# GROUP 15
## INTAKE AND EXHAUST

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<td>REMOVAL AND INSTALLATION &lt;4G1&gt;</td>
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</tbody>
</table>
The exhaust pipe is divided into three parts.

### SERVICE SPECIFICATIONS

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard value</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turbocharger supercharging pressure (waste gate solenoid valve not operating) kPa</td>
<td>39 – 65</td>
<td>–</td>
</tr>
<tr>
<td>Initial activation pressure of waste gate actuator (at the stroke of approximately 1mm) kPa</td>
<td>60</td>
<td>–</td>
</tr>
<tr>
<td>Waste gate solenoid valve coil resistance (at 20°C) Ω</td>
<td>29 – 35</td>
<td>–</td>
</tr>
<tr>
<td>Initial activation pressure of air by pass valve kPa</td>
<td>Approximately 53</td>
<td>–</td>
</tr>
<tr>
<td>Manifold distortion of the installation surface mm</td>
<td>0.15 or less</td>
<td>0.20</td>
</tr>
</tbody>
</table>

### SPECIAL TOOL

<table>
<thead>
<tr>
<th>Tool</th>
<th>Number</th>
<th>Name</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MB991953</td>
<td>Oxygen sensor wrench</td>
<td>Removal and installation of oxygen sensor</td>
</tr>
</tbody>
</table>
ON-VEHICLE SERVICE

TURBOCHARGER SUPERCHARGING PRESSURE CHECK <4G1>

**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 (white paint mark) 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 (white paint mark) has been disconnected.

2. Drive at full-throttle acceleration in second gear and then measure the supercharging pressure when the engine speed is about 3,000 r/min.

   **Standard value:** 39 – 65 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 following.
   - 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 <4G1>

1. Disconnect the hose (white paint mark) 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.

<table>
<thead>
<tr>
<th>Engine state</th>
<th>Hose end</th>
<th>Normal state</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop (Ignition switch: ON)</td>
<td>Opened</td>
<td>Negative pressure leaks.</td>
</tr>
<tr>
<td></td>
<td>Closed</td>
<td>Negative pressure is maintained.</td>
</tr>
<tr>
<td>Idling (after warm-up)</td>
<td>Normal</td>
<td>Negative pressure leaks.</td>
</tr>
</tbody>
</table>

**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 <4G1>

1. Connect a manual pump (pressure-application type) to nipple.
   **CAUTION**
   In order to avoid damage to the diaphragm, do not apply a pressure of 75 kPa or higher.
2. While gradually applying pressure, check the pressure that begins to activate (approximately 1 mm stroke) the waste gate actuator rod.
   **Standard value:** Approximately 60 kPa
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.

<table>
<thead>
<tr>
<th>Jumper wire</th>
<th>B nipple condition</th>
<th>Normal condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected</td>
<td>Opened</td>
<td>Negative pressure leaks.</td>
</tr>
<tr>
<td>Closed</td>
<td></td>
<td>Negative pressure is held.</td>
</tr>
<tr>
<td>Disconnected</td>
<td>Opened</td>
<td>Negative pressure is held.</td>
</tr>
</tbody>
</table>

COIL RESISTANCE CHECK

Measure the resistance between solenoid valve terminals

**Standard value:** 29 – 35 $\Omega$ (at 20°C)

WASTE GATE SOLENOID VALVE CHECK <4G1>

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.

<table>
<thead>
<tr>
<th>Negative pressure</th>
<th>Valve operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximately 53 kPa</td>
<td>It starts opening</td>
</tr>
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</table>

AIR BY-PASS VALVE CHECK <4G1>

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 93 kPa, and check that air tightness is maintained.
4. Also check operation of the valve.
   **Standard value:**

INTAKE MANIFOLD VACUUM CHECK

Refer to GROUP 11A – On-vehicle Service P.11A-13. <4A9>
Refer to GROUP 11C – On-vehicle Service P.11C-14. <4G1>
AIR CLEANER

REMOVAL AND INSTALLATION <4A9>

Removal steps
1. Air cleaner intake duct
2. Air cleaner cover
3. Air cleaner element
4. Fuel vapour control hose
5. Breather hose

Removal steps (Continued)
6. Air cleaner body assembly
7. Clip
8. Breather hose connection
9. Engine air intake hose <M/T>
10. Engine air intake hose <CVT>
Removal steps
1. Air cleaner intake duct
2. Air cleaner air flow sensor connector
3. Air cleaner air flow sensor, air cleaner cover assembly
4. Air cleaner air flow sensor
5. Air cleaner cover
6. Air cleaner element

Removal steps (Continued)
7. Breather hose
8. Air cleaner body assembly
9. Clip
10. Engine air intake hose
11. Breather hose connection
12. Air by-pass valve connection
13. Engine air intake hose
INSTALLATION SERVICE POINTS

>>A<< ENGINE AIR INTAKE HOSE INSTALLATION

Install by aligning the mating mark (green) on the engine air intake hose with the nipple on the turbocharger assembly.

>>B<< AIR BY-PASS VALVE CONNECTION

Install by aligning the mating mark (white) on the air by-pass valve and the mating mark on the engine air intake hose.
Removal steps

1. Air hose C
2. Air by-pass hose
3. Air by-pass valve

Removal steps (Continued)

- Air cleaner assembly (Refer to P.15-6)
4. Air pipe B
5. Air hose D
INLET AND EXHAUST
INTERCOOLER

Installation Service Points

>>A<< AIR HOSE A INSTALLATION

1. Install by aligning the mating mark (green) on air hose A and the mating mark on the intercooler assembly (inlet side).

2. Install by aligning the mating marks (yellow) on air hose A and on the air outlet fitting.

>>B<< AIR HOSE B INSTALLATION

Install by aligning the mating mark (yellow) on air hose B and the mating mark on the intercooler air pipe.

>>C<< AIR PIPE A INSTALLATION

Install by aligning the mating marks (white) on air pipe A and on air hose B.

>>D<< AIR HOSE D INSTALLATION

Install by aligning the mating mark (white) on air hose D and the projection on the throttle body.
1. Align the end of air hose D so that the width of the yellow line on air pipe B should be 4 mm.
2. Install by aligning the mating marks (yellow) on air pipe B and on air hose D.

Install by aligning the mating mark (white) on the air by-pass valve and the mating mark on the engine air intake hose.

1. Install by aligning the mating mark (green) on the air by-pass hose and the mating mark on air pipe B.
2. Install by aligning the mating mark (green) on the air hose C and the mating mark (white) on the air pipe A.
### Pre-removal Operation
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-4).
- Air Cleaner Assembly, Air Intake Duct Removal (Refer to P.15-5).
- Throttle Body Removal (Refer to GROUP 13A, Throttle Body P.13A-370).
- Fuel Injector Removal (Refer to Group 13A, Injector P.13A-367).
- EGR Valve Assembly Removal <CVT> (Refer to GROUP 17, EGR Valve P.17-22).

### Post-installation Operation
- EGR Valve Assembly Installation <CVT> (Refer to GROUP 17, EGR Valve P.17-22).
- Fuel Injector Installation (Refer to GROUP 13A, Injector P.13A-367).
- Throttle Body Installation (Refer to GROUP 13A, Throttle Body P.13A-370).
- Air Cleaner Assembly, Air Intake Duct Installation (Refer to P.15-5).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-4).

### Removal steps
1. Harness clamp connection
2. Alternator connector
3. Alternator terminal
4. PCV hose connection
5. Brake booster vacuum hose connection <M/T>
6. Purge hose connection <M/T>
7. Manifold absolute pressure sensor connector

### Removal steps (Continued)
8. Screw
9. Manifold absolute pressure sensor
10. Harness clamp connection
11. Harness clamp connection <M/T>
12. Inlet manifold stay <M/T>
13. Inlet manifold
14. Inlet manifold gasket
15. Ball stud
CAUTION
Do not over-tighten. As the self-forming-type screw is used, the excessive torque can damage the inlet manifold threads.

Pre-removal Operation
- Cowl Top Panel Removal (Refer to GROUP 42, Loose Panel P.42-81).
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-6).
- Air Cleaner Assembly, Air Intake Duct Removal (Refer to P.15-6).
- Air Hose C, Air Pipe B, Air Hose D Removal (Refer to P.15-8).
- Throttle Body Removal (Refer to GROUP 13B, Throttle Body Assembly P.13B-373).
- Fuel Injector Removal (Refer to GROUP 13B, Injector P.13B-370).

Post-installation Operation
- Fuel Injector Installation (Refer to GROUP 13B, Injector P.13B-370).
- Throttle Body Installation (Refer to GROUP 13B, Throttle Body Assembly P.13B-373).
- Air Hose C, Air Pipe B, Air Hose D Installation (Refer to P.15-8).
- Air Cleaner Assembly, Air Intake Duct Installation (Refer to P.15-6).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-6).
- Cowl Top Panel Installation (Refer to GROUP 42, Loose Panel P.42-81).
Removal steps
1. Purge control solenoid valve connector
2. Fuel pressure solenoid valve connector
3. Fuel vapour control hose connection
4. Purge control solenoid valve
5. O-ring
6. Vacuum hose connection
7. PCV hose connection

Removal steps (Continued)
8. Fuel pressure solenoid valve
9. Vacuum hose connection
10. Brake booster vacuum hose connection
11. Detonation sensor connector
12. Bracket
13. Inlet manifold stay
14. Inlet manifold
15. Inlet manifold gasket

INSPECTION

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

INLET MANIFOLD CHECK

1. Check for damage or cracking of any part.
2. Clogging of the negative pressure (vacuum) outlet port, or clogging of the exhaust gas recirculation passages.
3. Using a straight edge and feeler gauge, check for distortion of the cylinder head installation surface.

Standard value: 0.15 mm or less
Limit: 0.20 mm
EXHAUST MANIFOLD
REMOVAL AND INSTALLATION <4A9>

Pre-removal Operation
• Cowl Top Panel Removal (Refer to GROUP42, Loose Panel P.42-81).
• Front Exhaust Pipe Removal (Refer to GROUP 15 P.15-19).

Post-installation Operation
• Front Exhaust Pipe Installation (Refer to GROUP15 P.15-19).
• Cowl Top Panel Installation (Refer to GROUP42, Loose Panel P.42-81).

Removal steps
1. Exhaust manifold cover
2. Exhaust manifold bracket B
3. Exhaust manifold
4. Exhaust manifold gasket
5. Exhaust manifold bracket A

Removal steps (Continued)
4. Exhaust manifold gasket
5. Exhaust manifold bracket A

INSPECTION <4A9>
Check the following points; replace the part if a problem is found.

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
**Pre-removal Operation**
- Engine air Intake Hose Removal (Refer to P.15-6).
- Engine Coolant Draining (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-6).
- Engine Oil Draining (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-4).
- Front Catalytic Converter Removal (Refer to GROUP 17, Catalytic Converter P.17-24).

**Post-installation Operation**
- Front Catalytic Converter Installation (Refer to GROUP 17, Catalytic converter P.17-24).
- Engine Oil Refilling (Refer to GROUP 12, On-vehicle Service – Engine Oil Replacement P.12-4).
- Engine Coolant Refilling (Refer to GROUP 14, On-vehicle Service – Engine Coolant Replacement P.14-6).
- Engine air Intake Hose Installation (Refer to P.15-6).

**Removal steps**

1. Oxygen sensor 7. Turbocharger waste gate solenoid valve, vacuum hose and vacuum pipe assembly
2. Turbocharger cover 8. Turbocharger water return hose connection
3. Pin 9. Turbocharger water return pipe
4. Turbocharger waste gate actuator 10. Gasket
5. Turbocharger waste gate solenoid valve connector 11. Turbocharger oil feed tube

**Removal steps (Continued)**
Removal steps

13. Turbocharger oil return tube

14. Turbocharger oil return tube gasket (oil pan side)

15. Turbocharger oil return tube gasket (turbocharger assembly side)

16. Bracket
   - Air outlet fitting (Refer to P.15-8).

17. Turbocharger exhaust outlet fitting

18. Gasket

19. Bracket

Removal steps (Continued)

20. Turbocharger water feed hose connection

21. Turbocharger assembly

22. Gasket

23. Turbocharger water feed pipe

24. Gasket

25. Oil level gauge guide

26. O-ring

27. Nut

28. Exhaust manifold

29. Exhaust manifold gasket
REMOVAL SERVICE POINTS

<<A>> OXYGEN SENSOR REMOVAL

Remove the connection and clamp of oxygen sensor connector, and then use special tool oxygen sensor wrench (MB991953) to remove the oxygen sensor.

<<B>> TURBOCHARGER OIL FEED TUBE REMOVAL

⚠️ CAUTION
After removing the turbocharger oil feed tube, be careful that any foreign materials does not get into the oil passages of the turbocharger.

INSTALLATION SERVICE POINTS

>>A<< TURBOCHARGER ASSEMBLY INSTALLATION

1. Clean the turbocharger oil feed tube, water feed pipe and water return pipe fitting, the inside of eye bolts, and individual pipe for clogs.

⚠️ CAUTION
Be careful that any foreign materials does not get into the turbocharger.

2. Clean or blow the air if carbon residues are stuck to the oil passages of turbocharger assembly.

3. Add new engine oil through the turbocharger oil feed tube of turbocharger assembly.

>>B<< TURBOCHARGER OIL RETURN TUBE GASKET (TURBOCHARGER ASSEMBLY SIDE) INSTALLATION

Install the gasket as its protrusion is in the direction shown.

>>C<< TURBOCHARGER OIL RETURN TUBE GASKET (OIL PAN SIDE) INSTALLATION

With the print area on the gasket facing to the pipe, install the gasket so that the protrusion is in the direction shown in the figure.
**OXYGEN SENSOR INSTALLATION**

1. Tighten the oxygen sensor to the specified torque by using special tool oxygen sensor wrench (MB991953).
   - **Tightening torque**: $50 \pm 10 \, \text{N\cdotm}$

2. Connect the oxygen sensor connector and install the connector bracket.

**INSPECTION <4G1>**

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

**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
EXHAUST PIPE AND MAIN MUFFLER

REMOVAL AND INSTALLATION <4A9>

Exhaust main muffler removal steps

1. Exhaust pipe clamp
2. Exhaust pipe gasket
3. Exhaust main muffler
4. Exhaust muffler hanger bracket stopper
5. Exhaust muffler hanger

Exhaust centre pipe removal steps

1. Exhaust pipe clamp
2. Exhaust pipe gasket
6. Centre exhaust pipe

Exhaust centre pipe removal steps (Continued)

10. Exhaust pipe gasket
12. Exhaust muffler hanger
13. Exhaust pipe damper

Exhaust front pipe removal steps

7. Oxygen sensor
8. Oxygen sensor
9. Front exhaust pipe
10. Exhaust gasket
11. Seal ring
REMOVAL SERVICE POINT

<<A>> OXYGEN SENSOR REMOVAL

Remove the connection and clamp of oxygen sensor connector, and then use special tool oxygen sensor wrench (MB991953) to remove the oxygen sensor.

INSTALLATION SERVICE POINTS

>>A<< OXYGEN SENSOR INSTALLATION

1. Tighten the oxygen sensor to the specified torque by using special tool oxygen sensor wrench (MB991953).
   
   **Tightening torque:** \(50 \pm 10\) N·m

2. Connect the oxygen sensor connector and install the connector bracket.

>>B<< EXHAUST PIPE GASKET / EXHAUST PIPE CLAMP INSTALLATION

1. Install the exhaust pipe gasket in the direction shown in the illustration.

2. Confirm that the exhaust main muffler and the concave parts at the rear side of the centre exhaust pipe are located as shown in the illustration. Install the exhaust pipe clamp so that its mounting bolts are in the direction shown in the illustration.
Exhaust main muffler removal steps
1. Oxygen sensor
2. Exhaust pipe clamp
3. Exhaust pipe gasket
4. Exhaust main muffler
5. Exhaust muffler hanger

Exhaust centre pipe removal steps (Continued)
6. Centre exhaust pipe
7. Front exhaust pipe
8. Exhaust pipe gasket
9. Seal ring
10. Exhaust muffler hanger
**REMOVAL SERVICE POINT**

**<<A>> OXYGEN SENSOR REMOVAL**

Remove the connection and clamp of oxygen sensor connector, and then use special tool oxygen sensor wrench (MB991953) to remove the oxygen sensor.

**INSTALLATION SERVICE POINTS**

**>>A<< EXHAUST PIPE GASKET/EXHAUST PIPE CLAMP INSTALLATION**

1. Install the exhaust pipe gasket in the direction shown in the illustration.

2. Confirm that the exhaust main muffler and the concave parts at the rear side of the centre exhaust pipe are located as shown in the illustration. Install the exhaust pipe clamp so that its mounting bolts are in the direction shown in the illustration.

**>>B<< OXYGEN SENSOR INSTALLATION**

1. Tighten the oxygen sensor to the specified torque by using special tool oxygen sensor wrench (MB991953).

   **Tightening torque:** $50 \pm 10 \text{ N.m}$

2. Connect the oxygen sensor connector and install the connector bracket.