

ENGINE MECHANICAL

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual.

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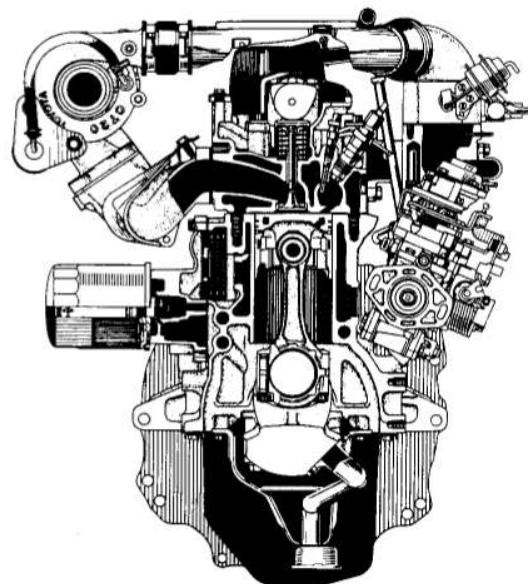
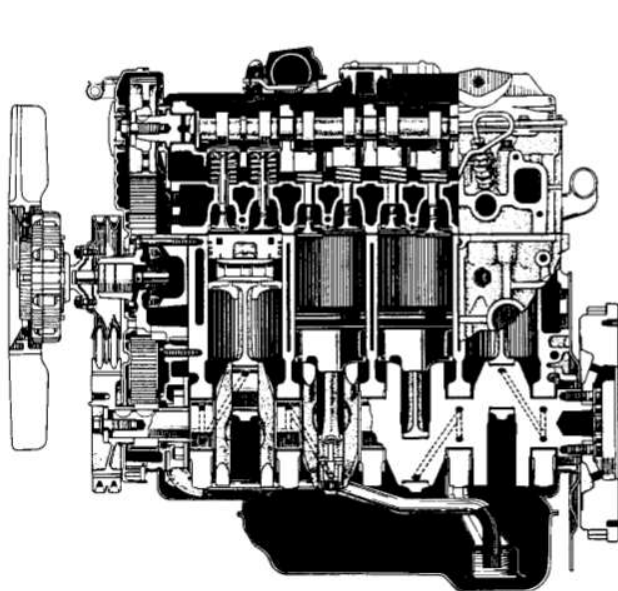
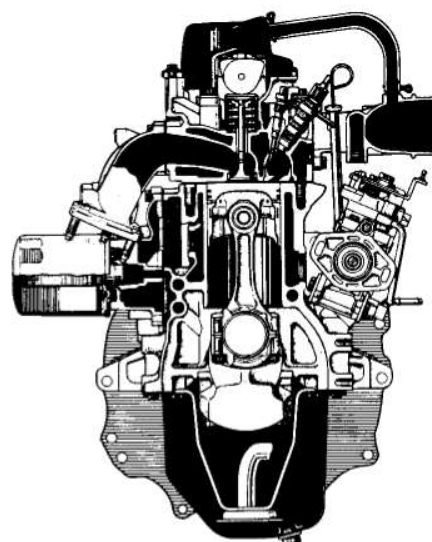
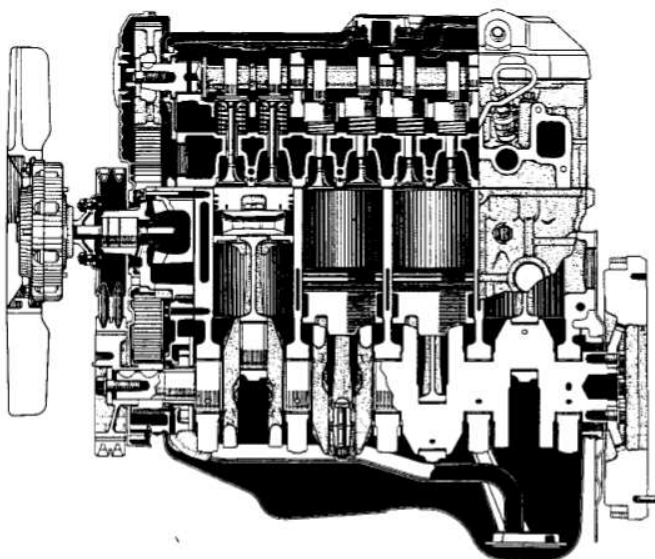
EM-2

ENGINE MECHANICAL – Description

DESCRIPTION

The 2L-T engine is an in-line 4-cylinder 2.4 liter OHC engine.

The 3L engine is an in-line 4-cylinder 2.8 liter OHC engine.

2L-T**3L**EM9181 EM9182
EM9183 EM6146

The 2L-T and 3L engines are in-line 4-cylinder engines with the cylinders numbered 1 — 2 — 3 — 4 from the front. The crankshaft is supported by 5 bearings on the inside of the crankcase. These bearings are made of aluminum. The crankshaft is integrated with 8 weights which are cast along with it for balancing. Oil holes are built into the center of the crankshaft for supplying oil to the connecting rods.

This engine's injection order is 1 — 3 — 4 — 2. The cylinder head is made of cast iron with a cross flow type intake and exhaust layout and with swirl type combustion chambers. The glow plugs are located in the combustion chambers.

Exhaust and intake valves are equipped with irregular pitch springs which are capable of following the valves even at high engine speeds.

The camshaft is driven by the timing belt. There are 2 types of camshaft bearing, No. 1 and No. 2. No. 1 bearing is integrated with the thrust washer. The camshaft journal is supported at 5 places between the valve lifters of each cylinder and on the cylinder head of front end. Lubrication of the camshaft journal and cam is accomplished by oil being supplied through the oiler port in the No. 1 camshaft journal.

Adjustment of the valve clearance is done by means of an outer shim type system, in which valve adjusting shims are located above the valve lifters. This permits replacement of the shims without removal of the camshafts.

Pistons are made of highly temperature-resistant aluminum alloy.

Piston pins are the full-floating type, with the pins fastened to neither the piston boss nor the connecting rods. Instead, snap rings are fitted on both ends of the pins, preventing the pins from falling out.

The No. 1 compression ring is made of steel and the No. 2 compression ring is made of cast iron. The oil ring is made of steel. The outer diameter of each piston ring is slightly larger than the diameter of the piston and the flexibility of the rings allows them to hug the cylinder walls when they are mounted on the piston. Compression rings No. 1 and No. 2 work to prevent the leakage of gas from the cylinder and the oil ring works to scrape oil off the cylinder walls to prevent it from entering the combustion chamber.

The cylinder block is made of cast iron. It has 4 cylinders which are approximately 2 times the length of the piston stroke. The top of each cylinder is closed off by the cylinder head and the lower end of cylinder becomes the crankcase, in which the crankshaft is installed. In addition, the cylinder block contains a water jacket, through which coolant is pumped to cool the cylinders.

The oil pan is bolted onto the bottom of the cylinder block. The oil pan is an oil reservoir made of pressed steel sheet. A dividing plate is included inside the oil pan to keep sufficient oil in the bottom of the pan even when the vehicle is tilted. This dividing plate also prevents the oil from making waves when the vehicle is stopped suddenly and thus shifting the oil away from the oil pump suction pipe.

EM-4**ENGINE MECHANICAL – Troubleshooting (Diesel Engine Diagnosis)**

TROUBLESHOOTING**Diesel Engine Diagnosis****GENERAL**

1. Diesel engine problems are usually caused by the engine or fuel system. The injection pump is very rarely the cause of fuel system problems.
2. Before beginning fuel system tests, first check that the engine compression, valve timing and other major systems are within specifications.

PRELIMINARY CHECKS

1. Before performing fuel system checks, ensure that the engine is in good running condition. If necessary, first check the compression, timing and major components or systems.
2. Check the air filter, and clean or replace it if necessary.
3. Check that there is sufficient fuel in the tank.
4. Check if the fuel is contaminated with gasoline or other foreign elements. Only good-quality diesel fuel should be used.
5. Bleed air from the system by pumping the priming.
6. Check for water in the fuel filter and fuel tank, and drain as necessary.
7. If the engine will not crank or if it cranks slowly, first troubleshoot the electrical system.

ENGINE MECHANICAL – Troubleshooting (Diesel Engine Diagnosis)**EM-5****PRECAUTION:**

1. The basic troubleshooting procedures for the diesel engine (valve clearance, compression, bearings, valves, pistons, etc.) are the same checks you would make for gasoline engine.
2. Repair of the injection pump requires considerable skill and use of a special test bench.

ENGINE WILL NOT CRANK**(Possible Cause)****(Check Procedure and Correction Method)**

1. LOOSE OR CORRODED BATTERY CABLES	Check cables from battery to starter and make necessary repairs.
2. DISCHARGED BATTERY	Check alternator output and drive belt. If necessary, repair. (See page CH-3)
3. INOPERATIVE STARTER	Check for battery voltage at starter terminals 30 and 50. If okay, see STARTING SYSTEM for repair procedure.

ENGINE CRANKS SLOWLY-WILL NOT START**HINT:** Minimum cranking speed:

Cold 100 rpm
Hot 150 rpm

(Possible Cause)**(Check Procedure and Correction Method)**

1. LOOSE OR CORRODED BATTERY CABLES	Check cables from battery to starter and make necessary repairs.
2. DISCHARGED BATTERY	Check alternator output and drive belt. If necessary, repair. (See page CH-3)
3. IMPROPER ENGINE OIL	Check engine oil. If improper viscosity, drain and refill with oil of viscosity recommended by manufacturer. (See page LU-4)

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ENGINE MECHANICAL — Troubleshooting (Diesel Engine Diagnosis)

ENGINE CRANKS NORMALLY BUT WILL NOT START

(Possible Cause)

(Check Procedure and Correction Method)

1. NO FUEL TO NOZZLE

Loosen any one injection pipe union nut from its nozzle holder.

Crank engine for about 5 seconds while confirming that fuel is being discharged from pipe.

If fuel is coming out, begin diagnosis from item 4.

If not, begin from item 2.

2. NO FUEL CUT SOLENOID OPERATION

With starter switch turned ON, check for fuel cut solenoid operation noise (clicking sound) while repeatedly connecting and disconnecting fuel cut solenoid.

If no noise, check if there is battery voltage to solenoid when starter switch is ON.

If battery voltage is confirmed, fuel cut solenoid is faulty and should be replaced. If no voltage, refer to ELECTRICAL DIAGNOSIS and make necessary repairs.

3. NO FUEL INTO INJECTION PUMP

Disconnect inlet hoses from fuel filter, and feed clean fuel from separate container directly into fuel pump.

HINT: When feeding fuel tank directly into pump, keep container at same level as vehicle fuel tank.

If engine starts, either fuel filter or line between fuel tank and filter is clogged and should be repaired accordingly.

If engine still does not start (no fuel intake), check fuel line between filter and pump.

If normal, pump is faulty and should be replaced.

4. FUEL LEAKAGE FROM INJECTION PIPES

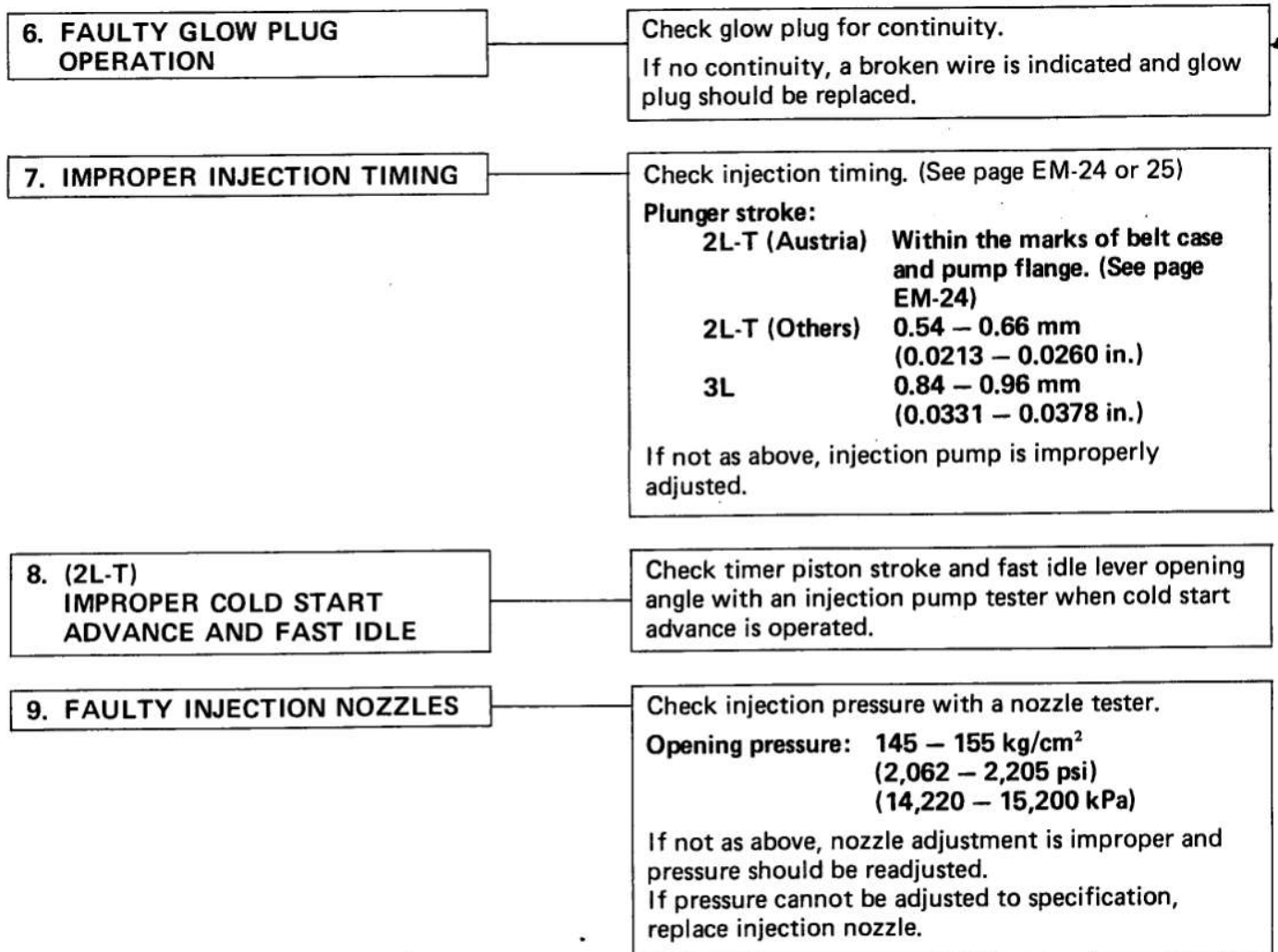
Check for loose unions or cracks.

If leaking, tighten to standard torque or, if necessary, replace pipe(s).

5. INOPERATIVE PRE-HEATING OPERATION

With starter switch turned ON and glow plug indicator light illuminated, check that there is voltage applied to glow plug.

If not, refer to ELECTRICAL DIAGNOSIS and repair as necessary.

ENGINE MECHANICAL – Troubleshooting (Diesel Engine Diagnosis)**EM-7**

EM-8

ENGINE MECHANICAL – Troubleshooting (Diesel Engine Diagnosis)

ROUGH IDLE WITH WARM ENGINE

(Possible Cause)

(Check Procedure and Correction Method)

1. IMPROPER ADJUSTMENT OF ACCELERATOR CABLE

With accelerator pedal released, check that adjusting lever is in contact with idle speed adjusting screw. Also check if accelerator cable or linkage is catching on something.

If necessary, adjust so that lever is in contact with screw, or make other required repairs.

2. IDLE SPEED TOO LOW

Check idle speed. (See page EM-27)

Idle speed: 2L-T 700 – 800 rpm
3L 650 – 750 rpm

HINT: If less than standard, idling would normally be rough.

If not as above, adjust with idle speed adjusting screw.

3. FUEL LEAKAGE

Check for leaks at injection pump connections, pump distributive head bolt, injection nozzles and delivery valve holders.

Tighten any loose connections to specified torque or replace parts as necessary.

4. IMPROPER INJECTION TIMING

Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START, above.

5. IMPROPER OPERATION OF INJECTION NOZZLES OR DELIVERY VALVES

With engine idling, loosen injection pipe to each cylinder in order, and check if idle speed changes.

If no change, a faulty cylinder is indicated. Check according to following procedure.

- Faulty injection nozzle

Check injection nozzle with a nozzle tester.

Opening pressure: 145 – 155 kg/cm²
(2,062 – 2,205 psi)
(14,220 – 15,200 kPa)

If not as above, nozzle adjustment is improper and pressure should be readjusted.

If pressure cannot be adjusted to specification, replace injection nozzle.

- Faulty delivery valve

If injection pressure is as specified, delivery valve is defective and should be replaced.

ENGINE MECHANICAL – Troubleshooting (Diesel Engine Diagnosis)**EM-9****ENGINE SUDDENLY STOPS**

(Possible Cause)	(Check Procedure and Correction Method)
1. ENGINE WILL NOT RE-START	Check to see if engine re-starts according to prescribed procedure. If not, refer to ENGINE CRANKS NORMALLY BUT WILL NOT START , above, and repair as necessary.
2. ROUGH IDLE	Refer to ROUGH IDLE WITH WARM ENGINE and repair accordingly.
3. MALFUNCTION OF FUEL CUT SOLENOID	Refer to ENGINE CRANKS NORMALLY BUT WILL NOT START , above, and check accordingly. HINT: No operation noise from fuel cut solenoid may be due to loose electrical connections, so check connectors before proceeding with further repairs.
4. NO FUEL INTO INJECTION PUMP	Refer to step 3 of ENGINE CRANKS NORMALLY BUT WILL NOT START , above.

LACK OF POWER**HINT:**

- First check that the air cleaner is not clogged or the engine overheating.
- Not applicable if the customer desires an output power higher than specified for that vehicle. For accuracy, adjust with a chassis dynamo.

(Possible Cause)	(Check Procedure and Correction Method)
1. IMPROPER ADJUSTMENT OF ACCELERATOR CABLE	With accelerator fully depressed, check that adjusting lever is in contact with maximum speed adjusting screw. Also check if accelerator cable or linkage is catching on something. If necessary, adjust so that lever is in contact with screw, or make other required repairs.
2. INSUFFICIENT MAXIMUM SPEED	Check maximum speed. (See page EM-27) Maximum speed: 2L-T 4,700 – 4,900 rpm 3L (Hong Kong, Singapore and Malaysia) 4,300 – 4,500 rpm 3L (Others) 4,500 – 4,700 rpm If not as above, adjust with maximum speed adjusting screw.

EM-10**ENGINE MECHANICAL – Troubleshooting (Diesel Engine Diagnosis)****3. INTERCHANGED OVERFLOW SCREW (OUT) AND INLET (NO MARK) FITTING**

HINT: Overflow screw is marked "OUT" and has an inner jet. Although both fittings are same size, they must not be interchanged.

4. FUEL LEAKAGE

Refer to step 3 of **ROUGH IDLE WITH WARM ENGINE**.

5. CLOGGED FUEL FILTER

Disconnect inlet hose to fuel filter, and feed clean fuel directly into pump.

HINT: When feeding fuel directly into pump, keep container at same level as vehicle fuel tank.

If engine condition improves, fuel filter is clogged and should be replaced.

If no increase in engine condition after replacing fuel filter, check priming pump (hand pump) or perform other necessary repairs.

6. IMPROPER INJECTION TIMING

Refer to step 7 of **ENGINE CRANKS NORMALLY BUT WILL NOT START**.

7. FAULTY INJECTION NOZZLES

Refer to step 9 of **ENGINE CRANKS NORMALLY BUT WILL NOT START**.

EXCESSIVE EXHAUST SMOKE**HINT:**

- Check that the air cleaner is not clogged.
- Check with the customer whether or not oil consumption has been excessive.

(Possible Cause)**(Check Procedure and Correction Method)****1. IMPROPER INJECTION TIMING**

Refer to step 7 of **ENGINE CRANKS NORMALLY BUT WILL NOT START**.

HINT: Black smoke indicates advanced timing while white smoke indicates retarded timing. Adjustments should be made accordingly.

2. CLOGGED FUEL FILTER

Refer to step 5 of **LACK OF POWER**.

HINT: At high speed (2,000 – 3,000 rpm), a clogged filter tends to make exhaust smoke white.

3. FAULTY INJECTION NOZZLES

Refer to step 9 of **ENGINE CRANKS NORMALLY BUT WILL NOT START**.

HINT: Excessive exhaust smoke is often caused by nozzle pressure being too low.

EXCESSIVE FUEL CONSUMPTION

HINT: Check whether clutch slipping, brakes grabbing, tires wrong size or air filter clogged.

(Possible Cause)	(Check Procedure and Correction Method)
1. FUEL LEAKAGE	Refer to step 3 of ROUGH IDLE WITH WARM ENGINE.
2. IDLE SPEED TOO HIGH	After sufficiently warming up engine, check idle speed. (See page EM-27) Idle speed: 2L-T 700 – 800 rpm 3L 650 – 750 rpm If not as above, adjust with idle speed adjusting screw.
3. MAXIMUM SPEED TOO HIGH	Check maximum speed. (See page EM-27) Maximum speed: 2L-T 4,700 – 4,900 rpm 3L (Hong Kong, Singapore and Malaysia) 4,300 – 4,500 rpm 3L (Others) 4,500 – 4,700 rpm If not as above, adjust with maximum speed adjusting screw.
4. IMPROPER INJECTION TIMING	Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START.
5. FAULTY INJECTION NOZZLES	Refer to step 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START.

EM-12**ENGINE MECHANICAL – Troubleshooting (Diesel Engine Diagnosis)**

ENGINE NOISE WHEN WARM
(Cranking Noise with Excessive Vibration)

(Possible Cause)**(Check Procedure and Correction Method)**

**1. ENGINE COOLANT
TEMPERATURE TOO LOW**

Check coolant temperature with water temperature gauge.
If not sufficiently warm, thermostat is faulty and should be replaced.

2. IMPROPER INJECTION TIMING

Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START.

3. FAULTY INJECTION NOZZLES

Refer to step 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START.

ENGINE WILL NOT RETURN TO IDLE

(Possible Cause)**(Check Procedure and Correction Method)**

BINDING ACCELERATOR CABLE

Operate adjusting lever on top of injection pump, and check if engine returns to idle. (See page EM-27)

If so, accelerator cable is binding or improperly adjusted and should be repaired accordingly.

If engine does not return to idle, injection pump is faulty and should be replaced.

ENGINE WILL NOT SHUT OFF WITH KEY

(Possible Cause)**(Check Procedure and Correction Method)**

**IMPROPER FUEL CUT SOLENOID
OPERATION**

Disconnect connector of fuel cut solenoid, and check if engine stops.

If so, starter switch is faulty and should be repaired as necessary or replaced.

If engine does not stop, either fuel cut solenoid is faulty or there is interference by foreign particles. Repair as necessary.

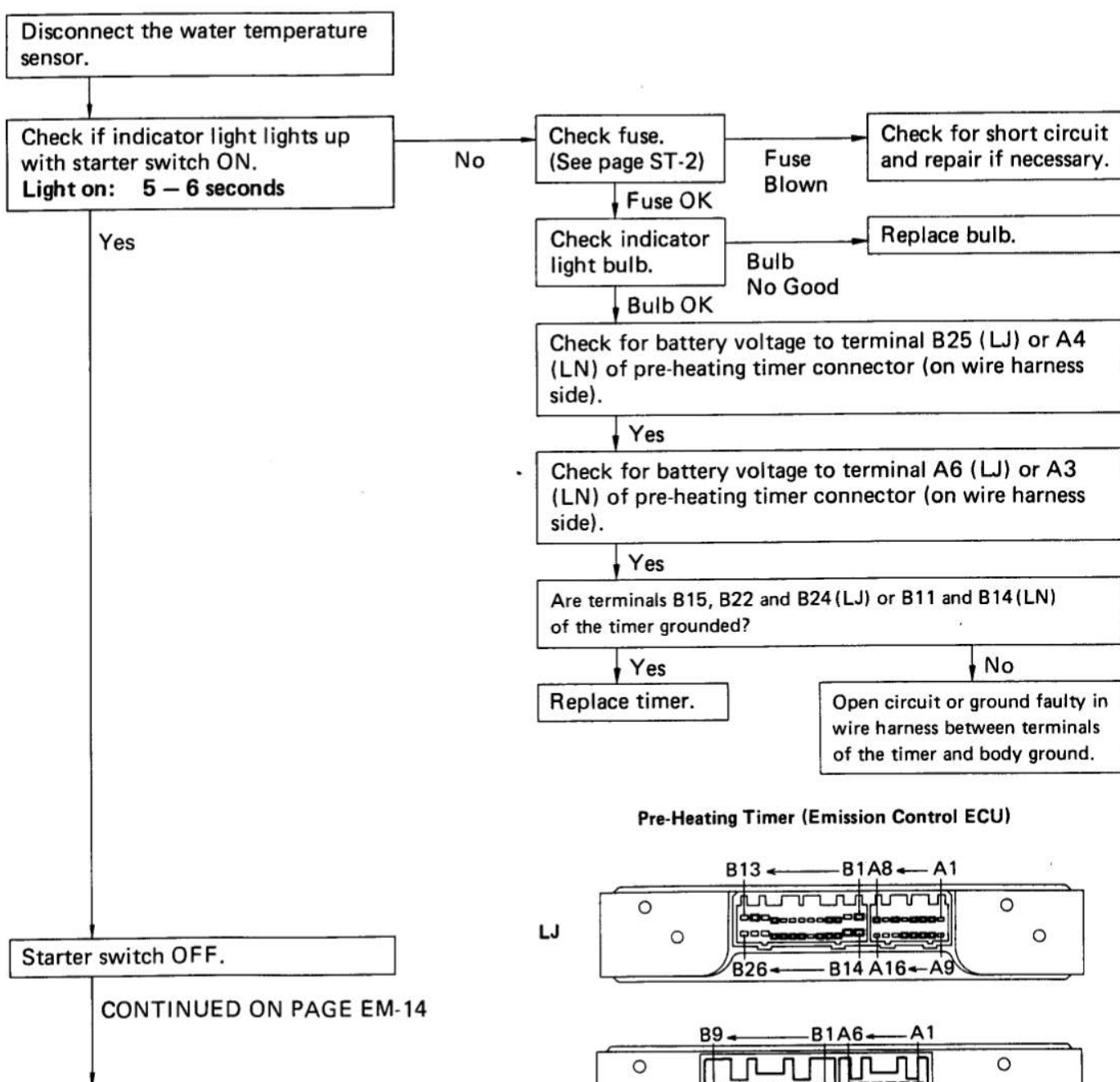
Diesel Electrical System Diagnosis [2L-T Austria]

ENGINE DOES NOT START COLD

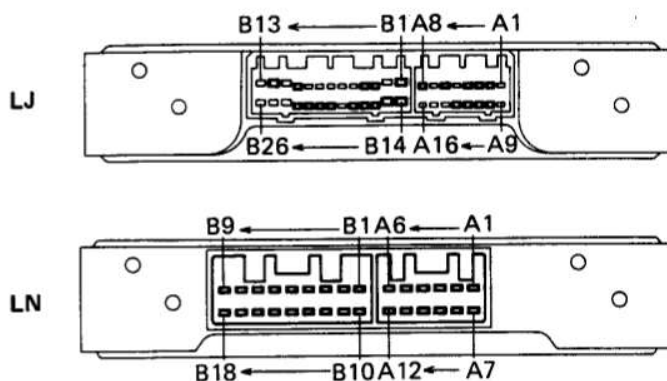
HINT:

- Battery voltage at least 12 V – starter switch OFF.
- Engine cranks normally.
- Fusible link okay.
- Check the voltage marked with an asterisk (*) just as the starter switch is placed at ON because the voltage will change.

1. Pre-Heating System (Super Glow Type)

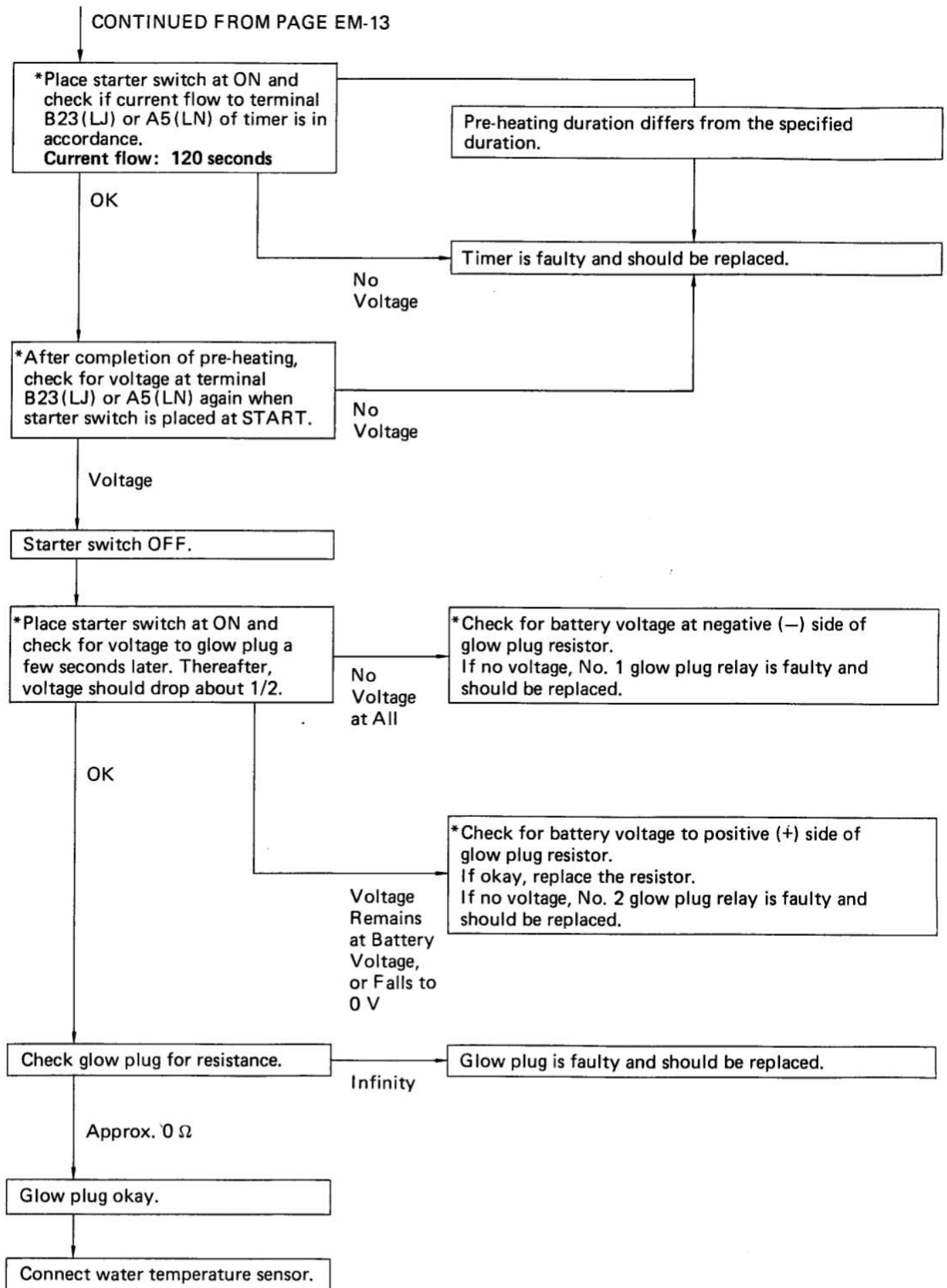


Pre-Heating Timer (Emission Control ECU)

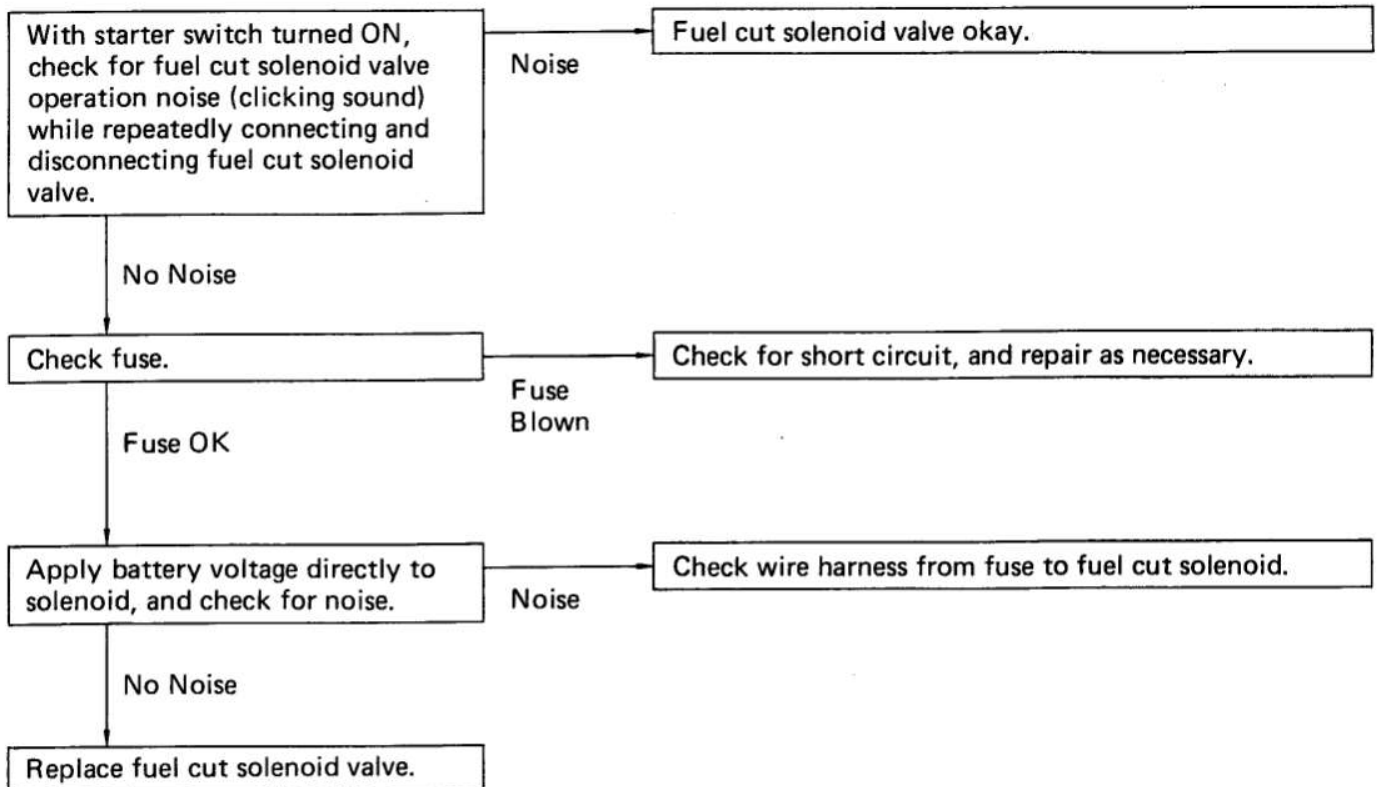


EM9185
EM9233

Troubleshooting
EM-14 ENGINE MECHANICAL – (Diesel Electrical System Diagnosis [2L-T Austria])



Troubleshooting
ENGINE MECHANICAL – (Diesel Electrical System Diagnosis [2L-T Austria])

EM-15**2. Fuel Cut Solenoid Valve**

Troubleshooting

EM-16 ENGINE MECHANICAL – (Diesel Electrical System Diagnosis [2L-T Others])

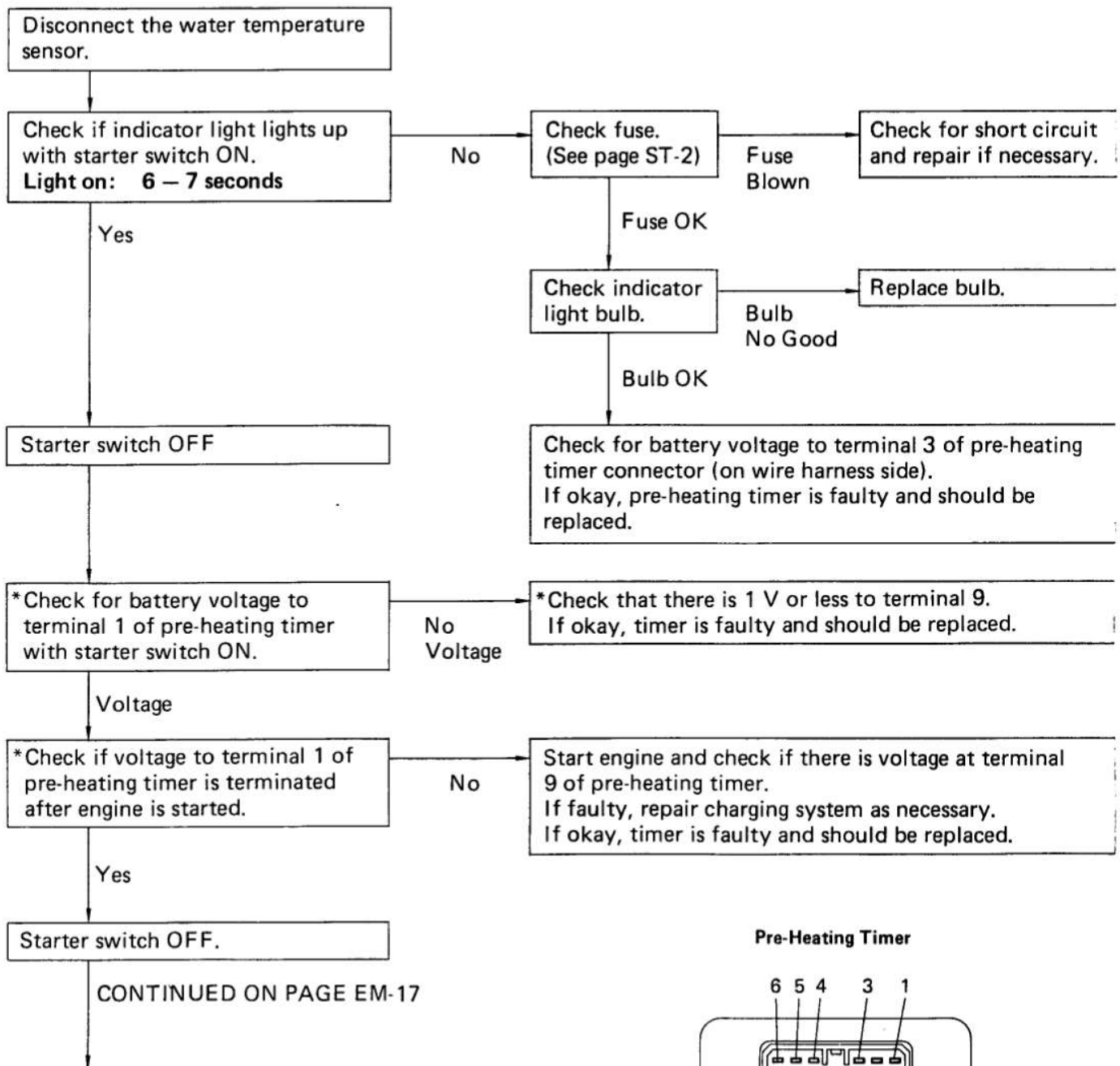
Diesel Electrical System Diagnosis [2L-T Others]

ENGINE DOES NOT START COLD

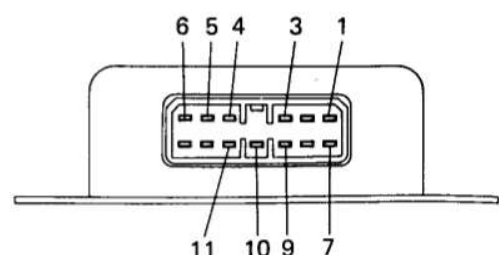
HINT:

- Battery voltage at least 12 V – starter switch OFF.
- Engine cranks normally.
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1. Pre-Heating System (Super Glow Type)



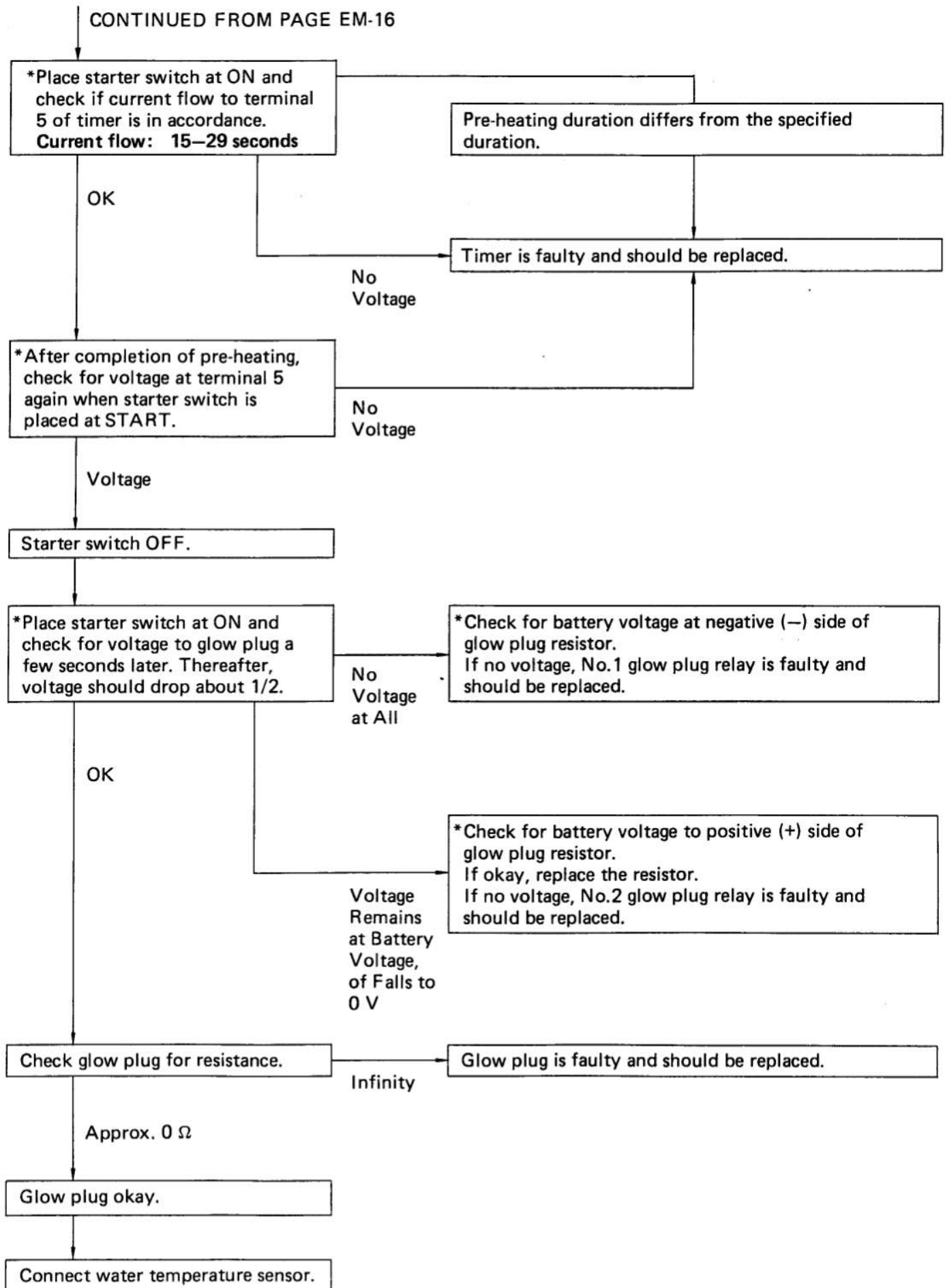
Pre-Heating Timer



ST0049

Troubleshooting ENGINE MECHANICAL – (Diesel Electrical System Diagnosis [2L-T Others])

EM-17



ENGINE TUNE-UP

INSPECTION OF ENGINE COOLANT

(See steps 1 and 2 on page CO-4)

INSPECTION OF ENGINE OIL

(See steps 1 and 2 on page LU-4)

INSPECTION OF BATTERY

(See pages 1 and 2 on page CH-3)

Standard specific gravity:

When fully charged at 20°C (68°F)

1.27 – 1.29 (80D26R)

1.25 – 1.27 (Others)

INSPECTION OF AIR FILTER (Paper Filter Type)

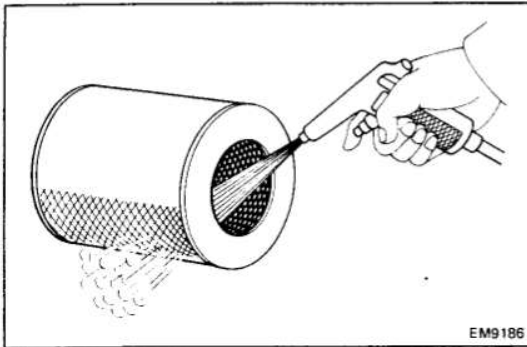
1. INSPECT AIR FILTER

Visually check that the filter element is not excessively dirty, damaged or oily.

2. CLEAN AIR FILTER

Clean the filter element with compressed air.

First blow from the inside thoroughly. Then blow off the outside of the filter element.



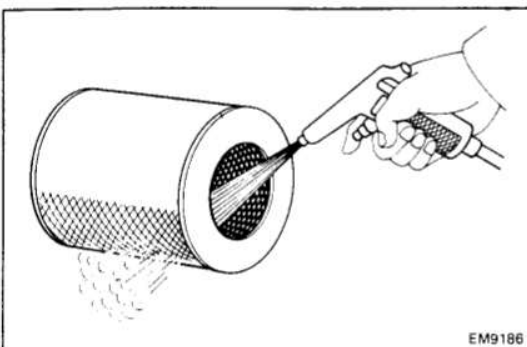
(Washable Type)

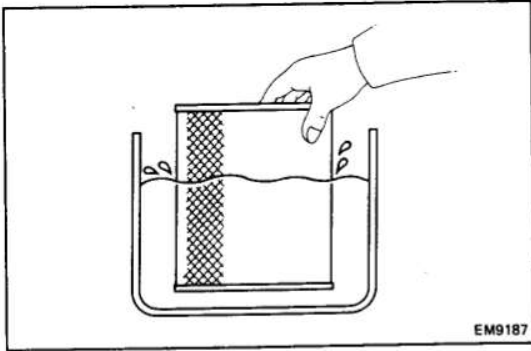
1. INSPECT AIR FILTER

Visually check that the filter element is not excessively dirty, damaged or oily.

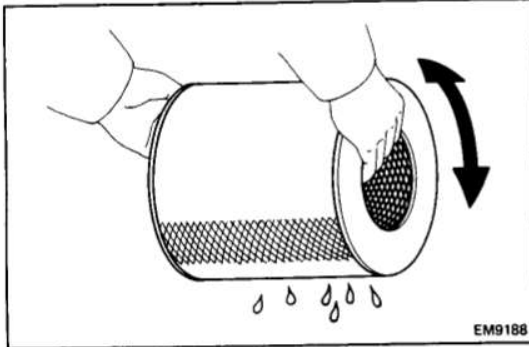
2. CLEAN AIR FILTER

- (a) Blow dirt off in the filter element with compressed air.



ENGINE MECHANICAL – Engine Tune-Up**EM-19**

- (b) Submerge the filter element in the water and agitate it up and down more than ten times.
- (c) Repeat rinsing in clean water until rinse water is clear.



- (d) Remove excess water by shaking the filter element or blowing with compressed air.

NOTICE: Do not beat or drop filter element.

- (e) Wipe off dust on the air cleaner case interior.

INSPECTION OF ALTERNATOR DRIVE BELTS

(See step 3 on page CH-3)

Drive belt deflection:

New belt 7 – 10 mm (0.28 – 0.39 in.)
Used belt 10 – 15 mm (0.39 – 0.59 in.)

Drive belt tension (Reference):

New belt 40 – 60 kg
Used belt 20 – 35 kg

INSPECTION OF GLOW PLUGS

(See page ST-6)

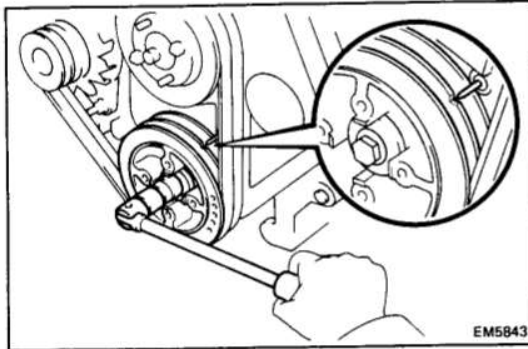
EM-20

ENGINE MECHANICAL – Engine Tune-Up

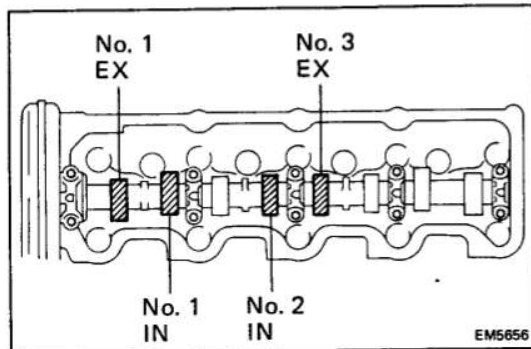
ADJUSTMENT OF VALVE CLEARANCE

HINT: Adjust the valve clearance while the engine is cold.

1. (2L-T)
REMOVE AIR CLEANER
2. (w/ Intake Pipe)
REMOVE INTAKE PIPE
3. REMOVE CYLINDER HEAD COVER
(See step 16 on page EM-38)
4. SET NO. 1 CYLINDER TO TDC/COMPRESSION



- (a) Turn the crankshaft pulley clockwise, and align its groove with the timing pointer.
- (b) Check that the valve lifters on the No. 1 cylinder are loose and valve lifters on the No. 4 cylinder are tight. If not, turn the crankshaft one revolution (360°) and align the mark as above.



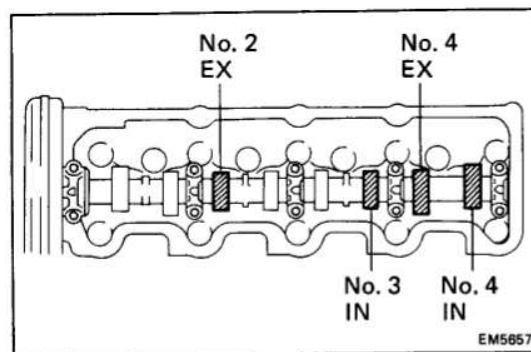
5. ADJUST VALVE CLEARANCE

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

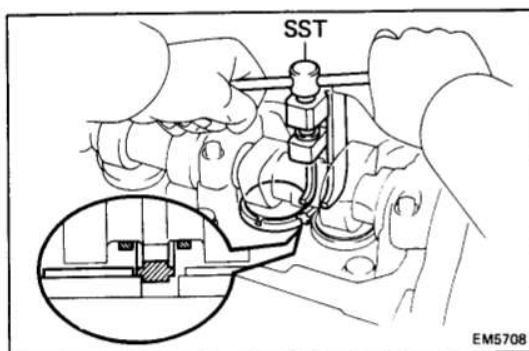
Valve clearance (Cold):

Intake 0.20 – 0.30 mm (0.008 – 0.012 in.)

Exhaust 0.40 – 0.50 mm (0.016 – 0.020 in.)



- (b) Turn the crankshaft one revolution (360°), and align the mark as above (See procedure step 4).
- (c) Check only the valves indicated in the illustration. Measure the valve clearance. (See procedure step (a))

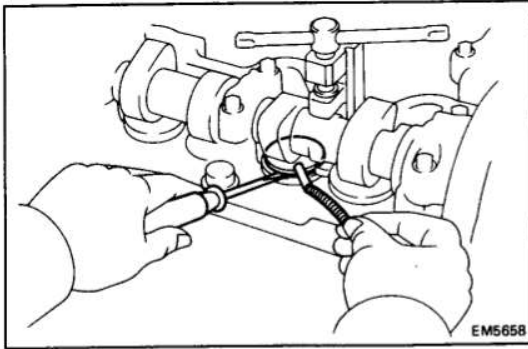


- (d) Remove the adjusting shim.

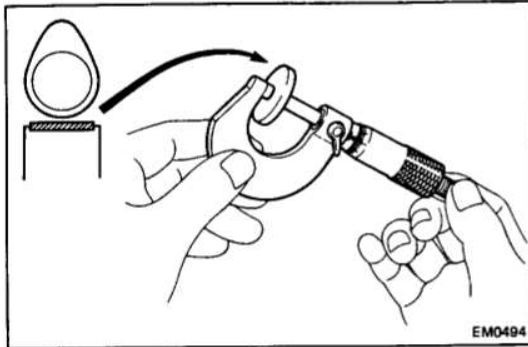
- Turn the crankshaft to position the cam lobe of the camshaft on the adjusting valve upward.
- Using SST, press down the valve lifter.

SST 09248-64010

HINT: Before pressing down the valve lifter, position the notch on the exhaust manifold side.

ENGINE MECHANICAL – Engine Tune-Up**EM-21**

- Remove the adjusting shim with small screwdriver and magnetic finger.



- (e) Determine the replacement adjusting shim size by using following the formula or charts:

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

T Thickness of used shim

A Measured valve clearance

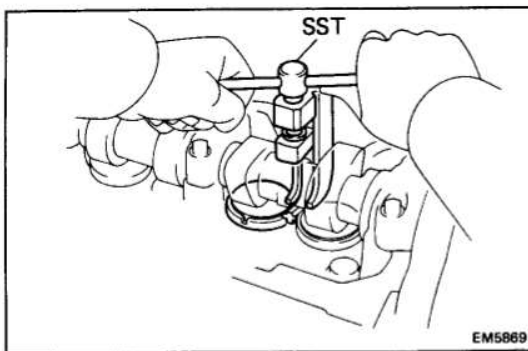
N Thickness of new shim

Intake side: $N = T + (A - 0.25 \text{ mm (0.010 in.)})$

Exhaust side: $N = T + (A - 0.45 \text{ mm (0.018 in.)})$

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

HINT: Shims are available in seventeen sizes in increments of 0.050 mm (0.0020 in.), from 2.500 mm (0.0984 in.) to 3.300 mm (0.1299 in.).



- (f) Install a new adjusting shim.

- Place a new adjusting shim on the valve lifter.
- Remove SST.

SST 09248-64010

- (g) Recheck the valve clearance.

6. REINSTALL CYLINDER HEAD COVER
(See step 4 on page EM-43)

7. (w/ Intake Pipe)
REINSTALL INTAKE PIPE

8. (2L-T)
REINSTALL AIR CLEANER

ENGINE MECHANICAL – Engine Tune-Up

INTAKE

Shim No.	Thickness	Shim No.	Thickness
01	2.50 (0.0984)	46	2.95 (0.1161)
42	2.55 (0.1004)	26	3.00 (0.1181)
06	2.60 (0.1024)	47	3.05 (0.1201)
43	2.65 (0.1043)	31	3.10 (0.1220)
11	2.70 (0.1063)	48	3.15 (0.1240)
44	2.75 (0.1083)	36	3.20 (0.1260)
16	2.80 (0.1102)	49	3.25 (0.1280)
45	2.85 (0.1122)	41	3.30 (0.1299)
21	2.90 (0.1142)		

EXAMPLE: The 2.800 mm (0.1102 in.) shim is installed and the measured clearance is 0.350 mm (0.0138 in.). Replace the 2.800 mm (0.1102 in.) shim with a No. 21 shim.

ENGINE MECHANICAL – Engine Tune-Up

EM-23

Adjusting Shim Selection Using Chart

EXHAUST

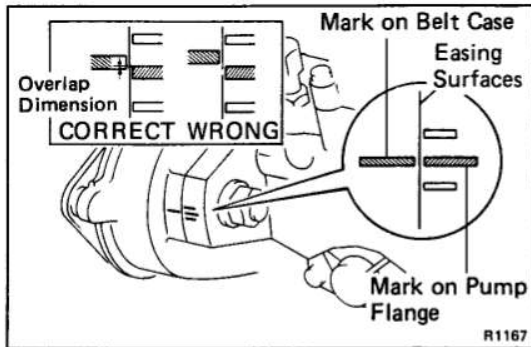
Measured clearance mm (in.)	Installed shim thickness mm (in.)																							
	2.500 (0.0984)	2.520 (0.0992)	2.540 (0.1000)	2.550 (0.1004)	2.560 (0.1008)	2.580 (0.1016)	2.600 (0.1024)	2.620 (0.1031)	2.640 (0.1039)	2.650 (0.1043)	2.660 (0.1047)	2.680 (0.1055)	2.700 (0.1063)	2.720 (0.1071)	2.740 (0.1079)	2.750 (0.1083)	2.760 (0.1087)	2.780 (0.1094)	2.800 (0.1102)	2.820 (0.1110)	2.840 (0.1118)	2.850 (0.1122)	2.860 (0.1126)	2.880 (0.1134)
0.000 – 0.020 (0.0000 – 0.0008)																								
0.021 – 0.040 (0.0008 – 0.0016)																								
0.041 – 0.060 (0.0016 – 0.0024)																								
0.061 – 0.080 (0.0024 – 0.0031)																								
0.081 – 0.100 (0.0032 – 0.0039)																								
0.101 – 0.120 (0.0040 – 0.0047)																								
0.121 – 0.140 (0.0048 – 0.0055)																								
0.141 – 0.160 (0.0056 – 0.0063)																								
0.161 – 0.180 (0.0063 – 0.0071)																								
0.181 – 0.200 (0.0071 – 0.0079)																								
0.201 – 0.220 (0.0079 – 0.0087)																								
0.221 – 0.240 (0.0087 – 0.0094)																								
0.241 – 0.260 (0.0095 – 0.0102)																								
0.261 – 0.280 (0.0103 – 0.0110)																								
0.281 – 0.300 (0.0111 – 0.0118)																								
0.301 – 0.320 (0.0119 – 0.0126)																								
0.321 – 0.340 (0.0126 – 0.0134)																								
0.341 – 0.360 (0.0134 – 0.0142)																								
0.361 – 0.380 (0.0142 – 0.0150)																								
0.381 – 0.399 (0.0150 – 0.0157)																								
0.400 – 0.500 (0.0157 – 0.0197)																								
0.501 – 0.520 (0.0197 – 0.0205)	42	06	06	06	06	06	43	43	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.521 – 0.540 (0.0205 – 0.0213)	06	06	06	43	43	43	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.541 – 0.560 (0.0213 – 0.0220)	06	06	43	43	43	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.561 – 0.580 (0.0221 – 0.0228)	06	43	43	43	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.581 – 0.600 (0.0229 – 0.0236)	43	43	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.601 – 0.620 (0.0237 – 0.0244)	43	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.621 – 0.640 (0.0244 – 0.0252)	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.641 – 0.660 (0.0252 – 0.0260)	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.661 – 0.680 (0.0260 – 0.0268)	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
0.681 – 0.700 (0.0268 – 0.0276)	44	44	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
0.701 – 0.720 (0.0276 – 0.0283)	44	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
0.721 – 0.740 (0.0284 – 0.0291)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
0.741 – 0.760 (0.0292 – 0.0299)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
0.761 – 0.780 (0.0300 – 0.0307)	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
0.781 – 0.800 (0.0307 – 0.0315)	45	45	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
0.801 – 0.820 (0.0315 – 0.0323)	45	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
0.821 – 0.840 (0.0323 – 0.0331)	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
0.841 – 0.860 (0.0331 – 0.0339)	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
0.861 – 0.880 (0.0339 – 0.0346)	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
0.881 – 0.900 (0.0347 – 0.0354)	46	46	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
0.901 – 0.920 (0.0355 – 0.0362)	46	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
0.921 – 0.940 (0.0363 – 0.0370)	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
0.941 – 0.960 (0.0370 – 0.0378)	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
0.961 – 0.980 (0.0378 – 0.0386)	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
0.981 – 1.000 (0.0386 – 0.0394)	47	47	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
1.001 – 1.020 (0.0394 – 0.0402)	47	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
1.021 – 1.040 (0.0402 – 0.0409)	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
1.041 – 1.060 (0.0410 – 0.0417)	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
1.061 – 1.080 (0.0418 – 0.0425)	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
1.081 – 1.100 (0.0426 – 0.0433)	48	48	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
1.101 – 1.120 (0.0433 – 0.0441)	48	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
1.121 – 1.140 (0.0441 – 0.0449)	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
1.141 – 1.160 (0.0449 – 0.0457)	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
1.161 – 1.180 (0.0457 – 0.0465)	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
1.181 – 1.200 (0.0465 – 0.0472)	49	49	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
1.201 – 1.220 (0.0473 – 0.0480)	49	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
1.221 – 1.240 (0.0481 – 0.0488)	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
1.241 – 1.260 (0.0489 – 0.0496)	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
1.261 – 1.280 (0.0496 – 0.0504)	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41
1.281 – 1.300 (0.0504 – 0.0512)	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41	41

New shim thickness mm (in.)

Shim No.	Thickness	Shim No.	Thickness
01	2.50 (0.0984)	46	2.95 (0.1161)
42	2.55 (0.1004)	26	3.00 (0.1181)
06	2.60 (0.1024)	47	3.05 (0.1201)
43	2.65 (0.1043)	31	3.10 (0.1220)
11	2.70 (0.1063)	48	3.15 (0.1240)
44	2.75 (0.1083)	36	3.20 (0.1260)</

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ENGINE MECHANICAL – Engine Tune-Up



INSPECTION AND ADJUSTMENT OF INJECTION TIMING (2L-T Austria)

1. CHECK INJECTION TIMING

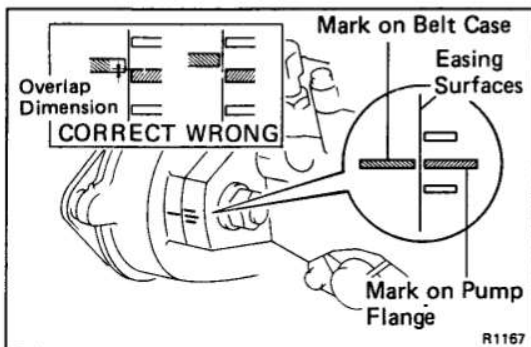
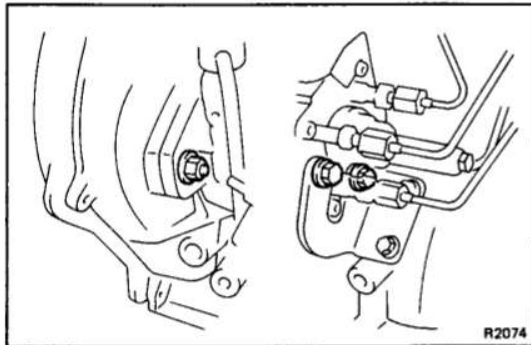
Using a mirror, check that the mark on the belt case and the center mark on the pump flange are correctly aligned with the amount of overlap as shown.

2. ADJUST INJECTION TIMING

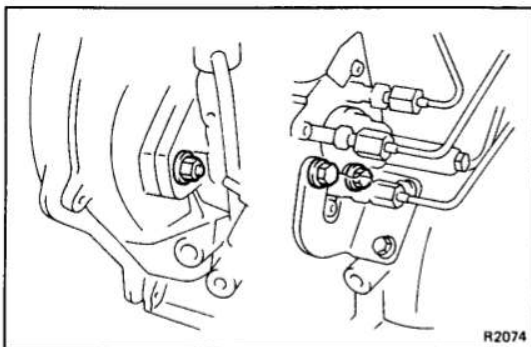
(a) Loosen the following bolts and nuts:

- (1) Two bolts holding injection pump to injection pump stay.
- (2) Two nuts holding injection pump to timing belt case.

HINT: Do not loosen the union nuts of injection pump more than 1/4 of a turn.



(b) Slightly tilt the injection pump body and align the belt case mark with the center mark on the pump flange to the correct overlap dimension.



(c) Tighten the following bolts and nuts:

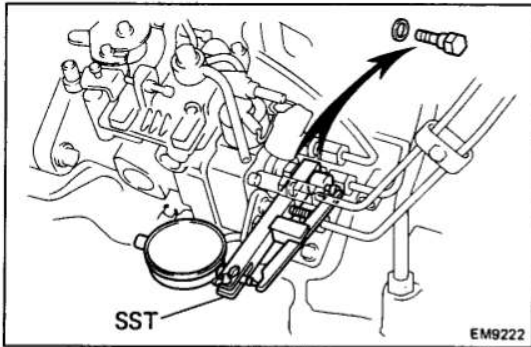
- (1) Two nuts holding injection pump to timing belt case.

Torque: 210 kg-cm (15 ft-lb, 21 N-m)

- (2) Two bolts holding injection pump to injection pump stay.

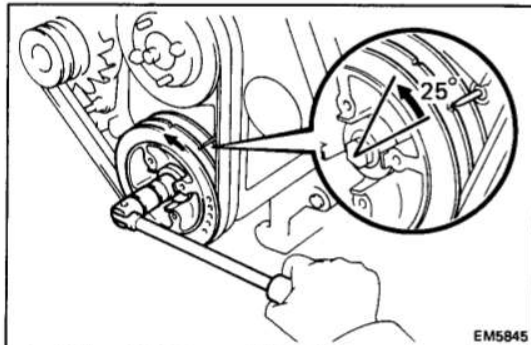
Torque: 185 kg-cm (13 ft-lb, 18 N-m)

3. START ENGINE AND CHECK FOR LEAKS

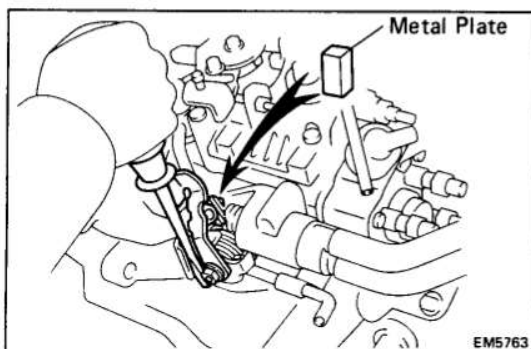
ENGINE MECHANICAL — Engine Tune-Up**EM-25****ADJUSTMENT OF INJECTION TIMING (Others)****1. INSTALL SST AND DIAL INDICATOR**

- Remove the plug bolt and gasket from the distributive head plug of the injection pump.
- Install SST (plunger stroke measuring tool) and a dial indicator to the plug bolt hole of distributive head plug.

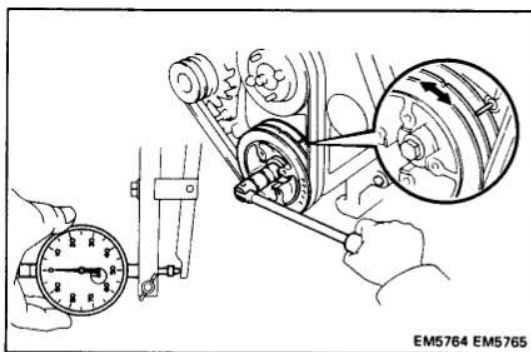
SST 09275-54010

**2. SET NO. 1 OR NO. 4 CYLINDER TO 25° OR MORE BTDC/COMPRESSION**

Turn the crankshaft pulley clockwise so the pulley groove is 25° or more from the timing pointer.

**3. (2L-T) RELEASE ACSD ADVANCE**

- Using a screwdriver, turn the cold starting lever counterclockwise approx. 20°.
- Put a metal plate (thickness of 8.5 – 10 mm (0.335 – 0.394 in.)) between the cold starting lever and thermo wax plunger.

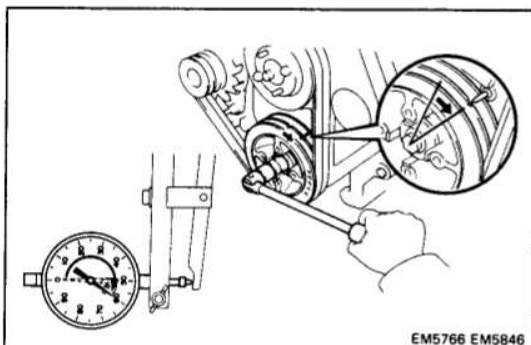
**4. ADJUST INJECTION TIMING**

- Set the dial indicator at 0 mm (0 in.).
- Recheck to see that the dial indicator remains at 0 mm (0 in.) while slightly rotating the crankshaft pulley clockwise or counterclockwise.

- Slowly rotate the crankshaft pulley clockwise until pulley groove is aligned with the timing pointer.
- Measure the plunger stroke.

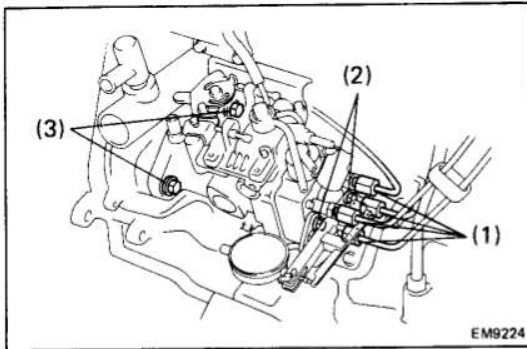
Plunger stroke:

2L-T 0.54 – 0.66 mm (0.0213 – 0.0260 in.)
 3L 0.84 – 0.96 mm (0.0331 – 0.0378 in.)



EM-26

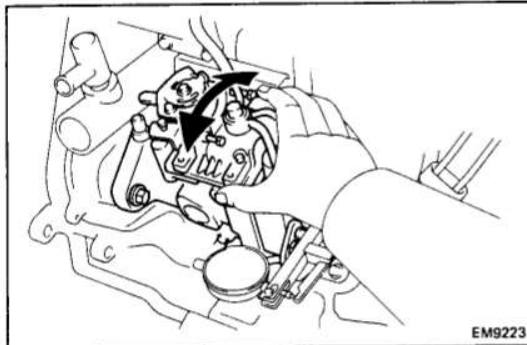
ENGINE MECHANICAL – Engine Tune-Up



(e) Loosen the following bolts and nuts:

- (1) Four union nuts of injection pipes at injection pump side.
- (2) Two bolts holding injection pump to injection pump stay.
- (3) Two nuts holding injection pump to timing belt case.

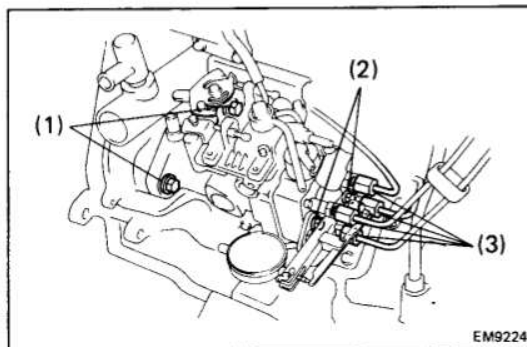
HINT: Do not loosen the union nuts of injection pump more than 1/4 of a turn.



(f) Adjust plunger stroke by slightly tilting the injection pump body.

If the stroke is less than specified, tilt the pump toward the engine.

If the stroke is greater than specified, tilt the pump away from the engine.



(g) Tighten the following bolts and nuts:

- (1) Two nuts holding injection pump to timing belt case.

Torque: 210 kg-cm (15 ft-lb, 21 N·m)

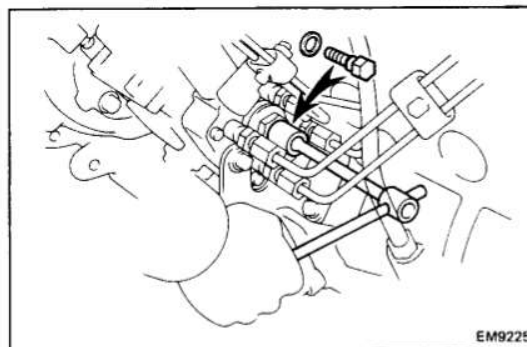
- Recheck the plunger stroke.

- (2) Two bolts holding injection pump to injection pump stay.

Torque: 185 kg-cm (13 ft-lb, 18 N·m)

- (3) Four union nuts of injection pipes.

Torque: 250 kg-cm (18 ft-lb, 25 N·m)



5. (2L-T)
REMOVE METAL PLATE

6. **REMOVE SST AND DIAL INDICATOR**

(a) Remove SST and the dial indicator.

SST 09275-54010

(b) Install a new gasket and the plug bolt of the distributive head plug.

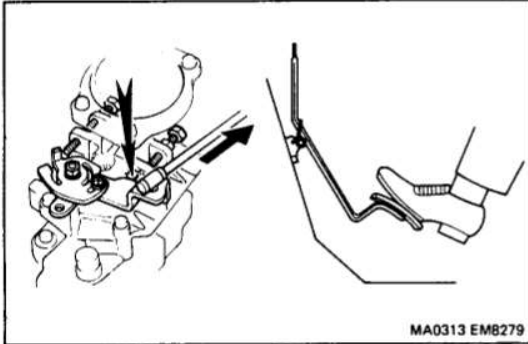
Torque: 170 kg-cm (12 ft-lb, 17 N·m)

7. **START ENGINE AND CHECK FOR LEAKS**

ADJUSTMENT OF IDLE SPEED AND MAXIMUM SPEED

1. INITIAL CONDITIONS

- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All accessories switched OFF
- (d) All vacuum lines properly connected
- (e) Valve clearance set correctly
- (f) Injection timing set correctly
- (g) Transmission in neutral range



2. CONNECT TACHOMETER

3. ADJUST IDLE SPEED

- (a) Check that the adjusting lever touches the idle speed adjusting screw when the accelerator pedal is released.

If not, adjust the accelerator linkage.

- (b) Start the engine.

- (c) Check the idle speed.

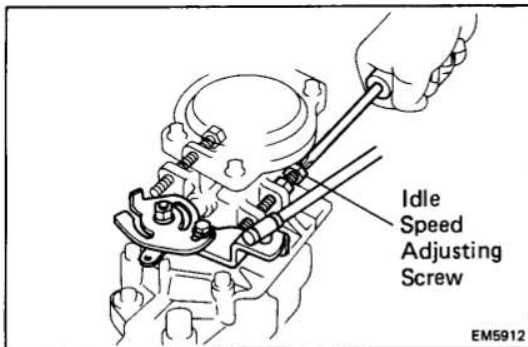
Idle speed: 2L-T 700 – 800 rpm
3L 650 – 750 rpm

- (d) Adjust the idle speed.

- Disconnect the accelerator linkage.
- Loosen the lock nut of the idle speed adjusting screw.
- Adjust the idle speed by turning the IDLE SPEED ADJUSTING SCREW.

Idle speed: 2L-T 750 rpm
3L 700 rpm

- Securely tighten the lock nut, and recheck the idle speed.
- Reconnect the accelerator linkage.
- After adjustment, adjust the accelerator linkage.



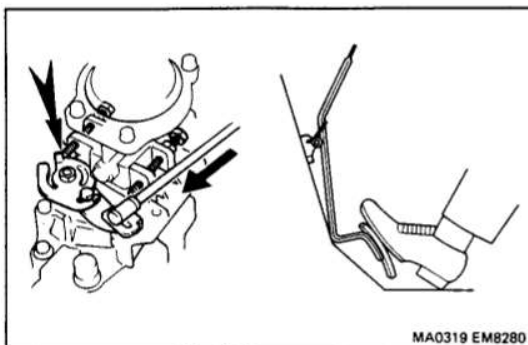
4. ADJUST MAXIMUM SPEED

- (a) Check that the adjusting lever touches the maximum speed adjusting screw when the accelerator pedal is depressed all the way.

If not, adjust the accelerator linkage.

- (b) Start the engine.

- (c) Depress the accelerator pedal all the way.



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(d) Check the maximum speed.

Maximum speed:

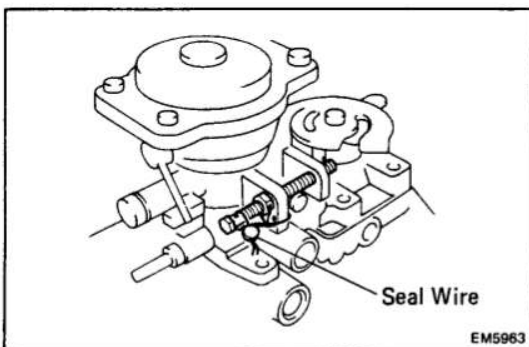
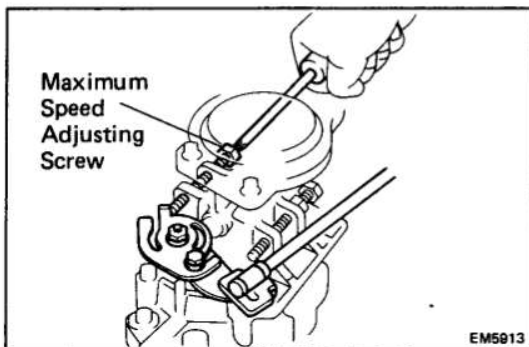
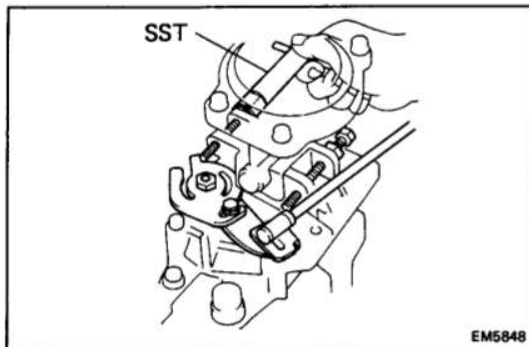
- 2L-T 4,700 – 4,900 rpm
 3L (Hong Kong, Singapore and Malaysia) 4,300 – 4,500 rpm
 3L (Others) 4,500 – 4,700 rpm

(e) Adjust the maximum speed.

- Disconnect the accelerator linkage.
- Cut out the seal wire of the maximum speed adjusting screw.
- (2L-T and w/ HAC)
Using SST, loosen the lock nut of the maximum speed adjusting screw.

SST 09275-54020

- (w/o HAC)
Loosen the lock nut of the maximum speed adjusting screw.



- Adjust the maximum speed by turning the MAXIMUM SPEED ADJUSTING SCREW.

Maximum speed:

- 2L-T 4,800 rpm
 3L (Hong Kong, Singapore and Malaysia) 4,400 rpm
 3L (Others) 4,600 rpm

HINT: Adjust at idle speed. Then, raise engine speed and recheck the maximum speed.

- (2L-T and w/ HAC)
Using SST, securely tighten the lock nut.

SST 09275-54020

- (w/o HAC)
Securely tighten the lock nut.
- Recheck the maximum speed.
- Reconnect the accelerator linkage.
- After adjustment, adjust the accelerator linkage.
- Seal the maximum speed adjusting screw with a new seal wire.

ADJUSTMENT OF AIR CONDITIONER IDLE-UP SETTING SPEED

1. INITIAL CONDITIONS

- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All vacuum lines properly connected
- (d) Valve clearance set correctly
- (e) Injection timing set correctly
- (f) Transmission in neutral range
- (g) Idle speed set correctly

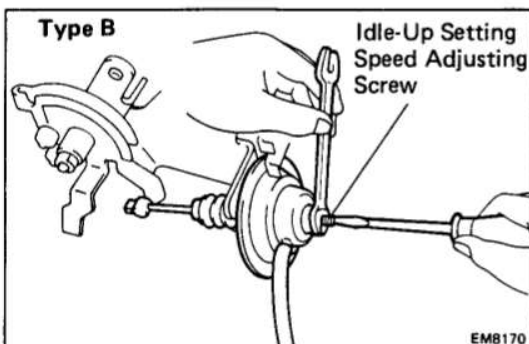
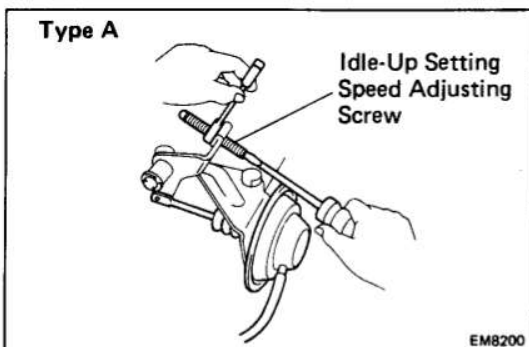
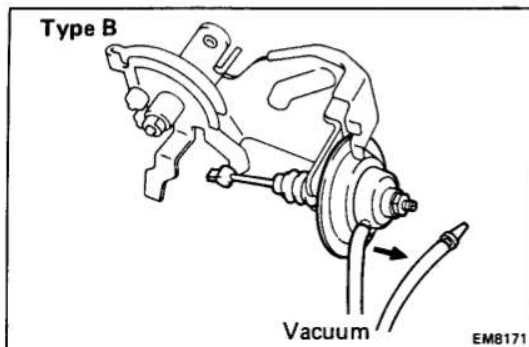
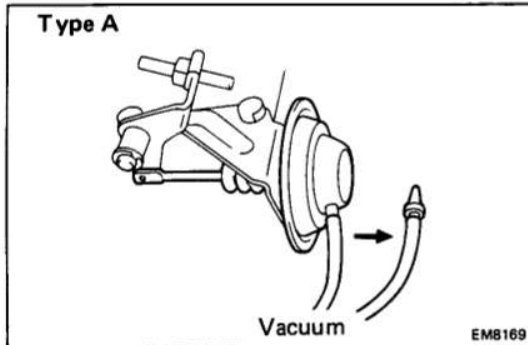
2. CONNECT TACHOMETER

3. ADJUST AIR CONDITIONER IDLE-UP SETTING SPEED

- (a) Start the engine.
- (b) A/C switches ON.
- (c) Disconnect the vacuum hose from the idle-up actuator.
- (d) Apply vacuum to the idle-up actuator.
- (e) Race the engine to 2,500 rpm for a few seconds, release the throttle and check the idle-up setting speed.

A/C idle-up setting speed: 950 rpm

- (f) Adjust the idle-up setting speed by turning the IDLE-UP SETTING SPEED ADJUSTING SCREW.
- (g) Race the engine to 2,500 rpm for a few seconds, release the throttle and recheck the A/C idle-up setting speed.
- (h) Reconnect the vacuum hose to the idle-up actuator.



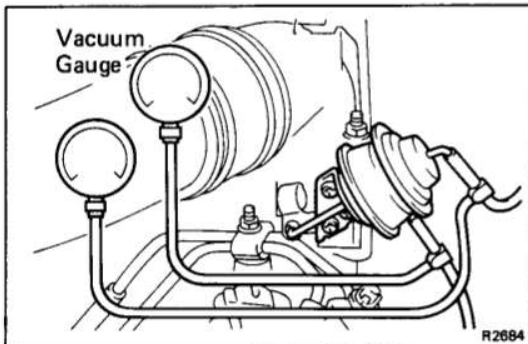
EM-30

ENGINE MECHANICAL – Intake Venturi System (LN 2L-T only)

INTAKE VENTURI SYSTEM (LN 2L-T only)

ON-VEHICLE INSPECTION

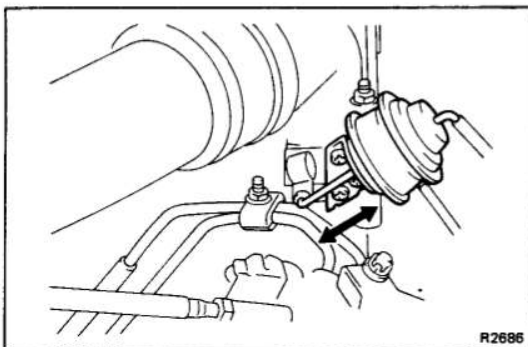
NOTICE: Always stop the engine when installing or removing the vacuum gauges, or removing the vacuum hoses.



(Austria)

1. PREPARATION

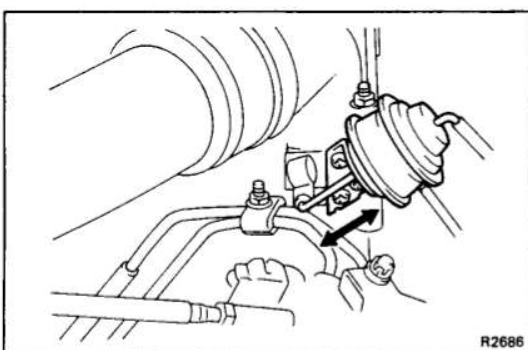
Using two 3-way connectors, connect two vacuum gauges to hoses between the actuator and VSV.



2. CHECK THROTTLE VALVE (LOW ALTITUDE AREA)

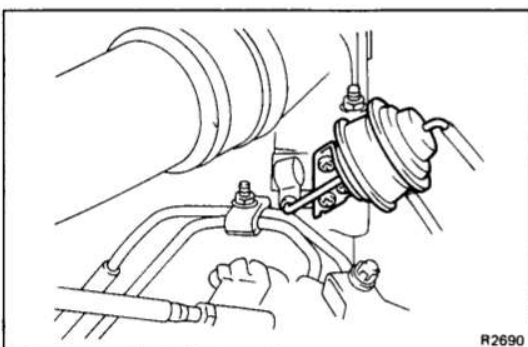
HINT: Perform this check at an altitude below 800 m (2,600 ft) and at an atmospheric pressure above 700 mm Hg (94.5 kg/cm²).

- Start the engine and check that vacuum operates on diaphragm chamber B so that the rods are pulled up.
- Check that when the accelerator pedal is depressed, atmospheric air operates on both diaphragm chambers so that the rods return.



- Check that when the starter switch is turned OFF (engine stopped) from idling condition, vacuum operates on both diaphragm chambers so that the rods are pulled up.

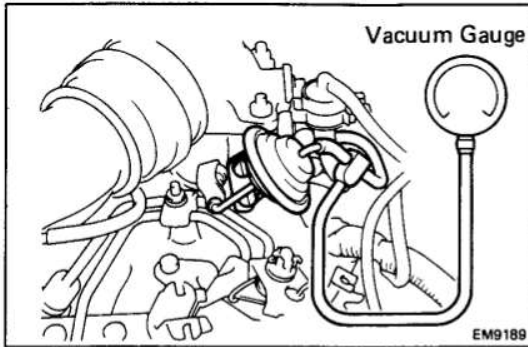
- Check that after the starter switch is turned OFF, the rods gradually return.



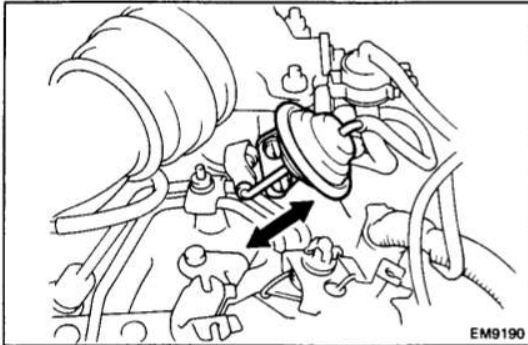
3. CHECK THROTTLE VALVE (HIGH ALTITUDE AREA)

HINT: Perform this check at an altitude above 800 m (2,600 ft) and at an atmospheric pressure below 690 mm Hg (93.2 kg/cm²).

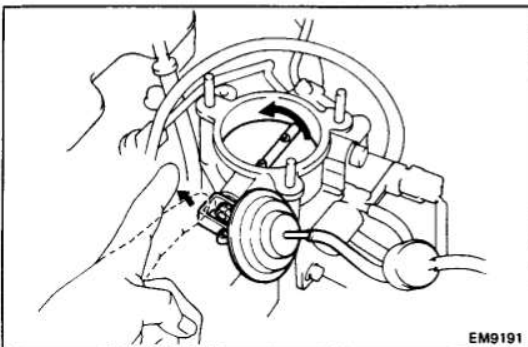
Check that during idling or with the starter switch OFF (engine stopped), vacuum is not operating on either diaphragm chamber.

ENGINE MECHANICAL — Intake Venturi System (LN 2L-T only)**EM-31****(Others)****1. PREPARATION**

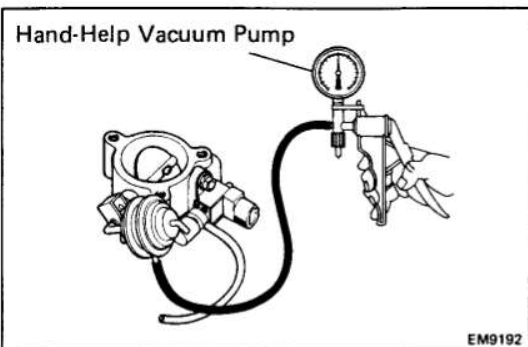
Using a 3-way connector, connect a vacuum gauge to hose between the actuator and VSV.

**2. CHECK THROTTLE VALVE**

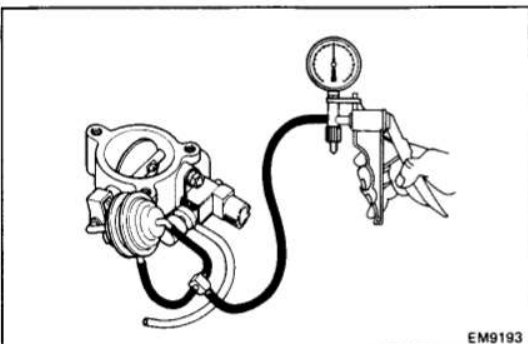
- (a) Start the engine and check that the vacuum gauge indicates zero vacuum.
- (b) Check that when the starter switch is turned OFF (engine stopped) from idling condition, vacuum operates on the diaphragm chamber so that the rods return.
- (c) Check that after the starter switch is turned OFF, the rods gradually return.

**INSPECTION OF INTAKE VENTURI SYSTEM COMPONENTS****1. INSPECT VENTURI**

- (a) Fully close the throttle valve, and check that it returns smoothly.



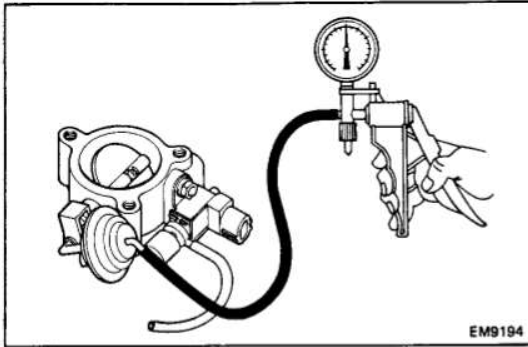
- (b) (Austria)
Using the hand-help vacuum pump, check that when vacuum is gradually applied to diaphragm chamber B of the actuator, the throttle valve opens half-way.



- (c) (Austria)
Using the hand-help vacuum pump check that when vacuum is gradually applied to diaphragm chambers A and B of the actuator, the throttle valve fully opens.

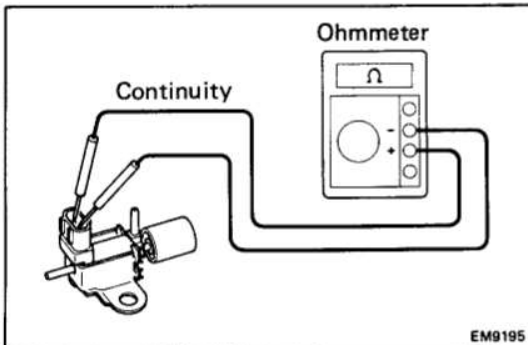
EM-32

ENGINE MECHANICAL – Intake Venturi System (LN 2L-T only)



(d) (Others)

Using the hand-help vacuum pump, check that when vacuum is gradually applied to the diaphragm chamber of the actuator, the throttle valve opens half-way.



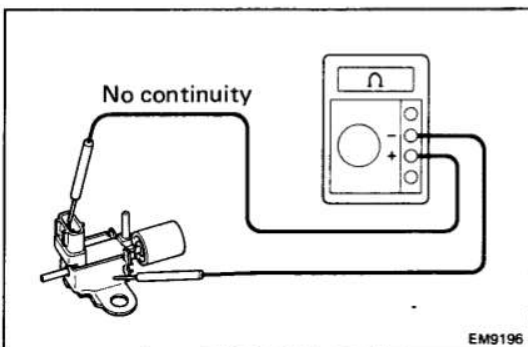
2. INSPECT VSV

A. Inspect VSV for open circuit

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

Resistance (Cold): 37 – 44 Ω

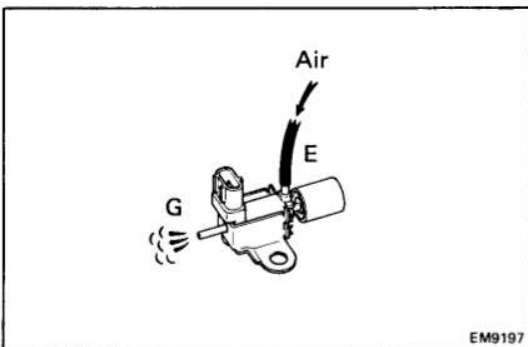
If there is no continuity, replace the VSV.



B. Inspect VSV for ground

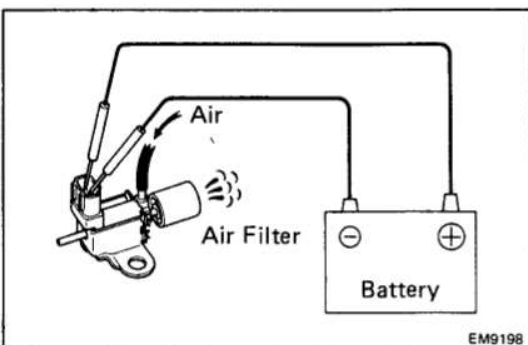
Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.



C. Inspect VSV operation

(a) Check that air flows from pipes E to G.



(b) Apply battery voltage across the terminals.

(c) Check that air flows from port E to the filter.

If operation is not as specified, replace the VSV.

COMPRESSION CHECK

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

1. WARM UP AND STOP ENGINE

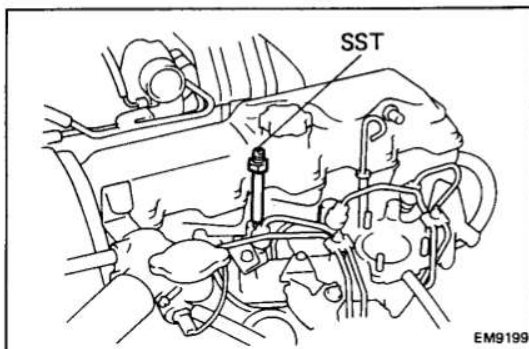
Allow the engine to reach normal operating temperature.

2. DISCONNECT INJECTION PUMP (FUEL CUT SOLENOID) CONNECTOR

3. REMOVE AIR CLEANER

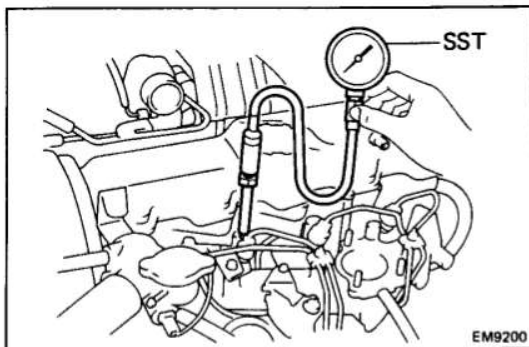
4. (w/ Intake Pipe) REMOVE INTAKE PIPE

5. REMOVE GLOW PLUGS



6. CHECK CYLINDER COMPRESSION PRESSURE

- (a) Install SST (attachment) to the glow plug hole.
SST 09992-00024 (09992-00121)



- (b) Connect SST (compression gauge) to SST (attachment).

SST 09992-00024 (09992-00121, 09992-00211)

- (c) Fully open the throttle valve.

- (d) While cranking the engine, measure the compression pressure.

HINT: Always use a fully charged battery to obtain engine revolution of 250 rpm or more.

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

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

Compression pressure:

2L-T 31.0 kg/cm² (441 psi, 3,040 kPa) or more

3L 32.0 kg/cm² (455 psi, 3,138 kPa) or more

Minimum pressure:

20.0 kg/cm² (284 psi, 1,961 kPa)

Difference between each cylinder:

5.0 kg/cm² (71 psi, 490 kPa) or less

EM-34**ENGINE MECHANICAL – Compression Check**

- (f) If the cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the glow plug hole and repeat steps (a) through (d) for the cylinder with low compression.
- If adding oil helps the compression, chances are that the piston rings and/or cylinder bore are worn or damaged.
 - If pressure stays low, a valve may be sticking or seating improperly, or there may be leakage past the gasket.

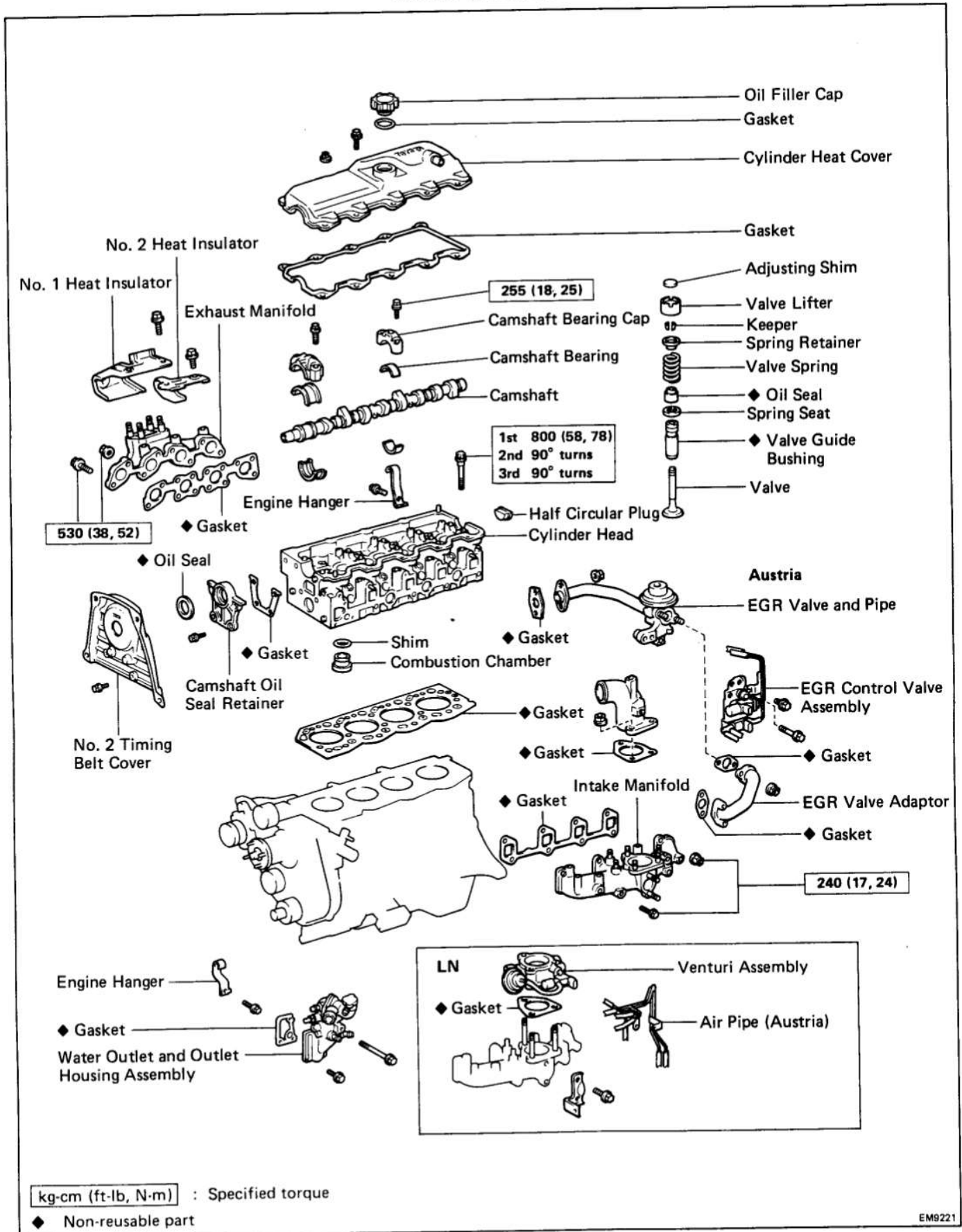
7. REINSTALL GLOW PLUGS**8. (w/ Intake Pipe)
REINSTALL INTAKE PIPE****9. REINSTALL AIR CLEANER****10. RECONNECT INJECTION PUMP (FUEL CUT
SOLENOID) CONNECTOR**

ENGINE MECHANICAL – Cylinder Head (2L-T)

EM-35

CYLINDER HEAD (2L-T)

COMPONENTS

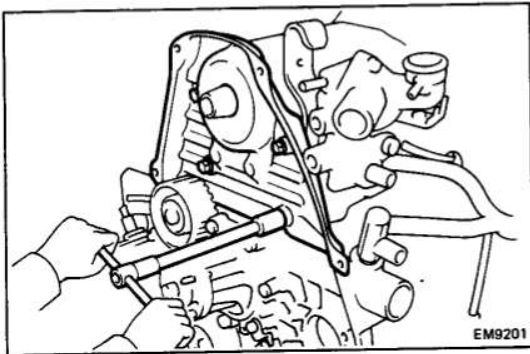


EM9221

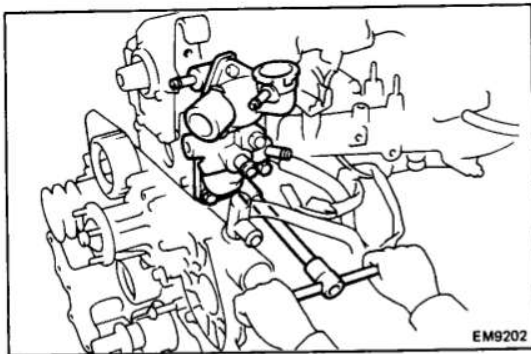
EM-36**ENGINE MECHANICAL – Cylinder Head (2L-T)****REMOVAL OF CYLINDER HEAD**

(See page EM-35)

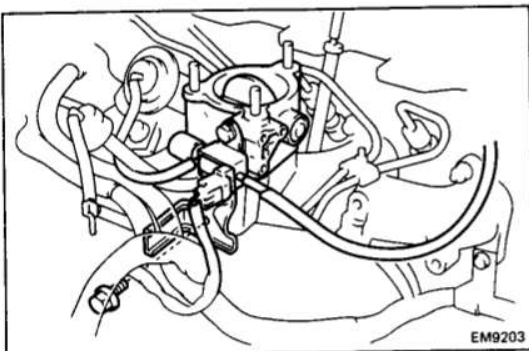
1. DRAIN ENGINE COOLANT (See page CO-4)
2. REMOVE TURBOCHARGER
(See steps 2 to 7 on pages TC-10 and 11)
3. REMOVE TIMING BELT
(See steps 2 to 7 on page FU-4)
4. REMOVE INJECTION PUMP
(See steps 8 to 16 on pages FU-4 and 5)
5. REMOVE INJECTION NOZZLES
6. REMOVE CAMSHAFT TIMING PULLEY



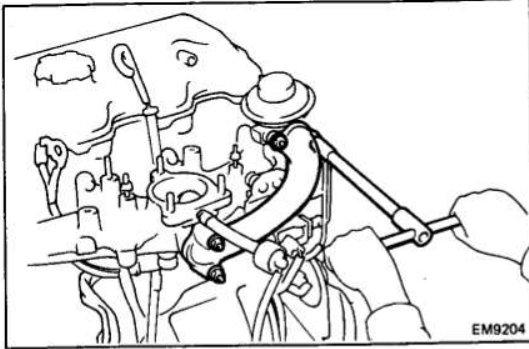
7. REMOVE NO. 2 TIMING BELT COVER
Remove the four bolts and belt cover.



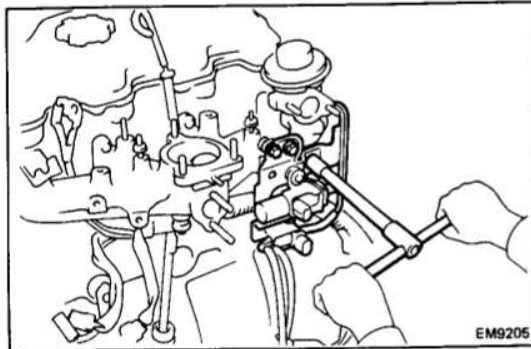
8. REMOVE WATER OUTLET AND OUTLET HOUSING ASSEMBLY
 - (a) Disconnect the water temperature switch connector.
 - (b) Disconnect the by-pass hose from the thermo wax of the injection pump.
 - (c) Remove the three bolts, water outlet, outlet housing assembly and gasket.
9. REMOVE LH ENGINE HANGER



10. (LN)
REMOVE VENTURI ASSEMBLY
 - (a) Disconnect the connector and vacuum hoses from the VSV.
 - (b) Remove the venturi assembly and gasket.
 - (c) Remove the two bolts and wire support.

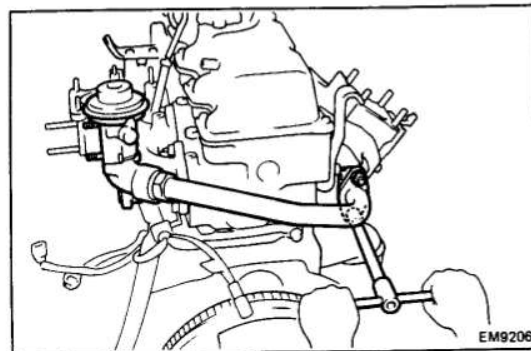
ENGINE MECHANICAL – Cylinder Head (2L-T)**EM-37****11. (Austria)
REMOVE EGR VALVE, PIPE, VALVE ADAPTOR AND
CONTROL VALVE ASSEMBLY**

- (a) Remove the four nuts, air pipe (LN only), EGR valve adaptor and two gaskets.

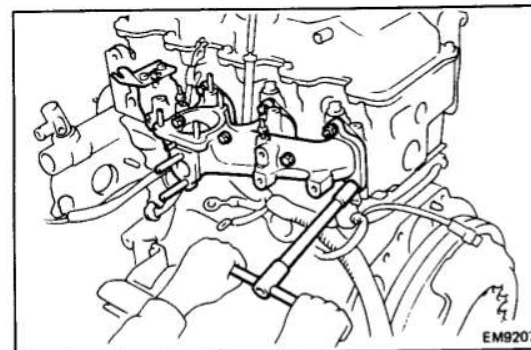


- (b) Disconnect the connectors from the VSV and EVRV.

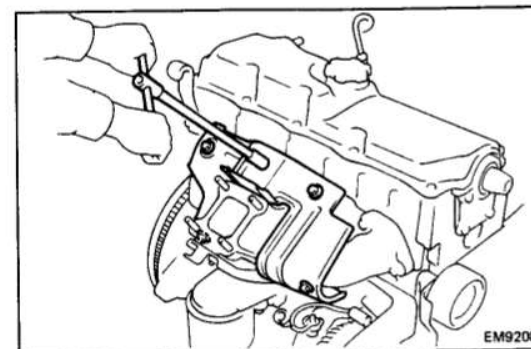
- (c) Remove the three bolts and EGR control valve assembly.



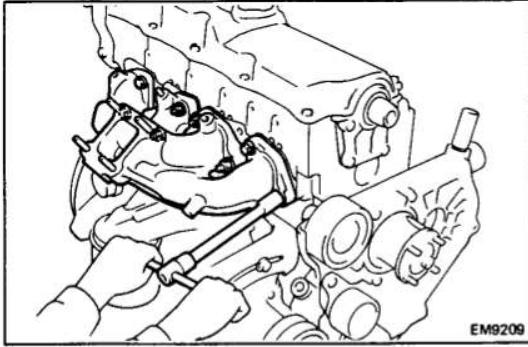
- (d) Remove the two nuts, EGR valve with the pipe and gasket.

**12. REMOVE INTAKE MANIFOLD**

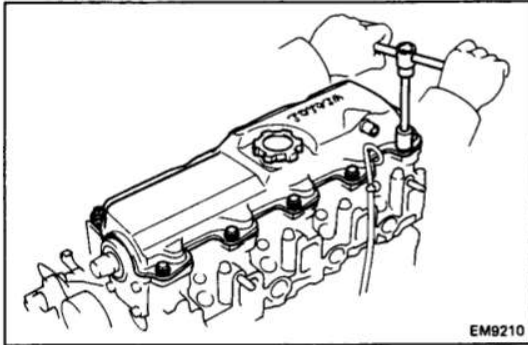
- (a) Remove the nut and insulator of the glow plug resistor.
- (b) Remove the six bolts, two nuts, intake manifold and gasket.

**13. REMOVE EXHAUST MANIFOLD**

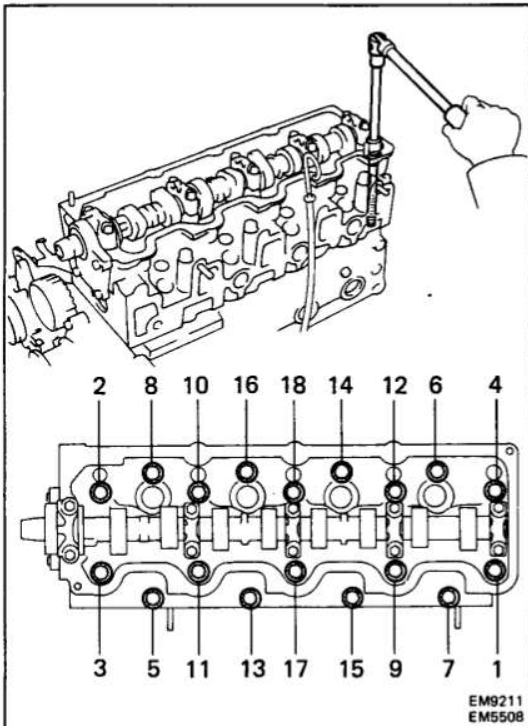
- (a) Remove the four bolts, nut and two heat insulators.

EM-38**ENGINE MECHANICAL — Cylinder Head (2L-T)**

- (b) Remove the four bolts, four nuts, exhaust manifold and gasket.

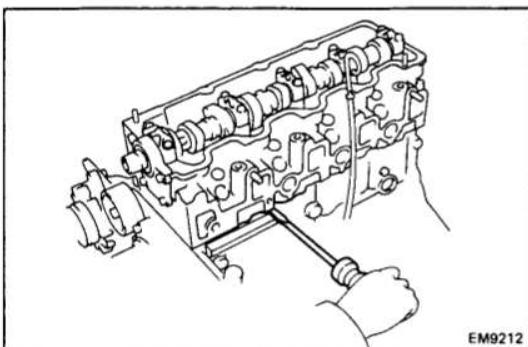
14. REMOVE RH ENGINE HANGER**15. REMOVE CYLINDER HEAD COVER**

- Remove the eight bolts, two nuts, cylinder head cover and gasket.

**16. REMOVE CYLINDER HEAD**

- (a) Uniformly loosen and remove the eighteen cylinder head bolts in several passes in the sequence shown.

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



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

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

NOTICE: Be careful not to damage the cylinder head and cylinder block surfaces of cylinder head gasket side.

DISASSEMBLY OF CYLINDER HEAD

(See page EM-35)

INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS**INSPECT CAMSHAFTS AND BEARINGS****B. Inspect cam lobes**

Using a micrometer, measure the cam lobe height.

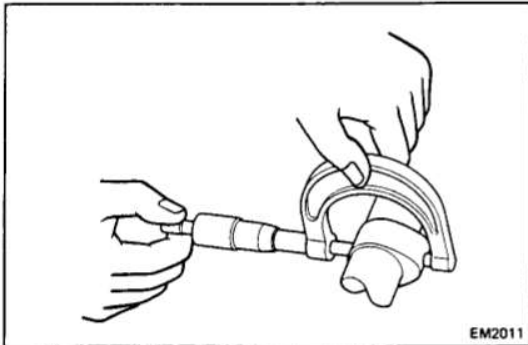
Standard cam lobe height:

Intake	2L-T	53.450 – 53.470 mm (2.1043 – 2.1051 in.)
	3L	54.290 – 54.310 mm (2.1374 – 2.1382 in.)
Exhaust		54.990 – 55.010 mm (2.1650 – 2.1657 in.)

Minimum cam lobe height:

Intake	2L-T	52.95 mm (2.0846 in.)
	3L	53.79 mm (2.1177 in.)
Exhaust		54.49 mm (2.1453 in.)

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



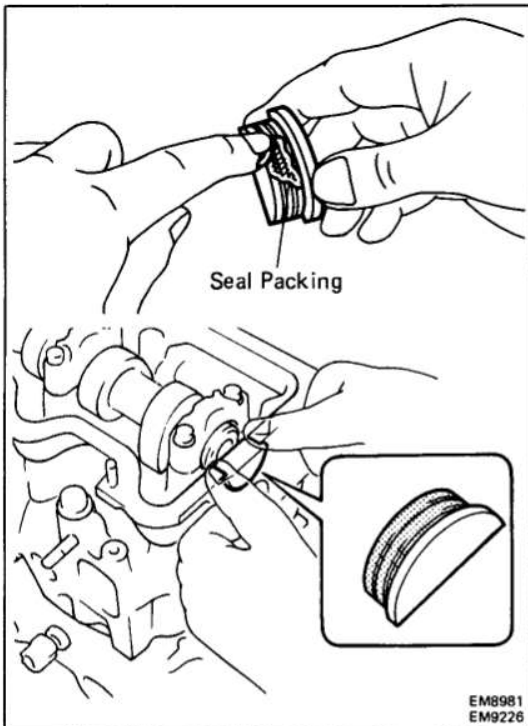
EM2011

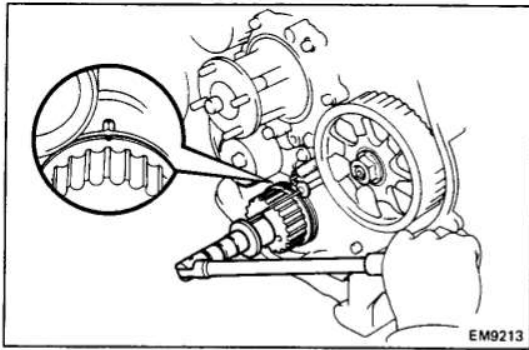
ASSEMBLY OF CYLINDER HEAD

(See page EM-35)

INSTALL HALF CIRCULAR PLUG

- Remove any old packing (FIPG) material.
 - Apply seal packing to the half circular plug as shown.
- Seal packing: Part No. 08826-00080 or equivalent**
- Install the half circular plug to the cylinder head.

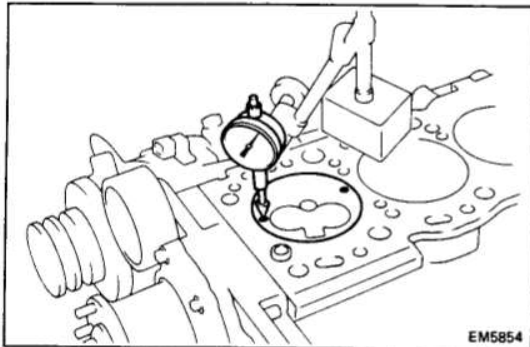
EM8981
EM9226

EM-40**ENGINE MECHANICAL – Cylinder Head (2L-T)****INSTALLATION OF CYLINDER HEAD**

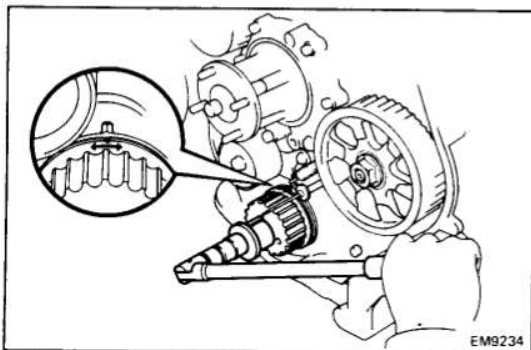
(See page EM-35)

1. CHECK PISTON PROTRUSION AND SELECT CYLINDER HEAD GASKET**A. Check protrusions of No. 1 and No. 4 pistons**

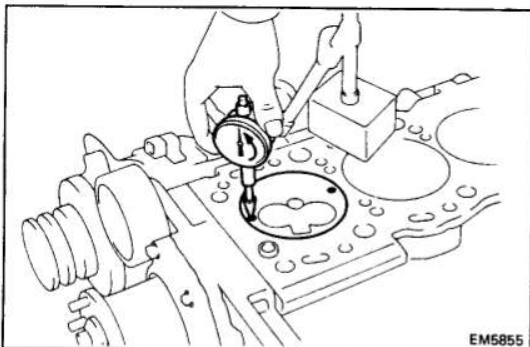
(a) Align the timing marks of the crankshaft timing pulley and timing belt case.



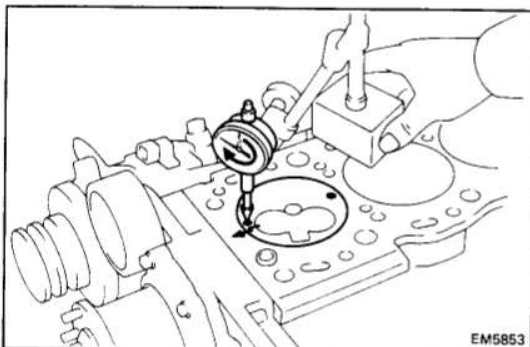
(b) Place a dial indicator on the cylinder block, and set the dial indicator needle on the piston measuring point.



(c) Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.



(d) Set the dial indicator at 0 mm (0 in.).



(e) Measure the piston protrusion from the cylinder block by sliding the dial indicator.

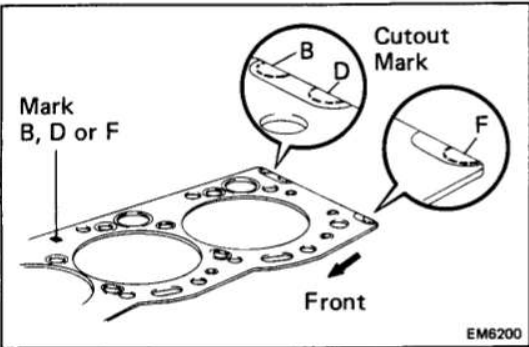
**Protrusion: 0.68 – 0.97 mm
(0.0268 – 0.0382 in.)**

HINT: For each piston, measure the piston protrusion at two measuring points.

(When removing piston and connecting rod assembly)
If the protrusion is not as specified, remove the piston and connecting rod assembly and reinstall it.

- B. Check protrusions of No. 2 and No. 3 pistons
- (a) Turn the crankshaft 1/2 of a revolution (180°).

(b) Measure the piston protrusions.
(See procedure steps A (b) to (e))



Piston protrusion mm (in.)	Gasket size
0.68 – 0.77 (0.0268 – 0.0303)	Use B
0.78 – 0.87 (0.0307 – 0.0343)	Use D
0.88 – 0.97 (0.0316 – 0.0382)	Use F

C. Select new cylinder head gasket

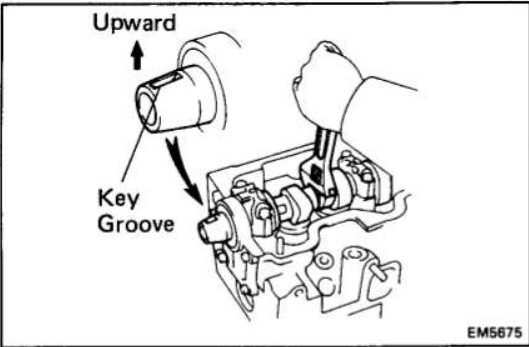
HINT: There are three sizes of new cylinder head gasket, marked either "B", "D" or "F", or indicated by a cutout mark.

New cylinder head gasket thickness:

- Mark B 1.40 – 1.50 mm
(0.0551 – 0.0591 in.)
- Mark D 1.50 – 1.60 mm
(0.0591 – 0.0630 in.)
- Mark F 1.60 – 1.70 mm
(0.0630 – 0.0669 in.)

When selecting a new cylinder head gasket, use the largest value from the eight measurements made of the piston protrusion.

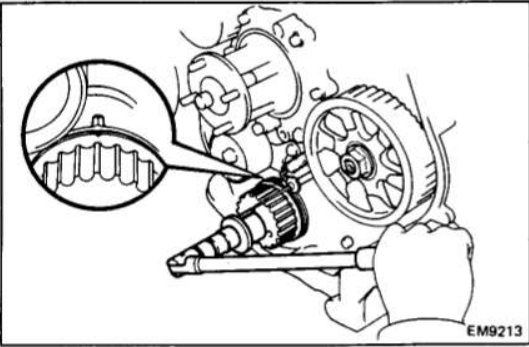
HINT: There are 6 types of cylinder head gasket (marks A to F) installed at the factory, but only 3 types for supply parts (mark B, D and F), so when replacing the gasket, choose from one of the 3 types above.



2. SET NO. 1 CYLINDER TO TDC/COMPRESSION

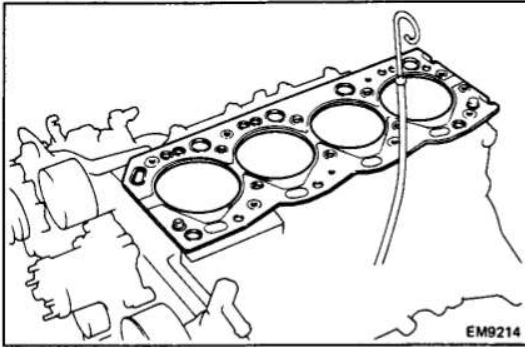
HINT: Set the No. 1 cylinder to TDC/compression to avoid interference with the piston top and valve head.

- (a) (Camshaft Position)
Set the camshaft by turning the hexagonal wrench head portion, facing the key groove upward.
- (b) (Crankshaft Position)
Using the crankshaft pulley bolt, align the timing marks of the timing pulley and timing belt case by turning the crankshaft.



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ENGINE MECHANICAL – Cylinder Head (2L-T)



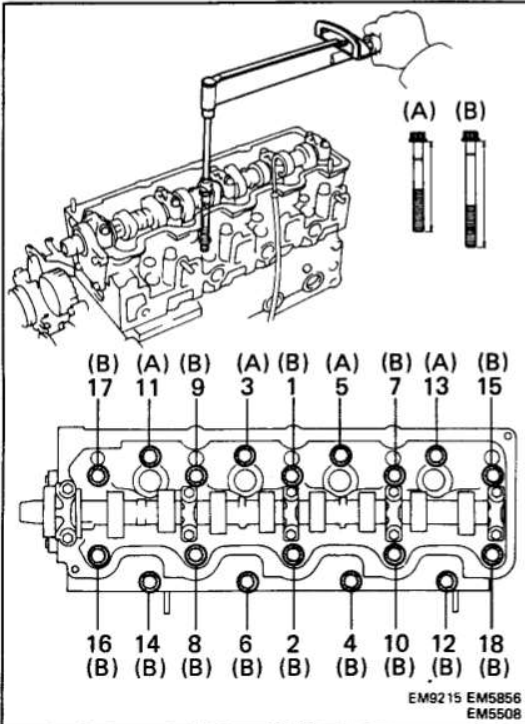
3. INSTALL CYLINDER HEAD

A. Place cylinder head on cylinder block

- (a) Place a new cylinder head gasket in position on the cylinder block.

NOTICE: Be careful of the installation direction.

- (b) Place the cylinder head in position on the cylinder head gasket.



B. Install cylinder head bolts

HINT:

- The cylinder head bolts are tightened in three progressive steps.
 - If any of bolts break or deform, replace them.
- (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
- (b) First, install and uniformly tighten the eighteen cylinder head bolts in several passes in the sequence shown.

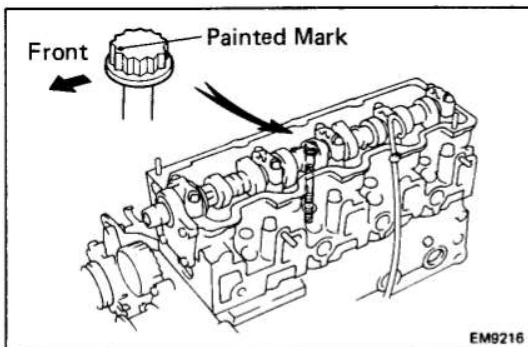
Torque: 800 kg-cm (58 ft-lb, 78 N-m)

HINT: The bolt lengths for bolt types A and B shown in the illustration are:

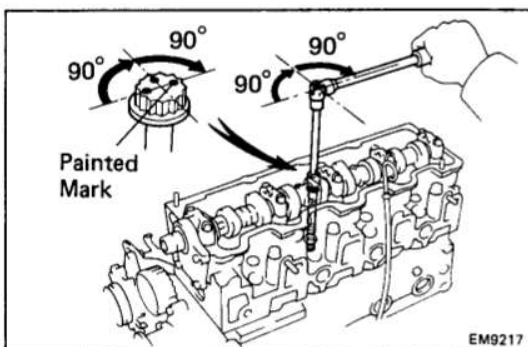
A 107 mm (4.12 in.)

B 127 mm (5.00 in.)

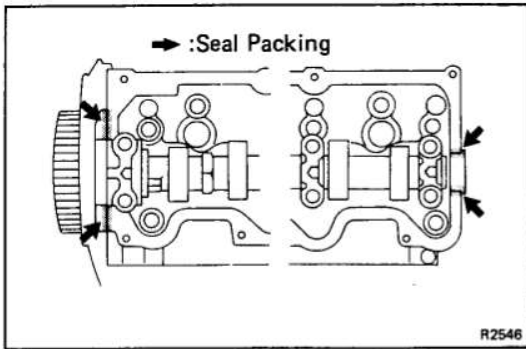
If any one of the bolts does not meet the torque specification, replace the bolt.



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

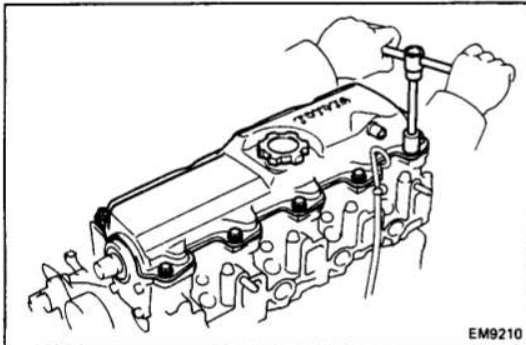


- (d) Second, retighten the cylinder head bolts 90° in the numerical order shown.
- (e) Third, retighten cylinder head bolts by an additional 90°.
- (f) Check that the painted mark is now facing rearward.

ENGINE MECHANICAL – Cylinder Head (2L-T)**EM-43****4. INSTALL CYLINDER HEAD COVER**

- (a) Apply seal packing to the cylinder heads as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent



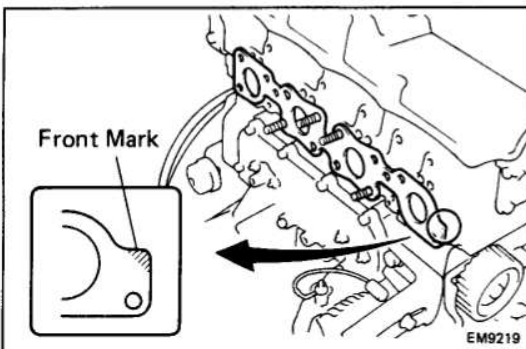
- (b) Install the gasket to the cylinder head cover.

- (c) Install the cylinder head cover with the eight bolts and two nuts.

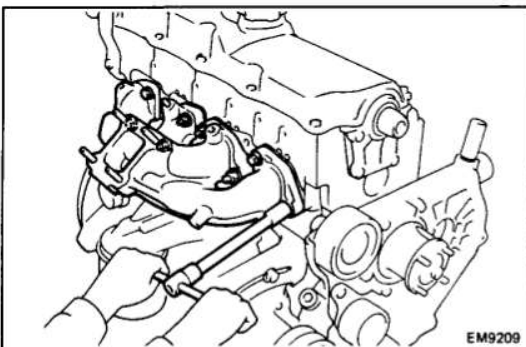
Torque: 50 kg-cm (43 in.-lb, 4.9 N·m)

5. INSTALL RH ENGINE HANGER

Torque: 380 kg-cm (27 ft-lb, 37 N·m)

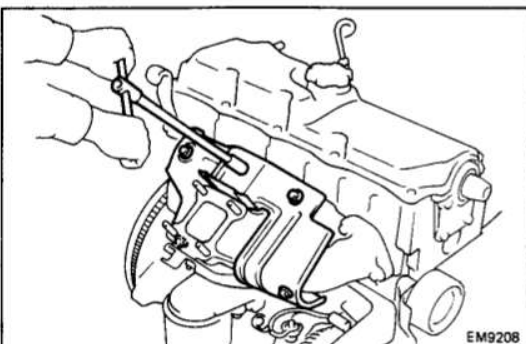
**6. INSTALL EXHAUST MANIFOLD**

- (a) Install a new gasket in direction as shown in the illustration.



- (b) Install the exhaust manifold with the four nuts and four bolts.

Torque: 530 kg-cm (38 ft-lb, 52 N·m)

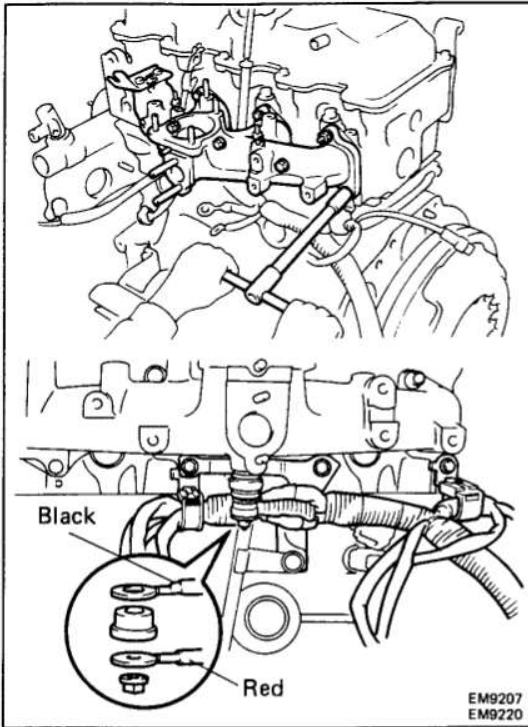


- (c) Install the two heat insulators with the four bolts and nut.

Torque: 120 kg-cm (9 ft-lb, 12 N·m)

EM-44

ENGINE MECHANICAL — Cylinder Head (2L-T)



7. INSTALL INTAKE MANIFOLD

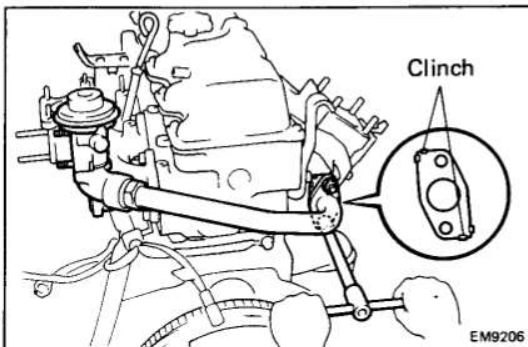
- (a) Install a new gasket and the intake manifold with the six bolts and two nuts.

Torque: 240 kg-cm (17 ft-lb, 24 N·m)

HINT: Torque the three bolts on the bottom of the manifold together with the oil level gauge guide support and the clamp for the engine wires, as shown in the illustration.

- (b) Install the insulator and nut to the glow plug resistor.

HINT: Install the insulator and engine wire terminals as shown in the illustration.

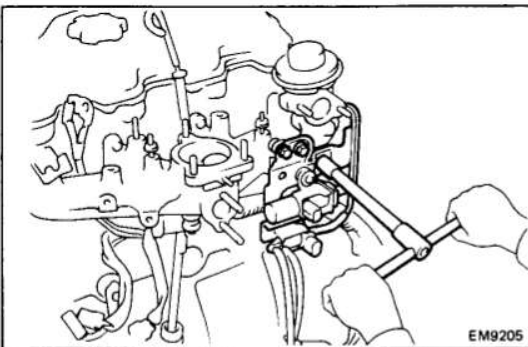


8. (Austria)

INSTALL EGR VALVE, PIPE, VALVE ADAPTOR AND CONTROL VALVE ASSEMBLY

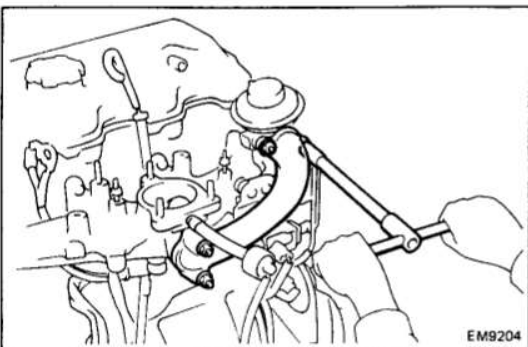
- (a) Place a new gasket in position on the intake manifold.
(b) Install the EGR valve and pipe with the two nuts.

Torque: 130 kg-cm (9 in.-lb, 13 N·m)



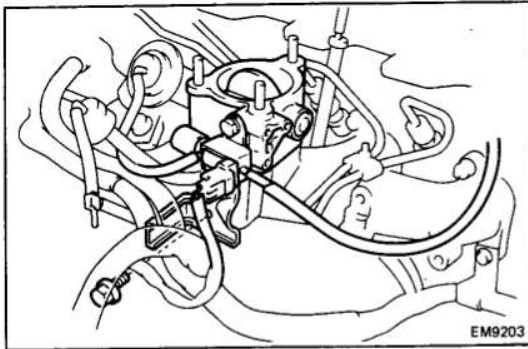
- (c) Install the EGR control valve assembly with the three bolts.

- (d) Connect the connectors to the VSV and EVRV.



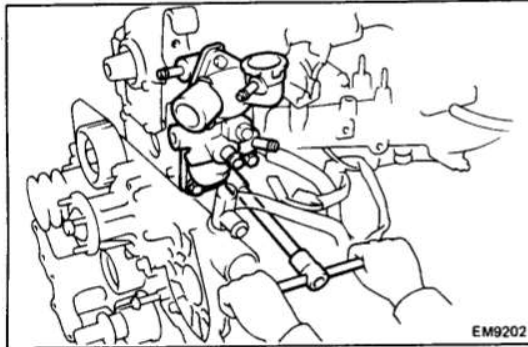
- (e) Install two new gaskets, the EGR valve adaptor and air pipe (LN only) with the four nuts.

Torque: 195 kg-cm (14 ft-lb, 19 N·m)

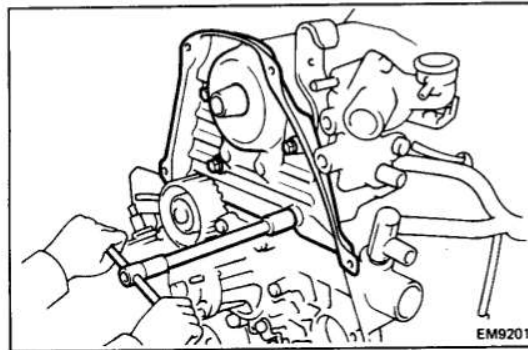
ENGINE MECHANICAL – Cylinder Head (2L-T)**EM-45**

- 9. (LN) INSTALL VENTURI ASSEMBLY**
- (a) Install the wire support with the two bolts.
 - (b) Install a new gasket and the venturi assembly.
 - (c) Connect the connector and vacuum hoses to the VSV.

- 10. INSTALL LH ENGINE HANGER**
 Torque: 380 kg-cm (27 ft-lb, 37 N·m)



- 11. INSTALL WATER OUTLET AND OUTLET HOUSING ASSEMBLY**
- (a) Install a new gasket, the water outlet and outlet housing assembly with the three bolts.
- Torque: 195 kg-cm (14 ft-lb, 19 N·m)
- (b) Connect the by-pass hose to the thermo wax of the injection pump.
 - (c) Connect the water temperature switch connector.

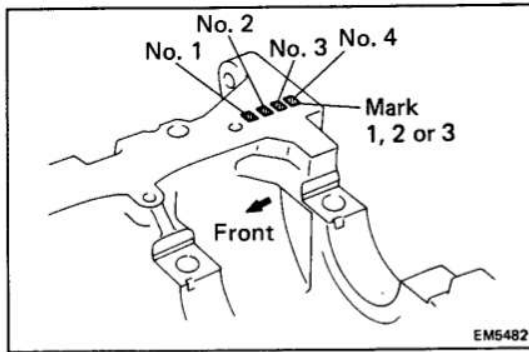


- 12. INSTALL NO. 2 TIMING BELT COVER**
 Install the timing belt cover with the four bolts.
 Torque: 185 kg-cm (13 ft-lb, 18 N·m)

13. INSTALL CAMSHAFT TIMING PULLEY**14. INSTALL INJECTION NOZZLES****15. INSTALL INJECTION PUMP**
(See steps 2 to 11 on pages FU-46 and 47)**16. INSTALL TIMING BELT**
(See steps 12 to 18 on page FU-48)**17. INSTALL TURBOCHARGER**
(See steps 3 to 8 on pages TC-13 and 14)**18. FILL WITH ENGINE COOLANT** (See page CO-5)**19. START ENGINE AND CHECK FOR LEAKS****20. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL**

EM-46

ENGINE MECHANICAL – Cylinder Block



CYLINDER BLOCK

INSPECTION OF CYLINDER BLOCK

INSPECT CYLINDER BORE DIAMETER

HINT: There are three sizes of the standard cylinder bore diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the lower left rear of the cylinder block.

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

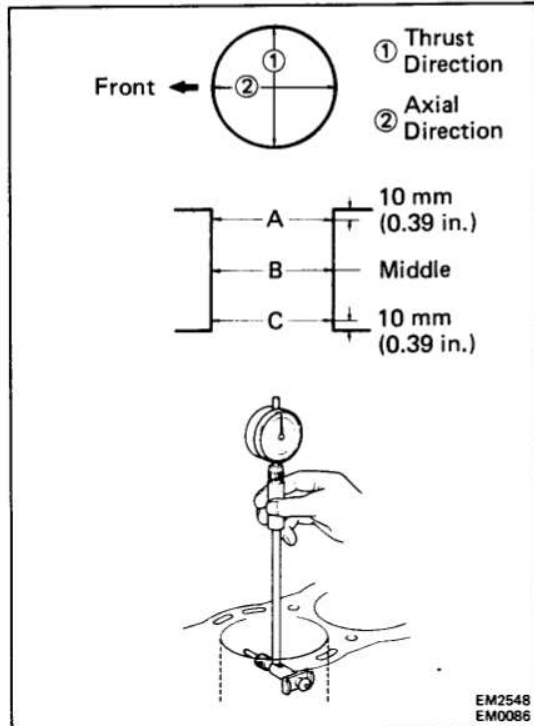
Standard diameter:

2L-T	STD mark "1"	92.000 – 92.010 mm (3.6220 – 3.6224 in.)
	STD mark "2"	92.010 – 92.020 mm (3.6224 – 3.6228 in.)
	STD mark "3"	92.020 – 92.030 mm (3.6228 – 3.6232 in.)
3L	STD mark "1"	96.000 – 96.010 mm (3.7795 – 3.7799 in.)
	STD mark "2"	96.010 – 96.020 mm (3.7799 – 3.7803 in.)
	STD mark "3"	96.020 – 96.030 mm (3.7803 – 3.7807 in.)

Maximum diameter:

2L-T	STD	92.23 mm (3.6311 in.)
	O/S 0.50	92.73 mm (3.6508 in.)
3L	STD	96.23 mm (3.7886 in.)
	O/S 0.50	96.73 mm (3.8083 in.)

If the diameter is greater than maximum, rebore all four cylinders. If necessary, replace the cylinder block.



INSPECTION OF PISTON AND CONNECTING ROD ASSEMBLIES

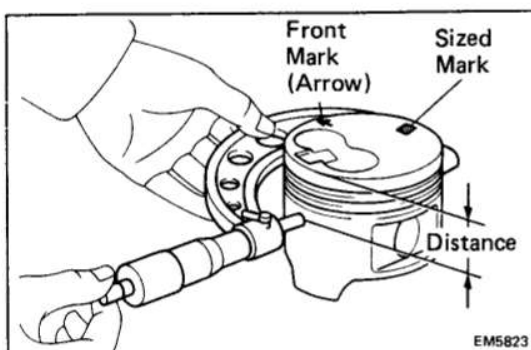
1. INSPECT PISTON DIAMETER AND OIL CLEARANCE

HINT: There are three sizes of the standard piston diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the top of the piston.

- (a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, the indicated distance from the piston head.

Distance:

2L-T	58.27 – 58.33 mm (2.2941 – 2.2965 in.)
3L	56.27 – 56.33 mm (2.2153 – 2.2177 in.)



ENGINE MECHANICAL – Cylinder Block**EM-47****Piston diameter:**

2L-T STD mark "1"	91.940 – 91.950 mm (3.6197 – 3.6201 in.)
STD mark "2"	91.950 – 91.960 mm (3.6201 – 3.6205 in.)
STD mark "3"	91.960 – 91.970 mm (3.6205 – 3.6209 in.)
O/S 0.50	92.440 – 92.470 mm (3.6394 – 3.6405 in.)

Piston diameter:

3L STD mark "1"	95.940 – 95.950 mm (3.7772 – 3.7776 in.)
STD mark "2"	95.950 – 95.960 mm (3.7776 – 3.7779 in.)
STD mark "3"	95.960 – 95.970 mm (3.7779 – 3.7783 in.)
O/S 0.50	96.440 – 96.470 mm (3.7968 – 3.7980 in.)

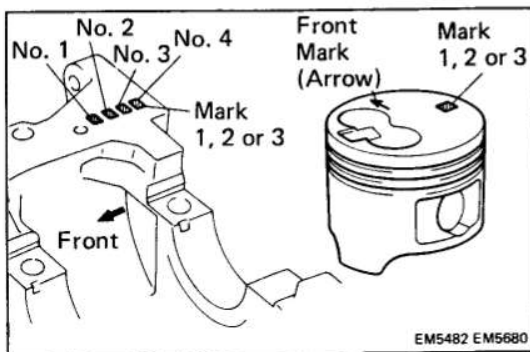
- (b) Measure the cylinder bore diameter in the thrust directions. (See page EM-46)
- (c) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance: 0.050 – 0.070 mm
(0.0020 – 0.0028 in.)

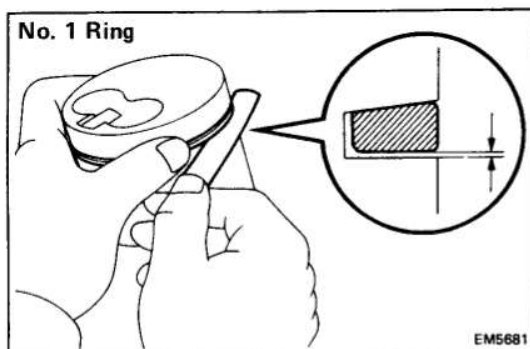
Maximum oil clearance: 0.14 mm (0.0055 in.)

If the oil clearance is greater than maximum, replace all four pistons and rebore all four cylinders. If necessary, replace the cylinder block.

HINT (Use cylinder block subassembly): When installing a standard piston, install one with the same number mark as the standard bore diameter mark on the cylinder block.



EM5482 EM5680



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2. INSPECT CLEARANCE BETWEEN WALL OF RING GROOVE AND NEW PISTON RING

(No. 1 Ring)

Install a No. 1 piston ring to the piston. Using a feeler gauge, measure the clearance between the piston ring and wall of the piston ring groove.

Standard ring groove clearance:

No. 1 0.028 – 0.077 mm (0.0011 – 0.0030 in.)

Maximum ring groove clearance: 0.20 mm (0.008 in.)

If the clearance is greater than maximum, replace the piston.

EM-48**ENGINE MECHANICAL – Cylinder Block****(No.2 and Oil Rings)**

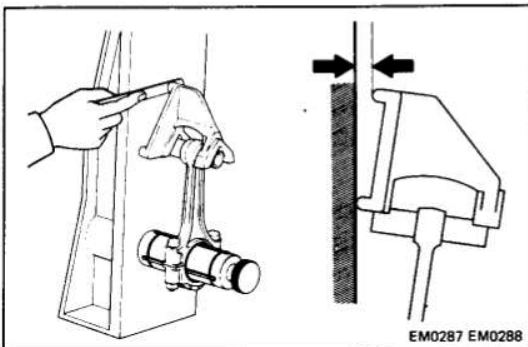
Using a feeler gauge, measure the clearance between new piston ring and the wall of the piston ring groove.

Standard ring groove clearance:

No. 2	2L-T	0.070 – 0.115 mm (0.0028 – 0.0045 in.)
	3L	0.060 – 0.105 mm (0.0024 – 0.0041 in.)
Oil		0.030 – 0.070 mm (0.0012 – 0.0028 in.)

Maximum ring groove clearance: 0.20 mm (0.008 in.)

If the clearance is greater than maximum, replace the piston.

**3. INSPECT CONNECTING ROD****A. Inspect connecting rod alignment**

Using a rod aligner, check the connecting rod alignment.

- Check for bending.

Maximum bending:

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

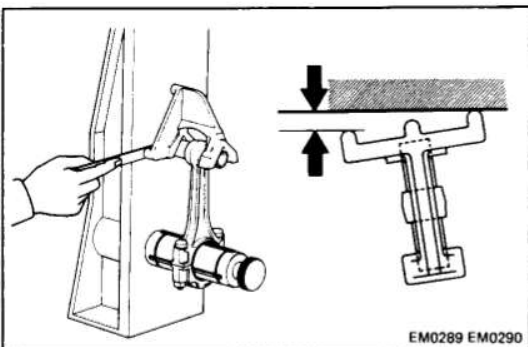
If bent is greater than maximum, replace the connecting rod assembly.

- Check for twist.

Maximum twist:

0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

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

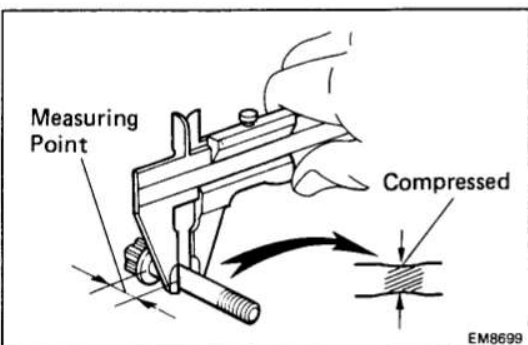
**B. Inspect connecting rod bolts**

Using vernier calipers, measure the minimum diameter of the compressed bolt at the measuring point.

Standard diameter: 8.400 – 8.600 mm
(0.3307 – 0.3386 in.)

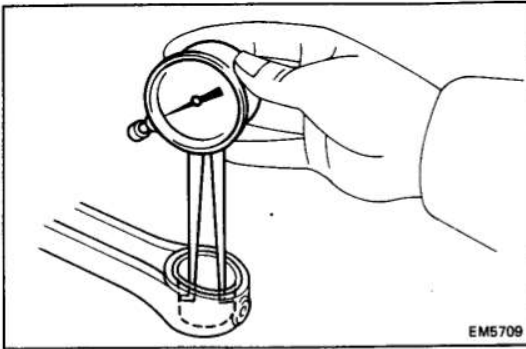
Minimum diameter: 8.20 mm (0.3228 in.)

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

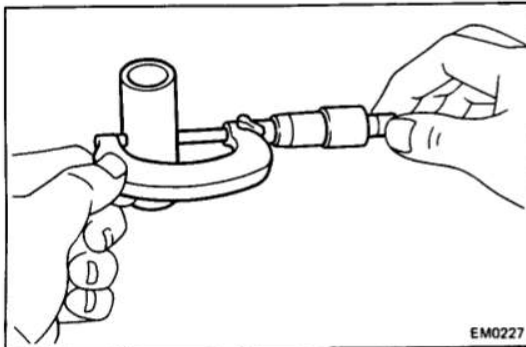


ENGINE MECHANICAL – Cylinder Block

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**C. Inspect piston pin oil clearance**

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

Bushing inside diameter:**29.008 – 29.020 mm (1.1420 – 1.1425 in.)**

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

Piston pin diameter:**29.000 – 29.012 mm (1.1417 – 1.1422 in.)**

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

Standard oil clearance: 0.004 – 0.012 mm
(0.0002 – 0.0005 in.)

Maximum oil clearance: 0.05 mm (0.0020 in.)

BORING OF CYLINDERS**HINT:**

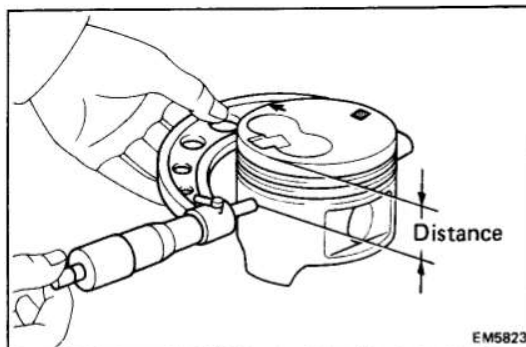
- Bore all four cylinders for the oversized piston outside diameter.
- Replace the piston rings with ones to match the oversized pistons.

1. KEEP OVERSIZED PISTONS**Oversized (O/S 0.50) piston diameter:****2L-T 92.440 – 92.470 mm (3.6394 – 3.6405 in.)****3L 96.440 – 96.470 mm (3.7968 – 3.7980 in.)****2. CALCULATE AMOUNT TO BORE CYLINDER**

- (a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, the indicated distance from the piston head.

Distance:**2L-T 58.27 – 58.33 mm (2.2941 – 2.2965 in.)****3L 56.27 – 56.33 mm (2.2153 – 2.2177 in.)**

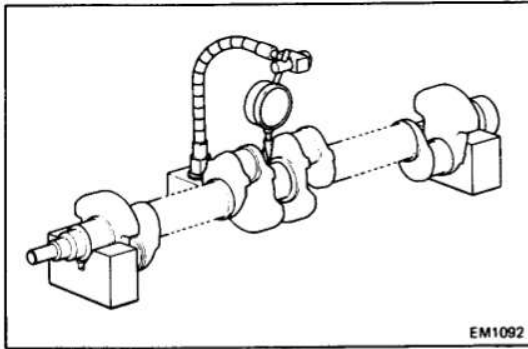
- (b) Calculate the amount each cylinder is to be rebored as follows:

Size to be rebored = P + C – H**P = Piston diameter****C = Piston oil clearance****0.05 – 0.07 mm (0.0020 – 0.0028 in.)****H = Allowance for honing****0.02 mm (0.0008 in.) or less****3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS****Maximum honing: 0.02 mm (0.0008 in.)**

NOTICE: Excess honing will destroy the finished roundness.

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ENGINE MECHANICAL — Cylinder Block



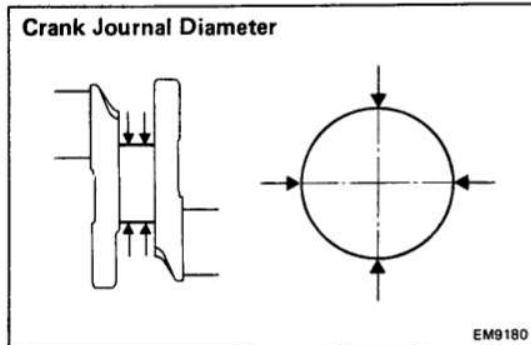
INSPECTION AND REPAIR OF CRANKSHAFT

1. INSPECT CRANKSHAFT FOR RUNOUT

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

Maximum circle runout: 0.06 mm (0.0024 in.)

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



2. INSPECT MAIN JOURNALS AND CRANK PINS

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

Main journal diameter:

STD	61.985 – 62.000 mm (2.4403 – 2.4409 in.)
U/S 0.25	61.745 – 61.755 mm (2.4309 – 2.4313 in.)
U/S 0.50	61.495 – 61.505 mm (2.4211 – 2.4215 in.)

Crank pin diameter:

STD	54.988 – 55.000 mm (2.1649 – 2.1654 in.)
U/S 0.25	54.745 – 54.755 mm (2.1553 – 2.1557 in.)
U/S 0.50	54.495 – 54.505 mm (2.1455 – 2.1459 in.)

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

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

**Maximum taper and out-of-round: 0.02 mm
(0.0008 in.)**

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

3. IF NECESSARY, GRIND AND HONE MAIN JOURNALS AND/OR CRANK PINS

Grind and hone the main journals and/or crank pins to the finished undersized diameter (See procedure step 2).

Install new main journal and/or crank pin undersized bearings.

ASSEMBLY OF CYLINDER BLOCK

The connecting rod cap nut tightening torque has been changed as follows:

Torque:

Previous	1st	550 kg-cm (40 ft-lb, 54 N·m)
	2nd	90° turns
		↓
New	1st	350 kg-cm (25 ft-lb, 34 N·m)
	2nd	120° turns

