
SECTION 1G

ENGINE INTAKE & EXHAUST

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DESCRIPTION AND OPERATION

EXHAUST SYSTEM

Notice: When you are inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor panel and possible damage to the passenger compartment insulation and trim materials.

Check the complete exhaust system and the nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit exhaust fumes to seep into the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately.

MUFFLER

Aside from the exhaust manifold connection, the exhaust system uses a flange and seal joint design rather than a slip joint coupling design with clamp and U-bolts. If hole, open seams, or any deterioration is discovered upon inspection of the front muffler and pipe assembly, the complete assembly should be replaced, the complete assembly should be replaced. The same procedure is applicable to the rear muffler assembly.

Heat shields for the front and rear muffler assembly and catalytic converter protect the vehicle and the environment from the high temperatures that the exhaust system develops.

CATALYTIC CONVERTER (GASOLINE ENGINE)

Notice: When jacking or lifting the vehicle from the body side rails, be certain that the lift pads do not contact the catalytic converter, as this could damage the catalytic converter.

Notice: Use of anything other than unleaded fuel will damage the catalyst in the catalytic converter.

The catalytic converter are emission-control devices added to the exhaust system to reduce pollutants from the exhaust pipes.

The oxidation catalyst is coated with a catalytic material containing platinum and palladium, which reduces levels of hydrocarbon (HC) and carbon monoxide (CO) from the exhaust gas. The three-way catalyst has coatings which contain platinum and rhodium, which additionally lower the levels of oxides of nitrogen (NOx).

DOC (DIESEL OXIDATION CATALYST)

System and Principle

Oxidation catalytic technology for diesel engine is basically the same with it of gasoline engine used before development of 3 primary catalyst (2 primary catalyst), and its effect and performance were already proved.

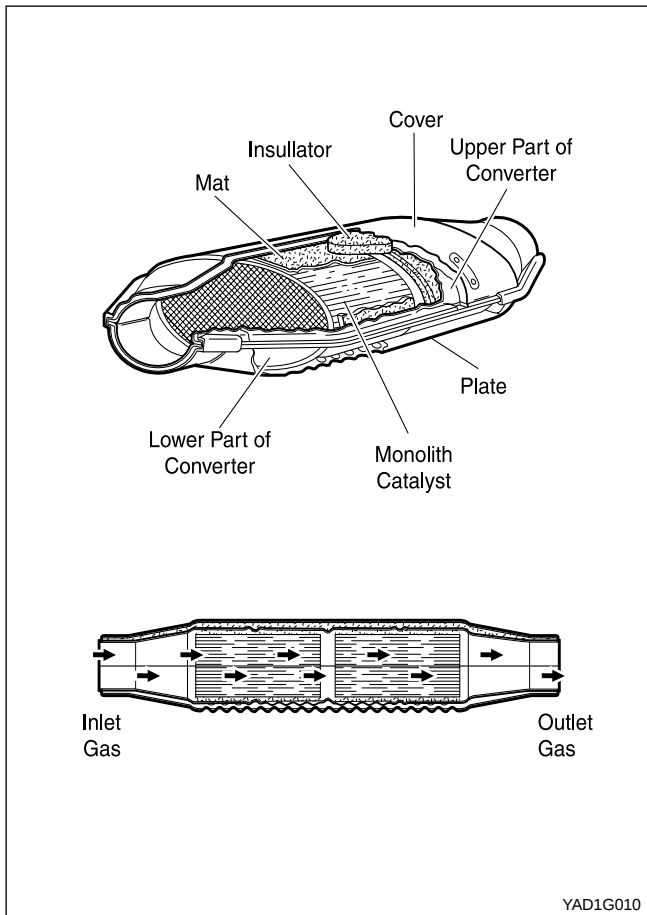
DOC (Diesel Oxidation Catalyst) reduces HO and CO contained exhaust gas over 80%, and removes SOF (Soluble Organic Fraction) over 50~80%, but because its portion in total PM is low, it reduces approx, 20~40% of TPM (Total Particulate Material).

Because of low reducing rate for PM of DOC, in order to guarantee safety rate of PM regulation, this technology is being used mainly.

And it should keep over 80% of PM reducing rate, and at present it plays a role as a transition stage.

And also it reduces diesel odor and black smoke, platinum or palladium are being used as a catalyst.

On the other hand, it is a problem that it makes the reaction of oxidation, which SO_2 produce SO_3 and H_2SO_4 by reacting to oxygen in exhaust gas, if temperature of exhaust gas becomes over 300°C , and this produced gas is very harmful to human body. To prevent is, previously it is requested that the sulfur content rate of fuel should be below 0.05%, and in the future it is being expected to keep it below 0.01%.



Catalytic Converter Structure

The Catalytic converter of monolith type consists of 2 walled metal bodies which is made of Cordierite.

The principal element of converter consists of the materials like Alumina or oxidized Serume in order to apply to Ceramic Monolith.

Washer coat operates first, and catalytic metal elements (Pt, Pd, Rh) operates to washer coat next.

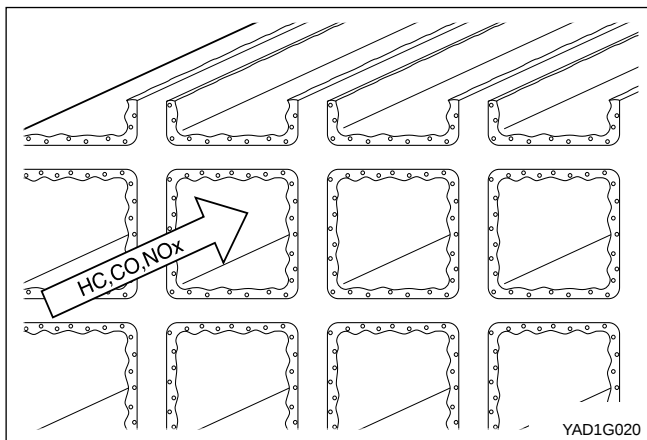
Monolith type is lighter than other types, easy to manufacture and quickly approaches to proper temperature.

Washer coat is used to make a contact surface with exhaust gas bigger by adhering closely to small holes of inner layer.

If a lead compound or phosphorus adheres to the surface and the temperature rises, its surface is decreased.

The total area of general monolith converter is about 45,000~500,000ft³. (10 times of a football field)

Generally Alumina (AL₂ O₃) is used as a raw material and its 7 phases of gamma, delta, theta have big areas and high stability for the temperature, and nowadays gamma Alumina is used usually.



Catalytic Converter and Temperature

Catalytic converter has the normal function of purification at a range of the temperature.

Because it has a weak point of decreasing of the purification rate in the condition of continuous high temperature, it should keep the temperature range of 400 to 500°C for normal condition.

HC purification rate becomes better according to the increase of temperature in the normal range of temperature.

CO purification rate becomes the best near the temperature of 450°C, and NO_x does so near the temperature of 400 to 500°C.

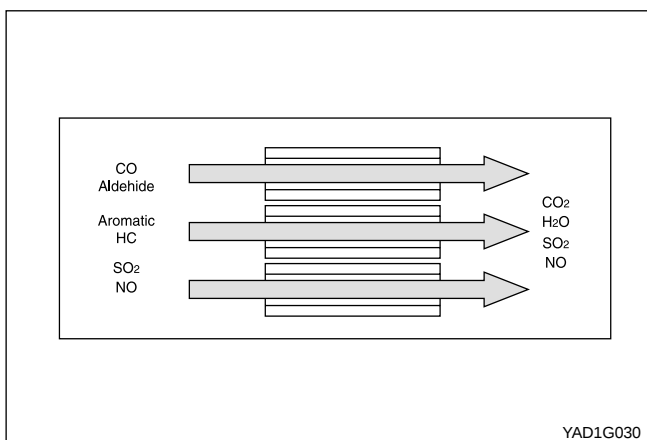
Purification of Catalytic Converter

- Adhesion of soluble organic fraction (SOF) below 180°C
- Purification of soluble organic fraction (SOF) over 180°C

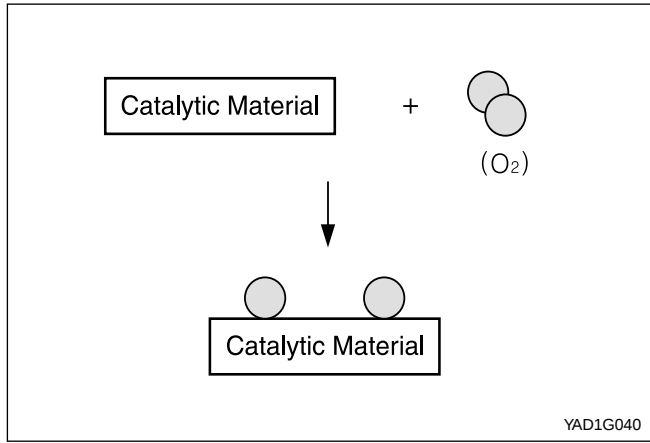
Chemical reaction formula

- $\text{SOF(HC)} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$
- $2\text{CO} + \text{O}_2 \rightarrow 2\text{CO}_2$
- $2\text{C}_2\text{H}_6 + 7\text{O}_2 \rightarrow 4\text{CO}_2 + 6\text{H}_2\text{O}$

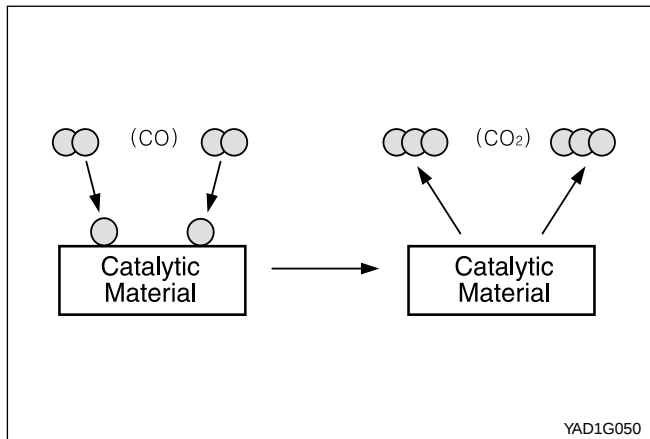
- By catalytic action of two primary catalytic converter, oxidation occurs in order to decrease HC and CO.



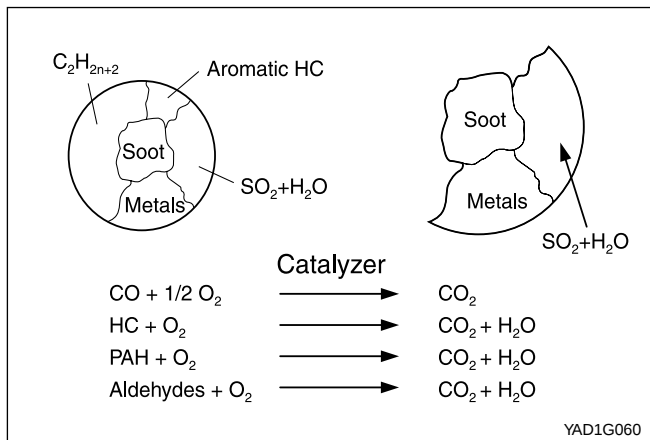
1G-4 ENGINE INTAKE & EXHAUST



- Oxygen adheres to catalytic material : below 180°C



- Catalytic material supplies each CO and HC with O_2 for their oxidation : above 180°C

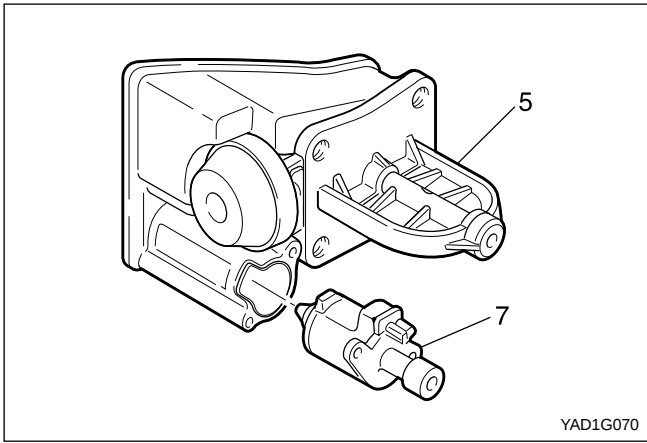


- Catalytic material conversion process by DOC

Method for Reduction of NOx

NOx is generated a great deal in case that combustion temperature and excess air factor are high. EGR valve can decrease NOx (30 to 35% decrease) by making temperature of combustion chamber fall by means of exhaust gas re-circulation.

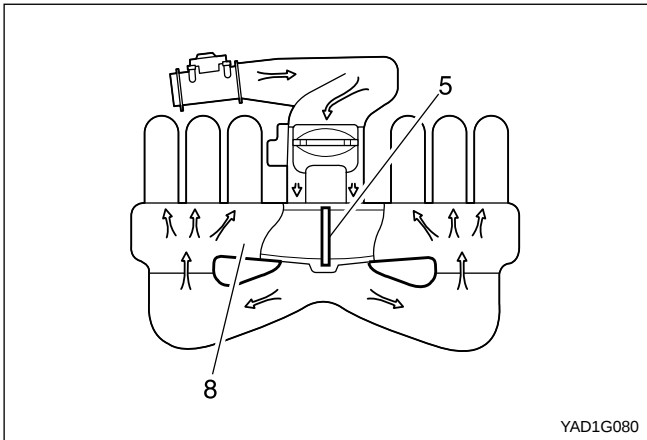
- EGR valve is installed on the diesel engine of Musso, Korando, Istana and Rexton.
And micro switch is installed together to control EGR valve.
- The setting method of micro switch is identical with the existing one.



RESONANCE FLAP (GASOLINE ENGINE)

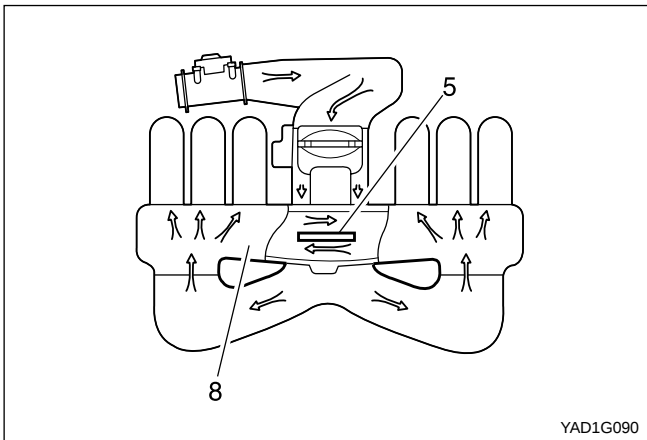
Function

A pneumatically actuated resonance flap (5) is located on the intake manifold, and will be opened and closed by load, which operates resonance flap according to engine and controlled by ECU and rpm.



Resonance flap closed (at idle/partial load : less than 3,800/rpm)

The switch valve (7) will be adjusted by ECU and resonance flap will be closed. By increasing air flow passage through dividing intaking air flow toward both air collection housing (8). This leads to a significant increase in the torque in the lower speed range.



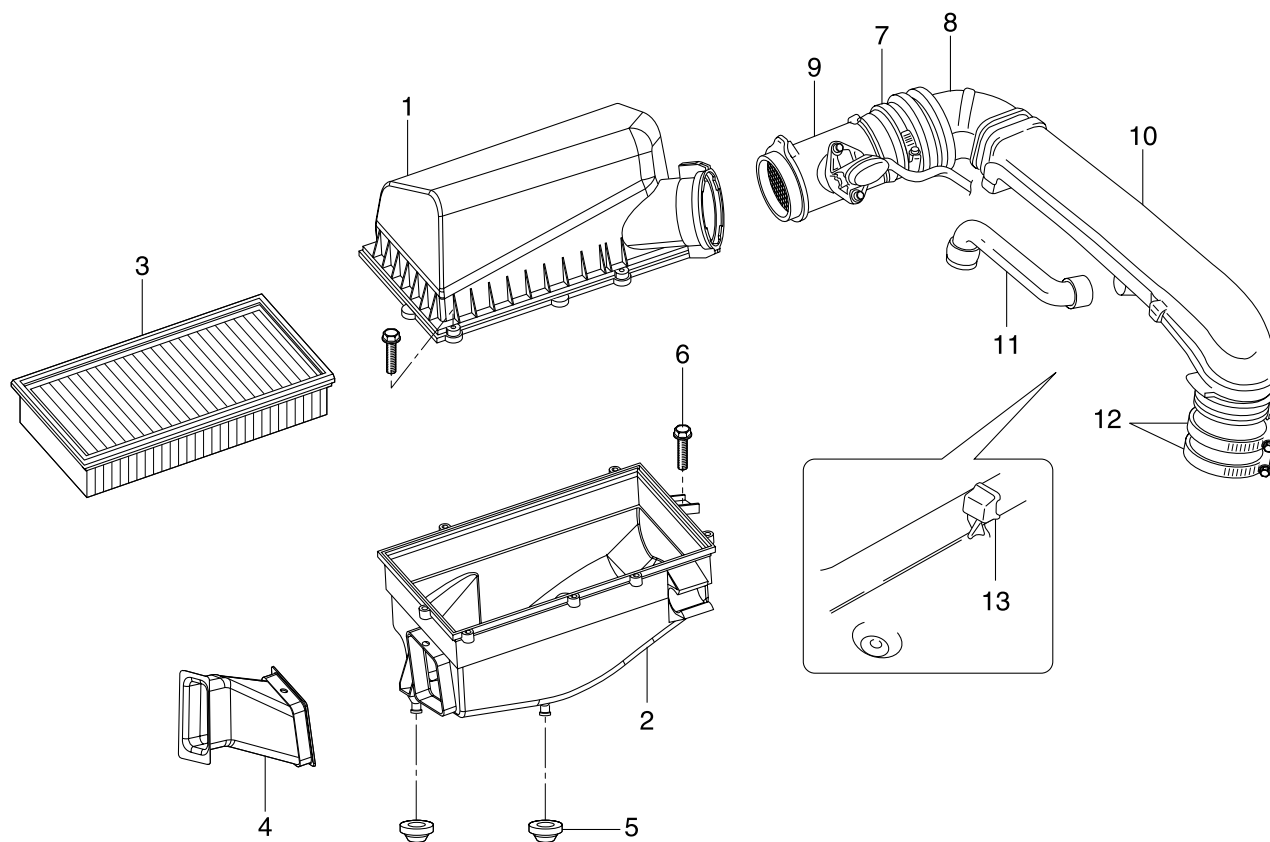
Resonance flap open (at full load : over 3,800/rpm)

The switch valve (7) will not be adjusted by ECU and resonance flap (5) will be open. The collected air in the air collection housing (8) will not be divided and intaking air passage will be shorten.

REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

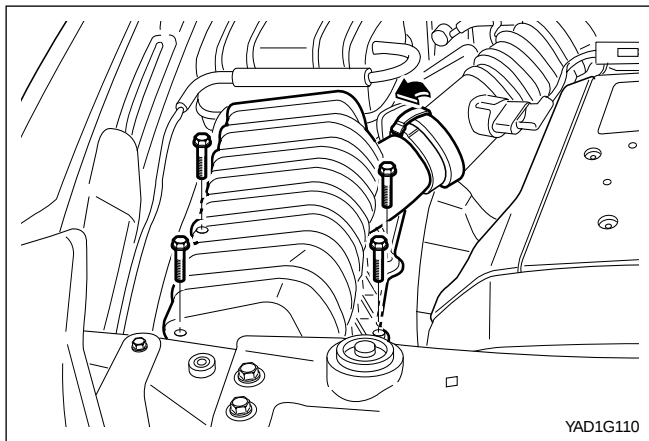
AIR CLEANER AND INTAKE AIR DUCT (GASOLINE ENGINE)



YAD1G100

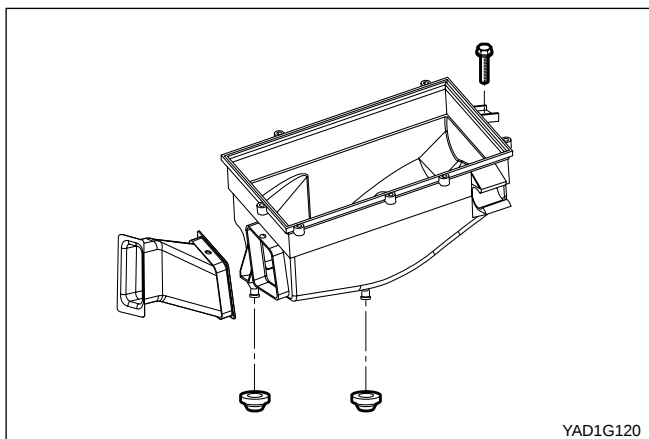
- 1 Air Cleaner Upper Housing
- 2 Air Cleaner Lower Housing
- 3 Element
- 4 Air Duct Inlet
- 5 Insulator
- 6 Bolt
- 7 Clamp

- 8 Sleeve
- 9 HFM Sensor
- 10 Intake Air Duct
- 11 Blow-by Hose
- 12 Clamp (2 Pieces)
- 13 Intake Air Duct Mounting Clamp

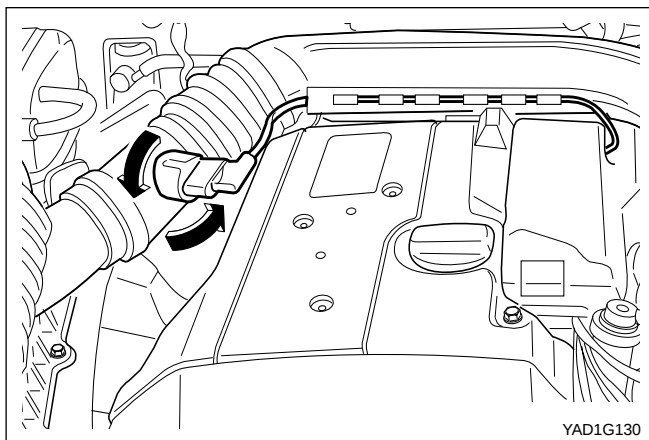


Removal & Installation Procedure

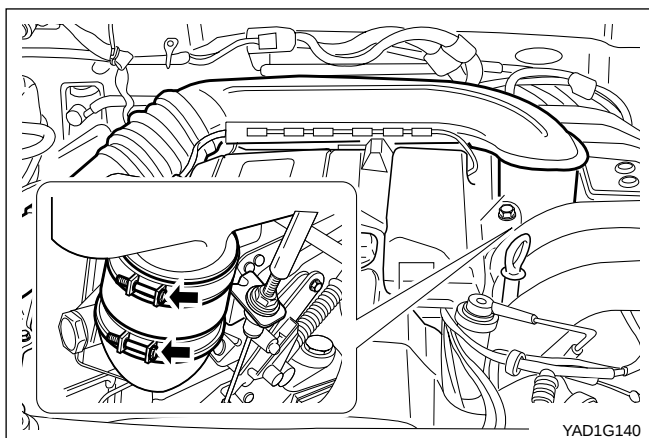
1. Remove the air cleaner upper housing clamp and mounting bolts and remove the air cleaner upper housing and element.



2. remove the air cleaner lower housing bolt and air cleaner lower housing and insulators.

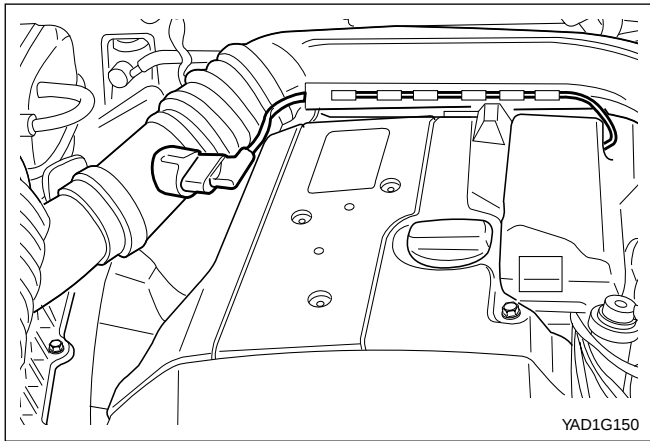


3. Disconnect the HFM sensor connector.

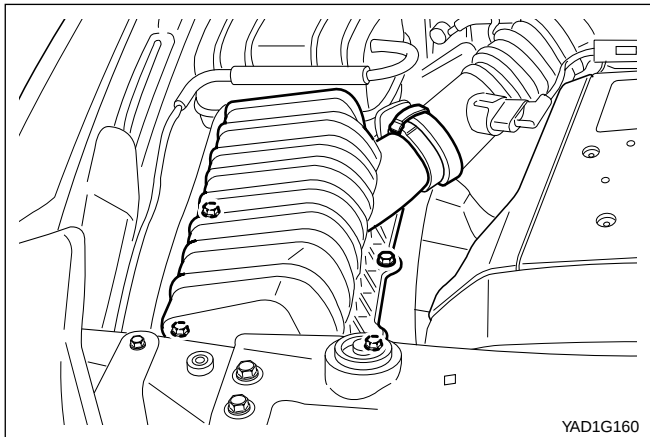


4. Remove the intake air duct housing clamp and intake air duct assembly.

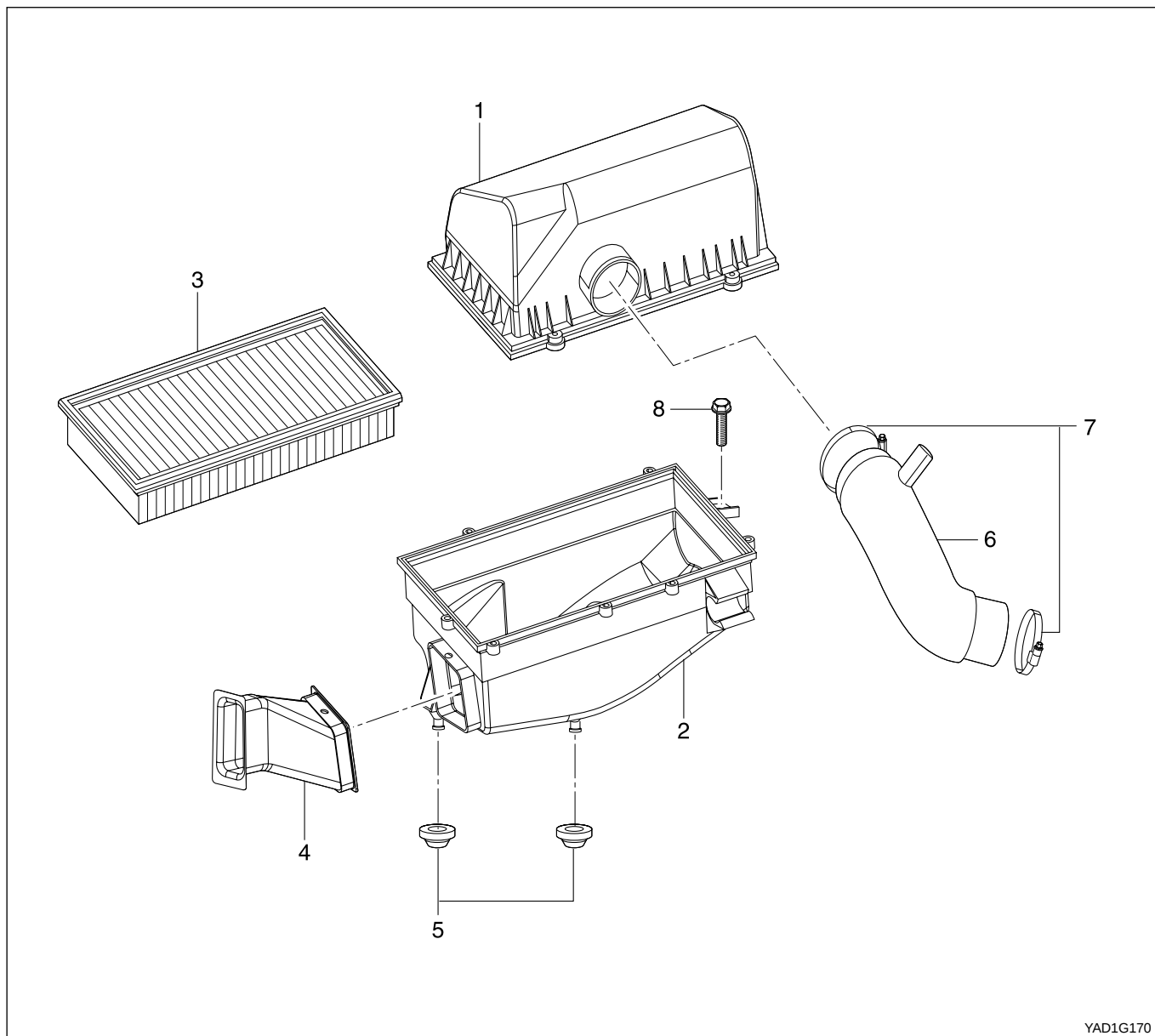
1G-8 ENGINE INTAKE & EXHAUST



5. Install the intake air duct to intake manifold and intake air duct mounting clamp.
6. Connect the HFM sensor connector.



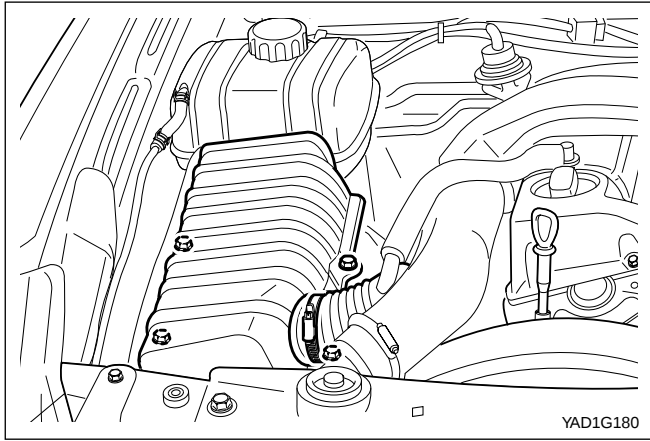
7. Install the air cleaner housing assembly.

AIR CLEANER (DIESEL ENGINE)

YAD1G170

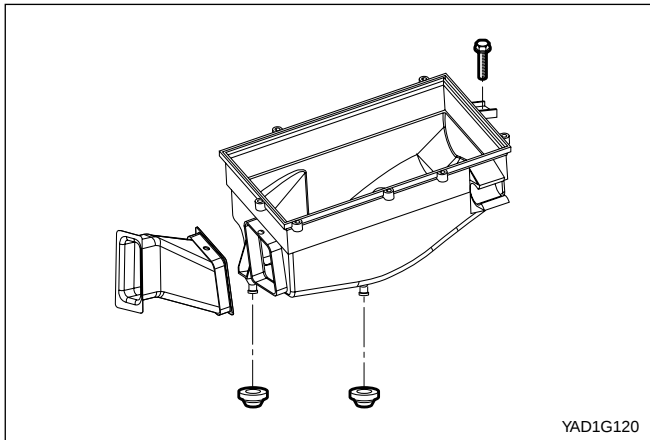
- 1 Air Cleaner Upper Housing
- 2 Air Cleaner Lower Housing
- 3 Element
- 4 Air Duct Inlet

- 5 Insulator
- 6 Air Cleaner to T/C Hose
- 7 Clamp
- 8 Bolt



Removal & Installation Procedure

1. Remove the air cleaner upper housing clamp and mounting bolts and remove the air cleaner upper housing and element.

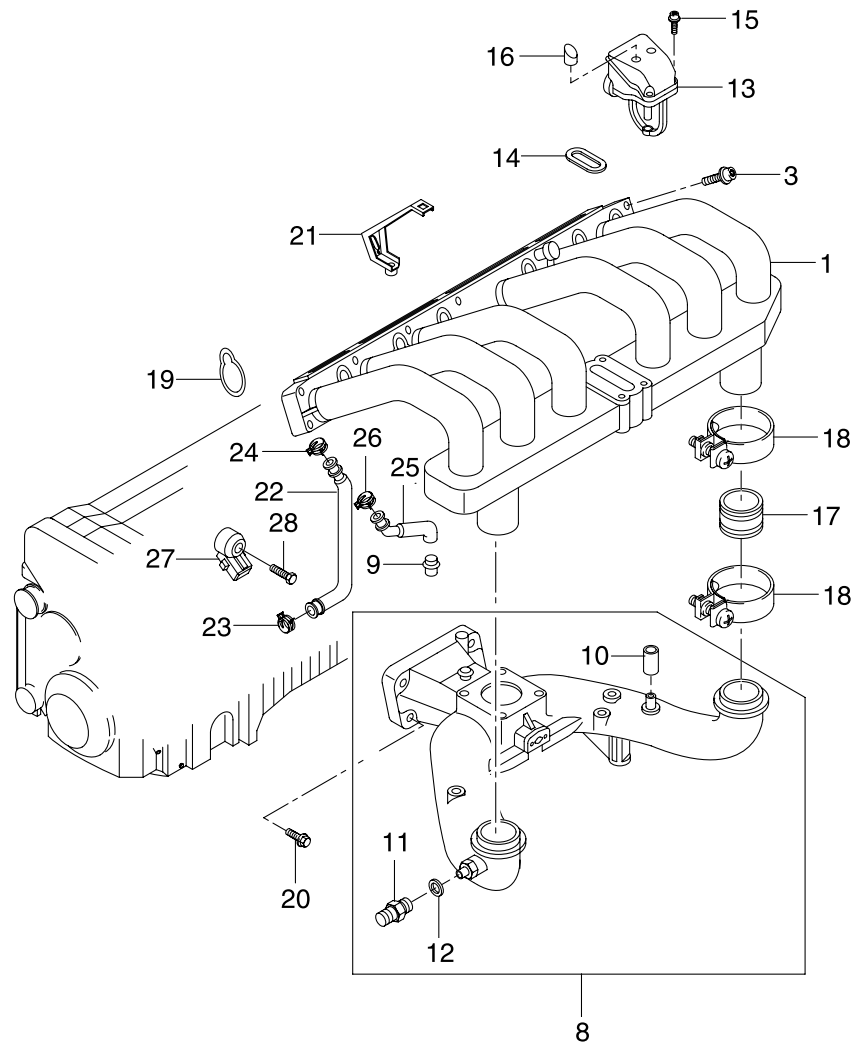


2. Remove the air cleaner lower housing bolt, air cleaner lower housing, air duct inlet and insulators.

3. Installation should follow the removal procedure in the reverse order.

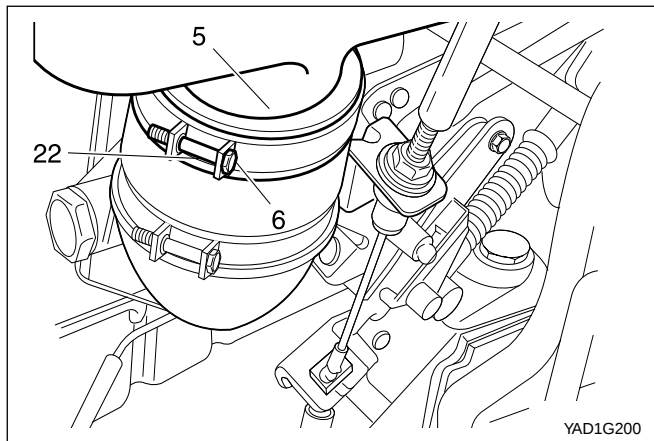
INTAKE MANIFOLD (GASOLINE ENGINE)

Preceding Work : Removal of fuel distributor and injection valve



YAD1G190

- | | |
|---|--|
| 1 Bolt (M6 X 40, 4 pieces)
..... 9-11 N•m (80-97 lb-in) | 13 Bolt (M6 X 40, 4 pieces)
..... 9-11 N•m (80-97 lb-in) |
| 2 Softcap | 14 Throttle Body-Electric |
| 3 Resonance Flap | 15 Gasket..... Replace |
| 4 Gasket..... Replace | 16 Lower Intake Manifold |
| 5 Upper Intake Manifold | 17 Bolt (M8 X 40, 4 pieces)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft) |
| 6 Bolt (M8 X 50, 9 pieces)
..... 22.5-27.5 N•m (16.6-20.3 lb-ft) | 18 Nipple |
| 7 Gasket..... Replace | 19 Seal Ring |
| 8 Blow-by Hose | 20 Connector |
| 9 Blow-by Hose | 21 Connection House |
| 10 Clamp | 22 Clamp |
| 11 Blow-by Nipple | 23 Noise Damper Assembly |
| 12 Inlet Air Housing | 24 Tapping Screw |



Removal & Installation Procedure

Upper Intake Manifold

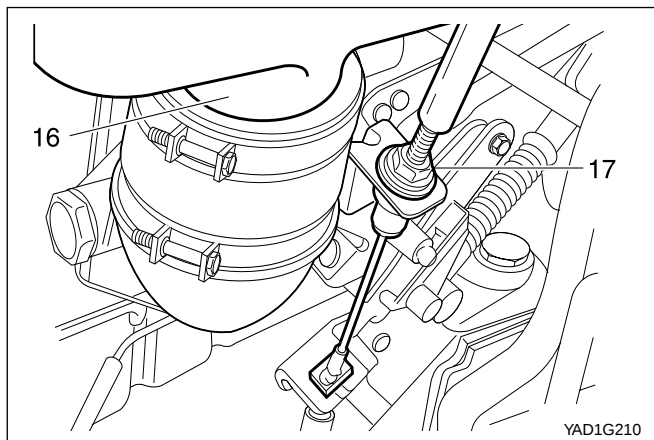
1. Disconnect the vacuum hose (8, 9).
2. Loosen the clamp (22).
3. Remove the upper intake manifold (5) after unscrewing the bolt (6).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
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Check the gasket and replace it if necessary.

4. Installation should follow the removal procedure in the reverse order.



Lower Intake Manifold

Preceding work : removal of upper intake manifold

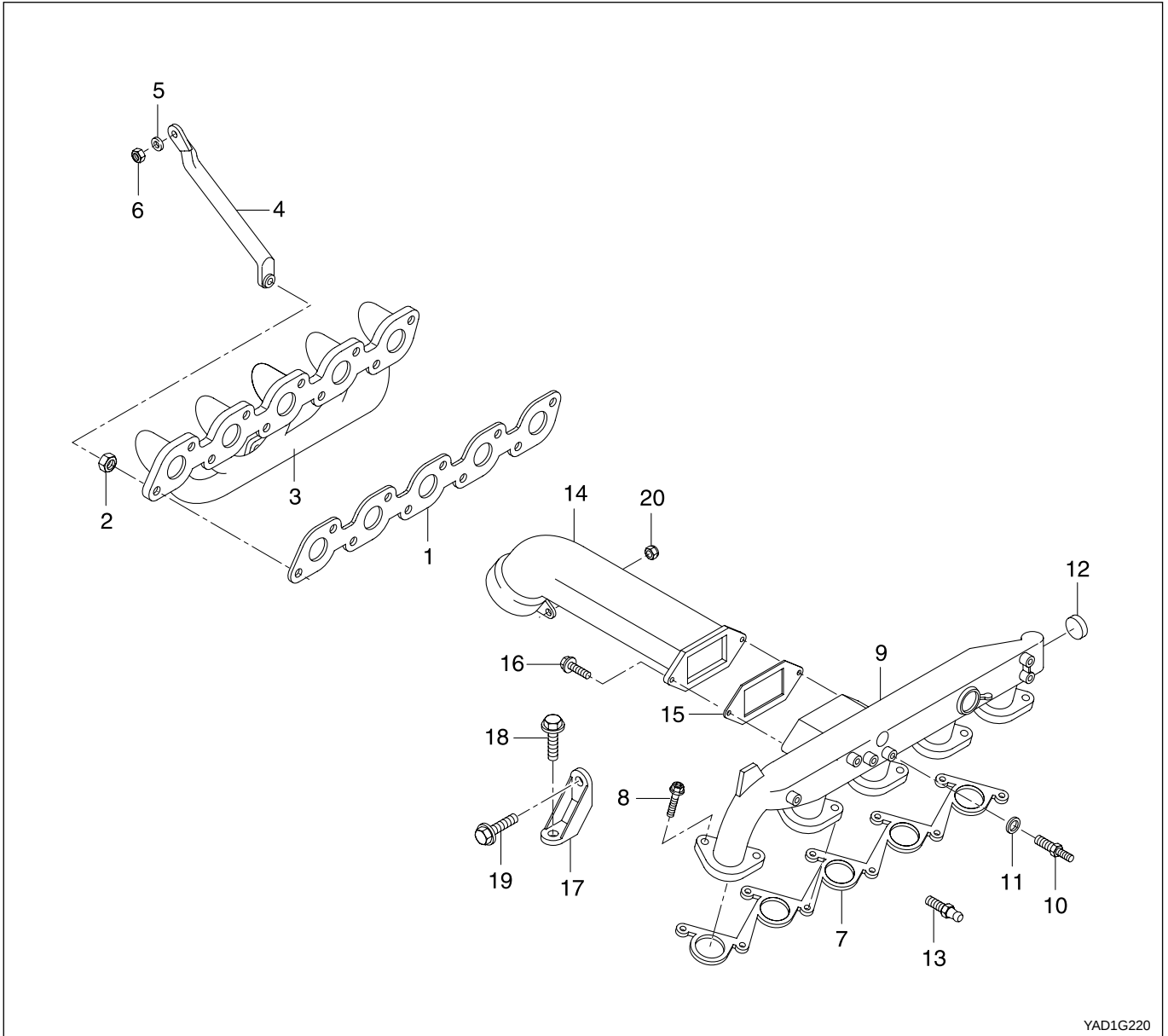
1. Remove the hose of brake booster vacuum line and idle speed connector.
2. Disconnect the water inlet pipe from the bottom of lower intake manifold.
3. Unscrew the bolt (17) and remove the lower intake manifold (16).

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
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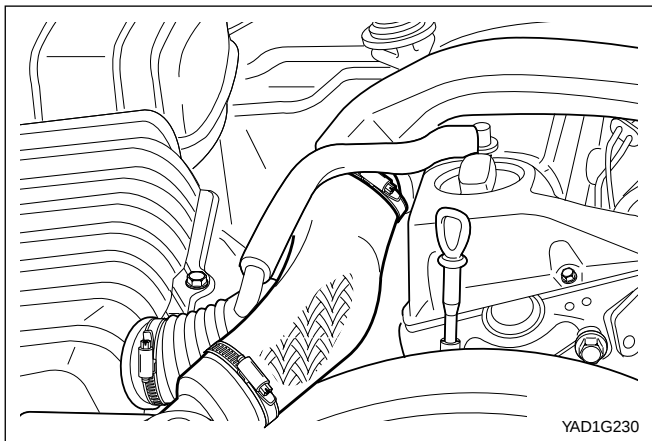
4. Installation should follow the removal procedure in the reverse order.
5. Start the engine and check for leaks at each connection part.

INTAKE MANIFOLD (DIESEL ENGINE)



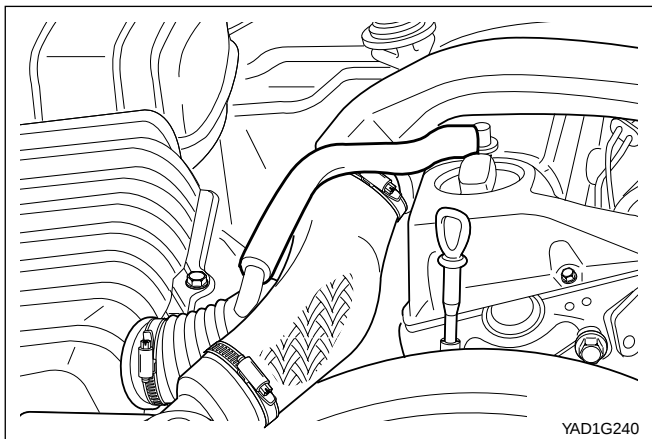
YAD1G220

- | | |
|--|---|
| 1 Gasket | 11 Seal Ring |
| 2 Nut 22.5-27.5 N•m (16.6-20.3 lb-ft) | 12 Expansion Plug |
| 3 Exhaust Manifold | 13 Ball Pivot |
| 4 Support Assembly | 14 Intake Air Duct |
| 5 Washer | 15 Gasket |
| 6 Nut 22.5-27.5 N•m (16.6-20.3 lb-ft) | 16 Bolt 22.5-27.5 N•m (16.6-20.3 lb-ft) |
| 7 Gasket | 17 Bracket |
| 8 Bolt 22.5-27.5 N•m (16.6-20.3 lb-ft) | 18 Bolt |
| 9 Intake Manifold | 19 Bolt |
| 10 Stud Bolt | 20 Nut |

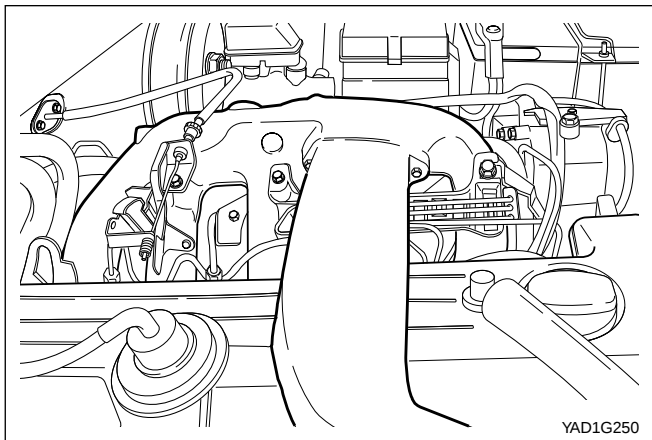


Removal & Installation Procedure

1. Loosen the air hose clamp from the intake air duct and remove the air hose.



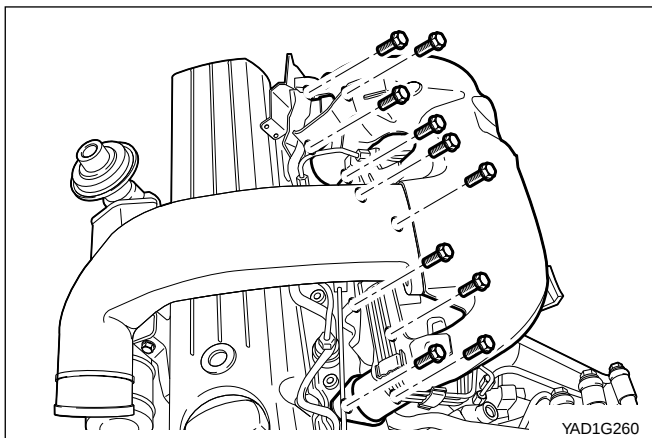
2. Disconnect the blow-by hose.
3. Disconnect the air cleaner and turbo charger hoses.
4. Disconnect the intercooler hoses.



5. Remove the intake air duct mounting bolts and intake air duct.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
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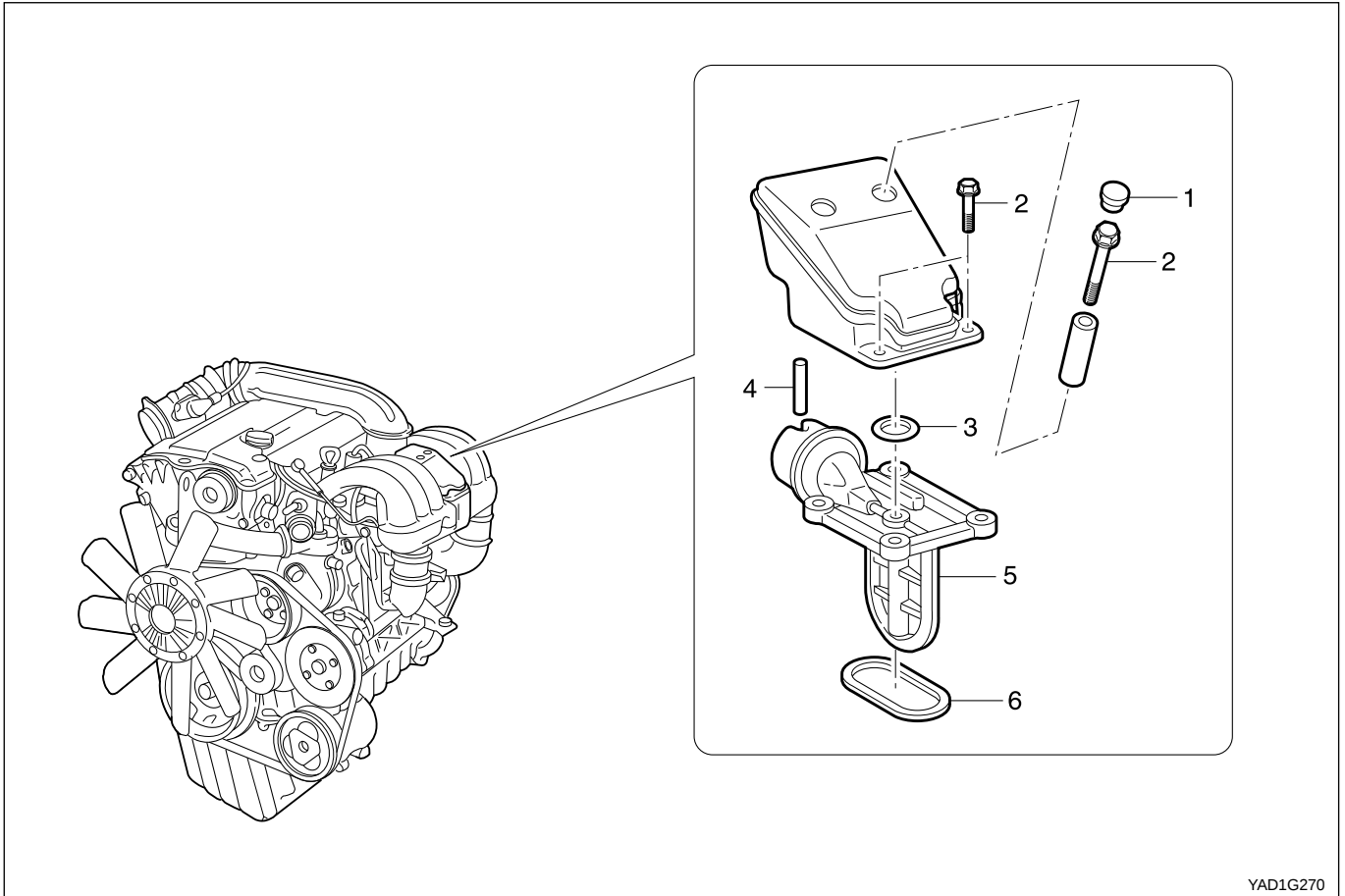


6. Remove the intake manifold mounting bolts and intake manifold.

Installation Notice

Tightening Torque	22.5 - 27.5 N•m (16.6 - 20.3 lb-ft)
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RESONANCE FLAP (GASOLINE ENGINE)



- | | |
|--|-----------------------|
| 1 Soft Cap (2) | 4 Vacuum Hose |
| 2 Bolt (M6 X 40, 4 pieces)
..... 9-11 N•m80-97 lb-in) | 5 Resonance Flap |
| 3 O-ring | 6 Gasket..... Replace |

Removal & Installation Procedure

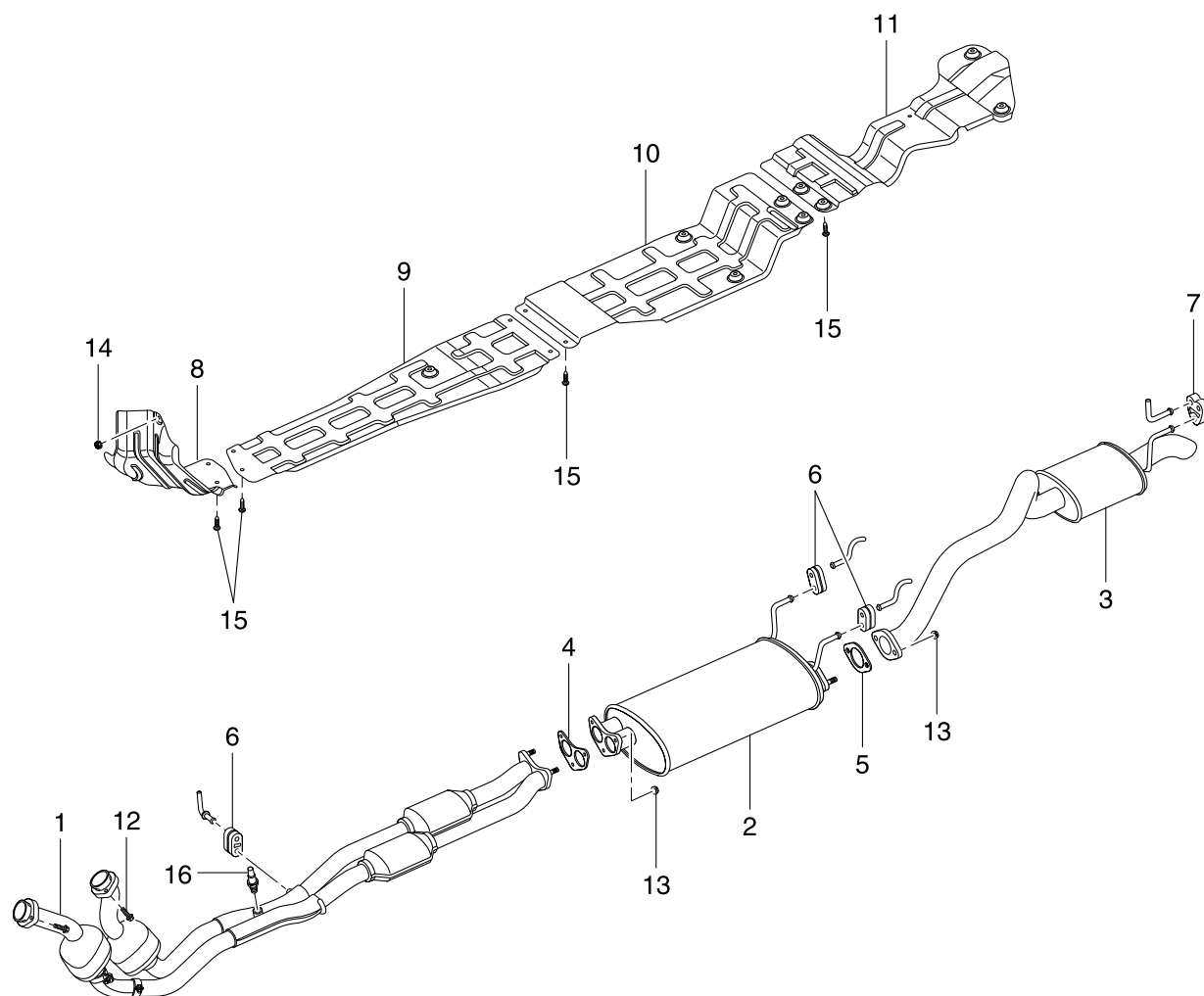
1. Remove the 2 soft caps (1).
2. Remove the upper resonance flap coupling after removing 4 bolt (2).

Installation Notice

Tightening Torque	9 - 11 N•m (80 - 97 lb-ft)
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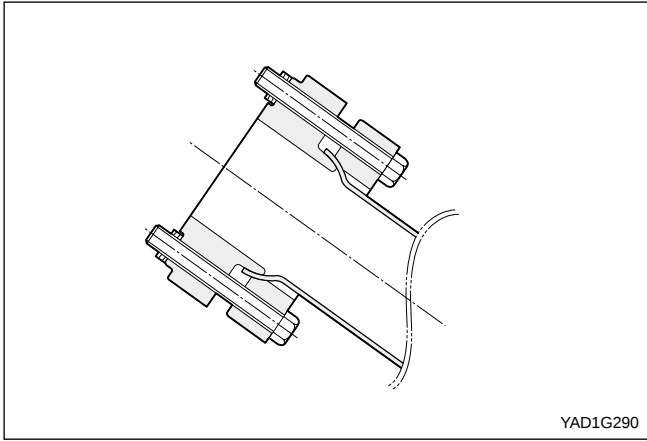
3. Check the O-ring (3) and replace it if necessary.
4. Remove the lower resonance flap (5).
5. Replace the gasket (6).
6. Installation should follow the removal procedure in the reverse order.

EXHAUST LINE (GASOLINE ENGINE)



YAD1G280

- | | |
|------------------------|--------------------------------------|
| 1 Front Exhaust Pipe | 9 Heat Protector No. 2 |
| 2 Muffler | 10 Heat Protector No. 3 |
| 3 Tail Exhaust Pipe | 11 Heat Protector No. 4 |
| 4 Gasket..... Replace | 12 Bolt..... 15-28 N•m (11-21 lb-ft) |
| 5 Gasket..... Replace | 13 Nut 28-47 N•m (21-35 lb-ft) |
| 6 Hanger | 14 Nut 8-18 N•m (6-13 lb-ft) |
| 7 Hanger | 15 Screw |
| 8 Heat Protector No. 1 | 16 Oxygen Sensor |

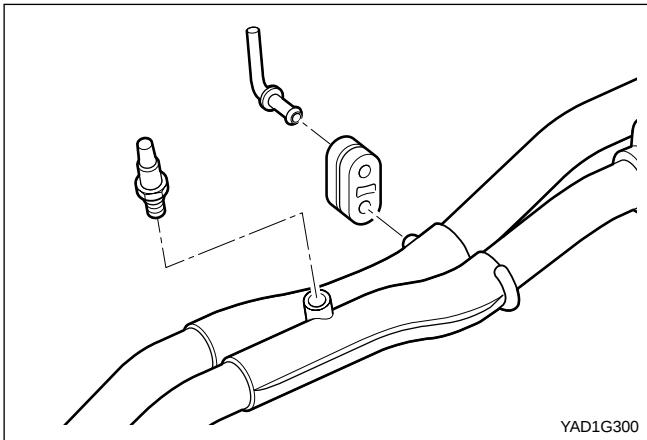


Removal & Installation Procedure

1. Disconnect the oxygen sensor electrical connectors.
2. Remove the exhaust manifold to front exhaust pipe nuts.

Installation Notice

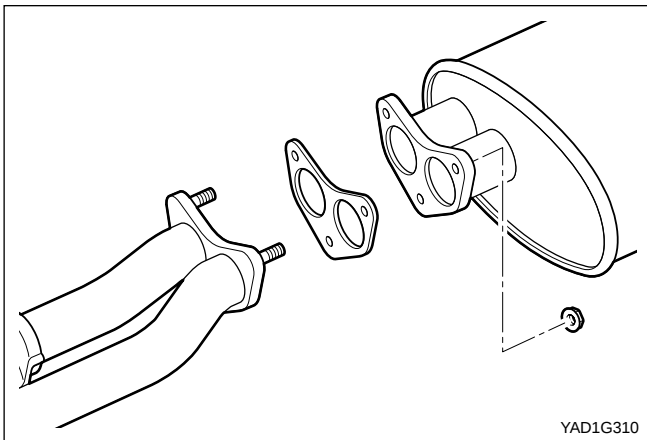
Tightening Torque	15 - 28 N•m (11 - 21 lb-ft)
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3. Remove the oxygen sensor and hanger from the front exhaust pipe.
4. Remove the front exhaust pipe to muffler nuts.

Installation Notice

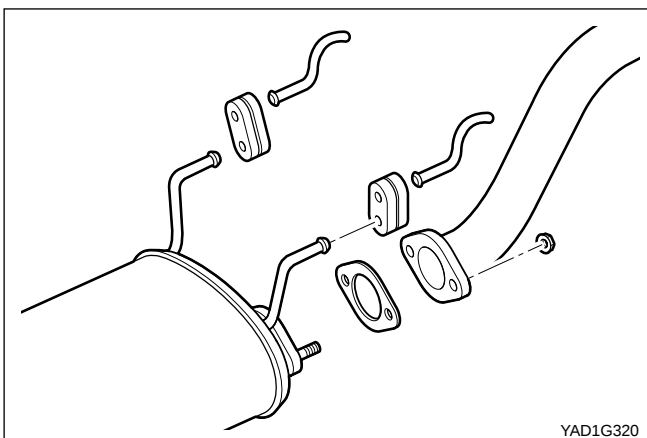
Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)
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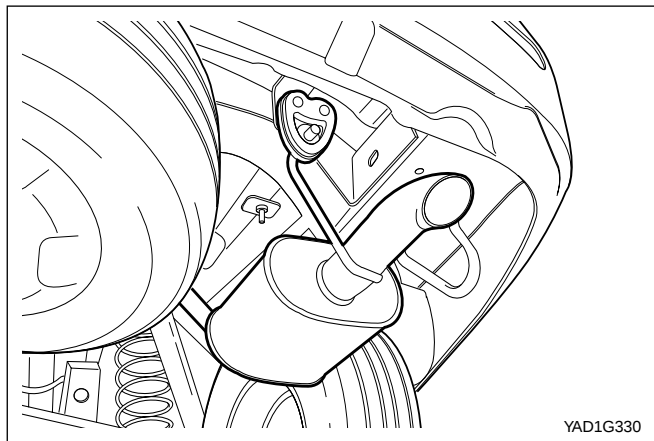
5. Remove the muffler to tail exhaust pipe nuts.

Installation Notice

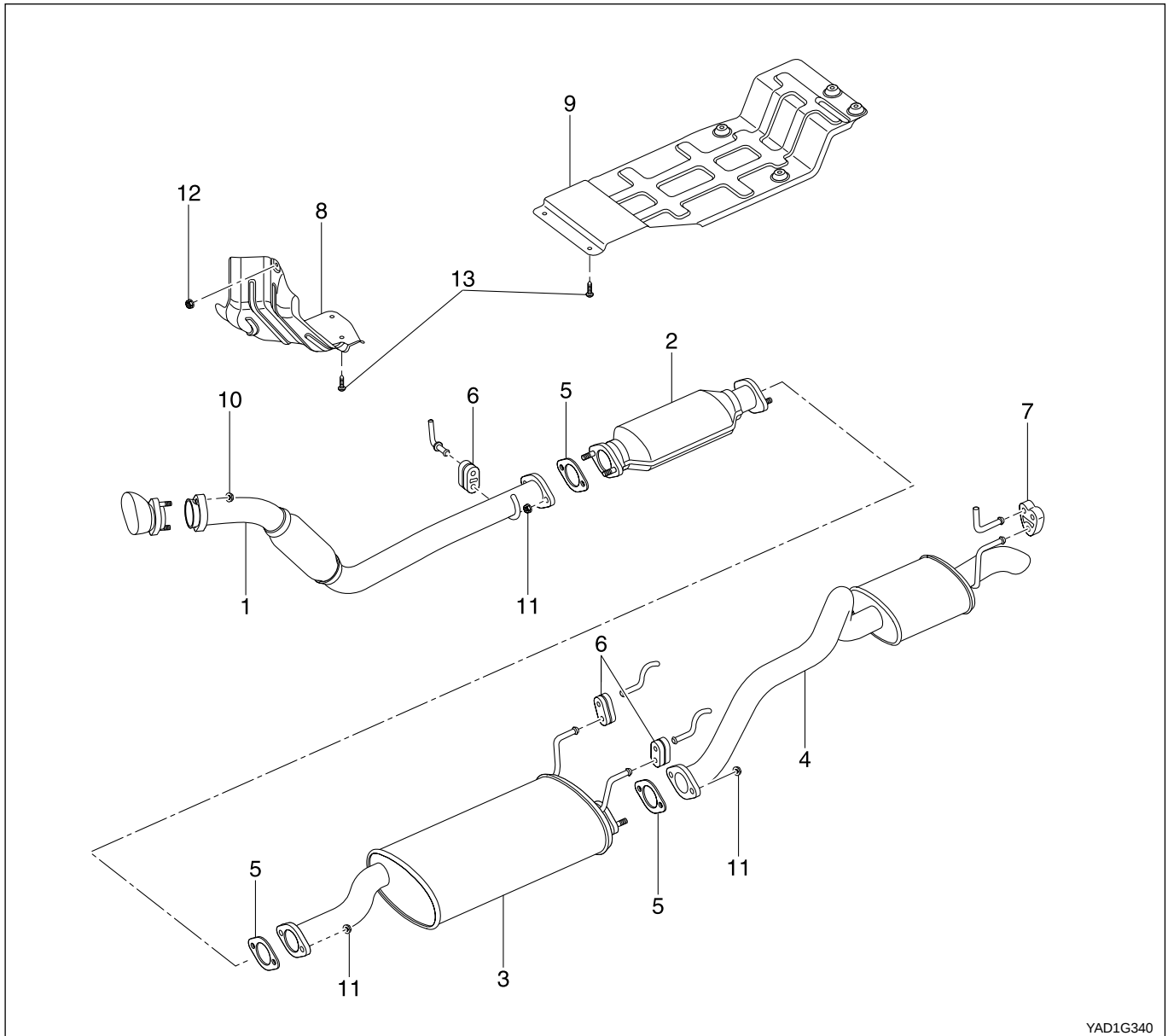
Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)
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6. Remove the Mounting hanger and muffler.

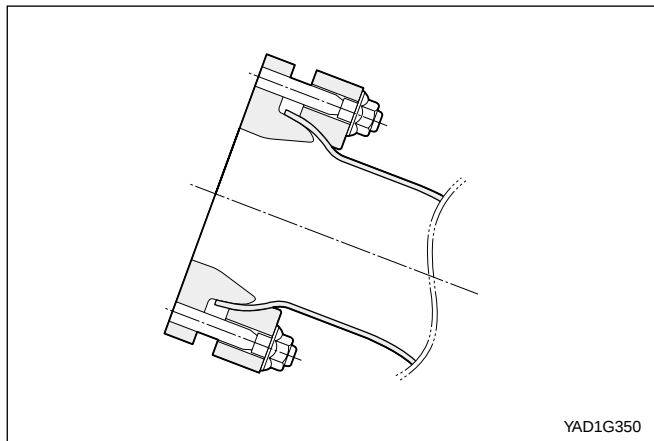


7. Remove the mounting hanger and tail exhaust pipe.
8. Check the muffler and pipes for holes, damage, open seams, or other deterioration. Which could permit exhaust fumes to seep into the passenger compartment or the trunk.
9. Installation should follow the removal procedure in the reverse order.

EXHAUST LINE (DIESEL ENGINE)

YAD1G340

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|---------------------------------------|--------------------------------------|
| 1 Front Exhaust Pipe | 8 Heat Protector No. 1 |
| 2 Diesel Oxidation Catalyst Converter | 9 Heat Protector No. 3 |
| 3 Muffler | 10 Nut 15-28 N•m (11-21 lb-ft) |
| 4 Tail Exhaust Pipe | 11 Nut 28-47 N•m (21-35 lb-ft) |
| 5 Gasket | 12 Nut 8-18 N•m (6-13 lb-ft) |
| 6 Hanger | 13 Screw |
| 7 Hanger | |

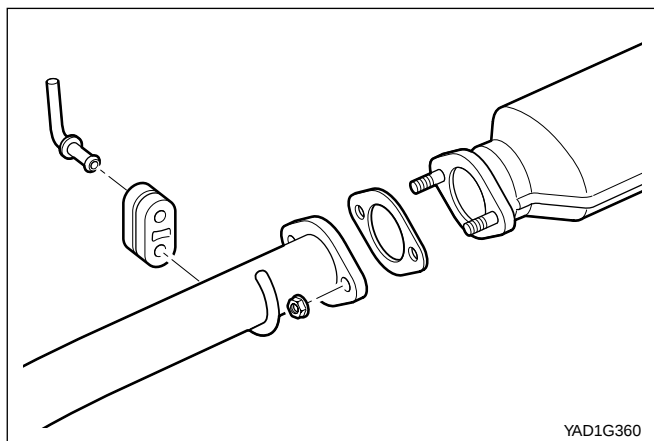


Removal & Installation Procedure

1. Remove the exhaust manifold to front exhaust pipe nuts and mounting hanger.

Installation Notice

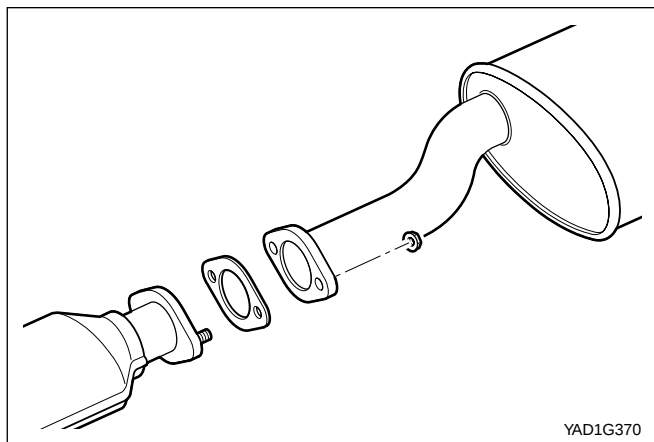
Tightening Torque	15 - 28 N•m (11 - 21 lb-ft)
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2. Remove the front exhaust pipe to diesel oxidation catalyst converter nuts and front exhaust pipe.

Installation Notice

Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)
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3. Remove the diesel oxidation catalyst converter to muffler nuts and diesel oxidation catalyst converter.

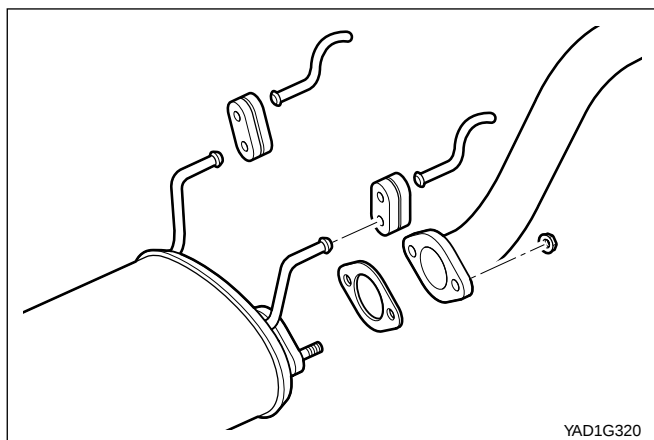
Installation Notice

Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)
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4. Remove the muffler to tail exhaust pipe nuts.

Installation Notice

Tightening Torque	28 - 47 N•m (21 - 35 lb-ft)
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5. Remove the mounting hangers and then remove the muffler and tail exhaust pipe.
6. Check the muffler and pipes for holes, damage, open seams, or other deterioration which could permit exhaust fumes to seep into the passenger compartment or the trunk.
7. Installation should follow the removal procedure in the reverse order.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N•m	Lb-Ft	Lb-In
DOC to Muffler Nut	28 - 47	21 - 35	-
Exhaust Manifold to Front Exhaust Pipe Nut	15 - 28	11 - 21	-
Front Exhaust Pipe to DOC Nut	28 - 47	21 - 35	-
Front Exhaust Pipe to Muffler Nut	28 - 47	21 - 35	-
Intake Air Duct Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Intake Manifold Mounting Bolt	22.5 - 27.5	16.6 - 20.3	-
Muffler to Tail Exhaust Pipe Nut	28 - 47	21 - 35	-
Resonance Flap Mounting Bolt	9 - 11	-	80 - 97