
SECTION 7B

GENERAL HVAC (HEATING, VENTILATION AND AIR CONDITIONING) SYSTEM

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DESCRIPTION AND OPERATION

SPECIFICATIONS

Component	Application	Specifications	
Compressor	Model	V 5	V 7
	Type	Variable Displacement	←
	Displacement	9.8 - 151 cc/rev	9.8 - 179 cc/rev
	PCD	Ø130	←
	Cylinder	5	7
	Oil (Synthetic Oil)	265 ml	←
Condenser	Type	MFC (6-PASS)	
	Size	620 w x 479 h x 20 t	
Receiver-Dryer	Capacity	250 cc	
	Desiccant	XH-9 (35 g)	
	Pressure Switch	DSL : Dual Pressure, GSL: Triple Pressure	
Refrigerant	Type	R-134a	
	Refrigerant Capacity	Single: 850 ± 50 g, Dual: 1200 ± 50 g	

REPAIR INSTRUCTIONS

Air Conditioning

Vehicle air conditioning is the cooling (refrigerant), heating and ventilation of the air in the passenger compartment. Refrigerant is accomplished by making practical use of the three laws of nature. These laws of nature and their practical application are as follows:

- Heat transfer
- Latent heat of vaporization
- Effect of pressure on boiling or condensation

Heat Transfer

The principle of heat transfer are that the heat always flow from hot to cold, the rate of heat transfer will increase as the difference in temperature between two objects increases, and the mass of an object remains the same regardless of its heat contents.

Latent Heat of Vaporization

Everything in the world is composed of matter and the matter exists in one of following states;

- Solid
- Liquid
- Vapor

When a liquid boils, it changes to vapor and absorbs heat without raising the temperature of the resulting vapor.

When the vapor condenses, it changes back to a liquid and gives off heat without lowering the temperature of the resulting liquid.

Effect of Pressure on Boiling or Condensing

When the pressure on the liquid or vapor changes, the boiling point changes. Increasing the pressure increases the boiling point, while the boiling point decreased by decreasing the pressure on the liquid or vapor.

Another effect of the compression is an increase in temperature even through heat has not been added. For example, if you compress the refrigerant R-134a from 206kPa (30 psi) to 1206kPa (175 psi) the temperature of vapor will increase from 0 °C (32 °F) to 54 °C (130 °F) and boiling point increase. Condensing point also will increase.

Testing the refrigerant system

1. Check the outer surfaces of the radiator and the condenser cores to be sure that the airflow is not blocked by dirt leaves or other foreign material. Check between the condenser and the radiator as well as all outer surfaces.
2. Check for any restrictions or kinks in the condenser core, the hoses and the pipes.

3. Check the operation of the blower fan.
4. Check all the air ducts for leaks or restrictions. Low airflow rate may indicate a restricted evaporator core.
5. Check for slippage of the compressor clutch.
6. Check the drive belt tension.

Handling O-Ring

1. Even though O-rings may look identical, it is extremely important that only recommended service replacement air conditioning O-rings be used, or excessive leakage of the refrigerant may occur.
2. Always O-ring and installation area should be kept clean. Any foreign material and dust may result in excessive refrigerant leakage.
3. Before installation, verify that both O-ring and fittings have not been nicked or deformed. Deformed or nicked parts must be replaced.
4. Failure to use the proper service replacement parts and procedures may result in excessive refrigerant leakage.

Handling Refrigerant

1. Always work in a well-ventilated area.
2. If you have difficulty breathing, seek medical attention immediately. If refrigerant comes in contact with any part of your body, flush the exposed area with water. If a rash or pain develops seek medical attention.

Handling of Refrigerant Lines and Fittings

1. Using too low or too high a torque when tightening a fitting can result in loose joints or deformed joint parts.
2. Back up the opposing fitting to prevent the distortion of the connecting lines or the components. Back up both the swaged fitting on the flexible hose connections and the coupling to which it is attached two wrenches to prevent turning the fitting and damaging the ground seat.

Maintaining Chemical Stability In the Refrigeration System

The efficient operation and life of the air conditioning system is dependent upon the chemical stability of the refrigeration system.

When foreign materials, such as dirt, air or moisture, contaminate the refrigeration system, they will change the stability of the refrigeration and the polyalkylene glycol (PAG) compressor oil. They will also affect the pressure-temperature relationship, reduce efficient operation and can possibly cause interior corrosion and abnormal wear of moving parts.

7B-4 GENERAL HVAC SYSTEM

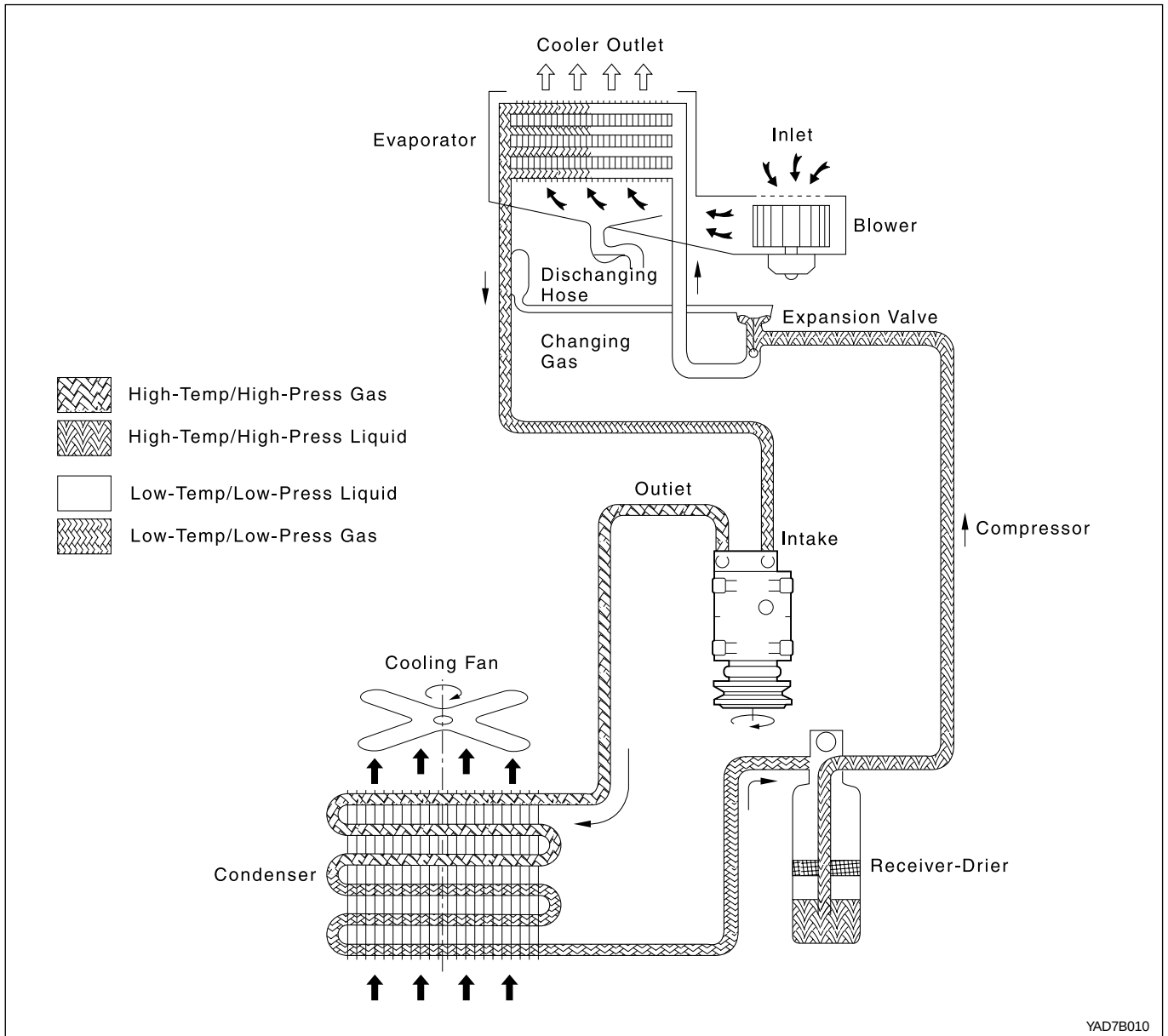
Observe the following practices to ensure chemical stability in the system:

1. Wipe away dirt or oil at and near any connection before opening that connection. This will reduce the chance of dirt entering the system.
2. Cap, plug or tape both sides of a connection as soon as possible after opening the connection. This will prevent the entry of dirt, foreign material and moisture.
3. Keep all tools clean and dry including the manifold gauge set and all replacement parts.
4. Use a clean and dry transfer device and container to add PAG refrigerant oil. This will ensure that the oil remains as moisture-free as possible.
5. When opening an A/C system, have everything needed to perform all operations ready. Do not leave the A/C system open any longer than necessary.
6. Evacuate and recharge any A/C system that has been opened.

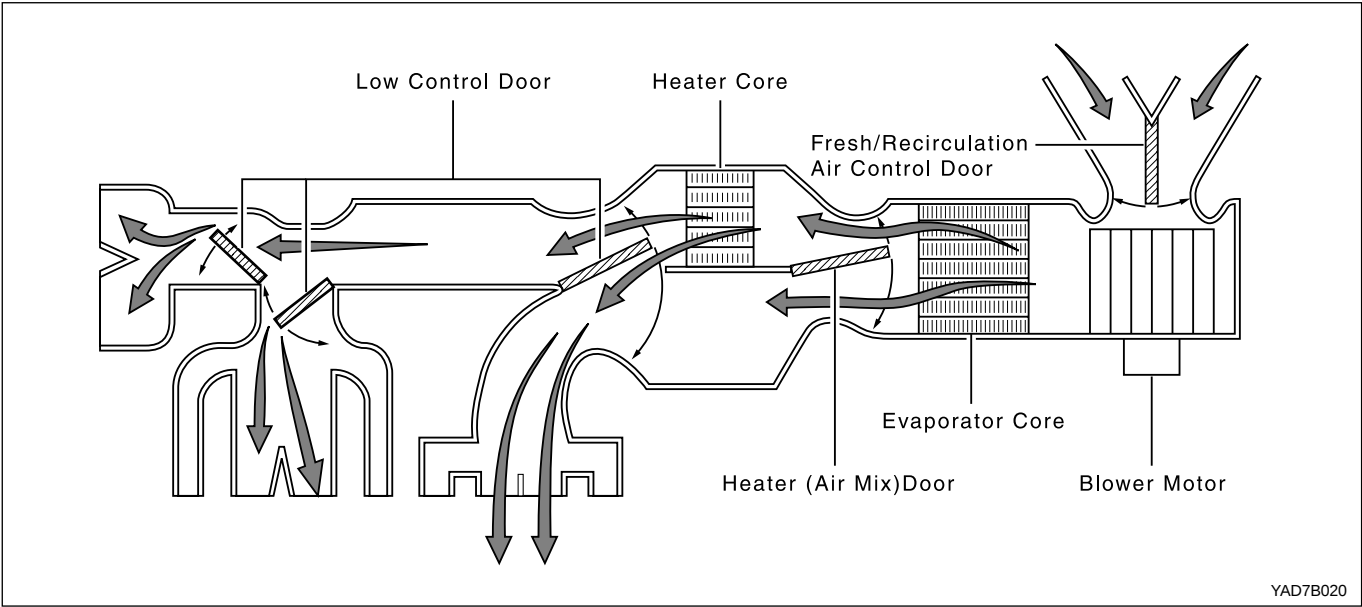
BASIC A/C SYSTEM FUNCTION

A/C System consists of the following component basically.

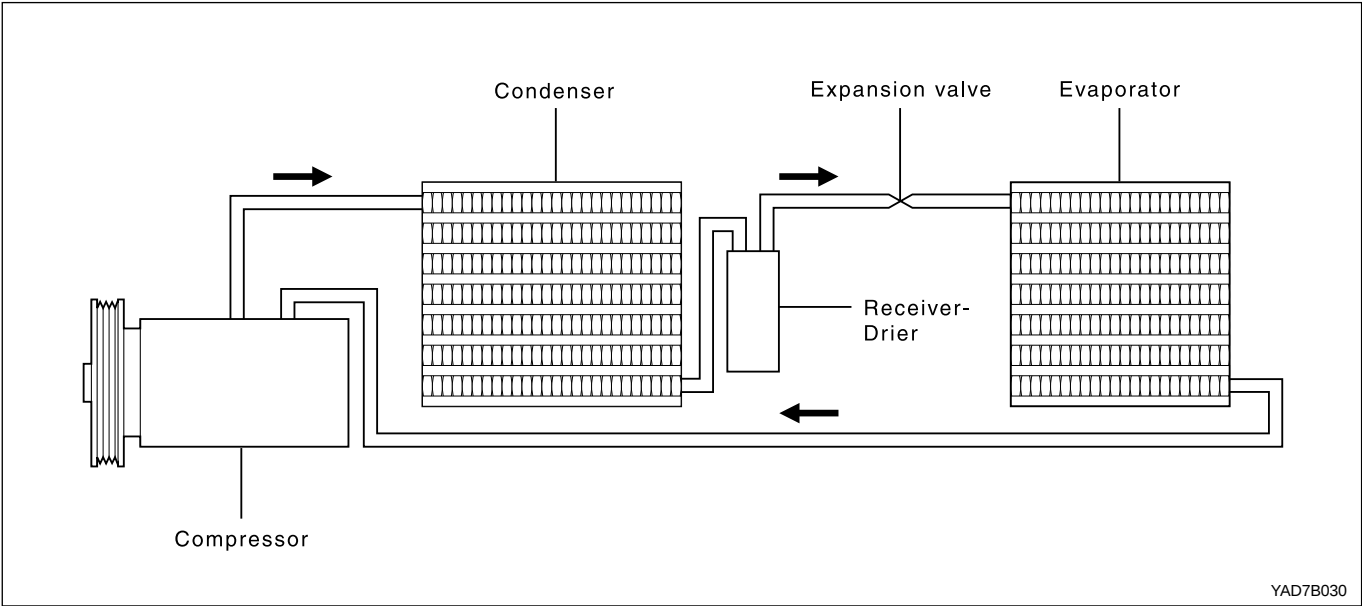
The refrigerant continues to change the phase, liquid
→ gas → liquid to maximize the cooling effect.



Airflow - Typical

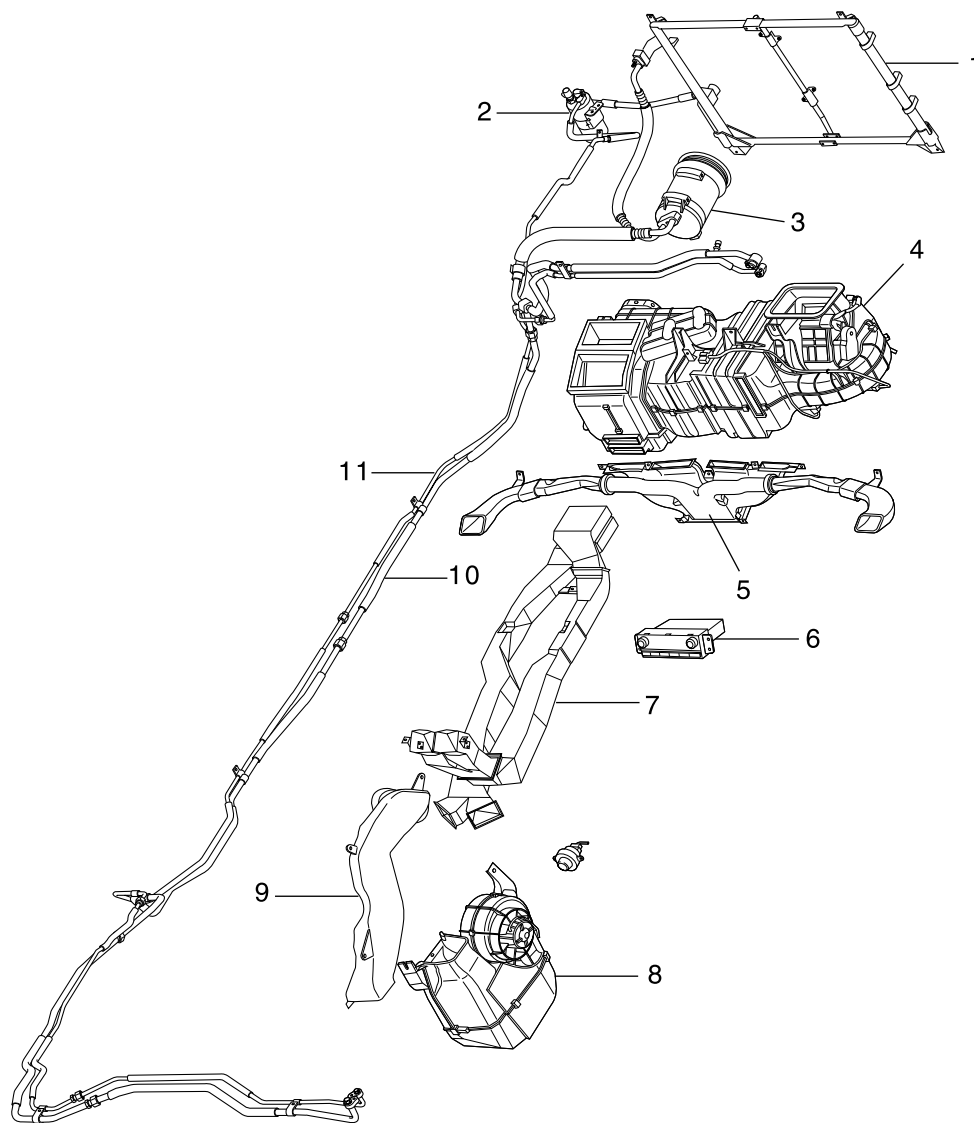


A/C System - Typical



COMPONENT LOCATOR

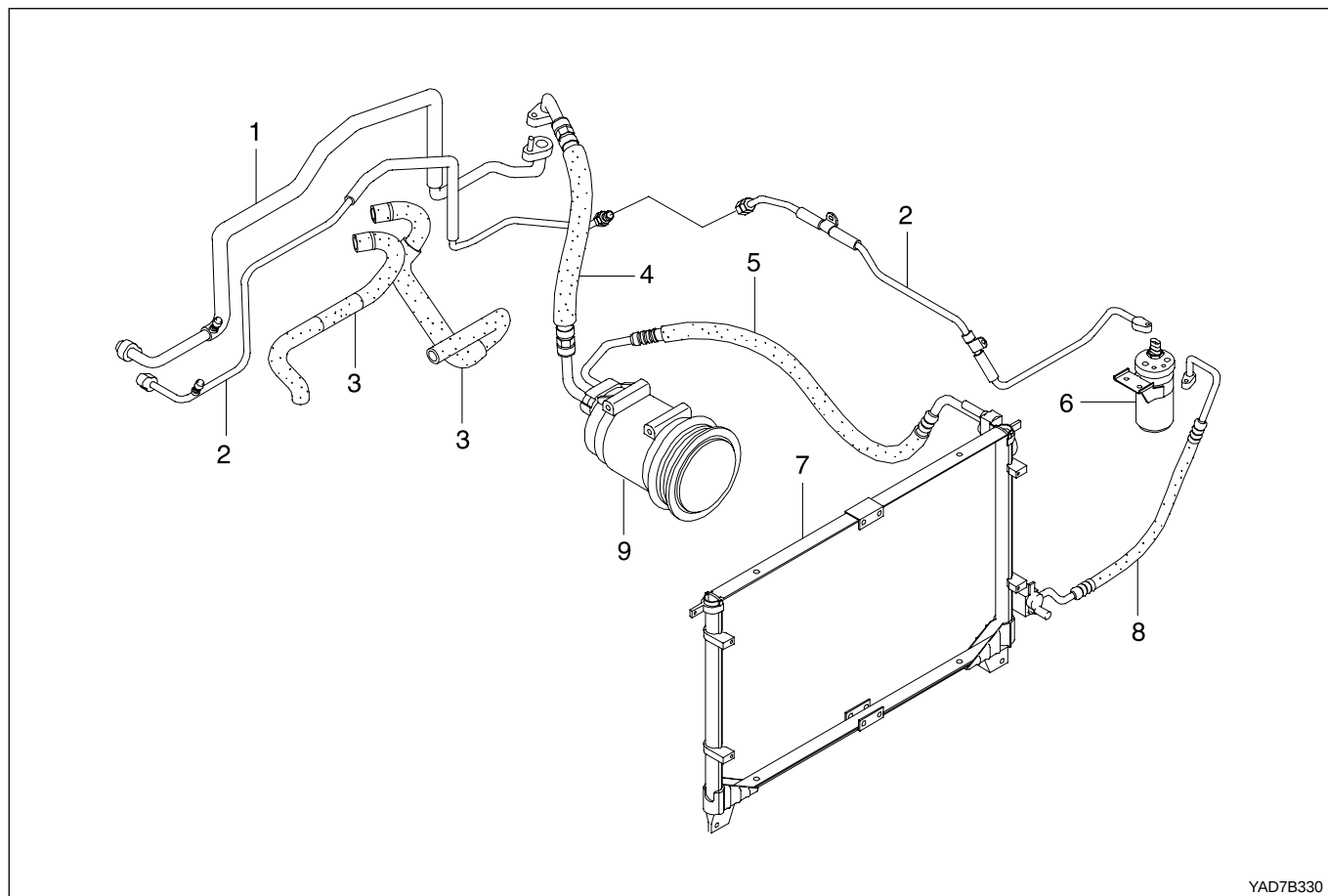
A/C SYSTEM COMPONENT



YAD7B040

- | | |
|--------------------------------|---------------------------|
| 1 Condenser | 7 Rear Duct |
| 2 Receiver-Drier | 8 Rear Cooler Assembly |
| 3 Compressor | 9 Rear Cooler Duct |
| 4 A/C & Heater (Blower) Module | 10 Suction Rear Pipe Line |
| 5 Defrost Nozzle/Duct | 11 Liquid Rear Pipe Line |
| 6 Front A/C Controller | 12 Rear Cooler Controller |

A/C SYSTEM PIPE LINE

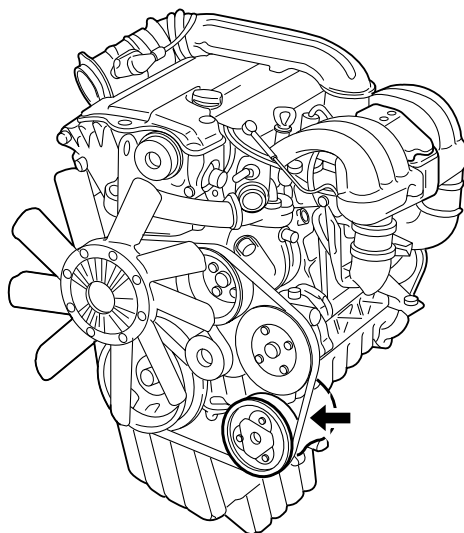


YAD7B330

- | | |
|-------------------------------|------------------|
| 1 High Pressure Pipe | 6 Receiver-Drier |
| 2 Low Pressure Pipe | 7 Condenser |
| 3 Heater Hose | 8 Liquid Hose |
| 4 High Pressure Hose And Pipe | 9 Compressor |
| 5 High Pressure Hose | |

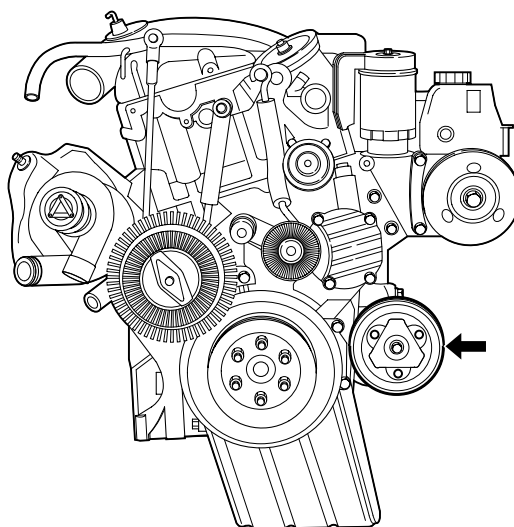
COMPRESSOR LOCATION

Gasoline Engine



YAD7B050

Diesel Engine



YAD7B060

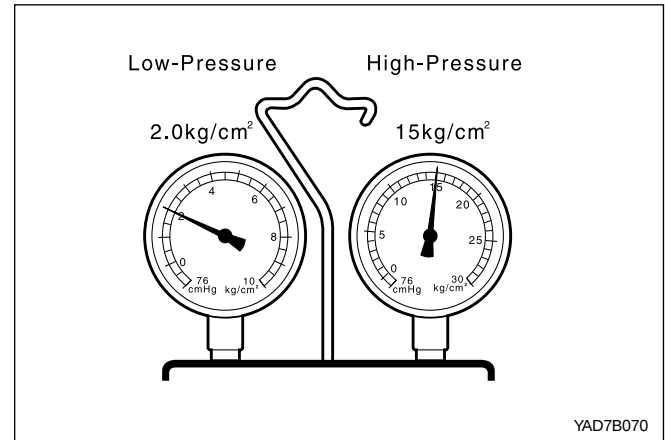
DIAGNOSTIC INFORMATION AND PROCEDURES

GENERAL DIAGNOSIS

Symptom		Check	Action
Airflow not cold.	Magnetic clutch switch don't turn ON.	Check the fuse	Replace
		Check the A/C switch	Replace
		Check the triple switch (DSL: Dual switch)	Replace
		Check the thermo switch (GSL)	Replace
		Check the compressor relay	Replace
		Check the magnetic clutch	Replace
		Check the A/C control unit	Replace
	Insufficient refrigerant	Check the refrigerant capacity	Adding refrigerant
	Faulty receiver-drier	Check the receiver-drier	Replace
	Abnormal rotating of compressor	Check the drive belt's tension, slip of the compressor and clutch	Adjusting belt
Airflow is cold but insufficient.	Abnormal compression of compressor	Check the compressor	Replace
	Faulty expansion valve	Check the expansion valve	Replace
	Duct joint leak	Check the Duct joint	Replace
	Evaporator frozen	Check the intake air temperature switch	Replace
	Faulty blower motor	Check the blower motor	Replace
Airflow is not continuous.	Blower 1th - 3th inoperative, 4th operative	Check the resistor, connector	Replace
	There is air in the refrigerant	Measure the pressure	Evacuating and charging refrigerant
Insufficient cooling.	Faulty expansion valve	Check the expansion valve	Replace
	Insufficient refrigerant	Check the refrigerant capacity	Adding refrigerant
	Faulty receiver-drier	Check the receiver-drier	Replace
	Faulty condenser	Check the fin's surface and crack of the tube, tank	Cleaning surface, Replace
	Excessive refrigerant in the system	Check the refrigerant capacity (Verify the capacity higher than high pressure)	Recharging refrigerant
	Abnormal rotating of compressor	Check the drive belt's tension	Adjusting belt
	Insufficient compression of compressor	Check the compressor	Replace
	There is air in the unit.	Check the pressure	Evacuating and charging refrigerant
	Faulty expansion valve	Check the expansion valve	Replace

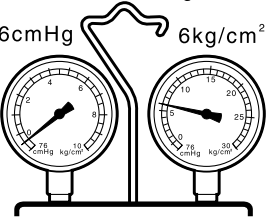
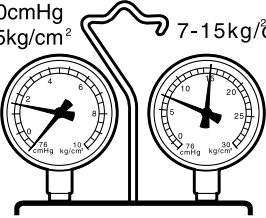
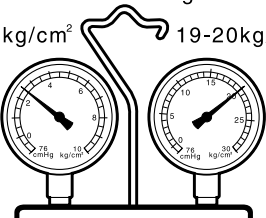
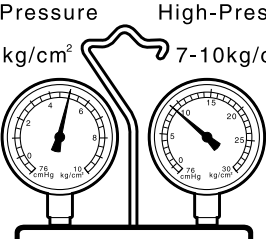
DIAGNOSIS USING THE MANIFOLD GAUGE

On normal operation during the cooling cycle, the manifold gauge must indicate approximately 1.5 - 2.0 kg/cm² at low pressure side and 14.5 - 15 kg/cm² at high pressure side, on condition that the temperature at the cooler inlet, 30 °C - 35 °C, 2,000 rpm of the engine rpm , full cold and maximum blower speed.

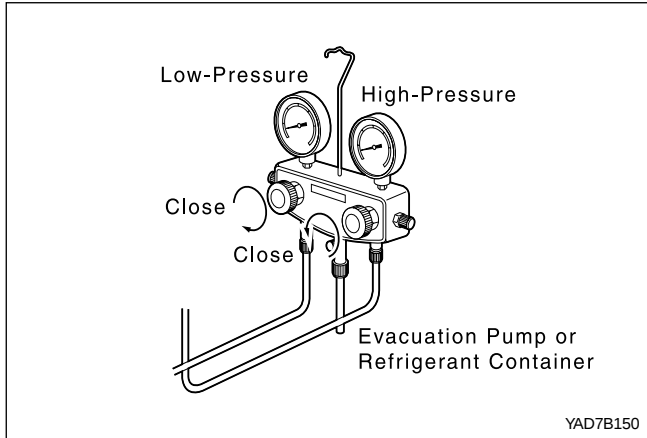


Symptom	Cause	Action
1. High and low pressure are abnormally low. 2. Air at cooler outlet is not cold. Low-Pressure High-Pressure 0.8kg/cm² 8-9kg/cm² YAD7B080	There is a gas leak in the cooling system.	- Check the oil leak, repair - Add the refrigerant
1. High and low pressure are abnormally high. Low-Pressure High-Pressure 2.5kg/cm² 20kg/cm² YAD7B090	Insufficient cooling and faulty condenser cooling by excessive refrigerant.	- Keep the specified amount of the refrigerant, Clean the condenser - Repair the belt
1. High and low pressure are abnormally high. 2. Connection at the low pressure is not cold. Low-Pressure High-Pressure 2.5kg/cm² 23kg/cm² YAD7B100	- Belt is slipped - There is an air in the cooling system	- Clean and repair the receiver-drier - Check the oil contamination etc.

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Symptom	Cause	Action
- The low-pressure side indicates excessive high and high-pressure indicates excessive low. - There is a moisture in the connection of the receiver-drier and the front/back of the expansion valve. Low-Pressure High-Pressure 76cmHg 6kg/cm²  YAD7B110	- The dust and moisture etc. are frozen at the expansion valve - A gas leak in the heat reducer	- Repair the receiver-drier - Replace the expansion valve for the faulty heat reducer
The low-side pressure is high or normal intermittently. Low-Pressure High-Pressure 50cmHg 7-15kg/cm² -1.5kg/cm²  YAD7B120	The mixed moisture is frozen at the expansion valve	Repair the receiver-drier and perform the bleeding
- The low-pressure and high-pressure are excessive high. - There are a lot of moistures in the connection of the low-side pressure Low-Pressure High-Pressure 2.5kg/cm² 19-20kg/cm²  YAD7B130	- The faulty expansion valve, the improper installation of the heat reducer - Fail to control the flow rate	- Repair the receiver-drier - Check the oil contamination etc.
The low-pressure is excessive high and high-pressure is excessive low. Low-Pressure High-Pressure 4-6kg/cm² 7-10kg/cm²  YAD7B140	There is an oil leak in the compressor	Replace the compressor

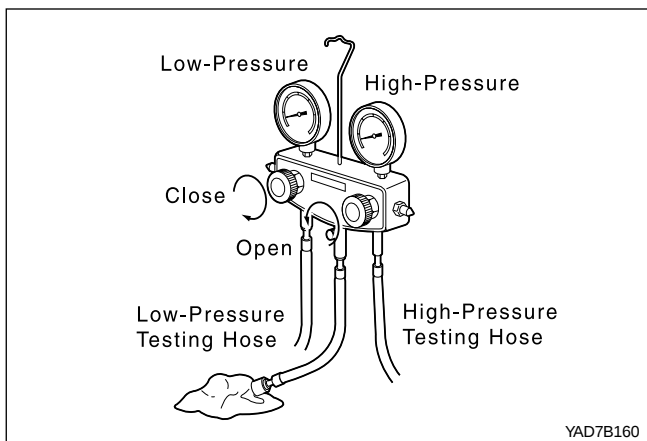
MAINTENANCE AND REPAIR



REFRIGERANT CHARGING

Installation of Manifold Gauge

1. Close both high/low pressure hand valves of manifold gauge before installation of gauge to the charging valve.
2. Both high/low pressure hand valves of manifold gauge connect the appropriate charging valve. Tighten the hose nuts by hand.
 - high pressure hand valve → high pressure charging valve
 - low pressure hand valve → low pressure charging valve

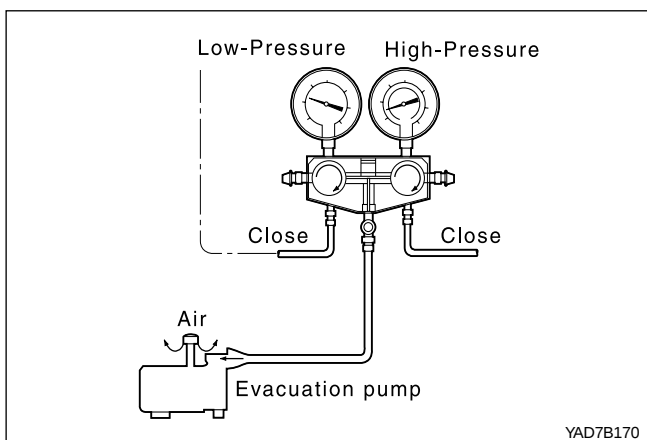


Discharging Refrigerant

1. Connect the manifold gauge to the charging valve.
2. Place the free end of the center hose in a shop towel.
3. Slowly open the high pressure hand valve and discharge refrigerant.

Notice: If refrigerant is allowed to escape too fast, compressor oil will be drawn out of the system.

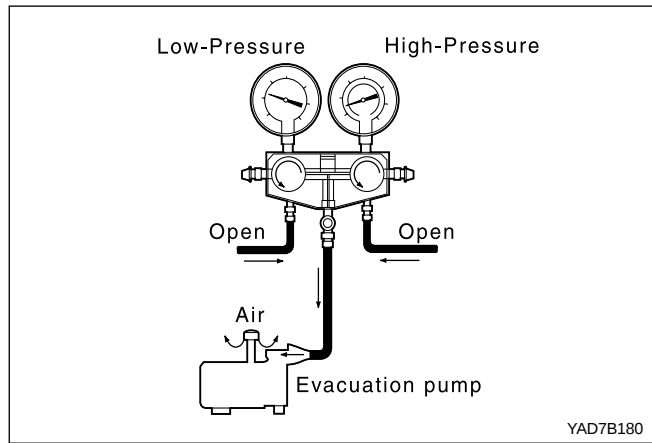
4. Check whether the shop towel gets wet in oil and if wet, close the hand valve.
5. After the high pressure gauge reading drops below 3.5 kg/cm^2 , slowly open the low pressure valve.
6. When both high and low pressure gauges reading drops to 0 kg/cm^2 , discharging is completed.



Evacuating Refrigeration System

Notice: The unit tank must contain a sufficient amount of R-134a refrigerant for charging. Check the amount of refrigerant in the tank. If there is less than 3.6 kg (8 pounds) of refrigerant, add new refrigerant to the tank.

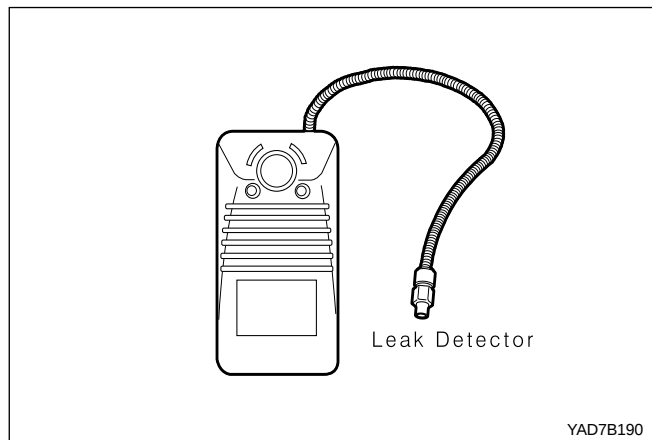
1. Verify that the high-side and the low-side hoses are connected to the A/C system. Open both the high-side and the low-side valves on the unit's control panel.
2. Open both the gas and the liquid valves on the tank.



Important: Refer to the manufacturer's instructions for the charging station in use. It is necessary to evacuate the system before recharging it with new or recycled refrigerant.

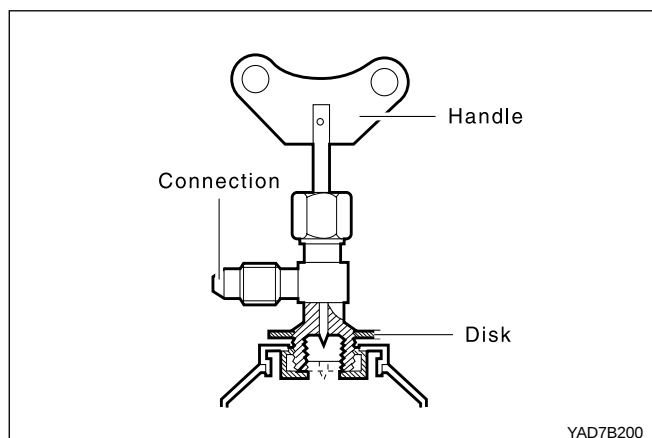
3. Start the vacuum pump and begin the evacuation process. Non-condensable gases (mostly air) are vented from the tank automatically during the recycling process. The pressure being released may be heard.
4. Check for leaks in the system. Refer to the manufacturer's instructions for the charging station in use.

Important: Change the vacuum pump oil frequently. Refer to the manufacturer's instructions for the charging station in use.



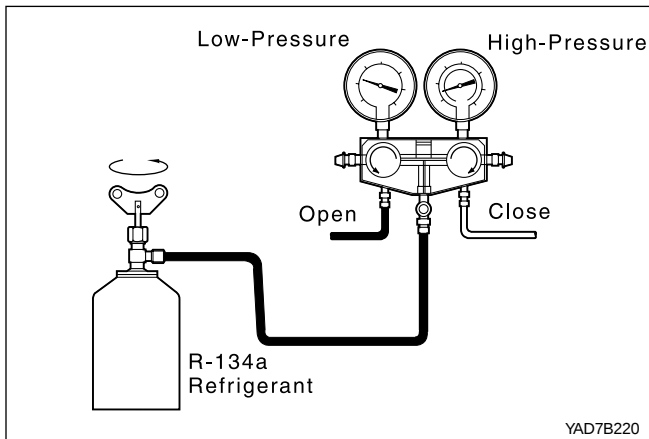
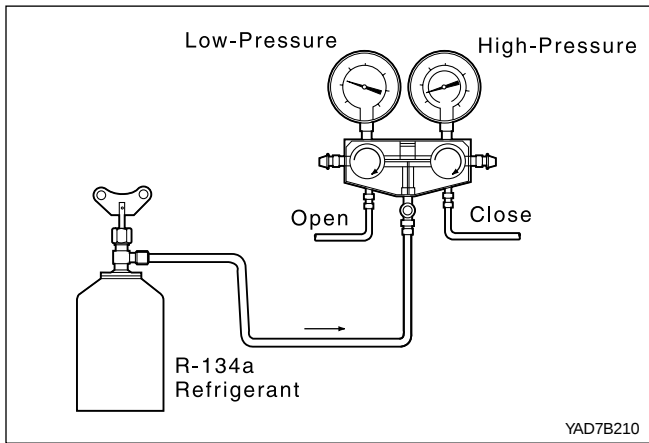
Check for Refrigerant Leaks

1. Connect the center hose of the gauge to the refrigerant tank.
2. Open the high pressure valve of the gauge to charge with refrigerant gas.
3. Charge until the low pressure gauge reads 1.0 kg/cm² and close the valve.
4. Using a gas leak detector, check the system for leaks.
5. If any leak is found, replace O-ring or repair the faulty connection.



How to Use the Tap Valve

1. Rotate the handle counterclockwise fully before connecting the valve to the refrigerant tank.
2. Rotate the disk counterclockwise fully.
3. Connect the center hose to the valve fitting and then rotate the disk clockwise fully by hand.
4. Rotate the handle clockwise to drill the sealed hole.
5. Remove the hose nut securing the center fitting of the manifold gauge and then tighten the nut again in a few seconds.



Charging Refrigerant

Charging for Gas

1. Connect the tap valve to the refrigerant tank.
2. Open the low pressure and adjust the low-side reading below 4.2 kg/cm^2 .
3. Place the refrigerant tank in the warm water (40°C) and keep the gas pressure in the refrigerant tank higher than the gas pressure in the charging valve.
4. Run the engine at high speed and operate A/C system.

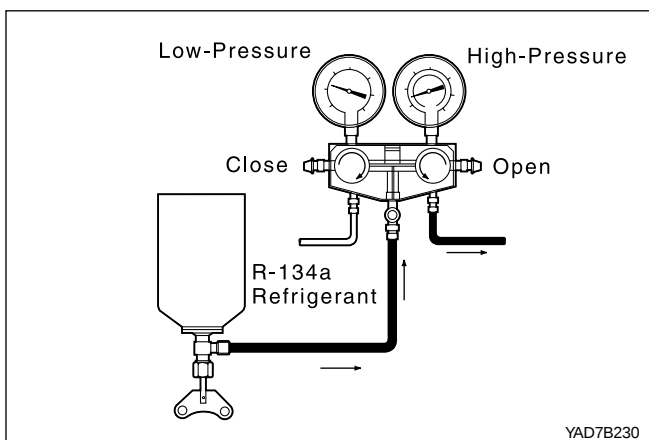
Notice: Place the refrigerant tank on the flat floor to protect the liquid refrigerant from coming through the suction inlet resulting in the compressor's damage.

5. Charge the specified amount to the charging valve and close the low pressure valve.

Specified amount	Single: $850 \pm 50 \text{ g}$
	Dual: $1200 \pm 50 \text{ g}$

Notice:

- If the charging speed is low, it's more efficient to place the refrigerant tank in the warm water (40°C). But the temperature should keep below (52°C) at any situation.
- Be careful not to contact the heating device or material.

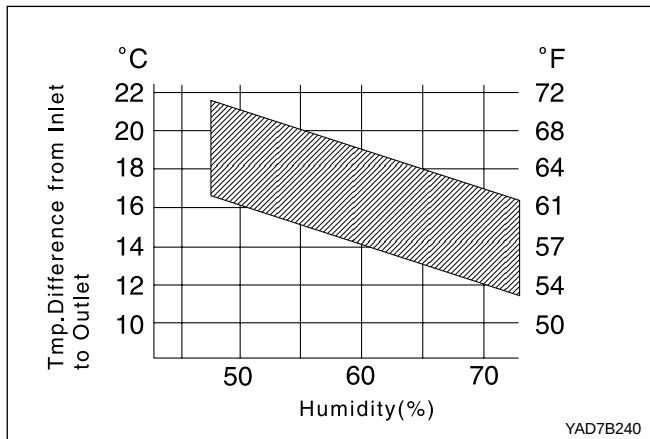


Charging for Liquid

Notice:

- Do not operate when charging the system through the high-side pressure.
 - Do not open the low pressure valve when charging the system by the liquid refrigerant.
1. Tighten both high pressure and low pressure completely before evacuating the charging valve.
 2. Connect the tap valve of the refrigerant tank.
 3. Open the high pressure valve and turn the refrigerant tank upside down.

4. The discharging pressure increases when the charging valve charges excessively, so charge the charging valve to the specified amount with measuring the weight of the refrigerant before closing the high pressure valve.
5. Charge the specified amount of the refrigerant and then close the valve of the manifold gauge. Check the system for any leak.



Operation Check

Notice: Operation Check is recommended before removing the manifold gauge.

1. Install the manifold gauge set.
2. Run the engine at 2,000 rpm and set the blower switch at 'HI' and A/C switch 'ON'. Set the temperature control lever at 'COOL'.
3. Keep opening all of the window and door.
4. Place a dry bulb thermometer to the front duct.
5. Place a psychrometer close to the inlet of the cooling unit.
6. Check the high pressure gauge reading within 14 - 16 kg/cm².
If the reading indicates high excessively, spray the water to the condenser.
If the reading indicates low excessively, cover the condenser with the towel.
7. Check the temperature of air inlet within 25 - 35 °C.
8. Calculate the relative humidity from the psychrometric graph comparing the wet/dry temperature at the air inlet.
9. Measure the wet/dry temperature at the cold air outlet and calculate the temperature difference of the dry bulb between the inlet and the outlet.
10. Check the cross point of the relative humidity and check the temperature difference between the black line. If the cross point is located between the black line, the cooling performance is normal.

COMPRESSOR OIL REPLACEMENT

Before Oil Replacement

When any part is replaced or there are a lot of gas leaks in the A/C system, you should add the specified amount of the oil to keep the approval oil capacity because the oil for lubricating the compressor circulates through the A/C system during operating the compressor.

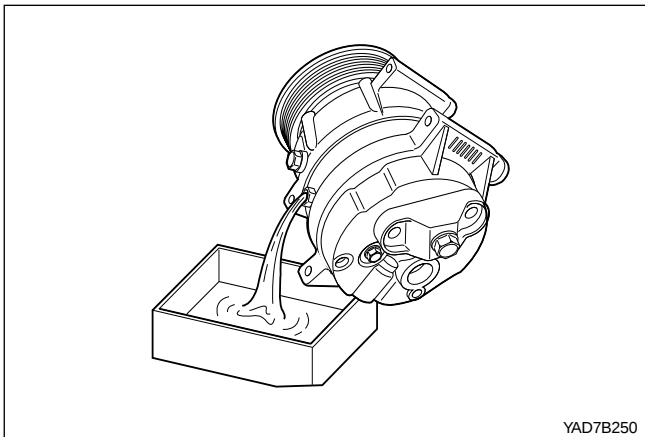
Total Oil Capacity	265 cc
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Handling Oil

- Be careful that moistures, dusts etc. must not flow into the oil.
- Do not mix with any other material.
- If the oil leaves outside for long time, it's possible to mix it with the moistures and so keep the oil sealed with a container.

Circulating Oil

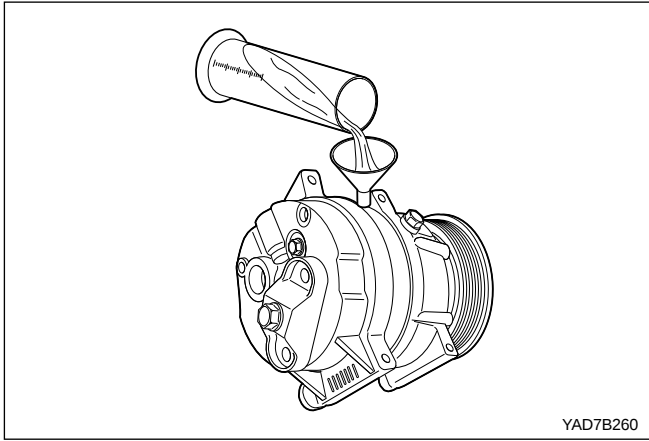
For checking or adjusting the oil level, set the control unit to full cold and max blower speed with keeping the engine run at idle for 20 - 30 minutes in order to circulate the oil through the compressor.



Replacement Oil

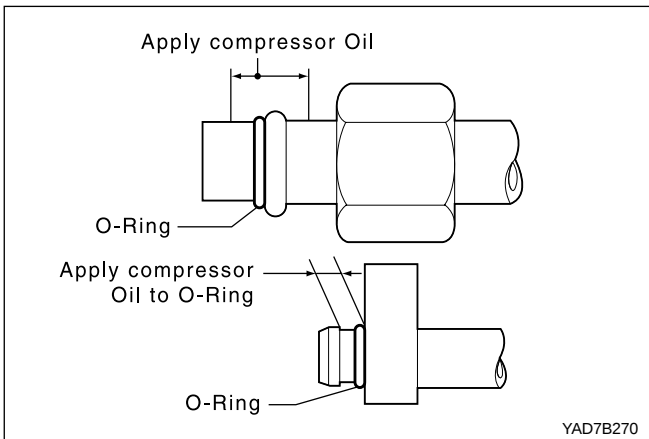
1. Perform the oil circulation and stop the engine. Remove the compressor on the vehicle.
2. Drain the oil at the position of the system line connection.

Notice: It may be difficult to discharge the oil when the compressor is cold. At this time warm the compressor (40 - 50 °C) before discharging the oil.



3. Measure the amount of the discharged oil. If the the amount of the discharged oil is below 70 cc, it means the oil leak. Check the connections of the system and repair or replace as needed.
4. Check the oil contamination and add the oil or adjust the oil level.

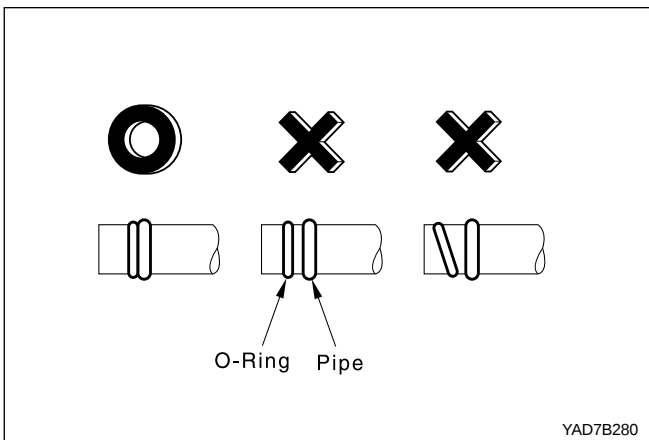
Notice: For contaminating the oil by the dust or the foreign material, charge the refrigerant in the system and clean the receiver-drier.



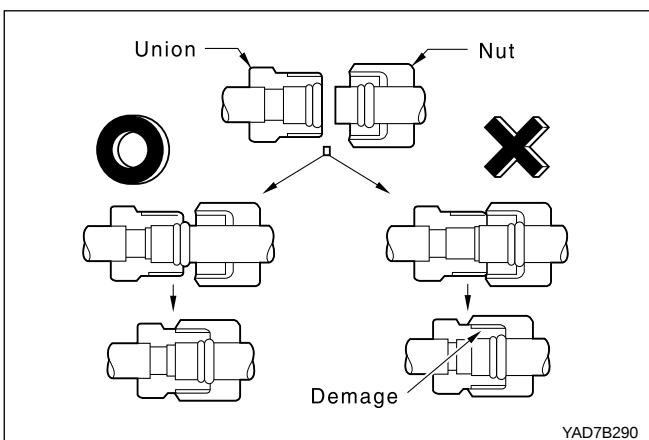
REPLACEMENT OF REFRIGERANT CONNECTION

1. When connecting a O-ring type, apply compressor oil to portions shown in illustration. Be careful not to apply oil to threaded portion.

Notice: Use the approval compressor oil.



2. O-rings must be closely attached to inflated portion of pipe and always replace used O-rings.



3. After inserting the pipe to the union, tighten the nut by hand as much as possible and tighten the nut with the specified torque.

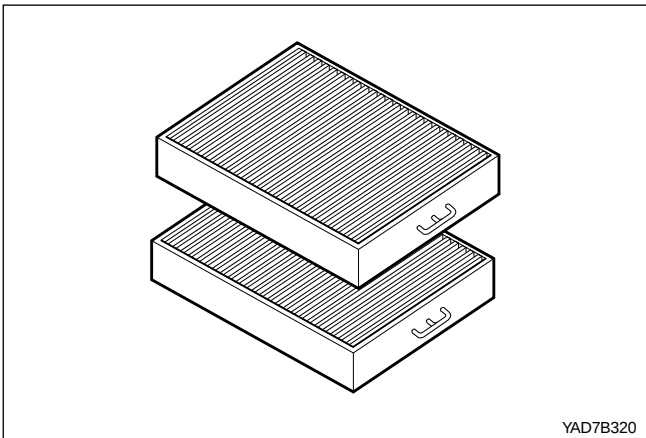
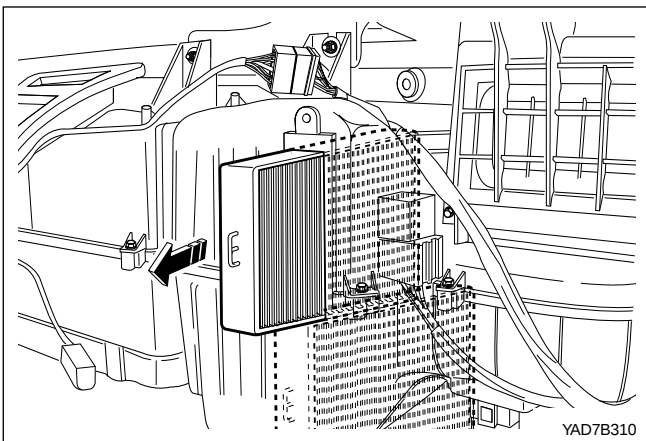
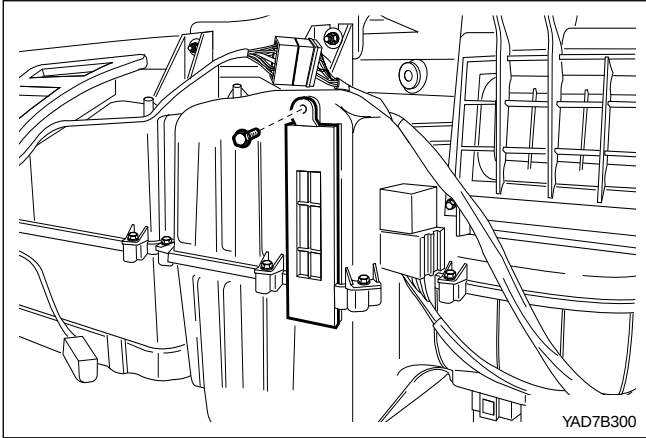
REPAIR INSTRUCTIONS

ON-VEHICLE SERVICE

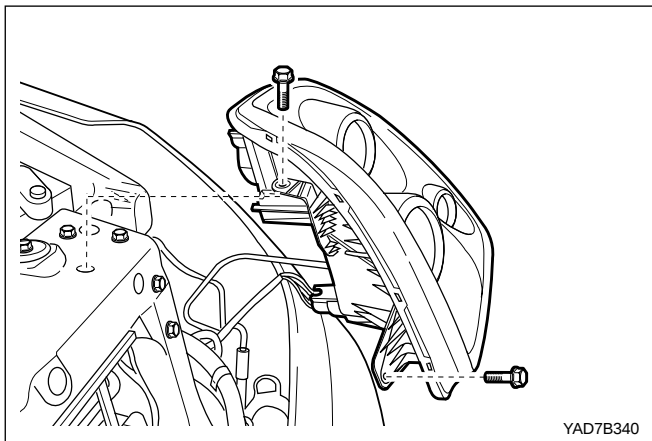
AIR FILTER (AUTO A/C)

Removal & Installation Procedure

1. Remove the glove box.
2. Remove the lower bracket of crash pad.
3. Remove the air filter.
4. For replacing the air filter, verify that the flowing direction mark of the air filter face toward the evaporator core.



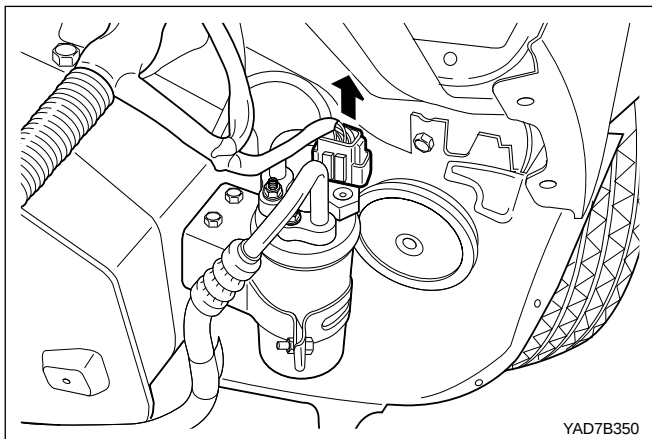
Notice: Installation should follow the removal procedure in the reverse order.



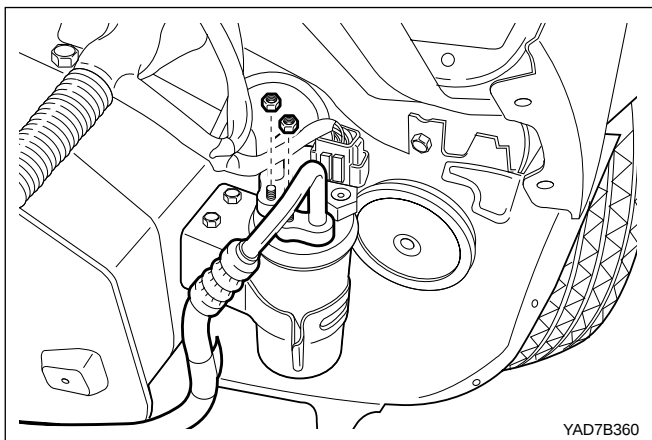
RECEIVER-DRIER

Removal & Installation Procedure

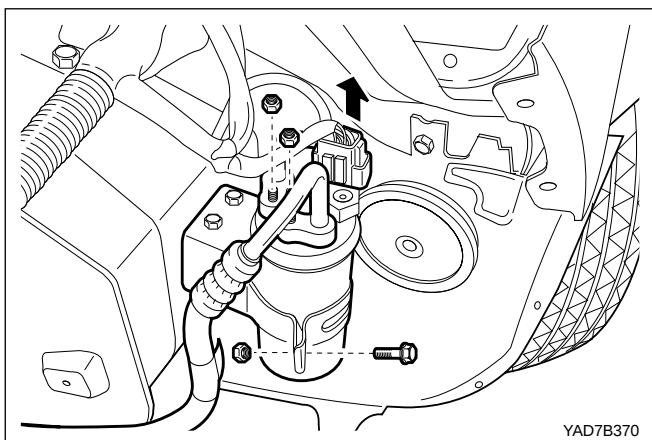
1. Discharge and recover the refrigerant from the system.
2. Remove the head lamp assembly.



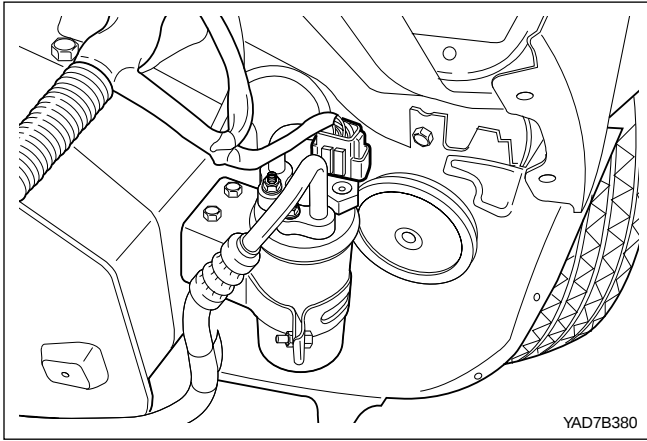
3. Disconnect refrigerant pressure sensor connector.



4. Remove the receiver-drier.
 - Remove two flange nuts.
 - Remove the O-ring



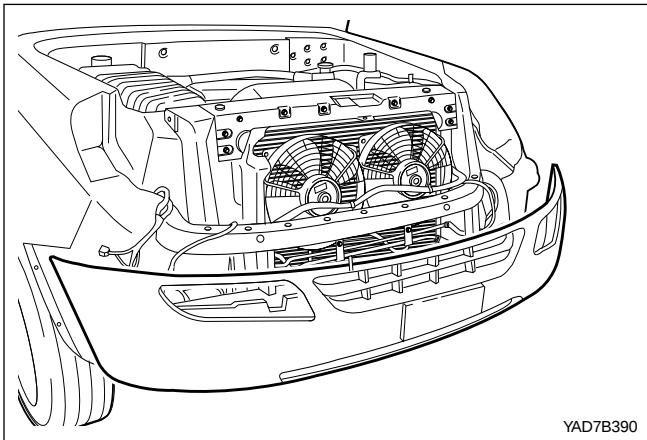
- Remove the bracket bolt retaining the receiver-drier and then remove the receiver-drier.



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

- Tighten the two flange nuts.
- Evacuate and recharge the A/C system.

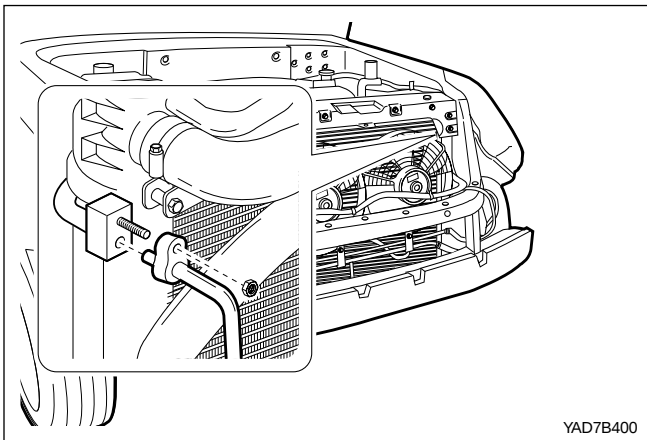
Notice: Before installing, check the O-ring and apply the compressor oil.



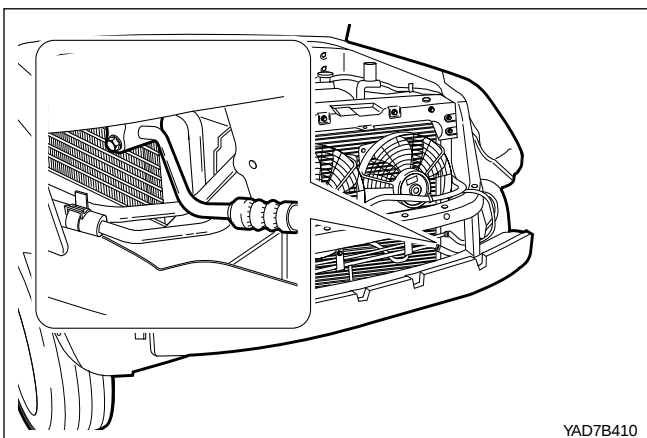
CONDENSER

Removal & Installation Procedure

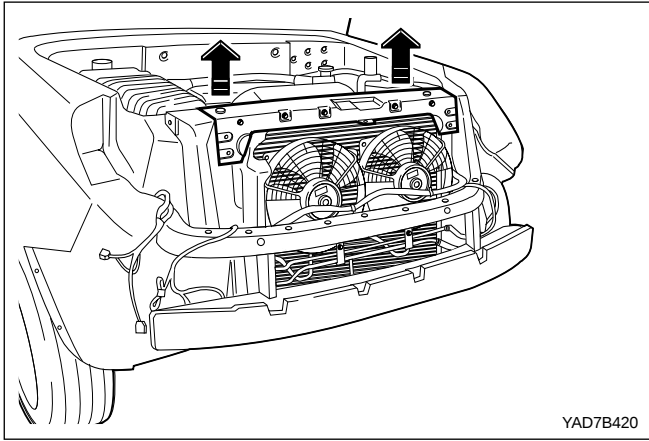
1. Discharge and recover the refrigerant from the system.
2. Remove the radiator grill and front bumper.



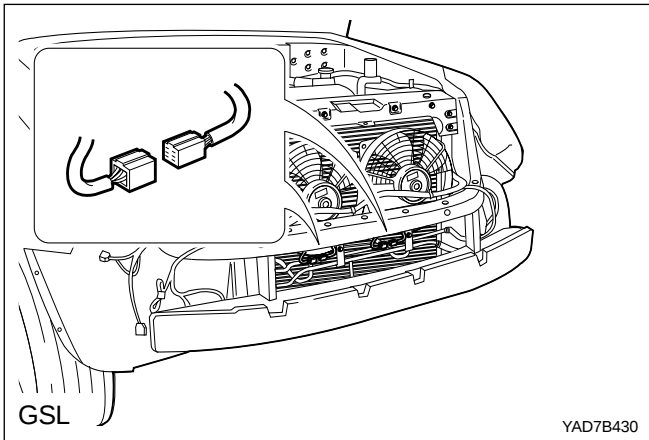
3. Remove the inlet pipe.
Remove the O-ring at the same time.



4. Remove the outlet pipe (at the bottom side) with O-ring.

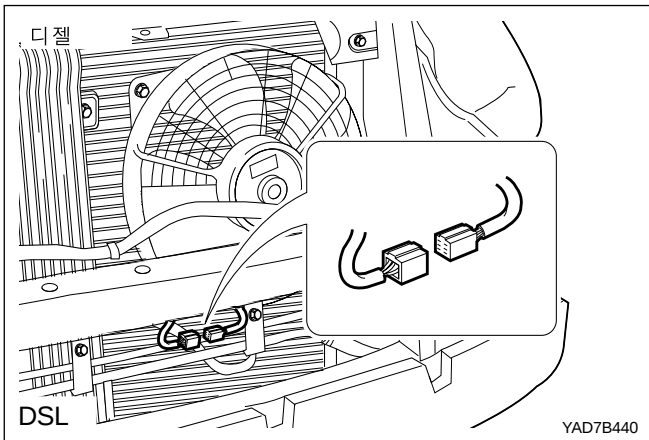


5. Remove the radiator grill plate.



6. Remove the fan bolts.

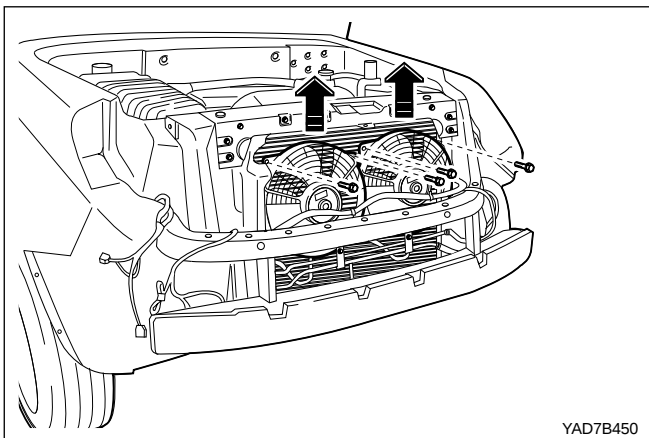
7. Disconnect the fan connector and then remove the condenser fan from the condenser.

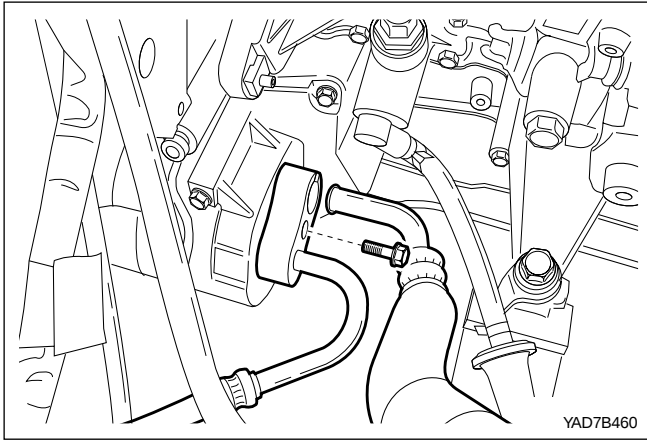


8. Remove the bolts and nuts retaining condenser and then remove the condenser from the vehicle.

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

Notice: The used O-ring must be replaced by the new part.



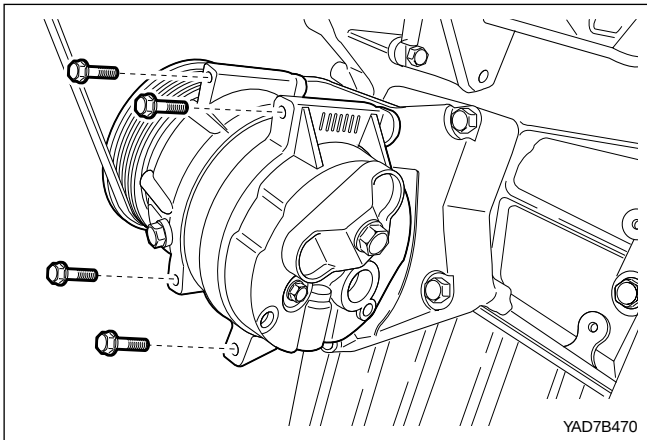


COMPRESSOR

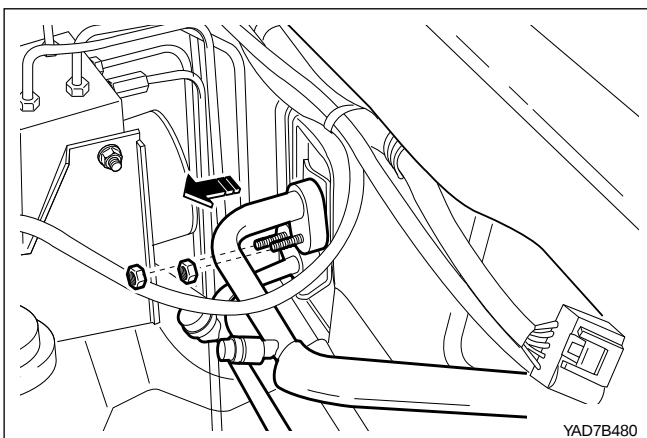
Removal & Installation Procedure

1. Discharge and recover the refrigerant from the system.
2. Remove the fan belt.
3. Disconnect suction/discharge hose from the compressor.
 - Remove the flange bolt retaining the hoses.
 - Disconnect the hoses.
 - Remove two sealing washer.
4. Lift the vehicle and support safely.
5. Remove the skid plate.
6. Remove the compressor.
 - Disconnect the connector of the compressor.
 - Remove three front bracket bolts retaining compressor.

Notice: Discard the used sealing washer.



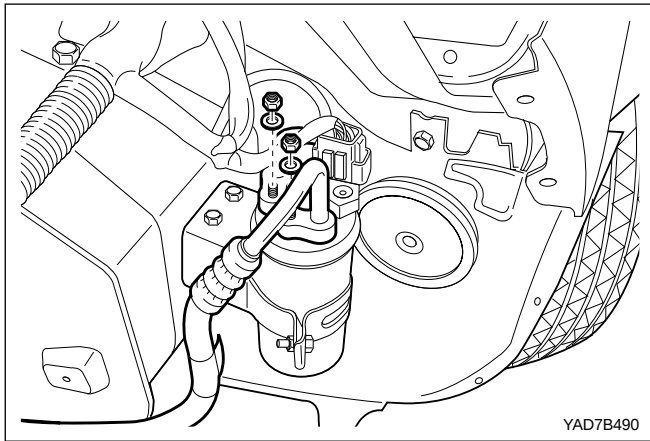
7. Installation should follow the removal procedure in the reverse order.
 - ① Tighten the bolts with the specified torque.
 - ② Evacuate and recharge the A/C system.



A/C HIGH/LOW PRESSURE LINE

Removal Procedure

1. Discharge and recover the refrigerant from the system.

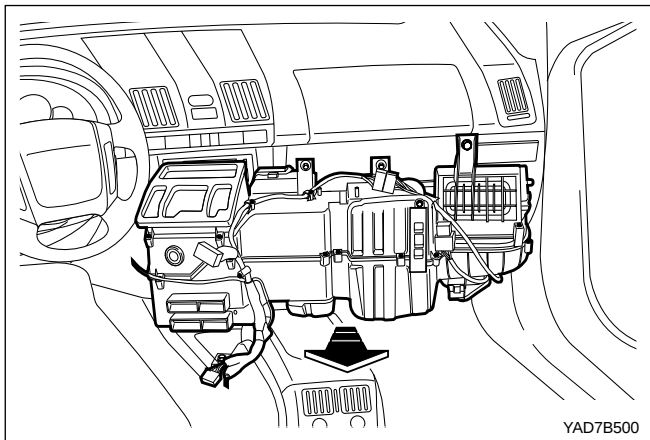


2. Remove the high/low pressure pipe lines.
3. Remove the high/low pressure pipe lines from the evaporator.

Installation Procedure

Notice: Discard the used O-ring and sealing washer.

1. Installation should follow the removal procedure in the reverse order.
2. Tighten the flange nut securing the high pressure line with the specified torque.
 - flange nut at compressor
 - flange nut at evaporator
3. Evacuate and recharge the A/C system.



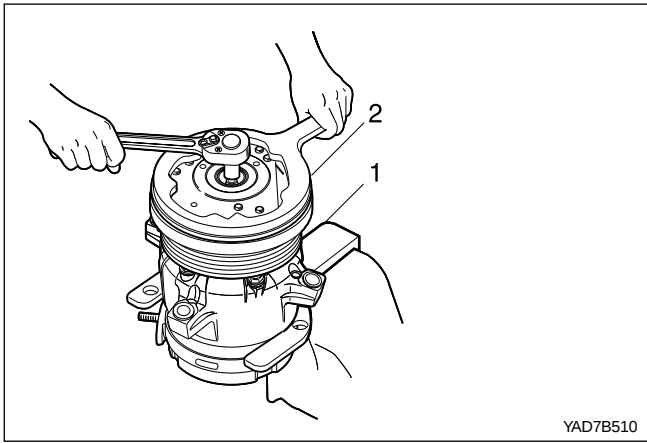
A/C MODULE ASSEMBLY

Removal Procedure

1. Discharge the coolant from the system.
2. Discharge and recover the refrigerant from the system.
3. Disconnect the inlet and outlet hose of the heater.
4. Disconnect the high/low pressure pipe from the evaporator core.
5. Remove five bolts securing the A/C module.
 - two bolts at evaporator
 - two bolts at heater core
 - a bolt at I/P
6. Remove the instrument panel.
7. Remove the fiber panel.
8. Remove the A/C module assembly.

Installation Procedure

1. Installation should follow the removal procedure in the reverse order.
2. Tighten five bolts securing A/C module with the specified torque.
3. Recharging the coolant.
4. Evacuate and recharge the A/C system.

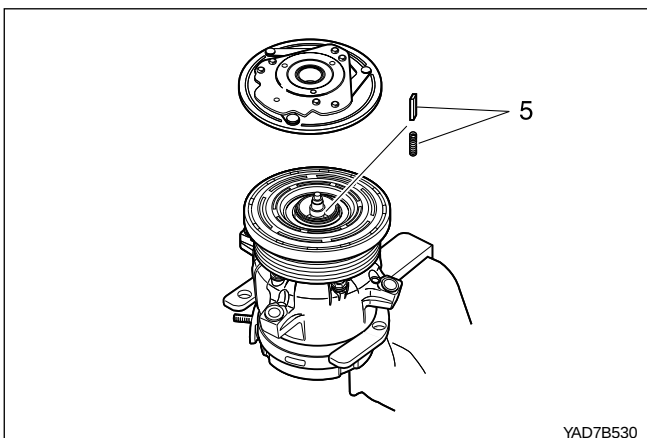
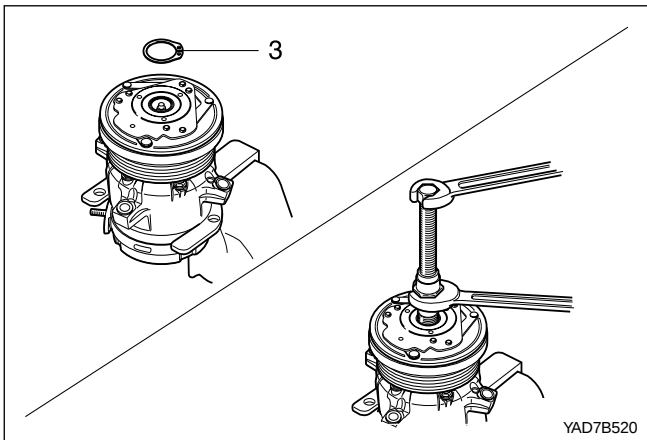


UNIT REPAIR

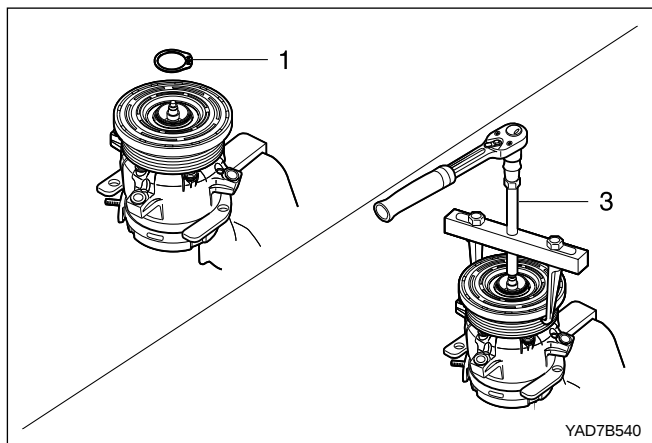
COMPRESSOR

Disassembly and Assembly Procedure

1. Remove the compressor.
2. Remove the clutch driver.
 - Install the compressor holding fixture to the compressor and hold the compressor holding fixture using a bench vise.
 - Use the clutch hub holding tool to keep the clutch drive plate and the hub assembly from turning to remove the shaft nut.
 - Remove the snap ring using the ring plier.
 - Remove the clutch drive using the special tool.

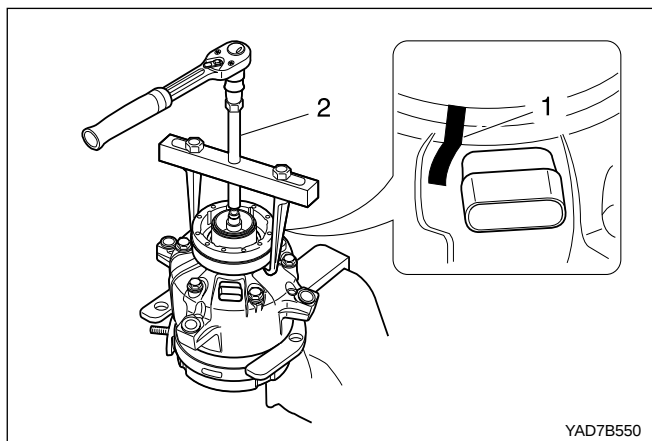


- Remove the clutch shaft key and spring.



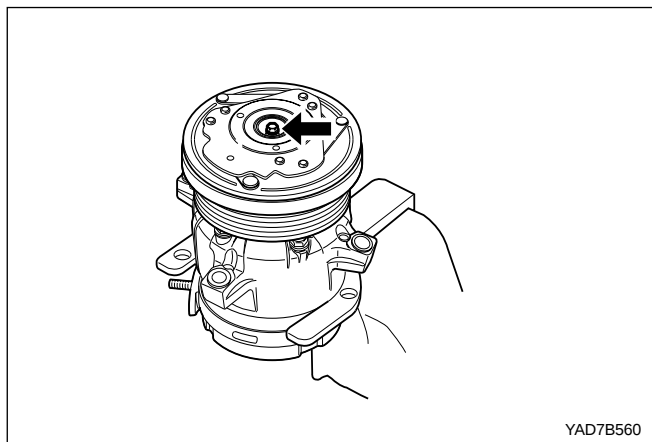
3. Remove the compressor pulley.

- Remove the snap ring using the ring plier.
- Remove the compressor pulley using the special tool.



4. Remove the clutch coil.

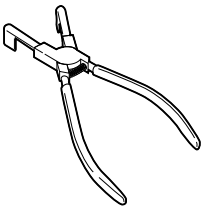
- Mark the location of the clutch coil connector at the clutch housing.
- Remove the clutch coil using the special tool.



5. Assembly should follow the disassembly procedure in the reverse order.

SPECIAL TOOLS AND EQUIPMENT

SPECIAL TOOLS TABLE

 YAD7B570	DW 100-010 Spring Clamp Remover & Installer
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