

CO/HC INSPECTION

EM05J-08

HINT:

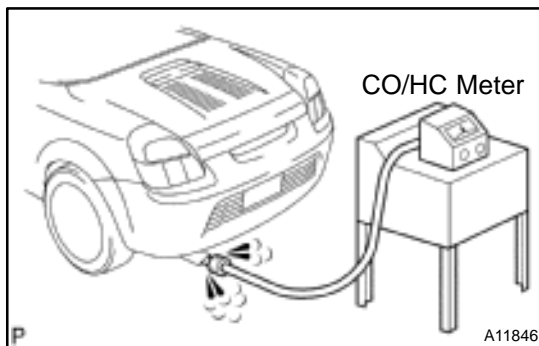
This check is used only to determine whether or not the idle CO/HC complies with regulations.

1. INITIAL CONDITIONS

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

2. START ENGINE

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



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

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

Complete the measuring within 3 minutes.

HINT:

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

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

- Check heated oxygen sensor operation (See page [DI-47](#)).
- See the table below for possible causes, then inspect and correct the causes if necessary.

CO	HC	Problems	Causes
Normal	High	Rough idle	3. Faulty ignitions: <ul style="list-style-type: none"> • Incorrect timing • Fouled, shorted or improperly gapped plugs 4. Incorrect valve clearance 5. Leaky intake and exhaust valves 6. Leaky cylinders
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: <ul style="list-style-type: none"> • PCV hoses • Intake manifold • Throttle body • IAC valve • Brake booster line 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. Faulty SFI systems: <ul style="list-style-type: none"> • Faulty fuel pressure regulator • Defective ECT sensor • Defective IAT sensor • Faulty ECM • Faulty injectors • Faulty throttle position sensor

COMPRESSION INSPECTION

EM05K-07

HINT:

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

1. WARM UP AND STOP ENGINE

Allow the engine to warm up to normal operating temperature.

2. REMOVE IGNITION COILS (See page IG-4)

3. REMOVE SPARK PLUGS

4. INSPECT CYLINDER COMPRESSION PRESSURE

- (a) Insert a compression gauge into the spark plug hole.
- (b) Fully open the throttle.
- (c) While cranking the engine, measure the compression pressure.

HINT:

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

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

NOTICE:

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

Compression pressure:

1,270 kPa (13.0 kgf/cm², 184 psi)

Minimum pressure: 1,000 kPa (10.2 kgf/cm², 145 psi)

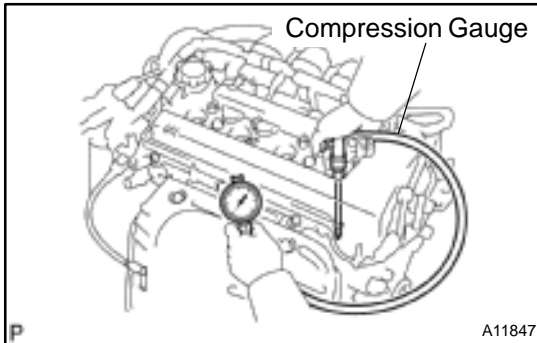
Difference between each cylinder:

100 kPa (1.0 kgf/cm², 15 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 through the gasket.

5. REINSTALL SPARK PLUGS

6. REINSTALL IGNITION COILS (See page IG-4)



VALVE CLEARANCE ADJUSTMENT

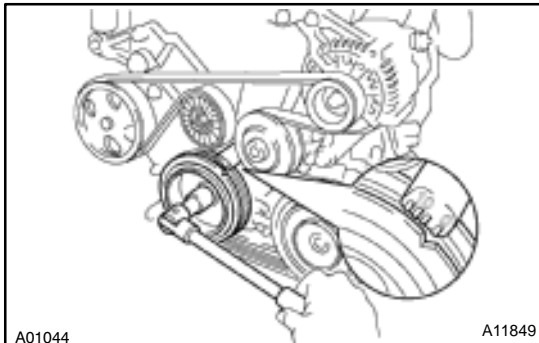
EM19B-01

HINT:

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

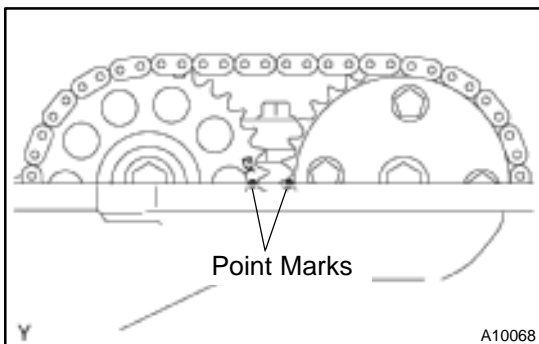
1. REMOVE CYLINDER HEAD COVER

(See page [EM-13](#))



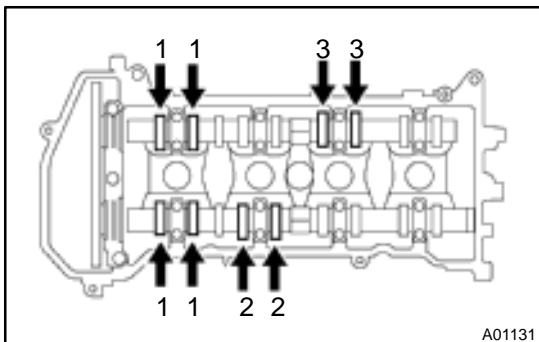
2. SET NO. 1 CYLINDER TO TDC/COMPRESSION

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



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

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



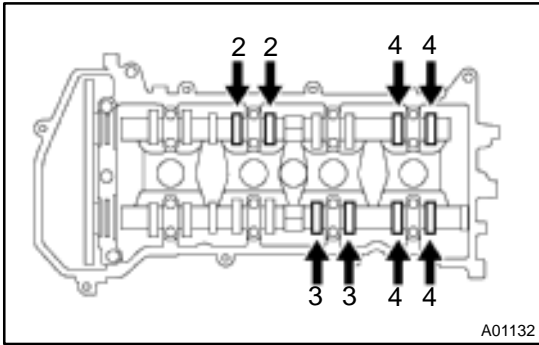
3. INSPECT VALVE CLEARANCE

- (a) Check only the valves indicated.
- (1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
 - (2) Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

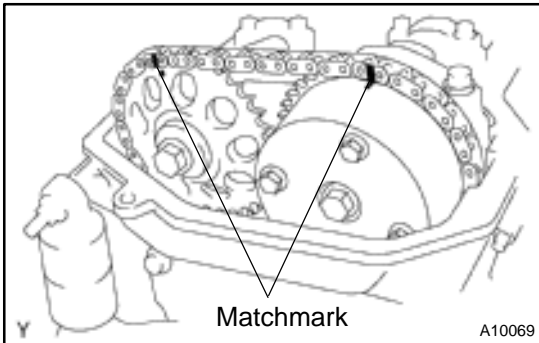
Valve clearance (Cold):

Intake	0.15 – 0.25 mm (0.006 – 0.010 in.)
Exhaust	0.25 – 0.35 mm (0.010 – 0.014 in.)

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

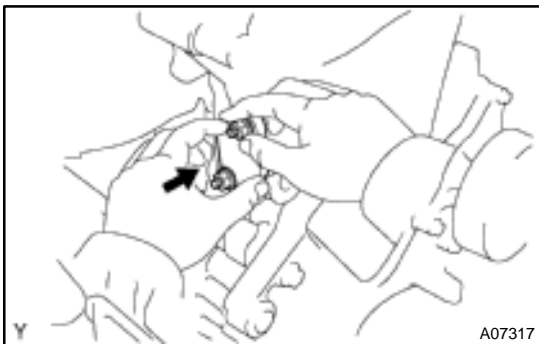


- (c) Check only the valves indicated as shown. Measure the valve clearance (See step (a)).

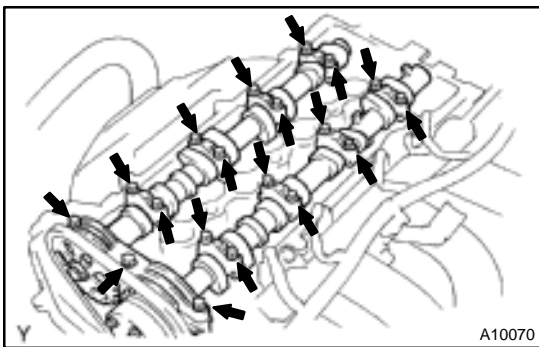


4. ADJUST VALVE CLEARANCE

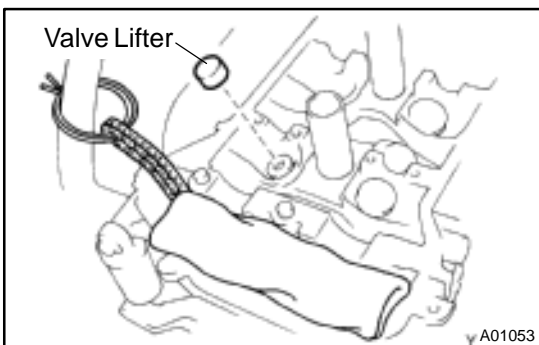
- (a) Set the No. 1 cylinder to the TDC/compression (See step 2).
 (b) Place matchmarks on the timing chain and camshaft timing sprockets.



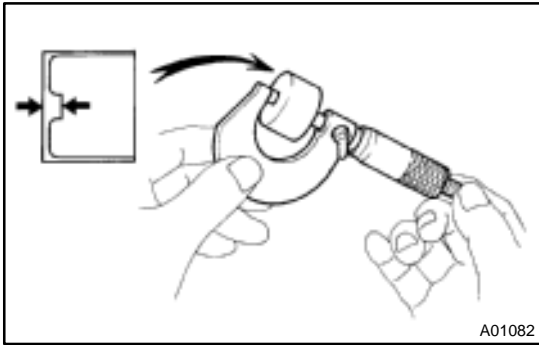
- (c) Remove the 2 nuts and chain tensioner.



- (d) Remove the 2 camshaft and timing sprocket assemblies.
 (1) Remove the 19 bolts and 9 camshaft bearing caps (See page EM-20).
 (2) Remove the 2 camshaft and timing sprocket assemblies.



- (e) Tie the timing chain as shown in the illustration.
NOTICE:
- Be careful not to drop anything inside the timing chain cover.
 - Do not allow the chain to come into contact with water or dust.
- (f) Remove the valve lifter.



- (g) 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: $N = T + (A - 0.20 \text{ mm (0.008 in.)})$

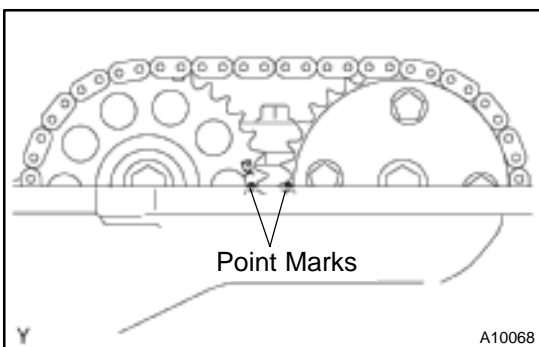
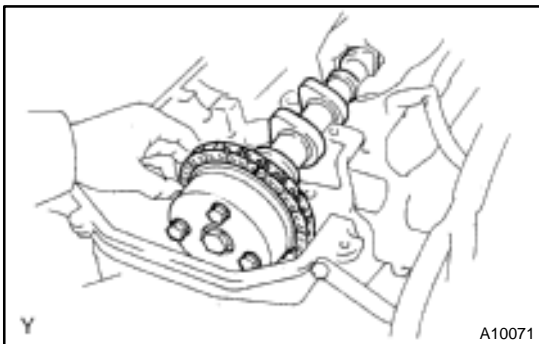
Exhaust: $N = T + (A - 0.30 \text{ mm (0.012 in.)})$

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

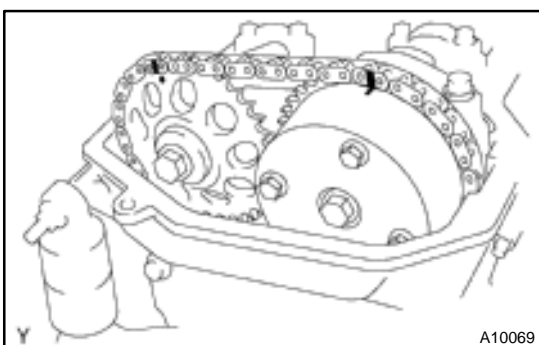
HINT:

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

- (h) Reinstall the valve lifter (See page [EM-44](#)).
- (i) Align the crankshaft pulley groove with the timing mark 0 of the timing chain cover.
- (j) Hold the timing chain, and place the intake camshaft and timing sprocket assembly.
- (k) Align the matchmarks on the timing chain and camshaft timing sprocket.
- (l) Reinstall the 2 camshaft and timing sprocket assemblies (See page [EM-46](#)).



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



- (n) Check that the matchmarks on the timing chain and 2 timing sprockets.
- (o) Install the chain tensioner (See page [EM-20](#)).
- (p) Recheck the valve clearance (See step 3).
- (q) Check the valve timing (See page [EM-20](#)).

5. REINSTALL CYLINDER HEAD COVER
(See page [EM-20](#))

Valve Lifter Selection Chart (Exhaust)

Measured clearance mm (in.)	Installed lifter thickness mm (in.)	0.030 (0.0012)	0.031 (0.0012)	0.032 (0.0012)	0.033 (0.0013)	0.034 (0.0013)	0.035 (0.0014)	0.036 (0.0014)	0.037 (0.0015)	0.038 (0.0015)	0.039 (0.0016)	0.040 (0.0016)	0.041 (0.0016)	0.042 (0.0017)	0.043 (0.0017)	0.044 (0.0018)	0.045 (0.0018)	0.046 (0.0018)	0.047 (0.0019)	0.048 (0.0019)	0.049 (0.0019)	0.050 (0.0020)	0.051 (0.0020)	0.052 (0.0021)	0.053 (0.0021)	0.054 (0.0021)	0.055 (0.0022)	0.056 (0.0022)	0.057 (0.0022)	0.058 (0.0023)	0.059 (0.0023)	0.060 (0.0023)	0.061 (0.0024)	0.062 (0.0024)	0.063 (0.0024)	0.064 (0.0025)	0.065 (0.0025)	0.066 (0.0025)	0.067 (0.0026)	0.068 (0.0026)	0.069 (0.0026)	0.070 (0.0027)	0.071 (0.0027)	0.072 (0.0027)	0.073 (0.0028)	0.074 (0.0028)	0.075 (0.0028)	0.076 (0.0029)	0.077 (0.0029)	0.078 (0.0029)	0.079 (0.0030)	0.080 (0.0030)	0.081 (0.0030)	0.082 (0.0031)	0.083 (0.0031)	0.084 (0.0031)	0.085 (0.0032)	0.086 (0.0032)	0.087 (0.0032)	0.088 (0.0033)	0.089 (0.0033)	0.090 (0.0033)	0.091 (0.0034)	0.092 (0.0034)	0.093 (0.0034)	0.094 (0.0035)	0.095 (0.0035)	0.096 (0.0035)	0.097 (0.0036)	0.098 (0.0036)	0.099 (0.0036)	0.100 (0.0037)	0.101 (0.0037)	0.102 (0.0037)	0.103 (0.0038)	0.104 (0.0038)	0.105 (0.0038)	0.106 (0.0039)	0.107 (0.0039)	0.108 (0.0039)	0.109 (0.0040)	0.110 (0.0040)	0.111 (0.0040)	0.112 (0.0041)	0.113 (0.0041)	0.114 (0.0041)	0.115 (0.0042)	0.116 (0.0042)	0.117 (0.0042)	0.118 (0.0043)	0.119 (0.0043)	0.120 (0.0043)	0.121 (0.0044)	0.122 (0.0044)	0.123 (0.0044)	0.124 (0.0045)	0.125 (0.0045)	0.126 (0.0045)	0.127 (0.0046)	0.128 (0.0046)	0.129 (0.0046)	0.130 (0.0047)	0.131 (0.0047)	0.132 (0.0047)	0.133 (0.0048)	0.134 (0.0048)	0.135 (0.0048)	0.136 (0.0049)	0.137 (0.0049)	0.138 (0.0049)	0.139 (0.0050)	0.140 (0.0050)	0.141 (0.0050)	0.142 (0.0051)	0.143 (0.0051)	0.144 (0.0051)	0.145 (0.0052)	0.146 (0.0052)	0.147 (0.0052)	0.148 (0.0053)	0.149 (0.0053)	0.150 (0.0053)	0.151 (0.0054)	0.152 (0.0054)	0.153 (0.0054)	0.154 (0.0055)	0.155 (0.0055)	0.156 (0.0055)	0.157 (0.0056)	0.158 (0.0056)	0.159 (0.0056)	0.160 (0.0057)	0.161 (0.0057)	0.162 (0.0057)	0.163 (0.0058)	0.164 (0.0058)	0.165 (0.0058)	0.166 (0.0059)	0.167 (0.0059)	0.168 (0.0059)	0.169 (0.0060)	0.170 (0.0060)	0.171 (0.0060)	0.172 (0.0061)	0.173 (0.0061)	0.174 (0.0061)	0.175 (0.0062)	0.176 (0.0062)	0.177 (0.0062)	0.178 (0.0063)	0.179 (0.0063)	0.180 (0.0063)	0.181 (0.0064)	0.182 (0.0064)	0.183 (0.0064)	0.184 (0.0065)	0.185 (0.0065)	0.186 (0.0065)	0.187 (0.0066)	0.188 (0.0066)	0.189 (0.0066)	0.190 (0.0067)	0.191 (0.0067)	0.192 (0.0067)	0.193 (0.0068)	0.194 (0.0068)	0.195 (0.0068)	0.196 (0.0069)	0.197 (0.0069)	0.198 (0.0069)	0.199 (0.0070)	0.200 (0.0070)	0.201 (0.0070)	0.202 (0.0071)	0.203 (0.0071)	0.204 (0.0071)	0.205 (0.0072)	0.206 (0.0072)	0.207 (0.0072)	0.208 (0.0073)	0.209 (0.0073)	0.210 (0.0073)	0.211 (0.0074)	0.212 (0.0074)	0.213 (0.0074)	0.214 (0.0075)	0.215 (0.0075)	0.216 (0.0075)	0.217 (0.0076)	0.218 (0.0076)	0.219 (0.0076)	0.220 (0.0077)	0.221 (0.0077)	0.222 (0.0077)	0.223 (0.0078)	0.224 (0.0078)	0.225 (0.0078)	0.226 (0.0079)	0.227 (0.0079)	0.228 (0.0079)	0.229 (0.0080)	0.230 (0.0080)	0.231 (0.0080)	0.232 (0.0081)	0.233 (0.0081)	0.234 (0.0081)	0.235 (0.0082)	0.236 (0.0082)	0.237 (0.0082)	0.238 (0.0083)	0.239 (0.0083)	0.240 (0.0083)	0.241 (0.0084)	0.242 (0.0084)	0.243 (0.0084)	0.244 (0.0085)	0.245 (0.0085)	0.246 (0.0085)	0.247 (0.0086)	0.248 (0.0086)	0.249 (0.0086)	0.250 (0.0087)	0.251 (0.0087)	0.252 (0.0087)	0.253 (0.0088)	0.254 (0.0088)	0.255 (0.0088)	0.256 (0.0089)	0.257 (0.0089)	0.258 (0.0089)	0.259 (0.0090)	0.260 (0.0090)	0.261 (0.0090)	0.262 (0.0091)	0.263 (0.0091)	0.264 (0.0091)	0.265 (0.0092)	0.266 (0.0092)	0.267 (0.0092)	0.268 (0.0093)	0.269 (0.0093)	0.270 (0.0093)	0.271 (0.0094)	0.272 (0.0094)	0.273 (0.0094)	0.274 (0.0095)	0.275 (0.0095)	0.276 (0.0095)	0.277 (0.0096)	0.278 (0.0096)	0.279 (0.0096)	0.280 (0.0097)	0.281 (0.0097)	0.282 (0.0097)	0.283 (0.0098)	0.284 (0.0098)	0.285 (0.0098)	0.286 (0.0099)	0.287 (0.0099)	0.288 (0.0099)	0.289 (0.0100)	0.290 (0.0100)	0.291 (0.0100)	0.292 (0.0101)	0.293 (0.0101)	0.294 (0.0101)	0.295 (0.0102)	0.296 (0.0102)	0.297 (0.0102)	0.298 (0.0103)	0.299 (0.0103)	0.300 (0.0103)	0.301 (0.0104)	0.302 (0.0104)	0.303 (0.0104)	0.304 (0.0105)	0.305 (0.0105)	0.306 (0.0105)	0.307 (0.0106)	0.308 (0.0106)	0.309 (0.0106)	0.310 (0.0107)	0.311 (0.0107)	0.312 (0.0107)	0.313 (0.0108)	0.314 (0.0108)	0.315 (0.0108)	0.316 (0.0109)	0.317 (0.0109)	0.318 (0.0109)	0.319 (0.0110)	0.320 (0.0110)	0.321 (0.0110)	0.322 (0.0111)	0.323 (0.0111)	0.324 (0.0111)	0.325 (0.0112)	0.326 (0.0112)	0.327 (0.0112)	0.328 (0.0113)	0.329 (0.0113)	0.330 (0.0113)	0.331 (0.0114)	0.332 (0.0114)	0.333 (0.0114)	0.334 (0.0115)	0.335 (0.0115)	0.336 (0.0115)	0.337 (0.0116)	0.338 (0.0116)	0.339 (0.0116)	0.340 (0.0117)	0.341 (0.0117)	0.342 (0.0117)	0.343 (0.0118)	0.344 (0.0118)	0.345 (0.0118)	0.346 (0.0119)	0.347 (0.0119)	0.348 (0.0119)	0.349 (0.0120)	0.350 (0.0120)
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Intake 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.

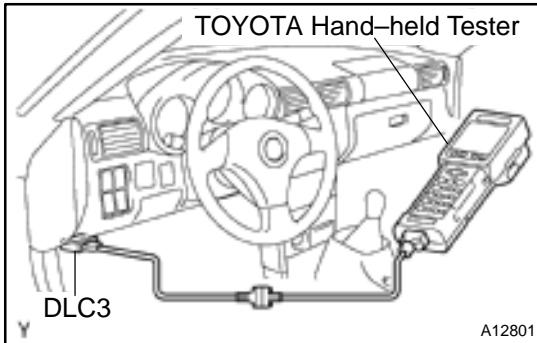
New lifter thickness mm (in.)					
Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 (0.1992)	30	5.300 (0.2087)	54	5.540 (0.2181)
08	5.080 (0.2000)	32	5.320 (0.2094)	56	5.560 (0.2189)
10	5.100 (0.2008)	34	5.340 (0.2102)	58	5.580 (0.2197)
12	5.120 (0.2016)	36	5.360 (0.2110)	60	5.600 (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)		

IGNITION TIMING INSPECTION

EM19C-01

1. WARM UP ENGINE

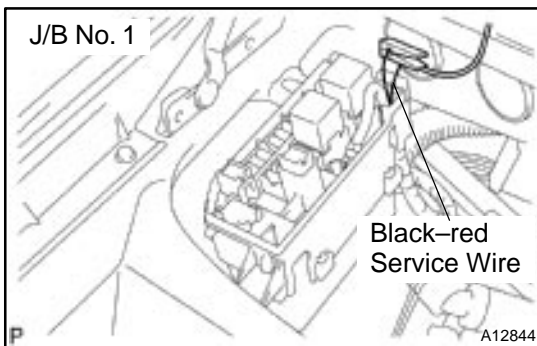
Allow the engine to warm up to normal operating temperature.



2. CONNECT TOYOTA HAND-HELD TESTER OR OBD II SCAN TOOL

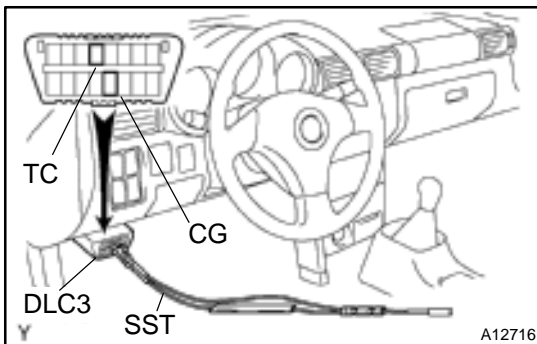
- Connect the TOYOTA hand-held tester or OBD II scan tool to the DLC3.
- Please refer to the TOYOTA hand-held tester or OBD II scan tool operator's for further details.

3. CHECK IDLE SPEED (See page EM-10)



4. CONNECT TIMING LIGHT

Connect the tester probe of a timing light to the black-red service wire in the J/B No. 1 as shown in the illustration.

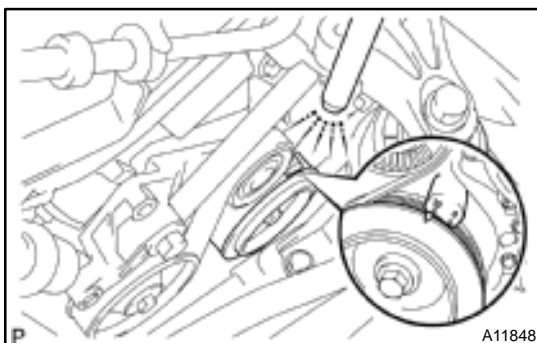


5. INSPECT IGNITION TIMING

- Using SST, connect terminals to TC and CG of the DLC3.
SST 09843-18040

HINT:

After engine rpm is kept at 1,000 – 1,500 rpm for 5 seconds, check that it returns to idle speed.



- Using a timing light, check the ignition timing.

Ignition timing: 8 – 12° BTDC @ idle

- Remove the SST from the DLC3.

6. FURTHER CHECK IGNITION TIMING

Ignition timing: 6 – 15° BTDC @ idle

HINT:

The timing mark moves in a range between 6° and 15°.

7. DISCONNECT TIMING LIGHT

8. DISCONNECT TOYOTA HAND-HELD TESTER OR OBD II SCAN TOOL

IDLE SPEED

INSPECTION

EM19D-01

1. INITIAL CONDITIONS

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

2. CONNECT TOYOTA HAND-HELD TESTER OR OBD II SCAN TOOL (See page [EM-9](#))

3. INSPECT IDLE SPEED

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

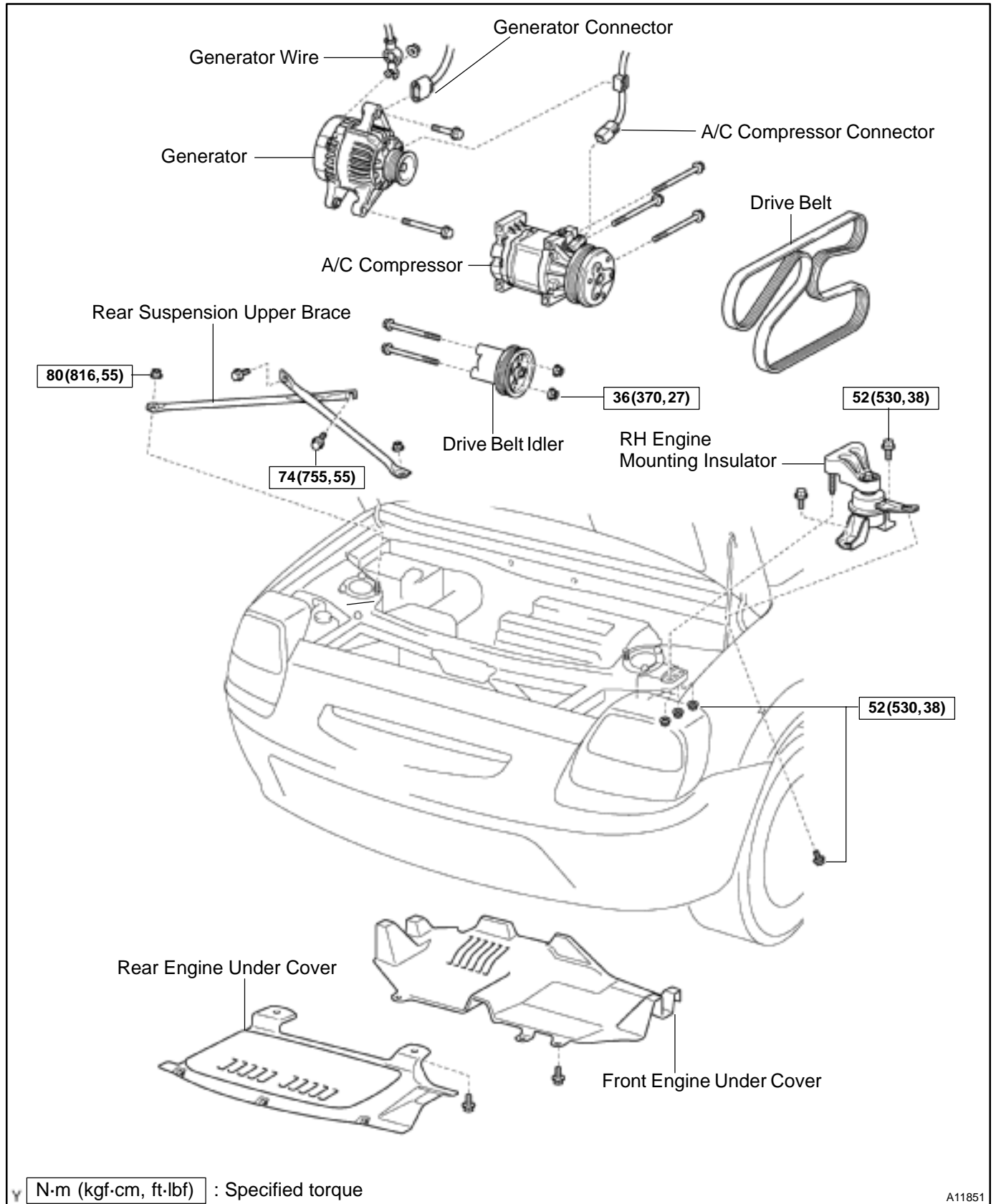
Idle speed (w/ Cooling fan OFF): 700 ± 50 rpm

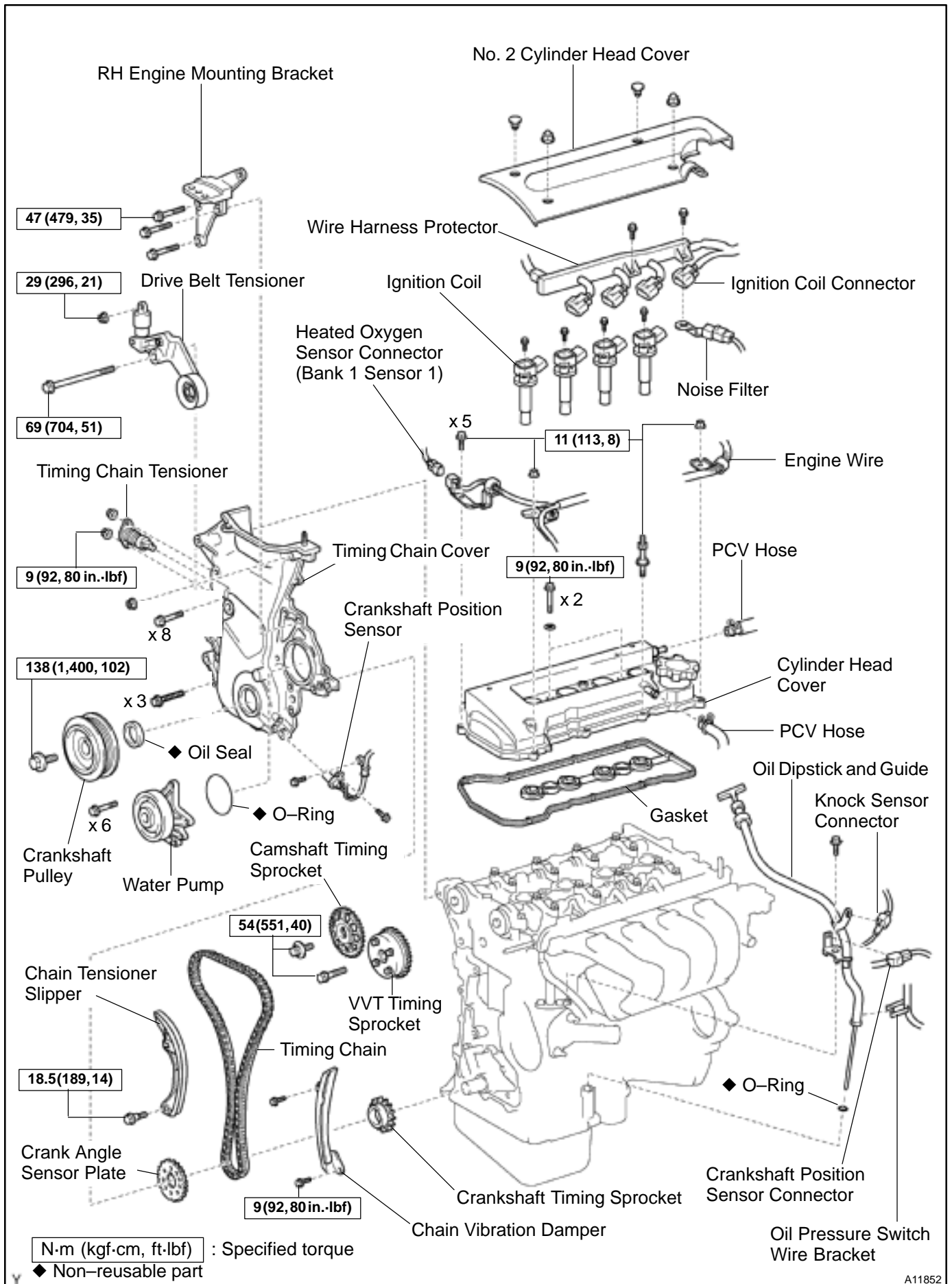
If the idle speed is not as specified, check the IAC valve and air intake system.

4. DISCONNECT TOYOTA HAND-HELD TESTER OR OBD II SCAN TOOL

TIMING CHAIN COMPONENTS

EM19E-01

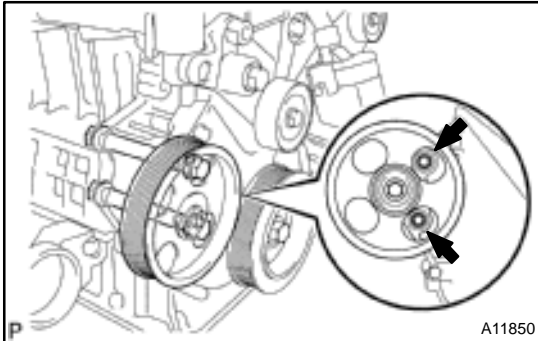




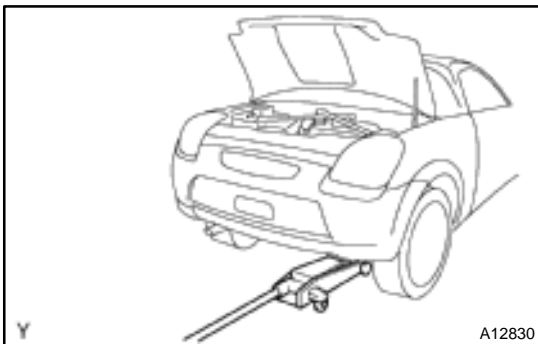
A11852

REMOVAL

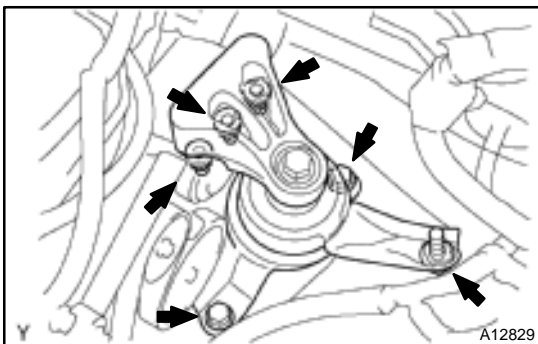
1. DRAIN ENGINE COOLANT
2. REMOVE REAR SUSPENSION UPPER BRACE
3. REMOVE ENGINE UNDER COVERS
4. REMOVE DRIVE BELT AND GENERATOR
(See page [CH-7](#))



5. REMOVE DRIVE BELT IDLER
Remove the 2 bolts, 2 nuts and drive belt idler.



6. REMOVE RH ENGINE MOUNTING INSULATOR
 - (a) Set a jack to the oil pan.**NOTICE:**
Place a wooden block or rubber block between a jack and the oil pan.

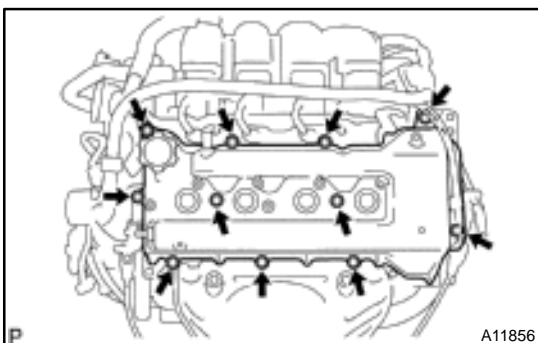


- (b) Remove the 3 bolts, 3 nuts and engine mounting insulator.

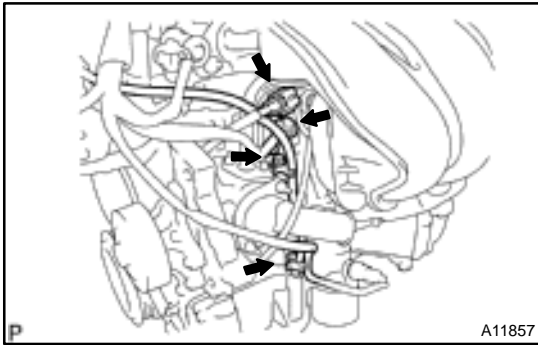
7. REMOVE IGNITION COILS (See page [IG-4](#))

8. REMOVE CYLINDER HEAD COVER

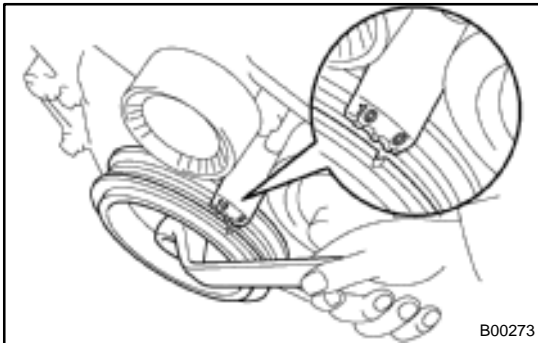
- (a) Disconnect the 2 PCV hoses from the cylinder head cover.
- (b) Disconnect the noise filter.
- (c) Disconnect the heated oxygen sensor (bank 1 sensor 1) connector.



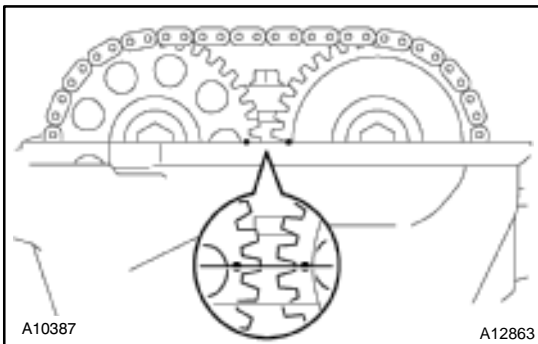
- (d) Remove the 9 bolts, 2 nuts and 2 seal washers.
- (e) Disconnect the engine wire together with the 3 engine wire brackets, and remove the cylinder head cover and gasket.

**9. REMOVE OIL DIPSTICK AND GUIDE**

- (a) Remove the bolt, and disconnect the oil dipstick and guide.
- (b) Disconnect the 2 connectors and wire bracket from the oil dipstick guide, and remove the oil dipstick and O-ring.

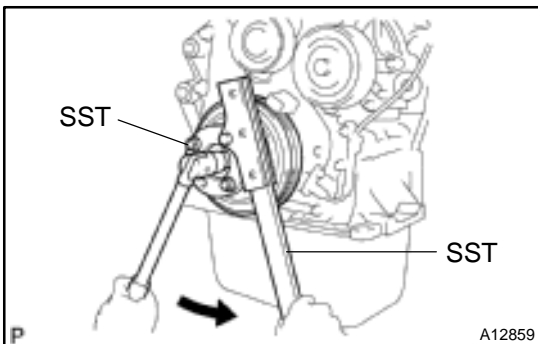
**10. SET NO. 1 CYLINDER TO TDC/COMPRESSION**

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

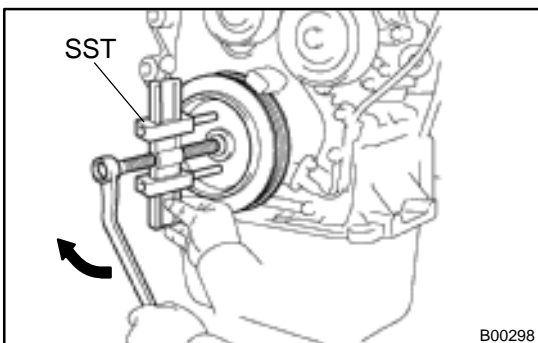


- (b) Check that the point marks of the camshaft timing sprocket and VVT timing sprocket are in straight line on the timing chain cover surface as shown in the illustration.

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

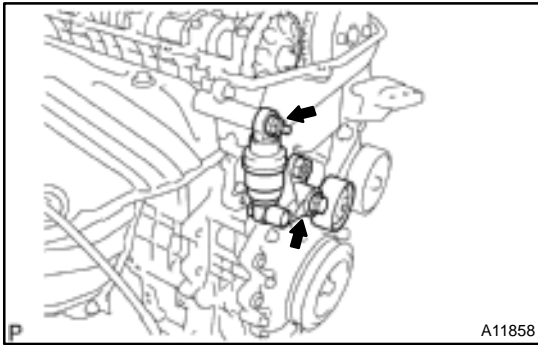
**11. REMOVE CRANKSHAFT PULLEY**

- (a) Using SST, remove the pulley bolt.
SST 09213-70011, 09330-00021
- (b) Remove the crankshaft pulley.

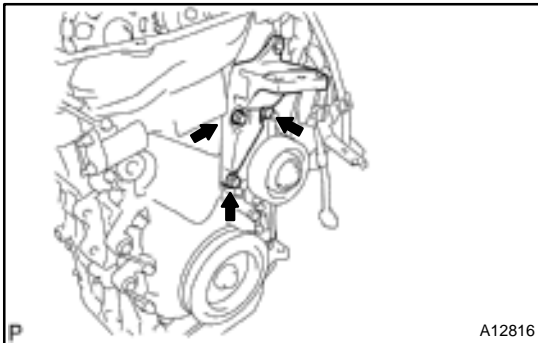
**HINT:**

If necessary, remove the pulley with SST.

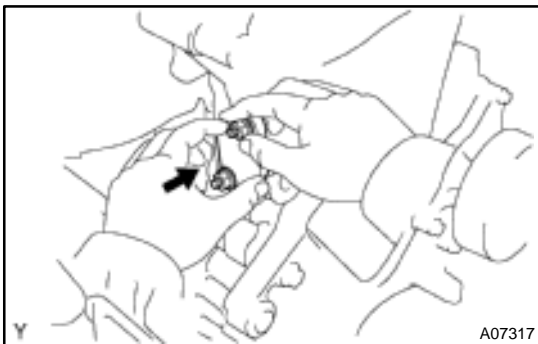
SST 09950-50012 (09951-05010, 09952-05010, 09953-05020, 09954-05020)

**12. REMOVE DRIVE BELT TENSIONER**

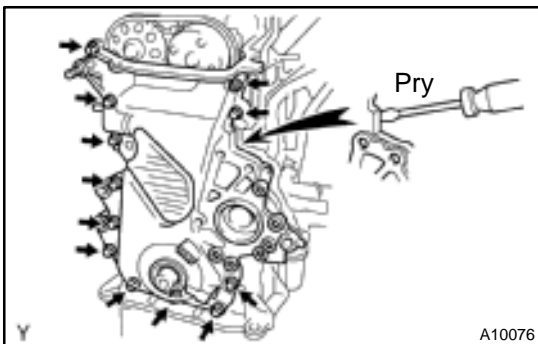
Remove the bolt, nut and drive belt tensioner.

**13. REMOVE RH ENGINE MOUNTING BRACKET**

Remove the 3 bolts and engine mounting bracket.

**14. REMOVE CHAIN TENSIONER**

Remove the 2 nuts and chain tensioner.

15. REMOVE WATER PUMP (See page CO-7)**16. REMOVE CRANKSHAFT POSITION SENSOR (See page IG-6)****17. REMOVE TIMING CHAIN COVER**

(a) Remove the 11 bolts and nut.

(b) Using a screwdriver, pry between the timing chain cover and cylinder head or cylinder block.

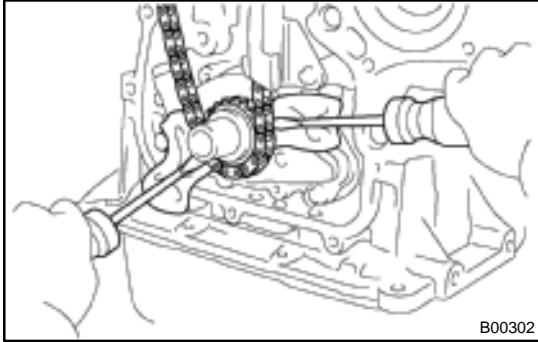
(c) Remove the timing chain cover.

NOTICE:

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

18. REMOVE CRANK ANGLE SENSOR PLATE**19. REMOVE CHAIN TENSIONER SLIPPER**

Remove the bolt and slipper.



20. REMOVE TIMING CHAIN AND CRANKSHAFT TIMING SPROCKET

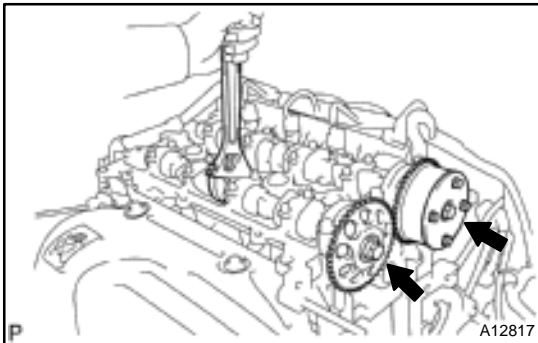
If necessary, pry between the timing chain and oil pump by 2 screwdrivers.

NOTICE:

Position shop rags as shown to prevent damage.

21. REMOVE CHAIN VIBRATION DAMPER

Remove the 2 bolts and damper.



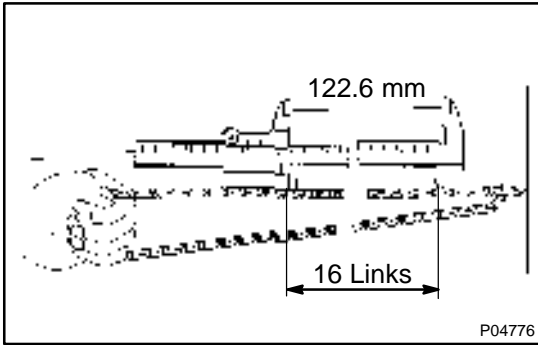
22. REMOVE CAMSHAFT TIMING SPROCKET AND VVT TIMING SPROCKET

- (a) Hold the hexagonal head wrench portion of the camshaft with a wrench, and loosen the sprocket.

NOTICE:

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

- (b) Remove the bolt and camshaft timing sprocket.
 (c) Remove the bolt and VVT timing Sprocket.



INSPECTION

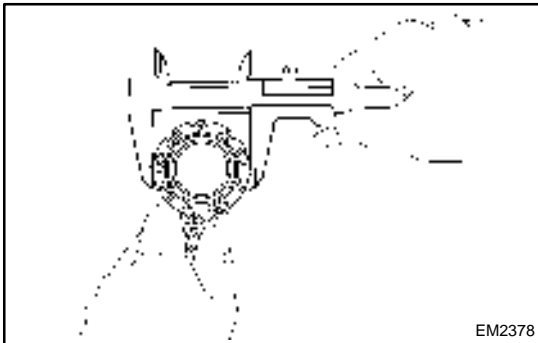
1. **INSPECT TIMING CHAIN AND TIMING SPROCKETS**
 - (a) Using vernier calipers, measure the length of the 16 links with the chain fully stretched.

Maximum chain elongation: 122.6 mm (4.827 in.)

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

HINT:

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



- (b) Wrap the chain around the timing sprocket.
- (c) Using vernier calipers, measure the timing sprocket diameter with the chain.

NOTICE:

Vernier calipers contact the chain rollers for measuring.

Minimum sprocket diameter (w/ Chain):

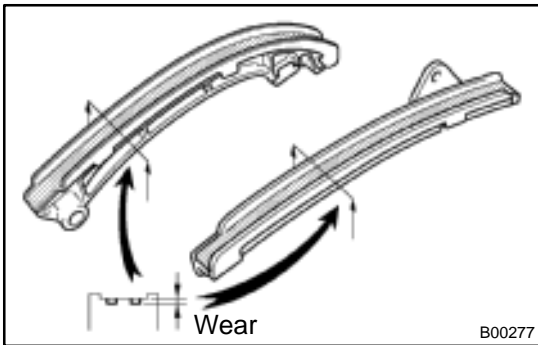
Camshaft	97.3 mm (3.831 in.)
Crankshaft	51.6 mm (2.031 in.)

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

2. INSPECT DRIVE BELT IDLER

Check that the pulley rotates smoothly.

If necessary, replace the bearing (See page [EM-18](#)).

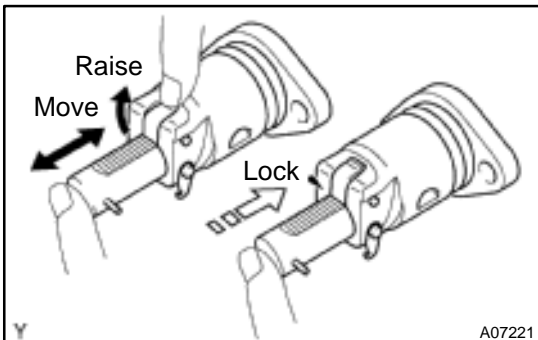


3. INSPECT CHAIN TENSIONER SLIPPER AND VIBRATION DAMPER

Measure the chain tensioner slipper and vibration damper wears.

Maximum wear: 1.0 mm (0.039 in.)

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



4. INSPECT CHAIN TENSIONER

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

5. INSPECT OIL JET (See page [LU-10](#))

6. INSPECT DRIVE BELT TENSIONER

Check the oil leakage and crack.

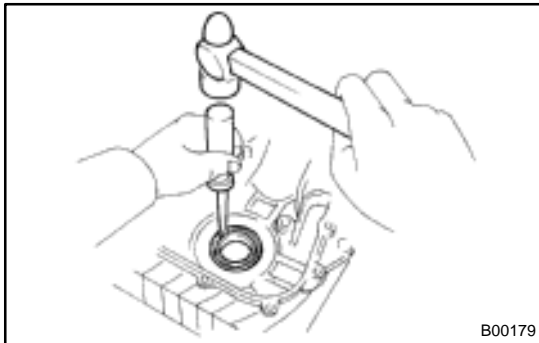
If necessary, replace the drive belt tensioner.

REPLACEMENT

1. REPLACE CRANKSHAFT FRONT OIL SEAL

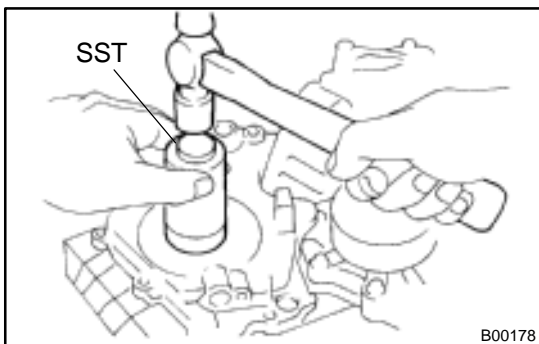
HINT:

There are 2 methods ((a) and (b)) to replace the oil seal.



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

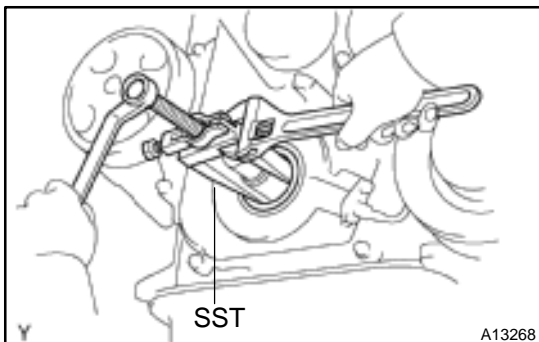
(1) Using a screwdriver and a hammer, tap out the oil seal.



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

SST 09309-37010

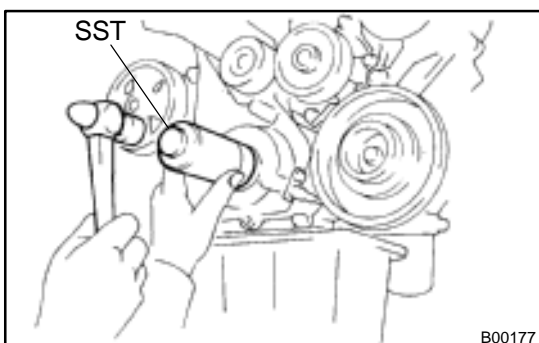
(3) Apply MP grease to the oil seal lip.



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

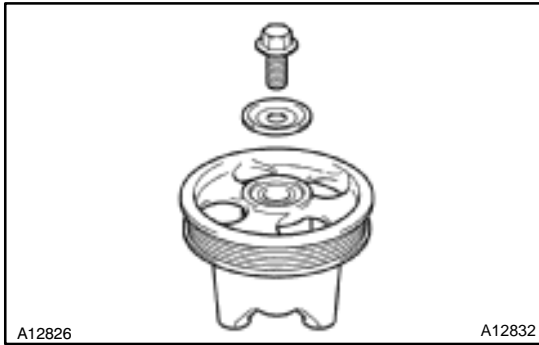
(1) Using SST, remove the oil seal.

SST 09308-10010



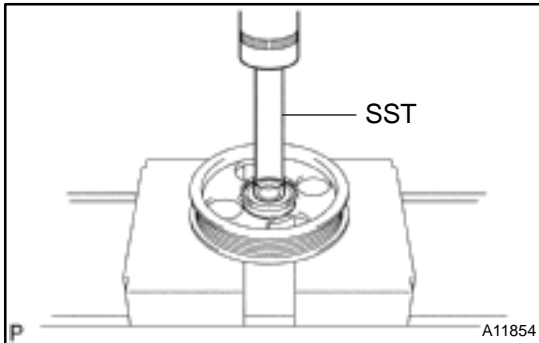
(2) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.

SST 09309-37010

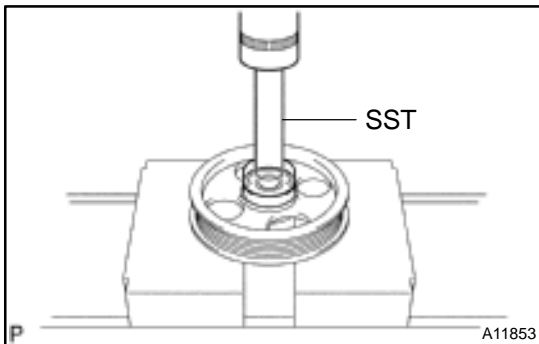


2. REPLACE DRIVE BELT IDLER BEARING

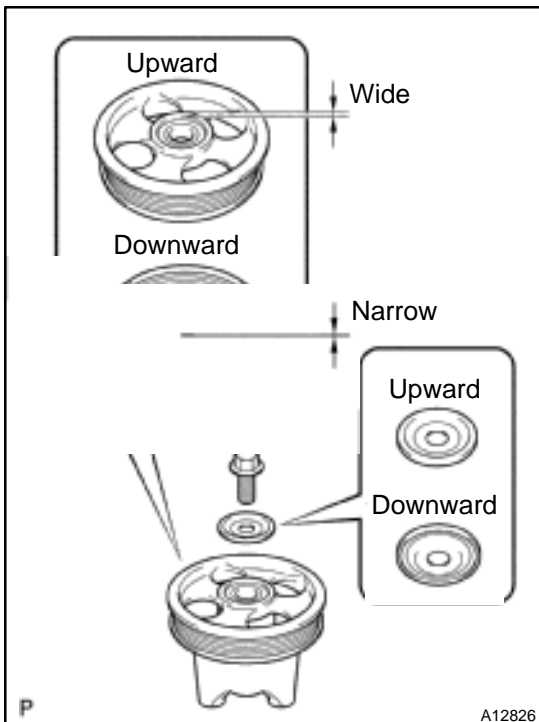
- (a) Mount the drive belt idler in a vice, and remove the bolt, washer and pulley.



- (b) Using SST and a press, press out the bearing.
SST 09950-60010 (09951-00240), 09950-70010 (09951-07100)



- (c) Using SST and a press, press in a new bearing.
SST 09950-60010 (09951-00390), 09950-70010 (09951-07100)

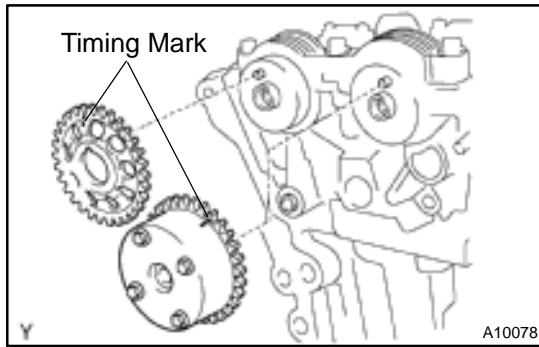


- (d) Mount the drive belt idler in a vice, and reinstall the pulley with the washer and bolt.

Torque: 43 N·m (440 kgf·cm, 32 ft·lbf)

NOTICE:

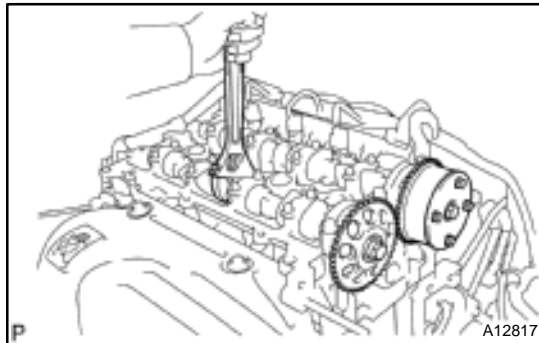
Be careful of the installation direction of pulley and washer.



INSTALLATION

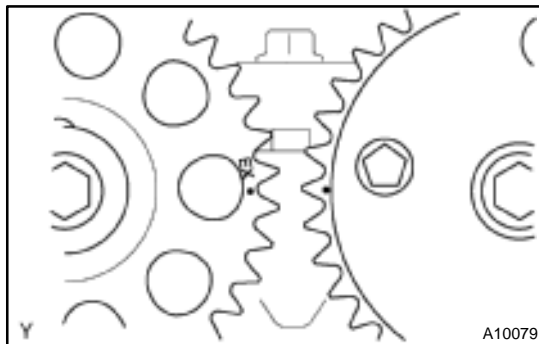
1. INSTALL CAMSHAFT TIMING SPROCKET AND VVT TIMING SPROCKET

- (a) Align the camshaft knock pin with the knock pin groove on the sprocket side with the timing mark, and slide on the camshaft timing sprocket and VVT timing sprocket.



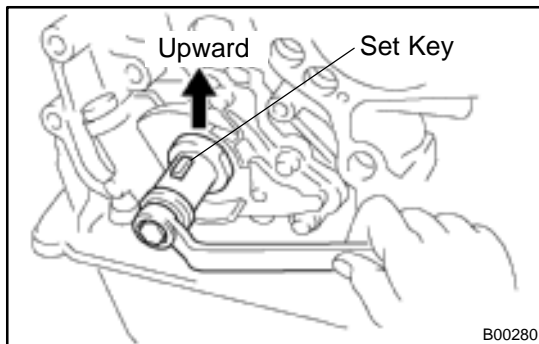
- (b) Temporary install the 2 timing sprocket bolts.
 (c) Hold the hexagon wrench head portion of the camshaft with a wrench, and tighten the timing sprocket bolt.

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

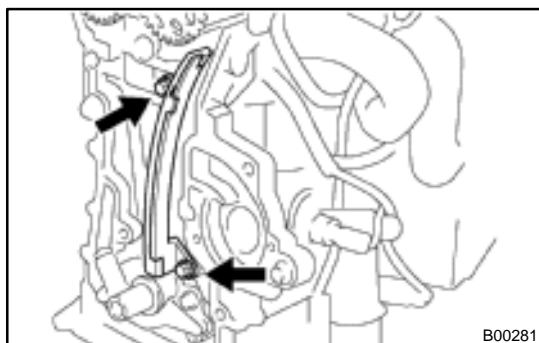


2. SET NO. 1 CYLINDER TO TDC/COMPRESSION

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



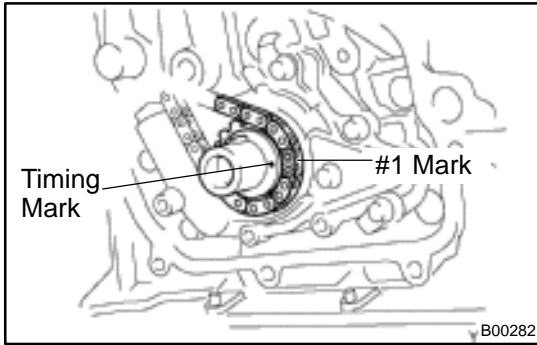
- (b) Using the crankshaft pulley bolt, turn the crankshaft and set the set key on the crankshaft upward.



3. INSTALL CHAIN VIBRATION DAMPER

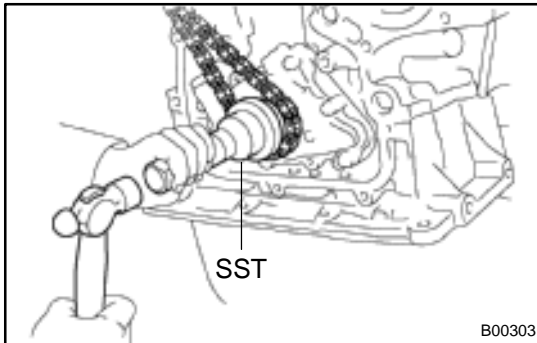
Install the damper with the 2 bolts.

Torque: 9 N·m (92 kgf·cm, 80 in.-lbf)



4. INSTALL TIMING CHAIN AND CRANKSHAFT TIMING SPROCKET

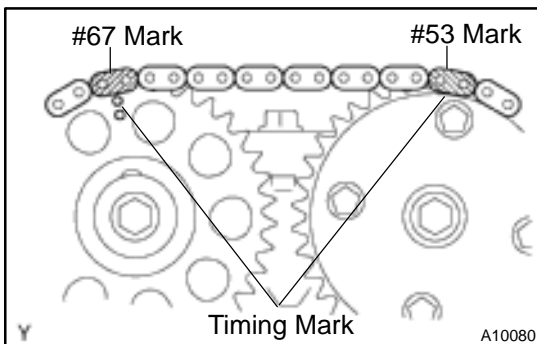
- (a) Install the timing chain on the crankshaft timing sprocket with the #1 mark link aligned with the timing mark on the crankshaft timing sprocket.



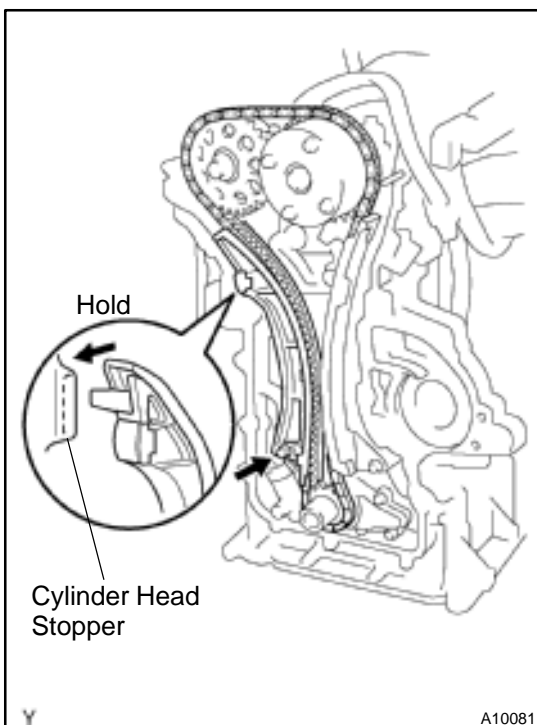
HINT:

If necessary, tap in the sprocket with SST and a hammer.

SST 09223-22010



- (b) Install the timing chain on the camshaft timing sprocket and VVT timing sprocket with the #53 and #67 mark links aligned with the timing marks on the camshaft timing sprocket and VVT timing sprocket.



- (c) Check that the tension between the VVT timing sprocket and crankshaft timing sprocket.

5. INSTALL CHAIN TENSIONER SLIPPER

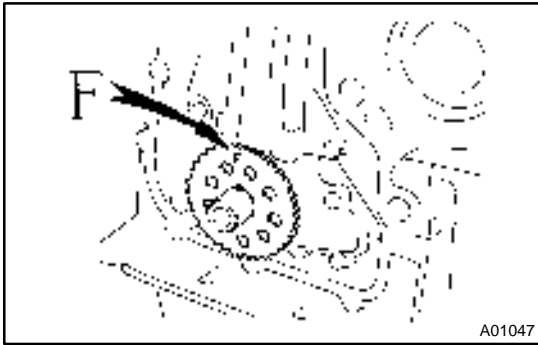
- (a) Install the slipper with the bolt.

Torque: 18.5 N·m (189 kgf·cm, 14 ft·lbf)

- (b) Check that the slipper is held on the cylinder head stopper.

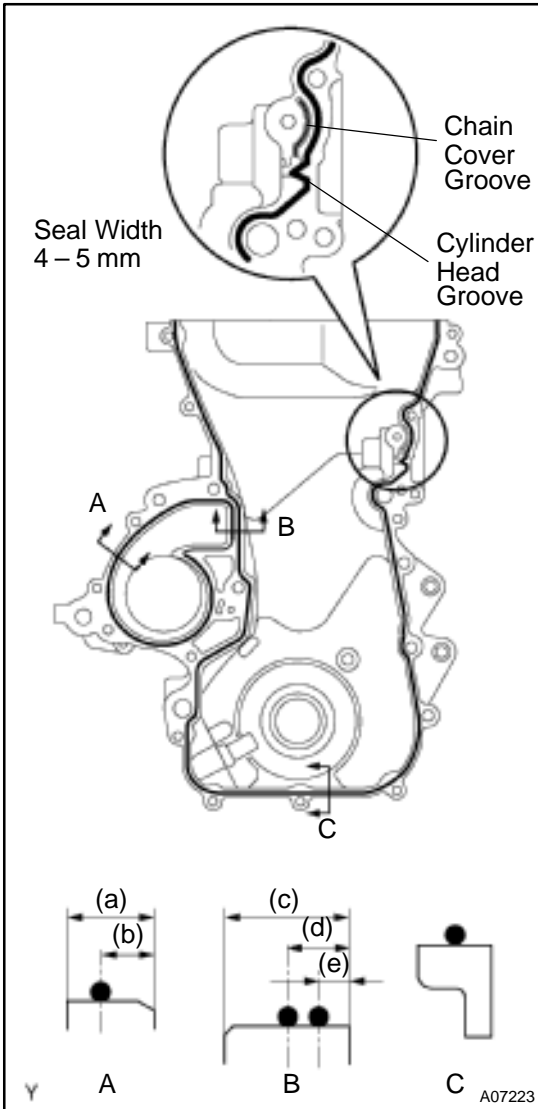
NOTICE:

Do not turn the crankshaft.



6. INSTALL CRANK ANGLE SENSOR PLATE

Install the plate with the F mark facing forward.



7. 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 position:

(a) of A position	7 mm (0.28 in.)
(b) of A position	4.5 mm (0.177 in.)
(c) of B position	12 mm (0.47 in.)
(d) of B position	6 mm (0.24 in.)
(e) of B position	3 mm (0.12 in.)

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.

HINT:

Avoid applying an excessive amount to the surface.

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

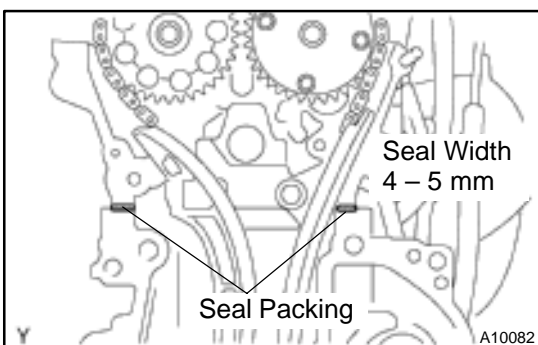
(c) Apply seal packing to 2 locations as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

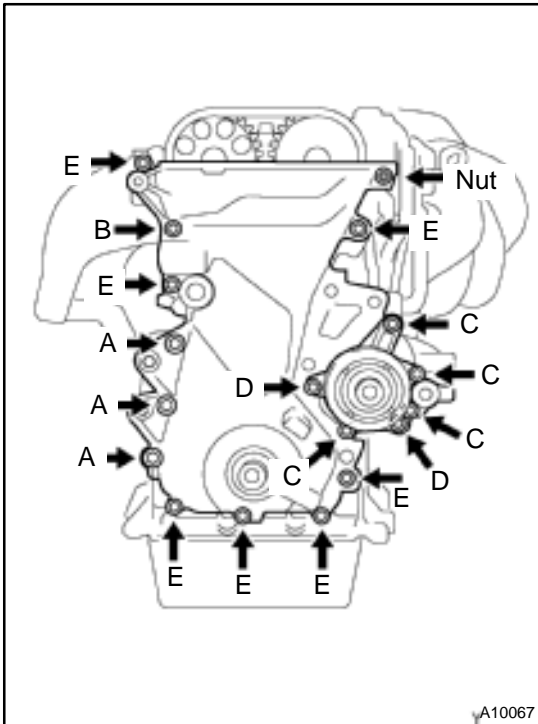
- Install a nozzle that has been cut to a 4 – 5 mm (0.16 – 0.20 in.) opening.

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 the timing chain cover, a new O-ring and the water pump with the 17 bolts and nut. Uniformly tighten the bolts and nut in several passes.

Torque:

- 18.5 N-m (189 kgf-cm, 14 ft.-lbf) for A**
- 13 N-m (133 kgf-cm, 10 ft.-lbf) for B**
- 9 N-m (92 kgf-cm, 80 in.-lbf) for C**
- 11 N-m (113 kgf-cm, 8 ft.-lbf) for others**

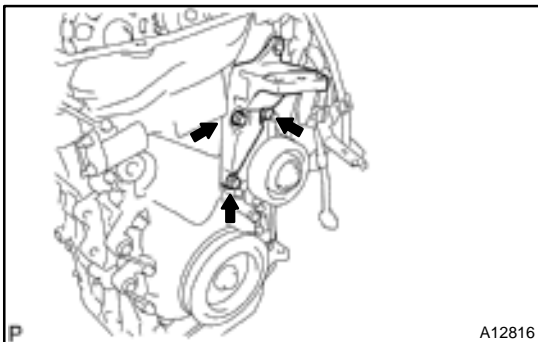
NOTICE:

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

HINT:

Each bolt length in indicated in the illustration.

Bolt A	45 mm (1.77 in.) length 12 mm head
Bolt B	45 mm (1.77 in.) length 10 mm head
Bolt C	35 mm (1.38 in.) length 10 mm head
Bolt D	30 mm (1.18 in.) length 10 mm head
Bolt E	25 mm (0.98 in.) length 10 mm head



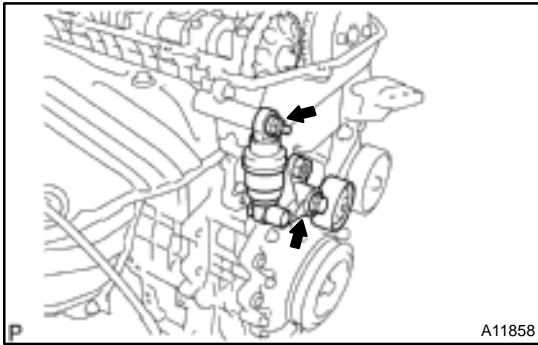
8. INSTALL RH ENGINE MOUNTING BRACKET

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

NOTICE:

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

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



9. INSTALL DRIVE BELT TENSIONER

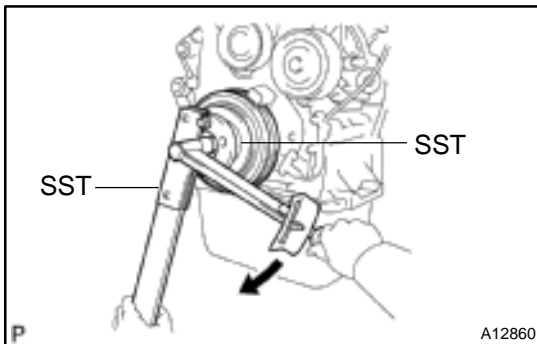
- (a) Install the drive belt tensioner with the bolt and nut.
Torque:
69 N·m (704 kgf·cm, 51 ft·lbf) for bolt
29 N·m (296 kgf·cm, 21 ft·lbf) for nut
- (b) Hook the tool on the hexagonal portion of the drive belt tensioner bracket and operate drive belt tensioner 3 times with full stroke.

HINT:

Take 3 seconds or more for 1 full stroke.

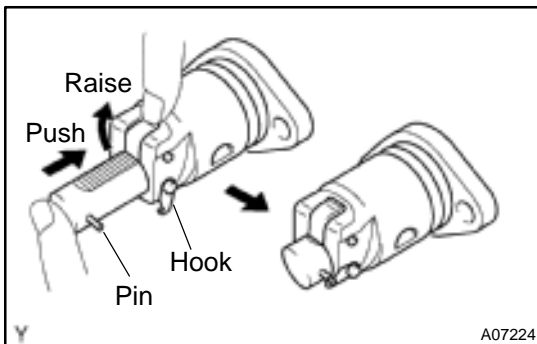
10. INSTALL CRANKSHAFT POSITION SENSOR

Torque: 9 N·m (92 kgf·cm, 80 in.-lbf)



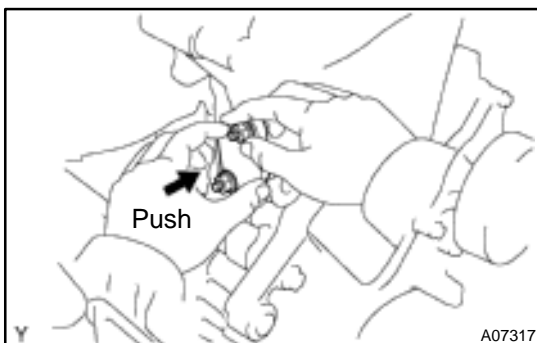
11. INSTALL CRANKSHAFT PULLEY

- (a) Clean the crankshaft pulley inside.
- (b) Align the pulley set key with the key groove of the pulley, and slide on the pulley.
- (c) Using SST, install the pulley bolt.
 SST 09213-70011, 09330-00021
Torque: 138 N·m (1,409 kgf·cm, 102 ft·lbf)



12. INSTALL CHAIN TENSIONER

- (a) Release the ratchet pawl, fully push in the plunger and apply the hook to the pin so that the plunger cannot spring out.
- (b) Install the O-ring to the chain tensioner.

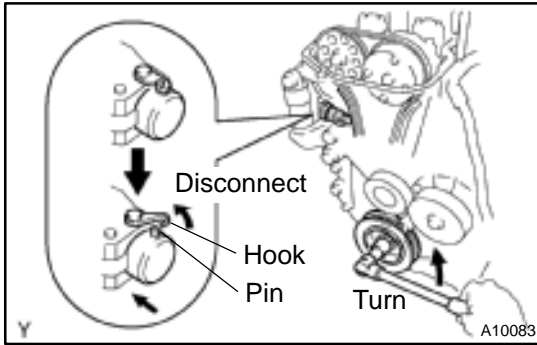


- (c) Push the chain tensioner into the timing chain cover, and install the 2 nuts.

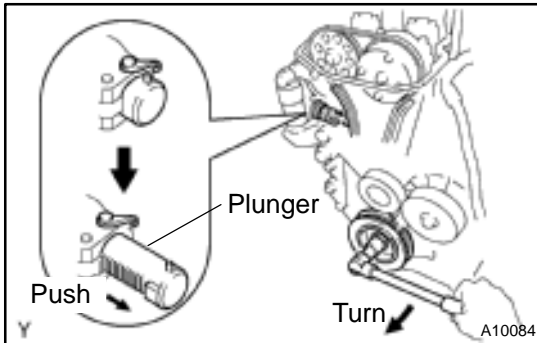
Torque: 9 N·m (92 kgf·cm, 80 in.-lbf)

HINT:

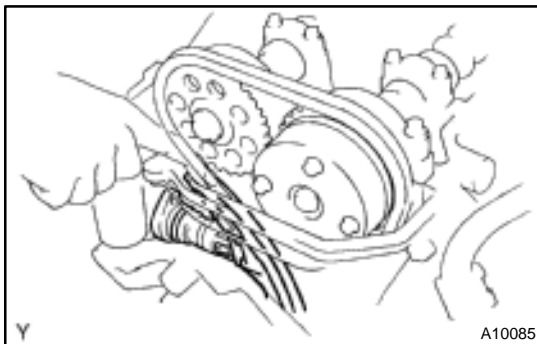
- In case that the hook is released while pushing in, apply the hook again and push the tensioner in.
- Pay attention not to catch the O-ring as it is built in the chain tensioner previously.

**13. SET CHAIN TENSION**

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



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

**HINT:**

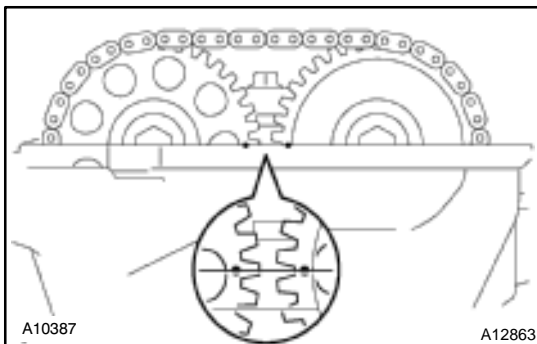
If the plunger does not spring out, press the slipper into the chain tensioner with a screwdriver or your finger so that the hook is released from the knock pin and the plunger springs out.

14. CHECK VALVE TIMING

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

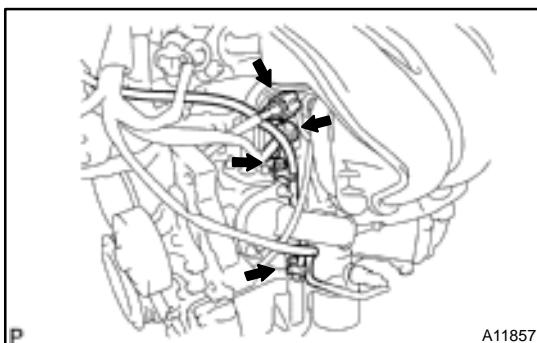
NOTICE:

Always turn the crankshaft clockwise.



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

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

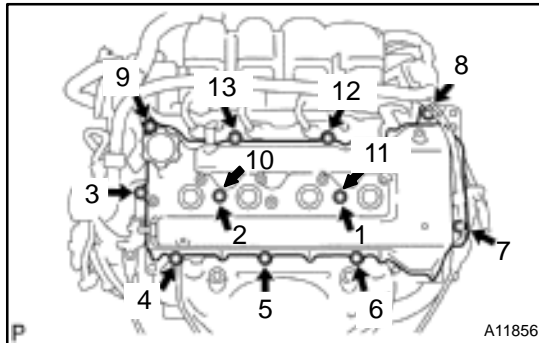
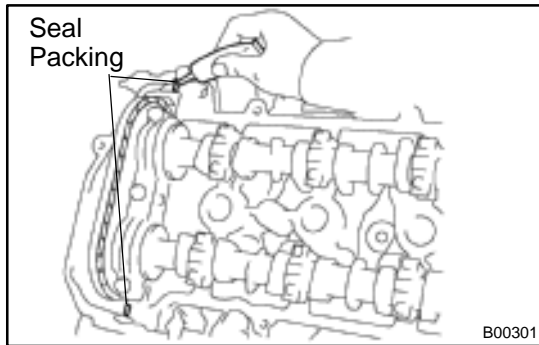
**15. INSTALL OIL DIPSTICK AND GUIDE**

- (a) Connect the knock sensor connector, crankshaft position sensor connector and oil pressure sensor wire bracket to the oil dipstick guide.

- (b) Install a new O-ring to the oil dipstick.

- (c) Install the oil dipstick and guide with the nut.

Torque: 13 N·m (133 kgf·cm, 10 ft·lbf)



16. 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.

If the gasket has damage, replace a new one.

HINT:

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

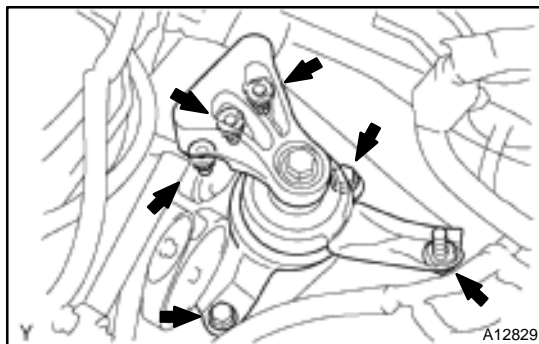
- (d) Install the cylinder head cover and engine wire bracket with the 9 bolts, 2 seal washers and 2 nuts. Uniformly tighten the bolts and nuts in the several passes, in the sequence shown.

Torque:

11 N·m (113 kgf·cm, 8 ft·lbf) for w/o washer

9 N·m (92 kgf·cm, 80 in·lbf) for w/ washer

- (e) Connect the noise filter.
- (f) Disconnect the heated oxygen sensor (bank 1 sensor 1) connector.
- (g) Connect the 2 PCV hoses to the cylinder head cover.



17. INSTALL RH ENGINE MOUNTING INSULATOR

- (a) Install the engine mounting insulator with the 3 bolts and 3 nuts.

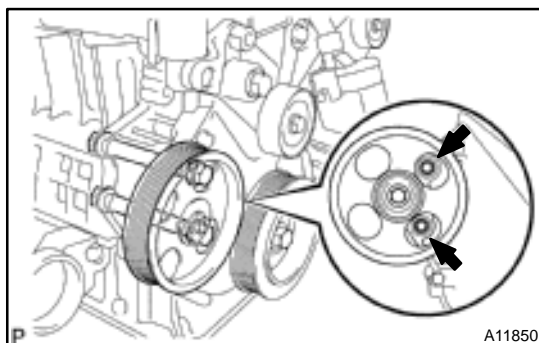
Torque: 52 N·m (530 kgf·cm, 38 ft·lbf)

- (b) Remove the jack.

18. INSTALL IGNITION COILS (See page IG-4)

19. INSTALL NO. 2 CYLINDER HEAD COVER

Install the No. 2 cylinder head cover with the 2 nuts and 2 clips.



20. INSTALL DRIVE BELT IDLER

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

21. INSTALL GENERATOR AND DRIVE BELT

(See page CH-17)

22. INSTALL ENGINE UNDER COVERS

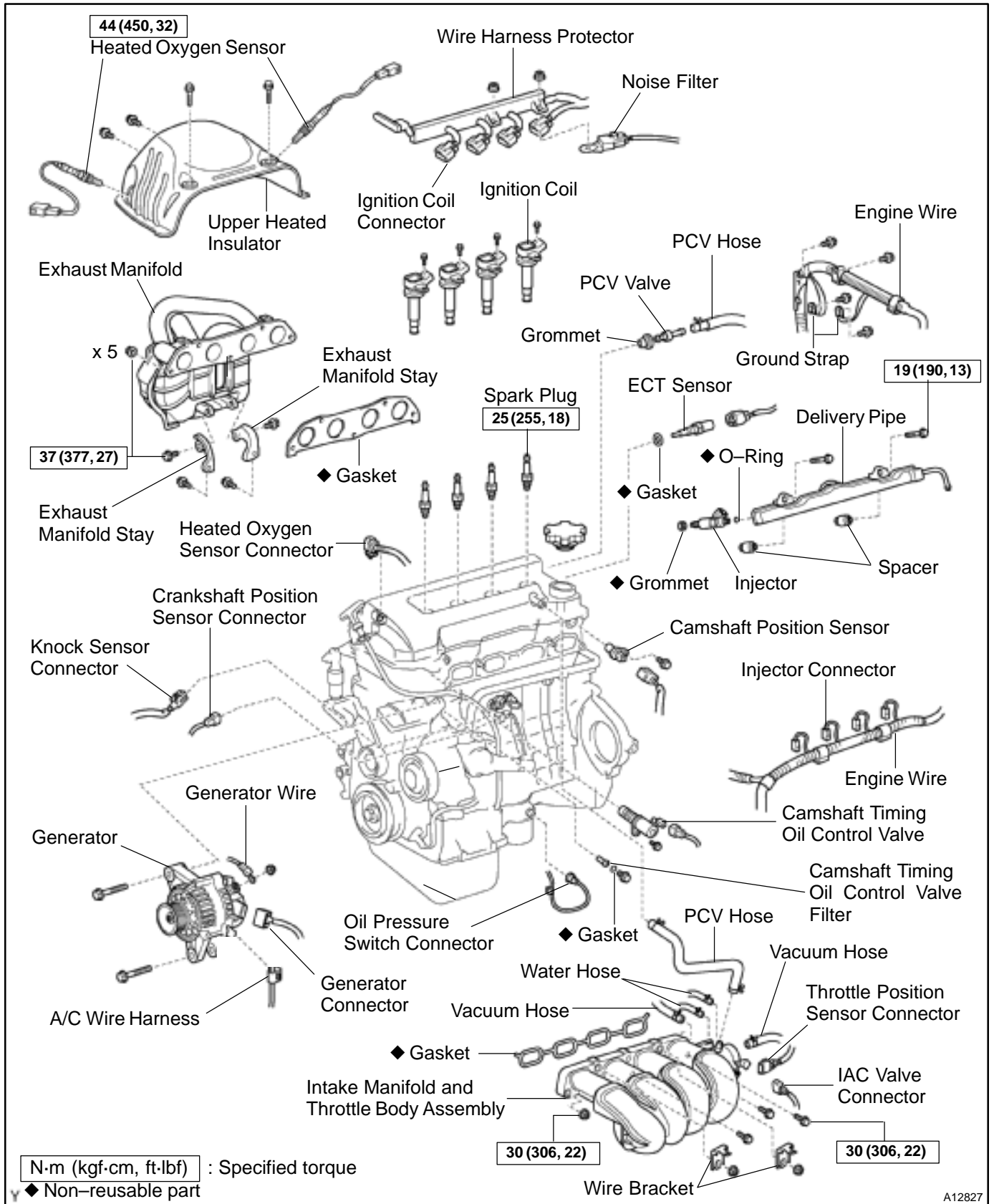
23. INSTALL SUSPENSION UPPER BRACE

24. FILL WITH ENGINE COOLANT (See page CO-1)

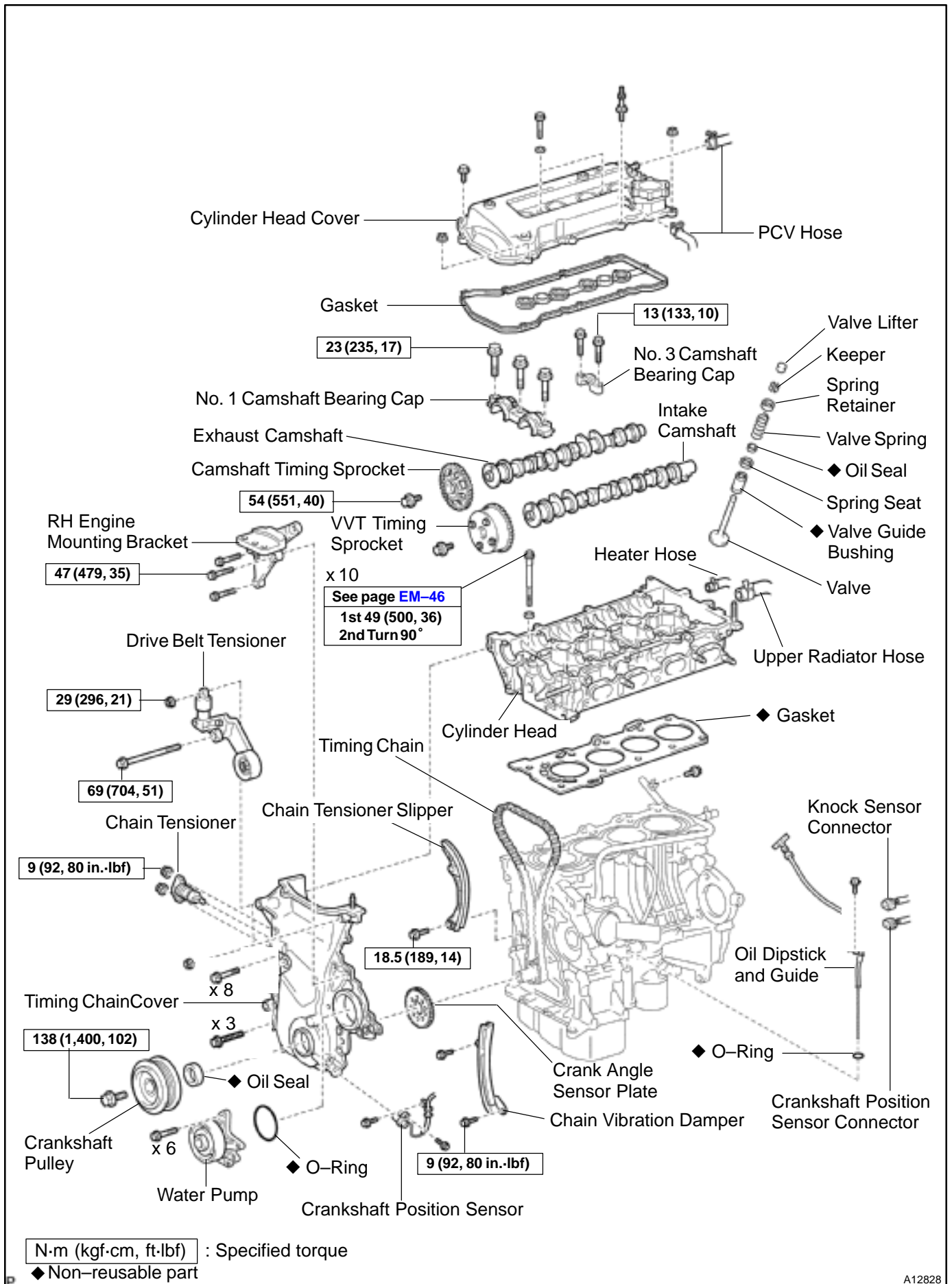
25. START ENGINE AND CHECK FOR COOLANT LEAKS

CYLINDER HEAD COMPONENTS

EM19H-01



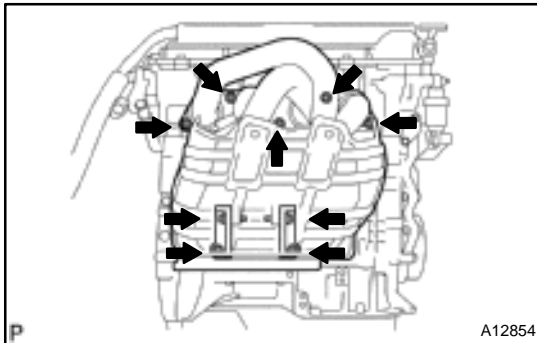
A12827



A12828

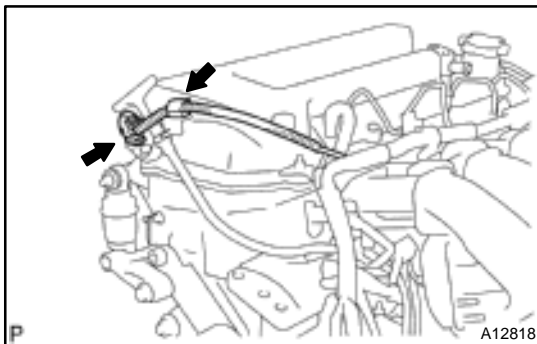
REMOVAL

1. REMOVE ENGINE UNIT (See page EM-54)
2. REMOVE GENERATOR (See page CH-7)
3. REMOVE IGNITION COILS (See page IG-4)
4. REMOVE SPARK PLUGS (See page IG-1)
5. REMOVE INJECTORS (See page SF-23)



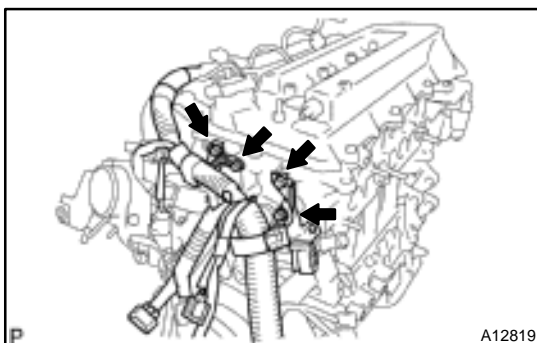
6. REMOVE EXHAUST MANIFOLD

- (a) Disconnect the 2 heated oxygen sensor connectors, and remove the 2 heated oxygen sensors.
- (b) Remove the 4 bolts and upper heat insulator.
- (c) Remove the 4 bolts and 2 exhaust manifold stays.
- (d) Remove the 5 nuts, exhaust manifold and gasket.

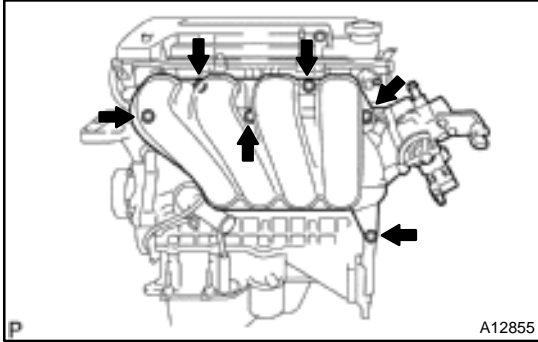


7. DISCONNECT ENGINE WIRE

- (a) Disconnect the heated oxygen sensor (bank 1 sensor 1) wire from the 2 wire brackets.
- (b) Disconnect the camshaft timing oil control valve connector.
- (c) Disconnect the crankshaft position sensor connector.
- (d) Disconnect the knock sensor connector.
- (e) Disconnect the oil pressure switch connector and wire.
- (f) Disconnect the camshaft position sensor connector.
- (g) Disconnect the ECT sensor connector.
- (h) Disconnect the throttle position sensor connector.
- (i) Disconnect the IAC valve connector.
- (j) Disconnect the noise filter.



- (k) Remove the 2 bolts, and disconnect the 2 ground straps.
 - (l) Remove the 2 bolts and engine wire.
- ### 8. REMOVE OIL FILLER CAP
- ### 9. REMOVE PCV HOSES AND VALVE
- (a) Remove the 2 PCV hoses.
 - (b) Remove the PCV valve and grommet.



10. REMOVE INTAKE MANIFOLD AND THROTTLE BODY ASSEMBLY

- (a) Disconnect the 2 water hoses from the throttle body.
- (b) Disconnect the 2 vacuum hoses from the intake manifold.
- (c) Remove the 4 bolts, 2 nuts, 2 wire brackets, the intake manifold and throttle body assembly.
- (d) Remove the gasket from the intake manifold and throttle body assembly.

11. REMOVE CAMSHAFT TIMING CHAIN

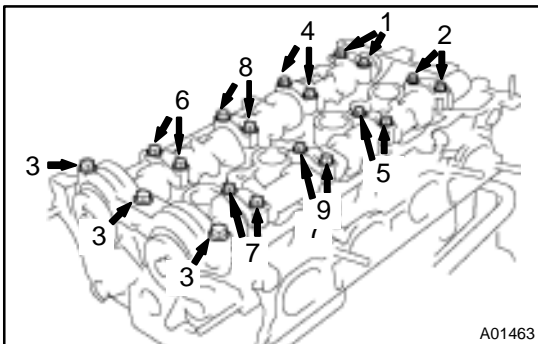
(See page [EM-13](#))

12. REMOVE TIMING SPROCKET AND VVT SPROCKET

(See page [EM-13](#))

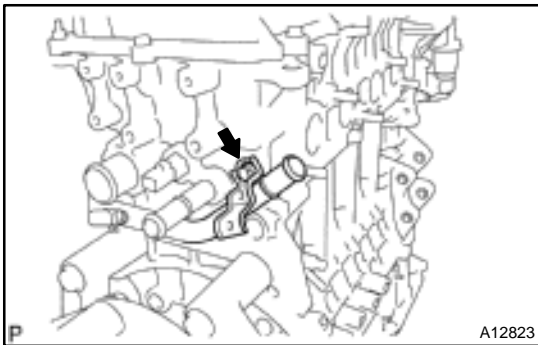
13. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE

(See page [SF-42](#))



14. 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.



15. REMOVE CYLINDER HEAD ASSEMBLY

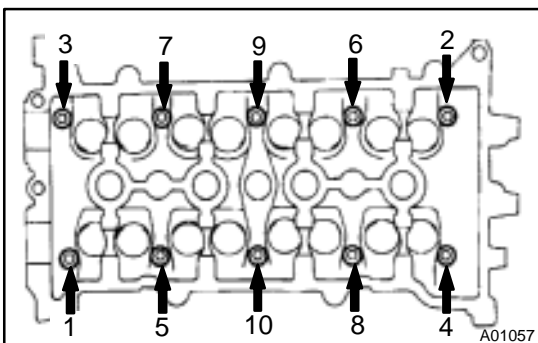
- (a) Remove the bolt of the water bypass pipe from the cylinder head.

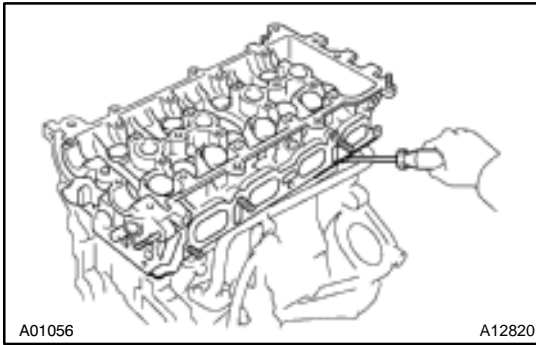
- (b) Using a 10 mm bi-hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts in several passes, in the sequence shown.

NOTICE:

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

- (c) Remove the 10 plate washers.



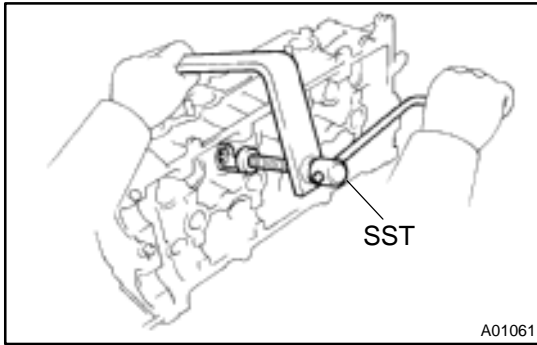


- (d) Using a screwdriver, pry between the cylinder head and cylinder block, and remove the cylinder head.

NOTICE:

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

16. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE FILTER (See page [SF-42](#))
17. REMOVE CAMSHAFT POSITION SENSOR (See page [IG-5](#))
18. REMOVE ECT SENSOR (See page [SF-55](#))



DISASSEMBLY

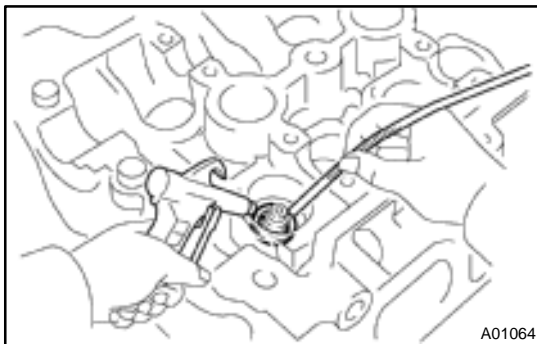
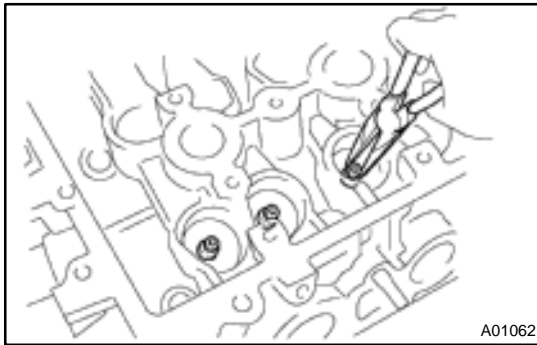
1. REMOVE VALVE LIFTERS

HINT:

Arrange the valve lifters in the correct order.

2. REMOVE VALVES

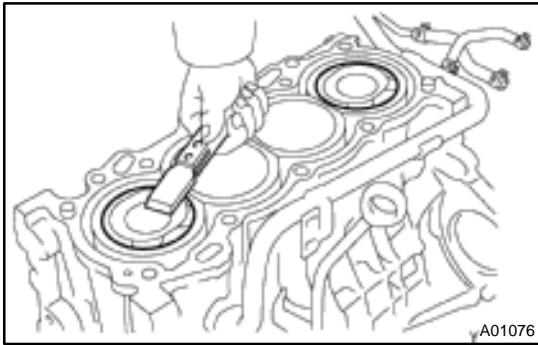
- (a) Using SST, compress the valve spring and remove the 2 keepers.
- (b) Remove the spring retainer, valve spring and valve.
- (c) Using needle-nose pliers, remove the oil seal.



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

HINT:

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

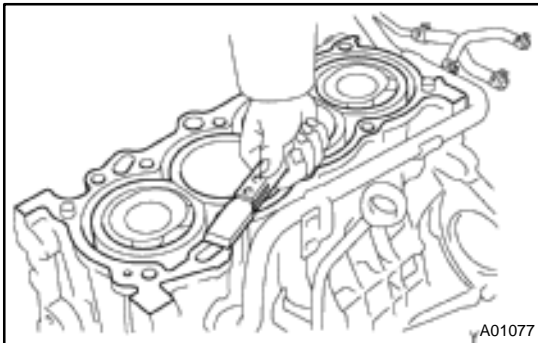


A01076

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.



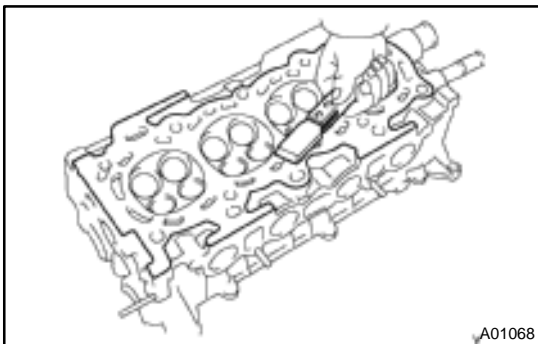
A01077

- (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. INSPECT CYLINDER BLOCK FOR FLATNESS (See page [EM-74](#))



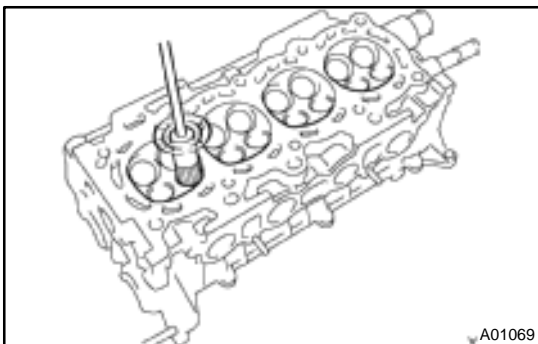
A01068

3. CLEAN CYLINDER HEAD

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

NOTICE:

Be careful not to scratch the cylinder block contact surface.

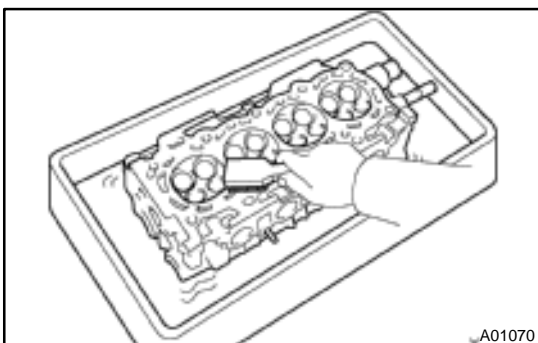


A01069

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

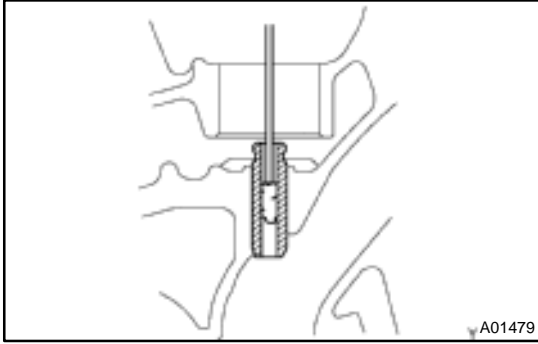
NOTICE:

Be careful not to scratch the cylinder block contact surface.

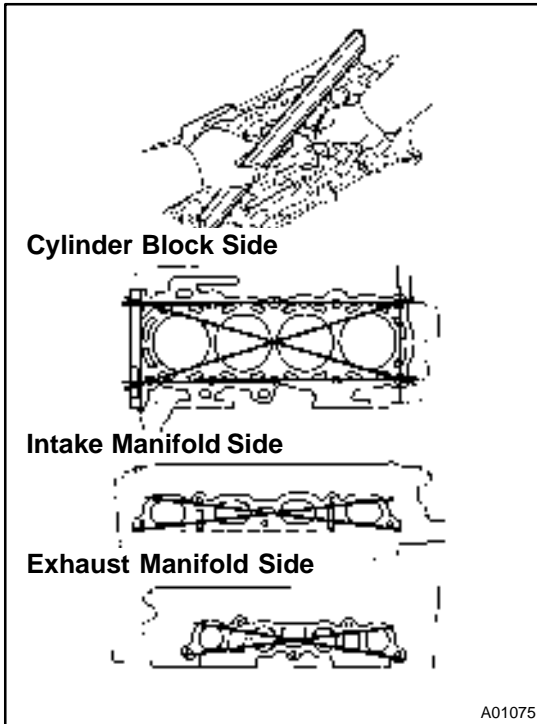


A01070

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



- (d) Using a valve guide bushing brush and solvent, clean all the guide bushings.



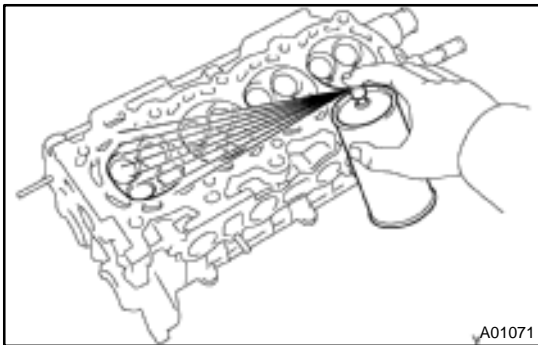
4. INSPECT CYLINDER HEAD

- (a) Inspect for flatness.

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

Maximum warpage: 0.05 mm (0.0020 in.)

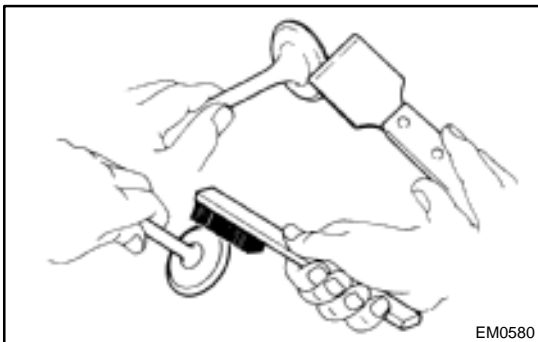
If warpage is greater than maximum, replace the cylinder head.



- (b) Inspect for cracks.

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

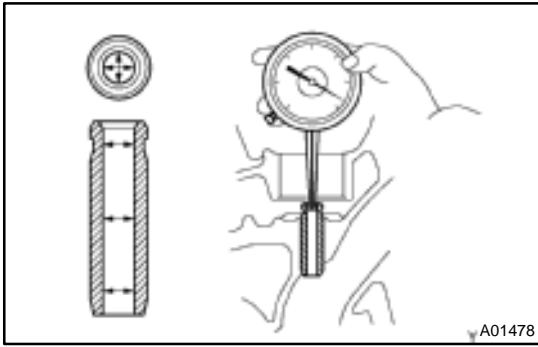
If cracked, replace the cylinder head.



5. CLEAN VALVES

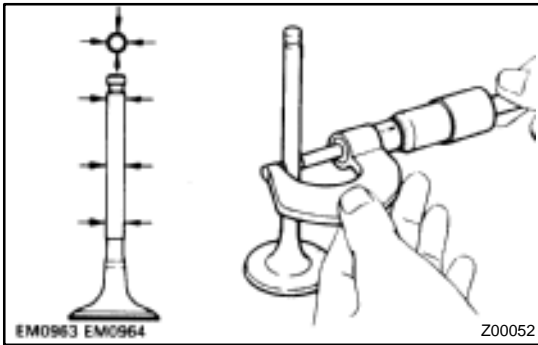
- (a) Using a gasket scraper, chip off any carbon from the valve head.

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



- 6. INSPECT VALVE STEMS AND GUIDE BUSHINGS**
 (a) Using a caliper gauge, measure the inside diameter of the guide bushing.

Bushing inside diameter:
 5.510 – 5.530 mm (0.2169 – 0.2177 in.)



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

Intake	5.470 – 5.485 mm (0.2154 – 0.2159 in.)
Exhaust	5.465 – 5.480 mm (0.2152 – 0.2157 in.)

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

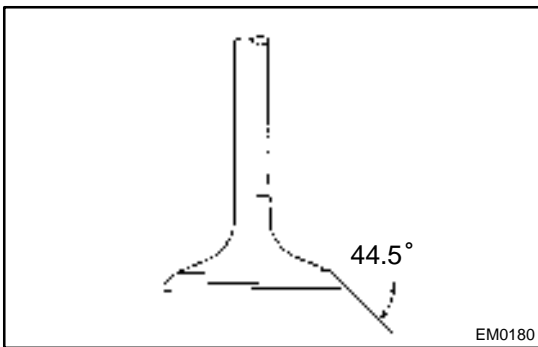
Standard oil clearance:

Intake	0.025 – 0.060 mm (0.0010 – 0.0024 in.)
Exhaust	0.030 – 0.065 mm (0.0012 – 0.0026 in.)

Maximum oil clearance:

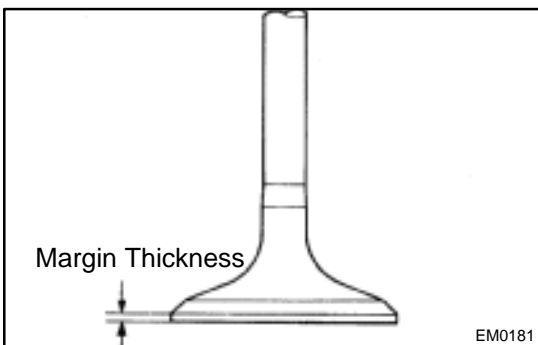
Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

If the clearance is greater than maximum, replace the valve and guide bushing (See page EM-42).



7. 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.

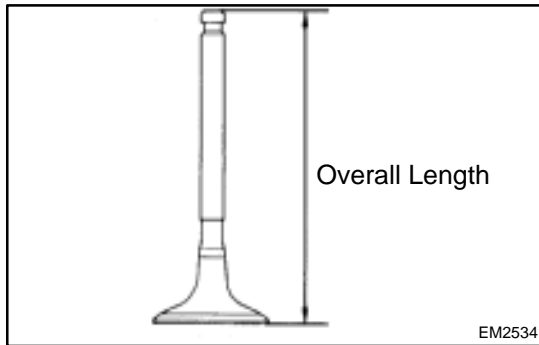


- (c) Check the valve head margin thickness.

Margin thickness:

Standard	1.0 mm (0.039 in.)
Minimum	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	88.65 mm (3.4902 in.)
Exhaust	88.69 mm (3.4917 in.)

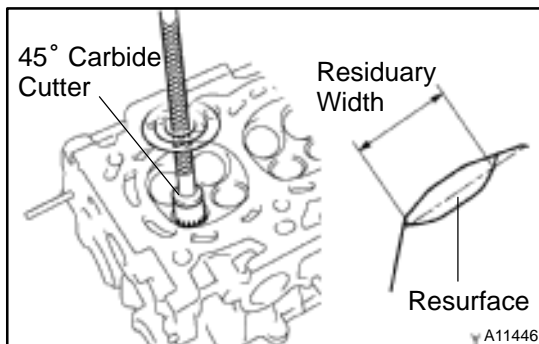
Minimum overall length:

Intake	88.35 mm (3.4783 in.)
Exhaust	88.39 mm (3.4799 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.

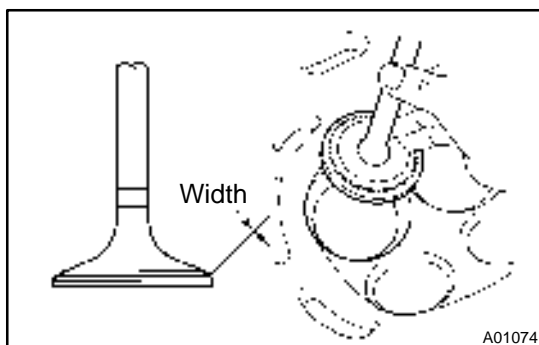
**8. INSPECT AND CLEAN VALVE SEATS**

- (a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.
- (b) After resurfacing the valve seat 45°, measure the residuary width of the valve seat 45°.

Minimum residuary width:

Intake	3.3 mm (0.130 in.)
Exhaust	3.2 mm (0.126 in.)

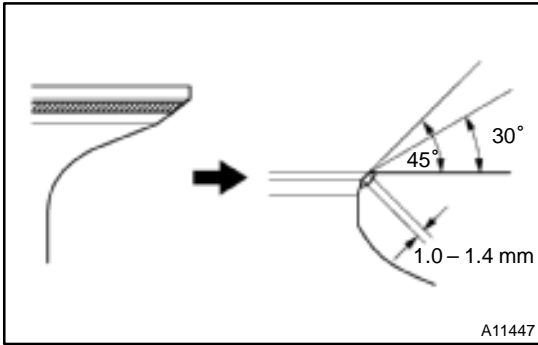
If the valve seat 45° residuary width is less than minimum, replace the cylinder head.



- (c) Check the valve seating position. Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate valve.

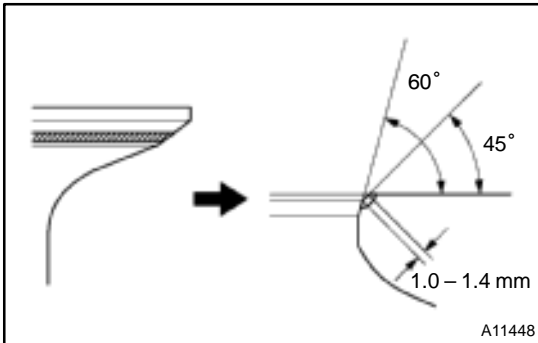
- (d) Check the valve face and seat for the following:
- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
 - If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
 - Check that the seat contact is in the middle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

1.0 – 1.4 mm (0.039 – 0.055 in.)

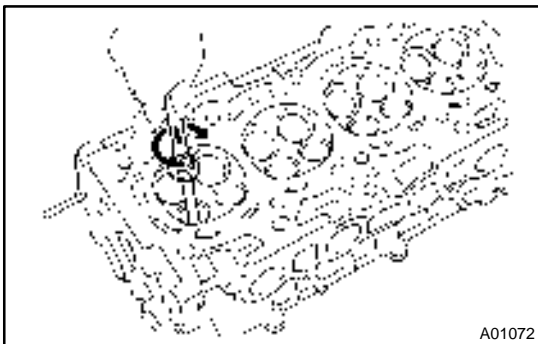


If not, correct the valve seats as follows:

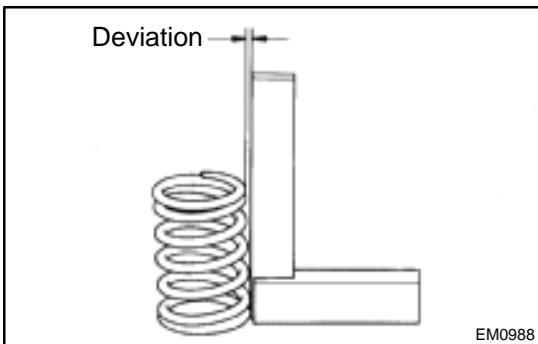
- (1) If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.



- (2) If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



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



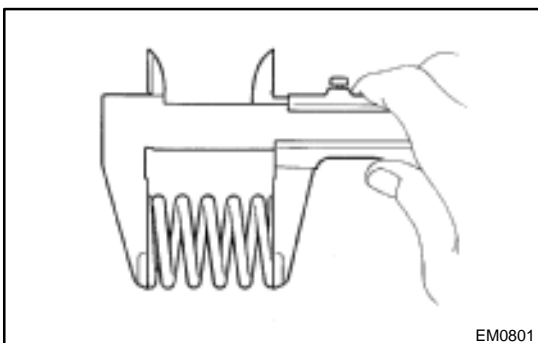
9. INSPECT VALVE SPRINGS

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

Maximum deviation: 1.6 mm (0.063 in.)

Maximum angle (reference): 2°

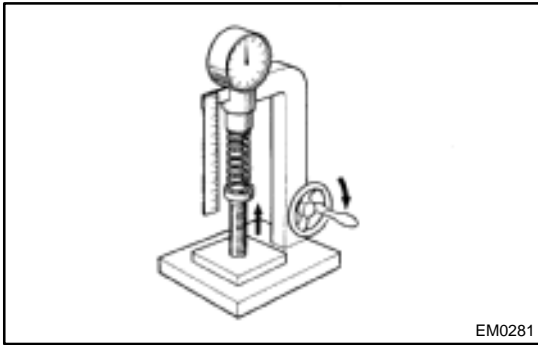
If the deviation is greater than maximum, replace the valve spring.



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

Free length: 43.40 mm (1.7087 in.)

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



EM0281

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

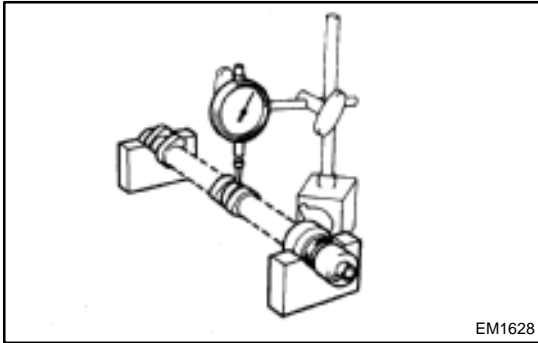
Installed tension:

**158.6 – 175.4 N (16.2 – 17.9 kgf, 35.7 – 39.5 lbf)
at 33.6 mm (1.323 in.)**

Maximum working tension:

**335.3 – 370.7 N (34.2 – 37.8 kgf, 75.4 – 83.3 lbf)
at 24.1 mm (0.949 in.)**

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



EM1628

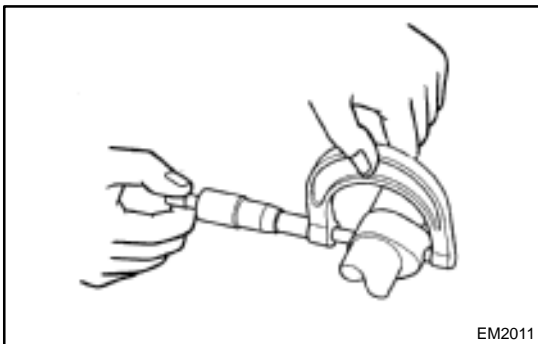
10. INSPECT CAMSHAFT

- (a) Inspect for runout.

- (1) Place the camshaft on V-blocks.
- (2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.03 mm (0.0012 in.)

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



EM2011

- (b) Inspect the cam lobes.

Using a micrometer, measure the cam lobe height.

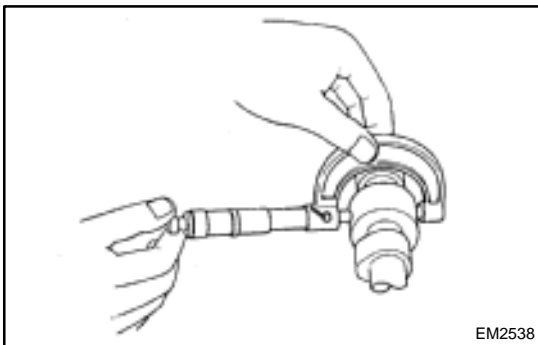
Standard cam lobe height:

Intake	44.578 – 44.678 mm (1.7550 – 1.7590 in.)
Exhaust	43.761 – 43.861 mm (1.7229 – 1.7268 in.)

Minimum cam lobe height:

Intake	44.43 mm (1.7492 in.)
Exhaust	43.61 mm (1.7169 in.)

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



EM2538

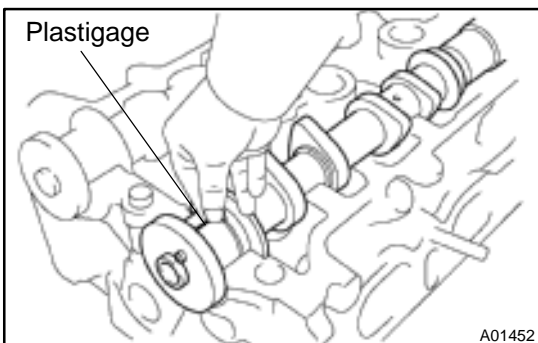
- (c) Inspect the camshaft journals.

Using a micrometer, measure the journal diameter.

Journal diameter:

No.1	34.449 – 34.465 mm (1.3563 – 1.3569 in.)
Others	22.949 – 22.965 mm (0.9035 – 0.9041 in.)

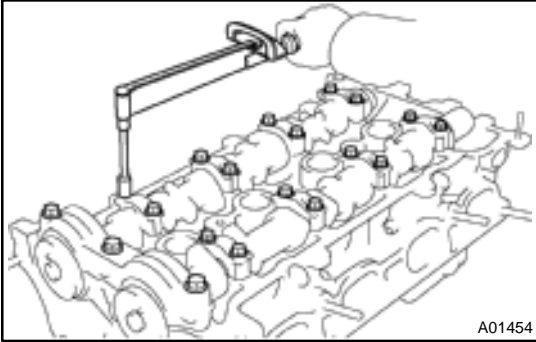
If the journal diameter is not as specified, check the oil clearance.



A01452

- (d) Inspect the journal clearance.

- (1) Clean the bearing caps and camshaft journals.
- (2) Place the camshafts on the cylinder head.
- (3) Lay a strip of Plastigage across each of the camshaft journal.



(4) Install the bearing caps (See page EM-46).

Torque:

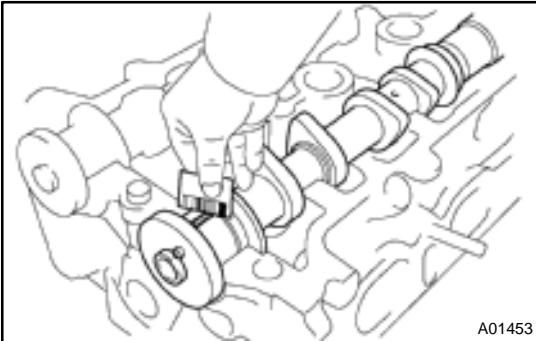
23 N·m (235 kgf·cm, 17 ft·lbf) for No. 1

13 N·m (133 kgf·cm, 10 ft·lbf) for No. 3

NOTICE:

Do not turn the camshaft.

(5) Remove the bearing caps.



(6) Measure the Plastigage at its widest point.

Standard oil clearance:

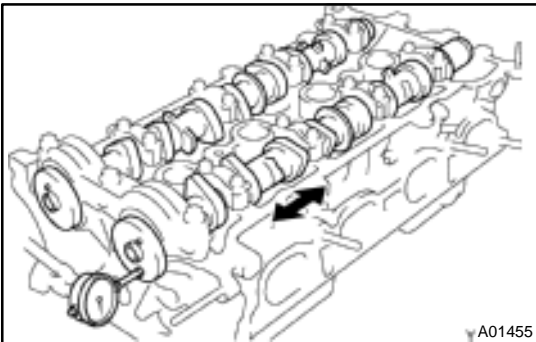
0.035 – 0.072 mm (0.0014 – 0.0028 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

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

(7) Remove the Plastigage completely.

(8) Remove the camshafts.



(e) Inspect the thrust clearance.

(1) Install the camshafts (See page EM-46).

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

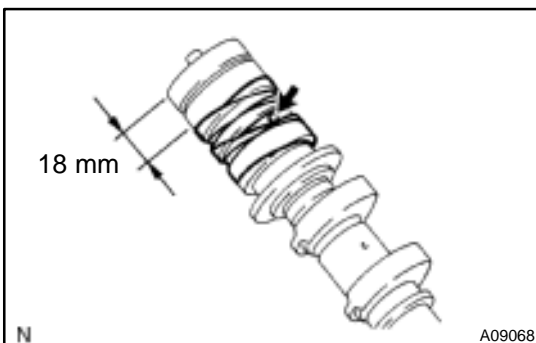
Standard thrust clearance:

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.

(3) Remove the camshaft.



11. INSPECT VVT TIMING SPROCKET (VALVE TIMING CONTROLLER ASSEMBLY)

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

NOTICE:

Do not apply tape in the range from the tip of the camshaft to 18 mm (0.71 in.) from that tip.

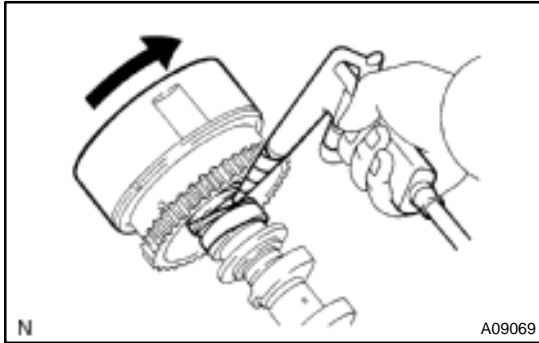
(b) Install the VVT timing sprocket.

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

NOTICE:

Do not push VVT timing sprocket to the camshaft forcibly when installing it.

- (c) Check that the VVT timing sprocket will not turn.



- (d) Wind tape around the tip of the air gun and apply air of approx. 100 kPa (1 kgf/cm², 14 psi) to the port of the camshaft.

NOTICE:

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

HINT:

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

- (e) Under the condition of (d), turn the VVT timing sprocket to the advance angel side (the arrow marked direction in the illustration) with your hand.

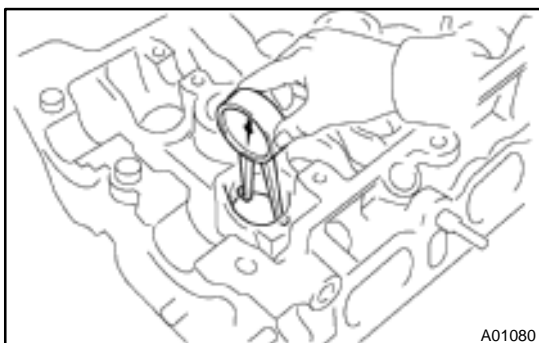
Standard: Must turn**HINT:**

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

- (f) Except the position where the lock pin meets at the maximum delay angle, let the VVT timing sprocket turn back and forth and check the movable range and that there is no disturbance.

Standard: Movable smoothly in the range about 30°

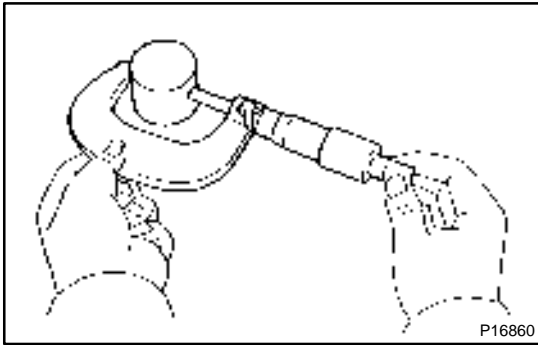
- (g) Turn the VVT timing sprocket with your hand and lock it at the maximum delay angel position.

**12. INSPECT VALVE LIFTERS AND LIFTER BORES**

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

Lifter bore diameter:

31.000 – 31.025 mm (1.2205 – 1.2215 in.)



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

Lifter diameter:

30.966 – 30.976 mm (1.2191 – 1.2195 in.)

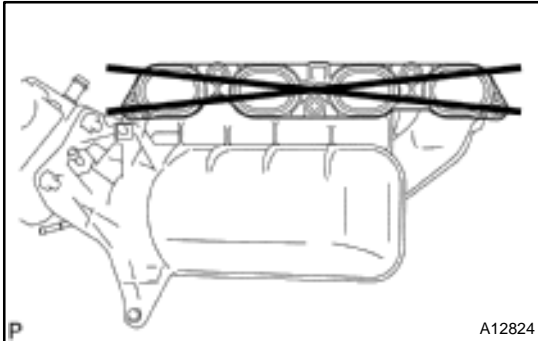
- (c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance:

0.024 – 0.059 mm (0.0009 – 0.0023 in.)

Maximum oil clearance: 0.079 mm (0.0031 in.)

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

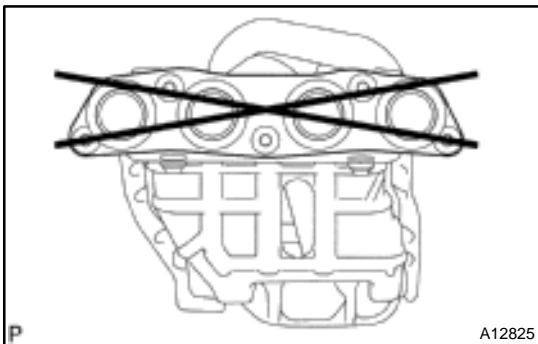


13. INSPECT INTAKE MANIFOLD

Using a precision straight edge and a 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 intake manifold.

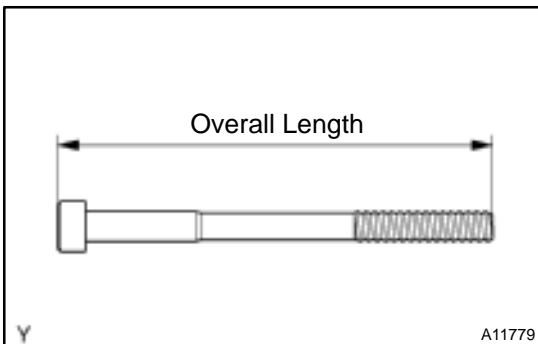


14. INSPECT EXHAUST MANIFOLD

Using a precision straight edge and a 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 exhaust manifold.



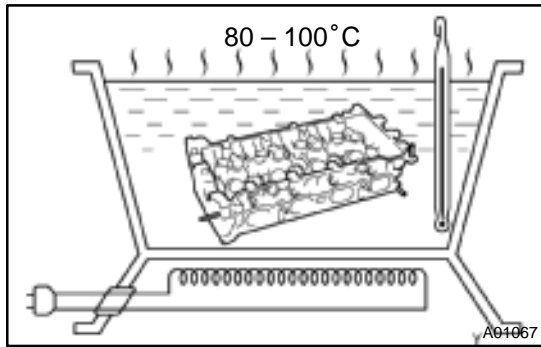
15. INSPECT CYLINDER HEAD BOLTS

Standard overall length:

156.0 – 159.0 mm (6.142 – 6.260 in.)

Maximum overall length: 159.5 mm (6.280 in.)

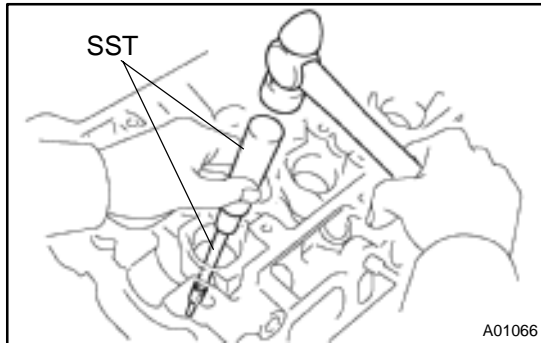
If the overall length is greater than maximum, replace the bolt.



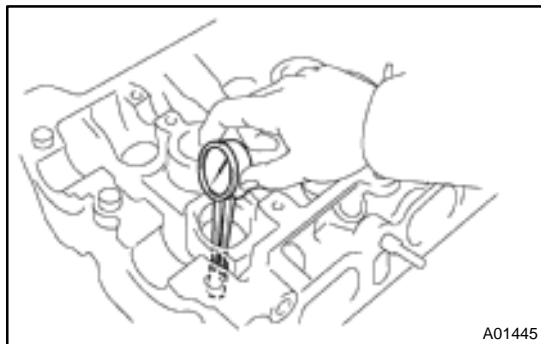
REPLACEMENT

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.

Both intake and exhaust

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

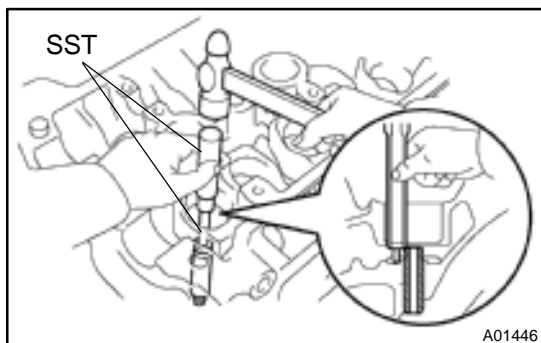
(d) Select a new guide bushing (STD or O/S 0.05).

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

10.335 – 10.356 mm (0.4068 – 0.4077 in.)

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

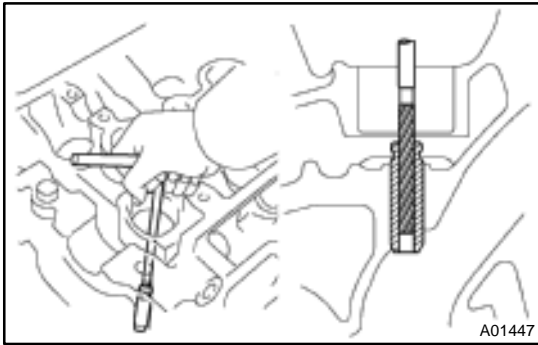
(e) Gradually heat the cylinder head to 80 – 100°C (176 – 212°F).



(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: 8.7 – 9.1 mm (0.342 – 0.358 in.)

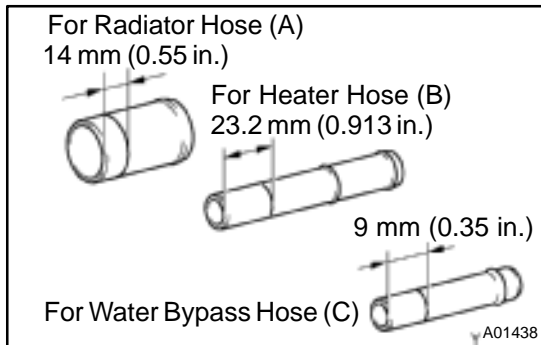


- (g) Using a sharp 5.5 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page [EM-33](#)) between the guide bushing and valve stem.

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.

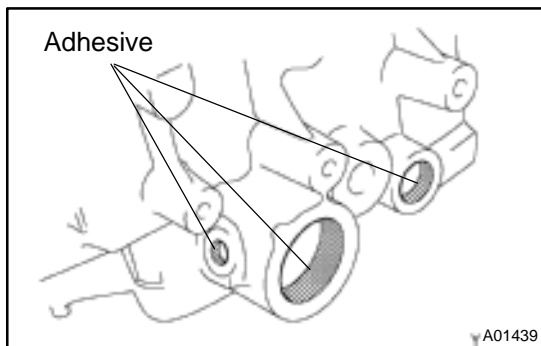


1. INSTALL WATER HOSE UNIONS

HINT:

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

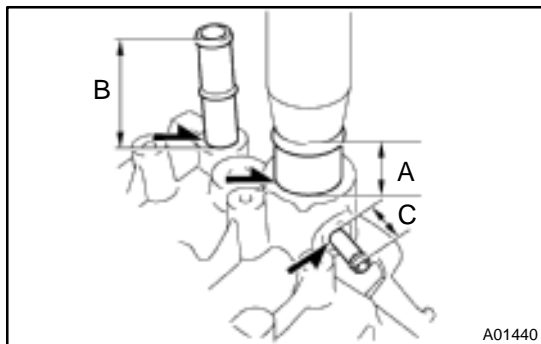
- (a) Mark the standard position away from the edge, onto the water hose union.



- (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 it is protruding from the cylinder head.

Standard protrusion:

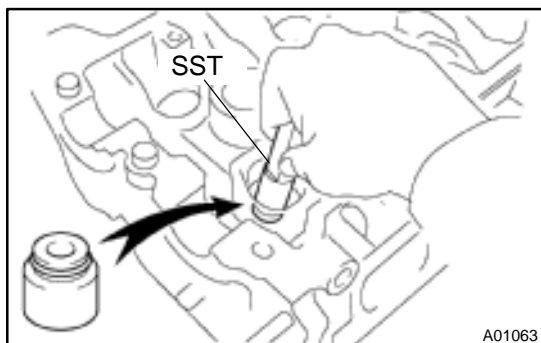
29 mm (1.14 in.) for A

66.5 mm (2.618 in.) for B

24 mm (0.95 in.) for C

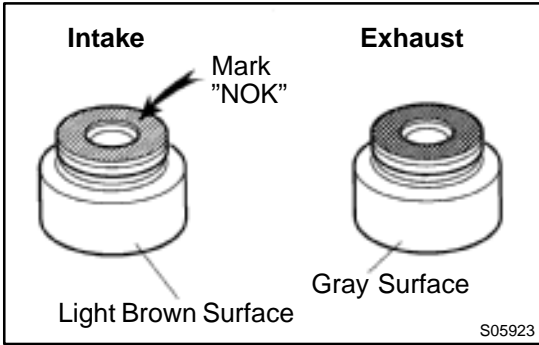
NOTICE:

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



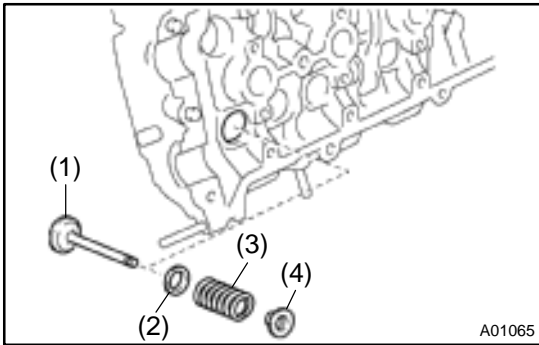
2. INSTALL VALVES

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

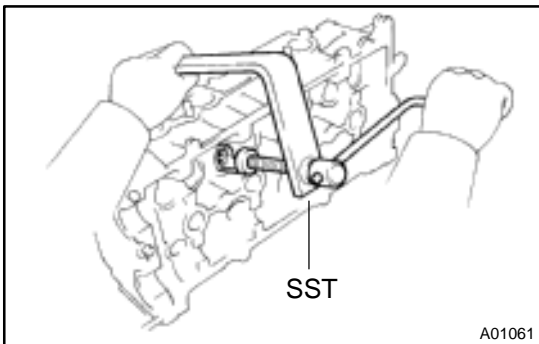


HINT:
The intake valve oil seal is light brown and the exhaust valve oil seal is gray.

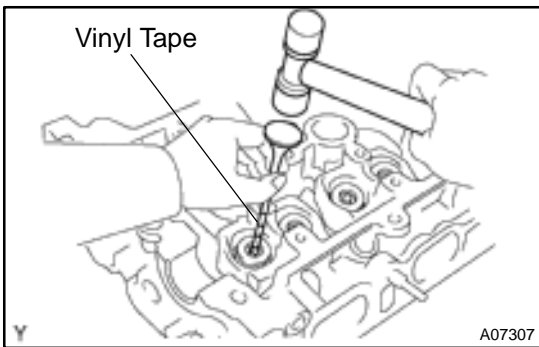
NOTICE:
Pay much attention to assemble the oil seal for intake and exhaust. Assembling the wrong one may cause a failure.



(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 (092002-00010)



(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.

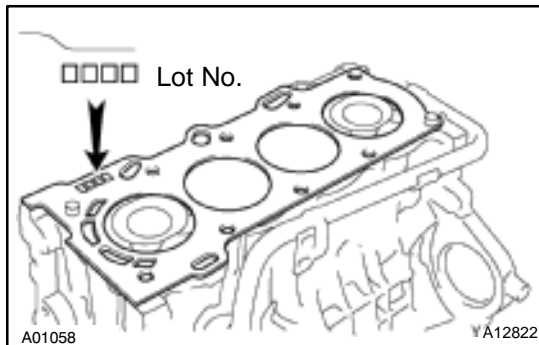
3. INSTALL VALVE LIFTERS

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

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.



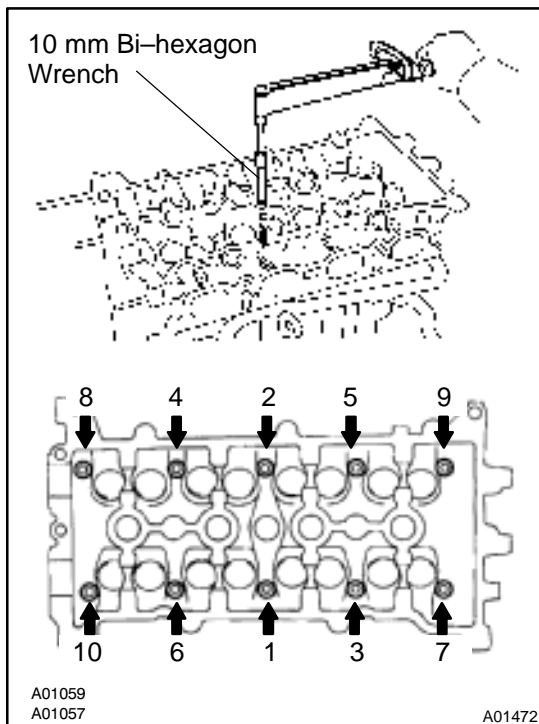
1. PLACE CYLINDER HEAD ON CYLINDER BLOCK

- Place a new cylinder head gasket on the cylinder block surface with the lot No. upward.

NOTICE:

Be careful of the installation direction.

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



2. INSTALL CYLINDER HEAD BOLTS

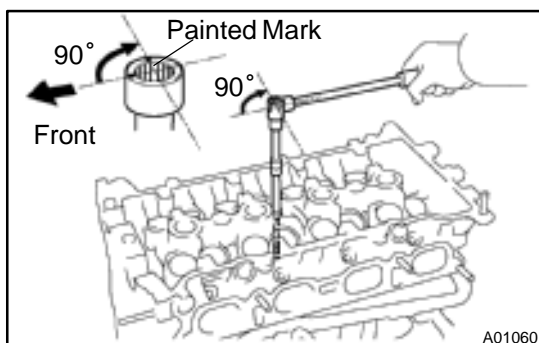
HINT:

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

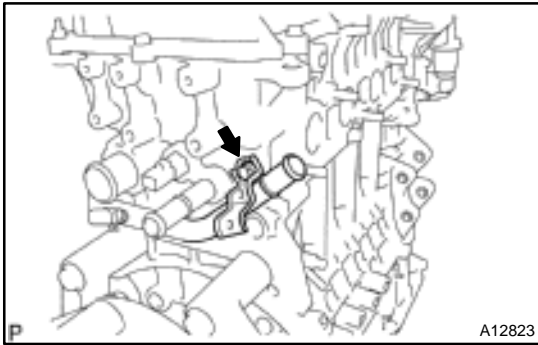
- Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
- Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 10 cylinder head bolts and plate washers in several passes, in the sequence shown.

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

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



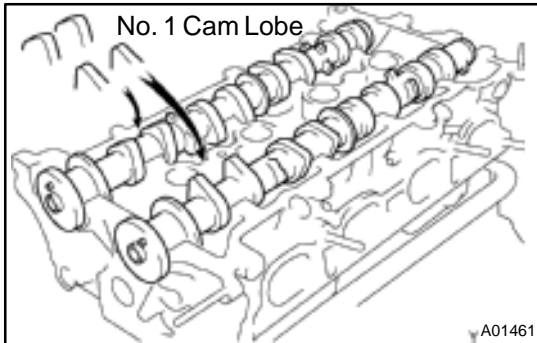
- Mark the front of the cylinder head bolt with paint.
- Retighten the cylinder head bolts 90° in the numerical order shown.
- Check that the painted mark is not at a 90° angle to the front.



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

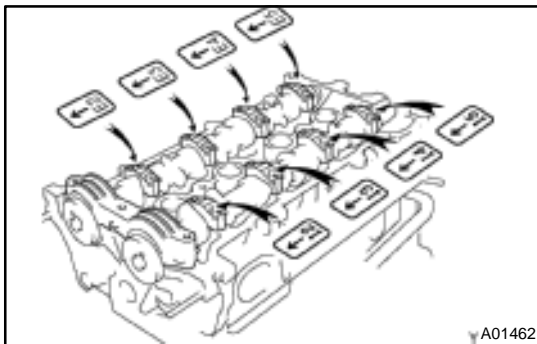
Torque: 9 N·m (92 kgf·cm, 80 in.-lbf)

- (g) Connect the upper radiator hose to the water hose union.
 (h) Connect the heater hose to the water hose union.



3. INSTALL CAMSHAFTS

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

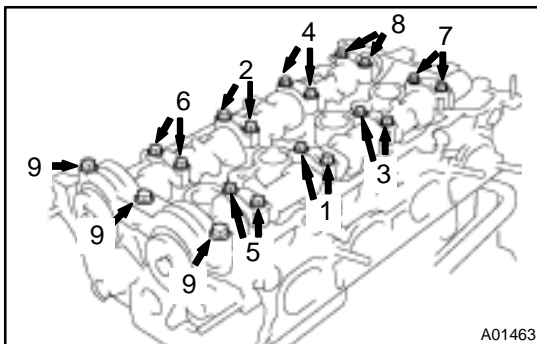


- (b) Install the bearing caps in their proper locations.

HINT:

No. 3 camshaft bearing cap has a number and front mark.

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



- (d) Install and uniformly tighten the 19 bearing cap bolts. After tightening the No. 1 camshaft bearing cap, tighten them in several passes, in the sequence shown.

Torque:

23 N·m (235 kgf·cm, 17 ft·lbf) for No. 1

13 N·m (133 kgf·cm, 10 ft·lbf) for No. 3

4. CHECK AND ADJUST VALVE CLEARANCE

(See page [EM-4](#))

5. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE

(See page [SF-42](#))

6. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE

FILTER (See page [SF-42](#))

7. INSTALL CAMSHAFT TIMING SPROCKET AND VVT

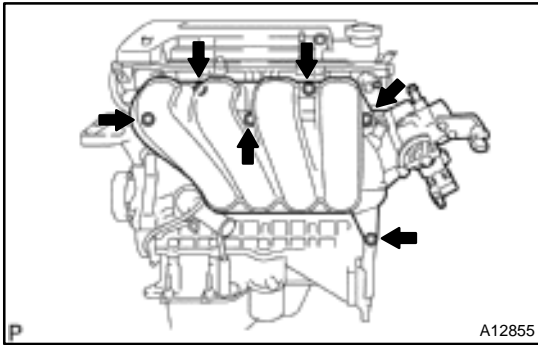
TIMING SPROCKET (See page [EM-20](#))

8. INSTALL TIMING CHAIN (See page [EM-20](#))

9. INSTALL CAMSHAFT POSITION SENSOR

(See page [IG-5](#))

10. INSTALL OIL FILLER CAP



11. INSTALL INTAKE MANIFOLD AND THROTTLE BODY ASSEMBLY

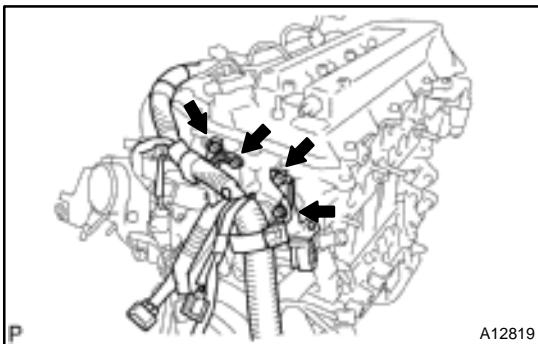
- (a) Install a new gasket to the intake manifold.
- (b) Install the intake manifold and throttle body assembly with the 2 brackets, 4 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

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

- (c) Connect the 2 vacuum hoses to the intake manifold.
- (d) Connect the 2 water hoses to the throttle body.

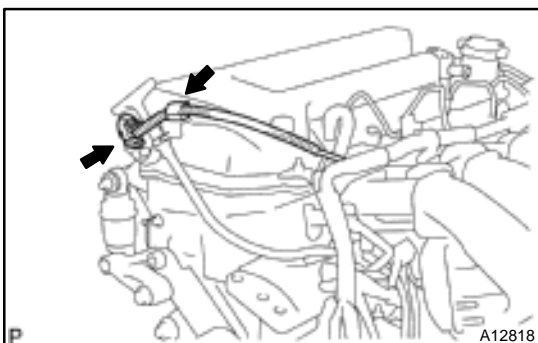
12. INSTALL PCV VALVE AND HOSES

- (a) Install the PCV valve with the grommet.
- (b) Install the PCV hoses.

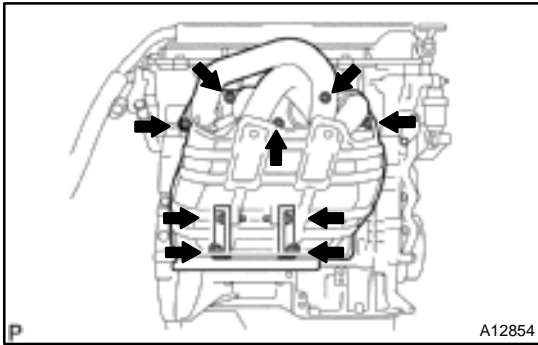


13. CONNECT ENGINE WIRE

- (a) Install the engine wire with the 2 bolts.
- (b) Install the 2 ground straps with the 2 bolts.
- (c) Connect the noise filter.
- (d) Connect the throttle position sensor connector.
- (e) Connect the IAC valve connector.
- (f) Connect the ECT sensor connector.
- (g) Connect the camshaft position sensor connector.
- (h) Connect the oil pressure switch connector and wire.
- (i) Connect the knock sensor connector.
- (j) Connect the crankshaft position sensor connector.
- (k) Connect the camshaft timing oil control valve connector.



- (l) Connect the heated oxygen sensor (bank 1 sensor 1) wire to the wire bracket.

**14. INSTALL EXHAUST MANIFOLD**

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

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

- (b) Install the 2 exhaust manifold stays with the 4 bolts.

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

- (c) Place the upper heat insulator on the exhaust manifold.

- (d) Install the 2 heated oxygen sensors (bank 1 sensor 1, bank 2 sensor 1).

Torque: 44 N·m (450 kgf·cm, 32 ft·lbf)

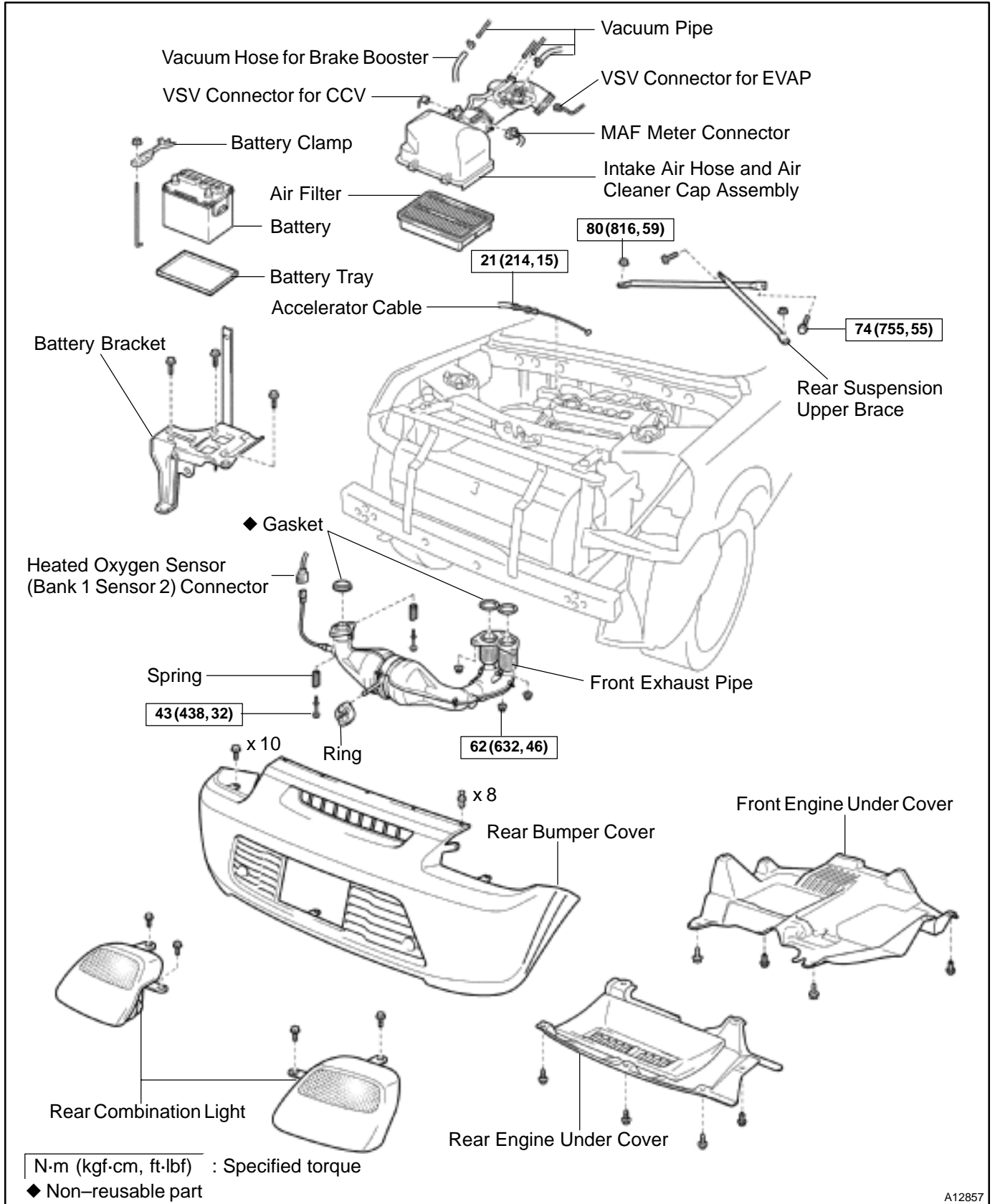
- (e) Install the upper heat insulator with the 4 bolts.

- (f) Connect the 2 heated oxygen sensors.

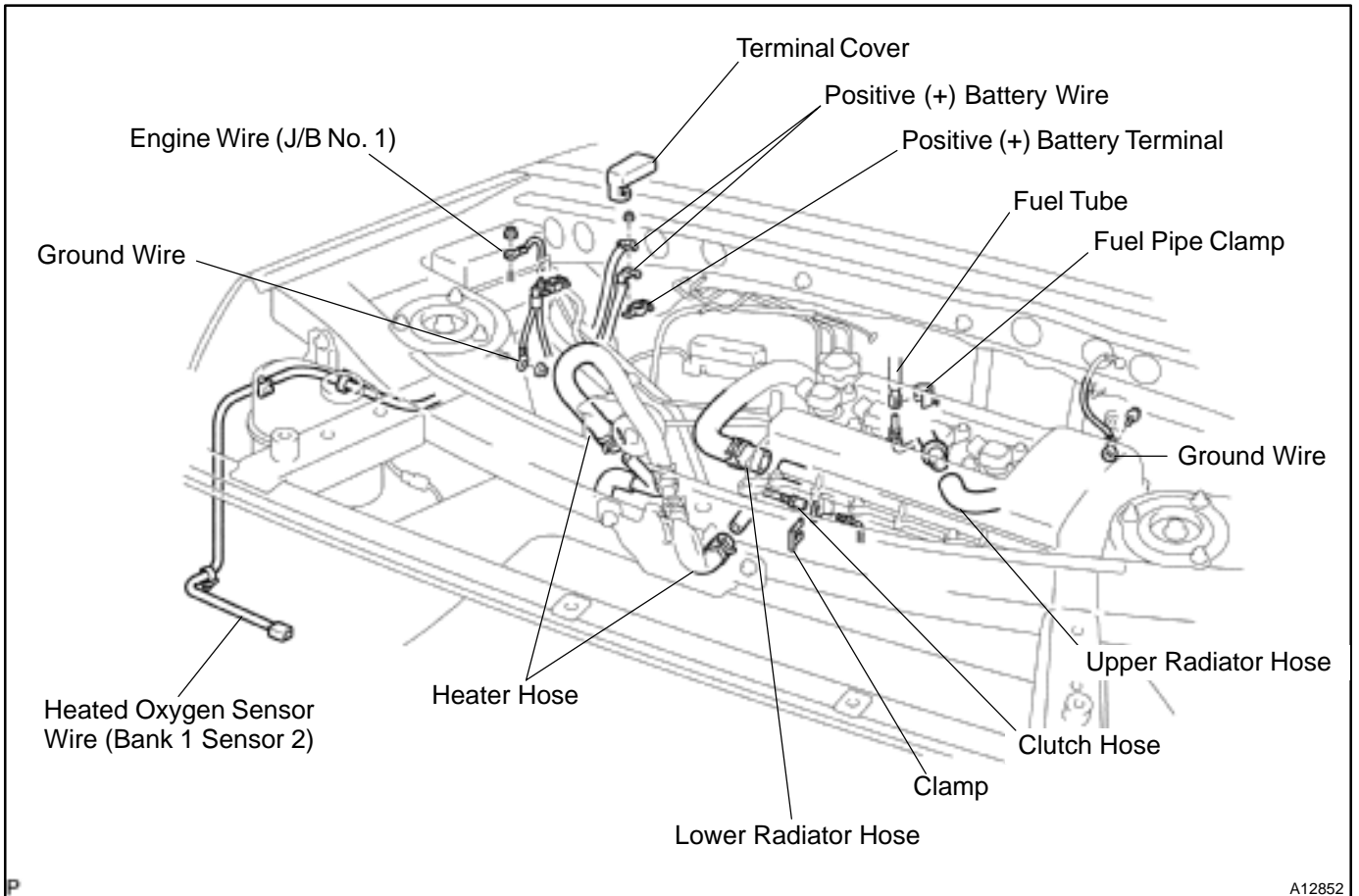
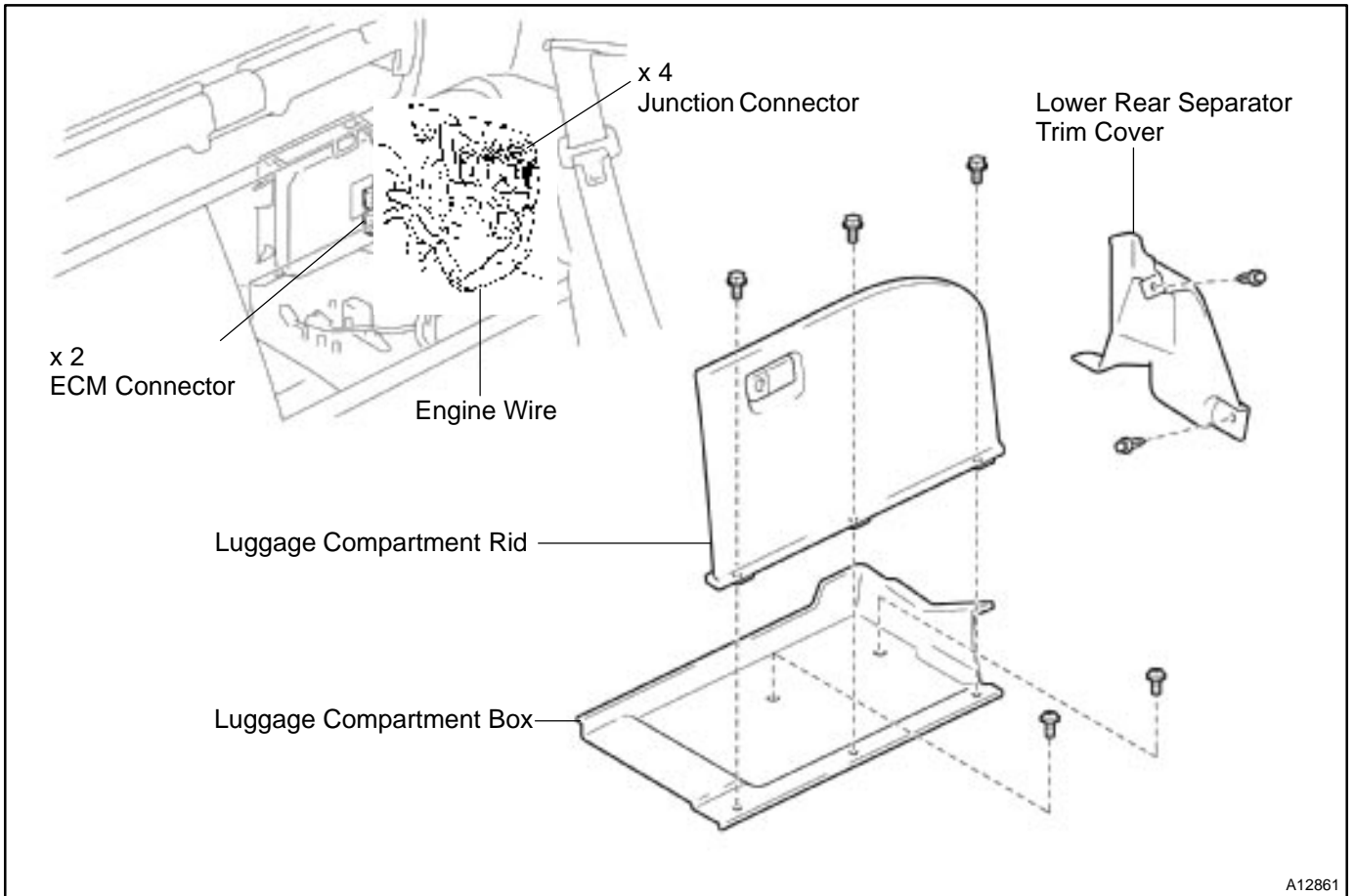
15. INSTALL INJECTORS (See page [SF-27](#))**16. INSTALL SPARK PLUGS (See page [IG-1](#))****17. INSTALL IGNITION COILS (See page [IG-4](#))****18. INSTALL GENERATOR (See page [CH-17](#))****19. INSTALL ENGINE UNIT (See page [EM-59](#))**

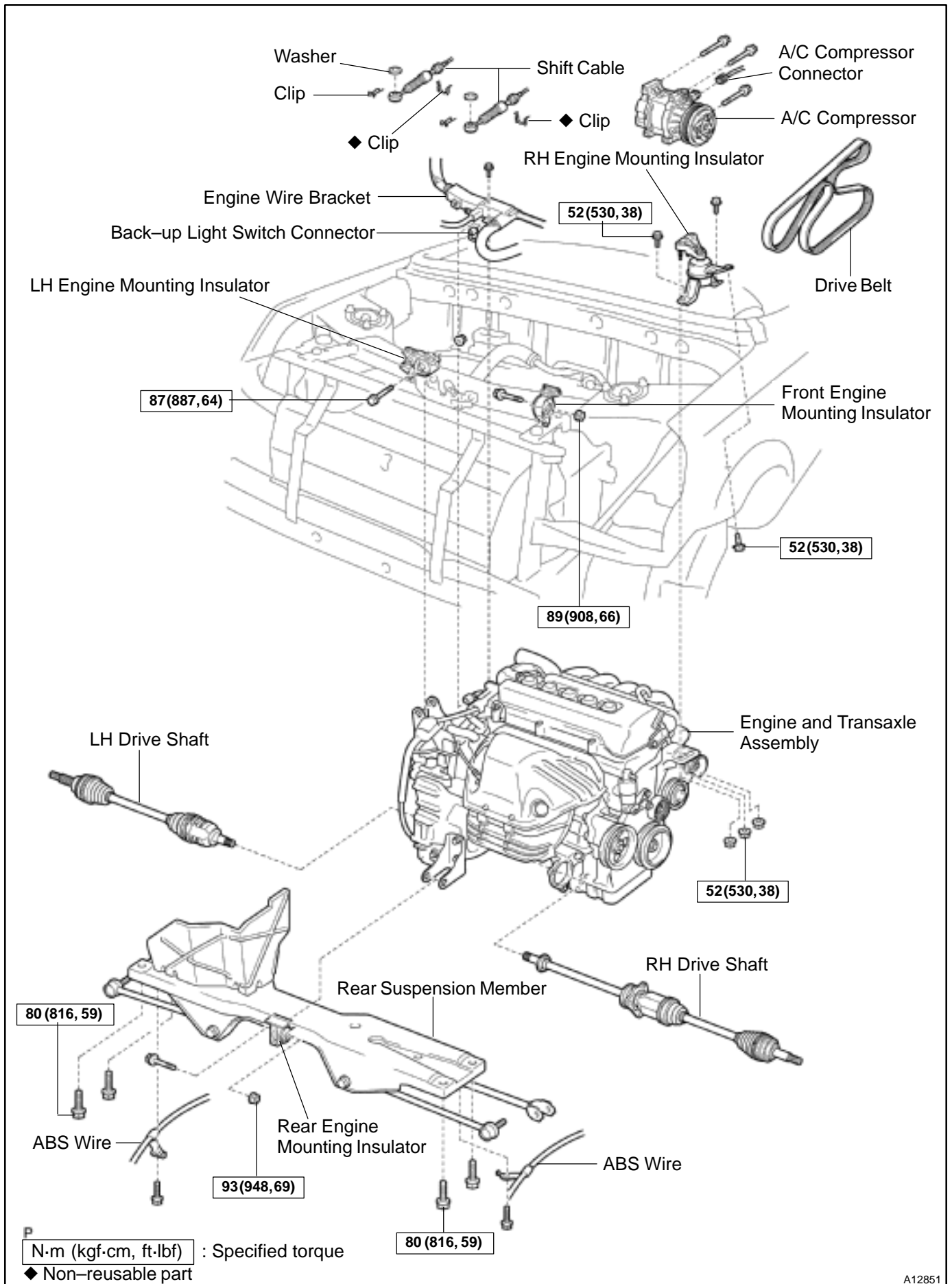
ENGINE UNIT COMPONENTS

EM19M-01

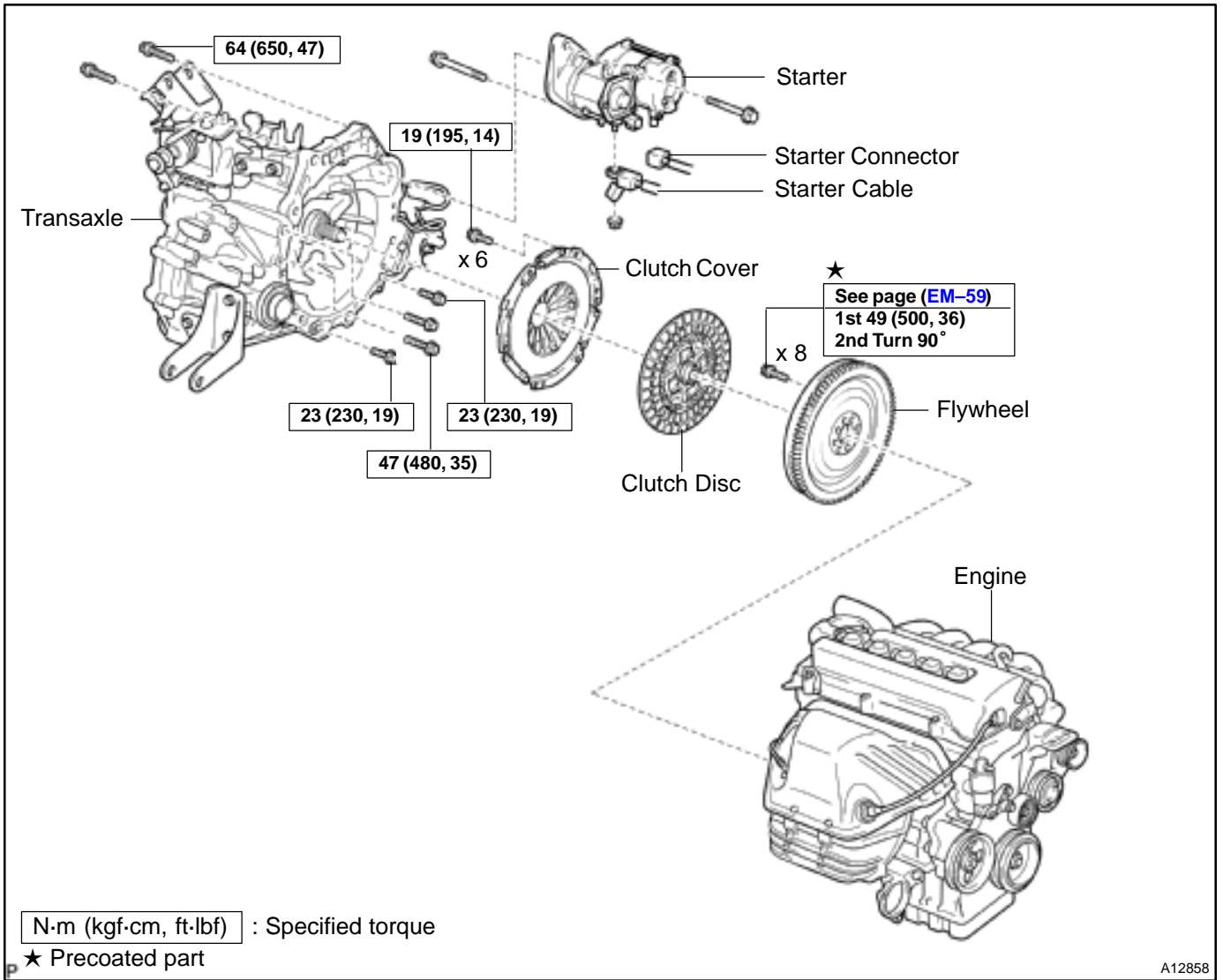


A12857





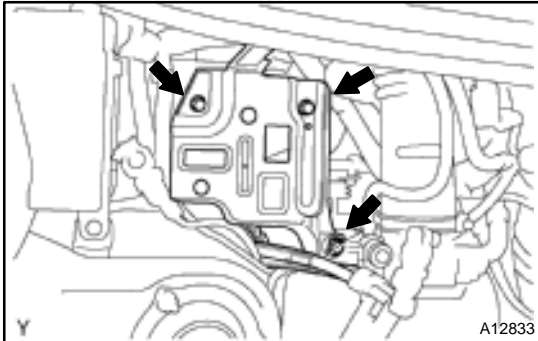
A12851



A12858

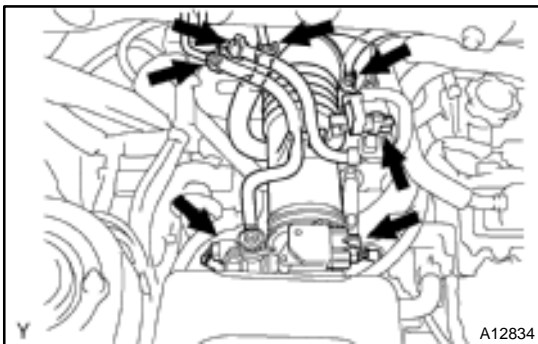
REMOVAL

1. REMOVE ENGINE HOOD
2. REMOVE REAR SUSPENSION UPPER BRACE
3. REMOVE ENGINE UNDER COVERS
4. DRAIN ENGINE COOLANT
5. DRAIN ENGINE OIL
6. DRAIN TRANSAXLE OIL



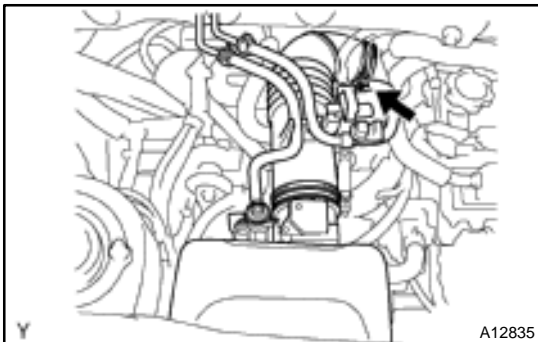
7. REMOVE BATTERY BRACKET

- (a) Remove the battery and tray.
- (b) Disconnect the battery wire from the battery bracket.
- (c) Remove the 3 bolts and battery bracket.



8. REMOVE INTAKE AIR HOSE AND AIR CLEANER CAP ASSEMBLY

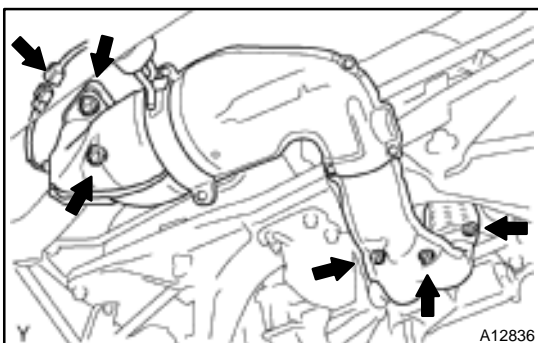
- (a) Disconnect the MAF meter connector, VSV connector for EVAP and VSV connector for CCV.
- (b) Disconnect the 4 vacuum hoses.
- (c) Disconnect the 2 clamps and air cleaner cap.



- (d) Loosen the hose clamp, and remove the intake air hose and air cleaner cap assembly from the throttle body.
- (e) Remove the air filter.

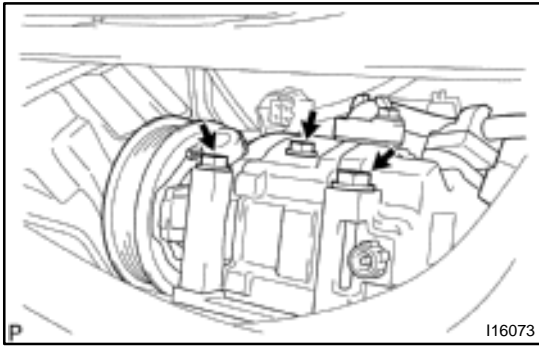
9. DISCONNECT ACCELERATOR CABLE

10. REMOVE REAR BUMPER COVER (See page [EM-50](#))



11. REMOVE FRONT EXHAUST PIPE

- (a) Disconnect the heated oxygen sensor (bank 1 sensor 2) connector.
- (b) Remove the 2 bolts, 2 springs and 3 nuts.
- (c) Disconnect the ring, and remove the front exhaust pipe and 3 gaskets.

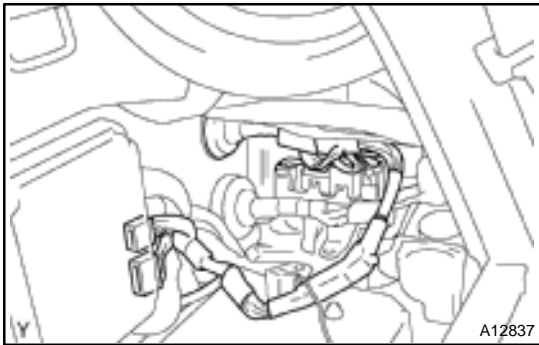


12. DISCONNECT A/C COMPRESSOR

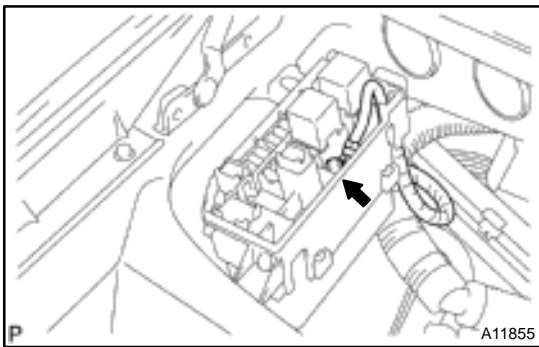
- (a) Remove the drive belt (See page CH-7).
- (b) Disconnect the A/C compressor connector.
- (c) Remove the 3 bolts, and disconnect the A/C compressor.
- (d) Suspend the A/C compressor securely.

13. DISCONNECT ENGINE WIRE

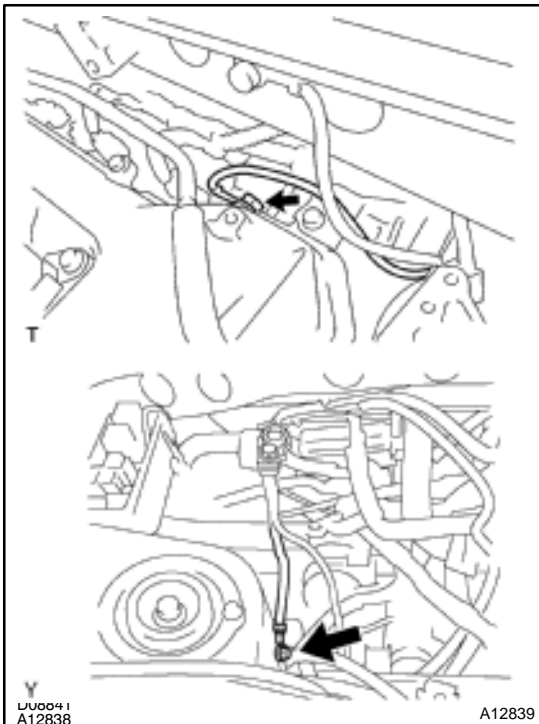
- (a) Disconnect the engine wire from the luggage compartment.
 - (1) Remove the luggage compartment box (See page EM-50).
 - (2) Disconnect the 2 ECM connectors.
 - (3) Disconnect the 4 junction connectors.
 - (4) Disconnect the grommet, and pull out the engine wire.

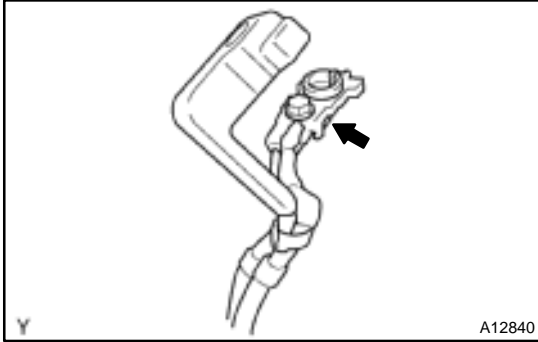


- (b) Disconnect the engine wire from the J/B No. 1.
 - (1) Remove the relay box cover.
 - (2) Remove the nut, and disconnect the engine wire.

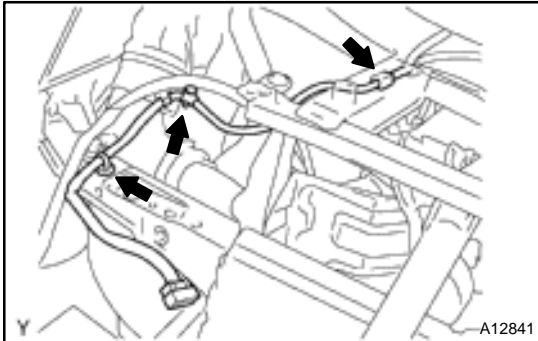


- (c) Remove the 2 bolts, and disconnect the 2 ground wires.

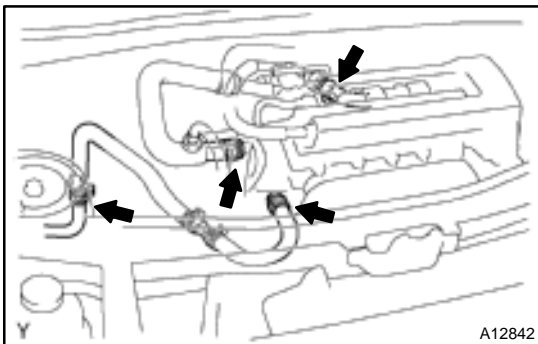




- (d) Separate the positive (+) battery wires.
- (1) Remove the terminal cover.
 - (2) Remove the nut and terminal, and separate the battery wires.
 - (3) Disconnect the battery wire from the vehicle.

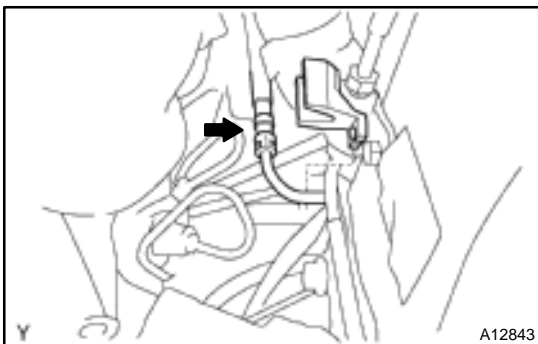


- (e) Disconnect the 3 wire brackets and heated oxygen sensor (bank 1 sensor 2) wire from the vehicle.



14. DISCONNECT WATER HOSES

Disconnect the 2 radiator hoses and 2 heater hoses.



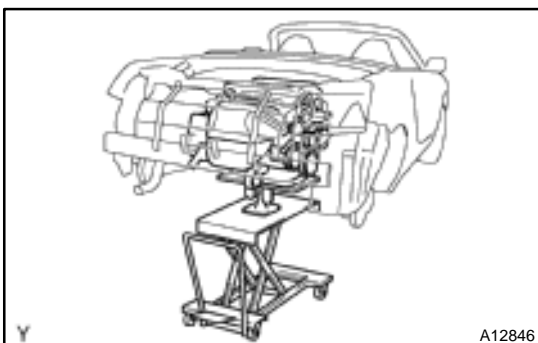
15. DISCONNECT FUEL TUBE

Remove the fuel pipe clamp, and disconnect the fuel tube from the fuel pipe.

16. DISCONNECT CLUTCH HOSE (See page [CL-10](#))

17. DISCONNECT TRANSAXLE CONTROL CABLES (See page [CL-15](#))

18. REMOVE DRIVE SHAFTS (See page [SA-41](#))

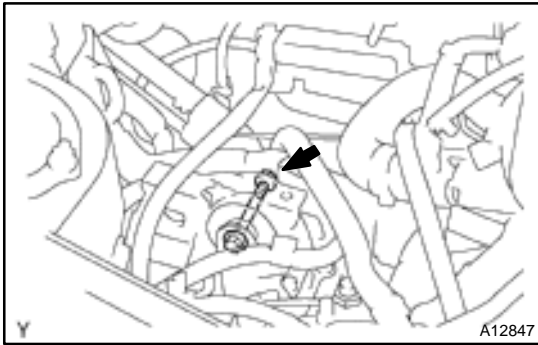


19. SET ENGINE JACK

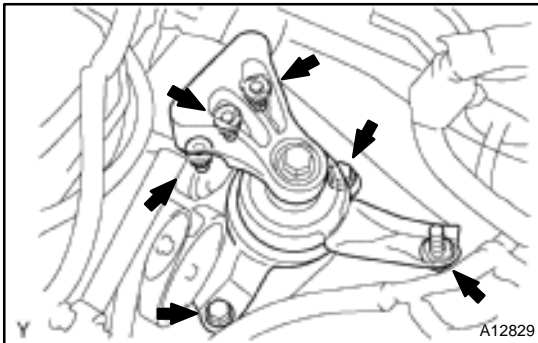
Remove the 2 clips, 2 nuts and No. 2 cylinder head cover, and set a engine jack.

NOTICE:

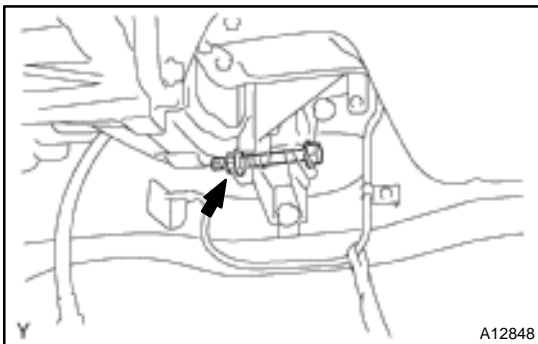
Using chain, hold the engine tightly.

**20. DISCONNECT ENGINE MOUNTING**

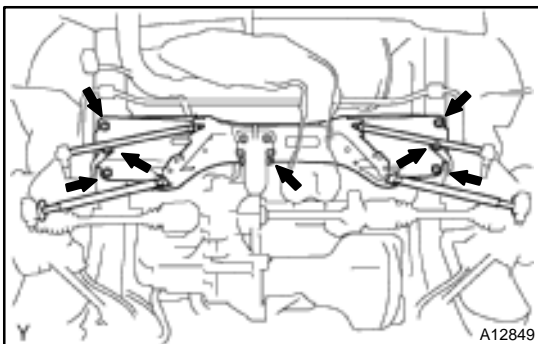
- (a) Remove the through bolt and nut holding the LH engine mounting insulator to the mounting bracket.



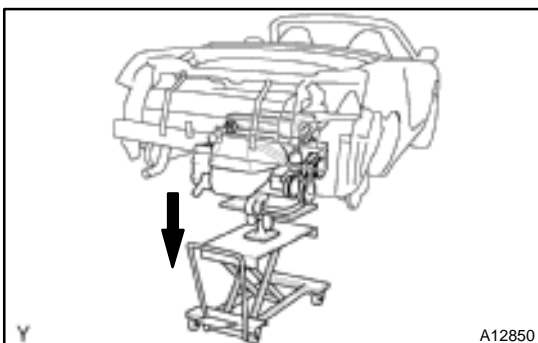
- (b) Remove the 3 bolts, 3 nuts and RH engine mounting insulator.



- (c) Remove the through bolt and nut holding the front engine mounting insulator to the mounting bracket.

**21. REMOVE SUSPENSION MEMBER**

- (a) Remove the 2 bolts, and disconnect the ABS wire.
 (b) Remove the 4 bolts, and disconnect the suspension member.
 (c) Remove the through bolt, nut and suspension member.

**22. 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.

23. SEPARATE ENGINE AND TRANSAXLE (See pageCL-15)

- (a) Remove the starter (See pageST-4).

(b) Remove the 6 bolts, and separate the engine and trans-axle.

24. REMOVE CLUTCH DISC (See page [MX-4](#))

25. REMOVE FLYWHEEL

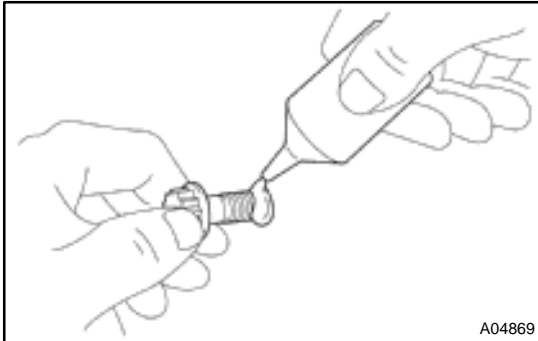
Remove the 8 bolts and flywheel.

INSTALLATION

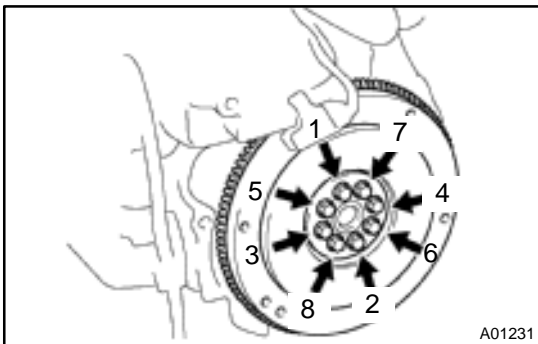
1. INSTALL FLYWHEEL

HINT:

- The mounting bolts are tightened in steps (c) and (e).
- If any one of the mounting bolts is broken or deformed, replace it.

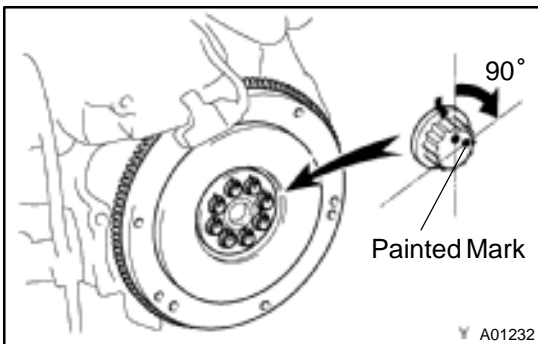


- (a) Apply adhesive to 2 or 3 threads of the mounting bolt end.
Adhesive:
Part No. 08833-00070, THREE BOND 1324 or equivalent



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

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



- (d) Mark the flywheel bolt with paint.
 (e) Retighten the flywheel bolts by an additional 90°.

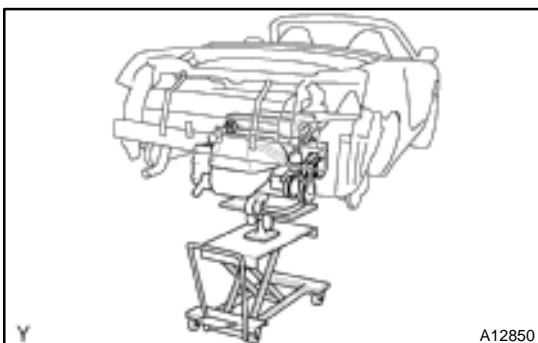
2. INSTALL CLUTCH DISC AND COVER

(See page [CL-17](#))

3. INSTALL TRANSAXLE TO ENGINE

(See page [CL-17](#))

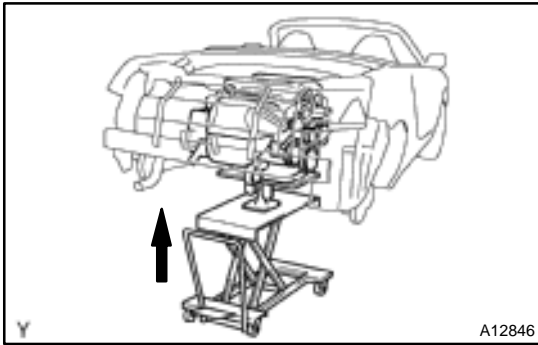
- (a) Attach the transaxle to the engine, and install the 6 bolts.
 (b) Install the starter (See page [ST-16](#)).



4. SET ENGINE JACK

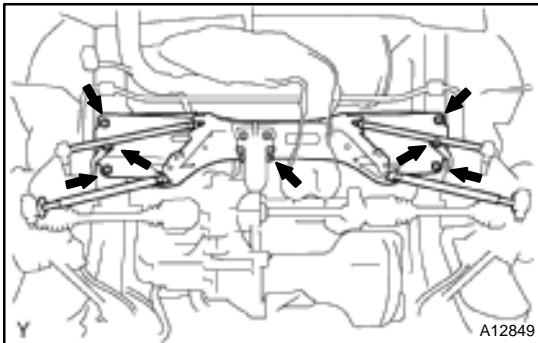
NOTICE:

Using a chain, hold the engine tightly.



5. INSTALL ENGINE AND TRANSAXLE ASSEMBLY IN VEHICLE

- (a) Raise the engine into the engine compartment.

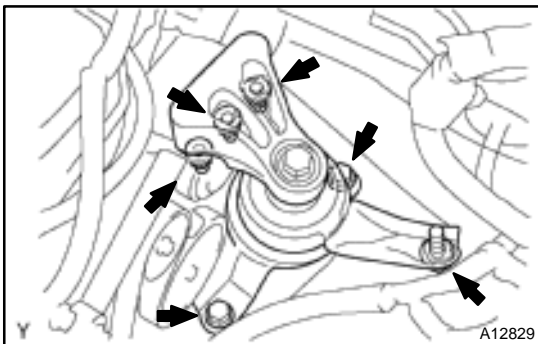


- (b) Temporary install the rear suspension member to the engine with the through bolt and nut.

- (c) Connect the rear suspension member with the 4 bolts.

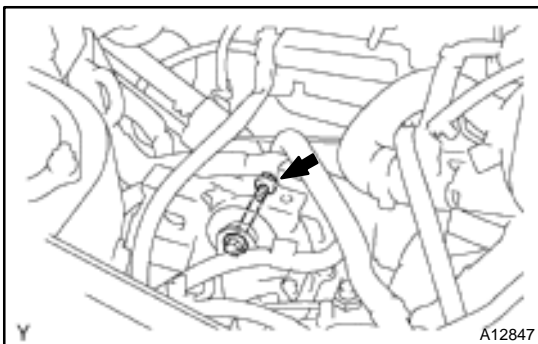
Torque: 80 N·m (816 kgf-cm, 59 ft-lbf)

- (d) Connect the ABS wire with the 2 bolts.

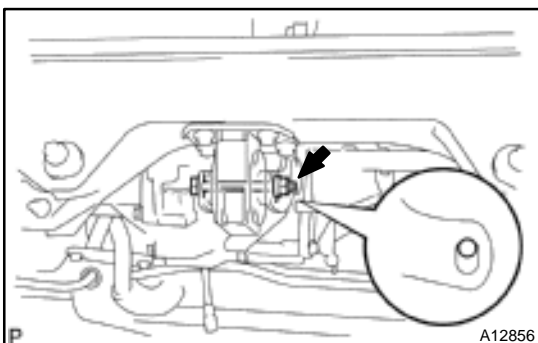


- (e) Install the RH engine mounting insulator with the 3 bolts and 3 nuts.

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



- (f) Temporary install the through bolt and nut holding the LH engine mounting insulator and mounting bracket.

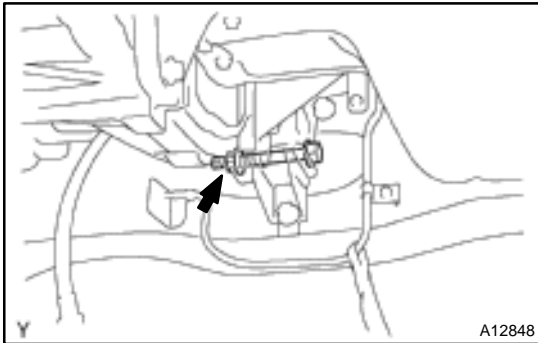


- (g) Tighten the through bolt and nut holding the rear engine mounting insulator and mounting bracket.

Torque: 93 N·m (948 kgf-cm, 69 ft-lbf)

NOTICE:

Be sure to tighten the bolt at the upper end of slot.



- (h) Install the through bolt holding the front engine mounting insulator and mounting bracket.

Torque: 89 N·m (908 kgf·cm, 66 ft·lbf)

- (i) Tighten the through bolt and nut holding the LH engine mounting insulator and mounting bracket.

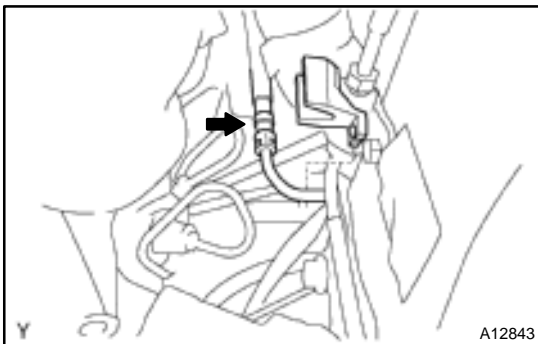
Torque: 87 N·m (887 kgf·cm, 64 ft·lbf)

- (j) Remove the engine jack, and install the No. 2 cylinder head cover with the 2 clips and 2 nuts.

6. INSTALL DRIVE SHAFTS (See page SA-49)

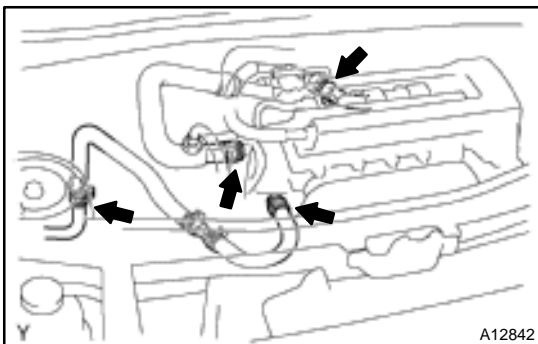
7. CONNECT TRANSAXLE CONTROL CABLES (See page CL-17)

8. CONNECT CLUTCH HOSE (See page CL-13)



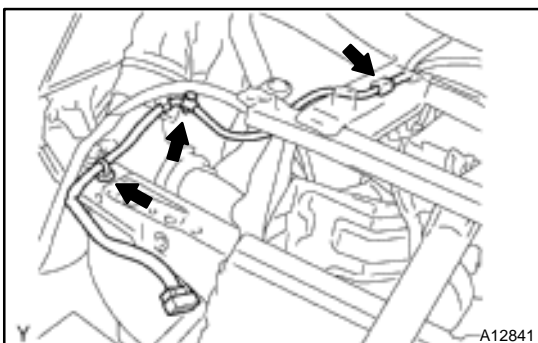
9. CONNECT FUEL TUBE

Connect the fuel tube to the fuel pipe, and install the fuel pipe clamp.



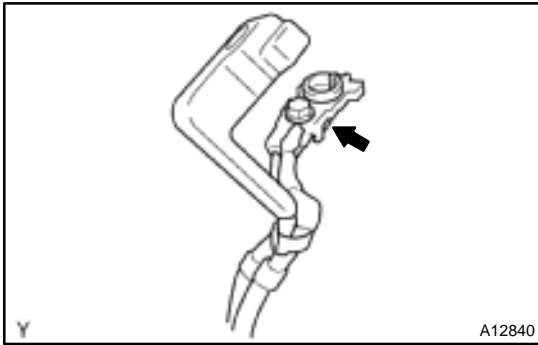
10. CONNECT WATER HOSES

Connect the 2 radiator hoses and 2 heater hoses.

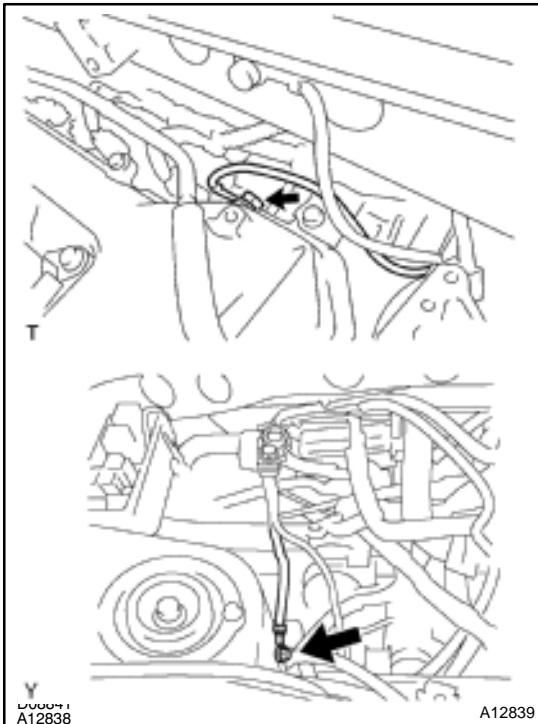


11. CONNECT ENGINE WIRE

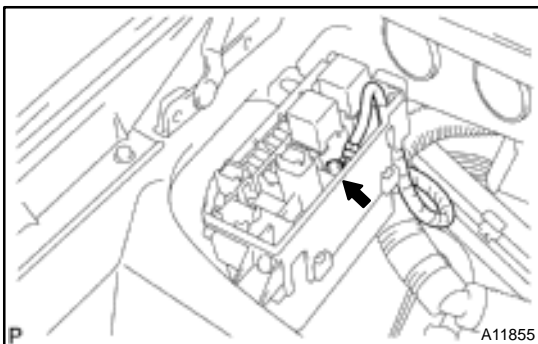
- (a) Connect the 3 wire brackets and heated oxygen sensor (bank 1 sensor 2) wire to the vehicle.



- (b) Assemble the positive (+) battery wires.
- (1) Assemble the battery wires, and install the terminal with the nut.
 - (2) Install the terminal cover.



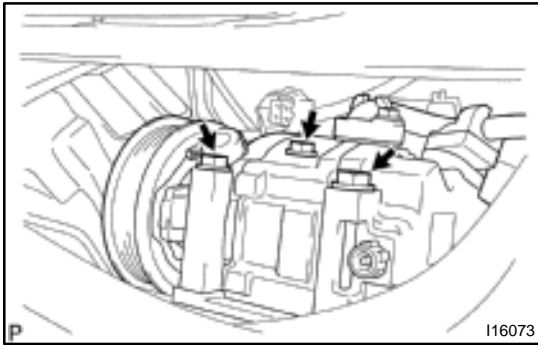
- (c) Connect the 2 ground wires with the 2 bolts.



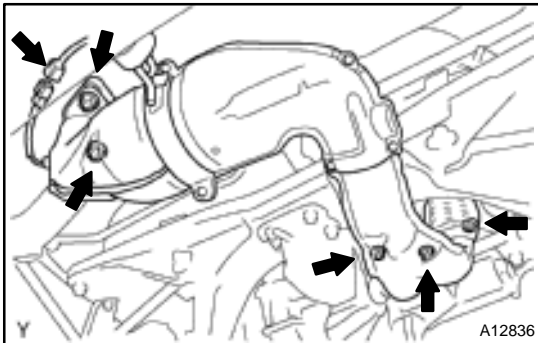
- (d) Connect the engine wire to the J/B No. 1.
- (1) Connect the engine wire with the nut.
 - (2) Install the relay box cover.



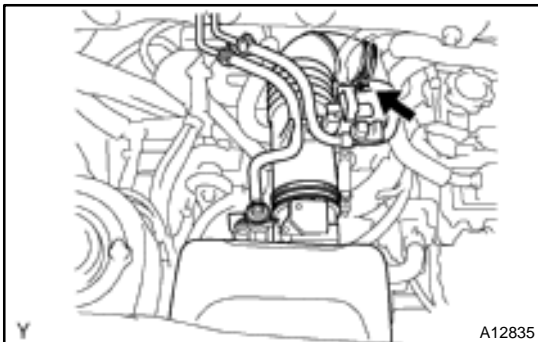
- (e) Connect the engine wire to the luggage compartment.
- (1) Pull in the engine wire to the luggage compartment, and connect the grommet.
 - (2) Connect the 4 junction connectors.
 - (3) Connect the 2 ECM connectors.
 - (4) Install the luggage compartment box (See page [EM-50](#)).

**12. INSTALL A/C COMPRESSOR**

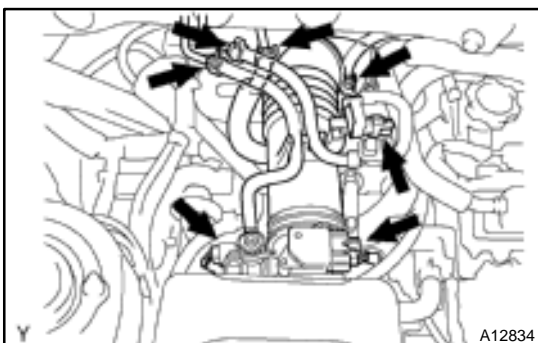
- (a) Install the A/C compressor with the 3 bolts.
Torque: 25 N·m (255 kgf·cm, 18 ft·lbf)
- (b) Connect the A/C compressor connector.
- (c) Install the drive belt (See page [CH-17](#)).

**13. INSTALL FRONT EXHAUST PIPE**

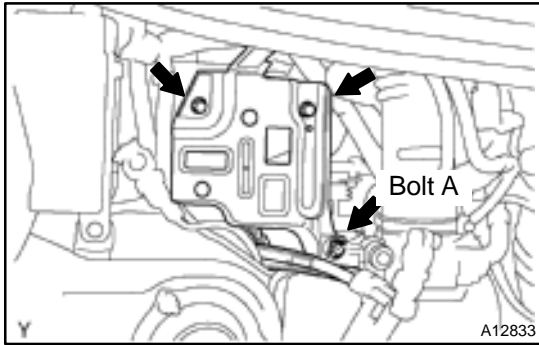
- (a) Connect the ring.
- (b) Install 3 new gaskets and the front exhaust pipe with the 2 bolts, 2 springs and 3 nuts.
Torque:
43 N·m (438 kgf·cm, 32 ft·lbf) for bolt
62 N·m (632 kgf·cm, 46 ft·lbf) for nut
- (c) Connect the heated oxygen sensor (bank 2 sensor 1) connector.

14. INSTALL REAR BUMPER COVER AND REAR COMBINATION LIGHTS (See page [EM-50](#))**15. CONNECT ACCELERATOR CABLE****Torque: 21 N·m (214 kgf·cm, 15 ft·lbf)****16. INSTALL INTAKE AIR HOSE AND AIR CLEANER CAP ASSEMBLY**

- (a) Install the air filter.
- (b) Install the intake air hose and air cleaner cap assembly to the throttle body, and tighten the hose clamp.
- (c) Connect the air cleaner cap with the 2 clamps.



- (d) Connect the 4 hoses.
- (e) Connect the MAF meter connector, VSV connector for EVAP and VSV connector for CCV.

**17. INSTALL BATTERY BRACKET**

(a) Install the battery bracket with the 3 bolts.

HINT:

Install bolt A with the air cleaner case.

(b) Install the tray and battery.

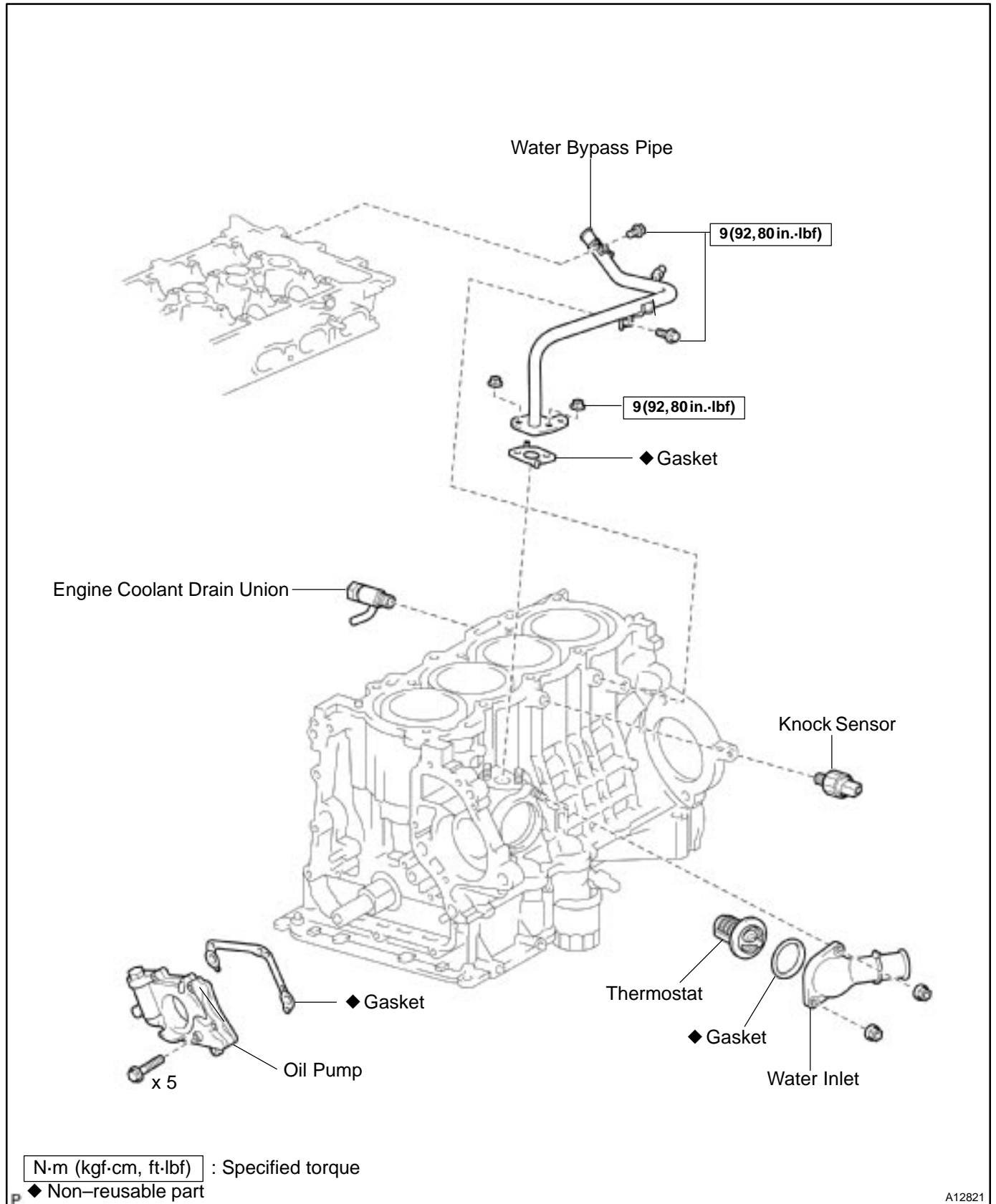
18. FILL CLUTCH RESERVOIR WITH BRAKE FLUID AND BLEED CLUTCH SYSTEM**19. FILL WITH TRANSAXLE OIL****20. FILL WITH ENGINE OIL****21. FILL WITH ENGINE COOLANT (See page [CO-2](#))****22. START ENGINE AND CHECK FOR LEAKS****23. PERFORM ENGINE ADJUSTMENT****24. CHECK FRONT WHEEL ALIGNMENT****25. INSTALL ENGINE UNDER COVERS****26. INSTALL SUSPENSION UPPER BRACE****27. INSTALL ENGINE HOOD****28. ROAD TEST VEHICLE**

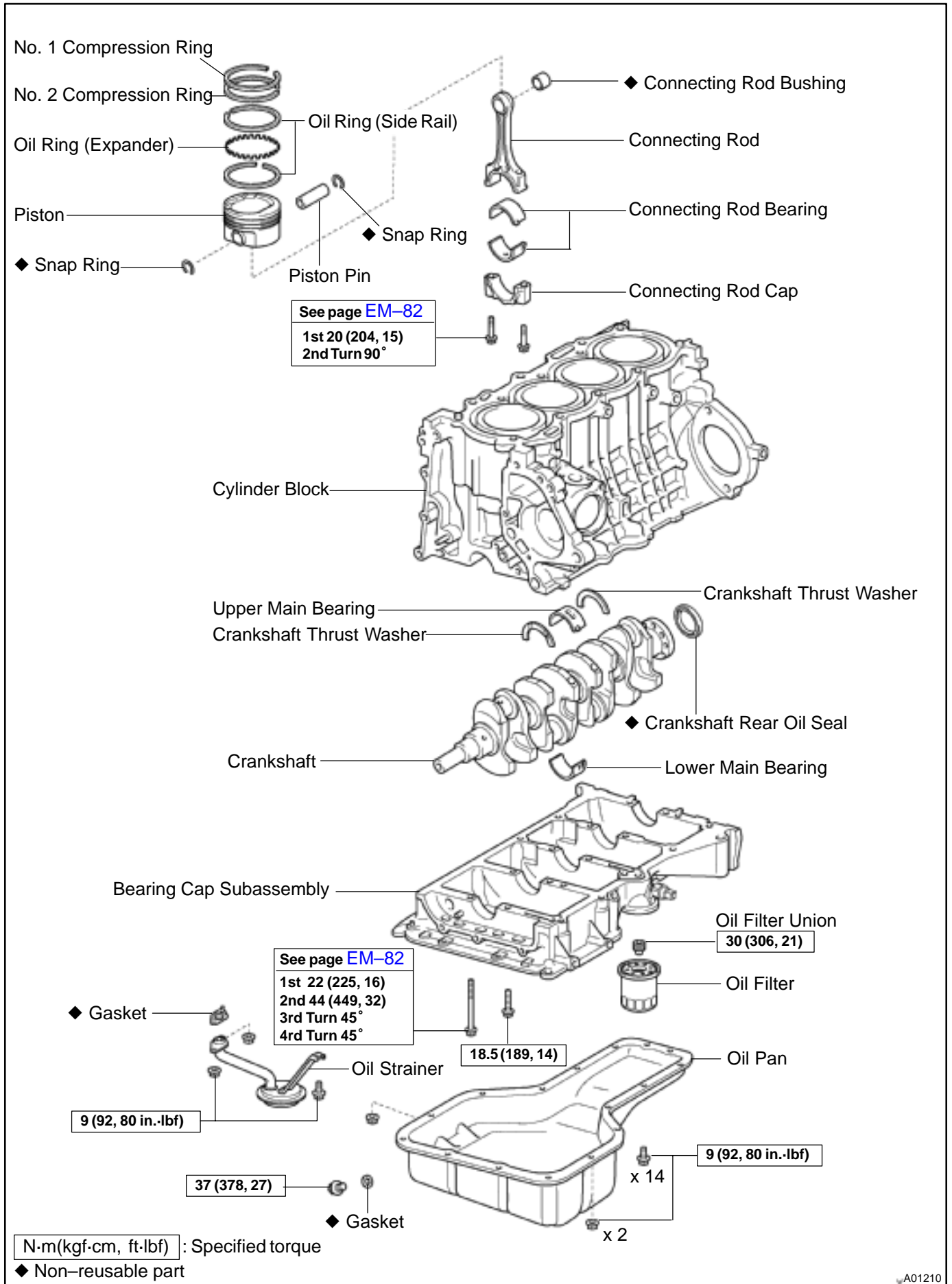
Check for abnormal noises, shock slippage, correct shift points and smooth operation.

29. RECHECK ENGINE COOLANT AND OIL LEVELS

CYLINDER BLOCK COMPONENTS

EM19P-01

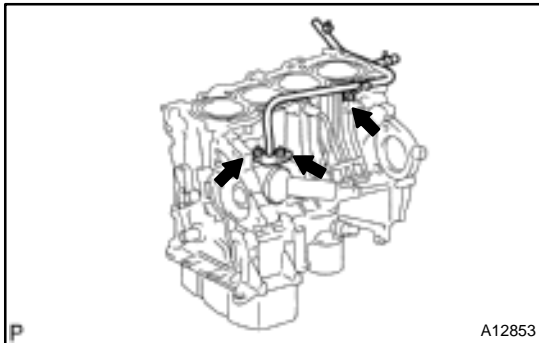




A01210

DISASSEMBLY

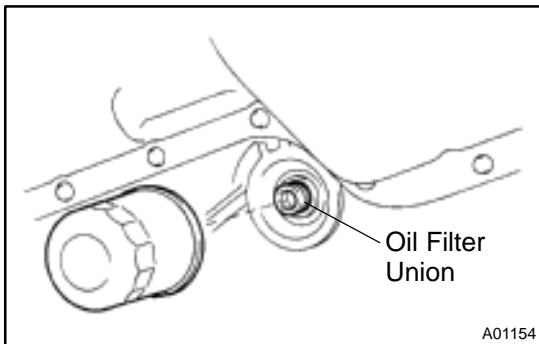
1. INSTALL ENGINE TO ENGINE STAND FOR DISASSEMBLY
2. REMOVE CYLINDER HEAD (See page EM-29)



3. REMOVE WATER BYPASS PIPE

Remove the 2 nuts, bolts, water bypass pipe and gasket.

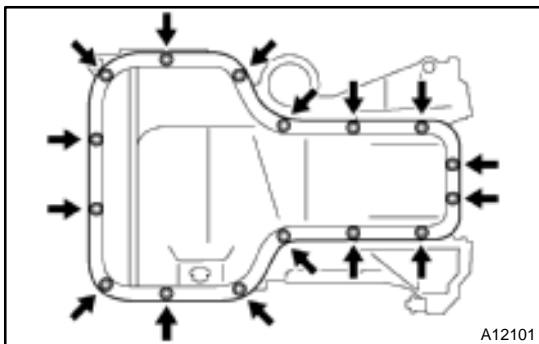
4. REMOVE THERMOSTAT (See page CO-11)
5. REMOVE KNOCK SENSOR
6. REMOVE ENGINE COOLANT DRAIN UNION
7. REMOVE OIL PUMP (See page LU-8)



8. REMOVE OIL FILTER (See page LU-3)

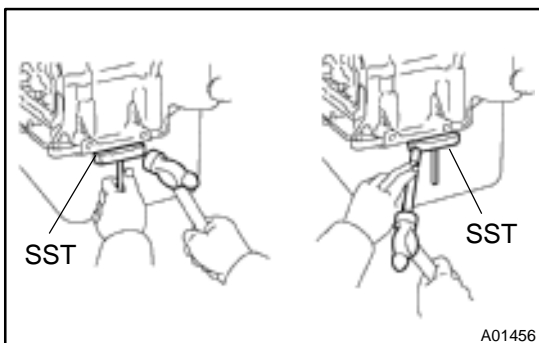
9. REMOVE OIL FILTER UNION

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



10. REMOVE OIL PAN

- (a) Remove the 14 bolts and 2 nuts.

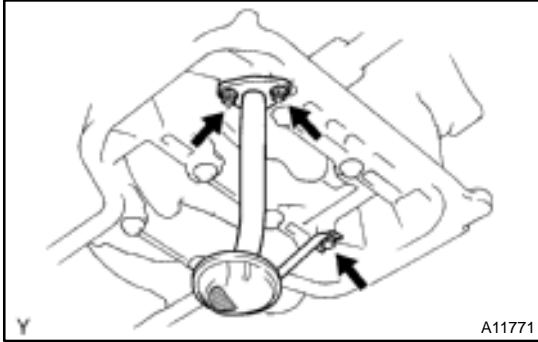


- (b) Insert the blade of SST between the bearing cap subassembly and oil pan, and cut off applied sealer and remove the oil pan.

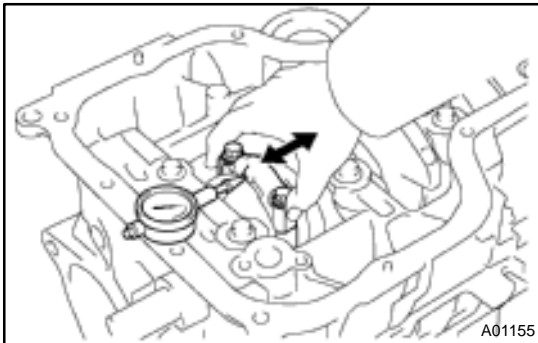
SST 09032-00100

NOTICE:

- Be careful not to damage the oil pan contact surface of the bearing cap subassembly.
- Be careful not to damage the oil pan flange.

**11. REMOVE OIL STRAINER**

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

**12. CHECK CONNECTING ROD THRUST CLEARANCE**

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

Standard thrust clearance:

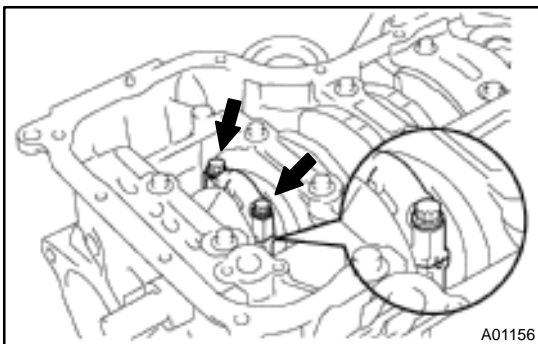
0.160 – 0.342 mm (0.0063 – 0.0135 in.)

Maximum thrust clearance: 0.342 mm (0.0135 in.)

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

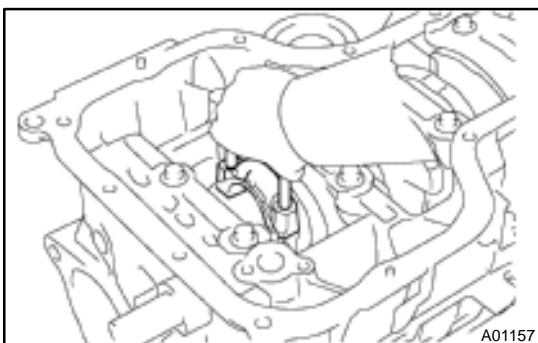
Connecting rod thickness:

19.788 – 19.840 mm (0.7791 – 0.7811 in.)

**13. 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:

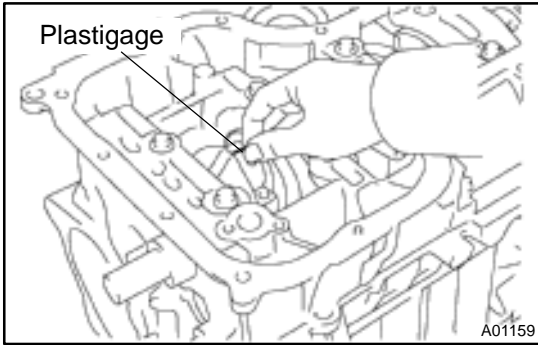
Keep the lower bearing inserted with the connecting rod cap.

(d) Clean the crank pin and bearing.

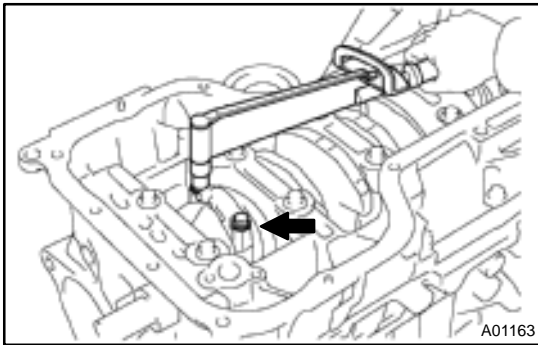
(e) Check the crank pin and bearing for pitting and scratches.

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

If necessary, replace the crankshaft.



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

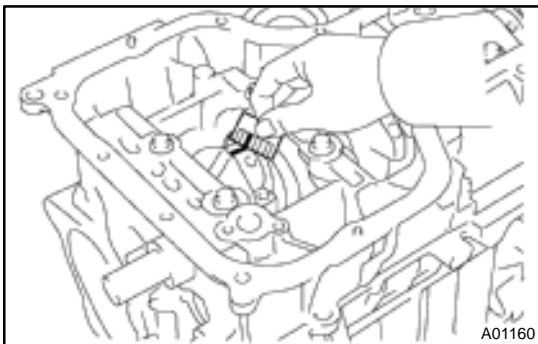


(g) Install the connecting rod cap with the 2 bolts (See page EM-82).

NOTICE:

Do not turn the crankshaft.

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



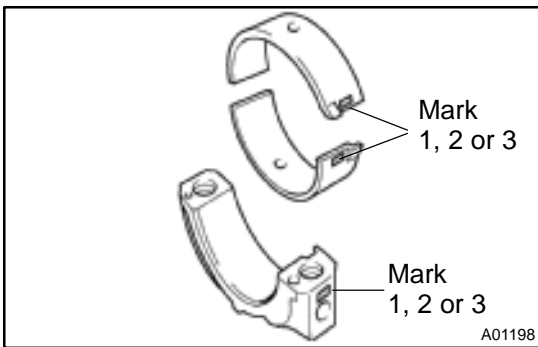
(i) Measure the Plastigage at its widest point.

Standard oil clearance:

0.028 – 0.060 mm (0.0011 – 0.0024 in.)

Maximum oil clearance: 0.08 mm (0.0031 in.)

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



HINT:

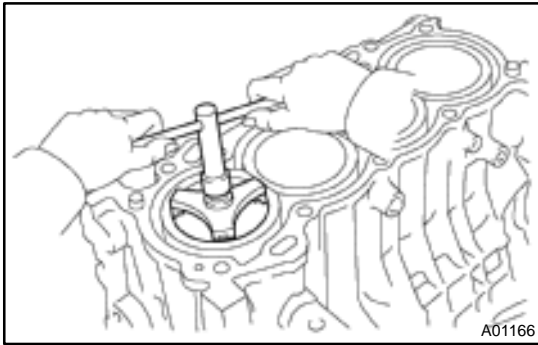
If replacing a bearing, replace it with one having the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked "1", "2" and "3" accordingly.

Reference

Standard bearing center wall thickness:

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

(j) Completely remove the Plastigage.

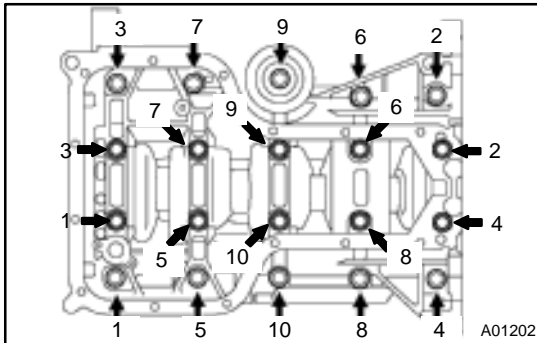


14. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES

- (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.

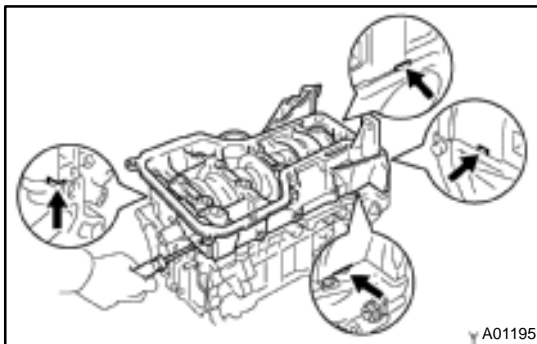
HINT:

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



15. REMOVE BEARING CAP SUBASSEMBLY AND CRANKSHAFT REAR OIL SEAL, AND CHECK OIL CLEARANCE

- (a) Remove the 10 hexagon head bearing cap bolts.
- (b) Uniformly loosen and remove the 10 bearing cap bolts in several passes, in the sequence shown.



- (c) Using a screwdriver, remove the bearing cap subassembly by prying the portions between the cylinder block and bearing cap subassembly. Remove the 5 lower main bearings.

NOTICE:

Be careful not to damage the contact surfaces of the cylinder block and bearing cap subassembly.

HINT:

Keep the lower bearing and bearing cap subassembly together.

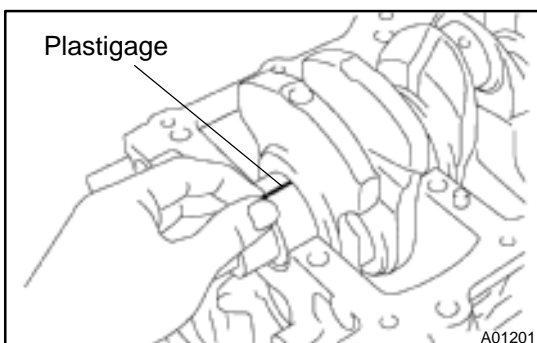
- (d) Remove the crankshaft rear oil seal.
- (e) Lift out the crankshaft.

HINT:

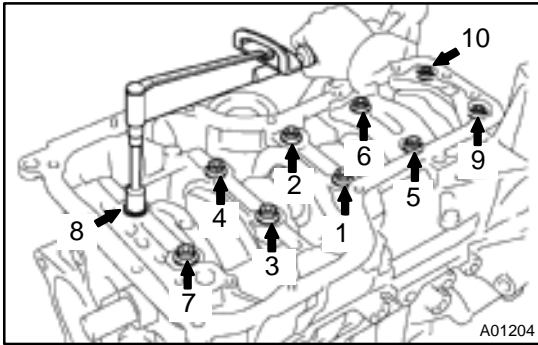
Keep the upper bearings together with the cylinder block.

- (f) Clean each main journal and bearing.
- (g) Check each main journal, bearing for pitting and scratches.

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



- (h) Place the crankshaft on the cylinder block.
- (i) Lay a strip of Plastigage across each journal.

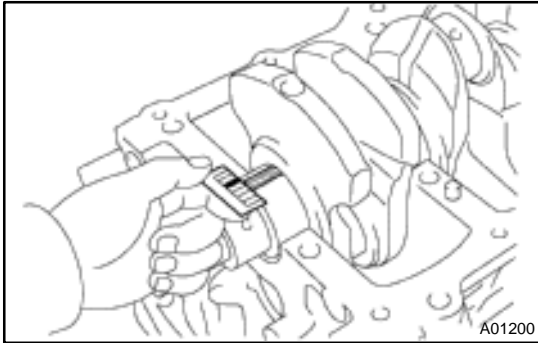


(j) Install the bearing cap subassembly (See page EM-82).

NOTICE:

Do not turn the crankshaft.

(k) Remove the bearing cap subassembly (See procedures (a) to (d) above).



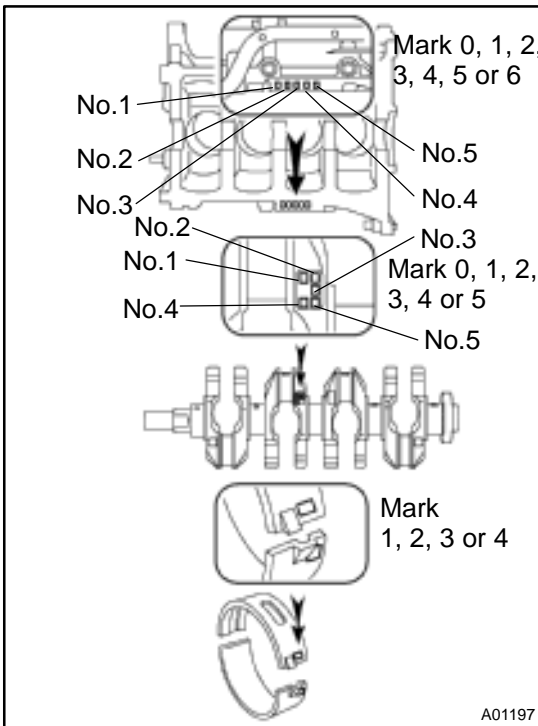
(l) Measure the Plastigage at its widest point.

Standard oil clearance:

0.015 – 0.032 mm (0.0006 – 0.0013 in.)

Maximum oil clearance: 0.050 mm (0.0020 in.)

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



(m) 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")

Standard bearings selection chart

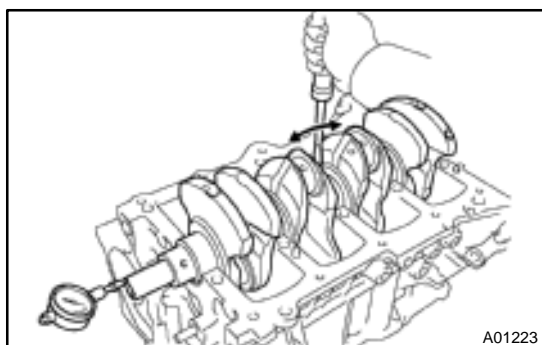
Cylinder block Number mark	Crankshaft number mark					
	0	1	2	3	4	5
0	1	1	1	2	2	2
1	1	1	2	2	2	3
2	1	2	2	2	3	3
3	2	2	2	3	3	3
4	2	3	3	3	4	4
5	3	3	3	4	4	4
6	3	3	4	4	4	5

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

Reference

Item	Mark	mm (in.)
Cylinder block main journal bore diameter (A)	0	52.000 – 52.003 (2.0472 – 2.0473)
	1	52.003 – 52.005 (2.0473 – 2.0474)
	2	52.005 – 52.007 (2.0474 – 2.0475)
	3	52.007 – 52.010 (2.0475 – 2.0476)
	4	52.010 – 52.012 (2.0476 – 2.0477)
	5	52.012 – 52.014 (2.0477 – 2.0478)
	6	52.014 – 52.016 (2.0478 – 2.0479)
Crankshaft main journal diameter (B)	0	47.998 – 48.000 (1.8897 – 1.8898)
	1	47.996 – 47.998 (1.8896 – 1.8897)
	2	47.994 – 47.996 (1.8895 – 1.8896)
	3	47.992 – 47.994 (1.8894 – 1.8895)
	4	47.990 – 47.992 (1.8893 – 1.8894)
	5	47.988 – 47.990 (1.8892 – 1.8893)
Standard bearing center wall thickness	1	1.993 – 1.996 (0.0785 – 0.0786)
	2	1.996 – 1.999 (0.0786 – 0.0787)
	3	1.999 – 2.002 (0.0787 – 0.0788)
	4	2.002 – 2.005 (0.0788 – 0.0789)

(n) Completely remove the Plastigage.



16. CHECK CRANKSHAFT THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance:

0.04 – 0.24 mm (0.0016 – 0.0094 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

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

Thrust washer thickness:

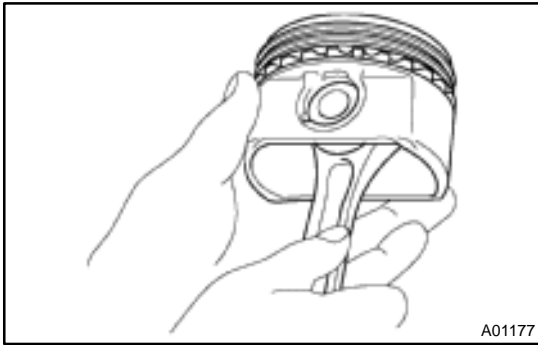
2.430 – 2.480 mm (0.0957 – 0.0976 in.)

17. REMOVE CRANKSHAFT

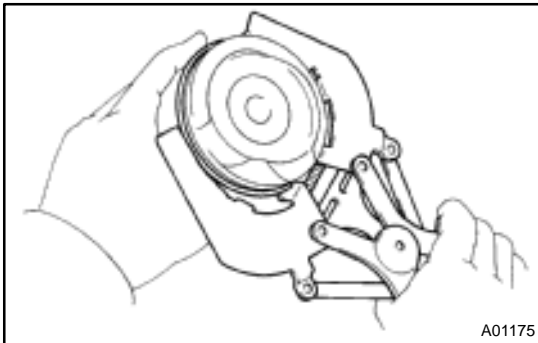
- Lift out the crankshaft.
- Remove the 5 upper main bearings and 2 thrust washers from the cylinder block.

HINT:

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

**18. 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.

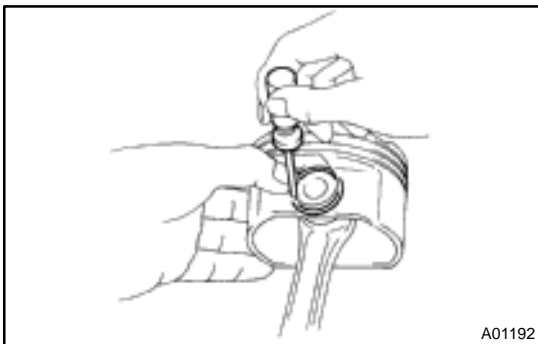
**19. REMOVE PISTON RINGS**

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

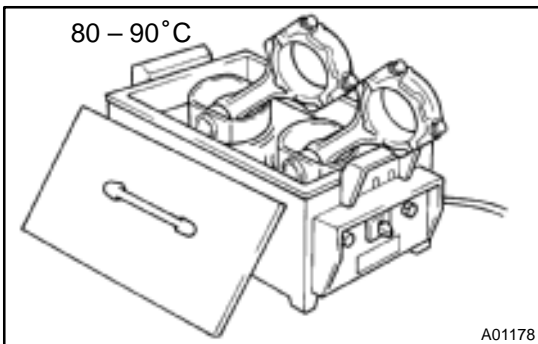
(b) Remove the 2 side rails and oil ring by hand.

HINT:

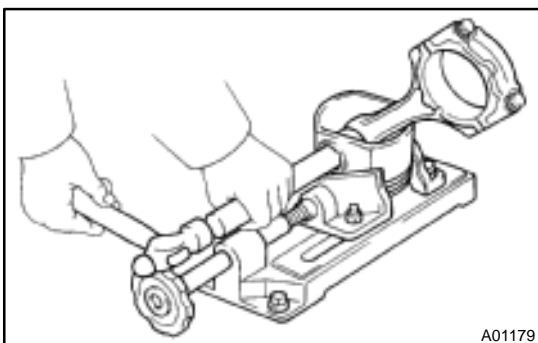
Arrange the piston rings in the correct order only.

**20. DISCONNECT CONNECTING ROD FROM PISTON**

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



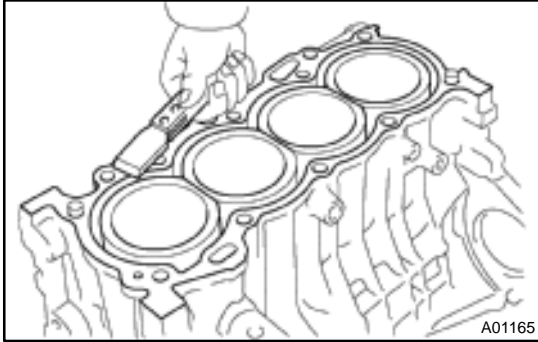
(b) Gradually heat the piston to 80 – 90°C (176 – 194°F).



(c) Using a plastic-faced hammer and a brass bar, lightly tap out the piston pin and remove the connecting rod.

HINT:

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



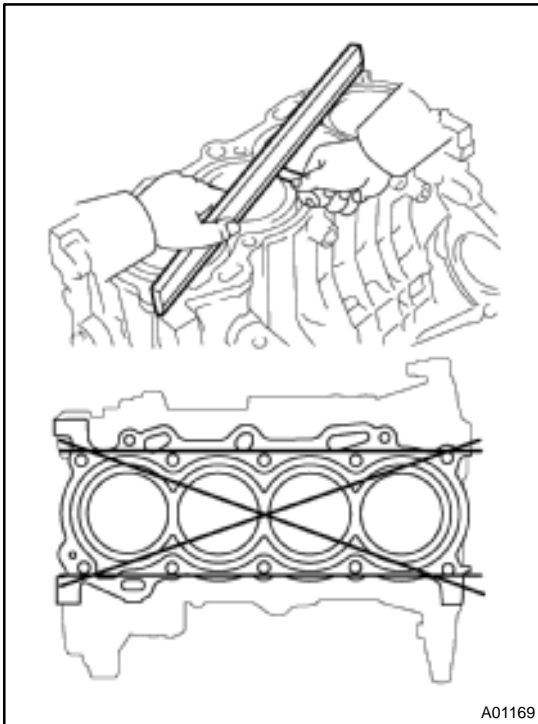
INSPECTION

1. CLEAN CYLINDER BLOCK

- (a) Remove the gasket material.
Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
- (b) Clean the 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.

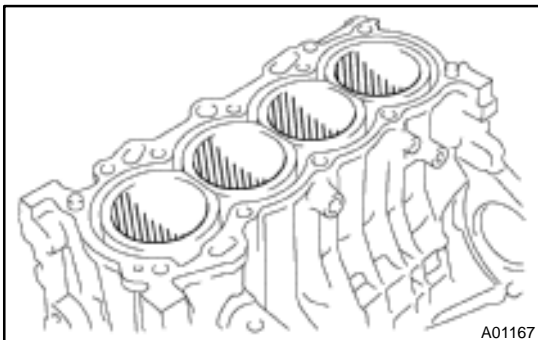


2. INSPECT CYLINDER BLOCK

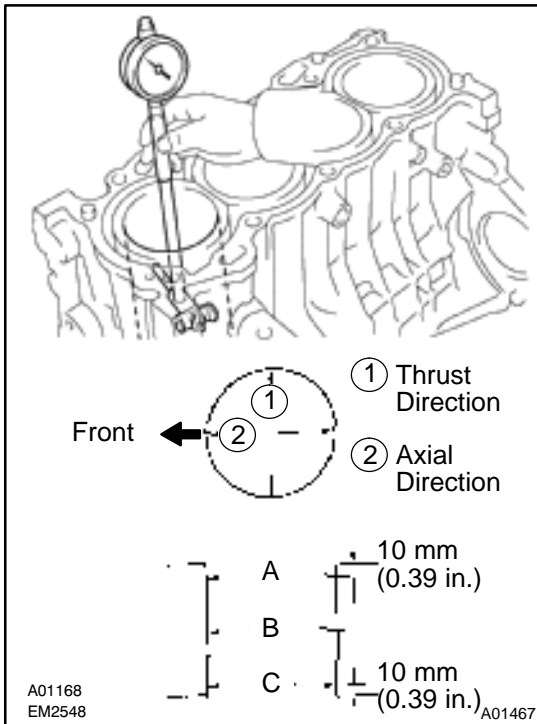
- (a) Inspect for flatness.
Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

Maximum warpage: 0.05 mm (0.0020 in.)

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



- (b) Visually check the cylinder for vertical scratches.
If deep scratches are present, replace the cylinder block.



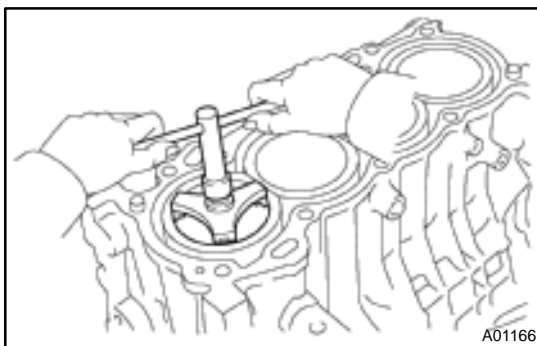
- (c) Inspect the cylinder bore diameter.
Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions.

Standard diameter:

79.000 – 79.013 mm (3.1102 – 3.1107 in.)

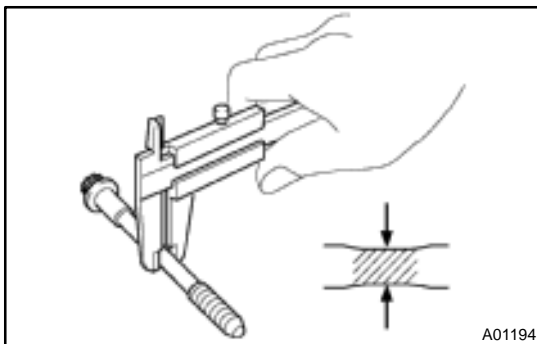
Maximum diameter: 79.013 mm (3.1107 in.)

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



3. 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.



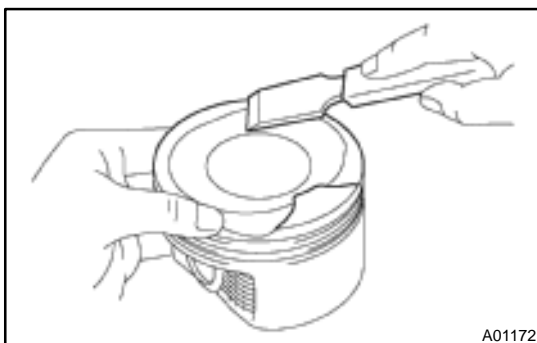
4. INSPECT 12 POINTED HEAD BEARING CAP SUB-ASSEMBLY BOLTS

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

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

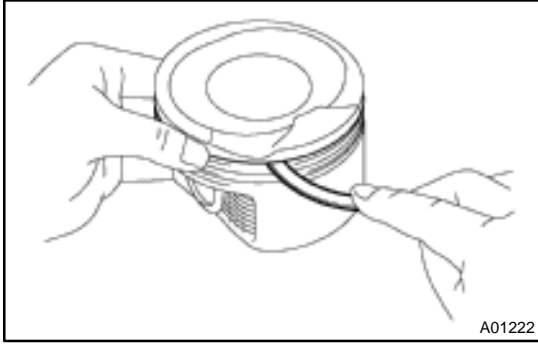
Minimum diameter: 7.3 mm (0.287 in.)

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

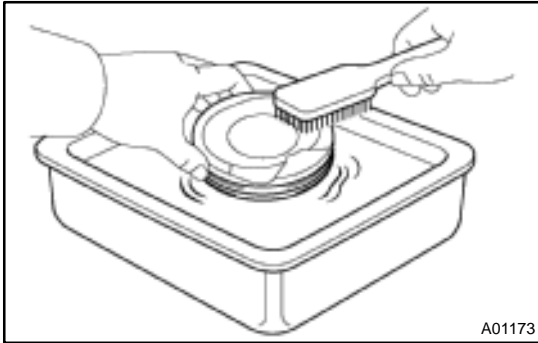


5. CLEAN PISTON

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



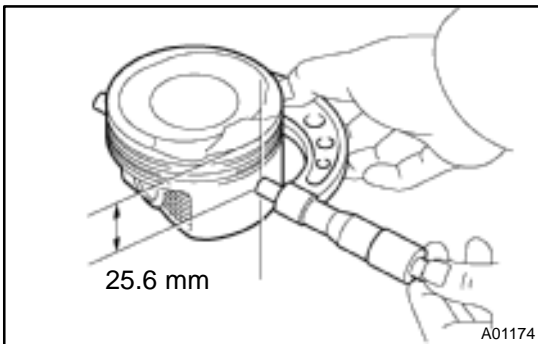
- (b) Using a groove cleaning tool or a broken ring, clean the piston ring grooves.



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

NOTICE:

Do not use a wire brush.



6. INSPECT PISTON

- (a) Inspect the piston oil clearance.

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

Piston diameter:

78.925 – 78.935 mm (3.1073 – 3.1077 in.)

- (2) Measure the cylinder bore diameter in the thrust directions (See step 2).

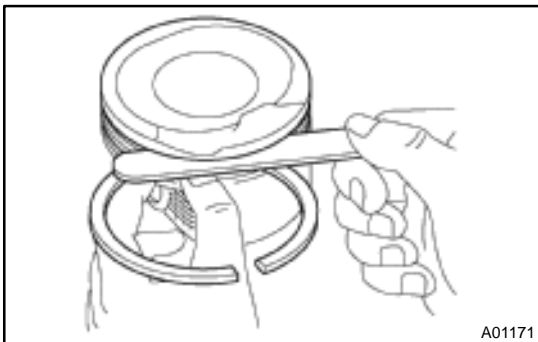
- (3) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:

0.065 – 0.088 mm (0.0026 – 0.0035 in.)

Maximum oil clearance: 0.10 mm (0.0039 in.)

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



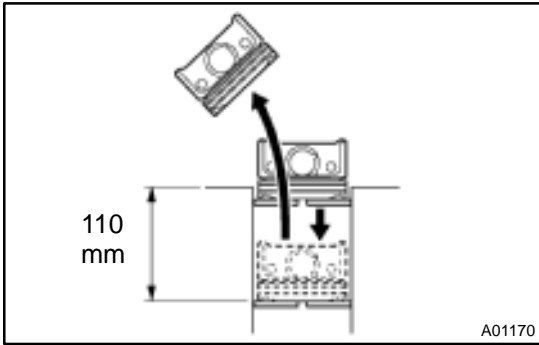
- (b) Inspect the piston ring groove clearance.

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

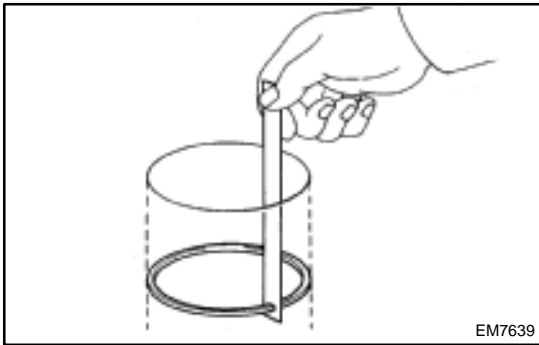
Ring groove clearance:

0.020 – 0.070 mm (0.0008 – 0.0028 in.)

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



- (c) Inspect the piston ring end gap.
 - (1) Insert the piston ring into the cylinder bore.
 - (2) Using the 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.



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

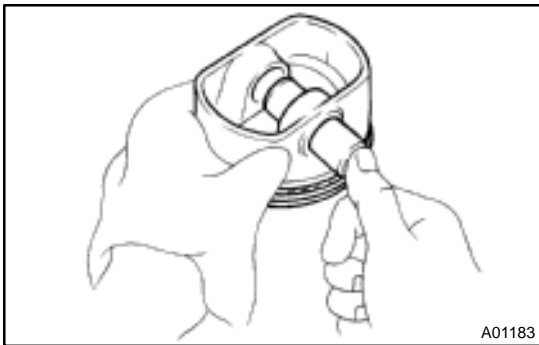
Standard end gap:

No. 1	0.25 – 0.35 mm (0.0098 – 0.0138 in.)
No. 2	0.35 – 0.50 mm (0.0138 – 0.0197 in.)
Oil ring (side rail)	0.15 – 0.40 mm (0.0059 – 0.0157 in.)

Minimum end gap:

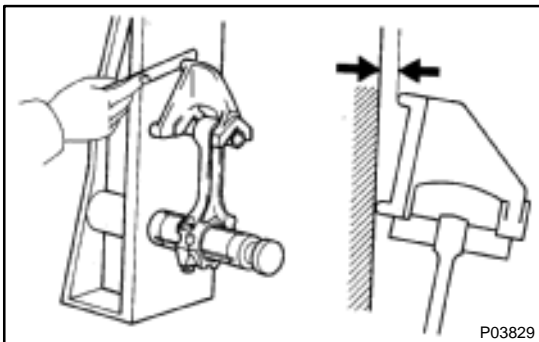
No. 1	1.05 mm (0.0413 in.)
No. 2	1.20 mm (0.0472 in.)
Oil ring (side rail)	1.05 mm (0.0413 in.)

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



- (d) Inspect the piston pin fit.

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



7. INSPECT CONNECTING ROD

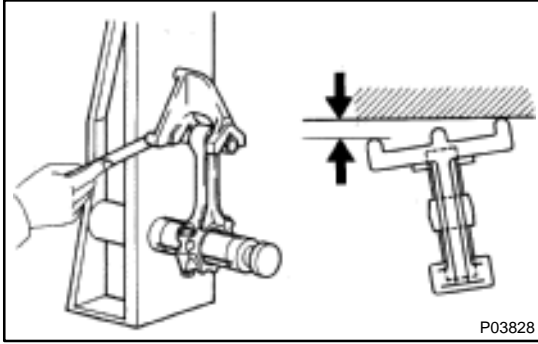
- (a) Using a rod aligner and a feeler gauge, check the connecting rod alignment.

- (1) Check for out-of-alignment.

Maximum out-of-alignment:

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

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



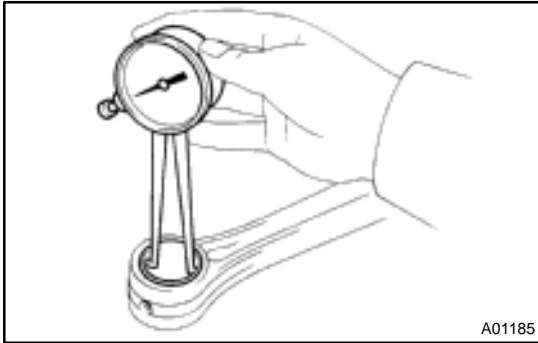
P03828

- (2) 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.



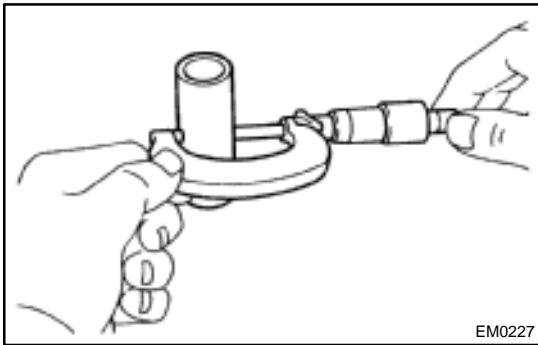
A01185

- (b) Inspect the piston pin oil clearance.

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

Bushing inside diameter:

20.012 – 20.021 mm (0.7879 – 0.7882 in.)



EM0227

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

Piston pin diameter:

20.004 – 20.013 mm (0.7876 – 0.7879 in.)

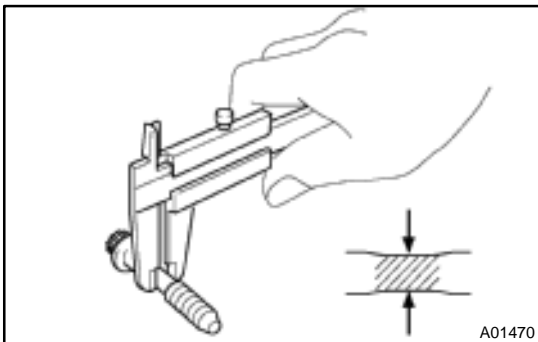
- (3) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.

Standard oil clearance:

0.005 – 0.011 mm (0.0002 – 0.0004 in.)

Maximum oil clearance: 0.05 mm (0.0020 in.)

If the oil clearance is greater than maximum, replace the bushing (See page [EM-80](#)). If necessary, replace the piston and piston pin as a set.



A01470

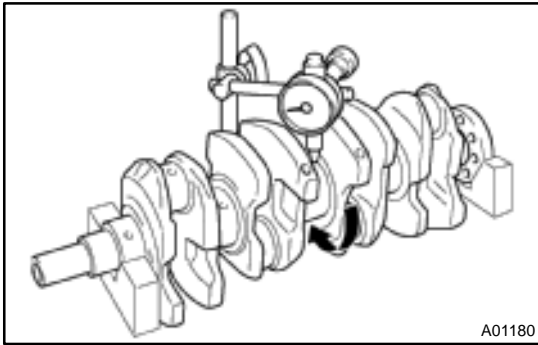
8. INSPECT CONNECTING ROD BOLTS

Using 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.



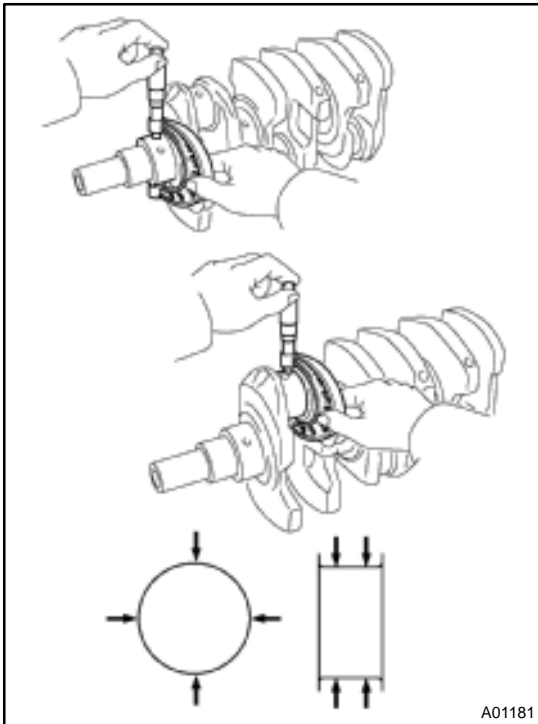
9. INSPECT CRANKSHAFT

(a) Inspect for circle runout.

- (1) Place the crankshaft on V-blocks.
- (2) 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.



(b) Inspect the main journals and crank pins.

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

Diameter:

Main journal	47.988 – 48.000 mm (1.8893 – 1.8898 in.)
Crank pin	43.992 – 44.000 mm (1.7320 – 1.7323 in.)

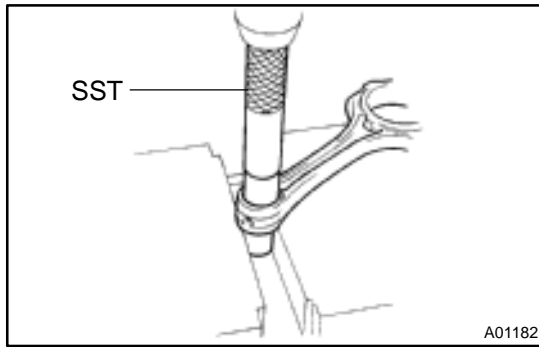
If the diameter is not as specified, check the oil clearance (See page [EM-67](#)). If necessary, replace the crankshaft.

- (2) 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.)

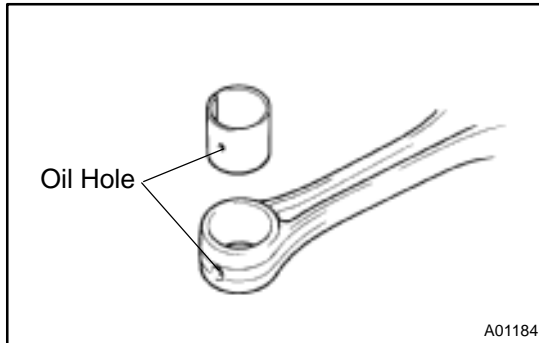
If the taper and out-of-round is greater than maximum, replace the crankshaft.



REPLACEMENT

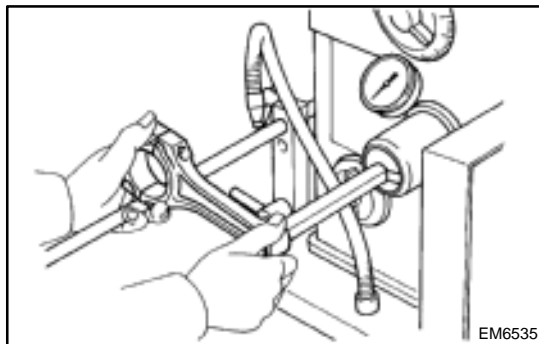
1. REPLACE CONNECTING ROD BUSHINGS

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

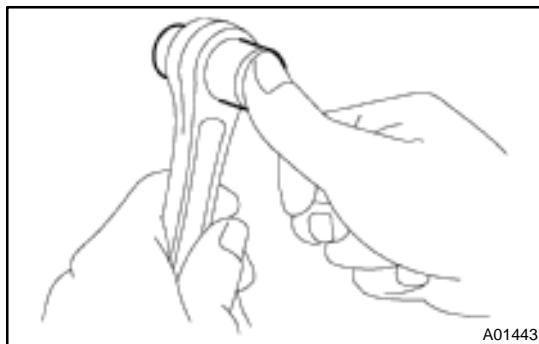


- (b) Align the oil hoses of a new bushing and the connecting rod.

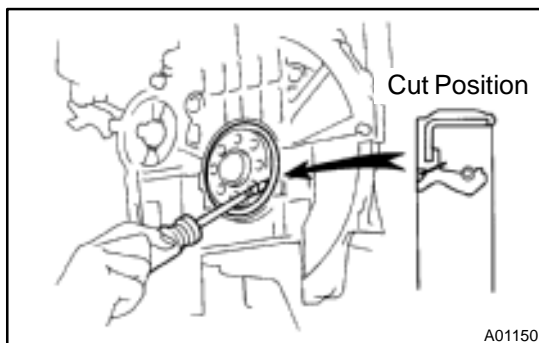
- (c) Using SST and a press, press in the bushing.
SST 09222-30010



- (d) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (See page EM-74) between the bushing and piston pin.



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



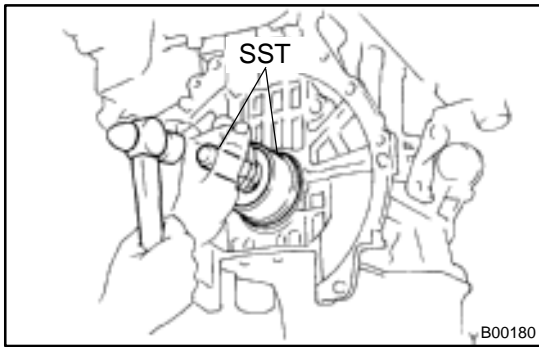
2. REPLACE CRANKSHAFT REAR OIL SEAL

If the rear oil seal is installed to the cylinder block.

- (1) Using a knife, cut off the oil seal lip.
- (2) Using a screwdriver, pry out the oil seal.

NOTICE:

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

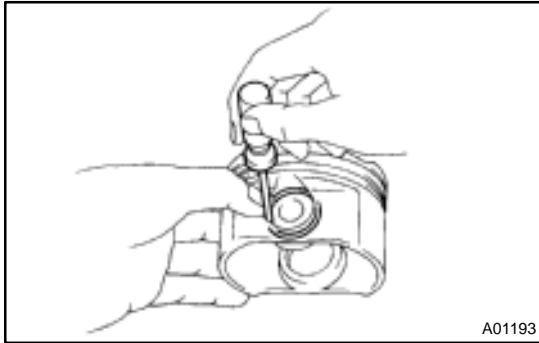


- (3) Apply MP grease to a new oil seal lip.
 - (4) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
- SST 09223-15030, 09950-70010 (09951-07100)

REASSEMBLY

HINT:

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

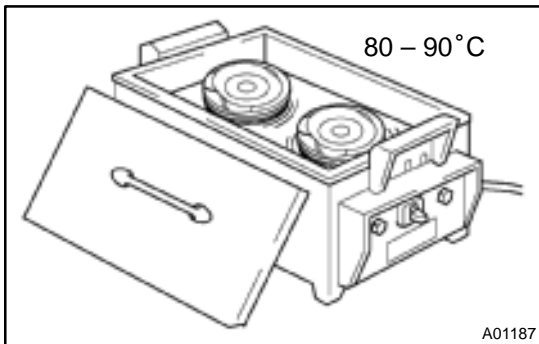


1. ASSEMBLE PISTON AND CONNECTING ROD

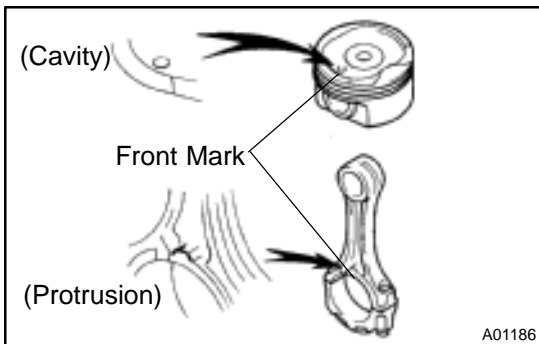
- (a) Using a small screwdriver, install a new snap ring at one end of the piston pin hole.

HINT:

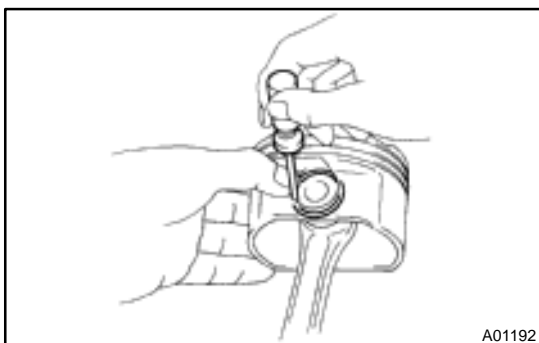
Be sure that end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



- (b) Gradually heat the piston to 80 – 90°C (176 – 194°F).



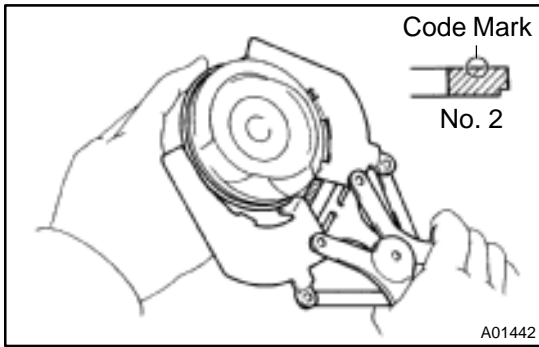
- (c) Coat the piston pin with engine oil.
 (d) Align the front marks on the piston and connecting rod, and push in the piston with your thumb.



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

HINT:

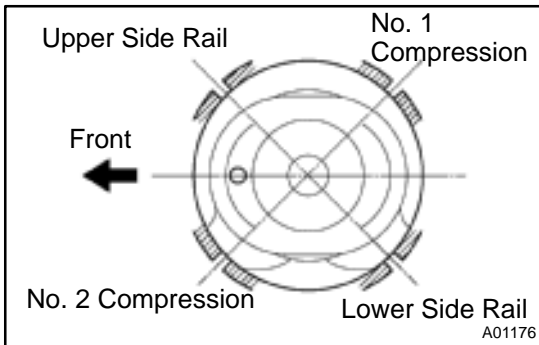
Be sure that end gap of the snap ring is not as aligned with the pin hole cutout portion of the piston.



2. INSTALL PISTON RINGS

- (a) Install the oil ring expander and 2 side rails by hand.
- (b) Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

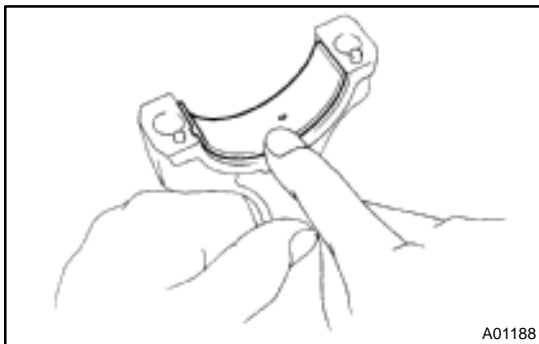
Code mark (No. 2 only): T or 2R



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

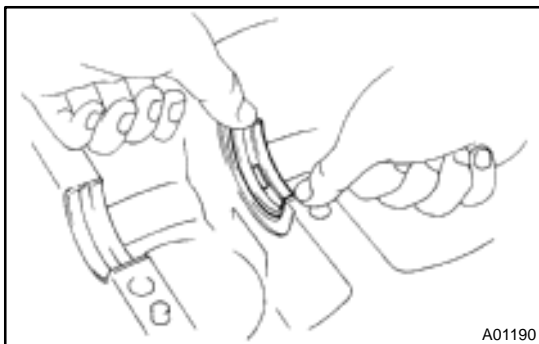
NOTICE:

Do not align the ring ends.



3. INSTALL CONNECTING ROD BEARINGS

- (a) Align the bearing claw with the groove of the connecting rod or connecting cap.
- (b) Install the bearings in the connecting rod and connecting rod cap.



4. INSTALL MAIN BEARINGS

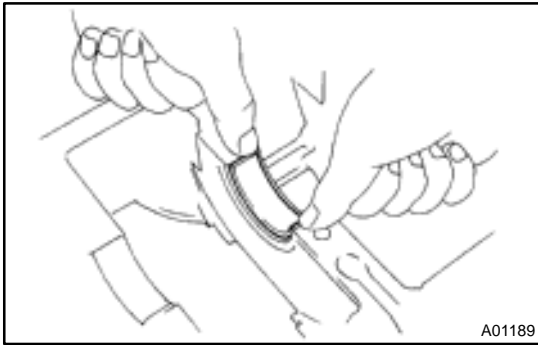
HINT:

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

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

NOTICE:

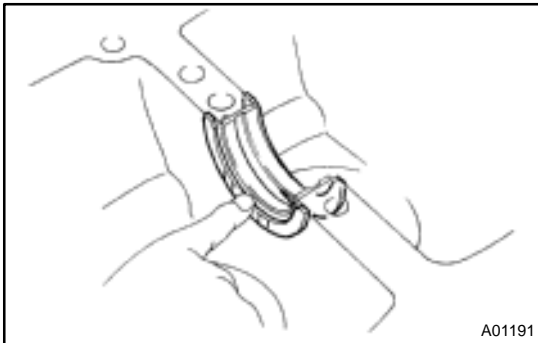
- **Install the bearing with the oil hole in the cylinder block.**
- **Clean the backside of the bearing and the bearing surface of the bearing cap and do not let the oils and fats stick.**



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

NOTICE:

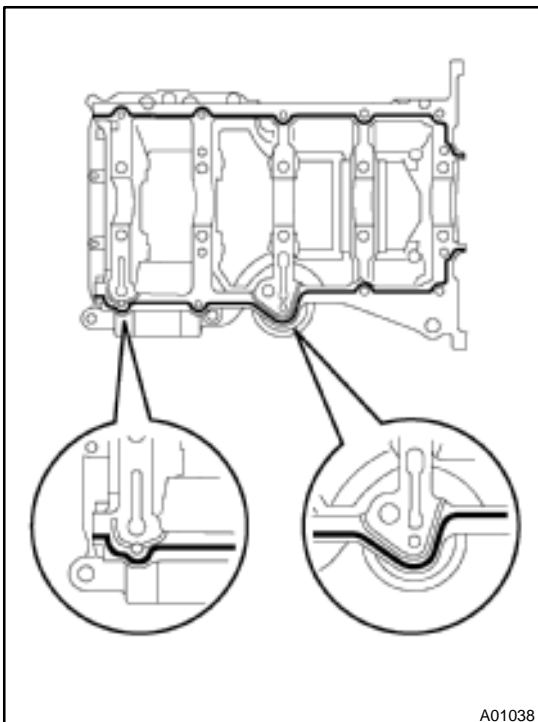
Clean the backside of the bearing and the bearing surface of the bearing cap and do not let the oils and fats stick.

**5. INSTALL THRUST WASHERS**

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

6. PLACE CRANKSHAFT ON CYLINDER BLOCK**7. PLACE BEARING CAP SUBASSEMBLY ON CYLINDER BLOCK**

- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the bearing cap subassembly 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-reusable solvent, clean both sealing surfaces.



- (b) Apply seal packing to the bearing cap subassembly as shown in the illustration.

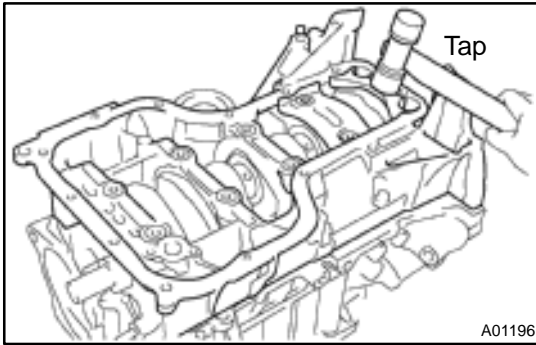
Seal packing: Part No. 08826-00080 or equivalent

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

HINT:

Avoid applying an excessive amount to the surface.

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

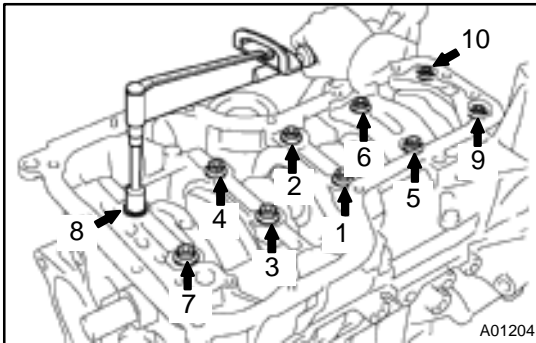


- (c) Using a plastic-faced hammer, lightly tap the bearing cap subassembly to ensure a proper fit.

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

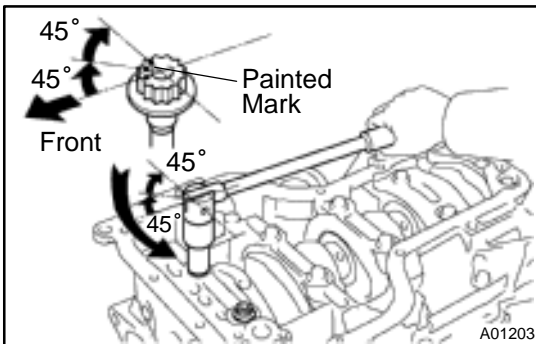
HINT:

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



- (a) Apply a light coat of engine oil on the threads and under the bearing cap subassembly bolts.
- (b) Install and uniformly tighten the 10 bearing cap subassembly bolts in several passes, in the sequence shown.
Torque: 22 N·m (225 kgf-cm, 16 ft-lbf)
- (c) Tighten the bearing cap subassembly bolts in several passes, in the sequence shown.
Torque: 44 N·m (449 kgf-cm, 32 ft-lbf)

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

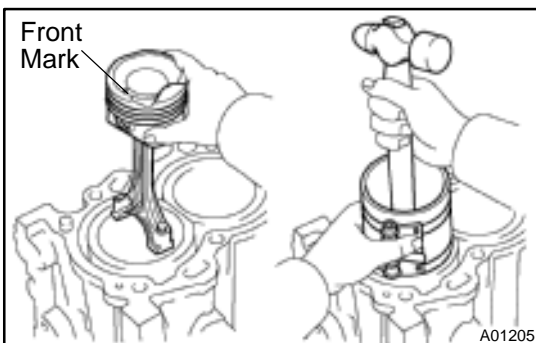


- (d) Mark the front of the bearing cap subassembly bolts with paint.
- (e) Retighten the bearing cap subassembly bolts by 45° and additional 45° in the numerical order shown.
- (f) Check that the painted mark is now at a 90° angle to the front.

9. INSTALL HEXAGON HEAD BEARING CAP SUB-ASSEMBLY BOLTS

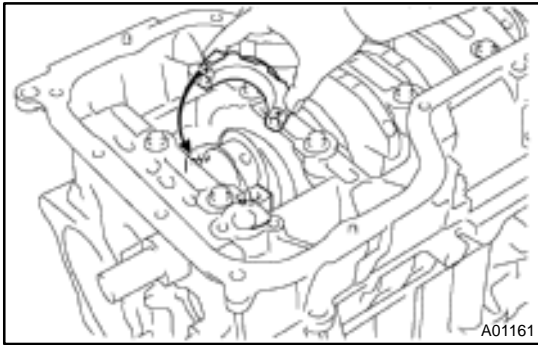
- (a) Install and uniformly tighten the 10 bearing cap subassembly bolts in several passes.
Torque: 18.5 N·m (189 kgf-cm, 14 ft-lbf)
- (b) Check that the crankshaft turns smoothly.

10. CHECK CRANKSHAFT THRUST CLEARANCE (See page EM-74)



11. INSTALL PISTON AND CONNECTING ROD ASSEMBLES

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

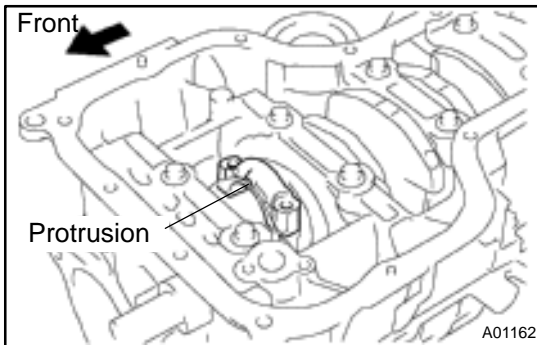


12. PLACE CONNECTING ROD CAP ON CONNECTING ROD

- Match the numbered connecting rod cap with the connecting rod.
- Align the pin dowels of the connecting rod cap with the pins of the connecting rod, and install the connecting rod.

NOTICE:

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



- Check that the protrusion of the connecting rod cap is facing in the correct direction.

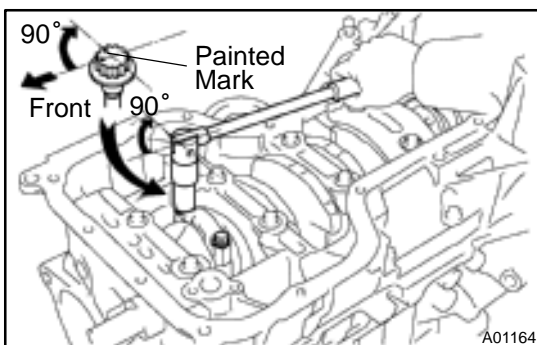
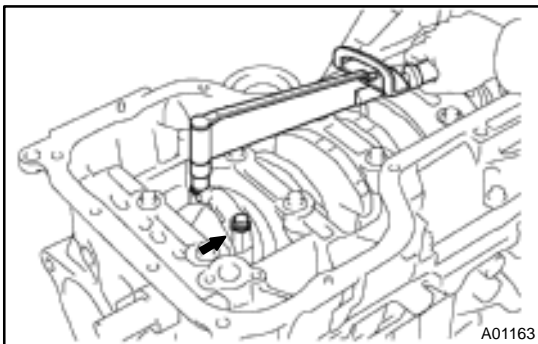
13. INSTALL CONNECTING ROD CAP BOLTS

HINT:

- The connecting rod cap bolts are tightened in 2 steps (steps (b) and (d)).
 - If any of the connecting rod cap bolts is broken or deformed, replace it.
- Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.
 - Install and alternately tighten the 2 connecting rod cap bolts in several passes.

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

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



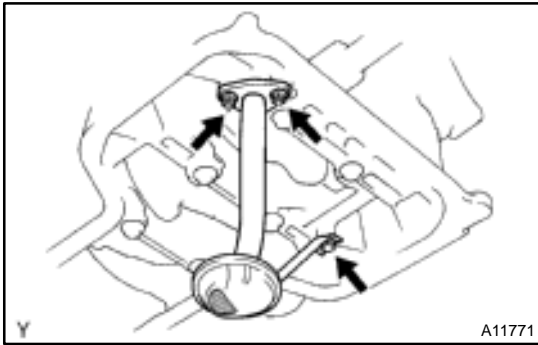
- Mark the front of the connecting cap bolts with paint.
- Retighten the cap bolts by 90° as shown.
- Check that the painted mark is now at a 90° angle to the front.
- Check that the crankshaft turns smoothly.

14. CHECK CONNECTING ROD THRUST CLEARANCE (See page EM-74)

15. INSTALL REAR CRANKSHAFT OIL SEAL (See page EM-80)

HINT:

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

**16. INSTALL OIL STRAINER**

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

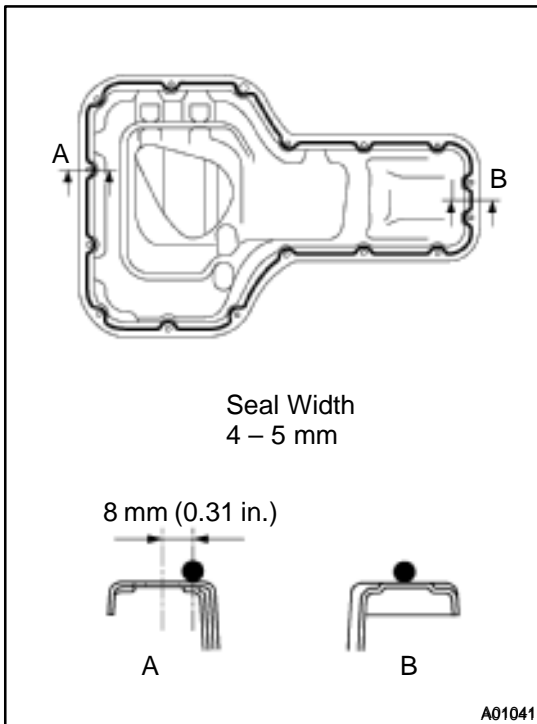
Torque: 9 N·m (92 kgf·cm, 80 in.-lbf)

17. INSTALL OIL PAN

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

NOTICE:

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



- (b) Apply seal packing to the oil pan as shown in the illustration.

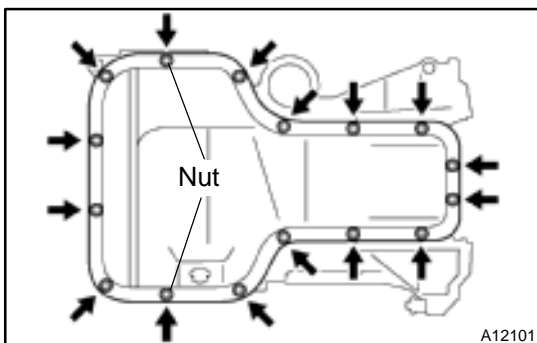
Seal packing: Part No. 08826-00080 or equivalent

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

HINT:

Avoid applying an excessive amount to the surface.

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



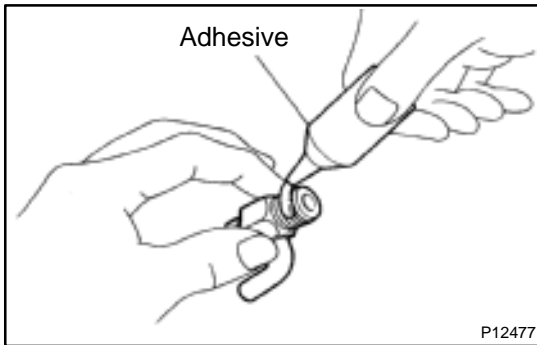
- (c) Install the oil pan with the 14 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque: 9 N·m (92 kgf·cm, 80 in.-lbf)

18. INSTALL OIL FILTER UNION

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

19. INSTALL OIL FILTER (See page LU-3)**20. INSTALL OIL PUMP (See page LU-12)**

**21. 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.

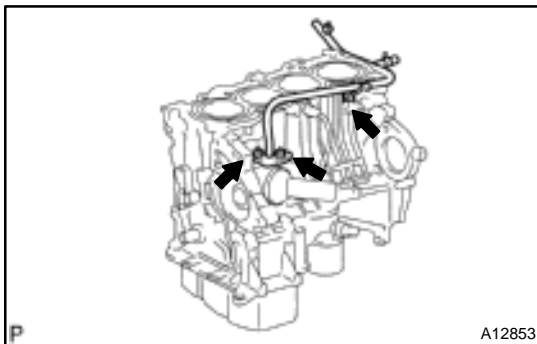
Torque: 20 N·m (204 kgf-cm, 15 ft-lbf)

HINT:

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

22. INSTALL KNOCK SENSOR

Torque: 39 N·m (400 kgf-cm, 29 ft-lbf)

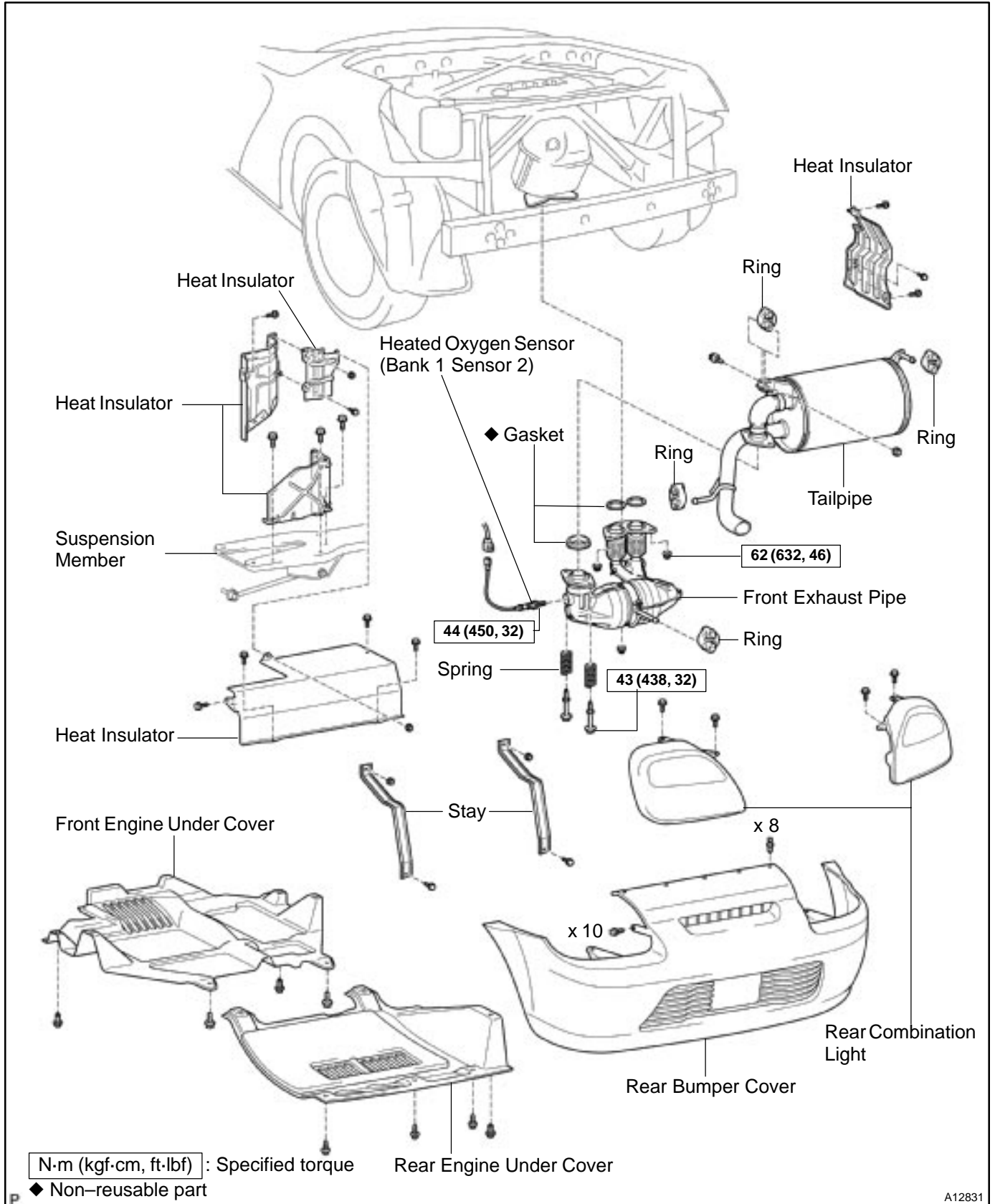
23. INSTALL THERMOSTAT (See page [CO-13](#))**24. INSTALL WATER BYPASS PIPE**

Torque: 9 N·m (92 kgf-cm, 80 in.-lbf)

25. INSTALL CYLINDER HEAD (See page [EM-46](#))**26. INSTALL TIMING SPROCKETS AND TIMING CHAIN (See page [EM-20](#))****27. REMOVE ENGINE STAND**

EXHAUST SYSTEM COMPONENTS

EM166-02



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

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