

TURBOCHARGER SYSTEM

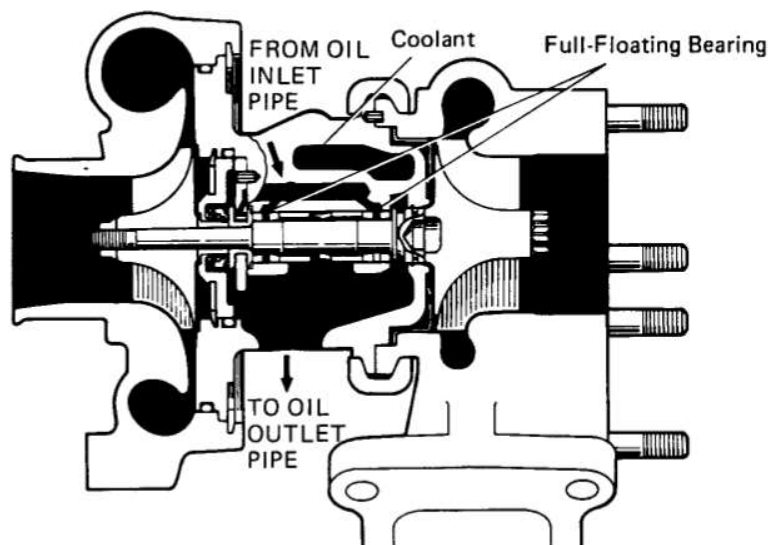
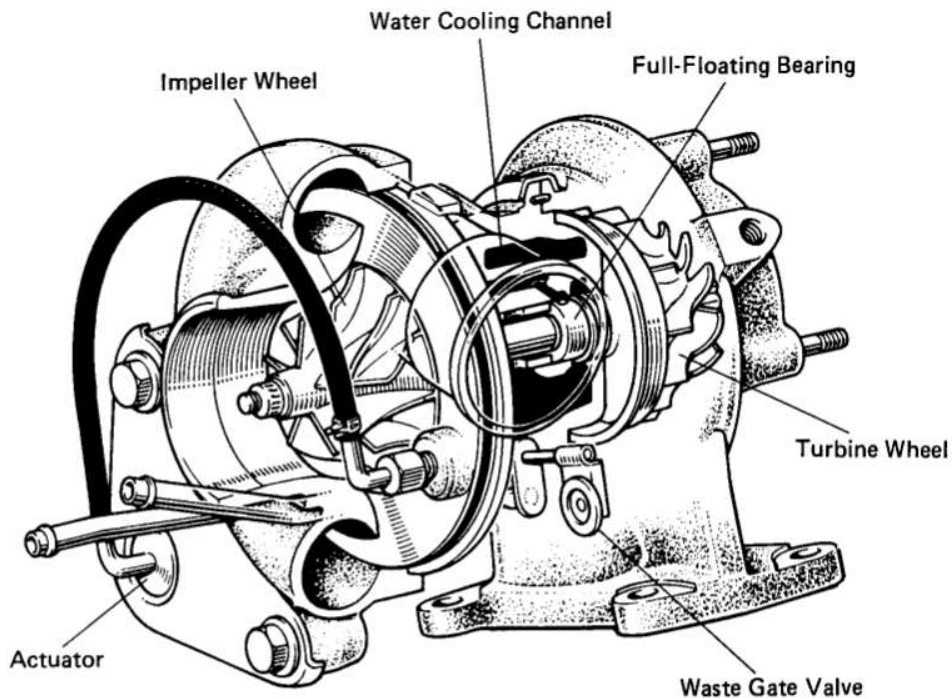
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TC

TC-2

TURBOCHARGER SYSTEM — Description

DESCRIPTION

TC0135
LS0225

Systems which increase the amount of air sent to the engine are either turbocharger type (using exhaust gas to turn the turbine) or supercharger type (using the engine crankshaft, etc. to mechanically turn the pump, etc.). For LAND CRUISER and 4RUNNER 2L-T engine, the turbocharger type has been adopted.

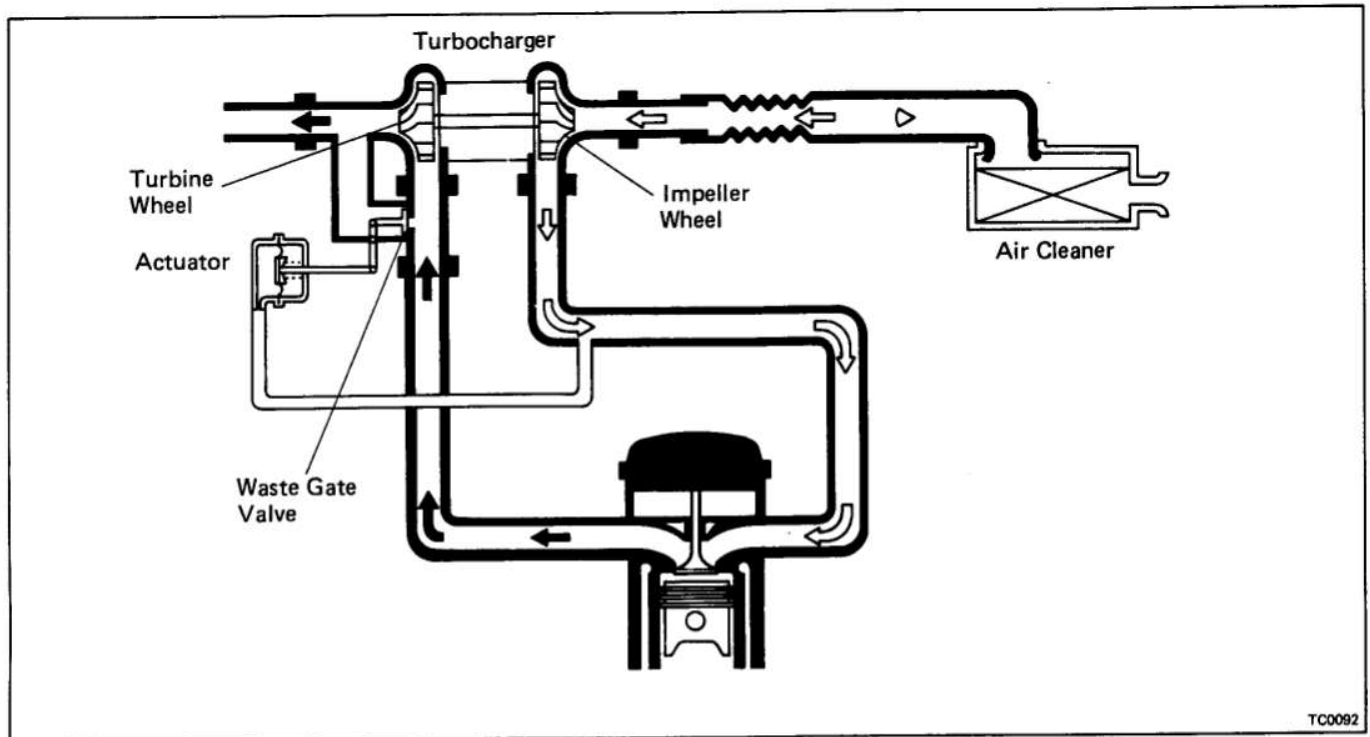
The turbocharger is a device which increases engine output by introducing a greater amount of

air to the engine. This allows a proportional increase in the fuel that can be burned and hence raises the potential power output.

In other words, by installing a special turbocharger and providing a higher air than usual, engine output can be increased by increasing the average combustion pressure without increasing the engine speed.

TURBOCHARGER SYSTEM – Description

TC-3

**Operation of Turbocharger**

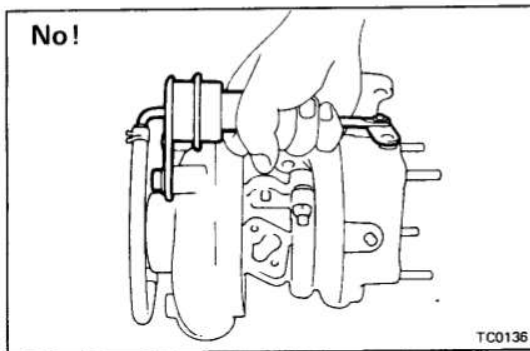
Exhaust gas acts on the turbine wheel inside the turbine housing, causing it to revolve. When the turbine wheel revolves, the impeller wheel which is located on the same shaft also revolves, compressing the intake air which has passed through the air cleaner. When expelled from the compressor housing the compressed air is supplied to the cylinders. When the engine speed increases, the exhaust gas volume increases and the turbine wheel revolutions increase (approx. 20,000 – 115,000 rpm), thus the turbocharged air pressure grows greater and engine output increases.

Waste Gate Valve

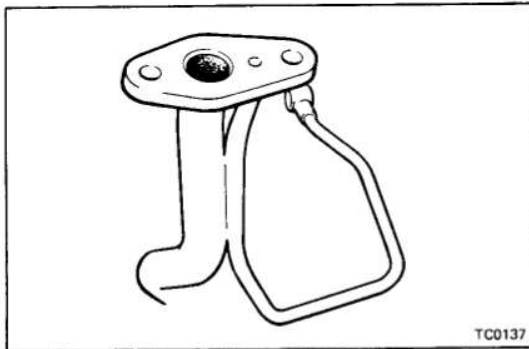
If the turbocharged air pressure exceeds the prescribed air pressure, the flow of exhaust gas by-passes the turbine, controlling turbine wheel revolutions and turbocharged air pressure. This by-pass valve which controls the quantity of exhaust gas flowing to the turbine is called the waste gate valve. When the charged air pressure exceeds the prescribed pressure, the actuator operates, the waste gate valve opens and part of the exhaust gas by-passes the turbine. This causes a drop in the turbine revolution rate and controls the charged air pressure within the prescribed limits.

PRECAUTIONS

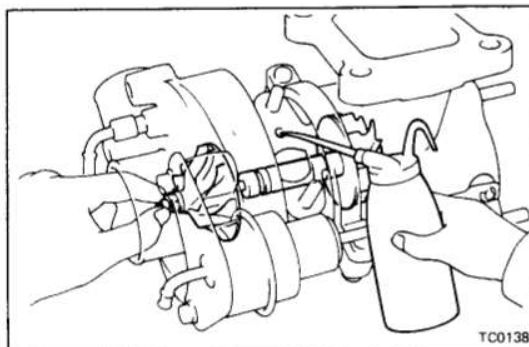
1. Do not stop the engine immediately after pulling a trailer or high speed or uphill driving. Idle the engine for 20 – 120 seconds, depending on the severity of the driving condition.
2. Avoid sudden racing or acceleration immediately after starting a cold engine.
3. If the turbocharger is defective and must be replaced, first check for the cause of the defect in reference to the following items and replace parts if necessary:
 - Engine oil level and quality
 - Conditions under which the turbocharger was used
 - Oil lines leading to the turbocharger



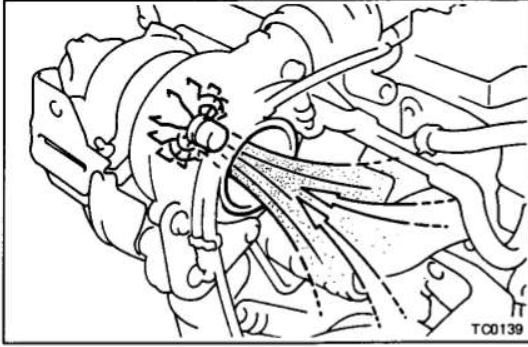
4. Use caution when removing and reinstalling the turbocharger assembly. Do not drop it or bang it against anything or grasp it by easily-deformed parts, such as the actuator or rod, when moving it.
5. Before removing the turbocharger, plug the intake and exhaust ports and oil inlet to prevent entry of dirt or other foreign material.



6. If replacing the turbocharger, check for accumulation of sludge particles in the oil pipes and, if necessary, replace the oil pipes.
7. Completely remove the gasket adhered to the lubrication oil pipe flange and turbocharger oil flange.
8. If replacing bolts or nuts, do so only with the specified new ones to guard against breakage or deformation.



9. If replacing the turbocharger, put 20 cc (1.2 cu in.) of oil into the turbocharger oil inlet and turn the impeller wheel by hand to spread oil to the bearing.
10. If overhauling or replacing the engine, cut the fuel supply after reassembly and crank the engine for 30 seconds to distribute oil throughout the engine. Allow the engine to idle for 60 seconds.

TURBOCHARGER SYSTEM – Precautions, Troubleshooting**TC-5**

11. If the engine is running with the air cleaner, case cover and hose removed, entry of foreign particles will damage the wheels which run at extremely high speed.

TROUBLESHOOTING

HINT: Before troubleshooting the turbocharger, first check the engine itself. (Valve clearance, engine compression, injection timing etc.)

**INSUFFICIENT ACCELERATION, LACK OF POWER OR
EXCESSIVE FUEL CONSUMPTION**

(Possible Cause)**(Check Procedure and Correction Method)**
1. TURBOCHARGING PRESSURE TOO LOW

Check turbocharging pressure. (See page TC-8)

Turbocharging pressure:

0.61 – 0.81 kg/cm²

(8.7 – 11.5 psi, 60 – 79 kPa)

If the pressure is below specification, begin diagnosis from item 2.

2. RESTRICTED INTAKE AIR SYSTEM

Check intake air system, and repair or replace parts as necessary. (See page TC-8)

3. LEAK IN INTAKE AIR SYSTEM

Check intake air system, and repair or replace parts as necessary. (See page TC-8)

4. RESTRICTED EXHAUST SYSTEM

Check exhaust system, and repair or replace parts as necessary. (See page TC-8)

5. LEAK IN EXHAUST SYSTEM

Check exhaust system, and repair or replace parts as necessary. (See page TC-8)

6. ERRATIC TURBOCHARGER OPERATION

Check rotation of impeller wheel. If it does not turn or turns with a heavy drag, replace the turbocharger assembly.

Check plays of turbine shaft. (See page TC-12)

Axial play: 0.13 mm (0.0051 in.) or less

Radial play: 0.18 mm (0.0071 in.) or less

If not within specification, replace the turbocharger assembly.

TC-6

TURBOCHARGER SYSTEM – Troubleshooting

ABNORMAL NOISE

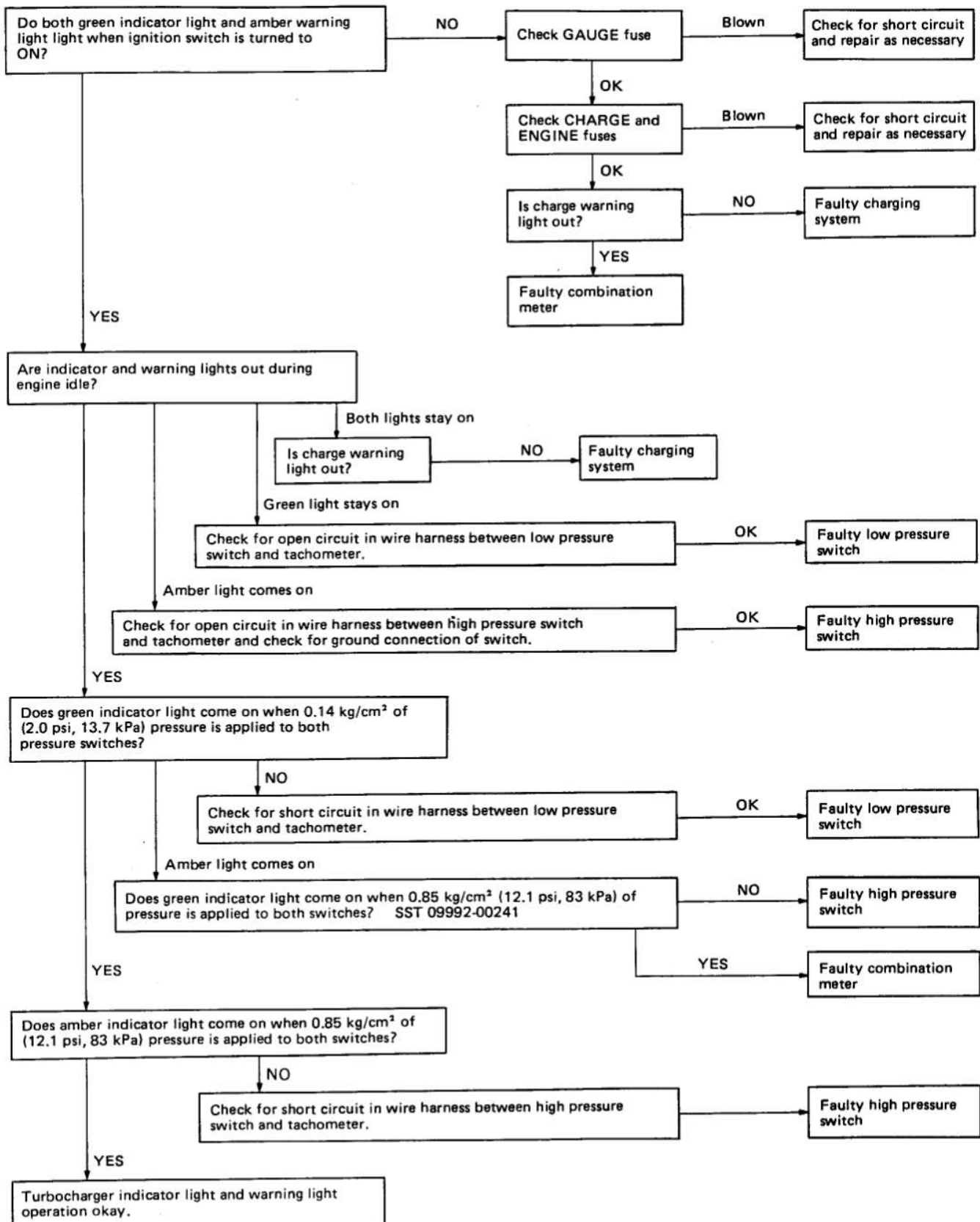
(Possible Cause)	(Check Procedure and Correction Method)
1. TURBOCHARGER INSULATOR RESONANCE	Check for loose, improperly installed or deformed insulator mounting bolts and nuts, and repair or replace as necessary.
2. EXHAUST PIPE LEAKING OR VIBRATING	Check for exhaust pipe deformation, loose mounting bolts or a damaged gasket, and repair or replace as necessary.
3. ERRATIC TURBOCHARGER OPERATION	Refer to item 6 of INSUFFICIENT ACCELERATION, LACK OF POWER OR EXCESSIVE FUEL CONSUMPTION.

EXCESSIVE OIL CONSUMPTION OR WHITE EXHAUST

(Possible Cause)	(Check Procedure and Correction Method)
FAULTY TURBOCHARGER OIL SEAL	Check for oil leakage in exhaust system. - Remove the turbine elbow from the turbocharger and check for excessive carbon deposits on the turbine wheel. Excessive carbon deposits would indicate a faulty turbocharger. Check for oil leakage in intake air system. - Check plays of turbine shaft, and replace the turbocharger if necessary. (See page TC-12) Axial play: 0.13 mm (0.0051 in.) or less Radial play: 0.18 mm (0.0071 in.) or less

TURBOCHARGER ELECTRICAL SYSTEM DIAGNOSIS

TROUBLESHOOTING OF TURBOCHARGER INDICATOR LIGHT AND WARNING LIGHT OPERATION



TC-8

TURBOCHARGER SYSTEM — Turbocharger

TURBOCHARGER

ON-VEHICLE INSPECTION OF TURBOCHARGER

1. INSPECT INTAKE AIR SYSTEM

Check for leakage or clogging between the air cleaner and turbocharger inlet and between the turbocharger outlet and cylinder head.

- Clogged air cleaner Clean or replace the element
- Hoses collapsed or deformed Check each connection and repair
- Cracks in components Check and replace

2. INSPECT EXHAUST SYSTEM

Check for leakage or clogging between the cylinder head and turbocharger inlet and between the turbocharger outlet and exhaust pipe.

- Deformed components Repair or replace
- Foreign material in passages Remove
- Leakage from components Repair or replace
- Cracks in components Check and replace

3. CHECK TURBOCHARGING PRESSURE

- (a) Warm up the engine.
- (b) Connect a 3-way union to the intake pipe pressure hose and install SST (turbocharger pressure gauge) to it.

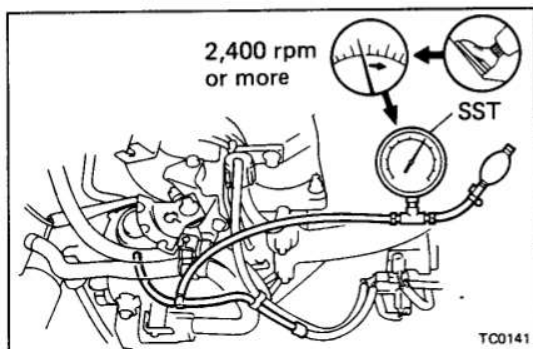
SST 09992-00241

- (b) Press in the clutch pedal, then press the accelerator pedal down as far as it will go. Measure the turbocharging pressure at 2,400 rpm or more.

Standard pressure: 0.61 – 0.81 kg/cm²
(8.7 – 11.5 psi, 60 – 79 kPa)

If the pressure is less than specification, check the intake air and exhaust systems for leakage. If there is no leakage, replace the turbocharger assembly.

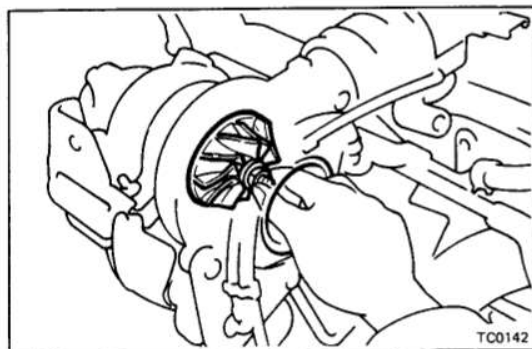
If the pressure is above specification, check if the actuator hose is disconnected or cracked. If not, replace the turbocharger assembly.



4. INSPECT IMPELLER WHEEL ROTATION

- (a) Disconnect the air cleaner hose.
- (b) Grasp the edge of the impeller wheel and turn it. Check that it turns smoothly.

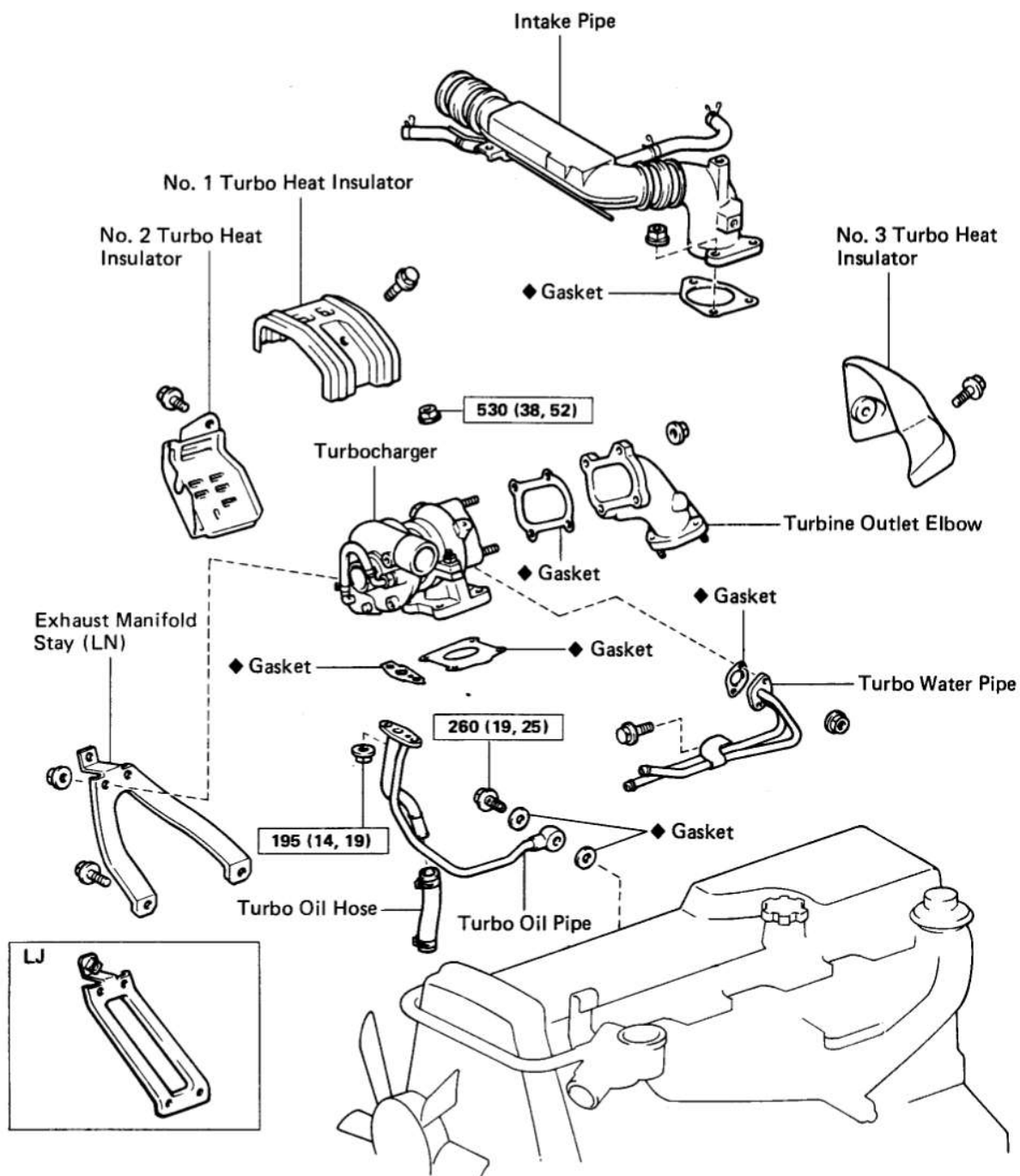
If it does not turn or if it turns with a drag, replace the turbocharger assembly.



TURBOCHARGER SYSTEM – Turbocharger

TC-9

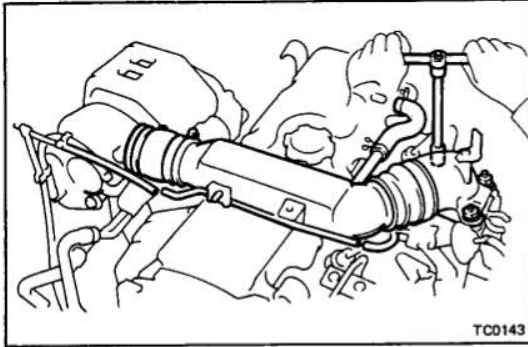
COMPONENTS



kg-cm (ft-lb, N·m) : Specified torque

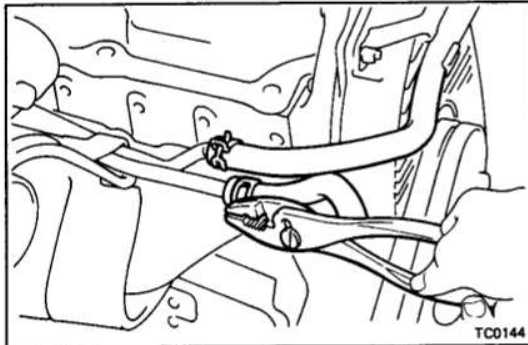
◆ Non-reusable part

TC0158

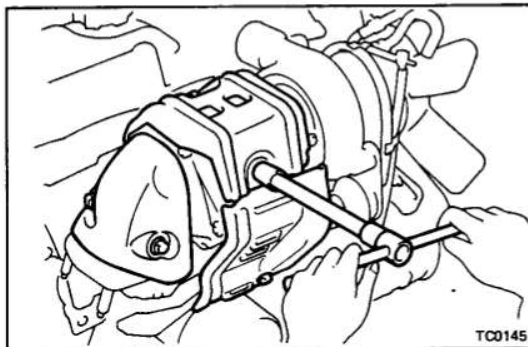
TC-10**TURBOCHARGER SYSTEM – Turbocharger****REMOVAL OF TURBOCHARGER**

(See page TC-9)

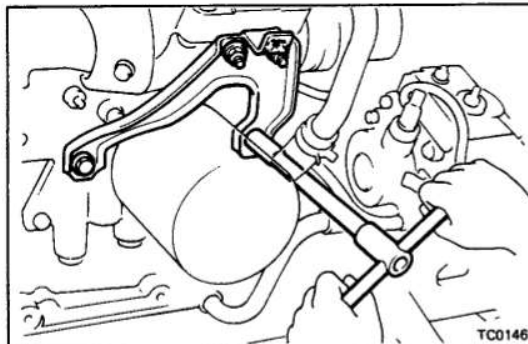
1. **DRAIN ENGINE COOLANT** (See page CO-4)
2. **REMOVE INTAKE PIPE**
 - (a) Disconnect the vacuum hoses for the boost compensator.
 - (b) Disconnect the air hose clamp bolt.
 - (c) Remove the three nuts, intake pipe and gasket.



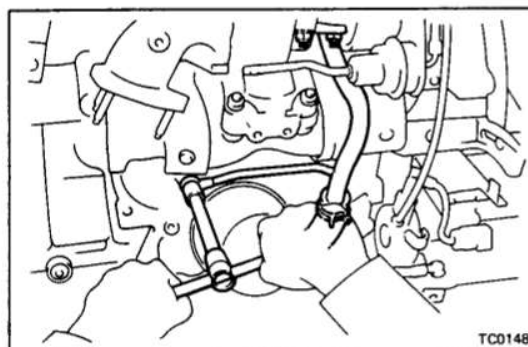
3. **DISCONNECT WATER BY-PASS HOSES**



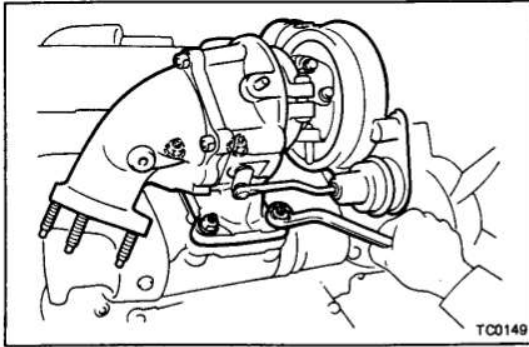
4. **REMOVE TURBO HEAT INSULATORS**
Remove the four bolts and three heat insulators.



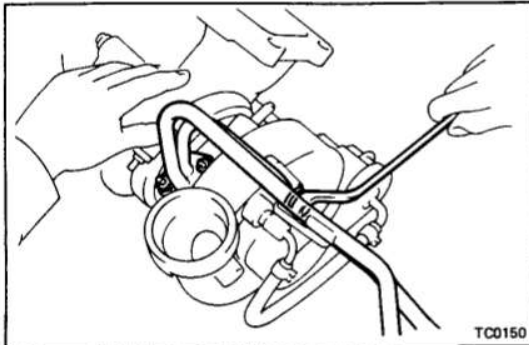
5. **REMOVE EXHAUST MANIFOLD STAY**
Remove the two bolts, two nuts and exhaust manifold stay.



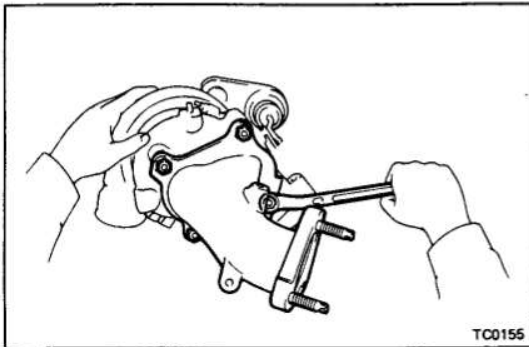
6. **REMOVE TURBO OIL PIPE**
 - (a) Remove the union bolt and two gaskets holding the turbo oil pipe to the cylinder block.
 - (b) Disconnect the turbo oil hose.
 - (c) Remove the two nuts, turbo oil pipe and gasket.

TURBOCHARGER SYSTEM — Turbocharger**TC-11****7. REMOVE TURBOCHARGER FROM EXHAUST MANIFOLD**

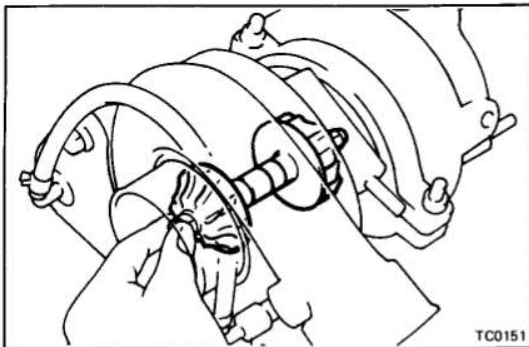
Remove the four nuts, turbocharger and gasket.

**8. REMOVE TURBO WATER PIPE**

Remove the bolt and two nuts, turbo water pipe and gasket.

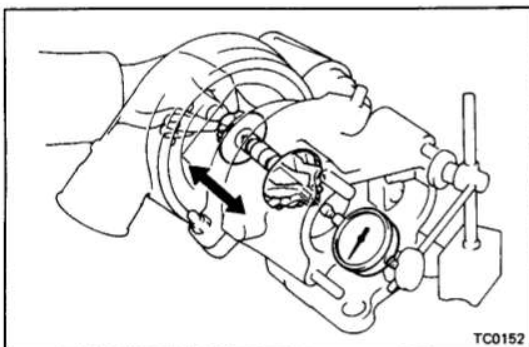
**9. REMOVE TURBINE OUTLET ELBOW**

Remove the four nuts, turbine outlet elbow and gasket.

**INSPECTION OF TURBOCHARGER****1. INSPECT IMPELLER WHEEL ROTATION**

Grasp the edge of the turbine wheel and turn it. Check that the impeller wheel turns smoothly.

If the impeller wheel does not turn or if it turns with a drag, replace the turbocharger assembly.

**2. INSPECT AXIAL PLAY OF IMPELLER WHEEL**

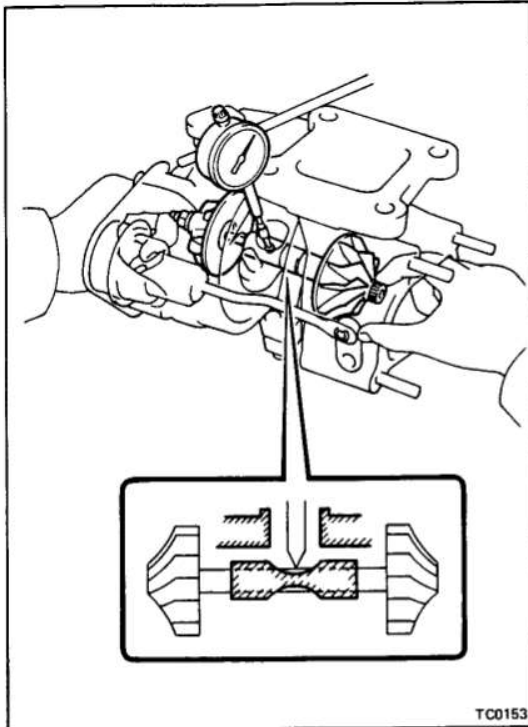
Insert a dial indicator into the intake side, hold the turbine wheel edge by hand and check the axial play.

Axial play: 0.13 mm (0.0051 in.) or less

If the axial play is not as specified, replace the turbocharger assembly.

TC-12

TURBOCHARGER SYSTEM – Turbocharger

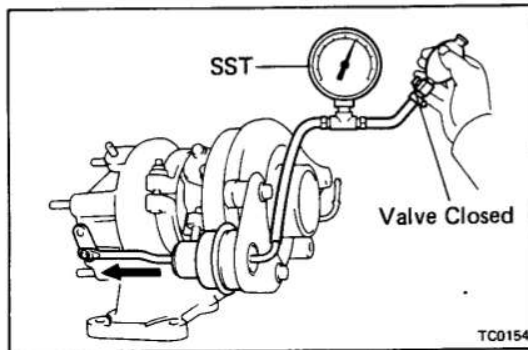


3. INSPECT RADIAL PLAY OF TURBINE SHAFT

- (a) From the oil outlet hole, insert the dial indicator through the hole in the spacer bearing and set it in the center of the turbine shaft.
- (b) Moving the turbine shaft in a radial direction, measure the radial play of the shaft.

Radial play: 0.18 mm (0.0071 in.) or less

If the radial play is not as specified, replace the turbocharger assembly.



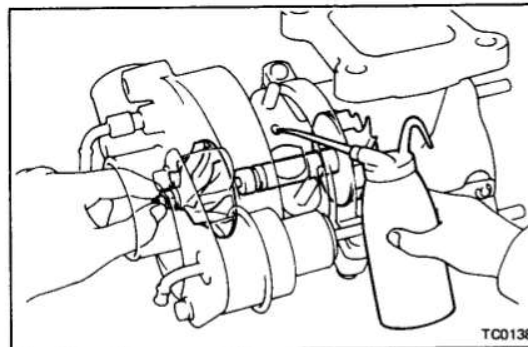
4. INSPECT ACTUATOR OPERATION

- (a) Disconnect the actuator hose.
- (b) Using SST (turbocharger pressure gauge), apply approx. 0.81 kg/cm² (11.5 psi, 79 kPa) of pressure to the actuator and check that the rod moves.

SST 09992-00241

If the rod does not move, replace the turbocharger assembly.

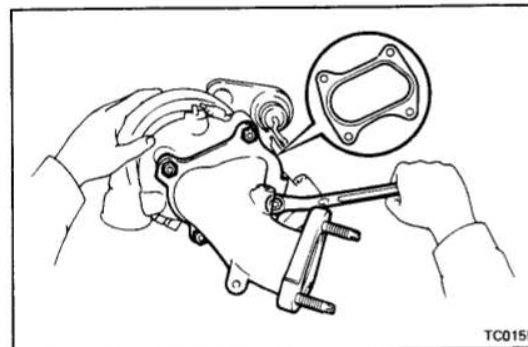
NOTICE: Never apply more than 0.95 kg/cm² (13.5 psi, 94 kPa) of pressure to the actuator.



INSTALLATION OF TURBOCHARGER

(See page TC-9)

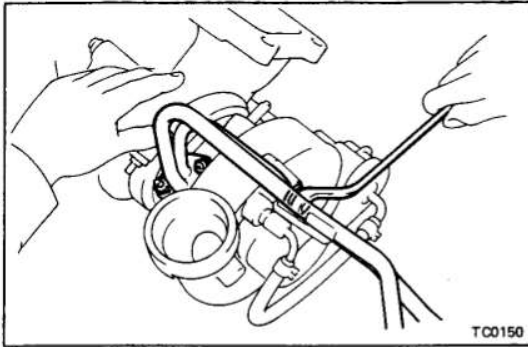
NOTICE: After replacing the turbocharger assembly, pour approx. 20 cc (1.2 cu in.) of new oil into the oil inlet and turn the impeller wheel by hand to splash oil on the bearing.



1. INSTALL TURBINE OUTLET ELBOW

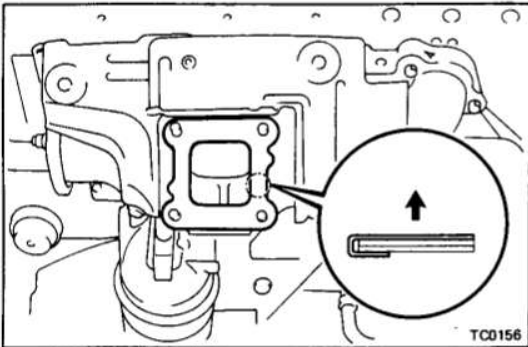
Install a new gasket and the turbine outlet elbow with the four nuts.

Torque: 260 kg-cm (19 ft-lb, 25 N-m)

TURBOCHARGER SYSTEM – Turbocharger**TC-13****2. INSTALL TURBO WATER PIPE**

Install a new gasket and the water pipe with the two nuts and bolt.

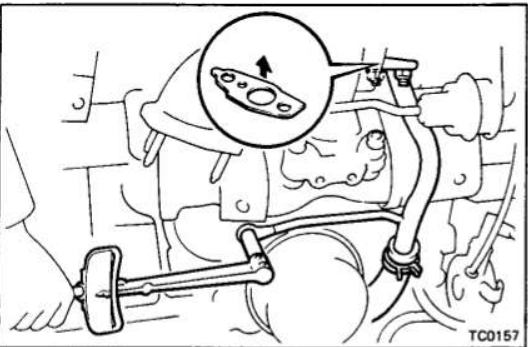
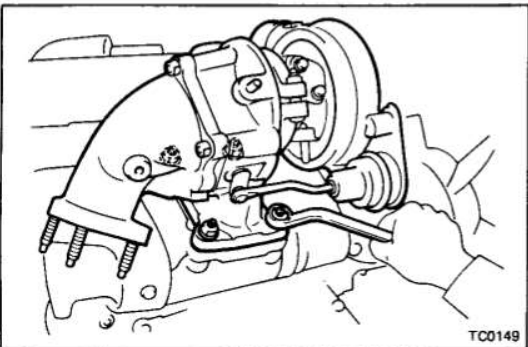
Torque: 80 kg-cm (69 in.-lb, 7.8 N-m)

**3. INSTALL TURBOCHARGER TO EXHAUST MANIFOLD**

(a) Install a new gasket to the exhaust manifold.

(b) Install the turbocharger with the four nuts.

Torque: 530 kg-cm (38 ft-lb, 52 N-m)

**4. INSTALL TURBO OIL PIPE**

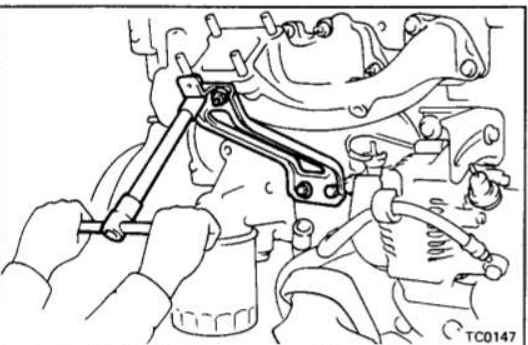
(a) Install a new gasket and the turbo oil pipe with the two nuts.

Torque: 195 kg-cm (14 ft-lb, 19 N-m)

(b) Connect the turbo oil hose.

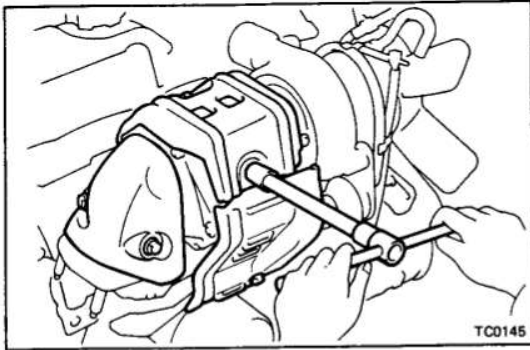
(c) Install two new gaskets and the union bolt of the turbo oil pipe.

Torque: 260 kg-cm (19 ft-lb, 25 N-m)

**5. INSTALL EXHAUST MANIFOLD STAY**

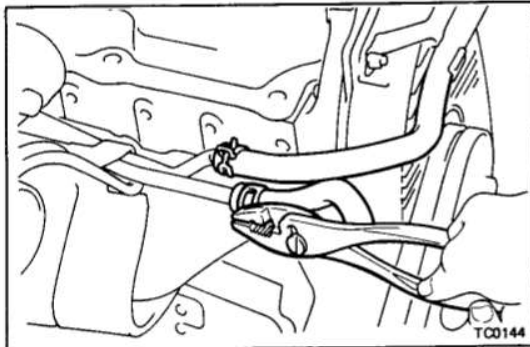
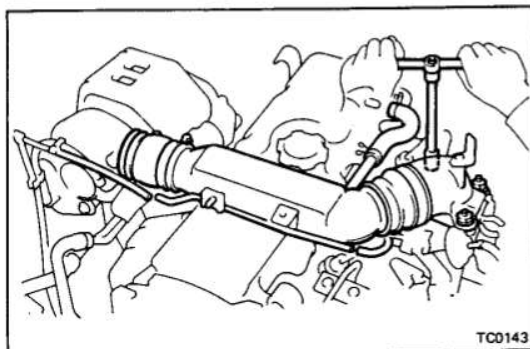
Install the exhaust manifold stay with the two bolts and two nuts.

Torque: 195 kg-cm (14 ft-lb, 19 N-m)

TC-14**TURBOCHARGER SYSTEM – Turbocharger****6. INSTALL TURBOCHARGER HEAT INSULATOR**

Install the three heat insulators with the four bolts.

Torque: 120 kg-cm (9 ft-lb, 12 N-m)

**7. CONNECT WATER BY-PASS HOSES****8. INSTALL INTAKE PIPE**

(a) Connect the air hose and install a new gasket and the intake pipe with the three nuts.

Torque: 120 kg-cm (9 ft-lb, 12 N-m)

(b) Connect boost compensator vacuum hoses.

9. FILL ENGINE WITH COOLANT (See page CO-5)**10. START ENGINE AND CHECK FOR LEAKS****11. CHECK ENGINE OIL LEVEL**

