INTAKE AND EXHAUST

CONTENTS

GENERAL

OUTLINE OF CHANGES

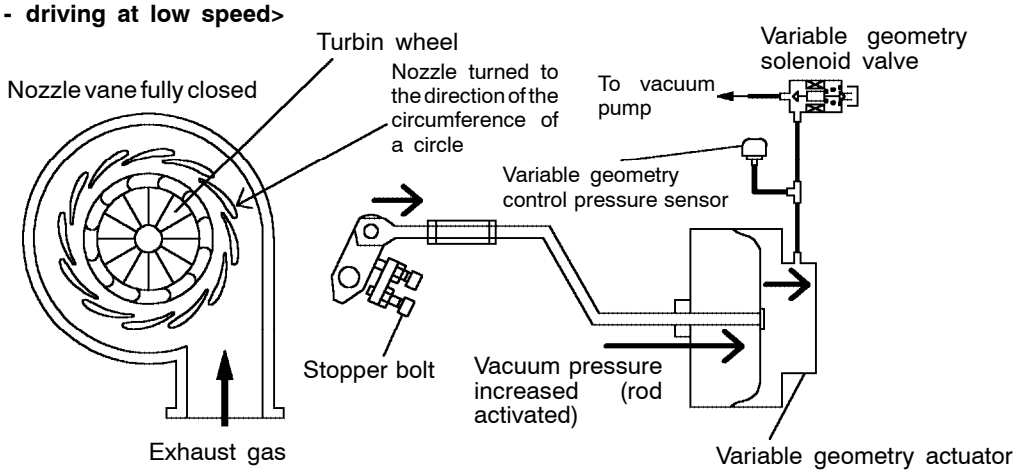
With the modification below by additional emission regulation step III compatible 4D5 engine, the service procedure of the part that is different from previous service procedure has been established.

- The turbocharger has been changed to a Variable Geometry (VG) type.
- A catalytic converter has been added.
- The variable geometry turbocharger can not be disassembled, and must be always replaced as an assembly.

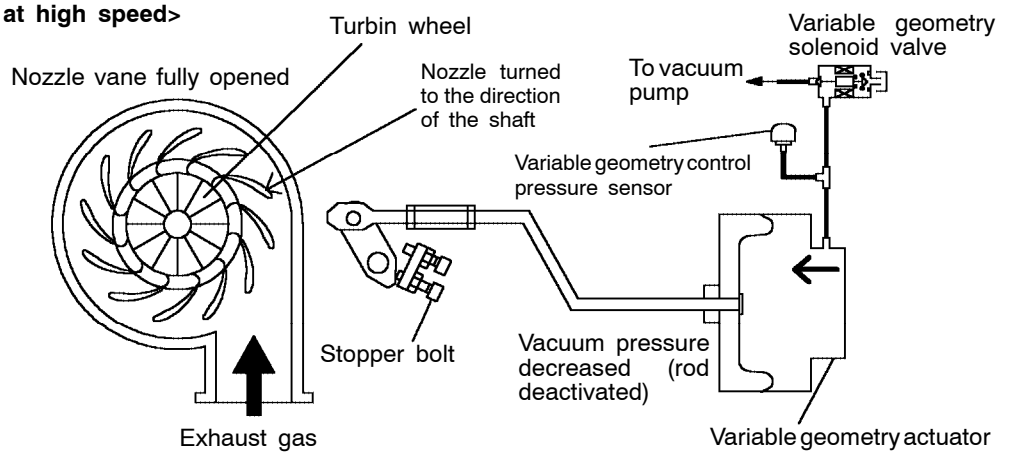
GENERAL INFORMATION <4D5-Step III>

The variable geometry solenoid valve is duty controlled to control the variable nozzle opening angle of the variable geometry turbocharger. This allows to obtain the characteristic of boost pressure corresponding to the engine operation status.

<At starting - driving at low speed>



<Driving at high speed>



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At starting and driving at low speed, the duty control value of the variable geometry solenoid valve is increased to apply the vacuum pressure of the vacuum pump to the variable geometry actuator. Applying the vacuum pressure to the variable geometry actuator pulls the actuator rod so that it can move towards the direction of closing the variable nozzle of the variable geometry turbocharger. As closing the nozzle reduces the exhaust gas mass, the speed of exhaust gas flow will be increased and efficiency will be improved. Since the characteristic of boost pressure becomes a low speed type, boost pressure will suddenly rise from low speed.
At driving at high speed, the duty control value of the variable geometry solenoid valve is decreased to reduce the vacuum pressure from the vacuum pump so that the actuator rod can return to the deactivated status and move towards the direction of opening the nozzle of the variable geometry turbocharger.
Opening the nozzle allows the characteristic of boost pressure to become a high speed type so that the appropriate boost pressure can be maintained.
Therefore, boost pressure can be controlled by appropriate duty control of the variable geometry solenoid valve. The engine-ECU calculates the correct boost pressure based on the engine speed and fuel injection amount. Furthermore, the duty control of the variable geometry solenoid valve is given feedback of the signals from the variable geometry control pressure sensor and the boost pressure sensor so that the variable nozzle opening angle of the variable geometry turbocharger can be quickly adjusted to obtain the desired boost pressure.

SERVICE SPECIFICATIONS <4D5-Step III>

Items	Standard value
Variable geometry actuator activation vacuum (Approximately 1 mm stroke) kPa	Approximately 10.5 - 12.5
Variable geometry solenoid valve coil resistance (at 20°C) Ω	29 - 35

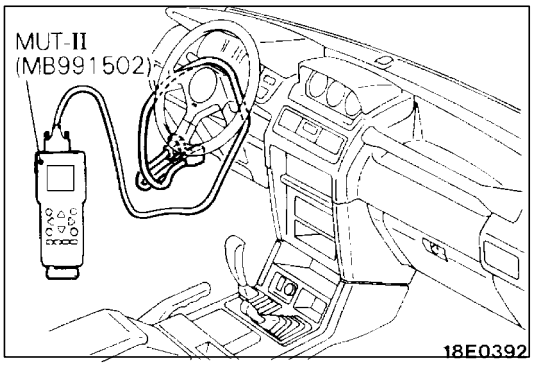
SEALANT <4D5-Step III>

Item	Specified sealant	Remarks
Thread of the intake manifold mounting bolts	3M Stud Locking No.4170 or equivalent	Anaerobic sealant

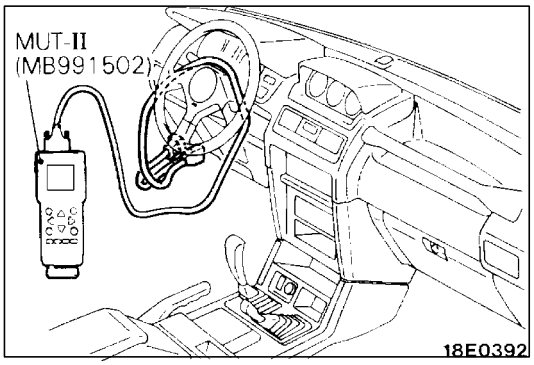
ON-VEHICLE SERVICE

TURBOCHARGER SUPERCHARGING CHECK

Caution
Conduct the driving test in a location where driving at full acceleration can be done with safety. Two person should be in the vehicle when the test is conducted; the person in the passenger seat should read the indications shown by the MUT-II.



1. Set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position, and connect the diagnosis connector to the MUT-II.
3. Use the data list function named "Item No. 04" boost pressure sensor of the MUT-II to check the supercharging pressure when the engine speed increases to approximately 3,000 r/min or more by driving at full acceleration in 2nd.
4. When the indicated supercharger does not become positive pressure, check the following items.
   - Malfunction of the boost pressure sensor
   - Leakage of supercharging pressure
   - Malfunction of the turbocharger
5. When the indicated supercharger is 133 kPa or more, supercharging control may be faulty, therefore check the followings.
   - Malfunction of the variable geometry actuator
   - Malfunction of the variable nozzle
   - Malfunction of the variable geometry solenoid valve
   - Malfunction of the boost pressure sensor
   - Malfunction of the variable geometry control pressure sensor



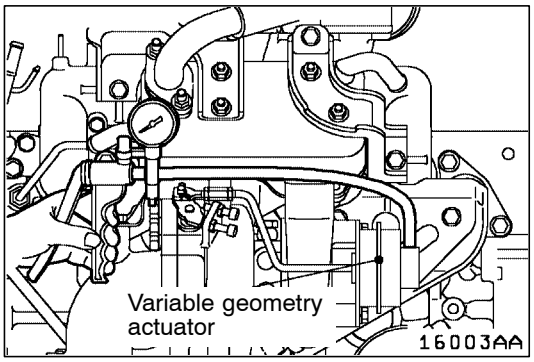
SUPERCHARGING PRESSURE CONTROL SYSTEM CHECK

1. Set the vehicle to the pre-inspection condition.
2. Turn the ignition switch to "LOCK" (OFF) position, and connect the diagnosis connector to the MUT-II.
3. Start the engine, and let it run at idle.
4. Select the actuator testing function named "Item No. 35 or No. 36" of the MUT-II to check that the variable geometry actuator vacuum and the supercharging pressure increase when the variable geometry solenoid valve is activated.

Variable geometry solenoid valve condition	Variable geometry actuator vacuum	Supercharging pressure
OFF	0 kPa	Approximately -1 kPa
ON	Approximately 80 kPa	Approximately 3 kPa

NOTE
(1) If the variable geometry actuator vacuum is not in a normal condition, the variable geometry actuator, variable geometry solenoid valve, variable geometry control pressure sensor, vacuum pump or hose may be faulty.
(2) If the variable geometry actuator vacuum is in a normal condition but the supercharging pressure is not in a normal condition, the variable geometry turbocharger nozzle, boost pressure sensor, or hose may be faulty.

Caution
Be careful not to forcibly activate the variable geometry solenoid valve to the fullest degree when running at a high speed. Too much supercharging pressure could damage the engine or the turbocharger.



VARIABLE GEOMETRY ACTUATOR CHECK

1. Connect the hand vacuum pump to nipple.
2. While gradually applying vacuum, check the vacuum that begins to active (approximately 1 mm stroke) the variable geometry actuator rod.

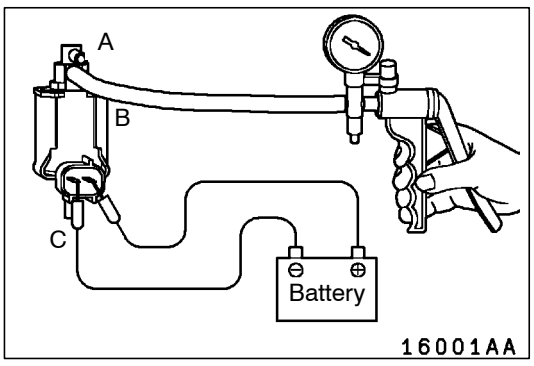
Standard value: Approximately 10.5 - 12.5 kPa

Caution
In order to avoid damage to the diaphragm, do not apply a vacuum of 59 kPa or higher.

3. If there is a significant deviation from the standard value, check the actuator or the variable nozzle: replace if necessary.

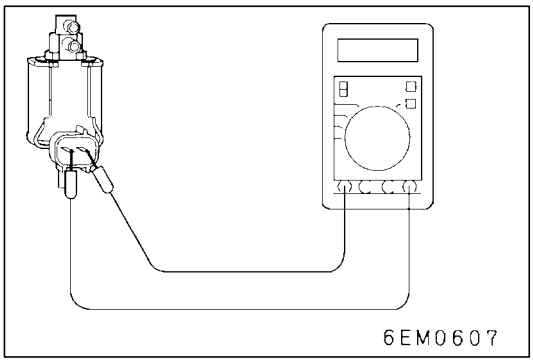
VARIABLE GEOMETRY SOLENOID VALVE CHECK

NOTE
When disconnecting the vacuum hose, always make a mark so that it can be reconnected at original position.



1. Disconnect the vacuum hose (black, red stripe) from the solenoid valve.
2. Disconnect the harness connector.
3. Connect a hand vacuum pump to the nipple to which the red striped vacuum hose was connected.
4. Check airtightness by applying a vacuum with voltage applied directly from the battery to the variable geometry solenoid valve and without applying voltage.

Battery voltage	Nipple condition	Normal condition
Applied	Both nipples are opened.	Vacuum leaks.
	Nipple A is closed.	Vacuum is maintained.
Not applied	Both nipples are opened.	Vacuum leaks.
	Nipple C is closed.	Vacuum is maintained.



5. Measure the resistance between the terminals of the solenoid valve.

Standard value: 29 - 35 Ω (at 20°C)

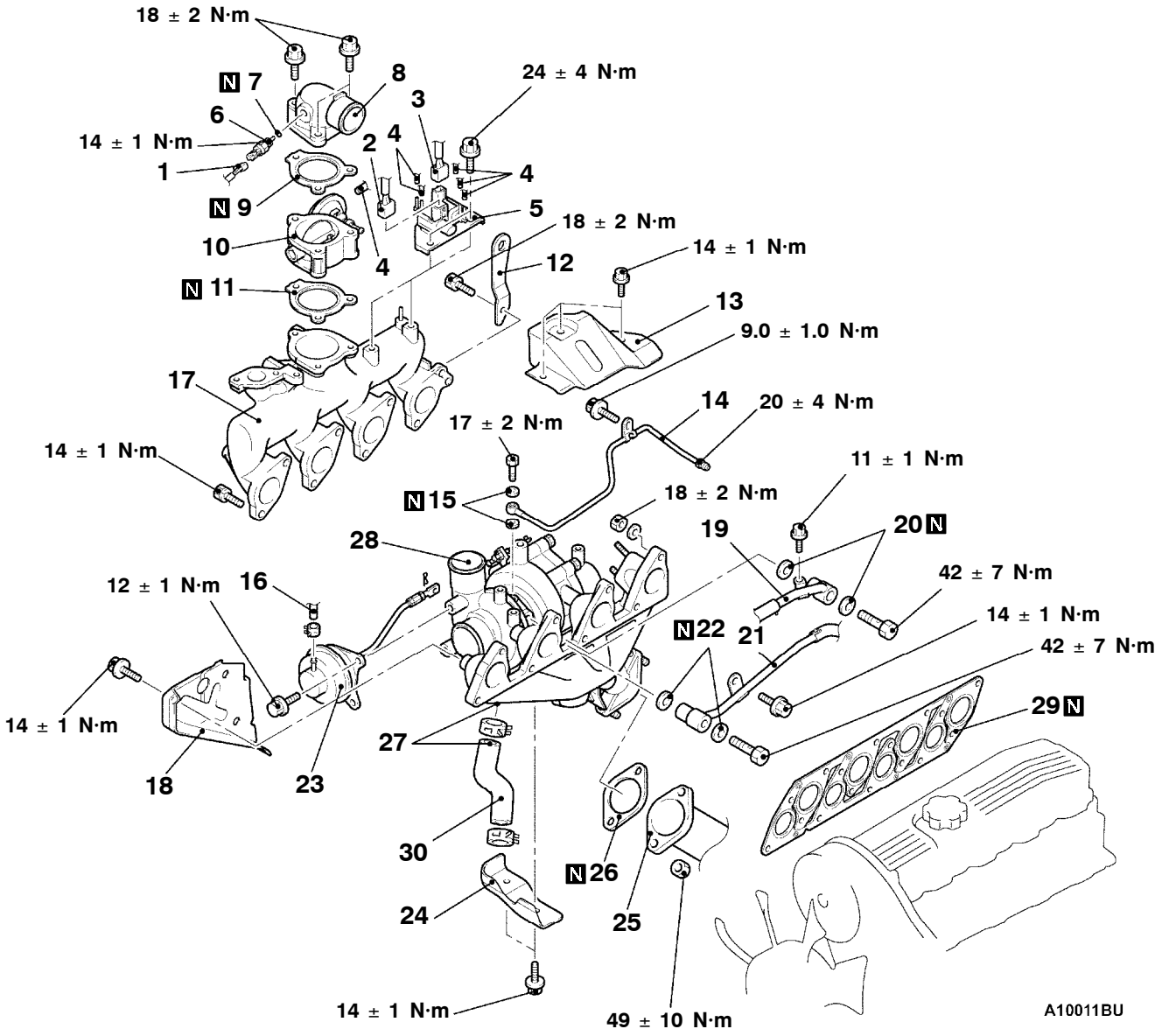
INTERCOOLER <4D5-Step III>

The air temperature switch has been replaced with an air temperature sensor as an electronic-controlled injection pump has been introduced. The intercooler service procedure is the same as before except the air temperature sensor and reshaped hose B.
On new models, the engine-ECU controls the intercooler fan. Due to this change, the intercooler fan-ECU has been discontinued.

INTAKE AND EXHAUST MANIFOLD, THROTTLE BODY AND TURBOCHARGER <4D5-Step III>

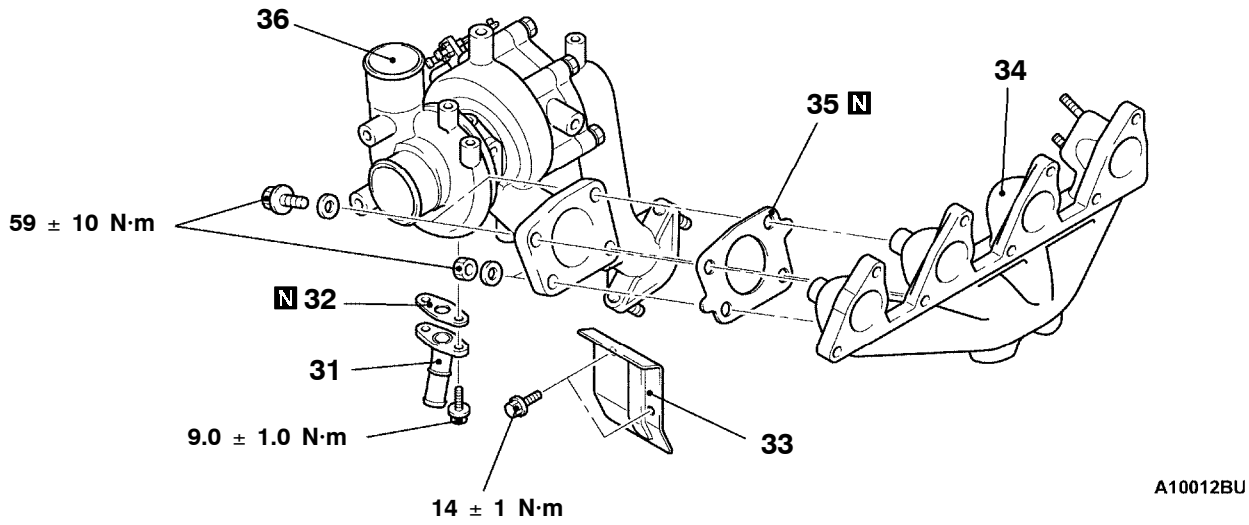
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operations
- Engine Coolant Draining and Refilling.
- Skid Plate and Under Cover Removal and Installation.
- Battery, Battery Tray Removal and Installation.
- Air Cleaner Assembly Removal and Installation.
- Intercooler Removal and Installation (Refer to P.15-2.)
- EGR valve and EGR cooler Removal and Installation (Refer to GROUP 17.)

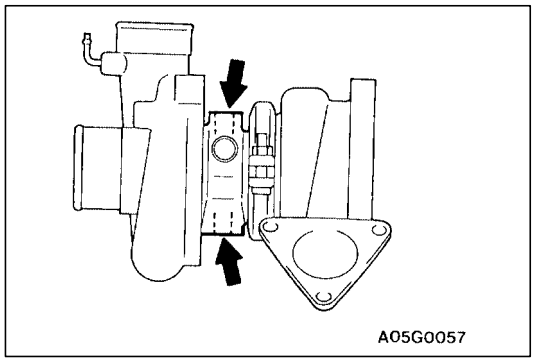


Removal steps

1. Air temperature sensor connector
2. Throttle solenoid valve connector
3. VGT solenoid valve connector
4. Vacuum hose connection
5. Solenoid valve assembly
6. Air temperature sensor
7. Gasket
8. Air intake fitting
9. Gasket
10. Throttle body assembly
11. Gasket
12. Engine hanger
13. Turbocharger upper heat protector
14. Oil pipe assembly
15. Gasket
16. Vacuum hose connection
17. Intake manifold
18. Exhaust manifold heat protector
19. Water pipe A and water hose assembly
20. Gasket
21. Water pipe B connection
22. Gasket
23. VG actuator
24. Turbocharger lower heat protector
25. Front exhaust pipe connection
26. Gasket
27. Oil return hose connection
28. Exhaust manifold and turbocharger assembly
29. Intake and exhaust manifold gasket
30. Oil return hose



31 Oil return pipe
32. Oil return pipe gasket
33. Exhaust fitting heat protector
34. Exhaust manifold
35. Turbocharger gasket
▶A◀ 36. Turbocharger assembly



INSTALLATION SERVICE POINT

▶A◀ TURBOCHARGER ASSEMBLY INSTALLATION

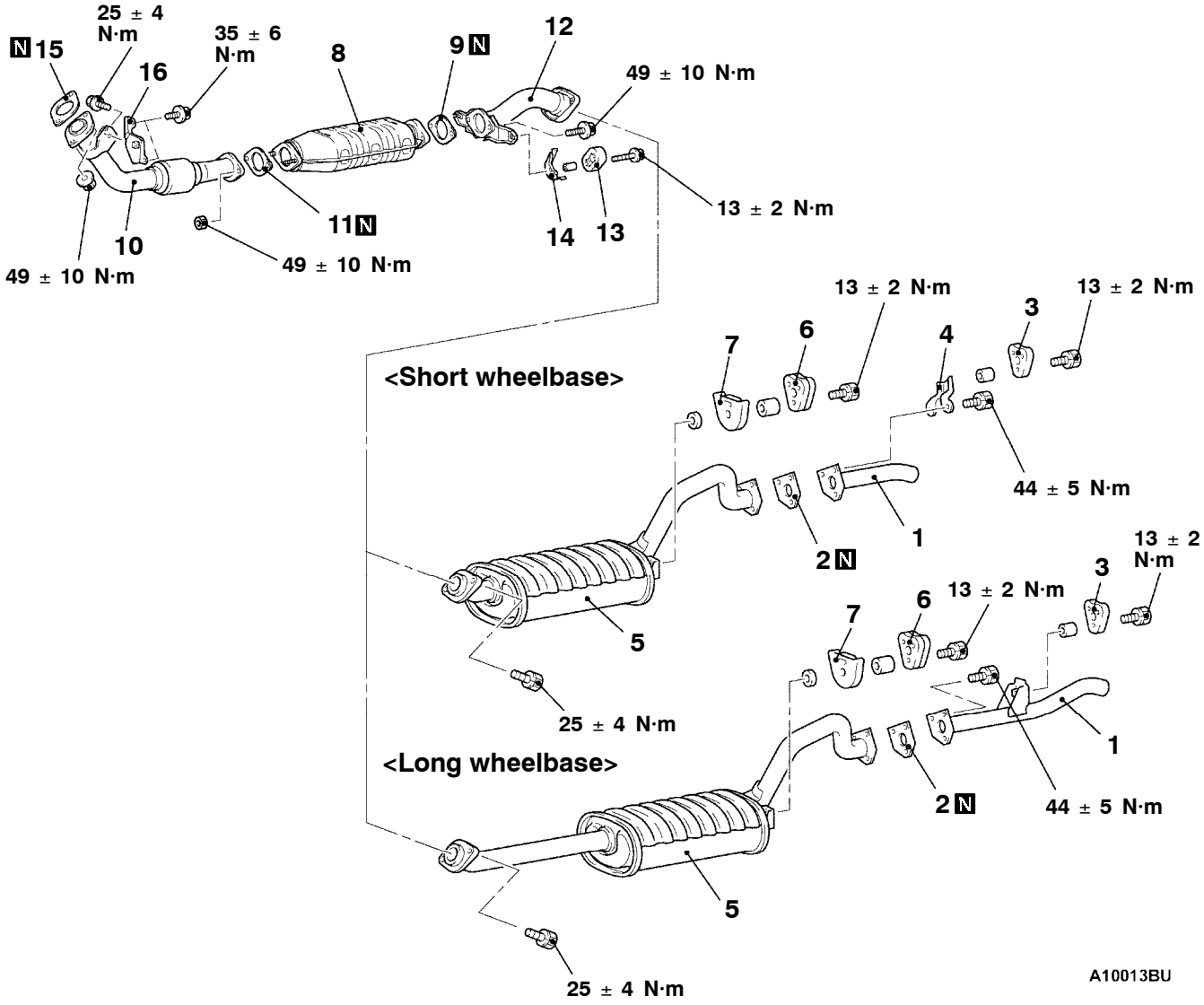
1. Clean the alignment surfaces shown in the illustration.
2. Supply clean engine oil from the oil pipe mounting hole of the turbocharger assembly.

Caution
When cleaning, take care that no foreign material gets into the engine coolant or oil passages hole.

EXHAUST PIPE AND MAIN MUFFLER <4D5-Step III>

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
Front Under Cover Removal and Installation



Exhaust main muffler removal steps

1. Tail pipe
2. Gasket
3. Hanger
4. Hanger bracket <Short wheelbase>
5. Exhaust main muffler
6. Hanger
7. Heat protector

Center exhaust pipe and catalytic converter removal steps

8. Catalytic converter
9. Gasket
11. Gasket
12. Center exhaust pipe
13. Hanger
14. Heat protector

Front exhaust pipe removal steps

10. Front exhaust pipe
11. Gasket
15. Gasket
16. Exhaust support bracket