
TURBOCHARGING

TROUBLESHOOTING	TC-1
TURBOCHARGER	TC-2
INTERCOOLER	TC-20
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VSV FOR TURBOCHARGING	
PRESSURE CONTROL	TC-23



TROUBLESHOOTING

PROBLEM SYMPTOMS TABLE

TC00N-02

HINT:

Before troubleshooting the turbocharger, first check the engine itself. (valve clearance, engine compression, etc.)

INSUFFICIENT ACCELERATION, LACK OF POWER OR EXCESSIVE FUEL CONSUMPTION

Possible Cause	Check Procedure and Correction Method	See page
5. Turbocharging pressure too low	Check turbocharging pressure.	TC-4
6. Restricted intake system	Check intake air system, and repair or replace parts as necessary.	EM-1 EM-28
7. Leak in intake air system	Check intake air system, and repair or replace parts as necessary.	EM-1 EM-28
8. Restricted exhaust system	Check exhaust system, and repair or replace parts as necessary.	EM-28 EC-10
9. Leak in exhaust system	Check exhaust system, and repair or replace parts as necessary.	EM-28 EC-10
10. Erratic turbocharger operation	Check rotation of turbine shaft, and replace bearing housing if necessary. Check axial and radial plays of turbine shaft, and replace bearing housing if necessary.	TC-12

ABNORMAL NOISE

Possible Cause	Check Procedure and Correction Method	See page
1. Turbocharging heat insulator resonance	Check for loose, improperly installed or deformed insulator nuts and bolt, and repair or replace as necessary.	TC-7
2. Exhaust pipe leaking or vibrating	Check for deformed exhaust pipe, loose bolts or damaged gasket, and repair or replace as necessary.	EC-10
3. Erratic turbocharger operation	Check rotation of turbine shaft, and replace bearing housing if necessary. Check axial and radial plays of turbine shaft, and replace bearing housing if necessary.	TC-12

EXCESSIVE OIL CONSUMPTION OR WHITE EXHAUST

NOTICE:

Some oil mist in blowby from PCV is normal. Do not mistake it for oil leak from turbocharger.

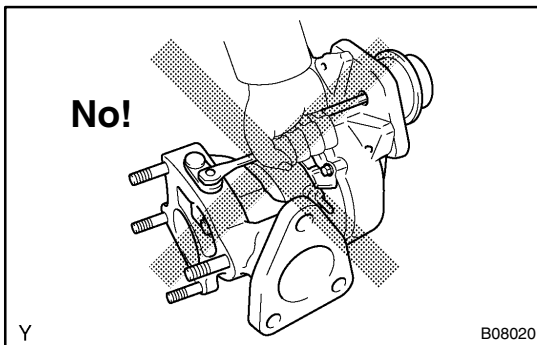
Possible Cause	Check Procedure and Correction Method	See page
Faulty turbocharger oil seal	Check for oil leakage in exhaust system. • Remove exhaust manifold converter from turbocharger, and check for excessive carbon deposits on turbine wheel. Excessive carbon deposits indicate a faulty turbocharger. Check for oil leakage in intake air system. • Check for axial and radial plays of turbine shaft, and replace bearing housing if necessary.	TC-12

TURBOCHARGER PRECAUTION

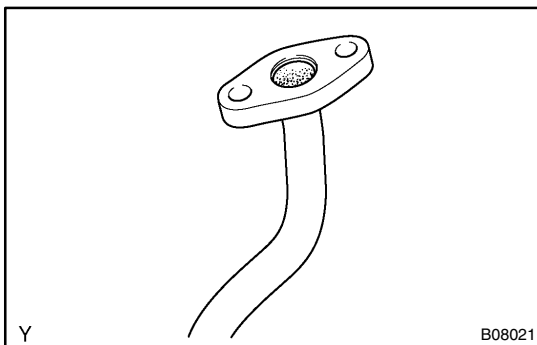
TC000-02

MAINTENANCE PRECAUTION

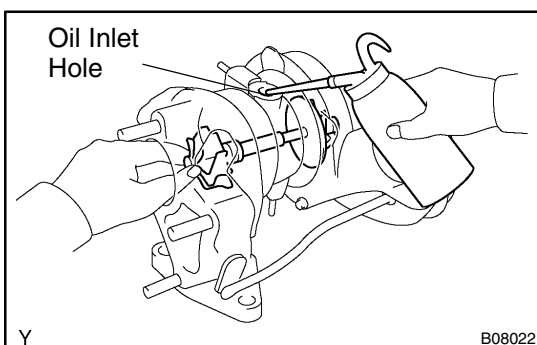
- (a) Do not stop the engine immediately after pulling a trailer or after high speed or uphill driving. Idle the engine for 20 – 120 seconds, depending on how hard the vehicle has been driven.
- (b) Avoid sudden acceleration or racing immediately after starting a cold engine.
- (c) If the turbocharger is found to be defective and must be replaced, check for the cause, and repair or replace these items as necessary:
 - Engine oil level and quality
 - Conditions under which the turbocharger was used
 - Oil lines leading to the turbocharger



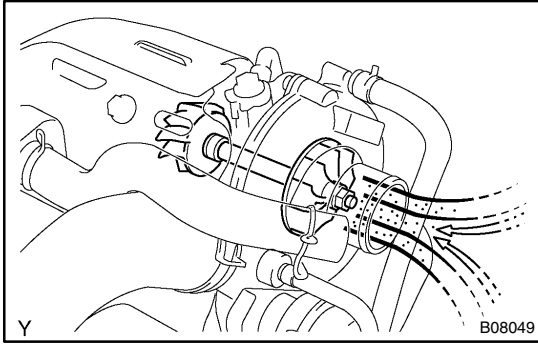
- (d) Use caution when removing and reinstalling the turbocharger assembly do not drop it or bang it against anything or grasp it by easily-deformed parts, such as the actuator or push rod, when moving it.
- (e) Before removing the turbocharger, plug the intake and exhaust ports and oil inlet to prevent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



- (f) If replacing the turbocharger, check for accumulation of sludge particles in the oil pipe, and if necessary, replace the oil pipe.
- (g) Completely remove the gasket adhered to the lubrication oil pipe flange and turbocharger oil flange.
- (h) When replacing the bolts or nuts, use only authorized replacement parts to prevent breakage or deformation.



- (i) If replacing the turbocharger, put 20 cm³ (1.2 cu in.) of fresh oil into the turbocharger oil inlet hole and turn the turbine wheel by hand to spread oil to the bearing.
- (j) 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.



- (k) If the engine is running without the air cleaner, case cover and hose, entry of foreign particles will damage the wheels which run at extremely high speed.

ON-VEHICLE INSPECTION

1. INSPECT INTAKE AIR SYSTEM

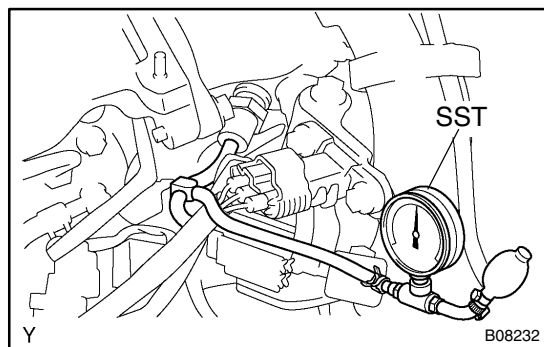
Check for leakage or clogging between the air cleaner housing and turbocharger inlet and between the turbocharger outlet and cylinder head.

- Clogged air cleaner...Clean or replace 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. CHECK TURBOCHARGING PRESSURE

- Warm up engine.
- Using a 3-way connector, connect SST (turbocharger pressure gauge) to the hose leading to the intake air connector.
SST 09992 – 00242
- Press in the clutch pedal, then press the accelerator pedal down as far as it will go. Measure the turbocharging pressure at maximum speed (5,100 – 5,250 rpm).

Standard pressure:

58.5 – 78.9 kPa (0.60 – 0.80 kgf/cm², 8.5 – 11.4 psi)

If the pressure is less than specified, check the intake air and exhaust systems for leakage.

If there is no leakage, check the turbocharger.

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

4. INSPECT TURBINE SHAFT ROTATION

(See page TC-12)

5. INSPECT ACTUATOR OPERATION

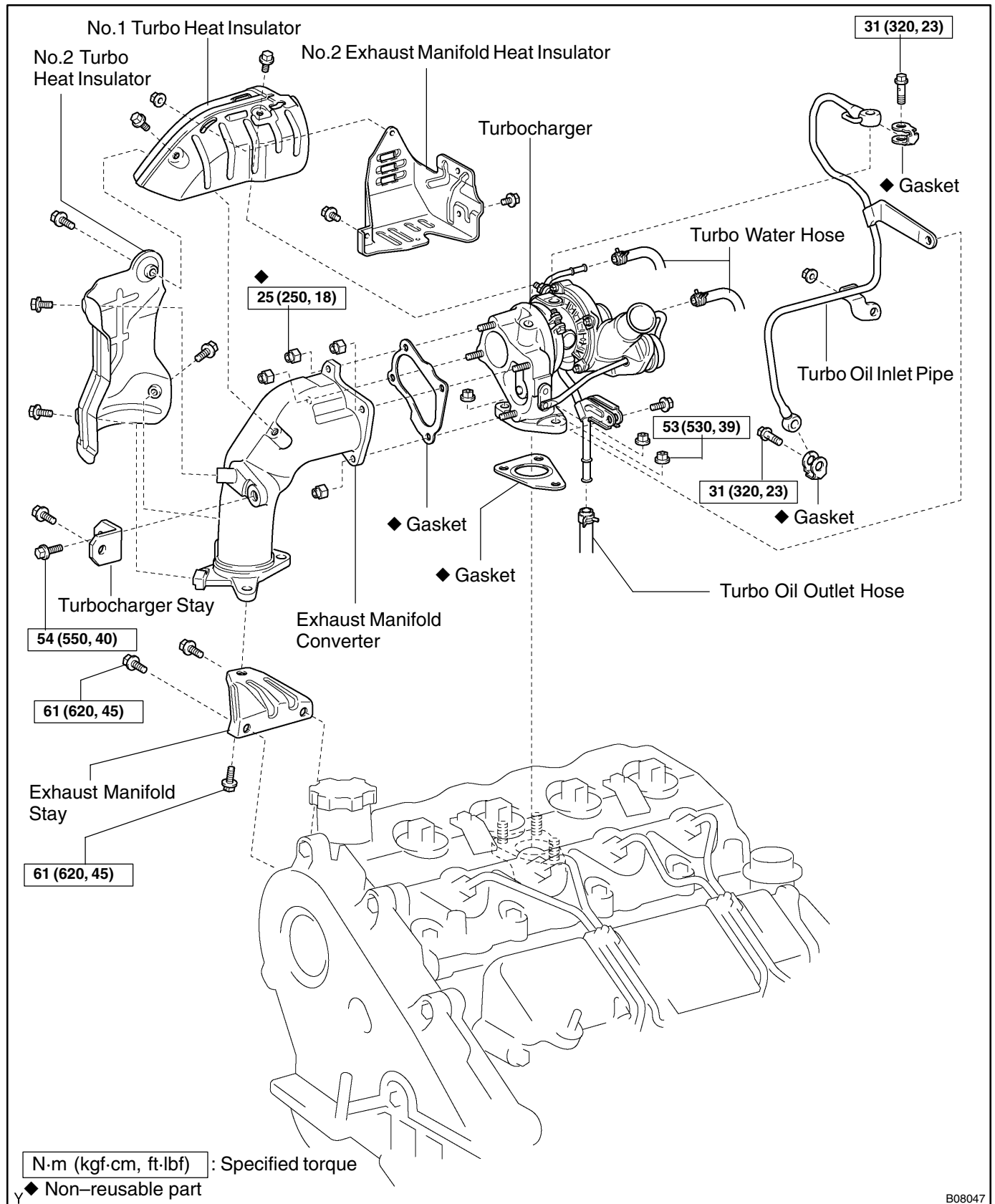
(See page TC-12)

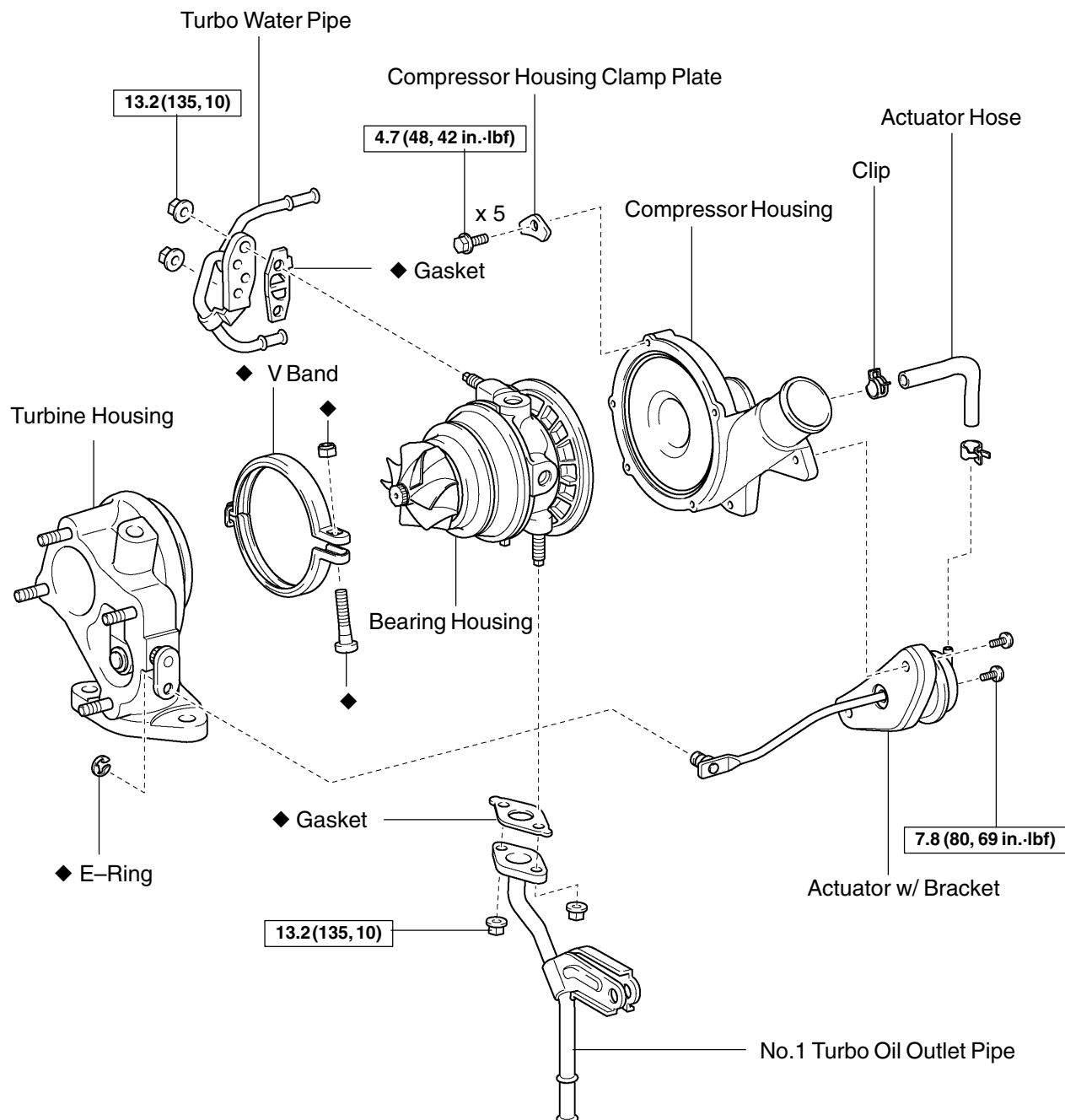
6. INSPECT TURBO PRESSURE SENSOR

(See page TC-21)

7. INSPECT VSV FOR TURBOCHARGING PRESSURE CONTROL (See page TC-24)

COMPONENTS





Y

N·m (kgf·cm, ft·lbf) : Specified torque

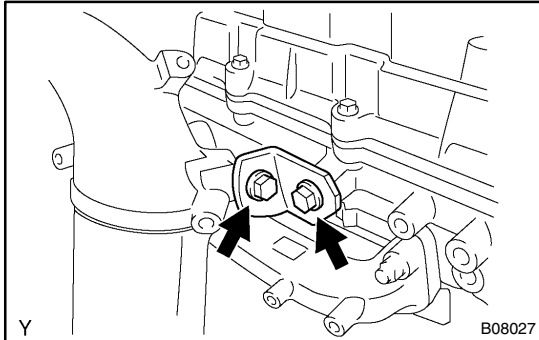
◆ Non-reusable part

REMOVAL

1. DRAIN ENGINE COOLANT

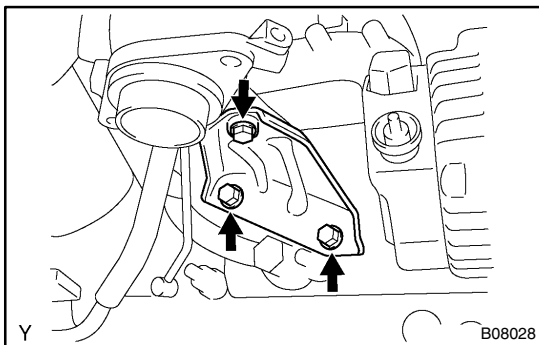
2. REMOVE HEAT INSULATORS

- (a) Remove the 4 bolts and No.2 turbo heat insulator.
- (b) Remove the 2 bolts, nut and No.1 turbo heat insulator.
- (c) Remove the 2 bolts and No.2 exhaust manifold heat insulator.



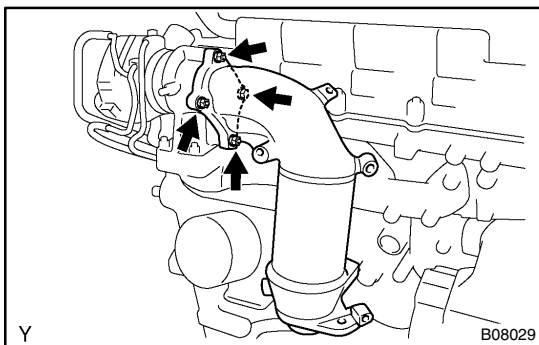
3. REMOVE TURBOCHARGER STAY

Remove the 2 bolts and turbocharger stay.



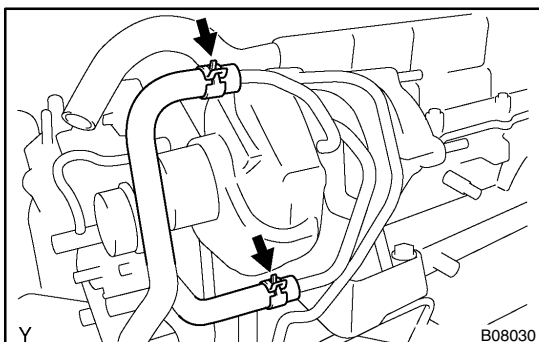
4. REMOVE EXHAUST MANIFOLD STAY

Remove the 3 bolts and exhaust manifold stay.



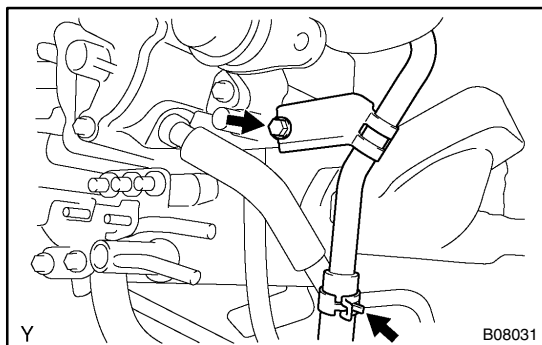
5. REMOVE EXHAUST MANIFOLD CONVERTER

Remove the 4 nuts, exhaust manifold converter and gasket.

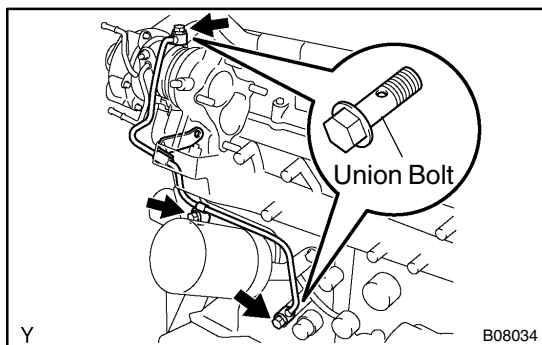


6. REMOVE TURBOCHARGER ASSEMBLY

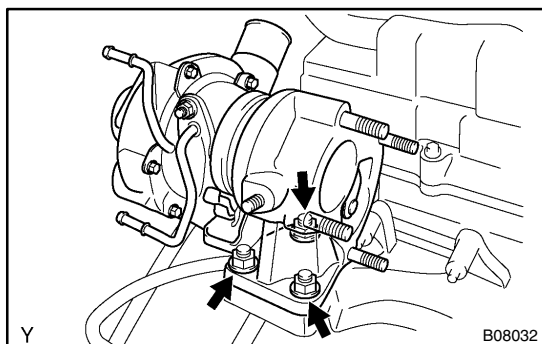
- (a) Disconnect the 2 turbo water hoses.



- (b) Remove the bolt holding the stays on the No.1 turbo oil outlet pipe and turbo oil inlet pipe to the cylinder head.
- (c) Disconnect the turbo oil outlet hose.



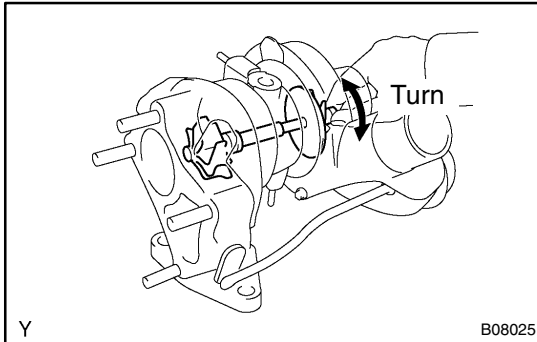
- (d) Remove the 2 union bolts, 2 gaskets, nut and turbo oil inlet pipe.



- (e) Remove the 3 nuts, turbocharger and gasket.

NOTICE:

Do not make the actuator push rod deformed with a tool.



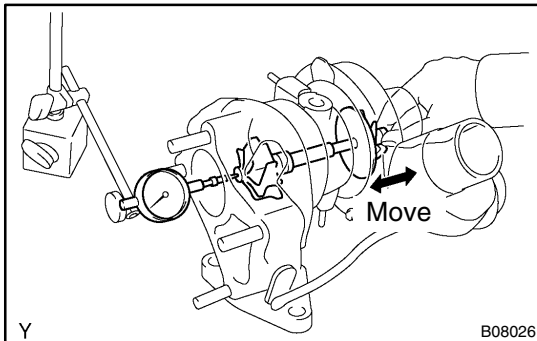
DISASSEMBLY

1. INSPECT TURBINE SHAFT ROTATION

Grasp the edge of the turbine shaft, and turn it.

Check that the turbine shaft turns smoothly.

If the turbine shaft turns remarkably heavily or is stuck, replace the bearing housing. At that time, check also the interference with the turbine housing and compressor housing.



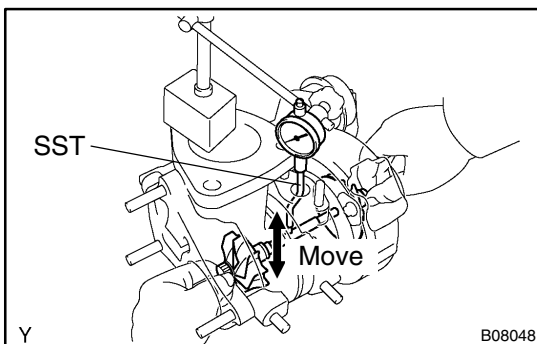
2. INSPECT AXIAL PLAY OF TURBINE SHAFT

(a) Using a dial indicator, insert the needle of the dial indicator into the exhaust side.

(b) Move the turbine shaft in an axial direction, measure the axial play of the turbine shaft.

Maximum oil clearance: 0.09 mm (0.0035 in.) or less

If the axial play is greater than maximum, replace the bearing housing. At that time, check also the interference with the turbine housing and compressor housing.



3. INSPECT RADIAL PLAY OF TURBINE SHAFT

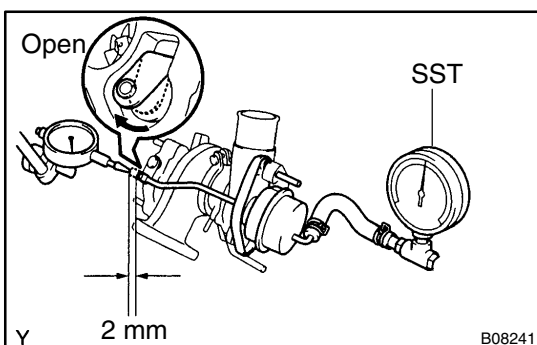
(a) Using SST and a dial indicator, insert the needle of the dial indicator into the oil outlet hole, and set it in the center of the turbine shaft.

SST 09992-00600

(b) Move the turbine shaft in a radial direction, measure the radial play of the turbine shaft.

Maximum oil clearance: 0.16 mm (0.0063 in.) or less

If the radial play is greater than maximum, replace the bearing housing. At that time, check also the interference with the turbine housing and compressor housing.



4. INSPECT ACTUATOR AND WASTE GATE VALVE OPERATION

(a) Disconnect the actuator hose from the compressor housing.

(b) Using SST and a dial indicator, read the graduation of SST when the actuator push rod moved 2 mm (0.079 in.).

Standard pressure:

156 – 169 kPa (1.59 – 1.72 kgf/cm², 22.6 – 24.5 psi)

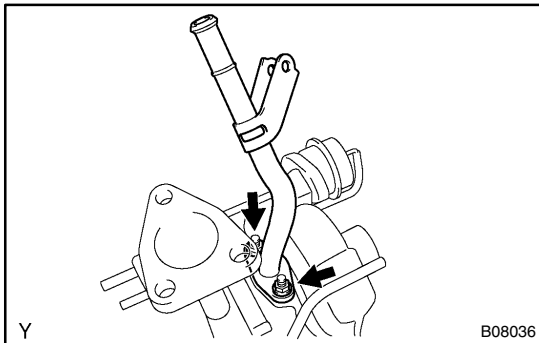
- (c) Move the actuator push rod, and check that the waste gate valve is open.

If operation is not as specified, replace the actuator and/or turbine housing.

NOTICE:

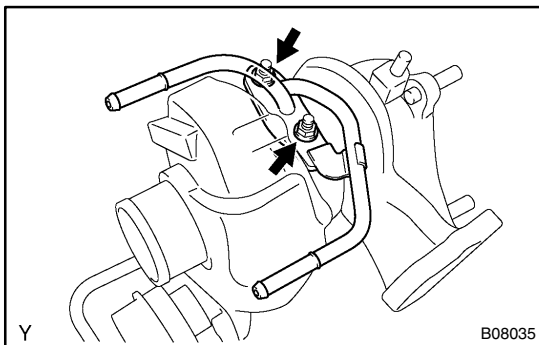
Never apply more than 197 kPa (2.01 kgf/cm², 28.5 psi) of pressure of the actuator.

- (d) Reconnect the actuator hose to the compressor hosing.



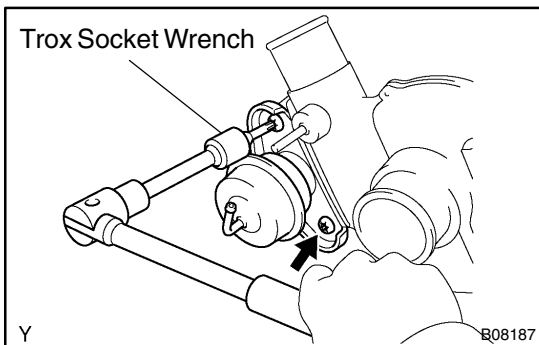
5. REMOVE NO.1 TURBO OIL OUTLET PIPE FROM TURBOCHARGER

Remove the 2 nuts, outlet pipe and gasket.



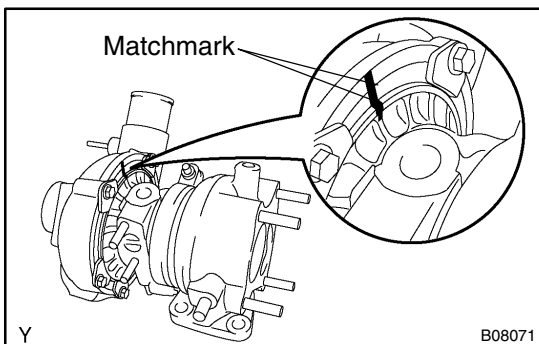
6. REMOVE TURBO WATER PIPE FROM TURBOCHARGER

Remove the 2 nuts, water pipe and gasket.



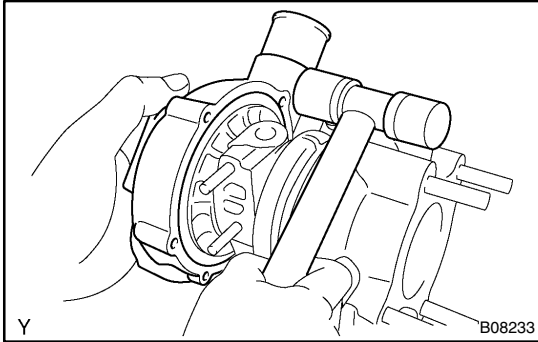
7. REMOVE ACTUATOR w/ BRACKET

- (a) Remove the actuator hose.
- (b) Using a trox socket wrench (T30), remove the 2 screws holding the actuator to the compressor housing.
- (c) Remove the E-ring holding the actuator push rod to the waste gate valve link, and remove the actuator w/ bracket.



8. REMOVE COMPRESSOR HOUSING

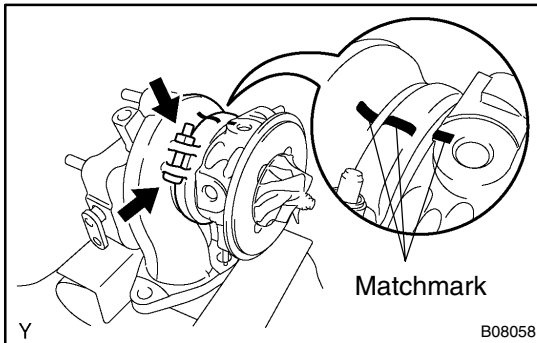
- (a) Place the matchmarks on the compressor housing and bearing housing.
- (b) Remove the 5 bolts and 5 camp plates.



- (c) Using a plastic-faced hammer, tap out the compressor housing.

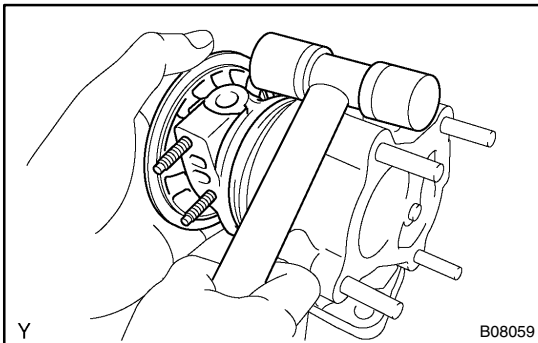
NOTICE:

Remove the compressor housing as straight as possible and do not make the impeller wheel interfere with the compressor housing.



9. REMOVE BEARING HOUSING

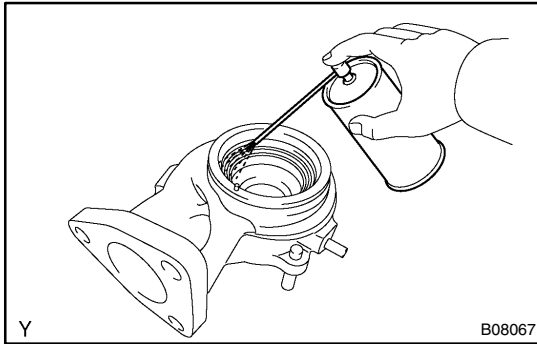
- (a) Place the matchmarks on the V band, turbine housing and bearing housing.
 (b) Remove the flat head square neck bolt, nut and V band.



- (c) Using a plastic-faced hammer, tap out the bearing housing.

NOTICE:

Remove the bearing housing as straight as possible and do not make the turbine wheel interfere with the turbine housing.



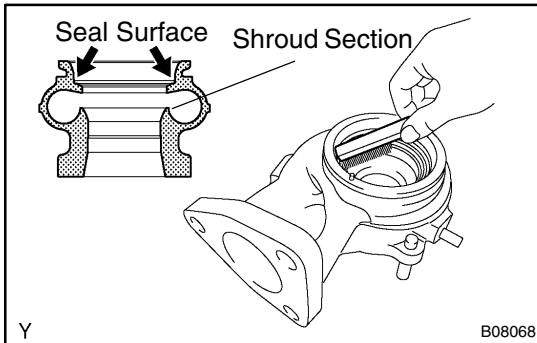
INSPECTION

1. CLEAN AND INSPECT TURBINE HOUSING

- (a) Spray the engine conditioner to the section where the carbon dirt is adhered.

NOTICE:

Be careful not to erase the matchmark of the turbine housing.



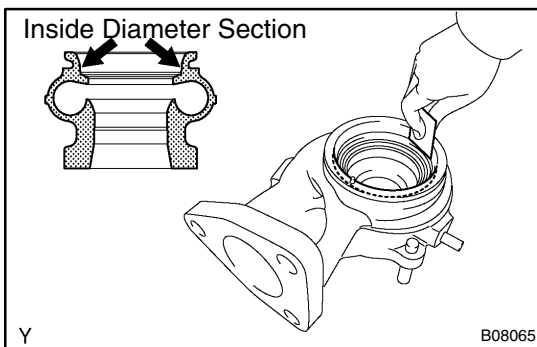
- (b) Using a wire brush, remove all the carbon dirt inside the turbine housing.

NOTICE:

Clean the seal surface and shroud section shown in the illustration sufficiently. And clean the waste gate valve seat sufficiently, too.

HINT:

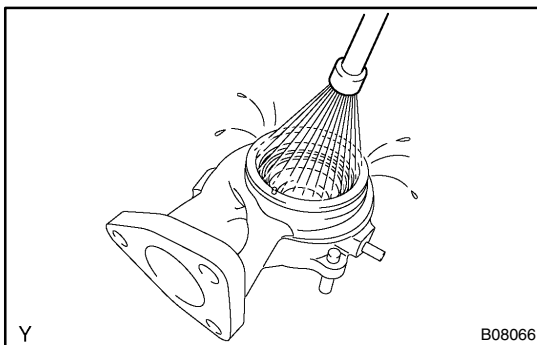
When the carbon dirt is heavily adhered, remove it using the screwdriver and the like.



- (c) Clean the inside diameter section with a sandpaper (No.100) until the metal surface can be seen.

NOTICE:

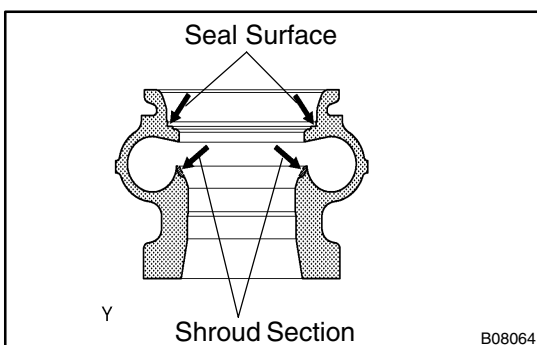
If the cleaning is not enough, installation of the bearing housing becomes harder, so clean it sufficiently.



- (d) Wash with compressed air or a steam cleaner.

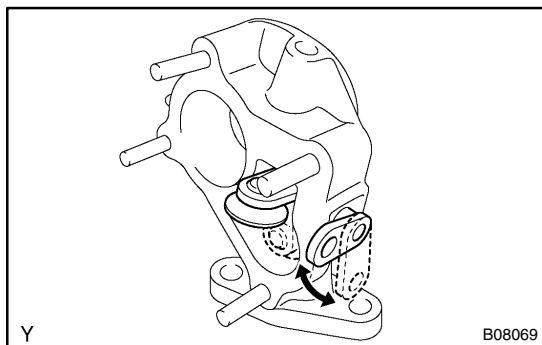
NOTICE:

Wash sufficiently without leaving any irregular objects.



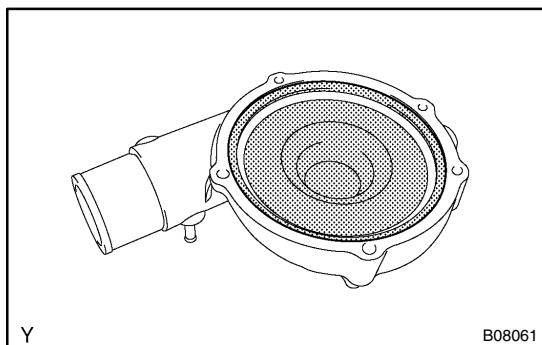
- (e) Check that there is no severe damage on the seal surface with the bearing housing.
(f) Check that there is no bore made by the interference with the turbine wheel in the shroud section.

If the turbine housing is having remarkable damage or bore, replace the turbine housing and bearing housing.



- (g) Move the waste gate valve link and check that it runs smoothly without sticking.

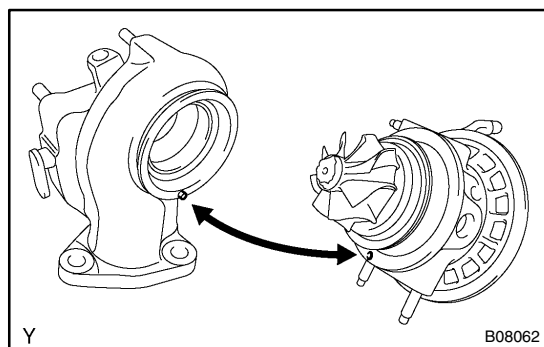
If the link is bad running, clean again. If it is bad running, even after cleaning, replace the turbine housing.



2. CLEAN AND INSPECT COMPRESSOR HOUSING

- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the compressor housing and bearing housing.
- (1) Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces.
 - (2) Thoroughly clean all components to remove all the loose material.
 - (3) Using a non-residue solvent, clean both sealing surfaces.
- (b) Wipe off the dirt from the inside of the housing with a shop rag.
- (c) Check that there is no severe interference with the impeller wheel.

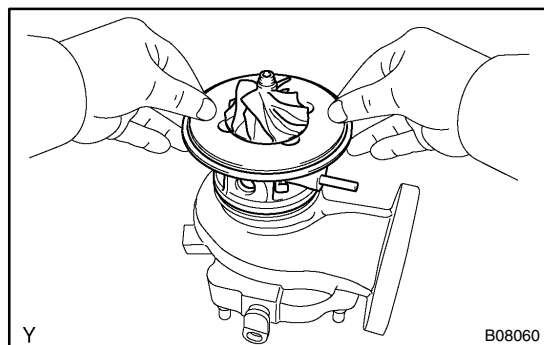
If it is having bur made by a slight interference damage, remove it with a sandpaper (No.400) and blow with compressed air.



REASSEMBLY

1. INSTALL BEARING HOUSING

- (a) Align the pin of the turbine housing with the pin hole of the bearing housing.



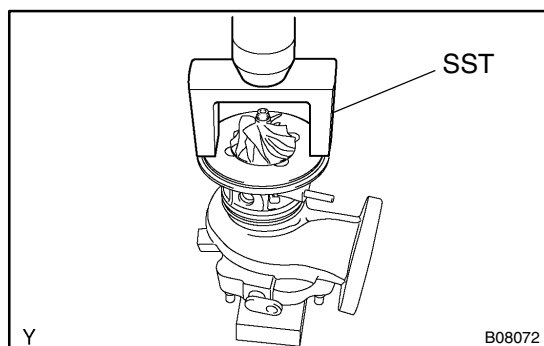
- (b) Install the bearing housing to the turbine housing.

NOTICE:

- Install the bearing housing straight, and be careful not to damage the turbine wheel.
- In case of having difficulty of pressing in the bearing housing to install with a hand due to hard engagement, apply the procedure (c).

HINT:

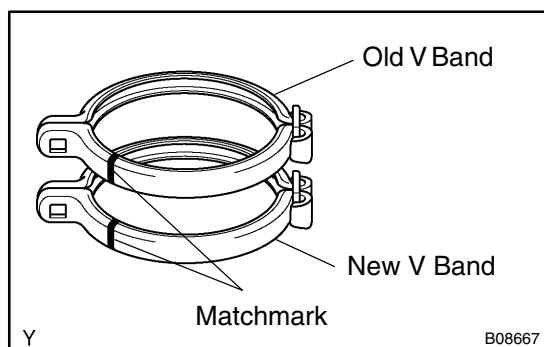
Apply a little penetrate rust prevention lubricant onto the engagement section to make installation easier.



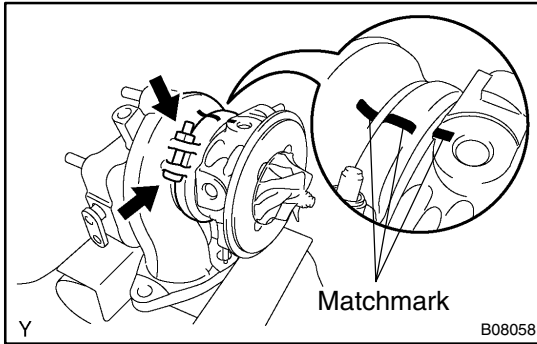
- (c) In case that the engagement of the bearing housing is hard, using SST and a press, install the bearing housing while checking the smooth rotation of the impeller wheel.
SST 09350-32014 (09351-32070)

NOTICE:

- Do not hold the turbine housing with the stud bolts.
- Be sure to install the bearing housing straight without tilting as the shaft may bent and cause the irregular noise.
- Press in the bearing housing slowly. When the rotation of the impeller wheel becomes heavy, return the press immediately and do the operation again.
- After installed, check that the turbine shaft turns smoothly.

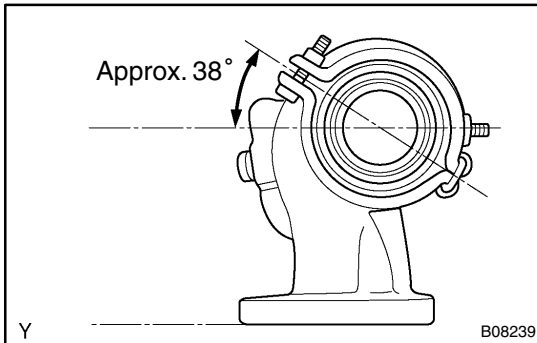


- (d) Place a new and old (used) V bands in line, then reprint the matchmark position on the old V band to the new one.



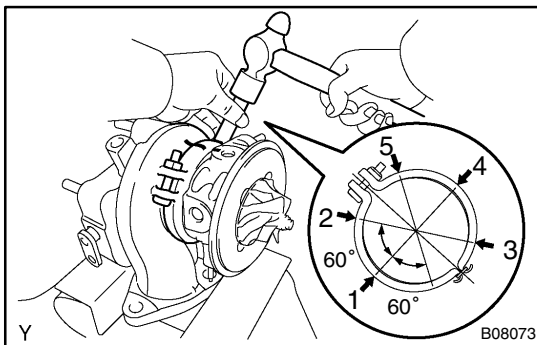
- (e) Align the matchmarks on the new V band, turbine housing and bearing housing, and temporarily torque with a new bolt and nut.

Torque: 8.3 N·m (85 kgf·cm, 74 in.-lbf)



HINT:

When the marks are erased, make the matching openings meet at the position shown in the illustration.



- (f) Using a brass bar and hammer, hit 2 or 3 times lightly at each place in order of 1 through 5.

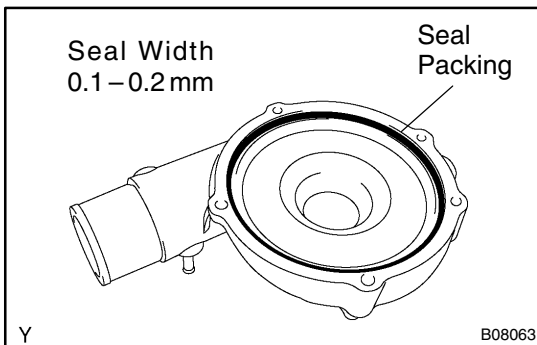
- (g) Torque the bolt and nut more.

Torque: 8.3 N·m (85 kgf·cm, 74 in.-lbf)

- (h) Using a brass bar and hammer, hit 2 or 3 times lightly at each place of 1 and 4.

- (i) Torque the bolt and nut completely.

Torque: 8.3 N·m (85 kgf·cm, 74 in.-lbf)



2. INSTALL COMPRESSOR HOUSING

- (a) In case of reusing the compressor housing and bearing housing:

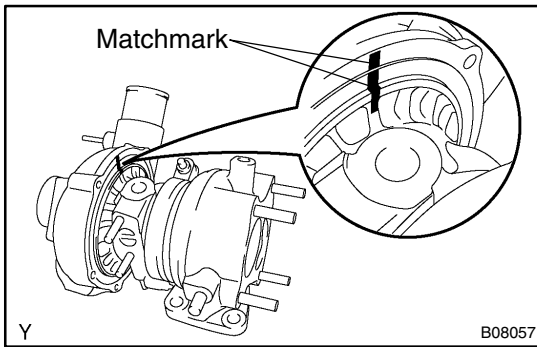
- (1) Apply seal packing to the compressor housing as shown in the illustration.

Seal packing: Part No. 08826–00080 or equivalent

NOTICE:

Avoid applying an excessive amount to the surface.

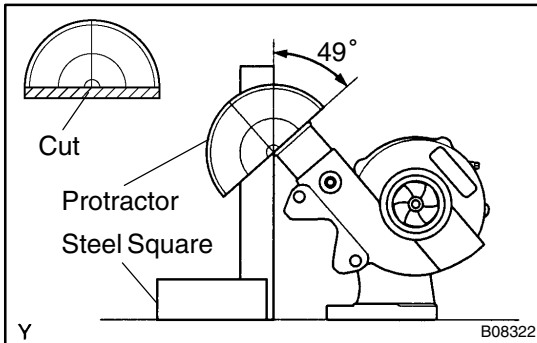
- Install a nozzle that has been cut to a 0.1 – 0.2 mm (0.004 – 0.08 in.) opening.
- Parts must be assembled within 7 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.



- (2) Align the matchmarks on the compressor housing and bearing housing, and install them.

NOTICE:

- **Do not make the impeller wheel interfere with the compressor housing.**
- **Check that the turbine shaft turns smoothly.**



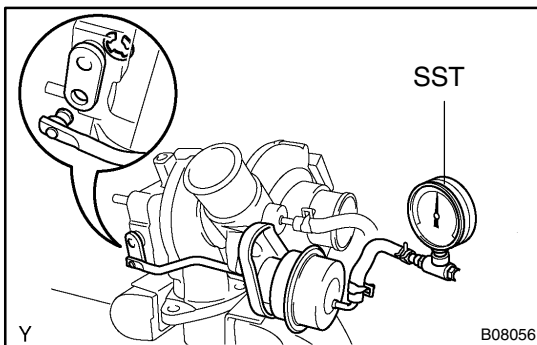
- (3) Using a steel square and protractor, check the installation angle of the outlet port of the compressor housing shown in the illustration.

- (4) Install the 5 clamp plates and bolts.

Torque: 4.7 N·m (48 kgf·cm, 42 in.-lbf)

- (b) In case of using a new compressor housing and/or bearing housing:

- (1) Temporarily install the compressor housing on the bearing housing, make the installation angle of the outlet port of the compressor housing meet at the position shown in the illustration, and place the matchmarks.
- (2) Remove the compressor housing.
- (3) The following procedure is the same as that of reusing the compressor housing and/or bearing housing.

**3. INSTALL ACTUATOR w/ BRACKET**

- (a) Using a torx wrench (T30), install the actuator w/ bracket to the compressor housing with the 2 screws.

Torque: 7.8 N·m (80 kgf·cm, 69 in.-lbf)

- (b) Using SST, move the actuator push rod.

NOTICE:

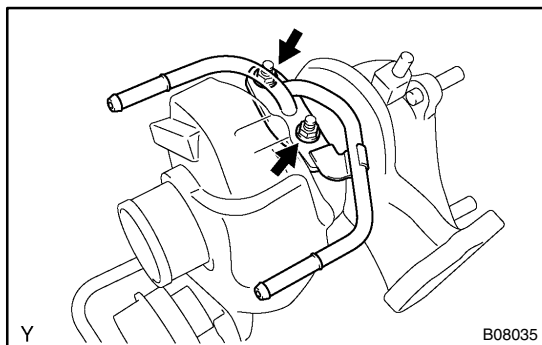
Never apply more than 197 kPa (2.01 kgf/cm², 28.5 psi) of pressure of the actuator.

- (c) Connect the actuator push rod to the waste gate valve link with a new E-ring.

NOTICE:

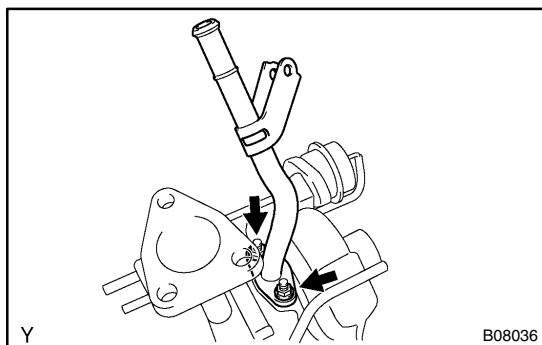
Do not use a hammer, etc. to force the actuator push rod onto the waste gate valve link.

- (d) Remove the SST.
- (e) Connect the actuator hose.

**4. INSTALL TURBO WATER PIPE TO TURBOCHARGER**

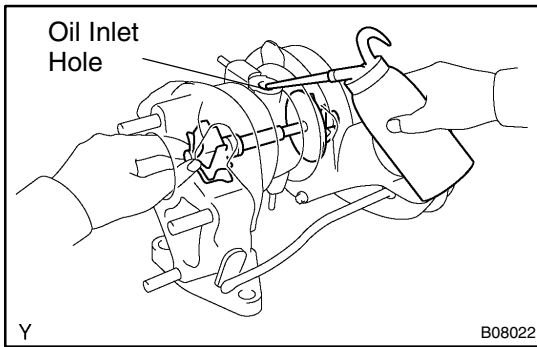
Install a new gasket and the water pipe with the 2 nuts.

Torque: 13.2 N·m (135 kgf·cm, 10 ft·lbf)

**5. INSTALL NO.1 TURBO OIL OUTLET PIPE TO TURBOCHARGER**

Install a new gasket and the outlet pipe with the 2 nuts.

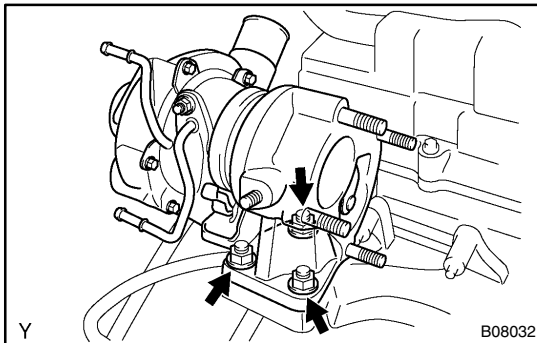
Torque: 13.2 N·m (135 kgf·cm, 10 ft·lbf)



INSTALLATION

NOTICE:

After replacing the turbocharger assembly, pour approx. 20 cm³ (1.2 cu in.) of fresh oil into the oil inlet hole and turn the turbine wheel by hand to splash oil on the bearing.



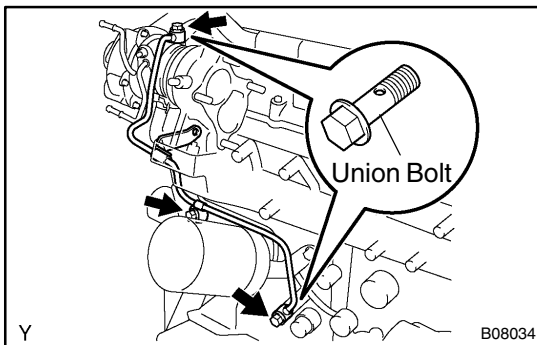
1. INSTALL TURBOCHARGER ASSEMBLY

- (a) Install a new gasket and the turbocharger assembly with the 3 nuts.

Torque: 53 N·m (530 kgf·cm, 39 ft·lbf)

NOTICE:

Do not make the actuator push rod deformed with a tool.



- (b) Apply a light coat of engine oil to 2 new gaskets and on the threads and under the heads of the union bolts.
 (c) Install the 2 gaskets and the turbo oil inlet pipe with the 2 union bolts and nut.

NOTICE:

Use the new gasket by separating it into two.

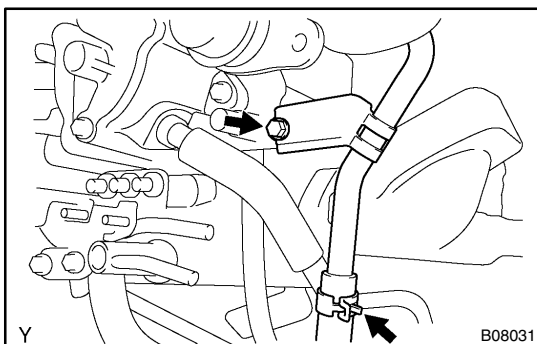
HINT:

The turbocharger side union bolt is yellow and the cylinder block side union bolt is black.

Torque:

31 N·m (320 kgf·cm, 23 ft·lbf) for union bolt

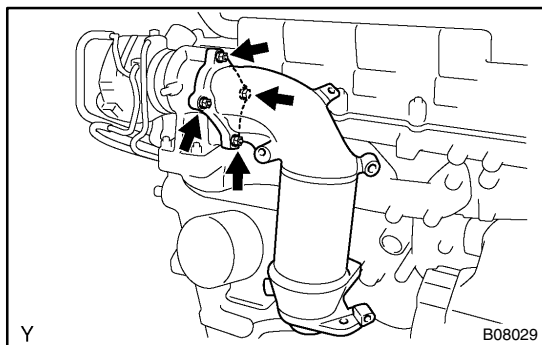
8.8 N·m (90 kgf·cm, 78 in·lbf) for nut



- (d) Connect the turbo oil outlet hose.
 (e) Connect the stays on the turbo oil inlet pipe and No.1 turbo oil outlet pipe to the cylinder head with the bolt.

Torque: 8.8 N·m (90 kgf·cm, 78 in·lbf)

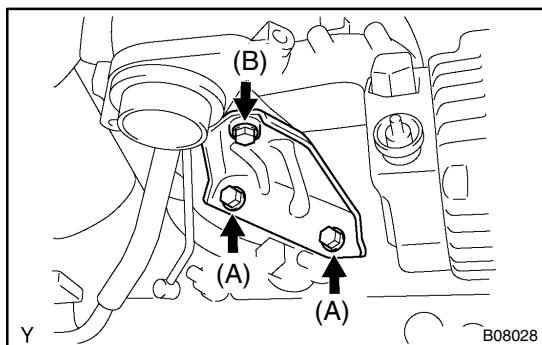
- (f) Connect the 2 turbo water hoses.



2. INSTALL EXHAUST MANIFOLD CONVERTER

Install a new gasket and the exhaust manifold converter with the 4 new nuts.

Torque: 25 N·m (250 kgf·cm, 18 ft·lbf)



3. INSTALL EXHAUST MANIFOLD STAY

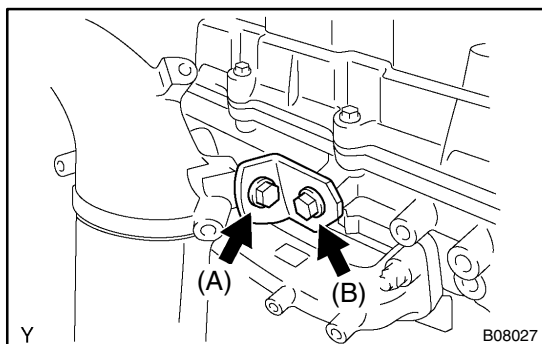
(a) Temporarily install the exhaust manifold stay with the 2 bolts (A).

(b) Install and torque the bolt (B).

Torque: 61 N·m (620 kgf·cm, 45 ft·lbf)

(c) Torque the 2 bolts (A).

Torque: 61 N·m (620 kgf·cm, 45 ft·lbf)



4. INSTALL TURBOCHARGER STAY

(a) Temporarily install the turbocharger stay with the bolt (A).

(b) Temporarily torque the bolt (B) by 30 N·m (305 kgf·cm, 22 ft·lbf) or less without making any clearance between the cylinder head and stay.

(c) Torque the bolt (A).

Torque: 54 N·m (550 kgf·cm, 40 ft·lbf)

(d) Torque the bolt (B).

Torque: 54 N·m (550 kgf·cm, 40 ft·lbf)

5. INSTALL HEAT INSULATORS

(a) Install the No.2 exhaust manifold heat insulator with the 2 bolts.

Torque: 12 N·m (120 kgf·cm, 9 ft·lbf)

(b) Install the No.1 turbo heat insulator with the 2 bolts and nut.

Torque:

12 N·m (120 kgf·cm, 9 ft·lbf) for bolt

18.1 N·m (185 kgf·cm, 13 ft·lbf) for nut

(c) Install the No.2 turbo heat insulator with the 4 bolts.

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

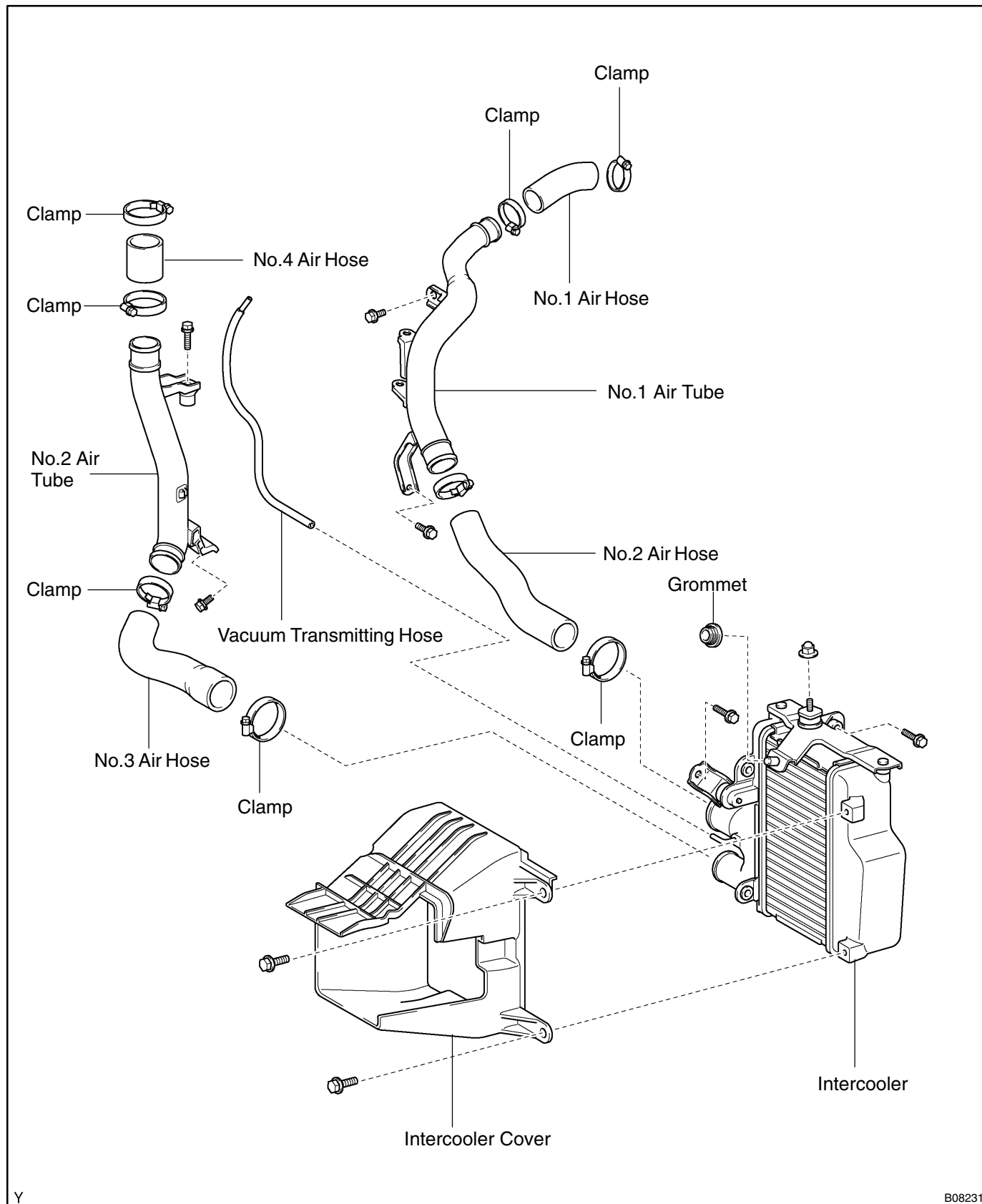
6. **FILL WITH ENGINE COOLANT (See page CO-2)**

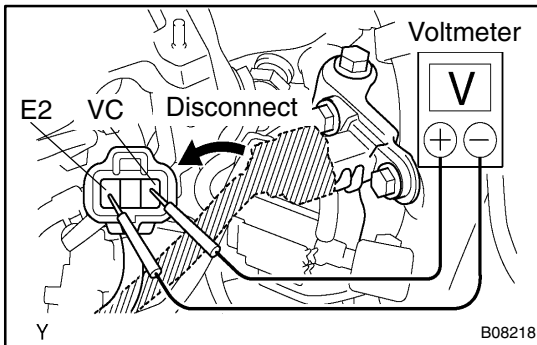
7. **START ENGINE AND CHECK FOR LEAK**

8. **CHECK ENGINE OIL LEVEL**

INTERCOOLER COMPONENTS

TC02P-01





TURBO PRESSURE SENSOR INSPECTION

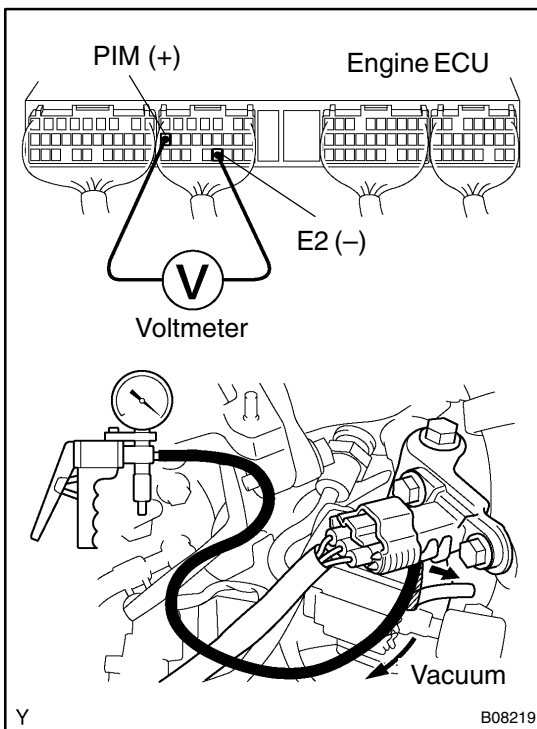
TC00V-02

1. INSPECT POWER SOURCE VOLTAGE OF TURBO PRESSURE SENSOR

- Disconnect the turbo pressure sensor connector.
- Turn the ignition switch ON.
- Using a voltmeter, measure the voltage between connector terminals VC and E2 of the wiring harness side.

Voltage: 4.5 – 5.5 V

- Turn the ignition switch OFF.
- Reconnect the turbo pressure sensor connector.

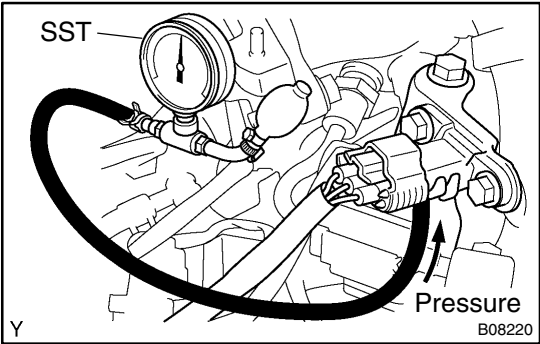


2. INSPECT SUPPLY POWER OF TURBO PRESSURE SENSOR

- Turn the ignition switch ON.
- Disconnect the vacuum hose from the turbo pressure sensor.
- Connect a voltmeter to terminals PIM and E2 of the ECU and measure the output voltage under ambient atmospheric pressure.
- Apply vacuum to the turbo pressure sensor in 13.3 kPa (100 mmHg, 3.94 in.Hg) segments to 66.7 kPa (500 mmHg, 19.96 in.Hg).
- Measure the voltage drop from step (c) above for each segment.

Voltage drop:

Apply vacuum kPa (mmHg, in.Hg)	Voltage drop V
13.3 (100, 3.94)	0.1 – 0.3
26.7 (200, 7.87)	0.3 – 0.5
40.0 (300, 11.81)	0.5 – 0.7
57.3 (400, 15.75)	0.7 – 0.9
66.7 (500, 19.96)	0.9 – 1.0



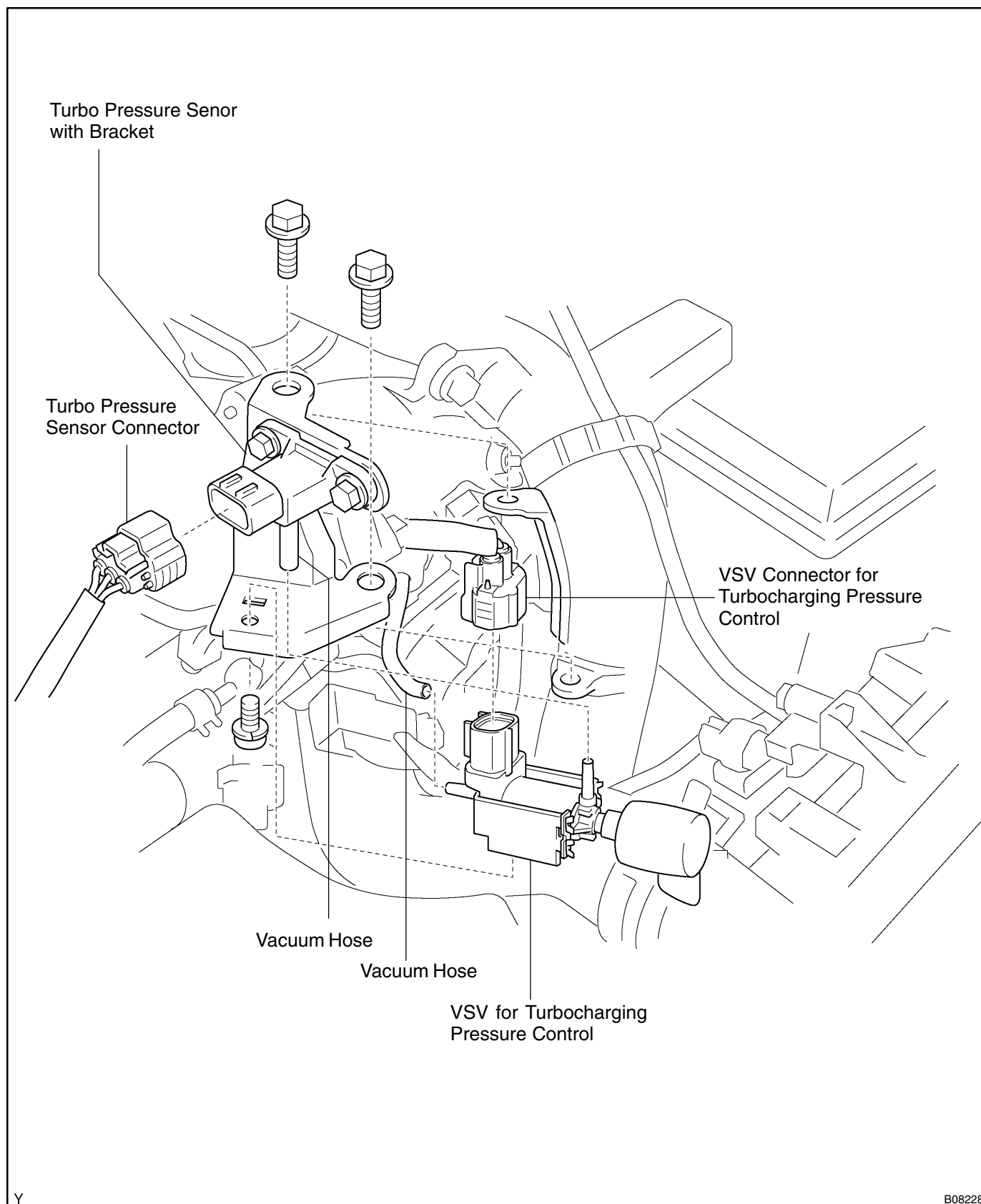
- (f) Using SST (turbocharger pressure gauge), apply pressure to the turbo pressure sensor in 19.6 kPa (0.20 kgf/cm², 2.84 psi) segments to 98.0 kPa (1.00 kgf/cm², 14.2 psi).
SST 09992-00242
- (g) Measure the voltage up from step (c) above for each segment.

Voltage up:

Applied pressure kPa (kgf/cm ² , psi)	Voltage up V
19.6 (0.20, 2.84)	0.1 – 0.4
39.2 (0.40, 5.69)	0.4 – 0.7
58.8 (0.60, 8.53)	0.7 – 1.0
78.5 (0.80, 11.4)	1.0 – 1.3
98.0 (1.00, 14.2)	1.3 – 1.6

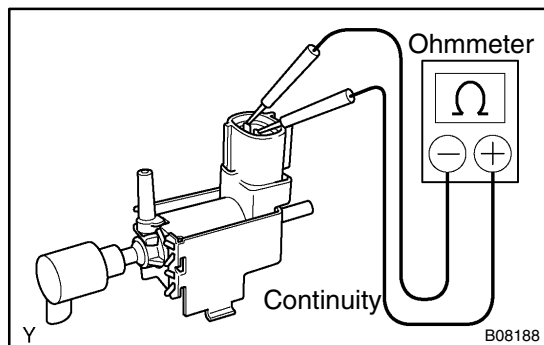
VSV FOR TURBOCHARGING PRESSURE CONTROL COMPONENTS

TC02Q-01



INSPECTION

1. REMOVE VSV

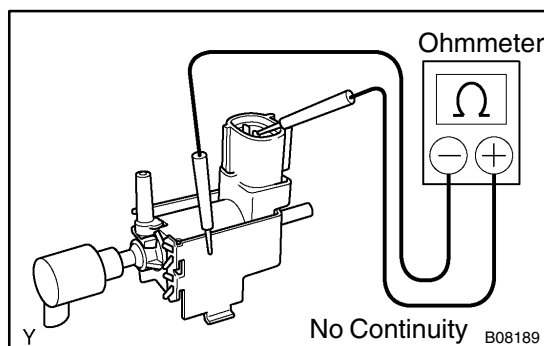


2. INSPECT VSV FOR OPEN CIRCUIT

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

Resistance: 37 – 44 Ω at 20°C (68°F)

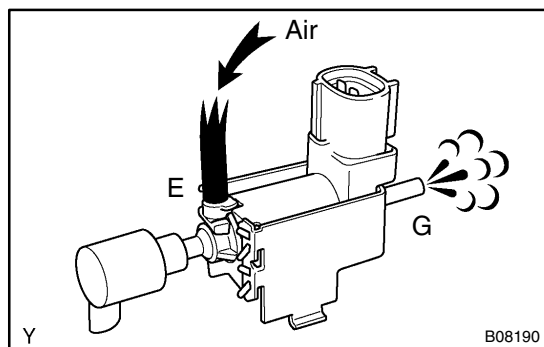
If there is no continuity, replace the VSV.



3. INSPECT VSV FOR GROUND

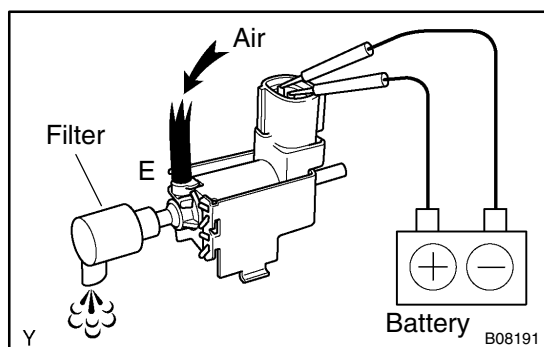
Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.



4. INSPECT VSV OPERATION

(a) Check that air does not flow from port E to G.



(b) Apply battery voltage across the terminals.

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

If operation is not as specified, replace the VSV.

5. REINSTALL VSV