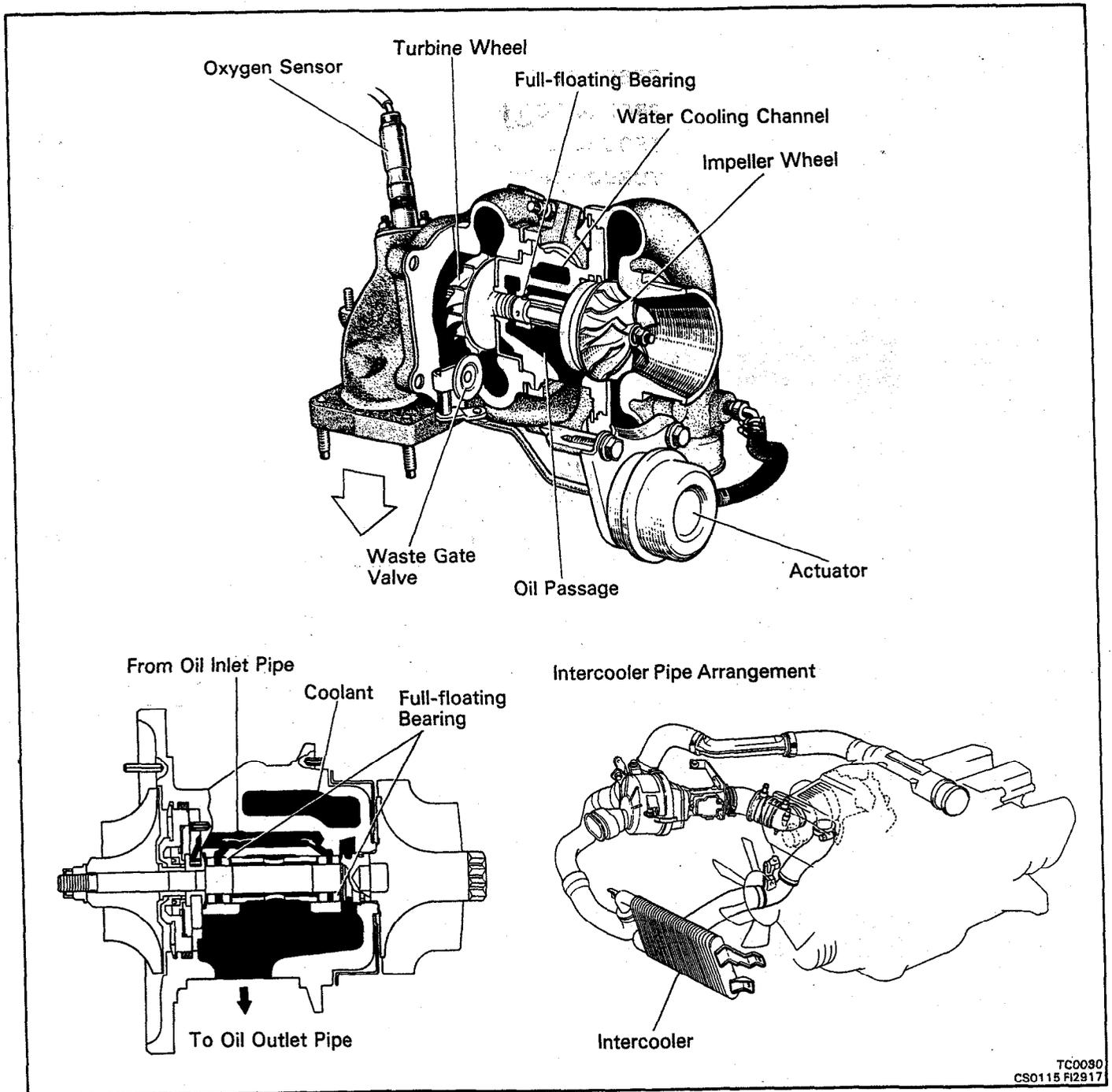


TURBOCHARGER SYSTEM

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TURBOCHARGER	TC-7



DESCRIPTION

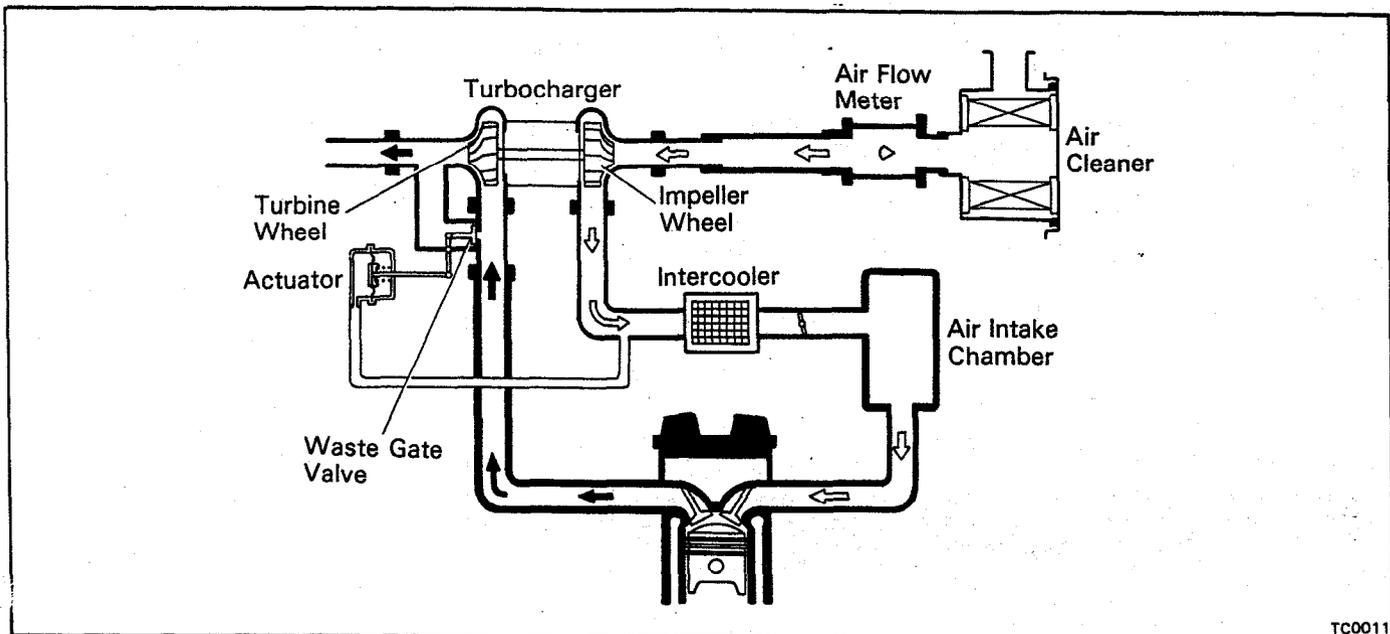


The turbocharger is a device which increases engine output by sending a greater amount of air-fuel mixture to the engine than under normal conditions. Engine output depends upon the amount of the air-fuel mixture ignited per unit of time. Therefore, to increase engine output, the most effective method is to send a greater amount of air-fuel mixture into the cylinder.

In other words, by installing a special turbocharger and providing more air-fuel mixture

than usual, engine output can be increased by increasing the average combustion pressure without increasing the engine speed.

Superchargers 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 the Supra 7M-GTE engine, the turbocharger type has been adopted.



TC0011

Operation of the 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 flow meter from 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 rpm – 110,000 rpm), thus the turbocharged air pressure grows greater and engine output increases.

Intercooler

The intercooler cools the turbocharged air (intake air) put out by the turbocharger, thereby increasing the air density. As the air intake efficiency increases, the gas temperature in the combustion chamber falls and the occurrence of knocking is suppressed, giving an increase in engine output.

The Supra 7M-GTE intercooler is an air cooling type located at the front of the vehicle, utilizing the vehicle windstream to cool the turbocharged air.

Waste Gate Valve

Although on the one hand high output is achieved by turbocharging, if the turbocharged air pressure becomes too high, knocking occurs and on the contrary, a reduction in engine output is caused. If the turbocharged air pressure exceeds the prescribed air pressure, the flow of exhaust gas bypasses the turbine, controlling turbine wheel revolutions and turbocharge air pressure. This bypass valve which controls the quantity of exhaust gas flowing to the turbine is called the waste gate valve.

When the supercharged 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 supercharged air 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 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 engine is run with the air cleaner removed, foreign material entering will damage the wheels which run at extremely high speed.
4. 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

5. 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.

6. Before removing the turbocharger, plug the intake and exhaust ports and oil inlet to prevent entry of dirt or other foreign material.

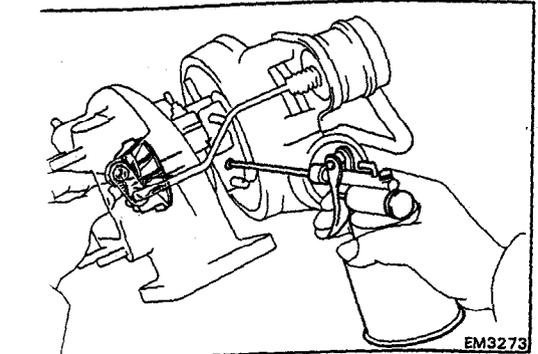
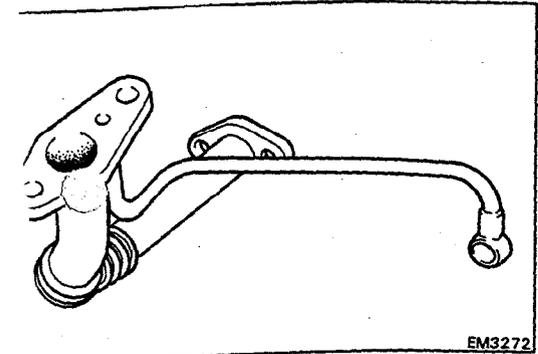
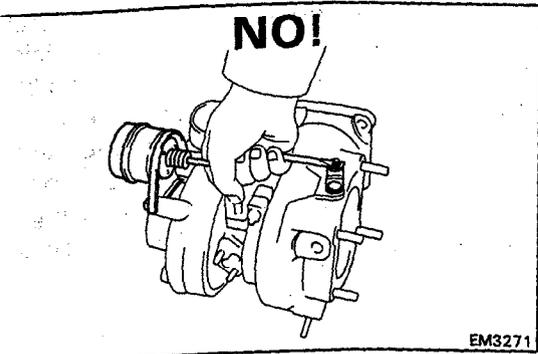
7. If replacing the turbocharger, check for accumulation of sludge particles in the oil pipes and, if necessary, replace the oil pipes.

8. Completely remove the gasket adhered to the lubrication oil pipe flange and turbocharger oil flange.

9. If replacing bolts or nuts, do so only with the specified new ones to guard against breakage or deformation.

10. 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.

11. 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. Then allow the engine to idle for 60 seconds.



TROUBLESHOOTING

NOTE: Before troubleshooting the turbocharger, first check the engine itself. (Valve clearance, engine compression, ignition 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:

M/T 0.39 — 0.53 kg/cm²
(5.5 — 7.5 psi, 38 — 52 kPa)

A/T 0.34 — 0.42 kg/cm²
(4.8 — 6.0 psi, 33 — 41 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-7)

3. LEAK IN INTAKE AIR SYSTEM

Check intake air system, and repair or replace parts as necessary. (See page TC-7)

4. RESTRICTED EXHAUST SYSTEM

Check exhaust system, and repair or replace parts as necessary. (See page TC-7)

5. LEAK IN EXHAUST SYSTEM

Check exhaust system, and repair or replace parts as necessary. (See page TC-7)

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 axial play of bearing shaft. (See page TC-14)

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

If not within specification, replace the turbocharger assembly.

ABNORMAL NOISE

(Possible Cause)

1. TURBOCHARGER INSULATOR RESONANCE

(Check Procedure and Correction Method)

Check for loose, improperly installed or deformed insulator mount bolts and nuts, and repair or replace as necessary.

2. EXHAUST PIPE LEAKING OR VIBRATING

Check for exhaust pipe deformation, loose mount 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 OF EXCESSIVE FUEL CONSUMPTION

EXCESSIVE OIL CONSUMPTION OR WHITE EXHAUST

(Possible Cause)

FAULTY TURBOCHARGER OIL SEAL

(Check Procedure and Correction Method)

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 for axial play in impeller wheel, and replace the turbocharger if necessary.
(See page TC-14)

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

CAUTION: Do not mistakenly diagnose ordinary oil mist from the PCV in the blow by gas as an oil leak from the 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 Repair or replace
- Leakage from connections Check each connection and repair
- Cracks in components Check and replace

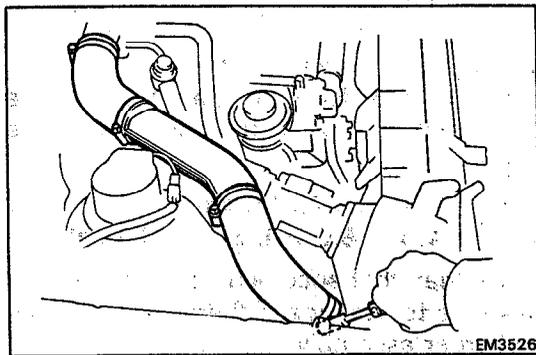
2. INSPECT EXHAUST SYSTEM

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

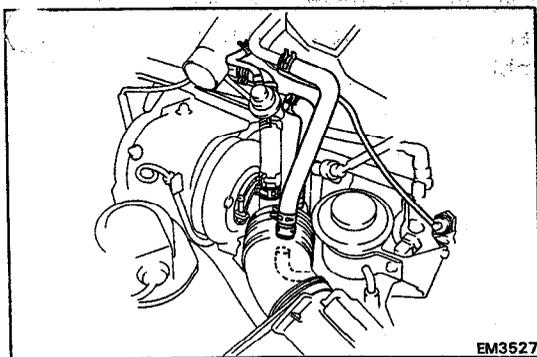
3. INSPECT OPERATION OF ACTUATOR AND WASTE GATE VALVE

- (a) Remove the No.4 air cleaner pipe with No.1 and No.2 air cleaner hoses.



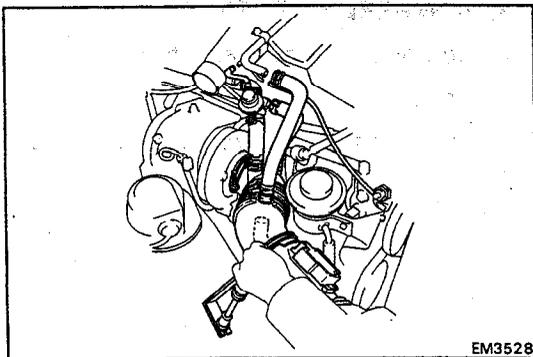
EM3526

- (b) Disconnect the air hoses.
- (c) Disconnect the air flow meter connector.

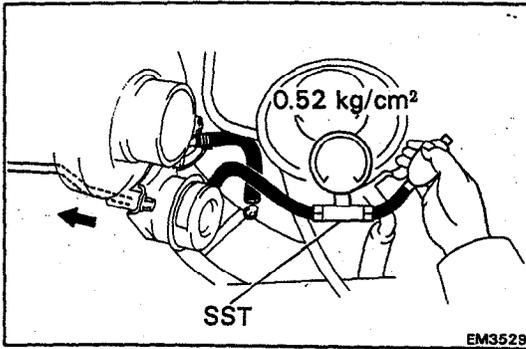


EM3527

- (d) Loosen the clamps and remove the bolt.
- (e) Remove the No.7 air cleaner hose with air flow meter and air cleaner cap.
- (f) Disconnect the PS idle up air hose.



EM3528



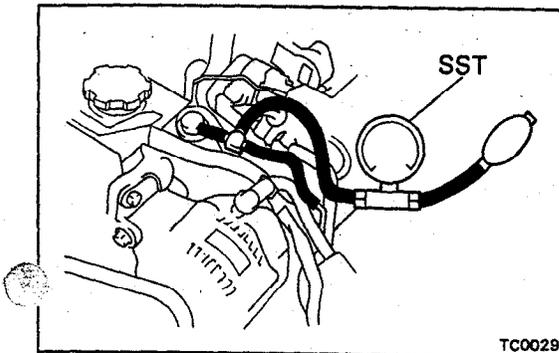
(g) Disconnect the actuator hose.

(h) Using SST (turbocharger pressure gauge), apply approx. 0.52 kg/cm² (7.4 psi, 51 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.

CAUTION: Never apply more than 0.8 kg/cm² (11.4 psi 78 kPa) of pressure to the actuator.



4. CHECK TURBOCHARGING PRESSURE

(a) Install SST (turbocharger pressure gauge) to the pressure regulator with a three way.

SST 09992-00241

(b) (M/T models)

Accelerate the vehicle with the throttle valve fully open after driving at 3-speed at 1,000 rpm. Measure the turbocharging pressure when the engine speed is over 2,500 rpm.

**Standard pressure: 0.39 – 0.53 kg/cm²
(5.5 – 7.5 psi, 38 – 52 kPa)**

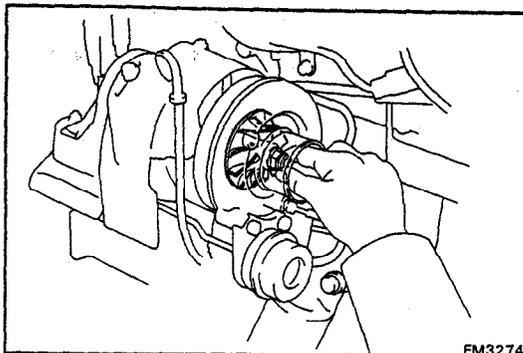
(c) (A/T models)

From a stationary state accelerate the vehicle in "L" range with the throttle valve fully open. Measure the turbocharging pressure when the engine speed is over 3,500 rpm.

**Standard pressure: 0.34 – 0.42 kg/cm²
(4.8 – 6.0 psi, 33 – 41 kPa)**

If the pressure is less than that specified, 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.



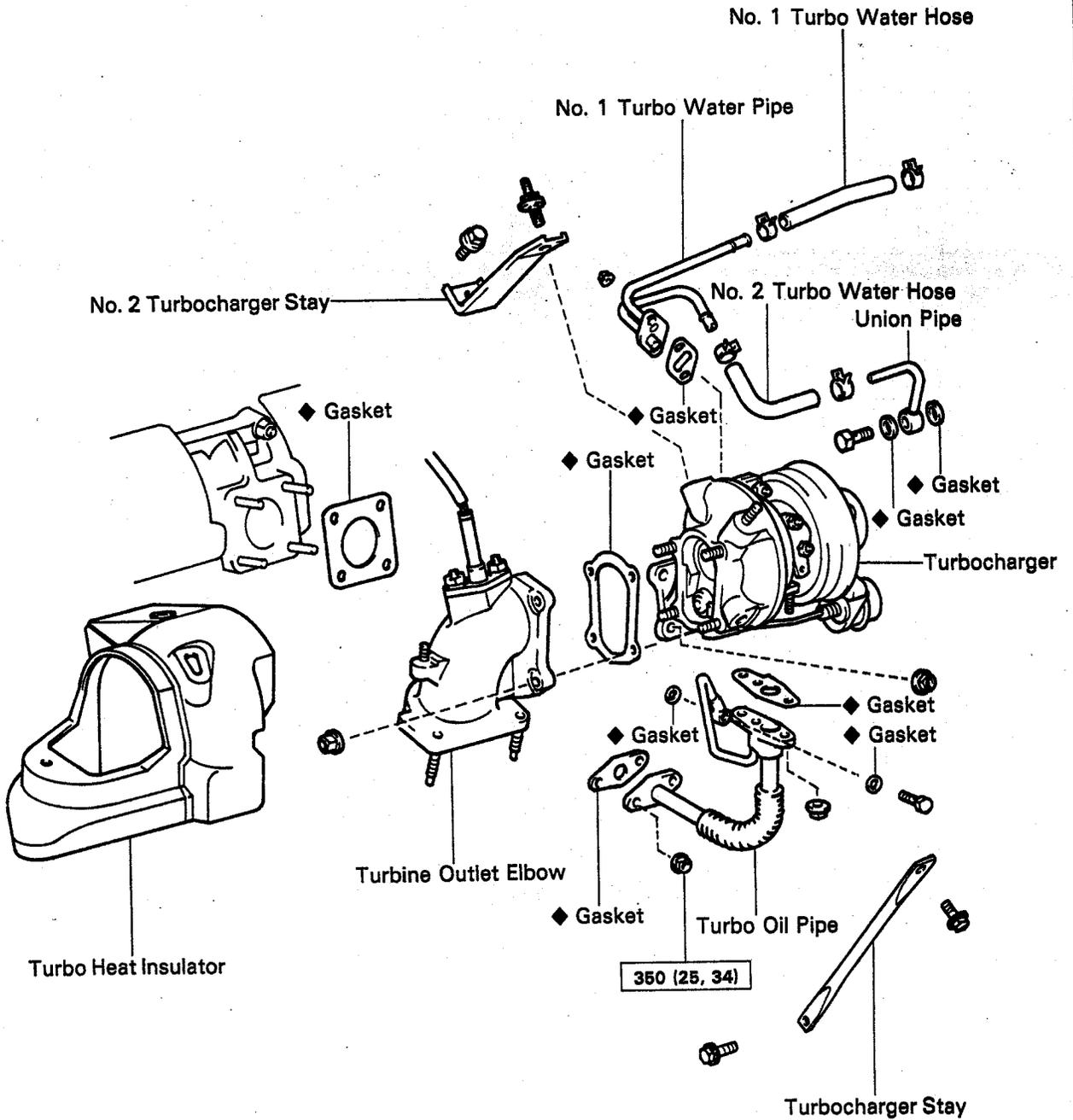
5. INSPECT IMPELLER WHEEL ROTATION

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.

COMPONENTS



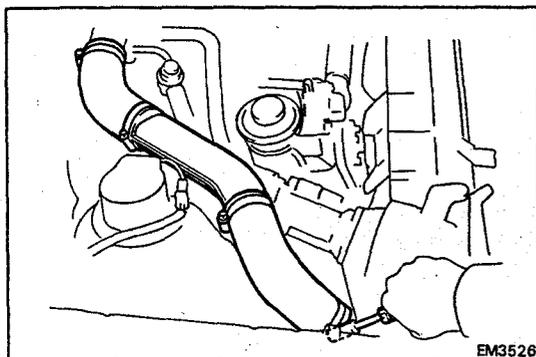
kg-cm (ft-lb, N·m) : Specified torque

◆ Non-reusable part

REMOVAL OF TURBOCHARGER

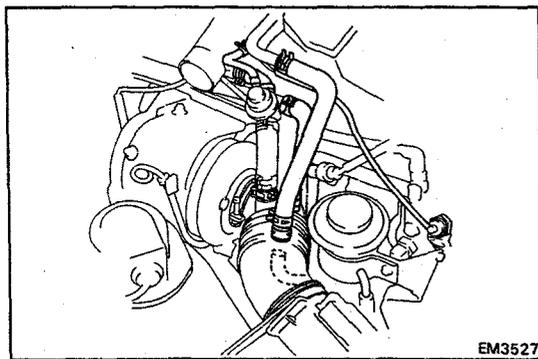
(See page TC-9).

1. **DISCONNECT CABLE FROM NEGATIVE TERMINAL OF BATTERY**
2. **DRAIN COOLANT**



EM3526

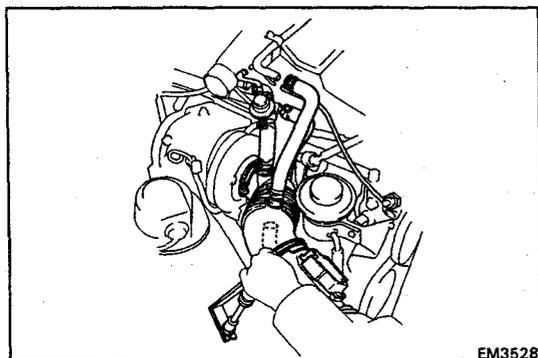
3. **REMOVE NO.4 AIR CLEANER PIPE WITH NO.1 AND NO.2 AIR CLEANER HOSES**



EM3527

4. **REMOVE NO.7 AIR CLEANER HOSE WITH AIR FLOW METER AND AIR CLEANER CAP**

- (a) Disconnect the three air hoses and PCV hose.
- (b) Disconnect the air flow meter connector.
- (c) Disconnect the PS idle up air hose.



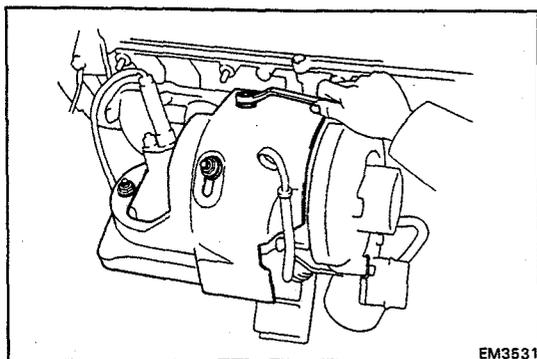
EM3528

- (d) Loosen the clamps and remove the bolt.

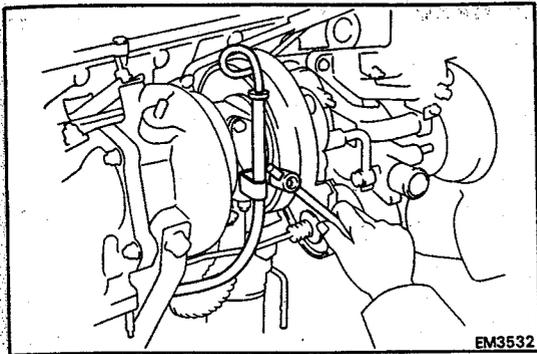
- (e) Remove the No.7 air cleaner hose with air flow meter and air cleaner cap.

5. **REMOVE TURBO HEAT INSULATOR**

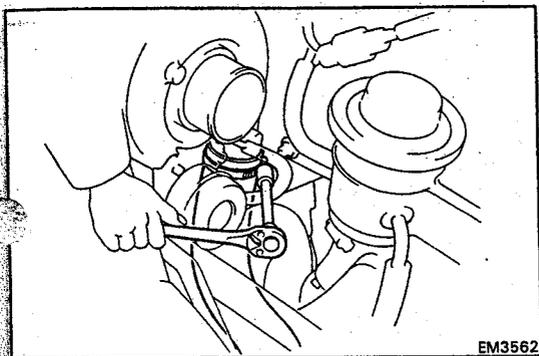
- (a) Disconnect the oxygen sensor connector.
- (b) Remove the three nuts, plate washer and turbo heat insulator.



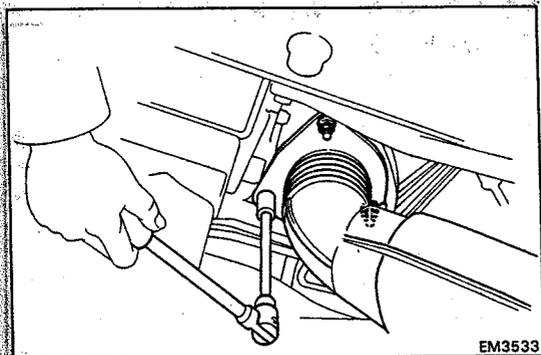
EM3531

**6. REMOVE OIL DIPSTICK GUIDE**

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

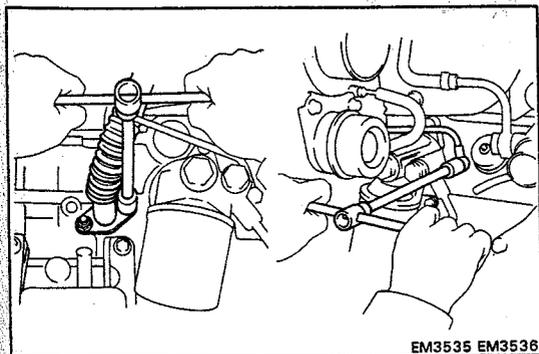
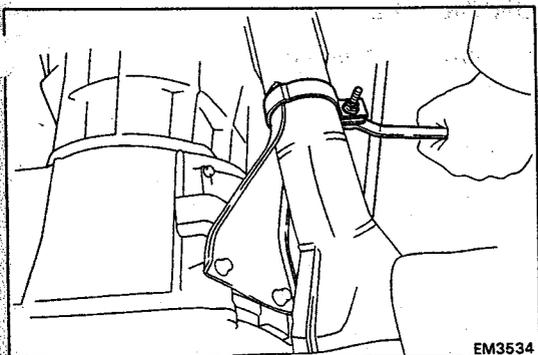
**7. REMOVE NO.1 AIR CLEANER PIPE WITH NO.6 AIR CLEANER HOSE**

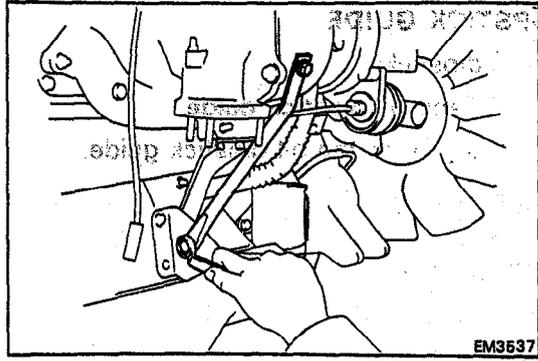
- (a) Loosen the No.5 and No.6 air cleaner hose clamps.
- (b) Remove the No.1 air cleaner pipe mounting bolt.
- (c) Remove the No.1 air cleaner pipe with No.6 air cleaner hose.

**8. DISCONNECT FRONT EXHAUST PIPE**

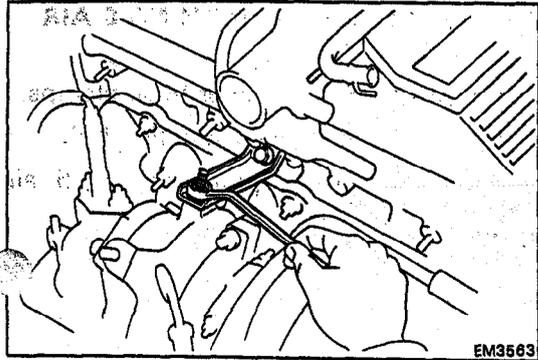
- (a) Remove the three nuts.

- (b) Remove the front exhaust pipe clamp.
- (c) Disconnect the front exhaust pipe from the exhaust manifold.
- (d) Remove the gasket.

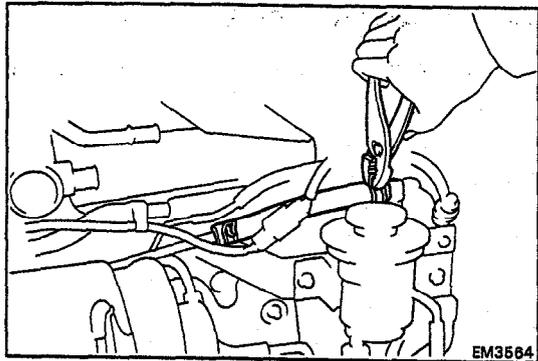
**9. REMOVE TURBO OIL PIPE MOUNTING NUTS****10. REMOVE TURBO OIL PIPE MOUNTING UNION BOLT**



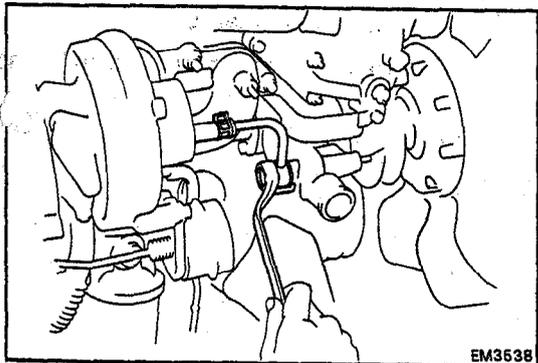
11. REMOVE TURBOCHARGER STAY



12. REMOVE NO.2 TURBOCHARGER STAY

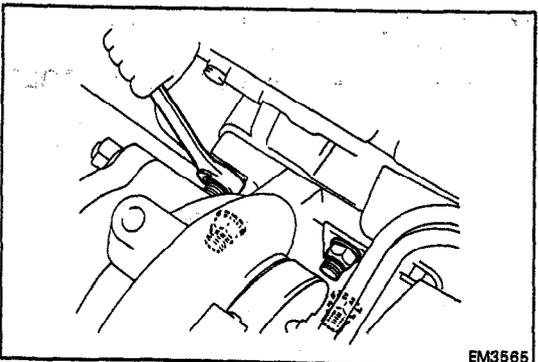


13. DISCONNECT NO.1 TURBO WATER HOSE FROM WATER OUTLET HOUSING



14. DISCONNECT UNION PIPE

Remove the union bolt and gaskets.

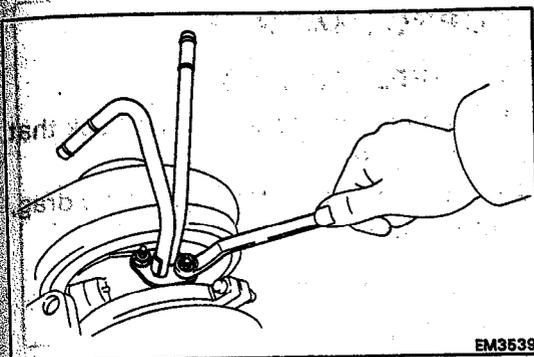


15. REMOVE TURBOCHARGER

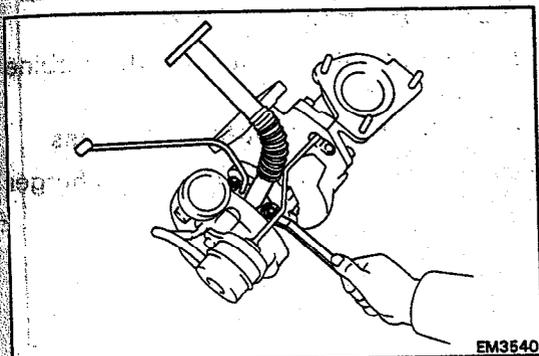
Remove the four nuts, turbocharger and gasket.

16. REMOVE NO.1 TURBO WATER PIPE

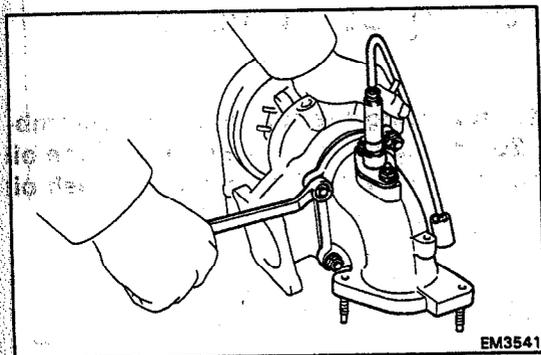
Remove the two nuts, No.1 turbo water pipe and gasket.

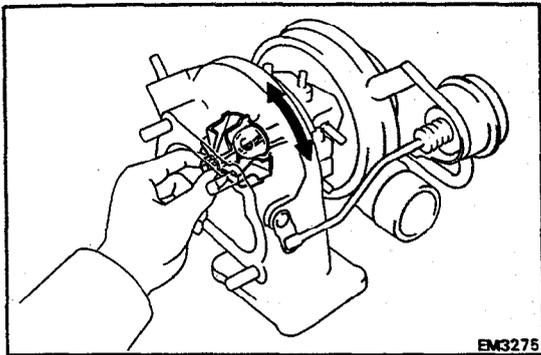
**17. REMOVE TURBO OIL PIPE**

Remove the two nuts, turbo oil pipe and gasket.

**18. REMOVE TURBINE OUTLET ELBOW**

Remove the four nuts, turbine outlet elbow and gasket.





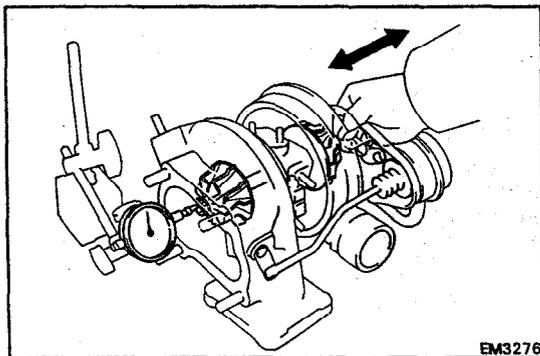
EM3275

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.



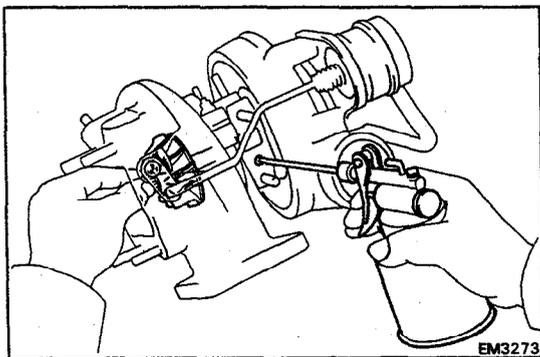
EM3276

2. INSPECT AXIAL PLAY OF SHAFT BEARING

Insert a dial gauge into the intake side hole the turbine wheel edge by and check the axial play.

Standard clearance: 0.13 mm (0.0051 in.) or less

If not within specification, replace the turbocharger assembly.

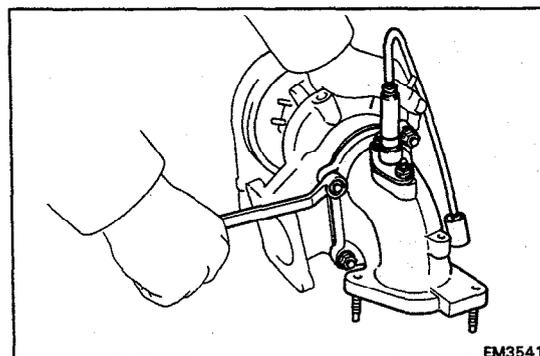


EM3273

INSTALLATION OF TURBOCHARGER

(See page TC-9)

CAUTION: 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.

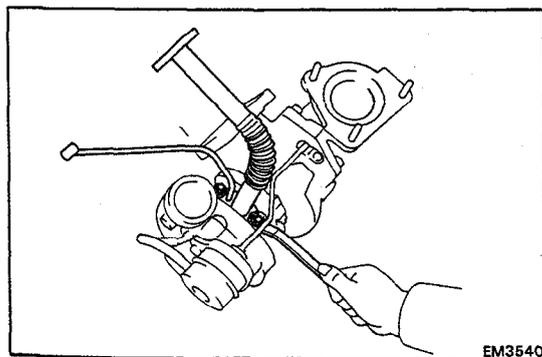


EM3541

1. INSTALL TURBINE OUTLET ELBOW

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

Torque: 440 kg-cm (32 ft-lb, 43 N·m)



EM3540

2. INSTALL TURBO OIL PIPE

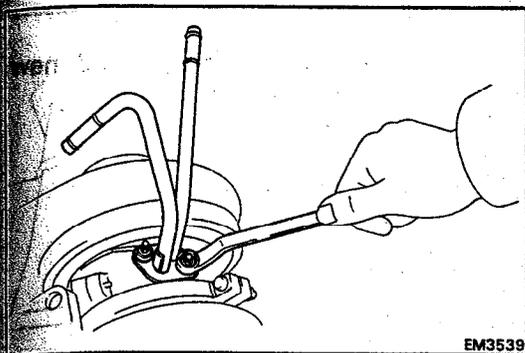
Install a new gasket and the turbo oil pipe with the two nuts.

Torque: 130 kg-cm (9 ft-lb, 13 N·m)

3. INSTALL NO.1 TURBO WATER PIPE

Install a new gasket and the No.1 turbo water pipe with the two nuts.

Torque: 75 kg-cm (65 in.-lb, 7.4 N·m)

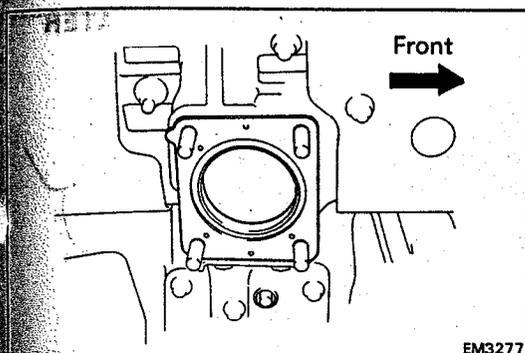


EM3539

4. INSTALL TURBOCHARGER

(a) Face the new gasket so the protrusion is facing the rear and install on the exhaust manifold.

(b) Place a new gasket on the oil return hole of the cylinder block.



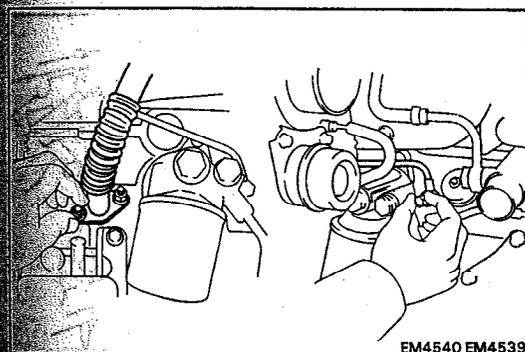
EM3277

(c) Install the turbocharger through the turbocharger stud bolts and turbo oil pipe stud bolts.

(d) Temporarily install the four nuts holding the exhaust manifold and turbocharger.

(e) Temporarily install the turbo oil pipe flange nuts.

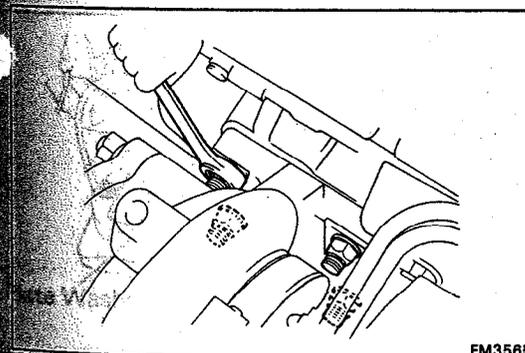
(f) Temporarily install the union bolt with two new gaskets.



EM4540 EM4539

(g) Torque the turbocharger mounting nuts.

Torque: 450 kg-cm (33 ft-lb, 44 N·m)

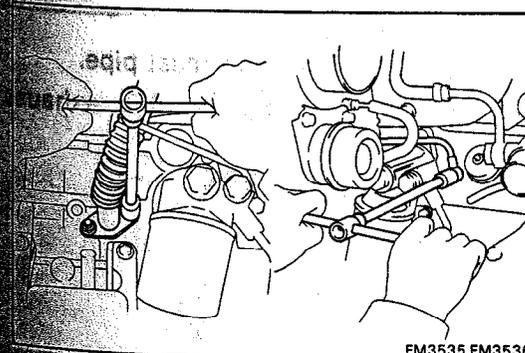


EM3565

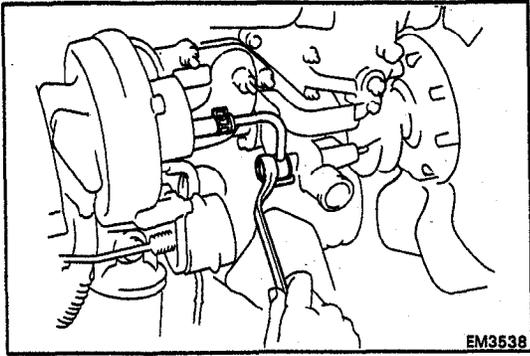
(h) Torque the turbo oil pipe union bolt and flange nuts.

Torque: Bolt 350 kg-cm (25 ft-lb, 34 N·m)

Nut 130 kg-cm (9 ft-lb, 13 N·m)

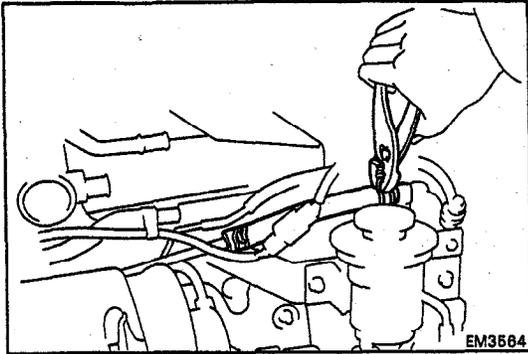


EM3535 EM3536

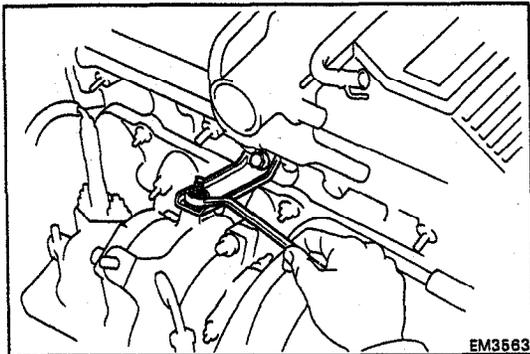


5. CONNECT UNION PIPE

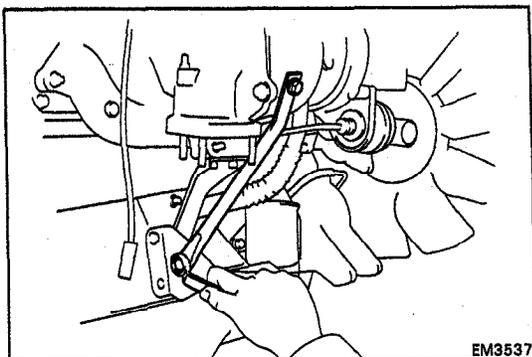
Connect the union pipe with the union bolt and new gaskets.



6. CONNECT NO.1 TURBO WATER HOSE TO WATER OUTLET HOUSING



7. INSTALL NO.2 TURBOCHARGER STAY



8. INSTALL TURBOCHARGER STAY

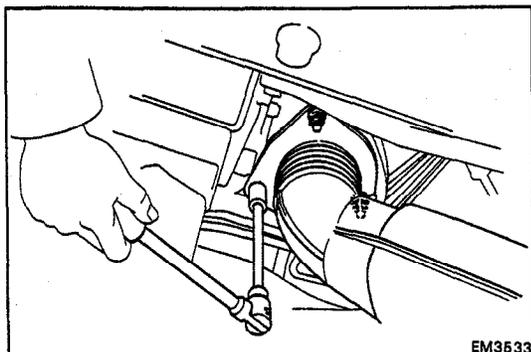
Torque:

To turbocharger

810 kg-cm (59 ft-lb, 79 N·m)

To engine mounting bracket

590 kg-cm (43 ft-lb, 58 N·m)

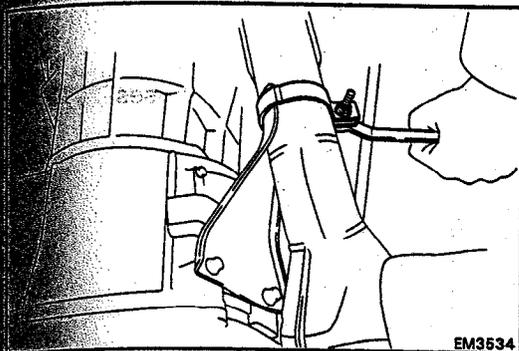


9. CONNECT FRONT EXHAUST PIPE

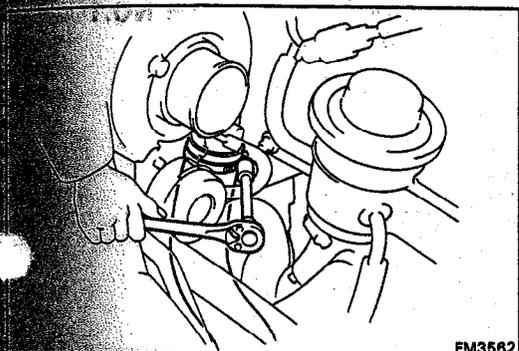
(a) Install a new gasket to the front exhaust pipe.

(b) Connect the front exhaust pipe to the exhaust manifold with three new nuts.

Torque: 630 kg-cm (46 ft-lb, 62 N·m)



- (c) Install the front exhaust pipe clamp.

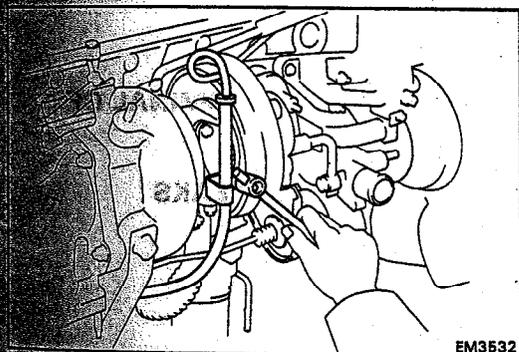


10. INSTALL NO.1 AIR CLEANER PIPE WITH NO.6 AIR CLEANER HOSE

- (a) Install the No.1 air cleaner pipe with No.6 air cleaner hose to the No.5 air cleaner hose and turbocharger.
 (b) Connect the No.1 air cleaner pipe to bracket with the bolt.

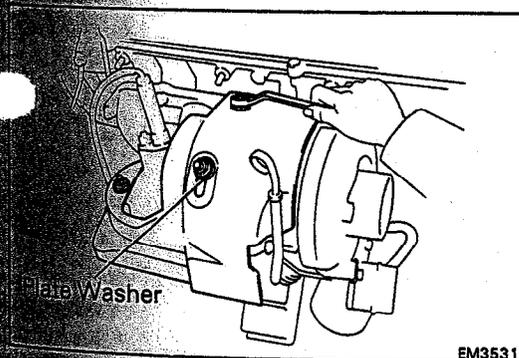
Torque: 130 kg-cm (9 ft-lb, 13 N·m)

- (c) Tighten the No.5 and No.6 air hose clamps.



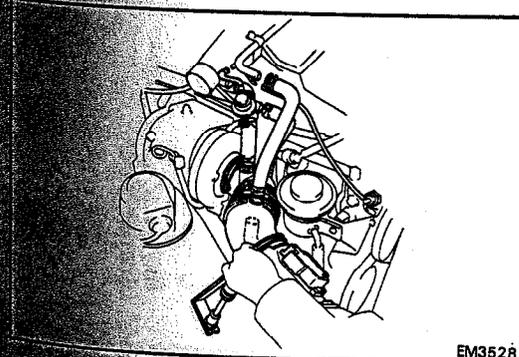
11. INSTALL OIL DIPSTICK GUIDE

- (a) Install a new O-ring to the oil dipstick guide.
 (b) Insert the oil dipstick guide to the No.2 oil dipstick guide.
 (c) Connect the oil dipstick guide to the turbocharger with the bolt.
 (d) Install the oil dipstick.



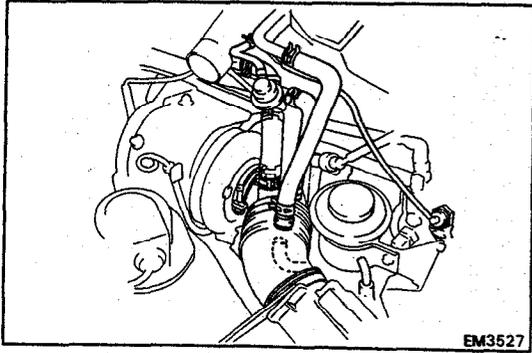
12. INSTALL TURBO HEAT INSULATOR

- (a) Install the turbo heat insulator and plate washer with the three nuts.
 (b) Connect oxygen sensor connector.

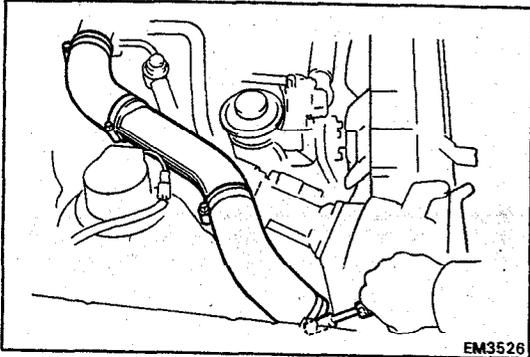


13. INSTALL NO.7 AIR CLEANER HOSE WITH AIR FLOW METER AND AIR CLEANER CAP

- (a) Install the No.7 air cleaner hose with air flow meter and air cleaner cap.
 (b) Install the bolt and tighten the clamps.



- (c) Connect the PS idle up air hose.
- (d) Connect the air flow meter connector.
- (e) Connect the PCV hose and three air hoses.



14. INSTALL NO.4 AIR CLEANER PIPE WITH NO.1 AND NO.2 AIR CLEANER HOSES

15. FILL WITH COOLANT
(See page CO-5)

16. CONNECT CABLE TO NEGATIVE TERMINAL OF BATTERY

17. START ENGINE AND CHECK FOR LEAKS