CO/HC

EM167–04

INSPECTION

HINT:

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

1. INSTALL CONDITIONS

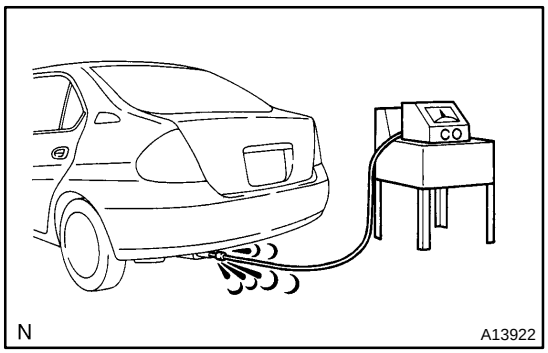
(a) Air cleaner installed
(b) Air pipes and hoses of air induction system connected
(c) All accessories switched OFF
(d) All vacuum lines properly connected
(e) EFI system wiring connectors fully plugged
(f) Ignition timing check correctly
(g) Transmission in parking range
(h) Tachometer and CO/HC meter calibrated by hand

2. ACTIVATE INSPECTION MODE AND WARM UP ENGINE (See page IN–10)

3. RACE ENGINE AT 2,250 RPM FOR APPROX. 180 SECONDS

HINT:

At the accelerator opening angle of 60% or more, the engine speed is controlled at 2,250 rpm.



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 2,250 RPM

Complete the measuring with 3 minutes.

HINT:

When doing the 2 mode (idle and 2,250 rpm) test, these measurement order prescribed by the applicable local regulations.

6. STOP ENGINE

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

- Check heated oxygen sensor operation.
  (See page DI–45)
- 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	1. Faulty ignitions: • Incorrect timing • Fouled, shorted or improperly gapped plugs • Open or crossed high–tension cords 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinders
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: • PCV hoses • Intake manifold • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. Faulty EFI systems: • Faulty pressure regulator • Defective water temperature sensor • Defective air flow meter • Faulty ECM • Faulty injectors • Faulty throttle position sensor
Normal	High		1. Faulty HCAC: • Faulty VSV • Faulty actuator

COMPRESSION

EM1IT–02

INSPECTION

HINT:

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

NOTICE:

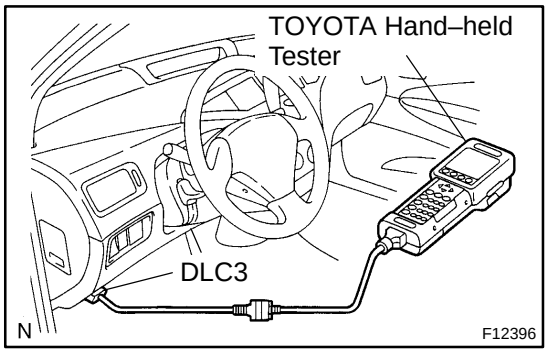
The measurement of compression pressure should be performed in the Cranking Mode.

1. WARM UP AND STOP ENGINE

Allow the engine to warm up to normal operating temperature.

2. REMOVE AIR CLEANER ASSEMBLY

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



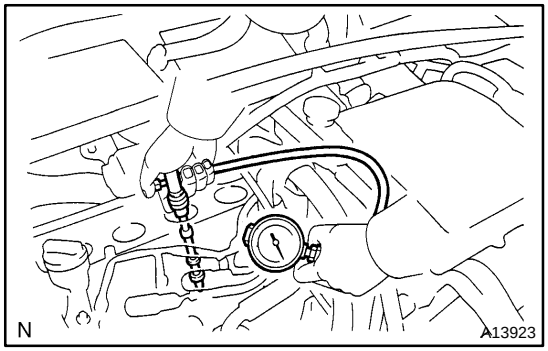
4. REMOVE SPARK PLUGS

5. CONNECT TOYOTA HAND–HELD TESTER

(a) Connect the TOYOTA hand–held tester to the DLC3.

(b) Select the cranking mode on the TOYOTA hand–held tester.

(c) Please refer TOYOTA hand–held tester operator's manual for further details.



6. 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:

In the Cranking Mode, the engine speed is automatically controlled at 250 rpm and the throttle valve is also automatically set in fully–opened condition.

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

NOTICE:

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

Compression pressure:
728 kPa (7.4 kgf/cm^2, 106 psi)
Minimum pressure:
534 kPa (5.4 kgf/cm^2, 77 psi)
Difference between each cylinder:
98 kPa (1.0 kgf/cm^2, 14 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.

7. REINSTALL SPARK PLUGS

8. REINSTALL IGNITION COIL (See page IG–7)

VALVE CLEARANCE

ADJUSTMENT

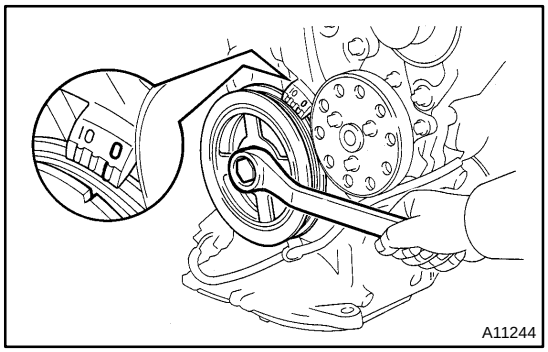
EM169–02

HINT:

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

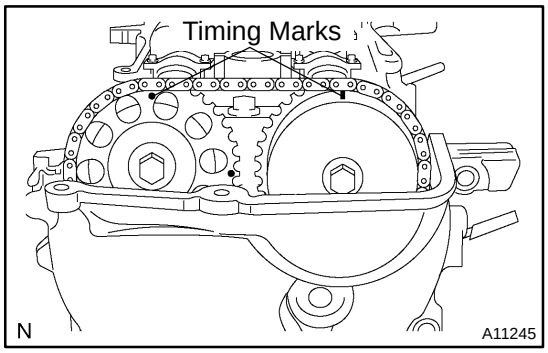
1. REMOVE CYLINDER HEAD COVER

(See page EM–15)



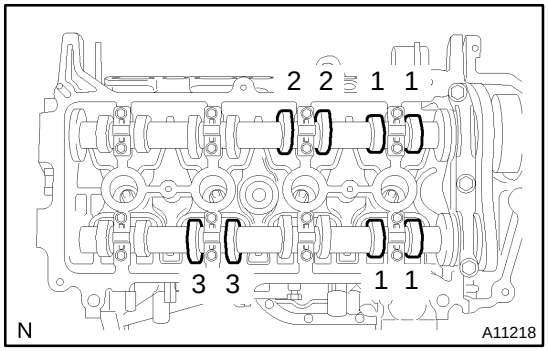
2. SET NO.1 CYLINDER TO TDC/COMPRESSION

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



(b) Check that both timing marks on the camshaft timing sprocket and valve timing controller assembly are facing right up 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 adjusting shim.

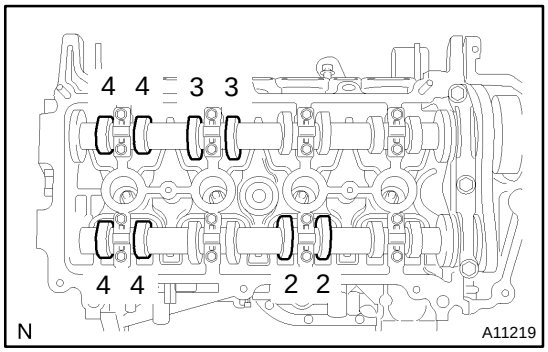
Valve clearance (Cold):

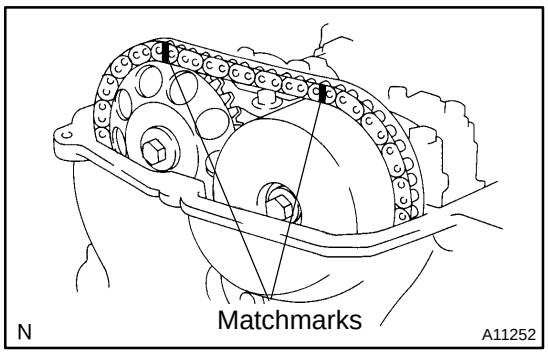
Intake: 0.17 – 0.23 mm (0.007 – 0.009 in.)

Exhaust: 0.27 – 0.33 mm (0.011 – 0.013 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))



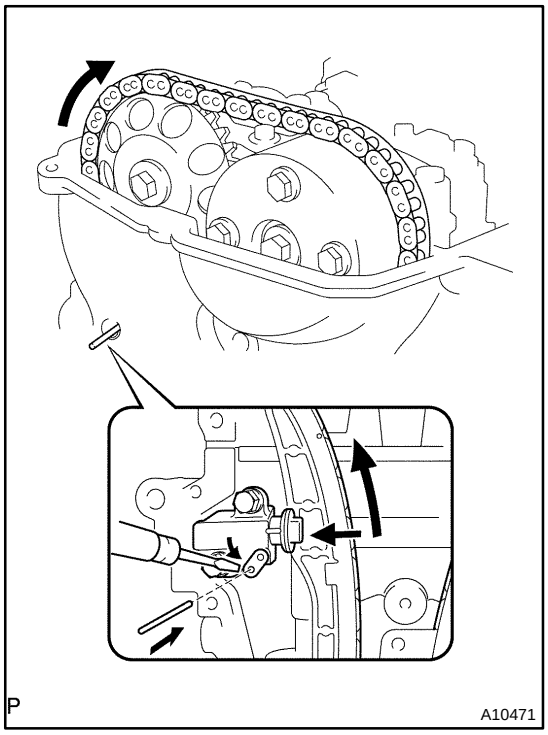


4. ADJUST VALVE CLEARANCE

(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 plug from the timing chain cover.



(d) Using drivers or equipment, while rotating the stopper plate of the tensioner downward, turn the exhaust camshaft right a little and push in the plunger of the chain tensioner as shown in the illustration.

HINT:

When the stopper plate cannot be lowered easily, rotate the exhaust camshaft right and left a little.

(e) Insert a bar of ø 2 – 3 mm (0.08 – 0.12 in.) into the holes in the stopper plate and tensioner to fix the stopper plate.

HINT:

- At this time, it is easier to fix by installing the bar while rotate the camshaft right and left a little.
- Fix the bar with tape so that the bar does not come off.

(f) Remove the timing chain from the camshaft timing sprocket.

NOTICE:

- **Never rotate the crankshaft with the timing chain removed.**
- **When rotating the camshaft with the timing chain removed, rotate the crankshaft counterclockwise 40˚ from the TDC and align the oil jet hole with the paint mark before rotating it.**
- **When installing the timing chain, make sure to return it to the position of the matchmarks for camshaft and then rotate the crankshaft clockwise to return.**

HINT:

When the chain cannot be removed easily, rotate the intake camshaft right and left a little.

(g) Hold the hexagonal portion of the camshaft with a wrench, and remove the bolt and valve timing controller assembly with the chain.

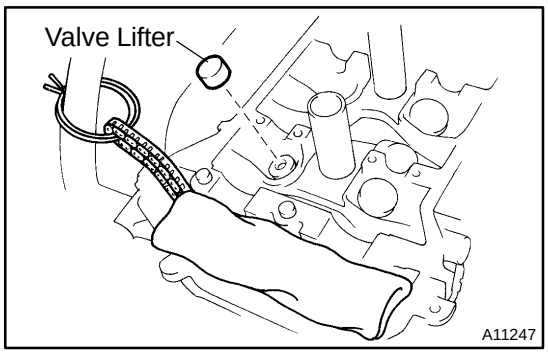
NOTICE:

Do not disassembled the valve timing controller assembly.

(h) Remove the intake and exhaust camshaft assembly.

HINT:

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

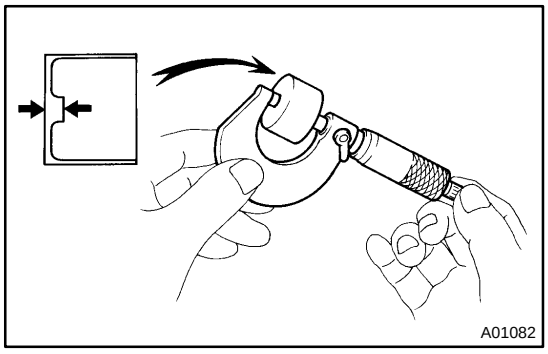


(i) Tie the timing chain with a string as shown in the illustration.

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.**

(j) Remove the valve lifters.



(k) Determine the replacement valve lifter size 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.).

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	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	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	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	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																										
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																										
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																										
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																										
0.691 – 0.710 (0.0272 – 0.0280)	56	58	60	62	64	66	68	70	72	72	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																										
0.731 – 0.750 (0.0288 – 0.0295)	60	62	64	66	68	70	72	74	74	74	74	74																										
0.751 – 0.770 (0.0296 – 0.0303)	62	64	66	68	70	72	74	74	74	74																										
0.771 – 0.790 (0.0304 – 0.0311)	64	66	68	70	72	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. 46 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

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	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	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
0.151 – 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	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	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	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	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	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						
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	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																																								

A01235

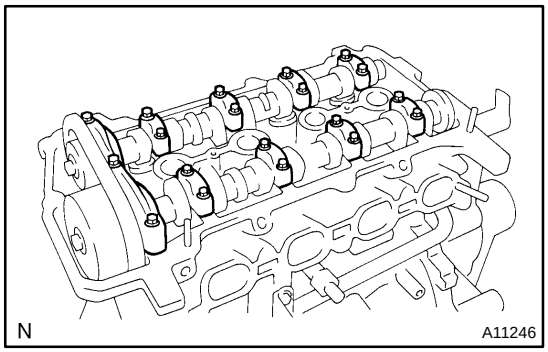
Exhaust valve clearance (Cold):
0.25 – 0.35 mm (0.010 – 0.014 in.)

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.

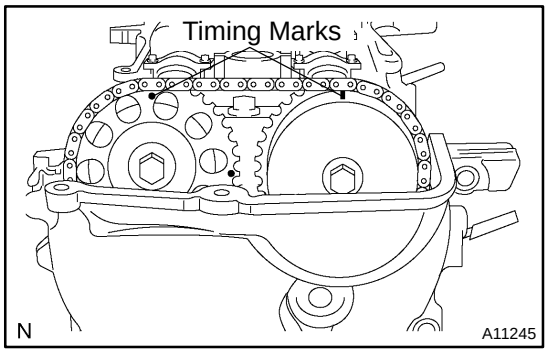
New lifter thickness mm (in.)

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)		

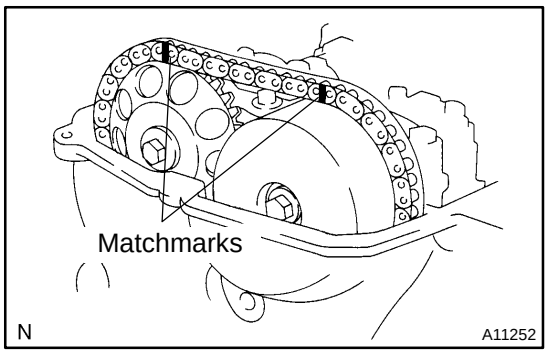
(l) Reinstall the valve lifters (See page EM–43).
(m) Align the crankshaft pulley groove with the timing mark ”0” of the timing chain cover.
(n) Hold the timing chain, and place the exhaust camshaft and timing sprocket assembly.
(o) Align the matchmarks on the timing chain and camshaft timing sprocket.



(p) Reinstall the intake camshaft, valve timing controller assembly and camshaft bearing caps (See page EM–45).
(q) Remove the bar from the timing chain tensioner.



(r) Check that both timing marks on the camshaft timing sprocket and valve timing controller assembly are facing right up as shown in the illustration.



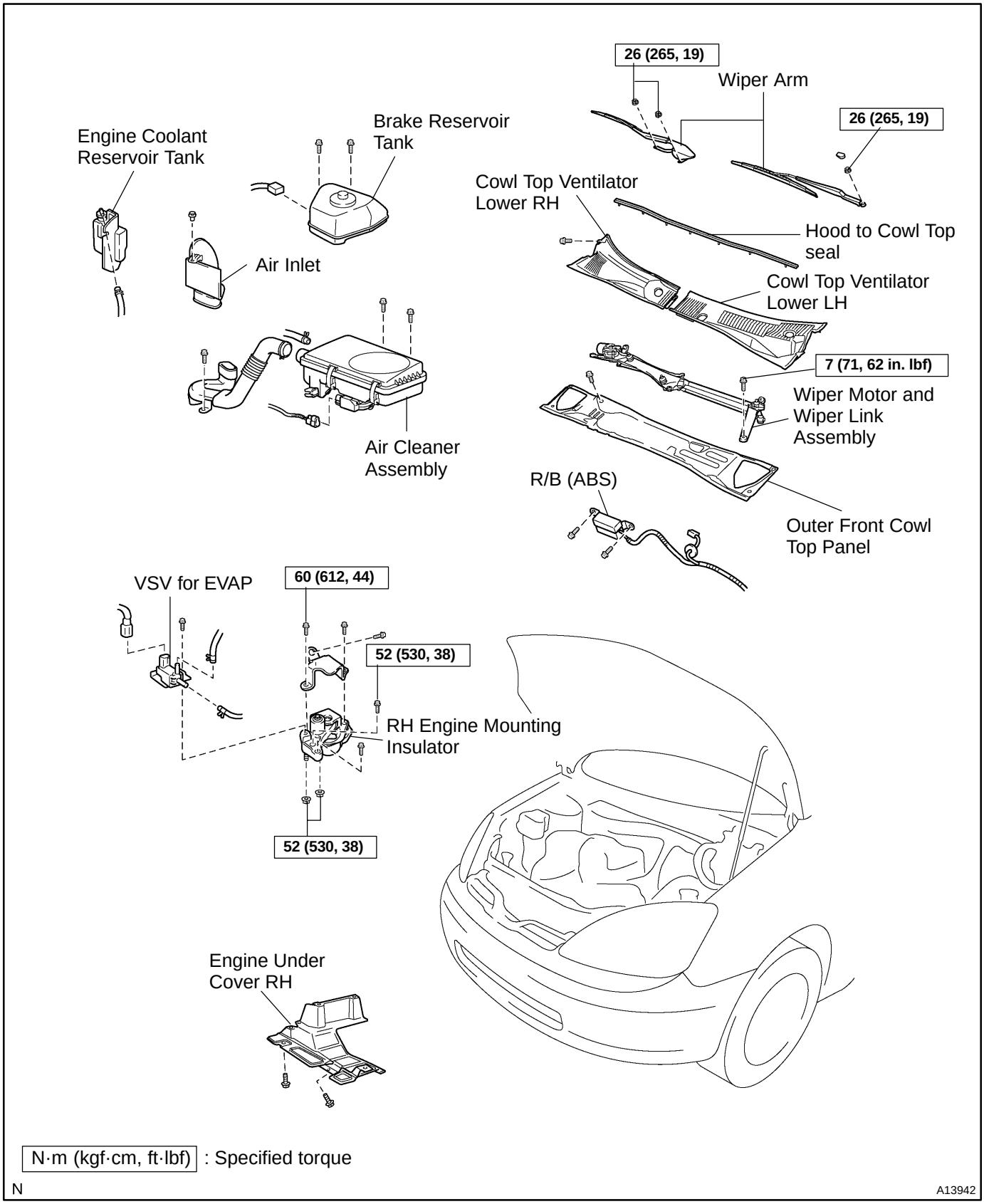
(s) Check that the matchmarks on the timing chain and camshaft timing sprockets.
(t) Install a new plug to the timing chain cover.
Torque: 15 N·m (150 kgf·cm, 11 ft·lbf)
(u) Recheck the valve clearance (See procedure in step 3).
(v) Check the valve timing (See page EM–19).

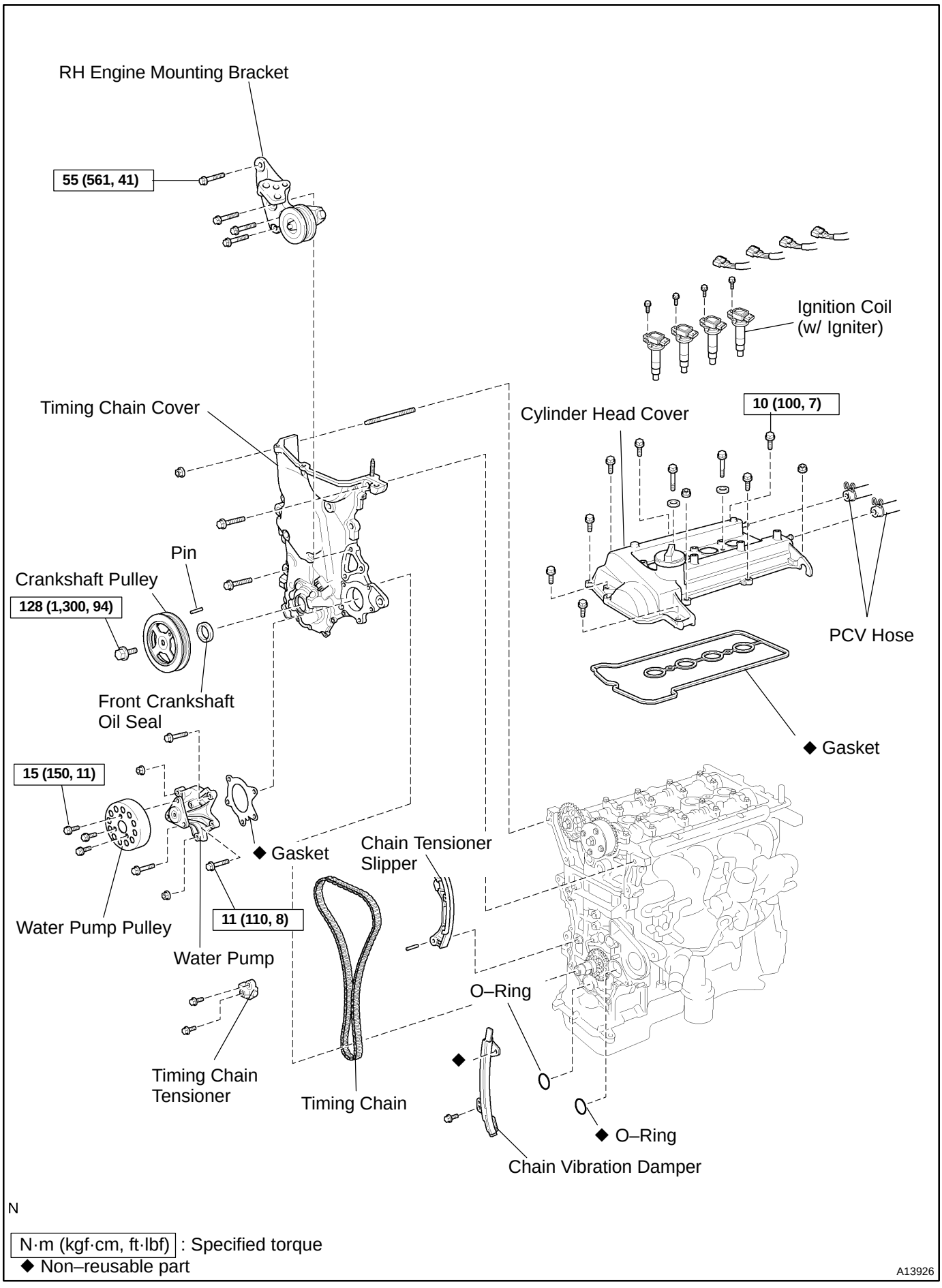
5. REINSTALL CYLINDER HEAD COVER
(See page EM–21)

TIMING CHAIN

COMPONENTS

EM173–04




RH Engine Mounting Bracket
55 (561, 41)
Ignition Coil
(w/ Igniter)
Timing Chain Cover
Cylinder Head Cover
10 (100, 7)
Pin
Crankshaft Pulley
128 (1,300, 94)
PCV Hose
Front Crankshaft
Oil Seal
◆ Gasket
15 (150, 11)
◆ Gasket
Chain Tensioner
Slipper
Water Pump Pulley
11 (110, 8)
Water Pump
O–Ring
Timing Chain
Tensioner
Timing Chain
◆ O–Ring
Chain Vibration Damper
N
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
A13926

EM1IU–04

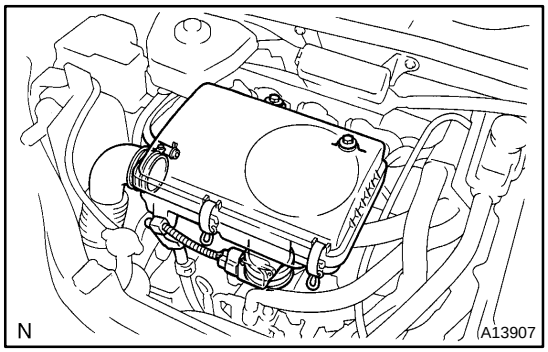
REMOVAL

1. DISCONNECT BATTERY NEGATIVE (–) TERMINAL AND HV BATTERY SERVICE PLUG
(See page HV–1)

2. REMOVE OUTER FR COWL TOP PANEL ASSEMBLY
(See page BO–32)

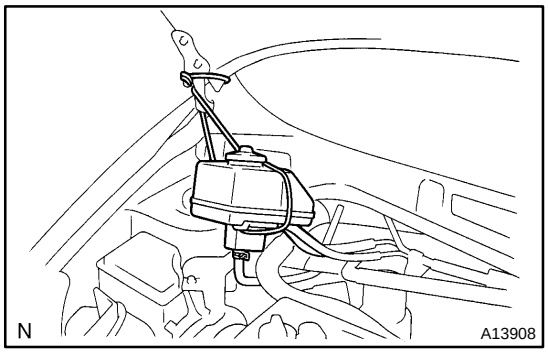
3. REMOVE RH ENGINE UNDER COVER

4. DRAIN ENGINE COOLANT



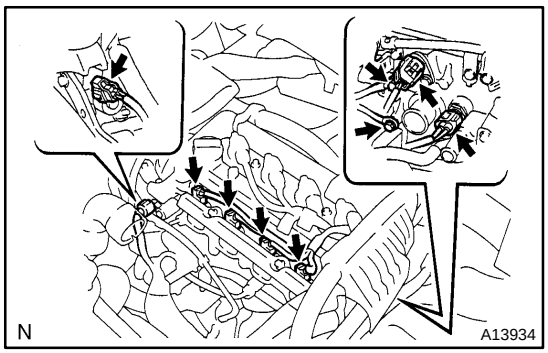
5. REMOVE AIR CLEANER ASSEMBLY

(a) Disconnect the MAF meter connector.
(b) Disconnect the EVAP hose from the air cleaner case.
(c) Loosen the 2 hose clamps.
(d) Remove the 3 bolts and air cleaner assembly.



6. REMOVE BRAKE RESERVOIR TANK

(a) Disconnect the brake fluid level sensor connector.
(b) Remove the 2 bolts and remove the reservoir tank and suspend it.
(c) Remove the 3 bolts and reservoir tank bracket.



7. DISCONNECT CONNECTORS

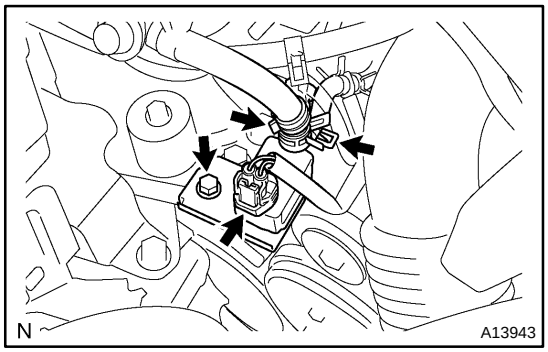
(a) Disconnect the 4 ignition connectors.
(b) Disconnect the 4 injector connectors.
(c) Disconnect the 2 VSV connectors.
(d) Disconnect the camshaft position sensor connector.
(e) Disconnect the water temperature connector.
(f) Disconnect the Camshaft timing oil control valve connector.

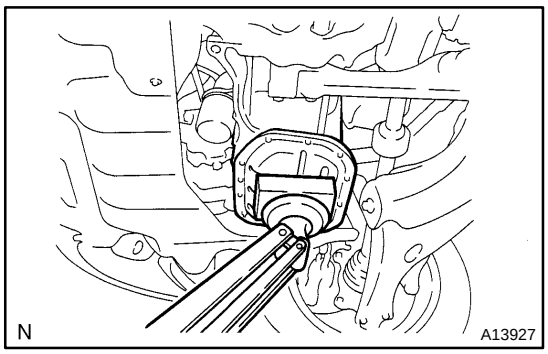
8. REMOVE AIR INLET

9. REMOVE ENGINE COOLANT RESERVOIR TANK

10. REMOVE VSV FROM ENGINE MOUNTING INSULATOR

11. REMOVE DRIVE BELT



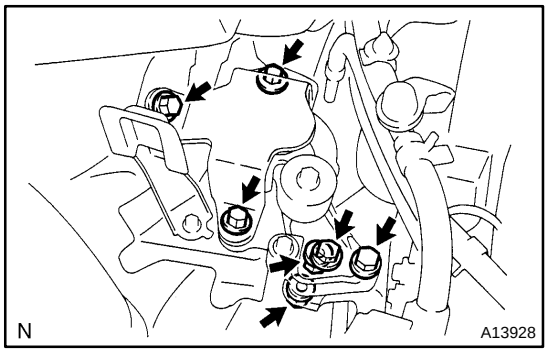


12. REMOVE RH ENGINE MOUNTING INSULATOR

(a) Set the jack to the engine.

HINT:

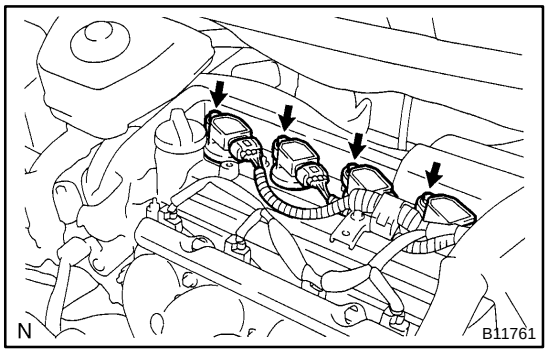
Place the wooden block between the jack and engine.



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

13. DISCONNECT ENGINE WIRE FROM CYLINDER HEAD COVER

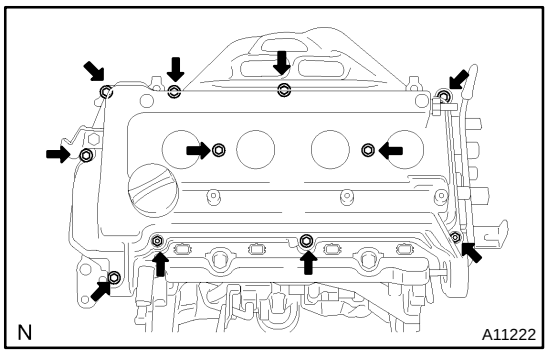
Remove the 3 bolts and disconnect the engine wire from the cylinder head.



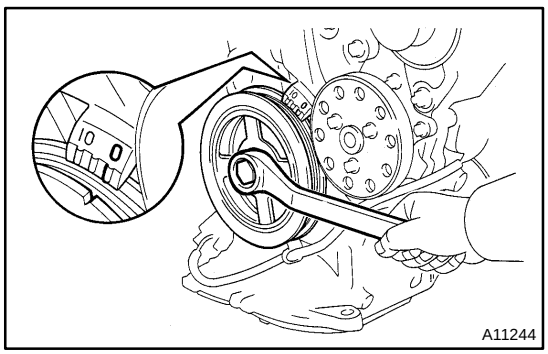
14. REMOVE CYLINDER HEAD COVER

(a) Remove the ignition coils (See page IG–6)

(b) Remove the 2 PCV hoses from the cylinder head cover.

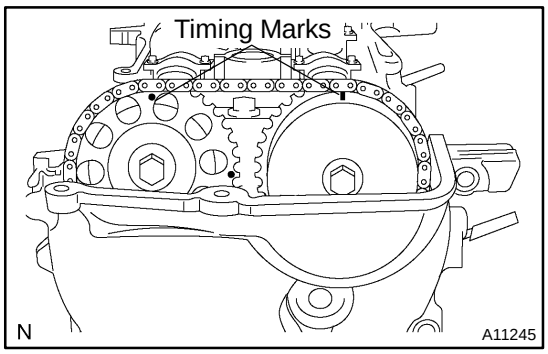


(c) Remove the 7 bolts, 2 seal washers, 2 nuts, cylinder head cover and gasket.



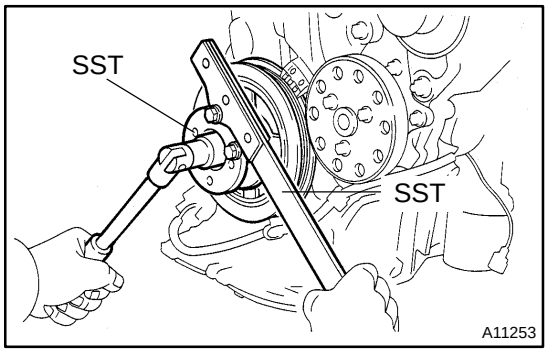
15. SET NO.1 CYLINDER TO TDC/COMPRESSION

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



(b) Check that both timing marks on the camshaft timing sprocket and valve timing controller assembly are facing right up as shown in the illustration.

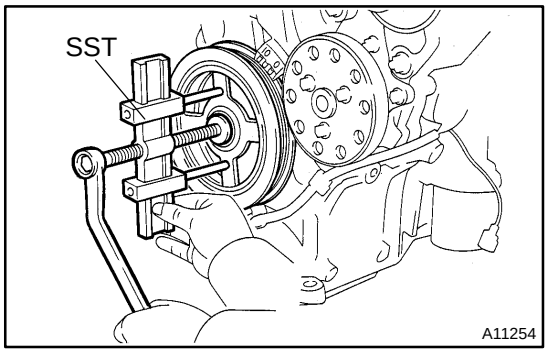
If not, turn the crankshaft 1 revolution (360˚) and align the marks as above.



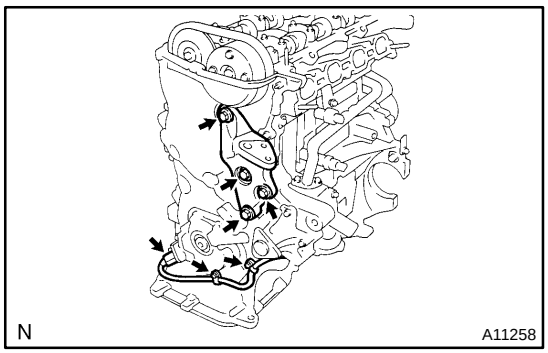
16. REMOVE CRANKSHAFT PULLEY

(a) Using SST, remove the pulley bolt.
SST 09213–70011, 09330–00021

(b) Remove the crankshaft pulley and pin.



HINT:
If necessary, remove the pulley with SST.
SST 09950–50013 (09951–05010, 09952–05010, 09953–05020, 09954–05021)



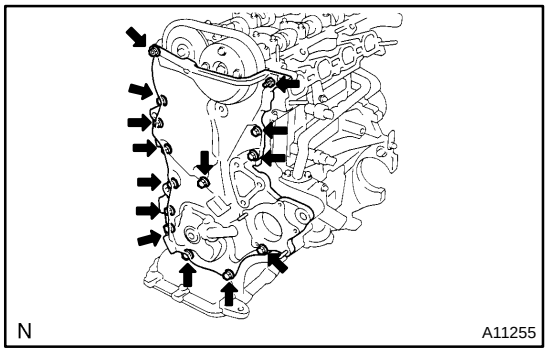
17. REMOVE CRANKSHAFT POSITION SENSOR (See page IG–12)

18. REMOVE RH ENGINE MOUNTING BRACKET

Remove the 4 bolts and mounting bracket.

19. REMOVE WATER PUMP (See page CO–6)

20. REMOVE OIL CONTROL VALVE (See page EM–29)



21. REMOVE TIMING CHAIN COVER

(a) Remove the 13 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.

(d) Remove the 2 O–rings from the cylinder block and oil pan No.1.

22. REMOVE CHAIN TENSIONER

Remove the 2 bolts and chain tensioner.

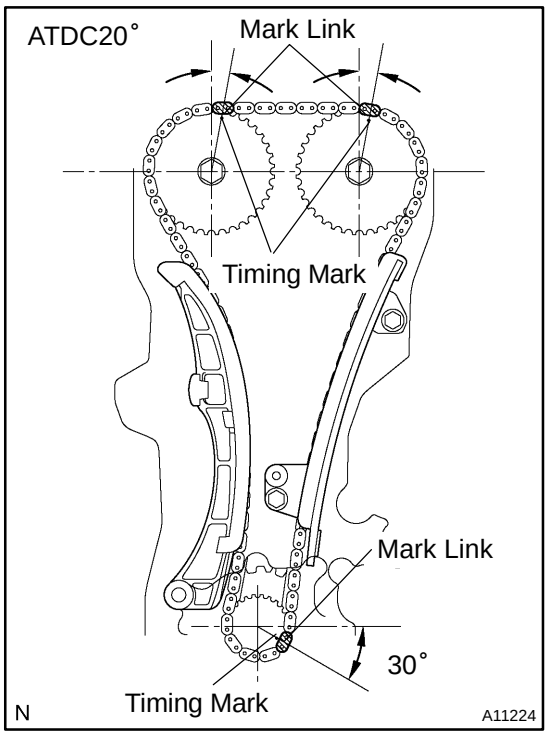
23. REMOVE CHAIN TENSIONER SLIPPER

24. REMOVE CHAIN VIBRATION DAMPER

Remove the 2 bolts and damper.

25. REMOVE TIMING CHAIN

EM1IV–03



INSTALLATION

1. INSTALL TIMING CHAIN

(a) After setting the crankshaft at ATDC40–140 ˚, set cams of intake and exhaust timing sprockets at ATDC 20 ˚ and then the reset the crankshaft at ATDC 20 ˚.

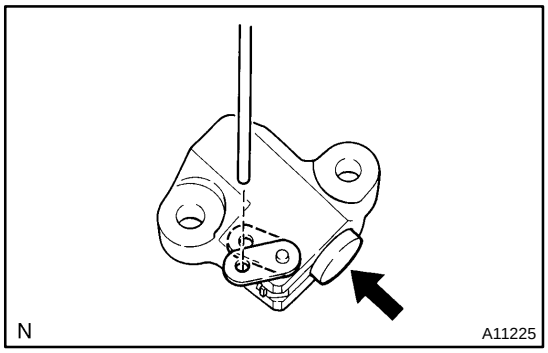
(b) Install the chain vibration damper with the 2 bolts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

(c) Align the match marks of timing chain mark plate (Yellow), camshaft timing sprocket, camshaft timing gear and crankshaft timing sprocket to install the timing chain as shown in the illustration.

HINT:

To prevent the exhaust camshaft from spring back turn it using a wrench and set it at the mark on a chain.

(d) Install the chain tensioner slipper.



2. INSTALL CHAIN TENSIONER

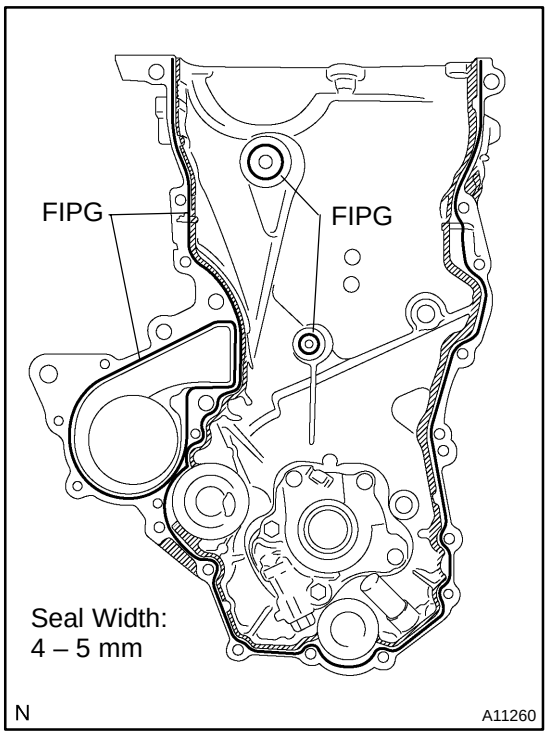
(a) While rotating the lock plate of the tensioner up–ward, push in the plunger of the tensioner as shown in the illustration.

(b) While rotating the lock plate of the tensioner down–ward, insert a bar of 2.5 mm (0.098 in.) into the holes in the lock plate.

(c) Install the chain tensioner with the 2 bolts.
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

(d) Remove the bar from the chain tensioner.

(e) Check that the tension between the intake and exhaust camshaft timing sprocket.



3. 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.

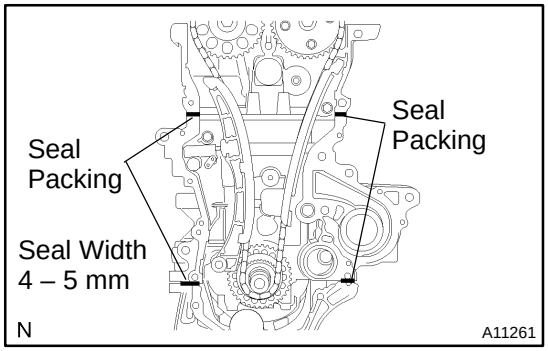
(b) Apply seal packing to the timing chain cover as shown in the illustration.

Seal packing:
Part No. 08826 – 00100 or equivalent

- Install a nozzle that has been cut to a 4 – 5 mm (0.16 – 0.20 in.) opening.
- FIPG shall be accumulated in the groove for FIPG to a depth of 2.5 mm (0.10 in.) or more.

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 4 locations as shown in the illustration.

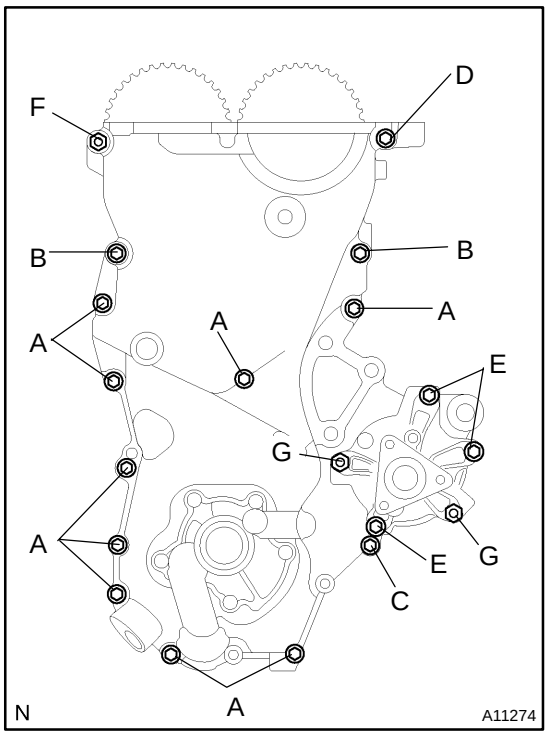
Seal packing:
Part No. 08826 – 00080 or equivalent

- 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.

(d) Install 2 new O–rings to the cylinder block and oil pan No. 1.



(e) Install the timing chain cover, new O–ring and water pump with the 16 bolts and 3 nuts. Uniformly tighten the bolts and nut in several passes.

Torque:
Bolt A 11 N·m (113 kgf·cm, 8 ft·lbf)
Bolt B 24 N·m (245 kgf·cm, 18 ft·lbf)
Bolt C 11 N·m (113 kgf·cm, 8 ft·lbf)
Bolt D 24 N·m (245 kgf·cm, 18 ft·lbf)
Bolt E 11 N·m (113 kgf·cm, 8 ft·lbf)
Nut F 24 N·m (245 kgf·cm, 18 ft·lbf)
Nut G 11 N·m (113 kgf·cm, 8 ft·lbf)

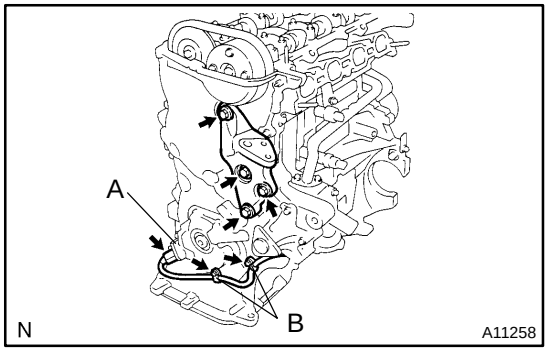
NOTICE:

- **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 20 mm (0.787 in.)
B 30 mm (1.181 in.)
C 35 mm (1.378 in.)
D 20 mm (0.787 in.)
E 35 mm (1.378 in.)



4. 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 4 bolts.

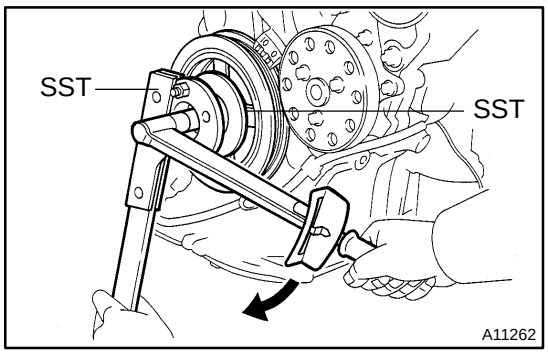
Torque: 55 N·m (561 kgf·cm, 41 ft·lbf)

5. INSTALL CRANKSHAFT POSITION SENSOR

Torque:
Bolt A 7.5 N·m (76 kgf·cm, 66 in.·lbf)
Bolt B 11 N·m (113 kgf·cm, 8 ft·lbf)

6. INSTALL OIL CONTROL VALVE (See page EM–45)

Torque: 7.5 N·m (76 kgf·cm, 66 in.·lbf)



7. INSTALL CRANKSHAFT PULLEY

(a) Clean the crankshaft pulley inside.

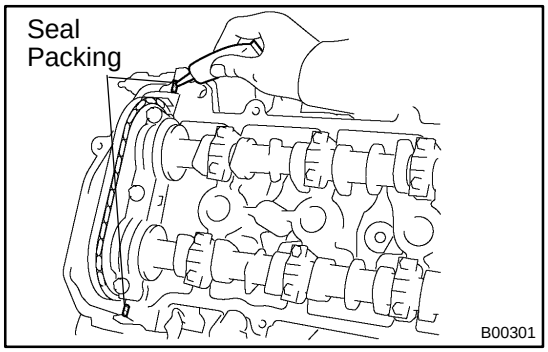
(b) Install the pin to the crankshaft.

(c) Align the hole in the crank pulley with the pin position and install the crank pulley.

(d) Using SST, install the pulley bolt.

SST 09213–70011, 09330–00021

Torque: 128 N·m (1,300 kgf·cm, 94 ft·lbf)



8. INSTALL CYLINDER HEAD COVER

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

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

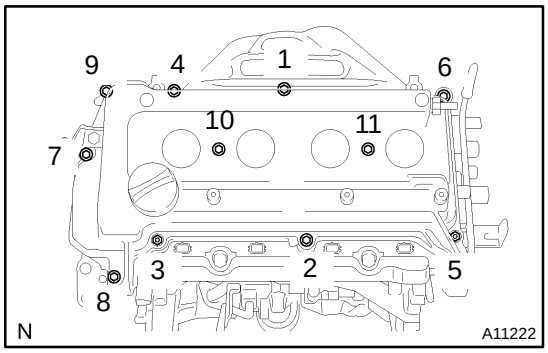
Seal packing:

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.



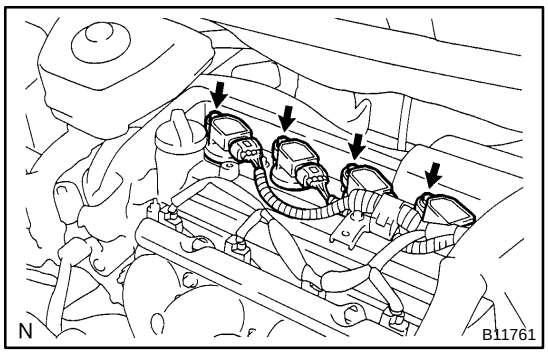
(d) Install the cylinder head cover and cable bracket with the 7 bolts, 2 seal washers and 2 nuts.

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

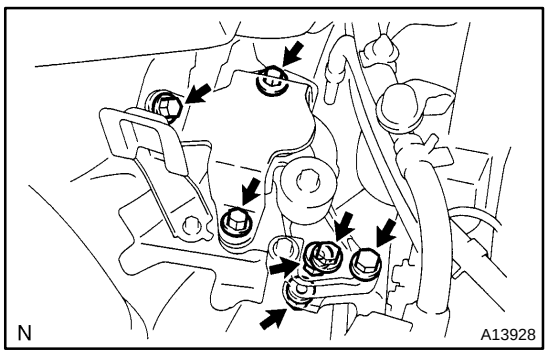
Torque: 10 N·m (100 kgf·cm, 7 ft·lbf)

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

9. CONNECT ENGINE WIRE TO CYLINDER HEAD COVER



10. INSTALL IGNITION COILS (See page IG–7)



11. REMOVE RH ENGINE MOUNTING INSULATOR

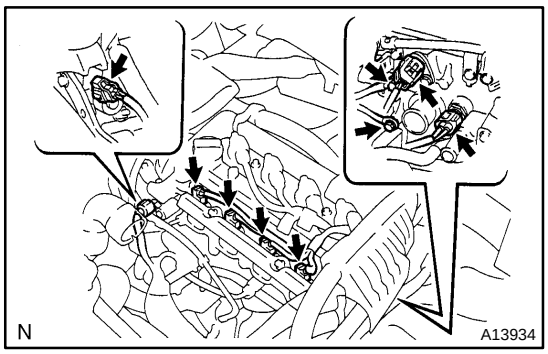
Install the RH engine mounting insulator with the 5 bolts and 2 nuts.

12. INSTALL VSV TO RH ENGINE MOUNTING INSULATOR

13. INSTALL DRIVE BELT

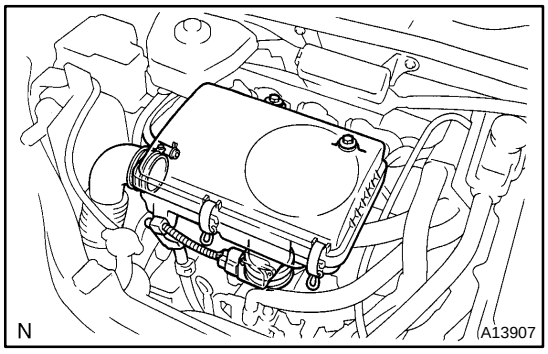
14. INSTALL ENGINE COOLANT RESERVOIR TANK

15. INSTALL AIR INLET



16. CONNECT CONNECTORS

(a) Connect the Camshaft timing oil control valve connector.
(b) Connect the water temperature sensor connector.
(c) Connect the camshaft position sensor connector.
(d) Connect the 2 VSV connectors.
(e) Connect the 4 injector connectors.
(f) Connect the 4 ignition connectors.



17. INSTALL AIR CLEANER ASSEMBLY

(a) Install the air cleaner assembly with the 2 bolts.
(b) Tighten the 2 hose clamps.
(c) Connect the EVAP hose to the air cleaner case.
(d) Connect the MAF meter connector.

18. INSTALL BRAKE RESERVOIR TANK

19. INSTALL OUTER FR COWL TOP PANEL ASSEMBLY (See page BO–35)

20. FILL WITH ENGINE COOLANT

21. INSTALL ENGINE UNDER COVERS

22. CONNECT BATTERY NEGATIVE (–) TERMINAL AND HV BATTERY SERVICE PLUG (See page HV–1)

23. ROAD TEST VEHICLE

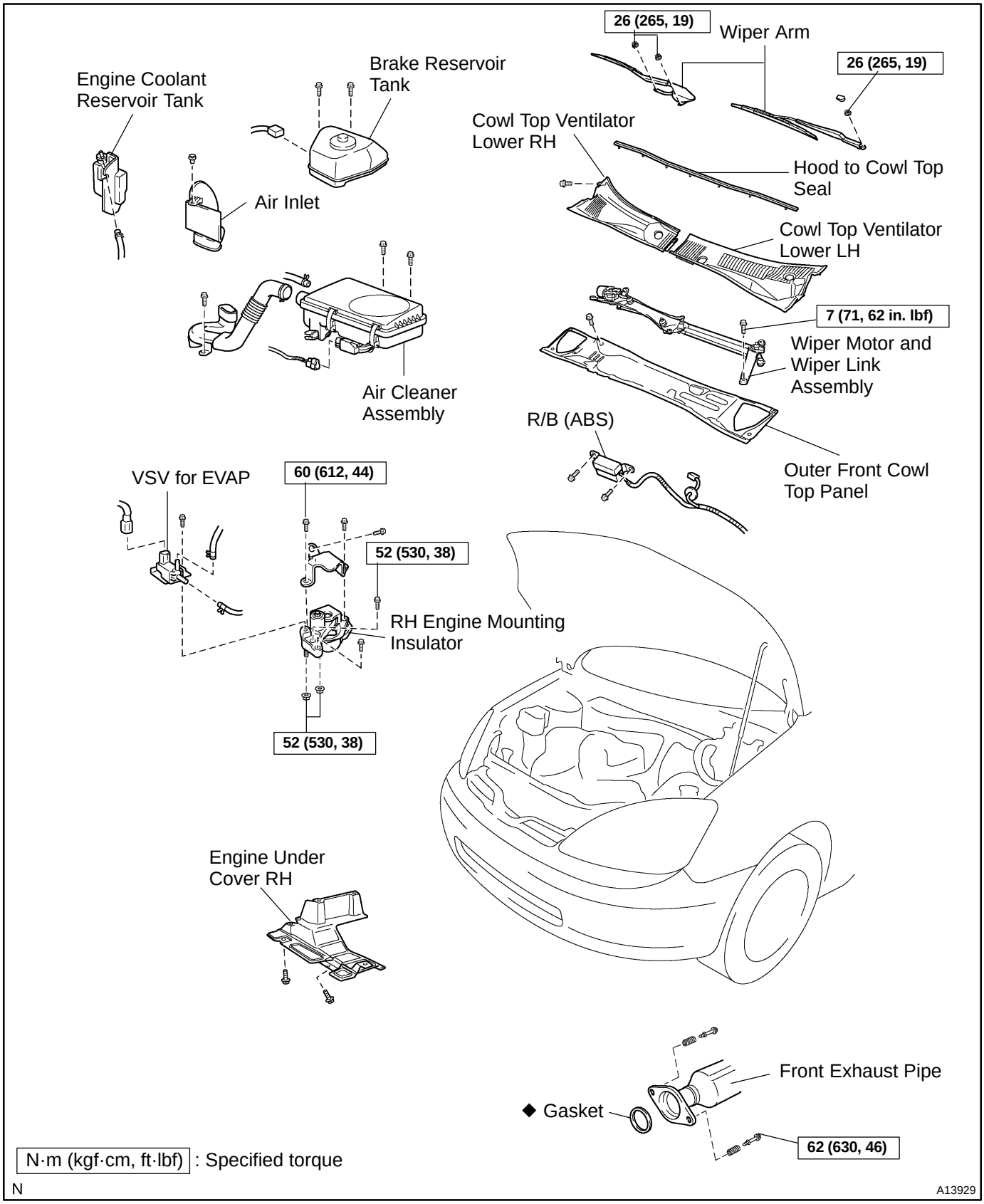
Check for abnormal noises, shock slippage, correct shift points and smooth operation.

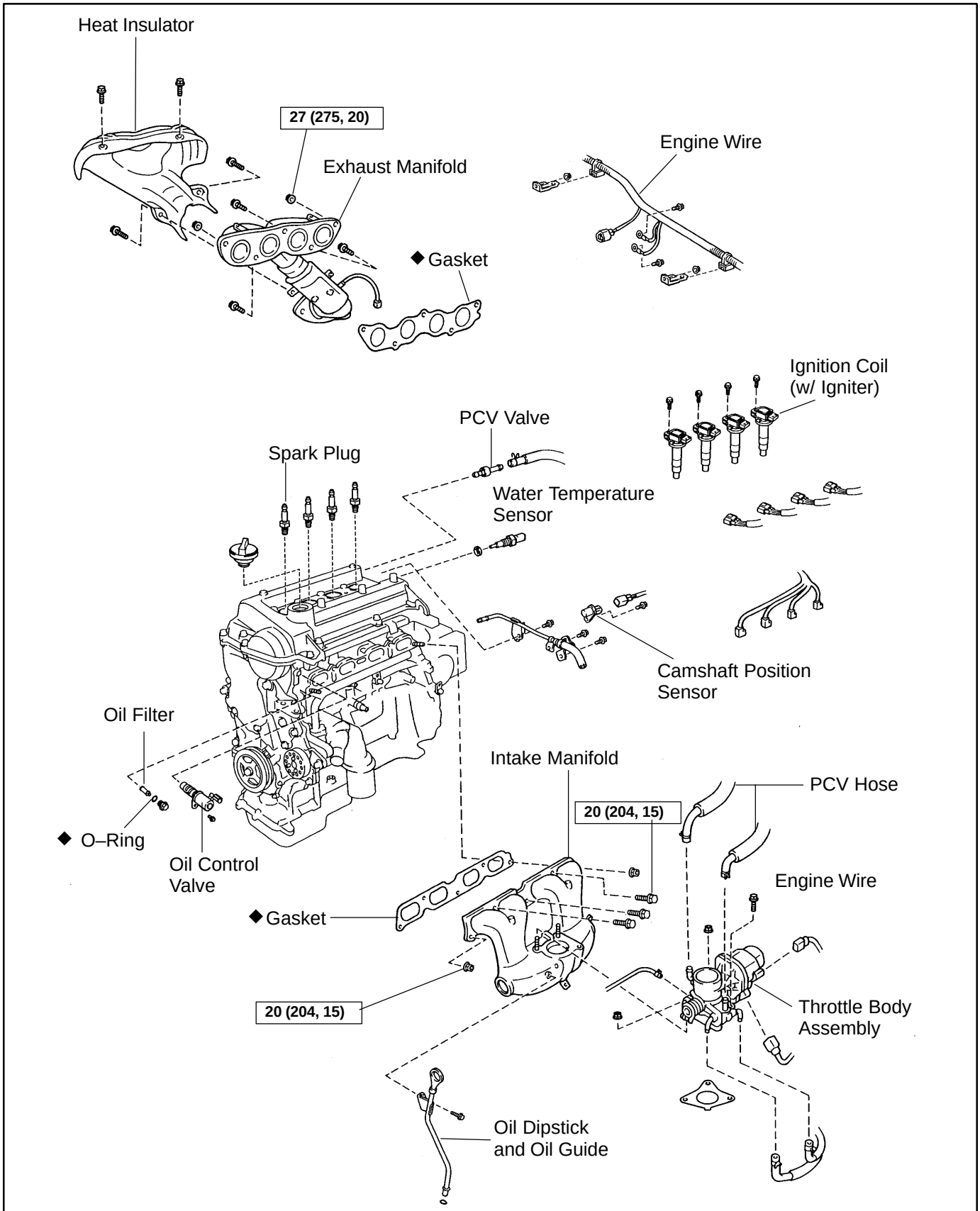
24. RECHECK ENGINE COOLANT AND HV TRANSAXLE COOLANT

CYLINDER HEAD

COMPONENTS

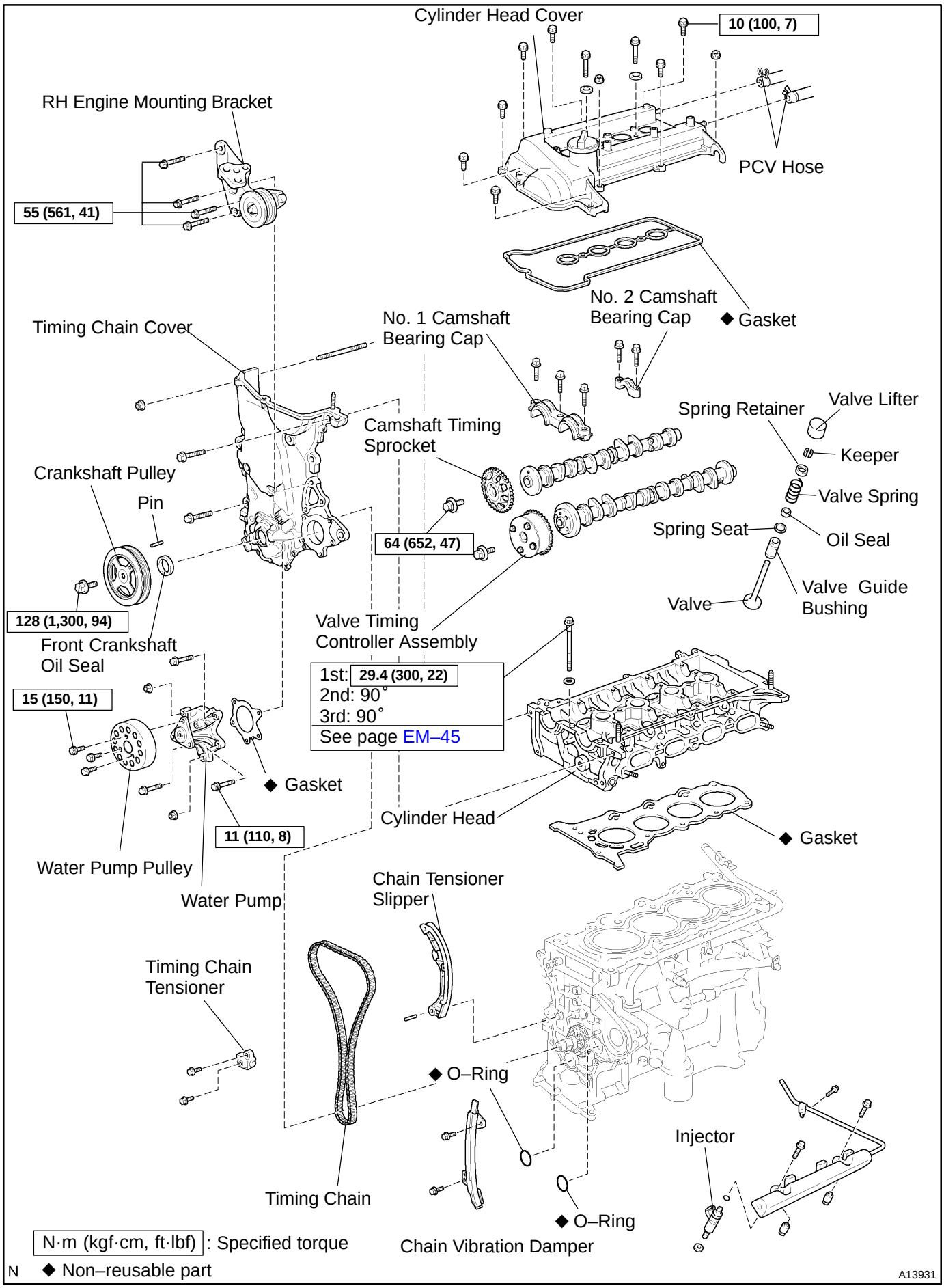
EM1IW–02





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

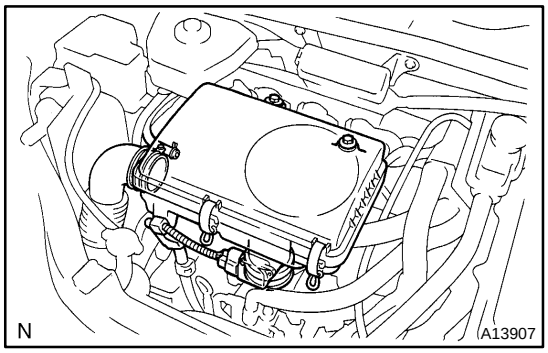
A13930


Cylinder Head Cover
10 (100, 7)
RH Engine Mounting Bracket
PCV Hose
55 (561, 41)
No. 2 Camshaft Bearing Cap
◆ Gasket
Timing Chain Cover
No. 1 Camshaft Bearing Cap
Spring Retainer
Valve Lifter
Camshaft Timing Sprocket
Keeper
Crankshaft Pulley
Pin
Valve Spring
Spring Seat
Oil Seal
64 (652, 47)
Valve
Valve Guide Bushing
128 (1,300, 94)
Valve Timing Controller Assembly
Front Crankshaft Oil Seal
1st: 29.4 (300, 22)
2nd: 90°
3rd: 90°
See page EM–45
15 (150, 11)
◆ Gasket
Cylinder Head
◆ Gasket
11 (110, 8)
Water Pump Pulley
Water Pump
Chain Tensioner Slipper
Timing Chain Tensioner
◆ O–Ring
Injector
Timing Chain
◆ O–Ring
N·m (kgf·cm, ft·lbf) : Specified torque
Chain Vibration Damper
N ◆ Non–reusable part
A13931

EM1IX–02

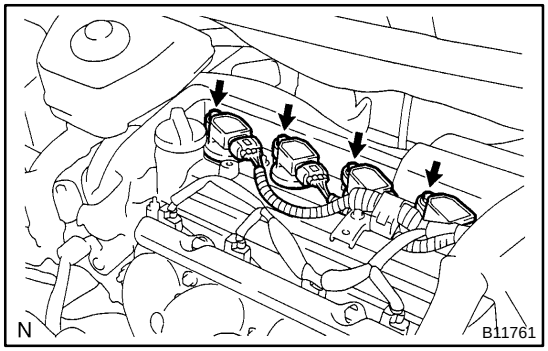
REMOVAL

1. **DISCONNECT BATTERY NEGATIVE (–)TERMINAL AND HV BATTERY SERVICE PLUG (See page HV–1)**
2. **REMOVE OUTER FRONT COWL TOP PANEL ASSEMBLY (See page BO–32)**
3. **DRAIN HV TRANSAXLE COOLANT (See page HT–6)**
4. **DRAIN ENGINE COOLANT**
5. **REMOVE CONVERTER AND INVERTER ASSEMBLY (See page HV–18)**

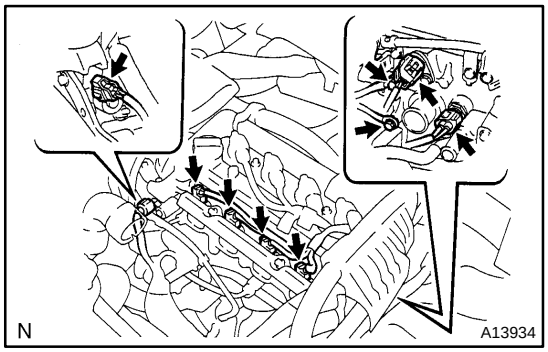


6. **REMOVE AIR CLEANER ASSEMBLY**

(a) Disconnect the MAF meter connector.
(b) Disconnect the EVAP hose from the air cleaner case.
(c) Loosen the 2 hose clamps.
(d) Remove the 3 bolts and air cleaner assembly.

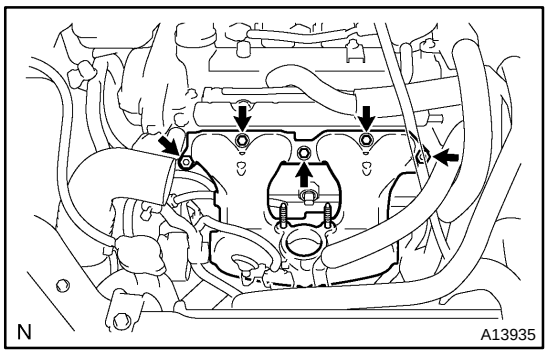


7. **REMOVE IGNITION COILS (See page IG–6)**
8. **REMOVE SPARK PLUGS (See page IG–1)**
9. **REMOVE PCV HOSES**
10. **REMOVE THROTTLE BODY (See page SF–28)**



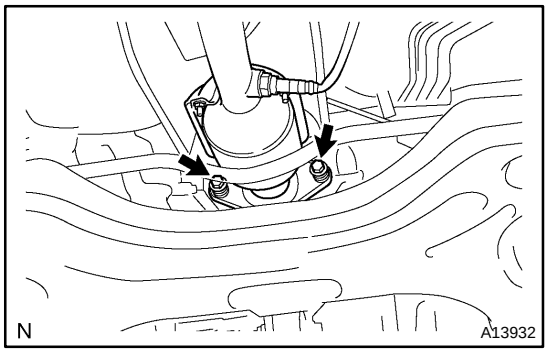
11. **DISCONNECT ENGINE WIRE FROM CYLINDER HEAD**

(a) Disconnect the ECT sensor connector.
(b) Disconnect the camshaft position sensor connector.
(c) Disconnect the oil control valve connector.
(d) Disconnect the 4 injector connectors.
(e) Remove the 3 bolts and disconnect the engine wire protector from the cylinder head cover.



12. REMOVE INTAKE MANIFOLD

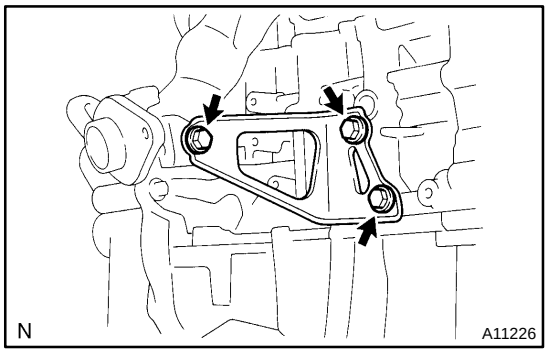
Remove the 3 bolts, 2 nuts intake manifold and gasket.



13. DISCONNECT FRONT EXHAUST PIPE FROM EXHAUST MANIFOLD

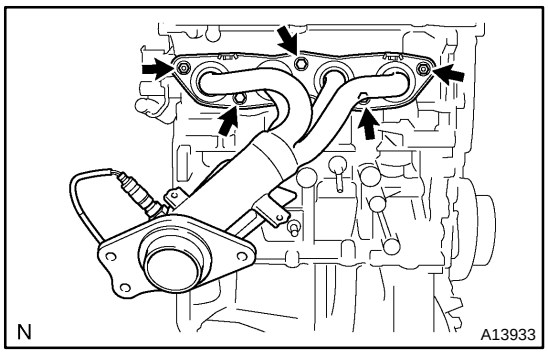
(a) Remove the 2 bolts and 2 springs holding the front exhaust pipe to the exhaust manifold.

(b) Remove the gasket.



14. REMOVE EXHAUST MANIFOLD STAY

Remove the 3 bolts and exhaust manifold stay.



15. REMOVE EXHAUST MANIFOLD

(a) Remove the 4 bolts and upper heat insulator.

(b) Remove the 3 bolts 2 nuts, exhaust manifold and gasket.

16. REMOVE CAMSHAFT POSITION SENSOR

17. REMOVE ECT SENSOR

18. REMOVE OIL CONTROL VALVE

19. REMOVE PCV VALVE

20. REMOVE OIL FILLER CAP

21. REMOVE HEAD COVER (See page EM–15)

22. REMOVE INJECTOR (See page SF–11)

23. REMOVE TIMING CHAIN COVER (See page EM–15)

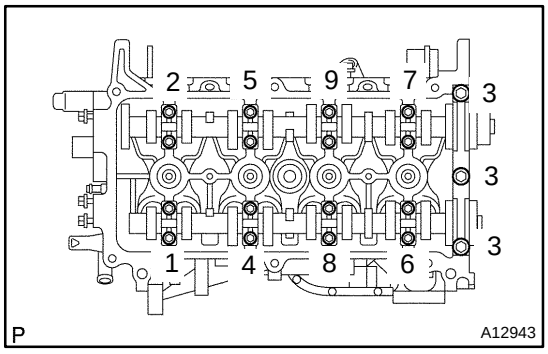
24. REMOVE CAMSHAFT TIMING SPROCKET AND VALVE TIMING CONTROL ASSEMBLY

Hold the hexagonal head portion of the camshaft with a wrench, and remove the 2 bolts and timing sprocket and valve timing controller assembly.

NOTICE:

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

- **Do not disassembly the valve timing controller assembly.**



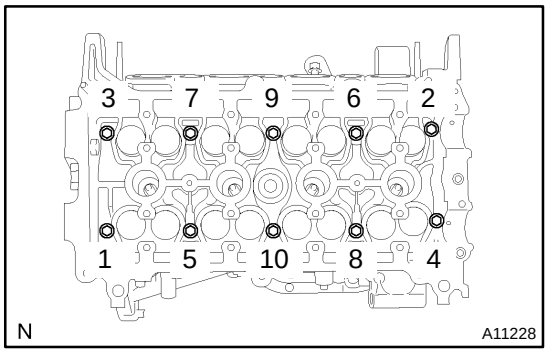
25. REMOVE CAMSHAFTS

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.

26. REMOVE CYLINDER HEAD

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

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



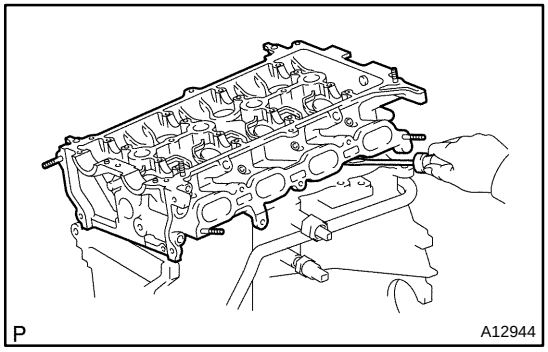
(c) Using a 8 mm bi–hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown. Remove the 10 cylinder head bolts and plate washers.

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 head from the dowels on the cylinder block and replace the cylinder head on wooden blocks on a bench.



HINT:

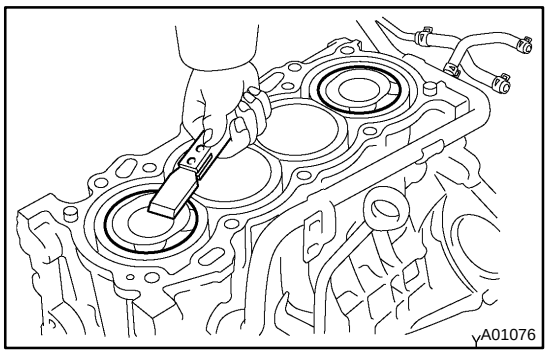
If the cylinder head is difficult to lift off, pry between the cylinder head and cylinder block with a screwdriver.

NOTICE:

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

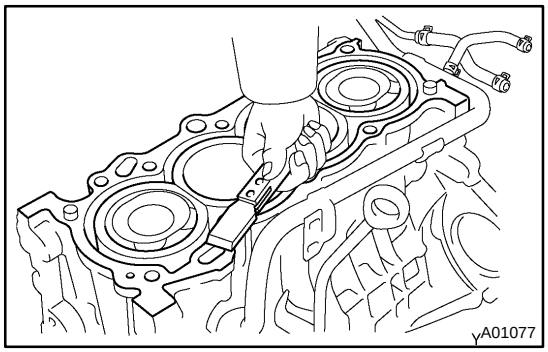
EM16K–03

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.

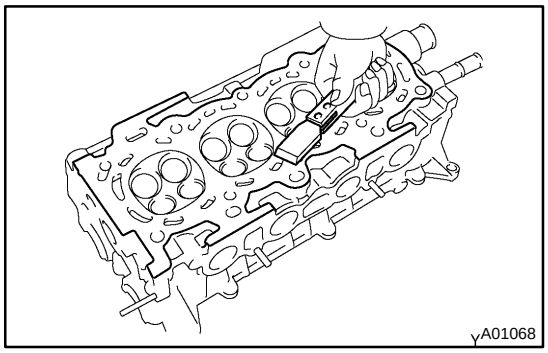


(b) Using a gasket scraper, remove all the gasket material from the cylinder block surface.

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

CAUTION:

Protect your eyes when using high pressure compressed air.

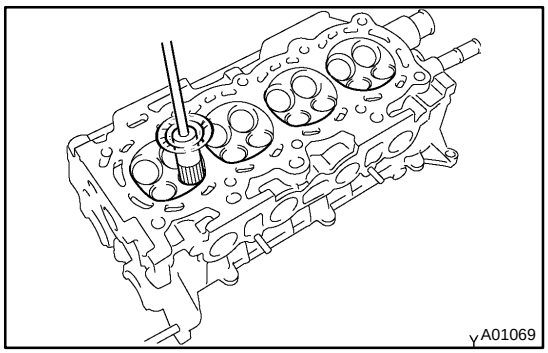


2. REMOVE GASKET MATERIAL

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

NOTICE:

Be careful not to scratch the cylinder block contact surface.

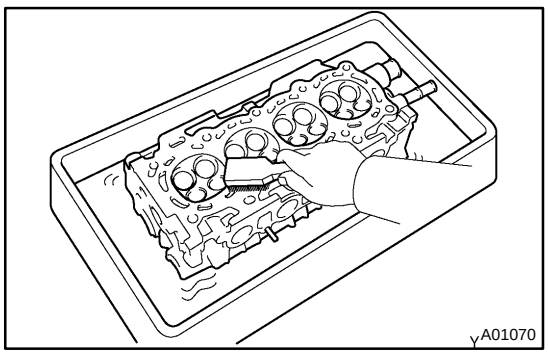


3. CLEAN COMBUSTION CHAMBERS

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

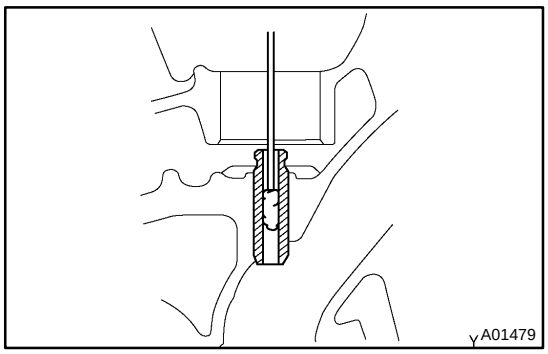
NOTICE:

Be careful not to scratch the cylinder block contact surface.



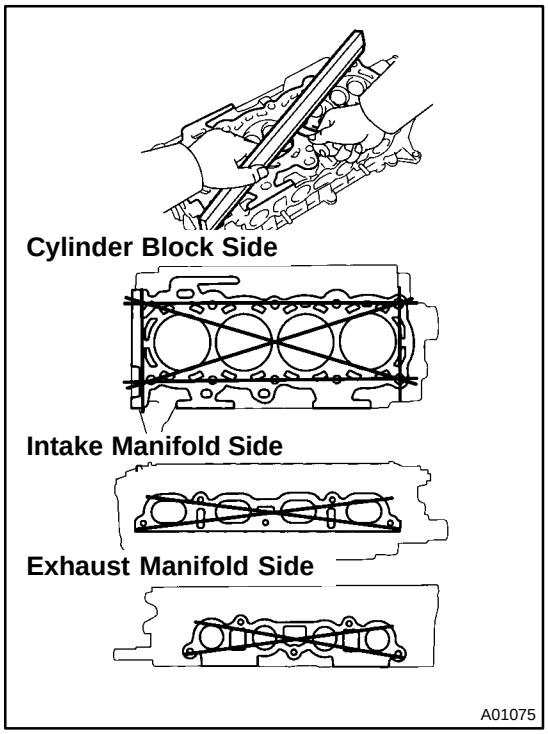
4. CLEAN CYLINDER HEAD

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.



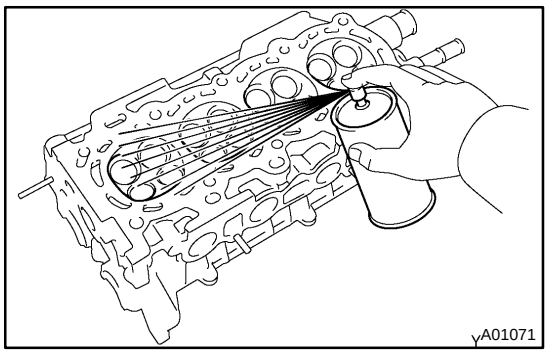
6. INSPECT FOR FLATNESS

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

Maximum warpage:

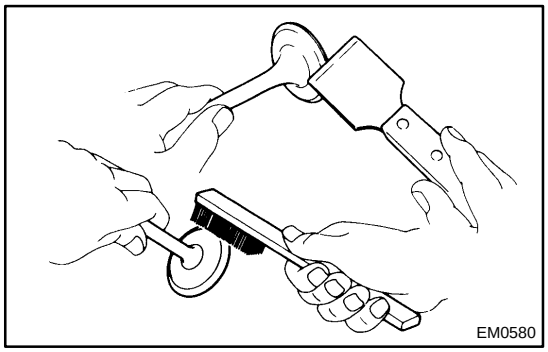
Cylinder block side	0.05 mm (0.0020 in.)
Intake Manifold side	0.10 mm (0.0394 in.)
Exhaust manifold side	0.10 mm (0.0394 in.)

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



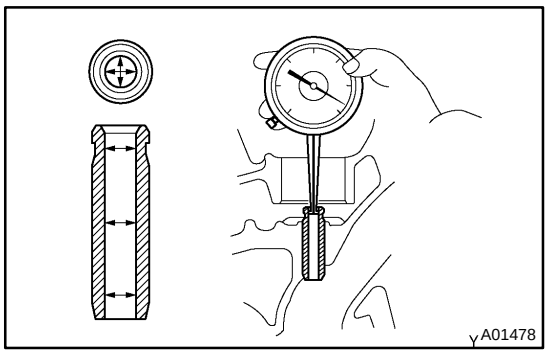
7. INSPECT FOR CRACKS

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



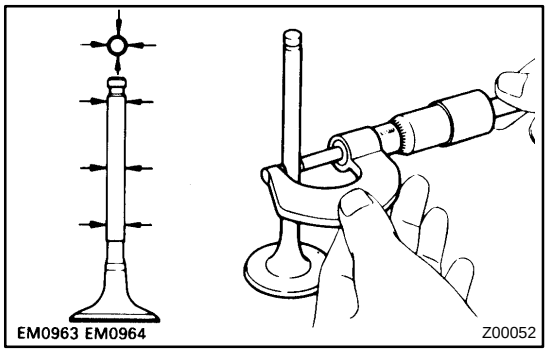
8. CLEAN VALVES

(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

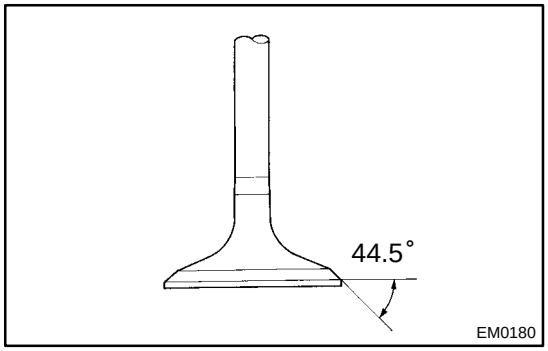
(a) Using a caliper gauge, measure the inside diameter of the guide bushing.
Bushing inside diameter:
5.010 – 5.030 mm (0.19724 – 0.19803 in.)



(b) Using a micrometer, measure the diameter of the valve stem.
Valve stem diameter:
Intake 4.970 – 4.985 mm (0.19567 – 0.19626 in.)
Exhaust 4.965 – 4.980 mm (0.19547 – 0.19606 in.)

(c) Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.
Standard oil clearance:
Intake 0.025 – 0.060 mm (0.00098 – 0.00236 in.)
Exhaust 0.030 – 0.065 mm (0.00118 – 0.00256 in.)
Maximum oil clearance:
Intake 0.08 mm (0.0031 in.)
Exhaust 0.10 mm (0.0039 in.)

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

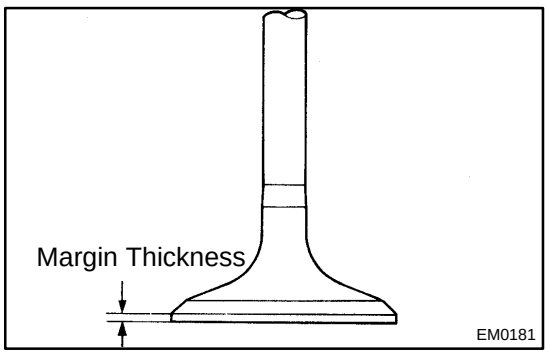


10. INSPECT VALVES

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

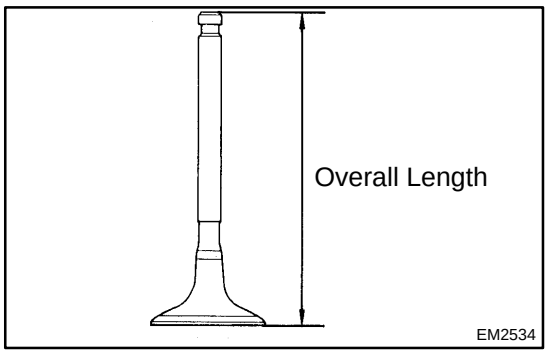
(b) Check that the surface of the valve for wear.

If the valve face is worn, replace the valve.



(c) Check the valve head margin thickness.
Standard margin thickness:
1.00 – 1.15 mm (0.0393 – 0.0453 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:
Intake 89.25 mm (3.5138 in.)
Exhaust 87.90 mm (3.4606 in.)
Minimum overall length:
Intake 88.95 mm (3.5020 in.)
Exhaust 87.60 mm (3.4488 in.)

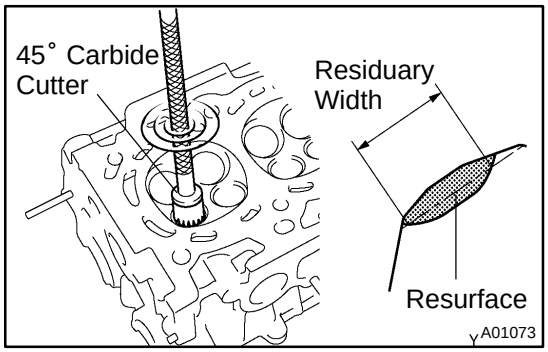
If the overall length is less than minimum, replace the valve.

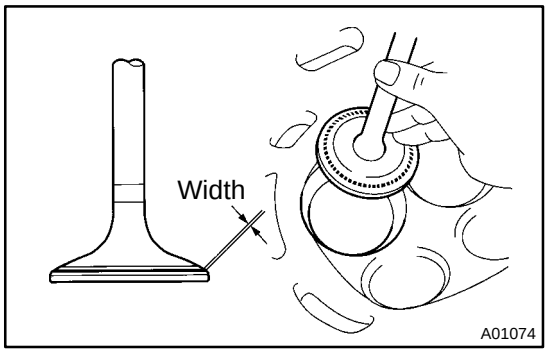
(e) Check the surface of the valve stem tip for wear.

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) 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.

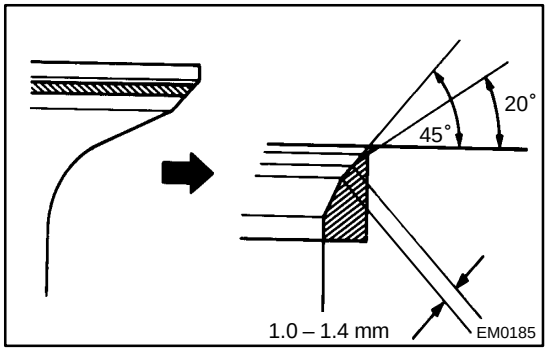
(c) Check the valve face and seat for the following:

- 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:

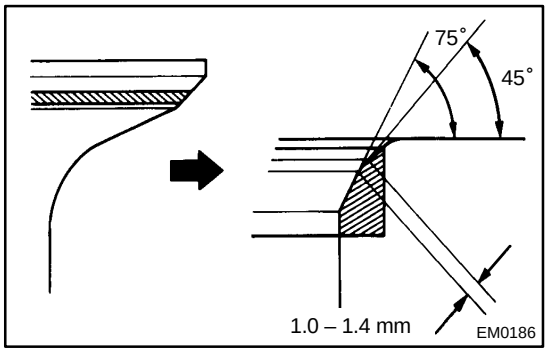
1.0 – 1.4 mm (0.039 – 0.055 in.)

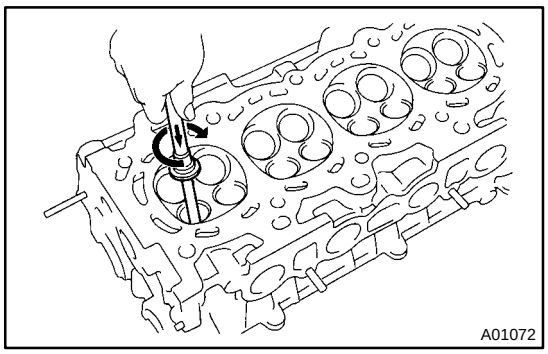
If not, correct the valve seats as follows:

(1) If the seating is too high on the valve face, use 20˚ and 45˚ cutters to correct the seat.

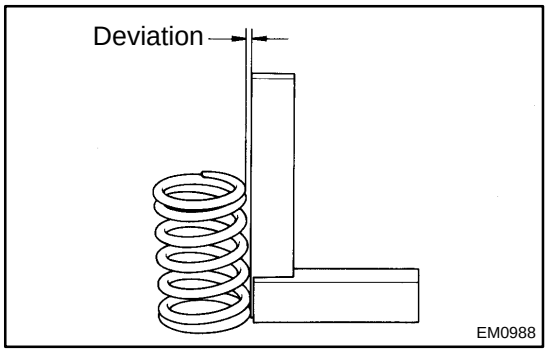


(2) If the seating is too low on the valve face, use 75˚ and 45˚ cutters to correct the seat.





(d) Hand–lap the valve and valve seat with an abrasive compound.
(e) After hand–lapping, clean the valve and valve seat.

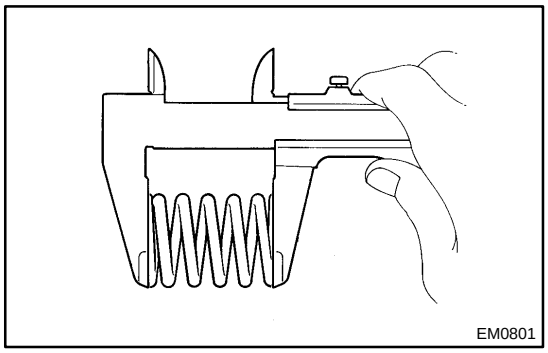


12. INSPECT VALVE SPRINGS

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

Maximum deviation: 1.6 mm (0.063 in.)
Maximum angle (reference): 2°

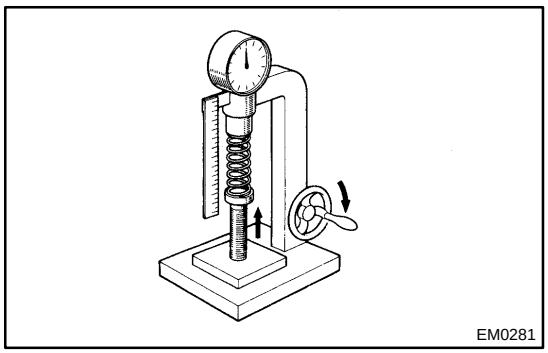
If the deviation is greater than maximum, replace the valve spring.



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

Free length: 59.77 mm (2.353 in.)

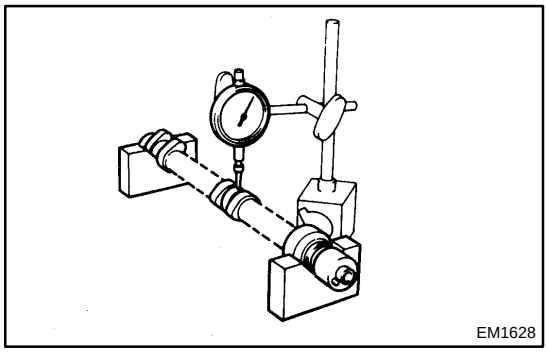
If the free length is not as specified, replace the valve spring.



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

Installed tension:
140 – 154 N (14.3 – 15.7 kgf, 31.5 – 34.6 lbf)
at 32.5 mm (1.280 in.)
Maximum working tension:
180 – 198 N (18.4 – 20.2 kgf, 40.4 – 44.8 lbf)
at 25.1 mm (0.988 in.)

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

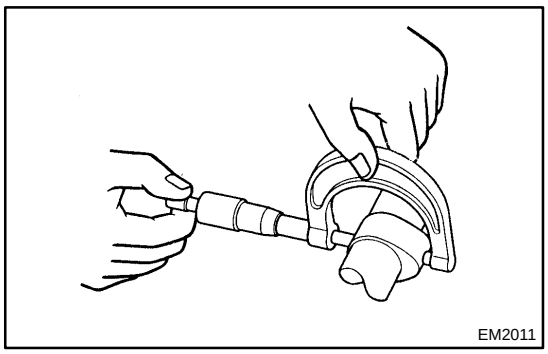


13. INSPECT CAMSHAFT FOR RUNOUT

(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.

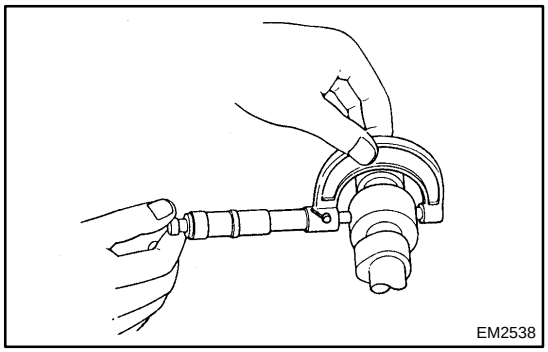


14. INSPECT CAM LOBES

Using a micrometer, measure the cam lobe height.

Standard cam lobe height:
Intake 42.310 – 42.410 mm (1.62637 – 1.66968 in.)
Exhaust 44.046 – 44.146 mm (1.73409 – 1.73803 in.)
Minimum cam lobe height:
Intake 42.16 mm (1.6598 in.)
Exhaust 43.90 mm (1.7283 in.)

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

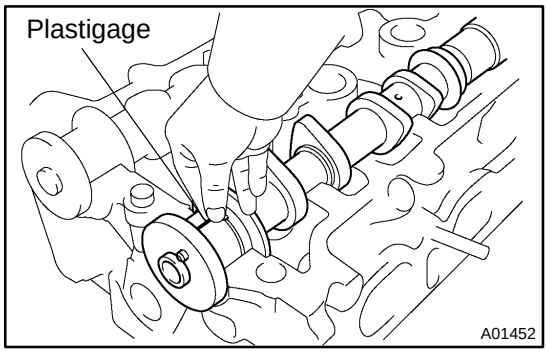


15. INSPECT CAMSHAFT JOURNALS

Using a micrometer, measure the journal diameter.

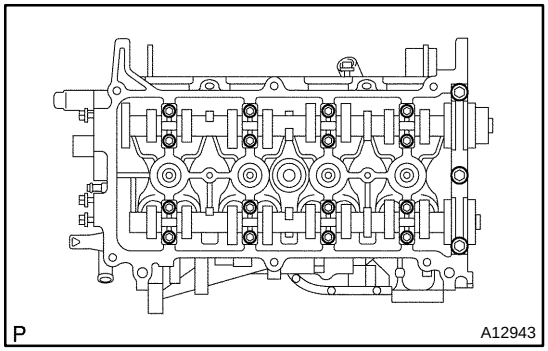
No.1 journal diameter:
34.449 – 34.465 mm (1.35626 – 1.35689 in.)
Others journal diameter:
22.949 – 22.965 mm (0.90350 – 0.90413 in.)

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.

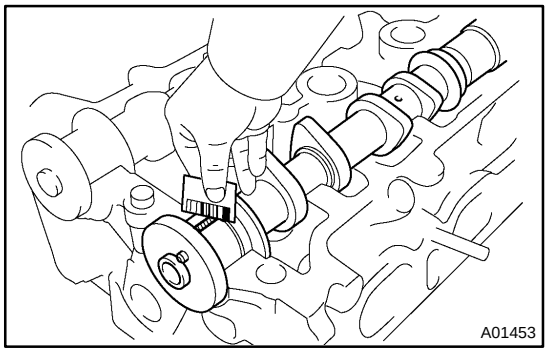


(d) Install the bearing caps (See page EM–45).

Torque:
No.1 23 N·m (235 kgf·cm, 17 ft·lbf)
No.2 12.7 N·m (130 kgf·cm, 10 ft·lbf)

NOTICE:
Do not turn the camshaft.

(e) Remove the bearing caps.

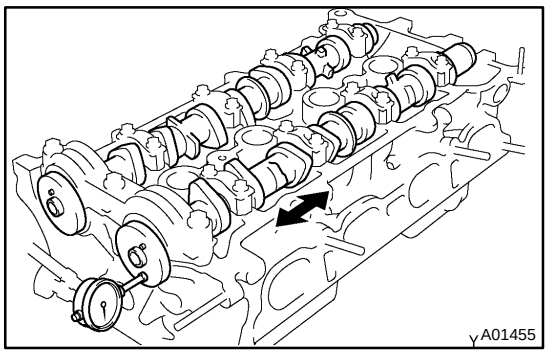


(f) Measure the plastigage at its widest point.

Standard oil clearance:
0.040 – 0.095 mm (0.00157 – 0.00374 in.)
Maximum oil clearance:
0.115 mm (0.00453 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

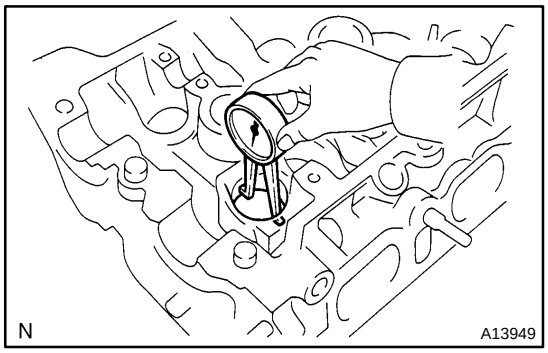
(a) Install the camshafts (See page EM–45).

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

Standard thrust clearance:
0.040 – 0.095 mm (0.0016 – 0.0037 in.)
Maximum thrust clearance:
0.11 mm (0.0043 in.)

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

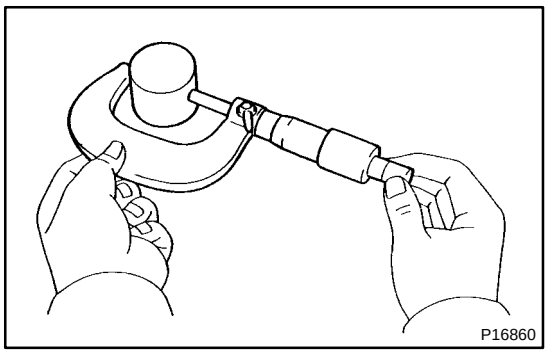
(c) Remove the camshafts.



18. INSPECT VALVE LIFTERS AND LIFTER BORES

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

Lifter bore diameter:
31.009 – 31.025 mm (1.22082 – 1.22145 in.)



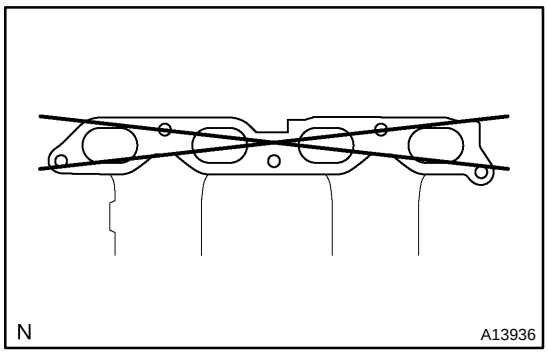
(b) Using a micrometer, measure the lifter diameter.

Lifter diameter:
30.966 – 30.976 mm (1.21913 – 1.21953 in.)

(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance:
0.031 – 0.059 mm (0.00122 – 0.00232 in.)
Maximum oil clearance:
0.1 mm (0.004 in.)

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

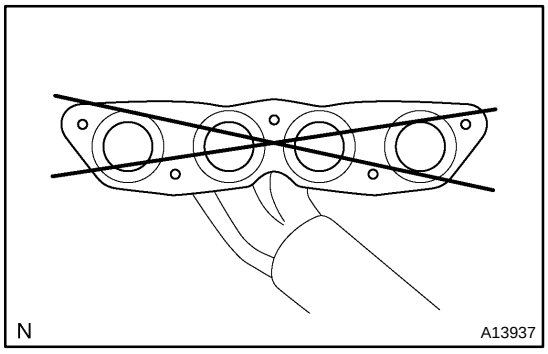


19. INSPECT INTAKE MANIFOLD

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.



20. 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.

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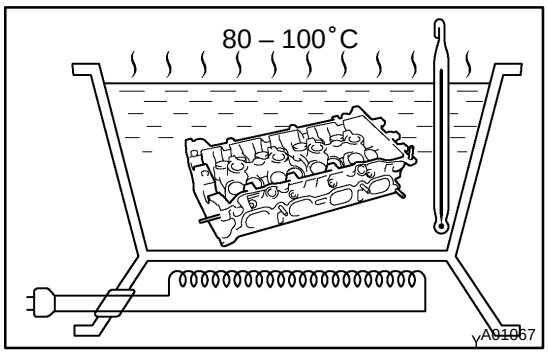
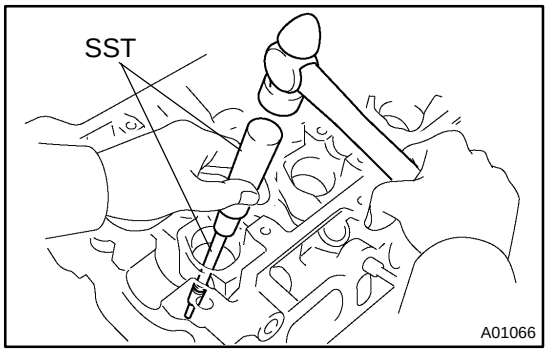


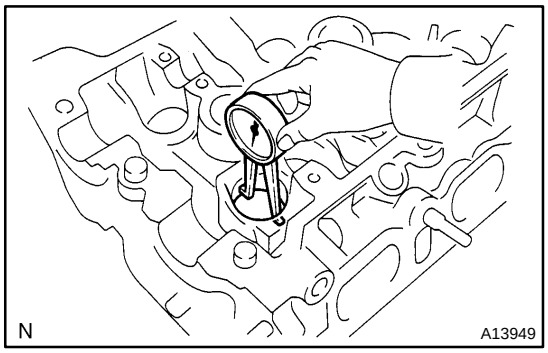
REPLACEMENT

REPLACE VALVE GUIDE BUSHINGS

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

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

If the bushing bore diameter of the cylinder head is greater than 9.706 mm (0.38213 in.), machine the bushing bore to the following dimension:

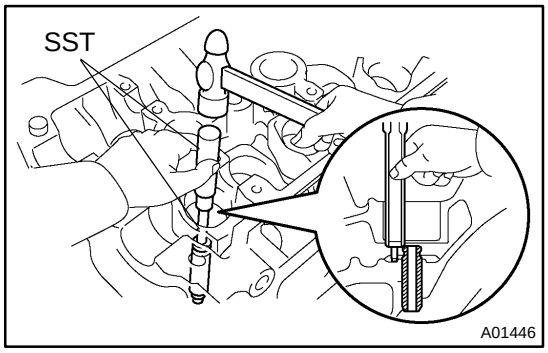
9.735 – 9.756 mm (0.38327 – 0.38493 in.)

If the bushing bore diameter of the cylinder head is greater than 9.756 mm (0.38493 in.), replace the cylinder head.

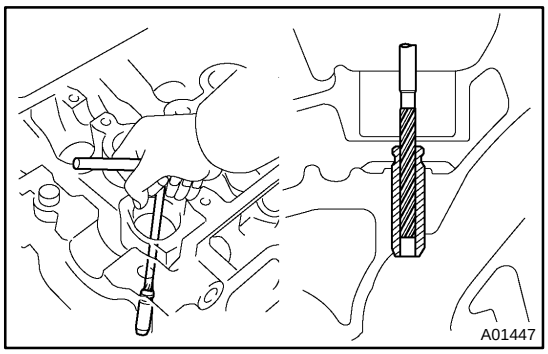
Both intake and exhaust

Bushing bore diameter mm (in.)	Bushing size
9.685 – 9.706 (0.38130 – 0.38213)	Use STD
9.735 – 9.756 (0.38327 – 0.38493)	Use O/S 0.05

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



(f) 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:
9.0 – 9.4 mm (0.354 – 0.370 in.)



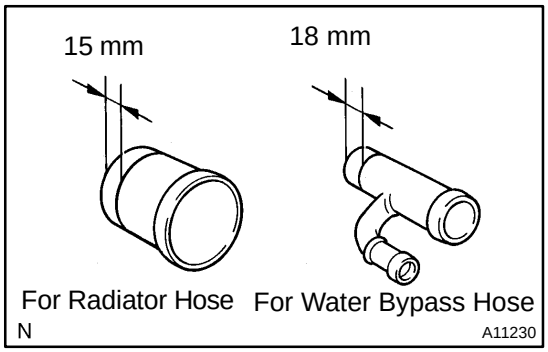
(g) Using a sharp 5 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page EM–33) between the guide bushing and valve stem.

EM16M–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.

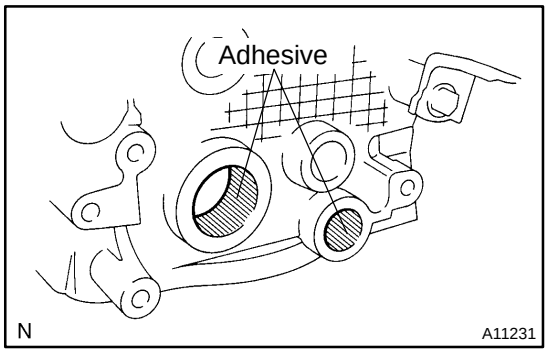


1. INSTALL WATER HOSE UNIONS

HINT:

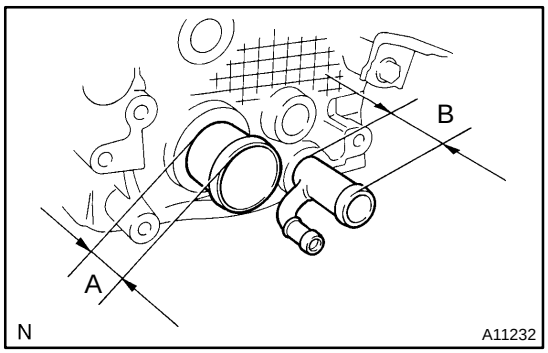
When using a new cylinder head, water hose unions must be installed.

(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

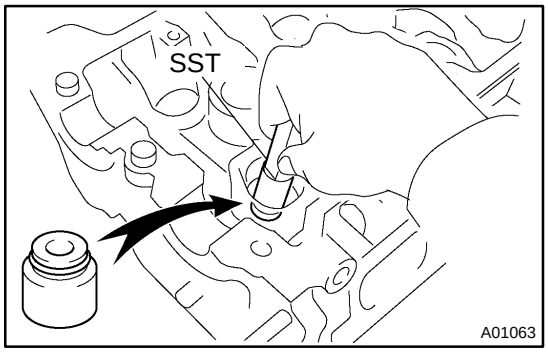


(c) Using a press, press in a new water hose union until there is protruding from the cylinder head.

Standard protrusion:
A 29 mm (1.14 in.)
B 44 mm (1.73 in.)

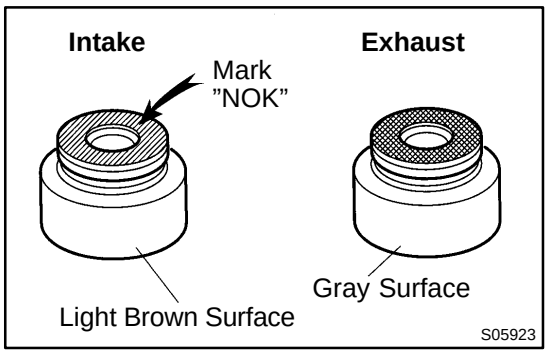
NOTICE:

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



2. INSTALL VALVES

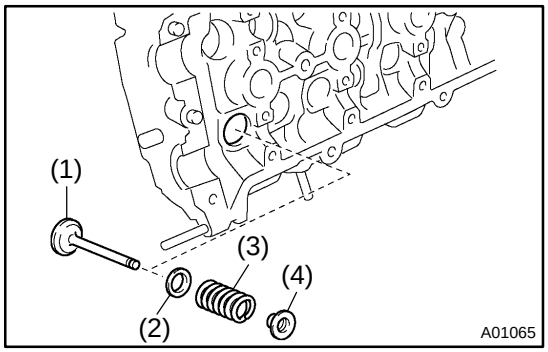
(a) Using SST, push in a new oil seal.
SST 09201–41020



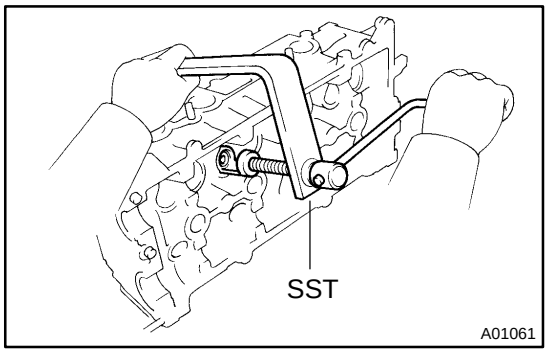
HINT:
The intake valve oil seal is light brown and the exhaust valve oil seal is gray.

NOTICE:

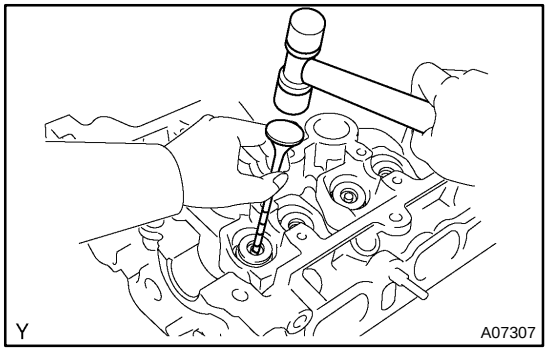
Pay much attention assembling the oil seal for intake and exhaust. Assembling the wrong one may cause a failure.



(b) Install the valve (1), spring (2), valve spring (3), and spring retainer (4).



(c) Using SST, compress the valve spring and place the 2 keepers around the valve stem.
SST 09202–70020 (09202–00010)



(d) 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.

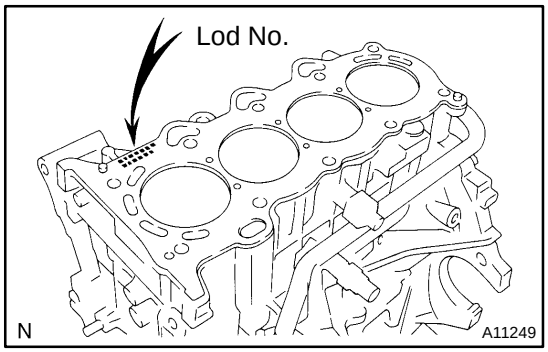
(b) Check that the valve lifter rotates smoothly by hand.

EM1IY–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.



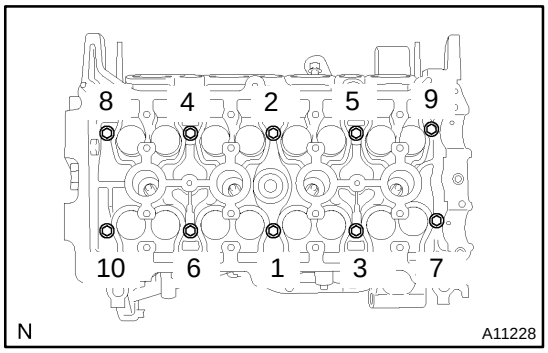
1. PLACE CYLINDER HEAD ON CYLINDER BLOCK

(a) Place a new cylinder head gasket on the cylinder block surface with the Lod 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:

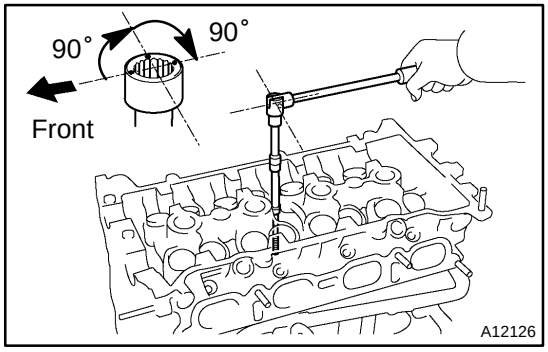
- The cylinder head bolts are tightened in 2 progressive steps (steps (b) and (d)).
- If any cylinder head bolt is broken or deformed, replace it.

(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: 29.4 N·m (300 kgf·cm, 22 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.

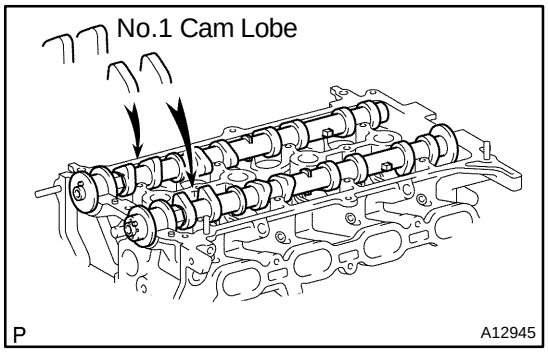
(d) Retighten the cylinder head bolts by 90˚ and 90˚ in the numerical order shown.

(e) Check that the paint mark is now at a 180˚ angle to the front.

(f) Install the bolt holding the water bypass pipe to the cylinder head.

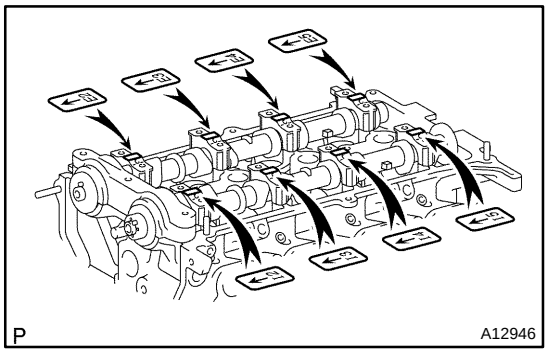
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

(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.

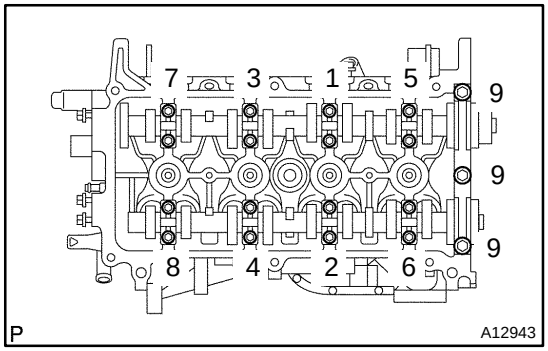


(b) Install the bearing caps in their proper locations.

HINT:

No. 2 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) Install and uniformly tighten the 19 bearing cap bolts.
After tightening the No.1 camshaft bearing cap, tighten then in several passes, in the sequence shown.
Torque:
No. 1 23 N·m (235 kgf·cm, 17 ft·lbf)
No. 2 12.7 N·m (130 kgf·cm, 10 ft·lbf)

4. INSTALL VALVE TIMING CONTROLLER ASSEMBLY AND CAMSHAFT TIMING SPROCKET

(a) Apply engine oil in the rage from the tip of the intake camshaft to 16 mm from that tip.
(b) Except leaded gasoline spec:
Align the timing mark on the valve 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 install the sprocket to the camshaft.

(d) Temporarily install the timing sprocket bolt.
(e) Hold the hexagon head portion of the camshaft with a wrench, and install the bolt.
Torque: 64 N·m (650 kgf·cm, 47 ft·lbf)

5. CHECK AND ADJUST VALVE CLEARANCE
(See page EM–5)

6. INSTALL CYLINDER HEAD COVER
(See page EM–21)

7. INSTALL OIL CONTROL VALVE

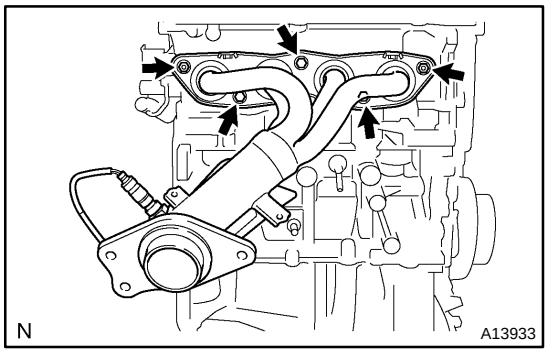
8. INSTALL OIL FILTER CAP

9. INSTALL PCV VALVE

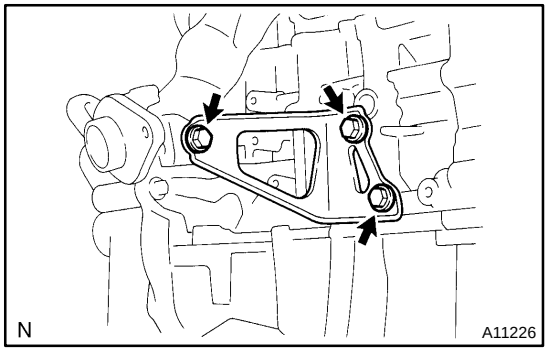
10. INSTALL ECT SENSOR
(See page SF–49)

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

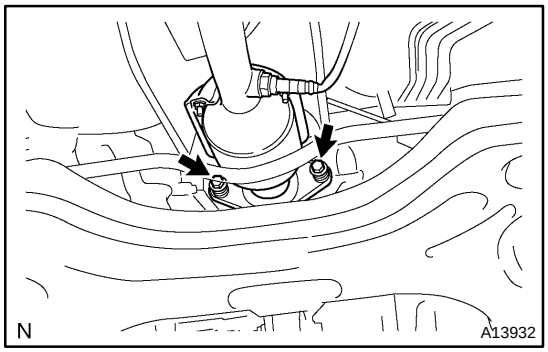
12. INSTALL TIMING CHAIN COVER
(See page EM–21)



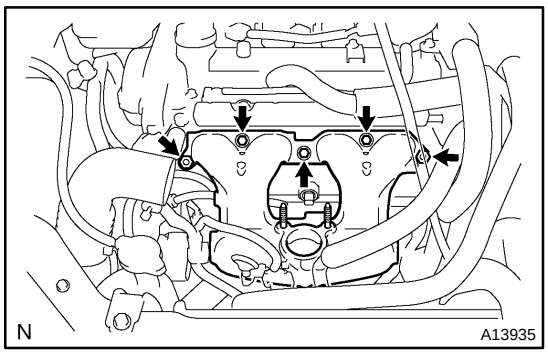
13. INSTALL EXHAUST MANIFOLD
(a) Install a new gasket and the exhaust manifold with the 3 bolts 2 nuts. Uniformly tighten the bolts and nuts in several passes.
Torque: 27 N·m (275 kgf·cm, 20 ft·lbf)
(b) Install the upper heat insulator with the 4 bolts.
Torque: 8.0 N·m (82 kgf·cm, 71 in.·lbf)



14. INSTALL EXHAUST MANIFOLD STAY
Install the manifold stay with the 3 bolts. Alternately tighten the bolts.
Torque: 37 N·m (377 kgf·cm, 27 ft·lbf)



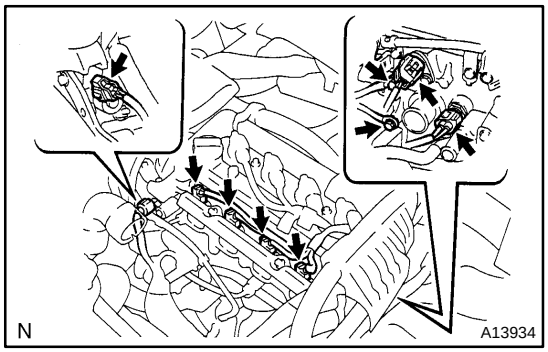
15. CONNECT FRONT EXHAUST PIPE TO EXHAUST MANIFOLD
(a) Place a new gasket to the exhaust manifold.
(b) Install the 2 bolts and 2 springs holding the front exhaust pipe to the exhaust manifold.
Torque: 62 N·m (630 kgf·cm, 46 ft·lbf)



16. INSTALL INTAKE MANIFOLD

Install a new gasket, the intake manifold and 2 brackets with the 2 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque: 20 N·m (204 kgf·cm, 15 ft·lbf)



17. CONNECT ENGINE WIRE TO CYLINDER HEAD

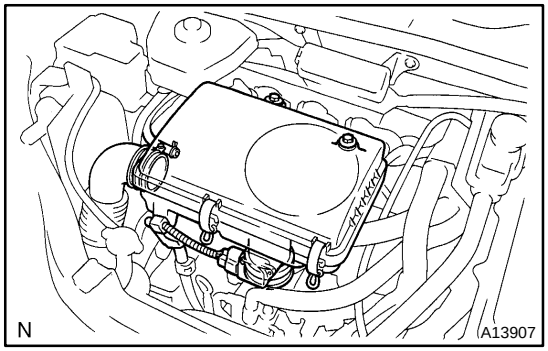
(a) Install the engine wire protector to the cylinder head cover with the 2 bolts.
(b) Connect the water ECT sensor connector.
(c) Connect the camshaft position sensor connector.
(d) Connect the oil control valve connector.
(e) Connect the 4 injector connectors.

18. INSTALL THROTTLE BODY (See page SF–31)

19. INSTALL PCV HOSES

20. INSTALL SPARK PLUGS (See page IG–1)

21. INSTALL IGNITION COILS (See page IG–7)



22. INSTALL AIR CLEANER ASSEMBLY

(a) Install the air cleaner assembly with the 2 bolts.
(b) Tighten the 2 hose clamps.
(c) Connect the EVAP hose to the air cleaner case.
(d) Connect the MAF meter connector.

23. INSTALL CONVERTER AND INVERTER ASSEMBLY (See page HV–18)

24. INSTALL OUTER FR COWL TOP PANEL ASSEMBLY (See page BO–32)

25. FILL WITH ENGINE COOLANT

26. FILL WITH HV COOLANT

27. INSTALL ENGINE UNDER COVERS

28. CONNECT BATTERY NEGATIVE (–) TERMINAL AND HV BATTERY SERVICE PLUG (See page HV–1)

29. ROAD TEST VEHICLE

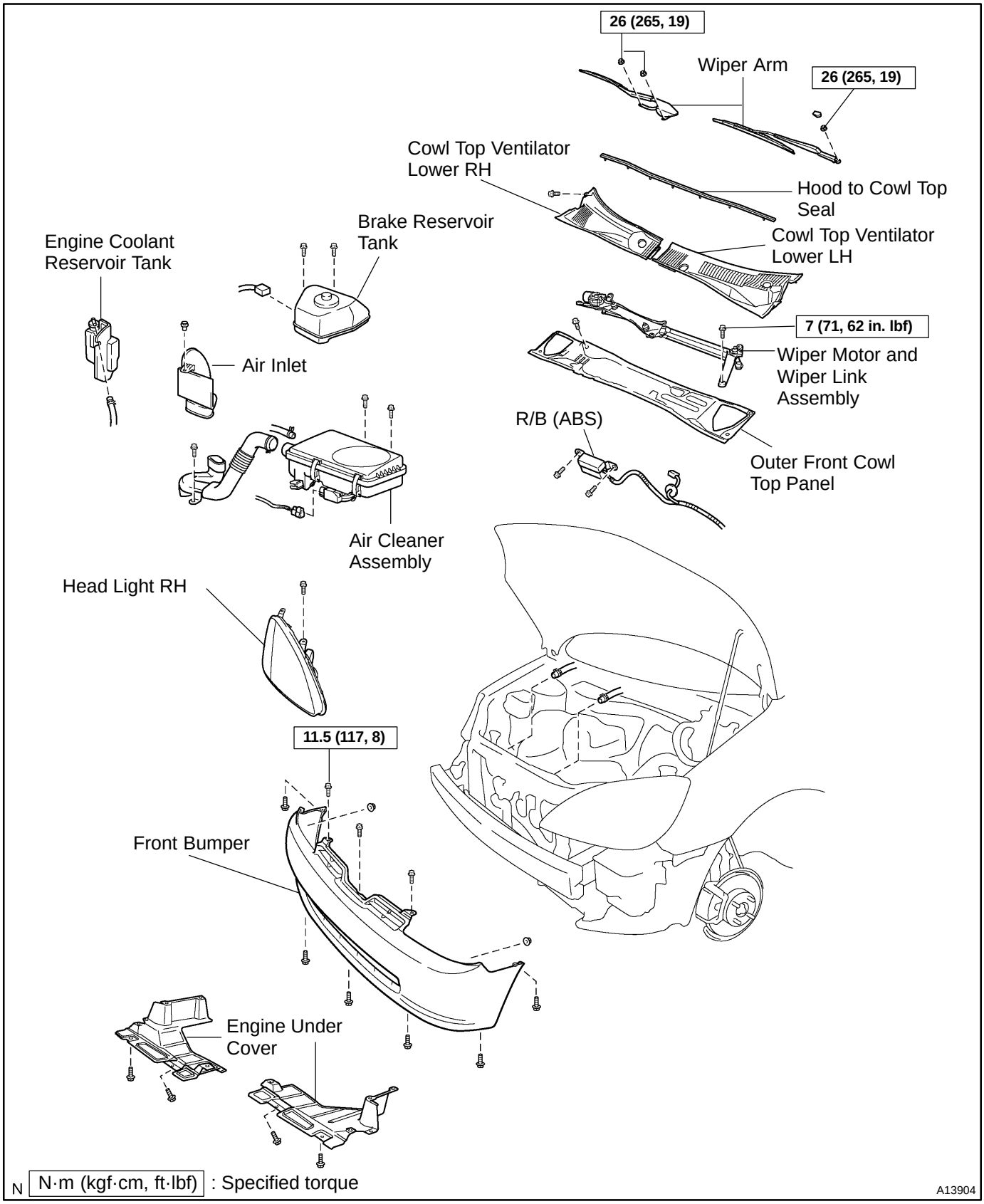
Check for abnormal noises, shock slippage, correct shift points and smooth operation.

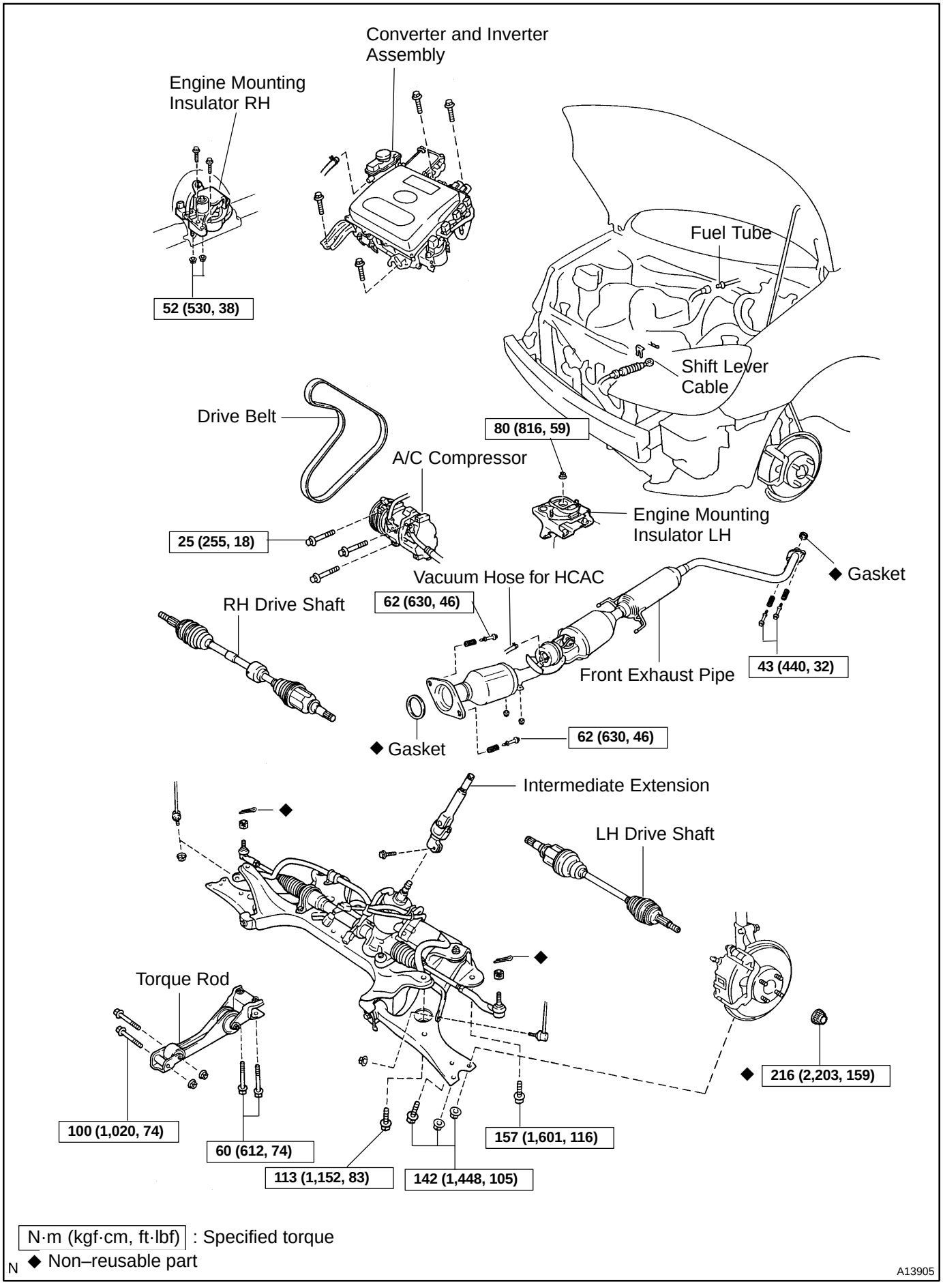
30. RECHECK ENGINE COOLANT AND HV COOLANT

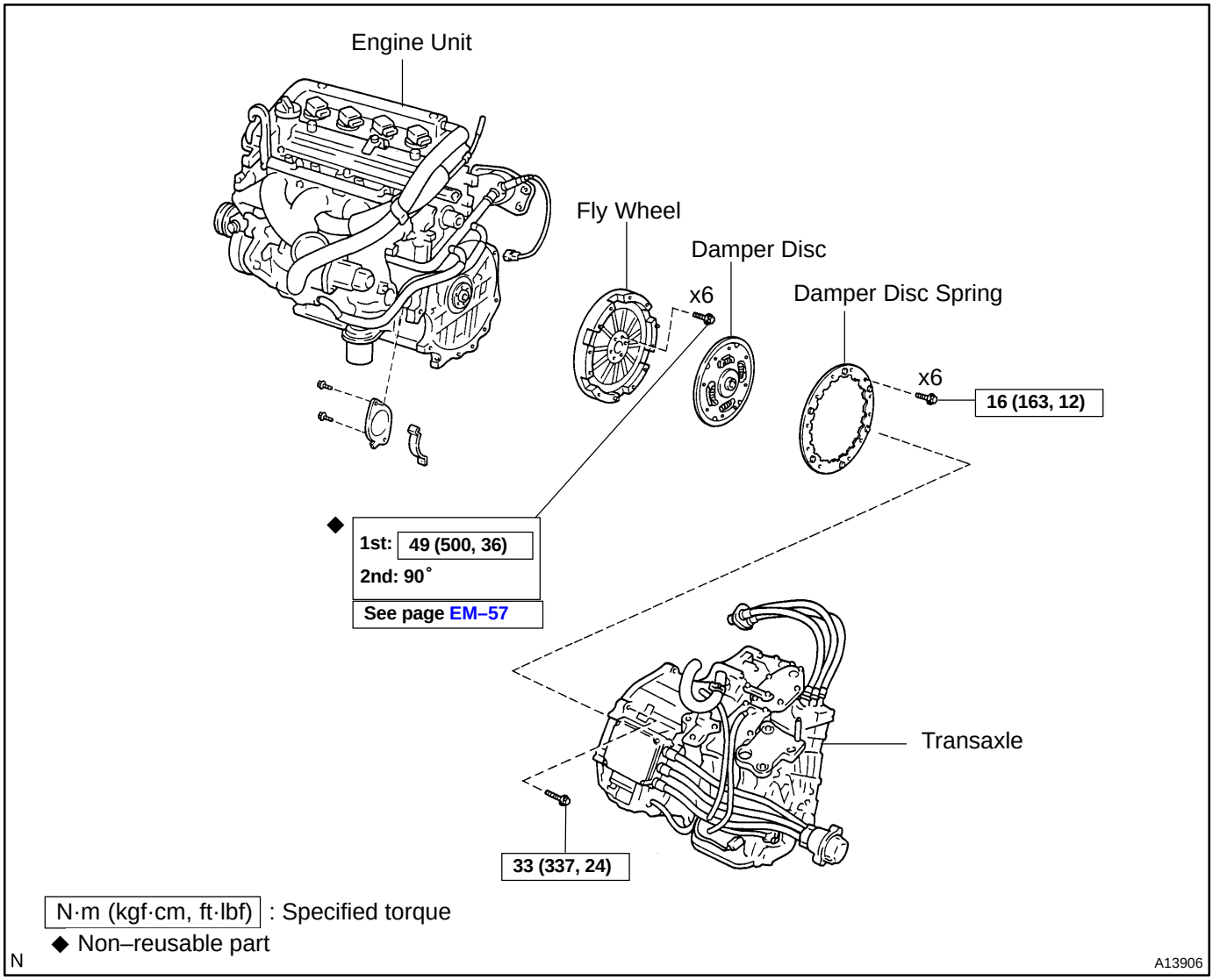
ENGINE UNIT

COMPONENTS

EM1IZ–02



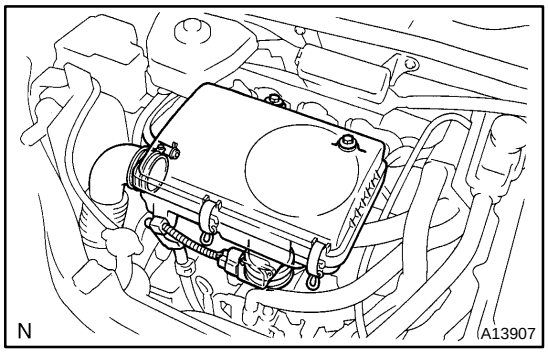

Converter and Inverter Assembly
Engine Mounting Insulator RH
52 (530, 38)
Fuel Tube
Shift Lever Cable
Drive Belt
80 (816, 59)
A/C Compressor
25 (255, 18)
Engine Mounting Insulator LH
Vacuum Hose for HCAC
62 (630, 46)
◆ Gasket
RH Drive Shaft
Front Exhaust Pipe
43 (440, 32)
◆ Gasket
62 (630, 46)
Intermediate Extension
LH Drive Shaft
Torque Rod
◆ 216 (2,203, 159)
100 (1,020, 74)
60 (612, 74)
113 (1,152, 83)
142 (1,448, 105)
157 (1,601, 116)
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
N
A13905


Engine Unit
Fly Wheel
Damper Disc
x6
Damper Disc Spring
x6
16 (163, 12)
◆
1st: 49 (500, 36)
2nd: 90°
See page EM–57
Transaxle
33 (337, 24)
N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part
N
A13906

EM1J0–02

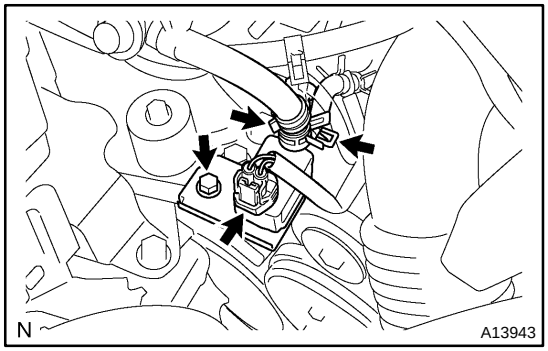
REMOVAL

1. **DISCONNECT BATTERY NEGATIVE (–) TERMINAL AND HV BATTERY SERVICE PLUG (See page HV–1)**
2. **REMOVE OUTER FRONT COWL TOP PANEL ASSEMBLY (See page BO–32)**
3. **DRAIN HV COOLANT (See page HT–8)**
4. **DRAIN ENGINE COOLANT**
5. **REMOVE CONVERTER AND INVERTER ASSEMBLY (See page HV–18)**
6. **REMOVE HEATER UNIT WATER PUMP (See page AC–55)**



7. REMOVE AIR CLEANER ASSEMBLY

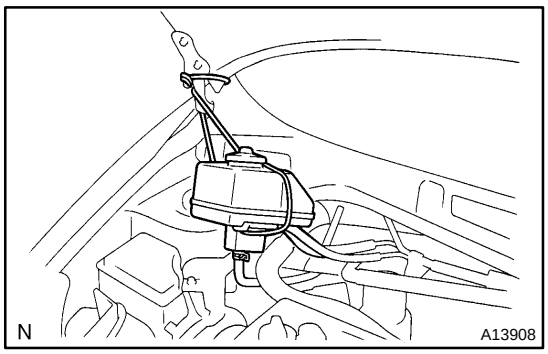
(a) Disconnect the MAF meter connector.
(b) Disconnect the EVAP hose from the air cleaner case.
(c) Loosen the 2 hose clamps.
(d) Remove the 2 bolts and air cleaner assembly.



8. DISCONNECT CONNECTORS, CLAMPS AND HOSES

(a) Disconnect the engine wire clamps.
(b) Disconnect the heated oxygen sensor connector.
(c) Disconnect the 2 power steering connectors.
(d) Disconnect the VSV connector for purge line.
(e) Disconnect the VSV hose for purge line.
(f) Disconnect the ground strap from RH fender apron.
(g) Disconnect the ground strap from LH fender apron.

9. **REMOVE AIR INLET**
10. **REMOVE ENGINE COOLANT RESERVOIR TANK**
11. **DISCONNECT 2 RADIATOR HOSES FROM RADIATOR**
12. **DISCONNECT HEATER HOSE FROM CYLINDER BLOCK**

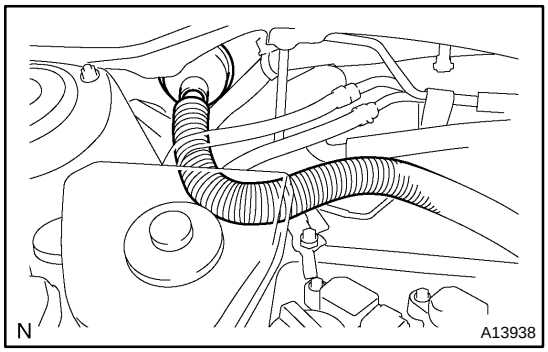


13. DISCONNECT SHIFT LEVER CABLE

14. REMOVE BRAKE RESERVOIR TANK

(a) Disconnect the brake fluid level sensor connector.

(b) Remove the 2 bolts and remove the reservoir tank and suspend it.

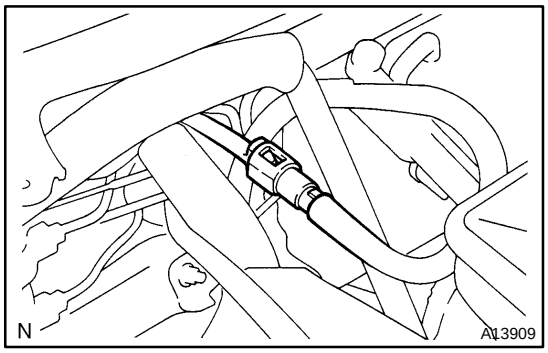


15. DISCONNECT ENGINE WIRE FROM CABIN

(a) Remove the ECM (See page SF–63).

(b) Disconnect the grommet from the cowl panel, and pull out the engine wire.

16. REMOVE J/B NO. 1 FROM RH FENDER APRON

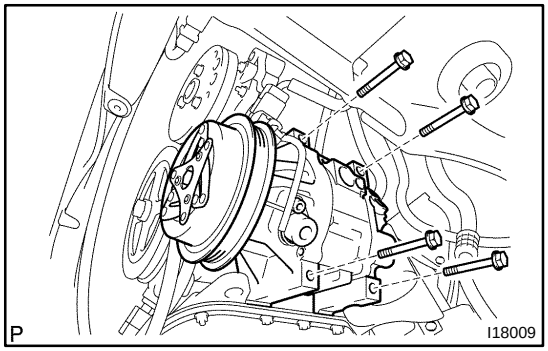


17. DISCONNECT FUEL TUBE

Disconnect the fuel tube from the fuel pump.

18. REMOVE DRIVE BELT

19. REMOVE ENGINE UNDER COVERS



20. REMOVE A/C COMPRESSOR

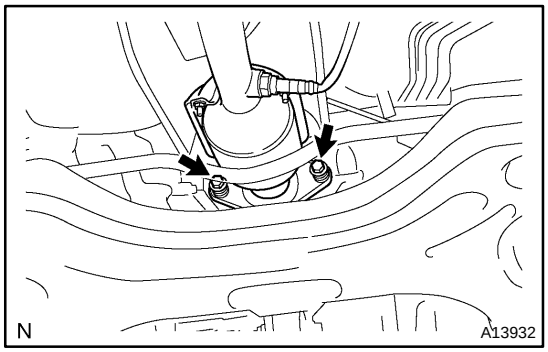
(a) Disconnect the A/C compressor connector.

(b) Remove the 4 bolts and disconnect the A/C compressor from the engine.

HINT:

Suspend the A/C compressor securely.

21. DISCONNECT INTERMEDIATE EXTENSION FROM STEERING ASSEMBLY (See page SR–8)

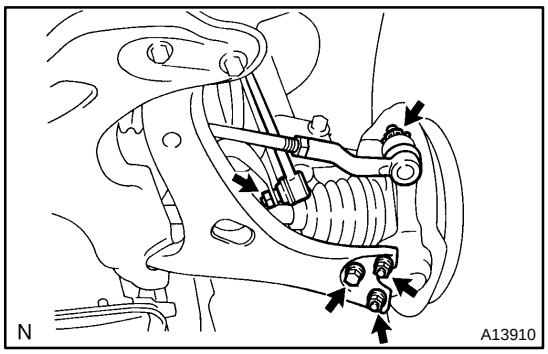


22. REMOVE EXHAUST PIPE

(a) Disconnect the heated oxygen sensor from the exhaust pipe.

(b) Remove the 2 springs and 3 bolts.

(c) Disconnect the 2 O–rings, and remove the exhaust pipe and 2 gaskets.



23. DISCONNECT TIE ROD END FROM STEERING KNUCKLE (See page SA–10)

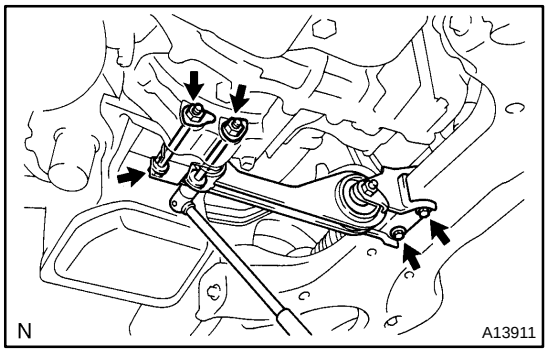
24. DISCONNECT STABILIZER BAR LINK

Remove the nut and disconnect the stabilizer bar link from the suspension member.

25. DISCONNECT BALL JOINT FROM LOWER ARM

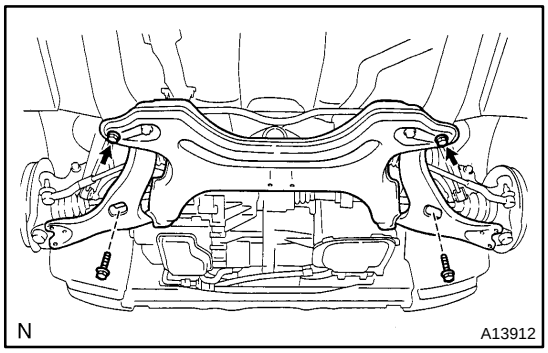
Remove the 2 bolts and 4 nuts, disconnect the ball joint.

26. REMOVE DRIVE SHAFTS (See page SA–18)



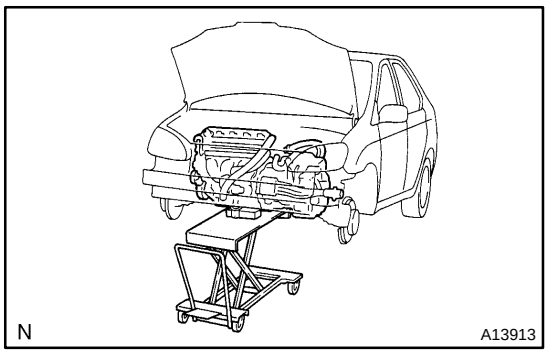
27. REMOVE TORQUE ROD

Remove the 4 bolts and 2 nuts and torque rod from the body.



28. REMOVE SUSPENSION MEMBER

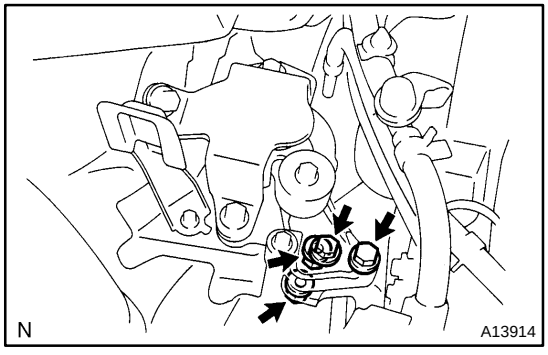
Remove the 4 bolts and disconnect the suspension member from the body.



29. SET ENGINE JACK

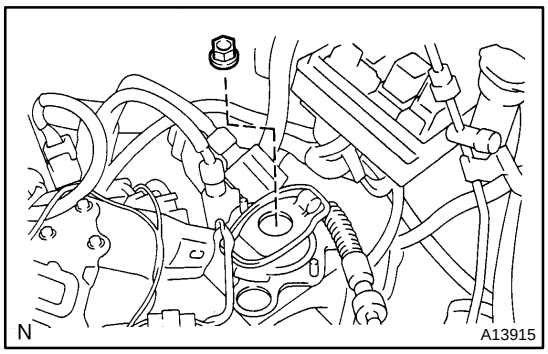
NOTICE:

Using chain, hold the engine tightly.

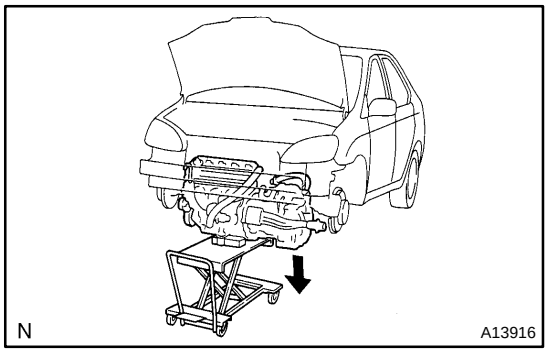


30. DISCONNECT ENGINE MOUNTINGS

(a) Remove the 2 bolts, 2 nuts and disconnect the RH engine mounting insulator from the bracket.



(b) Remove the nut and disconnect the LH engine mounting from the insulator.



31. REMOVE ENGINE AND TRANSAXLE ASSEMBLY

(a) Lower the engine out of vehicle slowly and carefully.

NOTICE:

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

(b) Using a engine sliding device, and place the engine and transaxle assembly onto the stand.

32. SEPARATE ENGINE AND TRANSAXLE

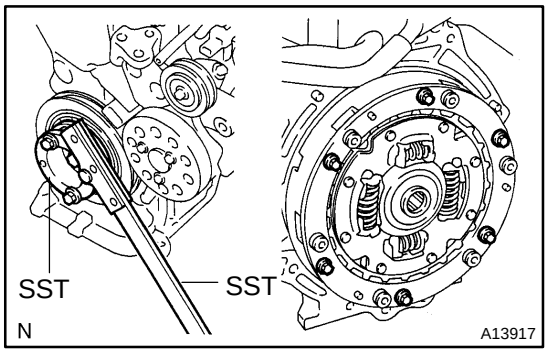
(a) Remove the 2 bolts and dust cover.

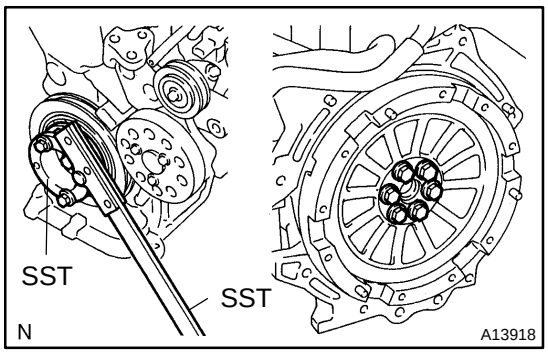
(b) Remove the 6 bolts and transaxle from the engine.

33. REMOVE DAMPER DISC

Using SST, hold the crankshaft pulley, remove the 6 bolts and damper disc and spring.

SST 09213–58012 (91111–580845), 09330–00021





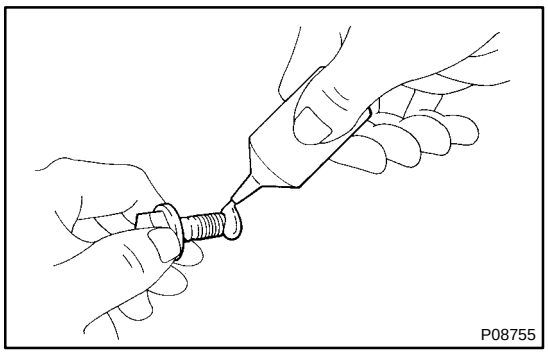
34. REMOVE FLYWHEEL

Using SST, hold the crankshaft pulley, remove the 6 bolts and flywheel.

SST 09213–58012 (91111–580845), 09330–00021

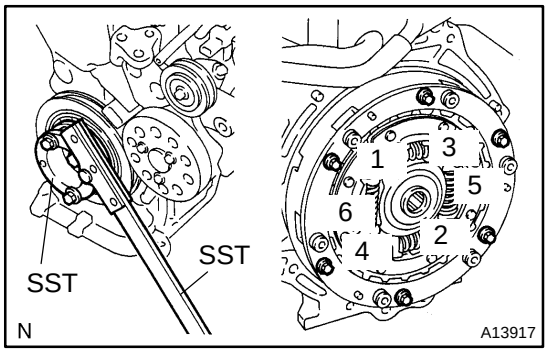
EM1J2–02

INSTALLATION



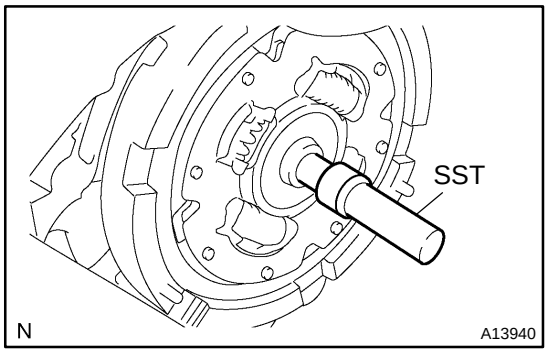
1. INSTALL FLYWHEEL

(a) Apply adhesive to 2 or 3 threads of the bolt end.
Adhesive: Part No. 08833–00070, THREE BOND 1324 or equivalent



(b) Install and uniformly tighten the new 6 bolts in several passes, in the sequence shown.
Torque: 84 N·m (857 kgf·cm, 62 ft·lbf)

(c) Retighten the flywheel bolts by 90° in the numerical order shown.



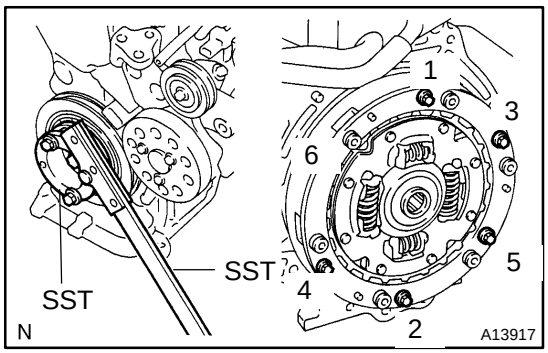
2. INSTALL DAMPER DISC

(a) Insert SST in the damper disc, then insert them in the flywheel.
SST 09301–00110

HINT:
Take care not to insert damper disc in the wrong direction.

(b) Set the damper spring on the damper disc.

(c) Following the procedures shown in the illustration, tighten the 6 bolts in the order starting the bolt locating near the knock pin on the top.
Torque: 16 N·m (163 kgf·cm, 12 ft·lbf)



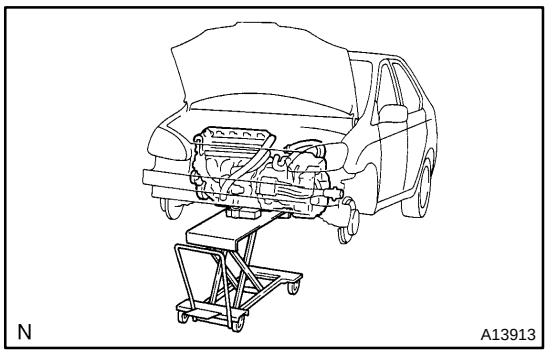
HINT:
- Following the order in the illustration, tighten the bolts at a time evenly.
- Move SST up and down, right and left lightly, after checking that the disc in the center, tighten the bolts.

3. INSTALL TRANSAXLE TO ENGINE

(a) Attach the transaxle to the engine, and install the 6 bolts.
Torque: 33 N·m (337 kgf·cm, 24 ft·lbf)

(b) Install the dust cover.

(c) Install the LH engine mounting bracket.
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)



4. SET ENGINE JACK

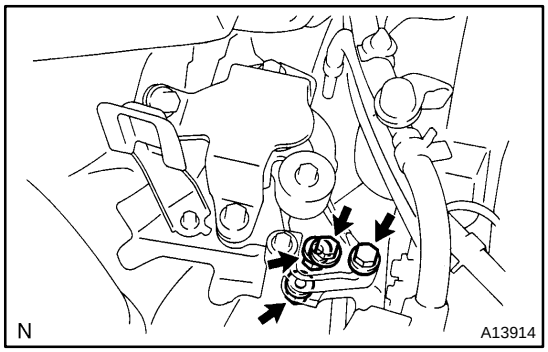
NOTICE:

Using a chain, hold the engine tightly.

5. INSTALL ENGINE AND TRANSAXLE ASSEMBLY IN VEHICLE

(a) Raise the engine into the engine compartment.

(b) Keep the engine level, and align RH and LH mountings with the insulator.

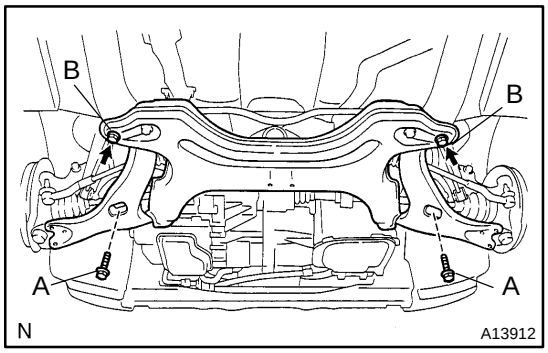


(c) Connect the LH mounting bracket to the insulator with the nut.

Torque: 80 N·m (816 kgf·cm, 59 ft·lbf)

(d) Connect the RH mounting bracket to the insulator with the 2 bolts and 2 nuts.

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



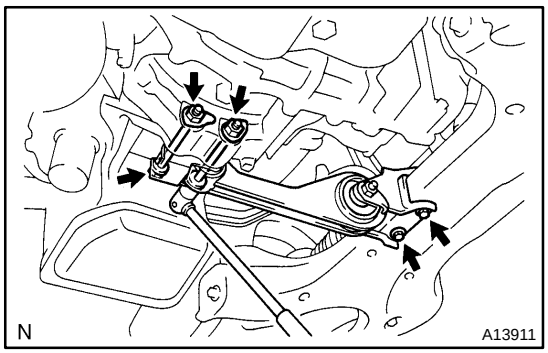
6. INSTALL SUSPENSION MEMBER

Connect the suspension member with the 4 bolts.

Torque:

Bolt A: 113 N·m (1,152 kgf·cm, 83 ft·lbf)

Bolt B: 157 N·m (1,601 kgf·cm, 116 ft·lbf)



7. INSTALL TORQUE ROD

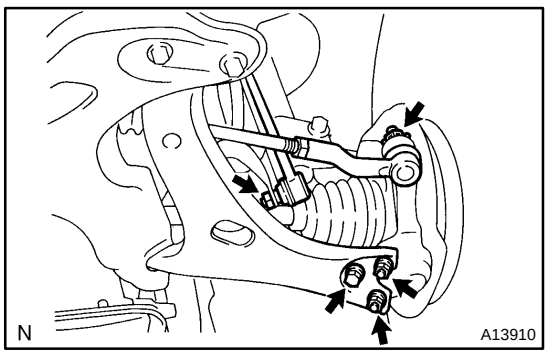
(a) Install the torque rod through bolt and nut.

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

(b) Install the 2 bolts.

Torque: 60 N·m (612 kgf·cm, 44 ft·lbf)

8. INSTALL DRIVE SHAFTS (See page SA–24)



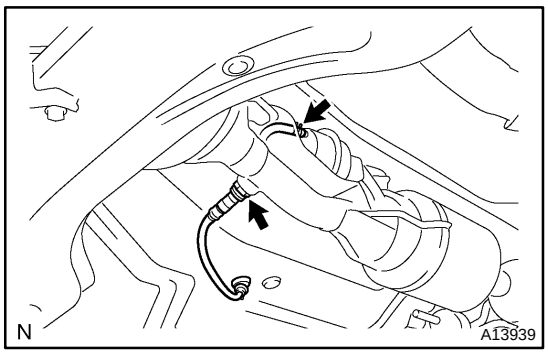
9. CONNECT BALL JOINT TO LOWER ARM

Torque: 142 N·m (1,448 kgf·cm, 105 ft·lbf)

10. CONNECT STABILIZER BAR LINK

Torque: 74 N·m (755 kgf·cm, 55 ft·lbf)

11. CONNECT TIE ROD END TO STEERING KNUCKLE (See page SA–15)



12. INSTALL EXHAUST PIPE

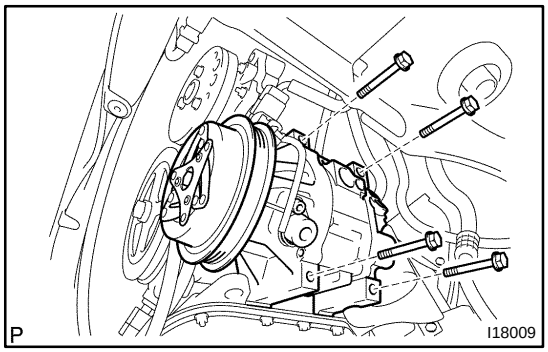
(a) Install the 2 gaskets to the exhaust pipe and connect the 2 O–rings.

(b) Install the 2 springs and 3 bolts.

Torque:
Front exhaust pipe: 62 N·m (630 kgf·cm, 46 ft·lbf)
Tailpipe: 32 N·m (326 kgf·cm, 24 ft·lbf)

(c) Connect the hose to the actuator.

(d) Connect the heated oxygen sensor.



13. INSTALL A/C COMPRESSOR

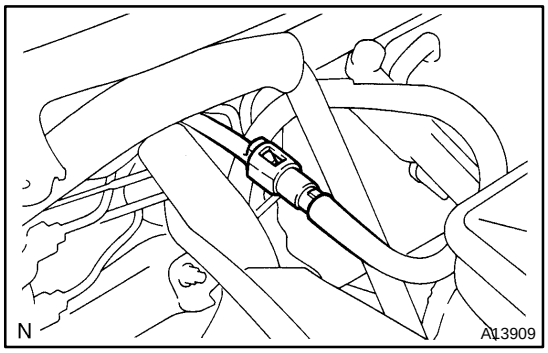
(a) Connect the A/C compressor to the engine with the 4 bolts.

Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)

(b) Connect the A/C compressor connector.

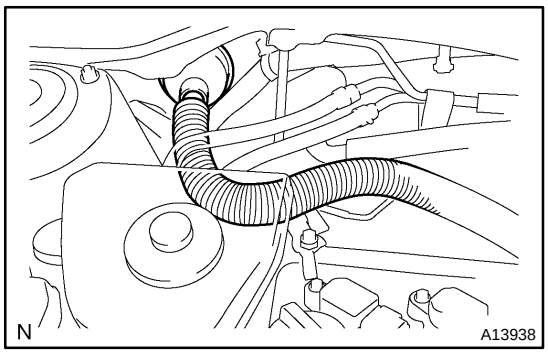
14. CONNECT INTERMEDIATE EXTENSION STEERING ASSEMBLY (See page SR–16)

15. INSTALL DRIVE BELT (See page SA–24)



16. CONNECT FUEL TUBE

17. INSTALL J/B NO. 1 TO RH FENDER APRON



18. CONNECT ENGINE WIRE TO CABIN

(a) Pull in the engine wire to the cowl panel and connect the grommet.

(b) Connect the ECM connectors.

(c) Install the ECM (See page SF–63).

19. INSTALL BRAKE RESERVOIR TANK

(a) Install the reservoir tank with the 2 bolts.

(b) Connect the brake fluid level sensor connector.

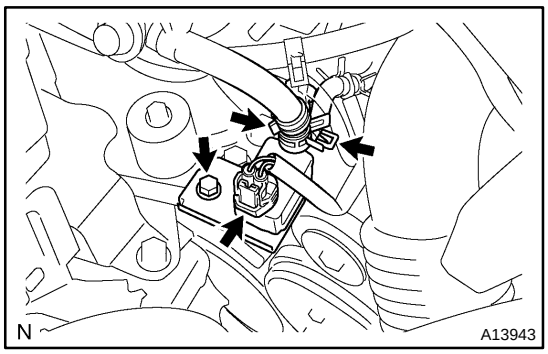
20. CONNECT SHIFT LEVER CABLE TO TRANSAXLE

21. CONNECT HEATER HOSE TO CYLINDER BLOCK

22. CONNECT 2 RADIATOR HOSES TO RADIATOR

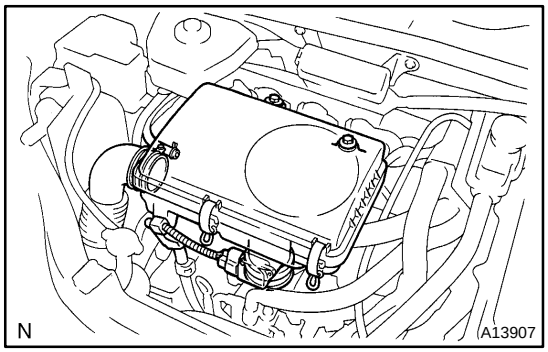
23. INSTALL ENGINE COOLANT RESERVOIR TANK

24. INSTALL AIR INLET



25. CONNECT CONNECTORS, CLAMPS AND HOSES

(a) Connect the Ground strap from LH fender apron.
(b) Connect the Ground strap from RH fender apron.
(c) Connect the VSV hose for purge line.
(d) Connect the VSV connector for purge line.
(e) Connect the 2 power steering connectors.
(f) Connect the Heated oxygen sensor connector.
(g) Connect the Engine wire clamps.



26. INSTALL AIR CLEANER ASSEMBLY

(a) Install the air cleaner assembly with the 2 bolts.
(b) Tighten the 2 hose clamps.
(c) Connect the EVAP hose to the air cleaner case.
(d) Connect the MAF meter connector.

27. INSTALL HEATER UNIT WATER PUMP (See page AC–55)

28. INSTALL CONVERTER AND INVERTER ASSEMBLY (See page HV–22)

29. INSTALL OUTER FR COWL TOP PANEL ASSEMBLY (See page BO–35)

30. FILL WITH ENGINE COOLANT

31. FILL WITH HV COOLANT

32. INSTALL ENGINE UNDER COVERS

33. CONNECT BATTERY NEGATIVE (–) TERMINAL AND HV BATTERY SERVICE PLUG (See page HV–1)

34. ROAD TEST VEHICLE

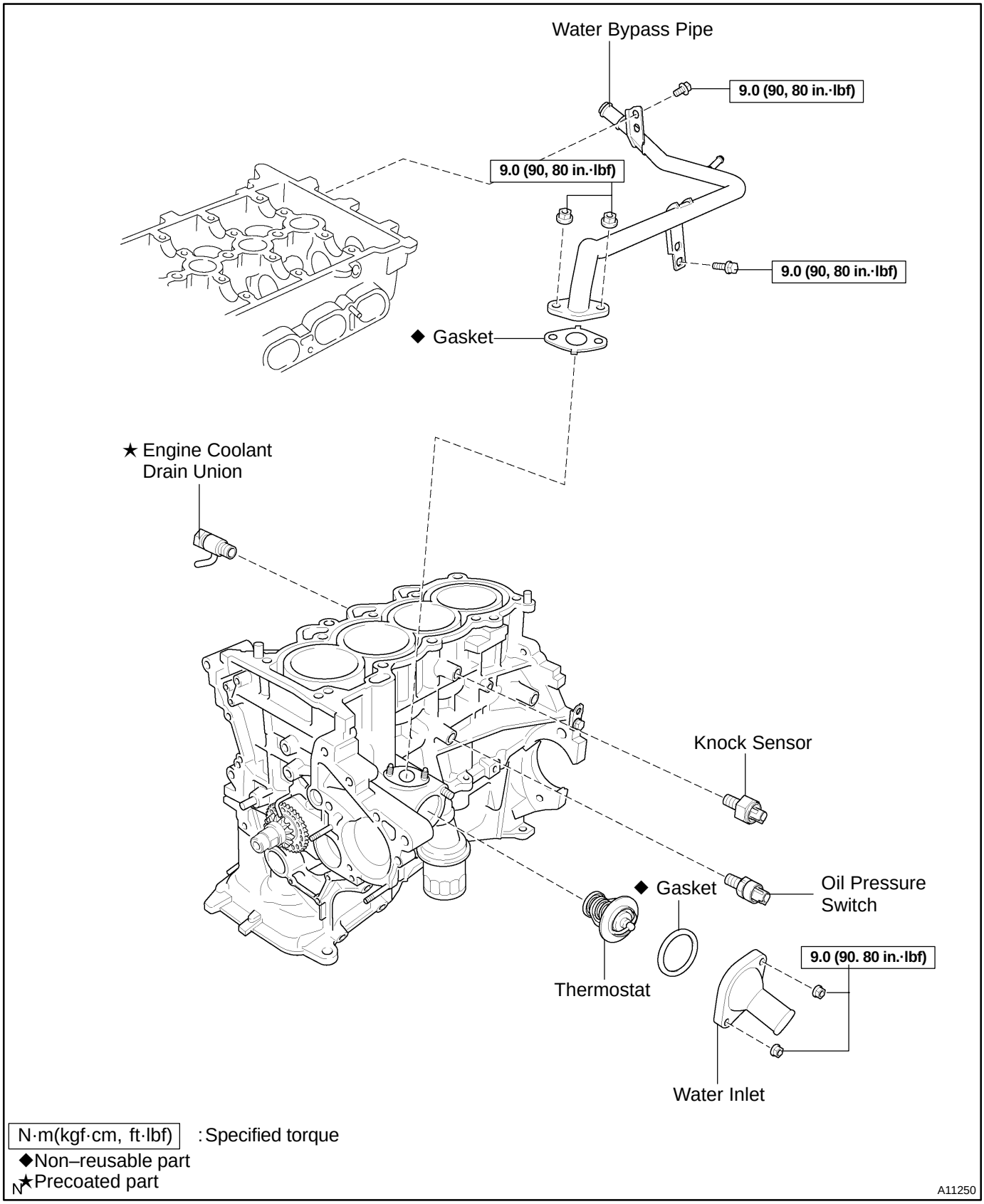
Check for abnormal noiss, shock slippage, correct shift points and smooth operation.

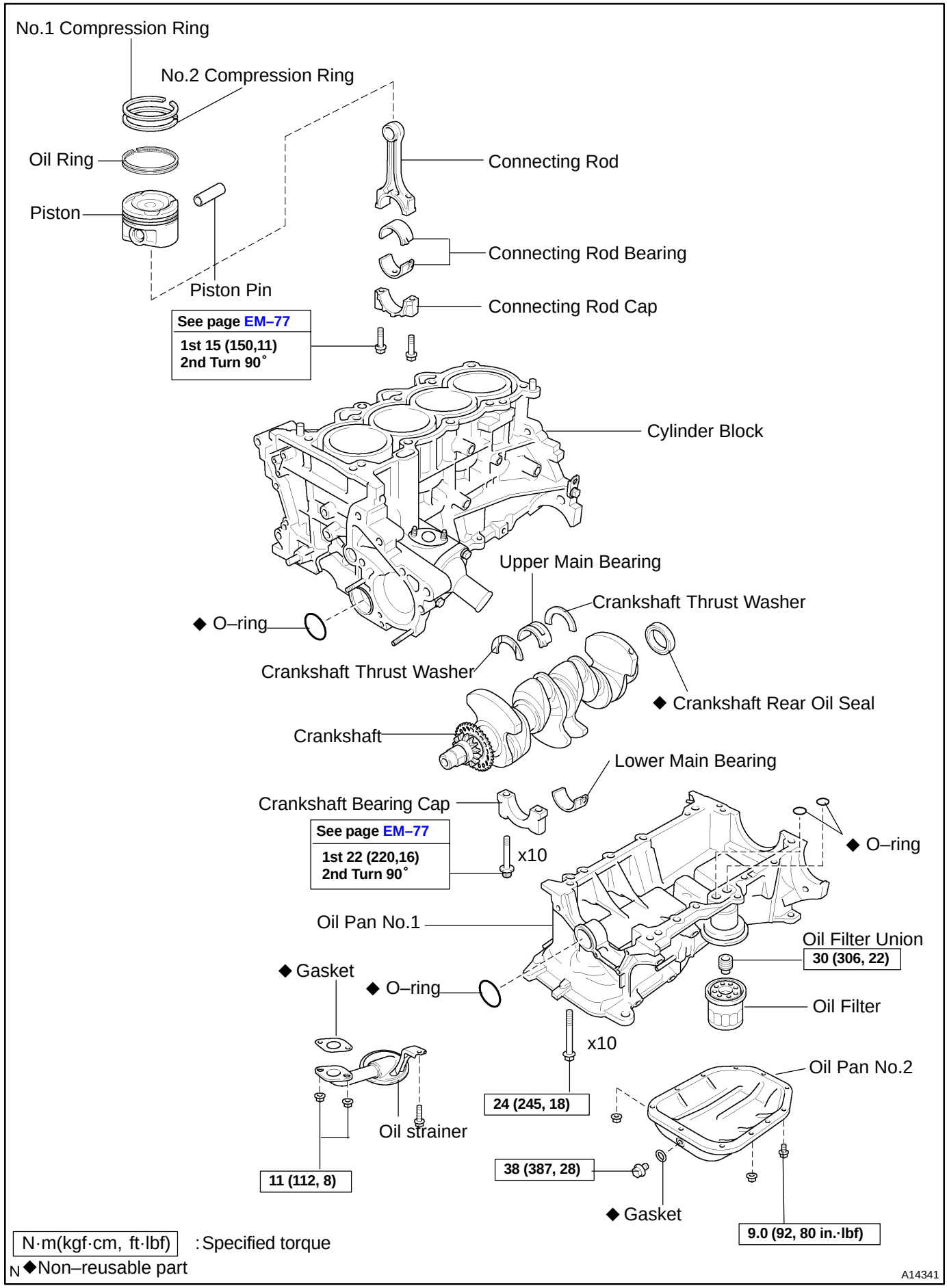
35. RECHECK ENGINE COOLANT AND HV TRANSAXLE COOLANT

CYLINDER BLOCK

COMPONENTS

EM17B–02

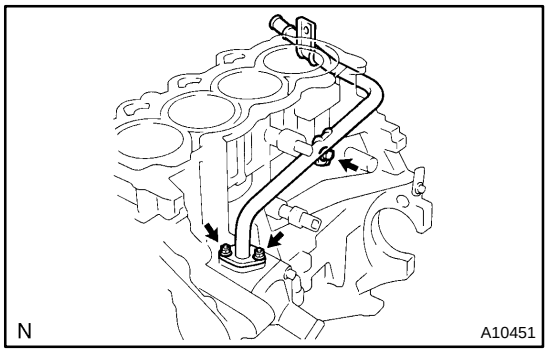



No.1 Compression Ring
No.2 Compression Ring
Oil Ring
Piston
Piston Pin
Connecting Rod
Connecting Rod Bearing
Connecting Rod Cap
See page EM–77
1st 15 (150,11)
2nd Turn 90°
Cylinder Block
Upper Main Bearing
Crankshaft Thrust Washer
◆ O–ring
Crankshaft Thrust Washer
◆ Crankshaft Rear Oil Seal
Crankshaft
Lower Main Bearing
Crankshaft Bearing Cap
See page EM–77
1st 22 (220,16)
2nd Turn 90°
x10
◆ O–ring
Oil Pan No.1
Oil Filter Union
30 (306, 22)
◆ Gasket
◆ O–ring
Oil Filter
x10
Oil Pan No.2
24 (245, 18)
Oil strainer
38 (387, 28)
11 (112, 8)
◆ Gasket
9.0 (92, 80 in.·lbf)
N·m(kgf·cm, ft·lbf) : Specified torque
N ◆Non–reusable part
A14341

EM17C–04

DISASSEMBLY

1. **INSTALL ENGINE TO ENGINE STAND FOR DISASSEMBLY**
2. **REMOVE TIMING CHAIN (See page EM–15)**
3. **REMOVE CYLINDER HEAD (See page EM–29)**
4. **REMOVE ENGINE WIRE**

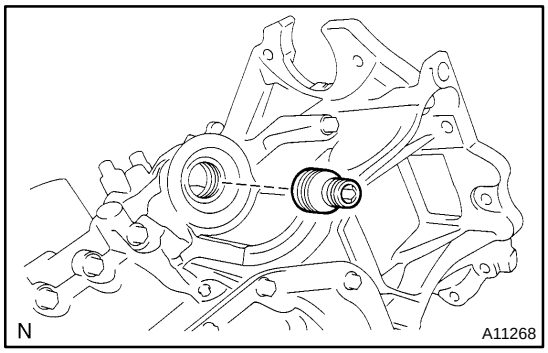


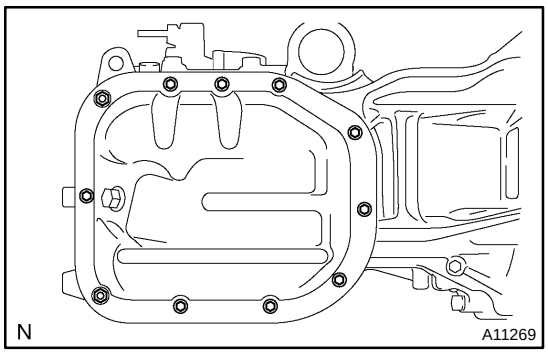
5. **REMOVE WATER BYPASS PIPE**

Remove the 2 nuts, bolt and water bypass pipe.

6. **REMOVE THERMOSTAT (See page CO–10)**
7. **REMOVE KNOCK SENSOR (See page SF–56)**
8. **REMOVE OIL PRESSURE SWITCH (See page LU–1)**
9. **REMOVE ENGINE COOLANT DRAIN UNION**
10. **REMOVE OIL FILTER (See page LU–3)**
11. **REMOVE OIL FILTER UNION**

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





12. **REMOVE OIL PAN NO. 2**

(a) Remove the 9 bolts and 2 nuts.

(b) Insert the blade of SST between the oil pan No. 1 and oil pan No. 2, and cut off applied sealer and remove the oil pan.

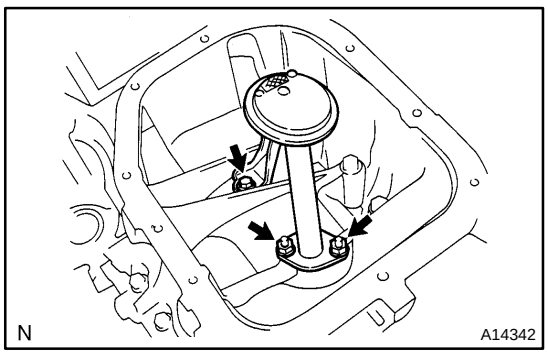
SST 09032–00100

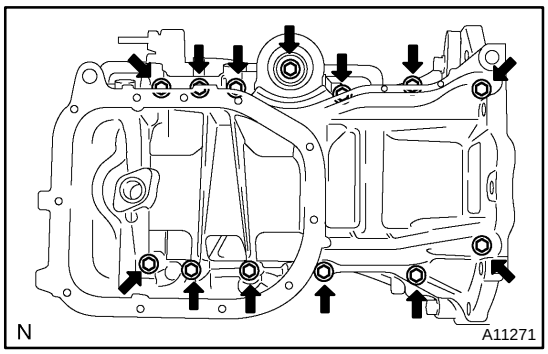
NOTICE:

- **Be careful not to the damage the oil pan contact surface of the oil pan No. 1.**
- **Be careful not to damage the oil pan No. 2 flange.**

13. **REMOVE OIL STRAINER**

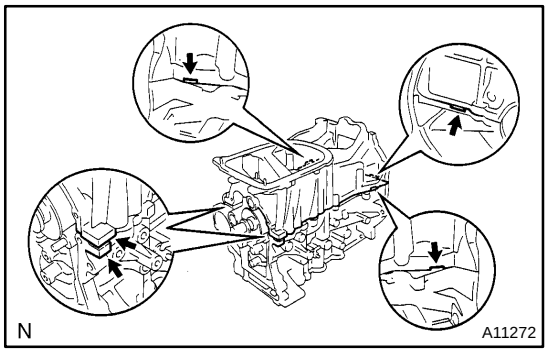
Remove the bolt and 2 nuts, oil strainer and gasket.





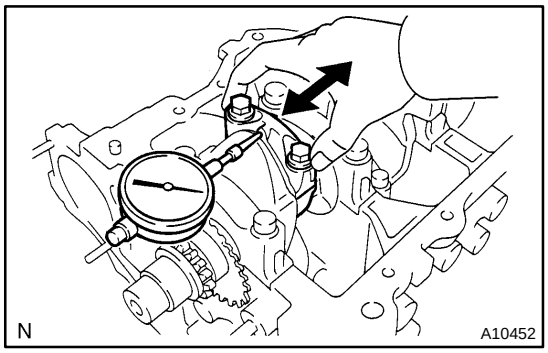
14. REMOVE OIL PAN NO. 1

(a) Uniformly loosen and remove the 13 bolts, in several passes, in the sequence shown.



(b) Using screwdriver remove the oil pan No. 1 by prying the portions between the cylinder block and oil pan No. 1.

(c) Remove the 2 O–rings from the cylinder block.

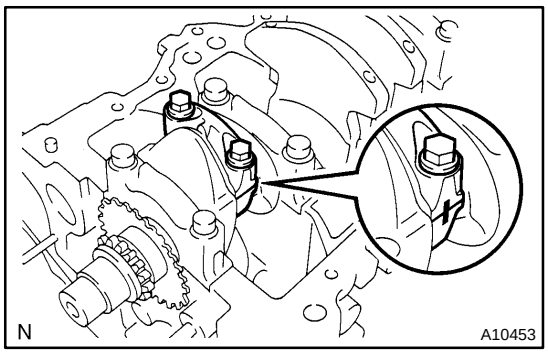


15. CHECK CONNECTING ROD THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance:
0.16 – 0.36 mm (0.0063 – 0.0142 in.)
Maximum thrust clearance:
0.36 mm (0.0142 in.)

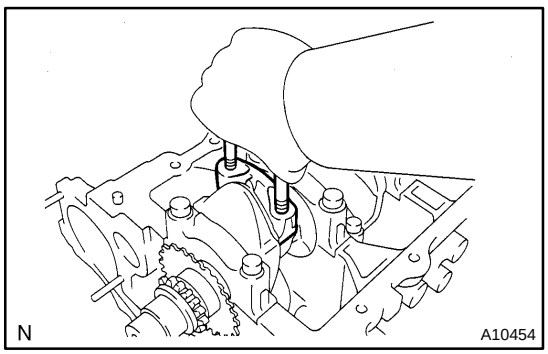
If the thrust clearance is greater than maximum, replace the connecting rod assembly(s). If necessary, replace the crankshaft.



16. 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:

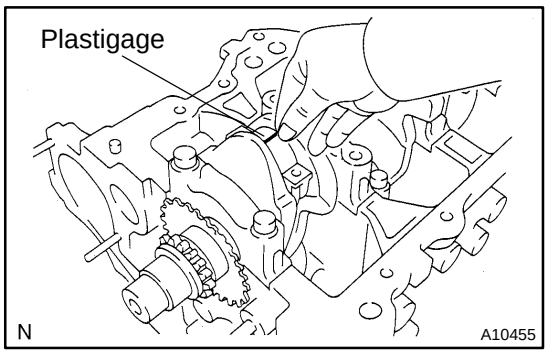
Keep the lower bearing inserted with the connecting rod cap.

(d) Clean the crank pin and bearing.

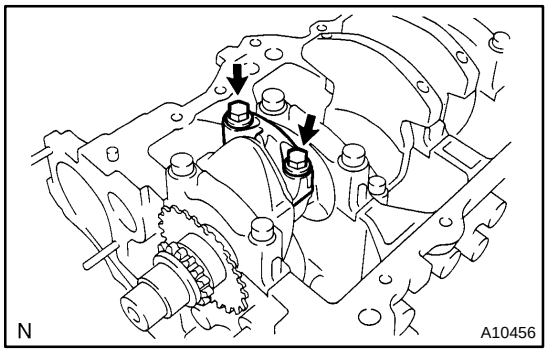
(e) Check the crank pin and bearing for pitting and scratches.

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

If necessary, replace the crankshaft.

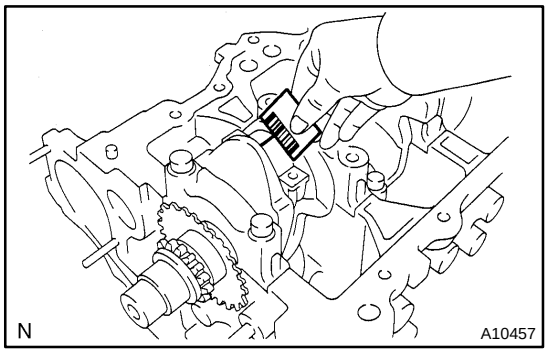


(f) Lay a strip of Plastigage the crank pin.



(g) Install the connecting rod cap with the 2 bolts.
(See page EM–77)
Torque:
1ST 15 N·m (150 kgf·cm, 11 ft·lbf)
2ND Turn 90 °

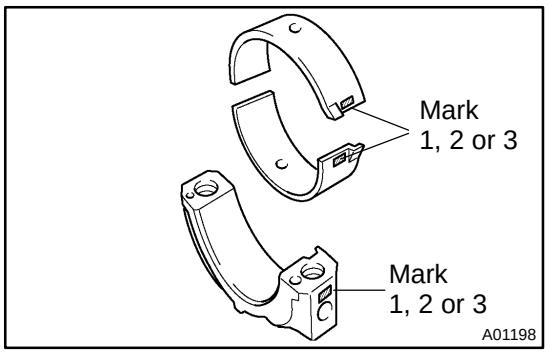
NOTICE:
Do not turn the crankshaft.



(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:
0.016 – 0.040 mm (0.0006 – 0.0016 in.)
Maximum oil clearance:
0.06 mm (0.0024 in.)

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

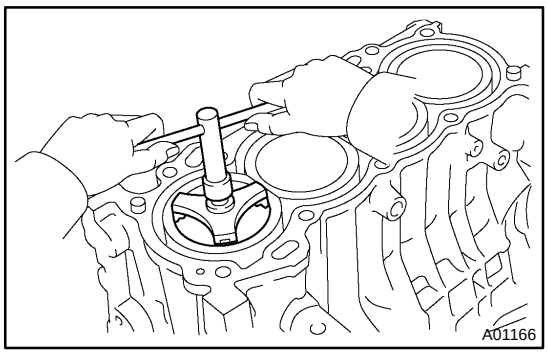


HINT:
If replacing a bearing, replace it with one having the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked ”1”, ”2” and ”3” accordingly.

Reference
Standard bearing center wall thickness

Mark	mm (in.)
”1”	1.488 – 1.492 (0.0586 – 0.0587)
”2”	1.492 – 1.496 (0.0587 – 0.0589)
”3”	1.496 – 1.500 (0.0589 – 0.0591)

(j) Completely remove the plastigage.



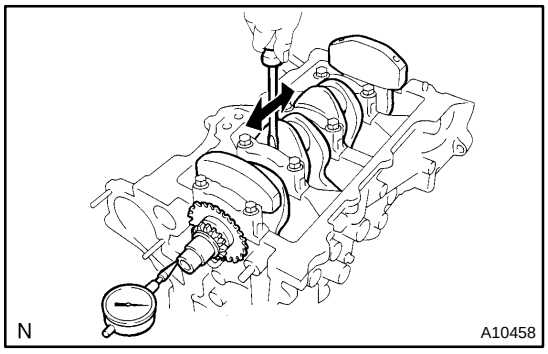
17. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES

(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.



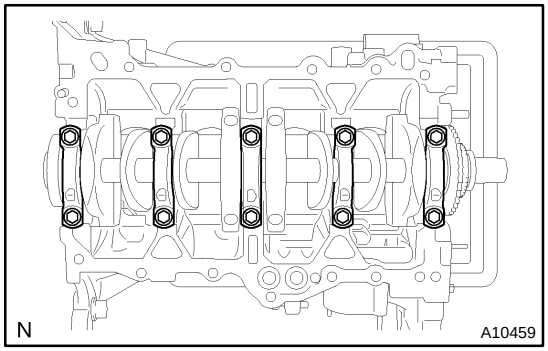
18. CHECK CRANKSHAFT THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while moving the crankshaft back and forth.

Standard thrust clearance:
0.09 – 0.19 mm (0.0035 – 0.0075 in.)
Maximum thrust clearance:
0.3 mm (0.012 in.)

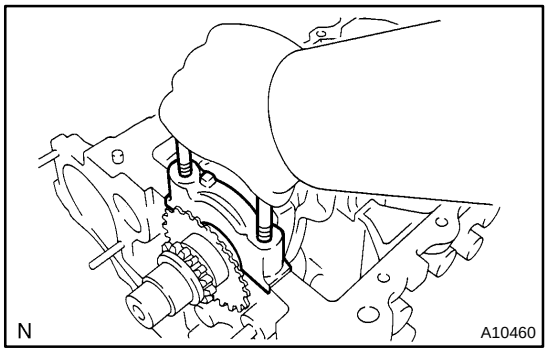
If the thrust clearance is greater than maximum, replace the thrust washer as a set.

Thrust washer thickness:
2.430 – 2.480 mm (0.09567 – 0.09764 in.)



19. REMOVE BEARING CAPS AND CHECK OIL CLEARANCE

(a) Uniformly loosen and remove the 10 bearing cap bolts in several passes in the sequence shown.



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

HINT:

Keep the lower bearing inserted with the bearing cap.

(c) Lift out the crankshaft.

HINT:

Keep the upper bearings and thrust washers together with the cylinder block.

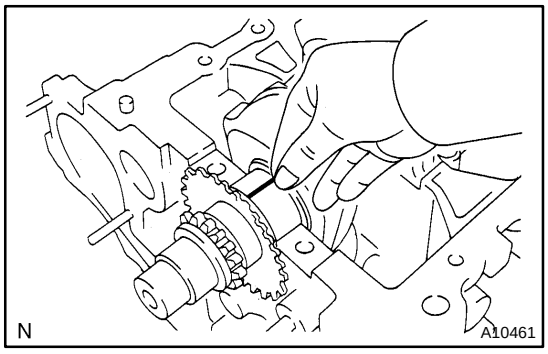
(d) Clean each main journal and bearing.

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

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

If necessary, grind or replace the crankshaft.

(f) Place the crankshaft on the cylinder block.



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

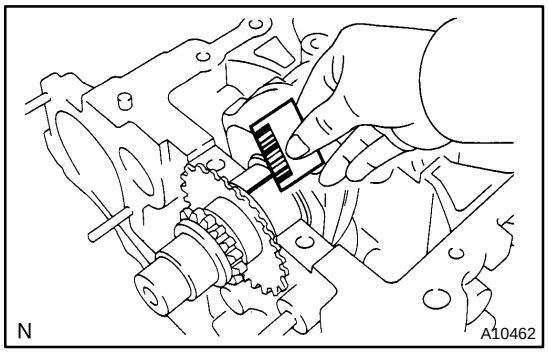
(h) Install the bearing caps (See page EM–45).

Torque:
1ST 22 N·m (220 kgf·cm, 16 ft·lbf)
2ND Turn 90 °

NOTICE:

Do not turn the crankshaft.

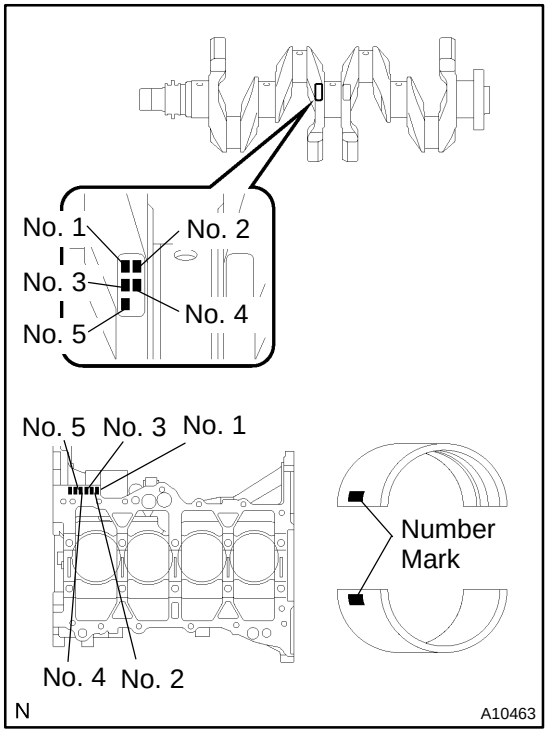
(i) Remove the bearing caps (See procedure (a) and (b) above).



(j) Measure the plastigage at its widest point.

Standard oil clearance:
0.010 – 0.023 mm (0.0004 – 0.0009 in.)
Maximum oil clearance:
0.07 mm (0.0028 in.)

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



HINT:

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”)

Reference

Item	Mark	mm (in.)
Cylinder block main journal bore diameter (A)	”0”	50.000 – 50.003 (1.96850 – 1.96862)
	”1”	50.003 – 50.005 (1.96862 – 1.96870)
	”2”	50.005 – 50.007 (1.96870 – 1.96878)
	”3”	50.007 – 50.010 (1.96878 – 1.96889)
	”4”	50.010 – 50.012 (1.96889 – 1.96897)
	”5”	50.012 – 50.014 (1.96897 – 1.96905)
	”6”	50.014 – 50.016 (1.96905 – 1.96913)
Crankshaft main journal diameter (B)	”0”	46.000 – 46.002 (1.81102 – 1.81110)
	”1”	46.002 – 46.004 (1.81110 – 1.81118)
	”2”	46.004 – 46.006 (1.81118 – 1.81126)
	”3”	46.006 – 46.008 (1.81126 – 1.81133)
	”4”	46.008 – 46.010 (1.81133 – 1.81141)
	”5”	46.010 – 46.012 (1.81141 – 1.81149)
Standard bearing center wall thickness	”1”	1.992 – 1.995 (0.07843 – 0.07854)
	”2”	1.995 – 1.998 (0.07854 – 0.07866)
	”3”	1.998 – 2.001 (0.07866 – 0.07878)
	”4”	2.001 – 2.004 (0.07878 – 0.07890)

(k) Completely remove the Plastigage.

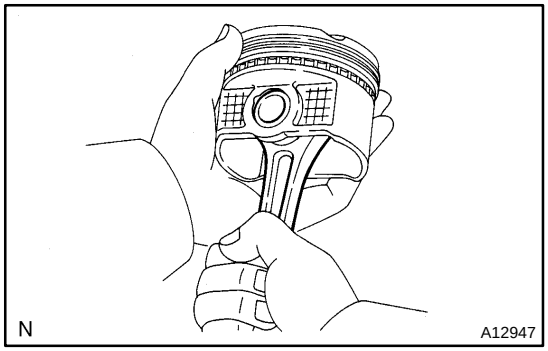
20. REMOVE CRANKSHAFT

(a) Lift out the crankshaft.

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

HINT:

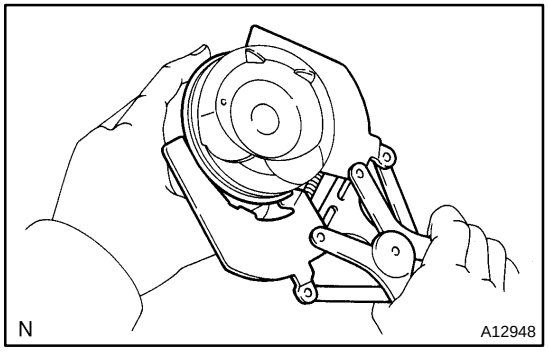
Arrange the main bearings and thrust washers in the correct order.



21. 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.



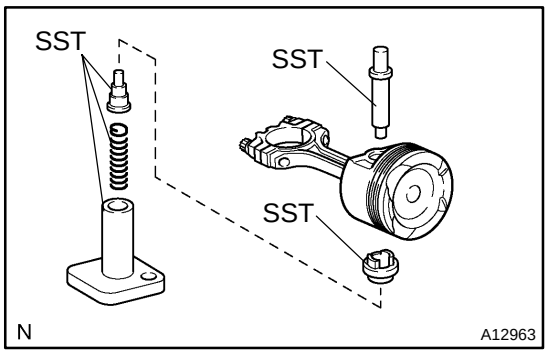
22. REMOVE PISTON RINGS

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

(b) Remove the oil ring by hand.

HINT:

Arrange the piston rings in the correct order only.



23. DISCONNECT CONNECTING ROD FROM PISTON

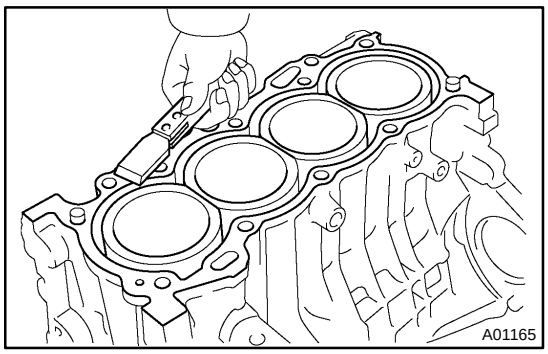
Using SST, press out the piston pin from the piston. Remove the piston.

SST 09221–25026 (09221–00021, 09221–00030, 09221–00190, 09221–00141, 09221–00150)

HINT:

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

EM17D–03



INSPECTION

1. REMOVE GASKET MATERIAL

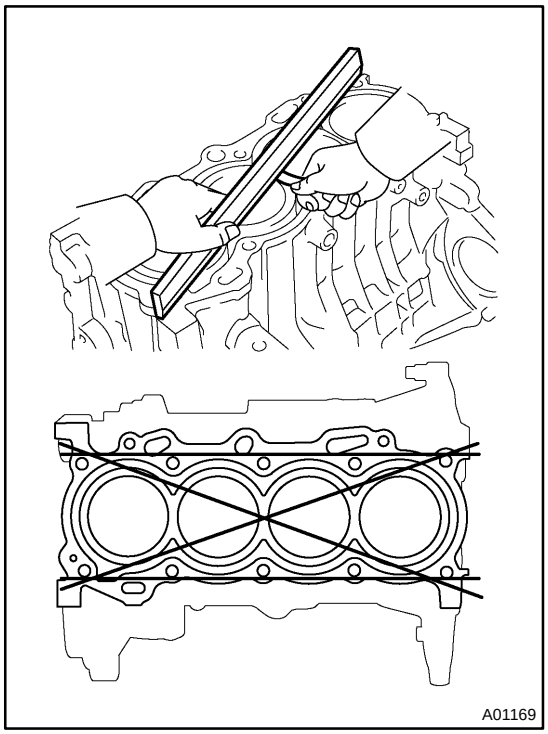
Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

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.

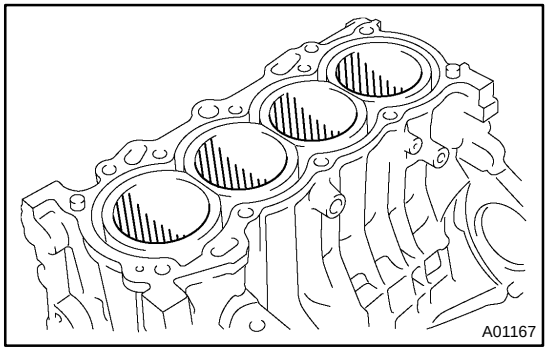


3. INSPECT TOP SURFACE OF CYLINDER BLOCK FOR FLATNESS

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.)

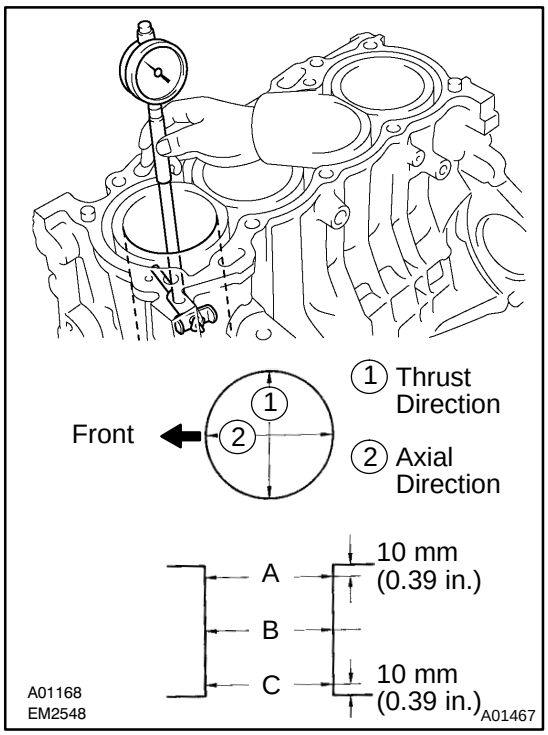
If warpage is greater than maximum, replace the cylinder block.



4. INSPECT CYLINDER BORE DIAMETER

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

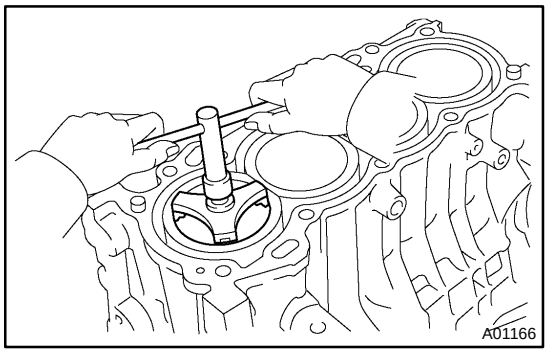


5. INSPECT CYLINDER BORE DIAMETER

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

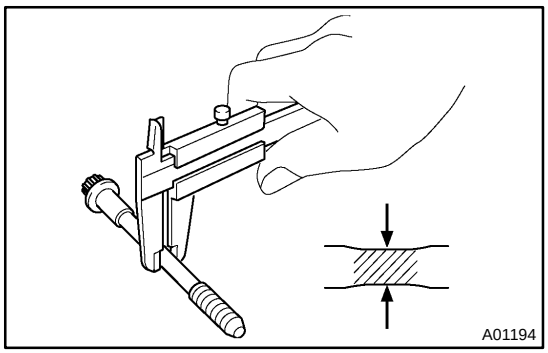
Standard diameter:
75.000 – 75.013 mm (2.95275 – 2.95326 in.)
Maximum diameter:
75.013 mm (2.95326 in.)

If the diameter 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.

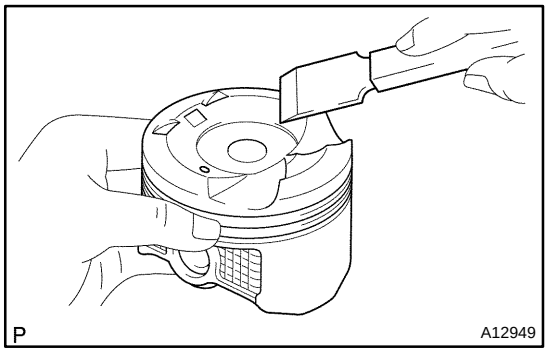


7. INSPECT 12 POINTED HEAD BEARING CAP SUB–ASSEMBLY BOLTS

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

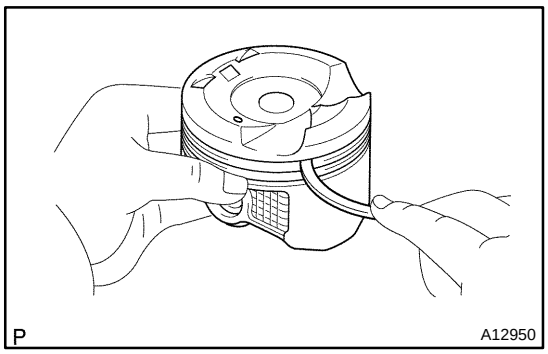
Standard diameter: 7.3 – 7.5 mm (0.287 – 0.295 in.)
Minimum diameter: 7.3 mm (0.287 in.)

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

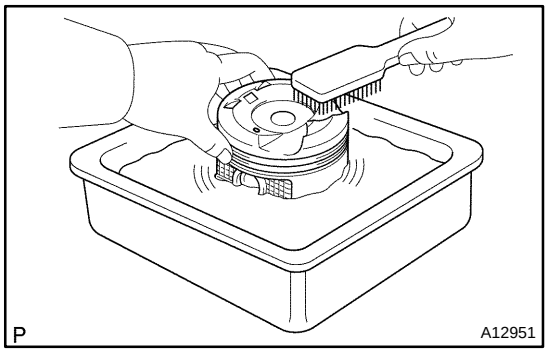


8. CLEAN PISTON

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



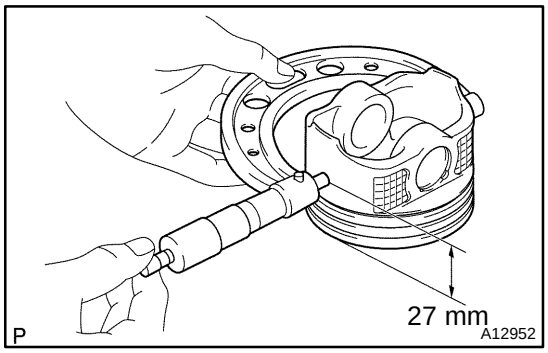
(b) Using a groove cleaning tool or broken ring, clean the piston ring grooves.



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

NOTICE:

Do not use a wire brush.



9. INSPECT PISTON OIL CLEARANCE

(a) Using a micrometer, while placing the piston up side down, take measurement at the position of 27 mm (1.06 in.).

Piston diameter:

74.930 – 74.940 mm (2.94999 – 2.95039 in.)

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

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

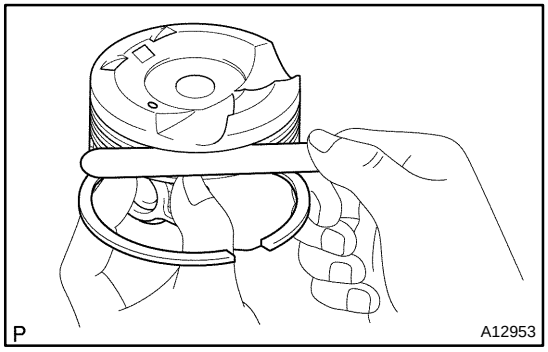
Standard oil clearance:

0.045 – 0.068 mm (0.00177 – 0.00268 in.)

Maximum oil clearance:

0.095 mm (0.0037 in.)

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



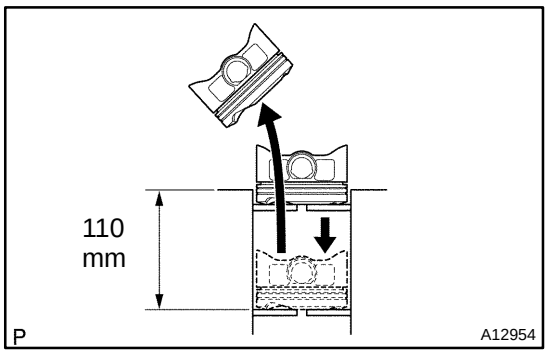
10. INSPECT PISTON RING END GAP

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.



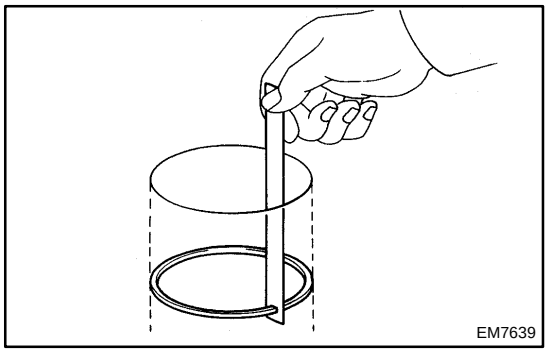
11. INSPECT PISTON RING END GAP

(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 0.22 – 0.32 mm (0.0087 – 0.0126 in.)
No. 2 0.32 – 0.47 mm (0.0126 – 0.0185 in.)
Oil (Side rail) 0.15 – 0.45 mm (0.0059 – 0.0177 in.)
Maximum end gap:
No. 1 0.88 mm (0.0346 in.)
No. 2 1.03 mm (0.0406 in.)
Oil 0.92 mm (0.0362 in.)



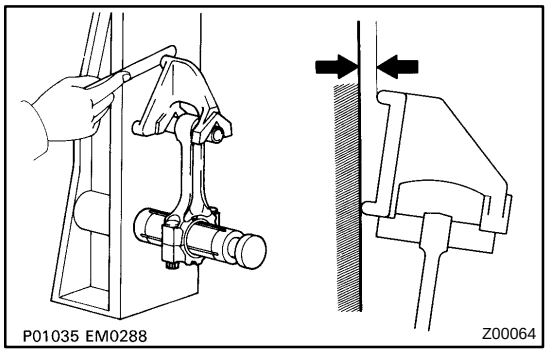
If the end gap is greater than maximum, replace the piston ring.
If the end gap is greater than maximum, even with a new piston ring, replace the cylinder block.

12. INSPECT CONNECTING ROD ALIGNMENT

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

- Check for out–of–alignment

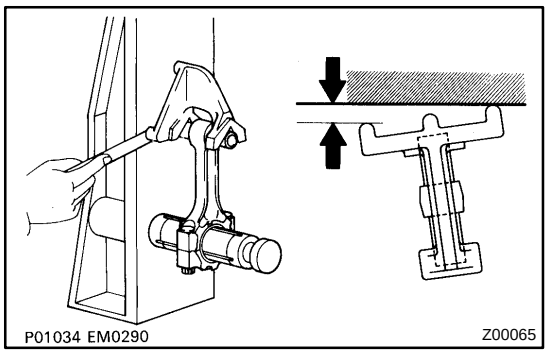
Maximum out–of alignment:
0.05 mm (0.0020 in.) per 100 mm (3.94 in.)



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.)

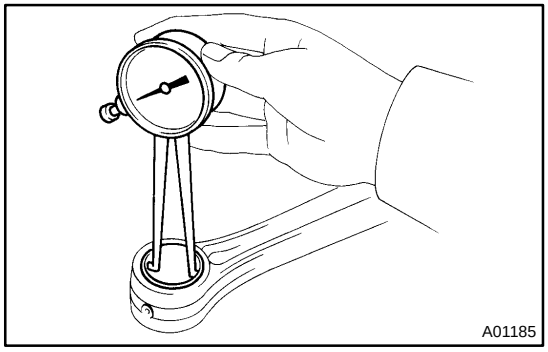


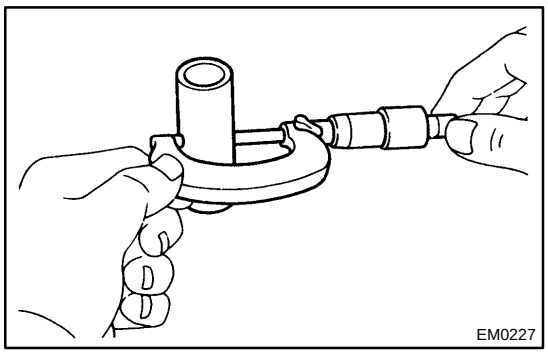
If twist is greater than maximum, replace the connecting rod assembly.

13. INSPECT PISTON PIN OIL CLEARANCE

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

Bushing inside diameter:
18.010 – 18.019 mm (0.7091 – 0.7094 in.)

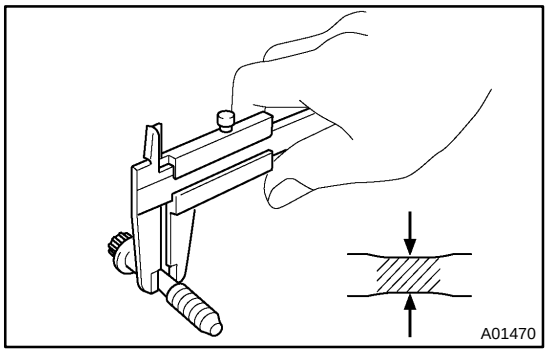




(b) Using a micrometer, measure the piston pin diameter.
Piston pin diameter:
17.988 – 18.007 mm (0.7086 – 0.7089 in.)

(c) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.
Standard oil clearance:
0.009 – 0.015 mm (0.0003 – 0.0006 in.)
Maximum oil clearance:
0.05 mm (0.0020 in.)

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

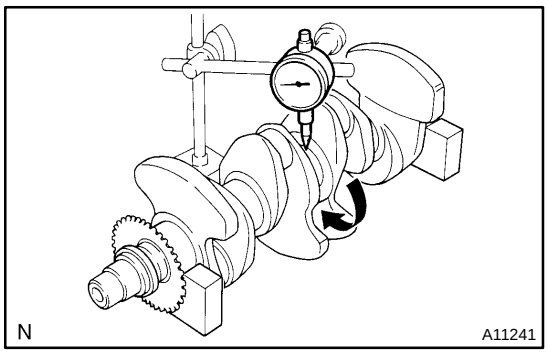


14. INSPECT CONNECTING ROD BOLTS

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.

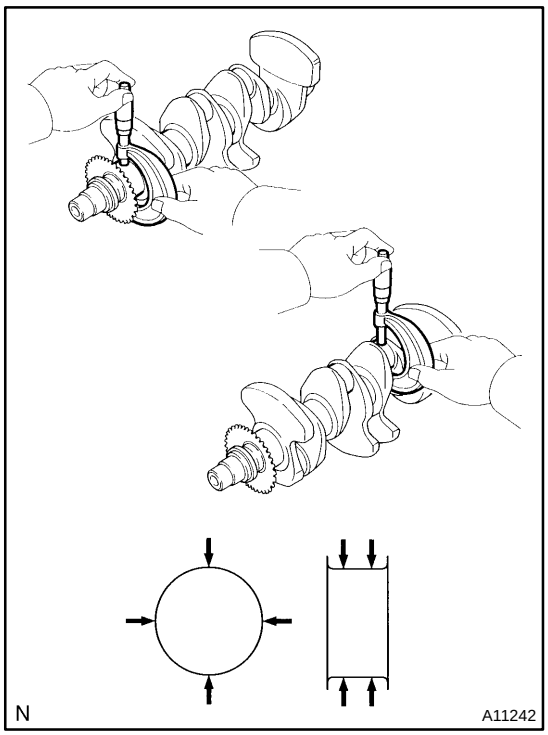


15. INSPECT CRANKSHAFT FOR CIRCLE RUNOUT

(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.



16. INSPECT MAIN JOURNALS AND CRANK PINS

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

Main journal diameter:
45.988 – 46.000 mm (1.81054 – 1.81102 in.)
Crank pin diameter:
39.992 – 40.000 mm (1.5745 – 1.5748 in.)

If the diameter is not as specified, check the oil clearance.
(See page EM–63)
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.

EM1J4–02

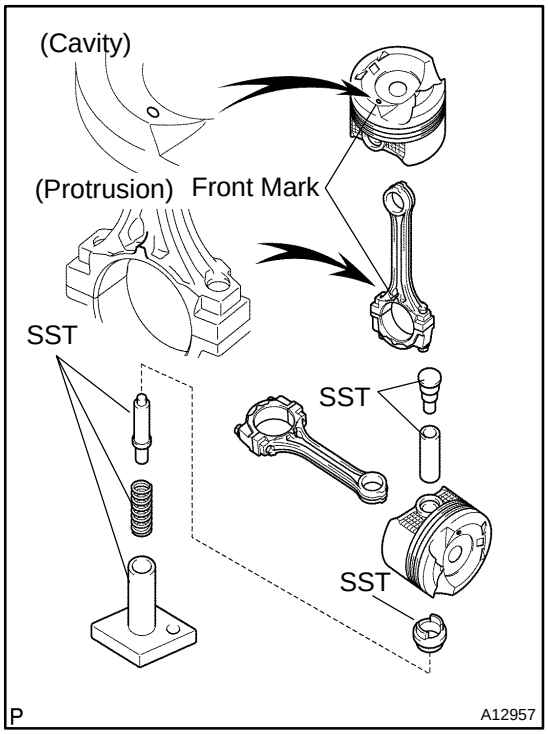
REASSEMBLY

HINT:

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

1. ASSEMBLE PISTON AND CONNECTING ROD

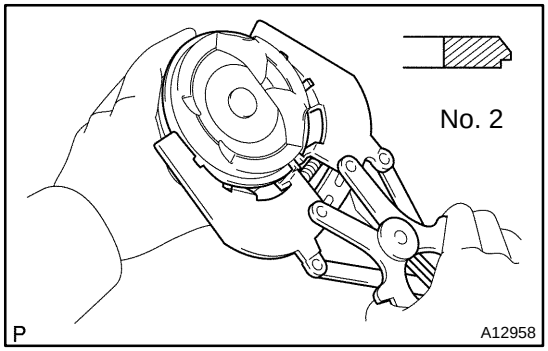
(a) Gradually heat the piston side of connecting rod to 80 – 90˚C (176 – 194˚F).



(b) Coat the piston pin and pin holes of the piston with engine oil.

(c) Align the cavity on the piston with the protrusion on the connecting rod.

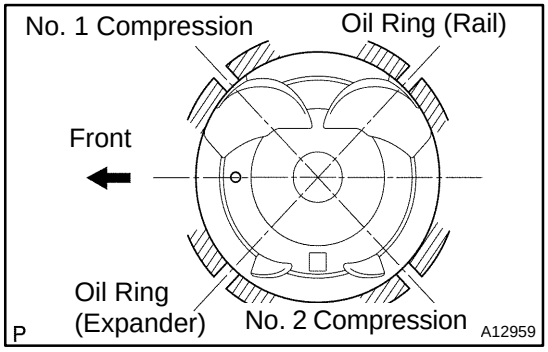
(d) Using SST, press in the piston pin.
SST 09221–25026 (09221–00021, 09221–00030, 09221–00190, 09221–00141, 09221–00150)



2. INSTALL PISTON RINGS

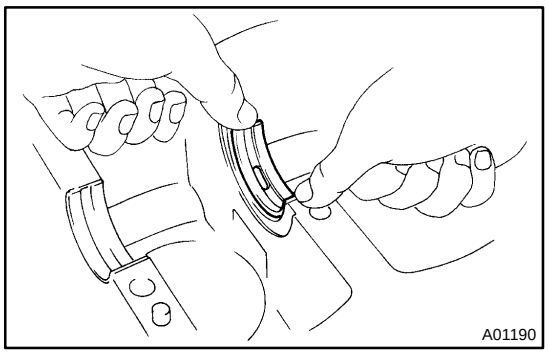
(a) Install the oil ring expander and 2 side rails by hand.

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



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

NOTICE:
Do not align the ring ends.



3. Supply parts:
INSTALL MAIN BEARINGS

HINT:

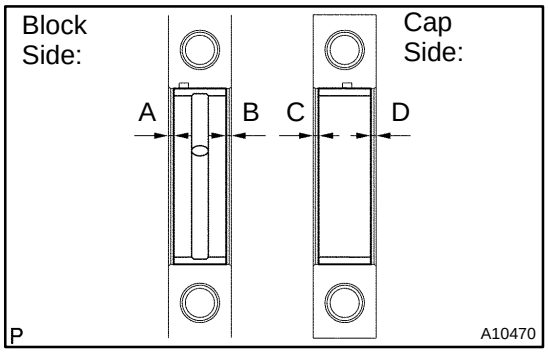
Upper bearings have an oil groove and oil holes; Lower bearings do not.

(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.



4. Manufacture parts:
INSTALL MAIN BEARINGS

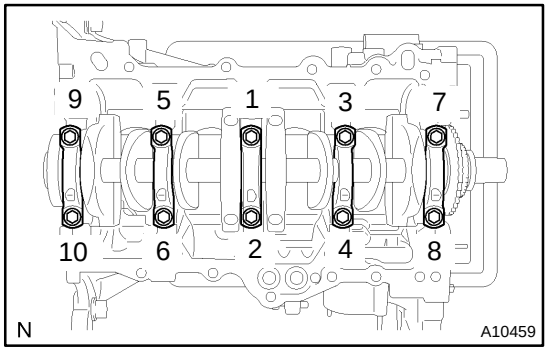
HINT:

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

Measure the clearance on both sides of the bearing and install it so that the difference between measured values will be within the specified bellow.

Specified clearance:
A – B = 0.8 mm (0.032 in.)
C – D = 0.4 mm (0.016 in.)

5. PLACE CRANKSHAFT ON CYLINDER BLOCK



6. INSTALL BEARING CAPS

(a) Install the 5 bearing caps.

HINT:

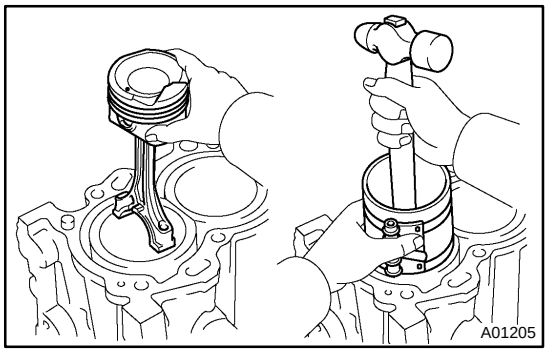
Each bearing cap has a number and front mark.

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

(c) Install and uniformly tighten the 10 bolts of the bearing cap is several passes, in the sequence shown.
Torque:
1ST 22 N·m (220 kgf·cm, 16 ft·lbf)
2ND Turn 90 °

(d) Check that the crankshaft turns smoothly.

7. CHECK CRANKSHAFT THRUST CLEARANCE
(See page EM–63)



8. 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.

9. 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.

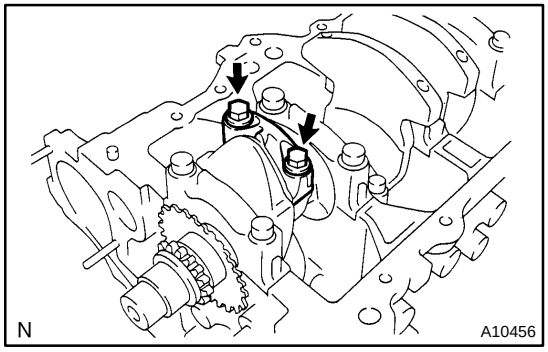
(c) Check that the protrusion of the connecting rod cap is facing in the correct direction.

10. 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.

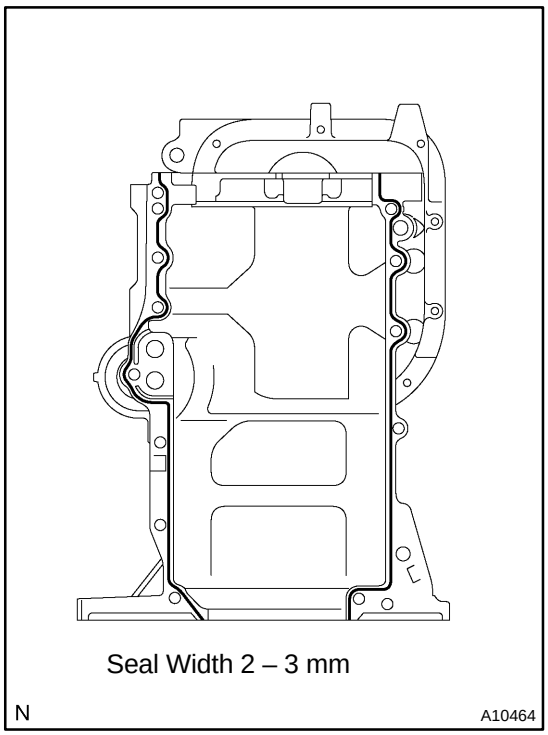
(a) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.



(b) Install and alternately tighten the 2 connecting rod cap bolts in several passes.
Torque:
1ST 15 N·m (150 kgf·cm, 11 ft·lbf)
2ND Turn 90 °

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

11. CHECK CONNECTING ROD THRUST CLEARANCE
(See page EM–63)



12. INSTALL OIL PAN NO. 1

(a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surface of the oil pan No. 1 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 material.
- Using a non–residue solvent, clean both sealing surfaces.

(b) Apply seal packing to the oil pan No. 1 as shown in the illustration.

Seal packing:

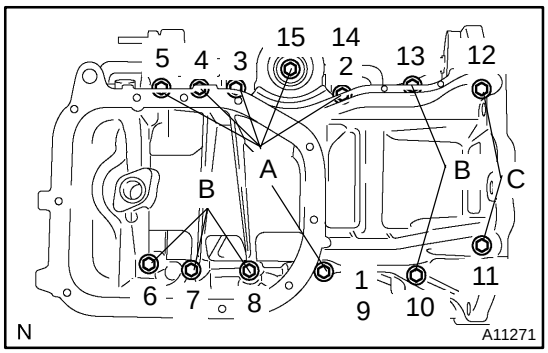
Part No. 08826–00080 or equivalent
- Install a nozzle that has been cut to a 2 – 3 mm (0.08 – 0.12 in.) opening.

HINT:

Avoid applying an excessive amount to the surface.
- Parts must be assembled within 3 minutes of application. Otherwise the material must be remove d and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

(c) Install new O–rings to the cylinder block.

(d) Using a plastic–faced hammer, lightly tap the oil pan No. 1 to ensure a proper fit.



(e) Install and uniformly tighten the 13 bolts, in several passes, in the sequence shown.

Torque: 24 N·m (245 kgf·cm, 18 ft·lbf)

HINT:

Each bolt length in indicated in the illustration.

A: 49 mm (1.929 in.)

B: 88 mm (3.465 in.)

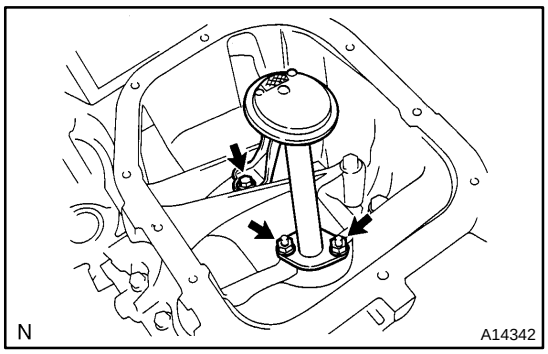
C: 144 mm (5.669 in.)

13. INSTALL REAR CRANKSHAFT OIL SEAL

(See page EM–76)

HINT:

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



14. INSTALL OIL STRAINER

Install a new gasket, and oil strainer with the bolt and 2 nuts.

Torque: 11 N·m (112 kgf·cm, 8 ft·lbf)

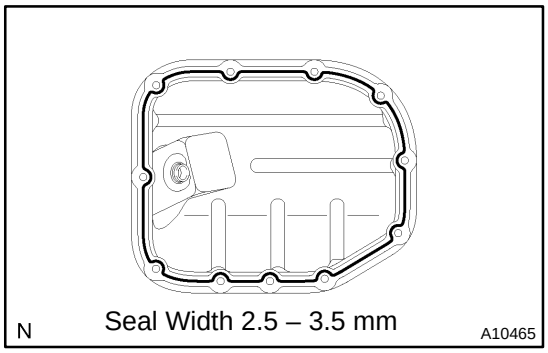
15. INSTALL OIL PAN

(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:

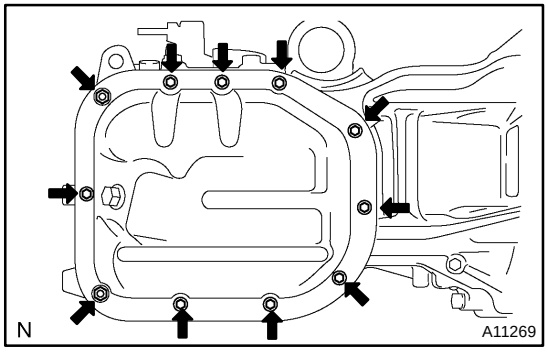
Part No. 08826–00080 or equivalent

- Install a nozzle that has been cut to a 2.5 – 3.5 mm (0.098 – 0.138 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 remove d and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.



(c) Install the oil pan with the 9 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

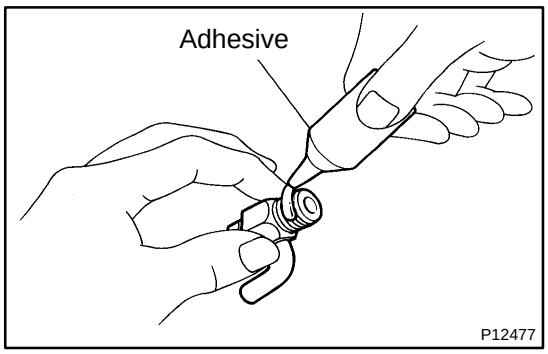
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

16. INSTALL OIL FILTER UNION

Torque: 30 N·m (306 kgf·cm, 21 ft·lbf)

17. INSTALL OIL FILTER

(See page LU–3)



18. 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

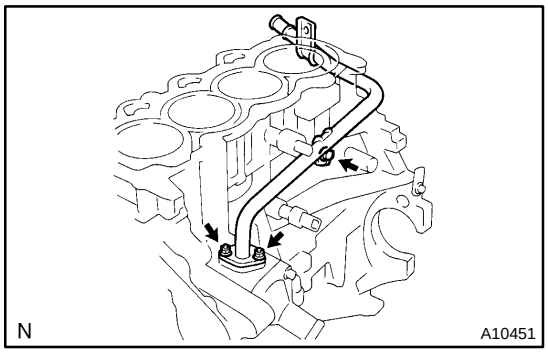
(b) Install the drain union.
Torque: 35 N·m (350 kgf·cm, 25 ft·lbf)

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

19. INSTALL KNOCK SENSOR
Torque: 39 N·m (400 kgf·cm, 29 ft·lbf)

20. INSTALL OIL PRESSURE SWITCH
(See page LU–1)

21. INSTALL THERMOSTAT
(See page CO–12)



22. INSTALL WATER BYPASS PIPE
Torque: 9.0 N·m (92 kgf·cm, 80 in.·lbf)

23. INSTALL ENGINE WIRE

24. INSTALL CYLINDER HEAD
(See page EM–45)

25. INSTALL TIMING SPROCKETS AND TIMING CHAIN
(See page EM–21)

26. REMOVE ENGINE STAND