part No. 08826 – 00080 or equivalent

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

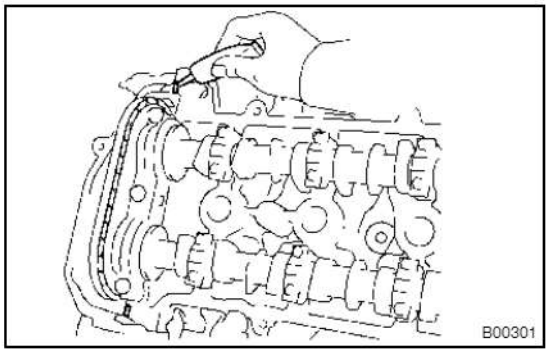
HINT:
Part must be assembled within 3 minutes of application. Otherwise the material must be remove and reapplied.



(d) Install the cylinder head cover with the 9 bolts, 2 seal washers and 2 nuts.
Uniformly tighten the bolts and nuts, in the several passes, in the sequence shown.
Torque:
w/o washer
11 N·m (113 kgf·cm, 8 ft·lbf)
w/ washer
9.0 N·m (92 kgf·cm, 80 in.·lbf)

(e) Connect the 2 PCV hoses to the cylinder head cover.

(f) Install the ignition coil (See page IG–7).



21. 2ZZ–GE:
INSTALL CYLINDER HEAD COVER

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

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

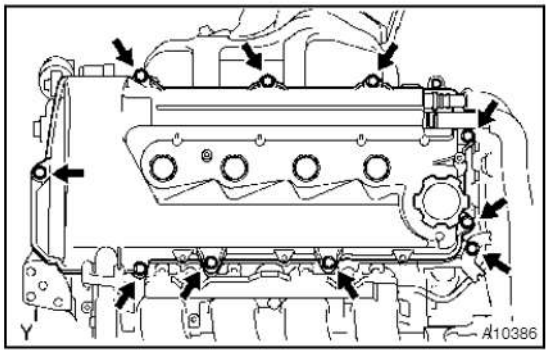
(b) Apply seal packing to 2 locations as shown in the illustration.
Seal packing:
Part No. 08826–00080 or equivalent

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

HINT:

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

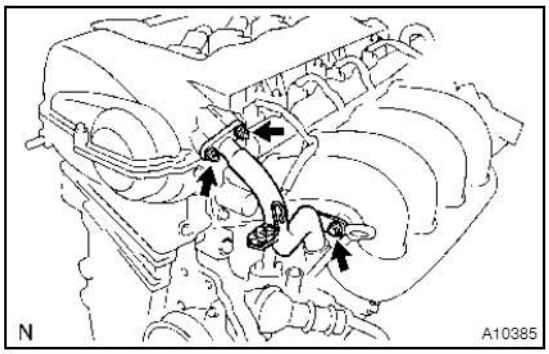
(d) Install a new O–ring to the cylinder head cover.



(e) Install the cylinder head cover and wire harness protector with the9 bolts. Uniformly tighten the bolts, in the several passes, in the sequence shown.

Torque: 10 N·m (100 kgf·cm, 7 ft·lbf)

(f) Connect the 2 PCV hoses to the cylinder head cover.

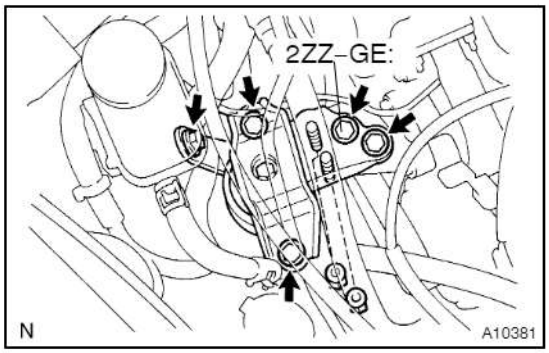


(g) Install a new gasket and No. 1 ventilation pipe with 2 nuts and bolt.

Torque:
Nut 10 N·m (100 kgf·cm, 7 ft·lbf)
Bolt 25 N·m (255 kgf·cm, 18 ft·lbf)

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

(i) Install the ignition coil (See page IG–7).



22. INSTALL RH ENGINE MOUNTING INSULATOR

(a) 1ZZ–FE:
Install the RH engine mounting insulator with the 4 bolts and 2 nuts.

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

(b) 2ZZ–GE:
Install the RH engine mounting insulator with the 5 bolts and 2 nuts.

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

23. INSTALL PS PUMP

(a) Install the PS pump with the 2 through bolts and nuts.

Torque: 36 N·m (370 kgf·cm, 27 ft·lbf)

(b) Install the PS pump pulley with the pulley nut.

(c) Connect the PS oil pressure switch connector.

24. INSTALL GENERATOR AND DRIVE BELT
(See page CH–17)

25. 2ZZ–GE:
INSTALL AIR SWITCHING VALVE (See page EC–18)

26. INSTALL RH ENGINE UNDER COVER

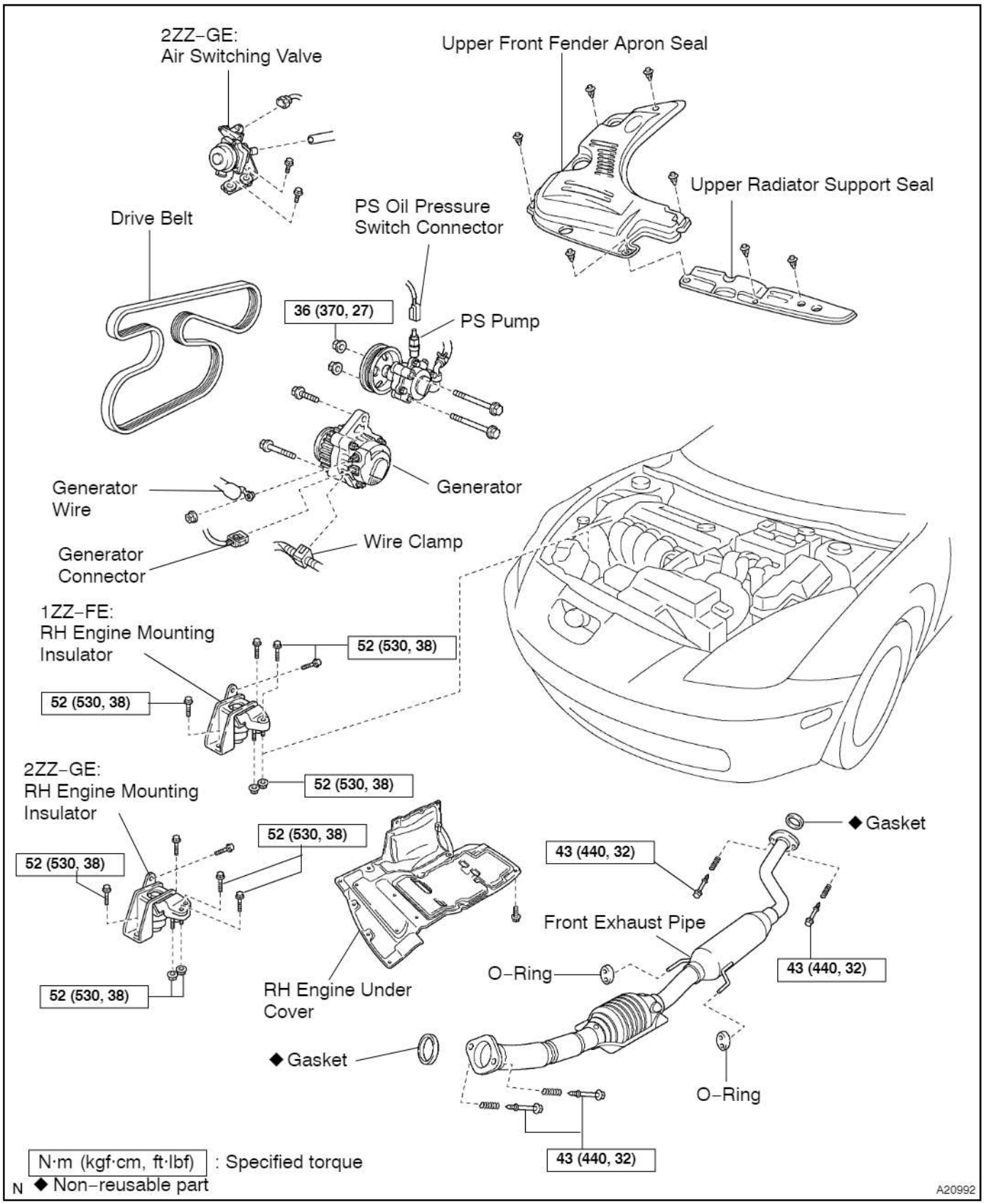
27. INSTALL RH FRONT WHEEL

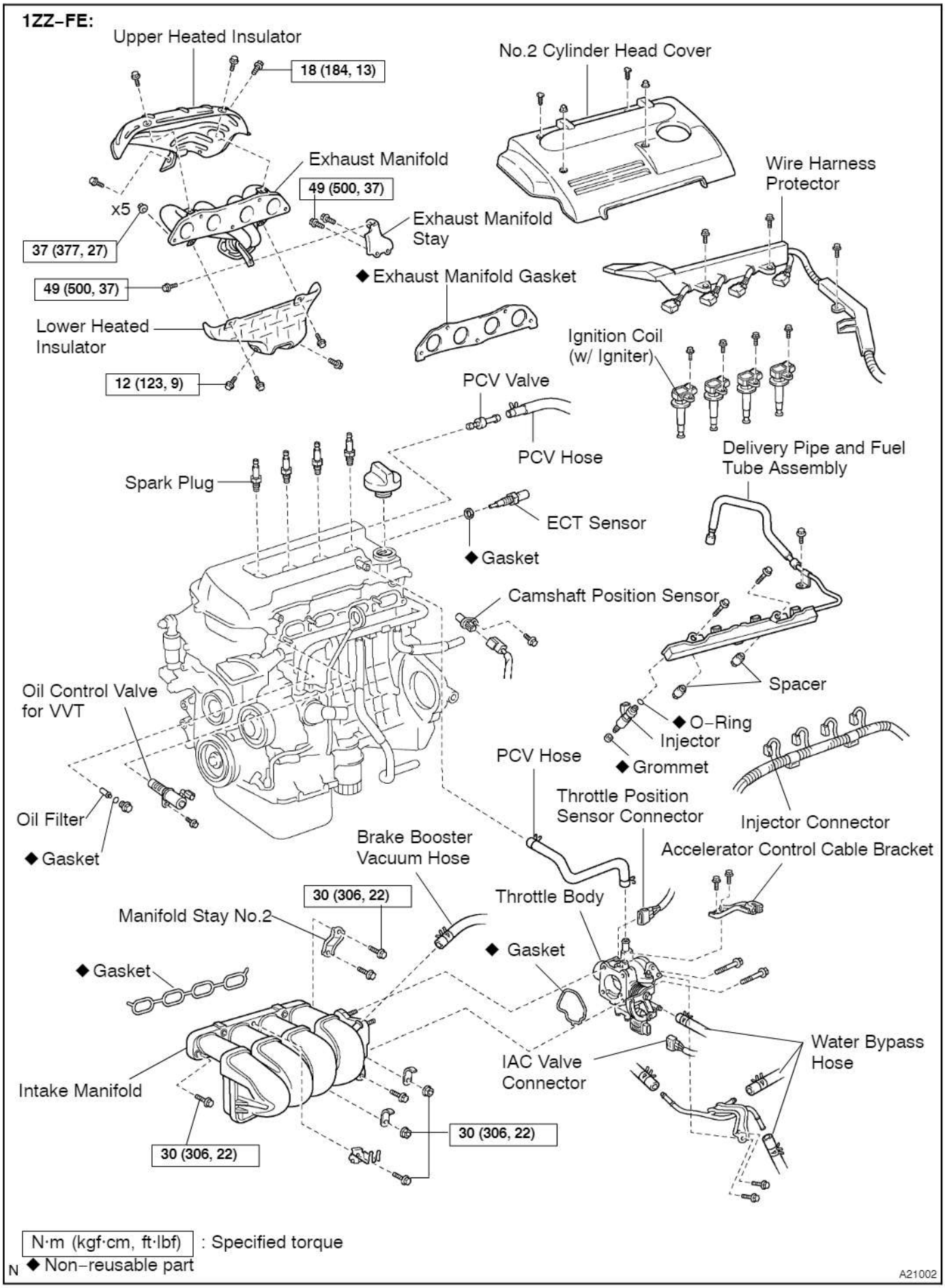
28. FILL WITH ENGINE COOLANT (See page CO–2)
29. INSTALL FRONT FENDER APRON SEAL AND UPPER RADIATOR SUPPORT SEAL
30. START ENGINE AND CHECK FOR COOLANT LEAKS

CYLINDER HEAD

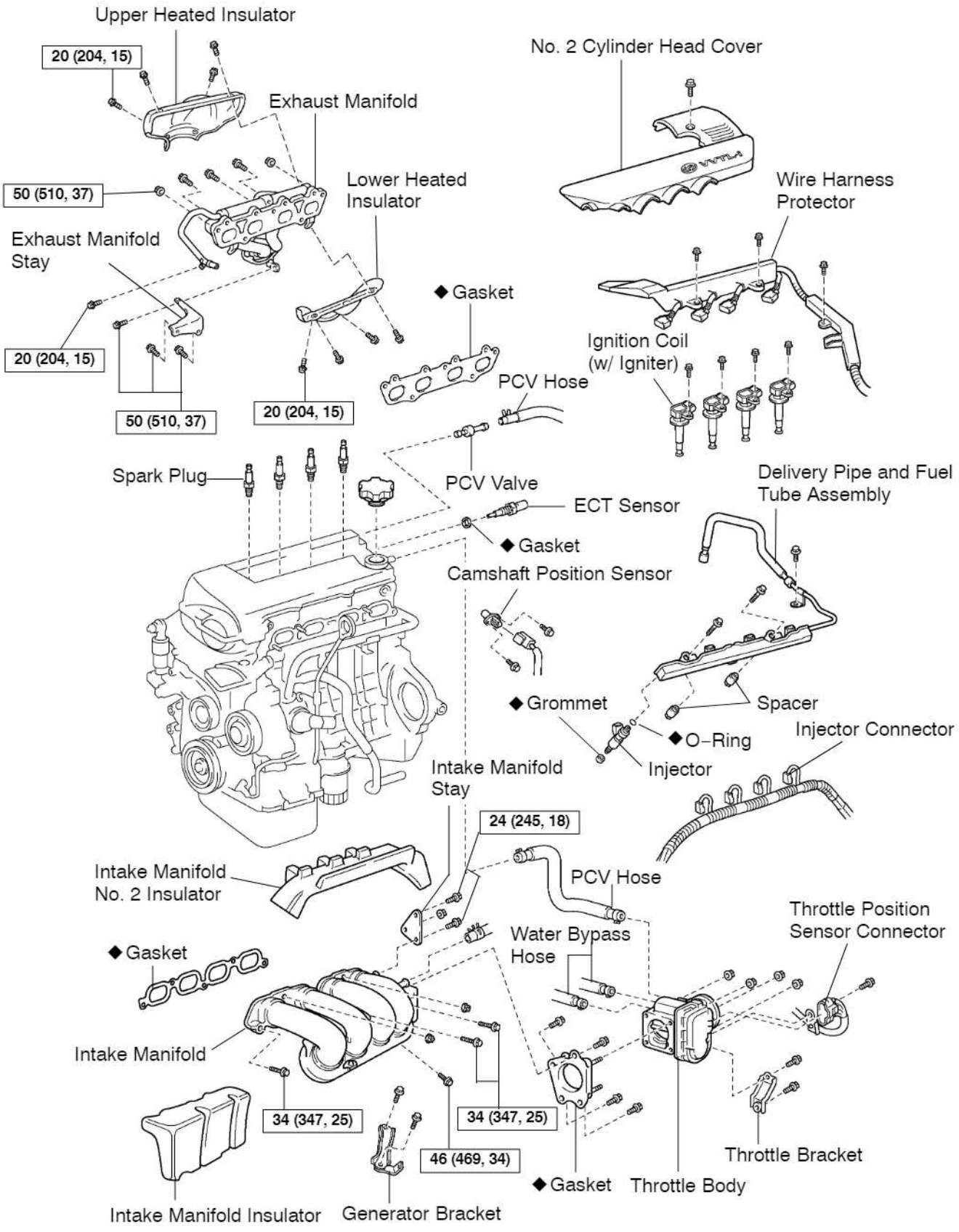
COMPONENTS

EM15T–06




1ZZ–FE:
Upper Heated Insulator
18 (184, 13)
No.2 Cylinder Head Cover
Exhaust Manifold
49 (500, 37)
x5
37 (377, 27)
Exhaust Manifold Stay
Wire Harness Protector
◆ Exhaust Manifold Gasket
49 (500, 37)
Lower Heated Insulator
12 (123, 9)
Ignition Coil (w/ Igniter)
PCV Valve
PCV Hose
Delivery Pipe and Fuel Tube Assembly
Spark Plug
ECT Sensor
◆ Gasket
Camshaft Position Sensor
Spacer
Oil Control Valve for VVT
◆ O–Ring
Injector
◆ Grommet
PCV Hose
Throttle Position Sensor Connector
Injector Connector
Oil Filter
◆ Gasket
Brake Booster Vacuum Hose
Accelerator Control Cable Bracket
30 (306, 22)
Manifold Stay No.2
Throttle Body
◆ Gasket
◆ Gasket
Water Bypass Hose
IAC Valve Connector
Intake Manifold
30 (306, 22)
30 (306, 22)
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
A21002

2ZZ–GE:

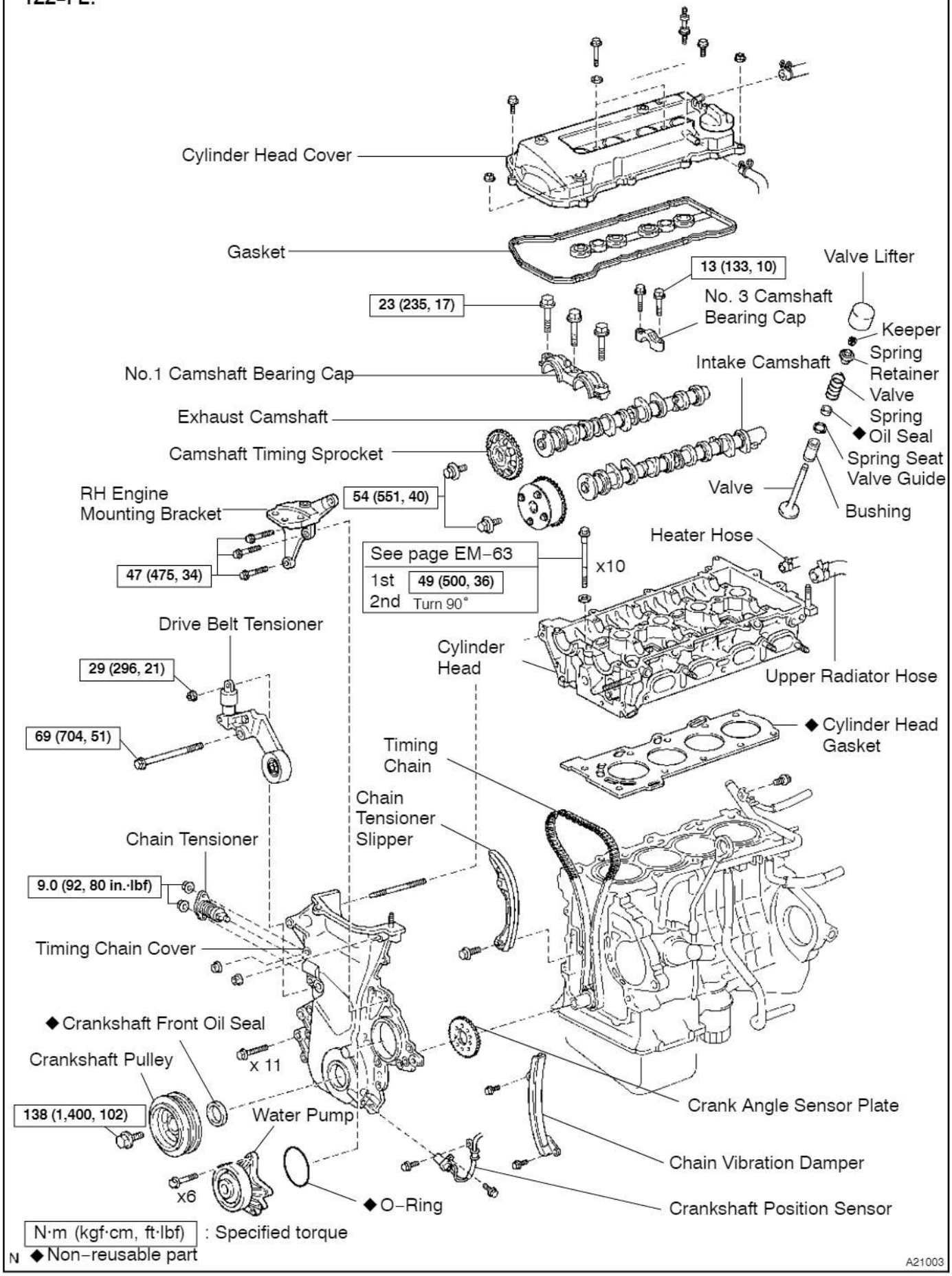


N·m (kgf·cm, ft·lbf) : Specified torque

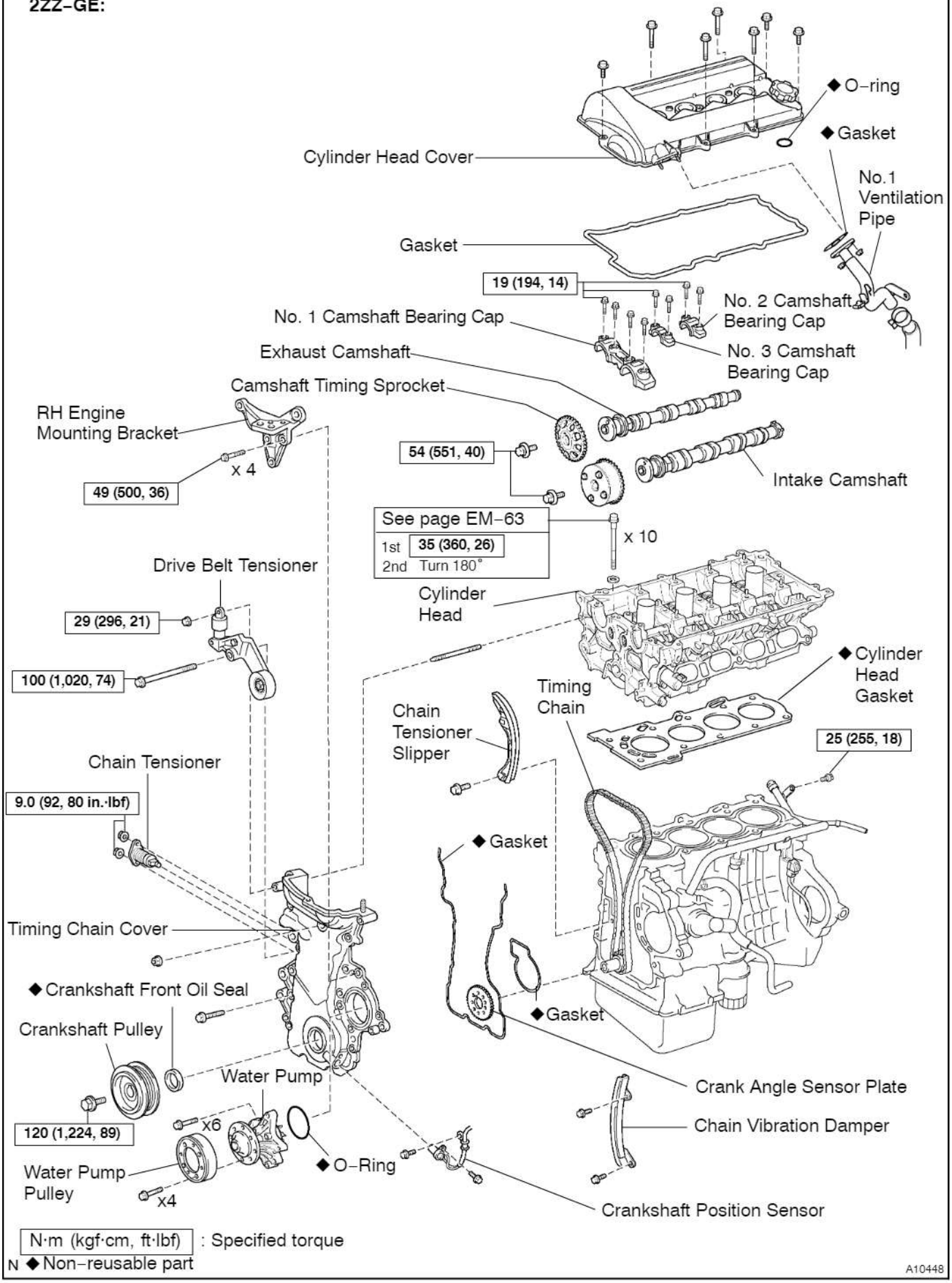
N ◆ Non–reusable part

A20994

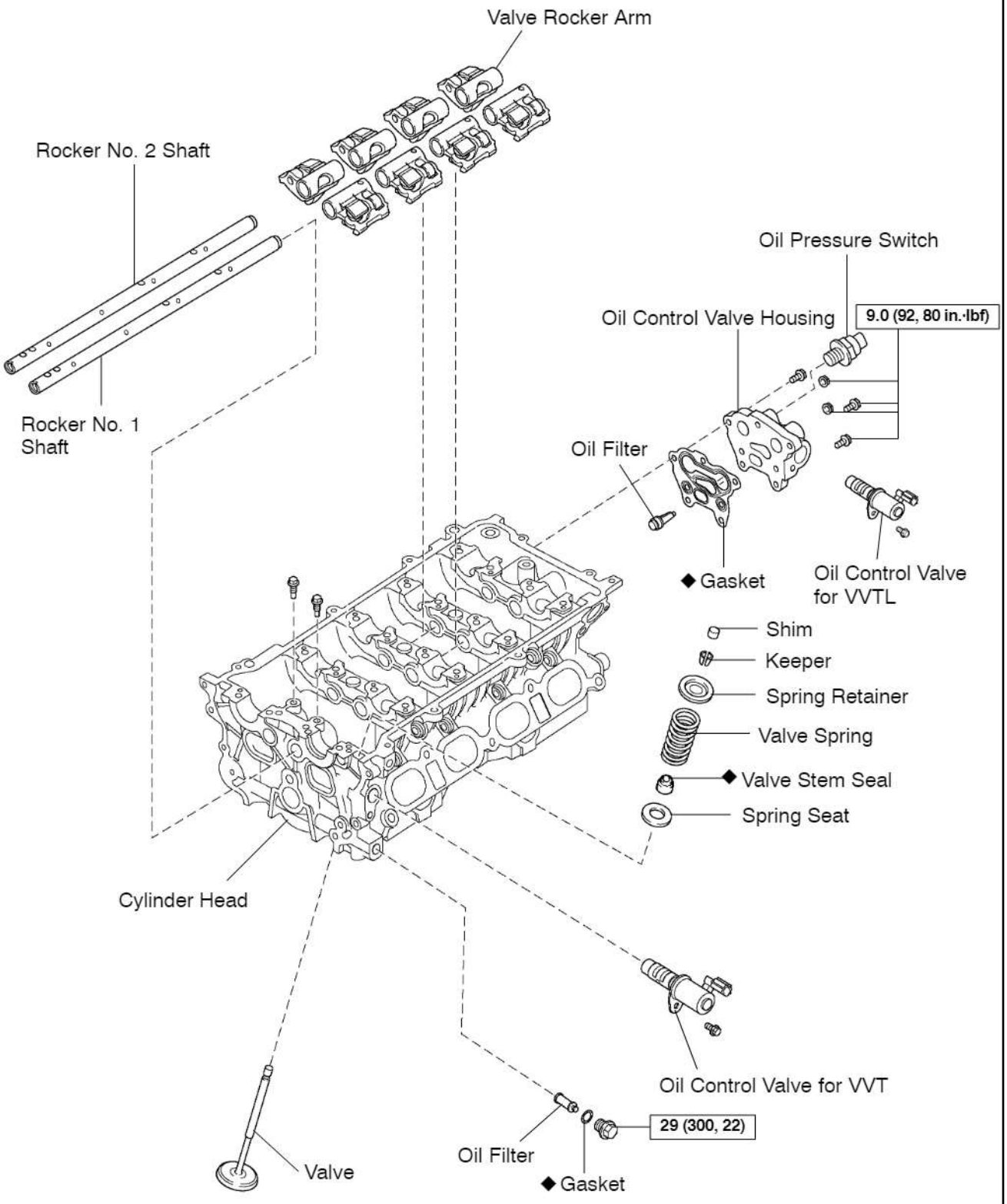
1ZZ–FE:


Cylinder Head Cover
Gasket
13 (133, 10)
23 (235, 17)
No. 3 Camshaft Bearing Cap
Valve Lifter
Keeper
Spring Retainer
Valve Spring
◆ Oil Seal
Spring Seat
Valve Guide
Bushing
Valve
Intake Camshaft
No.1 Camshaft Bearing Cap
Exhaust Camshaft
Camshaft Timing Sprocket
54 (551, 40)
RH Engine Mounting Bracket
47 (475, 34)
See page EM–63
1st 49 (500, 36)
2nd Turn 90°
x10
Heater Hose
Upper Radiator Hose
Cylinder Head
◆ Cylinder Head Gasket
Drive Belt Tensioner
29 (296, 21)
69 (704, 51)
Timing Chain
Chain Tensioner Slipper
Chain Tensioner
9.0 (92, 80 in.·lbf)
Timing Chain Cover
◆ Crankshaft Front Oil Seal
Crankshaft Pulley
x 11
138 (1,400, 102)
Water Pump
x6
◆ O–Ring
Crank Angle Sensor Plate
Chain Vibration Damper
Crankshaft Position Sensor
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
A21003

2ZZ–GE:


◆O–ring
◆Gasket
Cylinder Head Cover
No.1 Ventilation Pipe
Gasket
19 (194, 14)
No. 2 Camshaft Bearing Cap
No. 1 Camshaft Bearing Cap
No. 3 Camshaft Bearing Cap
Exhaust Camshaft
Camshaft Timing Sprocket
RH Engine Mounting Bracket
x 4
49 (500, 36)
54 (551, 40)
Intake Camshaft
See page EM–63
1st 35 (360, 26)
2nd Turn 180°
x 10
Drive Belt Tensioner
Cylinder Head
29 (296, 21)
100 (1,020, 74)
◆Cylinder Head Gasket
Timing Chain
Chain Tensioner Slipper
25 (255, 18)
Chain Tensioner
9.0 (92, 80 in.·lbf)
◆Gasket
Timing Chain Cover
◆Crankshaft Front Oil Seal
Crankshaft Pulley
Water Pump
x6
120 (1,224, 89)
◆O–Ring
Water Pump Pulley
x4
◆Gasket
Crank Angle Sensor Plate
Chain Vibration Damper
Crankshaft Position Sensor
N·m (kgf·cm, ft·lbf) : Specified torque
N ◆Non–reusable part
A10448

2ZZ–GE



N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part

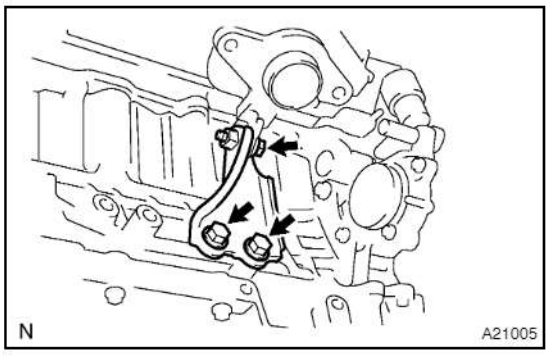
N

A23920

EM15U–06

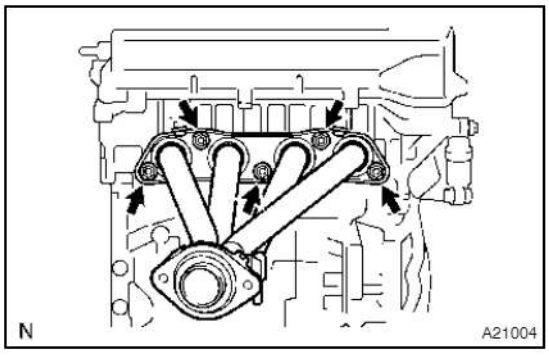
REMOVAL

1. REMOVE BATTERY
2. REMOVE ECU BOX (See page EM–76)
3. DRAIN ENGINE COOLANT
4. DISCONNECT ENGINE COOLANT RESERVOIR
5. REMOVE AIR CLEANER ASSEMBLY
6. 1ZZ–FE:
   DISCONNECT ACCELERATOR CABLE
7. 2ZZ–GE:
   REMOVE AIR SWITCHING VALVE (See page EC–15)
8. REMOVE DRIVE BELT AND ALTERNATOR
   (See page CH–7)
9. REMOVE EXHAUST PIPE (See page EM–76)

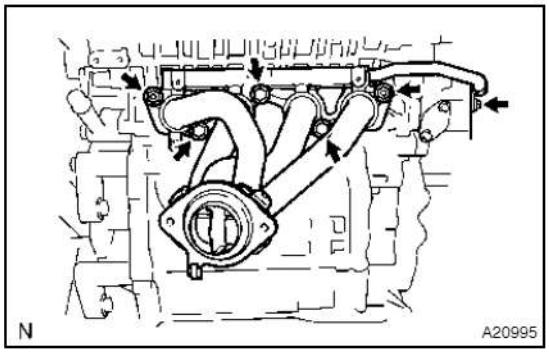


10. 1ZZ–FE:
    REMOVE EXHAUST MANIFOLD

(a) Remove the 3 bolts and exhaust manifold stay.
(b) Remove the 4 bolts and upper heat insulator.



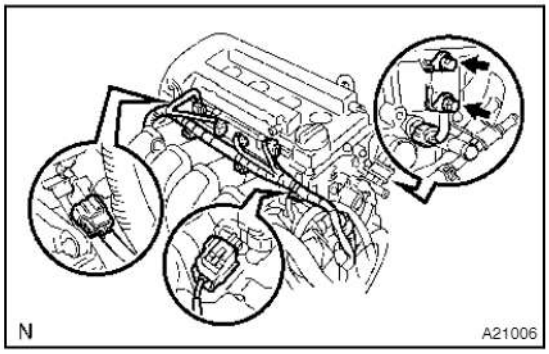
(c) Remove the 5 nuts, exhaust manifold and gasket.
(d) Remove the 4 bolts and lower heat insulator.



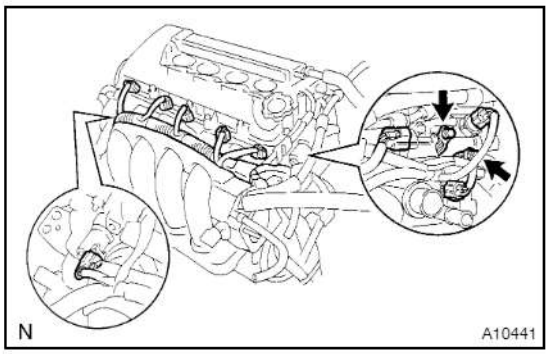
11. 2ZZ–GE:
    REMOVE EXHAUST MANIFOLD

(a) Remove the 4 bolts and exhaust manifold stay.
(b) Remove the 5 bolts and upper heat insulator.
(c) Remove the 4 bolts, 2 nuts, exhaust manifold and gasket.
(d) Remove the 4 bolts and lower heat insulator.

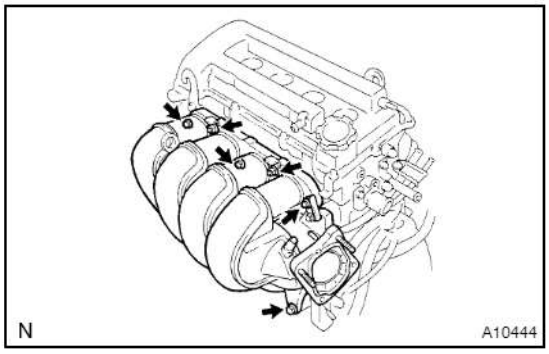
12. **REMOVE IGNITION COIL (See page IG–6)**
13. **REMOVE SPARK PLUG (See page IG–1)**
14. **REMOVE PCV HOSES**
15. **REMOVE THROTTLE BODY (See page SF–35 or SF–42)**
16. **REMOVE INJECTOR (See page SF–21)**



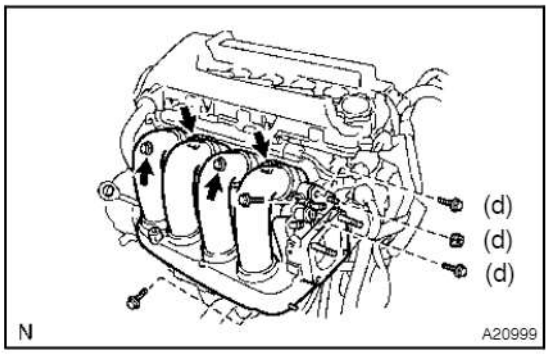
17. **1ZZ–FE:**
DISCONNECT ENGINE WIRE FROM CYLINDER HEAD
(a) Disconnect the ECT sensor connector.
(b) Disconnect the camshaft position sensor connector.
(c) Disconnect the oil control valve for VVT connector.
(d) Disconnect the 2 ground wires.
(e) Disconnect the 2 clamps and engine wire protector from the intake manifold.



18. **2ZZ–GE:**
DISCONNECT ENGINE WIRE FROM CYLINDER HEAD
(a) Disconnect the ECT sensor connector.
(b) Disconnect the camshaft position sensor connector.
(c) Disconnect the oil control valve for VVT connectors.
(d) Disconnect the oil control valve for VVTL connectors.
(e) Disconnect the oil pressure switch connector.
(f) Disconnect the 2 ground wires.
(g) Remove the 2 bolts, and disconnect the engine wire.
(h) Remove the intake manifold No. 2 insulator.



19. **1ZZ–FE:**
REMOVE INTAKE MANIFOLD
(a) Disconnect the EVAP hose for ORVR.
(b) Disconnect the brake booster vacuum hose.
(c) Remove the 4 bolts, 2 nuts, intake manifold, 2 wire harness stays and gasket.



20. 2ZZ–GE:
REMOVE INTAKE MANIFOLD

(a) Disconnect the EVAP hose for ORVR.
(b) Disconnect the brake booster vacuum hose.
(c) Remove the bolt and disconnect the No. 1 ventilation pipe and oil dipstick and guide.
(d) Remove the 2 bolts, nut and stay.
(e) Remove the 4 bolts, 2 nuts, intake manifold and gasket.
(f) Remove the intake manifold insulator.

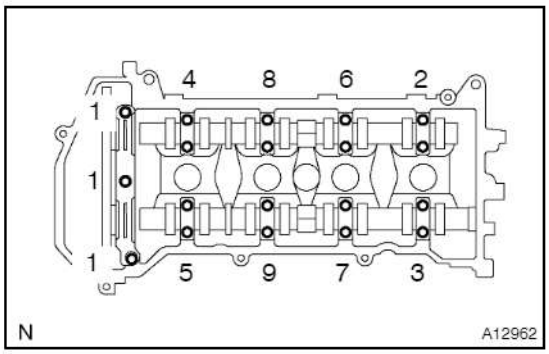
21. REMOVE CAMSHAFT POSITION SENSOR

22. REMOVE ECT SENSOR

23. REMOVE PCV VALVE AND GROMMET

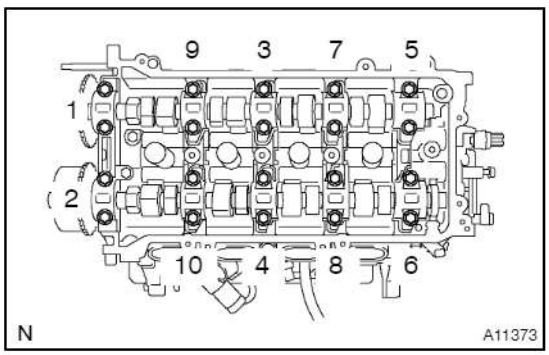
24. REMOVE OIL FILLER CAP

25. REMOVE CAMSHAFT TIMING SPROCKETS
(See page IG–9)



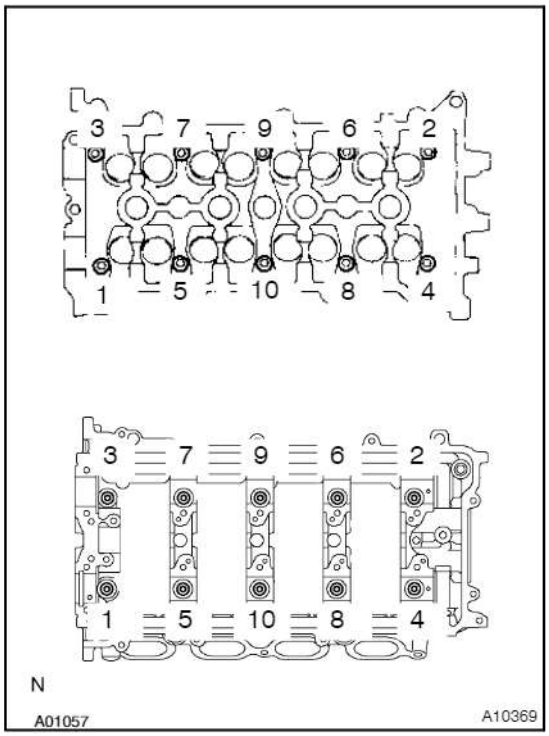
26. 1ZZ–FE:
REMOVE CAMSHAFT

Uniformly loosen and remove the 19 bearing cap bolts, in several passes, in the sequence shown, and remove the 9 bearing caps, intake and exhaust camshafts.



27. 2ZZ–GE:
REMOVE CAMSHAFT

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 camshaft.



28. REMOVE CYLINDER HEAD

(a) Disconnect the upper radiator hoses from the water hose union.

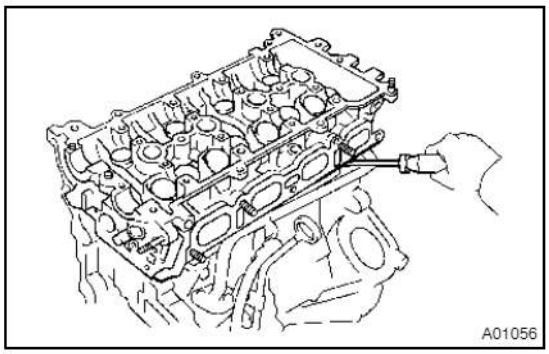
(b) Disconnect the heater water hose from the water hose union.

(c) 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:

Head warpage or cracking could result from removing bolts in an incorrect order.

(d) Remove the bolt holding the water bypass pipe to the cylinder head.



(e) Lift the cylinder from the dowels on the cylinder block and replace the cylinder head on wooden blocks on a bench.

HINT:

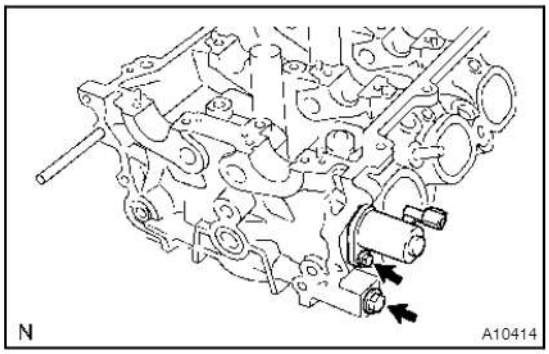
If the cylinder head is difficult to lift off, pry between the cylinder head and cylinder block with a screwdriver.

NOTICE:

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

EM15V–02

DISASSEMBLY

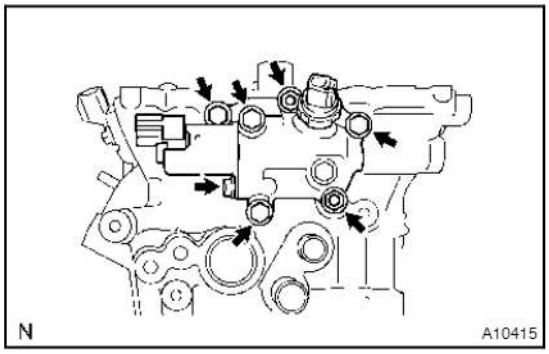


1. REMOVE OIL CONTROL VALVE for VVT

Remove the bolt and cam timing oil control valve.

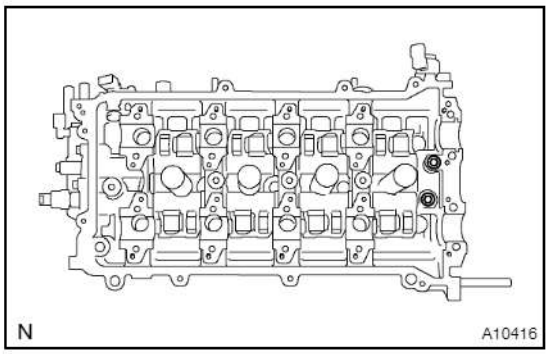
2. REMOVE OIL CONTROL VALVE FILTER

Remove the bolt, gasket and oil control valve filter.



3. 2ZZ–GE:
REMOVE OIL CONTROL VALVE HOUSING

(a) Remove the bolt and oil control valve for VVTL.
(b) Using SST, remove the oil pressure switch.
SST 09816–30010
(c) Remove the 3 bolts, 2 nuts, oil control valve housing and gasket.
(d) Remove the oil control valve filter.



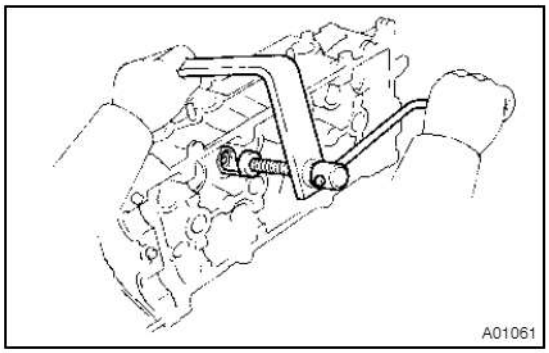
4. 2ZZ–GE:
REMOVE VALVE ROCKER ARM

(a) Remove the 2 bolts, rocker No. 1 and No. 2 shafts.
(b) Remove the 8 valve rocker arms.

HINT:
Arrange the rocker arms in the correct order.

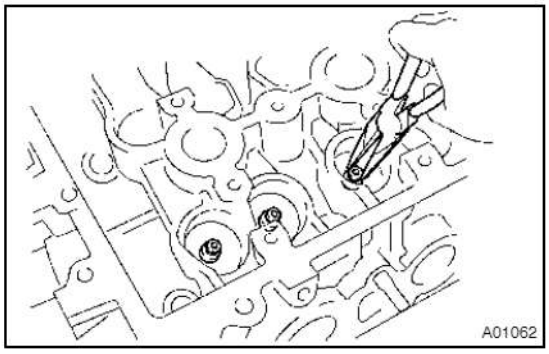
5. REMOVE VALVE LIFTERS

HINT:
Arrange the valve lifters in the correct order.

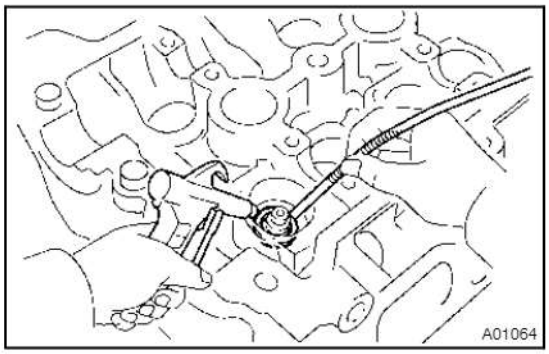


6. REMOVE VALVES

(a) Using SST, compress the valve spring and remove the 2 keepers.
SST 09202–70020 (09202–00020)
(b) Remove the spring retainer.
(c) Remove the valve spring.
(d) Remove the valve.



(e) Using needle–nose pliers, remove the oil seal.



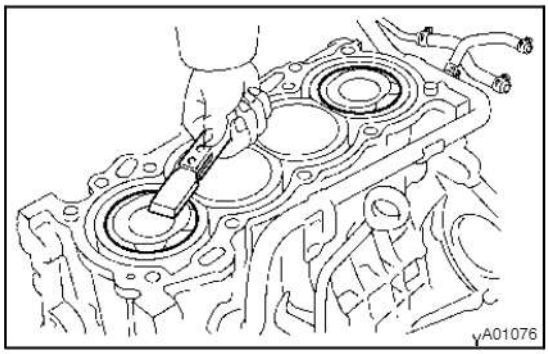
(f) Using compressed air and magnetic finger, remove the spring seat by blowing air.

HINT:

Arrange the valves, valve springs, spring seats, and spring retainers in the correct order.

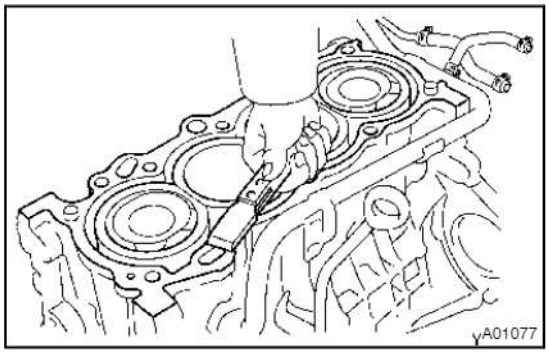
EM15W–08

INSPECTION



1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

(a) Turn the crankshaft, and bring each piston to top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston surface.

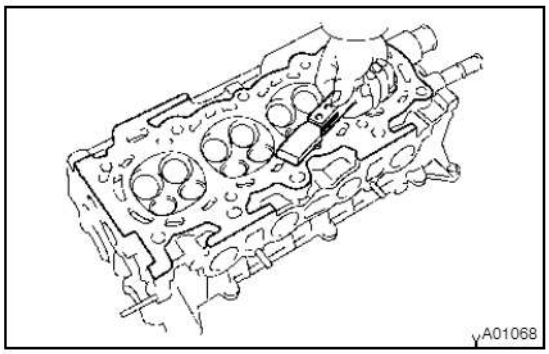


(b) Using a gasket scraper, remove all the gasket material from the cylinder block surface.

(c) Using compressed air, blow carbon and oil from the bolt holes.

CAUTION:

Protect your eyes when using high pressure compressed air.

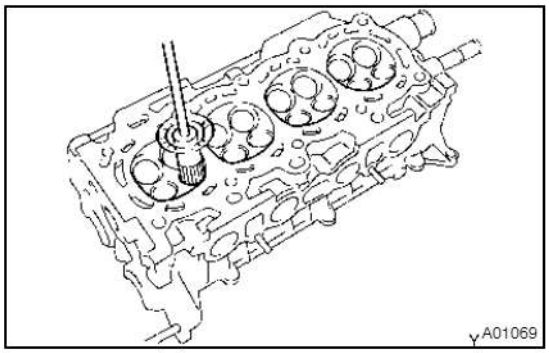


2. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all the gasket materials from the cylinder block contact surface.

NOTICE:

Be careful not to scratch the cylinder block contact surface.

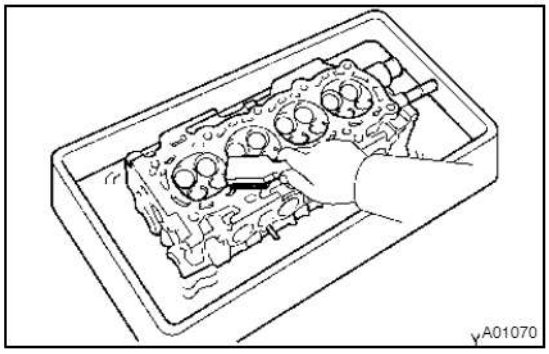


3. CLEAN COMBUSTION CHAMBERS

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

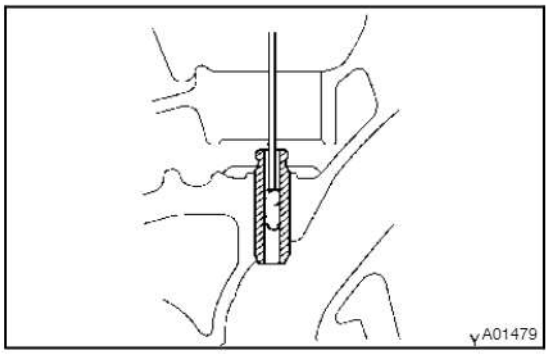
NOTICE:

Be careful not to scratch the cylinder block contact surface.



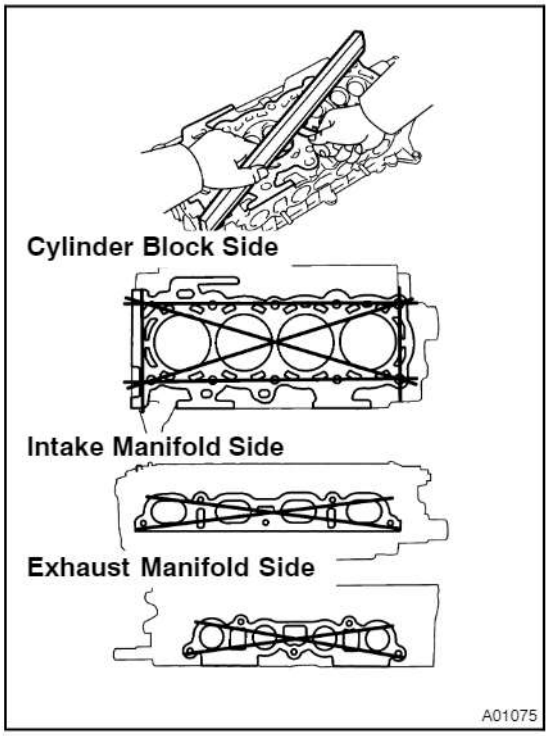
4. CLEAN CYLINDER HEAD

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



5. CLEAN VALVE GUIDE BUSHINGS

Using a valve guide bushing brush and solvent, clean all the guide bushings.

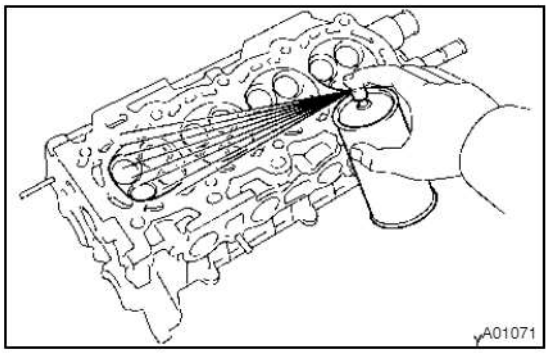


6. INSPECT FOR FLATNESS

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

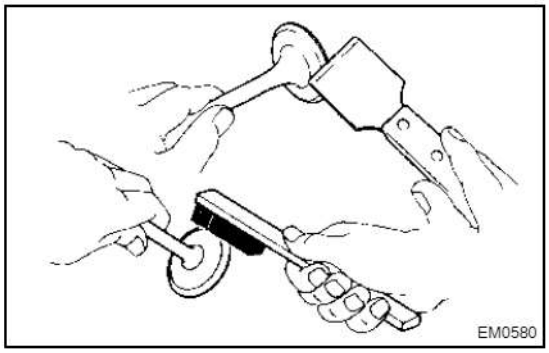
Maximum warpage: 0.05 mm (0.0020 in.)

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



7. INSPECT FOR CRACKS

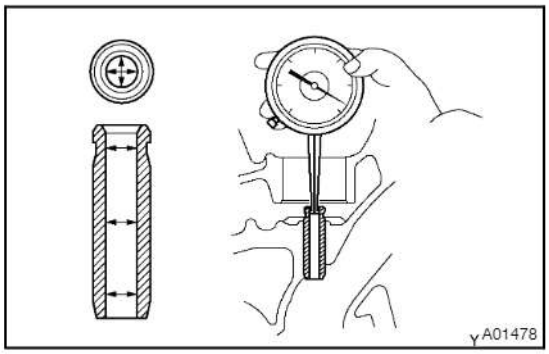
Using a dye penetrate, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.
If cracked, replace the cylinder head.



8. CLEAN VALVES

(a) Using a gasket scraper, chip off any carbon from the valve head.

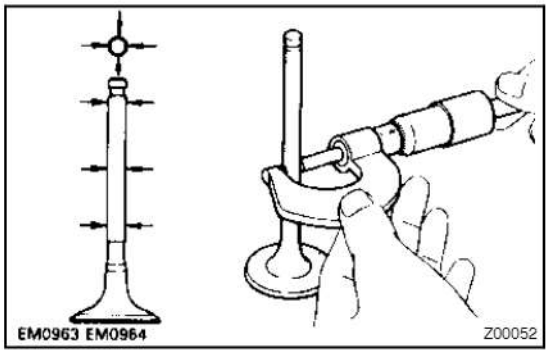
(b) Using a wire brush, thoroughly clean the valve.



9. INSPECT VALVE STEMS AND GUIDE BUSHINGS

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

Bushing inside diameter:
1ZZ–FE 5.510 – 5.530 mm (0.2169 – 0.2177 in.)
2ZZ–GE 5.500 – 5.518 mm (0.2165 – 0.2172 in.)



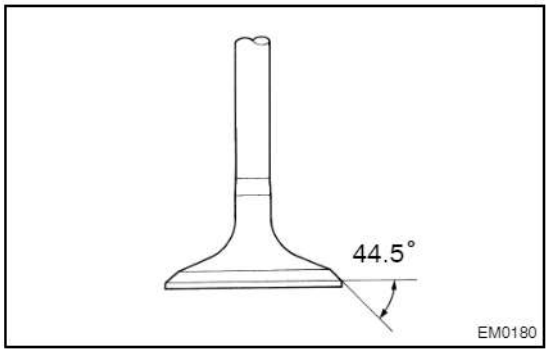
(b) Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter:
1ZZ–FE
Intake 5.470 – 5.485 mm (0.2154 – 0.2159 in.)
Exhaust 5.465 – 5.480 mm (0.2152 – 0.2157 in.)
2ZZ–GE
Intake 5.460 – 5.475 mm (0.21496 – 0.21555 in.)
Exhaust 5.445 – 5.470 mm (0.21437 – 0.21535 in.)

(c) Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.

Standard oil clearance:
1ZZ–FE
Intake 0.025 – 0.060 mm (0.0010 – 0.0024 in.)
Exhaust 0.030 – 0.065 mm (0.0012 – 0.0026 in.)
2ZZ–GE
Intake 0.025 – 0.058 mm (0.00098 – 0.00228 in.)
Exhaust 0.030 – 0.063 mm (0.00118 – 0.00248 in.)
Maximum oil clearance:
1ZZ–FE
Intake 0.08 mm (0.0031 in.)
Exhaust 0.10 mm (0.0039 in.)
2ZZ–GE
0.10 mm (0.0039 in.)

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

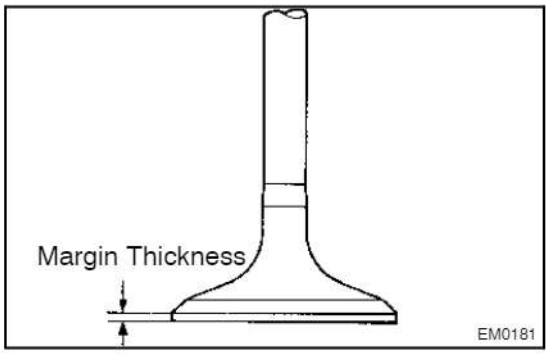


10. INSPECT VALVES

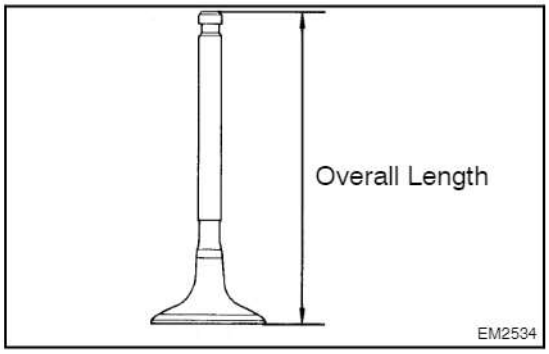
(a) Check the valve is ground to the correct valve face angle.
Valve face angle: 44.5°

(b) Check that the surface of the valve for wear.

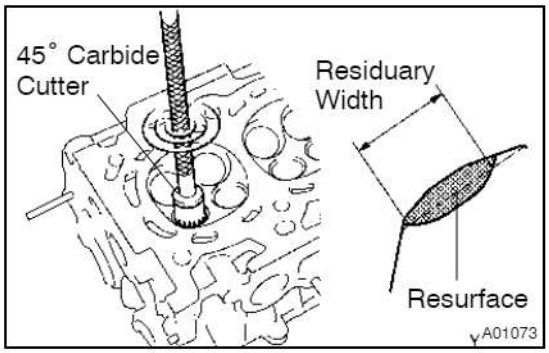
If the valve face is worn, replace the valve.



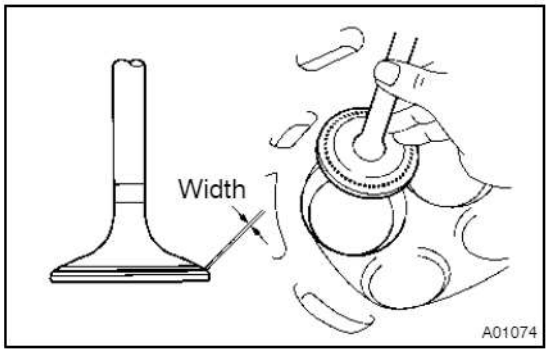
(c) Check the valve head margin thickness.
Standard margin thickness: 1.0 mm (0.039 in.)
Minimum margin thickness: 0.7 mm (0.028 in.)
If the margin thickness is less than minimum, replace the valve.



(d) Check the valve overall length.
Standard overall length:
1ZZ–FE
Intake 88.65 mm (3.4902 in.)
Exhaust 88.69 mm (3.4917 in.)
2ZZ–GE
Intake 111.3 mm (4.382 in.)
Exhaust 111.7 mm (4.398 in.)
Minimum overall length:
1ZZ–FE
Intake 88.35 mm (3.4783 in.)
Exhaust 88.39 mm (3.4799 in.)
2ZZ–GE
Intake 110.9 mm (4.366 in.)
Exhaust 111.3 mm (4.382 in.)
If the overall length is less than minimum, replace the valve.
(e) Check the surface of the valve stem tip for wear.
If the valve stem tip is worn, replace the valve.



11. INSPECT AND CLEAN VALVE SEATS
(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.
(b) After resurfacing the valve seat 45°, measure the residuary width of the valve seat 45°.
Minimum residuary length:
Intake 3.3 mm (0.130 in.)
Exhaust 3.2 mm (0.126 in.)

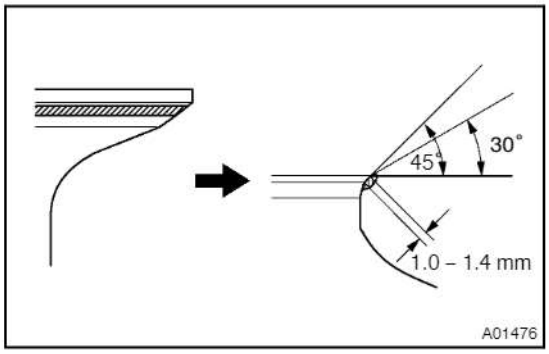


If the valve seat 45° residuary width less than minimum, replace the cylinder head.
(c) Check the valve seating position.
Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate valve.
(d) Check the valve face and seat for the following:
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.

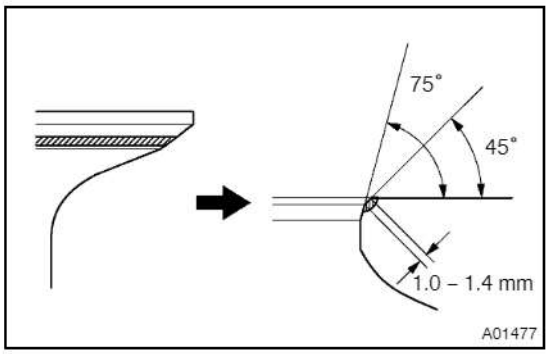
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is in the middle of the valve face with the following width:

1.0 – 1.4 mm (0.039 – 0.055 in.)

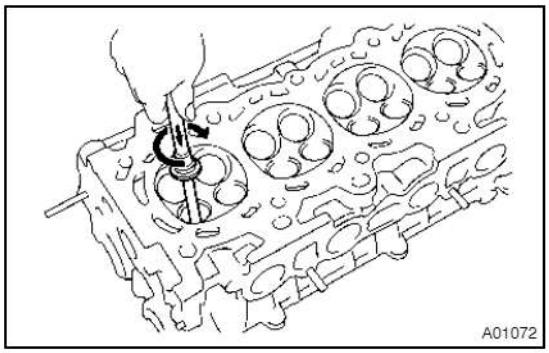
If not, correct the valve seats as follows:



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

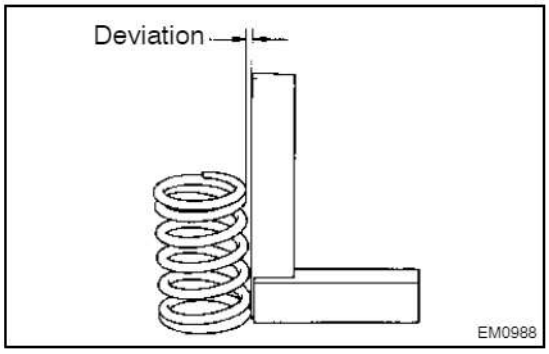


(2) If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.



(e) Hand–lap the valve and valve seat with an abrasive compound.

(f) After hand–lapping, clean the valve and valve seat.



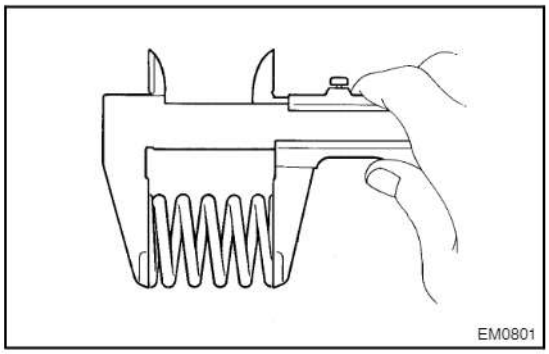
12. INSPECT VALVE SPRINGS

(a) Using a steel square, measure the deviation of the valve spring.

Maximum deviation: 1.6 mm (0.063 in.)

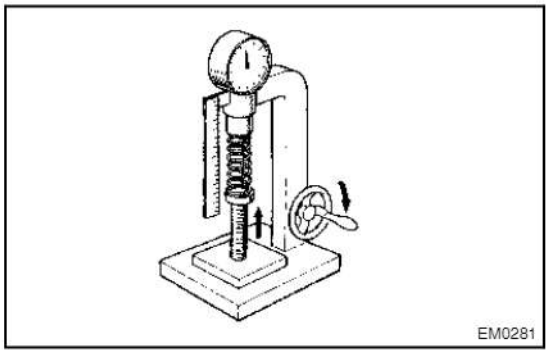
Maximum angle (reference): 2°

If the deviation is greater than maximum, replace the valve spring.



(b) Using vernier calipers, measure the free length of the valve spring.

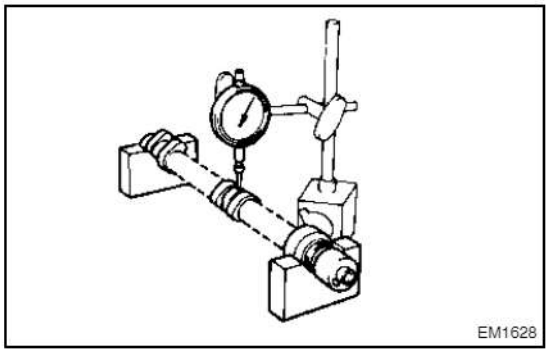
Free length:
1ZZ–FE 45.90 mm (1.8070 in.)
2ZZ–GE
Intake 46.4 mm (1.830 in.)
Exhaust 46.5 mm (1.831 in.)



(c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

Installed tension:
1ZZ–FE
139.6 – 154.4 N (14.2 – 15.8 kgf, 31.3 – 34.8 lbf)
at 33.6 mm (1.323 in.)
2ZZ–GE
Intake
220.2 – 243.8 N (22.5 – 24.7 kgf, 49.6 – 55.5 lbf)
at 38.5 mm (1.516 in.)
Exhaust
208.2 – 229.8 N (21.2 – 23.4 kgf, 47.6 – 52.6 lbf)
at 38.5 mm (1.516 in.)
Maximum working tension:
1ZZ–FE
244.9 – 276.1 N (25.5 – 28.1 kgf, 56.2 – 61.9 lbf)
at 24.6 mm (0.969 in.)
2ZZ–GE
Intake
533 – 589 N (54.4 – 60.1 kgf, 119.9 – 132.5 lbf)
at 27.3 mm (1.075 in.)
Exhaust
495.5 – 548.5 N (50.5 – 55.9 kgf, 111.3 – 123.2 lbf)
at 28.5 mm (1.122 in.)

If the installed tension is not as specified, replace the valve spring



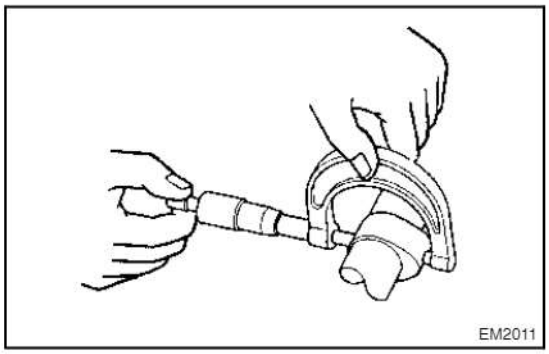
13. INSPECT CAMSHAFT FOR RUNOUT

(a) Place the camshaft on V–blocks.

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

Maximum circle runout: 0.03 mm (0.0012 in.)

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

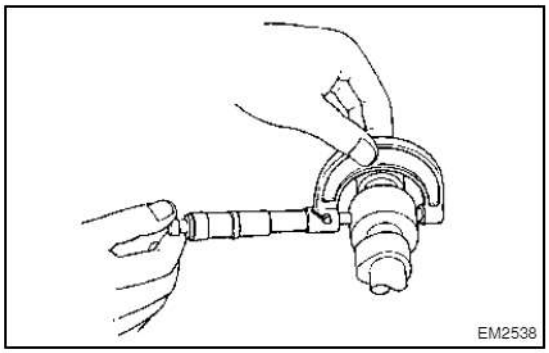

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14. INSPECT CAM LOBES

Using a micrometer, measure the cam lobe height.

Standard cam lobe height:
1ZZ–FE:
Intake 44.333 – 44.433 mm (1.7454 – 1.7493 in.)
Exhaust 43.761 – 43.861 mm (1.7229 – 1.7268 in.)
2ZZ–GE:
INTAKE
No. 1 40.607 – 40.707 mm (1.59586 – 1.59979 in.)
No. 2 38.769 – 38.869 mm (1.52362 – 1.52755 in.)
2ZZ–GE:
EXHAUST
No. 1 40.019 – 40.119 mm (1.57275 – 1.57668 in.)
No. 2 38.863 – 38.963 mm (1.52732 – 1.53125 in.)
Minimum cam lobe height:
1ZZ–FE:
Intake 44.18 mm (1.7394 in.)
Exhaust 43.61 mm (1.7169 in.)
2ZZ–GE:
Intake
No.1 40.45 mm (1.5925 in.)
No.2 38.61 mm (1.5201 in.)
Exhaust
No.1 39.86 mm (1.5693)
No.2 38.71 mm (1.5240)

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

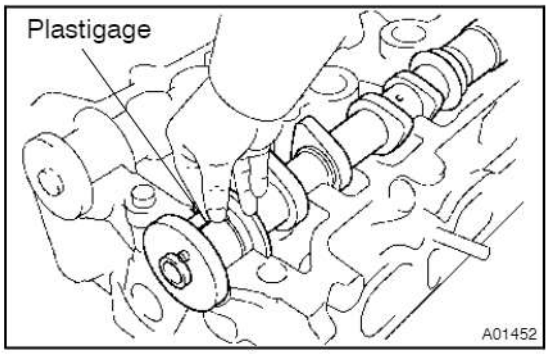

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15. INSPECT CAMSHAFT JOURNALS

Using a micrometer, measure the journal diameter.

1ZZ–FE:
No.1 journal diameter:
34.449 – 34.465 mm (1.3563 – 1.3569 in.)
Others journal diameter:
22.949 – 22.965 mm (0.9035 – 0.9041 in.)
2ZZ–GE:
No.1 journal diameter:
34.449 – 34.465 mm (1.35626 – 1.35689 in.)
Other journal diameter:
27.949 – 27.965 mm (1.10035 – 1.10098 in.)

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

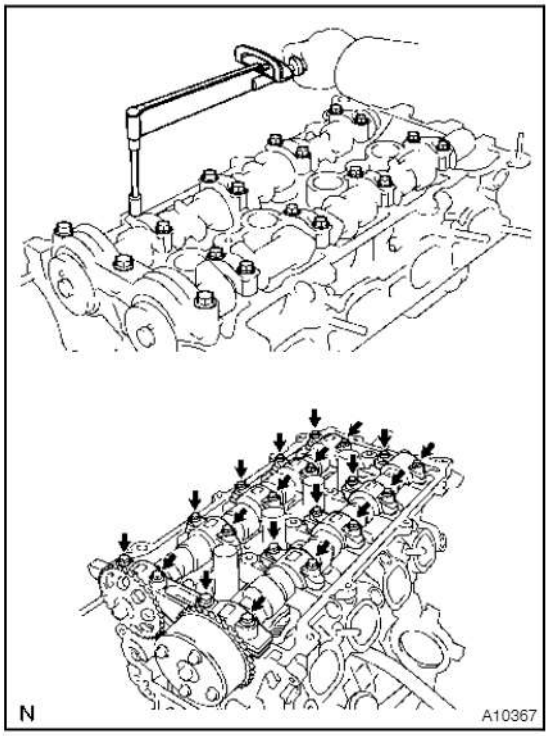


16. INSPECT CAMSHAFT JOURNAL CLEARANCE

(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.

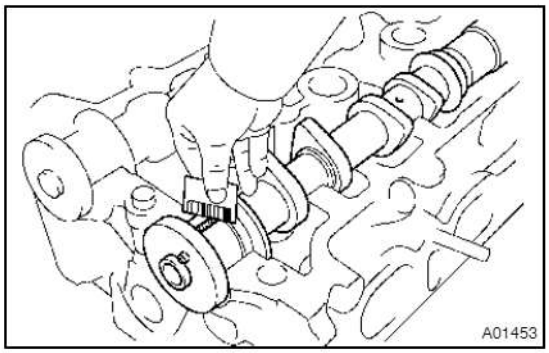


(d) Install the bearing caps (See page EM–67).

Torque:
1ZZ–FE:
No.1 23 N·m (235 kgf·cm, 17 ft·lbf)
No.3 13 N·m (133 kgf·cm, 10 ft·lbf)
2ZZ–GE: 18.5 N·m (189 kgf·cm, 14 ft·lbf)

NOTICE:
Do not turn the camshaft.

(e) Remove the bearing caps.



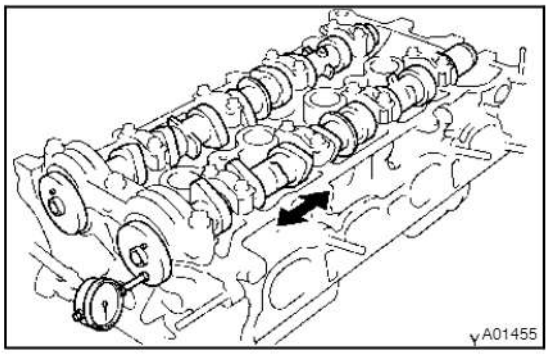
(f) Measure the plastigage at its widest point.

1ZZ–FE:
Standard oil clearance:
0.035 – 0.072 mm (0.0014 – 0.0028 in.)
Maximum oil clearance:
0.10 mm (0.0039 in.)
2ZZ–GE:
Standard oil clearance:
No. 1 journal 0.035 – 0.076 mm (0.00138 – 0.00299 in.)
Other journal 0.035 – 0.072 mm (0.00138 – 0.00283 in.)
Maximum oil clearance:
0.10 mm (0.039 in.)

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

(g) Completely remove the Plastigage.

(h) Remove the camshafts.



17. INSPECT CAMSHAFT THRUST CLEARANCE

(a) Install the camshafts (See page EM–67).

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

1ZZ–FE:

Standard thrust clearance:

0.040 – 0.095 mm (0.0016 – 0.0037 in.)

Maximum thrust clearance:

0.11 mm (0.0043 in.)

2ZZ–GE:

Standard thrust clearance:

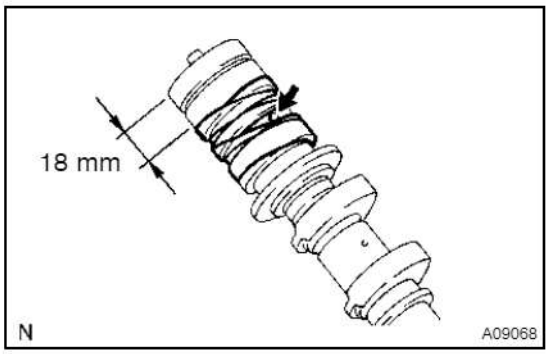
0.04 – 0.14 mm (0.0016 – 0.0055 in.)

Maximum thrust clearance:

0.15 mm (0.0059 in.)

If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

(c) Remove the camshafts.



18. INSPECT VALVE TIMING CONTROLLER ASSEMBLY

(a) Apply vinyl tape to all the ports except the one indicated by the arrow in the illustration.

NOTICE:

Do not apply tape in the range from the tip of the camshaft to 18 mm from that tip.

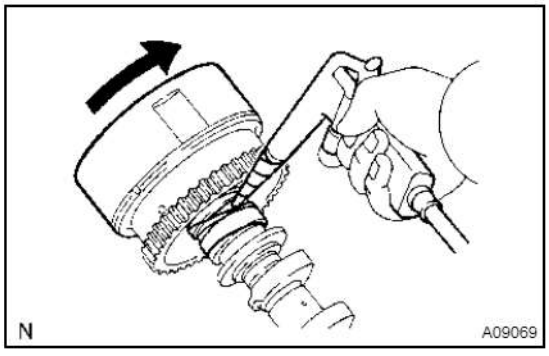
(b) Install the valve timing controller assembly.

Torque: 47 N·m (480 kgf·cm, 35 ft·lbf)

NOTICE:

Do not push valve timing controller assembly to the camshaft forcibly when installing it.

(c) Check that the valve timing controller assembly will not turn.



(d) Wind tape around the tip of the air gun and apply air of approx. 100 kPa (1 kgf/cm^2, 14 psi) to the port of the camshaft.

NOTICE:

When the oil splashes, wipe it off with a shop rag and the likes.

HINT:

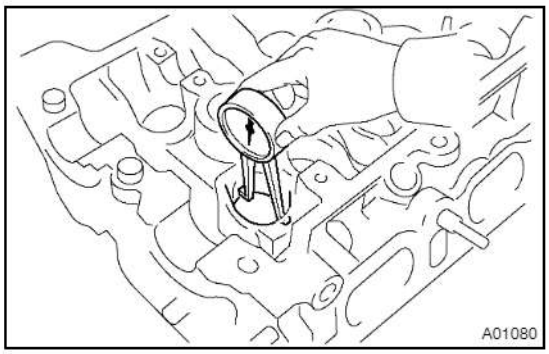
Perform this in order to release the lock pin for the maximum delay angle locking.

(e) Under the condition of (d), turn the valve timing controller assembly to the advance angel side (the arrow marked direction in the illustration) with your hand.
Standard: Must turn

HINT:
Depending on the air pressure, the valve timing controller assembly will turn to the advance angle side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.

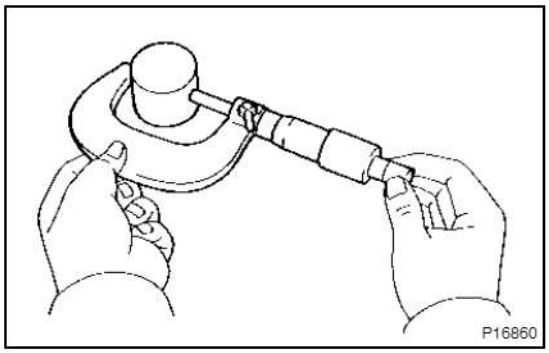
(f) Except the position where the lock pin meets at the maximum delay angle, let the valve timing controller assembly turn back and forth and check the movable range and that there is no disturbance.
Standard: Movable smoothly in the range about 30°

(g) Turn the valve timing controller assembly with your hand and lock it at the maximum delay angel position.



19. 1ZZ–FE:
INSPECT VALVE LIFTERS AND LIFTER BORES

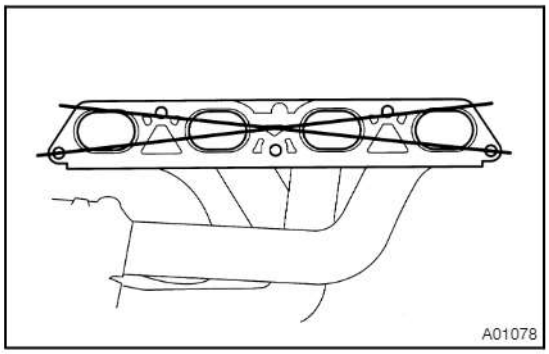
(a) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.
Lifter bore diameter:
31.000 – 31.025 mm (1.2205 – 1.2215 in.)



(b) Using a micrometer, measure the lifter diameter.
Lifter diameter:
30.966 – 30.976 mm (1.2191 – 1.2195 in.)

(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.
Standard oil clearance:
0.024 – 0.059 mm (0.0009 – 0.0023 in.)
Maximum oil clearance:
0.079 mm (0.0031 in.)

If the oil clearance is greater than maximum, replace the lifter. If necessary, replace the cylinder head.

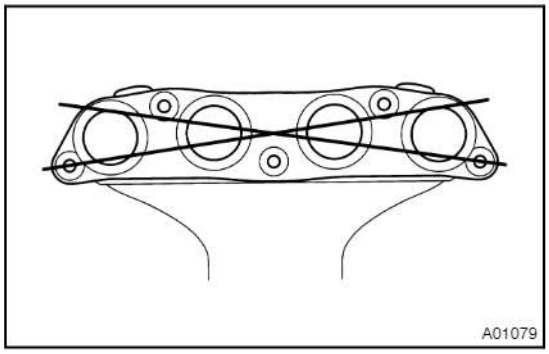


20. INSPECT INTAKE MANIFOLD

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

Maximum warpage: 0.10 mm (0.0039 in.)

If warpage is greater than maximum, replace the manifold.

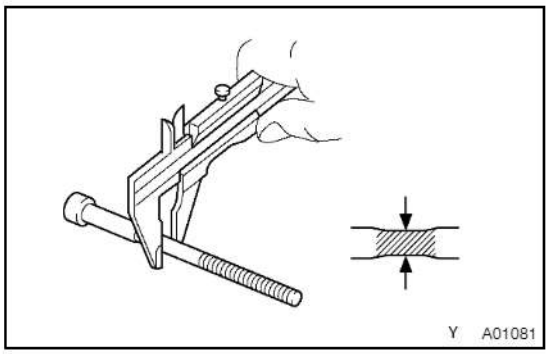


21. INSPECT EXHAUST MANIFOLD

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

Maximum warpage: 0.70 mm (0.0276 in.)

If warpage is greater than maximum, replace the manifold.



22. INSPECT CYLINDER HEAD BOLTS

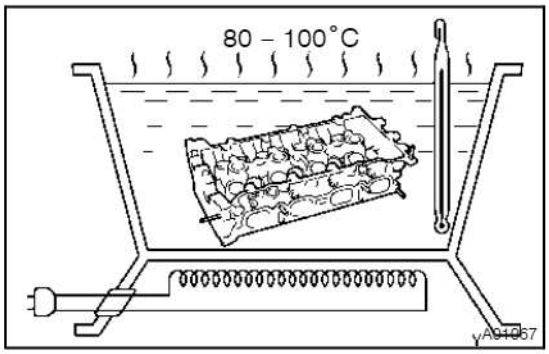
Standard outside diameter:
9.0 – 9.2 mm (0.354 – 0.362 in.)
Minimum outside diameter:
9.0 mm (0.354 in.)

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

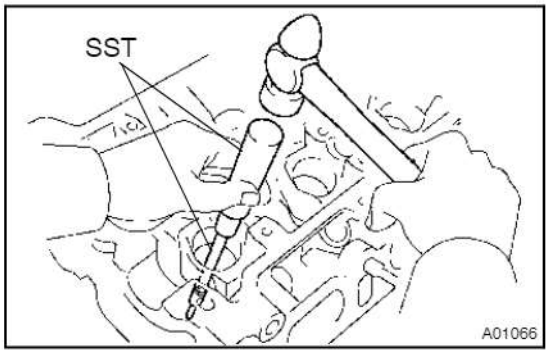
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REPLACEMENT

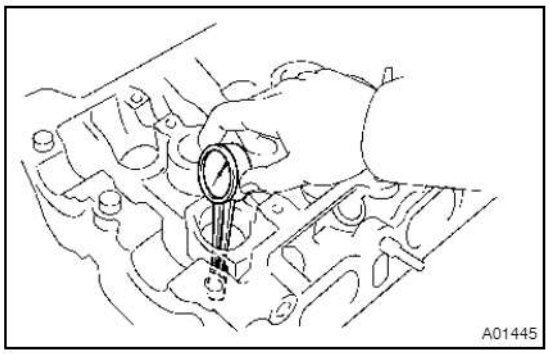
REPLACE VALVE GUIDE BUSHINGS



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



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



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

Both intake and exhaust

Bushing bore diameter mm (in.)	Bushing size
10.285 – 10.306 (0.4049 – 0.4057)	Use STD
10.335 – 10.356 (0.4068 – 0.4077)	Use O/S 0.05

(d) 1ZZ–FE:
Select the new guide bushing (STD or O/S 0.05).

If the bushing bore diameter of the cylinder head is greater than 10.306 mm (0.4057 in.), machine the bushing bore to the following dimension:

10.335 – 10.356 mm (0.4068 – 0.4077 in.)

If the bushing bore diameter of the cylinder head is greater than 10.356 mm (0.4077 in.), replace the cylinder head.

(e) 1ZZ–FE:
Gradually heat the cylinder head to 80 – 100 °C (176 – 212 °F).

Both intake and exhaust

Bushing bore diameter mm (in.)	Bushing size
10.488 – 10.506 (0.4129 – 0.4136)	Use STD
10.538 – 10.556 (0.4149 – 0.4156)	Use O/S 0.05

(f) 2ZZ–GE:

Select the new guide bushing (STD or O/S 0.05).

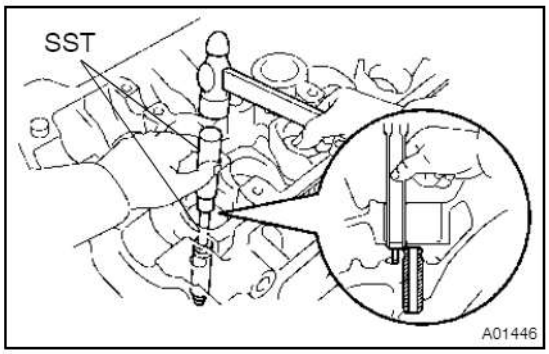
If the bushing bore diameter of the cylinder head is greater than 10.506 mm (0.4136 in.), machine the bushing bore to the following dimension:

10.538 – 10.556 mm (0.4149 – 0.4156 in.)

If the bushing bore diameter of the cylinder head is greater than 10.556 mm (0.4156 in.), replace the cylinder head.

(g) 2ZZ–GE:

Gradually heat the cylinder head to 110 – 130 °C (230 – 266 °F).



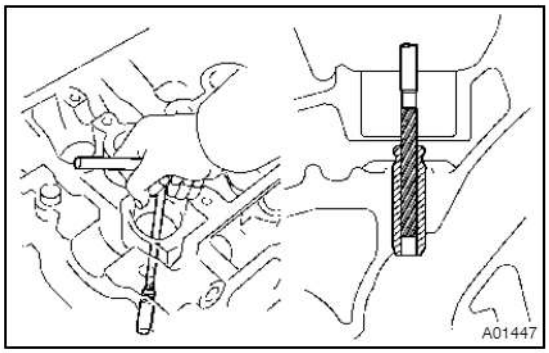
(h) Using SST and a hammer, tap in a new guide bushing to the specified protrusion height.

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

Protrusion height:

1ZZ–FE 8.7 – 9.1 mm (0.342 – 0.358 in.)

2ZZ–GE 15.3 – 15.7 mm (0.602 – 0.618 in.)



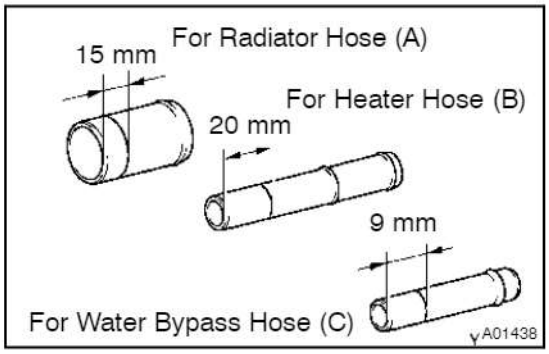
(i) Using a sharp 5.5 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page EM–50) between the guide bushing and valve stem.

EM15X–02

REASSEMBLY

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
- Replace oil seals with new ones.

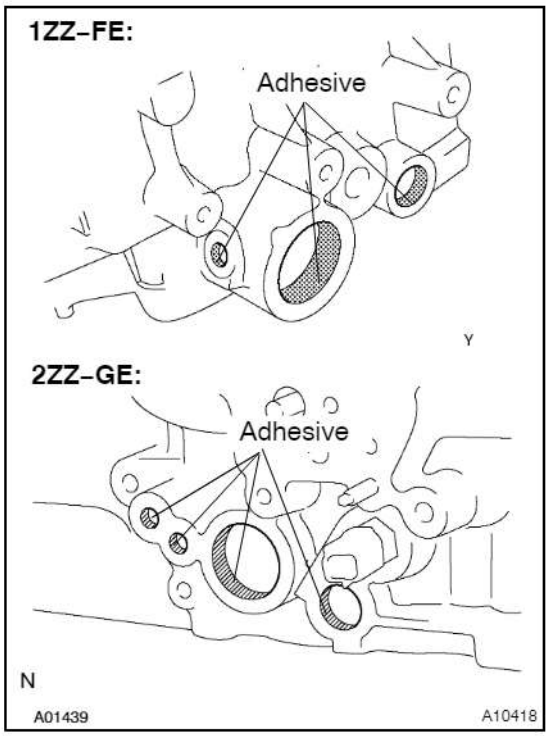


1. INSTALL WATER HOSE UNIONS

HINT:

When using a new cylinder head, water hose unions must be installed.

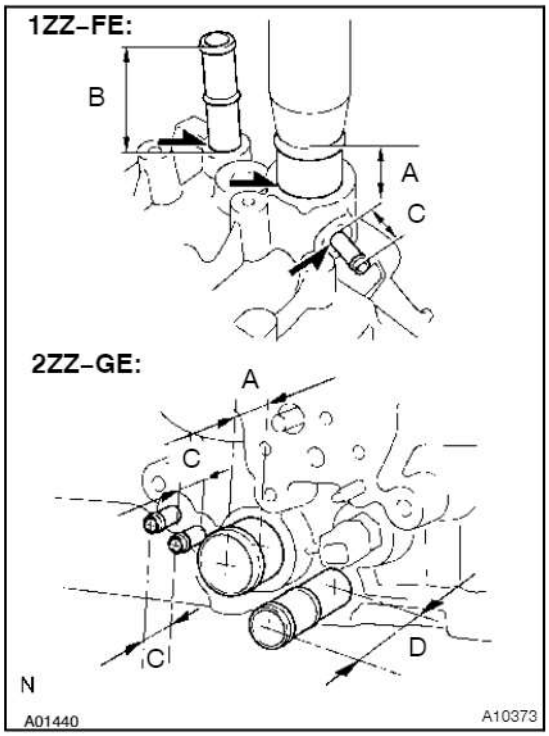
(a) Mark the standard position away from the edge, onto the water hose union.



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

Adhesive:

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

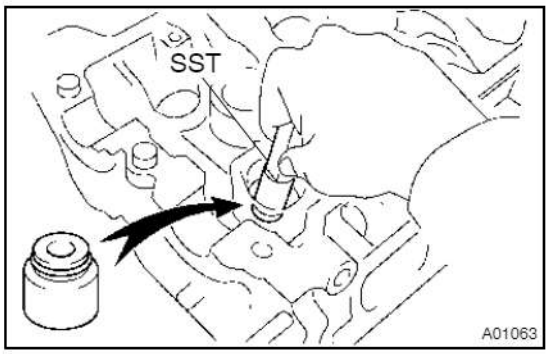


(c) Using a press, press in a new water hose union until there is protruding from the cylinder head.

Standard protrusion:
A 29 mm (1.14 in.)
B 66.5 mm (2.618 in.)
C 24 mm (0.95 in.)
D 69.8 mm (2.630 in.)

NOTICE:

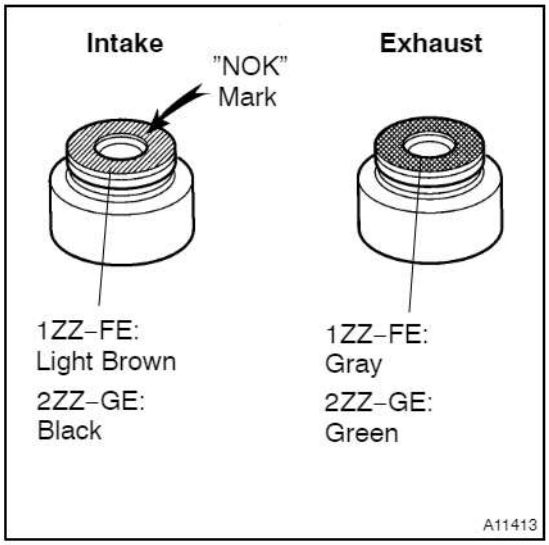
Avoid pressing a new water hose union in too far by measuring the amount of protrusion while pressing.



2. INSTALL VALVES

(a) Install the spring seat.

(b) Using SST, push in a new oil seal.
SST 09201–41020

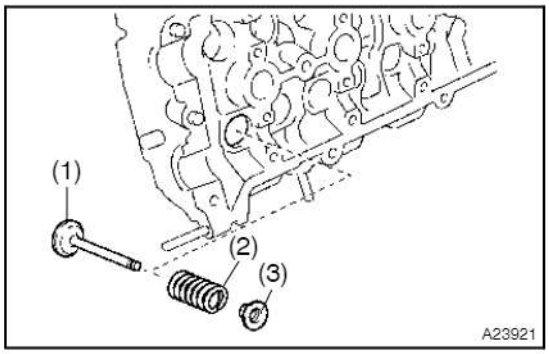


HINT:

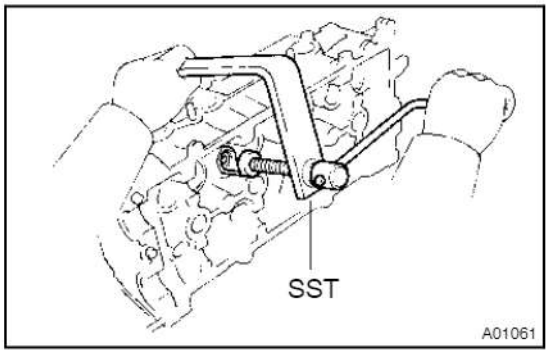
- 1ZZ–FE:
  The intake valve oil seal is light brown and the exhaust valve oil seal is gray.
- 2ZZ–GE:
  The intake valve oil seal is black and the exhaust valve oil seal is green.

NOTICE:

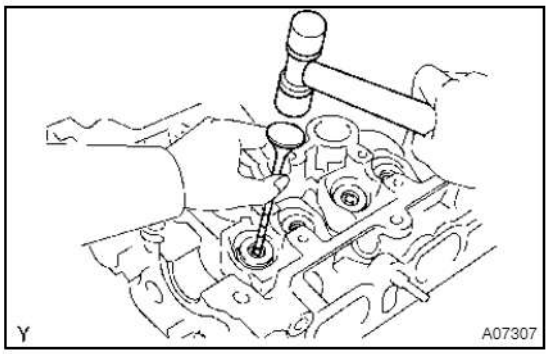
Pay much attention assembling the oil seal for intake and exhaust. Assembling the wrong one may cause a failure.



(c) Install the valve (1), valve spring (2), and spring retainer (3).



(d) Using SST, compress the valve spring and place the 2 keepers around the valve stem.
SST 09202–70020 (09202–00020)



(e) 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.

3. INSTALL VALVE LIFTERS

(a) Install the valve lifter.

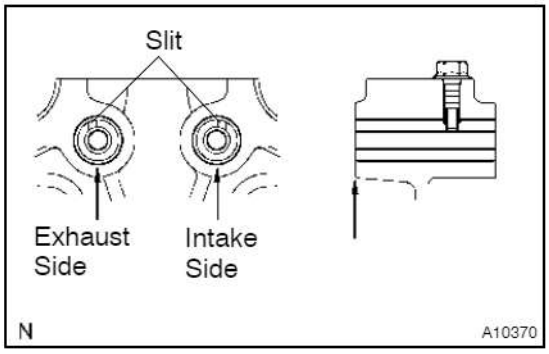
(b) Check that the valve lifter rotates smoothly by hand.

4. 2ZZ–GE:

INSTALL VALVE ROCKER ARM

(a) Set the 8 valve rocker arms.

(b) Install the rocker No. 1 and No. 2 shaft with the 2 bolts.
Torque: 7.5 N·m (76 kgf·cm, 66 in.·lbf)



HINT:

- Position the slit of the locker shaft in the direction shown in the illustration.
- Align the locker shaft end with the cylinder head end.

5. 2ZZ–GE:

INSTALL OIL CONTROL VALVE HOUSING

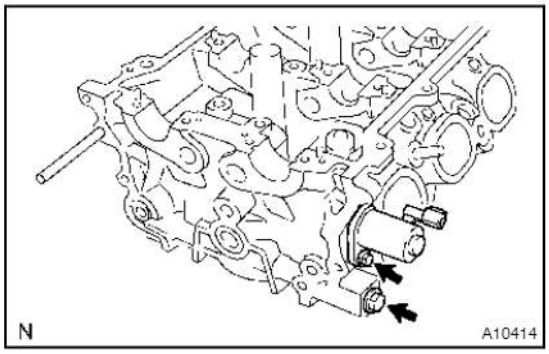
(a) Install the oil control valve filter.

(b) Install the gasket and oil control valve housing with the 3 bolts and 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

(c) Apply adhesive to 2 or 3 threads of the oil pressure switch.
Adhesive:
Part No. 08833–00080, THREE BOND 1344, LOCTITE 242 or equivalent

(d) Using SST, install the oil pressure switch.
SST 09816–30010
Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)

(e) Install the oil control valve for VVTL with the bolt.



6. INSTALL CONTROL VALVE for VVT

Install the oil control valve for VVT with the bolt.

7. INSTALL OIL CONTROL VALVE FILTER

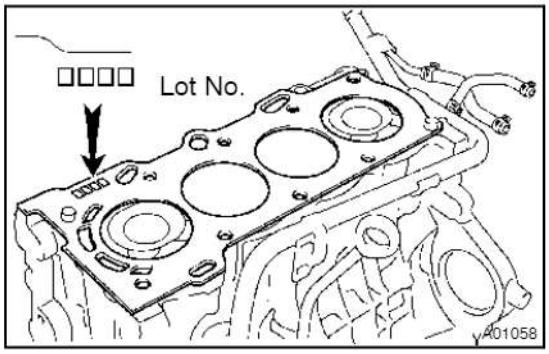
Install the oil control valve filter and new gasket with the bolt.
Torque: 29 N·m (300 kgf·cm, 22 ft·lbf)

EM1W7-03

INSTALLATION

HINT:

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



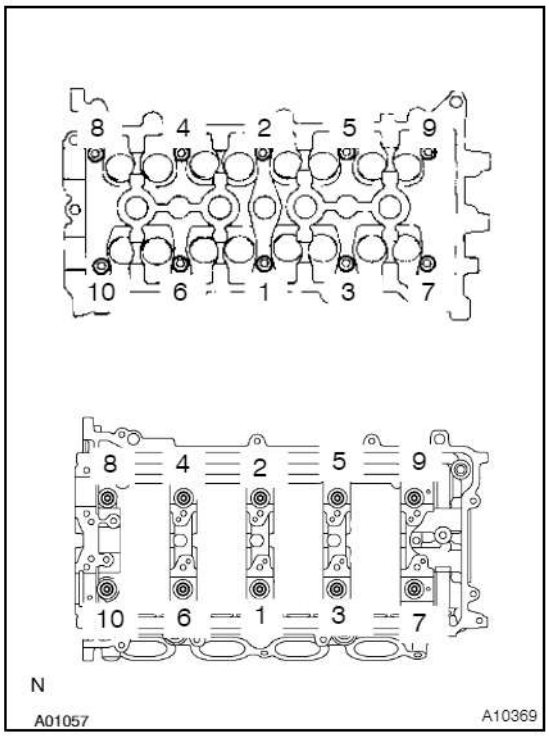
1. PLACE CYLINDER HEAD ON CYLINDER BLOCK

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

NOTICE:

Be careful of the installation direction.

(b) Place the cylinder head quietly in order not to damage the gasket with the bottom part of the head.



2. INSTALL CYLINDER HEAD BOLTS

HINT:

- The cylinder head bolts are tightened in 2 progressive steps (steps (b) and (d)).
- If any cylinder head bolt is broken or deformed, replace it.

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

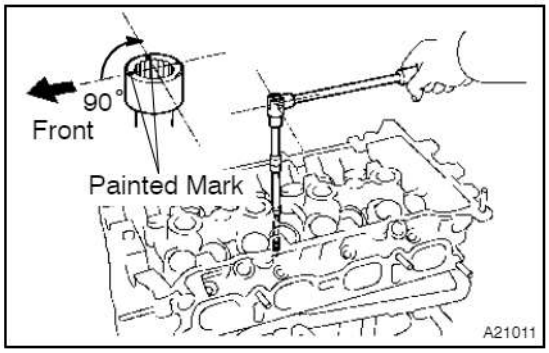
(b) Using a 10 mm bi–hexagon wrench, install and uniformly tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

Torque:

1ZZ–FE: 49 N·m (500 kgf·cm, 36 ft·lbf)

2ZZ–GE: 35 N·m (375 kgf·cm, 26 ft·lbf)

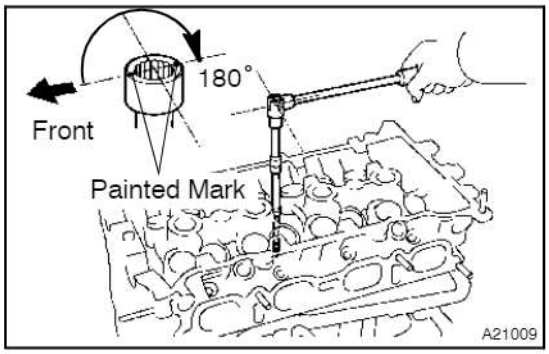
If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.



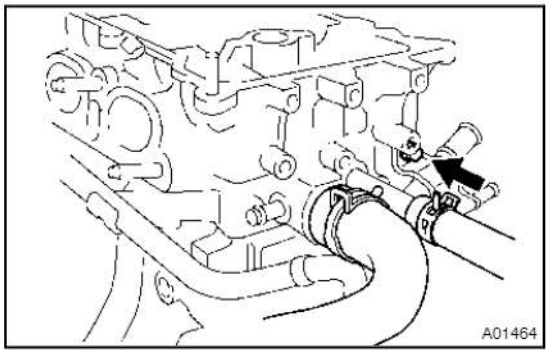
(c) Mark the front of the cylinder head bolt with paint.

(d) 1ZZ–FE:

Retighten the cylinder head bolts 90° in the numerical order shown and check that the paint mark is not at a 90° angle to the front.



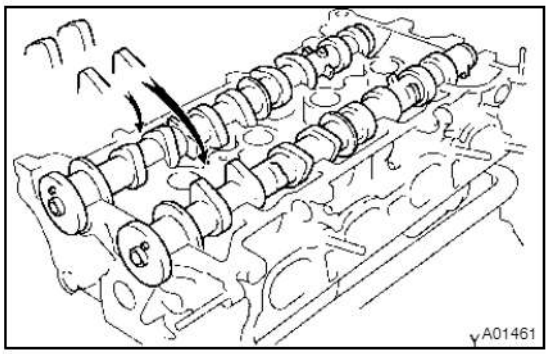
(e) 2ZZ–GE:
Retighten the cylinder head bolts 180° in the numerical order shown and check that the paint mark is not at a 180° angle to the front.



(f) Install the bolt holding the water bypass pipe to the cylinder head.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

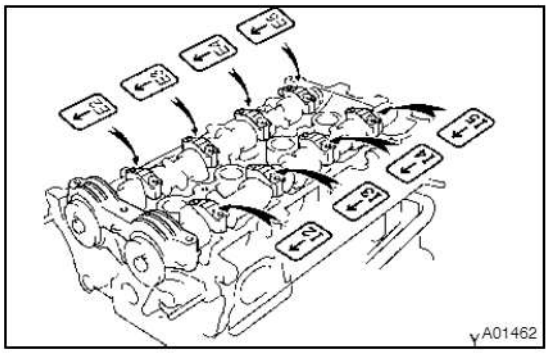
(g) Connect the upper radiator hose to the water hose unions.

(h) Connect the heater hose to the water hose unions.



3. INSTALL CAMSHAFTS

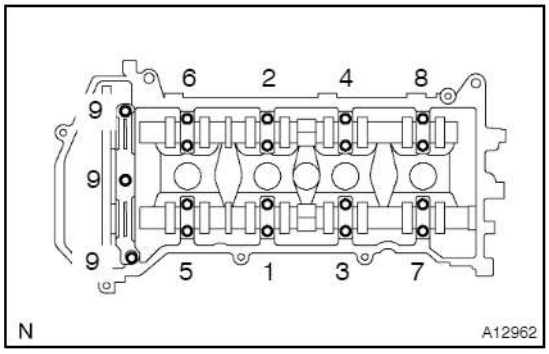
(a) Place the 2 camshafts on the cylinder head with the No. 1 cam lobes facing as shown the illustration.



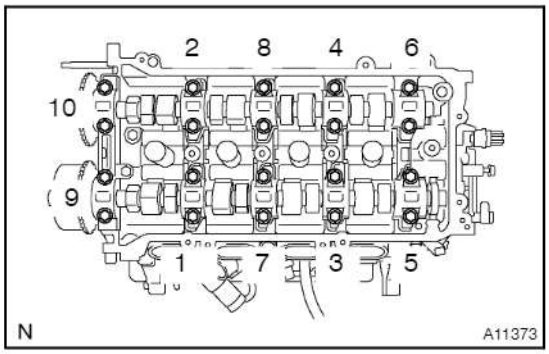
(b) Install the bearing caps in their proper locations.
HINT:

- 1ZZ–FE:
  No. 3 camshaft bearing cap has a number and front mark.
- 2ZZ–GE:
  No. 2, No.3 camshaft bearing cap has a number and front mark.

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



(d) 1ZZ–FE:
Install and uniformly tighten the 19 bearing cap bolts.
After tightening the No. 1 camshaft bearing cap, tighten them in several passes, in the sequence shown.
Torque:
No. 1 23 N·m (235 kgf·cm, 17 ft·lbf)
No. 3 13 N·m (133 kgf·cm, 10 ft·lbf)



(e) 2ZZ–GE:
Install and uniformly tighten the 20 bearing cap bolts. After tightening the No. 1 camshaft bearing cap, tighten them in several passes, in the sequence shown.
Torque: 19 N·m (194 kgf·cm, 14 ft·lbf)

4. CHECK AND ADJUST VALVE CLEARANCE (See page EM–4)

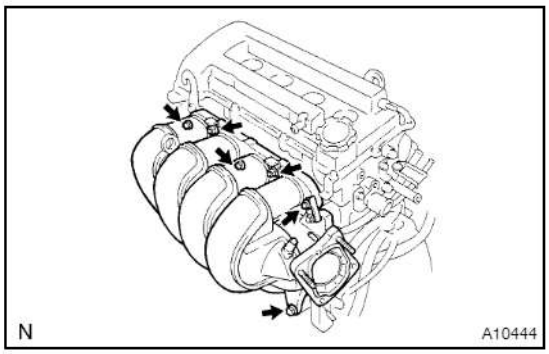
5. INSTALL CAMSHAFT TIMING SPROCKETS AND VALVE TIMING CONTROLLER ASSEMBLY (See page EM–26)

6. INSTALL OIL FILTER CAP

7. INSTALL GROMMET AND PCV VALVE

8. INSTALL ECT SENSOR (See page SF–67)

9. INSTALL CAMSHAFT POSITION SENSOR (See page IG–10)

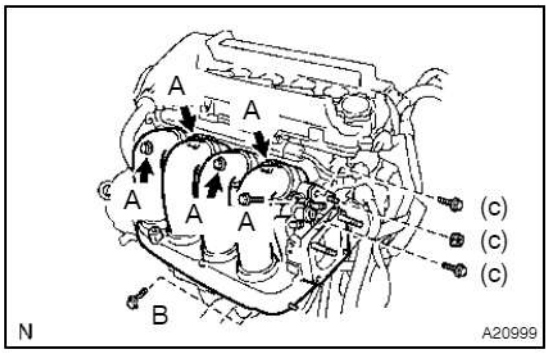


10. 1ZZ–FE:
INSTALL INTAKE MANIFOLD

(a) Install a new gasket, 2 wire harness stays and the intake manifold with the 4 bolts and 2 nuts.
Torque: 30 N·m (306 kgf·cm, 22 ft·lbf)

(b) Connect the brake booster vacuum hose.

(c) Connect the EVAP hose for ORVR.



11. 2ZZ–GE:
INSTALL INTAKE MANIFOLD

(a) Install the intake manifold insulator to the cylinder block.

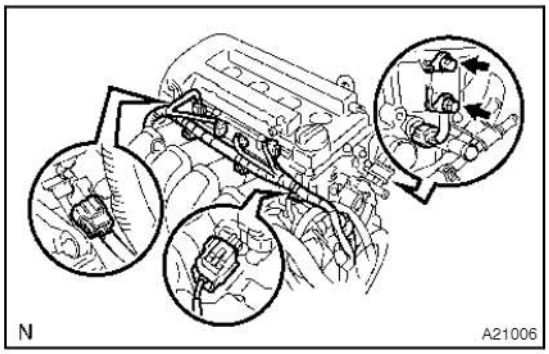
(b) Install a new gasket and the intake manifold with the 4 bolts and 2 nuts.
Torque:
A: 34 N·m (347 kgf·cm, 27 ft·lbf)
B: 46 N·m (469 kgf·cm, 34 ft·lbf)

(c) Install the stay with the 2 bolts and nut.
Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)

(d) Install the No.1 ventilation pipe, oil dipstick and guide with the bolt.
Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)

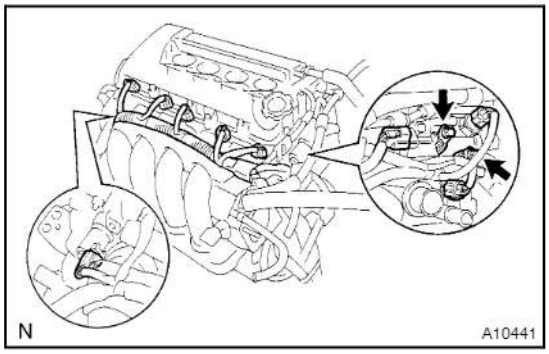
(e) Connect the brake booster vacuum hose.

(f) Connect the EVAP hose for ORVR.



12. 1ZZ–FE:
CONNECT ENGINE WIRE TO CYLINDER HEAD

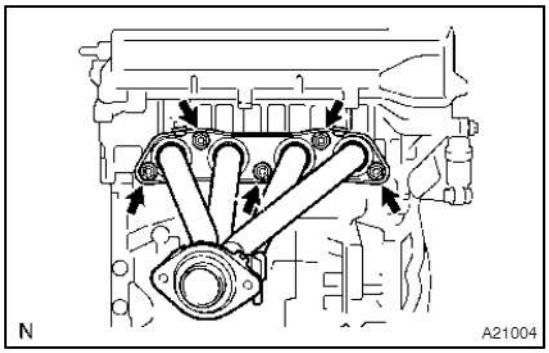
(a) Connect the 2 clamps of engine wire to the intake manifold.
(b) Connect the 2 ground cables.
(c) Connect the oil control valve for VVT connector.
(d) Connect the camshaft position sensor connector.
(e) Connect the ECT sensor connector.



13. 2ZZ–GE:
CONNECT ENGINE WIRE TO CYLINDER HEAD

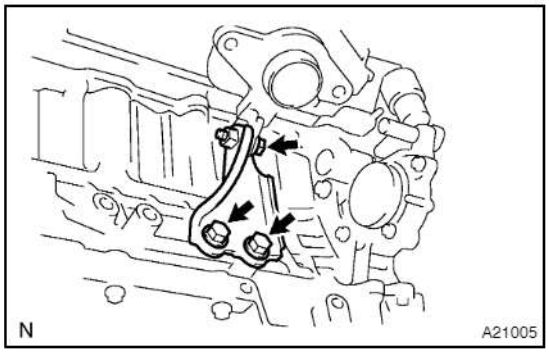
(a) Install the intake manifold insulator No. 2.
(b) Connect the 2 ground cables.
(c) Connect the oil pressure switch connector.
(d) Connect the oil control valve for VVT connector.
(e) Connect the oil control valve for VVTL connector.
(f) Connect the camshaft position sensor connector.
(g) Connect the ECT sensor connector.
(h) Install the accelerator cable bracket with the 2 bolts.

14. INSTALL INJECTORS (See page SF–24)
15. INSTALL THROTTLE BODY (See page SF–38 or SF–44)
16. INSTAL PCV HOSES
17. INSTALL SPARK PLUGS (See page IG–1)
18. INSTALL IGNITION COIL (See page IG–7)

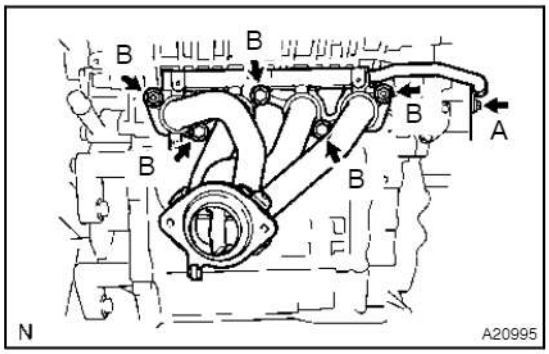


19. 1ZZ–FE:
INSTALL EXHAUST MANIFOLD

(a) Install the lower heat insulator with the 4 bolts.
Torque: 12 N·m (123 kgf·cm, 9 ft·lbf)
(b) Install a new gasket and the exhaust manifold with the 5 nuts. Uniformly tighten the nuts in several passes.
Torque: 37 N·m (377 kgf·cm, 27 ft·lbf)
(c) Install the upper heat insulator with the 4 bolts.
Torque: 18 N·m (184 kgf·cm, 13 ft·lbf)



(d) Install the exhaust manifold stay with the 3 bolts.
Torque: 49 N·m (500 kgf·cm, 37 ft·lbf)



20. 2ZZ–GE:
INSTALL EXHAUST MANIFOLD

(a) Install the lower heat insulator with the 4 bolts.
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)

(b) Install the exhaust manifold with the 4 bolts and 2 nuts.
Torque:
A:20 N·m (204 kgf·cm, 15 ft·lbf)
B:50 N·m (510 kgf·cm, 37 ft·lbf)

(c) Install the upper heat insulator with the 4 bolts.
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)

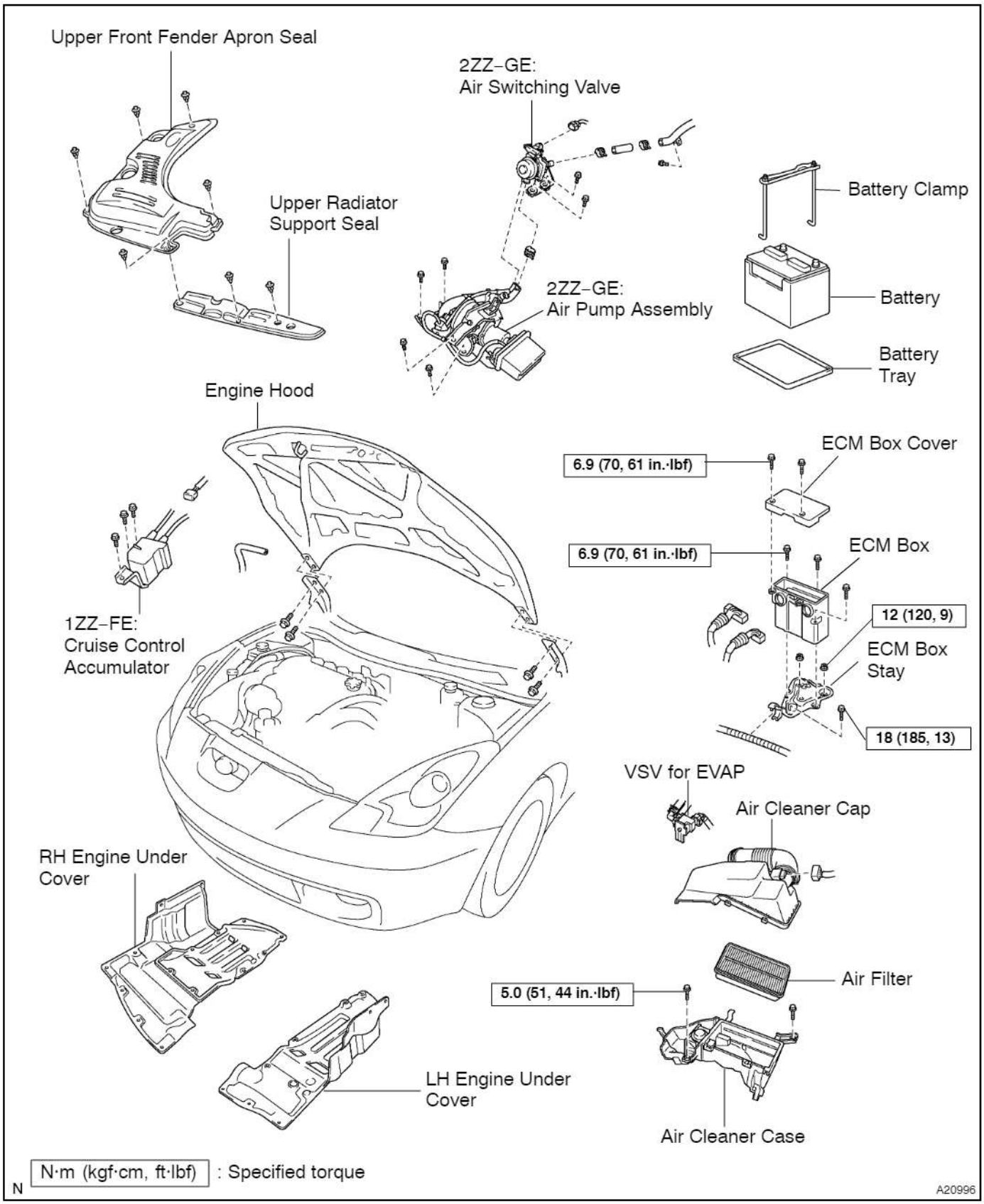
(d) Install the exhaust manifold stay with the 3 bolts.
Torque: 50 N·m (510 kgf·cm, 37 ft·lbf)

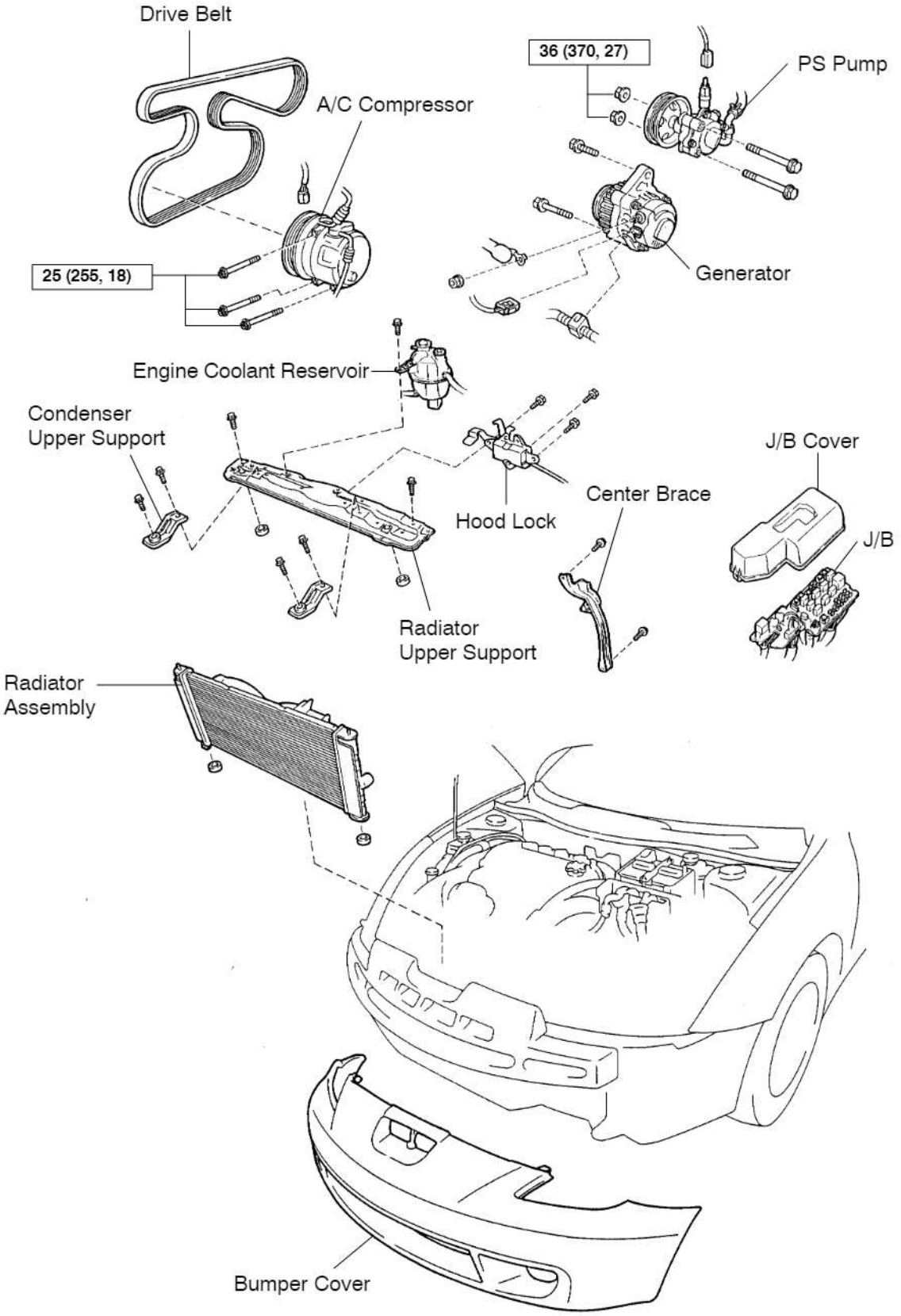
21. INSTALL EXHAUST PIPE (See page EM–82)
22. INSTALL GENERATOR AND DRIVE BELT (See page CH–17)
23. 2ZZ–GE:
INSTALL AIR SWITCHING VALVE (See page EC–18)
24. 1ZZ–FE:
CONNECT ACCELERATOR CABLE
25. INSTALL AIR CLEANER ASSEMBLY
26. INSTALL ECM BOX (See page EM–82)
27. INSTALL BATTERY
28. FILL WITH ENGINE COOLANT (See page CO–2)
29. START ENGINE AND CHECK FOR LEAKS
30. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL

ENGINE UNIT

COMPONENTS

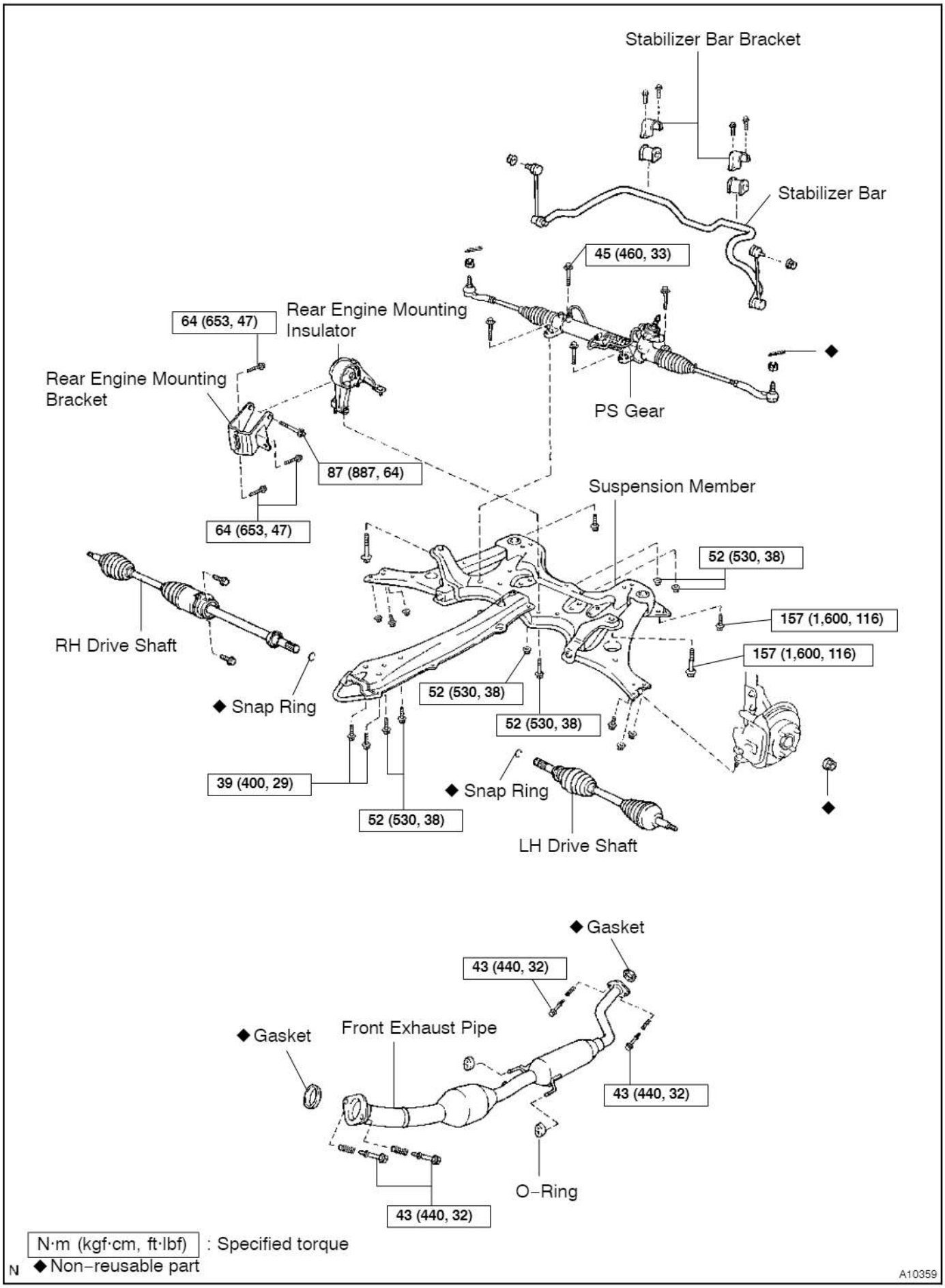
EM15Z-03

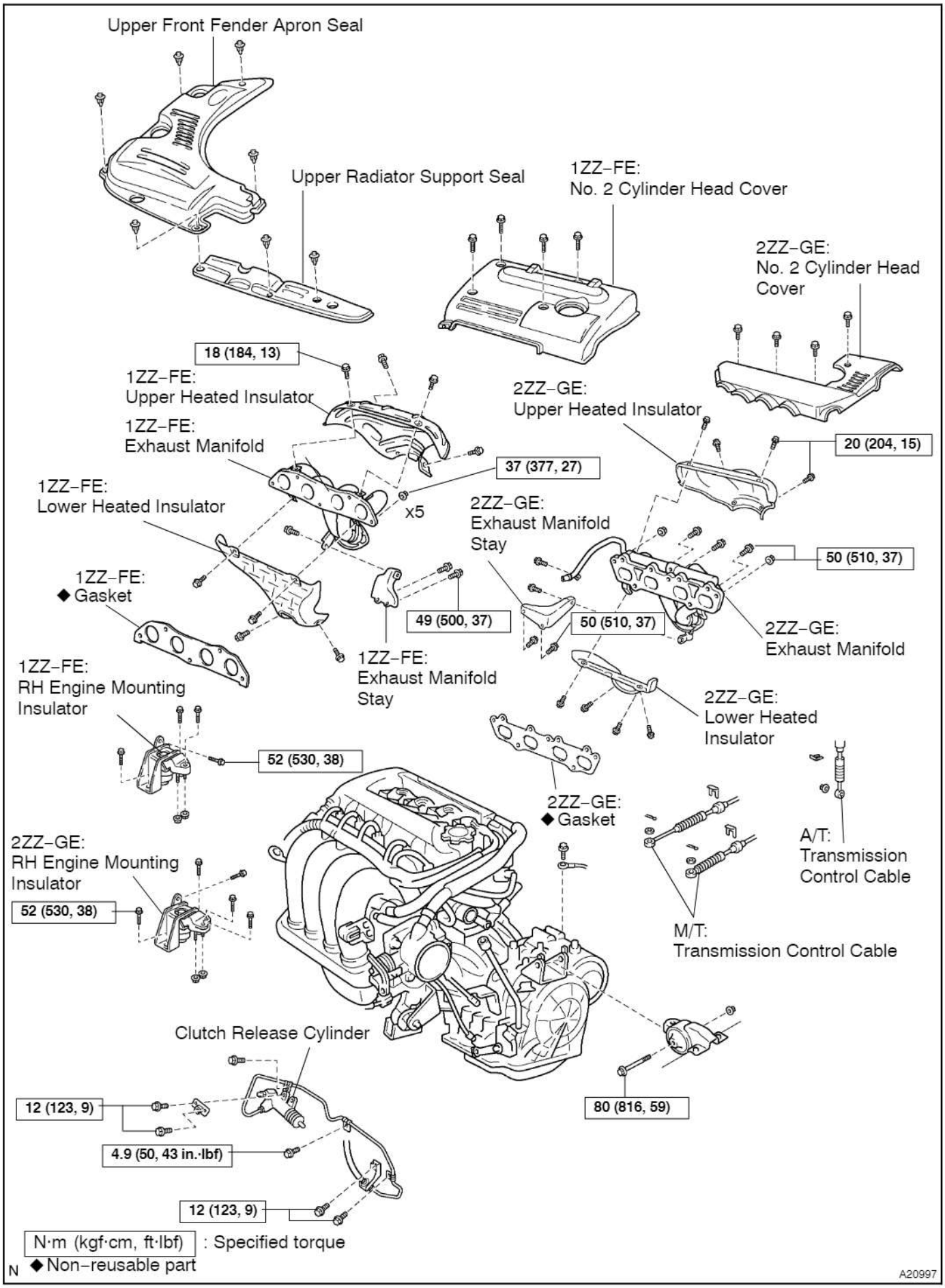




N N·m (kgf·cm, ft·lbf) : Specified torque

A10358

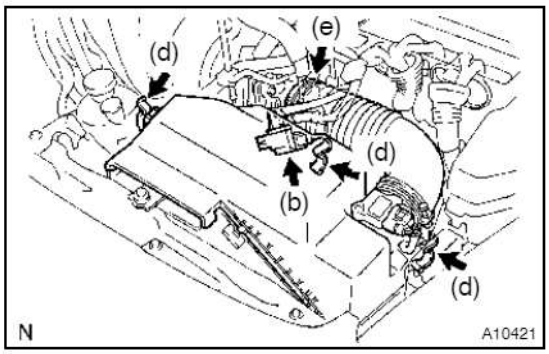

Stabilizer Bar Bracket
Stabilizer Bar
45 (460, 33)
64 (653, 47)
Rear Engine Mounting Insulator
Rear Engine Mounting Bracket
PS Gear
87 (887, 64)
64 (653, 47)
Suspension Member
52 (530, 38)
157 (1,600, 116)
RH Drive Shaft
157 (1,600, 116)
◆ Snap Ring
52 (530, 38)
52 (530, 38)
39 (400, 29)
◆ Snap Ring
52 (530, 38)
LH Drive Shaft
◆ Gasket
43 (440, 32)
◆ Gasket
Front Exhaust Pipe
43 (440, 32)
O–Ring
43 (440, 32)
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
A10359


Upper Front Fender Apron Seal
Upper Radiator Support Seal
1ZZ–FE:
No. 2 Cylinder Head Cover
2ZZ–GE:
No. 2 Cylinder Head
Cover
18 (184, 13)
1ZZ–FE:
Upper Heated Insulator
1ZZ–FE:
Exhaust Manifold
37 (377, 27)
x5
2ZZ–GE:
Upper Heated Insulator
20 (204, 15)
1ZZ–FE:
Lower Heated Insulator
2ZZ–GE:
Exhaust Manifold
Stay
50 (510, 37)
1ZZ–FE:
◆ Gasket
49 (500, 37)
50 (510, 37)
2ZZ–GE:
Exhaust Manifold
1ZZ–FE:
Exhaust Manifold
Stay
1ZZ–FE:
RH Engine Mounting
Insulator
2ZZ–GE:
Lower Heated
Insulator
52 (530, 38)
2ZZ–GE:
◆ Gasket
A/T:
Transmission
Control Cable
2ZZ–GE:
RH Engine Mounting
Insulator
52 (530, 38)
M/T:
Transmission Control Cable
Clutch Release Cylinder
12 (123, 9)
80 (816, 59)
4.9 (50, 43 in.·lbf)
12 (123, 9)
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
N
A20997

EM160-04

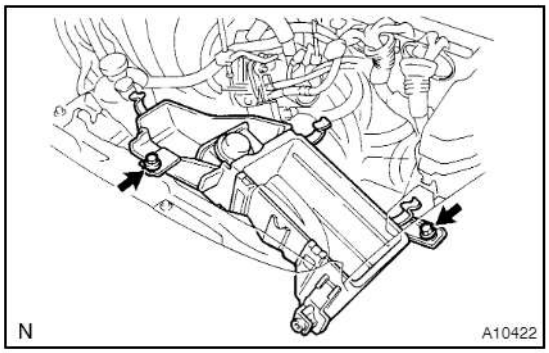
REMOVAL

1. **REMOVE BATTERY AND TRAY**
2. **REMOVE HOOD**
3. **REMOVE ENGINE UNDER COVERS**
4. **DRAIN ENGINE COOLANT**
5. **DRAIN ENGINE OIL**
6. **DRAIN TRANSAXLE OIL**
7. **REMOVE BUMPER COVER AND HEAD LIGHT**
8. **2ZZ–GE:**
   REMOVE AIR SWITCHING VALVE (See page EC–15)
9. **2ZZ–GE:**
   REMOVE AIR PUMP ASSEMBLY (See page EC–15)



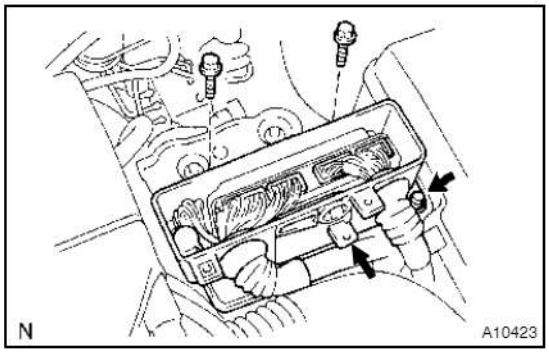
10. REMOVE AIR CLEANER CAP

(a) Disconnect the MAF meter connector.
(b) Disconnect the VSV for EVAP.
(c) Disconnect the 2 hoses.
(d) Disconnect the 3 clamps, and disconnect the air cleaner cap from the air cleaner case.
(e) Loosen the hose clamp, and disconnect the air cleaner hose from the throttle body.



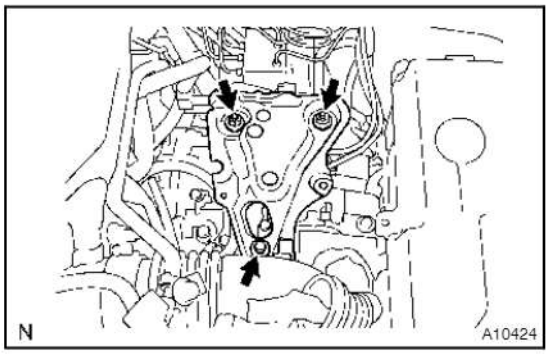
11. REMOVE AIR CLEANER CASE

(a) Remove the air filter.
(b) Disconnect the hose from the VSV for Canister Closed VALVE (CVC).
(c) Disconnect the hose from the intake air control valve.
(d) Remove the 2 bolts, and disconnect the air cleaner case.
(e) Disconnect the 2 hoses from the air cleaner case.

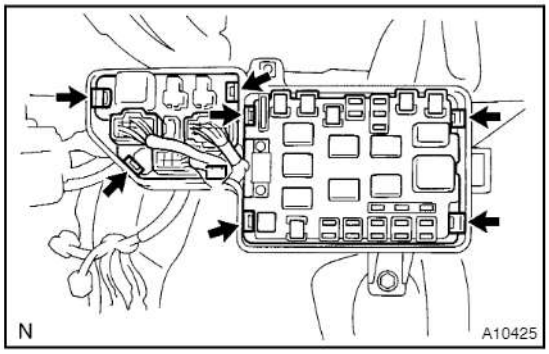


12. REMOVE ECM BOX

(a) Remove the 2 bolts and ECM cover.
(b) Disconnect the 4 connectors from the ECM.
(c) Disconnect the 2 connectors from the ECM box.
(d) Remove the ECM from the ECM box.
(e) Disconnect the clamp from the ECM box.
(f) Disconnect the 2 engine wires from the ECM box.
(g) Remove the 3 bolts and ECM box.

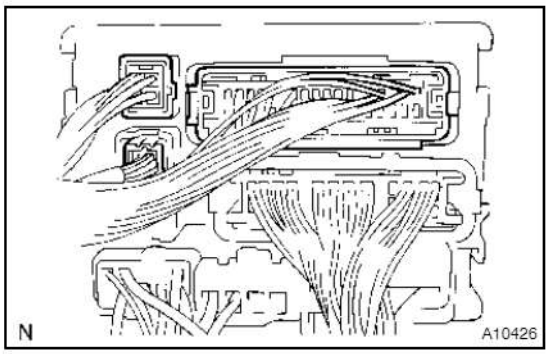


(h) Remove the 2 nuts, bolt and ECM box stay.

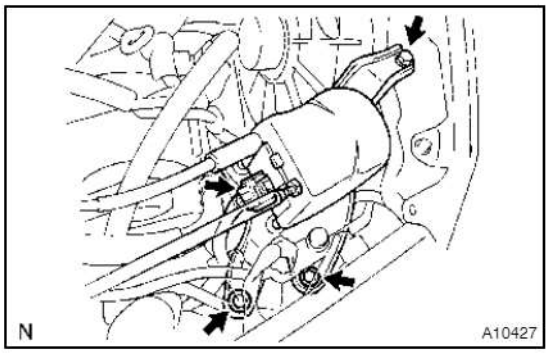


13. DISCONNECT ENGINE WIRE FROM ENGINE COMPARTMENT RELAY BOX

(a) Remove the relay box upper cover.
(b) Disconnect the 3 connectors.
(c) Disconnect the 7 claws and J/B from the relay box.



(d) Disconnect the 3 connectors.
(e) Disconnect the engine wire from the relay box.

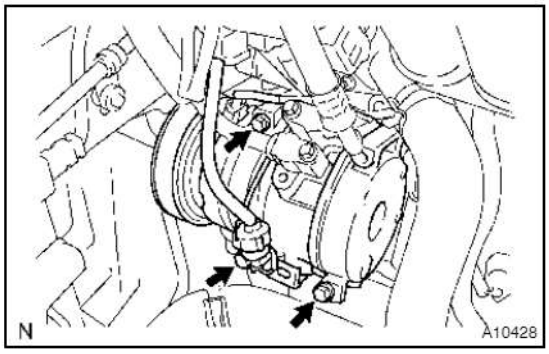


14. w/ Cruise Control System:
DISCONNECT CRUISE CONTROL ACTUATOR

(a) Disconnect the actuator connector.
(b) Remove the 3 bolts and disconnect the actuator from the body.

15. REMOVE RADIATOR ASSEMBLY (See page CO–17)

16. REMOVE DRIVE BELT AND GENERATOR (See page CH–7)



17. w/ A/C:
DISCONNECT A/C COMPRESSOR

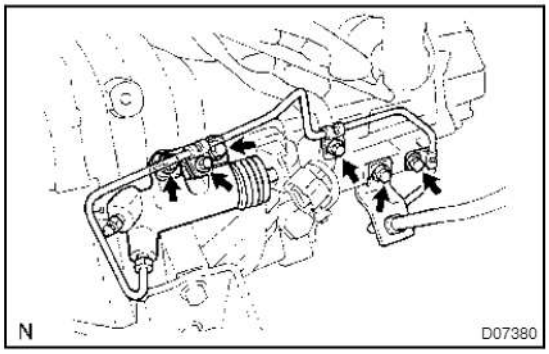
(a) Disconnect the A/C compressor connector.
(b) Remove the 3 bolts, and disconnect the A/C compressor from the engine.

HINT:
Suspend the A/C compressor securely.

18. DISCONNECT TUBE AND HOSE

(a) Disconnect the fuel tube from the fuel pipe on vehicle side.

(b) Disconnect the 2 heater hoses from the engine side.
(c) Disconnect the brake booster vacuum hose.

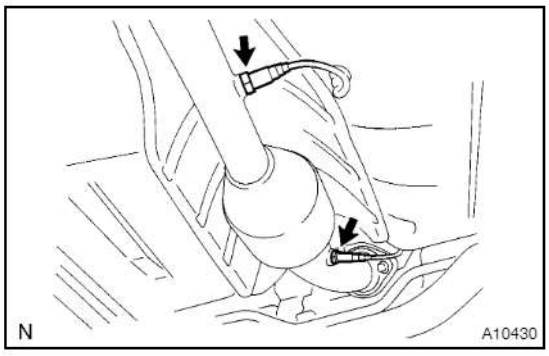


19. M/T:
DISCONNECT CLUTCH RELEASE CYLINDER
(a) Remove the 3 bolts, and disconnect the brackets from the transaxle.
(b) Remove the 2 bolts, and disconnect the release cylinder from the transaxle.

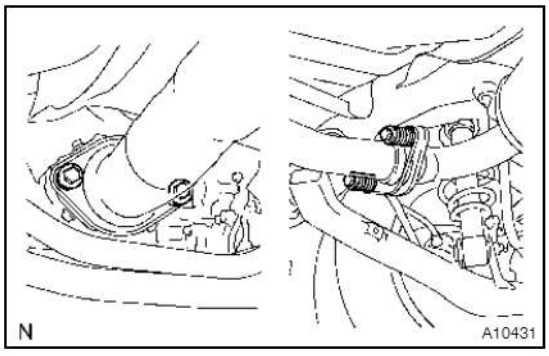
20. DISCONNECT TRANSAXLE CONTROL CABLE (S)

21. DISCONNECT 2 GROUND CABLES

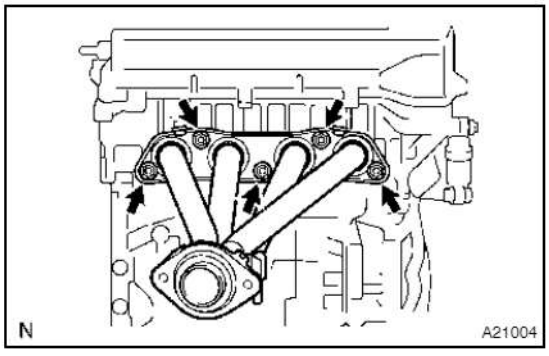
22. REMOVE DRIVE SHAFT (See page SA–21)



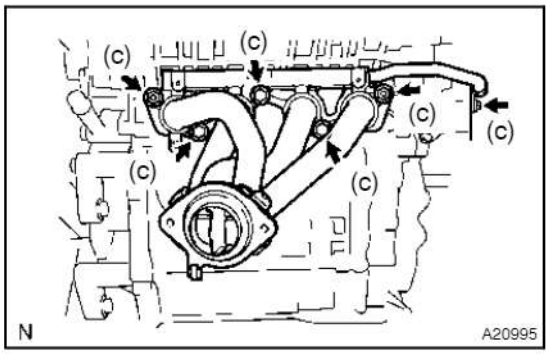
23. REMOVE EXHAUST PIPE
(a) Disconnect the 2 heated oxygen sensors.



(b) Remove the 4 bolts and springs.
(c) Disconnect the 2 O–rings, and remove the exhaust pipe and 2 gaskets.



24. 1ZZ–FE:
REMOVE EXHAUST MANIFOLD
(a) Remove the 4 bolts and upper heat insulator.
(b) Remove the 3 bolts and exhaust manifold stay.
(c) Remove the 5 nuts, exhaust manifold and gasket.



25. 2ZZ–GE:
REMOVE EXHAUST MANIFOLD

(a) Remove the 5 bolts and upper heat insulator.
(b) Remove the 4 bolts and exhaust manifold stay.
(c) Remove the 2 nuts, 4 bolts, exhaust manifold and gasket.

26. DISCONNECT PS PUMP

(a) Disconnect the PS oil pressure switch connector.
(b) Remove the 2 nuts and through bolts, and disconnect the PS pump from the engine (See page SR–26).

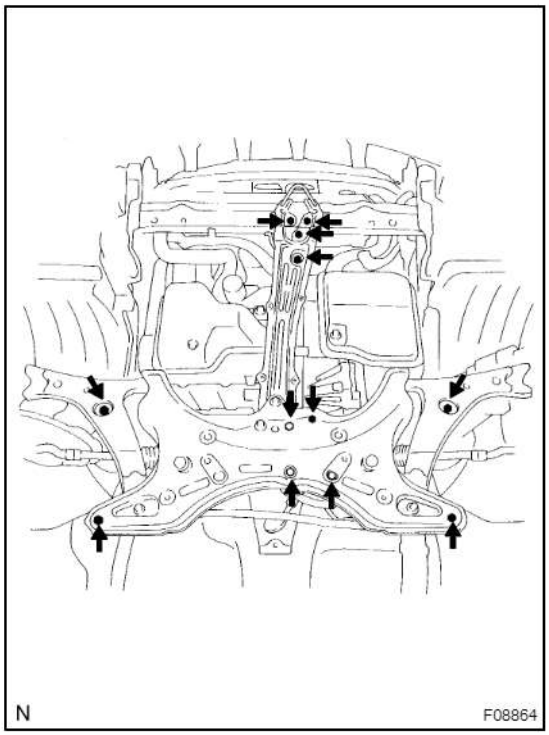
HINT:
Put aside the pump and suspend it to the cowl with a string.

27. REMOVE STABILIZER BAR BRACKET
(See page SA–52)

28. DISCONNECT PS GEAR

Remove the 4 bolts, and disconnect the PS gear from the suspension member.

HINT:
Suspend the PS gear securely.

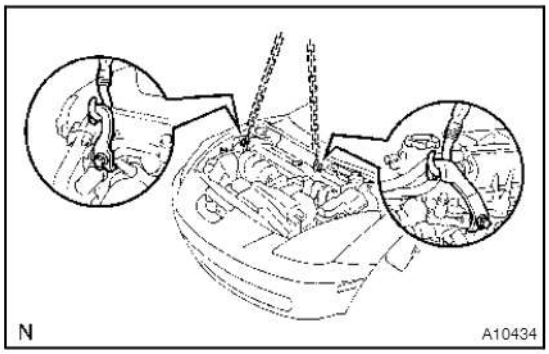


29. REMOVE SUSPENSION MEMBER

Remove the 9 bolts, 3 nuts and suspension member.

30. ATTACH ENGINE SLIDING DEVICE TO ENGINE HANGER

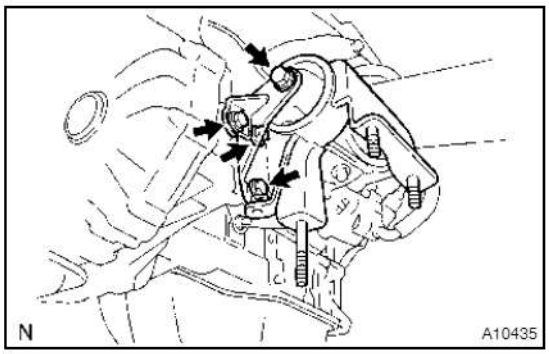
(a) Remove the 4 bolts and No. 2 cylinder head cover.
(b) Disconnect the PCV hoses from the cylinder head cover.



(c) Install the 2 engine hangers in the correct direction.
Engine hanger part No.:
1ZZ–FE
Front: 12281–22021
Rear: 12281–15040 or 12281–15050
Bolt: 91512–B1016
2ZZ–GE
Front: 12281–88600
Rear: 12282–88600
Bolt: 91512–61020
Torque: 38 N·m (388 kgf·cm, 28 ft·lbf)

(d) Attach the engine sling device to the engine hangers.

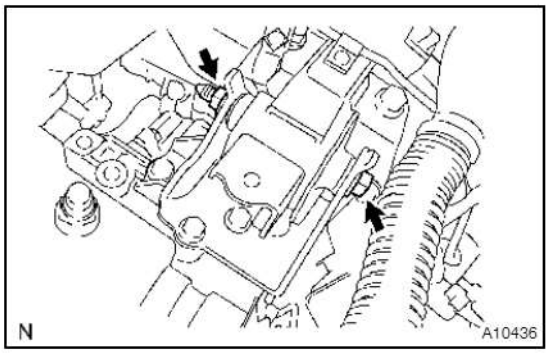
CAUTION:
Do not attempt to hang the engine by hooking the chain to any other part.



31. REMOVE REAR ENGINE MOUNTING

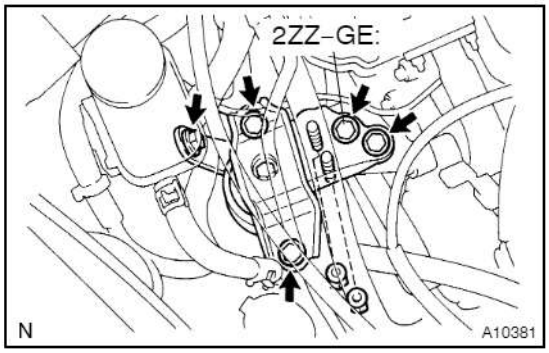
(a) Remove the through bolt and rear engine mounting insulator.

(b) Remove the 3 bolts and rear engine mounting bracket.



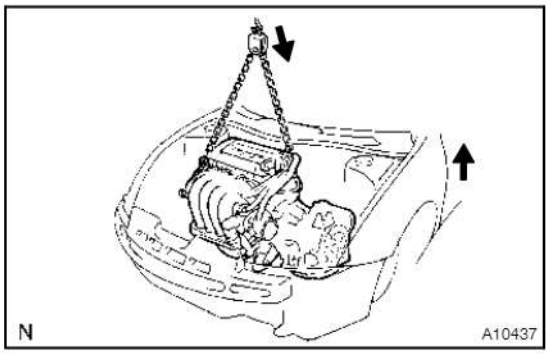
32. REMOVE ENGINE AND TRANSAXLE ASSEMBLY

(a) Remove the LH engine mounting through bolt and nut.



(b) 1ZZ–FE:
Remove the 4 bolts, 2 nuts and RH engine mounting insulator.

(c) 2ZZ–GE:
Remove the 5 bolts, 2 nuts and RH engine mounting insulator.



(d) Lower the engine out of vehicle slowly and carefully, and raise the vehicle.

HINT:

Make sure the engine is clear of all wiring, hoses and cables.

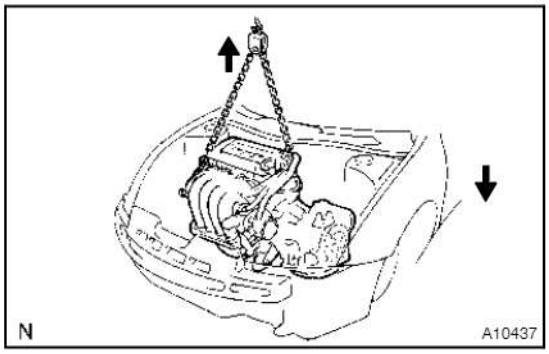
(e) Place the engine and transaxle assembly onto the stand.

33. SEPARATE ENGINE AND TRANSAXLE

(C56 M/T: See page MX–4)
(C60 M/T: See page MX–4)
(U240E A/T: See page AX–31)
(U341E A/T: See page AX–31)

INSTALLATION

1. ASSEMBLY ENGINE AND TRANSAXLE
(C56 M/T: See page MX–9)
(C60 M/T: See page MX–9)
(U240E A/T: See page AX–35)
(U341E A/T: See page AX–35)

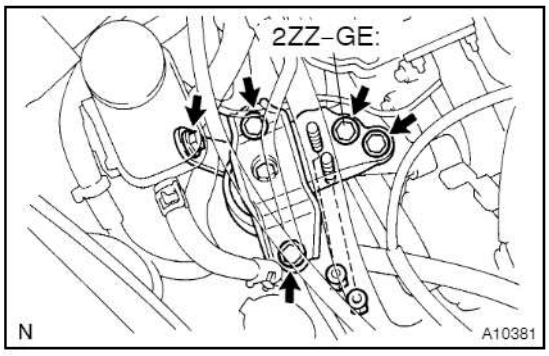


2. INSTALL ENGINE AND TRANSAXLE ASSEMBLY IN VEHICLE

(a) Attach the engine sling device to the engine hangers.

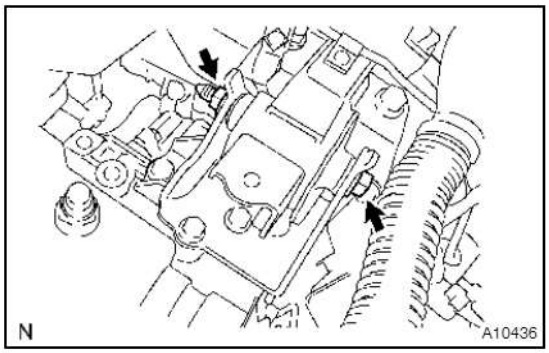
(b) Slowly lower the vehicle, and raise the engine into the engine compartment.

(c) Keep the engine level, and align RH and LH mountings with the body bracket.



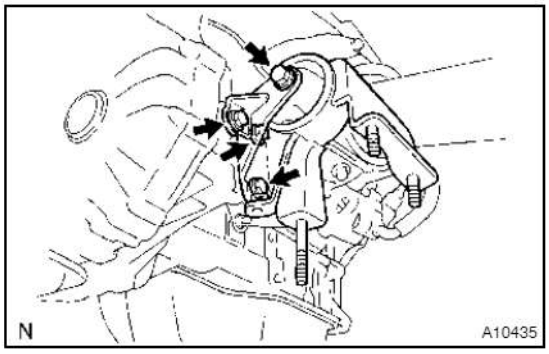
(d) 1ZZ–FE:
Install the RH engine mounting insulator with the 4 bolts and 2 nuts.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

(e) 2ZZ–GE:
Install the RH engine mounting insulator with the 5 bolts and 2 nuts.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)



(f) Install the LH engine mounting through bolt and nut.
Torque: 80 N·m (816 kgf·cm, 59 ft·lbf)

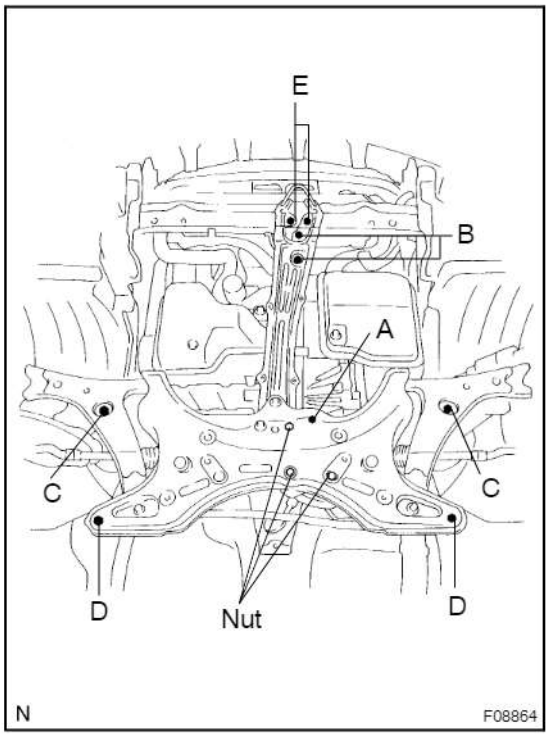
3. REMOVE ENGINE SLING DEVICE



4. INSTALL REAR ENGINE MOUNTING

(a) Install the rear engine mounting bracket with the 3 bolts.
Torque: 64 N·m (653 kgf·cm, 47 ft·lbf)

(b) Temporarily install the rear engine mounting insulator with the through bolt.



5. INSTALL SUSPENSION MEMBER

(a) Install the suspension member with the 9 bolts and 3 nuts.

Torque:
A 52 N·m (530 kgf·cm, 38 ft·lbf)
B 52 N·m (530 kgf·cm, 38 ft·lbf)
C 157 N·m (1,600 kgf·cm, 116 ft·lbf)
D 157 N·m (1,600 kgf·cm, 116 ft·lbf)
E 39 N·m (400 kgf·cm, 29 ft·lbf)
Nut 52 N·m (530 kgf·cm, 32 ft·lbf)

(b) Tighten the rear engine mounting through bolt.

Torque: 87 N·m (887 kgf·cm, 64 ft·lbf)

6. CONNECT PS GEAR

Install the PS gear with the 4 bolts.

Torque: 45 N·m (460 kgf·cm, 33 ft·lbf)

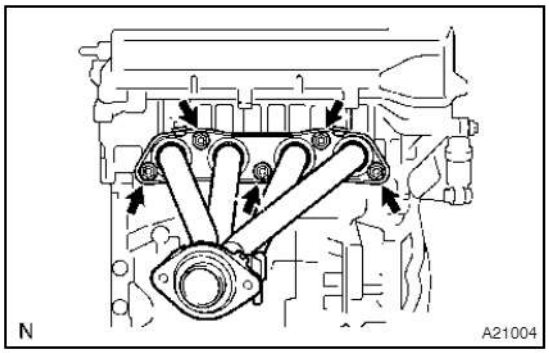
7. INSTALL STABILIZER BAR BRACKET
(See page SA–54)

8. CONNECT PS PUMP

(a) Install the PS pump with the 2 through bolts and nuts (See page SR–34).

Torque: 36 N·m (370 kgf·cm, 27 ft·lbf)

(b) Connect the PS oil pressure switch connector.



9. 1ZZ–FE:
INSTALL EXHAUST MANIFOLD

(a) Install the gasket and exhaust manifold with the 5 nuts.

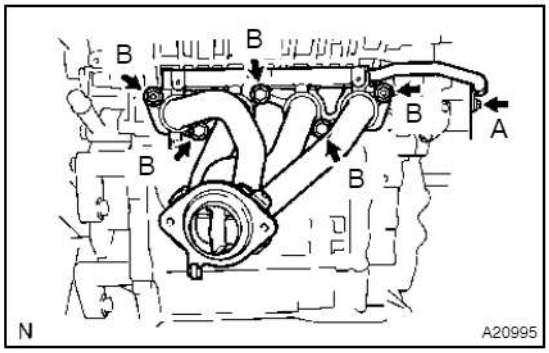
Torque: 37 N·m (377 kgf·cm, 27 ft·lbf)

(b) Install the exhaust manifold stay with the 3 bolts.

Torque: 49 N·m (500 kgf·cm, 37ft·lbf)

(c) Install the upper heat insulator with the 4 bolts.

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



10. 2ZZ–GE:
INSTALL EXHAUST MANIFOLD

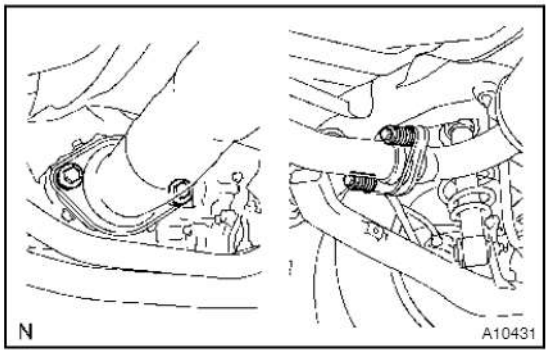
(a) Install the gasket and exhaust manifold with the 2 nuts and 4 bolts.

Torque:
A:20 N·m (204 kgf·cm, 15 ft·lbf)
B:50 N·m (510 kgf·cm, 37 ft·lbf)

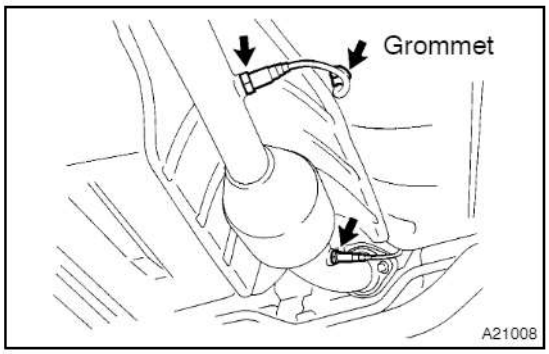
(b) Install the exhaust manifold stay with the 3 bolts.

Torque: 50 N·m (510 kgf·cm, 37 ft·lbf)

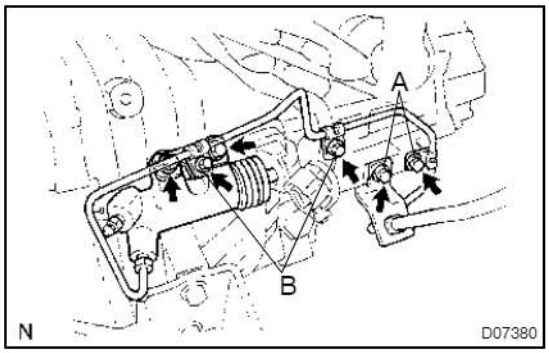
(c) Install the upper heat insulator with the 4 bolts.
Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)



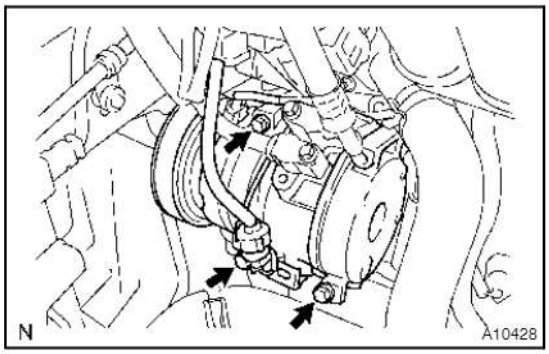
11. INSTALL EXHAUST PIPE
(a) Install new 2 gaskets and exhaust pipe.
(b) Connect the 2 O–rings.
(c) Install the 4 springs and bolts.
Torque: 43 N·m (440 kgf·cm, 32 ft·lbf)



(d) Connect the 2 heated oxygen sensors.
(See page EM–117)
12. INSTALL DRIVE SHAFT (See page SA–33)
13. CONNECT 2 GROUND CABLES
14. CONNECT TRANSAXLE CONTROL CABLE (S)



15. M/T:
CONNECT CLUTCH RELEASE CYLINDER
(a) Install the release cylinder with the 2 bolts.
Torque: 12 N·m (120 kgf·cm, 9 ft·lbf)
(b) Install the brackets with the 3 bolts.
Torque:
Bolt A 12 N·m (120 kgf·cm, 9 ft·lbf)
Bolt B 4.9 N·m (50 kgf·cm, 43 in.·lbf)
16. CONNECT TUBE AND HOSE
(a) Connect the brake booster vacuum hose.
(b) Connect the 2 heater hoses to the engine side.
(c) Connect the fuel tube to the fuel pipe on vehicle side.



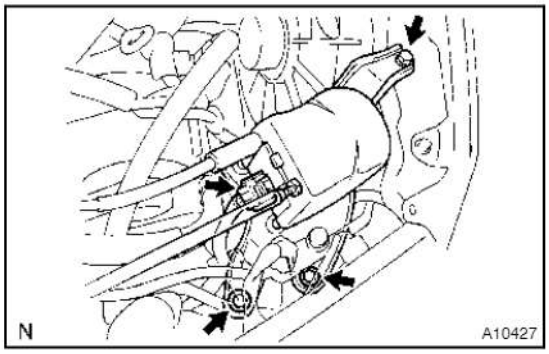
17. w/ A/C:
INSTALL A/C COMPRESSOR

(a) Install the A/C compressor with the 3 bolts.
Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)

(b) Connect the A/C compressor connector.

18. INSTALL GENERATOR AND DRIVE BELT
(See page CH–17)

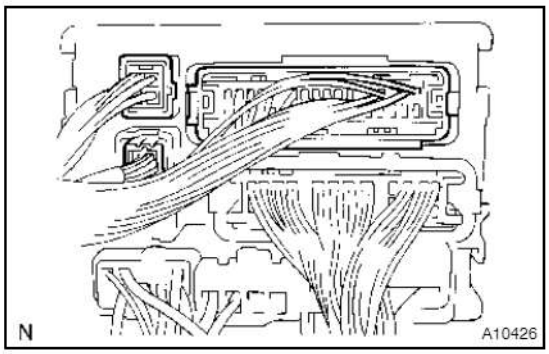
19. INSTALL RADIATOR ASSEMBLY (See page CO–23)



20. w/ Cruise Control System:
INSTALL CRUISE CONTROL ACTUATOR

(a) Install the actuator with the 3 bolts.

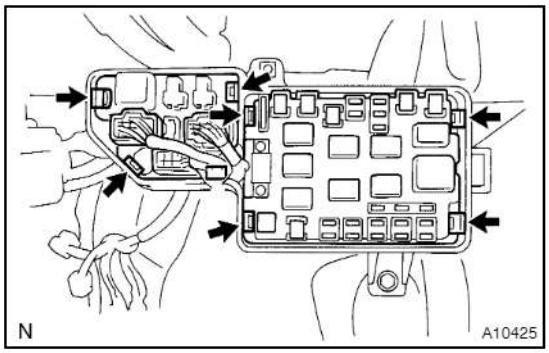
(b) Connect the actuator connector.



21. CONNECT ENGINE WIRE TO ENGINE COMPARTMENT RELAY BOX

(a) Install the engine wire to the relay box.

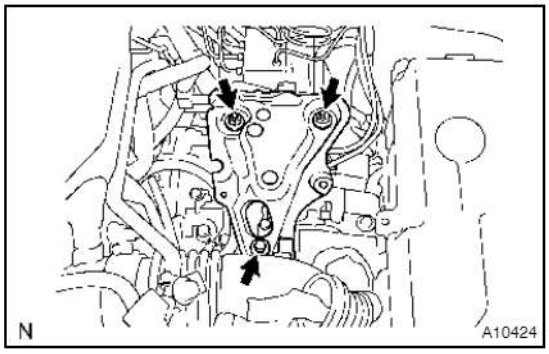
(b) Connect the 3 connectors.



(c) Connect the J/B to the relay box.

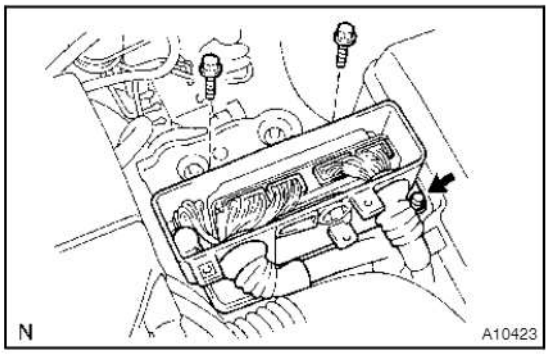
(d) Connect the 3 connectors.

(e) Install the relay box upper cover.

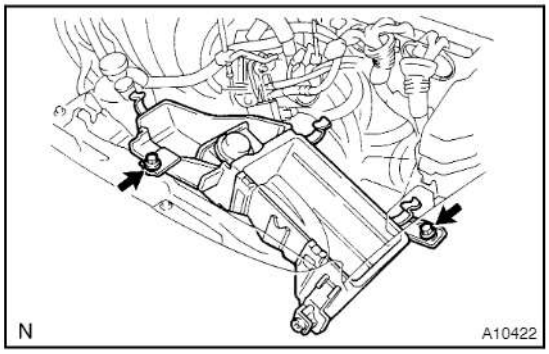


22. INSTALL ECM BOX

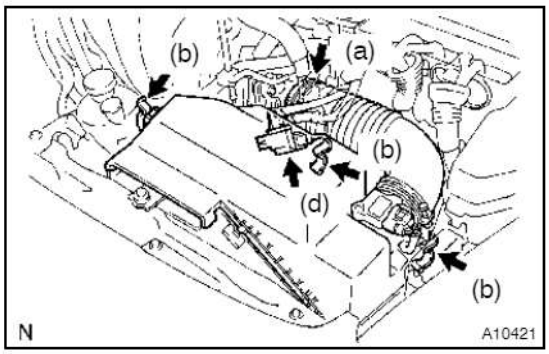
(a) Install the ECM box stay with the 2 nuts and bolt.
Torque:
Nut 12 N·m (120 kgf·cm, 9 ft·lbf)
Bolt 18 N·m (185 kgf·cm, 13 ft·lbf)



(b) Instal the ECM box with the 3 bolts.
Torque: 6.9 N·m (70 kgf·cm, 61 in.·lbf)
(c) Connect the 2 engine wires to the ECM box.
(d) Connect the clamp to the ECM box.
(e) Install the ECM to the ECM box.
(f) Connect the 2 connectors to the ECM box.
(g) Connect the 4 connectors to the ECM
(h) Install the ECM cover with the 2 bolts.
Torque: 6.9 N·m (70 kgf·cm, 61 in.·lbf)



23. INSTALL AIR CLEANER CASE
(a) Connect the 2 hoses to the air cleaner case.
(b) Install the air cleaner case with the 2 bolts.
Torque: 5.0 N·m (51 kgf·cm, 44 in.·lbf)
(c) Connect the hose to the intake air control valve.
(d) Connect the hose to the VSV for canister closed valve (CVC).
(e) Install the air filter.



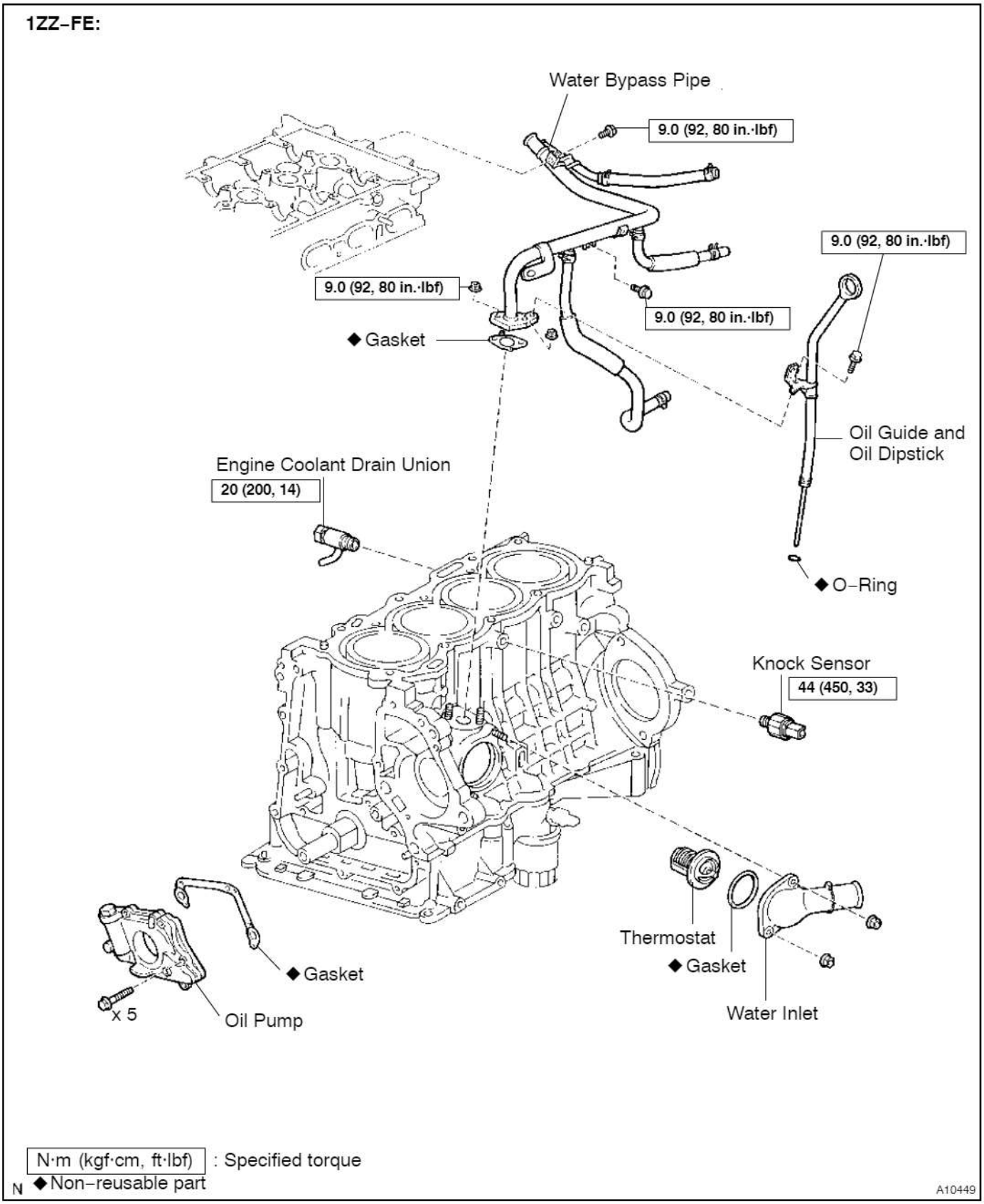
24. INSTALL AIR CLEANER CAP
(a) Install the air cleaner hose to the throttle body with the hose clamp.
(b) Connect the air cleaner cap to the air cleaner case with the 3 clamps.
(c) Connect the 2 hoses.
(d) Connect the VSV for EVAP.
(e) Connect the MAF meter connector.
25. 2ZZ–GE:
INSTALL AIR PUMP ASSEMBLY (See page EC–18)
26. 2ZZ–GE:
INSTALL AIR SWITCHING VALVE (See page EC–18)
27. INSTALL HEADLIGHT AND BUMPER COVER
28. INSTALL BATTERY AND TRAY
29. FILL WITH TRANSAXLE OIL
30. FILL WITH ENGINE OIL
31. FILL WITH ENGINE COOLANT (See page CO–2)
32. START ENGINE AND CHECK FOR LEADS
33. PERFORM ENGINE ADJUSTMENT
34. CHECK FRONT WHEEL ALIGNMENT
35. INSTALL ENGINE UNDER COVERS
36. INSTALL ENGINE HOOD
37. ROAD TEST VEHICLE
Check for abnormal noises, shock slippage, correct shift points and smooth operation.
38. RECHECK ENGINE COOLANT AND OIL LEVELS

CYLINDER BLOCK

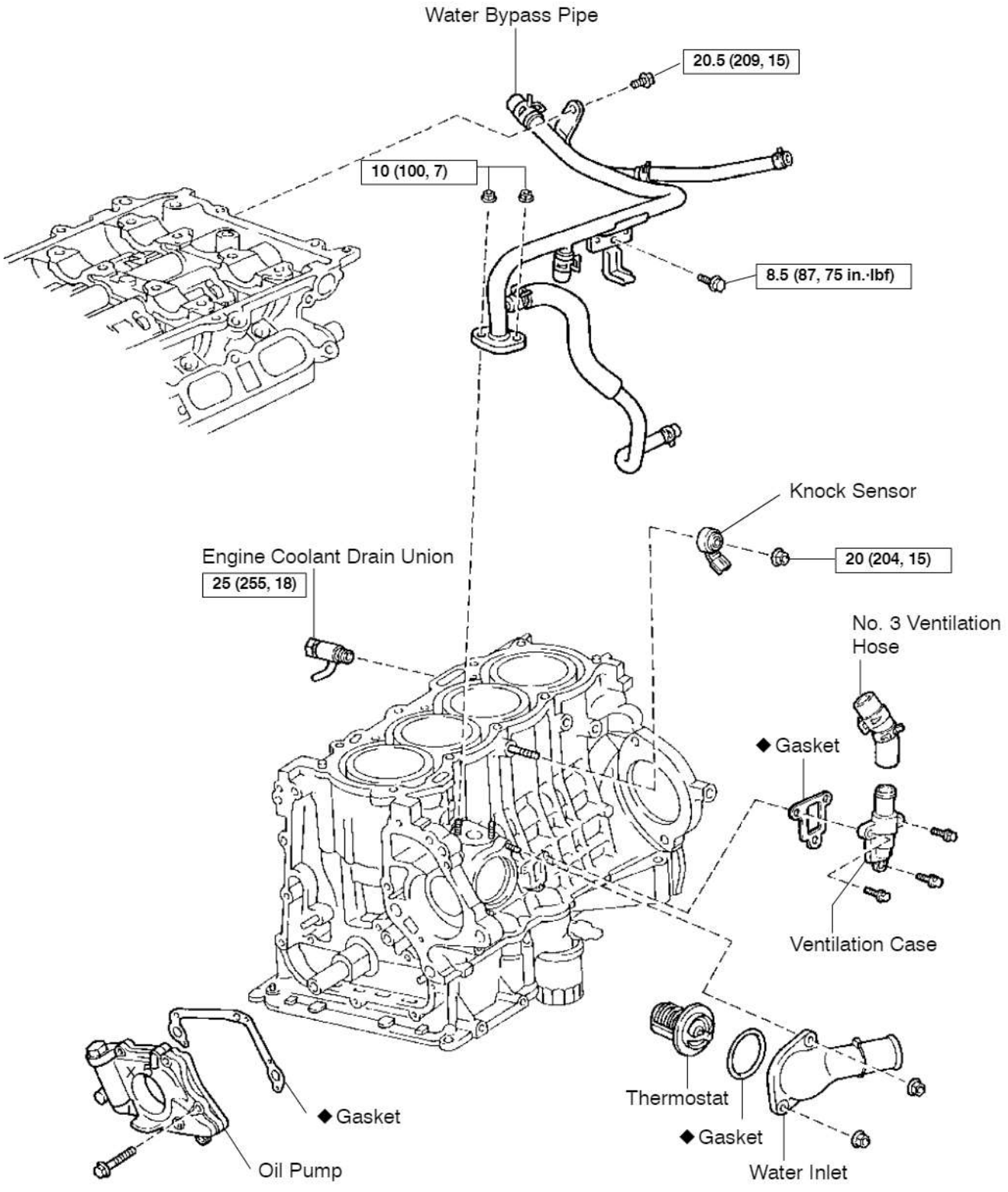
COMPONENTS

EM162–08

1ZZ–FE:



2ZZ–GE:

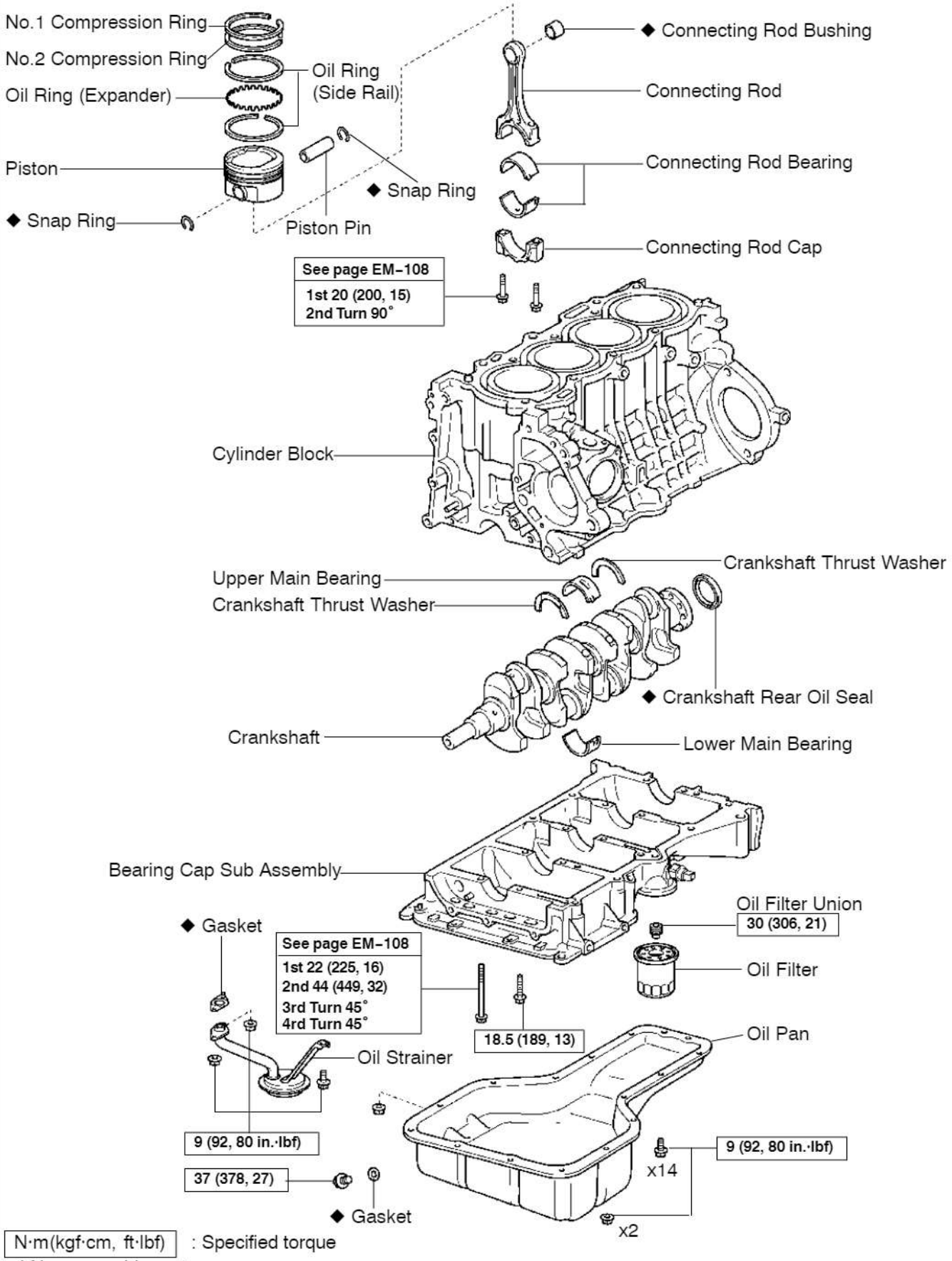


N·m (kgf·cm, ft·lbf) : Specified torque

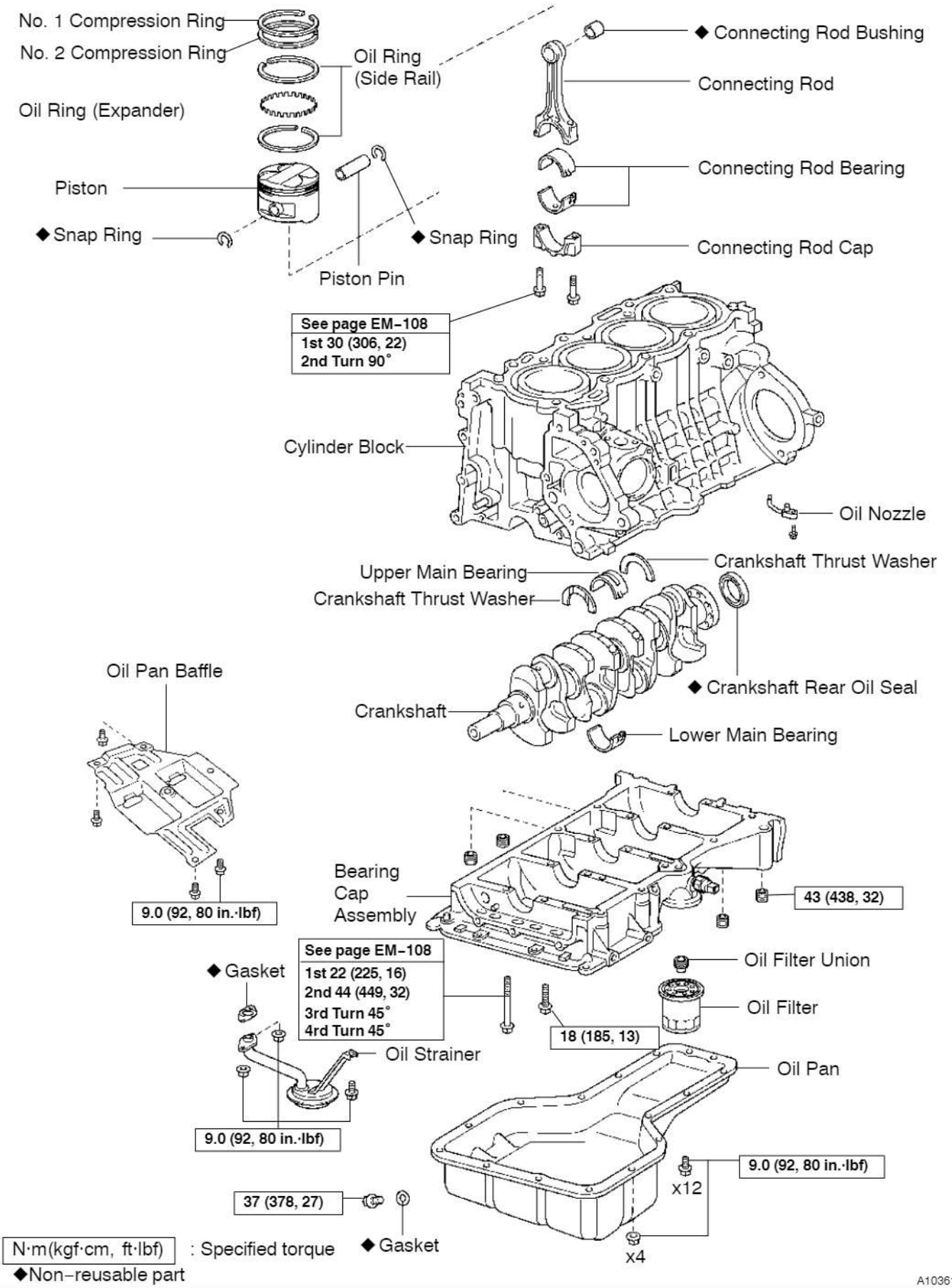
◆ Non–reusable part

A17323

1ZZ–FE:


No.1 Compression Ring
No.2 Compression Ring
Oil Ring (Side Rail)
Oil Ring (Expander)
Piston
◆ Snap Ring
◆ Snap Ring
Piston Pin
◆ Connecting Rod Bushing
Connecting Rod
Connecting Rod Bearing
Connecting Rod Cap
See page EM–108
1st 20 (200, 15)
2nd Turn 90°
Cylinder Block
Upper Main Bearing
Crankshaft Thrust Washer
Crankshaft Thrust Washer
◆ Crankshaft Rear Oil Seal
Crankshaft
Lower Main Bearing
Bearing Cap Sub Assembly
Oil Filter Union
30 (306, 21)
◆ Gasket
See page EM–108
1st 22 (225, 16)
2nd 44 (449, 32)
3rd Turn 45°
4rd Turn 45°
Oil Filter
18.5 (189, 13)
Oil Pan
Oil Strainer
9 (92, 80 in.·lbf)
37 (378, 27)
◆ Gasket
9 (92, 80 in.·lbf)
x14
x2
N·m(kgf·cm, ft·lbf) : Specified torque
◆Non–reusable part
A01210

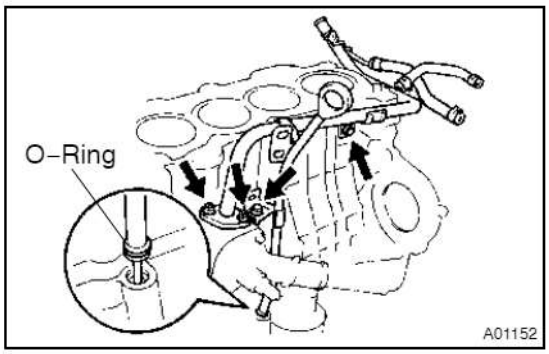
2ZZ–GE:


No. 1 Compression Ring
No. 2 Compression Ring
Oil Ring (Side Rail)
Oil Ring (Expander)
Piston
◆ Snap Ring
◆ Snap Ring
Piston Pin
◆ Connecting Rod Bushing
Connecting Rod
Connecting Rod Bearing
Connecting Rod Cap
See page EM–108
1st 30 (306, 22)
2nd Turn 90°
Cylinder Block
Oil Nozzle
Upper Main Bearing
Crankshaft Thrust Washer
Crankshaft Thrust Washer
◆ Crankshaft Rear Oil Seal
Crankshaft
Lower Main Bearing
Oil Pan Baffle
9.0 (92, 80 in.·lbf)
Bearing Cap Assembly
43 (438, 32)
See page EM–108
1st 22 (225, 16)
2nd 44 (449, 32)
3rd Turn 45°
4rd Turn 45°
◆ Gasket
Oil Filter Union
Oil Filter
18 (185, 13)
Oil Strainer
Oil Pan
9.0 (92, 80 in.·lbf)
9.0 (92, 80 in.·lbf)
x12
37 (378, 27)
◆ Gasket
x4
N·m(kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
N
A10361

EM183–06

DISASSEMBLY

1. **M/T:**
   REMOVE FLYWHEEL
2. **A/T:**
   REMOVE DRIVE PLATE
3. **INSTALL ENGINE TO ENGINE STAND FOR DISASSEMBLY**
4. **REMOVE TIMING CHAIN AND SPROCKETS (See page EM–19)**
5. **REMOVE ENGINE WIRE**
6. **REMOVE CYLINDER HEAD (See page EM–44)**



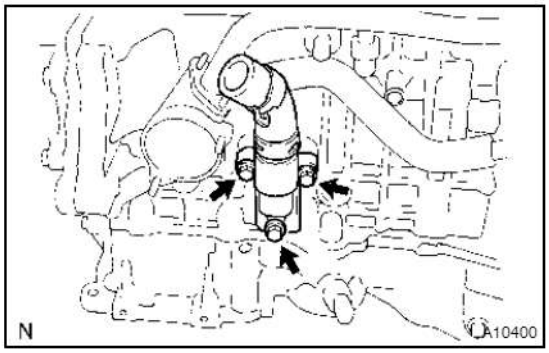
7. **1ZZ–FE:**
   REMOVE OIL DIPSTICK AND GUIDE

(a) Remove the bolt and oil dipstick and guide.
(b) Remove the O–ring from the dipstick.

8. **REMOVE WATER BYPASS PIPE**

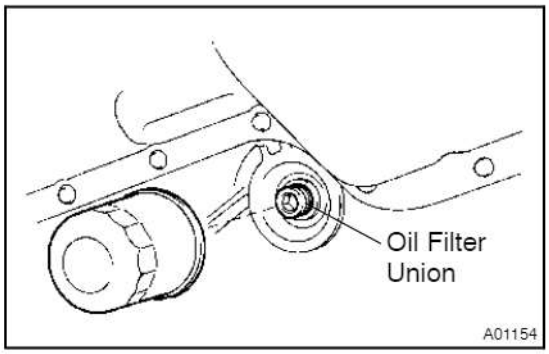
Remove the 2 nuts, bolts and water bypass pipe.

9. **REMOVE THERMOSTAT (See page CO–9)**
10. **REMOVE KNOCK SENSOR**
11. **REMOVE ENGINE COOLANT DRAIN UNION**
12. **REMOVE OIL PUMP (See page LU–9)**



13. **2ZZ–GE:**
    REMOVE VENTILATION CASE

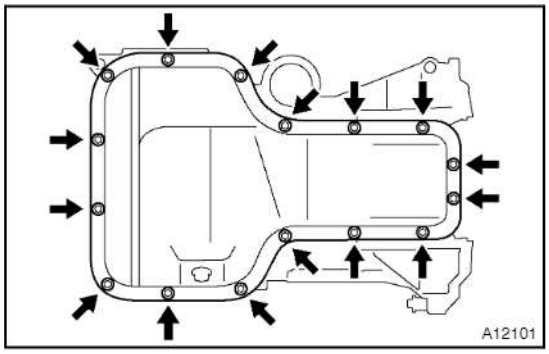
(a) Remove the 3 nuts, ventilation case and gasket.
(b) Remove the clip and No. 3 ventilation hose.



14. REMOVE OIL FILTER (See page LU–3)

15. REMOVE OIL FILTER UNION

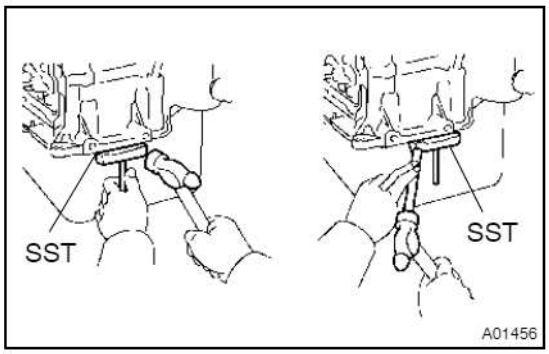
Using a 12 mm hexagon wrench, remove the oil filter union.



16. REMOVE OIL PAN

(a) 1ZZ–FE:
Remove the 14 bolts and 2 nuts.

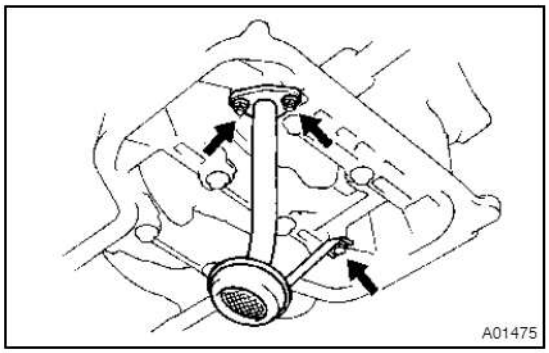
(b) 2ZZ–GE:
Remove the 12 bolts and 4 nuts.



(c) 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 09032–00101

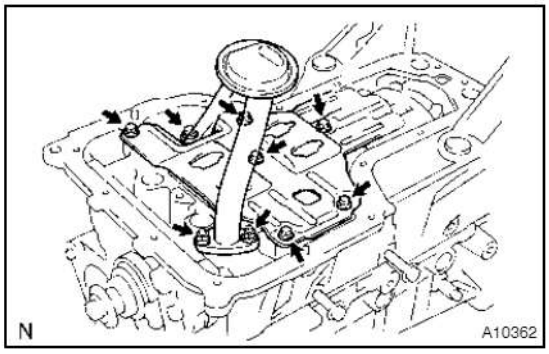
NOTICE:

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



17. 1ZZ–FE:
REMOVE OIL STRAINER

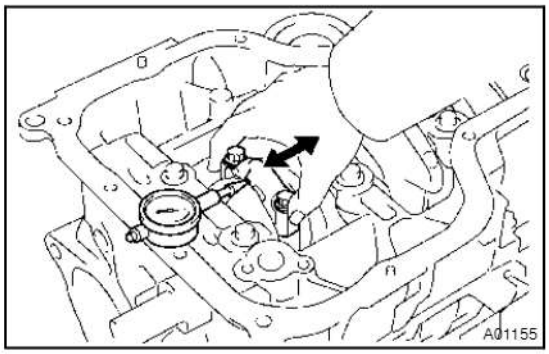
Remove the 2 nuts, bolt, oil strainer and gasket.



18. 2ZZ–GE:
REMOVE OIL STRAINER AND OIL PAN BAFFLE

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

(b) Remove the 4 bolts, 2 nuts and oil pan baffle.



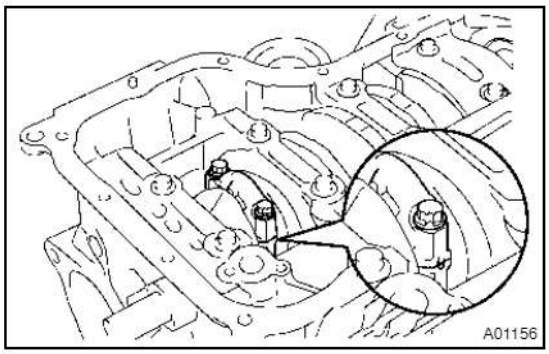
19. CHECK CONNECTING ROD THRUST CLEARANCE

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.)

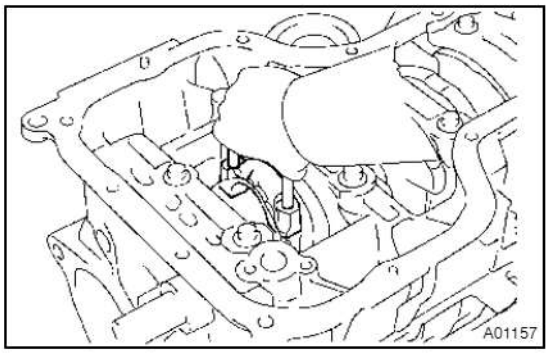
If the thrust clearance is greater than maximum, replace the connecting rod assembly(s). If necessary, replace the crankshaft.

Connecting rod thickness:
19.788 – 19.840 mm (0.7791 – 0.7811 in.)



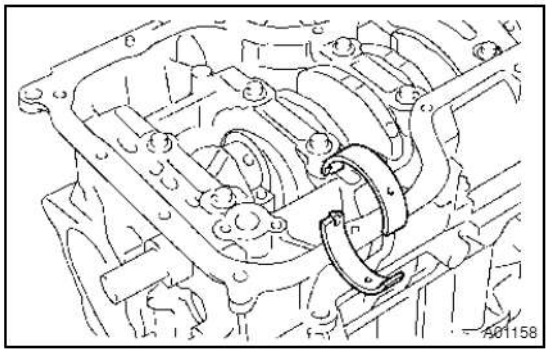
20. REMOVE CONNECTING ROD CAPS AND CHECK OIL CLEARANCE

(a) Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
(b) Remove the 2 connecting rod cap bolts.



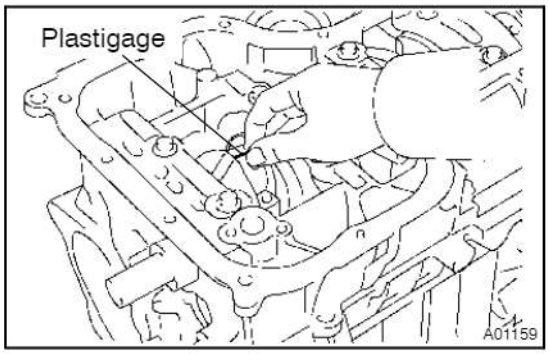
(c) Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

HINT:
Keep the lower bearing inserted with the connecting rod cap.

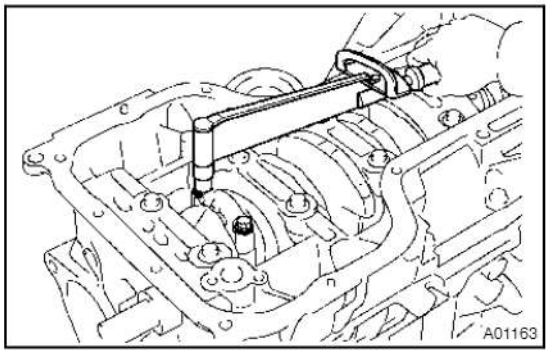


(d) Clean the crank pin and bearing.
(e) Check the crank pin and bearing for pitting and scratches.

If the crank pin or bearing is damaged, replace the bearings.
If necessary, replace the crankshaft.



(f) Lay a strip of Plastigage the crank pin.

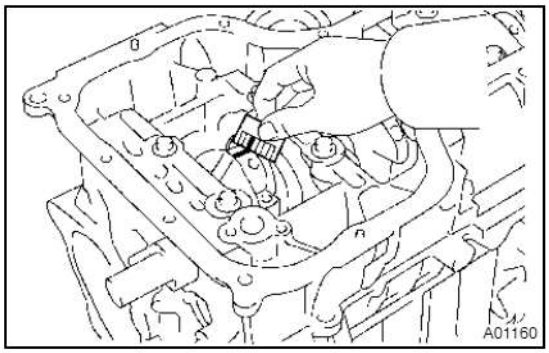


(g) Install the connecting rod cap with the 2 bolts (See page EM–108).
Torque:
1st:
1ZZ–FE: 20 N·m (204 kgf·cm, 15 ft·lbf)
2ZZ–GE: 30 N·m (306 kgf·cm, 22 ft·lbf)
2nd: Turn extra 90°

NOTICE:

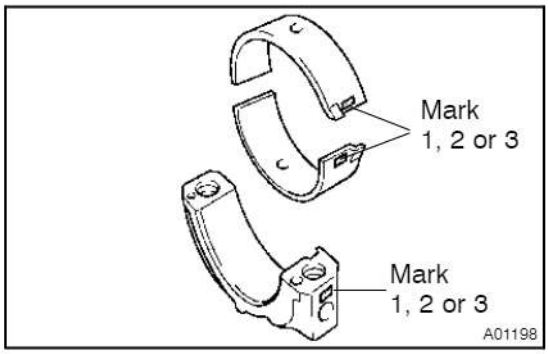
Do not turn the crankshaft.

(h) Remove the 2 bolts, connecting rod cap and lower bearing. (See procedure (b) and (c) above)



(i) Measure the Plastigage at its widest point.
Standard oil clearance:
1ZZ–FE:
0.028 – 0.060 mm (0.0011 – 0.0024 in.)
2ZZ–GE:
0.028 – 0.052 mm (0.0011 – 0.0020 in.)
Maximum oil clearance;
0.08 mm (0.0031 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, grind or replace the crankshaft.



HINT:

If replacing a bearing, replace it with 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

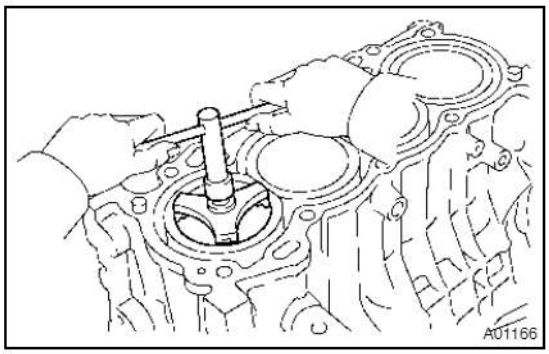
1ZZ–FE:

Mark	mm (in.)
"1"	1.486 – 1.490 (0.0585 – 0.0587)
"2"	1.490 – 1.494 (0.0587 – 0.0588)
"3"	1.494 – 1.498 (0.0588 – 0.0590)

2ZZ–GE:

Mark	mm (in.)
"1"	1.482 – 1.486 (0.0583 – 0.0585)
"2"	1.486 – 1.490 (0.0585 – 0.0587)
"3"	1.490 – 1.494 (0.0587 – 0.0588)

(j) Completely remove the Plastigage.



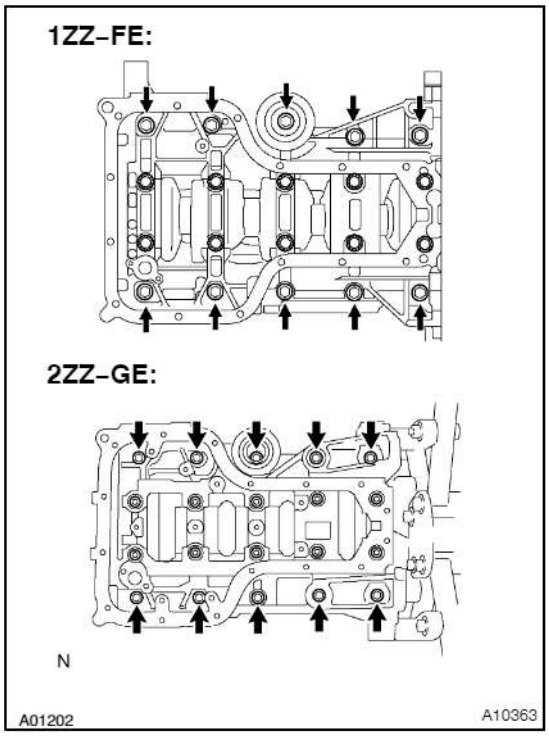
21. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES

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

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

HINT:

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

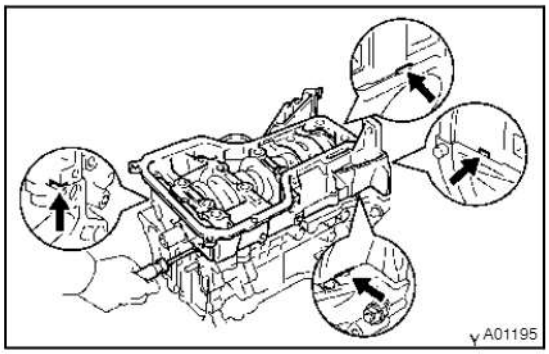


22. REMOVE BEARING CAP SUB–ASSEMBLY AND CRANKSHAFT REAR OIL SEAL, AND CHECK OIL CLEARANCE

(a) 2ZZ–GE:
Remove the 4 screw plugs from the bearing cap sub–assembly.

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

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



(d) Using a screwdriver, remove the bearing cap sub–assembly by prying the 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.

HINT:

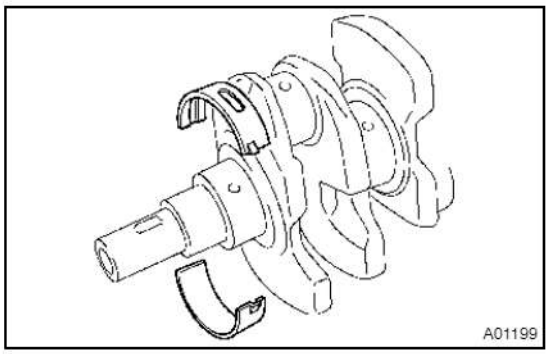
Keep the lower bearing and bearing cap sub–assembly together.

(e) Remove the crankshaft rear oil seal.

(f) Lift out the crankshaft.

HINT:

Keep the upper bearings together with the cylinder block.

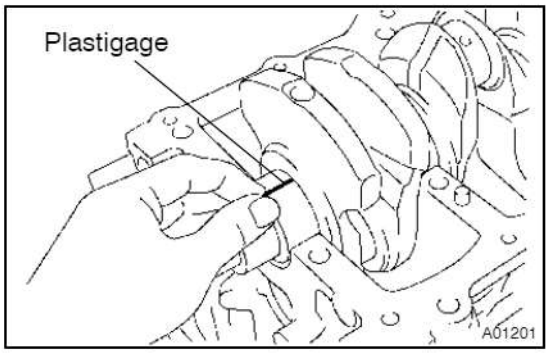


(g) Clean each main journal and bearing.

(h) Check each main journal and bearing for pitting and scratches.

If the journal or bearing is damaged, replace the bearings.

If necessary, replace the crankshaft.



(i) Place the crankshaft on the cylinder block.

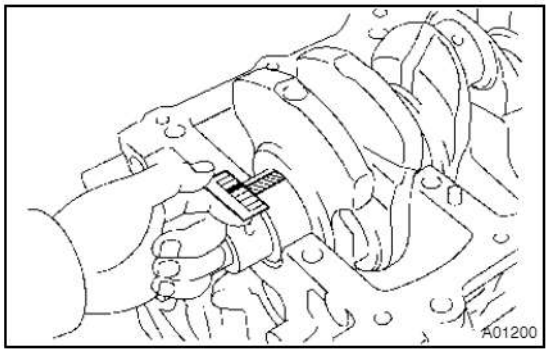
(j) Lay a strip of Plastigage across each journal.

(k) Install the bearing cap sub–assembly (See page EM–108).

NOTICE:

Do not turn the crankshaft.

(l) Remove the bearing cap sub–assembly (See procedures (a) to (e) above).



(m) Measure the Plastigage at its widest point.

Standard oil clearance:

1ZZ–FE:

0.015 – 0.032 mm (0.0006 – 0.0013 in.)

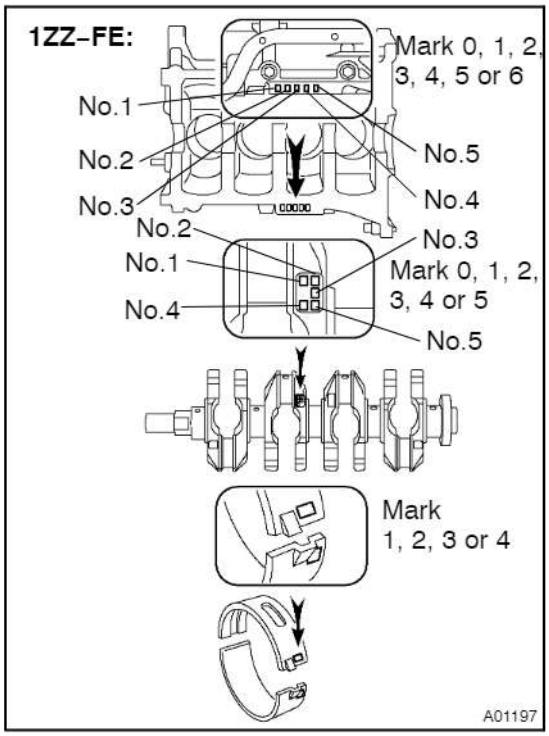
2ZZ–GE:

0.016 – 0.032 mm (0.0006 – 0.0013 in.)

Maximum oil clearance:

0.050 mm (0.0020 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, replace the crankshaft.

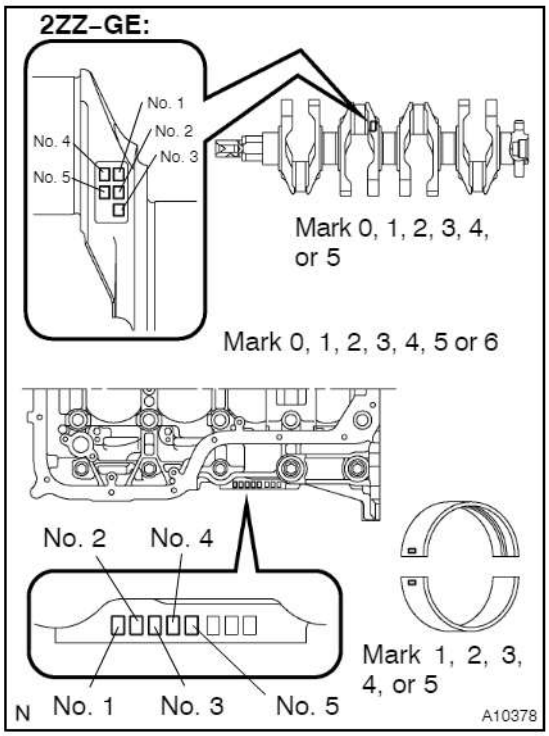


(n) 1ZZ–FE:

If using a standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then selecting the bearing with the same number as the total. There are 4 sizes of standard bearings, marked "1", "2", "3" and "4" accordingly.

	Total number		" ": Number mark	
Cylinder block (A) + Crankshaft (B)	0 – 2	3 – 5	6 – 8	9 –11
Use bearing	"1"	"2"	"3"	"4"

EXAMPLE: Cylinder block "4" (A)
+ Crankshaft "3" (B)
= Total number 7 (Use bearing "3")



(o) 2ZZ–GE:

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

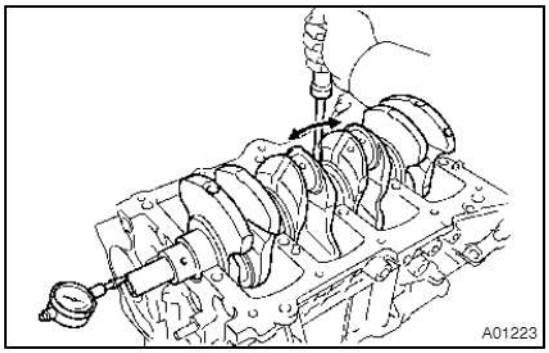
Cylinder block Number mark	Crank shaft number mark					
	0	1	2	3	4	5
0	1	1	1	2	2	2
1	1	1	2	2	2	3
2	1	2	2	2	3	3
3	2	2	2	3	3	3
4	2	3	3	3	4	4
5	3	3	3	4	4	4
6	3	3	4	4	4	5

EXAMPLE: Cylinder block "4", Crank shaft "3", Use bearing "3"

Reference

Item	Mark	mm (in.)
Cylinder block main journal bore diameter (A)	"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 (B)	"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)
1ZZ–FE: Standard bearing center wall thickness	"1"	1.993 – 1.996 (0.0785 – 0.0786)
	"2"	1.996 – 1.999 (0.0786 – 0.0787)
	"3"	1.999 – 2.002 (0.0787 – 0.0788)
	"4"	2.002 – 2.005 (0.0788 – 0.0789)
2ZZ–GE 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)

(p) Completely remove the Plastigage.



23. CHECK CRANKSHAFT THRUST CLEARANCE

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:
0.30 mm (0.0118 in.)

If the thrust clearance is greater than maximum, replace the thrust washers as a set.

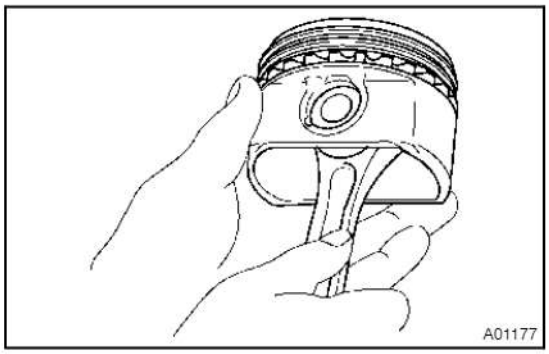
Thrust washer thickness:
2.430 – 2.480 mm (0.0957 – 0.0976 in.)

24. REMOVE CRANKSHAFT

(a) Lift out the crankshaft.

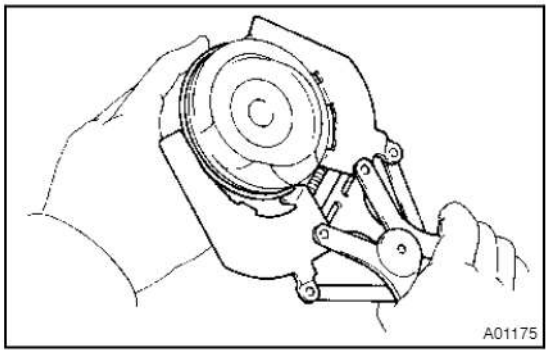
(b) Remove the 5 upper main bearings and 2 thrust washers from the cylinder block.

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



25. CHECK FIT BETWEEN PISTON AND PISTON PIN

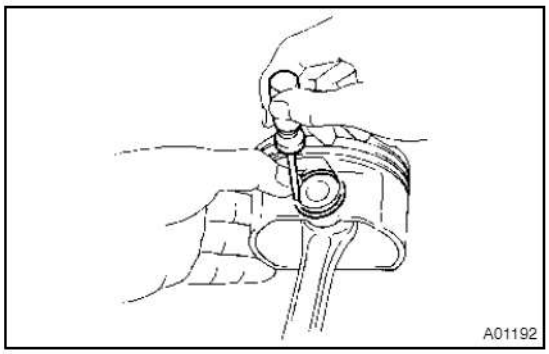
Try to move the piston back and forth on the piston pin.
If any movement is felt, replace the piston and pin as a set.



26. REMOVE PISTON RINGS

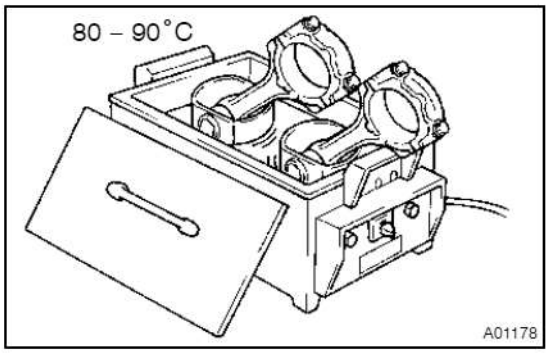
(a) Using a piston ring expander, remove the 2 compression rings.
(b) Remove the 2 side rails and oil ring by hand.

HINT:
Arrange the piston rings in the correct order only.

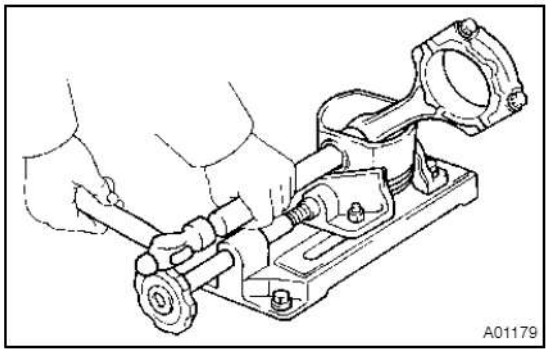


27. DISCONNECT CONNECTING ROD FROM PISTON

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



(b) 1ZZ–FE:
Gradually heat the piston to 80 – 90°C (176 – 194°F).

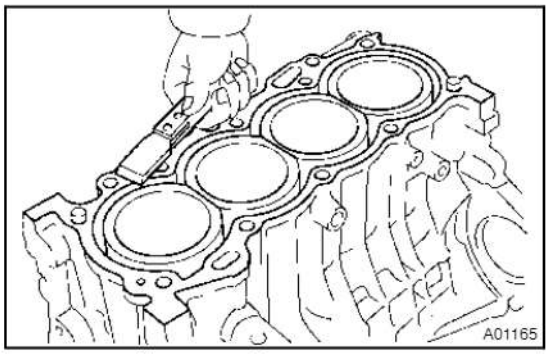


(c) 1ZZ–FE:
Using a plastic–faced hammer and brass bar, lightly tap out the piston pin and remove the connecting rod.

HINT:
- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.

(d) 2ZZ–GE:
Remove the pin and connecting rod from the piston.

EM164–07



INSPECTION

1. REMOVE GASKET MATERIAL

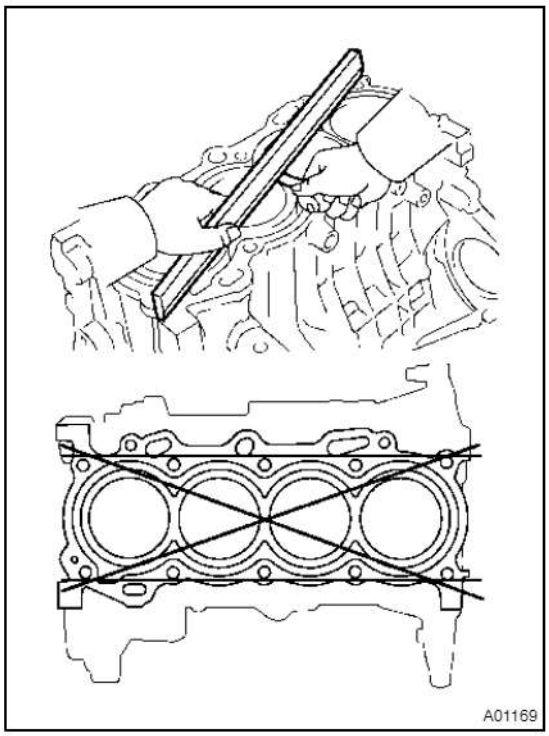
Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

2. CLEAN CYLINDER BLOCK

Using a soft brush and solvent, thoroughly clean the cylinder block.

NOTICE:

If the cylinder is washed at high temperatures, the cylinder liner sticks out beyond the cylinder block, so always wash the cylinder block at a temperature of 45°C (133°F) or less.

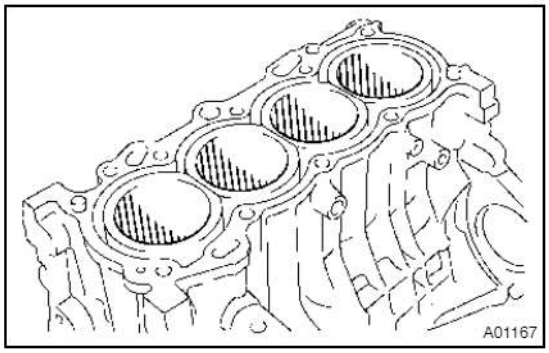


3. INSPECT TOP SURFACE OF CYLINDER BLOCK FOR FLATNESS

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.)

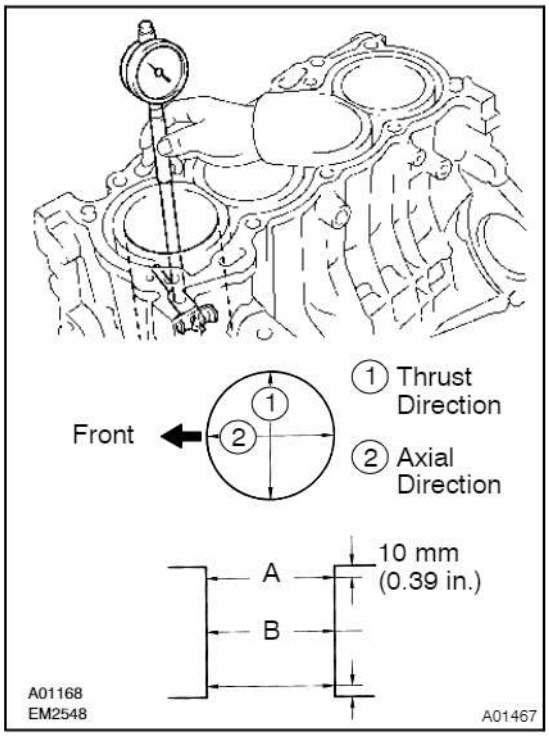
If warpage is greater than maximum, replace the cylinder block.



4. INSPECT CYLINDER BORE DIAMETER

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

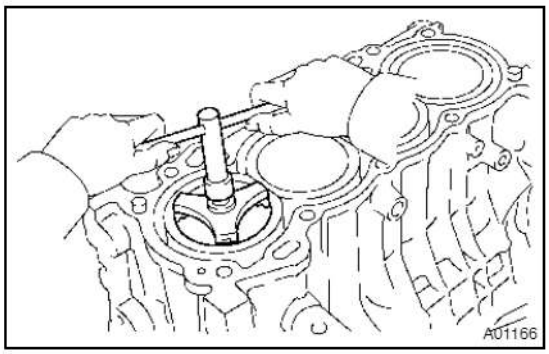


5. INSPECT CYLINDER BORE DIAMETER

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

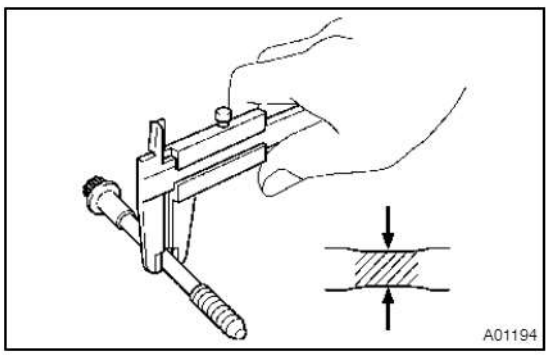
Standard diameter:
1ZZ–FE 79.00 – 79.01 mm (3.1102 – 3.1107 in.)
2ZZ–GE 82.00 – 82.01 mm (3.2283 – 3.2289 in.)
Maximum diameter:
1ZZ–FE 79.13 mm (3.1153 in.)
2ZZ–GE 82.13 mm (3.2335 in.)
Difference limit: 0.10 mm (0.0039 in.)

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



6. REMOVE CYLINDER RIDGE

If the wear is less than 0.2 mm (0.008 in.), using a ridge reamer, grind the top of the cylinder.

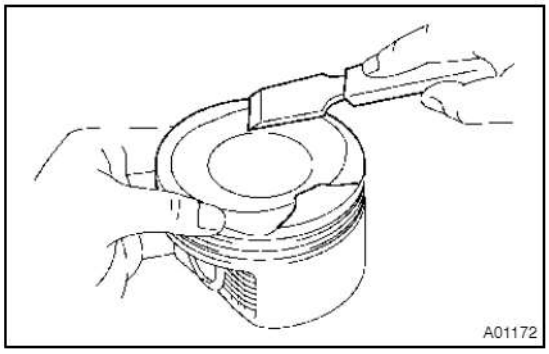


7. INSPECT 12 POINTED HEAD BEARING CAP SUB–ASSEMBLY BOLTS

Using vernier calipers, measure the tension portion diameter of the bolt.

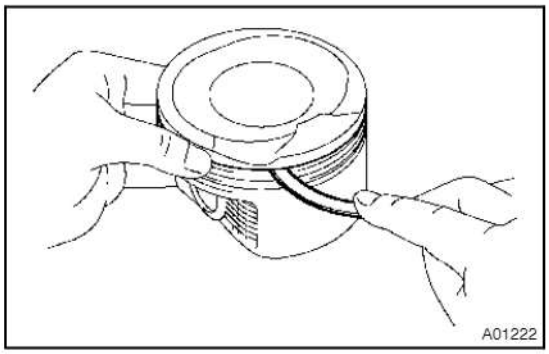
Standard diameter: 7.3 – 7.5 mm (0.287 – 0.295 in.)
Minimum diameter: 7.3 mm (0.287 in.)

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

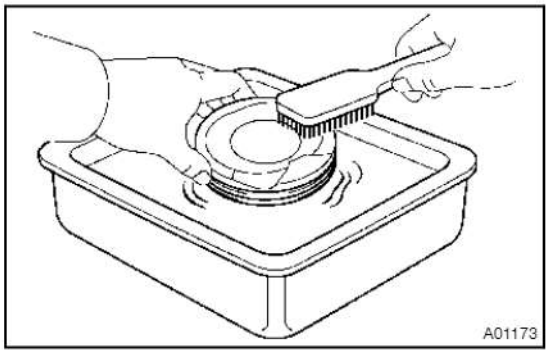


8. CLEAN PISTON

(a) Using a gasket scraper, remove the carbon from the piston top.



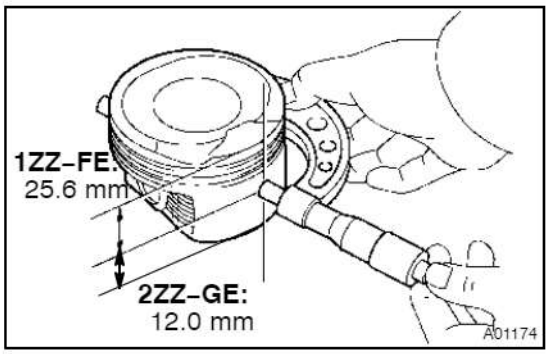
(b) Using a groove cleaning tool or broken ring, clean the piston ring grooves.



(c) Using solvent and a brush, thoroughly clean the piston.

NOTICE:

Do not use a wire brush.



9. INSPECT PISTON OIL CLEARANCE

(a) 1ZZ–FE:

Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 25.6 mm (1.008 in.) from the piston head.

(b) 2ZZ–GE:

Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 12.0 mm (0.048 in.) from the piston bottom.

Piston diameter:

1ZZ–FE:

78.925 – 78.935 mm (3.1073 – 3.1077 in.)

2ZZ–GE:

81.975 – 81.993 mm (3.2274 – 3.2281 in.)

(c) Measure the cylinder bore diameter in the thrust directions (See procedure in step 5).

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

Standard oil clearance:

1ZZ–FE:

0.065 – 0.088 mm (0.0026 – 0.0035 in.)

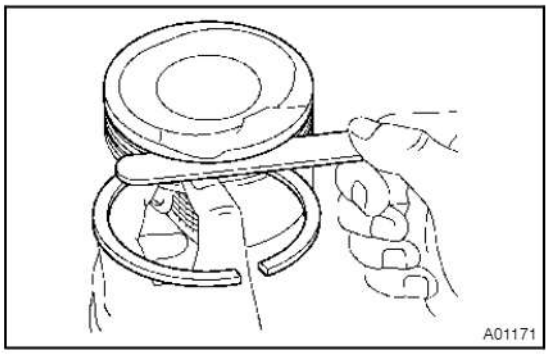
2ZZ–GE:

0.007 – 0.038 mm (0.0003 – 0.0015 in.)

Maximum oil clearance:

0.10 mm (0.0039 in.)

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

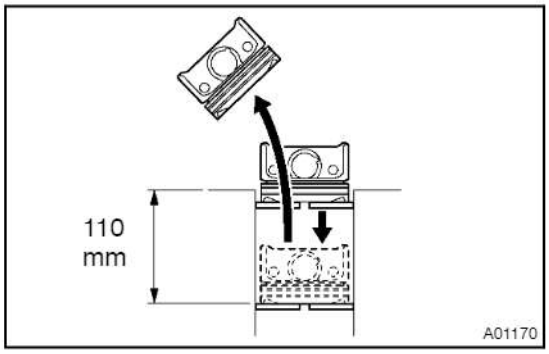


10. INSPECT PISTON RING GROOVE CLEARANCE

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

Ring groove clearance:
0.030 – 0.070 mm (0.0012 – 0.0028 in.)

If the clearance is not as specified, replace the piston.

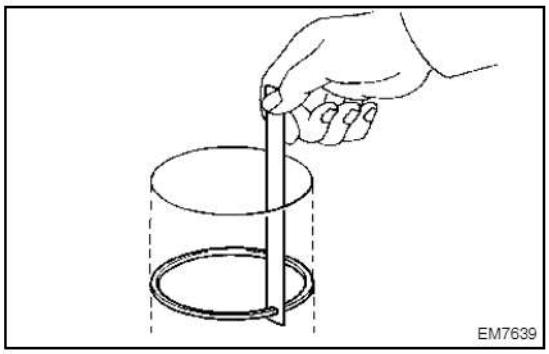


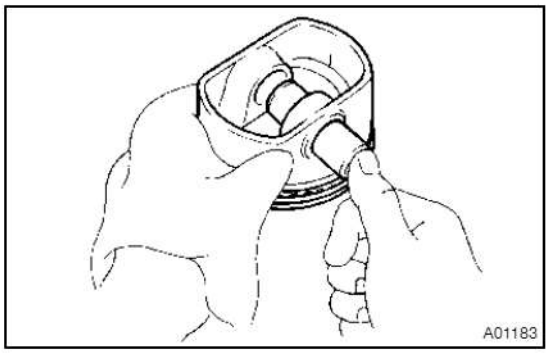
11. INSPECT PISTON RING END GAP

(a) Insert the piston ring into the cylinder bore.
(b) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.
(c) 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) 1.05 mm (0.0413 in.)

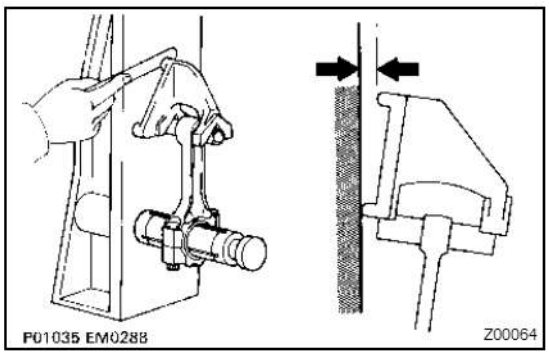
If the end gap is greater than maximum, replace the piston ring.
If the end gap is greater than maximum, even with a new piston ring, replace the cylinder block.





12. INSPECT PISTON PIN FIT

At 80 – 90°C (176 – 194°F), you should be able to push the piston pin into the piston pin hole with your thumb.



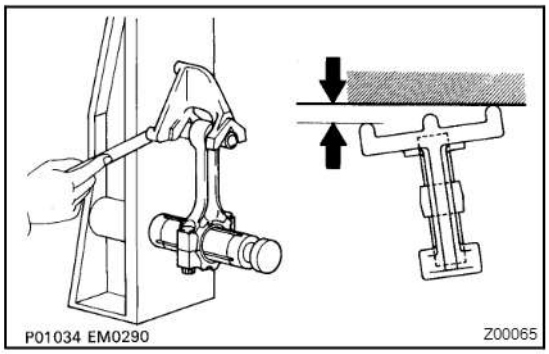
13. INSPECT CONNECTING ROD ALIGNMENT

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

- Check for out–of–alignment

Maximum out–of alignment:
0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

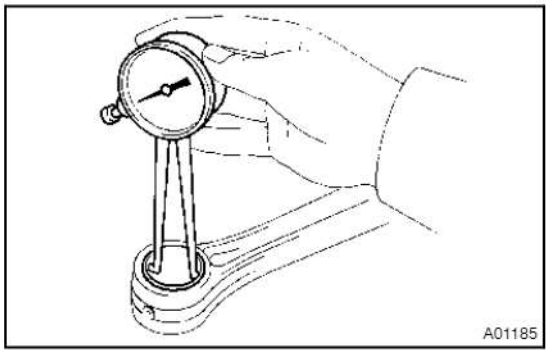
If out–of alignment is greater than maximum, replace the connecting rod assembly.



- Check for twist

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

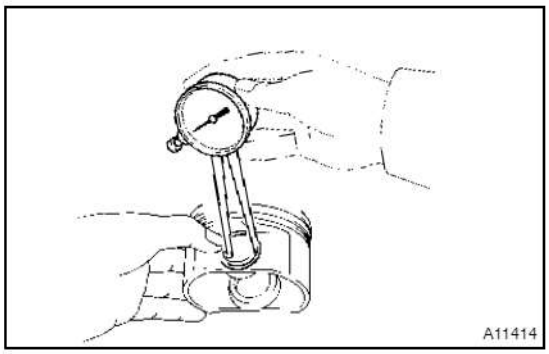
If twist is greater than maximum, replace the connecting rod assembly.



14. INSPECT PISTON PIN OIL CLEARANCE

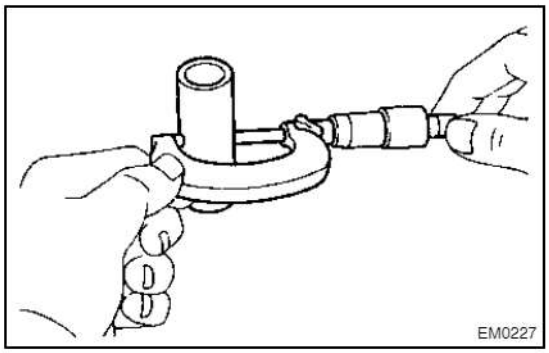
(a) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

Bushing inside diameter:
1ZZ–FE 20.012 – 20.021 mm (0.7879 – 0.7882 in.)
2ZZ–GE 20.011 – 20.023 mm (0.7878 – 0.7883 in.)



(b) 2ZZ–GE:
Using caliper gauge, measure the inside diameter of the piston bushing.

Bushing inside diameter:
20.013 – 20.025 mm (0.7879 – 0.7884 in.)



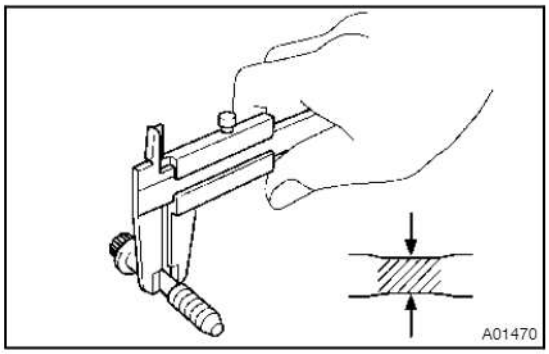
(c) Using a micrometer, measure the piston pin diameter.

Piston pin diameter:
1ZZ–FE 20.004 – 20.013 mm (0.7876 – 0.7879 in.)
2ZZ–GE 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:
1ZZ–FE 0.005 – 0.011 mm (0.0002 – 0.0004 in.)
2ZZ–GE
Piston x Piston pin
0.005 – 0.013 mm (0.0002 – 0.0005 in.)
Piston pin x Connecting rod
0.005 – 0.009 mm (0.0002 – 0.0004 in.)
Maximum oil clearance:
0.05 mm (0.0020 in.)

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



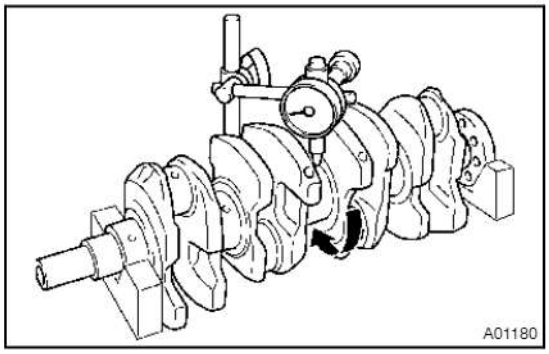
15. INSPECT CONNECTING ROD BOLTS

Using a vernier calipers, measure the tension portion diameter of the bolt.

Standard diameter: 6.6 – 6.7 mm (0.260 – 0.264 in.)

Minimum diameter: 6.4 mm (0.252 in.)

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



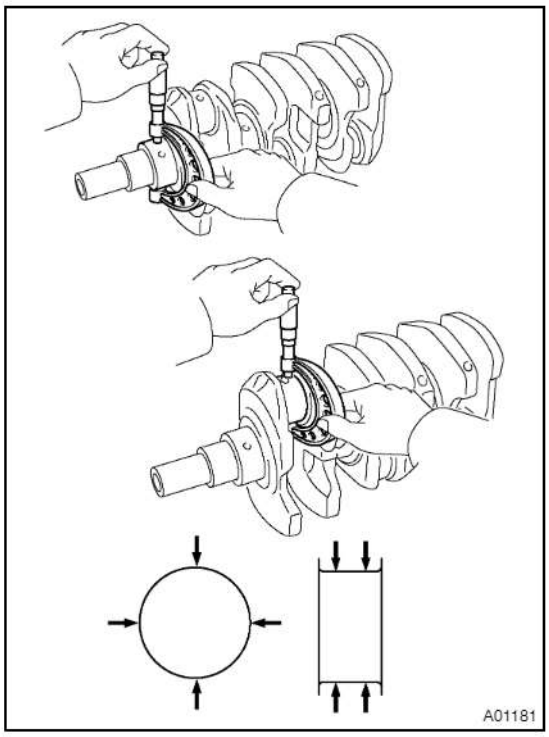
16. INSPECT CRANKSHAFT FOR CIRCLE RUNOUT

(a) Place the crankshaft on V–blocks.

(b) Using a dial indicator, measure the circle runout, as shown in the illustration.

Maximum circle runout: 0.03 mm (0.0012 in.)

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



17. INSPECT MAIN JOURNALS AND CRANK PINS

(a) Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter:

47.988 – 48.000 mm (1.8893 – 1.8898 in.)

Crank pin diameter:

1ZZ–FE:

43.992 – 44.000 mm (1.7320 – 1.7323 in.)

2ZZ–GE:

44.992 – 45.000 mm (1.7713 – 1.7717 in.)

If the diameter is not as specified, check the oil clearance (See page EM–91).

If necessary, replace the crankshaft.

(b) Check each main journal and crank pin for taper and out–of–round as shown.

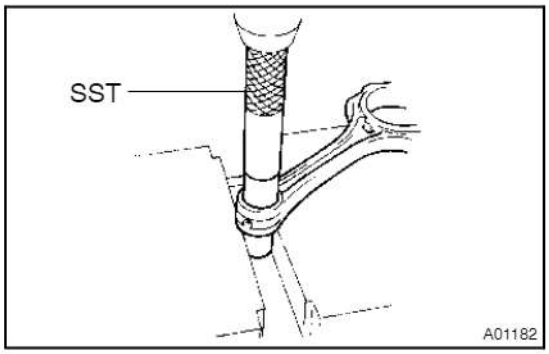
Maximum taper and out–of–round:

0.02 mm (0.0008 in.)

If the taper and out–of round is greater than maximum, replace the crankshaft.

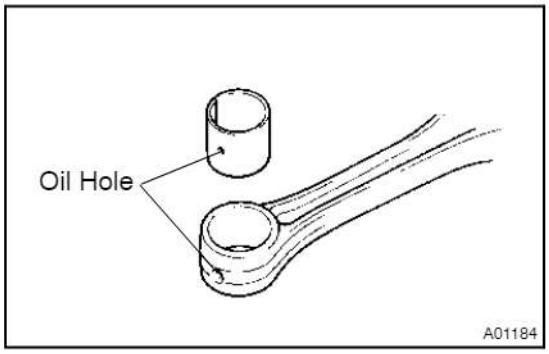
EM086-12

REPLACEMENT



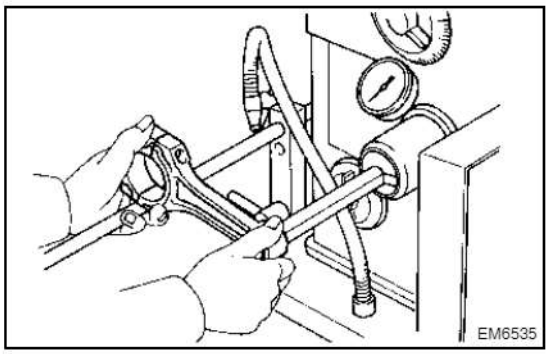
1. REPLACE CONNECTING ROD BUSHINGS

(a) Using SST and a press, press out the bushing.
SST 09222–30010

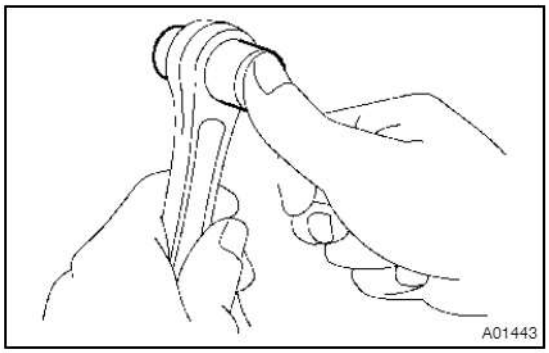


(b) Align the oil hoses of a new bushing and the connecting rod.

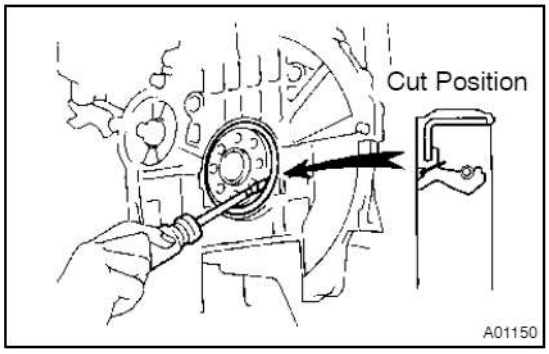
(c) Using SST and a press, press in the bushing.
SST 09222–30010



(d) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (See page EM–100) between the bushing and piston pin.



(e) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.



2. REPLACE CRANKSHAFT REAR OIL SEAL

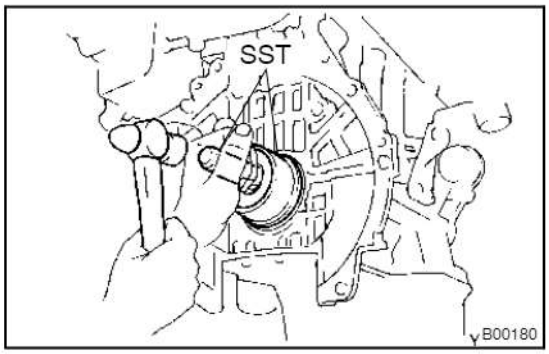
If rear oil seal is installed to cylinder block.

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

(b) Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft. Tape the screwdriver tip.



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

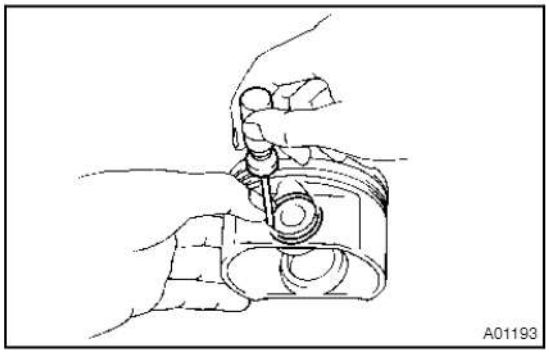
(d) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
SST 09223–15030, 09950–70010 (09951–07100)

EM165–05

REASSEMBLY

HINT:

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

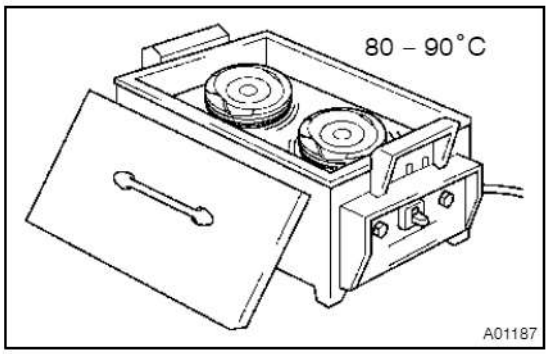


1. ASSEMBLE PISTON AND CONNECTING ROD

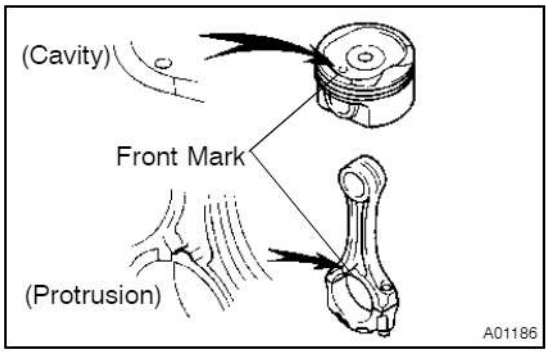
(a) Using a small screwdriver, install a new snap ring at one end of the piston pin hole.

HINT:

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

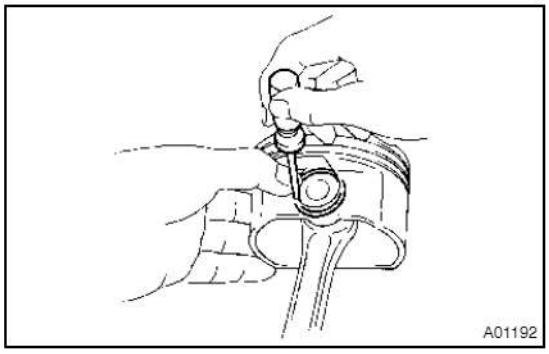


(b) 1ZZ–FE:
Gradually heat the piston to 80 – 90°C (176 – 194°F).



(c) Coat the piston pin with engine oil.

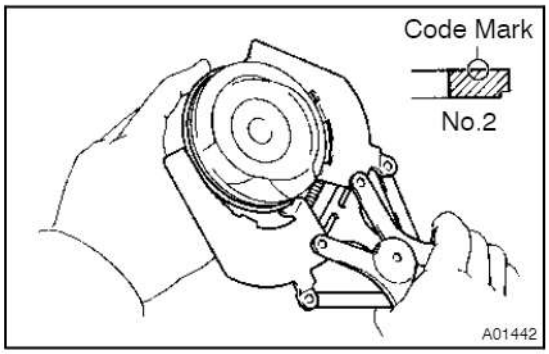
(d) Align the front marks on the piston and connecting rod, and push in the piston with your thumb.



(e) 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.

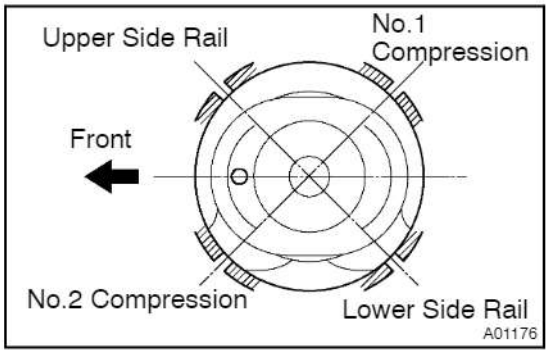


2. INSTALL PISTON RINGS

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

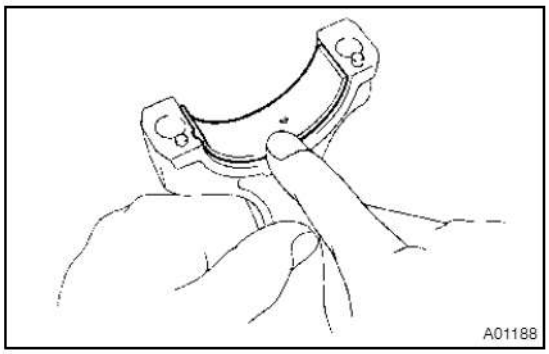
(b) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

Code mark :
1ZZ–FE: T or 2R
2ZZ–GE: T



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

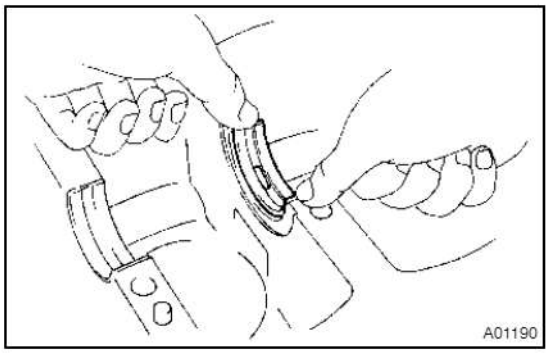
NOTICE:
Do not align the ring ends.



3. INSTALL CONNECTING ROD BEARINGS

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

(b) Install the bearings in the connecting rod and connecting rod cap.

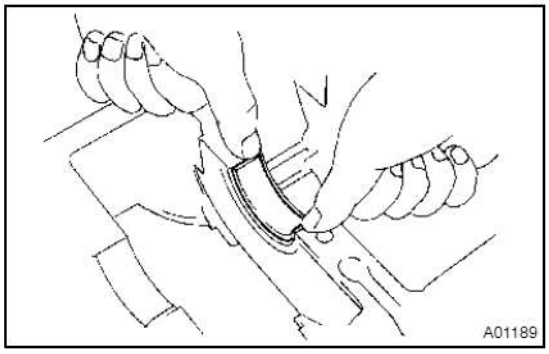


4. INSTALL MAIN BEARINGS

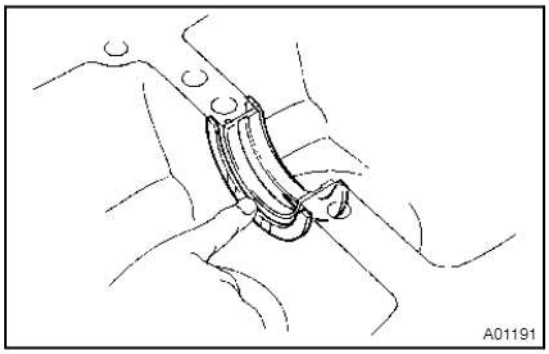
HINT:
Upper bearings have an oil groove and oil holes; Lower bearings do not.

(a) Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.

NOTICE:
Install the bearing with the oil hole in the cylinder block.



(b) Align the bearing claw with the claw grove of the main bearing cap, and push in the 5 lower bearings.

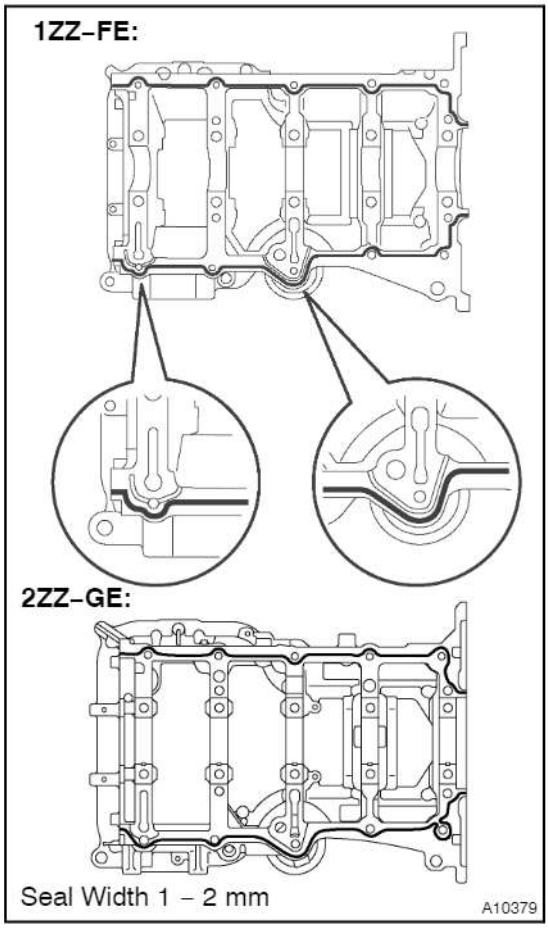


5. INSTALL THRUST WASHERS

Install the 2 thrust washers under the No.3 journal position of the cylinder block with the oil grooves facing outward.

6. PLACE CRANKSHAFT ON CYLINDER BLOCK

7. PLACE BEARING CAP SUB–ASSEMBLY ON CYLINDER BLOCK



(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the bearing cap sub–assembly and cylinder block.

- Using a razor blade and 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 materials.
- Using a non–reusable solvent, clean both sealing surfaces.

(b) Apply seal packing to the bearing cap sub–assembly as shown in the illustration.

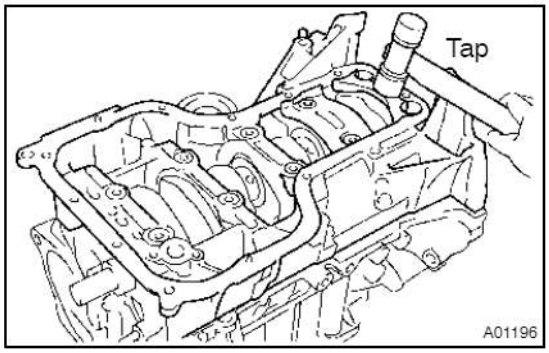
Seal packing:
Part No. 08826–00080 or equivalent

- Install a nozzle that has been cut to a 1 – 2 mm (0.004 – 0.08 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.

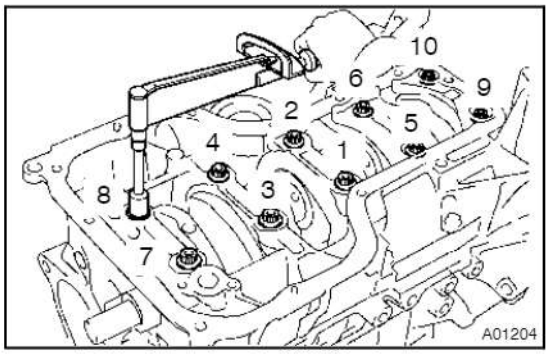


(c) Using a plastic–faced hammer, lightly tap the bearing cap sub–assembly to ensure a proper fit.

8. INSTALL 12 POINTED HEAD BEARING CAP SUB–ASSEMBLY BOLTS

HINT:

- The bearing cap sub–assembly bolts are tightened in 3 progressive steps (steps (b), (c) and (e)).
- If any of the bearing cap sub–assembly bolts in broken or deformed, replace it.

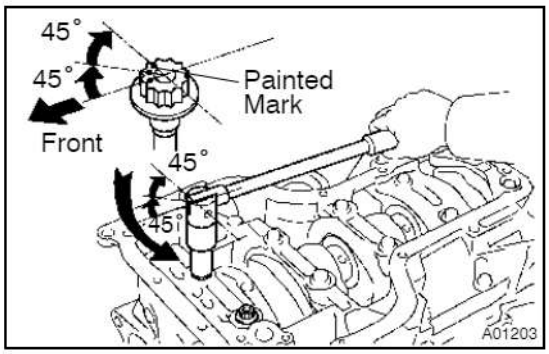


(a) Apply a light coat of engine oil on the threads and under the bearing cap sub–assembly bolts.

(b) Install and uniformly tighten the 10 bearing cap sub–assembly bolts, in several passes, in the sequence shown.
Torque: 22 N·m (225 kgf·cm, 16 ft·lbf)

(c) Retighten the bearing cap sub–assembly bolts, in several passes, in the sequence shown.
Torque: 44 N·m (449 kgf·cm, 32 ft·lbf)

If any of the bearing cap sub–assembly bolts does not meet the torque specification, replace the bearing cap sub–assembly bolt.



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

(e) Retighten the bearing cap sub–assembly bolts by 45° and 45° in the numerical order shown.

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

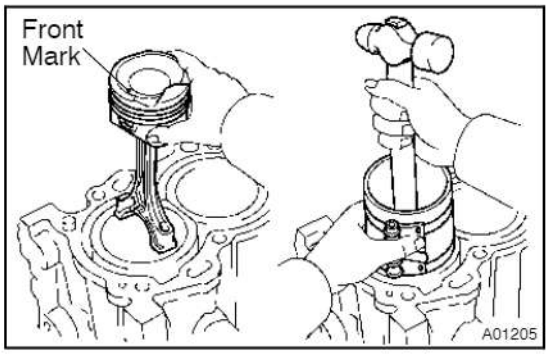
9. INSTALL HEXAGON HEAD BEARING CAP SUB–ASSEMBLY BOLTS

(a) Install and uniformly tighten the 10 bearing cap sub–assembly bolts in several passes.
Torque:
1ZZ–FE: 18.5 N·m (189 kgf·cm, 14 ft·lbf)
2ZZ–GE: 18 N·m (185 kgf·cm, 13 ft·lbf)

(b) Check that the crankshaft turns smoothly.

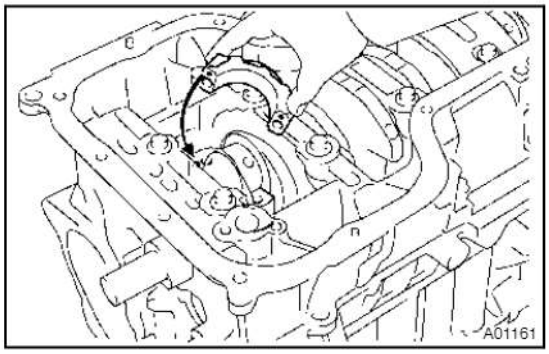
(c) 2ZZ–GE:
Apply adhesive to 2 or 3 threads, and install the 4 screw plugs.
Adhesive:
Part No. 08833 – 00070, THREE BOND 1324, or equivalent
Torque: 43 N·m (438 kgf·cm, 32 ft·lbf)

10. CHECK CRANKSHAFT THRUST CLEARANCE (See page EM–100)



11. INSTALL PISTON AND CONNECTING ROD ASSEMBLES

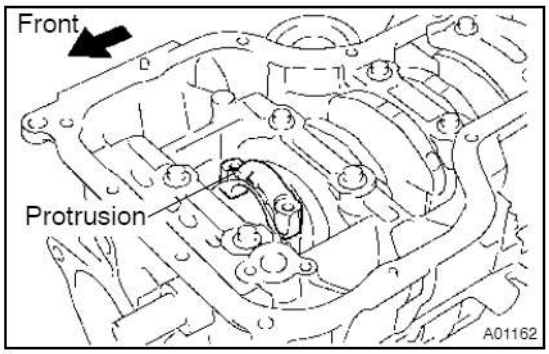
Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward.



12. PLACE CONNECTING ROD CAP ON CONNECTING ROD

(a) Match the numbered connecting rod cap with the connecting rod.

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

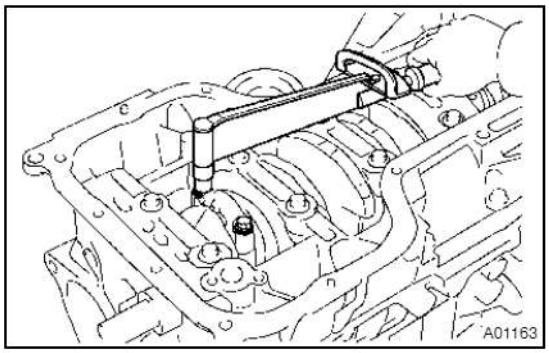


(c) Check that the protrusion of the connecting rod cap is facing in the correct direction.

13. INSTALL CONNECTING ROD CAP BOLTS

HINT:

- The connecting rod cap bolts are tightened in 2 progressive steps (steps (b) and (d)).
- If any of the connecting rod cap bolts is broken or deformed, replace it.

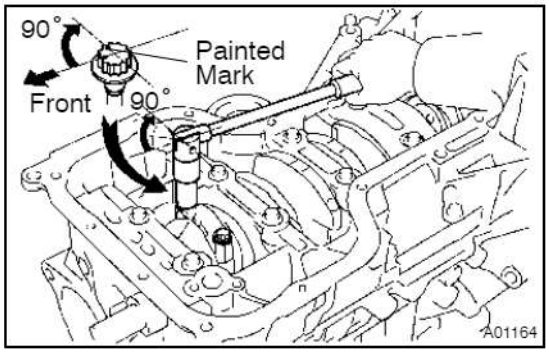


(a) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.

(b) Install and alternately tighten the 2 connecting rod cap bolts in several passes.

Torque:
1ZZ–FE: 20 N·m (204 kgf·cm, 15 ft·lbf)
2ZZ–GE: 30 N·m (306 kgf·cm, 22 ft·lbf)

If any of the connecting rod cap bolts does not meet the torque specification, replace the connecting rod cap bolts.



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

(d) Retighten the cap bolts by 90° as shown.

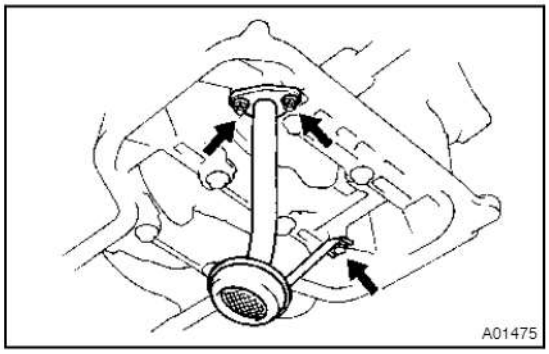
(e) Check that the painted mark is now at a 90° angle to the front.

(f) Check that the crankshaft turns smoothly.

14. CHECK CONNECTING ROD THRUST CLEARANCE (See page EM–100)

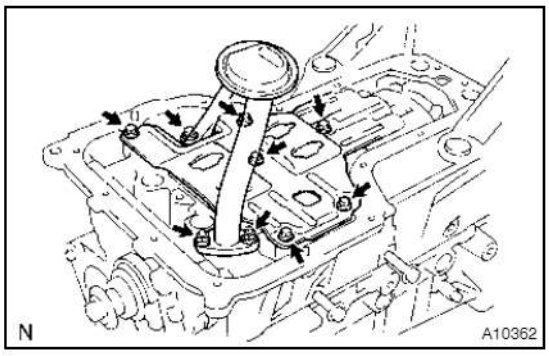
15. INSTALL REAR CRANKSHAFT OIL SEAL (See page EM–106)

HINT:
Wipe seal packing away from the contact surface of the cylinder block assembly and oil seal.



16. 1ZZ–FE:
INSTALL OIL STRAINER

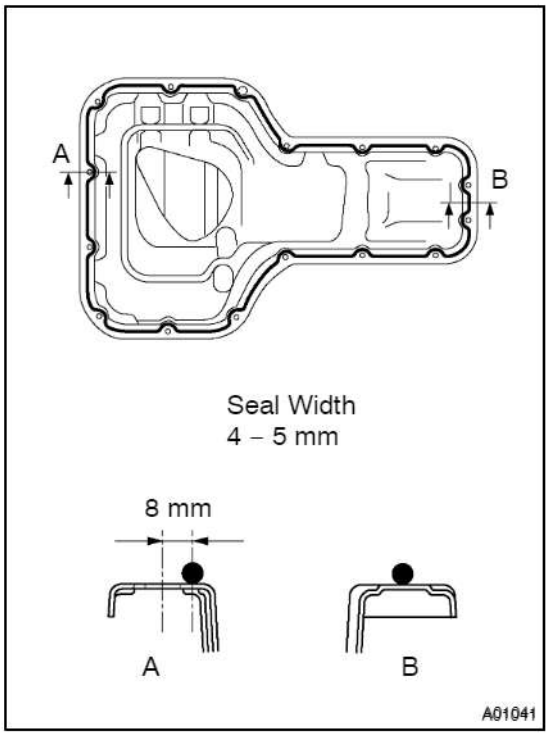
Install a new gasket and the oil strainer with the 2 nuts and bolt.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)



17. 2ZZ–GE:
INSTALL OIL PAN BAFFLE AND OIL STRAINER

(a) Install the oil pan baffle with the 4 bolts and 2 nuts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

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



18. INSTALL OIL PAN

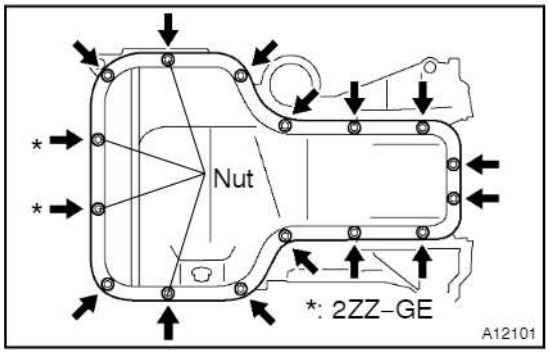
(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surface of the main bearing cap and oil pan.
- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing grooves.
- Thoroughly clean all components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

NOTICE:
Do not use a solvent which will affect the painted surfaces.

(b) Apply seal packing to the oil pan as 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.



(c) 1ZZ–FE:
Install the oil pan with the 14 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

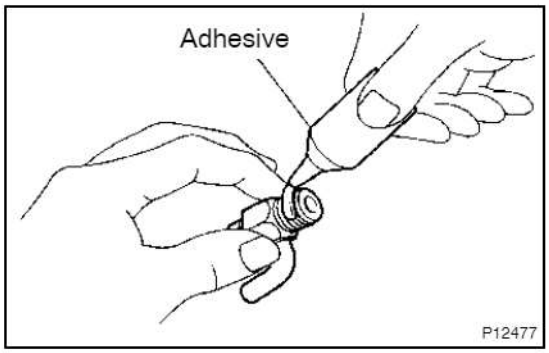
(d) 2ZZ–GE:
Install the oil pan with the 12 bolts and 4 nuts. Uniformly tighten the bolts and nuts in several passes.

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

19. INSTALL OIL FILTER UNION
Torque: 30 N·m (306 kgf·cm, 21 ft·lbf)

20. INSTALL OIL FILTER (See page LU–3)

21. INSTALL OIL PUMP (See page LU–14)



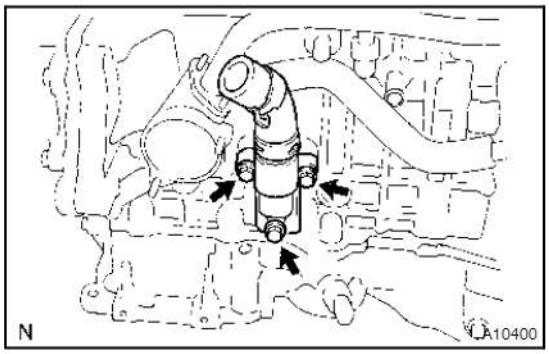
22. INSTALL ENGINE COOLANT DRAIN UNION

(a) Apply adhesive to 2 or 3 threads.
Adhesive:
Part No. 08833–00080, THREE BOND 1344, LOCTITE 242 or equivalent

(b) Install the drain union.
Torque:
1ZZ–FE 20 N·m (200 kgf·cm, 14 ft·lbf)
2ZZ–GE 25 N·m (255 kgf·cm, 18 ft·lbf)

HINT:
After applying the specified torque, rotate the drain union clockwise until its drain port is facing downward.

23. INSTALL KNOCK SENSOR
Torque:
1ZZ–FE 44 N·m (450 kgf·cm, 33 ft·lbf)
2ZZ–GE 20 N·m (204 kgf·cm, 15 ft·lbf)

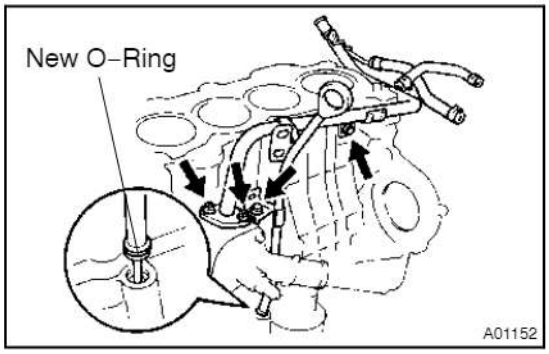


24. 2ZZ–GE:
INSTALL VENTILATION CASE

(a) Install a new gasket and ventilation case with the 3 bolts.
Torque: 8.5 N·m (87 kgf·cm, 75 in.·lbf)

(b) Install the No. 3 ventilation hose and connect the clip.

25. INSTALL THERMOSTAT (See page CO–11)



26. INSTALL WATER BYPASS PIPE
Torque:
1ZZ–FE 9.0 N·m (92 kgf·cm, 80 in.·lbf)
2ZZ–GE
Bolt 8.5 N·m (87 kgf·cm, 75 in.·lbf)
Nut 10 N·m (100 kgf·cm, 7 ft·lbf)

27. 1ZZ–FE:
INSTALL OIL DIPSTICK AND GUIDE

(a) Install a new O–ring on the dipstick guide.

(b) Apply soapy water on the O–ring.

(c) Connect the dipstick guide end to the main bearing cap.

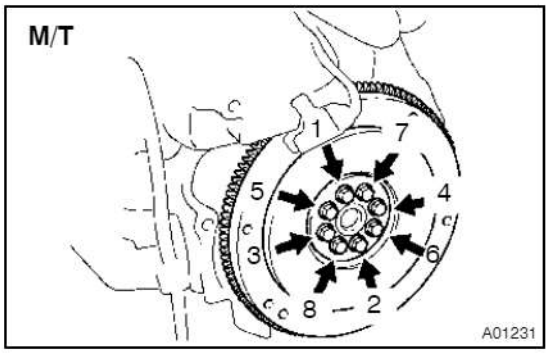
(d) Install the dipstick guide with the bolt.
Torque: 11 N·m (113 kgf·cm, 8 ft·lbf)

28. INSTALL CYLINDER HEAD (See page EM–67)

29. INSTALL ENGINE WIRE

30. INSTALL TIMING SPROCKETS AND TIMING CHAIN (See page EM–26)

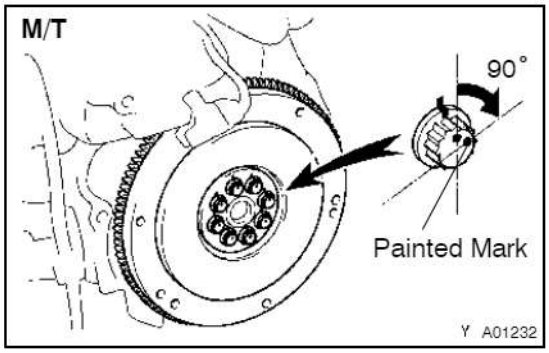
31. REMOVE ENGINE STAND



32. M/T:
INSTALL FLYWHEEL

HINT:
The flywheel bolts are tightened in 2 progressive steps, (a) and (c).

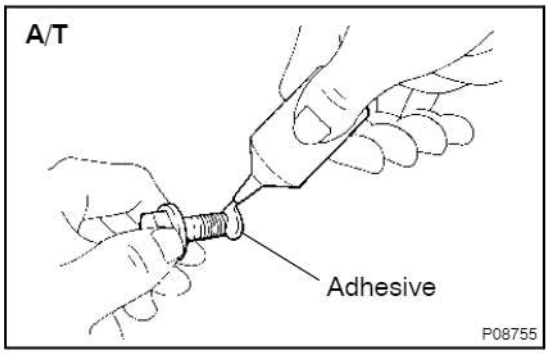
(a) Install and uniformly tighten the 8 mounting bolts, in several passes, in the sequence shown.
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)



(b) Mark the flywheel bolt with paint.

(c) Retighten the flywheel bolts by an additional 90°.

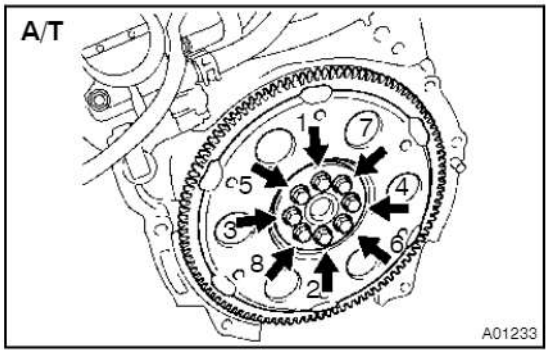
(d) Check that the painted mark in now at a 90° angle to (b).



33. A/T:
INSTALL DRIVE PLATE

(a) Install the front spacer, drive plate and rear plate on the crankshaft.

(b) Apply adhesive to 2 or 3 threads of the mounting bolt end.
Adhesive:
Part No. 08833–00070, THREE BOND or equivalent



(c) Install and uniformly tighten the 8 mounting bolts, in several passes, in the sequence shown.
Torque: 88 N·m (897 kgf·cm, 65 ft·lbf)

EXHAUST SYSTEM

COMPONENTS

EM166-09

