Heater – Air Conditioner

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Heater - Air Conditioner Introduction

The Heater and Air Conditioning System has been designed using modern technology to obtain the highest degree of reliability and performance.

The design incorporated unique features that increase the operator comfort and safety while at the same time making the system easier to maintain and service.

The system contains all the components common to a heater/air conditioning system. (See Figures 11-5 and 11-6 for typical system diagrams.)

The heater/air conditioning system operates on a *Blend Air* principle. This means that the desired comfort level in both the cab and sleeper are controlled by blending hot and cold air inside each of the combination units. There are doors inside the unit that are electrically positioned from the operator's control panel inside the vehicle to blend the air. The actuators that position the doors are easily accessible for servicing without disassembling the unit.

Both the Cab and Sleeper heating and air conditioning units are mounted in a central location in the vehicle to give equal air distribution to all the air outlets.

The Cab unit is mounted to the firewall and is accessible from the engine compartment. (See Figure 11-3.) The Cab unit is removed from the firewall very simply by moving it out of the engine compartment for service with the heater and air conditioning hoses connected. Service can then be performed on a bench along side the vehicle. (See Figure 11-25.)

The Cab unit features five (5) primary modes of air flow control, with 4 intermediate modes between each primary mode, for greater operator comfort and safety. (See Figure 11-1a.) The fan in both the Cab and Sleeper units have five (5) settings ranging from off to high speed for additional comfort. (See Figures 11-1a and 11-2.)

The temperature in the sleeper is controlled automatically once it has been set by the operator. The sleeper unit has an air temperature sensor in the Control Panel and an electronic control module which controls the voltage output to the electric actuator controlling the blend air door.

Heater - Air Conditioner Control Panels

The heating and air conditioning system is controlled from two (2) temperature control panels.

One (1) temperature control panel is located on the Cab dash to regulate cab comfort. The Cab temperature is controlled by selecting the desired temperature on the CAB CONTROL PANEL. (See Figure 11-1a, 11-1b, and 11-1c.)

The other temperature control panel is located in the Sleeper. The Sleeper temperature is controlled automatically after the desired temperature has been set on the SLEEPER CONTROL PANEL. (See Figure 11-2.

Full temperature control in the sleeper compartment can only be obtained if the cab unit control is on "ANY" blower speed position and the A/C rocker switch is "ON." These control settings allow for compressor operation and system cooling.

The SLEEPER CONTROL TEMPERATURE SENSOR compares the temperature in the "Sleeper Area" to the temperature that has been requested on the "SLEEPER CONTROL PANEL."

NOTE

When the selected temperature and the interior temperatures are the same, a constant temperature will be maintained automatically.

The temperature balance in the truck compartment does not occur immediately. Allow time for the system to balance before resetting the temperature control knob.

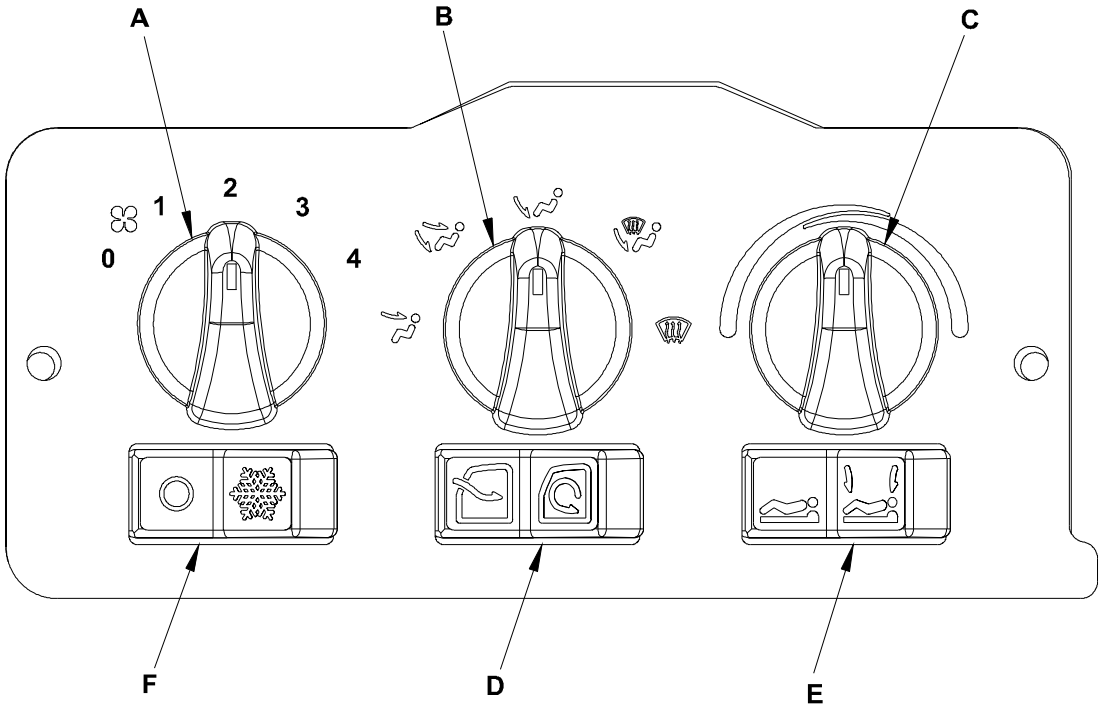
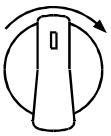


Figure 11-1a: Cab Unit Control Panel

A FAN SWITCH (selector switch)

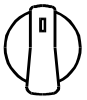


Increases fan speed ("0" = OFF POSITION)

B AIR FLOW MODE SELECTION (selector switch)

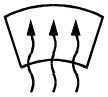
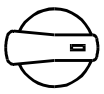

Air out thru DASH VENTS only


Air out thru DASH & FLOOR VENTS

Air out thru FLOOR VENTS only


Air out thru FLOOR & DEFROST VENTS (Compressor operation ON within the approximate setting.)

Air out for full DEFROST (DEFOG) (Compressor operation ON when outside temperature is above 32ºF.)

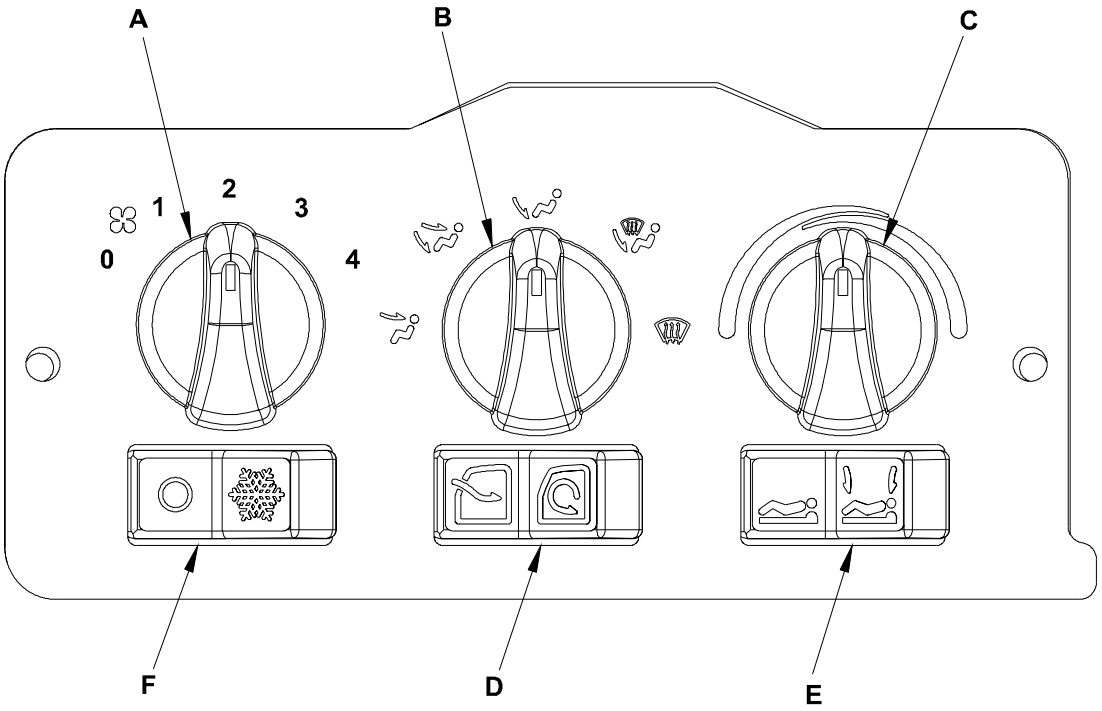
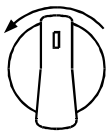
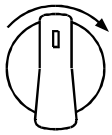


Figure 11-1b: Cab Unit Control Panel

C TEMPERATURE CONTROL (selector switch)

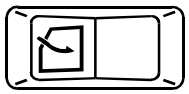


Turn knob counter-clockwise for COOLER AIR TO CAB

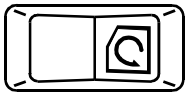


Turn knob clockwise for WARMER AIR TO CAB

D FRESH AIR (rocker switch)



Push in for FRESH AIR OPEN



Push in for FRESH AIR CLOSED

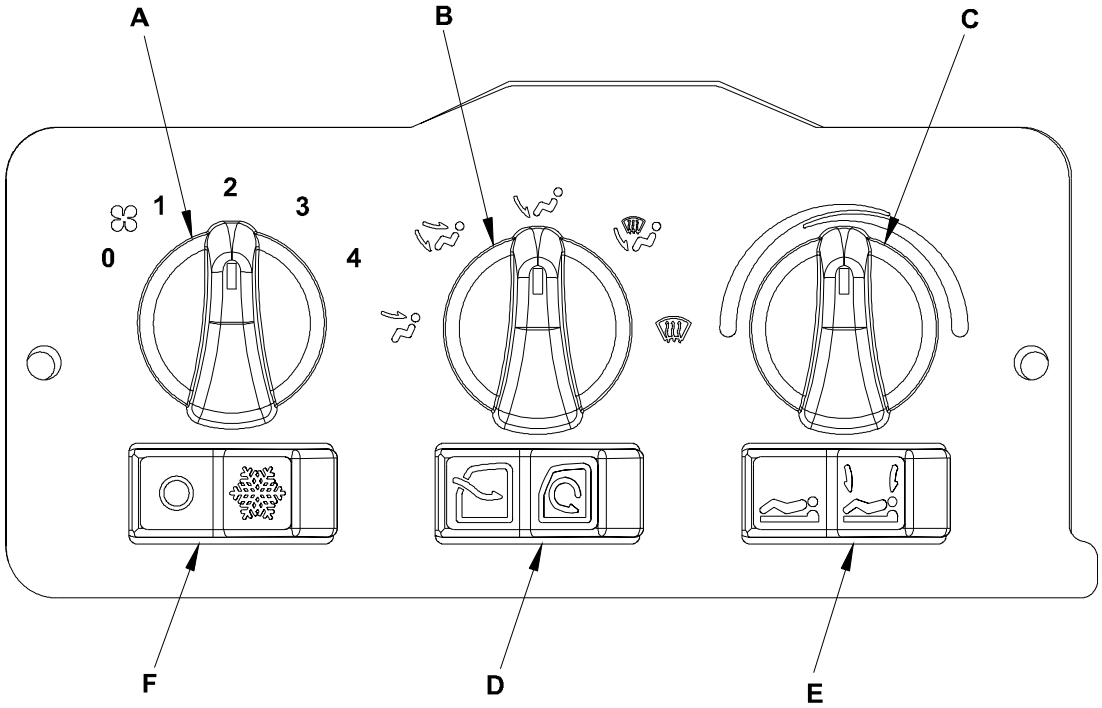
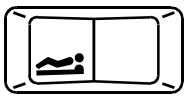
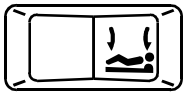


Figure 11-1c: Cab Unit Control Panel

E SLEEPER UNIT (rocker switch)

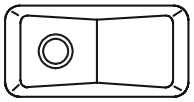


Push in for SLEEPER UNIT OFF

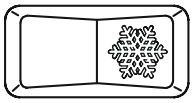


Push in for SLEEPER UNIT ON

F. AIR CONDITIONING (rocker switch)



Push in for AIR CODITIONING OFF



Push in for AIR CONDITIONING ON

NOTE: To DEFOG (Remove moisture from the inside of the windows):

1. Turn item "B" (AIR FLOW MODE) to defrost.
2. Turn item "A" (FAN SWITCH) to any "ON" position.

NOTE

The air conditioning compressor will automatically operate when the mode is selected to the defrost position, as long as the outside temperature is above approximately 32ºF. This provides dehumidification to help DEFOG the windshield and side windows. The fresh air door will also automatically OPEN, regardless of rocker switch "D" position, to aid in this process.

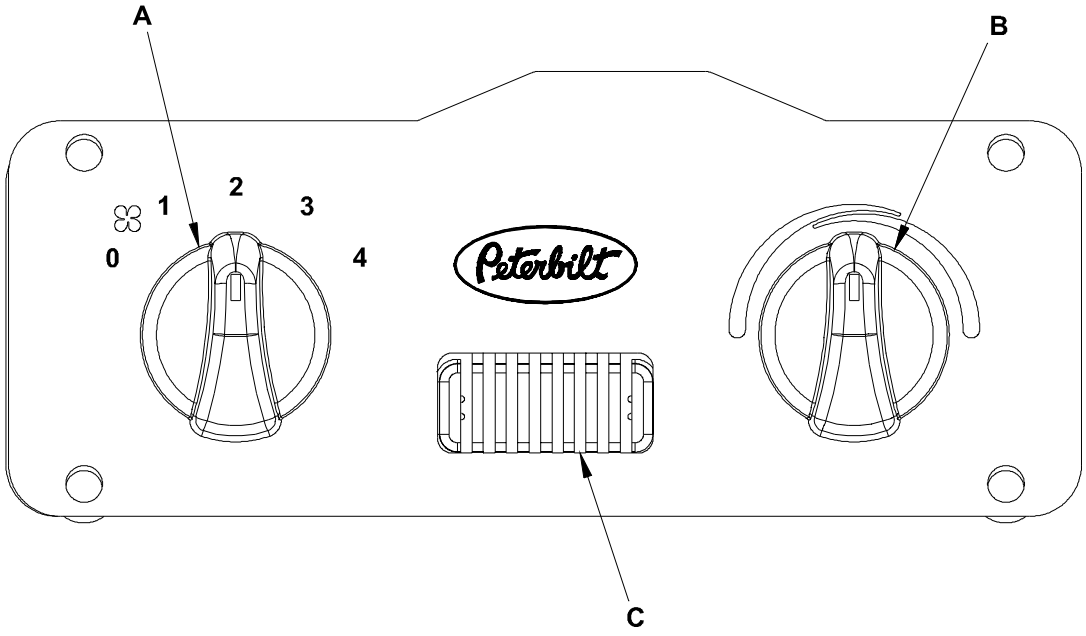
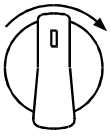


Figure 11-2 - Sleeper Unit Control Panel

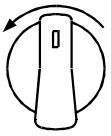
NOTE: The SLEEPER UNIT rocker switch, located on the "Cab Control," must be pushed to the "SLEEPER UNIT ON" position before the "Sleeper Control" will work.

A FAN SWITCH (selector switch)



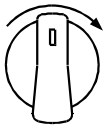
Increases Fan Speed
"0" = OFF POSITION

B TEMPERATURE CONTROL (selector switch)

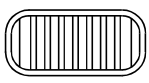


Turn knob counter-clockwise for COOLER AIR TO SLEEPER

C SLEEPER AIR TEMPERATURE GRILL



Turn knob clockwise for WARMER AIR TO SLEEPER



WARNING: Do not block! Temperature sensor located behind grill.

Heater - Air Conditioner System Description

GENERAL

Proper troubleshooting, diagnosis, and repair of this heating and air conditioning system requires an understanding of the system and its unique features. A brief review of the principles of heating and air conditioning will help explain the function of the major parts.

FEATURES

The Heater/AIR-CONDITIONING System operates on the *Blend Air* principle. This means that the desired comfort level in both the cab and sleeper are controlled by blending hot and cold air inside the heating/air-conditioning unit.

Both the Cab and Sleeper Heating and Air Conditioning Units are mounted in a central location giving equal air distribution to all outlets.

The Cab Unit is mounted to the firewall. This method of mounting permits easy access and removal without disconnecting any hoses. Service can be done on a bench along side the truck.

The Cab Unit features five (5) primary modes of air flow control for greater driver comfort and safety. The fan has five (5) settings from off to high for additional comfort. These controls are located on the control panel located inside the vehicle. (See Figure 11-1a.)

The temperature in the cab is controlled manually by setting the temperature select. The temperature in the sleeper is controlled automatically once set by the operator regardless of temperature changes in the surrounding air. The sleeper unit has an air temperature sensor in the Sleeper Control Panel and an electronic control module which adjusts the voltage output to the electric actuator controlling the blend air door.

The cab and sleeper compartment are designed to allow additional temperature comfort as air is directed through body exhausters when the cab unit is in fresh air mode. The body exhausters allow for uniform airflow to minimize temperature differences within the vehicle. They also limit cab pressurization from highway speeds and door closure.

THE HEATING CYCLE

Heating is the act of adding heat to the air in the cab/sleeper. This is done by bringing air into contact with a hot surface.

The vehicle engine supplies the heat. Hot engine coolant is constantly pumped to both heater coils, by the water pump, through hoses.

As this coolant flows through the heater coil, air being blown across it absorbs the heat. The cycle is completed when the coolant is again heated by the engine and returns to the heater coil.

THE REFRIGERATION CYCLE

Air conditioning is the act of removing heat from the air. Heat is removed from the air by moving the air over coils filled with low pressure/low temperature refrigerant (R134a).

The refrigerant is circulated through the system by using a compressor to increase the pressure of the vapor and liquefying it at the condenser located at the front of the vehicle.

The cycle is completed when the liquid refrigerant again vaporizes through the evaporator coil by absorbing heat from the surrounding cab/sleeper air.

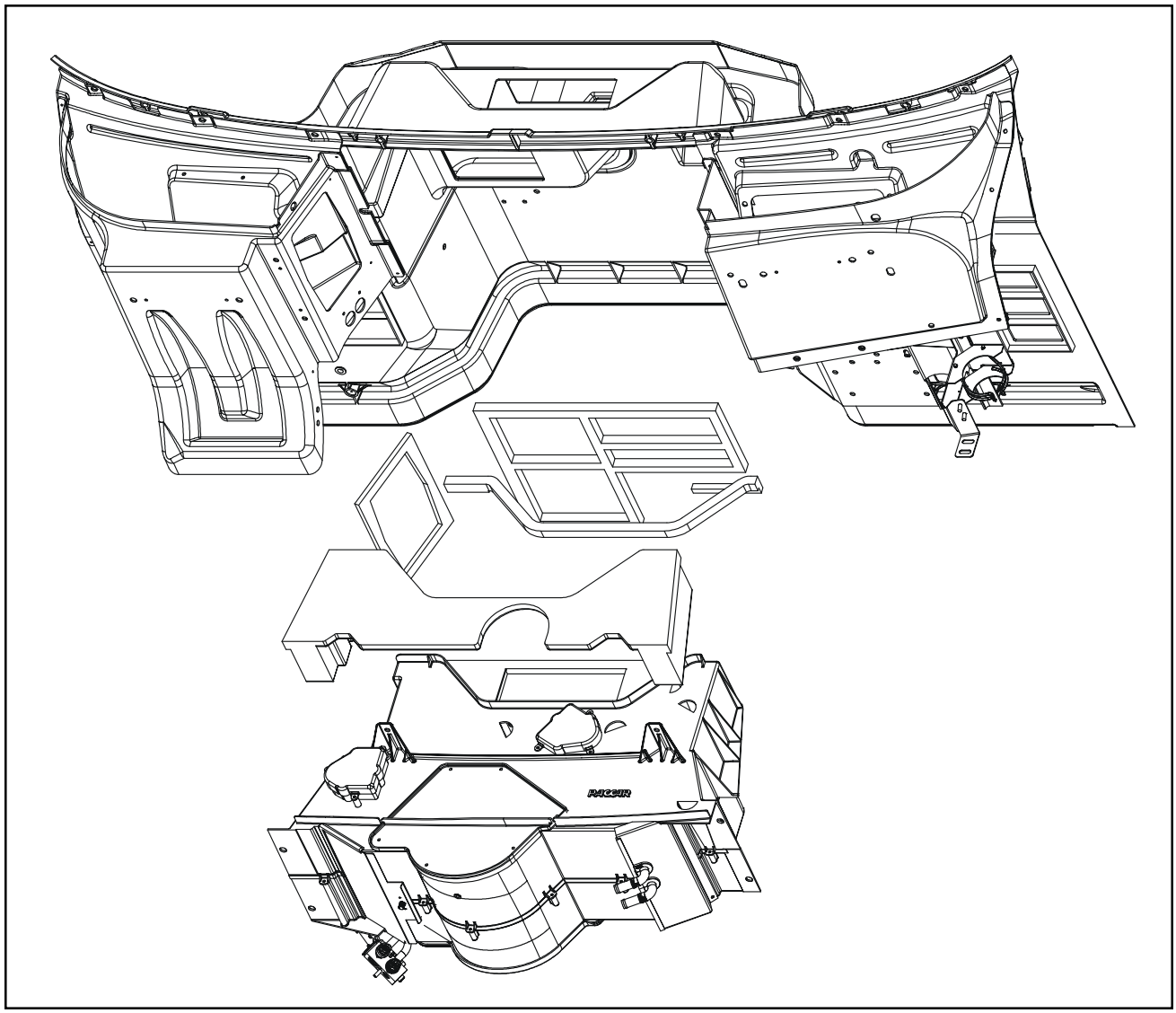


Figure 11-3: Cab Unit Location

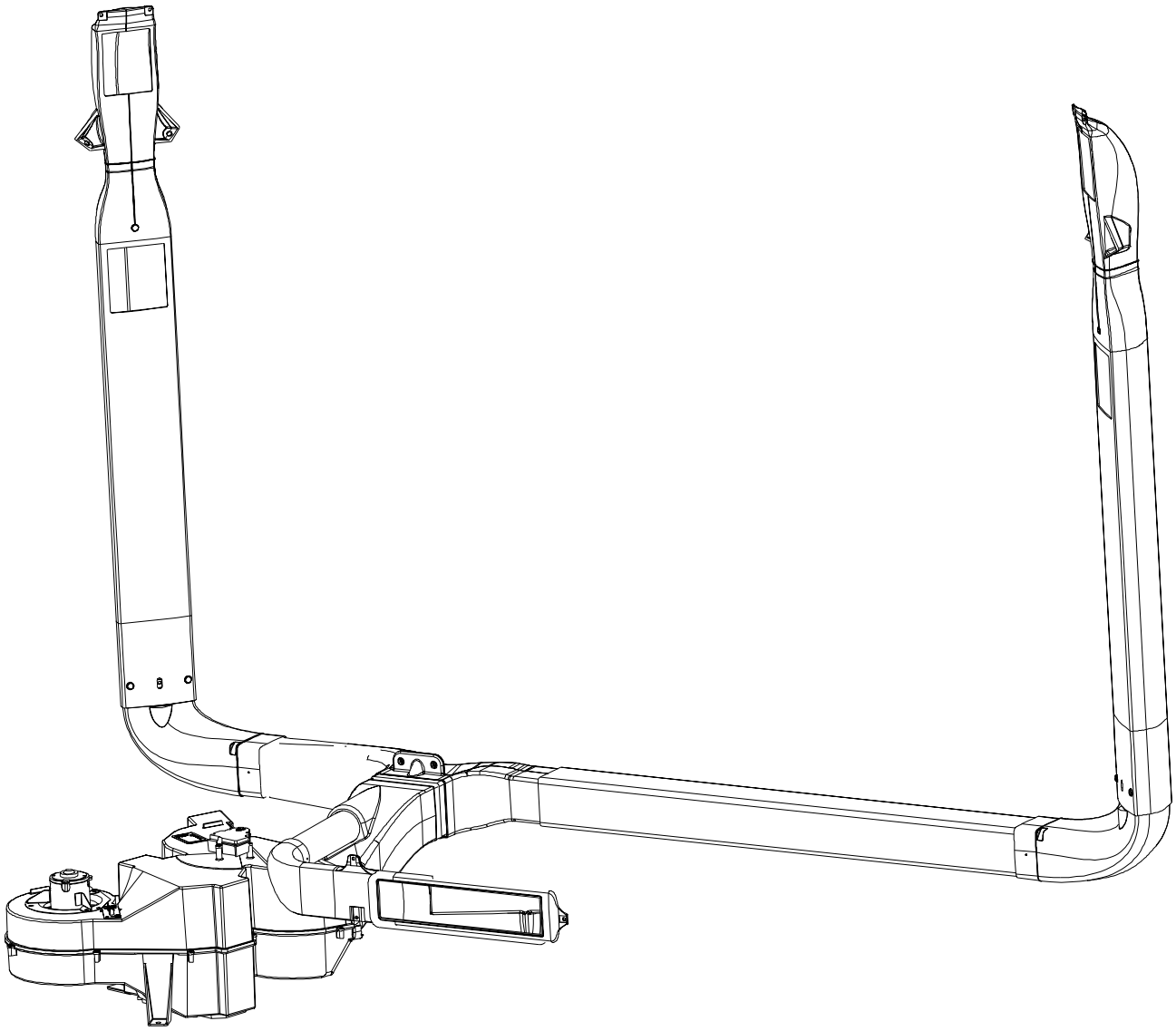


Figure 11-4: Sleeper Ducts

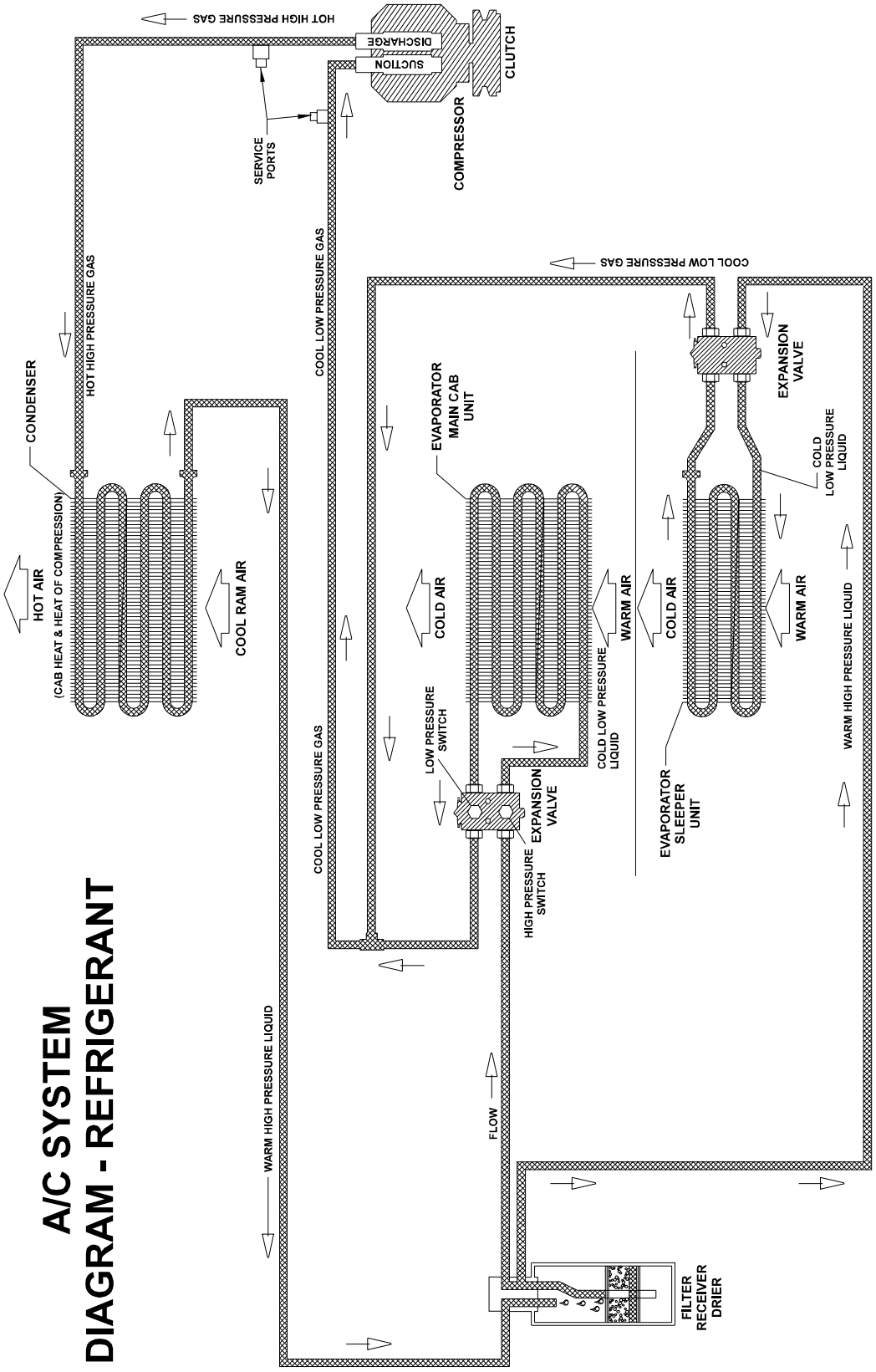


Figure 11-5: A/C System Diagram - Refrigerant

Peterbilt 387 Fitting Chart

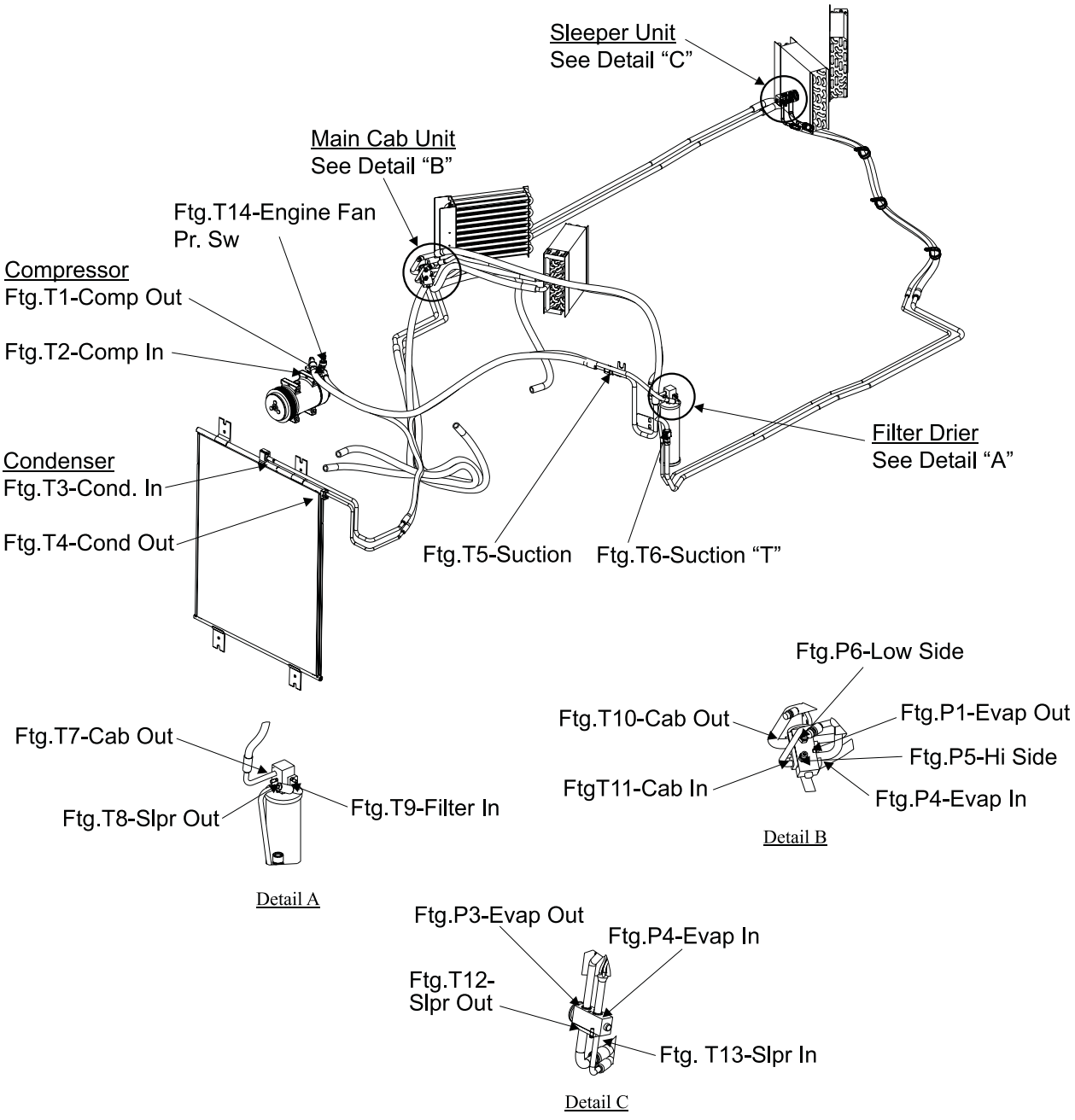


Figure 11-6: A/C System Diagram - Refrigerant

THE REFRIGERATION SYSTEM

The main component in the refrigeration system is the refrigerant, R134a. It is circulated, under pressure, in a closed-loop system through the following 5 components: (See Figure 11-5: A/C System Diagram - Refrigerant)

1. Compressor
2. Condenser
3. Filter-drier
4. Expansion valve
5. Evaporator coil

The refrigeration (air conditioning) system has a high pressure (discharge) side and a low pressure (suction) side.

These high and low sides are split at the expansion valves and at the compressor as follows:

- The high side extends from the compressor through the condenser and filter-drier to the expansion valve.
- The low side extends from the outlet of the expansion valve through the evaporator and back into the compressor.

The compressor pumps refrigerant through the air conditioning system. The compressor is an engine mounted assembly and is engaged and driven by the engine through its clutch pulley and belt(s).

The compressor takes in R134a refrigerant as a low-temperature, low-pressure gas, pressurizes it in the compressor, and forces it into the condenser as a high-temperature, high-pressure gas.

NOTE

The outlet capacity of the compressor is determined by the engine speed:

The higher the engine speed, the greater the output of the compressor; the lower the speed, the lower the output.

The function of the condenser is to cool the refrigerant gas from the compressor to a liquid before entering the expansion valve. The refrigerant enters the condenser as a high-temperature, high-pressure gas. As it flows through the coil, it gives up heat energy to the ambient air passing over the condenser coil.

The refrigerant becomes a high-temperature, high-pressure liquid. This liquid flows out of the condenser through the outlet tube.

A filter-drier is located between the condenser and the expansion valve. It has 3 functions:

- Dry the refrigerant
- Filter the refrigerant
- Hold a reservoir of liquid

A thermostatic expansion valve (TXV) meters the amount of refrigerant entering the evaporator. Refrigerant changes from a high temperature, high pressure liquid to a low temperature, low pressure liquid as it passes through the valve.

The evaporator receives low-temperature, low-pressure liquid from the expansion device. The blower moves air through the evaporator coil. As the refrigerant flows through the coil, heat moves from the warm air to the cooler refrigerant. The refrigerant absorbs heat energy during the phase change from liquid to gas.

The fins on the evaporator coil are colder than the dew point of the air moving across them, causing condensate (water) to form on the fins. The result will be cool, dry air in the vehicle. Condensate falls from the fins to the bottom of the case and flows out through the drain tubes.

HEATING AND AIR CONDITIONING SYSTEM COMPONENTS

Compressor

The compressor supplied has been designed specifically for use with R134a.

CAUTION

Lubrication is very important to the compressor in that it reduces friction and component wear. Refrigerant oil will lubricate the compressor while the system is in operation. See labeling for type and quantity.

Liquids are virtually incompressible; any liquid refrigerant entering the suction port could cause damage to the compressor.

Compressor Clutch

The compressor clutch drives the compressor and is powered by the engine. Compressor clutch operation is controlled by the A/C switch on the control panel or by requesting defrost on the mode selector.

An electromagnetic coil is mounted inside the pulley and is bolted to the compressor, setting up a magnetic field between the pulley to lock up the drive plate, thus engaging the clutch and allowing the pulley to turn the compressor shaft. When the clutch is disengaged, the pulley will spin free without turning the compressor shaft.

Filter-Drier

The filter-drier receives high-temperature, high-pressure liquid refrigerant from the condenser. It is an in-line drier designed specifically to dry and filter the refrigerant before it reaches the thermal expansion valve.

NOTE

The Filter-Drier must be replaced anytime the refrigerant system is opened for repairs or routine maintenance.

Thermal Expansion Valve

With this A/C system, the refrigerant flow is controlled in both the cab and sleeper by a spring loaded thermal expansion valve (TXV).

The expansion valve performs three main functions in the refrigerant system. They are:

- It maintains the pressure difference between the condenser and evaporator to obtain the best performance in the system.
- It meters the flow of liquid refrigerant to keep the proper amount of liquid in the evaporator.
- It responds to load changes in the system and controls the suction pressure to the compressor to balance the load on the system.

A gas charge in the valve above the diaphragm expands and contracts with changes in evaporator outlet temperature. This action moves the diaphragm and internal components thus controlling the amount of refrigerant entering the evaporator.

NOTE

The expansion valve in the cab is not the same as that in the sleeper. Do not attempt to install the cab expansion valve on the sleeper unit. Both Low and High Pressure switches are mounted to the Cab expansion valve.

Condenser

The aluminum parallel flow condenser is mounted in front of the radiator and charge air cooler and bolted to brackets for support.

Evaporator

A copper tube, aluminum fin type evaporator coil is used with the system. The fins on the coil are colder than the air moving across them causing condensate water to form on the fins. The result will be cool air entering the cab or sleeper and the condensate (water) from the fins will fall to the bottom of the assembly case and out through the drain tube.

NOTE

The rubber check valves must be in place and in good condition to allow water to drain out when the system is running.

The evaporator receives low temperature, low pressure liquid refrigerant through the TXV. As the refrigerant flows through the coil, heat moves from the warm air to the cooler refrigerant and the refrigerant absorbs energy during the phase change from a liquid to a gas.

In normal operation, the expansion valve will meter the proper amount of refrigerant into the evaporator to ensure that all of the liquid R134a changes to vapor before it reaches the compressor. However, there are certain conditions that may exist in the system that will prevent the evaporator from performing to its capacity, they are:

- The system has too little refrigerant: The expansion valve will not be able to meter the correct amount of refrigerant into the coil. The R134a will vaporize too quickly before passing through the evaporator and poor cooling will result.
- The system has too much refrigerant; If too much refrigerant is in the system, poor cooling could result due to high system pressures.

R134a Refrigerant (Tetraflouroethane)

WARNING

Wear protective clothing and eye protection.

Always take measures to avoid frostbite or eye damage when working with R134a.

The boiling point of R134a is -14.9º F (-26º C) and will be reached instantly when exposed to the atmosphere or your skin.

CAUTION

Never mix R12 and R134a in the system as serious system damage may occur.

Each refrigerant has its own distinct characteristics, so be sure to take this into account when working on this system.

- R134a uses synthetic oil to lubricate the system. It attracts moisture if left exposed to the air. In a closed refrigeration system, this will result in a loss of performance or can cause system damage. Take the following precautions when working with refrigerant oil:
  - Keep all A/C system components capped and sealed until the moment they are to be hooked up.
  - Store refrigerant oil in sealed containers. To ensure proper operation, the system is charged with a preset amount of R134a refrigerant and oil at the factory.
- Reclaiming, recycling and charging equipment must be compatible with R134a refrigerant.
- The charge level for the A/C system is noted on a label mounted on the radiator.
- The type of oil used in the refrigerant system is shown on the compressor label.

Hoses and Fittings

- Heater hoses are 5/8-inch (16 mm) ID rubber or silicone hoses. They are attached to other components with constant tension spring clamps.
- Refrigeration system hoses are constructed with multiple layers of material to prevent water vapor from enering the system and to keep refrigerant contained in the system.
- Refrigeration system switch ports have metric threads.
- Refrigeration system fittings that require O-rings use HNBR O-rings.

NOTE

Mineral oil is recommended for O-ring lubrication prior to installation.

- Refrigeration system service ports are quick-connect type and are of different sizes to preclude accidental cross-connection of service equipment.

Heater Coil

The A/C system uses a heater coil constructed of copper tubes with aluminum fins.

Pressure Switches

The air conditioning system has 3 pressure switches:

- Low-side, low-pressure switch
- High-side, high-pressure switch
- High-side/Engine fan switch

Low-side, Low-pressure Switch

The low-side, low-pressure switch is located on the suction side of the cab unit expansion valve. The pressure switch contacts are closed when the pressure is sufficiently high (above 34 psi nominal). Contacts open when the pressure falls below approximately 14 psi and reclose after the pressure climbs back above 34 psi (nominal). Low pressure switch activity is the primary indicator of a loss of charge.

- The switch disengages the compressor clutch when the suction pressure is below 14 psi.

Low pressure may be a result of refrigerant loss due to a leak or some type of restriction in the system.

High-Side, High-pressure Cutout Switch

The high-pressure cutout switch is located on the discharge side of the cab unit expansion valve. The switch contacts are closed when the pressure is low. Contacts open when the pressure climbs above approximately 350 psi (nominal) and will reclose after the pressure falls back below 230 psi (nominal). The high pressure switch is the primary control for minimizing excessive high pressure and is used to disengage the compressor clutch.

High-Side Engine Fan Switch

The engine fan pressure switch is used to control refrigerant discharge pressure by engaging the engine coding fan. The contacts are normally closed and open on an increasing system pressure (300 psig actuate, 230 psig reset). The circuit for the enginefan feeds directly in the electronic engine control module and maintains fan operation for 180 seconds upon actuation.

Relays and Resistors

Relays and resistors are an integral part of this system. They are electrical controls that are not normally affected by temperature and/or pressure.

A relay is an electrical device in the wiring circuit used to distribute power. It is used when the need for power exceeds the ability of the control switch.

Compressor operation is controlled by the A/C switch on the control panel. A diode in the compressor clutch suppresses any voltage spikes when the compressor clutch disengages.

A 4-speed resistor is used to control blower speed by varying the voltage to the blower motor. The resistor has a thermal limiter for upper temperature protection; this limiter is set at 250º F (121º C) for this system. If the temperature reaches this value at the resistor, due to malfunction or debris jammed in the blower wheel preventing it from turning, the thermal limiter opens up the circuit and shuts off power to the blower motor for all speed settings except high speed. This fuse is located on the cab and sleeper blower resistors. The thermal limiter is not a self-resettable device. Therefore, the resistor must be replaced if the thermal setpoint is reached.

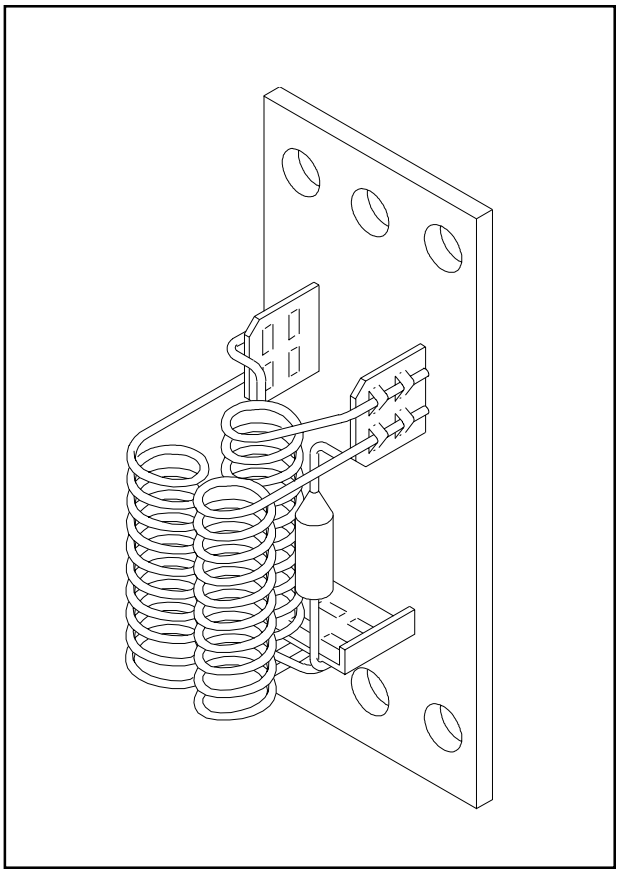


Figure 11-9: Resistor

Blower Motor Assembly

Mounted on the air conditioning unit case is a blower motor and wheel assembly which is used to move air across the heater and evaporator coils and distribute the air through the air duct system.

The blower draws air from either the outside (fresh air) or the cab (recirculated air). All the air passes through the evaporator coils in both systems (cab and sleeper) regardless of what mode the system is in. (Refer to Figure 11-10: Motor/Blower Assembly)

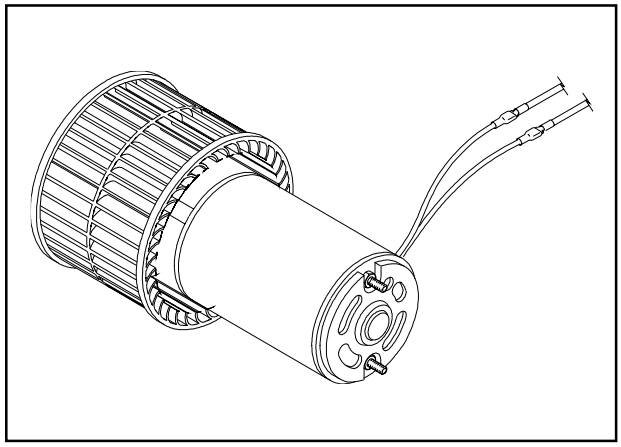


Figure 11-10: Motor & Blower Assembly

Mode Doors

Mode doors are located in the cab unit to direct the air to the appropriate outlets. These doors are positioned by electric actuators that are controlled by rotary knobs and switches on the control panel.

Freeze Switches

Freeze switches are temperature-activated electrical devices used to prevent the air conditioning coil condensate from freezing into ice and blocking the air flow. These switches *cut out* (open), when their probe temperature drops below the low set point, (usually just below 32ºF), and *cut in* (close), about 8ºF above freezing.

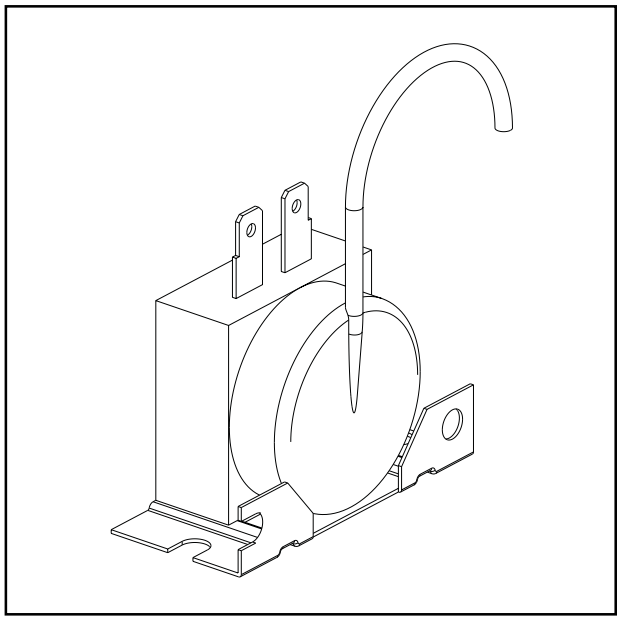


Figure 11-35: Freeze Switch

SYSTEM CONTROL PANELS

Two sleeper control panels are located in the truck for the heater/air conditioning system. One is located in the cab and the other is located in the sleeper.

Cab Control System

The temperature select function controls the blend air door actuator to maintain a selected door position in the blend chamber.

The A/C switch function requests when Air Conditioning is needed.

AC will always be requested when the A/C switch on the control panel is in the ON position or when MODE select is in defrost position.

Cab Control Panel

The main control panel is in the cab. It permits cab control of the system, but also contains a switch to provide power to the sleeper unit for temperature control from the sleeper control panel.

Cab Control Circuit Board

The cab control circuit board is located in the control harness for the cab control, underneath the vehicle dash and contained within a plastic wire harness connector. This simple device is used within the electrical system of the cab control to perform 2 functions. The first function allows for the proper rotation of the blend air door to that of the temperature control potentiometer on the cab control panel. The door and control panel can now operate in sequence to function as a unit. The second function of the circuit board is to provide an open signal to the fresh air door when the DEFROST mode is selected, regardless of the rocker switch position on the control panel. See Figure 11-13, Cab Unit Wiring Diagram, for specific components associated with the circuit board.

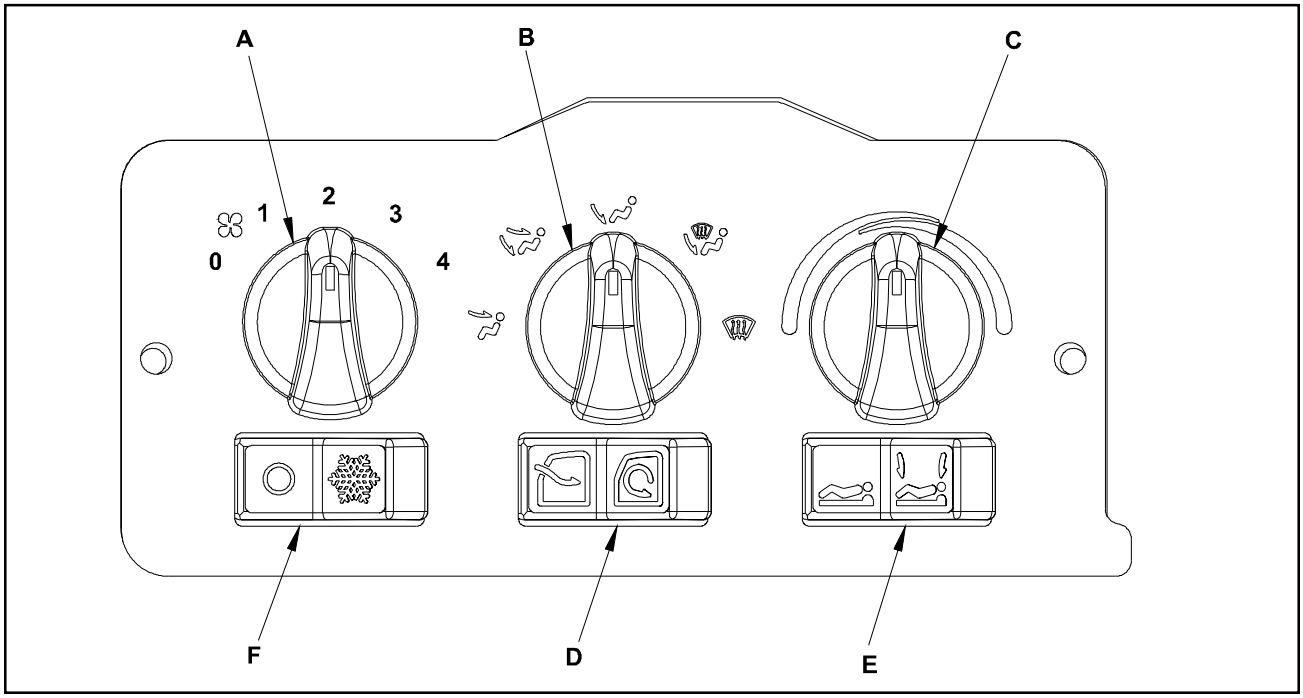


Figure 11-11: Cab Control Panel

Sleeper Control Panel

The SLEEPER CONTROL PANEL, (heater/air conditioning), has 2 control functions.

Sleeper Control System

The sleeper comfort control system maintains a preselected ambient sleeper temperature by modulating the blend air/temperature door. This door controls the amount of air directed through the heater coil (which always has hot engine coolant flowing through it), and the air conditioning coil, thus controlling temperature.

The system employs an electronic control module that senses the air temperature and makes necessary adjustments to the blend air/temperature door positioning actuator. The temperature control range is from 50º F (10º C) to 130º F (54º C). This corresponds to air temperature control knob settings from full counterclockwise to full clockwise, respectively.

NOTE:

Sleeper A/C control is intelocked with the cab unit to provide full temperature control in the sleeper compartment. For sleeper-compartment air conditioning, the cab unit control panel must have the A/C switch "ON" and the blower in ANY speed.

Electronic Control Module (Sleeper)

This module provides a voltage output to the electric actuator controlling the blend air/temperature door. It receives voltage inputs from the temperature control potentiometer and the air temperature sensor; it receives power and ground through the vehicle wiring harness. The electronic control module is located in the sleeper control panel.

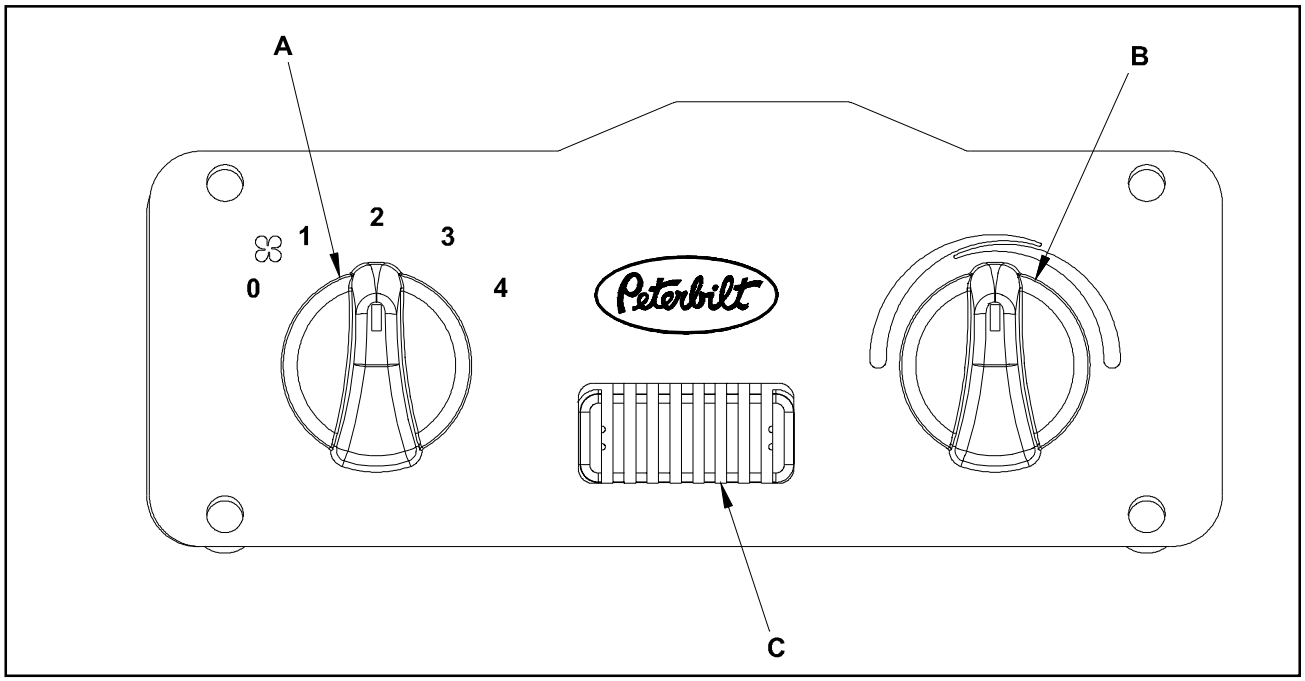


Figure 11-12: Sleeper Control Panel

Temperature Control Potentiomenter

This potentiometer translates the desired air temperature into a voltage input to the electronic control module in the sleeper. This signal is translated to a blend air door position for comfort control.

Blend Air Door Electric Actuator

This actuator positions the blend air door, located inside the sleeper assembly and between the heater and evaporator coils. The blend air door actuator is controlled directly by the electronic control module. This actuator is located on the top of the heater/air conditioning case.

Sleeper Air Temperature Sensor

This sensor compares the actual air temperature to the desired temperature selected and translates this into a voltage input to the electronic control module. It also receives power from the module.

The air temperature sensor is located on the sleeper control panel. (See Figure 11-13 through Figure 11-14 for heating/air conditioning wiring diagram(s).

Heater - Air Conditioner System Preventive Maintenance

INSPECTIONS

Perform the following preventive maintenance inspections.

Periodic Inspections

- visual inspection of overall system (engine off).
- Electrical inspection (engine off/ignition on).
- Air conditioning system performance inspection (engine on).
- Heating system performance inspection (engine on).

Preseason Inspections

- Compressor and clutch inspection.
- Leak test air conditioning system.
- Check Heater system for leaks and worn hoses.

PERIODIC INSPECTIONS

Perform the following Periodic Inspections for the Heater/Air Conditioner.

Visual Inspection (engine off)

- Inspect the evaporator and heater coils and air filter. They should be free of foreign material. Debris on any of these components will impair the heating and cooling efficiency as well as reduce the air flow. Remove debris with compressed air, being careful not to damage the blower wheel fan blades or coil fins.
- Clean the condenser coil with compressed air to remove debris. A partially blocked condenser will cause excessive head pressure, reduce cooling performance and shorten both compressor and clutch life.

NOTE

Use proper torque values shown on Page 29 to tighten all nuts and bolts on the compressor mounting bracket and clutch before and after inspecting belt tension and pulley alignment.

- Inspect drive belts for proper tension. Replace worn belts.
  - Loose belts can cause clutch slippage and result in intermittent cooling.
  - Belts under excessive tension will place damaging stress on the clutch, compressor, bearings, cranking shaft, and the belt.
- Inspect the alignment of the clutch to the crankshaft drive pulley. If the compressor has shifted out of alignment, belt wear and clutch bearing failure may result.
- Inspect hoses for abrasive wear, particularly at bends, clamps, and in areas that may rub against the vehicle. Replace worn hoses.
- Inspect heater hose connections for leaks.
- Inspect heater hoses for deterioration from heat and use. Replace if necessary.
- Inspect refrigerant piping connections for leaks around the compressor, evaporator and hose fittings. Oil may be present if there is a leak.
  - Look behind the clutch assembly to get a better view of the compressor shaft seal.

Electrical Inspection

(engine off/ignition on)

- Ensure all electrical connections are tight and properly secured. Clean any corrosion from connectors (It inhibits current flow).
- Check for frayed or cut wires.
- Check the current flow by first turning the air conditioning unit on, then opening and closing the lead wire connector on the compressor clutch. The clutch should disengage and engage respectively, as evidenced by a *clicking* sound.
- Check the blower operation by turning the blower on and adjusting the blower speed control. Verify that airflow at the ducts varies with varying blower speeds.

Air Conditioning System Performance Inspection
(engine on)

WARNING

To avoid personal injury, keep hands clear of the engine, compressor, belts, moving fans and other components while the engine is running.

Air Conditioning Performance

Perform the following procedure to inspect the air conditioning system performance:

1. Perform a Visual Inspection as outlined earlier on page 25.

2. Start the engine and place the system in the Fresh Air mode and full cold temperature select with doors and windows open to create a constant load on evaporator. Field service data (outlet temperatures and pressures at the specified ambient temperature) indicate the relative performance of the air conditioning system (See Page 58).

3. Measure the air temperature coming out of the left center register by using a needle thermometer. Place the needle into the register and observe the temperature swing.

4. Service the air conditioning system if required.

WARNING

Exercise caution when checking the relative temperature of the compressor discharge line. It may cause burns if touched by unprotected skin.

Another method to perform this inspection is to feel the refrigerant lines. Although not as accurate as the above inspection, this method is helpful in determining a service plan-of-action. Perform the following procedure:

1. Feel the compressor suction line; it should be *COOL*.

2. Feel the compressor discharge line; it should be *HOT*.

3. Service the air conditioning system if required.

Filter-Drier

- The Filter-Drier must be replaced whenever the system is opened for repair or preventive maintenance.

Heater System Performance Inspection

(engine on)

WARNING

To avoid personal injury, keep hands clear of the engine, compressor, belts, moving fans, and other parts while the engine is running.

Perform the following procedure to inspect for heating system performance:

1. Perform a Visual Inspection as outlined earlier on page 25.
2. Ensure that the system contains the proper amount of coolant.
3. Start the engine - Run the engine until the coolant reaches a temperature greater than 150º F (66º C).
4. Set the Blower speed on *High*.
5. Set the temperature control to *Full Hot*.
6. Compare the relative difference in temperature between the supply and return hoses of the heater coil. The supply hose should be *HOT*. The return hose should be cooler. If there is no difference in temperature or if the return hose is cold, check engine isolation valves for open indication and service the heating system as required.

Sleeper Heating/Air Conditioning Performance Inspection

Perform the following procedure to inspect the sleeper heating/air conditioning system.

1. Perform a Visual Inspection as outlined earlier on page 25.
2. Start the engine.
   a. Run the engine until the coolant reaches a temperature of greater than 150º F (66º C).
   b. Let the engine idle.
   c. Turn the Sleeper air conditioning system *On* from the Cab Unit control panel, as well as the A/C rocker switch.
   d. Set the mode control switch, on the Cab Unit control panel, to the Recirculated Air position, and turn the blower speed knob to any "ON" position.
   e. Set the blower speed knob, on the Sleeper Unit control panel, to any "ON" position.
3. Turn the air temperature control knob fully clockwise.
   a. Verify that the outlet air temperature gets hot.
4. Turn the air temperature control knob fully counterclockwise.
   a. Verify that the outlet air temperature gets cold.
5. Install a thermometer at the sleeper temperature sensor in the control panel.

NOTE

Do not obstruct the sleeper temperature sensor in the control panel as it tries to control sleeper compartment temperature to the temperature select position.

6. Increase the engine speed to 1500 rpm.

   a. Verify that the average sleeper temperature (not outlet temperature) does not vary by more than 5º F from thermometer at sleeper control panel.

7. Service the heating/air conditioning system if required.

Functional Check

NOTE

If either this inspection or later troubleshooting activities indicates a possible problem with the electronic control module, follow the procedure below to perform a functional check of it.

1. Ensure that all electrical connectors are fully seated.

2. Disconnect the actuator connector and connect a multimeter to the connector from the control module.

3. Perform the following test at 65º to 80º F ambient temperature.

   a. With the potentiometer turned fully clockwise, verify that the output voltage is approximately 0.11 volts at output pin 8 and 7 on actuator.

   b. With the potentiometer fully counter-clockwise, verify that the output voltage equals battery voltage (11-12.5 volts) less 0.5 volts for line loss.

PRESEASON INSPECTIONS

Heating and Air Conditioning System Inspection and Maintenance

The inspection, repair and restoration of a heating and air conditioning system prior to a season of continuous operation is necessary. In addition to the procedures described under Periodic Inspections, perform the following procedures:

Compressor/Clutch Inspection

Inspect the compressor and clutch for proper operation and pressure values.

Leak Test

Perform a leak test on the air conditioning system and repair any leaks that are observed. Refer to Table 11-1 for the appropriate torque values.

NOTE

All torques are in ft. lb. (N.m.) format.

CAUTION

To avoid damage, always use a backup wrench on a fitting when tightening or loosening it.

Fastener Size (mm)	Torque (N.m.)
M6	4-6 ft. lbs. (5-8)
M8	22 - 28 ft. lbs. (30-38)
#12 fitting (19.5 mm)	22 - 27 ft. lbs. (30-37)
#14 fitting	28 - 33 ft. lbs. (38-44)
Hi-Press Switch Port	5 ft. lbs. ± .5 (7 ± .7)
Lo-Press Switch Port	3 ft. Lbs. ± .5 (4 ± .7)

Table 11-1: Torque Values

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Heater - Air Conditioner Troubleshooting Guide

MOST COMMON PROBLEMS

1. Check that all interconnecting components are securely plugged into the proper/matching connector.

2. Confirm that electrical power, of the proper voltage, is actually reaching the unit and all components. Check main supply fuses or circuit breakers prior to tracing individual circuits.

3. Verify ground continuity. Paint or other coatings may block the electrical circuit and cause components to not operate. Wiring may be loose or not attached to the grounding point(s).

4. Check that the engine coolant system is full with no air lock in the system.

5. Check that antifreeze (engine coolant) is free to reach the unit. Engine block shut off valves for both supply and return lines must be open. Hoses must not be pinched or kinked anywhere.

6. Confirm that the cab and sleeper units are properly plumbed in parallel. Series plumbing will affect system performance.

7. Verify that the truck's air conditioning system is fully charged. The temperature control selector must be in the full cold position, the cab blower *ON,* and the A/C switch *ON*..

8. When checking the sleeper unit verify that the sleeper switch is *ON* on the drivers control panel and that the sleeper blower is *ON.*

9. The blower speed resistor has one thermal fuse. This fuse prevents overheating of the area near the speed wire coils should air flow be lost. Any significant reduction or loss of air movement past these coils will cause them to heat up when the fan control is selected. Radiant heat then warms the thermal fuse.

   If the temperature reaches the thermal fuse set point, the electrical circuit is opened and the blower speeds are lost. High speed will continue to operate since this circuit does not pass through the resistor.

   Disconnect the resistor and check for continuity with an Ohm meter. Replace the resistor if its thermal fuse has been activated (blown).

WARNING

Do not modify or attempt to bypass the activated (blown) thermal fuse. Replace the whole resistor assembly. Modification or bypassing of this protection devices could cause a fire and/or personal injury.

10. If there is low or no air flow in the cab during either the heating or cooling mode, the air filter may be dirty. Remove the filter and clean or replace with a new one. Check the inlet duct for blockage.

11. Time must be given for the ambient air temperature in the sleeper unit to balance with the selected temperature on the control panel Trouble shooting or replacing parts in the sleeper heater/air conditioning unit should be done after waiting for the system to stabilize.

TOOLS AND EQUIPMENT

The following is a list of tools and equipment required to service the heating and air conditioning units:

1. General mechanics tool set, including proper torque wrenches.

2. Air conditioning service/charging equipment set up.

   a. Manifold gauge set.
   b. Recover/reclaim and/or recycling station.
   c. Thermometer (pocket size to measure duct air temperature).
   d. Vacuum pump with micron measuring device.

3. Personal safety equipment for refrigerant handling.

   a. Goggles
   b. Gloves

4. Electronic leak detector capable of reacting to the type of refrigerant (R134a) contained in the system to be serviced.

5. Digital Multimeter

6. Jumper harness for main cab unit to check electrical functions from a work bench or beside the vehicle.

NOTE

A digital multimeter must be used to check certain electric circuits. An analog meter will not function properly.

Heater - Air Conditioner Troubleshooting Individual Parts Suspected of Being Defective

EXPANSION VALVE

The most frequent failure of this part is the loss of gas pressure from inside the mushroom-shaped power head attached to the main block body.

This loss of pressure in the power head causes the valves orifice to be pushed closed by spring pressure resulting in refrigerant not flowing through the unit. No cooling will occur even though air would be flowing through the unit's duct work.

Start the engine and set the cab or sleeper, or both, controls to *FULL COLD*, fresh air, high fan speed, A/C switch *ON*, and sleeper switch on cab control panel *ON* (if sleeper unit is being checked). (See section on T2000 CONTROL PANELS, and Figures, 11-1a, 11-1b, 11-1c, & 11-2 for control panel operation.)

Carefully feel the fittings passing into and out of each expansion block for temperature. The supply line (smaller diameter) going to the expansion valve should feel hot. The evaporator inlet tube should feel cold to the touch. This indicates that refrigerant is entering from the condenser into the expansion valve and expanding to cool the air passing across the evaporator.

If the evaporator inlet tube is not cold, then there is no refrigerant passing through the valve orifice.

Turn off the unit that is working and connect a manifold gauge set, to the high and low pressure connections in the refrigerant line. (See Manifold Gauge Set with Hoses, ATTACHING A MANIFOLD GAUGE SET along with Figure 11-17 in the Servicing the Air Conditioning System section in this manual)

If the expansion valve is defective, high readings will get higher, and low readings will drop toward zero or a vacuum at the compressor.

If the expansion valve is blocked or has actually failed, the pressure reading at the block will be nearly equal to the high pressure discharged from the compressor, and will stay fairly constant.

If there is a problem in the system plumbing, such as a clogged filter-drier, the pressure measured at the expansion valve will be low and drop off to nearly equal the compressor suction readings. This occurs because the expansion valve is powered wide open by its normal functioning. The compressor will pull all available refrigerant out of the piping back to the blockage point.

Check the refrigerant line going to the cab unit and especially the sleeper unit for dents, crimps or other defects that would restrict refrigerant flow to the unit.

If frost appears on the refrigerant supply line or on the drier, there is a restriction or blockage acting as an expansion point. This will reduce refrigerant available to the valve and cause poor cooling.

Troubleshoot, locate, and repair this problem before going on.

Do not remove an expansion valve until you have confirmed that there is a full supply of refrigerant available at the valve.

After an expansion valve has been removed, it can be checked for power head failure by attempting to blow low pressure air, (5-10 psi), through the inlet port. (See Cab Unit, Sleeper Unit, THERMAL EXPANSION VALVE in the Removing and Replacing Components section of this manual.)

A simple air adapter fitting can be made using common parts to fit the inlet port; then air can be blown through. If low pressure air passes through the inlet port, the power head is not dead and the orifice is not plugged. There is a good chance that the expansion valve is not actually defective.

MOTOR AND BLOWER ASSEMBLY

If a blower motor is suspect, check that the proper voltage is reaching the motor leads. This should be done with a volt meter attached to the harness positive lead (orange wire) and the harness ground (black wire), with the ignition *ON* and the blower speed switch *ON HIGH*.

Battery or alternator output voltage should be read. If no voltage is read, check the ground by touching the truck frame or engine block with the volt meter ground (negative) probe. If full voltage is not reaching the motor leads, check and repair this problem first, then retry the motor.

The motor in question can also be tested by attaching a set of jumper wires to the quick connectors on its leads. Supply voltage from a known good source of proper rating (12 V). Make sure the terminals are isolated and will not short out. The motor should then operate at full speed without excessive noise or vibration and in the proper direction (clockwise when looking in to the shaft end).

If the motor is actually seized or will not run when full voltage is supplied to it, it should be removed for further inspection and evaluation. (See Cab Unit, BLOWER ASSEMBLY and Sleeper Unit, MOTOR & BLOWER ASSEMBLY in the Removing and Replacing Components section of this manual.)

While removing the blower assembly, check to make sure the blower wheel is not bound up on the blower housing and that no foreign material is present to jam the wheel. If there is no binding of the wheel and the housing is clean, replace the motor. (See Cab Unit, BLOWER ASSEMBLY and Sleeper Unit, MOTOR & BLOWER ASSEMBLY in the Removing and Replacing Components section of this manual.)

Inspect the blower wheel for cracks or breaks and replace if necessary. Make sure it is installed with the blades facing in the right direction.

COILS - HEATER AND EVAPORATOR

Heater coils in the cab and sleeper are most likely to be leaking because of coolant escaping under the hose clamp seal and then spraying along the hose nipple. Coolant leaks around a coil-type heater element will almost always be from a bad hose clamping assembly. Coils will have to have a hole drilled or punched into them for a leak to occur. The rare exception is a pin-hole solder defect.

To test heater coils in or out of the truck, drain the coolant from the system and detach the hoses from the coil. Make a simple nipple to garden hose or shop air fitting which will allow the coil to be pressurized to 40-50 psi. (See Cab Unit, HEATER COIL and Sleeper Unit, HEATER COIL in the Removing and Replacing Components section of this manual.)

Once this is attached and pressure applied, use water and soap to search for bubbles being created by the air or dripping occurring from the water pressurization.

Searching for leaks in or around the evaporator coils should first be done with a leak detector. If any leaks are found at any of the fittings leading to or from the evaporator, they should be corrected before any test is performed on the evaporator coil.

After all corrections have been made and the system is still not holding pressure, evacuate the refrigerant system. (See Cab Unit, EVAPORATOR and Sleeper Unit, EVAPORATOR in the Removing and Replacing Components section of this manual.)

Evaporator coils can be tested with a fitting made up to allow nitrogen to pressurize only the coil and/or expansion block. **Make sure the fittings used to pressurize this coil are adequate for the pressure you are applying.** A test of 200 psi should be adequate to find most leaks. Use soap and water to detect leaks.

Coils removed from the truck can be pressurized and dipped in a container of water to look for leaks. Leaks will show as a steady stream of bubbles after any air trapped between the fins has escaped.

ELECTRICAL SWITCHES

A voltmeter and/or power source and load should be used to test any electrical switch that is suspected of not working. Multiple cycles of this item along with mechanical bumping should be able to confirm whether or not a switch is working properly.

FREEZE SWITCHES

The majority of parts returned for warranty have the capillary broken off. This is usually the result of rough handling or improper bending. This tube is delicate and must be manipulated with caution to prevent a fatigue failure. If a freeze switch is suspect, remove the wires from the spade terminals and check for continuity through the switch.

NOTE

The ambient temperature must be above the switch cut-in set point of approximately 42ºF. In a very cold climate, the switch can open. It must be warmed up and in the closed position before testing can proceed.

Use a volt meter or test light to see if the switch has closed after being warmed. If gas pressure in the probe has been lost, the switch will stay open. If the switch is closed (shows continuity), it can then be tested for opening by cooling it below its low cut-out set point of approximately 32ºF.

One easy way to do this is to carefully remove the switch and place its probe in the freezer compartment of a refrigerator. It will open in a short while and then

re-close when removed to warm air. This can be checked electrically, or the mechanical movement can be heard or felt while holding the part in your hand.

As an alternative to the freezer method, a small container, (e.g., a styrofoam cup), filled with ice, water, and table salt, will make a solution to lower the temperature of the switch below its set point.

NOTE

Plain ice water, (approximately 32ºF), may not be cold enough to activate the switch. The switch set-point combined with its tolerances, (+/- 1.5ºF), could cause the switch to activate at a temperature slightly below freezing.

RESISTORS

Resistors are checked with a volt/ohm meter for continuity through the thermal fuse and the resistance coils (Refer to Figure 11-9: Resistor).

If there is no continuity, the thermal fuse or the resistance coil has opened, and the item must be replaced. (See Cab Unit, RESISTOR and Sleeper Unit, RESISTOR in the Removing and Replacing Components section of this manual.)

If there is continuity, check the wiring leading to the resistor and see that the proper voltage is present and paths are complete to ground. Use Ohm meter to verify rating in ohms if given on the resistor.

WARNING

Do not modify or attempt to bypass the activated (blown) thermal fuse. Replace the whole part. Modification or bypassing of these protection devices could cause a fire and/or personal injury.

ELECTRIC ACTUATORS

The positioning of the blend air door on both the cab and sleeper units are controlled by an electric actuator. In the cab unit the fresh air door and the mode control doors are also controlled by an identical electric actuator. These actuators get an electric signal from a switch or potentiometer located on the control panel in the vehicle and react accordingly.

The position of the blend air door controls the amount of cold and warm air mix to achieve a desired temperature. If a change in temperature does not happen when the temperature control knob is rotated, the blend air actuator may not be functioning.

For the cab unit, the actuator is located on the upper case behind the firewall. A preliminary check should be made with a voltmeter of the voltage going to the actuator. This is checked at the harness connection from the temperature control knob behind the control panel. (Refer to Figure 11-13: Cab Unit Electrical Diagram for the correct voltages.)

If the electrical check is okay, the heater/air conditioning unit has to be removed from the firewall to reach the actuator. (See Cab Unit, BLEND AIR DOOR ACTUATOR in the Removing and Replacing Components section of this manual.)

NOTE

Be sure the sleeper switch on the cab control panel is in the "Sleeper ON" position before attempting to check the actuator in the sleeper.

For the sleeper unit, the actuator is located on the upper case of the heater/air conditioning unit and can be reached by lifting the mattress and cover. Look down on the actuator while changing the temperature setting from full cold to full hot and see if the actuator stem rotates. Note that movement of the door is based on sleeper inside temperature. Blowing warm

or cool air on the temperature sensor behind the grille will cause the blend-air door to move.

If it does not, check the power to it by checking the potentiometer on the back of the control panel and all connections between it and the actuator. (Refer to Figure 11-13: Cab unit Electrical Diagram for potentiometer electric ratings.)

If it is determined that the actuator is defective, remove and replace it. (See Sleeper Unit, BLEND AIR DOOR ELECTRIC ACTUATOR in the Removing and Replacing Components section of this manual.)

The actuator on the fresh air door is controlled by the fresh air switch on the cab control panel. With a voltmeter, check that the proper power is being supplied to the actuator. With proper power from the switch, rock the switch and watch the door open and close.

NOTE

The fresh-air door is interlocked with the defrost mode position. Regardless of fresh-air rocker switch position, the door defaults to open when in defrost!

If the door does not move, remove the actuator (See Cab Unit, FRESH AIR DOOR ACTUATOR in the Removing and Replacing Components section of this manual.)

The mode door actuators are controlled by the air flow mode control knob on the control panel. Before attempting to remove the actuators, check the electric outputs at the connectors in the harness behind the control panel. (Refer to Figure 11-13: Cab Unit Electrical Diagram for electric ratings.)

If the correct power is getting to the actuators, remove the heater/air conditioning unit from the firewall. (See Cab Unit, MODE DOOR ACTUATOR in the Removing and Replacing Components section of this manual.)

Remove the defective actuator(s) and replace with new. When removing an actuator always check the door it is controlling for foreign matter in the ducting and damage to the gasketing around the outer edges. If the gasketing is damaged, or dried out, replace the door before installing the new actuator. Remove any foreign matter.

TEMPERATURE SELECTOR

The rotary temperature selector (control potentiometer), located on the sleeper accessory panel, can be checked with an ohm meter. Its overall resistance should be 7,000 to 13,000 ohms. The wiper contact movement can be checked by observing that the resistance steadily changes from less than 100 ohms (full cold) to 10,000 ohms (full hot). This change should occur evenly over the full range of rotary movement.

Heater - Air Conditioner
Cab Heater - A/C Circuit Description

(See Figure 11-13)

45 - Blue/Black

Power for blower motor (30 amp fuse).

239-57 - Black

Ground for blower motor.

153 - Red/Blue

High speed (switches to ground).

240 - Lt. Green/White

Medium speed (switches to ground)s.

212 - Red/Green

Med. Low speed (switches to ground).

152 - Red/Yellow

Low speed (switches to ground).

342 - Yellow/White

Power for electronics, Compressor Clutch..

239-58 - Black

Ground for electronics.

634 - White/Black

Contro signal for defrost actuator.

Mode	Voltage
Vent	12V
Vent/Floor	12V
Heat	2V
Heat/Defrost	<1V
Defrost	<1V

629 - Blue/Black

Control signal for vent/heat actuator.

Mode	Voltage
Vent	<1V
Vent/Floor	6V
Heat	12V
Heat/Defrost	6V
Defrost	<1V

A634 - White/Black

Control voltage for blend air door (12V for cold, <1V for hot).

A629 - Blue/Black

Control voltage for fresh air door (<1V for fresh air, 12V for recirculation).

253 - Lt. Blue

Power from panel light dimmer.

570-5 - Yellow/White

A/C fresh air override circuit (<1V when in defrost).

180 - White

Circuit between freeze switch, low pressure switches.

93 - White

Circuit between high pressure switch, compressor clutch relay.

239-62 - Black

Ground for bunk HVAC select relay.

A248 - Red

Bunk HVAC select (switches to ground).

ACSW 1 - White

Switched ground for A/C from blower switch..

PSWCOM - White

Circuit between high and low pressure switches.

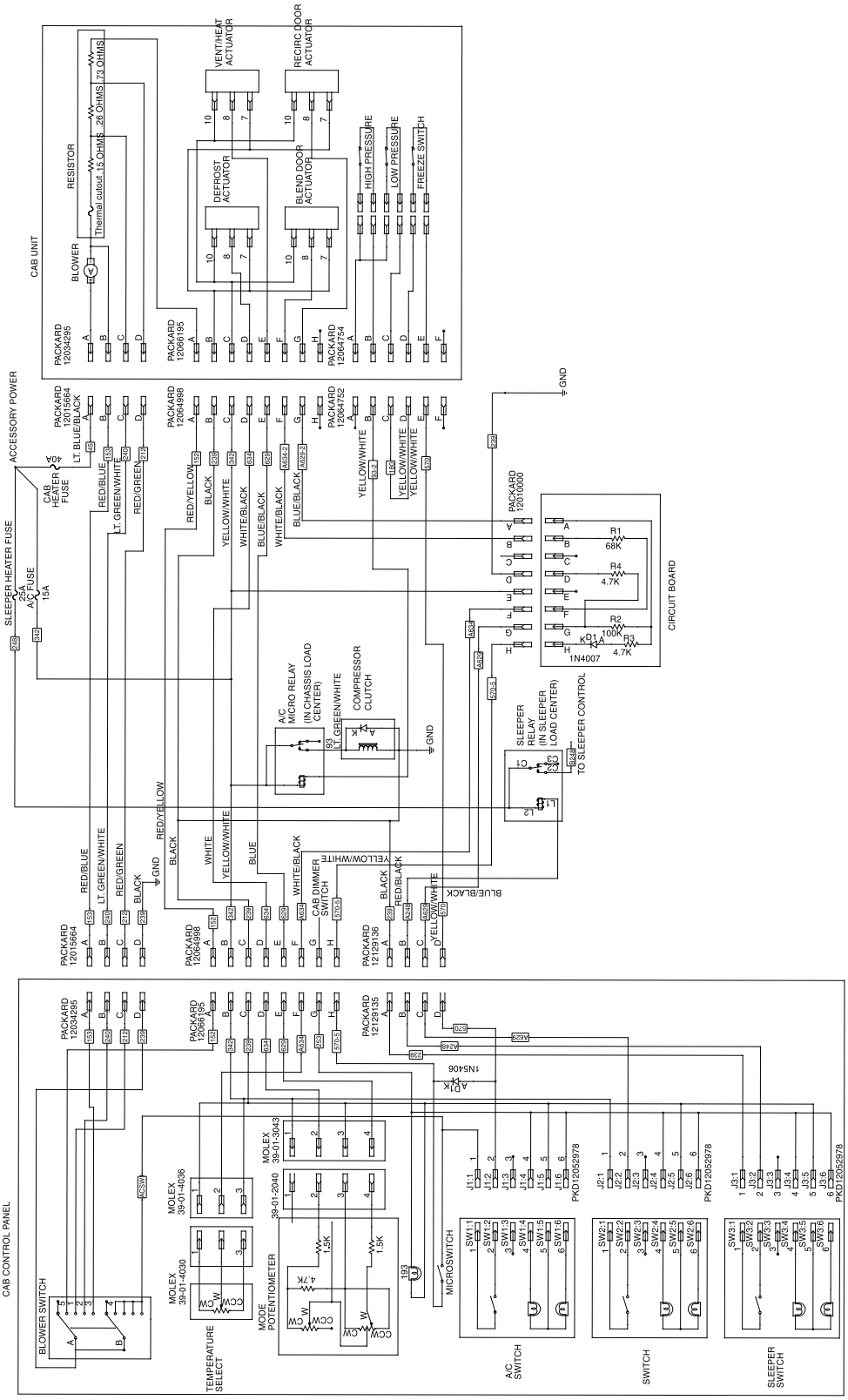

Figure 11-13: Cab Unit Wiring Diagram

Heater - Air Conditioner Sleeper Temperature Control Troubleshooting Guide

THEORY OF OPERATION

The temperature control system consists of three major components: (See Figure 11-14, Wiring Diagram.)

1. Control Module with built-in temperature sensor and potentiometer.

2. Blower switch.

3. Blend air door actuator.

These components are tied together by three wires:

1. SACT1 - 12V supply for the system.

2. GND - ground for the system.

3. SACT2 - control output voltage

You can change the potentiometer position in order to change the setpoint temperature, (between 50ºF and 130ºF). If the temperature is above the setpoint, the control module puts out approximately 1 volt. This moves the blend air door to close off the hot air passage. If the temperature goes below the setpoint, the control module starts to increase its output voltage, opening the door.

COMPONENT TROUBLESHOOTING

Blend Air Door

The blend air door actuator has three circuits:

1. SACT1 - 12V supply for actuator - pin 10 on actuator and pin A on unit connector.

2. GND - Ground connection - pin 7 on actuator and pin C on unit connector.

3. SACT2 - Control voltage - pin 8 on actuator and pin B on unit connector.

If SACT2 is not connected, the actuator will go to the center of its travel and stay there. If SACT2 is connected to the 12 volt supply, the blend air door will open the hot air passage all the way. If SACT2 is connected to ground, the blend air door will close the hot air passage all the way.

Control Module

The control module has three circuits:

1. SACT1 - 12V supply for module - pin 1 on module.

2. GND - Ground connection - pin 3 on module.

3. SACT2 - Control voltage - pin 2 on module.

4. P30CHA - Sleeper A/C request- Pin 4.

If the sleeper is at room temperature, (65ºF to 80ºF), turning the temperature control knob to full cold (counter-clockwise) will make the control voltage go to 0 volts. Turning the knob full hot (clockwise) will make the control voltage go to within 1 volt of the supply voltage.

In order to check the function of the temperature sensor, have the ignition on, but don't run the engine. Turn the blower on *LOW* to provide power. Attach the voltmeter to measure the voltage of wire SACT2. Adjust the control knob so the voltage is about 6 to 7 volts. Blow gently on the sensor grill in order to warm the sensor. Watch that the control voltage goes down, then returns to roughly the original voltage as the sensor cools back down.

TROUBLESHOOTING TREE

Complaint: Sleeper won't Heat

1. After checking the engine block valve and blower operation, check for power to SACT1 from blower switch.

   1.1 If no power, check connections and blower switch and repair or replace as necessary, retest system.

   1.2 If power is OK, go to step 2.

2. Check ground connection from sleeper harness.

   2.1 If no ground, repair connection, retest system.
   2.2 If ground is OK, go to step 3.

3. Make sure sleeper temperature is below 80ºF. Turn control knob full hot (clockwise). Check that SACT2 voltage is above 11 volts.

   3.1 If not, unplug the control module and check the actuator (see component check above).

      3.1.1 If actuator checks OK, replace control module, retest system.

      3.1.2 If actuator does not work, remove from blend air door and retest. Replace defective component and retest system.

   3.2 If voltage is OK, check wiring continuity to actuator.

      3.2.1 If no continuity or high resistance connection, repair wiring and retest the system.

3.2.2 If wiring is OK, check actuator and replace if defective. Retest system.

Complaint: Won't Cool

1. After checking the air conditioner compressor and blower operation (i.e., making sure the cab blower is *ON* and the cab A/C switch is *ON*), check for power to SACT1 from the blower switch.

   1.1. If no power, check connections and blower switch and repair or replace as necessary, retest system.

   1.2 If power is OK, go to step 5.

2. Check ground connection from sleeper harness.

   2.1 If no ground, repair connection, retest system.

   2.2 If ground is OK, go to step 7.

3. Make sure sleeper temperature is above 65ºF. Turn the control knob full cold (counter-clockwise). Check that SACT2 voltage is below 1.5 volts.

   3.1 If not, unplug the control module and check the actuator (see component check above).

      3.1.1 If actuator checks OK, replace control module, retest system.

      3.1.2 If actuator does not work, remove it from the blend air door and retest. Replace the defective component and retest system.

   4.2 If voltage is OK, check wiring continuity to actuator.

      4.2.1 If no continuity or high resistance connection, repair wiring and retest the system.

      4.2.2 If wiring is OK, check actuator and replace if defective. Retest system.

Complaint: Poor Control

1. Check to make sure nothing is obstructing air flow to the sensor, (i.e., hanging clothes, etc.).

   1.1 If air flow is OK, check temperature sensor function (see component check above).

      1.1.1 If sensor is bad, replace module and retest system.

      1.1.2 If sensor is OK, check blend air door actuator and replace if bad. Retest system.

Complaint: Erratic Operation

1. Check wiring for intermittent, loose, or corroded connections.

   1.1 If any are found, correct and retest system.

   1.2 If not, disconnect and check blend air door actuator.

      1.2.1 If actuator or blend air door is bad, replace and retest system.

      1.2.2 If actuator is OK, check control module and replace if bad.

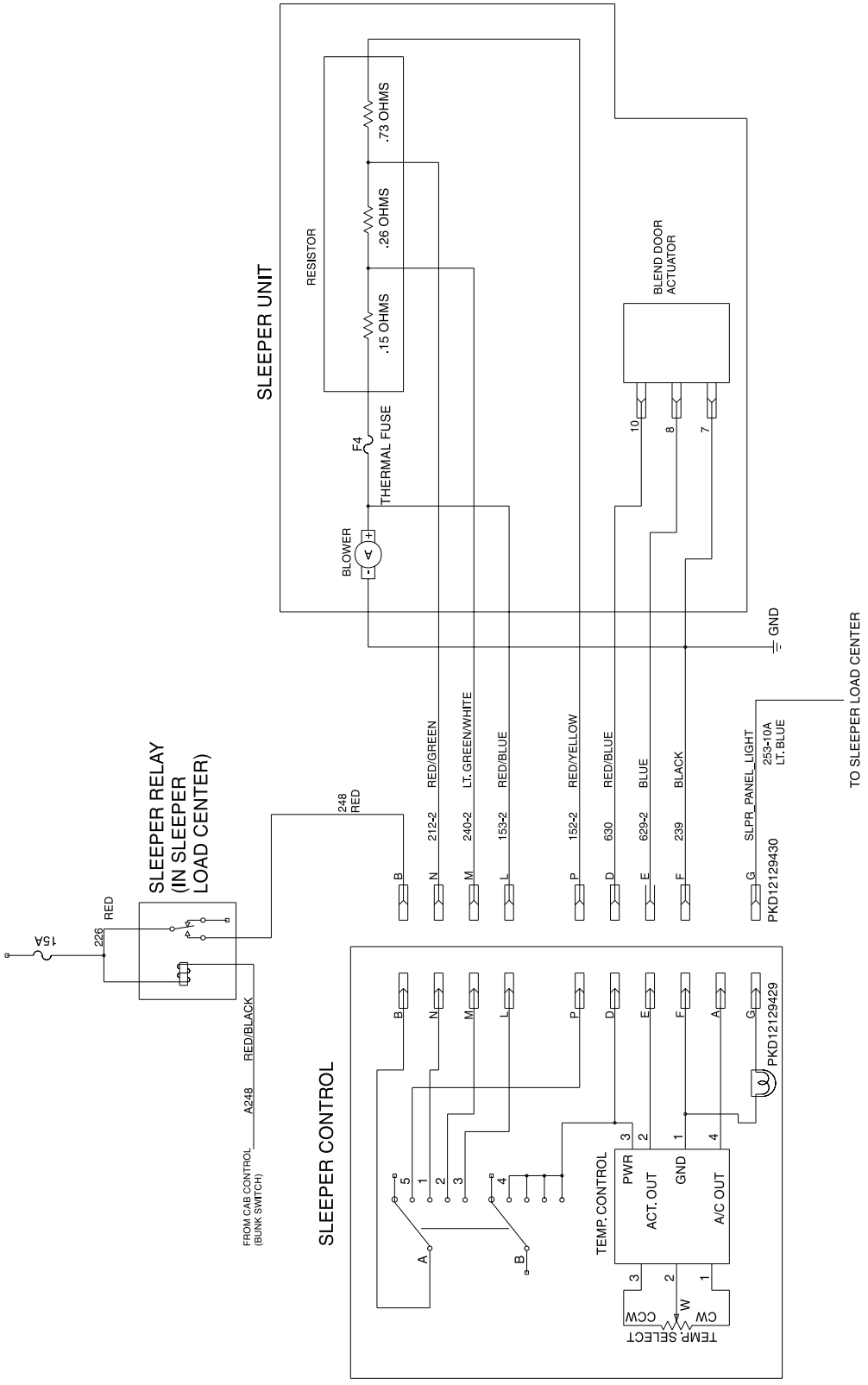

Figure 11-14: Sleeper Unit Wiring Diagram

Heater - Air Conditioner
Cab Unit Troubleshooting Tables

Contents - Problem Description

Refer to Section:

SECTION 1 - CAB UNIT TROUBLESHOOTING TABLE
No or Low Air Flow

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Little or no air flow	1. No electrical supply.	1. Use wiring schematic to check voltage supply. Check vehicle fuses and replace if necessary.
	2. Defective motor - runs slow.	2. Test motor separately and replace if necessary.
	3. Blower wheel bound up - rubbing.	3. Correct the problem and reinstall the blower.
	4. Foreign material blocking: A. Air into unit. B. Air out of unit.	4. Remove foreign material.
	5. Dirty air filter.	5. Remove and clean or replace.
	6. Duct work allowing loss of air.	6. Find leak and repair or replace damaged parts.
	7. Blower speed selector switch failure.	7. Use wiring schematic, check continuity between speed select. Repair or replace as required.
	8. Motor and/or wheel turning backward.	8. Check motor wiring. Reassemble correctly. Motor runs clockwise when viewed from the shaft end.

SECTION 2 - CAB UNIT TROUBLESHOOTING TABLE
Inadequate Cooling - Air Flow Normal

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Inadequate cooling Air flow normal Blower speed - On	1. Blend air door not functioning properly. A. Will not change position. B. No power to actuator. C. Actuator not connected at plug. D. Door gasket damaged.	1. Correct the problem. A. Replace the actuator. B. Trace circuit and repair. C. Reconnect the plug. D. Isolate engine coolant to unit and test for cooling. Replace door if cooling is restored.
	2. Expansion valve failed.	2. Replace.
	3. System refrigerant contaminated. A. Foreign material - dirt B. Moisture - (sporadic loss of cooling).	3. Correct the source of contamination. A. Recover, recycle, and flush the parts. B. Recover, replace, deep vacuum, and replace the drier.
	4. Refrigerant charge level incorrect. (4.0 lbs R134a) A. Too low - undercharged. B. Too high - overcharged.	4. Correct charge level. A. Identify and correct leak source. Recover and recharge to factory specified charge by weight. (4.0 lbs R134a) B. Recover and recharge to factory specified charge by weight.(4.0 lbs R134a)
	5. Filter drier/expansion valve/condenser plugged.	5. Use manifold gage set to capture system pressures. High discharge pressure and extremely low suction pressure indicates plugged component. Recover and replace.
	6. Refrigerant line(s) damaged.	6. Use leak detection equipment to locate leak or dent and repair.
	7. Evaporator coil damaged.	7. Correct source of damage, replace coil.
	8. Temperature selector knob inoperative. A. No power to switch. B. Switch not connected. C. No power out of switch.	8. Correct the problem. A. Trace circuit and repair. B. Reconnect the plug. C. Replace switch.
	9. Compressor operation.	9. See compressor manufacturer's Troubleshooting Chart.

SECTION 2 - CAB UNIT TROUBLESHOOTING TABLE
Inadequate Cooling - Air Flow Normal

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Inadequate cooling Air flow normal Blower speed - On (continued)	10. Condenser malfunction.	10. Use manifold gage set to capture system pressures and compare to expected performance parameters for the appropriate shop temperature. Look for plugged or excessive damage to fin surface. Repair or replace.
	11. Engine fan operation.	11. Pressure switch will activate engine fan on rising system pressure above 300 psig and reset at 230 psig. Test switch and replace if necessary.

AMBIENT SWEEP DATA - R134a

Cab Unit

Outside Air Temp.(Deg F)	Center Duct Outlet Temp.	Discharge Pres.(psig)	Suction Pres.(psig)
70	48-53	110-135	14-30
80	50-55	130-145	22-28
90	55-60	150-165	25-31
100	58-63	170-185	28-34
110	62-67	215-230	33-39

Bunk Unit

Outside Air Temp.(Deg F)	Lower Duct Outlet Temp.	Discharge Pres.(psig)	Suction Pres.(psig)
70	43-48	110-135	14-30
80	45-50	130-145	22-28
90	50-55	150-165	25-31
100	53-58	170-185	28-34
110	56-61	215-230	33-39

Engine Fan on Manual
Engine RPM @ 1500
Doors and Windows Open

SECTION 3 - CAB UNIT TROUBLESHOOTING TABLE
Inadequate Heating - Air Flow Normal

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Inadequate heating Air flow normal Blower speed - On	1. Blend air door not functioning properly. A. Actuator not connected at plug. B. No electrical power to actuator. C. Will not change position. D. Door gasket damaged.	1. Repair as necessary. A. Reconnect plug. B. Trace circuit and repair. C. Test and replace actuator. D. Replace door.
	2. Low coolant level.	2. Check and fill to proper level.
	3. Excessive air leaks into cab.	3. Locate leaks and seal.
	4. Heater hose pinched or kinked, restricting flow.	4. Find and correct.
	5. Incorrect plumbing.	5. Each heater coil must have one "Supply" and one "Return" from the engine coolant system. Correct any differences.
	6. Heater coil damaged or defective.	6. Replace.
	7. Auxiliary equipment reducing water flow such as air compressor cooling circuits.	7. Re-plumb from another source.
	8. Temperature selector knob inoperative.	8. (See Section 2)
	9. Engine coolant isolation valves.	9. Feel coolant hose temperature at inlet and outlet of heater box. Hoses should be hot to touch if engine is at temperature. If not, replace valve or identify hose blockage.

SECTION 4 - CAB UNIT TROUBLESHOOTING TABLE
High Blower Speed Only - No Variable Speeds

SYMPTOM	POSSIBLE CAUSE	SOLUTION
High blower speed only	1. Speed resistor failure. A. Resistance wire broken. B. Thermal fuse blown.	1. Trace and replace. A. Check and replace. B. Check and replace.
	2. Wiring harness not plugged in.	2. Use wiring schematic to test for voltage at blower speed connection in question. If no supply voltage, check connector interface.
	3. Wiring harness defective.	3. Using wiring schematic, trace wiring until voltage supply exists. Repair or replace defective wiring up to identified voltage source.
	4. Defective blower speed switch.	4. Using wiring schematic, check continuity between speed select. Repair and replace as required.

SECTION 5 - CAB UNIT TROUBLESHOOTING TABLE
Coolant Leak

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Coolant leak	1. Hose clamp not properly sealing.	1. Check for debris under heater hose connection. Repair or replace worn or defective hose or clamps.
	2. Heater coil damaged/defective.	2. Replace. Check for debris under heater hose connection. Repair or replace defective component.

SECTION 6 - CAB UNIT TROUBLESHOOTING TABLE
Refrigerant Leak

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Refrigerant Leak	1. Fittings not properly torqued.	1. Identify leak using a suitable leak detection method. Tighten and torque fittings per the specified setting. Evacuate and charge.
	2. O-rings missing, damaged, or cut.	2. Identify leak using a suitable leak detection method. Lubricate and replace o-rings. Tighten and torque fittings per the specified setting. Evacuate and charge.
	3. Fitting(s) cross threaded. A. Piping to unit. B. Internal to unit.	3. Identify leak using a suitable leak detection method. Replace damaged components, and install new, lubricated o-rings at leak point. Torque fittings as specified. Evacuate and charge system.
	4. Air conditioning coil damaged/defective.	4. Pressurize coil with nitrogen to confirm leak. Replace coil, install new, lubricated o-rings, torque fittings as specified. Evacuate and charge system.

Torque Values	
Fastener Size (mm)	**Torque (N.m.)**
M6	4 - 6 ft. lbs (5 -8)
M8	22 - 28 ft. lbs (30 - 38)
#12 Fitting (19.5 mm)	22 - 27 ft. lbs (30 - 37)
#14 fitting	28 - 33 ft. lbs (38 - 44)
Hi-Press Switch Port	5 ft. lbs ± .5 (7 ± .7)
Lo-Press Switch Port	3 ft. lbs ± .5 (4 ± .7)

SECTION 7 - CAB UNIT TROUBLESHOOTING TABLE
Excessive Vibration and/or Unusual Sounds

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Excessive vibration and unusual sounds	1. Blower wheel defect. A. Out-of-round or balance. B. Excessive run-out or wobble. C. Rubbing case. D. Cracked.	1. Check condition and replace if necessary. A. Replace. B. Replace. C. Correct problem and reassemble. D. Replace.
	2. Motor problem. A. Bushing wear. B. Construction defect. C. Shaft bent.	2. Replace defective motor A. Replace B. Replace C. Replace

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Heater - Air Conditioner
Sleeper Unit Troubleshooting Tables

Contents - Problem Description

Refer to Section:

SECTION 1 - SLEEPER UNIT TROUBLESHOOTING TABLE
No or Low Air Flow

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Little or no air flow	1. No electrical supply.	1. Use wiring schematic to check voltage supply. Check vehicle fuses and replace if necessary.
	2. Defective motor - runs slow.	2. Test motor separately and replace if necessary.
	3. Blower wheel bound up - rubbing.	3. Correct the problem and reinstall the blower.
	4. Foreign material blocking: A. Air into unit. B. Air out of unit.	4. Remove foreign material.
	5. Duct work allowing loss of air.	5 Find leak and repair or replace damaged parts.
	6. Blower speed selector switch failure.	6 Use wiring schematic, check continuity between speed select. Repair or replace as required.
	7. Motor and/or wheel turning backward.	7. Check motor wiring. Reassemble correctly. Motor runs clockwise when viewed from the shaft end.

SECTION 2 - SLEEPER UNIT TROUBLESHOOTING TABLE
Inadequate Cooling - Air Flow Normal

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Inadequate cooling Air flow normal Blower speed - On	1. Blend air door not functioning properly. A. Will not change position. B. No power to actuator. C. Actuator not connected at plug. D. Door gasket damaged.	1. Correct the problem. A. Replace the actuator. B. Trace circuit and repair. C. Reconnect the plug. D. Isolate engine coolant to unit and test for cooling. Replace door if cooling is restored.
	2. Expansion valve failed.	2. Replace.
	3. System refrigerant contaminated. A. Foreign material - dirt B. Moisture - (sporadic loss of cooling).	3. Correct the source of contamination. A. Recover, recycle, and flush the parts. B. Recover, replace, deep vacuum, and replace the drier.
	4. Refrigerant charge level incorrect. (4.0 lbs R134a) A. Too low - undercharged. B. Too high - overcharged.	4. Correct charge level. A. Identify and correct leak source. Recover and recharge to factory specified charge by weight. (4.0 lbs R134a) B. Recover and recharge to factory specified charge by weight.(4.0 lbs R134a)
	5. Filter drier/expansion valve/condenser plugged.	5. Use manifold gage set to capture system pressures. High discharge pressure and extremely low suction pressure indicates plugged component. Recover and replace.
	6. Refrigerant line(s) damaged.	6. Use leak detection equipment to locate leak or dent and repair.
	7. Evaporator coil damaged.	7. Correct source of damage, replace coil.
	8. Temperature selector knob inoperative. A. No power to switch. B. Switch not connected. C. No power out of switch.	8. Correct the problem. A. Trace circuit and repair. B. Reconnect the plug. C. Replace switch.
	9. Compressor operation.	9. See compressor manufacturer's Troubleshooting Chart.

SECTION 2 - SLEEPER UNIT TROUBLESHOOTING TABLE
Inadequate Cooling - Air Flow Normal

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Inadequate cooling Air flow normal Blower speed - On (continued)	10. Condenser malfunction.	10. Use manifold gage set to capture system pressures and compare to expected performance parameters for the appropriate shop temperature. Look for plugged or excessive damage to fin surface. Repair or replace.
	11. Engine fan operation.	11. Pressure switch will activate engine fan on rising system pressure above 300 psig and reset at 230 psig. Test switch and replace if necessary.
	12. Cab unit not *ON* with A/C *ON*	13. Make sure cab blower is *ON,* with A/C switch *ON.*

AMBIENT SWEEP DATA - R134a

Cab Unit

Outside Air Temp.(Deg F)	Center Duct Outlet Temp.	Discharge Pres.(psig)	Suction Pres.(psig)
70	48-53	110-135	14-30
80	50-55	130-145	22-28
90	55-60	150-165	25-31
100	58-63	170-185	28-34
110	62-67	215-230	33-39

Bunk Unit

Outside Air Temp.(Deg F)	Lower Duct Outlet Temp.	Discharge Pres.(psig)	Suction Pres.(psig)
70	43-48	110-135	14-30
80	45-50	130-145	22-28
90	50-55	150-165	25-31
100	53-58	170-185	28-34
110	56-61	215-230	33-39

Engine Fan on Manual
Engine RPM @ 1500
Doors and Windows Open

SECTION 3 - SLEEPER UNIT TROUBLESHOOTING TABLE
Inadequate Heating - Air Flow Normal

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Inadequate heating Air flow normal Blower speed - On	1. Blend air door not functioning properly. A. Actuator not connected at plug. B. No electrical power to actuator motor. C. Will not actuate (change position). D. Door gasket damaged.	1. Repair as necessary. A. Reconnect plug. B. Trace and repair using wire connection diagram. C. Test and replace actuator. D. Replace door.
	2. Electronic control circuit problem driving door toward cold position.	2. Locate and repair.
	3. Heater hose pinched or kinked restricting flow.	3. Find and correct any restrictions.
	4. Heater coil damaged or defective.	4. Test coil and replace.
	5. Auxiliary equipment reducing water flow to heater.	5. Re-plumb from another source.

SECTION 4 - SLEEPER UNIT TROUBLESHOOTING TABLE
Temperature Will Not Adjust

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Temperature will not adjust - Automatic system	1. Sleeper blower switch not on.	1. Select a speed setting.
	2. Sleeper blower switch failed open.	2. Check and replace switch.
	3. Extreme local temperature being sensed at temperature sensor.	3. Correct exposure.
	4. Cab control not set to "Bunk" position. Cab on low speed, A/C switch ON.	4. Select "Bunk" on cab control. Select a fan speed.
	5. Control circuit problem: A. Temperature sensor failed. B. Temperature sensor disconnected. C. Temperature adjustment potentiometer failed (three separate wires involved).	5. Test circuit and repair. A. Test and replace. B. Reconnect. C. Repair, replace.
	6. Wiring harness defective/damaged.	6. Trace, repair, or replace.
	7. Electrical harness not properly plugged-in	7. Reconnect all connectors.
	8. Control circuit failure. When all else fails and blend air door can be moved using jumper wire power, replace control board in sleeper panel.	8. Replace control board in sleeper panel.

Note: Use proper electrical schematic when troubleshooting the sleeper unit electrical wiring.

SECTION 5 - SLEEPER UNIT TROUBLESHOOTING TABLE High Blower Speed Only - No Variable Speeds		
SYMPTOM	**POSSIBLE CAUSE**	**SOLUTION**
High blower speed only	1. Speed resistor failure. A. Resistance wire broken. B. Thermal fuse blown.	1. Trace and replace. A. Check and replace. B. Check and replace.
	2. Wiring harness defective.	2. Trace, repair, or replace.

SECTION 6 - SLEEPER UNIT TROUBLESHOOTING TABLE Coolant Leak		
SYMPTOM	**POSSIBLE CAUSE**	**SOLUTION**
Coolant leak	1. Hose clamp not properly sealing.	1. Reset hose clamp
	2. Heater coil damaged/defective.	2. Replace

SECTION 7 - SLEEPER UNIT TROUBLESHOOTING TABLE
Refrigerant Leak

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Refrigerant Leak	1. Fittings not properly torqued.	1. Identify leak using a suitable leak detection method. Tighten and torque fittings per the specified setting. Evacuate and charge.
	2. O-rings missing, damaged, or cut.	2. Identify leak using a suitable leak detection method. Lubricate and replace o-rings. Tighten and torque fittings per the specified setting. Evacuate and charge.
	3. Fitting(s) cross threaded. A. Piping to unit. B. Internal to unit.	3. Identify leak using a suitable leak detection method. Replace damaged components, and install new, lubricated o-rings at leak point. Torque fittings as specified. Evacuate and charge system.
	4. Air conditioning coil damaged/defective.	4. Pressurize coil with nitrogen to confirm leak. Replace coil, install new, lubricated o-rings, torque fittings as specified. Evacuate and charge system.

SECTION 8 - SLEEPER UNIT TROUBLESHOOTING TABLE
Excessive Vibration and/or Unusual Sounds

SYMPTOM	POSSIBLE CAUSE	SOLUTION
Excessive vibration and unusual sounds	1. Blower wheel defect. A. Out-of-round or balance. B. Excessive run-out or wobble. C. Rubbing case.	1. Check condition and replace if necessary A. Replace. B. Replace. C. Correct problem and reassemble.
	2. Motor problem. A. Out of balance B. Bushing wear. C. Construction defect. D. Shaft bent.	2. Replace defective motor A. Replace B. Replace C. Replace D. Replace

Heater - Air Conditioner System Servicing

SERVICING THE HEATING SYSTEM

It may be necessary to disconnect the heating system to perform various work. Refer to the procedures below to simplify these tasks and to ensure that the system functions efficiently.

Purging the System

Engine coolant should be removed (purged) from the heating system when replacing the heater coil. This will limit the loss of coolant during these operations. Follow the procedure below to purge a heating system.

WARNING

Ensure that the engine coolant temperature is low enough not to cause skin burns before beginning this procedure.

CAUTION

Mark the heater hoses before removal to ensure they are installed on the proper fittings for proper flow regulation.

Cap open hose ends to keep dirt or debris from entering the system. These items can block hoses, water valves, and heater cores or contaminate the engine coolant.

1. Disconnect both heater hoses. Use a container to catch and retain coolant from the heating system for later return to the system if desired.

2. Once the system is completely drained any repair can be made. At this point, component parts may be cleaned using any of the radiator flushing solutions available commercially.

Refilling the System

After the system has been purged and repairs completed, the heating system is ready to be connected and refilled for operation. Perform the following procedure to refill the heating system.

1. Connect the heater hose from the inlet of the heater coil to the fitting on the engine block. This provides the pressure and flow to the heating system. Make sure that all other connections - except the outlet heater hose - have been made and secured with appropriate hose clamps.

2. When the coolant begins flowing out the outlet heater hose, connect it to the return fitting on the engine block. This will ensure that no air pockets exist to restrict water flow and decrease heater performance.

Detecting Leaks

Leaks will often occur at connections that have worked loose by vehicle vibration. Such leaks can be located visually by allowing coolant to circulate through the heating system and then examining all joints, fittings and connections.

These leaks may require only tightening of a hose clamp or creating a new hose end and reassembling a connection.

The heater coil should be checked to be sure that a seam or joint has not failed due to vibration or pressure surges. Occasionally, a heater hose will deteriorate at bends or where it rubs against a part of the vehicle; such hoses require replacement.

Flushing the System

Flush the cooling system and replace coolant at the proper interval.

SERVICING THE AIR CONDITIONING SYSTEM

Evacuating the System

Evacuating the system (pulling a vacuum) is an important process when servicing or replacing components in an air conditioning system.

Perform the following procedure to evacuate the system.

1. Tighten all connections and check all fittings. (See Table 11-1: Torque Values)

2. Attach a hose from the vacuum pump to the center service port on the manifold gauge set.

3. Start the vacuum pump.

4. Open the low-and high-side hand valves on the manifold gauge set. (Recommended evacuation vacuum time is 45 minutes.)

5. When the system has pulled down to 30 in. Hg. vacuum, close the low-and high-side hand valves on the manifold gauge set and stop the vacuum pump.

6. Observe the low-side gauge reading for 5 minutes without opening the valves:

   a. If the vacuum holds steady, open the valves and restart the pump and evacuate the system for a minimum of 45 minutes. This will allow excess moisture to evaporate. The low-side gauge will read approximately 29.9 in. Hg. (Without a thermistor vacuum gauge attached). Close both hand valves and stop the pump.

   b. If the vacuum does not hold steady (the gauge needle moves towards zero), the system has a leak or there is moisture in the system. Repeat steps 1 and 3 through 5 above until the vacuum holds steady.

NOTE

Always observe the amount of oil removed from the air conditioning system when evacuating with the vacuum pump. It is critical to proper compressor lubrication to replenish the amount of oil removed when charging the system with R134a. See compressor label or manual for specific type of lubricating oil.

Pad Fittings

The Evaporator, Expansion Valve and the inlet and outlet refrigerant hoses are connected without the use of threaded fittings. (See Figure 11-15 and 11-16.) The "E" Plate is slipped over the evaporator tubes and the expansion valve is secured to it by means of two (2) socket head cap screws. Be sure that when you assemble these parts that the O-rings are in the proper location as shown in the figure. To insure proper sealing of the O-rings, the cap screws must be properly torqued. (See Table 11-2)

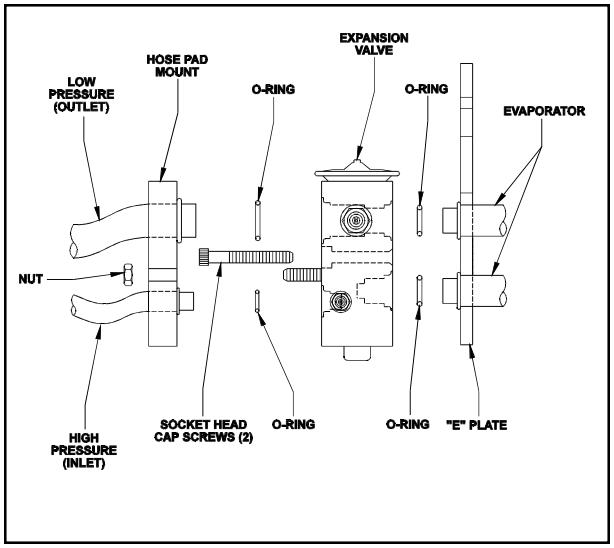

Figure 11-15: Cab Unit Pad Fittings

The hose pad mount is secured to the expansion valve with a nut torqued to the stud on the valve. When assembling, again be sure the O-rings are present and in their proper location. To insure proper sealing of the O-rings, the nut must be properly torqued. (See Table 11-2)

Part	Torque: Inch/lbs (N.m.)
Cap Screw	85 (10)
Nut	84 - 132 (10-16)

Table 11-2: Torque Values

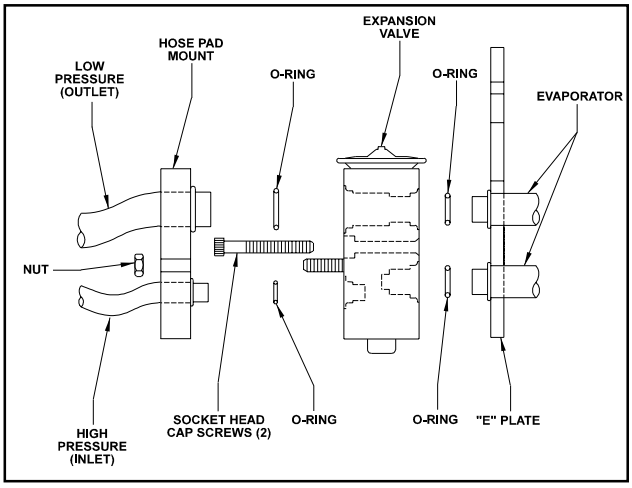

Figure 11-16: Sleeper Unit Pad Fittings

Charging Station

The function of the charging station is to meter the proper refrigerant charge into the system. It is recommended that a charging station containing the refrigerant container, manifold gauge set, charging meter, refrigerant hoses, and vacuum pump all be on the same base. You can perform all the functions needed to service and charge the system with this one stand.

Vacuum Pumps

The function of the vacuum pump is to remove any moisture or air from the system. When evacuating the R134a system, it is recommended to pull a vacuum of 29.9 in. Hg. for a minimum of 45 minutes. This will ensure that all the moisture and air is out of the system.

Recovery/Recycling Station

CAUTION

Never change hoses between R12 and R134a recovery/recycling systems.

NOTE

Recovery of R134a refrigerant is mandatory.

The recovery/recycling stand recovers the refrigerant from the system and recycles it through a filter, proper refrigerant purity levels must be obtained prior to revising the reclaimed refrigerant. See Manufacturers Recommendations and Instructions.

The recovery/recycle station contains a filter that traps moisture and debris as well as acting as a cleaning agent for the refrigerant. A refrigerant hose should be hooked up between the recovery part on the stand and the center port on the manifold gauge set.

Another refrigerant hose should be connected between the recycle port on the stand and the R134a container. Follow the operating instructions on the recovery/recycle station for proper procedures. Peterbilt recommends that you use an approved recovery/recycling stand for R134a systems.

Recovering Refrigerant from the System

Perform the following procedure to recover refrigerant from the system.

1. Turn off the system and the vehicle ignition.
2. Attach a manifold gauge set.
3. Follow the instructions on the recovery and reclamation equipment and recover the refrigerant from the system.
4. Determine the amount of refrigerant oil removed during recovery. Replenish the system with this amount of new oil. Refer to the vendor service literature at the end of this section for oil amounts.

Manifold Gauge Set with Hoses

NOTE

On most manifold gauge sets, blue represents low side and red represents high side.

The manifold gauge set is used for reading the high and low side pressure. (See Figure 11-17: Manifold Gage Set).

Manifold Gauge Set

The manifold gauge set allows the technician to read the low-side and high-side pressures. A service hose port on the center of the manifold gauge set is used to bleed, evacuate and replace R134a.

When the gauge set is connected to the system, pressures are recorded on both gauges simultaneously. This is done to assist in the servicing of the system. The refrigerant will flow to the respective gauges and pressures will be registered.

The valves are both closed so that the refrigerant does not enter or escape the system. With the valves closed, the refrigerant is not allowed to flow to the central system service hose port.

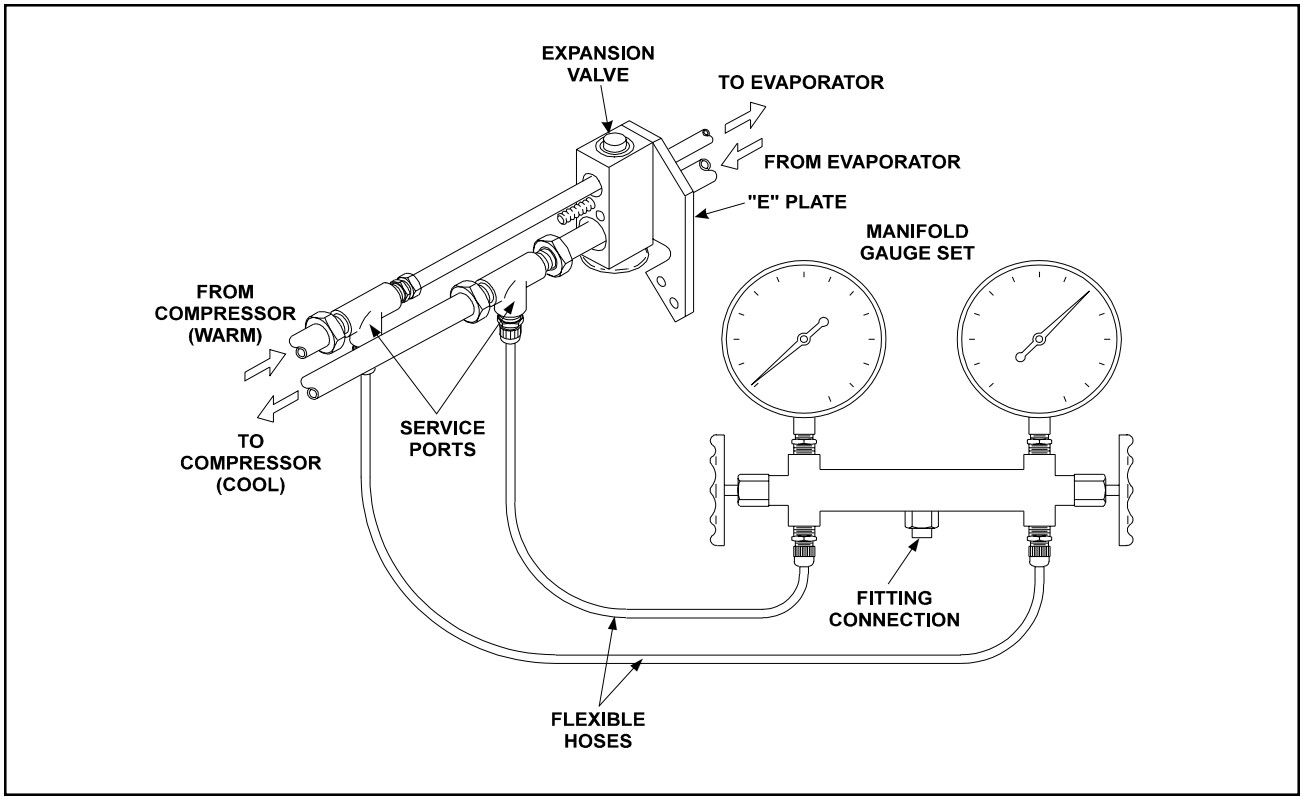

Figure 11-17: Manifold Gauge Set

Low-side Gauge

The low-side gauge reads pressures and vacuum. The gauge measures the pressure between the outlet of the expansion valve and the inlet to the compressor including the evaporator.

- Most low-side gauges read from 0-150 psig and 0 - 30 in. Hg of vacuum.

High-side Gauge

The high-side gauge measures the pressure between the compressor outlet and the expansion valve inlet including the condenser.

- Most high-side gauges read from 0 - 500 psig.
- High-side pressures seldom exceed 400 psi.

Attaching a Manifold Gauge Set

WARNING

Never hook up gauges while the engine is running. You could be injured by moving engine components.

Notes:

- The low-side, high-side, and center-port service hoses must have shutoff valves within 12 inches (300 mm) of the service hose fittings.
- Never hook up gauges until a visual inspection is completed. This will assist the technician in determining the correct service procedure.
- Make sure the low- and high-side gauges are both in the closed position.

Perform the following procedure to attach a manifold gauge set.

1. Ensure that all hand valves are closed.
2. Connect the high-side hose fitting to the service port on the compressor discharge line.
3. Connect the low-side hose fitting to the service port on the suction side.
4. Connect the center-port hose fitting to approved recovery and reclamation equipment.

Service Ports (R134a Quick Disconnect Fittings)

Refrigerant service ports are installed in the piping system for servicing the air conditioning system (evacuating and charging). The two R134a system service ports use quick disconnect fittings. (See Figure 11-17: Manifold Gauge Set).

The quick disconnect fitting (13mm) on the low side is located on the suction line near the cab unit expansion valve at the firewall.

The quick disconnect fitting (10 mm) on the high side is located on the liquid line near the cab expansion valve at the firewall.

The high and low side service fittings are of different sizes so that there can be no connection of a low-pressure refrigerant container to the high-pressure side of the system.

Flushing the System

NOTE

Do not flush the compressor or the expansion valve. These can be checked on a workbench to determine whether they are functional.

Perform the following procedure to flush the air conditioning system.

1. Flush the system using dry nitrogen. Flush in the opposite direction of normal refrigerant flow.

2. After flushing, install any components that were removed from the system.

Charging the System

CAUTION

Research and testing has been done to determine the optimum amount of refrigerant to be used in this system.

Always add only the amount of R134a that is specified on the charge label.

Overcharging or undercharging will inhibit peak performance and possibly cause component or system damage.

Perform the following procedure to charge with R134a gas.

WARNING

Do not open the high-side hand valve on the manifold gauge set. Refrigerant could be pumped into the container and cause it to burst, which could lead to personal injury or damage.

NOTE

Use the charging meter stand when charging the system.

1. Loosen the hose from the vacuum pump and hook it up to the red valve on the refrigerant container.

2. Select the amount of refrigerant to be used in the system on the charging meter.

3. Open both hand valves on the manifold gauge set.

4. Start the charging meter.

5. When the full amount of charge has been metered into the system, stop the charging meter and close the high-side hand valve on the gauge set. Close the valve on the refrigerant container.

6. Start the engine with the system on *Fresh Air*, *Full Cold* and let the engine idle at 1200 to 1500 rpm for 5 minutes. This will draw any remaining refrigerant in the charging hose through the system.

7. Turn off the engine and the system.

8. Close the low-side hand valve on the gauge set. Check to see that the gauges read within the normal range.

   a. If gauges read normal, remove the manifold gauge set and cap the service ports.

   b. If gauges do not read normal, refer to the troubleshooting section of this manual.

Adding Refrigerant to the System

NOTE

If any questions arise as to the amount of refrigerant that is in the system and whether you need to add more, always evacuate the system and replace with the proper amount of refrigerant.

This proper charge level will be noted on a label mounted on the firewall or the radiator.

Refrigerant should be added to the system in cases where there is insufficient refrigerant to perform effective leak diagnoses. This should be done only after the air is completely evacuated from the system.

Perform the following procedure to add refrigerant to the system.

1. Attach a manifold gauge set.
2. Attach the center hose of the manifold gauge set to the refrigerant container.
3. Open the valve on the container so that the refrigerant pressure will push against the air in the hose.
4. Loosen the hose at the center of the manifold gauge set and purge the air for about 3 seconds.
5. Tighten the hose and close the valve on the container.
6. Start the engine with the system on, air conditioner on, Fresh air selected, Full Cold selected, and let the engine idle at 1200 to 1500 rpm.
7. Open the low-side hand valve on the manifold gauge set to allow refrigerant to enter the system.
8. When the charge in the system reaches a minimum of 50 psig close the low-side hand valve and close the valve on the refrigerant container.
9. Let the system stabilize for 10 minutes with the windows open and the blower(s) on high speed.

Conducting a Leak Test

The electronic leak detector is a sensitive device and special care should be taken to keep the tip of the probe free of any debris. Move the probe around the system very slowly and check all components and hose fittings. If a leak is found, blow nitrogen into the suspected area and recheck very thoroughly.

Electronic Leak Detectors

CAUTION

An electronic leak detector is a very sensitive instrument. Exercise care to keep the probe tip free from debris or erroneous readings may result.

An electronic leak detector can detect leaks below an ounce per year. It has a probe that is moved around the system to find a refrigerant leak. If the probe senses a leak, it sends an audible or flashing signal.

Removing Air or Moisture From the System

Air or moisture in the system usually indicates that a leak is present. Perform the following procedure to remove air or moisture.

1. Recover refrigerant.
2. Repair leak.
3. Replace filter drier.
4. Replace any missing oil.
5. Pull vacuum on system for at least 45 minutes.
6. Charge system.
7. Conduct performance check.

REMOVING AND REPLACING COMPONENTS - CAB UNIT

The cab combination heater and air conditioning unit is mounted on the firewall and extends approximately 12" into the engine compartment. (See Figure 11-18: Cab Combo Assy.).

The heater coil, evaporator coil, thermostatic expansion valve, air filter, blower assembly, resistor and fresh air door actuator are accessible from the engine compartment without removing the unit from the firewall.

Heater Coil

To remove the heater coil you must isolate the coil from the system as described previously and remove the hoses from the coil. Be sure to mark one of the hoses to prevent reversing them upon reassembly.

Once the hoses are disconnected, remove the screws that secure the cover. To remove the cover, slide it to the driver's side and pull forward. The heater coil can now be pulled straight out for cleaning, repair or replacement as necessary. The gasket on the coil piping should be removed and replaced before reassembly.

After servicing of the heater coil is completed or a new coil used, reassemble in reverse order. When connecting the hoses be sure that they are installed on the same tubes they were originally on.

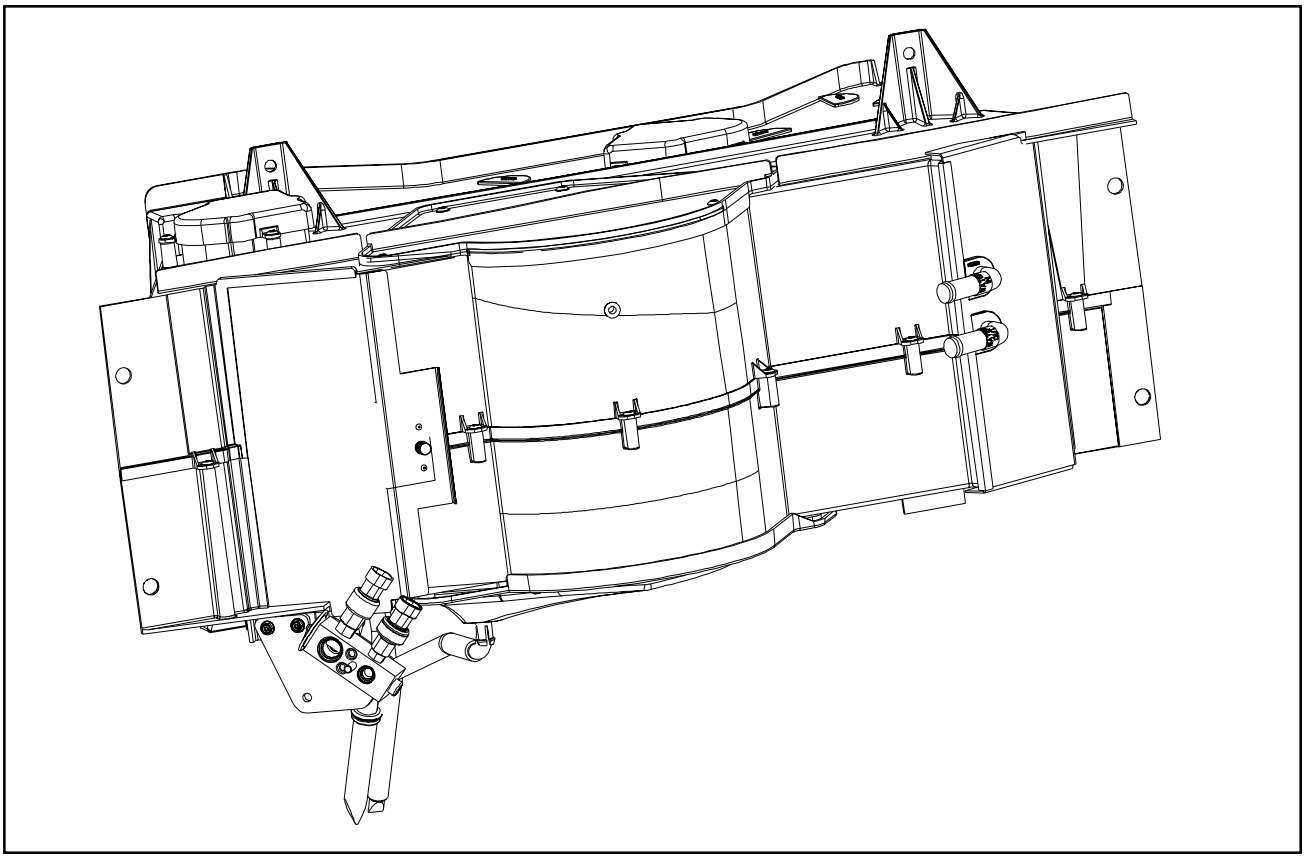

Figure 11-18: Cab Combo Assembly

Thermal Expansion Valve

Before loosening and removing the flange mounting plate from the thermostatic expansion valve, evacuate and recover the refrigerant from the system as described previously.

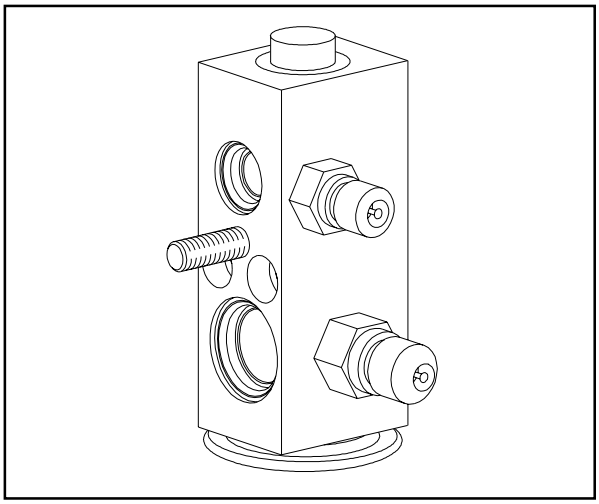

Figure 11-19: Thermal Expansion Valve

Remove the hose pad mount located on the high pressure side of the expansion valve by removing the nut from the stud on the expansion valve. Be careful not to lose the O-rings on the tubing.

Remove the expansion valve from the "E"-plate by removing the 2 socket head cap screws holding them together. Be careful not to lose the 2 O-rings on the evaporator piping. Cap the evaporator pipes.

If testing has determined that the expansion valve is defective, it has to be replaced. If no work is required to be done to the evaporator, replace the O-rings on the evaporator connections.

NOTE

Be sure to lubricate the O-rings with mineral oil prior to installation.

Reassemble the valve to the evaporator in reverse order. Replace the O-rings on the tubing and connect the hose pad mount to the expansion valve with the nut and tighten.

NOTE

It is recommended that new O-rings be used.

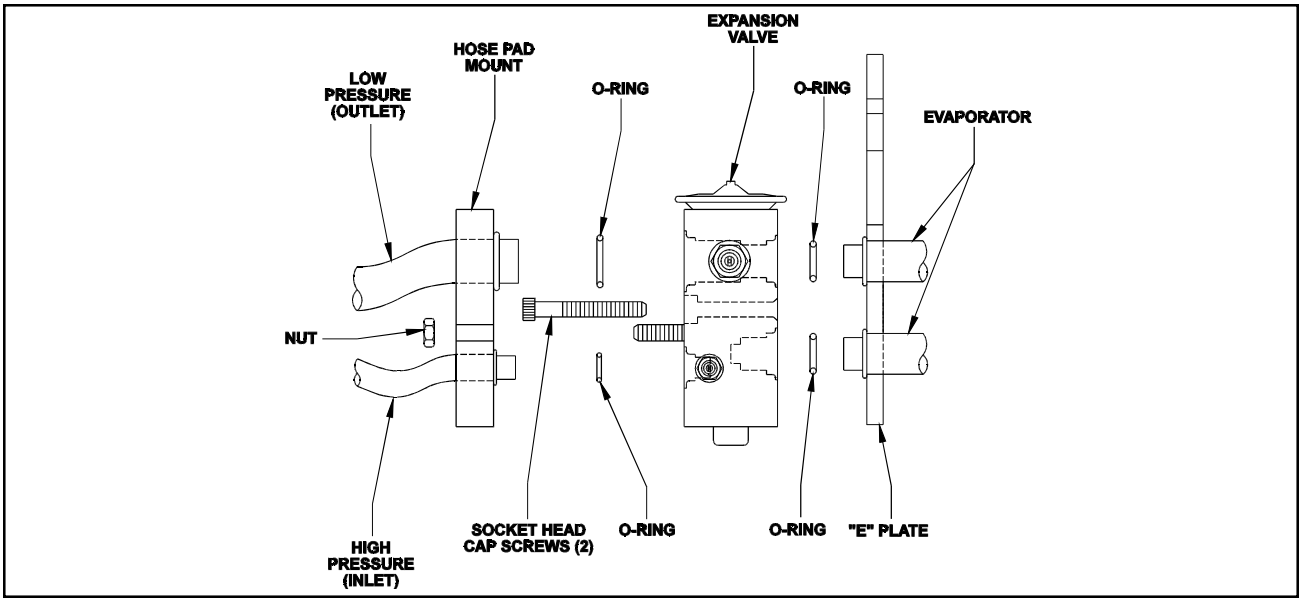

Figure 11-20: Pad Fitting Assembly (Cab Unit)

Evaporator

To remove the evaporator, it is not necessary to remove the hose pad mount from the expansion valve nor the valve from the "E"-plate. Remove the two screws holding the "E"-plate to the case and pull the assembly back and off the evaporator piping. Be careful not to lose the O-rings. Cap the open tubing connections.

To expose the evaporator, turn the door latch a quarter turn and slide the cover door open. The evaporator is removed from the case by pulling straight forward.

Disconnect the wires from the freeze protection switch before removing the evaporator completely.

The evaporator can now be tested, repaired or replaced as necessary. Before reinstalling the evaporator, reassemble the freeze protection switch to the evaporator and reconnect the wires. Replace the gasket on the evaporator piping. Slide the evaporator into the case making sure it is all the way into the case.

NOTE

It is recommended that the O-rings on the evaporator tubes be replaced before reassembly.

NOTE

Be sure to lubricate the O-rings with mineral oil prior to installation.

Slide the "E"-plate on to the evaporator tubes and reassemble the plate to the case with the 2 screws.

Air Filter

The air filter is located behind the door on the front of the case and in front of the evaporator. To remove the filter, turn the door latch a quarter turn and SLIDE the door open. When facing the unit, the filter is to the left of the evaporator. Grab the tab on the filter and pull it straight forward, clean the filter or insert the new filter and secure the door. **Take special note on the air-flow direction on the filter frame when installing the filter.**

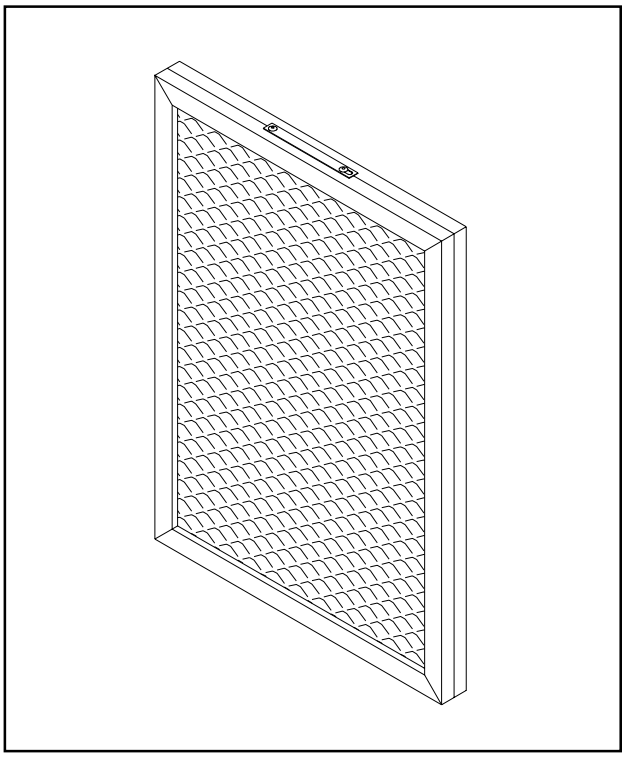

Figure 11-21: Air Filter

Blower Assembly

The blower assembly is located under the cover on the top of the case. To expose the blower assembly, remove the 6 cover screws and lift it off the case.

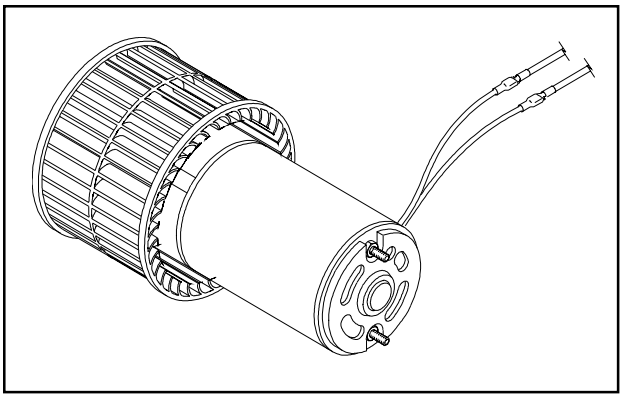

Figure 11-22: Motor & Blower Assembly

To service or replace any part of the blower assembly, remove the 3 screws holding it to the case. Disconnect the wire harness from the resistor and lift the blower assembly out of the case.

Check the blower wheel and be sure it is free of debris and that none of the blades are damaged or cracked. Check inside the blower housing to be sure that the wheel does not hit the case and that no debris is present to jam the wheel.

The blower wheel and motor are disassembled by removing the blower wheel retaining clip from the motor shaft and pulling the wheel off the shaft.

Reassemble the motor and blower wheel in reverse order. Be sure the blades on the blower wheel face in the same direction as the original. The blades must face the outlet of the housing.

Reconnect the wire harness and check the operation by turning on the ignition and turning the fan switch to its high speed position. Be sure that the blower is not rubbing and that the unit is quiet. Check at all fan speeds.

Resistor

To remove the resistor, disconnect the wire harness and remove the screw holding it to the case.

Reassemble in reverse order.

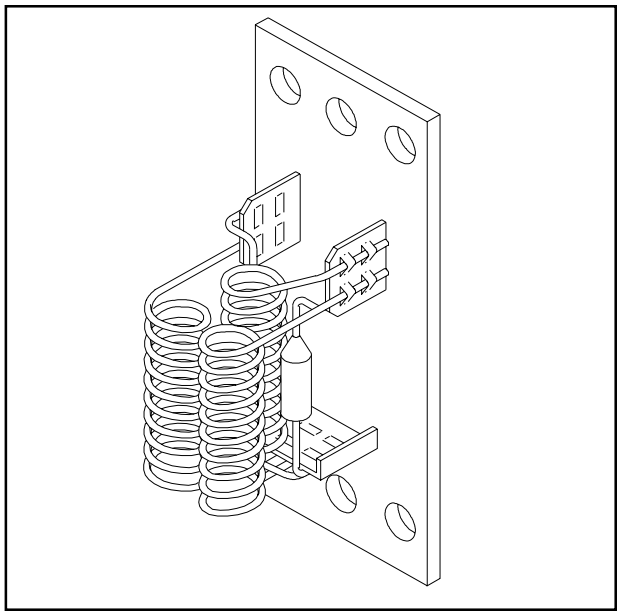

Figure 11-23: Resistor

Fresh Air Door Actuator

The fresh air door actuator is located under the cover on the top left side of the unit. To reach the actuator, remove the 3 screws securing the cover and the actuator to the case

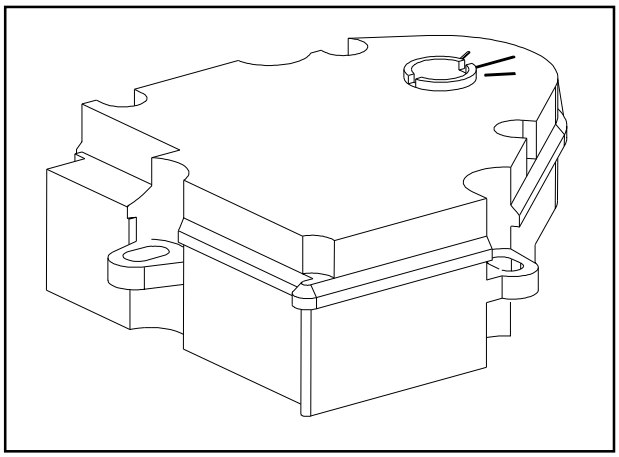

Figure 11-24: Door Actuator

Remove the plug that covers the wire harness from the case and pull the actuator straight up off the fresh air door hinge. Disconnect the wiring harness. Check the fresh air door gasket for wear or damage. Replace the door if necessary.

The actuator is not repairable and must be replaced if it is not functioning. Reassemble the new actuator in reverse order.

Removing Heater and Air Conditioning Unit from the Firewall

NOTE

The heater and air conditioning unit needs at least 12" of room In front of it. Before starting to remove the unit, move or remove all obstructions from in front of it.

NOTE

When removing the unit from the firewall, pay special attention to the refrigerant hoses as they may bend and kink. Ensure a generous hose radius is maintained when servicing.

The heater and air conditioner assembly is secured to the firewall with 2 nuts located at the top of the case near each outer end and 4 machine screws at the far outer ends of the case. Remove these nuts and screws. Disconnect the hose clamps along the top and side of the surge tank and begin sliding the entire assembly forward. Remove the heater coil from HVAC box or disconnect the hoses from the heater coil. Continue sliding the entire assembly forward.

After the unit is clear of the firewall, disconnect the wire connectors from the harness that lead to the control panel. The unit is now ready to be serviced. (See Figure 11-25.)

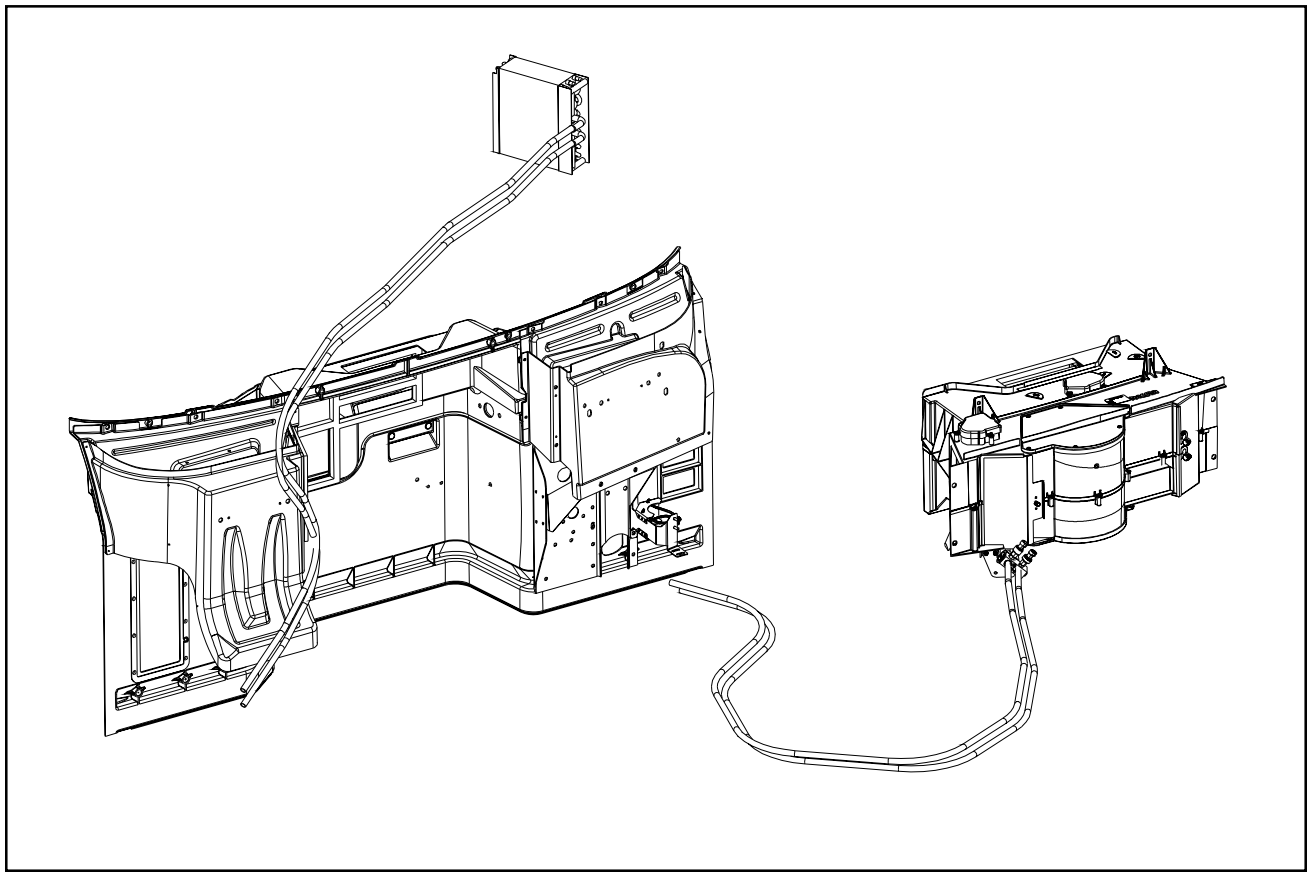

Figure 11-25: Removing The Heater/Air Conditioning Unit

Blend Air Door Actuator

The blend air door actuator is located on the top of the unit under a cover and can be serviced without opening the case.

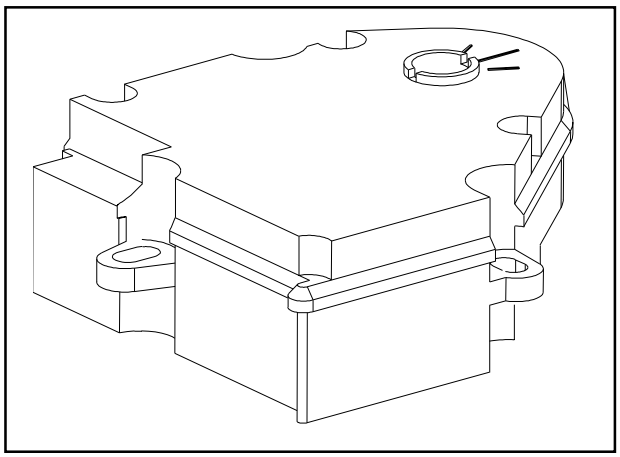

Figure 11-26: Door Actuator

To reach the actuator, remove the 3 screws securing the cover and the actuator to the case. Pull the actuator straight up off the blend air door hinge. Disconnect the wiring harness. The actuator is not repairable and must be replaced if not functioning. Reassemble in reverse order. Take care in replacing the actuator cover seals to prevent water contamination.

Mode Door Actuators

There are 2 mode door actuators mounted on the inside of the heater and air conditioning unit. To reach these actuators, remove the 4 screws holding the front plate to the case. Pull the plate from the case and disconnect the wiring harnesses.

Remove the actuator by removing the 3 nuts that secure it to the plate assembly and pull it free from the mode door hinge. There is a spacer under each screw. Be careful not to lose them.

The hinge coupling will remain either with the actuator or the door hinge. Do not lose it. Inspect the gasket and door for damage. Replace if necessary.

The actuator is not repairable and must be replaced if not functioning. Reassemble in reverse order.

NOTE

Before reassembling the front cover to the case, inspect the blend air door gasket. If the gasket is damaged, the door needs to be replaced.

To replace the blend air door, remove the blend air door and fresh air door actuators in accordance with previous instruction. Remove the screws that secure the top case half to the bottom case half and separate them. Replace the blend air door and reassemble in reverse order.

NOTE

Before reassembling the cab HVAC unit to the firewall, inspect seals on the firewall and fresh air inlet box. Replace seals if they are damaged or have been compression set.

Failure to replace damaged or worn seals may result in water leaks into the cab or degraded HVAC performance.

When all servicing is complete, slide the unit back into place and reassemble to the firewall. Check all connections for leaks and proper operation of all components.

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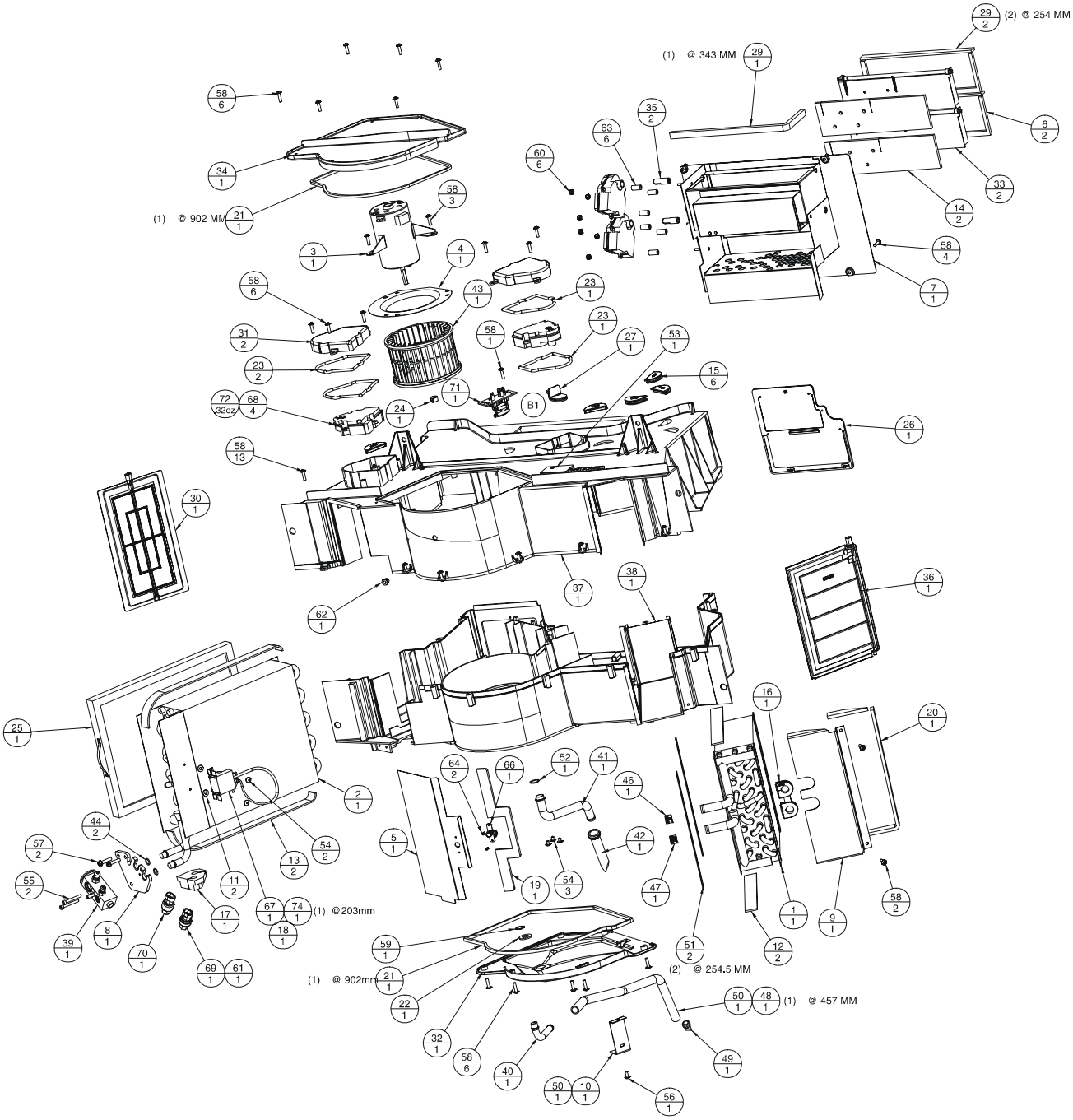

Figure 11-27: Cab Unit Serviceable Parts

Cab Unit Serviceable Parts List

BILL OF MATERIAL				
ITEM	QUANTITY	BERG PART NO.	CLIMATECH PART NO.	DESCRIPTION
1	1	108293	108293BSM	HEATER COIL
2	1	151338	151338BSM	EVAPORATOR COIL
3	1	203142	203142BSM	12V LONG LIFE MOTOR
4	1	351750	351750BSM	ORIFICE RING
5	1	452436	452436BSM	COVER, EVAPORATOR FILTER
6	2	520557	520557BSM	GASKET, AIR SEAL DIST. WALL
7	1	868788	868788BSM	WELDMENT
8	1	452808	452808BSM	MOUNTING PLATE TXV
9	1	452821	452821BSM	COVER, HEATER
10	1	452921	452921BSM	BRACKET, TUBE SUPPORT
11	2	514100	514100BSM	WASHER #10 FLAT
12	2	520152	UB1230	GASKET
13	2	520157	UB1335	GASKET
14	2	520465	520465BSM	GASKET, MODE DOOR
15	6	520549	520549BSM	GROMMET, ACCESS PLUG
16	1	520533	520533BSM	GROMMET, HEATER TUBE
17	1	520554	520554BSM	GASKET, EVAPORATOR TUBE
18	.083 ft.	570141	UE1100	TAPE, INSULATION
19	1	520570	520570BSM	GASKET, EVAPORATOR COVER
20	1	520572	520572BSM	GASKET, HEATER COVER
21	5.92 ft.	520591	520591BSM	GASKET, BULK (2) AT 902MM (35.5)
22	1	520618	520618BSM	WASHER, RUBBER
23	4	520706	520706BSM	GASKET, ACTUATOR COVER
24	1	525222	525222BSM	CLIP, BLOWER WHEEL RETAINER
25	1	525507	525507BSM	FILTER F/A
26	1	525525	525525BSM	RECIRC GRILL
27	1	520713	520713BSM	GROMMET ACTUATOR
28	-	-	-	
29	2.8 ft.	529500	UB1000	URETHANE, BULK (1) AT 343MM (13.5"), (2) AT 254MM (10")
30	1	530072	530072BSM	DOOR F/A
31	2	530075	530075BSM	COVER, ACTUATOR
32	1	530076	530076BSM	COVER, BLOWER BOTTOM
33	2	530077	530077BSM	DOOR, MODE
34	1	530078	530078BSM	COVER, BLOWER ACCESS
35	2	530079	530079BSM	ACTUATOR, COUPLING
36	1	530081	530081BSM	DOOR, BLEND AIR
37	1	530118	530118BSM	CASE HALF, TOP
38	1	530119	530119BSM	CASE HALF, BOTTOM
39	1	540057	540057BSM	EXPANSION VALVE
40	1	580122	580122BSM	FITTING, 90 DEG. , DRAIN 12.7MM (1/2") DIA.
41	1	550288	550288BSM	TUBE, SHORT 15.88MM (5/8") DIA.
42	1	560101	560101BSM	DRAIN TUBE, CHECK VALVE
43	1	563500	HC1005	BLOWER WHEEL
44	2	564700	AC1070	O-RING #8
45	-	-	-	
46	1	584150	584150BSM	DECAL, WATER IN
47	1	585217	585217BSM	DECAL, WATER OUT
48	1.5 ft.	585770	585770BSM	HOSE, 1/2" DRAIN, (1) AT 457(18")
49	1	585790	585790BSM	VALVE, 5/8" DRAIN
50	3	587750	587750BSM	CABLE TIE
51	1.67 ft.	589510	UB1045	SPONGE RUBBER, (2) AT 254.5(10")
52	1	589640	AC11254	O-RING HOSE FITTING
53	1	591120	591120BSM	DECAL, NAMEPLATE
54	5	600115	600115BSM	SCREW, #10 TRUSS HD. 8-15X.28"
55	2	600121	600121BSM	SCREW, SOCKET HD. CAP #10-32X35MM
56	1	600129	600129BSM	SCREW, #10 TRUSS HD. 8-15X .44"
57	2	600159	600159BSM	SCREW, #12-16 X 1" HI-LO
58	41	600163	600163BSM	SCREW, #10-16X .75 HI-LO
59	1	605051	605051BSM	WASHER, RETAINING
60	6	610058	610058BSM	NUT, 8-32 NYLOK
61	1	613300	613300BSM	CABLE TIE
62	1	615034	615034BSM	INSERT M6
63	6	615062	615062BSM	SPACER, ACTUATOR
64	2	620019	620019BSM	POP RIVET, 3/32"
65	-	-	-	
66	1	625034	625034BSM	LATCH, COIL COVER
67	1	650163	650163BSM	FREEZE SWITCH
68	4	650341	650341BSM	ACTUATOR, ELECTRIC
69	1	650697	650697BSM	SWITCH, HI PRESSURE
70	1	650446	650446BSM	SWITCH, LOW PRESSURE
71	1	650475	CA1070	RESISTOR, 4-SPEED W/121C FUSE
72	.32 oz.	650549	650549BSM	GREASE, DIELECTRIC .08 PER ACTUATOR

REMOVING AND REPLACING COMPONENTS - SLEEPER UNIT

To reach the sleeper unit and all its components and connections (except the heater hose and refrigerant connections), lift the hinged mattress tray.

The heater hose and refrigerant connections are located outside the vehicle under the sleeper floor. The following procedures explain how to remove and replace the appropriate sleeper unit components. (See Figure 11-28: Sleeper Unit Assy).

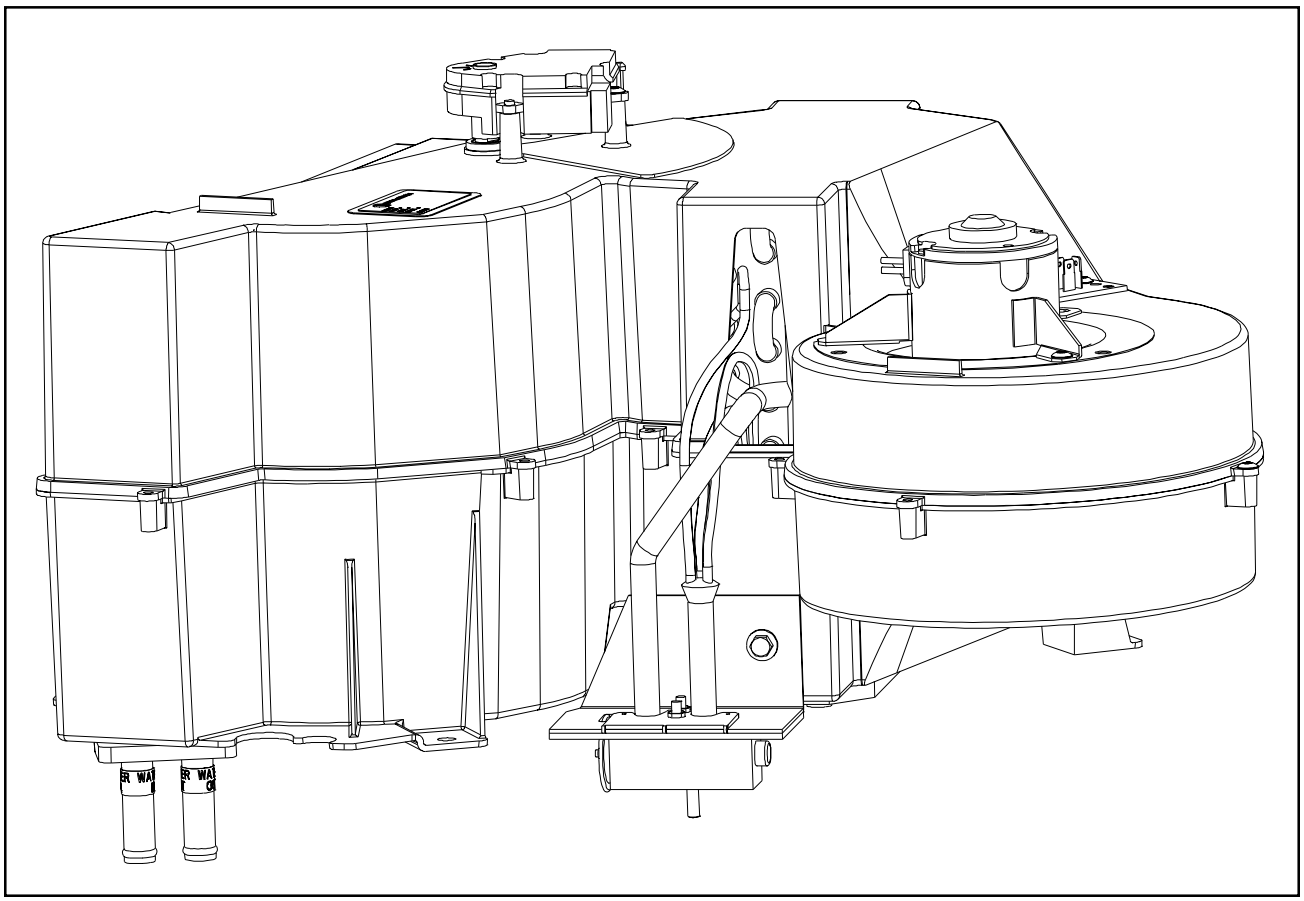

Figure 11-28: Sleeper Unit Assembly

Blend Air Door Electric Actuator

The blend air door actuator is located on top of the case. To remove it, remove the 2 screws securing the actuator to the case and pull it straight up. Disconnect the wiring harness. The actuator is not repairable and must be replaced. Reassemble in reverse order.

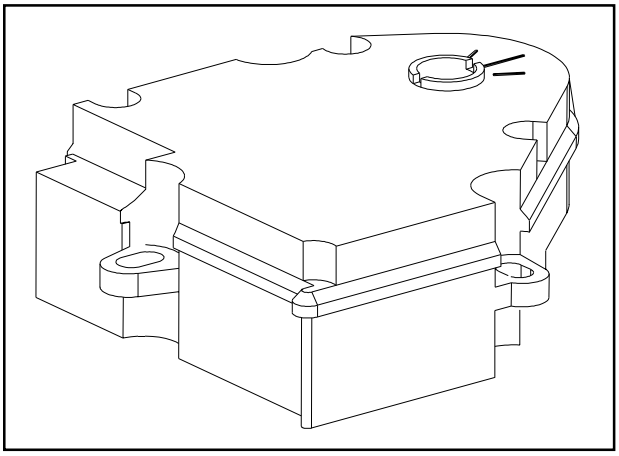

Figure 11-29: Door Actuator

Resistor

The resistor is mounted on the outside top of the case. To remove, disconnect the wire harness from the resistor and remove the 2 screws that fastens it to the case. Lift off and reassemble with new one.

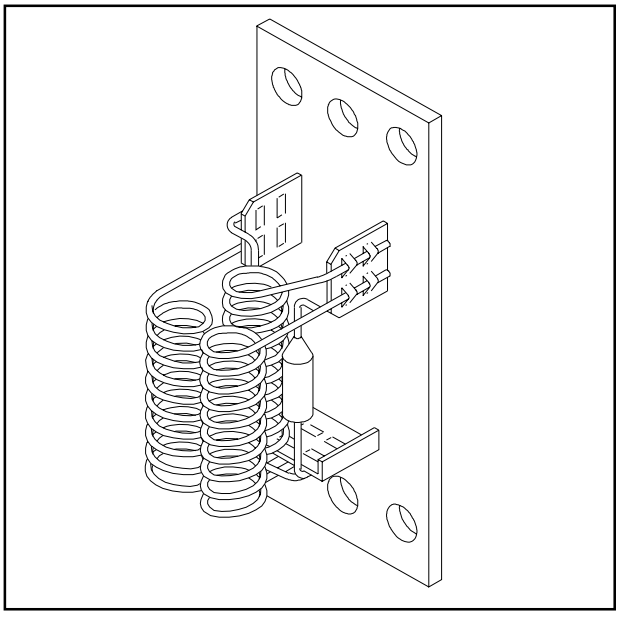

Figure 11-30: Resistor

Motor and Blower Assembly

To replace either the blower wheel or the motor, remove the blower assembly from the upper case by removing the 3 screws securing it to the case.

Inspect the blower wheel to be sure it is free of debris and that none of the blades are cracked. The motor and blower wheel are disassembled by removing the blower wheel retaining clip from the motor shaft. Replace the motor if it is not functioning or the blower wheel if it is broken.

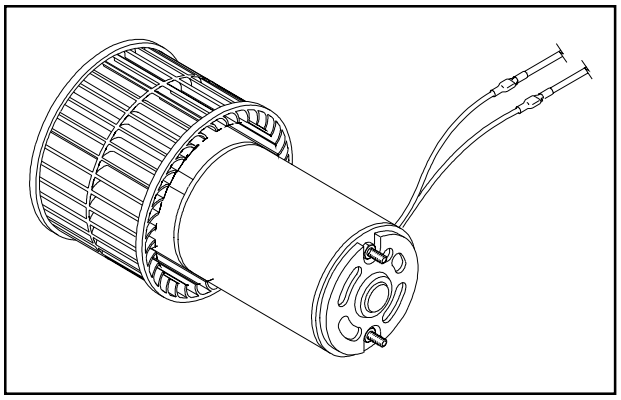

Figure 11-31: Motor & Blower Assembly

NOTE

In order to reach the heater coil and evaporator, the blend air door actuator must be removed from the case and the case disassembled. This is done by removing the screws that secure the upper case to the lower case.

Disconnect the wiring harness at the main connection leading to the A/C unit. Remove the screws holding the main duct to the unit and push the duct clear of the upper case. Remove the 3" round duct leading from the case to the kick panel in the front of the bunk.

Lift the upper case straight up approximately 6" to clear all the internal components. All the above parts are now accessible for service.

Heater Coil

To remove the heater coil you must isolate the coil from the coolant system as described previously and remove the hoses from the coil. These connections are outside of the vehicle and located under the floor of the sleeper.

Once the hoses are disconnected, the heater coil can be lifted straight up from the lower case. Clean, repair or replace as necessary.

Reassemble in reverse order and replace the coolant in the system.

Evaporator

Before starting the disassembly of the evaporator or expansion valve, recover the refrigerant from the system as described previously.

To remove the evaporator, remove the nut that holds the hose pad mount under the sleeper floor. Remove the 2 screws from the TXV into the mounting bracket at the side of the HVAC box and remove the valve and bracket. Cap all tube openings. Be careful not to lose the 2 O-rings. Lift the evaporator coil straight up from the lower case.
The evaporator can now be repaired or replaced.

NOTE

It is recommended that new O-rings be used.

NOTE

Be sure to lubricate the O-rings with mineral oil prior to installation.

Thermal Expansion Valve

To replace the expansion valve, remove the nut from the stud on the valve and pull the hose mounting plate off the stud. Be careful not to loose the 2 O-rings. Remove the 2 socket head cap screws that secure the expansion valve to the TXV mounting-plate.

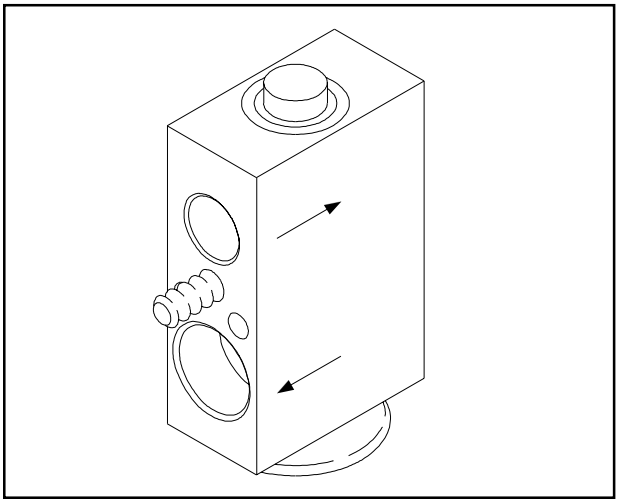

Figure 11-32: Thermal Expansion Valve

It is recommended that the O-rings be replaced before reassembly.

NOTE

Be sure to lubricate the O-rings with mineral oil prior to installation.

Replace the valve and reassemble in the reverse order.

After all parts have been repaired or replaced, and before reassembly, inspect the seal on the blend air door for wear or damage. Remove and replace the door if necessary. Also inspect the seal on the top and bottom case at the main duct connection and replace if necessary.

Reassemble the unit in reverse order and charge the air conditioning system as previously described. Check all fittings to be sure there are no leaks. Check the entire system for proper performance.

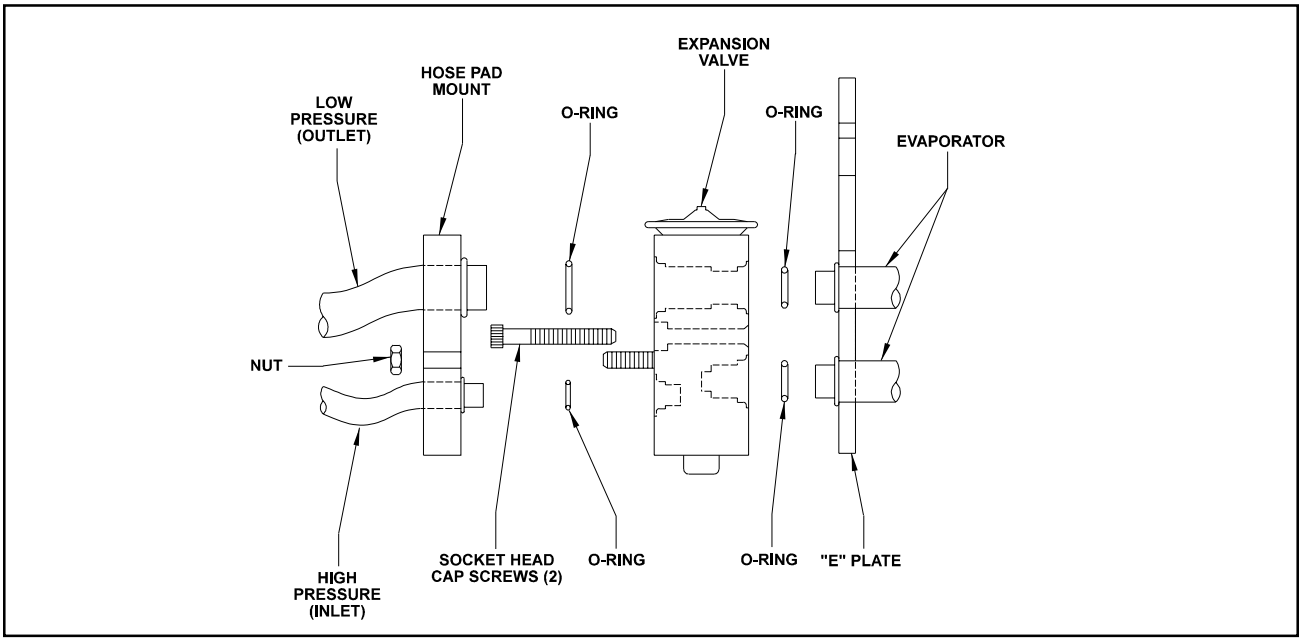

Figure 11-33: Pad Fitting Assembly (Sleeper Unit)

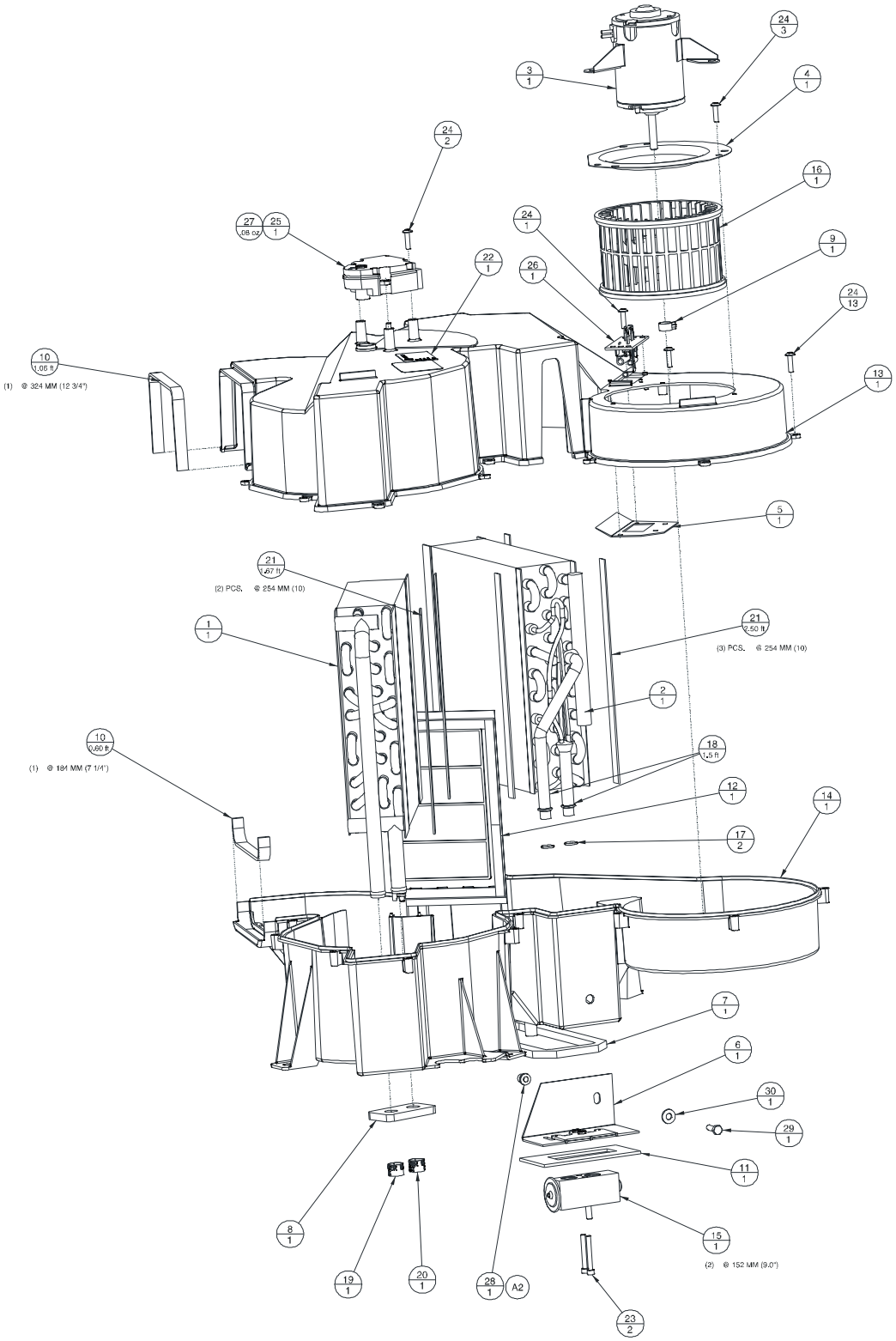

Figure 11-34: Sleeper Unit Serviceable Parts

Sleeper Unit Servicable Parts Listing

BILL OF MATERIAL				
ITEM	QUANTITY	BERG PART NO.	CLIMATECH PART NO.	DESCRIPTION
1	1	108322	108322BSM	HEATER
2	1	151385	151385BSM	EVAPORATOR COIL
3	1	203139	203139BSM	12V LONG LIFE MOTOR
4	1	351750	351750BSM	ORIFICE RING
5	1	452527	452527BSM	HEAT SHIELD, RESISTOR
6	1	453365	453365BSM	PLATE, TXV MOUNTING
7	1	520495	520495BSM	SEAL, CONDENSATE DRAIN
9	1	525222	525222BSM	CLIP, BLOWER WHEEL
10	1.67 ft.	529500	UB1000	URETHANE, 3/8 X 1/2 (1) AT 12 3/4" L AND (1) AT 7 1/4"L
11	1	520667	520667BSM	SEAL, TXV FLOOR
12	1	530084	530084BSM	DOOR, BLEND AIR
13	1	530121	530121BSM	CASE HALF, TOP
14	1	530122	530122BSM	CASE HALF, BOTTOM
15	1	540056	540056BSM	EXPANSION VALVE
16	1	563500	HC1005	BLOWER WHEEL
17	2	564700	AC1070	O-RING
18	1.5 ft.	570140	UE1095	MOISTURE SEAL WRAP
19	1	584150	584150BSM	DECAL, WATER IN
20	1	585217	585217BSM	DECAL, WATER OUT
21	4.17 ft.	589510	UB1045	SPONGE RUBBER 1/16" X 1/2" X (5) PCS. AT 10" L
22	1	591120	591120BSM	DECAL, NAMEPLATE
23	2	600121	600121BSM	SCREW SOC. HD. CAP - #10-32 X 1 3/8"L
24	19	600163	600163BSM	SCREW, #10-16 X 3/4" (HI - LO THD.)
25	1	650341	650341BSM	ACTUATOR, ELECTRIC
26	1	650475	CA1070	RESISTOR, 4 SPEED
27	.08 oz.	650549	650549BSM	GREASE, DIELECTRIC
28	1	615034	615034BSM	INSERT, AVK, M6 X 1.0
29	1	600047	600047BSM	SCREW, M6 X 20MM
30	1	509700	509700BSM	WASHER, 1/4" FLAT

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