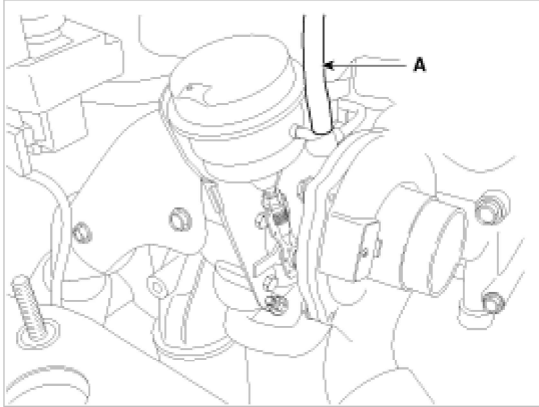


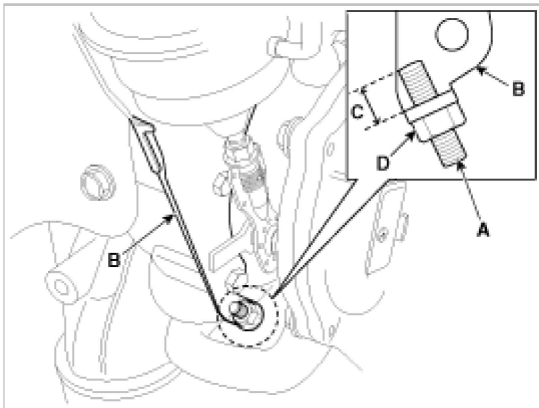
Replacement

[Turbocharger Actuator]

1. Remove the engine cover.
2. Remove the air cleaner assembly.
3. Disconnect the vacuum hose (A) from the turbocharger actuator.

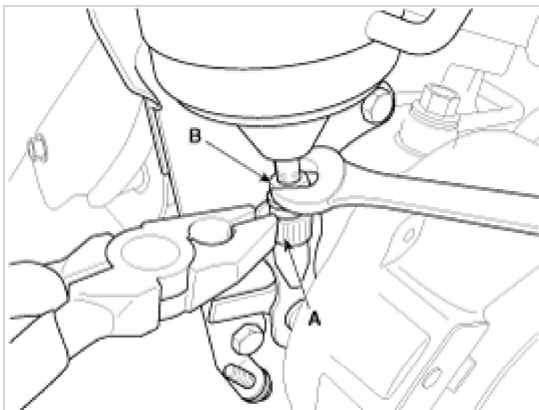


4. Measure the length of the projecting part (C) of the thread pin (piston rod lever stopper) (A) from the turbocharger actuator bracket (B). Record the measuring value.
5. Remove the thread pin (A) by unfastening the lock nut (D).



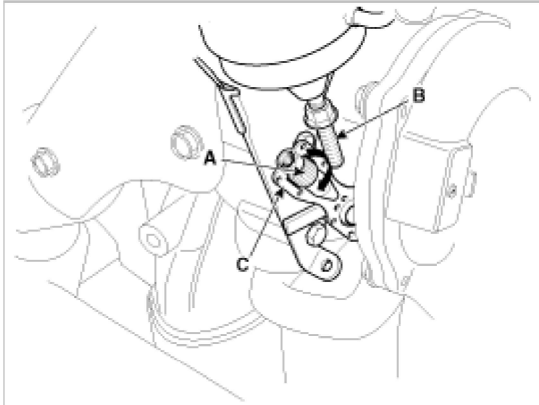
6. Hold the piston rod end (A) with pliers, and then loosen the piston rod lock nut (B) with an open spanner.

Tightening torque: 5.0 ~ 6.0Nm (0.5 ~ 0.6kgf.m, 3.7 ~ 4.4lbf-ft)



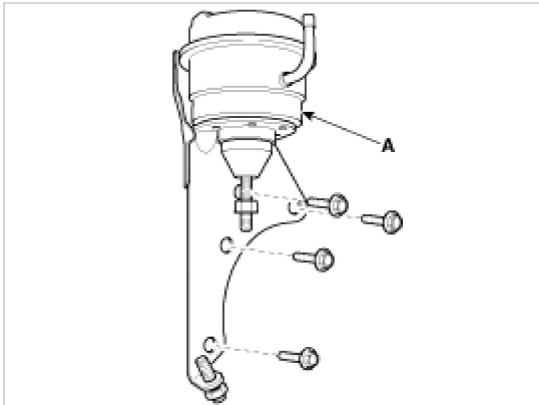
7. Disconnect the piston rod end (C) from the piston rod (B) by turning the piston rod end adjusting nut

(A) clockwise .



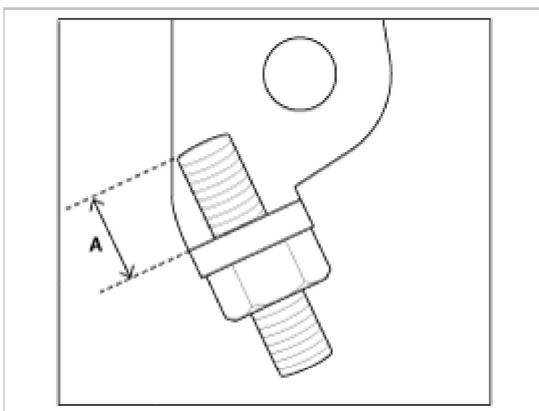
8. Unfasten the turbocharger actuator bracket mounting bolts and remove the turbocharger actuator (A) from the turbocharger assembly.

Tightening torque: 14~16 Nm(1.4~1.6kgf.m, 10.3~11.8lbf-ft)



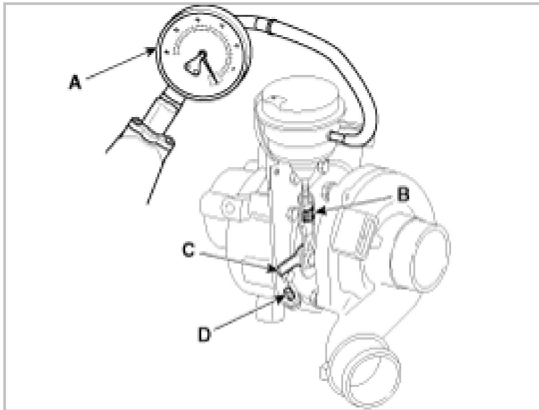
9. Installation is reverse order of removal.

Length of projecting part of thread pin (A): Recorded measuring value – [(0 ~ 0.02in. (0 ~ 0.5mm)]



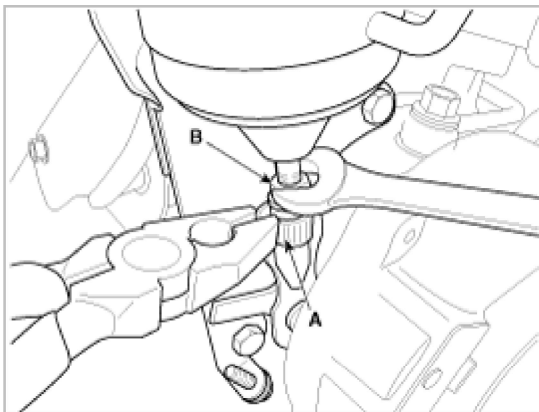
10. Using the vacuum gauge, set the turbocharger actuator stroke.
- (1) Connect a vacuum gauge.
 - (2) Lift the piston rod upward by turning the piston rod end adjusting nut.
 - (3) Set the vacuum pressure of the gauge (A) to be $60 \pm 1 \text{ kPa}$ ($0.6 \text{ kg} \pm 0.01 \text{ kg/cm}^2$, $17.4 \pm 0.3 \text{ inHg}$).

- (4) Adjust the piston rod end adjusting nut (B) until the piston rod lever (C) is contacted with the thread pin (D).



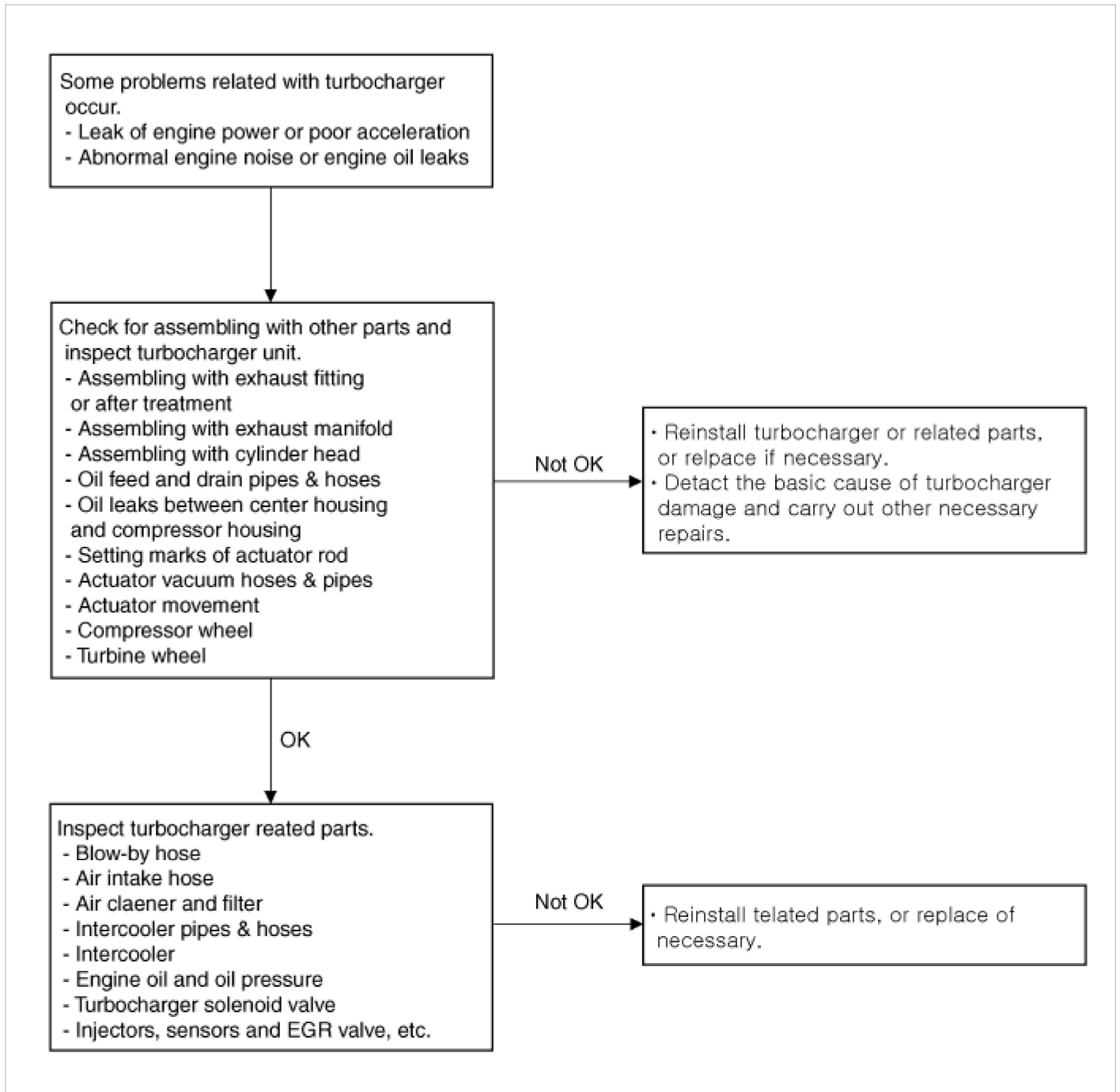
- (5) Release the vacuum, and then apply vacuum pressure up to $60 \pm 1 \text{ kPa}$ ($0.6 \text{ kg} \pm 0.01 \text{ kg/cm}^2$, $17.4 \pm 0.3 \text{ inHg}$). When the vacuum pressure reaches $60 \pm 1 \text{ kPa}$ ($0.6 \text{ kg} \pm 0.01 \text{ kg/cm}^2$, $17.4 \pm 0.3 \text{ inHg}$), check if the piston rod lever is contacted with the thread pin
- (6) If the piston rod lever is contacted with the thread pin at below or over $0.6 \pm 0.01 \text{ kg/cm}^2$ ($60 \pm 1 \text{ kPa}$), repeat the step 2) and 5).
- (7) After completing the stroke setting, hold the piston rod end (A) with pliers, and then fasten the piston rod lock nut (B) with an open spanner.

Tightening torque: 5.0 ~ 6.0Nm (0.5 ~ 0.6kgf.m, 3.7 ~ 4.4lbf-ft)



On-vehicle Inspection

Turbocharger Diagnostic Flow



If any problem related with turbocharger, such as lack of engine power, poor acceleration, abnormal engine noise or oil leaks, may occur, check the turbocharger according to the procedure as follows.

1. Check for assembling of the turbocharger and the exhaust fitting (or the after treatment).
 - A. Check if a gasket is installed.
 - A. Check if mounting bolts (or nuts) are tightened properly.
 - A. Check if there is a gas leak.
 - A. Check if there is any damage, such as crack, on the parts.

If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque

or replace the gasket or damaged parts with new ones if necessary.

2. Check for assembling of the turbocharger and the exhaust manifold.
 - A. Check if a gasket is installed.
 - B. Check if the mounting bolts (or nuts) are tightened properly.
 - C. Check if there is a gas leak.
 - D. Check if there is any damage, such as crack, on the parts.

If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.

3. Check for assembling of the exhaust manifold and the cylinder head.
 - A. Check if a gasket is installed.
 - B. Check if the mounting bolts (or nuts) are tightened properly.
 - C. Check if there is a gas leak.

If a gas leak occur as a gasket was not installed or mounting bolts (or nuts) were tightened inadequately, it may cause abnormal engine noise.

If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or install a new gasket if necessary.

4. Check the turbocharger oil feed pipe & hose and oil drain pipe & hose.
 - A. Check if a gasket is installed.
 - B. Check if the mounting bolts are tightened properly.
 - C. Check if the clamps are positioned in place.
 - D. Check if the oil pipes & hoses are damaged (bent, crushed, torn or cracked).

If a gas leak occur as a gasket was not installed or mounting bolts were tightened inadequately, it may cause oil leaks.

If the oil feed pipe & hose is damaged, engine oil is not supplied sufficiently to the turbocharger then it may damage the turbocharger. If the oil drain pipe & hose is damaged and clogged, engine oil is not drained smoothly then it may cause oil leaks from the turbocharger.

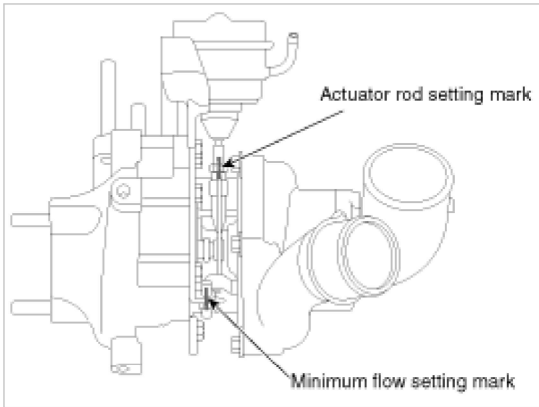
If the cause of the problem is detected, retighten the mounting bolts (or nuts) as the specified torque or replace the gasket or damaged parts with new ones if necessary.

5. Check for oil leaks between center housing and compressor housing.
 - A. Check if the mounting bolts are tightened properly.
 - B. Check if there is an oil leak.

If the O-ring (gasket) between the center housing and the compressor housing is damaged, it may cause oil leaks.

If an oil leak is detected, replace the turbocharger with a new one.

6. Check the setting marks of the turbocharger actuator rod.
 - A. Check if the actuator rod setting mark is aligned in line.
 - B. Check if the minimum flow setting mark is aligned in line.



If the setting marks are not aligned in line, the engine performance is changed by an arbitrary tune-up of the turbocharger after delivery.

If the setting marks are not aligned in line, replace the turbocharger with a new one.

7. Check the turbocharger actuator vacuum hoses & pipes.

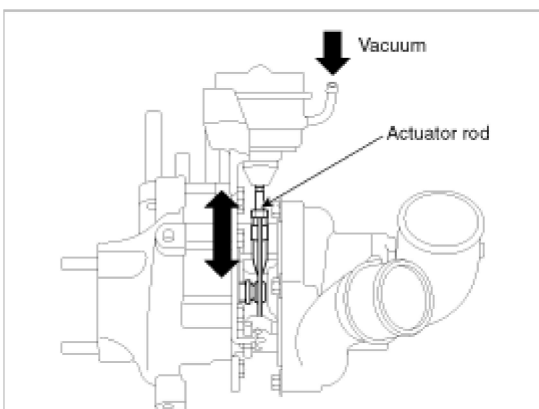
- A. Check if the vacuum hose is connected to the actuator properly.
- B. Check if the vacuum hoses & pipes are damaged (bent, detached or torn).
- C. Check if there is any damage, such as crack, on the vacuum pipes.
- D. Check if the vacuum hoses are connected to inlet or outlet of the solenoid valve correctly.

If the vacuum pipes & hoses are damaged or disconnected, the actuator does not work properly then it may cause lack of engine power and poor acceleration.

If the vacuum hoses & pipes are damaged, replace them with new ones.

8. Check the turbocharger actuator.

- A. Vacuum type actuator: Check for movement of the actuator rod when a vacuum of 60kPa (450mmHg, 8.7psi) is applied to the actuator or a forced actuator operating mode is performed by GDS. (Refer to DTC guide)



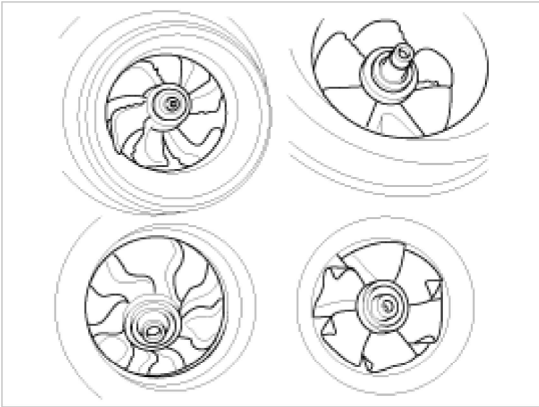
If the turbocharger actuator is damaged, it may cause lack of engine power and poor acceleration.

If the actuator rod does not move, replace the turbocharger with a new one.

9. Check the turbocharger compressor wheel.

- A. Check if the compressor wheel is damaged (bent or deformed).
- B. Check if the compressor wheel rotates smoothly.

EX)



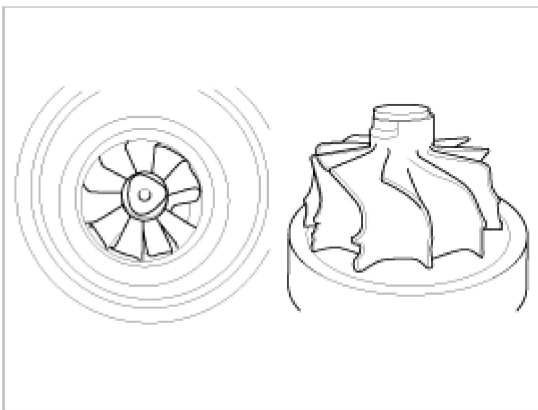
If the compressor wheel are damaged, it may cause abnormal noise from the turbocharger and poor acceleration.

If the compressor wheel are damaged or deformed, replace the turbocharger with new ones.

10. Check the turbocharger turbine wheel.

- A. Check if the turbine wheel is damaged.
- B. Check if the turbine wheel rotates smoothly.

EX)



If the turbine wheel are damaged, it may cause abnormal noise from the turbocharger and poor acceleration.

If the turbine wheel are damaged or deformed, replace the turbocharger with new ones.

If any problem is not detected in the turbocharger, check the turbocharger-related parts according to the procedure as follows.

1. Check the blow-by hose. (Refer to FL group)
 - A. Check if the breather hose is damaged (bent, clogged).
 - B. Check if the positive crankcase ventilation (PCV) valve is clogged.

If the breather hose is bent or clogged, the internal pressure in the engine increases then engine oil is not supplied smoothly to the turbocharger. So it may cause damage of the turbocharger and oil leaks.

If the cause of the problem is detected, replace the breather hose or the related parts with new ones.

2. Check the air intake hose connected to the turbocharger.

- A. Check if the air intake hose is damaged (bent, crushed, detached or torn).

If a cross-section of the hose diminishes as the air intake hose is bent or crushed, intake air to the turbocharger reduces and the pressure in front of turbocharger drops. So it may cause damage of

the turbocharger and oil leaks. If the air intake hose is detached or torn, a foreign substance goes into the turbocharger and causes damage of it.

If the air intake hose is damaged, replace it with a new one.

3. Check the air cleaner.

- A. Check the air cleaner filter for pollution state.
- B. Check the air cleaner filter for water influx.
- C. Check the air cleaner cover for dirtiness.
- D. Check if the air cleaner filter is a genuine part..

If the air cleaner filter is moistened or polluted excessively or a non-genuine part is used, intake air to the turbocharger reduces and the pressure in front of turbocharger drops. So it may cause damage of the turbocharger and oil leaks. .

If the air cleaner filter is moistened or polluted excessively, replace it with a new one.

Replace the air cleaner filter according to the maintenance schedule.

4. Check the intercooler hoses & pipes.

- A. Check if the intercooler hoses & pipes are connected properly.
- B. Check if the intercooler hoses & pipes are damaged (bent, detached or torn).
- C. Check if there is any damage, such as crack, on the intercooler pipes.
- D. Check if the clamps are positioned in place.

If the intercooler hoses & pipes are damaged or disconnected, oil leaks may occur from the hoses & pipes and the turbocharger may exceed the permissible speed then it may cause damage of the turbocharger.

If the intercooler hoses & pipes are damaged, replace them with new ones.

Use new clamps when replacing the hoses & pipes.

5. Check the intercooler.

- A. Check if the intercooler tubes and tanks are damaged (oil leak or crack).

If the intercooler is damaged, the turbocharger may exceed the permissible speed then it may cause damage of the turbocharger.

If the intercooler is damaged, replace them with a new one.

Use new clamps when replacing the intercooler.

6. Check the engine oil.

- A. Check the engine oil level.
- B. Check the engine oil for discoloration, water influx and viscosity degradation.
- C. Check the engine oil grade.

If the engine oil level is low, amount of engine oil fed to turbocharger reduces then the bearings in the turbocharger may adhere due to insufficient lubrication and cooling.

If the cause of the problem is detected, add or change engine oil.

Change the engine oil according to the maintenance schedule.

7. Check the engine oil pressure.

- A. Engine oil pressure: Check the oil pressure using an oil pressure gauge after removing the oil pressure switch on the cylinder block.
- B. Check the engine oil screen in the oil pan if the engine oil level is low. Then check the injectors for gas leaks if foreign substances are accumulated on the oil screen.

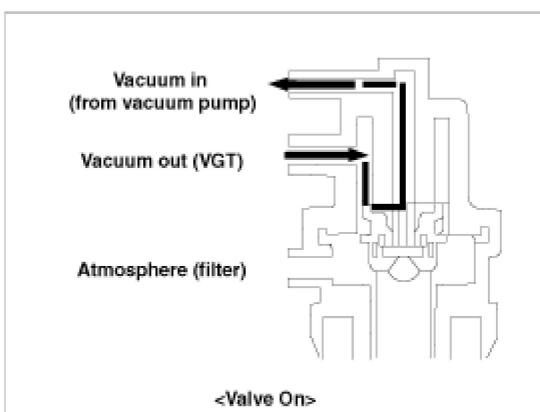
If the engine oil level is low, amount of engine oil fed to turbocharger reduces then the bearings in the turbocharger may adhere due to insufficient lubrication and cooling.

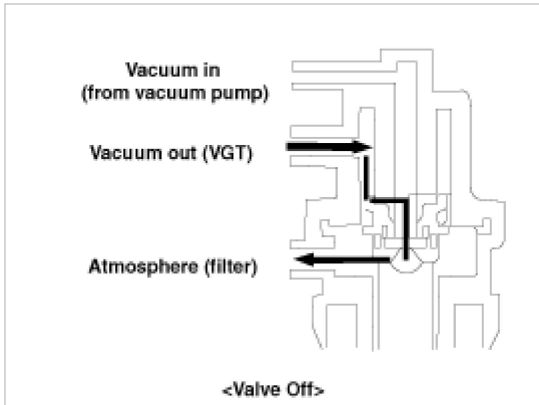
If the cause of the problem is detected, add or change engine oil. If foreign substances are accumulated on the oil screen, wash the oil screen and replace the injector's washer with a new one after checking the injectors for gas leaks. Check the engine oil-related parts, such as oil pump, if necessary.

As the turbocharger rotates at high speed of 100,000 rpm or above, deterioration of engine oil can cause damage of the turbocharger bearings. Check engine oil for discoloration, water influx, viscosity degradation and oil pressure lowering.

8. Check the solenoid valve of turbocharger. (Refer to DTC guide)

- A. Damage of the solenoid valve: Check if vacuum is generated at the disconnected vacuum hose from the actuator when a forced actuator operating mode is performed by GDS..
- B. Clog of the solenoid valve filter: Check if vacuum is released when a forced actuator operating mode is performed from max. duty (95%) to min. duty (5%) by GDS. (If the solenoid valve filter is clogged, the vacuum won't be released or it will take a long time to be released.)





If the solenoid valve is damaged, the actuator does not work properly then it may cause lack of engine power and poor acceleration. If the solenoid valve filter is clogged, vacuum is not released then it may cause damage of the turbocharger by overrunning.

If the solenoid valve is damaged, replace it with a new one.

9. Check the injectors, sensors, EGR valve, etc. (Refer to FL group)

- A. Check if the injectors operate properly.
- B. Check if the sensors, such as the mass air flow sensor (MAFS), intake air temperature sensor (IATS), boost pressure sensor (BPS), operate properly.
- C. Check if the exhaust gas recirculation (EGR) valve operates properly.

If the injectors, sensors, EGR valve and etc. don't work properly, it may cause lack of engine power.

If the cause of the problem is detected, replace the related parts with new ones.