4HV1-CNG Engine

Maintenance Precautions

To prevent damaging the engine and to ensure the reliability of engine performance, be careful of the following points when performing engine maintenance. For information on working safely, refer to "Precautions When Working" in Section 0A, Overview.

- When lifting or supporting the engine, do not directly attach the jack to the oil pan.
  When lowering the engine to the ground, do not let the oil pan directly contact the ground. Use a wooden frame, etc. to support it on its engine foot or flywheel housing.
  (There is only a small gap between the oil pan and oil pump strainer, so be careful not to damage the oil pan and oil pump strainer.)
- When the air intake system, such as the air duct or air cleaner, has been removed, cover the air intake to prevent foreign matter from entering the cylinder.
- To perform maintenance on the engine, always remove the battery ground terminals. If the battery ground terminals are not disconnected while performing work, there is the possibility of damaging the wire harness or electrical components. Take adequate precautions for safety, such as short circuits, when inspections require an energized state.
- To protect and lubricate the sliding surfaces when running the engine for the first time, apply an adequate amount of engine oil to the sliding surfaces.
- When the valve-related parts, pistons, piston rings, control rods, control rod bearings, crankshaft journal bearings, etc. have been removed, organize them in order for storage.
- When installing, use the same parts and install them in the same position as when they were removed.
- Whenever disassembling the gasket, oil seals and O-rings, replace them with new ones.
- Completely wipe off old liquid gaskets from the locations where liquid gaskets were used. After cleaning to completely remove any oil, moisture and filth, apply the specified liquid gasket and reassemble.
- After applying the liquid gasket, assemble within the specified amount of time. If the time of assembly has exceeded the specified amount of time, wipe away the liquid gasket and reapply it.
- When assembling and installing, tighten at the specified torque value.

Precautions for work particular to this engine

1. Gas-related matters

Natural gas (CNG) is combustible gas with a high pressure of a maximum of 200 atmospheres approx. 20 MPa(204 kg/cm^2/2900 psi). It is necessary to exercise sufficient caution when performing inspection and maintenance. Take particular caution with regard to the following when performing maintenance of gas-related devices.

1. Carry out maintenance in a well-ventilated work area where there is no fire.
2. When removing electrical wiring, etc., confirm that there is no accumulation of gas.
3. If a gas leak is discovered, do not carelessly proceed to operate switches such as for lighting and ventilation fans.
4. When removing and installing pipes and components such as CNG container (CNG cylinder) and gas passages, start the engine after fully closing the manual cylinder valve (at tank) for all of the CNG container (CNG cylinder). Turn off the ignition switch OFF after idling the engine and confirming that the gas remaining in the components and pipes has combusted and that the engine has stopped.
5. Make sure to use pipes that are equivalent to those specified by Isuzu.
6. When replacing CNG container (CNG cylinder) and components, securely install them after sufficiently inspecting each fitting section for damages.
7. After installation or removal work, force-open the valves and thoroughly confirm that there are no gas leaks at normal pressure.

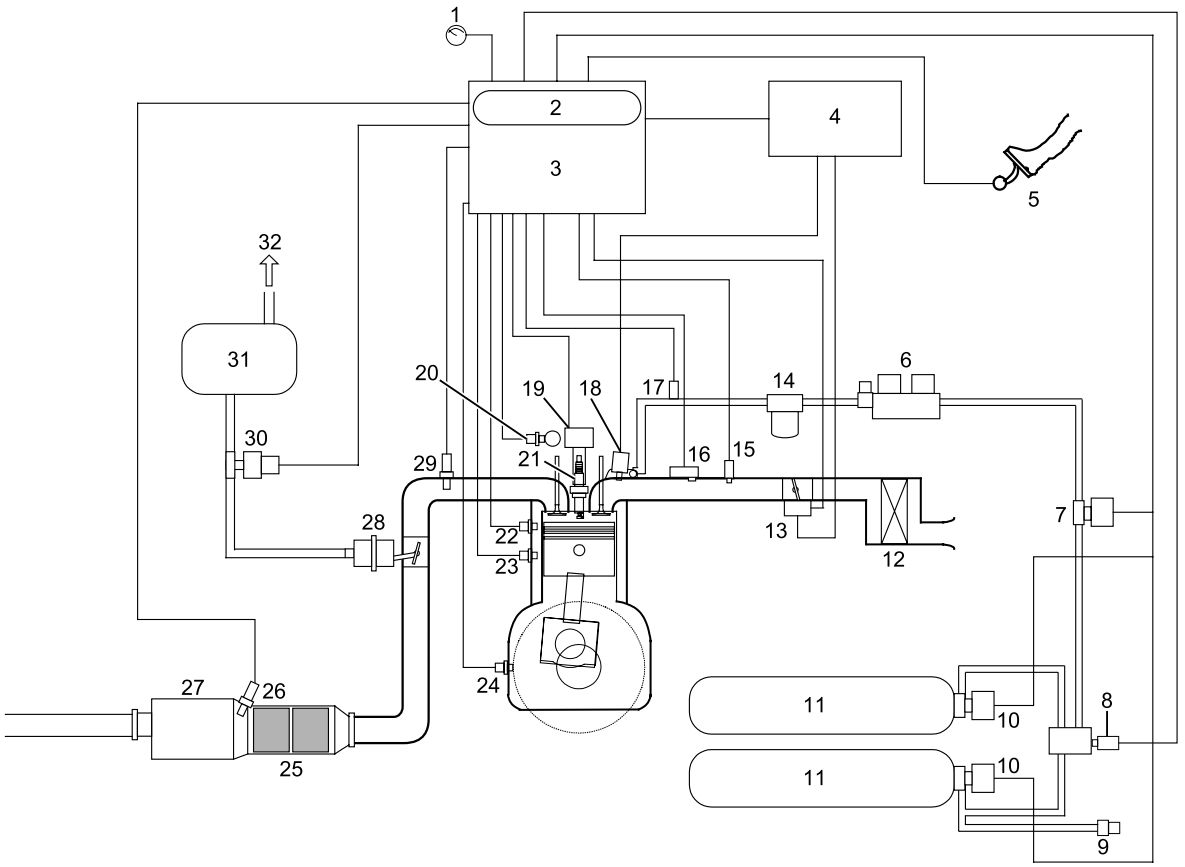
2. Axial-type oil seals

- Since axial-type front oil seals and rear oil seals are used for the crankshaft, exercise caution regarding the following points.
  - When replacing, replace the oil seal and slinger together.
  - Since it is important to set the position of the oil seal and slinger in the front and rear direction accurately, properly use special tools when doing so.

3. Valve caps

- As valve caps are used for the intake and exhaust valves, exercise great caution in detail when carrying out disassembly and assembly, such as not to drop valve caps into the gear case or oil return hole.

except Australia

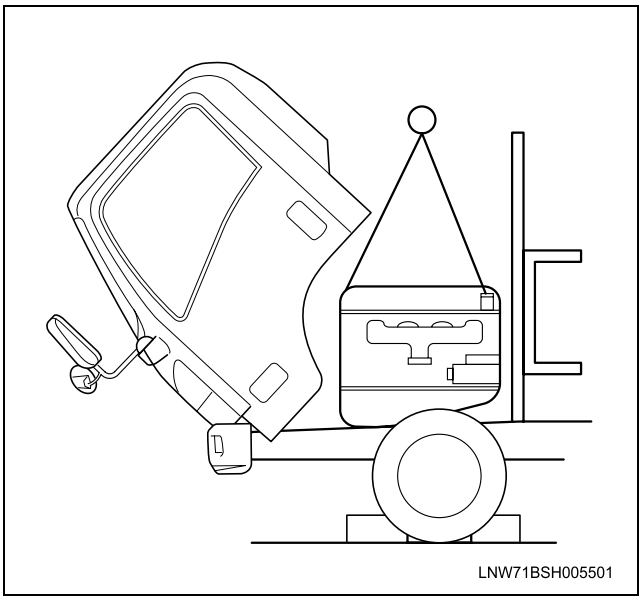


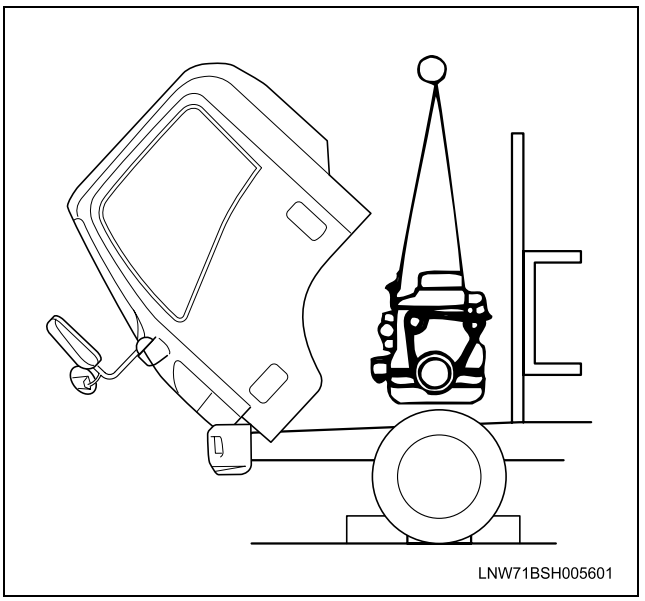
LNW91BLF001801

Legend

1. Fuel gauge
2. Barometric sensor
3. Engine control module (ECM)
4. Engine driver unit (EDU)
5. Accelerator pedal position (APP) sensor
6. Pressure regulator
7. Automatic valve (before regulator)
8. CNG pressure sensor
9. Filling unit
10. Automatic valve (at tank) and manual cylinder valve
11. CNG container (CNG cylinder)
12. Air cleaner
13. Intake throttle valve
14. Gas filter
15. Intake air temperature (IAT) sensor
16. Intake air pressure (MAP) sensor
17. CNG pressure / temperature sensor
18. Gas injector
19. Ignition coil
20. Camshaft position (CMP)sensor
21. Spark plug
22. Engine coolant temperature (ECT) sensor
23. Knock sensor
24. Crankshaft position (CKP) sensor
25. 3-way catalyst integrated silencer
26. O_2 sensor
27. Silencer
28. Exhaust brake
29. Air-fuel ratio (A/F) sensor
30. Exhaust brake magnetic valve
31. Vacuum tank
32. Vacuum

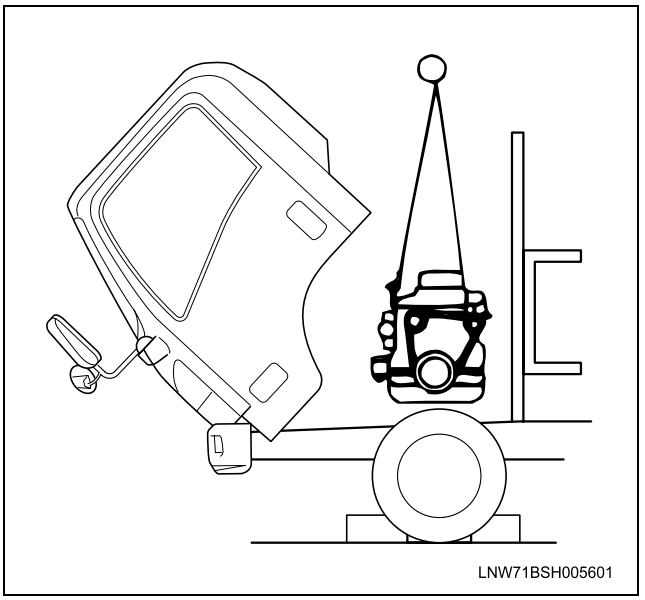
14. A/C compressor
    - Remove the A/C compressor drive belt.
    - Remove the compressor from the A/C compressor bracket and fasten it to any suitable position together with the hoses using a wire, etc.
15. Vacuum hose
    - Remove the hose at the vacuum pump side.
16. Disconnect the connectors and clips of the engine harness with the ECM, EDU and frame harness.
17. Engine mount
    - Before removing the engine mount, use the hoist to suspend the engine.
    - Remove the mounting bolts on the chassis frame side of the engine mount.
18. Engine assembly
    - Slowly operate the hoist to raise the engine above the surface of the chassis frame.
    - Turn the engine 90° and move it from the chassis frame top surface to remove the engine assembly.





Installation

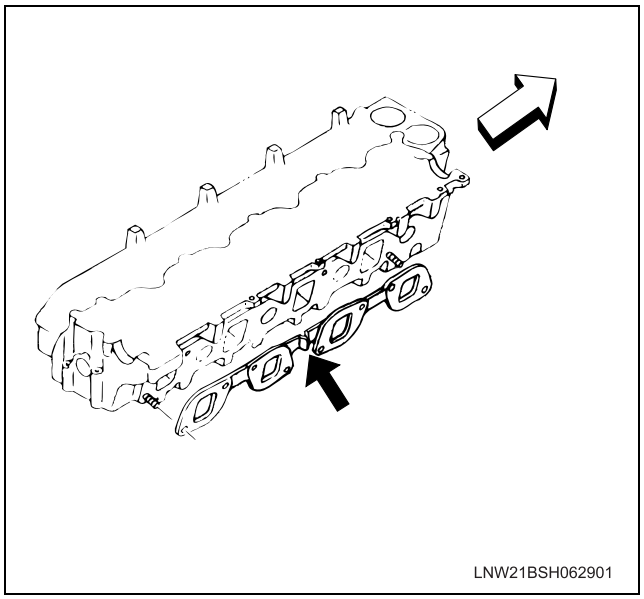
1. Install the engine assembly.
    - Install the hoist wire to the engine hanger and hoist to lift the engine.
    - Operate the hoist to move the engine to the installation position.



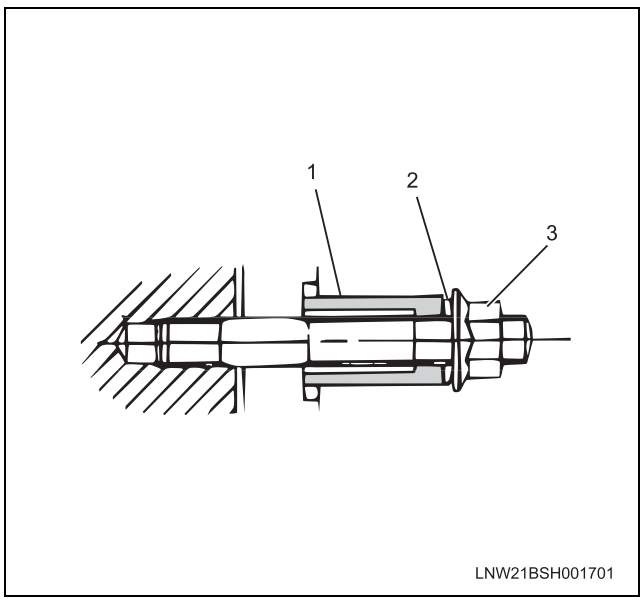
    - Turn the engine 90° and slowly lower it to the engine installation position.

Installation

1. Install the gasket of the exhaust manifold.
   - Face the protruding section in the center towards the outside.


LNW21BSH062901

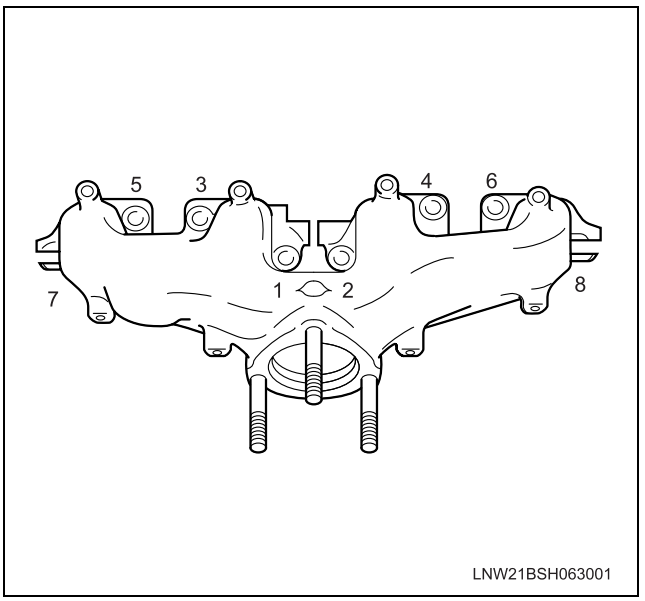
2. Install the exhaust manifold.
   - Install the distance tube (1), disc spring (2), nut (3), and bolt, in this order, to the stud on the cylinder head.



LNW21BSH001701

   - Tighten the exhaust manifold in the order shown in the diagram.

Tightening torque: 34 N·m (3.5 kg·m/25 lb·ft)



LNW21BSH063001

3. Install the heat protector.
   - Install the heat protector and tighten it at the specified torque.

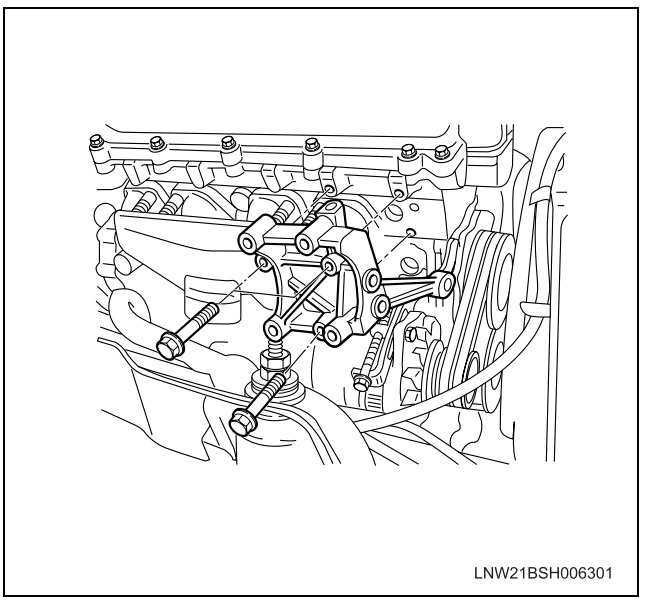
Tightening torque: 10 N·m (1.0 kg·m/87 lb·in)

4. Install the exhaust pipe.
   - Tighten the pipe at the specified torque.
   - Exhaust manifold side

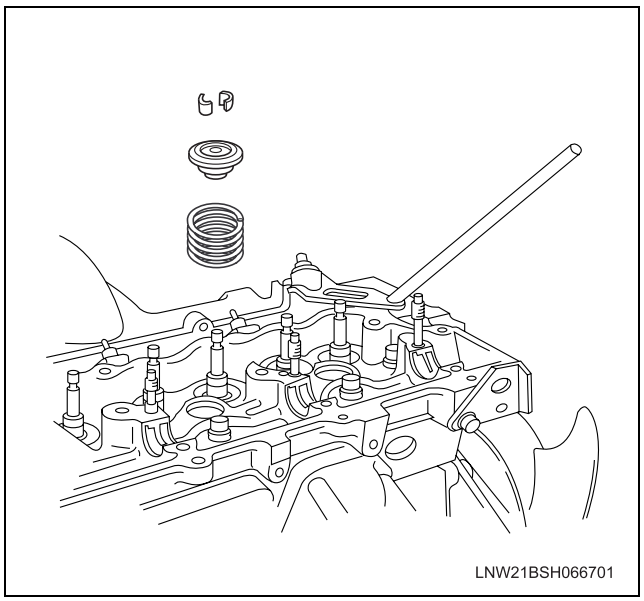
Tightening torque: 67 N·m (6.8 kg·m/49 lb·ft)

5. Install the A/C compressor.
   - Install the A/C compressor bracket to the cylinder head, and tighten it at the specified torque.

Tightening torque: 48 N·m (4.9 kg·m/35 lb·ft)

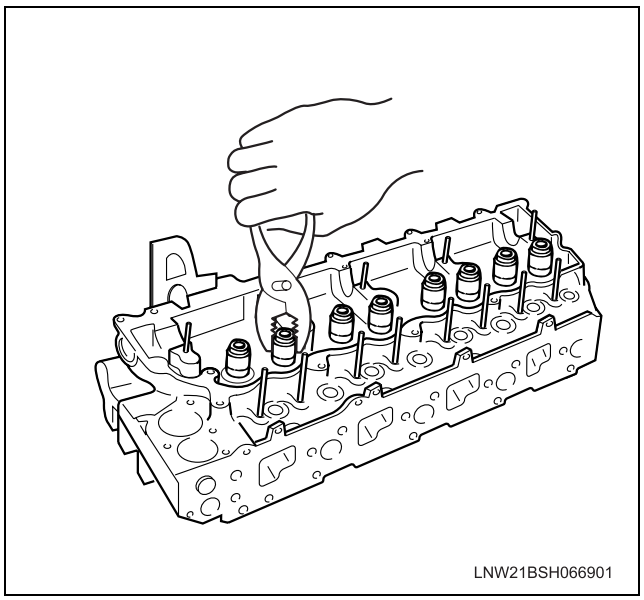

LNW21BSH006301

- Remove the special tool and then remove the upper seats and springs.
  Organize the removed valve springs in the order of the cylinder number.



4. Remove the valve stem oil seals.
   - Remove the oil seals using pliers.

NOTE:
Do not reuse the removed oil seals.



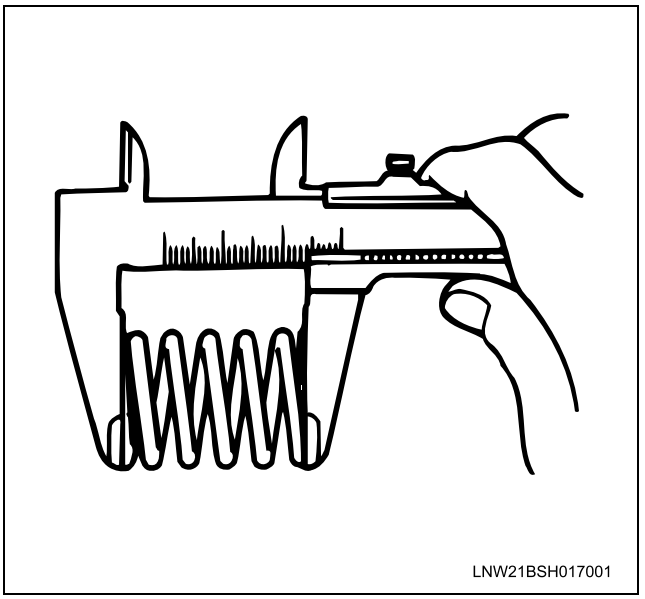
5. Remove the spring lower seats.

Inspection

Valve spring inspection
Visually inspect the valve springs and replace them when damage or abnormal wear is found.

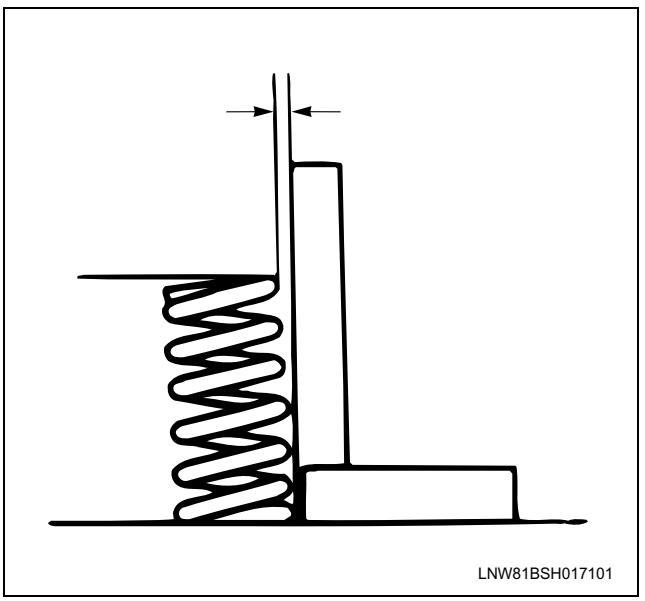
1. Free length
   - Measure the free length of the springs. If it is lower than the specified limit, replace the spring.

Free length of valve spring	mm(in)
Standard value	62.5(2.461)
Limit	59.4(2.339)



2. Degree of perpendicular condition
   - Measure the degree of perpendicular condition with a right-angle gauge. Replace the valve spring if the measured value exceeds the limit.

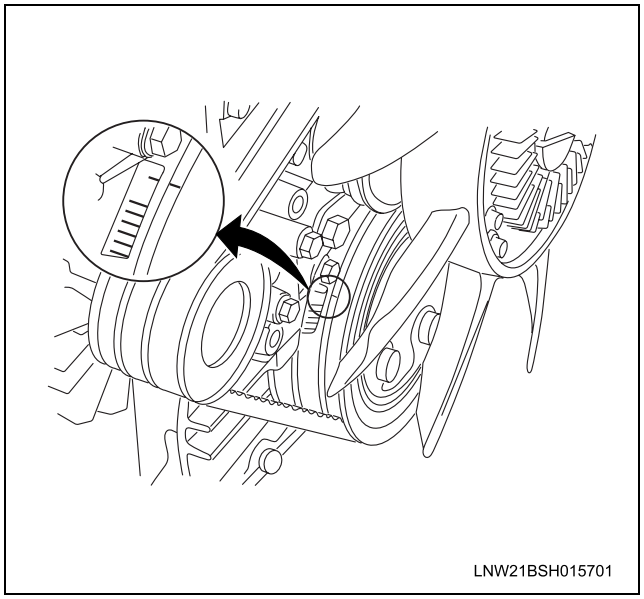
Perpendicularity of the valve spring	mm(in)
Limit	1.0(0.039)



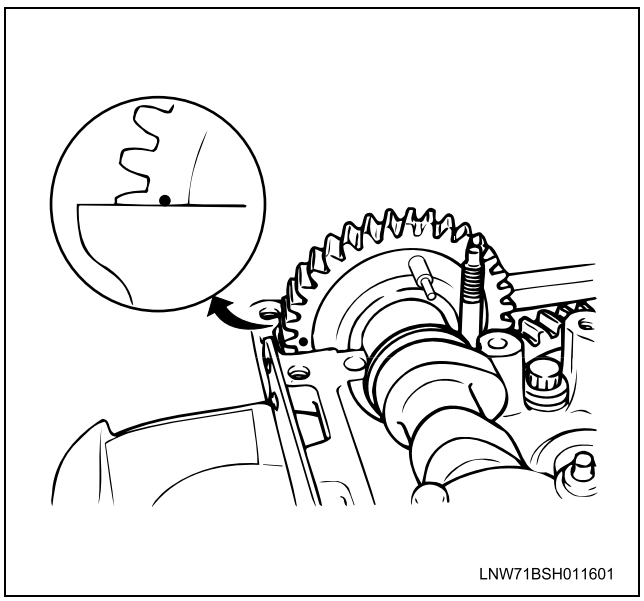
3. Tension

Installation

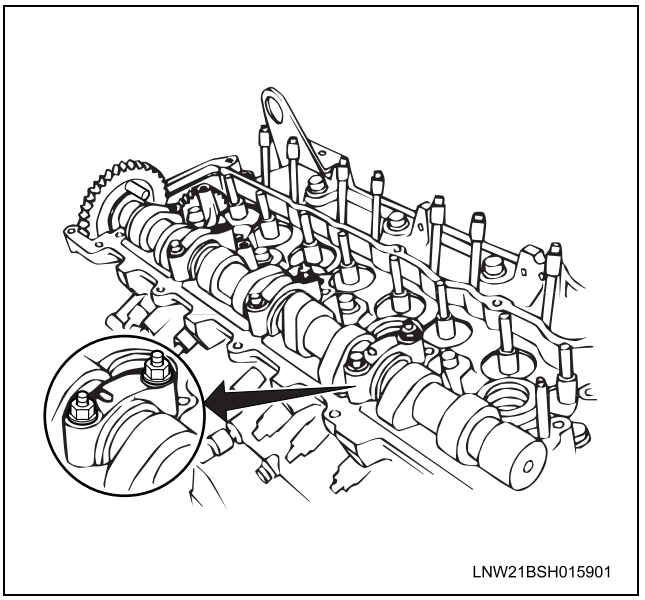
1. Rotate the crankshaft in the forward direction to align the 1st cylinder piston to compression top dead center.



2. Install the camshaft bearing lower.
   - Apply engine oil to the camshaft bearing lower and assemble to the cylinder head.
3. Install the camshaft assembly.
   - Assemble the camshaft assembly so that the "●" mark on the camshaft gear end aligns with the top surface of the cylinder head.

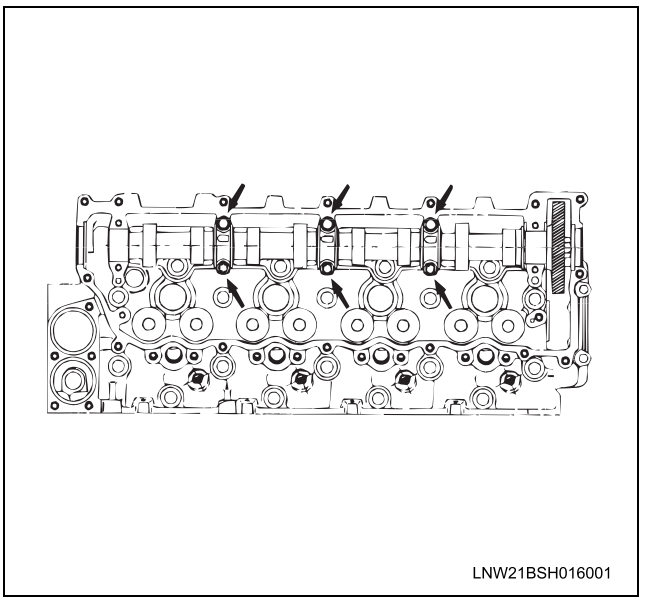


4. Install the bearing upper.
5. Install the bearing cap.
   - Apply engine oil to the bearing upper.
   - Face the front mark on the bearing cap to the engine front side, and assemble in the order of the numbers to the cylinder head.



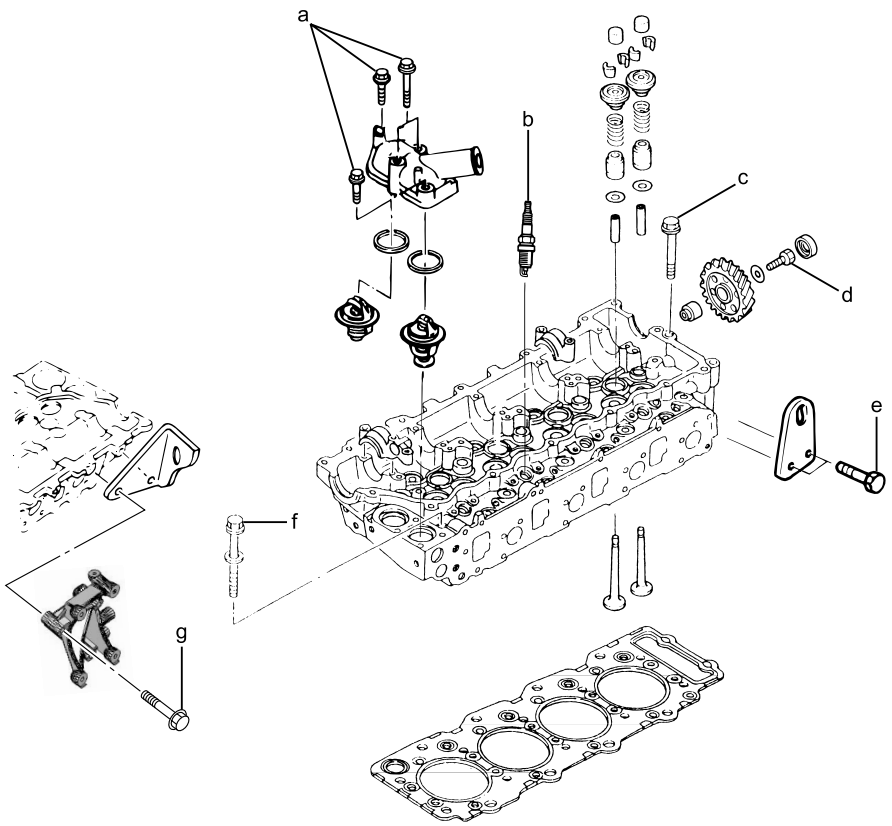
   - Apply engine oil to the threaded portion, and tighten the bearing cap at the specified torque.

Tightening torque: 27 N·m (2.8 kg·m/20 lb·ft)



   - Pull out the alignment pin (1) cautiously so as not to drop it into the engine.

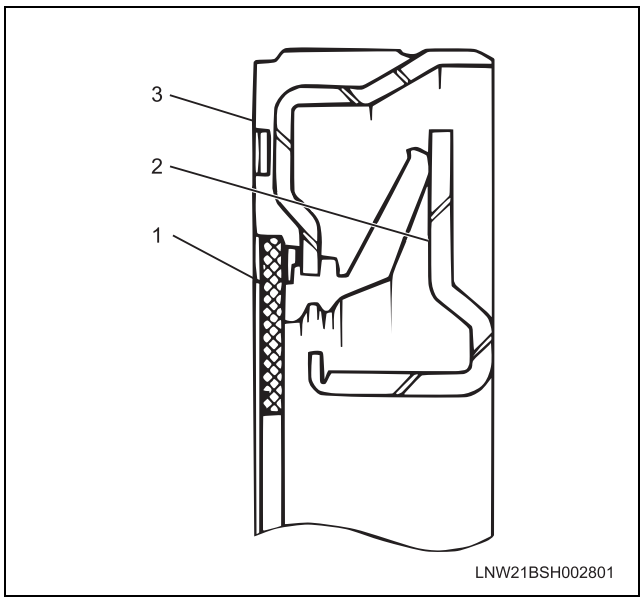
List of Tightening Torques



LNW71BLF004601

(a) 24 N·m (2.4 kg·m/17 lb·ft)
(b) 18 N·m (1.8 kg·m/13 lb·ft)
(c) 38 N·m (3.9 kg·m/28 lb·ft)
(d) 95 N·m (9.7 kg·m/70 lb·ft)
(e) 48 N·m (4.9 kg·m/35 lb·ft)
(f) 98 N·m (10.0 kg·m/72 lb·ft) → 147 N·m (15.0 kg·m/108 lb·ft) → 30° - 60°
(g) 48 N·m (4.9 kg·m/35 lb·ft)

- Be careful not to damage the shaft and oil seal installation surface of the flywheel housing. Use a screwdriver to pry only the oil seal to remove it.

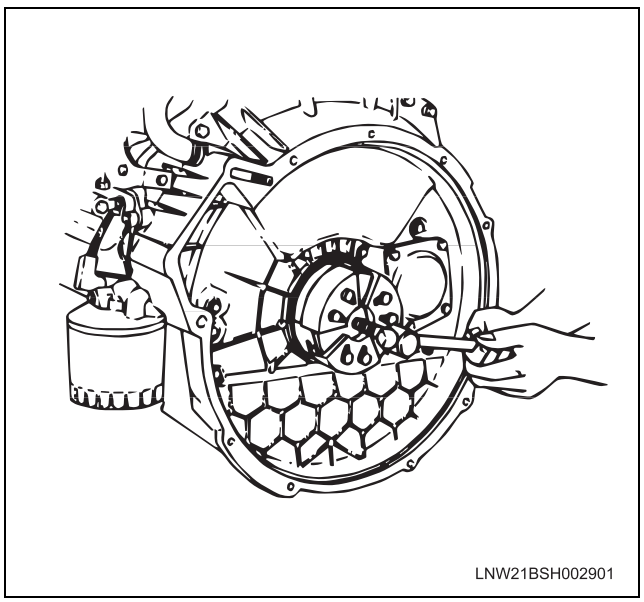


Legend
1. Felt
2. Slinger
3. Oil seal

3. Remove the crankshaft rear slinger.
   - Pull out the slinger using a puller.

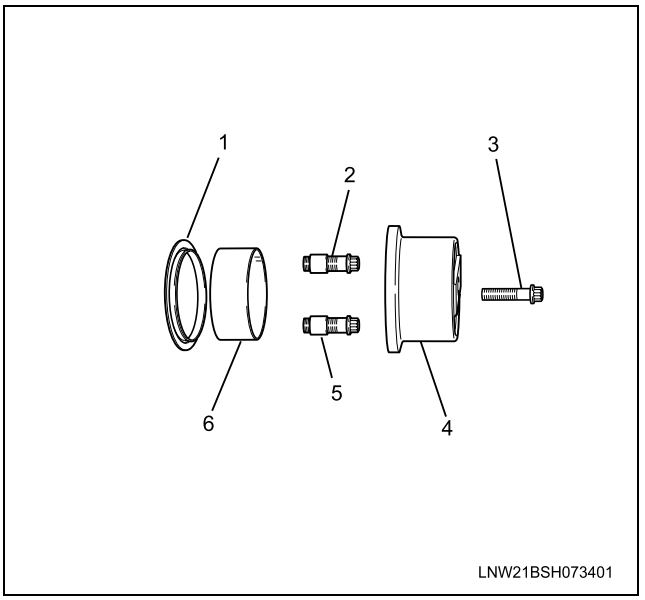
Special Tool

Slinger puller: 5-8840-2360-0



Installation

1. Install the crankshaft rear slinger.
   - Firmly fit the rear slinger using the oil seal installer kit.



Legend
1. Rear slinger
2. Fixing bolt
3. Center bolt
4. Sleeve (rear)
5. Collar (rear)
6. Adaptor (rear)

Special Tool

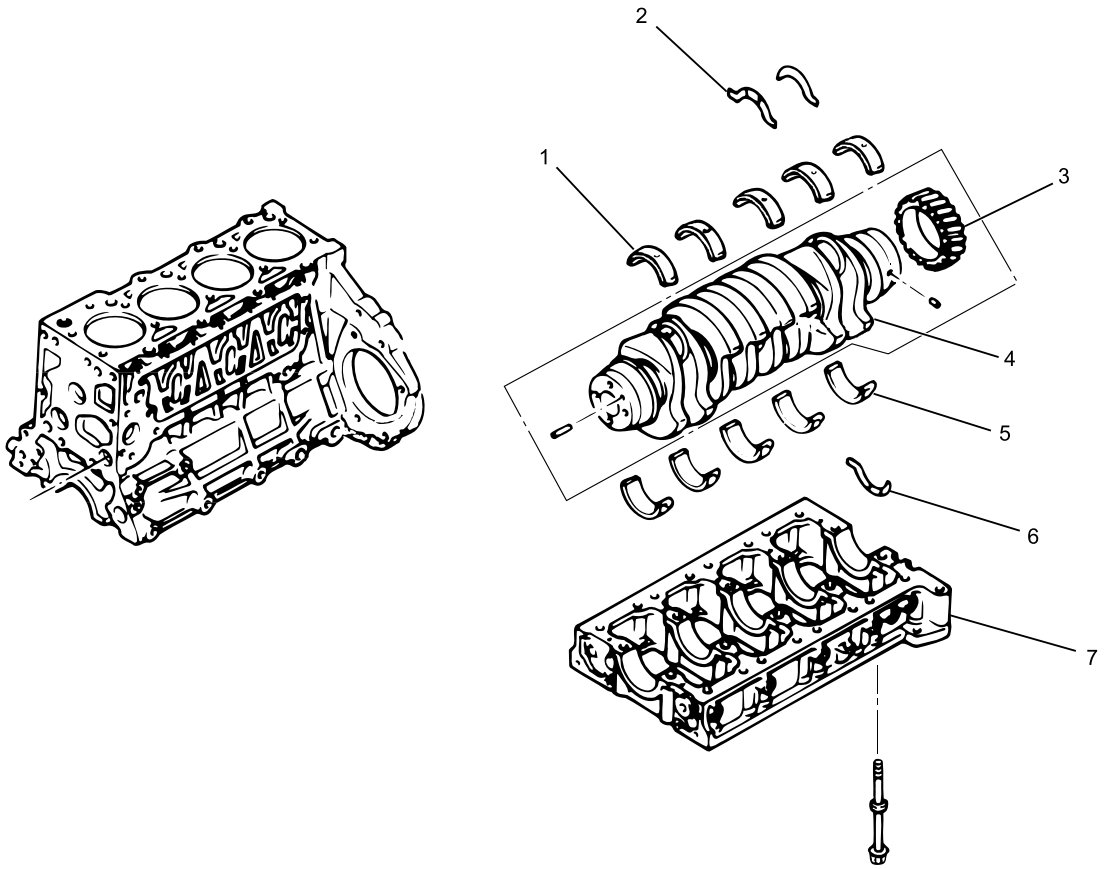
Oil seal installer kit: 5-8840-2703-0

No.	Parts No.	Name	Slinger	Oil seal
1	5-8840-2708-0	Sleeve(rear)	○	○
2	5-8840-2709-0	Adaptor(rear)	○	○
3	5-8840-2710-0	Collar (rear)	○	○
4	5-8840-2711-0	Adaptor ring (rear)	—	○
5	5-8840-2713-0	Center bolt	○	○
6	5-8840-2714-0	Fixing bolt	○	○

NOTE:
A sleeve for engines before '93.5 models (5-8840-2712-0) is included in the oil seal installer kit, but it will not be used with this engine.

Crankshaft

Components



Legend

1. Upper bearing
2. Thrust bearing upper
3. Gear
4. Crankshaft
5. Lower bearing
6. Thrust bearing lower
7. Crankcase

Removal

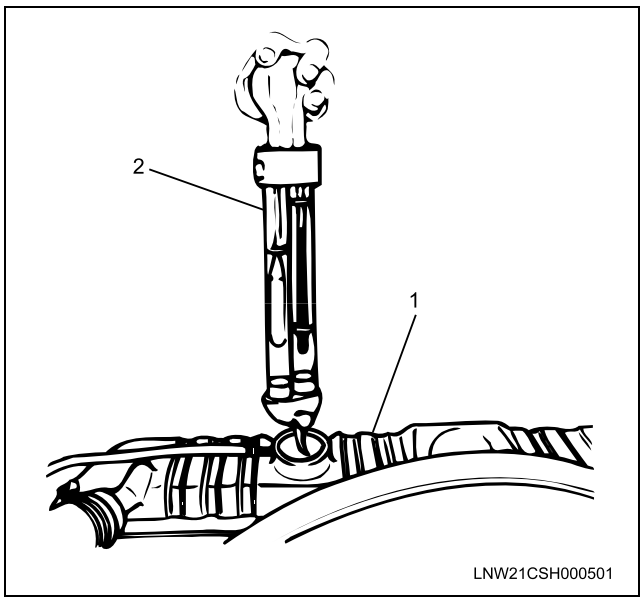
1. Remove the engine assembly from the vehicle.
   - Refer to "Engine Assembly" in this section.
2. Remove the cylinder head cover.
   - Refer to "Cylinder Head Cover" in this section.
3. Remove the rocker arm shaft assembly.
   - Refer to "Rocker Arm Shaft Assembly" in this section.
4. Remove the camshaft assembly.
   - Refer to "Camshaft Assembly" in this section.
5. Remove the cylinder head.
   - Refer to "Cylinder Head" in this section.
6. Remove the crankshaft front oil seal.
   - Refer to "Crankshaft Front Oil Seal" in this section.
7. Remove the crankshaft rear oil seal.
   - Refer to "Crankshaft Rear Oil Seal" in this section.

Freezing temperature reference	Mixture ratio L(imp·gal)		Engine coolant concentration
	Engine coolant	Tap water	
-18°C (-0.4°F)	4.2 (0.94)	7.8 (1.72)	35%
-25°C (-25°F)	5.0 (1.10)	7.0 (1.54)	42%
-35°C (-31°F)	6.0 (1.32)	6.0 (1.32)	50%
-40°C (-40°F)	6.4 (1.41)	5.6 (1.23)	53%

2. Measurement of engine coolant concentration

Specific gravity measurement method

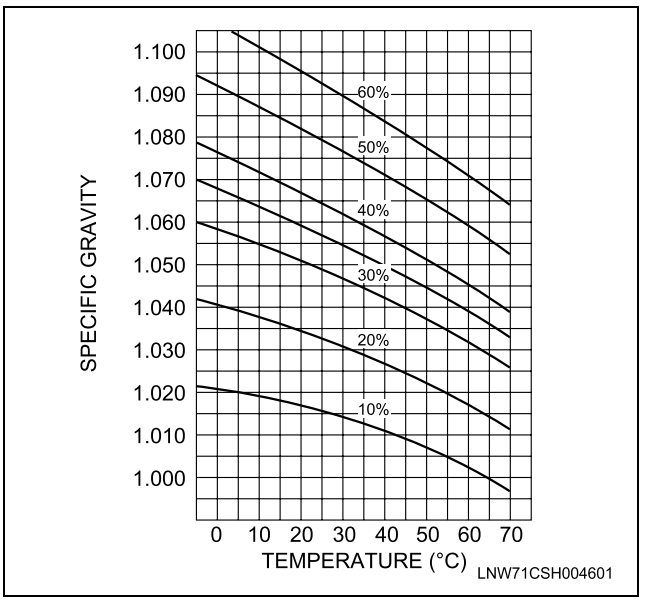
- Use an antifreeze hydrometer and thermometer to measure the specific gravity and coolant temperature.
  If the cap is removed when the coolant is hot, the boiled coolant will burst out, so be careful.
- Use a container that is deeper than the length of the hydrometer.



Legend

1. Radiator
2. Anti-freeze hydrometer

- The temperature of the coolant to be measured is to be between 0 and 50°C(32 and 122°F).
- After measuring the temperature and specific gravity, obtain the concentration from the table below.



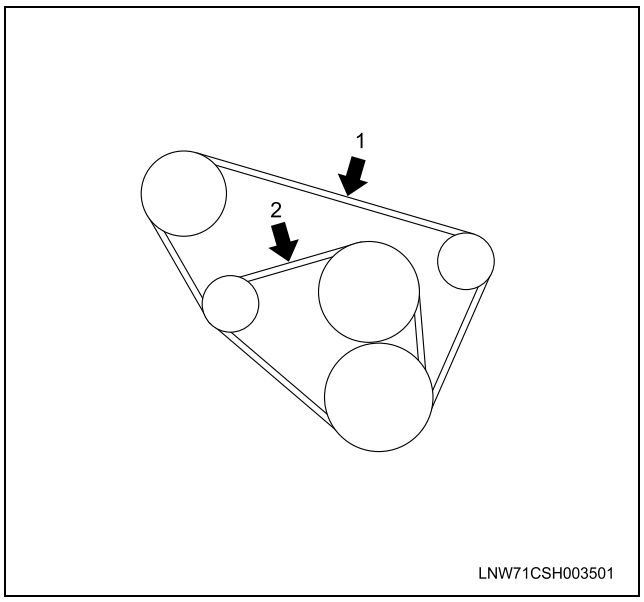
Refractometer method

- Measure the concentration using a refractometer.

Reference

WARNING:
Do not loosen or remove the radiator cap when the coolant is hot. Steam and boiling liquids can burst out from the radiator and possibly cause burns or heat related injuries. When opening the radiator cap, place a thick cloth over the cap when the coolant is cooled, and turn it gradually to release the pressure before opening it.

1. Check that the engine is cool.
2. Open the radiator cap.
3. Loosen the air removal plug of the water outlet pipe.
4. Refill coolant up to the filler neck.



Adjustment

When adjusting the belt tension, do so for both the fan belt and the A/C compressor drive belt.
After adjusting the fan belt, adjust the A/C compressor drive belt.

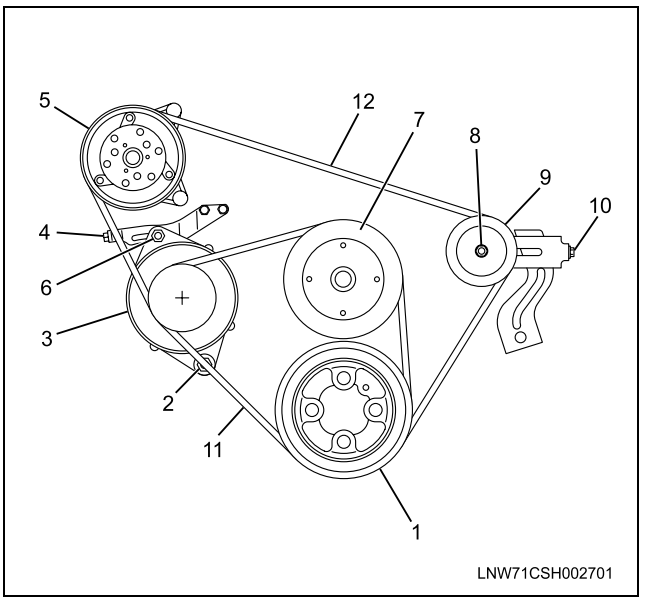
1. Loosen the tension pulley lock nut (8) and adjust bolt (10) of the A/C compressor drive belt to free the belt.
2. Loosen the adjust plate lock nut (6) of the generator and the tightening nut (2) at the bottom side of the generator.
3. Turn the adjust bolt (4) to adjust (or remove/attach, replace) the drive belt.
   - When replacing the belts, replace both of the 2 belts.
4. After adjustment, tighten the adjust plate lock nut (6) and the tightening nut (2) at the bottom side.

Tightening torque:

Nut (6) = 24 N·m (2.4 kg·m/17 lb·ft)
Nut (2) = 62 N·m (6.3 kg·m/46 lb·ft)

5. Adjust the tension of the A/C compressor drive belt.
   a. Turn the tension pulley adjust bolt (10) to adjust (or remove/attach, replace) the belt.
   b. After adjusting, tighten the lock nut (8) at the specified torque.

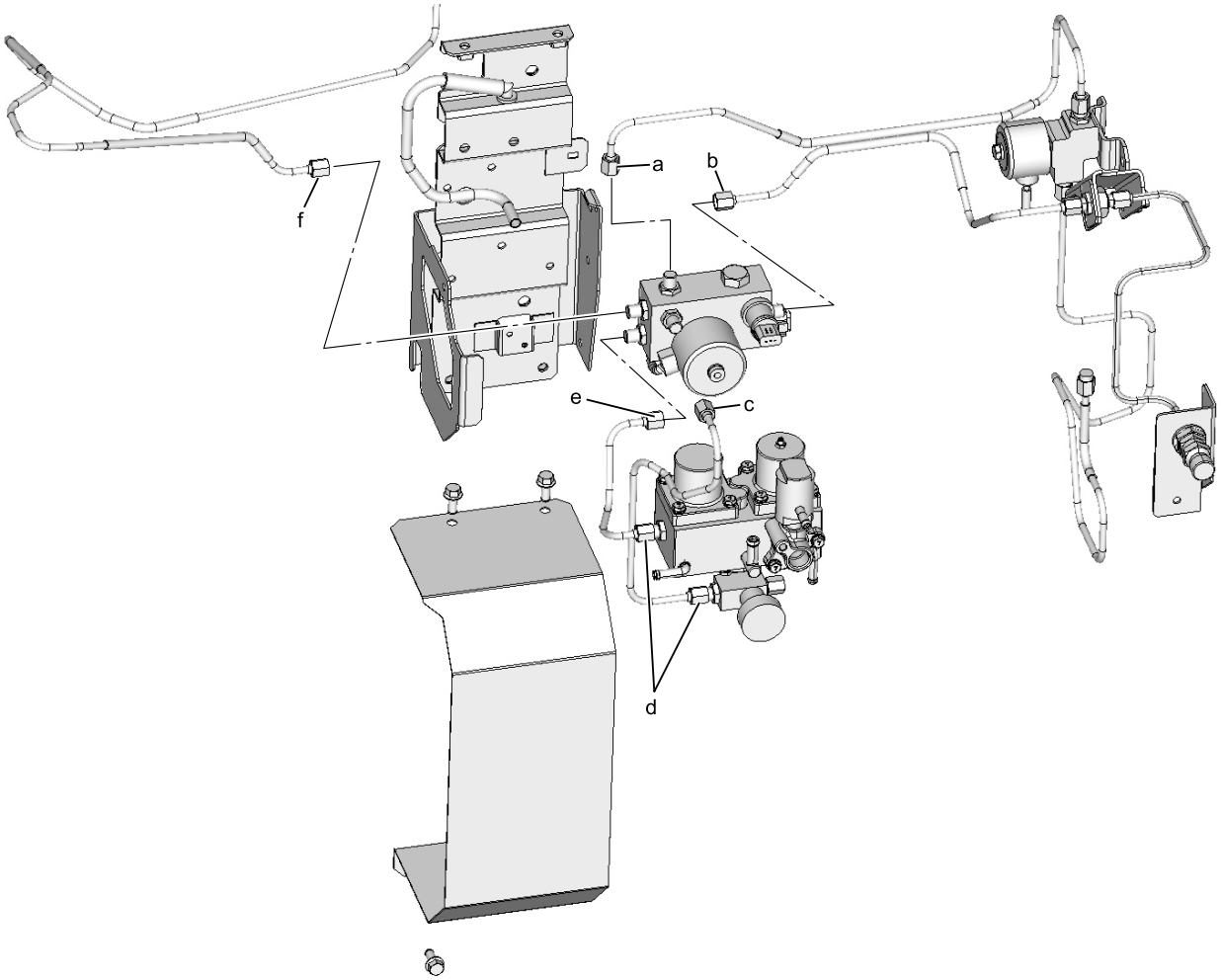
Tightening torque: 27 N·m (2.8 kg·m/20 lb·ft)



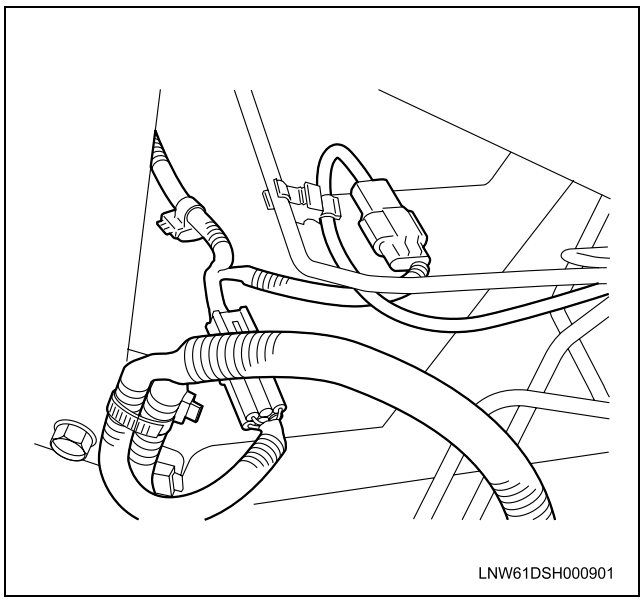
Legend

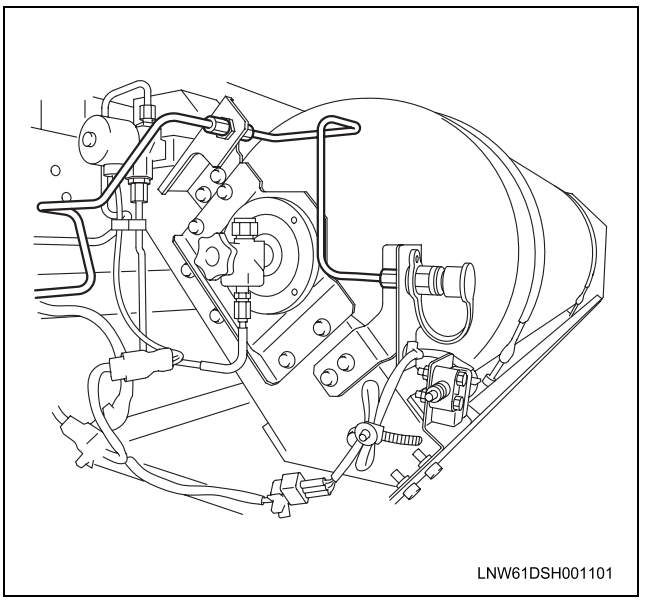
1. Crank pulley
2. Generator tightening nut
3. Generator
4. Adjust bolt
5. A/C compressor
6. Adjust plate lock nut
7. Water pump pulley (fan pulley)
8. Tension pulley lock nut
9. Tension pulley
10. Tension pulley adjust bolt
11. Drive belt
12. A/C compressor drive belt

List of Tightening Torques

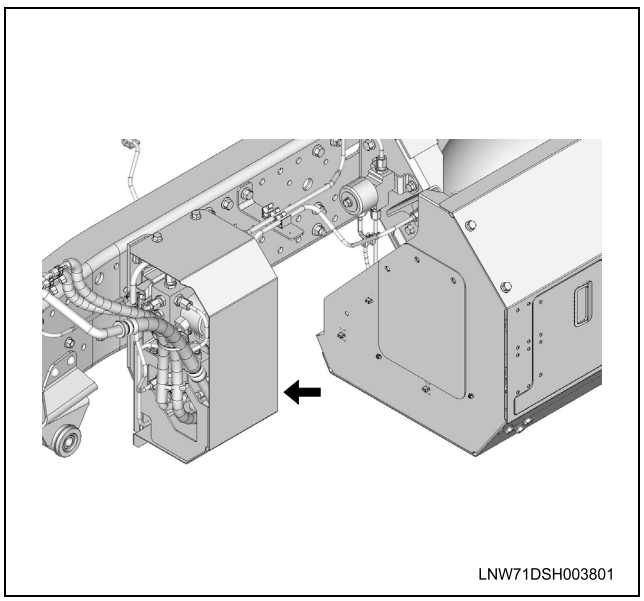


(a) 29 N·m (3.0 kg·m/22 lb·ft)
(b) 29 N·m (3.0 kg·m/22 lb·ft)
(c) 29 N·m (3.0 kg·m/22 lb·ft)
(d) 29 N·m (3.0 kg·m/22 lb·ft)
(e) 29 N·m (3.0 kg·m/22 lb·ft)
(f) 29 N·m (3.0 kg·m/22 lb·ft)





2. Remove the pressure regulator cover.

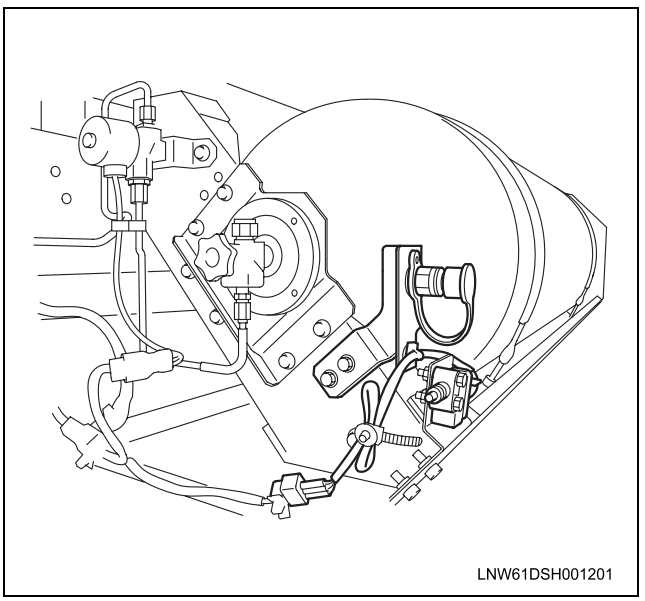


3. Remove the rigid fuel line with the bracket ASM.

NOTE:

- Before removing, adequately clean the removal section of the rigid fuel line.
- Use two wrenches to fasten one side, and to loosen the other side.
- Keep the removed rigid fuel line away from attachment of filth or dust.

4. Remove the filling unit and ignition cut switch ASM.



5. Remove the rigid fuel line with the automatic valve (at tank).

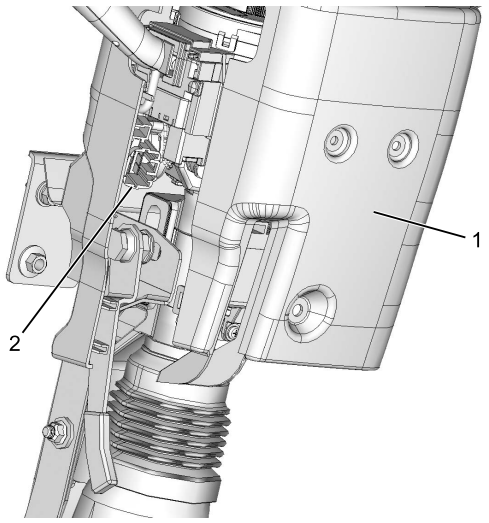
NOTE:

- Before removing, adequately clean the removal section of the rigid fuel line.
- Use two wrenches to fasten one side, and loosen at the other side.
- Keep the removed rigid fuel line away from attachment of filth or dust.

Starter Switch

Removal

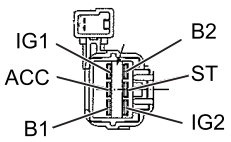
1. Remove the steering cowl (1).
   - Remove the screws to remove the cowl.
2. Disconnect the ignition switch connector (2).



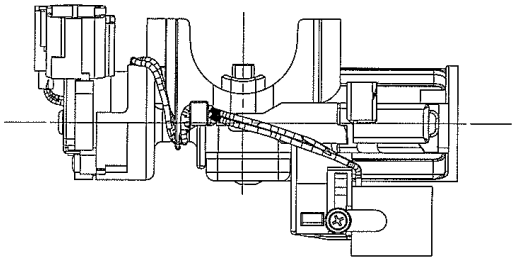
LNW71ESH001001

Inspection

Inspect the continuity between the ignition switch connector terminals.
If any abnormality is found in the inspection results, repair or replace it.



	OFF	ACC	ON	ST
B2			○	○
IG2			○	
ST				○
B1		○	○	○
ACC		○	○	
IG1			○	○

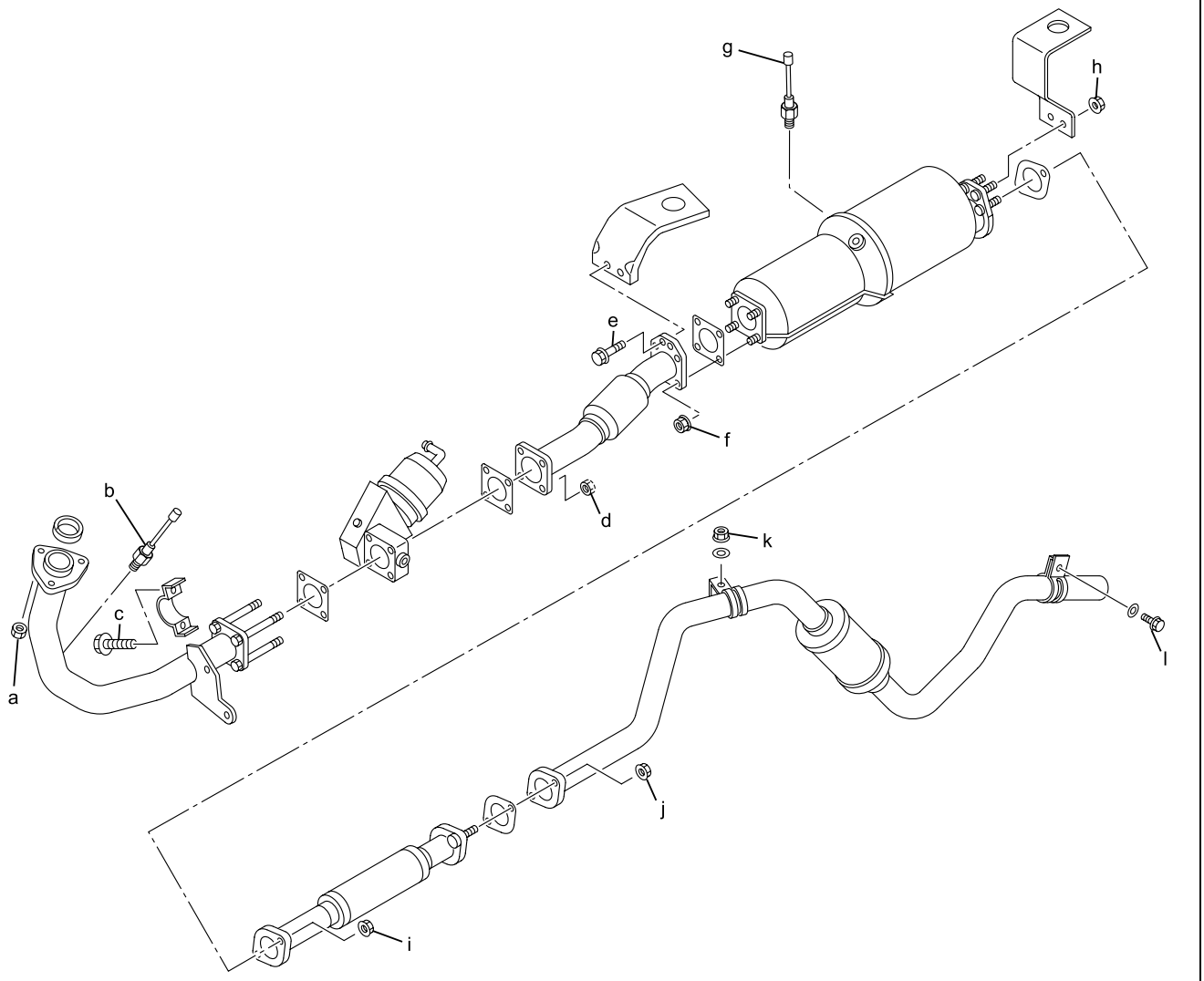


LNW71ESF000501

Installation

Perform installation in the reverse order of the removal.

List of Tightening Torques



Legend

(a) 67 N·m (6.8 kg·m/49 lb·ft)
(b) 44 N·m (4.5 kg·m/33 lb·ft)
(c) 41 N·m (4.2 kg·m/30 lb·ft)
(d) 27 N·m (2.8 kg·m/20 lb·ft)
(e) 24 N·m (2.4 kg·m/17 lb·ft)
(f) 24 N·m (2.4 kg·m/17 lb·ft)
(g) 44 N·m (4.5 kg·m/33 lb·ft)
(h) 24 N·m (2.4 kg·m/17 lb·ft)
(i) 50 N·m (5.1 kg·m/37 lb·ft)
(j) 50 N·m (5.1 kg·m/37 lb·ft)
(k) 37 N·m (3.8 kg·m/27 lb·ft)
(l) 37 N·m (3.8 kg·m/27 lb·ft)