INTAKE AND EXHAUST

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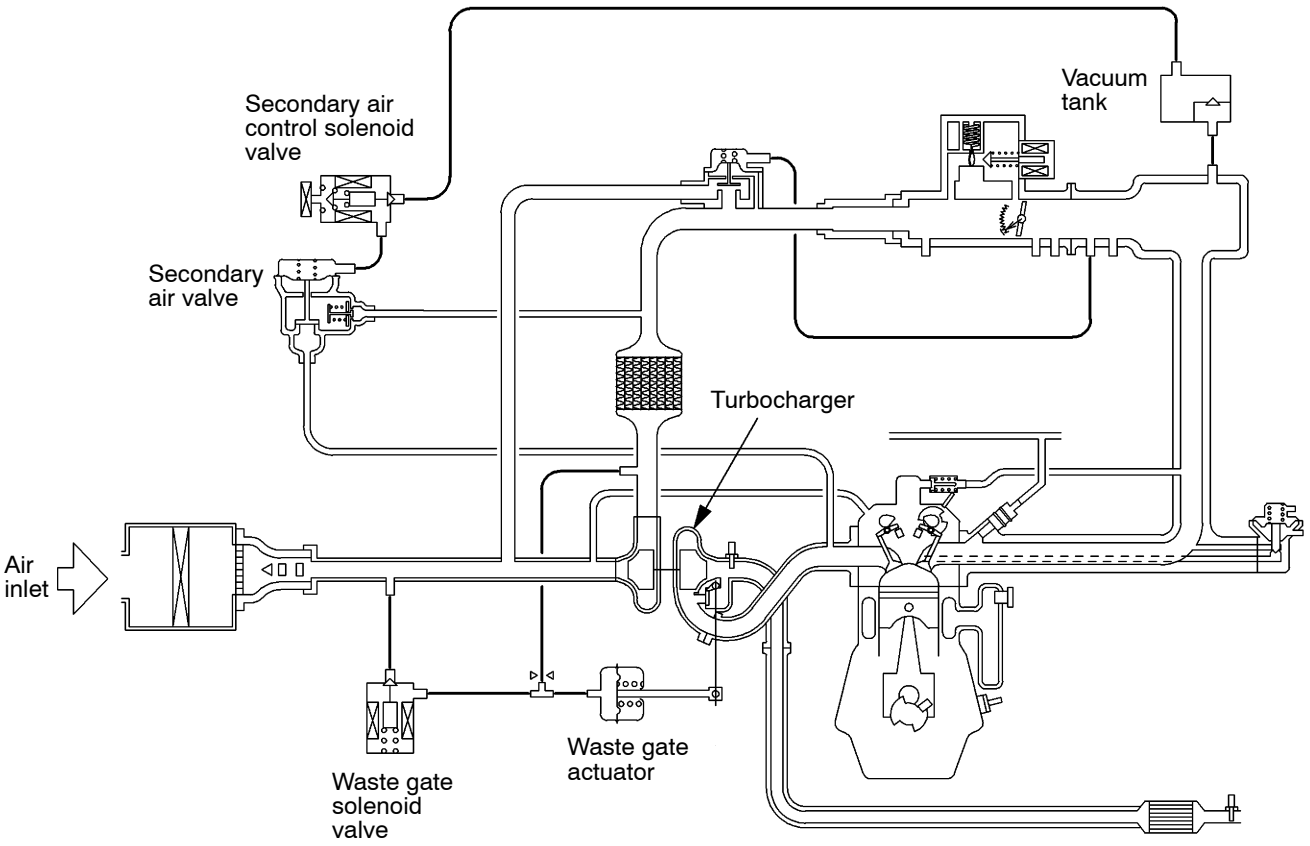
GENERAL INFORMATION

SUPERCHARGING PRESSURE CONTROL

By controlling the duty of the waste gate solenoid valve, the waste gate actuator functions to control the supercharging pressure. This allows a supercharged pressure matching the engine operation state to be attained. Control is carried out to prevent excessive supercharging and thereby prevent engine damage.

SECONDARY AIR CONTROL

When decelerating during high-speed travel, the secondary air is introduced into the upstream of the turbocharger to prevent the turbine speed from dropping and to increase the acceleration responsiveness after deceleration. The secondary air is introduced into each cylinder of the exhaust manifold to maximize the effect.



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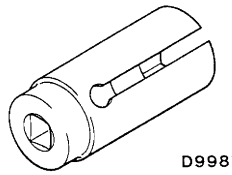
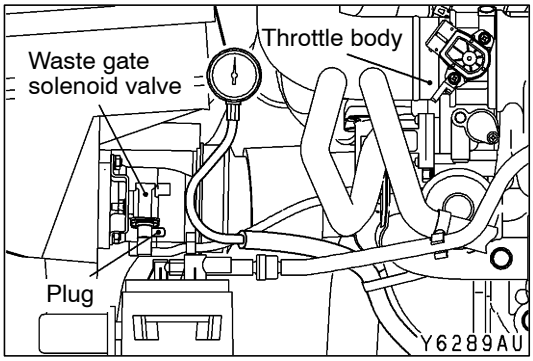
SERVICE SPECIFICATIONS

Item	Standard value	Limit
Turbocharger supercharging pressure (waste gate solenoid valve not operating) kPa	59 - 84	-
Initial activation pressure of waste gate actuator (at the stroke of approximately 1 mm) kPa	Approximately 100	-
Waste gate solenoid valve coil resistance (at 20°C) Ω	29 - 35	-
Initial activation pressure of air bypass valve kPa	Approximately 53	-
Secondary air control solenoid valve coil resistance (at 20°C) Ω	29 - 35	-
Manifold distortion of the installation surface mm	0.15 or less	0.20

SPECIAL TOOL

Tool	Number	Name	Use
	MD998770	Oxygen sensor wrench	Removal and installation of oxygen sensor



ON-VEHICLE SERVICE

TURBOCHARGER SUPERCHARGING PRESSURE CHECK

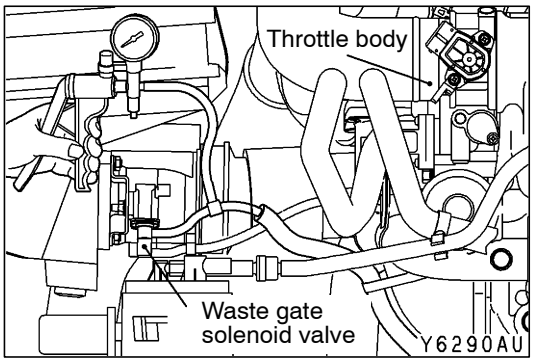
Caution
Two persons should be in the vehicle when the test is conducted; the person in the passenger seat should read the indications shown by the pressure meter.

1. Disconnect the hose (black) from the turbocharger waste gate solenoid valve, and connect the pressure gauge to the hose. Plug the nipple of the solenoid valve from which the hose (black) has been disconnected.
2. Drive at full-throttle acceleration in second gear and then measure the supercharging pressure when the engine speed in about 3,000 r/min.

   Standard value: 59 – 84 kPa

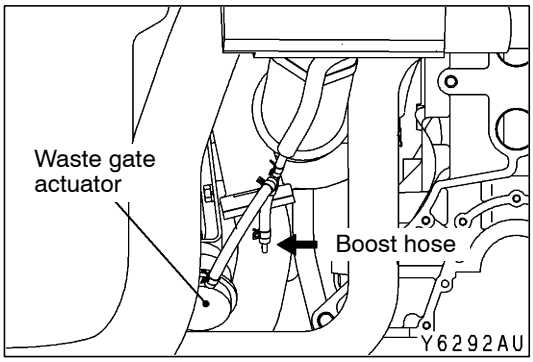
3. If the supercharging pressure deviates from the standard value, check the following items for possible cause.
   - Malfunction of the waste gate actuator
   - Leakage of supercharging pressure
   - Malfunction of the turbocharger

4. When the indicated supercharging is more than standard value, supercharging control may be faulty, therefore check the followings.
   - Malfunction of the waste gate actuator
   - Malfunction of waste gate valve
   - Disconnection or cracks of the waste gate actuator rubber hose



SUPERCHARGING PRESSURE CONTROL SYSTEM CHECK

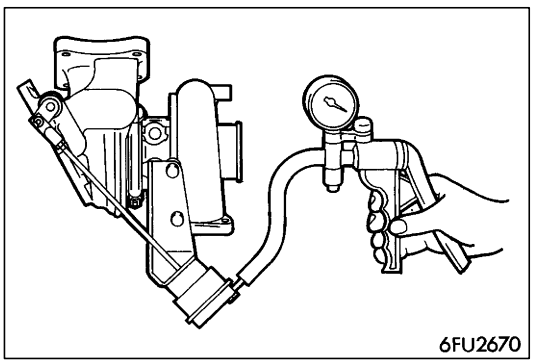
1. Disconnect the hose (black) from the turbocharger waste gate solenoid valve and connect a three-way joint between the hose and the solenoid valve.
2. Connect a hand vacuum pump to the three-way joint.



3. Disconnect the hose from the turbocharger waste gate actuator control boost nipple and plug the nipple.
4. Applying a negative pressure with the hand vacuum pump, check tightness both when the hose end is closed and when it is open.

Engine state	Hose end	Normal state
Stop (Ignition switch: "ON" position)	Opened	Negative pressure leaks.
	Closed	Negative pressure is maintained.
Idling (after warm-up)		Negative pressure leaks.

NOTE
If this check indicates an abnormal condition, the turbocharger waste gate actuator, turbocharger waste gate solenoid or hose is broken.



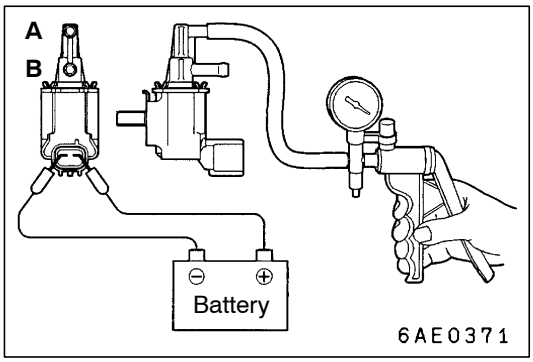
WASTE GATE ACTUATOR CHECK

1. Connect a manual pump (pressure-application type) to nipple.
2. While gradually applying pressure, check the pressure that begins to activate (approximately 1 mm stroke) the waste gate actuator rod.

   Standard value: Approximately 100 kPa

   Caution
   In order to avoid damage to the diaphragm, do not apply a pressure of 117 kPa or higher.

3. If there is a significant deviation from the standard value, check the actuator or the waste gate valve: replace actuator or turbocharger assembly if necessary.

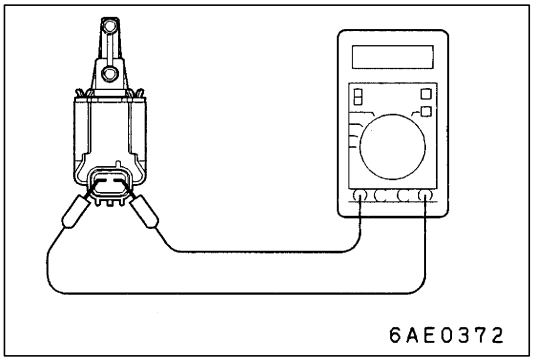


WASTE GATE SOLENOID VALVE CHECK

OPERATION CHECK

1. Connect a hand vacuum pump to the solenoid valve nipple A.
2. Using a jumper wire, connect between the solenoid valve terminal and battery terminal.
3. Connecting and disconnecting the jumper wire at the battery negative terminal to apply a negative pressure, check tightness.

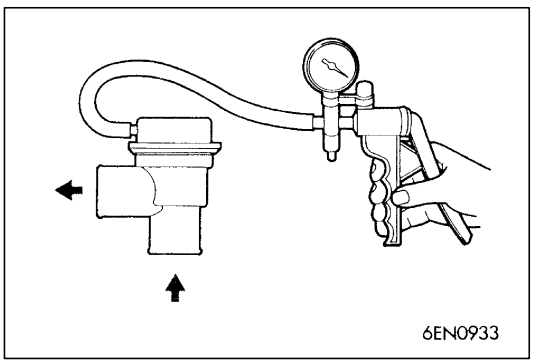
Jumper wire	B nipple condition	Normal condition
Connected	Opened	Negative pressure leaks.
	Closed	Negative pressure is held.
Disconnected	Opened	Negative pressure is held.



COIL RESISTANCE CHECK

Measure the resistance between solenoid valve terminals.

Standard value: 29 – 35 Ω (at 20°C)



AIR BYPASS VALVE CHECK

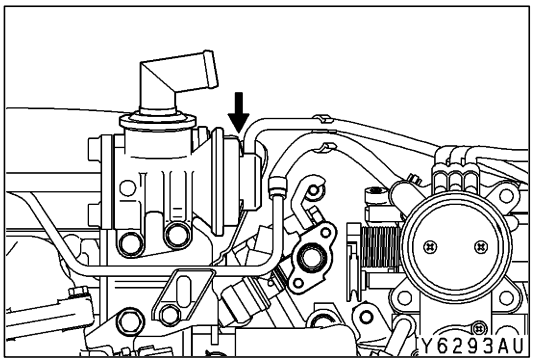
1. Remove the air bypass valve.
2. Connect the hand vacuum pump to the nipple of the air bypass valve.
3. Apply a negative pressure of approximately 49 kPa, and check that air tightness is maintained.
4. Also check operation of the valve.

Standard value:

Negative pressure	Valve operation
Approximately 53 kPa	It starts opening

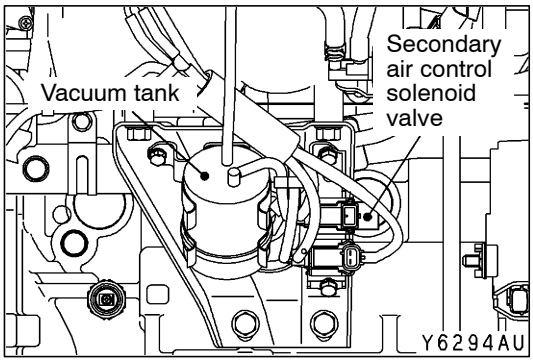
INTAKE MANIFOLD PRESSURE CHECK

Refer to GROUP 11A – On-vehicle Service.



SECONDARY AIR CONTROL SYSTEM CHECK

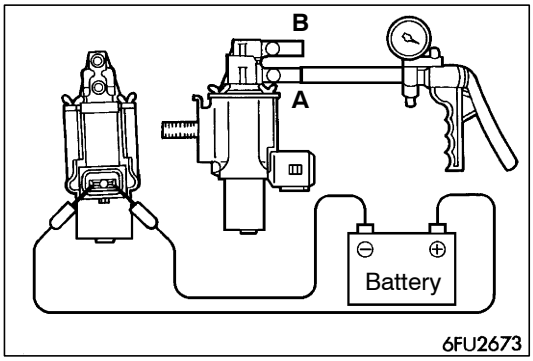
1. Start the engine and carry out idling.
2. Confirm that the secondary air valve lifts up when the engine-ECU connector No. 53 terminal is short-circuited with the earth using a jumper wire.
   The engine-ECU connector must be connected at this time.



SECONDARY AIR CONTROL SOLENOID VALVE CHECK

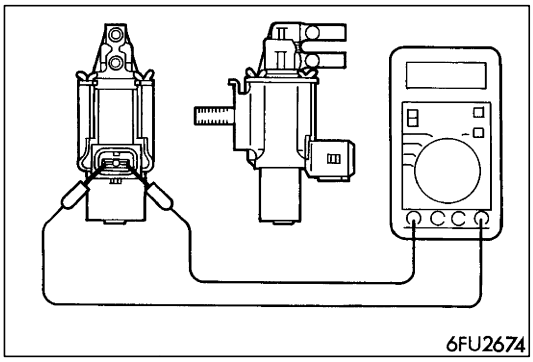
OPERATION CHECK

1. Disconnect the vacuum hose (white-striped, yellow-striped) from the solenoid valve.
2. Separate the harness connector.



3. Connect the hand vacuum pump to the solenoid valve's A nipple.
4. Connect the solenoid valve terminal and battery terminal with a jumper wire.
5. Disconnect the jumper wire between the battery's (-) terminals, apply a negative pressure, and inspect the tightness.

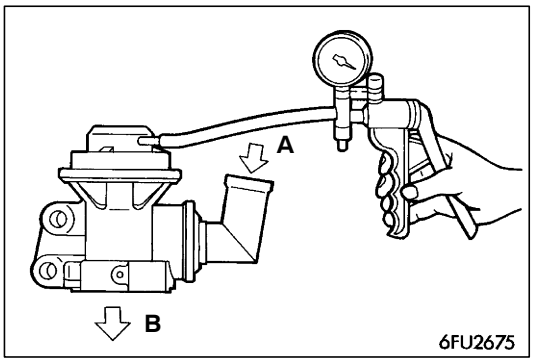
Jumper wire	State of B nipple	Normal state
Connected	Opened	Negative pressure leaks.
	Closed	Negative pressure is maintained.
Disconnected	Closed	Negative pressure leaks.



COIL RESISTANCE CHECK

Measure the resistance between the solenoid valve terminals.

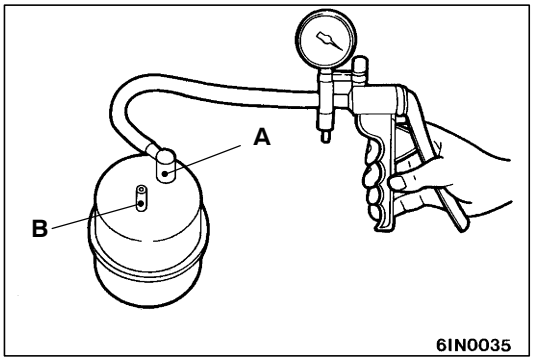
Standard value: 29 – 35 Ω (at 20°C)



SECONDARY AIR VALVE CHECK

1. Disconnect the secondary air valve.
2. Connect the hand vacuum pump to the secondary air valve's nipple.
3. Apply a negative pressure of 67 kPa, and confirm that the negative pressure is maintained.
4. Blow in air from the (A) side and (B) side of the secondary air valve, and inspect the ventilation.

Negative pressure	Air blow-in direction	Air ventilation
0 kPa (State without negative pressure)	(A) → (B)	Not ventilated
40 kPa or more	(A) → (B)	Ventilated
	(B) → (A)	Not ventilated



VACUUM TANK CHECK

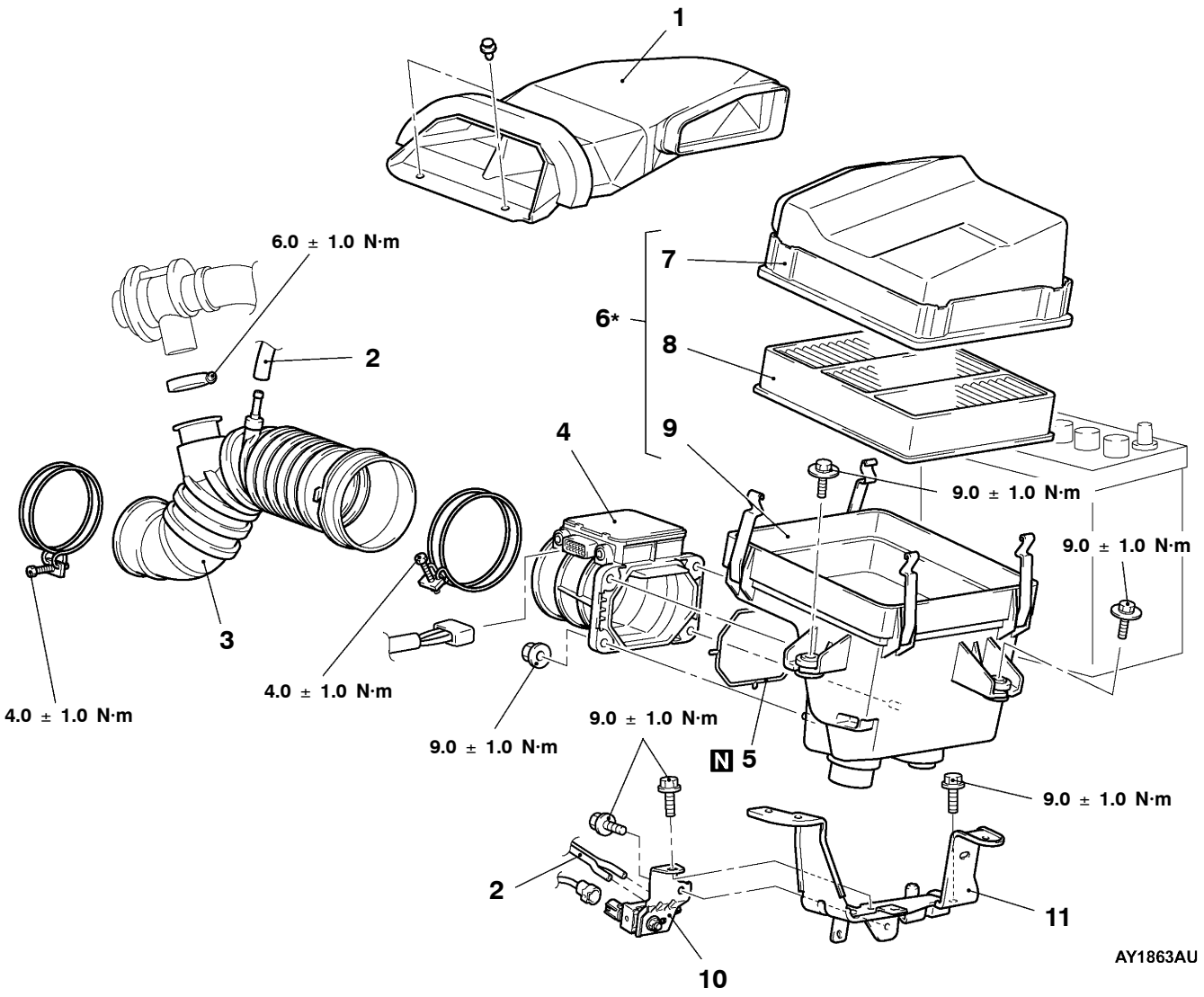
1. Connect the hand vacuum pump to the vacuum tank's A nipple. Apply a negative pressure of 67 kPa, and confirm that the negative pressure is maintained.
2. Connect the hand vacuum pump to the vacuum tank's B nipple.
3. Plug the A nipple with a finger, and apply a negative pressure of 67 kPa. Confirm that the negative pressure leaks immediately when the finger is released.

AIR CLEANER

REMOVAL AND INSTALLATION

Caution
Parts marked by * are made of recycled-paper mixed plastic material, so observe the following precautions.
1. Avoid any shock or load to these parts when removing and installing them.
2. Engage the case hinges securely when assembling these parts.

NOTE
Parts marked by * are made of recycled-paper mixed plastic material, so can be disposed of by incineration.



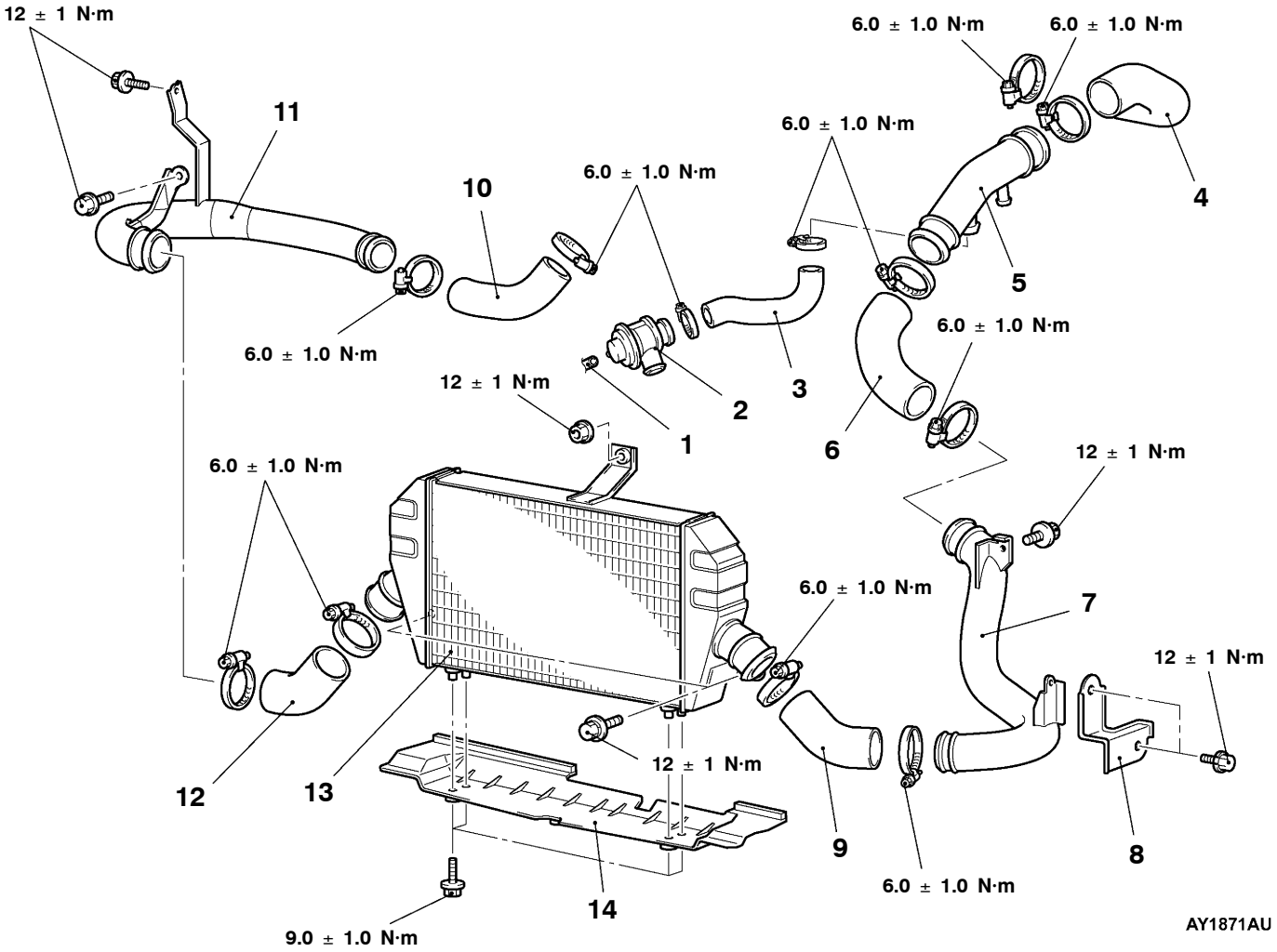
Removal steps

- Battery
1. Air duct
2. Vacuum hose
- Air pipe E, Air by-pass valve assembly, Air by-pass hose (Refer to P.15-9.)
3. Air intake hose
4. Air flow sensor assembly
5. Gasket
6. Air cleaner assembly
7. Air cleaner cover
8. Air cleaner element
9. Air cleaner body
10. Waste gate solenoid valve
11. Air cleaner bracket

INTERCOOLER

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Air Cleaner Removal and Installation (Refer to P.15-8.)
- Water Spray Hose Connection removal and Installation (Refer to P.15-10.)
- Front Bumper Removal and Installation (Refer to GROUP 51.)



Removal steps

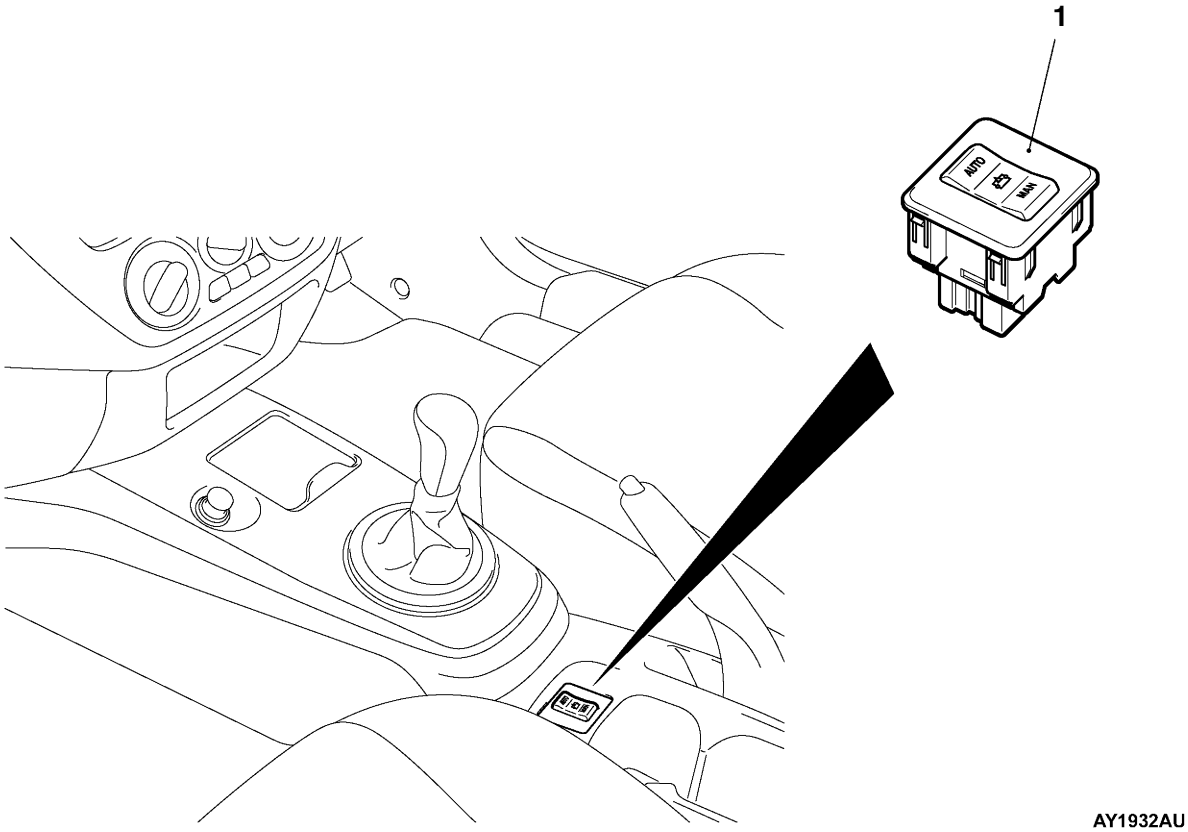
1. Vacuum hose
2. Air by-pass valve assembly
3. Air by-pass hose
4. Air hose E
5. Air pipe C
6. Air hose D
7. Air pipe B
8. Bracket
9. Air hose C
10. Air hose A
11. Air pipe A
12. Air hose B
13. Intercooler assembly
14. Air guide

INTERCOOLER WATER SPRAY

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Front Bumper Removal and Installation (Refer to GROUP 51.)

REMOVAL AND INSTALLATION

<WATER SPRAY SWITCH>



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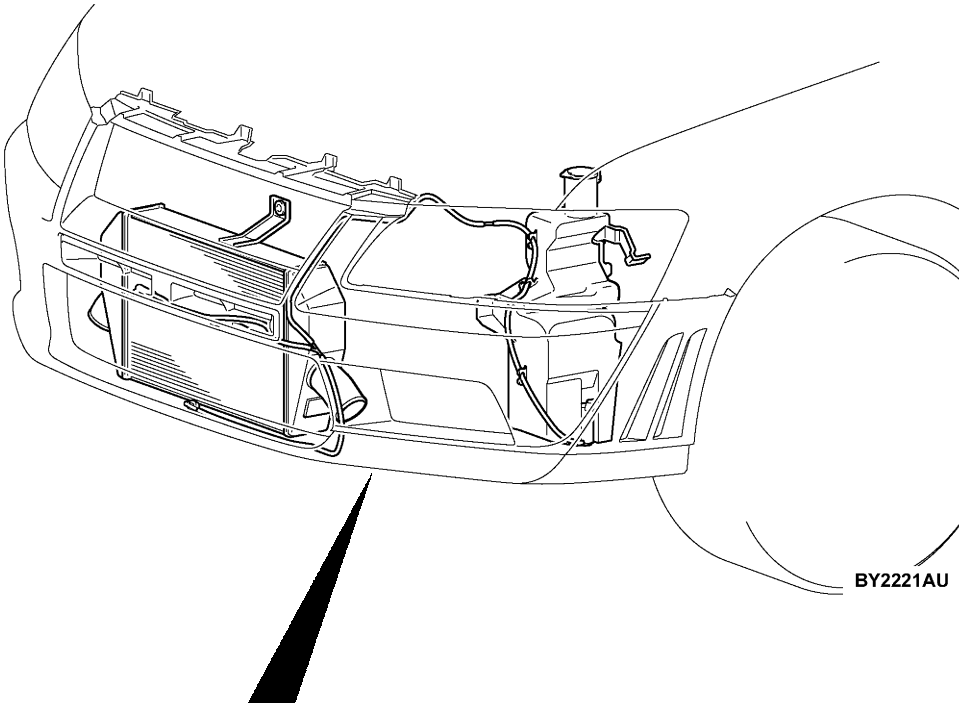
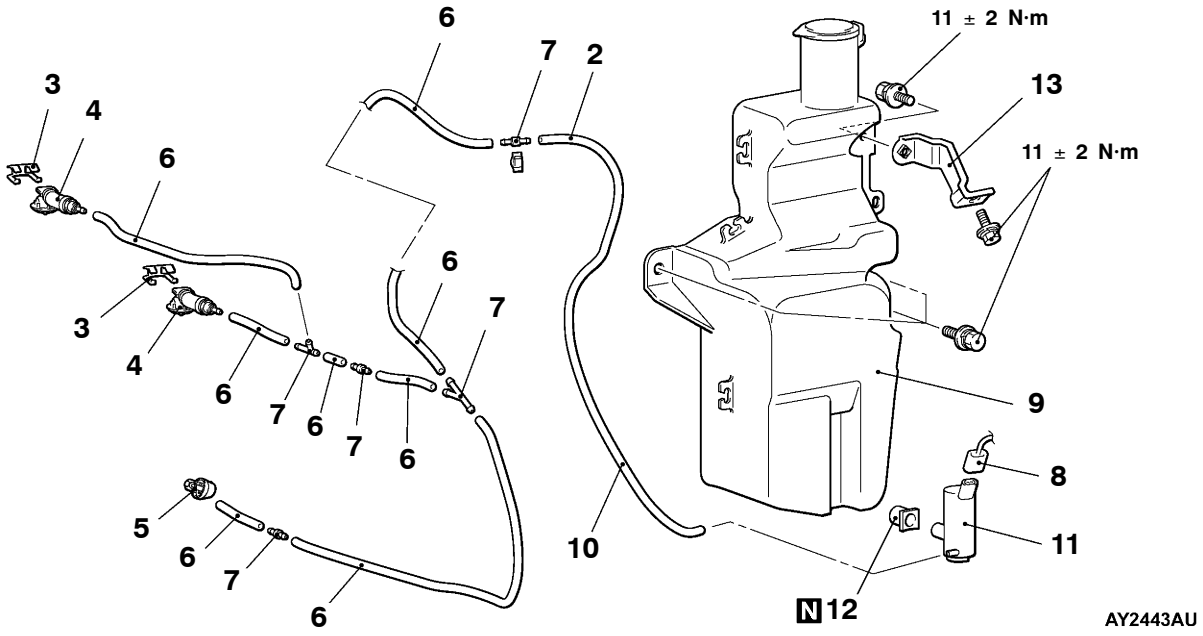
Water spray switch removal steps

1. Water spray switch
- Harness connector connection

<WATER SPRAY NOZZLE/WATER SPRAY HOSE/WASHER TANK>





Water spray nozzle/Water spray hose removal steps

- 2. Water spray hose connection
- ▶A◀ ● Tape
- 3. Clamp
- 4. Water spray nozzle (Upper)
- 5. Water spray nozzle (Lower)
- ▶A◀ 6. Water spray hose
- 7. Hose Joint

Washer tank removal steps

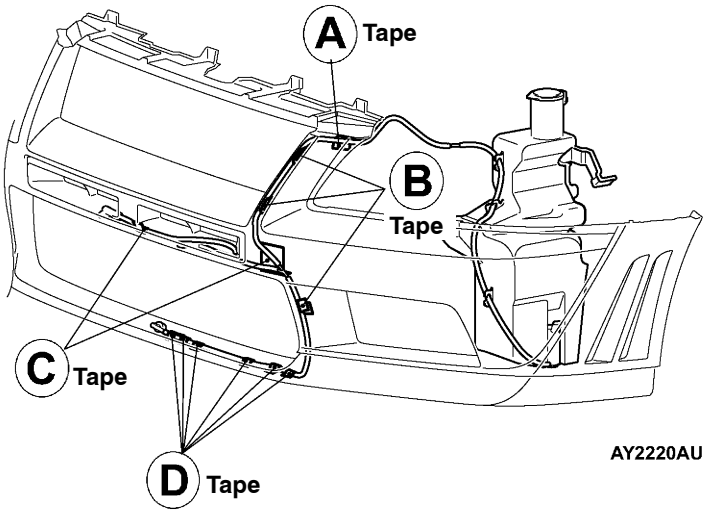
- 2. Water spray hose connection
- 8. Water spray motor harness connector connection
- 9. Washer tank
- 10. Water spray hose
- 11. Water spray motor
- 12. Packing
- 13. Washer tank bracket

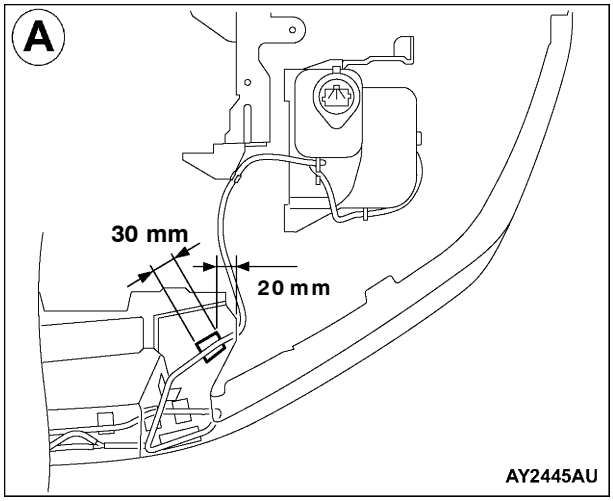
INSTALLATION SERVICE POINTS

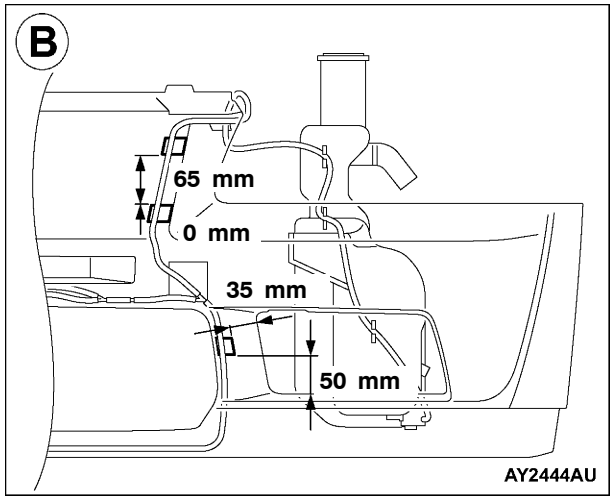
▶A◀ WATER SPRAY HOSE/TAPE INSTALLATION

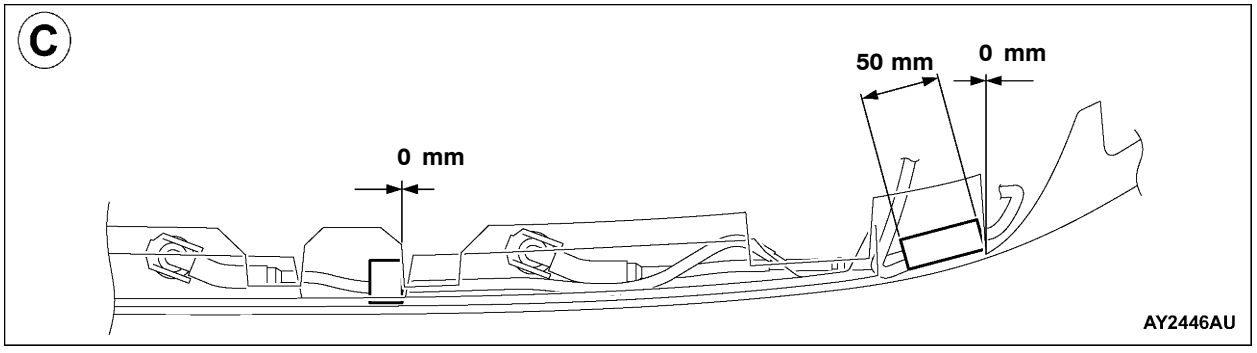
Attach the water spray hose to the front bumper with a tape as shown in the illustration.

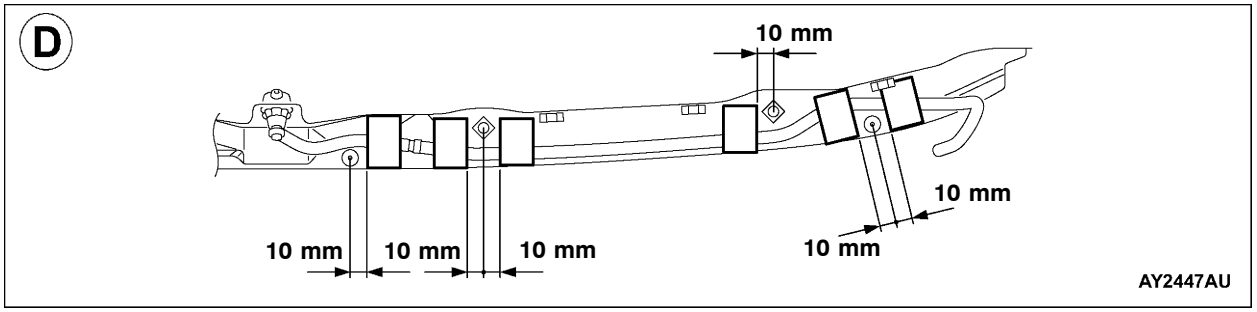
<Tape attachment position>



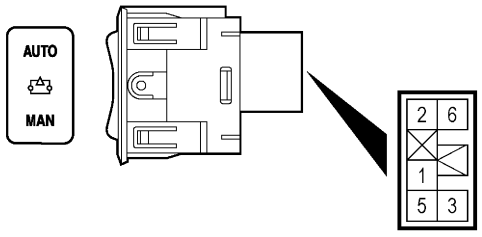








<Water spray switch>



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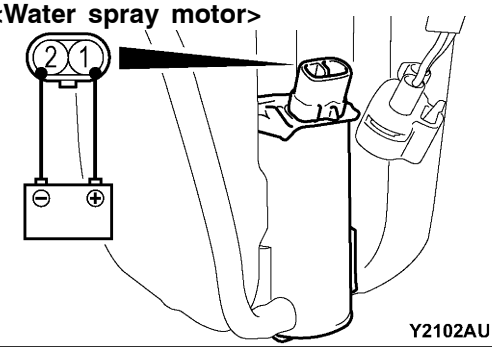
<Water spray motor>



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INSPECTION

1. WATER SPRAY SWITCH CONTINUITY CHECK

Switch position	Terminal No.				
	AUTO	MANUAL	EARTH	ILL (+)	ILL (-)
	1	2	3	5	6
AUTO	○		○	ILL	
NEUTRAL				○ ⌀ ○	
MAN		○	○		

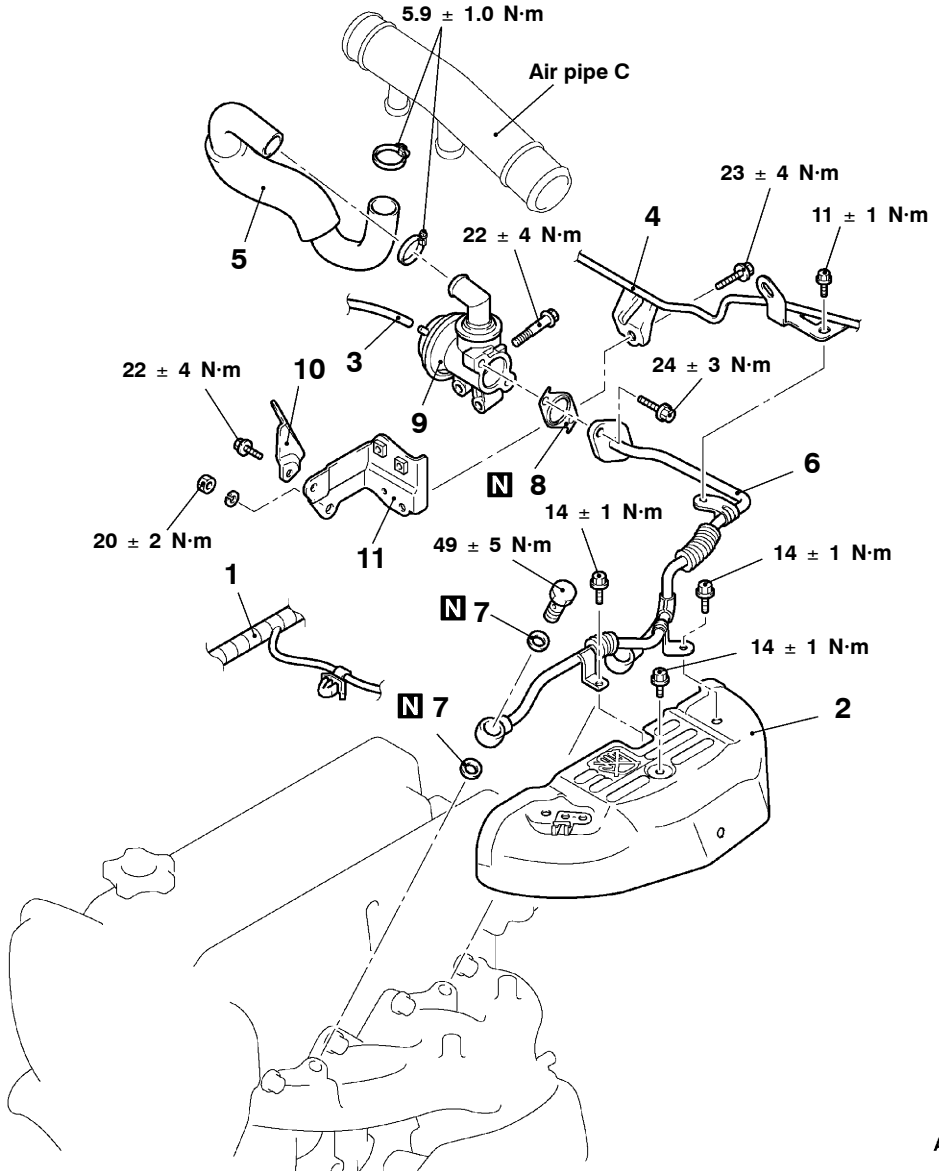
2. WATER SPRAY MOTOR CHECK

(1) Check the water spray motor with the washer tank attached after the washer tank is supplied with water.
(2) Check that the water is supplied with strong pressure after energizing terminal number 1 with battery voltage and earthing terminal number 2.

SECONDARY AIR SUPPLY SYSTEM

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Air Duct Removal and Installation (Refer to P.15-8.)
- Strut Tower Bar Removal and Installation (Refer to GROUP 42.)



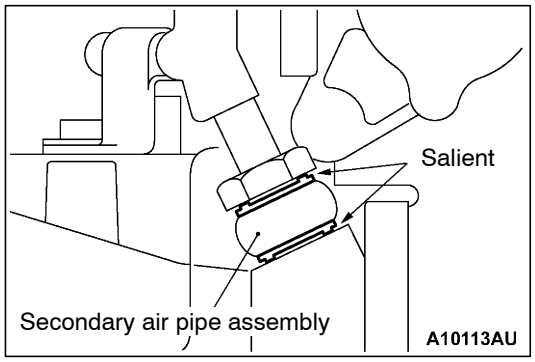
Removal steps

1. Control harness connector connection
2. Heat protector
3. Vacuum hose connection
- Air pipe C (Refer to P.15-9.)
4. Vacuum pipe
5. Secondary air hose
6. Secondary air pipe assembly

▶A◀ 7. Gasket

▶B◀ 8. Gasket

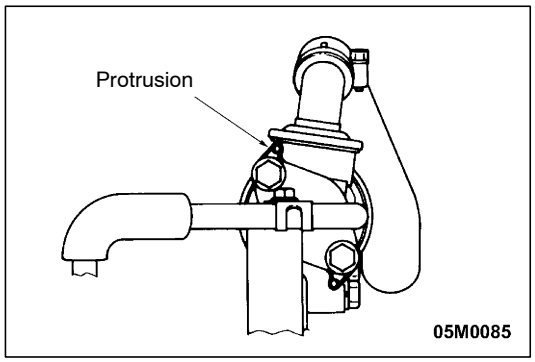
9. Secondary air control valve
10. Engine hanger
11. Secondary air control valve bracket



INSTALLATION SERVICE POINTS

▶A◀ GASKET INSTALLATION

Install the gasket so that its salient can face towards the direction as shown in the illustration.



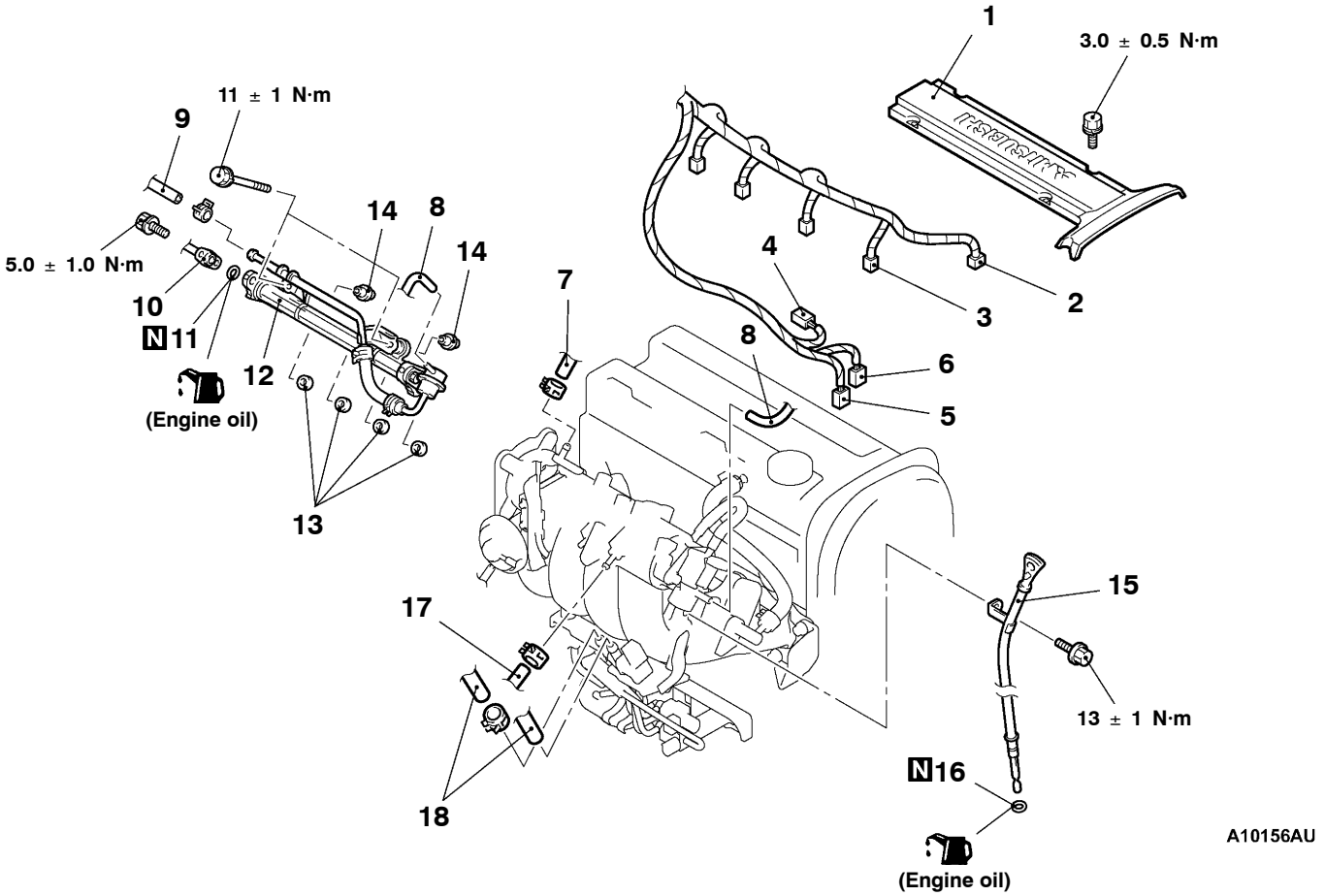
▶B◀ GASKET INSTALLATION

Install the gasket so that its protrusion can face towards the direction as shown in the illustration.

INTAKE MANIFOLD

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Air Duct Removal and Installation (Refer to P.15-8.)
- Strut Tower Bar Removal and Installation (Refer to GROUP 42.)
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Engine Coolant Draining and Supplying (Refer to GROUP 14 - On-vehicle Service.)
- Throttle Body Removal and Installation (Refer to GROUP 13A - Throttle Body.)
- Crossmember Bar Removal and Installation (Refer to GROUP 32 - Engine Roll Stopper, Centermember.)
- Front Exhaust Pipe Removal and Installation (Refer to GROUP 15 - Exhaust Pipe and Main Muffler.)
- Secondary Air Control Valve Bracket Removal and Installation (Refer to P.15-14.)
- Engine Oil Draining and Supplying

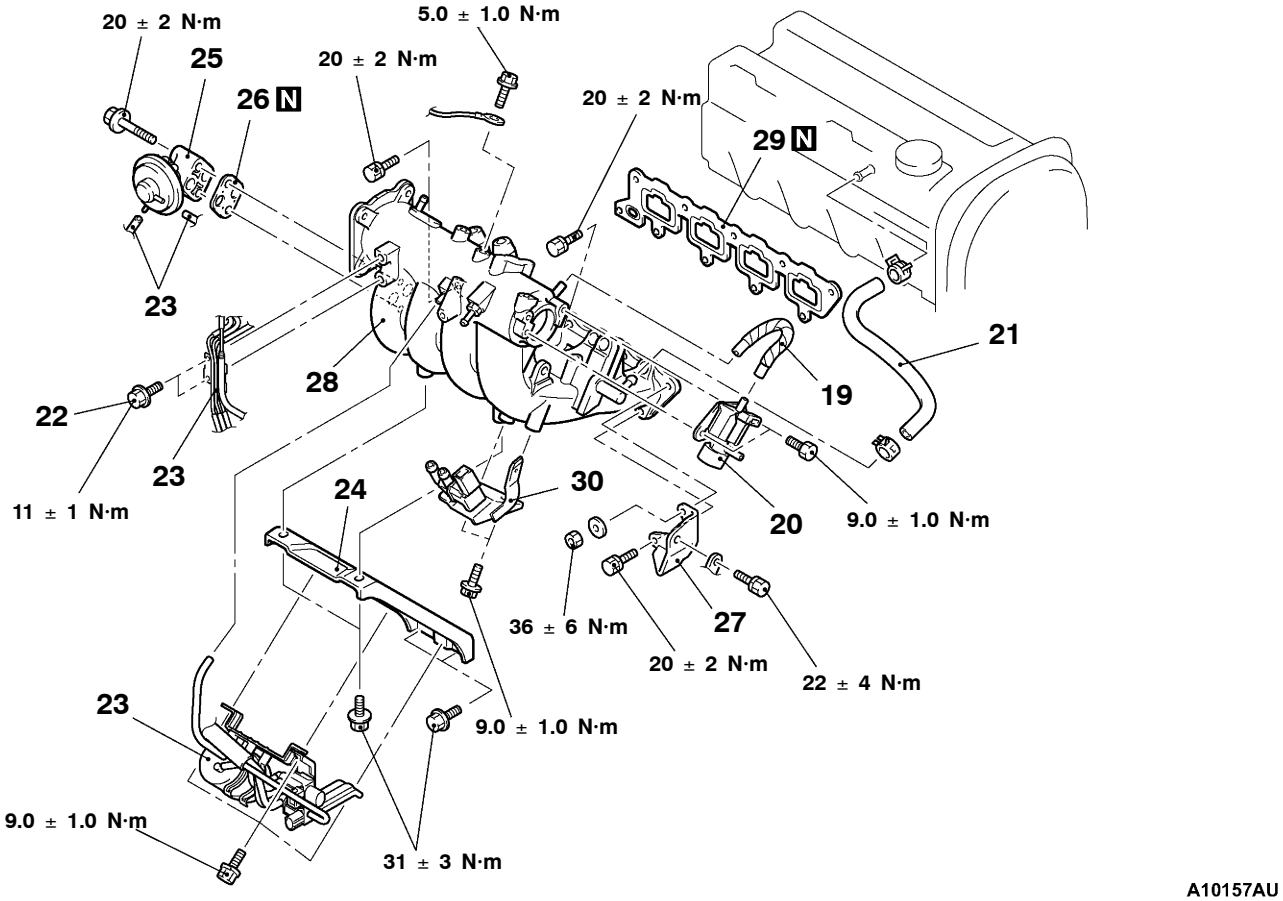


Removal steps

1. Center cover
2. Oxygen sensor connector connection
3. Injector connector connection
4. Fuel pressure solenoid valve connector connection
5. Purge control solenoid valve connector connection
6. Knock sensor connector connection
7. Vacuum hose connection
8. Vacuum hose
9. Fuel return hose connection

▶A◀ 10. Fuel high-pressure hose connection
11. O-ring

◀A▶ 12. Delivery pipe, Injector and fuel pressure regulator assembly
13. Insulator
14. Insulator
15. Oil level gauge and guide
16. O-ring
17. Brake booster vacuum hose connection
18. Purge hose connection



19. Vacuum hose
20. Fuel pressure solenoid valve
21. PCV hose
    - Alternator (Refer to GROUP 16.)
22. Vacuum hose and Vacuum pipe assembly connecting bolt
23. Vacuum tank, EGR solenoid valve, Secondary air control solenoid valve, Vacuum hose assembly
24. Intake manifold stay
25. EGR valve
26. EGR gasket
27. Alternator brace stay
28. Intake manifold
29. Intake manifold gasket
30. Purge control solenoid valve assembly

REMOVAL SERVICE POINTS

◀A▶ DELIVERY PIPE, INJECTOR AND FUEL PRESSURE REGULATOR ASSEMBLY REMOVAL

The delivery pipe must be removed with the injector and fuel pressure regulator attached.

Caution
Take care not to drop delivery pipe, injector, or fuel pressure regulator assembly when removing those parts.

INSTALLATION SERVICE POINTS

▶A◀ FUEL HIGH-PRESSURE HOSE CONNECTION

1. Apply a drop of new engine oil to the O-ring.

   Caution
   Be sure not to let engine oil enter the delivery pipe.

2. While turning the injector, high-pressure fuel hose and fuel pressure regulator to the right and left, install the delivery pipe, while being careful not to damage the O-ring. After installing, check that the hose turns smoothly.
3. If it does not turn smoothly, the O-ring may be trapped, remove the injector, high-pressure fuel hose or fuel pressure regulator and then re-insert it into the delivery pipe and check once again.
4. Tighten the high-pressure fuel hose to the specified torque.

   Tightening torque: 5.0 ± 1.0 N·m

INSPECTION

Check the following points; replace the part if a problem is found.

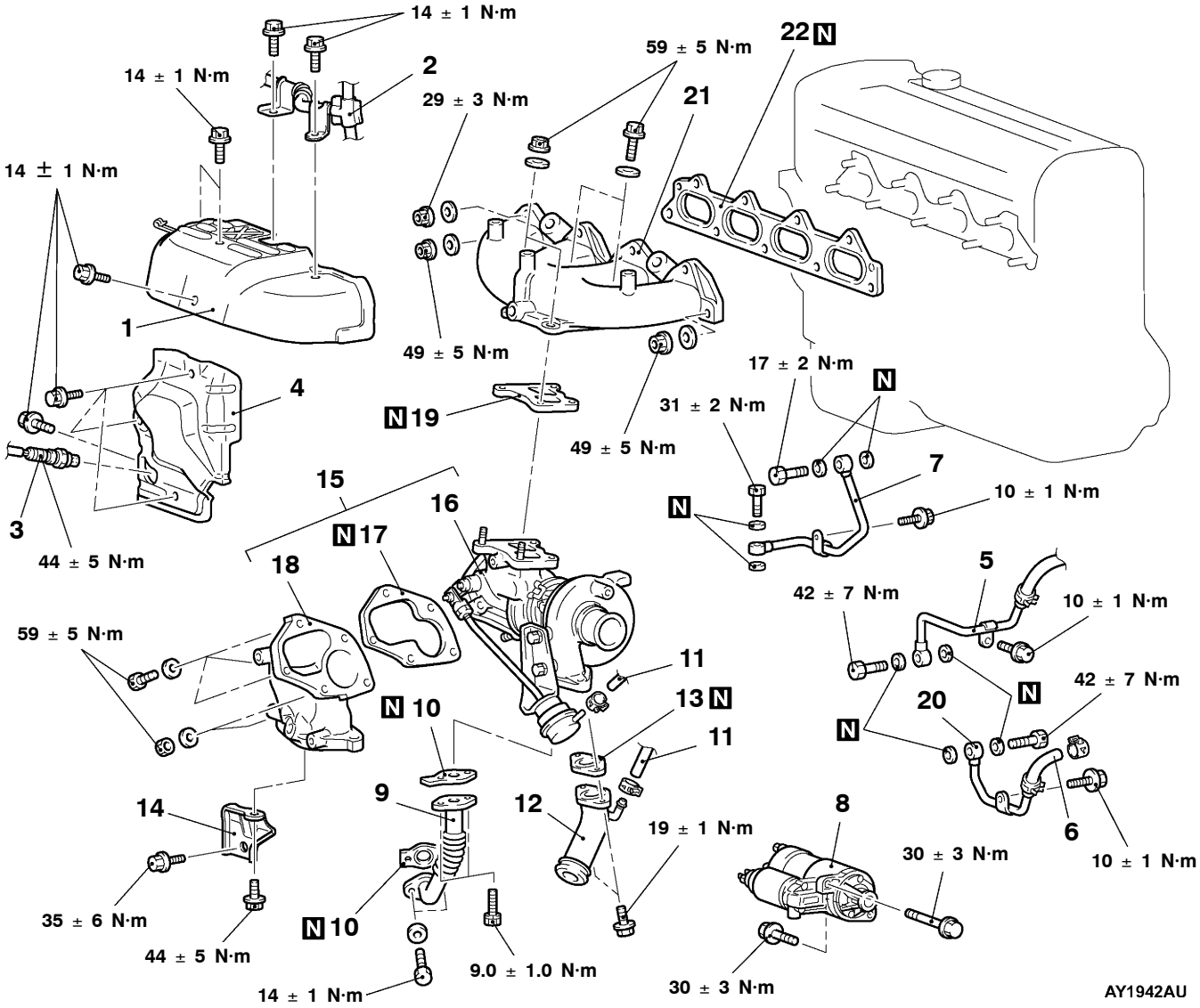
INTAKE MANIFOLD CHECK

1. Check for damage or cracking of any part.
2. Check for obstruction of the negative pressure (vacuum) outlet port, and for obstruction of the water passage or gas passage.
3. Using a straight edge and thickness gauge, check for distortion of the cylinder head installation surface.

   Standard value: 0.15 mm
   Limit: 0.20 mm

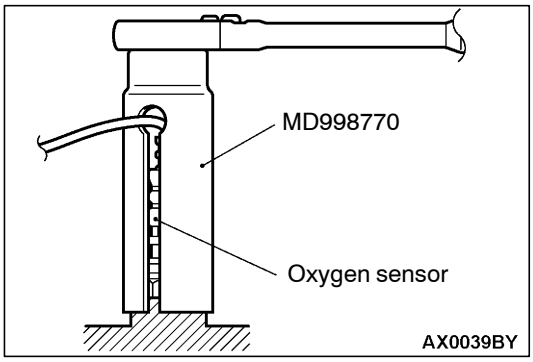
EXHAUST MANIFOLD
REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation (Refer to GROUP 51 - Front bumper.)
- Radiator Removal and Installation (Refer to GROUP 14.)
- Air Intake Hose Removal and Installation (Refer to P.15-8.)
- Air Pipe A, Air Pipe C, Air Hose D, Air Pipe B Removal and Installation (Refer to P.15-9.)
- Crossmember Bar Removal and Installation (Refer to GROUP 32 - Engine Roll Stopper, Centermember.)
- Front Exhaust Pipe Removal and Installation (Refer to P.15-26.)



Removal steps

1. Exhaust manifold heat protector
2. Air pipe assembly
◀A▶ 3. Oxygen sensor
4. Turbocharger heat protector
5. Turbocharger water feed pipe assembly connection
6. Turbocharger water return hose connection
◀B▶ 7. Oil feed pipe
8. Starter Motor
9. Oil return pipe
▶C◀ 10. Oil return pipe gasket
11. Vacuum hose connection
12. Air outlet fitting
▶B◀ 13. Air outlet fitting gasket
14. Exhaust fitting bracket
▶A◀ 15. Turbocharger assembly
16. Turbocharger
17. Exhaust fitting gasket
18. Exhaust fitting
19. Turbocharger gasket
20. Turbocharger water return pipe assembly connection
21. Exhaust manifold
22. Exhaust manifold gasket



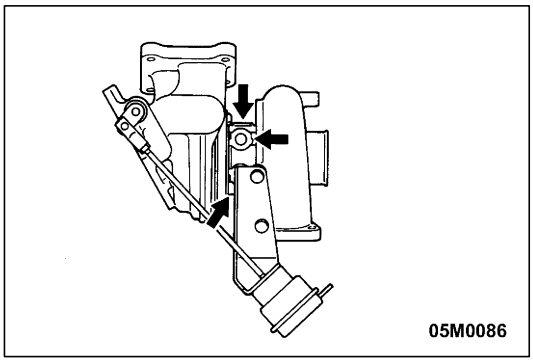
REMOVAL SERVICE POINT

◀A▶ OXYGEN SENSOR REMOVAL

Use special tool to remove the oxygen sensor.

◀B▶ OIL FEED PIPE REMOVAL

Take care not to let foreign objects get into the oil passage hole of the turbocharger after the oil feed pipe is removed.

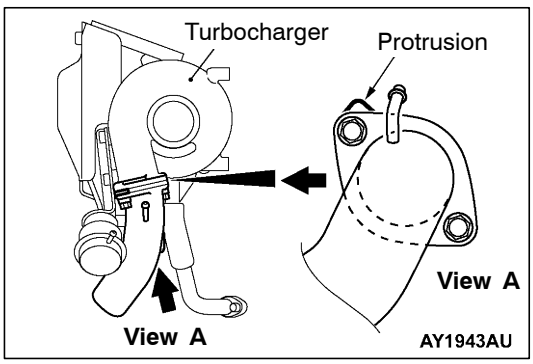


INSTALLATION SERVICE POINT

▶A◀ TURBOCHARGER INSTALLATION

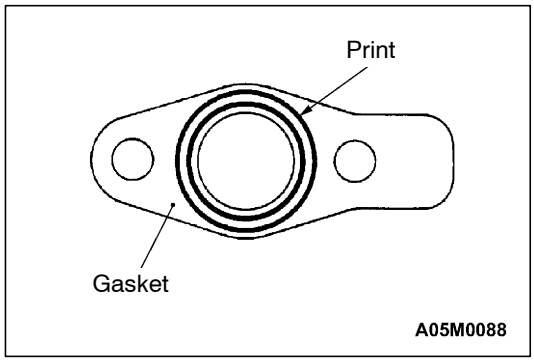
1. Clean the oil feed pipe, oil return pipe, water pipe fitting, the inside of eye bolt, and individual pipe for clogs.
2. Clean or blow the air if carbon particles are stuck to the oil passage of the turbocharger.

   Caution
   Take care not to let foreign objects get into the turbocharger.
3. Refill new engine oil at the oil feed pipe fitting hole of the turbocharger.



▶B◀ AIR OUTLET FITTING GASKET INSTALLATION

Install the gasket so that its protrusion can face towards the direction as shown in the illustration.



▶C◀ OIL RETURN PIPE GASKET INSTALLATION

Install the gasket so that its print part can face towards the oil pan side.

INSPECTION

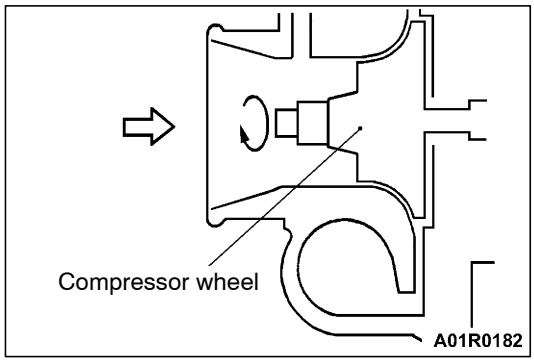
Check the following points; replace the part if a problem is found.

1. EXHAUST MANIFOLD CHECK

(1) Check for damage or cracking of any part.
(2) Using a straight edge and a feeler gauge, check for distortion of the cylinder head installation surface.

Standard value: 0.15 mm or less

Limit: 0.20 mm

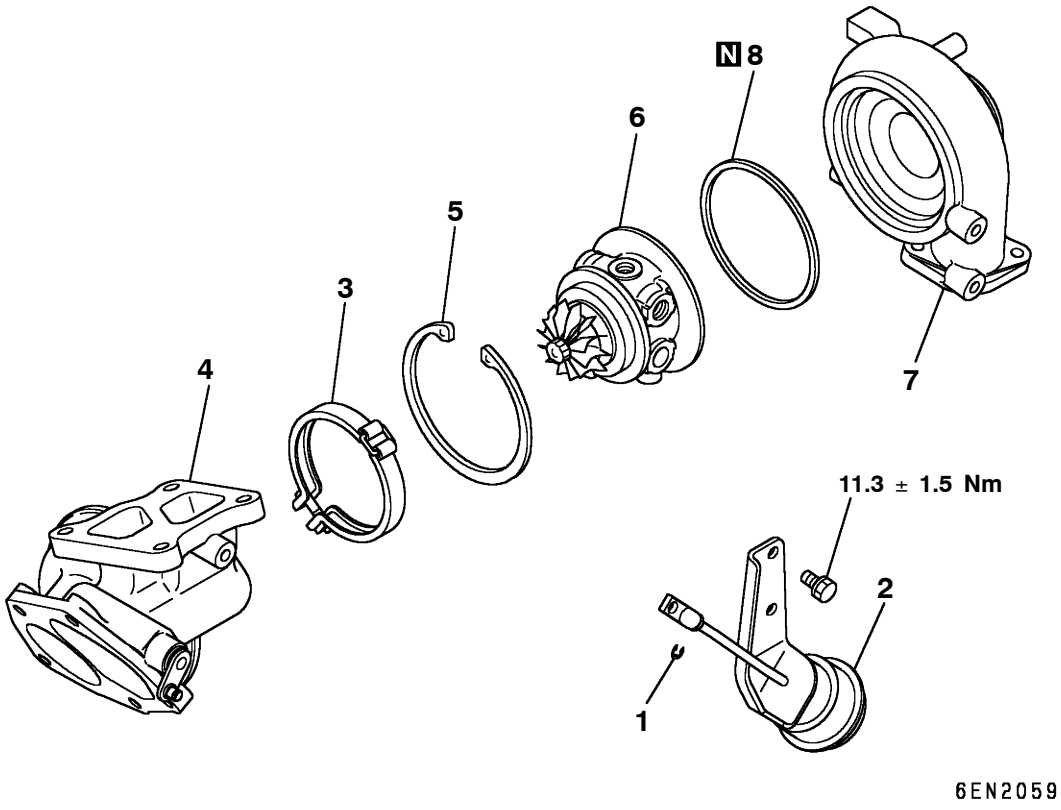


2. TURBOCHARGER ASSEMBLY CHECK

(1) Visually check the turbine wheel and the compressor wheel for cracking or other damage.
(2) Check whether the turbine wheel and the compressor wheel can be easily turned by hand.
(3) Check for oil leakage from the turbocharger assembly.
(4) Check whether or not the waste gate valve remains open.
If any problem is found, replace the part after disassembly.

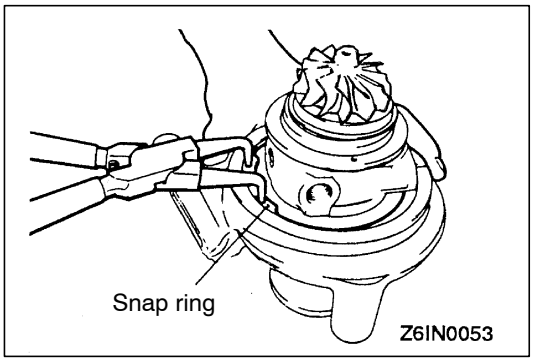
TURBOCHARGER

DISASSEMBLY AND REASSEMBLY



Disassembly steps

▶F◀ • Inspection of turbocharger waste gate actuator operation
1. E-ring
2. Waste gate actuator
▶E◀ 3. Coupling
▶D◀ 4. Turbine housing
◀A▶ ▶C◀ 5. Snap ring
◀B▶ ▶B◀ 6. Turbine wheel assembly
7. Compressor cover
▶A◀ 8. O-ring

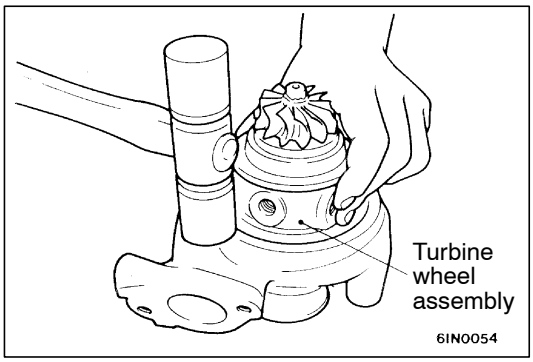


DISASSEMBLY SERVICE POINTS

◀A▶ SNAP RING REMOVAL

Lay the unit with the compressor cover side facing down and using snap ring pliers, remove the compressor cover attaching snap ring.

Caution
When removing the snap ring, hold it with fingers to prevent it from springing away.

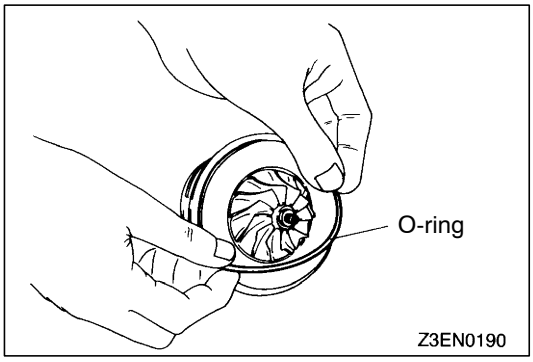


◀B▶ TURBINE WHEEL ASSEMBLY REMOVAL

Remove the turbine wheel assembly, striking the circumference of the compressor cover with a plastic hammer. The turbine wheel assembly may be a little hard to remove due to an O-ring put on the outer circumference.

CLEANING

1. Use a clean cleaning oil commercially available. Do not use corrosive cleaning oils as they could damage to some parts.
2. Use a plastic scraper or hard brush to clean aluminum parts.

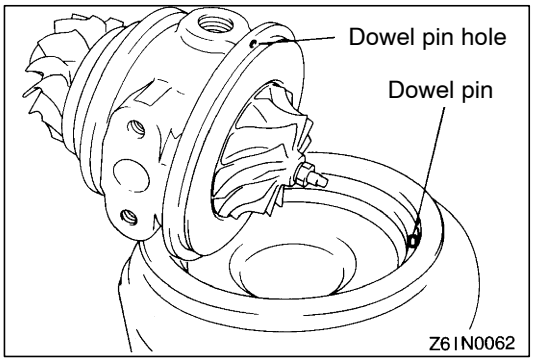


REASSEMBLY SERVICE POINTS

▶A◀ O-RING INSTALLATION

Apply a light coat of engine oil to a new O-ring and fit in the turbine wheel assembly groove.

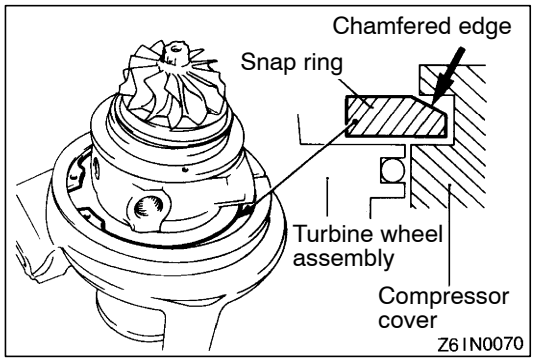
Caution
When installing the O-ring, use care not to damage it. A damaged O-ring causes oil leaks.



▶B◀ TURBINE WHEEL ASSEMBLY

1. Apply a light coat of engine oil to the periphery of the O-ring.
2. Install the turbine wheel assembly to the compressor cover in relation to the dowel pin.

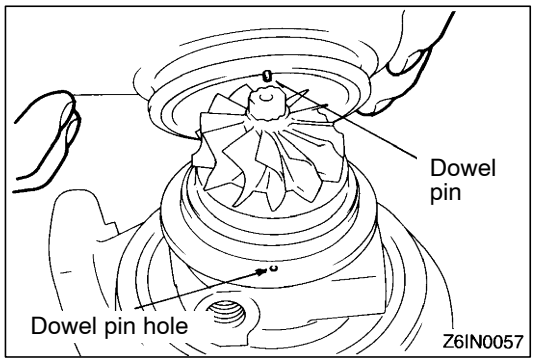
   Caution
   Use care not to damage the blades of turbine wheel and compressor wheel.



▶C◀ SNAP RING INSTALLATION

Lay the assembly with the compressor cover facing down and fit the snap ring.

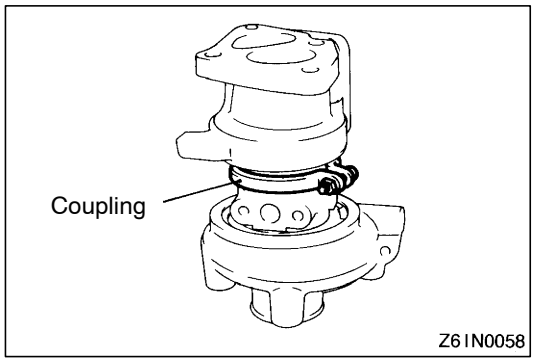
Caution
Fit the snap ring with its chamfered side facing up.



▶D◀ TURBINE HOUSING INSTALLATION

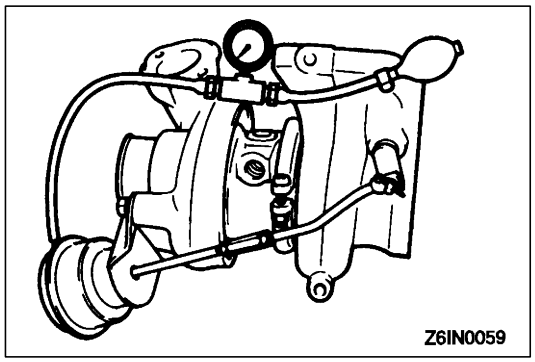
Install the turbine housing in relation to the dowel pin.

Caution
Use care not to damage the blades of turbine wheel.



▶E◀ COUPLING INSTALLATION

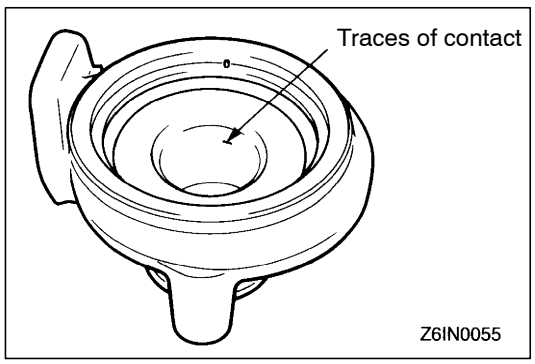
Install the coupling and tighten to the specified torque.



▶F◀ WASTE GATE ACTUATOR OPERATION CHECK

Using a tester, apply a pressure of approx. 100.0 kPa to the actuator and make sure that the rod moves.

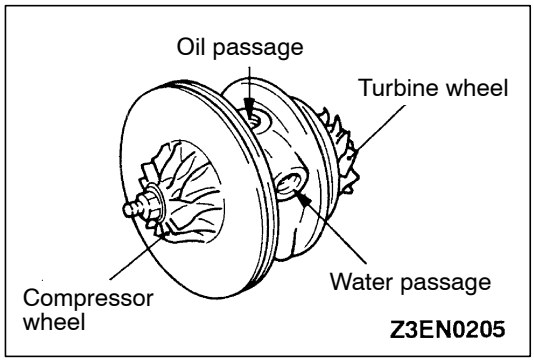
Caution
Do not apply a pressure of more than 113.3 kPa to the actuator. Otherwise, diaphragm may be damaged. Never attempt to adjust the waste gate valve.



INSPECTION

TURBINE HOUSING

1. Check the housing for traces of contact with the turbine wheel, cracks due to overheating, pitching, deformation and other damage. Replace with a new turbine housing if cracked.
2. Operate the waste gate valve lever manually to check that the gate can be operated and closed smoothly.



COMPRESSOR COVER

Check the compressor cover for traces of contact with the compressor wheel and other damage.

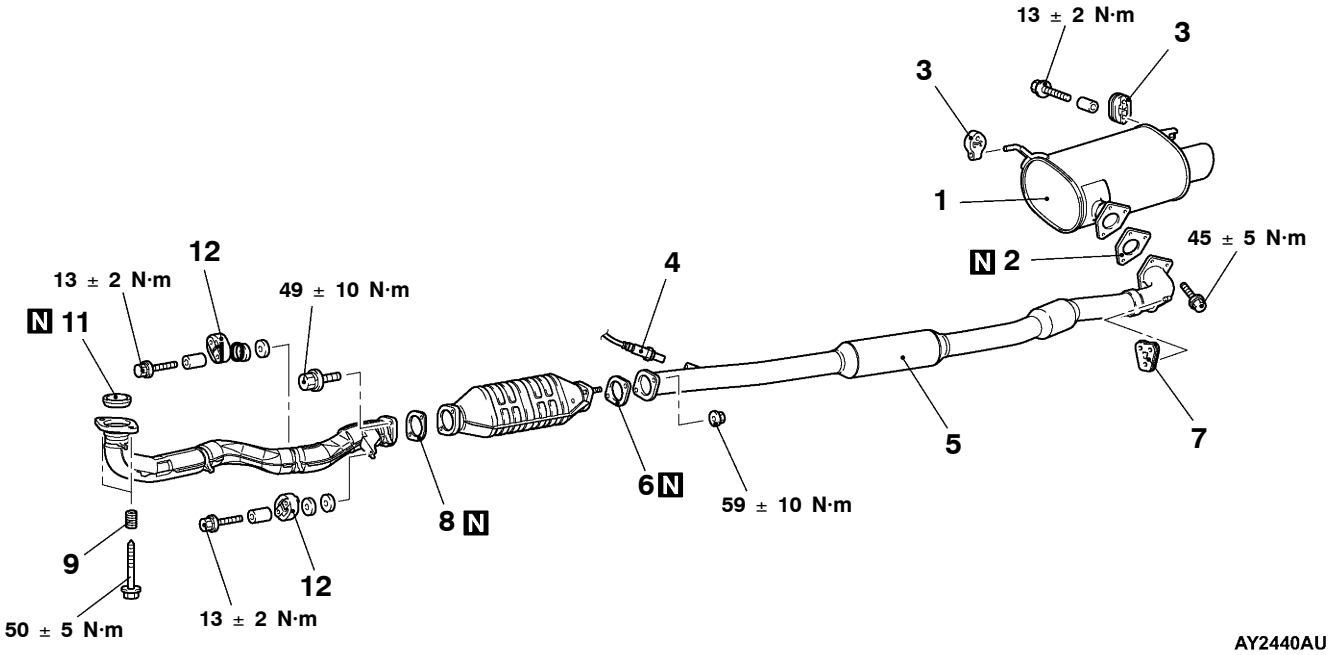
TURBINE WHEEL ASSEMBLY

1. Check the turbine and compressor wheel blades for bend, burr, damage, corrosion and traces of contact on the back side and replace if defective.
2. Check the oil passage of the turbine wheel assembly for deposit and clogging.
3. In the case of water cooled type, check also the water passage for deposit and clogging.
4. Check the turbine wheel and compressor wheel for light and smooth turning.

EXHAUST PIPE AND MAIN MUFFLER

REMOVAL AND INSTALLATION

Pre-removal and Post-installation Operation
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Crossmember Bar Removal and Installation (Refer to GROUP 32 - Engine Roll Stopper, Centermember.)

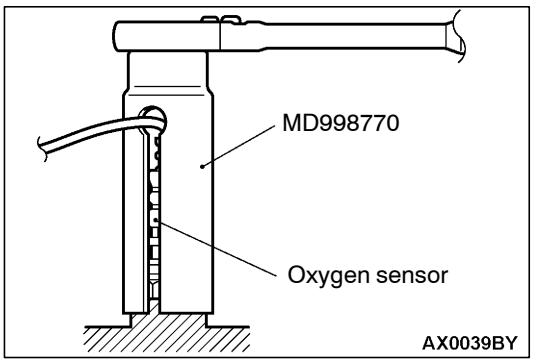


Exhaust main muffler removal steps
1. Exhaust main muffler
2. Exhaust pipe gasket
3. Exhaust muffler hanger

Center exhaust pipe removal steps

◀A▶ 4. Oxygen sensor
5. Center exhaust pipe
2. Exhaust pipe gasket
6. Exhaust pipe gasket
7. Exhaust pipe hanger

Front exhaust pipe removal steps
8. Exhaust pipe gasket
9. Spring
10. Front exhaust pipe
11. Seal ring
12. Exhaust pipe hanger



REMOVAL SERVICE POINT

◀A▶ OXYGEN SENSOR REMOVAL

Use special tool to remove the oxygen sensor.