SERVICE MANUAL SECTION

HEAT VENTILATION AIR CONDITIONING (HVAC) SYSTEM

Model: CF 500
Start Date: 05/01/2005

Model: CF 600
Start Date: 05/01/2005

Unit Code: 16VBV

Unit Code: 16WLN

S16030

09/13/2005

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1. SERVICE WARNINGS

WARNING – Safety goggles or other adequate eye protection must be worn when working with refrigerant. The temperature of liquid refrigerant is -20 degrees F (-29 degrees C). Serious injury or blindness will result from refrigerant contacting the eyes.

WARNING – If the refrigerant should contact the eyes, DO NOT rub them. Splash the eyes with cold water to gradually get the temperature above the freezing point. See a doctor immediately.

WARNING – Wear nonporous gloves. (Nitril is the recommended material.) Should liquid refrigerant come into contact with the skin, remove any contaminated clothing, including shoes; then treat the injury as though the skin had been frostbitten or frozen. See a doctor immediately.

WARNING – Be certain that pressurized refrigerant containers are not exposed to open flame or temperatures above 125 degrees F (51 degrees C). Do not discard empty refrigerant containers where they are likely to be subjected to the heat of trash burners, etc.; they may explode, resulting in personal injury or possible death. Containers must be stored, installed, and disposed of in accordance with all state and local ordinances.

WARNING – Never weld, solder, steam clean or use excessive heat on any of the air conditioning lines or equipment while the system is charged. Heat applied to any part will cause the pressure within the system to become excessive, which may result in an explosion and possible personal injury.

WARNING – Do not smoke or allow any type of fire or flame in the immediate area while servicing the air conditioning system. Refrigerant is not combustible; however, in the presence of heat it changes to a poisonous gas. Inhalation can cause death or serious injury.

WARNING – R-134a must not be mixed with air and then pressurized. When mixed with large quantities of air and pressurized, R-134a becomes combustible.

WARNING – Refrigerant must be recovered from the air conditioning system before any components of the system are removed or replaced. Removing components while pressure is in the system will cause personal injury or death.

WARNING – Do not install or remove A/C testing or charging equipment while the engine is running. Serious injury may result from doing so.

WARNING – Always use approved refrigerant recycling equipment when working with R-134a to prevent accidental discharge. If released into the atmosphere, the refrigerant evaporates very quickly and may displace the oxygen surrounding the work area, especially in small or enclosed areas. This situation creates the hazard of suffocation or brain damage for anyone in the work area. If a leak should occur, avoid breathing the refrigerant and lubricant vapor. Thoroughly ventilate the area before continuing with service. Federal and state laws require that refrigerant be recovered and recycled to help protect the environment.

WARNING – With the manifold gauge set connected to both the air conditioning system and the refrigerant supply cylinder, never open the high side hand valve of the manifold gauge set while the A/C system is operating. If hot, high pressure refrigerant is forced through the gauge to the refrigerant supply cylinder; it could cause the cylinder to rupture and cause personal injury.

WARNING – When purging the system or components, do not use nitrogen at pressures over 862 kPa (125 psi). Personal injury or death may result from doing so.

WARNING – Always use correct replacement refrigerant hoses. Do not use hoses other than those specified for the system being serviced. The use of improper hoses may cause a hose rupture, which may result in personal injury.

WARNING – During system diagnostic tests, DO NOT turn either hand valve on the manifold gauge set for any reason. Equipment can be damaged, and personal injury can result. When connected to the A/C system the gauges will indicate the system pressures with the valves closed (fully CW). These valves are used only while servicing the A/C refrigerant system.

CAUTION – To prevent damage to the test equipment, make sure test equipment is clear of all moving parts in the engine compartment.

CAUTION – When installing and removing any service hose or fitting, a small amount of refrigerant may escape. Always follow all safety precautions to avoid injury.

IMPORTANT – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

In addition to the Service Warnings above, special attention to the following rules during servicing, and component remove and install, will aid in avoiding unnecessary and time-consuming problems.

1. Perform service inside a warm, well ventilated dry shop.

2. When working on the A/C system keep the work area and tools as clean as possible. Also, clean all connections, ports or fittings before disconnecting or removing components.

3. Never use hot steam to clean the inside of the system. Dry nitrogen cleaning is recommended for this purpose.

4. All A/C component and refrigerant line openings should be immediately plugged during removal and remain so until re-installation to prevent the entry of dirt, moisture and other foreign material. Even the slightest particle can cause problems if carried to a vulnerable place within the system.

5. Never remove protective caps from components until the moment of assembly into the system.

6. Never install non-sealed components.

7. Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with **MINERAL-BASED** oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, Ester or PAG oil, etc. to lubricate O-rings and fittings.

8. All refrigerant hose and tubing support clamps and strap locks must be re-installed in their original positions.

   Never bend a hose to a radius less than ten times the diameter of the hose.

   Never route a hose any closer than two inches from the exhaust manifold or related piping.

   Periodically inspect hoses for leaks or brittleness. Replace lines immediately if damaged.

9. All fittings must be tightened only to the values specified in the TORQUE SPECIFICATIONS (See Table 24, page 103). The steel and aluminum fittings used in the refrigerant system will not tolerate overtightening. Use only a torque wrench known to be accurate.

10. When disconnecting a fitting, use a wrench on both halves of the fitting to prevent twisting of the refrigerant lines or tubes.

11. Replace the receiver/drier on any system which has been opened for more than a short period (approximately 30 minutes); after the system has been flushed or purged; and/or when the system has become contaminated (such as due to a internal compressor failure).

12. Refrigerant oil quickly absorbs moisture. Store oil only in moisture-free containers and keep oil containers closed until ready to use. Close refrigerant oil container immediately after use.

13. The air conditioning system must be flushed or purged any time the system has become contaminated (such as due to an internal compressor failure). Refer to FLUSHING AND PURGING THE AIR CONDITIONING SYSTEM.

14. Whenever the system is discharged, the refrigerant oil level must be checked and/or replaced as specified in OIL FILL GUIDELINES.

15. If multiple components have been serviced, always assemble the connections at the compressor last. This reduces the risk of exposing the refrigerant oil to the atmosphere.

16. Any system that has been discharged due to leakage, or opened to replace a component, must be evacuated (and the system oil quantity must be returned to normal) before charging.

17. Do not open a refrigerant system or uncap a replacement component unless it is as close as possible to room temperature. This will prevent condensation from forming inside a component that is cooler than the surrounding air.

18. Use extreme care to prevent moisture from entering the system. Moisture can freeze at the evaporator input orifice and block refrigerant flow during system operation. Always properly evacuate the system after service to remove any moisture and air from the system.

19. Spare components should be sealed and stored in a warm, dry facility.

2. DESCRIPTION AND OPERATION

2.1. PRINCIPLES OF AIR CONDITIONING / REFRIGERATION

There are 4 main principles involved with the basic theory of operation:

- Heat transfer
- Latent heat of vaporization
- Relative humidity
- Effects of pressure

Heat Transfer

If 2 substances of different temperature are placed near each other, the heat in the warmer substance will transfer to the colder substance.

Latent Heat of Vaporization

When a liquid boils (changes to gas), it absorbs heat without raising the temperature of the resulting gas. When the gas condenses (changes back to a liquid), it gives off heat without lowering the temperature of the resulting liquid.

Relative Humidity

The amount of moisture (water vapor content) that the air can hold is directly related to the air temperature. The more heat there is in the air, the more moisture the air can hold. The lower the moisture content in the air, the more comfortable you feel. Removing moisture from the air lowers its relative humidity and improves personal comfort.

Effects of Pressure on Boiling or Condensation

As the pressure is increased on a liquid, the temperature at which the liquid boils (changes to gas) also increases. Conversely, when the pressure on a liquid is reduced, its boiling point is also reduced. When in the gas state, an increase in pressure causes an increase in temperature, while a decrease in pressure will decrease the temperature of the gas.

The Refrigerant Cycle

During stabilized conditions (air conditioning system shutdown), the refrigerant is in a vaporized state and pressures are equal throughout the system. When the A/C compressor is in operation, it increases pressure on the refrigerant vapor raising its temperature. The high-pressure, high-temperature vapor is then released into the top of the A/C condenser core.

The A/C condenser core, being close to ambient temperature, causes the refrigerant vapor to condense into a liquid when heat is removed from the refrigerant by ambient air passing over the fins and tubing. The now liquid refrigerant, still at high pressure, exits from the bottom of the A/C condenser core and enters the inlet side of the receiver/drier.

The receiver/drier is designed to remove moisture from the refrigerant. The refrigerant, still at high pressure, exits the receiver/drier and enters the thermostatic expansion valve.

The thermostatic expansion valve is the restriction in the refrigerant system that creates the high-pressure buildup in the A/C condenser core and separates the high and low-pressure sides of the A/C system. As the liquid refrigerant leaves this restriction, its pressure and boiling point are reduced.

The liquid refrigerant is now at its lowest pressure and temperature. As it passes through the A/C evaporator core, it absorbs heat from the passenger compartment airflow passing over the plate/fin sections of the A/C evaporator core. This addition of heat causes the refrigerant to boil (convert to gas). The now cooler passenger compartment air can no longer support the same humidity level of the warmer air and this excess moisture condenses on the exterior of the evaporator coils and fins and drains outside the vehicle.

The refrigerant cycle is now repeated with the A/C compressor again increasing the pressure and temperature of the refrigerant.

The A/C thermostatic cycling switch interrupts compressor operation before the external temperature of the A/C evaporator core gets low enough to cause the condensed water vapor (excess humidity) to turn to ice.

The low charge protection switch protects the A/C compressor in the event of a low refrigerant charge. The low charge protection switch interrupts the A/C demand signal when the refrigerant pressure drops below acceptable levels.

The high side line pressure is also monitored so that A/C compressor operation can be interrupted if system pressure becomes too high.

The A/C compressor relief valve will open and vent refrigerant to relieve unusually high system pressure.

2.2. DESCRIPTION – AIR DISTRIBUTION AND FILTERING

NOTE – The air distribution system of this vehicle cannot be equipped with a cabin air filter.

There are 2 sources of air available to the air distribution system:

- Outside air
- Recirculated air

Recirculated air is available in any mode when the air inlet selector is in the RECIRC position.

Air distribution within the vehicle is determined by the function selector switch position. Airflow mode doors are used to direct airflow within the heater core and evaporator core housing. An airflow mode door control cable is used to position these airflow mode doors.

Air enters the passenger compartment from the:

- instrument panel A/C registers.
- floor duct.
- windshield defroster.
- side window demisters.

Passenger compartment air is exhausted from the vehicle through open windows or cab air vents.

2.3. DESCRIPTION – CONTROL COMPONENTS

The manual climate control system heats or cools the vehicle interior depending on the function selector position and the temperature selected. The function selector position determines air distribution. The temperature blend control setting determines air temperature.

The manual climate control components are used to:

- select the air inlet source (FRESH or RECIRC).
- select the blower motor speed.
- select the discharge air temperature (temperature blend).
- select airflow mode (DEFROST, PANEL, FLOOR).
- select A/C compressor clutch operation.

Climate Control Assembly

The climate control assembly has 4 system controls:

- The function selector operates the airflow mode doors using a push-pull type airflow mode door control cable. The airflow mode door control cable attaches to the airflow mode door linkage to operate the 2 airflow mode doors.
- The temperature selector operates the temperature blend door using a push-pull type temperature blend door control cable. The temperature blend door control cable attaches to the temperature blend door linkage to operate the temperature blend door.

- The air inlet selector operates the air inlet door using a push-pull type air inlet door control cable. The air inlet door control cable attaches to the air inlet door linkage to operate the air inlet door between the FRESH and RECIRC modes.
- The blower motor switch controls blower motor speed by adding or bypassing resistors in the blower motor resistor.

A/C Switch

The A/C switch is used to select A/C operation in any mode.

The A/C request button is enabled by the blower motor switch. The A/C request button is disabled when the blower motor switch is in the OFF position. A 5-volt reference voltage from the engine control module (ECM) is received at the A/C switch. When the A/C request button is activated (indicator ON), the reference voltage is grounded through the blower motor switch. When the reference voltage is grounded, an A/C demand signal is recognized by the ECM.

Blower Motor Resistor

The blower motor resistor adjusts the blower motor speed based on the blower motor switch setting. The blower motor resistor contains 3 resistor coils in series. The end of each resistor coil is wired to a setting in the blower motor switch. Voltage is available at the blower motor at all times when the ignition is in the ON position and then continues to the blower motor resistor. The blower motor switch will allow a path to ground with the addition of 1, 2 or 3 coils in the blower motor resistor to the circuit.

- When the blower motor switch is in the MED HI position, the blower motor switch will add a path to ground through one coil in the blower motor resistor.
- When the blower motor switch is in the MED LO position, the blower motor switch will add a path to ground through 2 coils (in series) in the blower motor resistor.
- When the blower motor switch is in the LO position, the blower motor switch will add a path to ground through 3 coils (in series) in the blower motor resistor.
- When the blower motor switch is in the HI position, the blower motor resistor is bypassed.

2.4. DESCRIPTION – SYSTEM AIRFLOW

Refer to FIGURE 1.

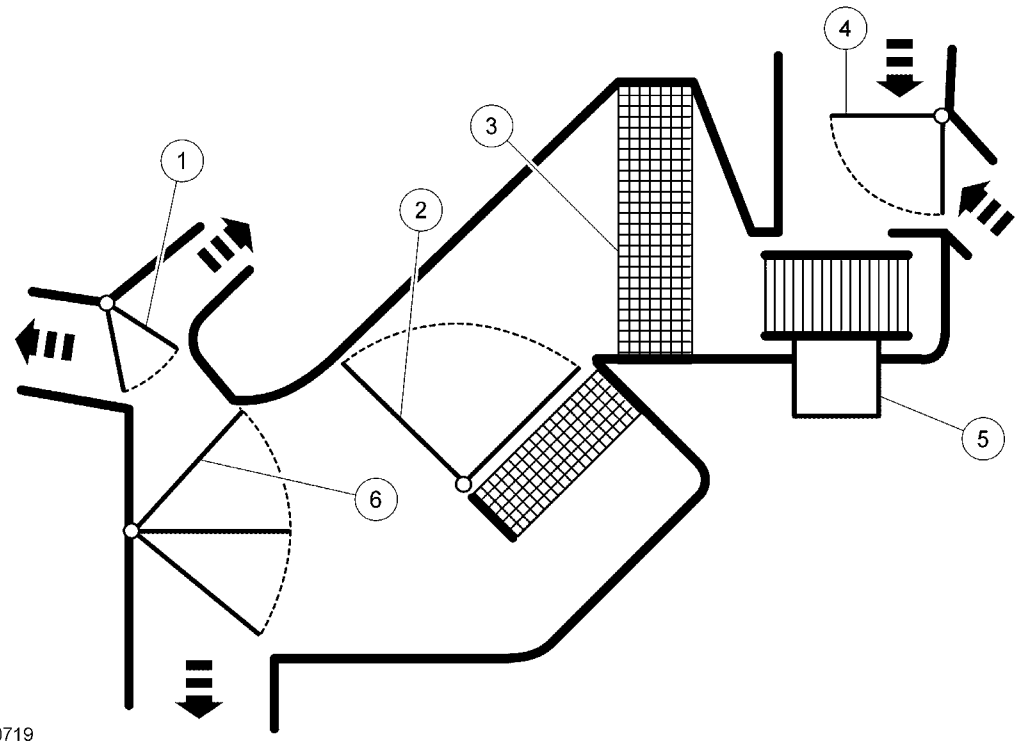

Figure 1

1. Panel/defrost mode door
2. Temperature blend door
3. Evaporator core
4. Air inlet door
5. Blower motor
6. Panel/floor mode door

OFF

When OFF is selected on the blower motor switch:

- The air inlet door is positioned by the air inlet selector and can be switched between FRESH and RECIRC.
- The airflow mode doors are in the position indicated by the function selector.
- The A/C compressor will not operate and the indicator will not illuminate.
- The blower motor is OFF.

PANEL

When PANEL is selected:

- The air inlet door is positioned by the air inlet selector and can be switched between FRESH and RECIRC.
- The panel/defrost door closes off the defrost outlet and opens the panel outlet. The panel/floor door closes off the floor outlet and opens the panel outlet.
- The temperature can be adjusted to heat the air but the air cannot be cooled below the outside temperature unless A/C is selected ON.

- The A/C switch is enabled if the blower motor switch is in an ON position. The A/C compressor will operate if the A/C switch is selected (indicator ON) and the outside temperature is above approximately 6°C (43°F).
- The blower motor speed is selected on the blower motor switch.

PANEL/FLOOR

When PANEL/FLOOR is selected:

- The air inlet door is positioned by the air inlet selector and can be switched between FRESH and RECIRC.
- The panel/defrost door closes off the defrost outlet and opens the panel outlet. The panel/floor door is in the mid-position to open the floor outlet and panel outlet.
- The temperature can be adjusted to heat the air but the air cannot be cooled below the outside temperature unless A/C is selected ON.
- The A/C switch is enabled if the blower motor switch is in an ON position. The A/C compressor will operate if the A/C switch is selected (indicator ON) and the outside temperature is above approximately 6°C (43°F).
- The blower motor speed is selected on the blower motor switch.

FLOOR

When FLOOR is selected:

- The air inlet door is positioned by the air inlet selector and can be switched between FRESH and RECIRC.
- The panel/defrost door closes off the defrost outlet and opens the panel outlet. The panel/floor door closes off the panel outlet and opens the floor outlet.
- The temperature can be adjusted to heat the air but the air cannot be cooled below the outside temperature unless A/C is selected ON.
- The A/C switch is enabled if the blower motor switch is in an ON position. The A/C compressor will operate if the A/C switch is selected (indicator ON) and the outside temperature is above approximately 6°C (43°F).
- The blower motor speed is selected on the blower motor switch.

FLOOR/DEFROST

NOTE – For most efficient defrost operation, the air inlet selector should be in the FRESH position and the A/C should be selected ON.

When FLOOR/DEFROST is selected:

- The air inlet door is positioned by the air inlet selector and can be switched between FRESH and RECIRC.
- The panel/defrost door is in the mid-position to open the defrost outlet. The panel/floor door is in the mid-position to open the floor outlet.
- The temperature can be adjusted to heat the air but the air cannot be cooled below the outside temperature unless A/C is selected ON.
- The A/C switch is enabled if the blower motor switch is in an ON position. The A/C compressor will operate if the A/C switch is selected (indicator ON) and the outside temperature is above approximately 6°C (43°F).
- The blower motor speed is selected on the blower motor switch.

DEFROST

NOTE – For most efficient defrost operation, the air inlet selector should be in the FRESH position and the A/C should be selected ON.

When DEFROST is selected:

- The air inlet door is positioned by the air inlet selector and can be switched between FRESH and RECIRC.
- The panel/defrost door closes off the panel outlet and opens the defrost outlet. The panel/floor door closes off the floor outlet.
- The temperature can be adjusted to heat the air but the air cannot be cooled below the outside temperature unless A/C is selected ON.
- The A/C switch is enabled if the blower motor switch is in an ON position. The A/C compressor will operate if the A/C switch is selected (indicator ON) and the outside temperature is above approximately 6°C (43°F).
- The blower motor speed is selected on the blower motor switch.

2.5. DESCRIPTION – HEATING AND VENTILATION

The heating and ventilation system has the following features:

- Controls the temperature and during A/C operation (if equipped), reduces the relative humidity of the air inside the vehicle
- Delivers heated or cooled air to maintain the vehicle interior temperature and comfort level
- Cooling or heating can be adjusted to maintain the desired temperature
- System uses a reheat method to provide conditioned air to the passenger compartment
- The temperature blending is varied by the air temperature control door, which regulates the amount of air that flows through and around the heater core, where it is then mixed and distributed

Blower Motor

The blower motor pulls air from the air inlet and forces it into the heater core and evaporator core housing where it is mixed and distributed.

Heater Core and Evaporator Core Housing

The heater core and evaporator core housing directs airflow from the blower motor through the evaporator core (if equipped) and heater core. All airflow from the blower motor passes through the evaporator core (if equipped). The airflow is then directed through or around the heater core by a cable-actuated temperature blend door. After passing through the heater core, the airflow is distributed to the selected outlet by 2 cable-actuated airflow mode doors.

Heater Core

The heater core consists of fins and tubes arranged to extract heat from the engine coolant and transfer it to air passing through the heater core from the blower motor.

2.6. DESCRIPTION – AIR CONDITIONING

The A/C refrigerant system is a clutch cycling thermostatic expansion valve (TXV) type. The system components are:

- A/C compressor and clutch assembly
- A/C condenser core
- A/C evaporator core
- Receiver/drier
- Connecting refrigerant lines

The refrigeration system operation is controlled by the following:

- Thermostatic expansion valve
- Thermostatic A/C cycling switch
- High-pressure cutoff switch
- Low-charge protection switch

The refrigerant system incorporates an A/C compressor controlled by a thermostatic A/C cycling switch. The thermostatic A/C cycling switch senses evaporator core temperature to control operation of the A/C compressor.

An A/C compressor pressure relief valve is installed to protect the compressor against excessively high refrigerant pressures. A TXV is used to meter the liquid refrigerant into the A/C evaporator core.

A/C Compressor and Clutch Assembly

NOTE – Internal A/C compressor and clutch components are not serviced separately. The FS-10 A/C compressor/clutch is serviced only as an assembly.

NOTE – Whenever a new A/C compressor is installed due to a failure that produces foreign material in the refrigerant system, also install a new receiver/drier and TXV. Refer to OIL FILL GUIDELINES (See OIL FILL GUIDELINES, page 69).

The FS-10 A/C compressor has the following characteristics:

- A 10-cylinder swashplate design utilizing the tangential design mount.
- A 1-piece lip-type seal is used to seal it at the shaft opening in the assembly.
- Five double-acting pistons operate within the cylinder assembly. The pistons are actuated by a swashplate that changes the rotating action of the shaft to a reciprocating force.
- Reed-type discharge valves are located between the cylinder assembly and the head at each end of the A/C compressor.
- The A/C compressor uses PAG Refrigerant Compressor Oil.

When battery voltage is applied to the A/C compressor clutch field coil, the clutch plate and hub assembly is drawn toward the A/C clutch pulley. The magnetic force locks the clutch plate and hub assembly and the A/C clutch pulley together as one unit, causing the compressor shaft to rotate. When battery voltage is removed from the A/C compressor clutch field coil, springs in the clutch plate and hub assembly move the clutch plate away from the A/C clutch pulley.

Thermostatic Expansion Valve

The thermostatic expansion valve (TXV) is located at the evaporator core inlet and outlet fittings below the instrument panel. The TXV provides a restriction to the flow of refrigerant from the high pressure side of the refrigerant system and separates the low pressure and high pressure sides of the refrigerant system. Refrigerant entering or exiting the evaporator core passes through the TXV through 2 separate flow paths. An internal temperature sensing bulb senses the temperature of the refrigerant flowing out of the evaporator core and adjusts an internal pin-type valve to meter the refrigerant flow into the evaporator core. The internal pin-type valve decreases the amount of refrigerant entering the evaporator core at lower temperatures and increases the amount of refrigerant entering the evaporator core at higher temperatures.

A/C Evaporator Core

NOTE – If an evaporator core leak is suspected, the evaporator core must be vacuum leak tested before it is removed. For additional information, refer to COMPONENT TESTS.

The evaporator core is an aluminum plate/fin type and is located in the heater core and evaporator core housing. A mixture of refrigerant and oil enters the bottom of the evaporator core through the evaporator core inlet tube and then moves out of the evaporator core through the evaporator core outlet tube. Air from the blower motor is cooled and dehumidified as it flows through the evaporator core fins.

A/C Condenser Core

The condenser is an aluminum fin and tube design heat exchanger, located in front of the vehicle radiator. It cools compressed refrigerant gas by allowing air to pass over fins and tubes to extract heat and by condensing gas to liquid refrigerant as it is cooled.

Thermostatic A/C Cycling Switch

The thermostatic A/C cycling switch monitors the temperature of the evaporator core. It is used (by the ECM) to prevent freezing of the evaporator core by controlling A/C compressor clutch engagement/disengagement. When the evaporator core temperature drops below specification, the thermostatic A/C cycling switch opens, interrupting the A/C demand signal to the ECM. When the evaporator core temperature rises above specification, the thermostatic A/C cycling switch contacts close.

Low-Charge Protection Switch

The low-charge protection switch is used to prevent A/C compressor damage in the event of a low refrigerant charge, by interrupting the A/C demand signal to the ECM, when the low side refrigerant pressure drops below acceptable levels. The electrical switch contacts open when the suction pressure drops below normal levels. The contacts close when the suction pressure rises.

High-Pressure Cutoff Switch

The high-pressure cutoff switch is used to interrupt A/C compressor operation, by interrupting the A/C demand signal to the ECM, in the event of high system discharge pressures. When the A/C compressor discharge pressure rises, the switch contacts open. When the pressure drops, the contacts close.

A/C Compressor Pressure Relief Valve

An A/C compressor pressure relief valve is incorporated in the compressor manifold and tube assembly to prevent damage to the A/C compressor and other system components and to avoid total refrigerant loss by relieving unusually high refrigerant system discharge pressure buildups.

Service Gauge Port Valves

The high-pressure service gauge port valve is located on the receiver/drier.

The low-pressure service gauge port valve is located on compressor manifold and tube near the evaporator fitting.

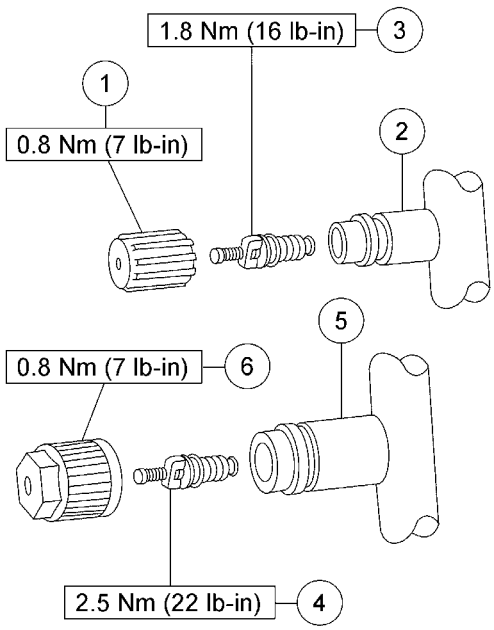

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Figure 2

1. Low-pressure service gauge port valve cap
2. Low-pressure service gauge port valve
3. Low-pressure Schrader-type valve
4. High-pressure Schrader-type valve
5. High-pressure service gauge port valve
6. High-pressure service gauge port valve cap

The fitting is an integral part of the refrigeration line or component.

- Special couplings are required for both the high-side and low-side service gauge ports.
- A very small amount of leakage will always be detectable around the Schrader-type valve when the service gauge port valve cap is removed and is considered normal. A new Schrader-type valve core can be installed if the seal leaks excessively.
- The service gauge port valve caps are used as primary seals in the refrigerant system to prevent leakage through the Schrader-type valves from reaching the atmosphere. Always install and tighten the A/C service gauge port valve caps to the correct torque after they are removed.

3. DIAGNOSIS AND TESTING

Refer to Circuit Diagrams S08311 for schematic and connector information.

Table 1 Special Tools

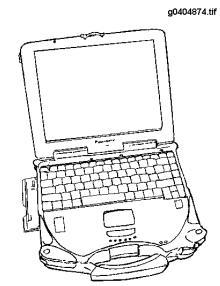
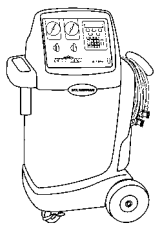
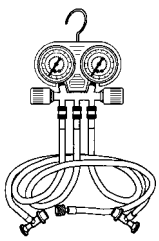
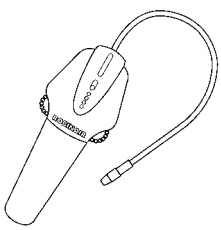
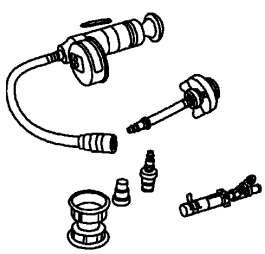
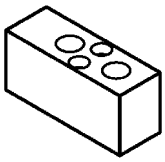
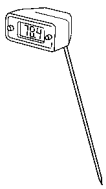
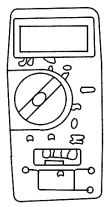
	Electronic Service Tool, EZ-Tech III®
	R-134a Refrigerant (Recovery/Recycling/Recharging) station ZTSE4615
	R-134a Manifold Gauge Set ZTSE4623
	Electronic Leak Detector ZTSE4617
 ST1474-A ST1474–A	Pressure Tester ZTSE2384

Table 1 Special Tools (cont.)

	Evaporator Flush/Purge Adapter ZTSE4718
	Digital Thermometer ZTSE4619
 ST1137-A ST1137–A	Automotive Meter ZTSE4357

3.1. INSPECTION AND VERIFICATION

1. Verify the customer concern by operating the climate control system to duplicate the condition.
2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart:

Table 2 Visual Inspection Chart

Mechanical	Electrical
• Loose, missing or damaged A/C compressor drive belt • Loose or disconnected A/C clutch • Loose, misrouted or damaged mode, temperature or air inlet door cable • Broken or damaged mode, temperature or air inlet door linkage • Discharged A/C system • Broken or leaking refrigerant lines	• Power distribution center (PDC) fuse(s): — 06 (40A) — 12 (20A) — 30 (30A) — 34 (20A) — 35 (15A) • Blower motor inoperative • A/C compressor inoperative • Circuitry open/shorted • Disconnected, loose fitting or incorrectly installed electrical connectors and pins

3. As pinpoint tests and measurements are being carried out, be sure to inspect for any disconnected, loose fitting or incorrectly installed component, module and in-line electrical connectors and pins.

4. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.

5. If the cause is not visually evident, connect a diagnostic tool to the data link connector and select the vehicle to be tested from the diagnostic tool menu. If the diagnostic tool does not communicate with the vehicle:

   - check that the program card is correctly installed.
   - check the connections to the vehicle.
   - check the ignition switch position.

6. If the diagnostic tool still does not communicate with the vehicle, refer to the diagnostic tool operating manual.

7. Carry out the DATA LINK DIAGNOSTICS test. If the diagnostic tool responds with:

   - SCP+, SCP- or UBP CIRCUITS FAULT = ALL ECUS NO RESP/NOT EQUIP, refer to Module Communications Network to diagnose the network concern.
   - If the engine control module (ECM) is not listed for a communication concern, turn the A/C controls to OFF and execute the self-test diagnostics for the ECM.

8. If any ECM DTCs are retrieved, and are related to the concern, go to the ENGINE CONTROL MODULE DIAGNOSTIC TROUBLE CODE (DTC) INDEX to continue diagnostics.

9. If no DTCs related to the concern are retrieved, GO to Symptom Chart to continue diagnostics.

Table 3 Symptom Chart

Condition	Possible Sources	Action
The blower motor is inoperative	• Fuse. • Blower motor switch. • Blower motor relay. • Power motor. • Circuitry open/shorted.	Go to PINPOINT TEST A page 17.
No operation in lower speeds	• Blower motor resistor. • Blower motor switch. • Circuitry short/open.	Go to PINPOINT TEST B page 22.
Insufficient, erratic or no heat	• Low engine coolant level. • Engine overheating. • Plugged or partially plugged heater core. • Temperature blend door binding/stuck.	Go to PINPOINT TEST C page 26.

Table 3 Symptom Chart (cont.)

Condition	Possible Sources	Action
The A/C is inoperative/does not operate correctly	• Low refrigerant charge. • Open fuse. • Thermostatic switch. • Low-charge protection switch. • High-pressure cutoff switch. • A/C switch. • A/C demand relay. • A/C clutch relay. • A/C compressor/clutch assembly. • Engine control module (ECM). • Circuitry short/open.	Go to PINPOINT TEST D page 27.
The A/C is always on	• Circuitry short. • A/C switch. • A/C clutch relay. • Engine control module (ECM). • A/C compressor/clutch assembly.	Go to PINPOINT TEST E page 39.
The A/C condenser pusher fan is inoperative	• Open fuse. • Pusher fan pressure switch. • Pusher fan relay. • Pusher fan. • Circuitry short/open.	Go to PINPOINT TEST F page 45.

3.2. PINPOINT TESTS

Pinpoint Test A: The Blower Motor Is Inoperative

Normal Operation

Under normal operation, B+ is available at the blower motor relay coil when the key is in the RUN position through circuit 489 (PK/BK). When the blower motor switch is in an ON position, the blower motor relay coil is grounded through circuits 753 (YE/RD) and 57 (BK). B+ is available to the blower motor relay switch contacts through circuit 364 (BK/LG). When the blower motor relay coil is grounded, the blower motor switch contacts close and B+ is supplied to the blower motor on circuit 371 (PK/WH). The blower motor ground circuit connects to the blower motor switch through circuit 515 (OG/RD). When in an ON position, the blower motor switch completes the blower motor ground circuit through circuit 57 (BK).

Possible Causes

- Fuse(s)

- Blower motor switch
- Blower motor relay
- Blower motor
- An open in circuit 489 (PK/BK), 753 (YE/RD), 364 (BK/LG), 371 (PK/WH), 515 (OG/RD) or 57 (BK)

Table 4 PINPOINT TEST A: THE BLOWER MOTOR IS INOPERATIVE

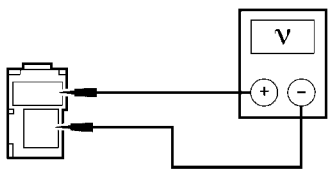
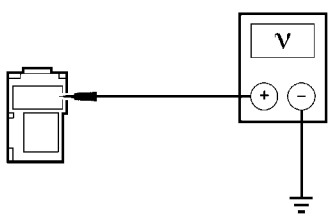
Test Step	Result / Action to Take
A1 CHECK FOR VOLTAGE AND GROUND AT THE BLOWER MOTOR • Key in OFF position. • **Disconnect:** Blower Motor C288 • Key in ON position. • Place the blower motor switch in the HI position. • Measure the voltage between blower motor C288-A, circuit 371 (PK/WH) and C288-B, circuit 515 (OG/RD).  N0024830 **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new blower motor. TEST the system for normal operation. **No** GO to A2.
A2 CHECK FOR VOLTAGE AT THE BLOWER MOTOR • Measure the voltage between blower motor C288-A, circuit 371 (PK/WH) and ground.  N0024829 **Is the voltage greater than 10 volts?**	**Yes** GO to A9. **No** GO to A3.

Table 4 PINPOINT TEST A: THE BLOWER MOTOR IS INOPERATIVE (cont.)

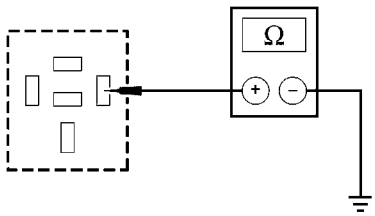
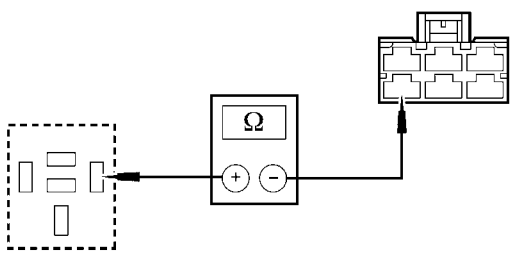
Test Step	Result / Action to Take
A3 CHECK THE BLOWER MOTOR RELAY COIL GROUND • Key in OFF position. • **Disconnect:** Blower Motor Relay • Measure the resistance between blower motor relay pin 86, circuit 753 (YE/RD) and ground.  A0013858 **Is the resistance less than 5 ohms?**	**Yes** GO to A6. **No** GO to A4.
A4 CHECK CIRCUIT 753 (YE/RD) FOR AN OPEN • **Disconnect:** Blower Motor Switch C294b • Measure the resistance between blower motor relay pin 86, circuit 753 (YE/RD) and blower motor switch C294b-B, circuit 753 (YE/RD).  N0024827 **Is the resistance less than 5 ohms?**	**Yes** GO to A5. **No** REPAIR circuit 753 (YE/RD). TEST the system for normal operation.

Table 4 PINPOINT TEST A: THE BLOWER MOTOR IS INOPERATIVE (cont.)

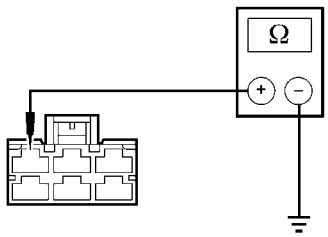
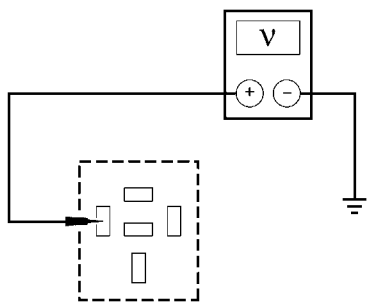
Test Step	Result / Action to Take
A5 CHECK CIRCUIT 57 (BK) FOR AN OPEN • Measure the resistance between blower motor switch C294b-B, circuit 57 (BK) and ground.  N0024826 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor switch. TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
A6 CHECK FOR VOLTAGE AT THE BLOWER MOTOR RELAY COIL • Key in ON position. • Measure the voltage between blower motor relay socket pin 85, circuit 489 (PK/BK) and ground.  A0013862 **Is the voltage greater than 10 volts?**	**Yes** GO to A7. **No** VERIFY that power distribution center (PDC), fuse 35 (15A) is OK. If OK, REPAIR circuit 489 (PK/BK). TEST the system for normal operation.

Table 4 PINPOINT TEST A: THE BLOWER MOTOR IS INOPERATIVE (cont.)

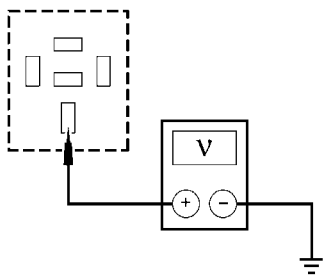
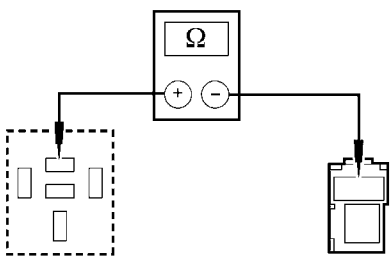
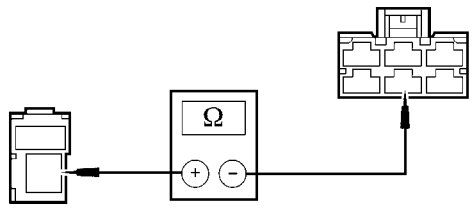
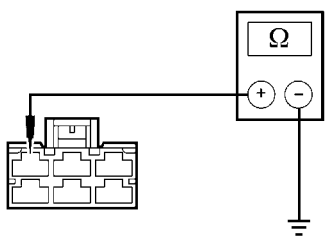
Test Step	Result / Action to Take
A7 CHECK FOR VOLTAGE AT THE BLOWER MOTOR RELAY SWITCH • Measure the voltage between blower motor relay socket pin 30, circuit 364 (BK/LG) and ground.  A0032581 **Is the voltage greater than 10 volts?**	**Yes** GO to A8. **No** VERIFY that power distribution center (PDC), fuse 6 (40A) is OK. If OK, REPAIR circuit 364 (BK/LG). TEST the system for normal operation.
A8 CHECK CIRCUIT 371 (PK/WH) • Key in OFF position. • Measure the resistance between blower motor relay socket pin 87, circuit 371 (PK/WH) and blower motor C288-A, circuit 371 (PK/WH).  N0024825 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor relay. TEST the system for normal operation. **No** REPAIR circuit 371 (PK/WH). TEST the system for normal operation.

Table 4 PINPOINT TEST A: THE BLOWER MOTOR IS INOPERATIVE (cont.)

Test Step	Result / Action to Take
A9 CHECK CIRCUIT 515 (OG/RD) FOR AN OPEN • Key in OFF position. • **Disconnect:** Blower Motor Switch C294b • Measure the resistance between blower motor C288-B, circuit 515 (OG/RD) and blower motor switch C294b-D, circuit 515 (OG/RD).  N0035450 **Is the resistance less than 5 ohms?**	**Yes** GO to A10. **No** REPAIR circuit 515 (OG/RD). TEST the system for normal operation.
A10 CHECK CIRCUIT 57 (BK) • Measure the resistance between blower motor switch C294b-A, circuit 57 (BK) and ground.  N0024826 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor switch. TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

Pinpoint Test B: No Operation in Lower Speeds

Normal Operation

Under normal operation, the blower motor resistor adjusts the blower motor speed based on the blower motor switch setting. The blower motor resistor contains 3 resistor coils in series. The end of each resistor coil is wired to a setting in the blower motor switch. When the blower motor switch is in the MED HI position, the blower motor switch will add a path to ground through circuit 751 (DB/WH). When the blower motor switch is in the MED LO position, the blower motor switch will add a path to ground through circuit 752 (YE/RD).

When the blower motor switch is in the LO position, the blower motor switch will add a path to ground through circuit 755 (BN/WH).

Possible Causes

- Blower motor resistor
- Blower motor switch
- An open in circuit 515 (OG/RD), 755 (BN/WH), 752 (YE/RD) or 751 (DB/WH)

Table 5 PINPOINT TEST B: NO OPERATION IN LOWER SPEEDS

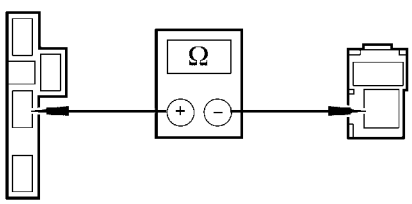
Test Step	Result / Action to Take
B1 CHECK THE BLOWER MOTOR OPERATION IN ALL SPEEDS • Key in ON position. • Check for correct blower motor operation in LO, MED LO and MED HI. **Is the blower motor inoperative in more than one lower speed?**	**Yes** GO to B2. **No** If the blower motor is inoperative in LO only, GO to B3. f the blower motor is inoperative in MED LO only, GO to B5. If the blower motor is inoperative in MED HI only, GO to B6.
B2 CHECK CIRCUIT 515 (OG/RD) • Key in OFF position. • **Disconnect:** Blower Motor Resistor C1228. • **Disconnect:** Blower Motor C288. • Measure the resistance between blower motor resistor C1228-B, circuit 515 (OG/RD) and blower motor C288-B, circuit 515 (OG/RD).  N0024835 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor resistor. TEST the system for normal operation. **No** REPAIR circuit 515 (OR/RD). TEST the system for normal operation.

Table 5 PINPOINT TEST B: NO OPERATION IN LOWER SPEEDS (cont.)

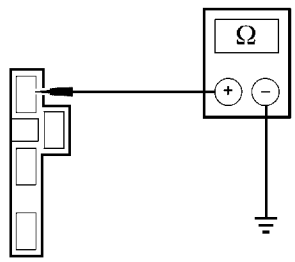
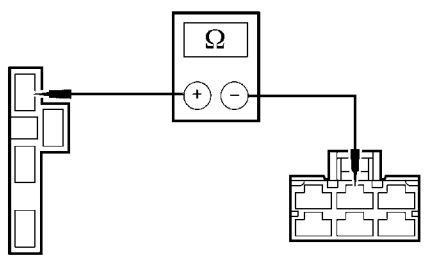
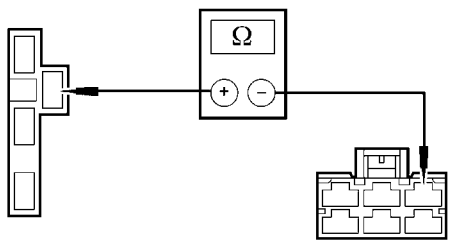
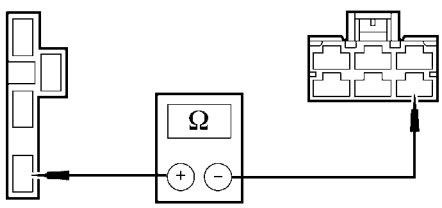
Test Step	Result / Action to Take
B3 CHECK THE BLOWER MOTOR SWITCH IN LO • Key in OFF position. • **Disconnect:** Blower Motor Resistor C1228. • Place the blower motor switch in LO. • Measure the resistance between blower motor resistor C1228-C, circuit 755 (BN/WH) and ground.  N0024834 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor resistor. TEST the system for normal operation. **No** GO to B4.
B4 CHECK CIRCUIT 755 (BN/WH) • **Disconnect:** Blower Motor Switch C294b. • Measure the resistance between blower motor resistor C1228-C, circuit 755 (BN/WH) and blower motor switch C294b-C, circuit 755 (BN/WH).  N0024833 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor switch. TEST the system for normal operation. **No** REPAIR circuit 755 (BN/WH). TEST the system for normal operation.

Table 5 PINPOINT TEST B: NO OPERATION IN LOWER SPEEDS (cont.)

Test Step	Result / Action to Take
B5 CHECK CIRCUIT 752 (YE/RD) • **Disconnect:** Blower Motor Switch C294b. • **Disconnect:** Blower Motor Resistor C1228. • Measure the resistance between blower motor resistor C1228-D, circuit 752 (YE/RD) and blower motor switch C294b-E, circuit 752 (YE/RD).  N0024832 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor switch. TEST the system for normal operation. **No** REPAIR circuit 752 (YE/RD) for an open. TEST the system for normal operation.
B5 CHECK CIRCUIT 751 (DB/WH) • **Disconnect:** Blower Motor Switch C294b. • **Disconnect:** Blower Motor Resistor C1228. • Measure the resistance between blower motor resistor C1228-A, circuit 751 (DB/WH) and blower motor switch C294b-F, circuit 751 (DB/WH).  N0024831 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new blower motor switch. TEST the system for normal operation. **No** REPAIR circuit 751 (DB/WH) for an open. TEST the system for normal operation.

Pinpoint Test C: Insufficient, Erratic or No Heat

Normal Operation

Under normal operation, engine coolant flows to the heater core through the heater core inlet hose. A cable operated temperature blend door is used to direct the blower motor airflow through the heater core fins. Heat is extracted from the engine coolant by blower motor airflow passing through the heater core fins. The coolant flows back to the engine cooling system through the heater core outlet hose.

Possible Causes

- Low engine coolant level
- Cooling system malfunction
- Plugged/restricted heater core
- Inoperative temperature blend door

Table 6 PINPOINT TEST C: INSUFFICIENT, ERRATIC OR NO HEAT

Test Step	Result / Action to Take
C1 CHECK THE ENGINE COOLANT LEVEL • Key in OFF position. • Check the engine coolant level when hot and cold. **Is the engine coolant hot/cold level correct as indicated on the degas bottle?**	**Yes** Go to C3. **No** Go to C2.
C2 CHECK THE ENGINE COOLING SYSTEM FOR LEAKS • Pressure test the cooling system for leaks. For additional information, refer to the EGES 305, ENGINE DIAGNOSTICS MANUAL. **Does the engine cooling system, including the radiator cap, hold pressure?**	**Yes** REPAIR the engine coolant leak. FILL and BLEED the engine cooling system. TEST the system for normal operation. **No** Go to C3.

Table 6 PINPOINT TEST C: INSUFFICIENT, ERRATIC OR NO HEAT (cont.)

Test Step	Result / Action to Take
C3 CHECK FOR COOLANT FLOW TO THE HEATER CORE **WARNING – The heater core inlet hose will become too hot to handle and may cause serious burns if the system is working correctly.** • Key in ON position. • Run the engine until it reaches normal operating temperature. • Select the FLOOR position on the control assembly. • Set the temperature control to full WARM. • With the engine running, feel the heater core inlet hose to see if it is hot. **Is the heater core inlet hose hot?**	**Yes** GO to C4. **No** REFER to the EGES 305, ENGINE DIAGNOSTICS MANUAL to check cooling system function.
C4 CHECK FOR A RESTRICTION IN THE HEATER CORE **WARNING – The heater core inlet hose will become too hot to handle and may cause serious burns if the system is working correctly.** • Feel the heater core outlet hose to see if it is hot. **Is the heater core outlet hose hot?**	**Yes** REPAIR the temperature blend door. TEST the system for normal operation. **No** INSTALL a new heater core. TEST the system for normal operation.

Pinpoint Test D: The Air Conditioning (A/C) is Inoperative/Does Not Operate Correctly

Normal Operation

Under normal operation, a 5-volt reference is sent from the ECM to the A/C switch via the high-pressure cutoff switch, low-charge protection switch, thermostatic switch and A/C demand relay. The 5-volt reference is sent to the high-pressure cutoff switch on circuit 348 (VT). If the high-pressure cutoff switch is reading an acceptable pressure in the high-pressure side of the refrigerant system, it will be in the CLOSED position. The 5-volt reference continues to the low-charge protection switch on circuit 1811 (RD/PK). If the low-charge protection switch is reading an acceptable pressure in the low-pressure side of the refrigerant system, it will be in the CLOSED position. The 5-volt reference continues to the thermostatic switch on circuit 439 (TN/LG). If the thermostatic switch is reading an acceptable evaporator core temperature, it will be in the CLOSED position. The 5-volt reference continues to the A/C demand relay on circuit 790 (WH/OG). When the blower motor switch is turned on, the A/C demand relay coil is grounded on circuit 753 (YE/RD) to close the A/C demand relay contacts. The 5-volt reference continues the A/C switch on circuit 790 (WH/OG). If the A/C

switch is selected, the 5-volt reference continues to the blower motor switch on circuit 753 (YE/RD). The 5-volt reference continues through the blower motor switch and is grounded through circuit 57 (BK). When the ECM reads a voltage drop in the 5-volt reference, an A/C demand signal is recognized. When an A/C demand is recognized by the ECM, the ECM will provide a ground for the A/C clutch relay coil through circuit 321 (GY/WH) to close the A/C clutch relay contacts. When the A/C clutch contacts are closed, B+ is supplied to the A/C clutch field coil through circuit 1810 (LG/OG) and circuit 3027 (RD/WH). The A/C clutch field coil is grounded through circuit 3028 (DB/YE) and circuit 57 (BK).

Possible Causes

- Low refrigerant charge
- Thermostatic switch
- Low-charge protection switch
- High-pressure cutoff switch
- A/C demand relay
- ECM
- A/C switch
- A/C clutch relay
- A/C compressor/clutch
- An open in circuit 790 (WH/OG), 439 (TN/LG), 1811 (RD/PK), 348 (VT), 297 (BK/LG), 321 (GY/WH), 883 (PK/LB), 1810 (LG/OG), 3028 (DB/YE), 3027 (RD/WH) or 57 (BK)

NOTE – Before carrying out the following test, diagnose any ECM DTCs.

IMPORTANT – Before carrying out the following test, connect the A/C refrigerant station (or manifold gauge set) to the A/C system and verify that the system pressure is above 290 kPa (42 psi). If the pressure is below 290 kPa (42 psi), refer to LEAK DETECTION (See LEAK DETECTION, page 75).

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY

Test Step	Result / Action to Take
D1 CHECK THE A/C DEMAND PID WITH THE A/C OFF • Key in ON position. • Place the blower motor switch in the OFF position. • Enter the following diagnostic mode on the diagnostic tool: ECM AC DEMAND PID **With the engine running, does the ECM A/C DEMAND PID read on?**	**Yes** REFER to EGES 305, ENGINE DIAGNOSTICS MANUAL. **No** GO to D2.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

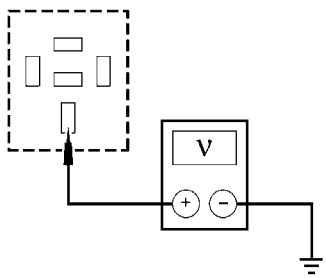
Test Step	Result / Action to Take
D2 CHECK THE A/C DEMAND PID WITH THE A/C ON • Place the blower motor switch in LO. • Select A/C ON. **With the engine running, does the ECM A/C DEMAND PID read on?**	**Yes** GO to D16. **No** GO to D3.
D3 CHECK THE A/C DEMAND REFERENCE SIGNAL TO THE A/C DEMAND RELAY • Key in OFF position. • **Disconnect:** A/C Demand Relay • Key in ON position. • With the engine running, measure the voltage between A/C demand relay socket pin 30, circuit 790 (WH/OG) and ground.  A0032581 **Is the voltage greater than 4 volts?**	**Yes** GO to D8. **No** GO to D4.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

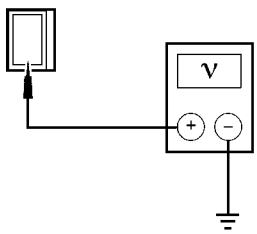
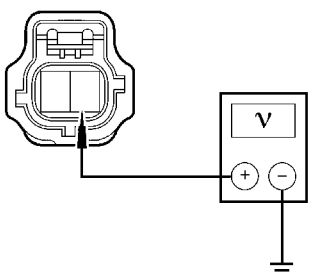
Test Step	Result / Action to Take
D4 CHECK THE A/C DEMAND REFERENCE SIGNAL TO THE THERMOSTATIC SWITCH • Key in OFF position. • **Disconnect:** Thermostatic Switch C1162b. • Key in ON position. • With the engine running, measure the voltage between thermostatic switch C1162b-B, circuit 439 (TN/LG) and ground.  N0024678 **Is the voltage greater than 4 volts?**	**Yes** GO to D13. **No** GO to D5.
D5 CHECK THE A/C DEMAND REFERENCE SIGNAL TO THE LOW-CHARGE PROTECTION SWITCH • Key in OFF position. • **Disconnect:** Low-Charge Protection Switch C130. • Key in ON position. • With the engine running, measure the voltage between low-charge protection switch C130-2, circuit 1811 (RD/PK) and ground.  N0024677 **Is the voltage greater than 4 volts?**	**Yes** GO to D14. **No** GO to D6.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

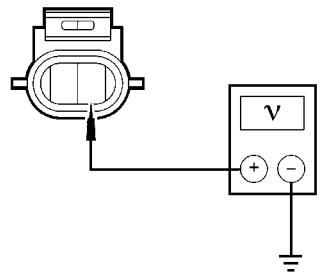
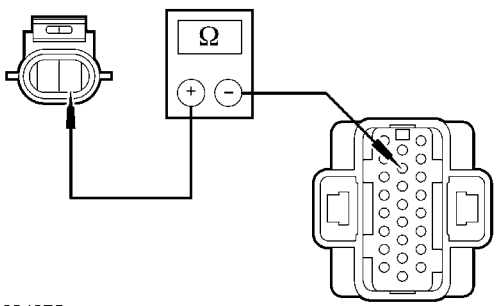
Test Step	Result / Action to Take
D6 CHECK THE A/C DEMAND REFERENCE SIGNAL TO THE HIGH-PRESSURE CUTOFF SWITCH • Key in OFF position. • **Disconnect:** High-Pressure Cutoff Switch C1078. • Key in ON position. • With the engine running, measure the voltage between high-pressure cutoff switch C1078-B, circuit 348 (VT) and ground.  N0024676 **Is the voltage greater than 4 volts?**	**Yes** GO to D15. **No** GO to D7.
D7 CHECK CIRCUIT 348 (VT) • Key in OFF position. • **Disconnect:** ECM C175b. • Measure the resistance between high-pressure cutoff switch C1078-B, circuit 348 (VT) and ECM C304E-10, circuit 348 (VT).  N0024675 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new ECM. TEST the system for normal operation. **No** REPAIR circuit 348 (VT). TEST the system for normal operation.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

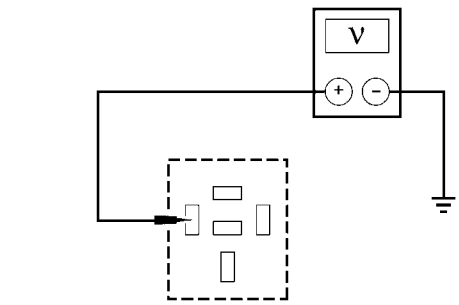
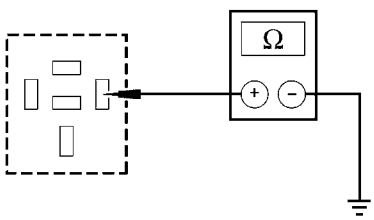
Test Step	Result / Action to Take
D8 CHECK VOLTAGE TO THE A/C DEMAND RELAY • Measure the voltage between A/C demand relay socket pin 85, circuit 489 (PK/BK) and ground.  A0013862 **Is the voltage greater than 10 volts?**	**Yes** GO to D9. **No** VERIFY the power distribution center (PDC), fuse 35 (15A) is OK. If OK, REPAIR circuit 489 (PK/BK). TEST the system for normal operation.
D9 CHECK THE GROUND AT THE A/C DEMAND RELAY • Measure the resistance between A/C demand relay socket pin 86, circuit 753 (YE/RD) and ground.  A0013858 **Is the resistance less than 5 ohms?**	**Yes** GO to D10. **No** REPAIR circuit 753 (YE/RD). TEST the system for normal operation.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

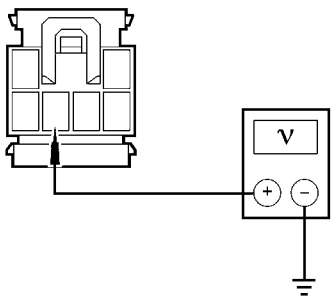
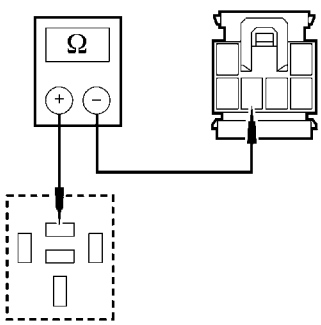
Test Step	Result / Action to Take
D10 CHECK THE A/C DEMAND REFERENCE SIGNAL TO THE A/C SWITCH • Key in OFF position. • **Connect:** A/C Demand Relay. • **Disconnect:** A/C Switch C294a. • Key in ON position. • With the engine running, measure the voltage between A/C switch C294a-5, circuit 790 (WH/OG) and ground.  N0024674 **Is the voltage greater than 4 volts?**	**Yes** GO to D12. **No** GO to D11.
D11 CHECK CIRCUIT 790 (WH/OG) • Key in OFF position. • **Disconnect:** A/C Demand Relay. • Measure the resistance between A/C demand relay socket pin 87, circuit 790 (WH/OG) and A/C switch C294a-5, circuit 790 (WH/OG).  N0024673 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new A/C demand relay. TEST the system for normal operation. **No** REPAIR circuit 790 (WH/OG). TEST the system for normal operation.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

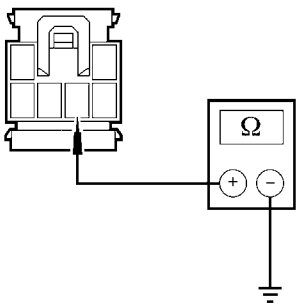
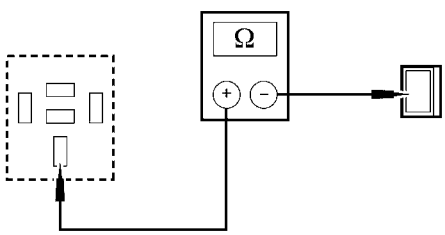
Test Step	Result / Action to Take
D12 CHECK CIRCUIT 753 (YE/RD) • Key in OFF position. • Measure the resistance between A/C switch C294a-4, circuit 753 (YE/RD) and ground.  N0024672 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new A/C switch. TEST the system for normal operation. **No** REPAIR circuit 753 (YE/RD). TEST the system for normal operation.
D13 CHECK CIRCUIT 790 (WH/OG) • Key in OFF position. • Measure the resistance between A/C demand relay socket pin 30, circuit 790 (WH/OG) and thermostatic switch C242A, circuit 790 (WH/OG).  N0024671 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new thermostatic switch. TEST the system for normal operation. **No** REPAIR circuit 790 (WH/OG). TEST the system for normal operation.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

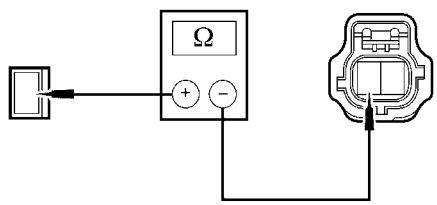
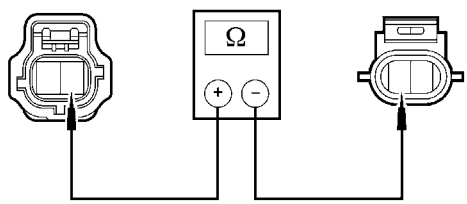
Test Step	Result / Action to Take
D14 CHECK CIRCUIT 439 (TN/LG) **IMPORTANT –** The A/C system pressure must be above 290 kPa (42 psi). If the pressure is below 290 kPa (42 psi), refer to LEAK DETECTION (See LEAK DETECTION, page 75). • Key in OFF position. • Measure the resistance between thermostatic switch C1162b, circuit 439 (TN/LG) and low-charge protection switch C130-1, circuit 439 (TN/LG).  N0024670 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new low-charge protection switch. TEST the system for normal operation. **No** REPAIR circuit 439 (TN/LG). TEST the system for normal operation.
D15 CHECK CIRCUIT 1811 (RD/PK) • Key in OFF position. • Measure the resistance between low-charge protection switch C2130-2, circuit 1811 (RD/PK) and high-pressure cutoff switch C1078-A, circuit 1811 (RD/PK).  N0024669 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new high-pressure cutoff switch. TEST the system for normal operation. **No** REPAIR circuit 1811 (RD/PK). TEST the system for normal operation.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

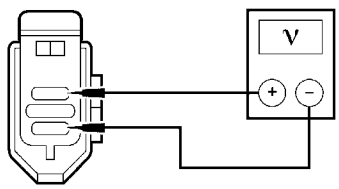
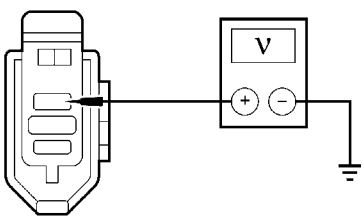
Test Step	Result / Action to Take
D16 CHECK THE VOLTAGE AND GROUND AT THE A/C COMPRESSOR CLUTCH FIELD COIL • Key in OFF position. • **Disconnect:** A/C Clutch Field Coil • Key in ON position. • With the engine running, measure the voltage between A/C compressor clutch field coil pin 1, circuit 3027 (RD/WH) and A/C compressor clutch field coil pin 2, circuit 3028 (DB/YE).  N0024668 **Is the voltage greater than 10 volts?**	**Yes** INSTALL a new A/C compressor/clutch assembly. TEST the system for normal operation. **No** GO to D17.
D17 CHECK THE VOLTAGE TO THE A/C COMPRESSOR CLUTCH FIELD COIL • Measure the voltage between A/C compressor clutch field coil pin 1, circuit 3027 (RD/WH) and ground.  A0013807 **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 3028 (DB/YE). TEST the system for normal operation. **No** GO to D18.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

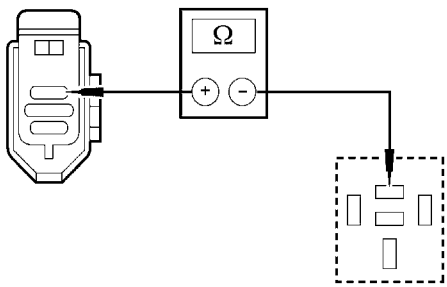
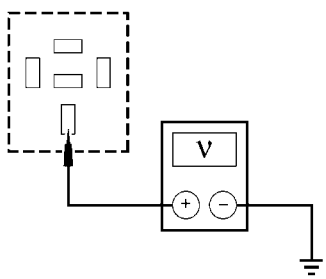
Test Step	Result / Action to Take
D18 CHECK CIRCUIT 3027 (RD/WH) AND CIRCUIT 1810 (LG/OG) • Key in OFF position. • **Disconnect:** A/C Clutch Relay. • Measure the resistance between A/C compressor clutch field coil pin 1, circuit 3027 (RD/WH) and A/C clutch relay socket pin 87, circuit 1810 (LG/OG).  N0024667 **Is the resistance less than 5 ohms?**	**Yes** GO to D19. **No** REPAIR circuit 3027 (RD/WH) or circuit 1810 (LG/OG). TEST the system for normal operation.
D19 CHECK CIRCUIT 883 (PK/LB) • Key in START position. • With the engine running, measure the voltage between A/C clutch relay socket pin 30, circuit 883 (PK/LB) and ground.  A0032581 **Is the voltage greater than 10 volts?**	**Yes** GO to D20. **No** VERIFY the power distribution center (PDC), fuse 34 (20A) is OK. REPAIR circuit 883 (PK/LB). TEST the system for normal operation.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

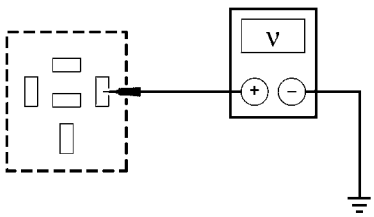
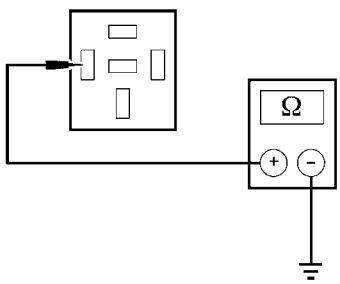
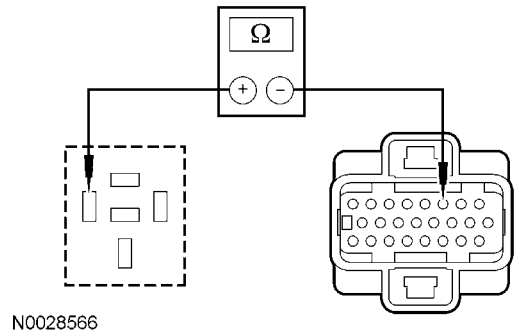
Test Step	Result / Action to Take
D20 CHECK CIRCUIT 297 (BK/LG) • Measure the voltage between A/C clutch relay socket pin 86, circuit 297 (BK/LG) and ground.  A0020210 **Is the voltage greater than 10 volts?**	**Yes** GO to D21. **No** VERIFY the power distribution center (PDC), fuse 12 (20A) is OK. REPAIR circuit 297 (BK/LG). TEST the system for normal operation.
D21 CHECK THE A/C CLUTCH RELAY OUTPUT FROM THE ECM • Measure the resistance between A/C clutch relay socket pin 85, circuit 321 (GY/WH) and ground.  N0018946 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new A/C clutch relay. TEST the system for normal operation. **No** GO to D22.

Table 7 PINPOINT TEST D: THE AIR CONDITIONING (A/C) IS INOPERATIVE/DOES NOT OPERATE CORRECTLY (cont.)

Test Step	Result / Action to Take
D22 CHECK CIRCUIT 321 (GY/WH) • Key in OFF position. • **Disconnect:** ECM C175b. • Measure the resistance between A/C clutch relay socket pin 85, circuit 321 (GY/WH) and ECM , circuit 321 (GY/WH).  N0028566 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new ECM. TEST the system for normal operation. **No** REPAIR circuit 321 (GY/WH). TEST the system for normal operation.

Pinpoint Test E: The Air Conditioning (A/C) Is Always On

Normal Operation

Under normal operation, the A/C switch receives a 5-volt reference signal from the ECM on circuit 790 (WH/OG). When the A/C switch is turned ON, the A/C switch completes the 5-volt reference circuit to ground and an A/C demand ON signal is recognized by the ECM. When the A/C is turned OFF, the A/C switch will open the 5-volt reference circuit to signal A/C demand OFF to the ECM. When the A/C demand is turned OFF, the ECM will not ground the A/C clutch relay coil through circuit 321 (GY/WH). When the A/C clutch relay coil is not grounded, the A/C clutch relay contacts will move to the OPEN position and B+ to the A/C clutch field coil over circuit 1810 (LG/OG) is removed. When B+ to the A/C clutch field coil is removed, the magnetic A/C clutch will disengage.

Possible Causes

- A/C switch
- A/C clutch relay
- Engine control module (ECM)
- A/C compressor/clutch assembly
- A short to ground in circuit 1811 (RD/PK), 439 (TN/LG), 790 (WH/OG), 348 (VT) or 321 (GY/WH)
- A short to power in circuit 3027 (RD/WH) or 1810 (LG/OG)

Table 8 PINPOINT TEST E: THE AIR CONDITIONING (A/C) IS ALWAYS ON

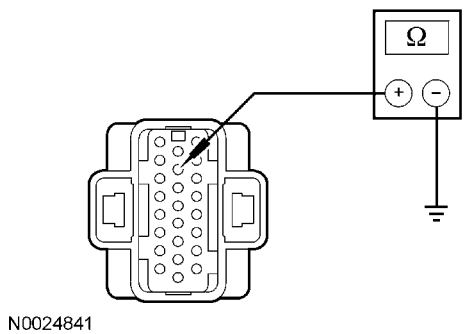
Test Step	Result / Action to Take
E1 CHECK THE A/C DEMAND PID WITH THE A/C OFF • Place the blower motor switch in the HI position. • Key in ON position. • Select A/C OFF. • Enter the following diagnostic mode on the diagnostic tool: ECM AC DEMAND PID **With the engine running, does the ECM A/C DEMAND PID read ON?**	**Yes** GO to E2. **No** GO to E8.
E2 CHECK FOR A SHORT TO GROUND IN THE A/C DEMAND CIRCUIT • Key in OFF position. • **Disconnect:** ECM C175b. • Key in ON position. • Measure the resistance between ECM C175b-10, circuit 348 (VT) and ground.  N0024841 **Is the resistance less than 5 ohms?**	**Yes** GO to E3. **No** INSTALL a new ECM. TEST the system for normal operation.

Table 8 PINPOINT TEST E: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

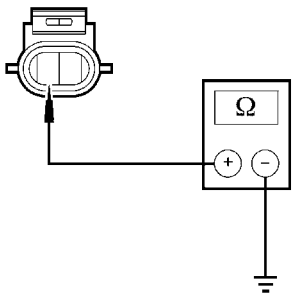
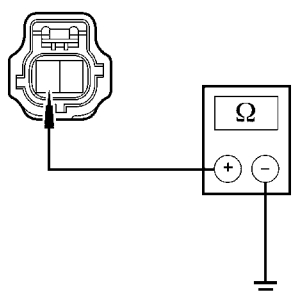
Test Step	Result / Action to Take
E3 CHECK FOR GROUND AT THE HIGH-PRESSURE CUTOFF SWITCH • Key in ON position. • **Disconnect:** High-Pressure Cutoff Switch C1078. • Key in ON position. • Measure the resistance between high-pressure cutoff switch C1078-A, circuit 1811 (RD/PK) and ground.  N0024840 **Is the resistance less than 5 ohms?**	**Yes** GO to E4. **No** REPAIR circuit 348 (VT). TEST the system for normal operation.
E4 CHECK FOR GROUND AT THE LOW-CHARGE PROTECTION SWITCH • Key in OFF position. • **Disconnect:** Low-Charge Protection Switch C130. • Key in ON position. • Measure the resistance between low-charge protection switch C130-1, circuit 439 (TN/LG) and ground.  N0024839 **Is the resistance less than 5 ohms?**	**Yes** GO to E5. **No** REPAIR circuit 1811 (RD/PK). TEST the system for normal operation.

Table 8 PINPOINT TEST E: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

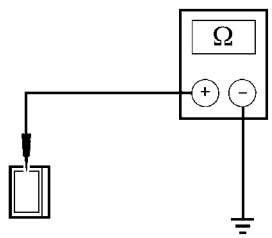
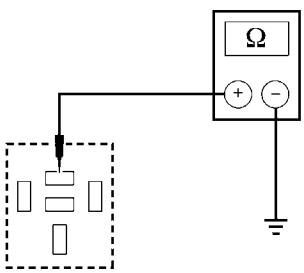
Test Step	Result / Action to Take
E5 CHECK FOR GROUND AT THE THERMOSTATIC SWITCH • Key in OFF position. • **Disconnect:** Thermostatic Switch C1162a. • Key in ON position. • Measure the resistance between thermostatic switch C1162a, circuit 790 (WH/OG) and ground.  N0024838 **Is the resistance less than 5 ohms?**	**Yes** GO to E6. **No** REPAIR circuit 439 (TN/LG). TEST the system for normal operation.
E6 CHECK FOR GROUND AT THE A/C DEMAND RELAY SOCKET • Key in OFF position. • **Disconnect:** A/C Demand Relay. • Key in ON position. • Measure the resistance between A/C demand relay socket pin 87 and ground.  N0024837 **Is the resistance less than 5 ohms?**	**Yes** GO to E7. **No** REPAIR circuit 790 (WH/OG). TEST the system for normal operation.

Table 8 PINPOINT TEST E: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

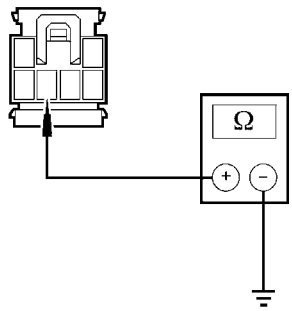
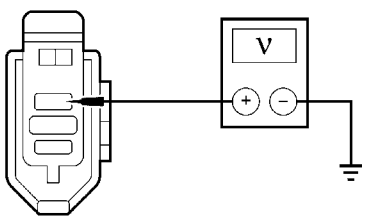
Test Step	Result / Action to Take
E7 CHECK FOR GROUND AT THE A/C SWITCH • Key in OFF position. • **Disconnect:** A/C Switch C294a. • Measure the resistance between A/C switch C294a-5, circuit 790 (WH/OG) and ground.  N0024836 **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuit 790 (WH/OG). TEST the system for normal operation. **No** INSTALL a new A/C switch. TEST the system for normal operation.
E8 CHECK FOR VOLTAGE AT THE A/C CLUTCH FIELD COIL • Key in OFF position. • **Disconnect:** A/C Clutch Field Coil. • Key in ON position. • With the engine running, measure the voltage between A/C clutch field coil pin 1, circuit 3027 (RD/WH) and ground.  A0013807 **Is the voltage greater than 10 volts?**	**Yes** GO to E9. **No** INSTALL a new A/C compressor/clutch assembly. TEST the system for normal operation.

Table 8 PINPOINT TEST E: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

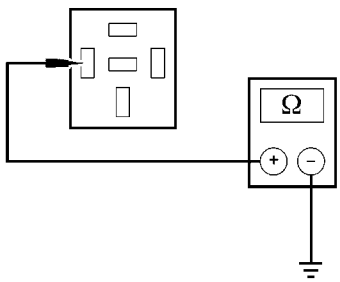
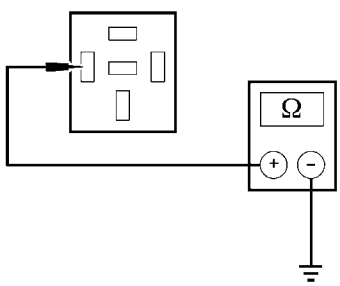
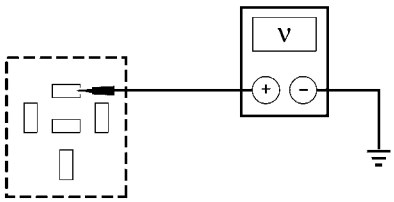
Test Step	Result / Action to Take
E9 CHECK THE ECM A/C CLUTCH RELAY GROUND • Key in OFF position. • **Disconnect:** A/C Clutch Relay. • Key in ON position. • With the engine running, measure the resistance between A/C clutch relay socket pin 85, circuit 321 (GY/WH) and ground.  N0018946 **Is the resistance less than 5 ohms?**	**Yes** GO to E10. **No** GO to E11.
E10 CHECK CIRCUIT 321 (GY/WH) FOR A SHORT TO GROUND • Key in OFF position. • **Disconnect:** ECM C175b. • Measure the resistance between A/C clutch relay socket pin 85, circuit 321 (GY/WH) and ground.  N0018946 **Is the resistance less than 5 ohms?**	**Yes** REPAIR circuit 321 (GY/WH). TEST the system for normal operation. **No** INSTALL a new ECM. TEST the system for normal operation.

Table 8 PINPOINT TEST E: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

Test Step	Result / Action to Take
E11 CHECK CIRCUITS 1810 (LG/OG) AND 3027 (RD/WH) FOR A SHORT TO POWER • Measure the voltage between A/C clutch relay socket pin 87, circuit 1810 (LG/OG) and ground.  A0025968 **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 1810 (LG/OG) or 3027 (RD/WH) for a short to power. TEST the system for normal operation. **No** INSTALL a new A/C clutch relay. TEST the system for normal operation.

Pinpoint Test F: The Air Conditioning (A/C) Condenser Pusher Fan Is Inoperative

Normal Operation

Under normal operation, the condenser pusher fan will operate when the high-side refrigerant system pressure rises above 275 psi and will disengage when the high-side pressure drops below 240 psi. Battery voltage is available at the pusher fan pressure switch on circuit 489 (PK/BK) when the ignition is in the ON position. When the high-side refrigerant system pressure is above 275 psi, the pusher fan pressure switch will be closed and battery voltage will continue to the pusher fan relay coil on circuit 3850 (LG/VT) to activate the pusher fan relay. The pusher fan relay coil is grounded on circuit 57 (BK). Battery voltage is available at the pusher fan relay contacts on circuit 1153 (RD/BK). When the pusher fan relay is activated (relay contacts closed), voltage continues to the pusher fan on circuit 1153 (RD/BK). The pusher fan is grounded on circuit 57 (BK).

Possible Causes

- Fuse
- Pusher fan pressure switch
- Pusher fan relay
- A/C condenser pusher fan
- An open in circuit 489 (PK/BK), 3850 (LG/VT), 1153 (RD/BK), 1153 (RD/BK) or 57 (BK)

Table 9 PINPOINT TEST F: THE AIR CONDITIONING (A/C) IS ALWAYS ON

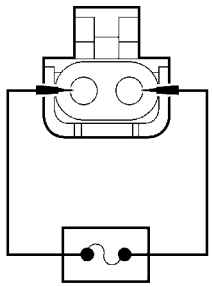
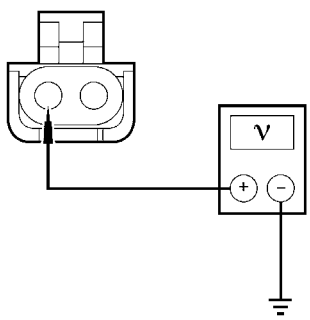
Test Step	Result / Action to Take
F1 CHECK THE PUSHER FAN PRESSURE SWITCH • Key in OFF position. • **Disconnect:** Pusher Fan Pressure Switch C2345 • Install a fused jumper between pusher fan pressure switch C2345-A, circuit 489 (PK/BK) and pusher fan pressure switch C2345-B, circuit 3850 (LG/VT).  N0035467 • Key in ON position. **Does the A/C condenser pusher fan operate?**	**Yes** INSTALL a new pusher fan pressure switch. TEST the system for normal operation. **No** GO to F2.
F2 CHECK FOR VOLTAGE AT THE A/C CONDENSER PUSHER FAN • Key in OFF position. • **Disconnect:** A/C Condenser Pusher Fan C1529. • Key in ON position. • Measure the voltage between A/C condenser pusher fan C1529-A, circuit 1153 (RD/BK) and ground.  N0035468 **Is the voltage greater than 10 volts?**	**Yes** GO to F3. **No** GO to F4.

Table 9 PINPOINT TEST F: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

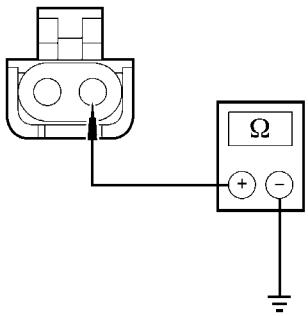
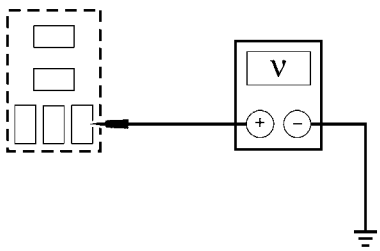
Test Step	Result / Action to Take
F3 CHECK FOR GROUND AT THE PUSHER FAN • Key in OFF position. • Measure the resistance between pusher fan C1529-B, circuit 57 (BK) and ground.  N0035469 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new pusher fan. TEST the system for normal operation. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.
F4 CHECK FOR VOLTAGE AT THE PUSHER FAN RELAY COIL • Key in OFF position. • **Disconnect:** Pusher Fan Relay. • Key in ON position. • Measure the voltage between pusher fan relay socket pin 1, circuit 3850 (LG/VT) and ground.  A0055256 **Is the voltage greater than 10 volts?**	**Yes** GO to F6. **No** GO to F5.

Table 9 PINPOINT TEST F: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

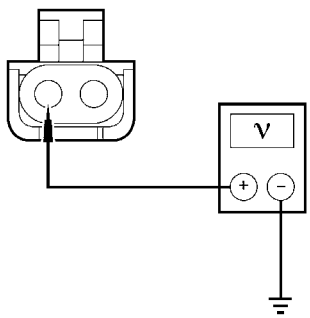
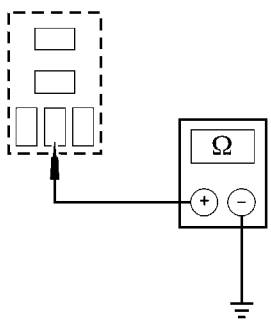
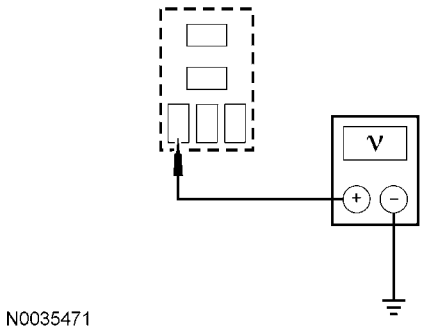
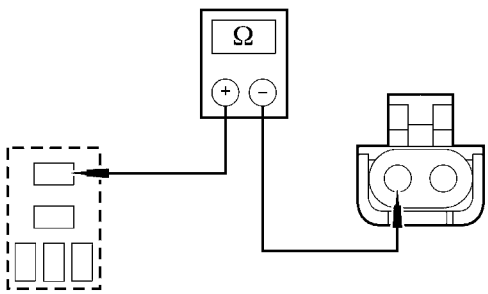
Test Step	Result / Action to Take
F5 CHECK CIRCUIT 489A (PK/BK) FOR AN OPEN • Key in OFF position. • Remove the fused jumper from pusher fan pressure switch C249-1, circuit 489 (PK/BK) and pusher fan pressure switch C249-2, circuit 3850 (LG/VT). • Key in ON position. • Measure the voltage between pusher fan switch C2345-A, circuit 489A (PK/BK) and ground.  N0035468 **Is the voltage greater than 10 volts?**	**Yes** REPAIR circuit 3850 (LG/VT). TEST the system for normal operation. **No** REPAIR circuit 489 (PK/BK). TEST the system for normal operation.
F6 CHECK CIRCUIT 57 (BK) FOR AN OPEN • Key in OFF position. • Measure the resistance between pusher fan relay socket pin 2, circuit 57 (BK) and ground.  N0035470 **Is the resistance less than 5 ohms?**	**Yes** GO to F7. **No** REPAIR circuit 57 (BK). TEST the system for normal operation.

Table 9 PINPOINT TEST F: THE AIR CONDITIONING (A/C) IS ALWAYS ON (cont.)

Test Step	Result / Action to Take
F7 CHECK FOR VOLTAGE AT THE PUSHER FAN RELAY SWITCH • Key in OFF position. • Measure the voltage between pusher fan relay socket pin 3, circuit 1153 (RD/BK) and ground.  N0035471 **Is the voltage greater than 10 volts?**	**Yes** GO to F8. **No** VERIFY that power distribution center (PDC) fuse 30 (30A) is OK. REPAIR circuit 1153 (RD/BK). TEST the system for normal operation.
F8 CHECK CIRCUIT 1153 (RD/BK) FOR AN OPEN • Measure the resistance between pusher fan relay pin 5, circuit 1153 (RD/BK) and pusher fan C1529-A, circuit 1153 (RD/BK).  N0035472 **Is the resistance less than 5 ohms?**	**Yes** INSTALL a new pusher fan relay. TEST the system for normal operation. **No** REPAIR circuit 1153 (RD/BK). TEST the system for normal operation.

3.3. COMPONENT TESTS

Heater Core

WARNING – Carbon monoxide is colorless, odorless and dangerous. If it is necessary to operate the engine with the vehicle in an enclosed area such as a garage, always use an exhaust collector to vent the exhaust gases outside the enclosed area.

NOTE – Testing of returned heater cores reveals that a large percentage of heater cores were good and did not require replacement. If a heater core leak is suspected, the heater core must be tested by following the plugged heater core component test before the heater core pressure test. Carry out a system inspection by checking the heater system thoroughly as follows:

1. Inspect for evidence of coolant leakage at the heater water hose to heater core attachments.
2. **NOTE: Spring-type clamps are installed as original equipment. Installation and overtightening of non-specification clamps can cause leakage at the heater water hose connection and damage the heater core.**

   Check the integrity of the heater water hose clamps.

Heater Core — Plugged

WARNING – The heater core inlet hose will become too hot to handle if the system is working correctly.

1. Check to see that the engine coolant is at the correct level.
2. Start the engine and turn on the heater.
3. When the engine coolant reaches operating temperature, feel the heater core inlet and outlet hose to see if they are hot.

If the inlet hose is not hot:

- the thermostat is not working correctly.

If the outlet hose is not hot:

- the heater core may have an air pocket.
- the heater core may be restricted or plugged.

Heater Core — Pressure Test

Use the Pressure Tester to carry out the pressure test.

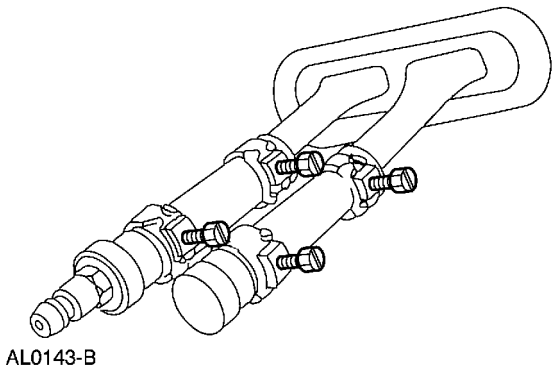


Figure 3

1. Clamp off the heater hoses.
2. Disconnect the heater water hoses from the heater core.
3. Install a short piece of heater water hose, approximately 101 mm (4 inches) long on each heater core tube.
4. Fill the heater core and heater water hoses with water.
5. Install a plug and adapter that will allow for connection of the Pressure Tester to the heater water hose ends. Secure the heater water hoses, plug and adapter with hose clamps.
6. Attach the pump and gauge assembly from the Pressure Tester to the adapter.
7. Close the bleed valve at the base of the gauge. Pump 138 kPa (20 psi) of air pressure into the heater core.
8. Observe the pressure gauge for a minimum of 3 minutes.
9. If the pressure drops, check the heater water hose connections to the core tubes for leaks. If the heater water hoses do not leak, remove the heater core from the vehicle and carry out the bench test.

A/C Evaporator/Condenser Core — On Vehicle Leak Test

NOTE – The use of a refrigerant (recovery/recycling/recharging) station is recommended for servicing this A/C system. If a refrigerant station is not available, refrigerant system testing and servicing may be accomplished using a separate recovery station, vacuum pump, charging meter and manifold gauge set. If separate equipment is used, refer to the manufacturer's instructions supplied with that equipment.

NOTE – The automatic shut-off valves on some gauge set hoses do not open when connected to the test fittings. If available, use hoses without automatic shut-off valves. If hoses with automatic shut-off valves are used, make sure the valve opens when attached to the test fittings or install an adapter which will activate the valve. The test is not valid if the shut-off valve does not open.

1. Recover the refrigerant. For additional information, refer to DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY).

2. Disconnect the suspect A/C evaporator core or A/C condenser core from the A/C system. (If the evaporator is being tested, the thermostatic expansion valve must be removed.)
3. Clean the fittings.
4. Connect the appropriate test fittings to the evaporator or condenser tube connections. (When testing the evaporator core, the evaporator adapter must be installed.) The fittings must allow connection of the refrigerant station (or manifold gauge set) to the component under test.
5. Connect the red and blue hoses from the R-134a refrigerant station (or manifold gauge set) to the test fittings on the A/C evaporator core or A/C condenser core. (If a manifold gauge set is being used, connect the yellow hose to a known good vacuum pump.)
6. On the refrigerant station, set both valves to the RECOVERY/VACUUM position, turn on the power, and press the VACUUM button. Allow the vacuum pump to operate for a minimum of 45 minutes after the low pressure gauge indicates 101 kPa (30 in-Hg). The 45 minute evacuation is necessary to remove any refrigerant from oil left in the A/C evaporator core or A/C condenser core. If the refrigerant is not completely removed from the oil, outgassing will degrade the vacuum and appear as a refrigerant leak.
7. If the low pressure gauge reading will not drop to 101 kPa (30 in-Hg) when the valves are open and the vacuum pump is operating, close the valves and observe the low pressure gauge. If the pressure rises rapidly to zero, a large leak is indicated. Recheck the test fitting connections and test equipment connections before installing a new A/C evaporator core or A/C condenser core.
8. After evacuating the system for 45 minutes, close both valves. (If a separate vacuum pump is used, switch off the vacuum pump.) Observe the low pressure gauge; it should remain at the 101 kPa (30 in-Hg) mark.

    - If the low pressure gauge reading rises 34 or more kPa (10 or more in-Hg) of vacuum from the 101 kPa (30 in-Hg) position in 10 minutes, a leak is indicated.
    - If a very small leak is suspected, wait 30 minutes and observe the vacuum gauge.
    - If a small amount of vacuum is lost, operate the vacuum pump with gauge valves open for an additional 30 minutes to remove any remaining refrigerant from the oil in the A/C evaporator core or A/C condenser core. Then recheck for loss of vacuum.
    - If a very small leak is suspected, allow the system to set overnight with vacuum applied and check for vacuum loss.

9. If the A/C evaporator core or A/C condenser core does leak, as verified by the above procedure, install a new A/C evaporator core or A/C condenser core.

3.4. OPERATIONAL TEST

NOTE – This test is used to determine if the air conditioning system is properly charged with refrigerant and the refrigerant cycle is functioning correctly. When a fault is detected, make the necessary repairs. Repeat this test after repairs involving the refrigerant system to verify correct operation.

NOTE – The vehicle should be parked so there is no solar loading or wind for this test.

1. Position a thermometer approximately 30 to 60 cm (12 to 24 inches) in front of the vehicle grille and record the ambient temperature.

2. Connect a refrigerant recovery station (or manifold gauge set) with high-pressure and low-pressure gauges to the refrigerant system.

3. Insert a thermometer into the passenger side, left instrument panel register. Do not allow thermometer to touch the side of the duct.

4. Open the windows and close both cab doors.

5. Run the engine at 1500 RPM.

6. Set the climate control assembly as follows: mode control to PANEL, blower speed control to HIGH, temperature control to full COOL, air inlet control to FRESH, and A/C switch ON.

7. Operate the system for at least 5 minutes, or until the gauge readings settle.

8. Record the high-pressure and low-pressure refrigerant system gauge readings.

9. Record the instrument panel register discharge air temperature.

10. Refer to the following chart to determine if the refrigerant system is properly charged, and is operating within normal limits.

Table 10 System Pressure Test Chart

Ambient Air Temperature		Relative Humidity	Vent Air Temperature Left Passenger		Refrigerant Pressure High Side Service Port	Refrigerant Pressure Low Side Service Port	Compressor Cycling?
(°F)	(°C)	(% RH)	(°F)	(°C)	(psig)	(psig)	
70	21.1	30–50	36–38	2.2–3.3	191–198	21–23	No
70	21.1	70–90	43–46	6.1–7.8	200–230	24–27	No
80	26.7	30–50	40–44	4.4–6.7	204–211	22–24	No
80	26.7	70–90	47–53	8.3–11.7	219–254	27–32	No
90	32.2	30–50	47–50	8.3–10	218–237	23–25	No
90	32.2	70–90	54–59	12.2–15	244–273	33–36	No
100	37.8	30–50	53–56	11.7–13.3	261–295	33–34	No
100	37.8	70–90	61–65	16.1–18.3	280–290	38–41	No

3.5. ABNORMAL GAUGE READINGS

WARNING – During system pressure tests, DO NOT open either hand valve on the recovery station for any reason. Equipment can be damaged, and personal injury can result.

CAUTION – To prevent damage to the test equipment, make sure test equipment and all connections are clear of all moving parts in the engine compartment.

If abnormal pressure readings are indicated during the Operational Test, and no HVAC related ECM DTCs have been set, refer to the following table. If any HVAC related Diagnostic Trouble Codes have been set, go to the ENGINE CONTROL MODULE DIAGNOSTIC TROUBLE CODE (DTC) INDEX to continue diagnostics.

Table 11 Abnormal Pressure Troubleshooting Chart

SYMPTOM	POSSIBLE CAUSES
Low Suction - High Discharge Pressure	(1) Restriction in system between compressor discharge port and the Thermostatic Expansion Valve (TXV). (2) Intermittent condition may indicate freezing of TXV due to moisture in system.
Extremely Low Suction - Normal to Low Discharge Pressure	(1) Restriction in system between outlet of the receiver/drier and the compressor, usually at TXV. (2) Low refrigerant charge. (3) Freezing of TXV due to moisture in system.
High Suction - Normal to Slightly Low Discharge Pressure	(1) Compressor not functioning correctly. (2) TXV stuck open.
High Suction - High Discharge Pressure	**IMPORTANT –** These readings may indicate normal operation for a stationary vehicle. Operate a large fan in front of the condenser and recheck readings. (1) Excessive air, water or oil in system. (2) Overcharged system. (3) Condenser plugged with debris. (4) Engine fan not operating properly.

Table 11 Abnormal Pressure Troubleshooting Chart (cont.)

SYMPTOM	POSSIBLE CAUSES
High Suction - Normal to Slightly High Discharge Pressure	**IMPORTANT –** These readings may indicate normal operation for a stationary vehicle. Operate a large fan in front of the condenser and recheck readings. (1) Excessive air, water or oil in system. (2) Overcharged system. (3) Condenser plugged with debris. (4) Temperature blend door not positioned for cooling.
Low Suction - Low Discharge Pressure	(1) Low refrigerant charge. (2) Compressor not functioning correctly.

4. SERVICE PROCEDURES

4.1. ADDING REFRIGERANT TO THE SYSTEM

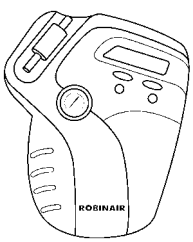
If it is suspected, during A/C system tests, that the refrigerant charge is too low or too high; it will be necessary to perform the following procedures:

- discharge the system, refer to DISCHARGING THE SYSTEM;
- evacuate the system, refer to EVACUATING THE SYSTEM;
- and recharge the system, refer to CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE).

This method insures that the new refrigerant charge, including refrigerant oil, is accurate.

4.2. REFRIGERANT IDENTIFICATION

Table 12 Special Tools

	Refrigerant Identifier ZTSE4616

WARNING – Before doing any of the work below, read the SERVICE WARNINGS. Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

IMPORTANT – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

Before any work is done on an HVAC system the refrigerant in the system must be identified.

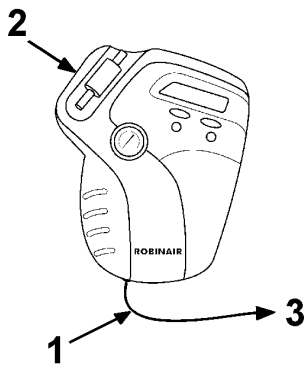


Figure 4 Refrigerant Identification Setup Diagram

1. SAMPLING HOSE
2. REFRIGERANT IDENTIFIER
3. TO LOW PRESSURE SERVICE PORT

1. Calibrate the Refrigerant Identifier per the manufacturer's instructions.
2. Connect the sampling hose to the low pressure service port located on the compressor manifold and tube near the evaporator fitting.
3. Connect the other end of the sampling hose to the Refrigerant Identifier.
4. Open the service valve.
5. Start the sampling procedure (refer to the manufacturer's instructions).
6. When the sampling is complete the Refrigerant Identifier will indicate a pass/fail condition, the type of refrigerant, and the percentage of concentration. International recognizes only R134a in a 98% concentration. Anything else is considered contaminated.
7. If contaminated refrigerant is detected, repeat the test to verify that the refrigerant is indeed contaminated.
8. Close the service valve and disconnect the sampling hose.

Handling of Contaminated Refrigerant

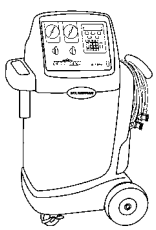
CAUTION – If contaminated refrigerant is detected, DO NOT recover the refrigerant into R-134a recovery/recycling equipment.

NOTE – If this equipment described below is not available, contact an A/C service facility in your area with the correct equipment to carry out this service.

1. Recover the contaminated refrigerant using suitable recover-only equipment designed for capturing and storing contaminated refrigerant only.
2. Determine what repairs are necessary and make the repairs.
3. Flush and purge the system. Refer to FLUSHING AND PURGING THE AIR CONDITIONING SYSTEM.
4. Dispose of the contaminated refrigerant in accordance with all federal, state and local regulations.

4.3. DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY)

Table 13 Special Tools

	R-134a Refrigerant (Recovery/Recycling/Recharging) station ZTSE4615

WARNING – Before doing any of the work below, read the SERVICE WARNINGS. Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

IMPORTANT – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

IMPORTANT – If the system is being discharged because a leak is suspected, the leak must be located before discharging the system. Refer to LEAK DETECTION.

The use of a refrigerant (recovery/recycling/recharging) station is recommended for servicing this A/C system. If a refrigerant station is not available, refrigerant system recovery, evacuation and charging may be accomplished using a separate recovery station, vacuum pump, charging meter and manifold gauge set. If separate equipment is used, refer to the manufacturer's instructions supplied with that equipment.

1. Empty the 'recovered oil' catch bottle on the recovery station. This will make it easier to determine the amount of oil recovered during the refrigerant recovery procedure.

2. Remove the protection caps from both service ports.

3. On the recovery station and hose fittings, verify that all valves are closed. The valves at the recovery station must be set to the CLOSED position. The valves at the quick-disconnect fittings must be set fully counter-clockwise (CCW).

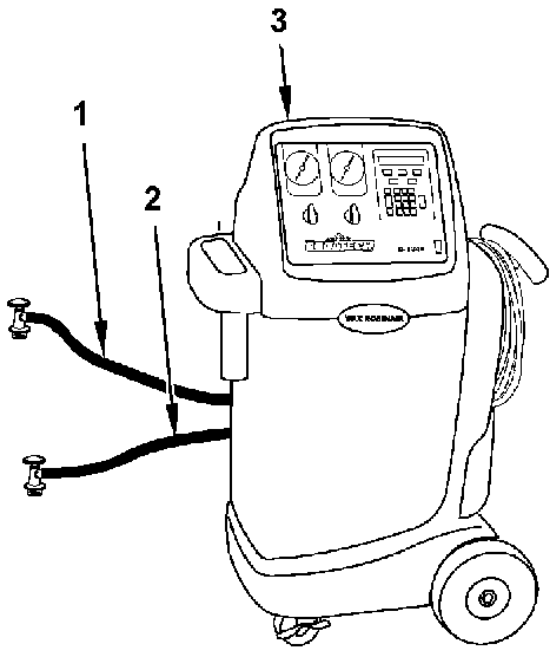


Figure 5 Equipment Hookup for Servicing the System

1. LOW PRESSURE HOSE (BLUE)
2. HIGH PRESSURE HOSE (RED)
3. RECOVERY/RECYCLING/CHARGING STATION

4. Connect the recovery station to the system as follows:
   a. Start with the **blue** low pressure hose, and connect it to the low pressure service port located on the compressor manifold and tube near the evaporator fitting.
   b. Connect the **red** hose to the high pressure service port located on the receiver/drier.

5. Open (turn cw) the valves on the Metric SAE quick-disconnect fittings connected to the service ports on the vehicle.

6. Set both hand valves on the recovery station to the RECOVERY/VACUUM position.

NOTE – During the recovery process in the next step, refrigerant may become trapped in the receiver/drier. Heating the receiver/drier with a heat gun will force the refrigerant out of the receiver/drier and assure that all of the refrigerant is recovered from the system.

WARNING – Never use an open flame torch to heat the receiver/drier. Heating the receiver/drier with an open flame could result in equipment damage and/or bodily injury.

7. Turn the recovery station main power switch on and press the RECOVER button. The recovery station will automatically shut off when the refrigerant in the system has been exhausted to the storage tank.

8. Close the valves on the quick-disconnect fittings by turning them fully CCW; and set both valves on the recovery station to the CLOSED position.

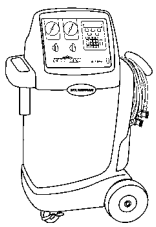
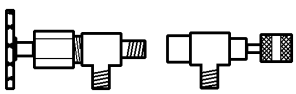
9. When recovering refrigerant by use of a recovery station, system oil is separated from the refrigerant during the recovery cycle. When the refrigerant recovery operation is complete, the recovery station will drain the oil into the station's calibrated catch bottle. The amount of oil recovered may be used to determine the amount of NEW oil that must be added back to the A/C system. Refer to OIL FILL GUIDELINES.

10. Disconnect the **blue** and **red** hoses from the service ports on the vehicle.

11. Work may now begin on the air conditioning system.

4.4. EVACUATING THE SYSTEM

Table 14 Special Tools

	R-134a Refrigerant (Recovery/Recycling/Recharging) station ZTSE4615
	Electronic Vacuum Gauge ZTSE4620
	Adapter for Electronic Vacuum Gauge ZTSE4624

WARNING – Before doing any of the work below, read the SERVICE WARNINGS. Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

CAUTION – The amount of oil lost during the recovery process, component replacement, or purging/flushing must be replaced with new oil. The method for determining how much refrigerant oil must be added to the A/C system is located in the OIL FILL GUIDELINES.

CAUTION – Use only the specified PAG lubricant in the refrigerant system. PAG oils absorb atmospheric moisture very quickly. Never leave PAG oil exposed to air for a prolonged time. Tightly reseal the oil container immediately after each use.

CAUTION – Do not re-use recovered oil. Be sure to dispose of recovered oil properly to avoid an environmental hazard.

IMPORTANT – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

Whenever the air conditioning system has been discharged, the system must be completely evacuated of air and moisture before being recharged. After evacuation the system vacuum should read at least 99.4 kPa (29.5 in-Hg) and as close to 101.1 kPa (30 in-Hg) as possible, when using analog gauges. If the electronic vacuum gauge is used the vacuum in the evacuated system should measure between 750 and 1000 microns.

1. Determine the amount of **NEW** refrigerant oil to be added to the system. Refer to OIL FILL GUIDELINES (See OIL FILL GUIDELINES, page 69). If oil is being added directly to the compressor, it must be added before starting the evacuation procedure. If oil is to be added during the evacuation/charging procedure, you must follow the instructions furnished with the recovery station, or refrigerant oil injector tool, to add the oil before the charging procedure.

2. On the recovery station and hose fittings, verify that all valves are closed. The valves at the recovery station must be set to the CLOSED position. The valves at the quick-disconnect fittings must be set fully counter-clockwise (CCW).

3. If the electronic vacuum gauge is being used, connect it to the recovery station vacuum manifold, using a valve and 'T' fittings.

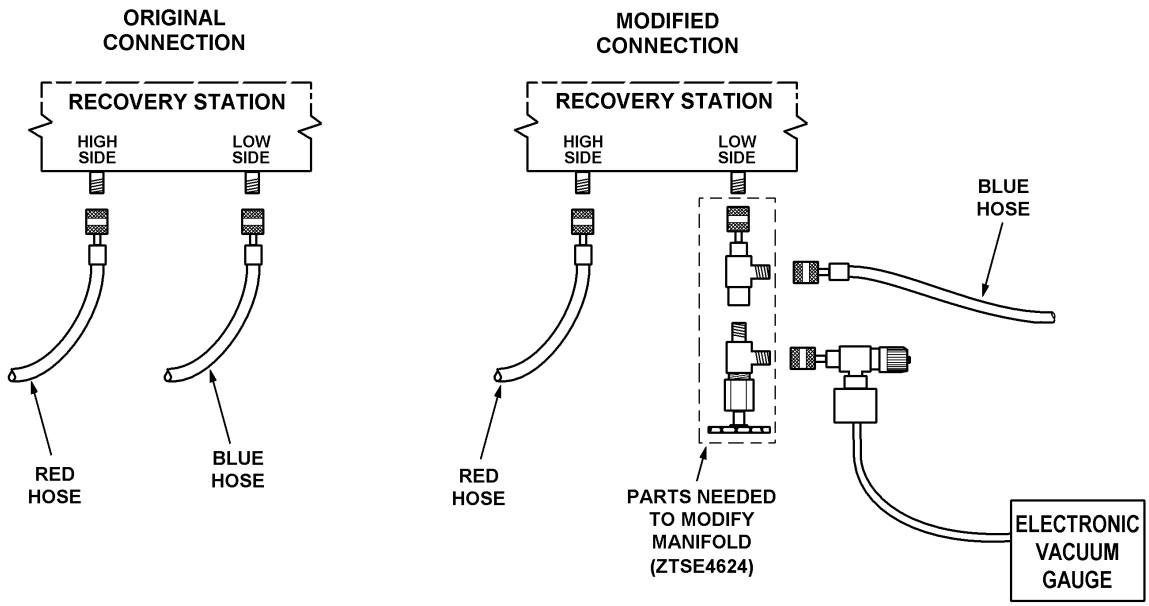


Figure 6 Connection of Electronic Vacuum Gauge

CAUTION – The valve for the electronic vacuum gauge must be in the closed position until instructed to open it. If the valve is open during system charging, excess pressure may damage the electronic vacuum gauge.

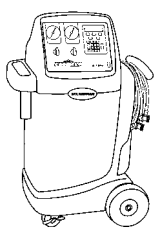
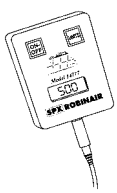
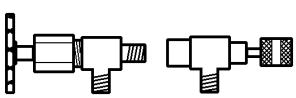
4. Connect the recovery station to the system as follows:
   a. Start with the **blue** low pressure hose, and connect it to the low pressure service port located on the compressor manifold and tube near the evaporator fitting.
   b. Connect the **red** hose to the high pressure service port located on the receiver/drier.
5. On the red and blue hoses, open the valves on the Metric SAE quick-disconnect fittings (turn the knobs fully CW).
6. On the recovery station, set both hand valves to the RECOVERY/VACUUM position.
7. On the recovery station, turn on main power switch and press the VACUUM button (turns vacuum pump on).
8. After the low pressure gauge reads at least 99.4 kPa (29.5 in-Hg), continue to operate the vacuum pump for ten minutes.
9. After ten minutes, set both valves to the CLOSED position. If a manual vacuum pump is being used, turn off the pump.
10. Observe the low side gauge for one minute. The gauge should **not** indicate a rise of more than 2 inches-Hg. If the gauge rises more than 2 inches-Hg in one minute, the system has a leak which must be repaired. Refer to LEAK DETECTION (See LEAK DETECTION, page 75).

11. If there are no leaks, and the electronic vacuum gauge IS being used:
    a. Set both hand valves on the recovery station to the RECOVERY/VACUUM position and press the VACUUM button.
    b. Open the valve connecting the electronic vacuum gauge to the recovery station low side line.
    c. Continue to operate the recovery station vacuum pump until the system has pulled a vacuum of 750 to 1000 microns as measured by the electronic vacuum gauge.
    d. Close both hand valves on the recovery station, and the valve connecting the electronic vacuum gauge to the recovery station low side line.
12. If there are no leaks, and the electronic vacuum gauge IS NOT being used:
    a. Open both hand valves and start the vacuum pump.
    b. Once the vacuum reads at least 99.4 kPa (29.5 in-Hg), continue to operate the vacuum pump for a minimum of 45 minutes.
    c. After 45 minutes, close both hand valves and turn off the vacuum pump.
    d. The vacuum in the system must read at least 99.4 kPa (29.5 in-Hg) and as close to 101.1 kPa (30 in-Hg) as possible.
13. The A/C system is ready to be charged. **REMEMBER** if the full amount of refrigerant oil has not yet been added to the system, it must be added before charging the system with refrigerant, as explained in the following procedure.

IMPORTANT – DO NOT disconnect the recovery/recycling/charging station from the A/C system before charging the system.

4.5. CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE)

Table 15 Special Tools

	R-134a Refrigerant (Recovery/Recycling/Recharging) station ZTSE4615
	Electronic Vacuum Gauge ZTSE4620
	Adapter for Electronic Vacuum Gauge ZTSE4624

WARNING – Before doing any of the work below, read the SERVICE WARNINGS. Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

CAUTION – Use only new or recycled R-134a refrigerant; not any of the so called "direct replacement" refrigerants. Use of equipment dedicated for R-134a is necessary to reduce the possibility of oil and refrigerant incompatibility concerns.

CAUTION – When charging the A/C system the refrigerant tank must be kept upright. If the tank is not in the upright position, liquid refrigerant may enter the system and cause compressor damage.

IMPORTANT – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

IMPORTANT – If recycled refrigerant is to be used, follow the instructions supplied with the recycling equipment to purge the air from the refrigerant before charging the system.

Perform the Charging procedures, using new or recycled refrigerant, only after the following actions have been completed:

- System components repaired and/or replaced.
- System flushed or purged **(if required)**.
- Refrigerant oil added (**only** if oil was added directly to the compressor, see OIL FILL GUIDELINES).
- System completely evacuated.

CAUTION – If the equipment being used adds system refrigerant oil during the evacuation/charging procedure, you must first determine the amount of oil to be added (refer to OIL FILL GUIDELINES). Then follow the instructions furnished with the recovery station, or refrigerant oil injector tool, to add the correct amount of NEW oil to the system during this procedure.

1. The recovery station **blue** (suction) and **red** (discharge) hoses should still be connected as they were during the evacuation operation.

2. If necessary, add oil to return the system oil capacity to its correct level. Refer to OIL FILL GUIDELINES (See OIL FILL GUIDELINES, page 69). To add oil during the evacuation/charging process, follow the instructions furnished with the recovery station, or refrigerant oil injector tool.

CAUTION – Due to the density of R-134a, the amount of refrigerant required to charge a typical air conditioning system has been reduced. Overcharging the system will result in excessively high head pressures during operation and may damage the compressor. Be sure to check specifications on the vehicle being serviced. This information is often located on a label on the refrigerant compressor.

3. Determine the amount of refrigerant needed to charge the A/C system. This information can be found in the GENERAL SPECIFICATIONS section of this manual (See Table 23, page 103).

4. Following the instructions provided with the recovery station; set the recovery station to charge the system with the specified amount of refrigerant.

5. On the recovery station, set the low side valve to CLOSED, and the high side valve to CHARGE.

6. Press the CHARGE button to start the charge procedure. When the system is fully charged, the recovery station will turn off.

7. Complete the charging procedure by setting both hand valves on the recovery station to the CLOSED position.

8. Before disconnecting the recovery station from the A/C system, perform the OPERATIONAL TEST.

9. After the pressure test is completed, stop the engine, close the valves on the Metric SAE quick-disconnect fittings (turn fully ccw) at the vehicle A/C service ports.

10. Disconnect the **blue** and **red** hose Metric SAE quick-disconnect fittings from the vehicle service ports.

11. Install the protective caps on both of the vehicle service port fittings.

4.6. FLUSHING AND PURGING THE AIR CONDITIONING SYSTEM

Table 16 Special Tools

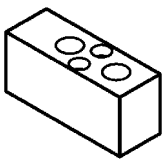
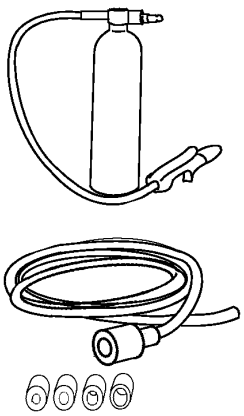
	Evaporator Flush/Purge Adapter ZTSE4718
	Flush Gun, Drain Hose and Adapters (Obtain Locally)

Table 17 Material

Item	Part No.
A/C Systems Flushing Solvent	See Fleetrite catalog

WARNING – Before doing any of the work below, read the SERVICE WARNINGS. Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

WARNING – Dry nitrogen gas is recommended for flushing and/or purging. Do not use nitrogen at pressures over 862 kPa (125 psi). Personal injury or death may result from doing so. Commercial cylinders of dry nitrogen contain pressures in excess of 13780 kPa (2000 psi). This pressure must be reduced, using a pressure regulator, to 621 to 862 kPa (90 to 125 psi) for purging.

CAUTION – When flushing and/or purging components of the system use only dry nitrogen. The introduction of compressed air into the A/C system may cause contamination of the system.

CAUTION – When flushing components, use only flushing agents approved for R-134a charged air conditioning systems (refer to the Fleetrite HVAC catalog for an approved flush solvent). R-11 and any other flushing agents that were used to flush R-12 charged air conditioning systems CANNOT be used to flush R-134a systems. The residue left by these flushing products will destroy the lubrication properties of the oil used in R-134a systems.

IMPORTANT – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

A flush gun, along with compressed dry nitrogen, is required to inject the flushing agent into the component being flushed. All items can be obtained locally.

Systems that have had an internal compressor failure, that have been overcharged with refrigeration oil, or that have been left open for an extended period of time, will need to be flushed, purged or both. Flushing is generally necessary only after an internal compressor failure has contaminated the refrigerant system. Flushing and purging are performed on a system after the refrigerant has been recovered and before the system is reassembled and evacuated.

Flushing removes heavy contamination, such as gritty oil and large dirt buildup, which occur after an internal compressor failure. When a part is flushed, a flushing solvent is forced through it; the liquid solvent cleans the part, picks up contaminants and flushes them out.

Purging must always be performed: after flushing the system; any time there is excessive refrigerant oil found in the system; or, when the system has been left open for an extended period of time. Purging removes flushing solvent, excessive refrigerant oil, damp air, and loose particles from A/C system components by passing a stream of inert, dry nitrogen gas through parts of the system or individual components. This assures that A/C system components are dry and free of any contaminants. If left in the system, these contaminants would have a negative effect on the life and operation of the air conditioning system.

The following procedures must be observed whenever a component or system is flushed or purged.

- Never flush or purge the entire system. Flush or purge the system in segments to lessen the chance of blowing contaminants throughout the system.
- Never flush or purge the compressor, expansion valve or receiver/drier.
- Flush or purge each system section or component in the opposite direction of normal refrigerant flow.
- After flushing the system, it must be purged; then, replace the compressor, expansion valve, and receiver/drier with new components prior to evacuating and charging the system.
- If the system is purged, without flushing (system not contaminated); change oil in the compressor (refer to OIL FILL GUIDELINES), reinstall (or replace) the expansion valve, and install a new receiver/drier prior to evacuating and charging the system.

NOTE – The following procedures for flushing and purging are general. The actual fittings and adapters required for each procedure will vary according to the component or components being connected.

Flushing Procedure

Refer to FIGURE 7.

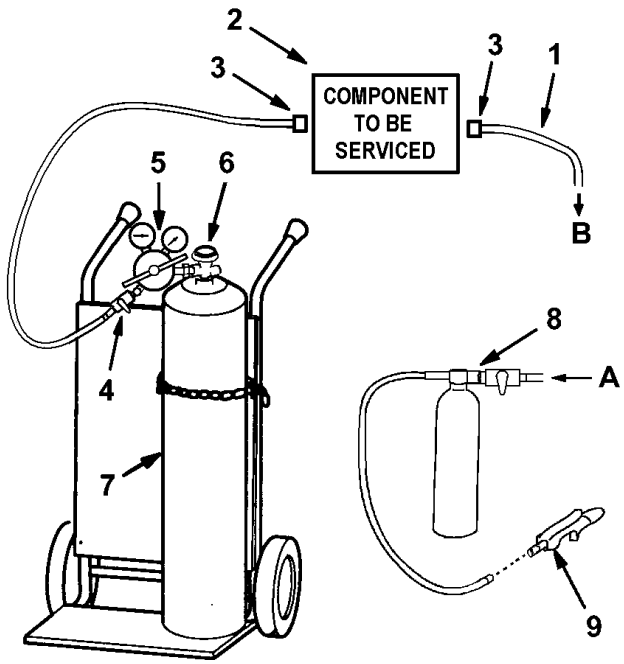


Figure 7 Typical Flushing and Purging Setup

A. NITROGEN IN
B. TO WASTE CONTAINER
1. DRAIN LINE
2. COMPONENT TO BE FLUSHED OR PURGED
3. FITTINGS OR ADAPTERS
4. SUPPLY LINE VALVE
5. NITROGEN BOTTLE REGULATOR/GAUGES
6. NITROGEN BOTTLE CONTROL VALVE
7. NITROGEN BOTTLE
8. FLUSH GUN
9. TRIGGER TYPE AIR GUN

1. Disconnect both ends of the component or components to be flushed, and tightly cap the rest of the system.

2. With the tank regulator (5) turned off (closed), open the main nitrogen tank valve (6), and using the input gauge on the regulator, verify that enough pressure is available to perform the flushing procedure.

3. Connect the input of the flush gun (8) to the output of the supply line from the nitrogen tank. Some form of shutoff valve should be installed at the input of the flush gun.

4. Using the correct fittings or adapters (3), connect the drain line (1) to the component to be flushed. Components are flushed in the opposite direction of normal refrigerant flow.

5. Using the correct fittings or adapters, connect the flush gun output to the component to be flushed.

6. Place the outlet of the drain line into a suitable waste container.

7. Fill the flush gun tank with an appropriate amount of flushing agent.

8. Set the supply line air regulator (5) to 75 psi.

9. Open the supply line valve (4) at the output of the tank regulator.

10. Slowly open the flush gun valve and allow the flushing solvent to flow through the system until the drain line is clear; then, close the flush gun valve. If a trigger type air gun (9) is being used on the flush gun output, actuate the trigger to release all pressure from the flush gun tank.

11. Close the supply line valve (4).

WARNING – The flush gun MUST be removed from the equipment setup before performing the purge procedures. The flush gun is not designed to be used at the pressures used for the purge procedures.

12. Connect the flushing equipment to the next component to be flushed; or, empty the flush gun tank and **remove the flush gun** from the supply line.

13. Disconnect drain hose and all fittings and adapters from the component.

14. Plug the inlet and outlet of the component until it can be purged.

NOTE – After flushing a component, that component must be purged

before connecting it to the air conditioning system. Refer to PURGING PROCEDURE.

Purging Procedure

Refer to FIGURE 7.

1. Disconnect both ends of the component to be purged and tightly cap the rest of the system.

2. With the tank regulator (5) turned off (closed), open the main nitrogen tank valve (6), and using the input gauge on the regulator, verify that enough pressure is available to perform the purging procedure.

3. Using the correct fittings or adapters (3), connect the drain line (1) to the component to be purged. Components are purged in the opposite direction of normal refrigerant flow.

4. Using the correct fittings or adapters, connect the nitrogen supply line output to the component to be purged. A trigger type air gun (9) may be hand–held for some components.

5. Place the outlet of the drain line into a suitable waste container.

6. Set the supply line air regulator (5) to 28 kPa (4 psi).

7. Slowly open the supply line valve (4) at the output of the tank regulator. If a trigger type air gun is being used, actuate the trigger.

8. Let the dry nitrogen flow at 28 kPa (4 psi) for one to two minutes, or until there is no trace of refrigerant flushing agent or refrigerant oil flowing from the drain tube.

9. Using the pressure regulator, raise the pressure to 621 to 862 kPa (90 to 125 psi) and let the dry nitrogen flow for 25 to 30 seconds.

10. Adjust the pressure regulator for 0 psi; then, close the supply line valve (4).

11. If a trigger type air gun is being used, actuate the trigger to release pressure in the hose.

12. Disconnect the supply and drain lines from the part, and remove all fittings and adapters (3). Tightly cap the openings of the part until you are ready to install it into the system.

NOTE – Always lubricate O-rings on fittings with mineral-based oil during installation.

13. The component is now ready to be installed into the air conditioner system using new O-rings, where applicable.

14. After purging the system, and prior to evacuating and charging the system;
    a. replace the receiver/drier,
    b. reinstall (or replace) the expansion valve,
    c. determine the correct quantity of oil needed to refill the system. Refer to OIL FILL GUIDELINES,
    d. reinstall (or replace) the compressor.

4.7. OIL FILL GUIDELINES

Table 18 Material

Item	Part No.
PAG Refrigerant Compressor Oil (R-134a Systems)	ZGGR6822

WARNING – Before doing any of the work below, read the SERVICE WARNINGS. Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

CAUTION – Do not re-use recovered oil. Be sure to dispose of recovered oil properly to avoid an environmental hazard.

CAUTION – Replacement compressors contain a quantity of oil when shipped. This oil must be drained from the new compressor before refilling the compressor (and system) with the correct amount of new oil.

CAUTION – During normal A/C operation, oil is circulated through the system with the refrigerant, and a small amount is retained in each component. If certain components of the system are removed, some of the refrigerant oil will go with the component. To maintain the original total oil charge, it is necessary to compensate for the oil lost by adding oil to the system with the new part.

The correct volume of refrigerant oil in the A/C system is critical for proper system operation. Insufficient oil will result in compressor failure. Too much oil decreases cooling efficiency, resulting in poor system cooling performance. In general, when servicing the system, ensure that the amount of oil (retained or added) in the repaired system (compressor and components) equals the total system oil capacity indicated in GENERAL SPECIFICATIONS (See Table 23, page 103). Replacement oil may be added directly into the compressor before evacuation, or injected into the system after evacuation. The following paragraphs describe how to determine the quantity of refill oil needed under the most common conditions.

IMPORTANT – Unless stated otherwise, the following procedures assume that the system is not being flushed and/or purged.

A. If the refrigerant was only recovered for the purpose of checking the refrigerant charge, or because system components had to be moved to provide access for unrelated repairs; add the amount of oil removed from the system during the refrigerant recovery procedure.

   - Total replacement oil quantity **=** oil from refrigerant recovery procedure.

B. If a compressor is replaced (and the system was **not** contaminated and had no leaks) refill the new compressor with the amount of oil removed from the system during the refrigerant recovery procedure, plus the quantity of oil that was contained in the old compressor. NOTE: New compressors must be drained of shipping oil before filling with new oil. Refer to DRAINING AND FILLING THE COMPRESSOR OIL (See DRAINING AND FILLING THE COMPRESSOR OIL, page 73).

   - Total replacement oil quantity **=** oil from refrigerant recovery procedure **+** oil drained from old compressor.

C. If a component other than the compressor is replaced, add the amount of oil removed from the system during the refrigerant recovery procedure, plus the amount indicated for the replaced component in TABLE 19 (See Table 19, page 71).

   - Total replacement oil quantity **=** oil from refrigerant recovery procedure **+** oil indicated in component table.

D. If the amount of oil in the system is unknown (due to an oil leak, ruptured hose, etc.); refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK, below.

E. Whenever the refrigerant system has become contaminated; flush and purge the system, make the necessary repairs, replace the receiver/drier, replace the expansion valve, and fill the new compressor with a full refill of new oil before installing it. NOTE: New compressors must be drained of shipping oil before filling with new oil (refer to DRAINING AND FILLING THE COMPRESSOR OIL).

   - Total replacement oil quantity **=** total system capacity as specified in GENERAL SPECIFICATIONS (See Table 23, page 103) **minus** 60 ml (2.0 fl oz), oil trapped in compressor.

Table 19 Refrigerant Oil Adding Amounts per Component and Methods of Installation

Component	PAG Oil Amount	Method of Adding
IMPORTANT – This table does **NOT** apply if the system being serviced must be purged or flushed.		
A/C compressor	Replacing compressor only: • Drain old compressor into calibrated container. Refer to DRAINING AND FILLING THE COMPRESSOR OIL. • Drain and discard shipping oil from new compressor. • Add new oil to new compressor. Total replacement oil quantity **=** oil drained from old compressor **+** oil from refrigerant recovery procedure.	Add directly to A/C compressor before installation
Receiver/drier	• Drill a 12 mm (0.5 inch) hole in the old receiver/drier cylinder and drain the oil into a calibrated container. • Total replacement oil quantity **=** oil drained from old receiver/drier **+** oil from refrigerant recovery procedure **+** 60 ml (2 fl oz).	Inject to low-side service port during system charging
Evaporator core	45 ml (1.5 fl oz) added to the amount collected during refrigerant recovery	Inject to low-side service port during system charging
Condenser core	60 ml (2 fl oz) added to the amount collected during refrigerant recovery	Inject to low-side service port during system charging
Thermostatic expansion valve	The amount collected during refrigerant recovery	Inject to low-side service port during system charging
A/C pressure relief valve	60 ml (2 fl oz) added to the amount collected during refrigerant recovery	Inject to low-side service port during system charging
Refrigerant hose/line A. - no leak/minor leak B - major leak	 A. - 60 ml (2 fl oz) added to the amount collected during refrigerant recovery B - Refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK below.	 A. - Inject to low-side service port during system charging B - Refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK below.
O-ring leak repair A. - minor leak B - major leak	 A. - 60 ml (2 fl oz) added to the amount collected during refrigerant recovery (The amount specified may be used for one or multiple O-ring leak repairs. Do not multiply the refrigerant oil amount by the number of O-ring leaks being repaired.) B - Refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK below.	 A. - Inject to low-side service port during system charging B - Refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK below.

Table 19 Refrigerant Oil Adding Amounts per Component and Methods of Installation (cont.)

Component	PAG Oil Amount	Method of Adding
Service port leak repair		
A. - minor leak	A. - 60 ml (2 fl oz) added to the amount collected during refrigerant recovery	A. - Inject to low-side service port during system charging
B - major leak	B - Refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK below.	B - Refer to EXCESSIVE OIL LOSS DUE TO REFRIGERANT LEAK below.

Oil Separation During Refrigerant Recovery

The oil removed from the system during the refrigerant recovery process must be replaced. Always empty the refrigerant station oil catch bottle, before recovering the refrigerant. After recovering the refrigerant, check the calibrated bottle to determine how much oil has been removed from the system. This quantity is used to help determine the amount of NEW oil that must be added to the system before or during the recharging of the A/C system. Do not use recovered refrigerant oil.

Excessive Oil Loss Due to Refrigerant Leak

When a minor refrigerant leak is detected (hose, O-ring, or service port) refer to the table above. When there is a significant refrigerant leak, an unknown amount of oil escapes from the system with the refrigerant. When a significant leak is detected, perform the following procedures to replace the old system oil with a full refill of new oil.

1. Use the service equipment and observation to determine the location of the leak.

2. Discharge the system. Refer to DISCHARGING THE SYSTEM.

3. If the system does not appear to be contaminated, purge the system. Refer to PURGING PROCEDURE. If the system appears contaminated, such as after an internal compressor failure, it should be flushed before purging.

4. Make any necessary repairs.

5. If the removed refrigerant **was not** contaminated:

    A. Replace the receiver/drier.

    B. Reinstall the expansion valve.

    C. Drain and discard old oil from the compressor. Refer to DRAINING AND FILLING THE COMPRESSOR OIL.

    D. Refill compressor with new oil.

    Total replacement oil quantity **=** total system capacity as specified in GENERAL SPECIFICATIONS **minus** 60 ml (2.0 fl oz), oil trapped in compressor.

6. If the removed refrigerant **was** contaminated:

    A. Replace the receiver/drier.

    B. Replace the expansion valve.

C. Add the new refrigerant oil to the new compressor. NOTE: New compressors must be drained of shipping oil before filling with new oil (refer to DRAINING AND FILLING THE COMPRESSOR OIL).

   Total replacement oil quantity **=** total system capacity as specified in GENERAL SPECIFICATIONS **minus** 60 ml (2.0 fl oz), oil trapped in compressor.

7. Install the compressor.

8. Using new O-rings reconnect all the components of the A/C system.

9. Evacuate the system; refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

10. Recharge the system; refer to CHARGING THE AIR CONDITIONING SYSTEM (See CHARGING THE AIR CONDITIONING SYSTEM (FULL CHARGE), page 62).

11. After repairing a leak, remove all traces of the fluorescent dye from the repaired area before retesting the area. The dye can be removed with UV Dye Cleaner, ZTSE4618–2.

12. After running the system, turn the engine off and retest the repaired area to verify the repair.

4.8. DRAINING AND FILLING THE COMPRESSOR OIL

Table 20 Material

Item	Part No.
PAG Refrigerant Compressor Oil (R-134a Systems)	ZGGR6822

The amount of oil contained in the compressor can only be determined by removing the compressor from the vehicle and draining the oil into a calibrated container.

NOTE – After draining the oil from the compressor, approximately 60 ml (2.0 fl oz) of oil will remain in the compressor.

1. Verify that the system is discharged.

2. Remove the compressor.

3. Drain compressor oil from the suction and discharge ports, into a calibrated container, while turning the shaft (clockwise only) 8 to 10 full rotations by hand or with a socket wrench on the armature retaining nut. If the compressor is to be reused, place protective caps on the suction and discharge ports.

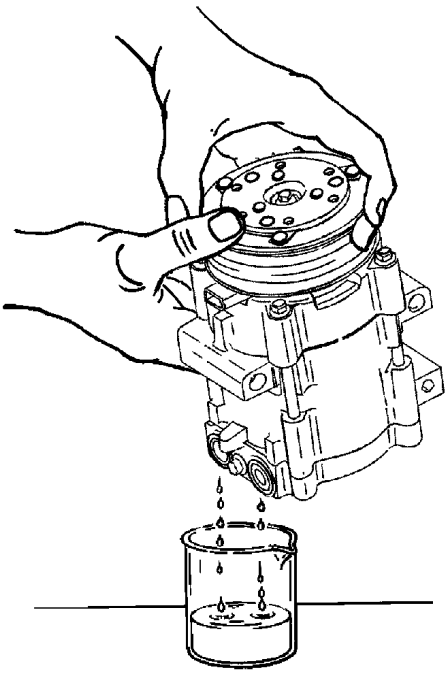


Figure 8 Drain Oil While Turning Shaft (Clockwise Only)

4. Measure and record the amount of oil drained from the compressor.

5. Inspect the oil for signs of contamination such as discoloration or foreign material.

> **CAUTION – When oil is added directly to the compressor, insure that it is added only to the SUCTION port. The SUCTION port is larger in diameter than the DISCHARGE port.**

NOTE – Refer to OIL FILL GUIDELINES for the correct quantity of new oil to put into the compressor.

NOTE – In the following step, it may be helpful to rotate the compressor shaft slowly (clockwise only) to distribute the oil being added.

6. Add the required amount of new oil directly to the SUCTION port of the compressor.

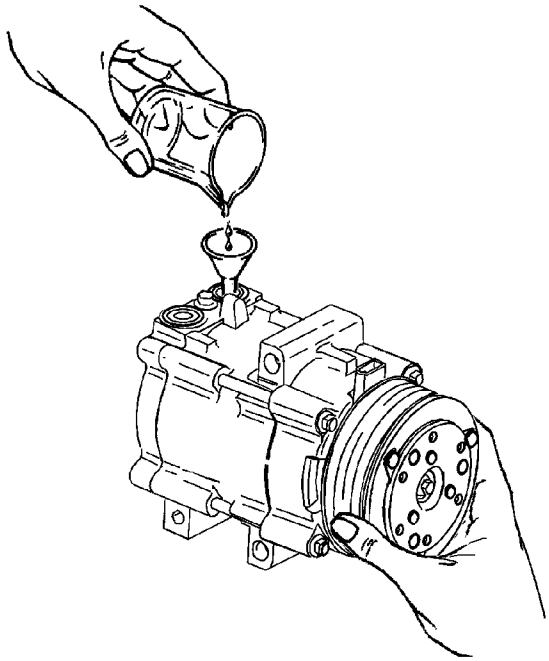
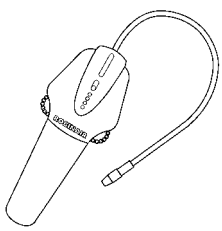
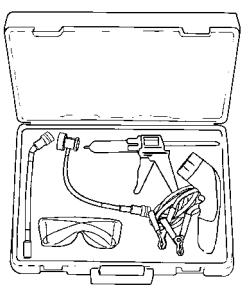


Figure 9 Add New Oil to the Suction Port

7. Place protective caps on the suction and discharge ports until the compressor is ready to be installed.

4.9. LEAK DETECTION

Table 21 Special Tools

	Electronic Leak Detector ZTSE4617
	Ultraviolet (UV) Leak Detector Kit ZTSE4618

WARNING – Before doing any of the work below, read the SERVICE WARNINGS. Failure to read the Service Warnings and to be aware of the dangers involved when working with refrigerant could lead to serious personal injury.

CAUTION – Good ventilation is necessary in the area where electronic A/C leak testing is to be carried out. If the surrounding air is contaminated with refrigerant gas, the leak detector will indicate this gas all the time. Odors from other chemicals such as antifreeze, diesel fuel, disc brake cleaner or other cleaning solvents can cause the same problem. Using a fan to ventilate the area to be tested before proceeding with the leak detection procedure is helpful in removing small traces of contamination from the air, but the fan should be turned off during actual testing.

NOTE – Refrigerant leaks are often indicated by an oily residue at the point of the leak.

NOTE – While performing a leak check, the system pressure should be between 413-551 kPa (60-80 psi) at 24°C (75°F) with the engine off.

If a refrigerant leak is detected:

A. Determine the leaking component.

B. Recover the refrigerant. Refer to DISCHARGING THE SYSTEM (See DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY), page 57).

C. Make the necessary repairs.

D. Evacuate, leak test, and recharge the system. Refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

Electronic Leak Detectors

IMPORTANT – Although your service equipment may appear physically different from the equipment shown here, the function of the equipment used to perform each service procedure is basically the same. If you are performing these service procedures using service equipment different from that shown, refer to the manufacturer's instructions supplied with that equipment.

In terms of sensitivity and safety, the electronic leak detector is excellent for finding both slow and major system leaks. Ensure that the detector being used is intended for use with R134a refrigerant. Many leak detectors intended for use with R-12 cannot detect R134a leaks.

The unit is a hand-held device having a flexible probe used to seek out refrigerant leaks. An audio leak indicator signals a warning in the presence of a leak.

Before starting to look for leaks, it is recommended to clean away all oil or grease, and blow away refrigerant residue from fittings and A/C components. All suspected areas should be cleaned using soap and water, not a solvent.

It is important to become familiar with the leak detector instructions for the detector being used. The speed at which the probe is moved over the component being checked is very important in locating larger than permissible leaks. Leak check procedure should be in accordance with SAE J1628.

A detected leak should be a flow of refrigerant, not a residual condition of refrigerant that is trapped under an oil film, etc. A detected leak rate in excess of 1.0 oz./year is unacceptable.

Ultraviolet Lamp Leak Testing

An alternate method to electronic leak testing is ultraviolet light. A phosphor dye can be injected into the system that will produce a bright yellow-green trace at the leak, when illuminated by an ultraviolet (UV) lamp. The ZTSE4618 kit provides the UV lamp used to illuminate the suspected leaks. The kit also contains connection hoses and a dye injector, as well as, eyeglasses used to enhance the effect of the UV light on the dye.

NOTE – The location of leaks can be pinpointed by the bright yellow-green glow of the fluorescent dye under a UV lamp. Since more than one leak can exist, make sure to inspect each component, line and fitting in the refrigerant system for a leak.

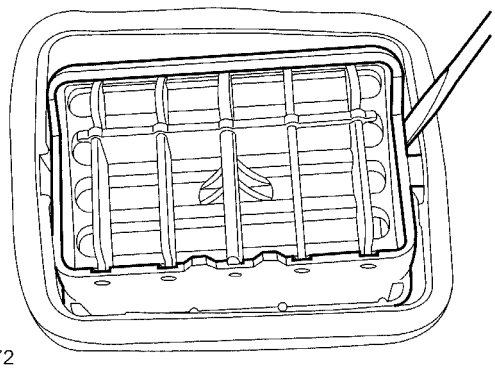
It has been discovered during the use of UV light, and phosphor dyes, that other types of leaks may also appear as a yellow-green trace when the UV light shines on them. If an UV lamp is used for leak detection, it is recommended that an electronic leak detector also be used to verify that any detected leaks are, in fact, refrigerant leaks. Refer to ELECTRONIC LEAK DETECTORS.

5. REMOVAL AND INSTALLATION

5.1. REGISTER — DRIVER SIDE

1. Remove the instrument cluster finish panel. For additional information, refer to INSTRUMENT PANEL AND CONSOLE.

2. Using a suitable tool, carefully pry the passenger side register barrel out of the housing.



N0020572

Figure 10

3. To install, reverse the removal procedure.

5.2. REGISTER — PASSENGER SIDE

1. Remove the instrument cluster finish panel. For additional information, refer to INSTRUMENT PANEL AND CONSOLE.

2. Remove the RH panel duct.

3. Using a suitable tool, carefully pry the passenger side register barrel out of the housing.

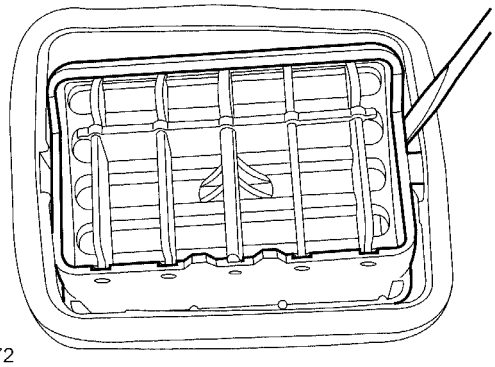


Figure 11

4. To install, reverse the removal procedure.

5.3. AIR INLET DUCT

1. Remove the blower motor. For additional information, refer to BLOWER MOTOR in this section.
2. Working through the blower motor opening, remove the air inlet duct screw.

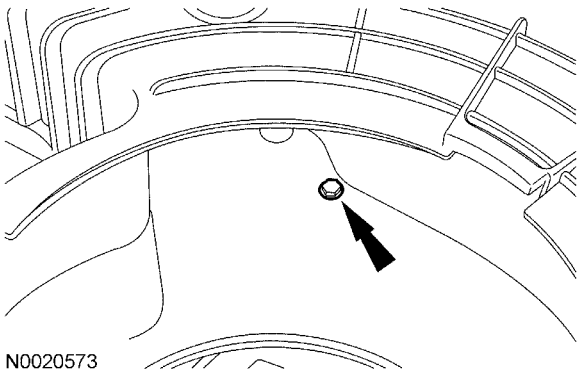


Figure 12

3. Remove the 3 remaining air inlet duct screws.

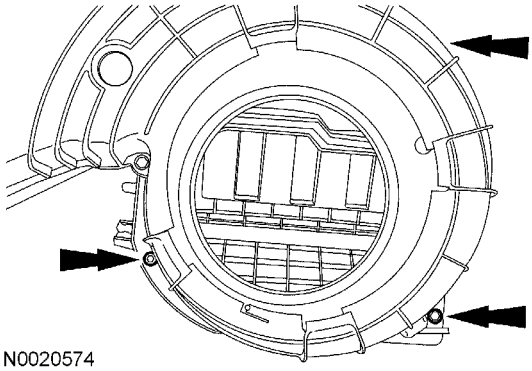


Figure 13

4. Remove the air inlet duct.

5. To install, reverse the removal procedure.

5.4. BLOWER MOTOR

1. Remove the heater core and evaporator core housing. For additional information, refer to HEATER CORE AND EVAPORATOR CORE HOUSING in this section.

2. Remove the blower motor vent tube.

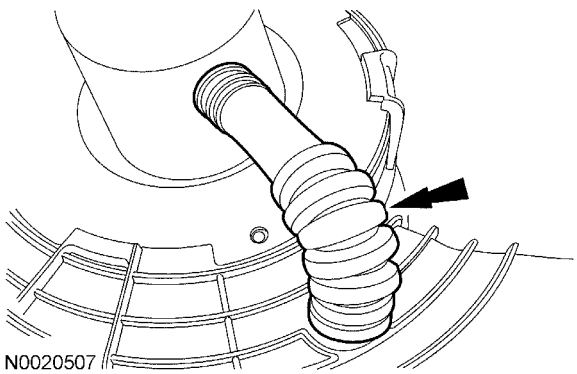


Figure 14

3. Remove the blower motor.

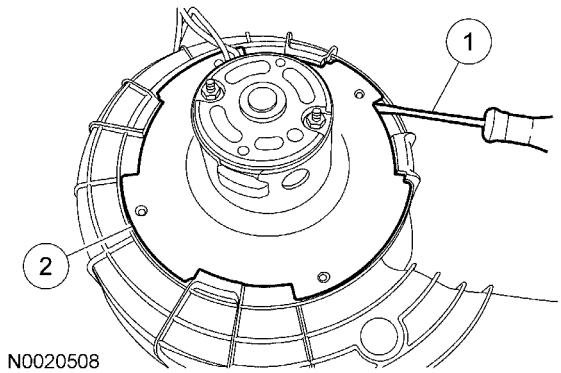


Figure 15

1. Using a suitable tool, carefully pry up the blower motor tab to clear the alignment pin.
2. Rotate the blower motor clockwise and remove.

4. Remove the clip and the blower motor wheel.

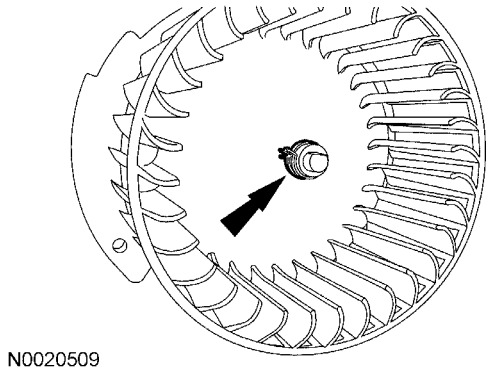


Figure 16

5. To install, reverse the removal procedure.

5.5. HEATER CORE AND EVAPORATOR CORE HOUSING

CAUTION – Anytime the refrigerant system is opened, the lubricant in the system must be replaced after the system is reassembled. The amount of lubricant, and the method of adding it to the system, varies based on the service performed on the system. To determine the correct amount of lubricant (refrigerant oil), refer to OIL FILL GUIDELINES.

CAUTION – Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with mineral-based oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, ester or PAG oil, etc. to lubricate O-rings and fittings.

NOTE – Installation of a new receiver/drier is not required when repairing the air conditioning system, except:

- **when there is physical evidence of system contamination from a failed A/C compressor;**
- **when there is damage to the receiver/drier;**
- **or, when the quantity of refrigerant oil retained in the system cannot otherwise be accurately determined.**

1. Remove the radiator grille.

2. Recover the refrigerant. For additional information, refer to DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY).

3. Drain the engine cooling system. For additional information, refer to the EGES 305, ENGINE DIAGNOSTICS MANUAL.

4. Remove the instrument panel (refer to S16032).

5. Release the clamps and disconnect the heater hoses at the heater core.

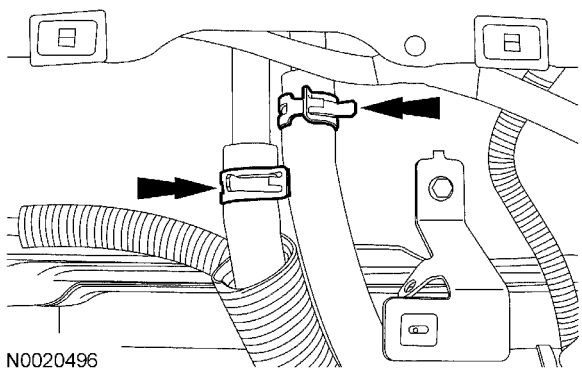


Figure 17

6. Disconnect the evaporator inlet and outlet lines. Cap all openings until ready to re-install.

    - Discard the O-ring seals.
    - To install, tighten the evaporator inlet line fitting to 23 Nm (17 lbf-ft).
    - To install, tighten the evaporator outlet line fitting to 66 Nm (49 lbf-ft).

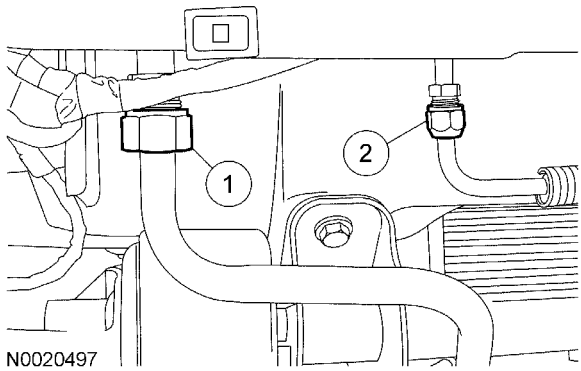


Figure 18

1. Disconnect the evaporator inlet line fitting.
2. Disconnect the evaporator outlet line fitting.

7. Disconnect the heater core and evaporator core housing electrical connectors.

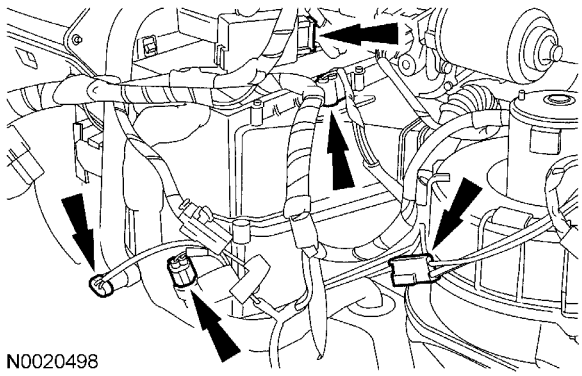


Figure 19

8. Disconnect the electrical connector and detach the wire harness pin-type retainer.

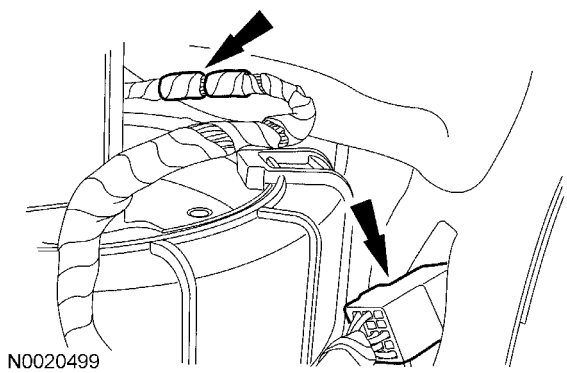


Figure 20

9. Remove the nuts and position the junction box aside.

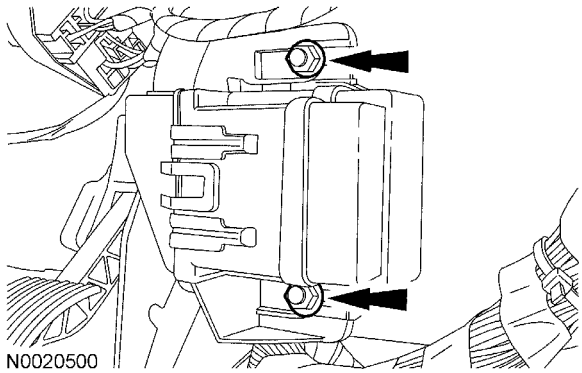


Figure 21

10. Disconnect the blower motor electrical connector.

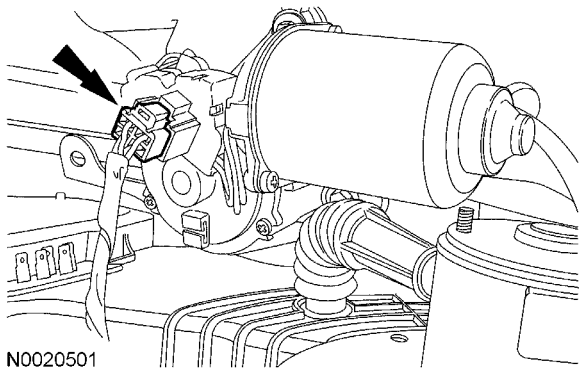


Figure 22

11. Remove the support brace (Figure 23).

    • To install, tighten the support brace retainers to 42 Nm (31 lbf-ft).

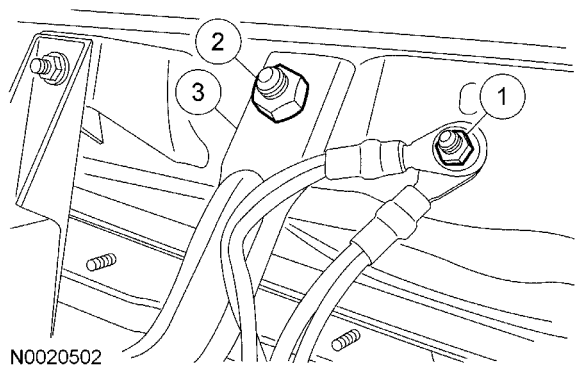


Figure 23

1. Remove the ground nut.
2. Remove the 2 support brace retainers.
3. Remove the support brace.

12. Remove the 2 heater core and evaporator core housing nuts and 3 heater core and evaporator core housing bolts.

    • To install, tighten the support brace retainers to 6 Nm (53 lbf-in).

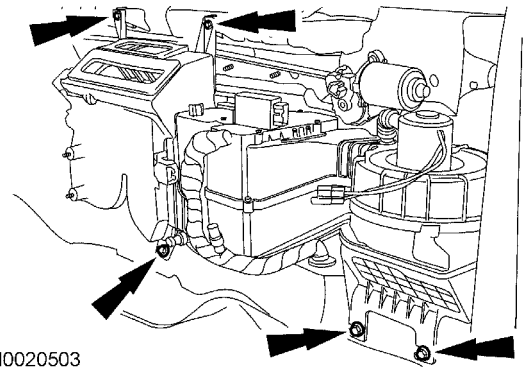


Figure 24

13. Remove the heater core and evaporator core housing.

14. To install, reverse the removal procedure.

    • Install new O-ring seals.

15. Fill the engine cooling system. For additional information, refer to the EGES 305, ENGINE DIAGNOSTICS MANUAL.

16. Evacuate, leak test and charge the refrigerant system. For additional information, refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

5.6. HEATER CORE

NOTE – If a heater core leak is suspected, the heater core must be leak-tested before it is removed from the vehicle. For additional information, refer to COMPONENT TESTS.

1. Remove the evaporator core. For additional information, refer to EVAPORATOR CORE in this section.

2. Remove the 2 screws and the floor duct.

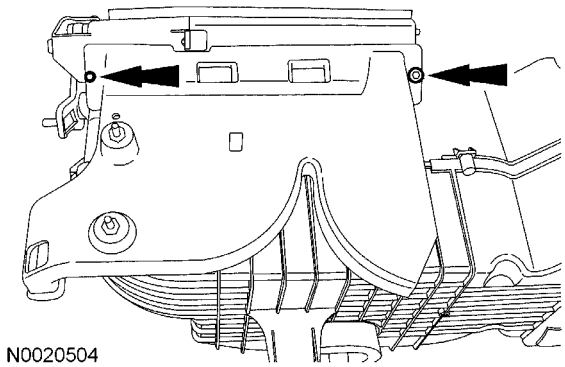


Figure 25

3. Remove the 11 screws and separate the 2 halves of the heater core and evaporator core housing.

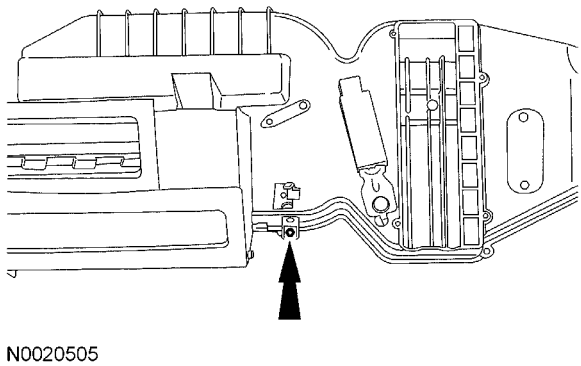


Figure 26

4. Remove the heater core.

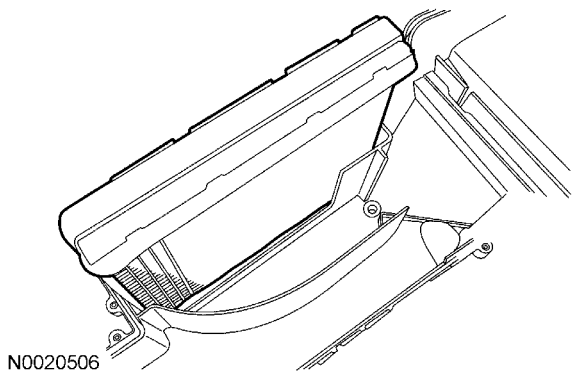


Figure 27

NOTE – The temperature blend door pivot shaft must be correctly seated when assembling the 2 halves of the heater core and evaporator core housing.

5. To install, reverse the removal procedure.

5.7. AIR CONDITIONING (A/C) COMPRESSOR

CAUTION – If installing a new air conditioning compressor due to an INTERNAL failure of the old unit, you must carry out the following procedures to remove contamination from the refrigerant system, before recharging the system. Refer to OIL FILL GUIDELINES for detailed instructions.

- **Flush and purge the air conditioning system.**
- **Install the new compressor.**
- **Install a new thermostatic expansion valve (TXV).**
- **Install a new receiver/drier.**

CAUTION – Anytime the refrigerant system is opened, the lubricant in the system must be replaced after the system is reassembled. The amount of lubricant, and the method of adding it to the system, varies based on the service performed on the system. To determine the correct amount of lubricant (refrigerant oil), refer to OIL FILL GUIDELINES.

CAUTION – Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with mineral-based oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, ester or PAG oil, etc. to lubricate O-rings and fittings.

NOTE – Installation of a new receiver/drier is not required when repairing the air conditioning system, except:

- **when there is physical evidence of system contamination from a failed A/C compressor;**
- **when there is damage to the receiver/drier;**
- **or, when the quantity of refrigerant oil retained in the system cannot otherwise be accurately determined.**

1. Recover the refrigerant. For additional information, refer to DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY).

2. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to JACKING AND LIFTING in S10019.

3. Disconnect the clutch field coil electrical connector.

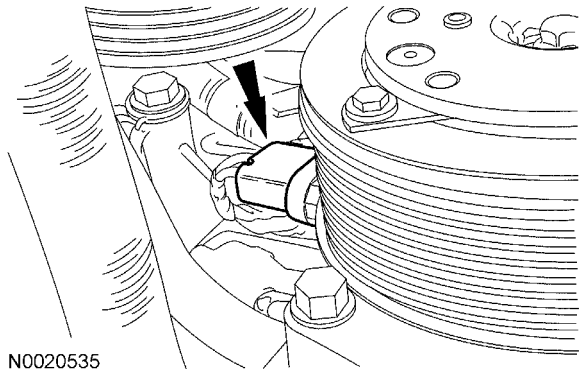


Figure 28

4. Loosen the bolt and detach the compressor manifold and tube assembly from the A/C compressor. Cap all openings until ready to reinstall.

    • To install, tighten to 21 Nm (15 lbf-ft).

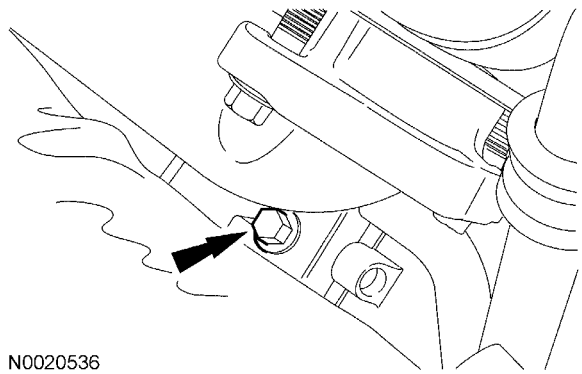


Figure 29

5. Remove the 3 bolts and the A/C compressor.

    • To install, tighten to 25 Nm (18 lbf-ft).

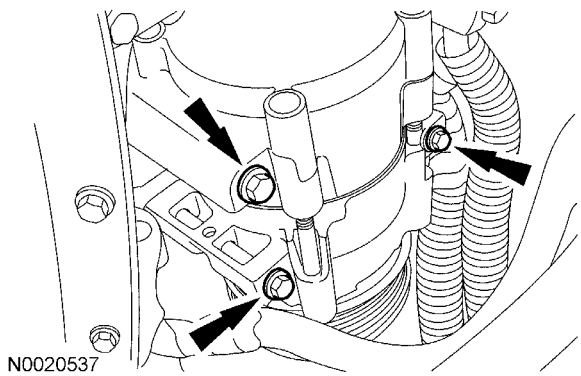


Figure 30

6. To install, reverse the removal procedure.
   - Install new O-ring seals.
7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

5.8. EVAPORATOR CORE

CAUTION – Anytime the refrigerant system is opened, the lubricant in the system must be replaced after the system is reassembled. The amount of lubricant, and the method of adding it to the system, varies based on the service performed on the system. To determine the correct amount of lubricant (refrigerant oil), refer to OIL FILL GUIDELINES.

CAUTION – Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with mineral-based oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, ester or PAG oil, etc. to lubricate O-rings and fittings.

NOTE – If an A/C evaporator core leak is suspected, the A/C evaporator core must be leak tested before it is removed from the vehicle. For additional information, refer to COMPONENT TESTS.

NOTE – Installation of a new receiver/drier is not required when repairing the air conditioning system, except:

- **when there is physical evidence of system contamination from a failed A/C compressor;**
- **when there is damage to the receiver/drier;**
- **or, when the quantity of refrigerant oil retained in the system cannot otherwise be accurately determined.**

1. Remove the heater core and evaporator core housing. For additional information, refer to HEATER CORE AND EVAPORATOR CORE HOUSING in this section.
2. Remove the insulation tape from the thermostatic expansion valve (TXV).
3. Remove the nut and disconnect the A/C lines from the TXV. Cap all openings until ready to reinstall.
   - Discard the O-ring seals.
   - To install, tighten to 9 Nm (80 lbf-in).

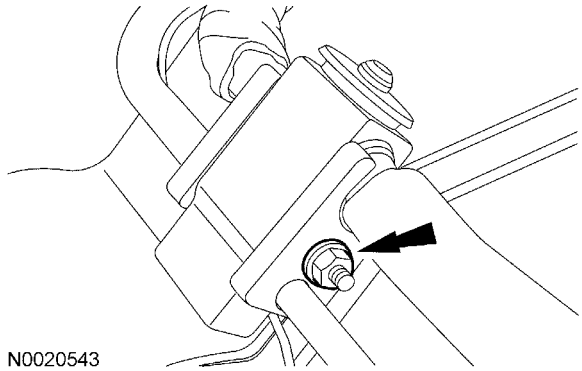


Figure 31

4. Remove the 2 thermostatic switch screws.

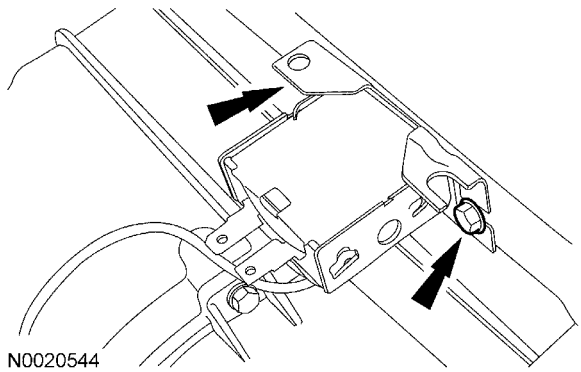


Figure 32

5. Remove the 4 screws and the evaporator core cover.

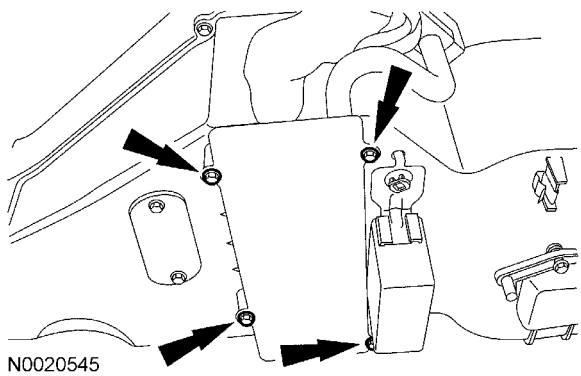


Figure 33

6. Remove the evaporator core.

7. To install, reverse the removal procedure.

- Install new O-ring seals.

8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

5.9. RECEIVER / DRIER

CAUTION – Anytime the refrigerant system is opened, the lubricant in the system must be replaced after the system is reassembled. The amount of lubricant, and the method of adding it to the system, varies based on the service performed on the system. To determine the correct amount of lubricant (refrigerant oil), refer to OIL FILL GUIDELINES.

CAUTION – Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with mineral-based oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, ester or PAG oil, etc. to lubricate O-rings and fittings.

NOTE – Installation of a new receiver/drier is not required when repairing the air conditioning system, except:

- **when there is physical evidence of system contamination from a failed A/C compressor;**
- **when there is damage to the receiver/drier;**
- **or, when the quantity of refrigerant oil retained in the system cannot otherwise be accurately determined.**

1. Recover the refrigerant. For additional information, refer to DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY).

2. Remove the receiver/drier. Cap all openings until ready to reinstall.

   • To install, tighten the receiver/drier fittings to 23 Nm (17 lbf-ft).

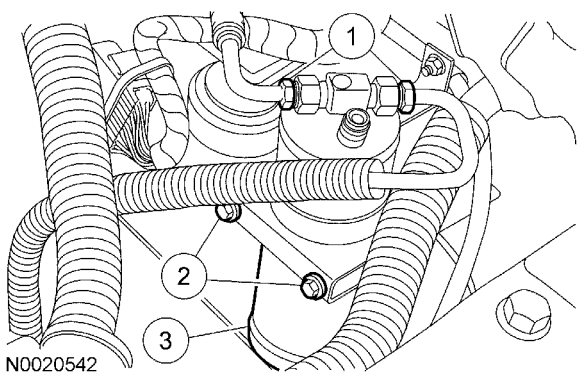


Figure 34

1. Disconnect the 2 receiver/drier fittings.
2. Remove the 2 receiver/drier bolts.
3. Remove the receiver/drier.

3. To install, reverse the removal procedure.
   - Install new O-ring seals.
4. Evacuate, leak test and charge the refrigerant system. For additional information, refer to Evacuating The System (See EVACUATING THE SYSTEM, page 59).

5.10. CONDENSER CORE

CAUTION – Anytime the refrigerant system is opened, the lubricant in the system must be replaced after the system is reassembled. The amount of lubricant, and the method of adding it to the system, varies based on the service performed on the system. To determine the correct amount of lubricant (refrigerant oil), refer to OIL FILL GUIDELINES.

CAUTION – Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with mineral-based oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, ester or PAG oil, etc. to lubricate O-rings and fittings.

NOTE – Installation of a new receiver/drier is not required when repairing the air conditioning system, except:

- **when there is physical evidence of system contamination from a failed A/C compressor;**
- **when there is damage to the receiver/drier;**
- **or, when the quantity of refrigerant oil retained in the system cannot otherwise be accurately determined.**

1. Recover the refrigerant. For additional information, refer to DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY).
2. Disconnect the condenser inlet and outlet lines. Cap all openings until ready to reinstall.
   - Discard the O-ring seals.
   - To install, tighten to 33 Nm (24 lbf-ft).
3. Disconnect the A/C condenser pusher fan electrical connector.

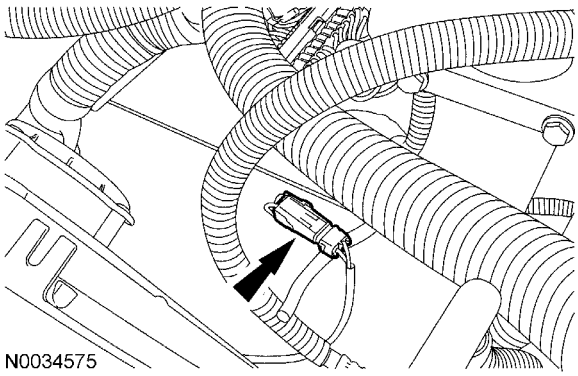


Figure 35

4. Remove the 4 nuts and the A/C condenser pusher fan.

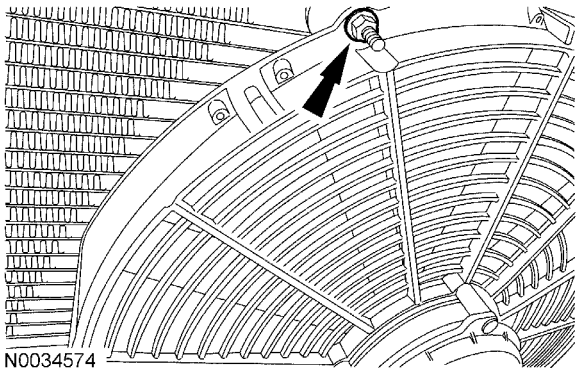


Figure 36

5. Remove the 4 condenser mounting nuts.

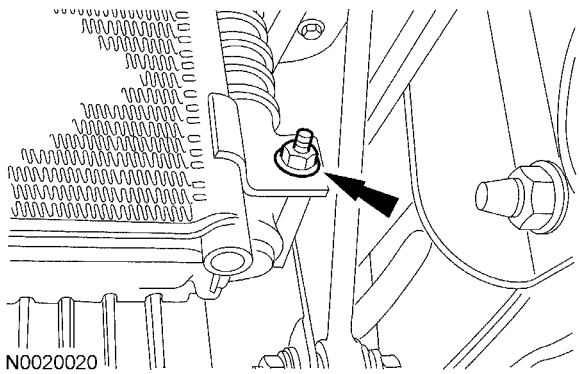


Figure 37

6. Remove the condenser core.

7. To install, reverse the removal procedure.

- Install new O-ring seals.

8. Evacuate, leak test and charge the refrigerant system. For additional information, refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

5.11. COMPRESSOR MANIFOLD AND TUBE ASSEMBLY

CAUTION – Anytime the refrigerant system is opened, the lubricant in the system must be replaced after the system is reassembled. The amount of lubricant, and the method of adding it to the system, varies based on the service performed on the system. To determine the correct amount of lubricant (refrigerant oil), refer to OIL FILL GUIDELINES.

CAUTION – Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with mineral-based oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, ester or PAG oil, etc. to lubricate O-rings and fittings.

NOTE – Installation of a new receiver/drier is not required when repairing the air conditioning system, except:

- **when there is physical evidence of system contamination from a failed A/C compressor;**
- **when there is damage to the receiver/drier;**
- **or, when the quantity of refrigerant oil retained in the system cannot otherwise be accurately determined.**

1. With the vehicle in NEUTRAL, position it on a hoist. For additional information, refer to JACKING AND LIFTING in S10019.

2. Remove the radiator grille.

3. Recover the refrigerant. For additional information, refer to DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY).

4. Remove the A/C line bracket bolt.

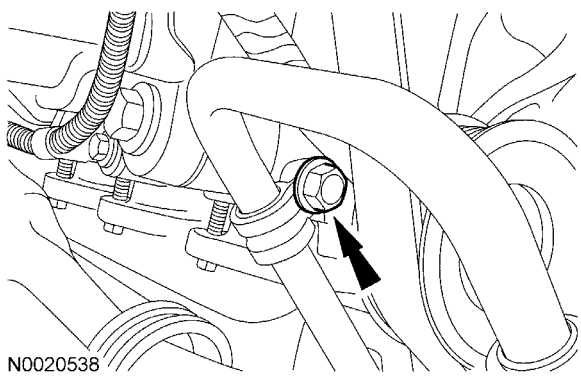


Figure 38

5. Remove the A/C line bracket nut.

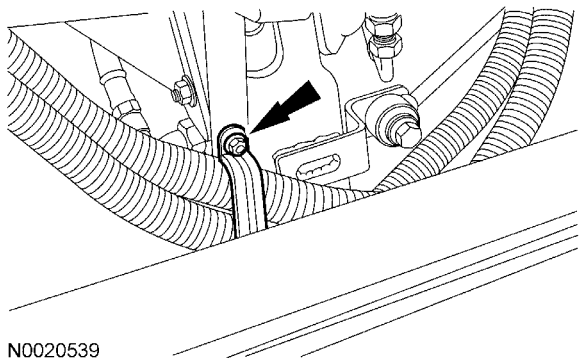


Figure 39

6. Disconnect the high-pressure compressor manifold and tube fitting at the condenser core. Cap all openings until ready to reinstall.

   - Discard the O-ring seal.
   - To install, tighten to 33 Nm (24 lbf-ft).

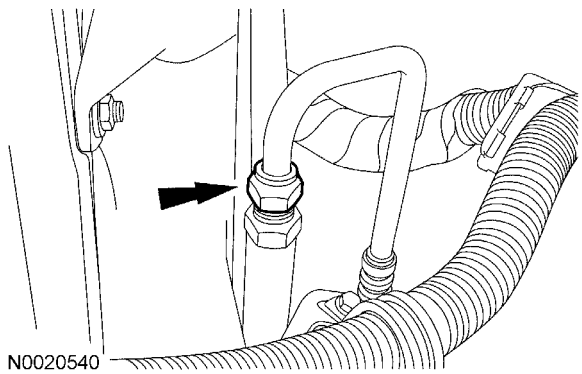


Figure 40

7. Working through the radiator grille opening, disconnect the low-pressure compressor manifold and tube fitting. Cap all openings until ready to reinstall.

   - Discard the O-ring seal.
   - To install, tighten to 66 Nm (49 lbf-ft).

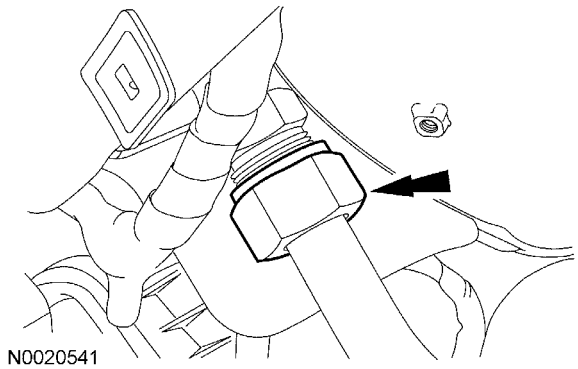


Figure 41

8. To install, reverse the removal procedure.
    - Install new O-ring seals.
9. Evacuate, leak test and charge the refrigerant system. For additional information, refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

5.12. THERMOSTATIC EXPANSION VALVE

CAUTION – Anytime the refrigerant system is opened, the lubricant in the system must be replaced after the system is reassembled. The amount of lubricant, and the method of adding it to the system, varies based on the service performed on the system. To determine the correct amount of lubricant (refrigerant oil), refer to OIL FILL GUIDELINES.

CAUTION – Anytime an A/C fitting is disconnected, the O-ring must be replaced. The new O-ring must be lubricated with mineral-based oil (International P/N ZGGR725008). Never use grease, penetrating oil, motor oil, ester or PAG oil, etc. to lubricate O-rings and fittings.

NOTE – Installation of a new receiver/drier is not required when repairing the air conditioning system, except:

- **when there is physical evidence of system contamination from a failed A/C compressor;**
- **when there is damage to the receiver/drier;**
- **or, when the quantity of refrigerant oil retained in the system cannot otherwise be accurately determined.**

1. Recover the refrigerant. For additional information, refer to DISCHARGING THE SYSTEM (REFRIGERANT RECOVERY).
2. Remove the RH lower instrument panel finish panel.

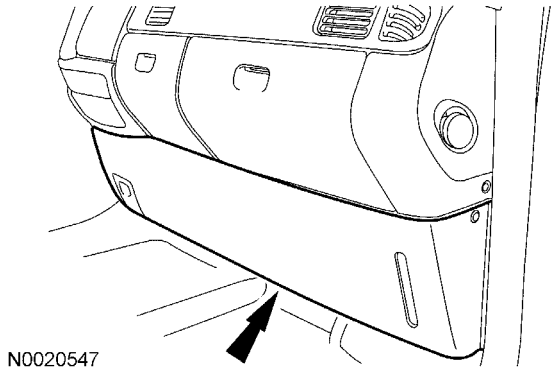


Figure 42

3. Remove the insulation tape from the thermostatic expansion valve (TXV).
4. Remove the nut and disconnect the A/C lines from the TXV. Cap all openings until ready to reinstall.
    - Discard the O-ring seal.
    - To install, tighten to 9 Nm (80 lbf-in).

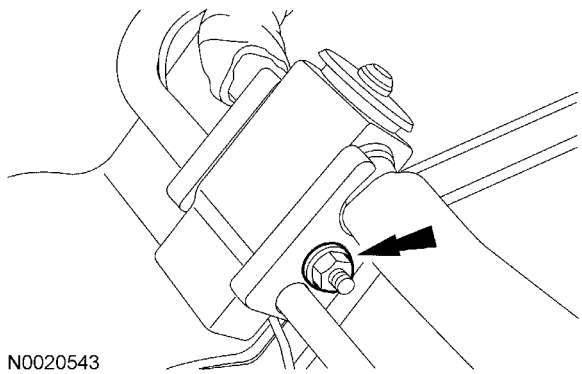


Figure 43

5. Remove the 2 TXV bolts and the TXV. Cap all openings until ready to reinstall.
    - Discard the O-ring seals.
    - To install, tighten to 8 Nm (71 lbf-in).

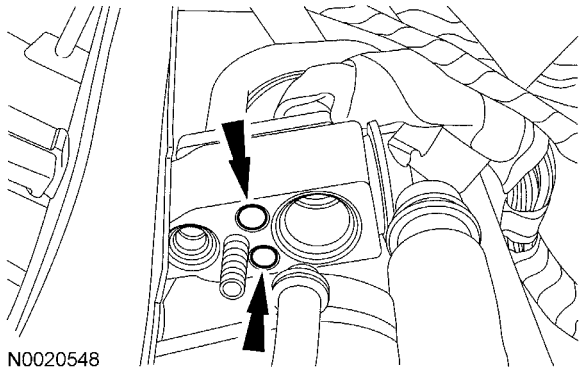


Figure 44

6. To install, reverse the removal procedure.

    - Install new O-ring seals.

7. Evacuate, leak test and charge the refrigerant system. For additional information, refer to EVACUATING THE SYSTEM (See EVACUATING THE SYSTEM, page 59).

5.13. AIR CONDITIONING (A/C) CYCLING SWITCH

1. Remove the evaporator core. For additional information, refer to EVAPORATOR CORE in this section.

2. Remove the thermostatic A/C cycling switch.

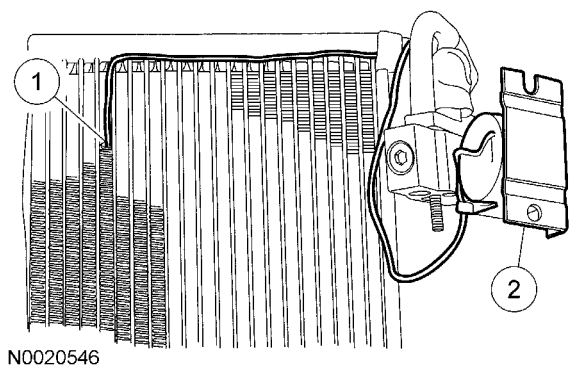


Figure 45

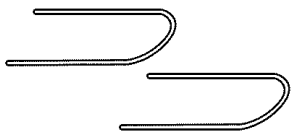
1. Detach the thermostatic A/C cycling switch probe from the evaporator core.
2. Remove the thermostatic A/C cycling switch.

NOTE – The end of the thermostatic switch probe must be installed securely between the evaporator core fins to make sure of correct operation.

3. To install, reverse the removal procedure.

5.14. CLIMATE CONTROL ASSEMBLY REMOVAL

Table 22 Special Tool

 ST1445-A	Radio Removing Tool ZTSE4715

1. Remove the RH lower instrument panel finish panel.

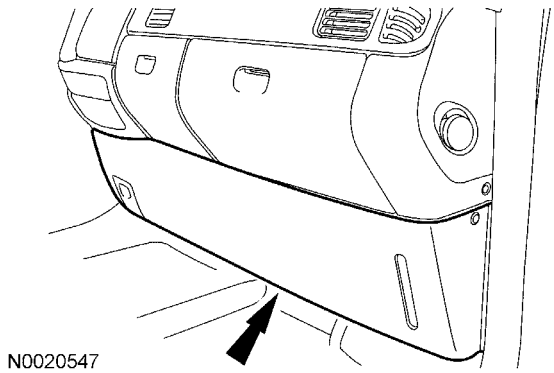


Figure 46

2. Remove the 6 screws and the instrument panel storage compartment.

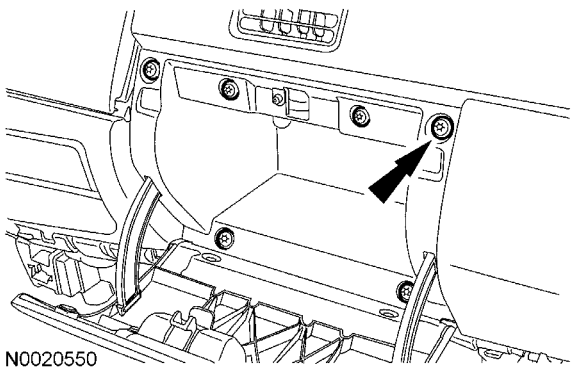


Figure 47

3. Remove the screw and the instrument panel storage compartment.

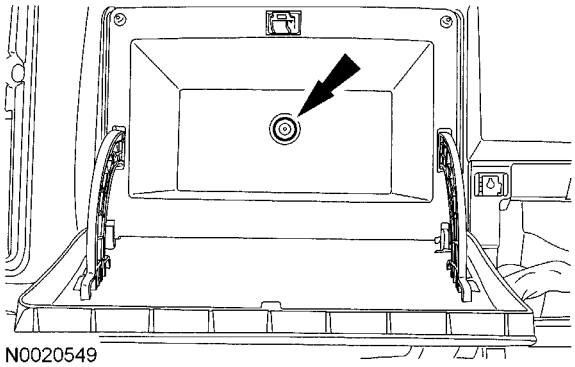


Figure 48

4. Disconnect the airflow mode door control cable.

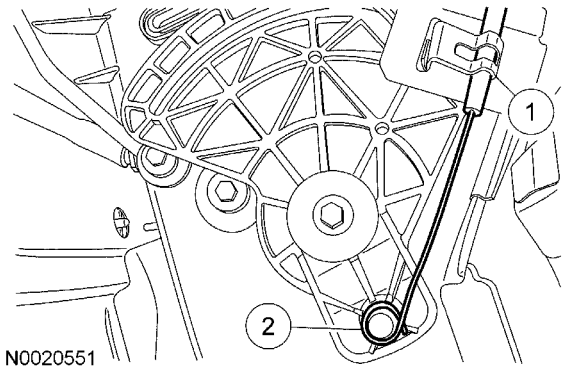


Figure 49

1. Detach the clip.
2. Disconnect the mode door control cable.

5. Disconnect the temperature blend door control cable.

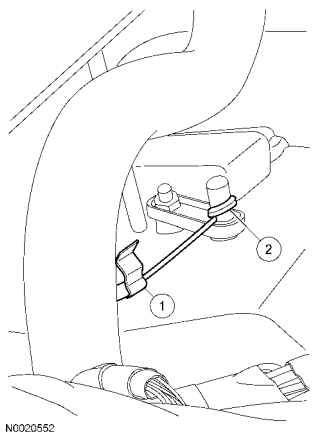


Figure 50

1. Detach the clip.
2. Disconnect the temperature blend door control cable.

6. Disconnect the air inlet door control cable.

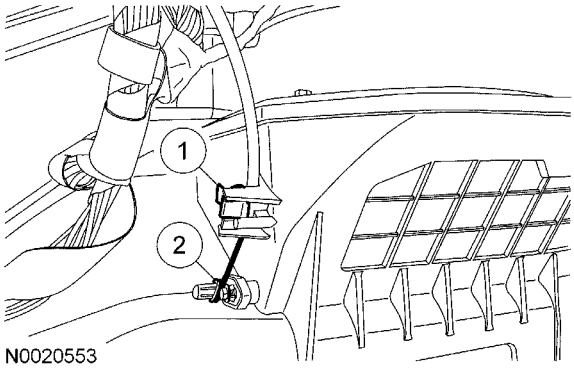


Figure 51

1. Detach the clip.
2. Disconnect the air inlet door control cable.

7. Install the special tools and partially remove the climate control assembly.

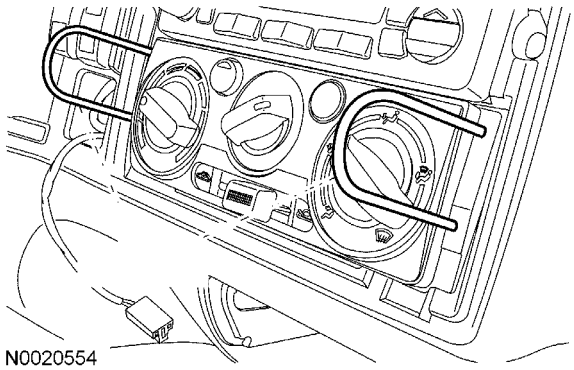


Figure 52

8. Disconnect the climate control assembly electrical connectors and detach the wire harness pin-type retainer.

9. Remove the climate control assembly.

5.15. CLIMATE CONTROL ASSEMBLY INSTALLATION

1. Connect the climate control assembly electrical connectors and wire harness pin-type retainer.

2. Install the climate control assembly in the instrument panel opening.

3. Position the temperature control knob to full COOL.

4. Manually position the temperature blend door in the full COOL position and attach the temperature blend door control cable.

5. Position the function selector in PANEL mode.

6. Manually position the mode door linkage in the PANEL mode (pushed away from you) and attach the mode door control cable.

7. Position the air inlet selector in RECIRC mode.

8. Manually position the air inlet door in RECIRC mode and attach the air inlet door control cable.

9. Operate the temperature, mode and air inlet controls to verify correct operation. Adjust the cables as needed.

10. Install the screw and the instrument panel storage compartment.

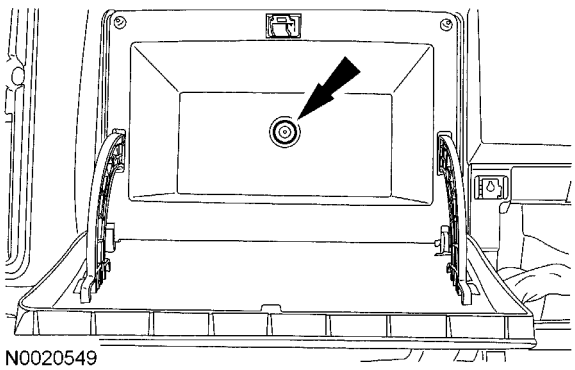


Figure 53

11. Install the 6 screws and the instrument panel storage compartment.

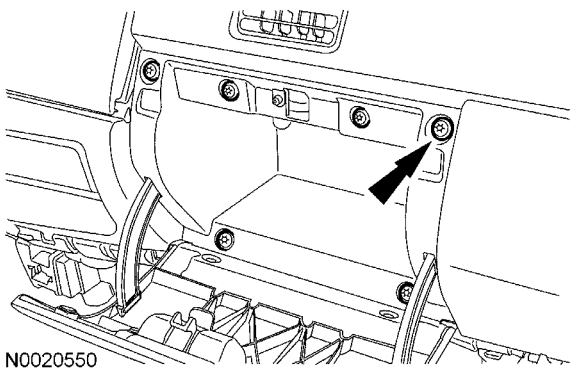


Figure 54

12. Install the RH lower instrument panel finish panel.

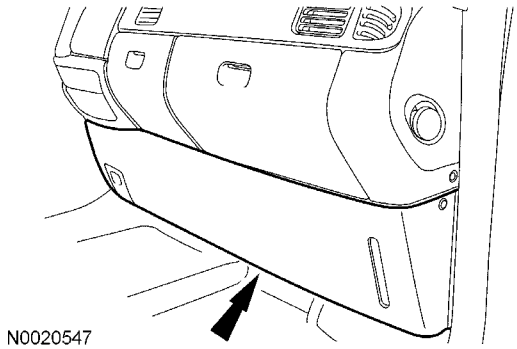


Figure 55

5.16. BLOWER MOTOR RESISTOR

1. Remove the 6 screws and the RH instrument panel storage compartment.

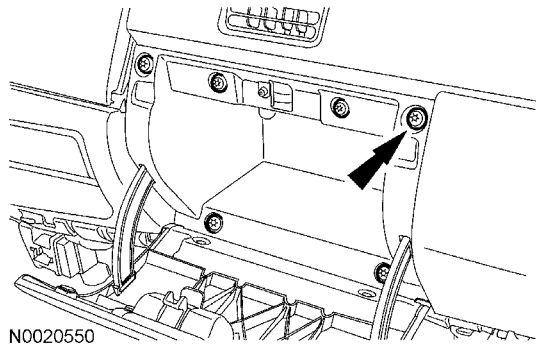


Figure 56

2. Remove the blower motor resistor.

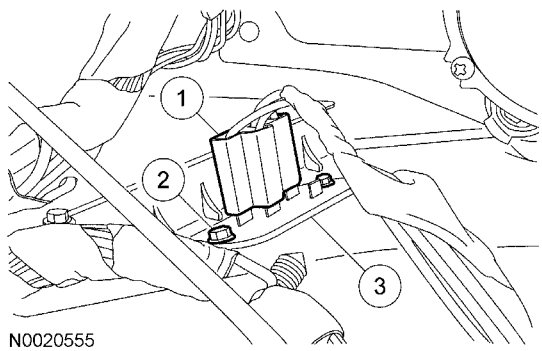


Figure 57

1. Disconnect the electrical connector.
2. Remove the 2 screws.
3. Remove the blower motor resistor.

3. To install, reverse the removal procedure.

6. SPECIFICATIONS

Table 23 General Specifications

Item	Specification
A/C Compressor	
Type	FS-10 swashplate, 5 double-acting pistons
Displacement	170 cc (10.4 cu in)
Rotation	Clockwise
Thermostatic Switch	
Open temperature	2°C (36°F)
High-Pressure Cutoff Switch	
Open pressure	2,275-2,551 kPa (330-370 psi)
Close pressure	1,448-1,724 kPa (210-250 psi)
Low-Charge Protection Switch	
Open pressure	48-90 kPa (7-13 psi)
Close pressure	103-172 kPa (15-25 psi)
Refrigerant Lubricant and Capacity	
PAG Refrigerant Compressor Oil (R-134a Systems)	ZGGR6822
Capacity	266 ml (9 fl oz)
Refrigerant and Capacity	
Refrigerant Type	R-134a
Capacity	1.25 kg (44 oz)
Refrigerant System Cleaner	
A/C Systems Flushing Solvent	See Fleetrite catalog
O-Ring/Seal Lubricant	
Mineral Based Lubricant	ZGGR6912

Table 24 Torque Specifications

Description	Nm	lbf-ft	lbf-in
Low-pressure service gauge port valve cap	0.8	—	7
High-pressure service gauge port valve cap	0.8	—	7
Low-pressure Schrader-type valve	1.8	—	16
High-pressure Schrader-type valve	2.5	—	22
Evaporator inlet line fitting	23	17	—
Evaporator outlet line fitting	66	49	—
Support brace fasteners	42	31	—

Table 24 Torque Specifications (cont.)

Description	Nm	lbf-ft	lbf-in
Heater core and evaporator core housing bolts	6	—	53
A/C compressor manifold bolt	21	15	—
A/C compressor bolts	25	18	—
Condenser fittings	33	24	—
Compressor manifold and tube low-pressure fitting	66	49	—
Receiver/drier fittings	23	17	—
Thermostatic expansion valve (TXV) fitting nut	9	—	80
TXV bolts	8	—	71