# SECTION 22: HEATING AND AIR CONDITIONING

## CONTENTS

## ILLUSTRATIONS

## 1. HEATING AND AIR CONDITIONING

The coach's interior is pressurized by its Heating, Ventilation, Air Conditioning (HVAC) units. Air flow and controls divide the vehicle in two sections: driver's and Central (passenger) sections. Vehicles equipped with a Central System are provided with a special air duct which allows a variable percentage of outside fresh air to be drawn into the vehicle and then mixed with recirculated air.

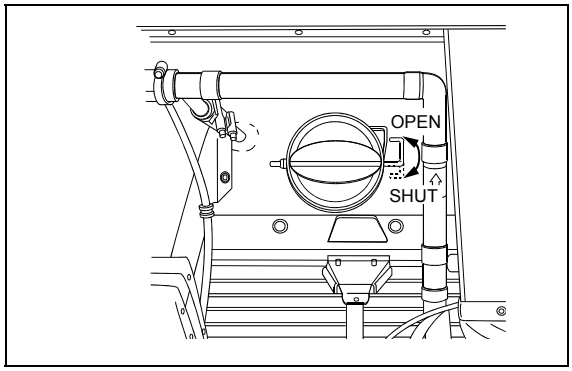



**FIGURE 1: ADJUSTABLE AIR DUCT** 22175

The adjustable air intake damper is located in the evaporator compartment (see *"18. BODY"* for compartment location). The damper should normally be left open. However, under extreme temperature conditions, it can be closed to block the addition of ambient air and heat or cool the air inside vehicle as desired. As soon as extreme heating or cooling is no longer required, the damper should be reopened. The interior of vehicle should always be slightly pressurized to prevent dust and moisture from entering vehicle. The HVAC systems have been designed to allow circulation of some outside fresh air, so windows should be kept closed at all times. In the event of ventilation failure, emergency escape hatch(es) (see *"18. BODY"*) can be used to provide air circulation, by simply pushing hatch upwards.

***Note:*** *Auxiliary A/C system (if so equipped) operates independently from main system, it has its own condenser, evaporator and compressor.*

***Note:*** *Driver's HVAC system operates independently from main system, even though it uses the same compressor.*

***Note:*** *Vehicles equipped with a HGB-1000 Tecumseh compressor (driver's or auxiliary A/C) have a time delay relay installed on the electrical circuit with a reaction time of 48 seconds before magnetic clutch is engaged.*

## 2. AIR CIRCULATION

### 2.1 DRIVER'S AREA

Fresh air is taken from a plenum behind the front bumper and enters the mixing box through an adjustable damper. Returning air is taken through a front dash panel into the mixing box. The "Driver A/C-Heating Recirc.-Fresh Air" control is located on the R.H. dashboard control panel. Mixed air goes through cooling and heating coils, fans and discharge ducts.

Both right and left discharge ducts defrost one half of the windshield. The driver can also, with the "Main Windshield Defroster" control divert some air flow to the console, from which he can direct vent to his knees and/or upper body with adjustable HVAC register and to his feet with the appropriate button (see operator's manual).

Two additional air outlets are installed on vehicles equipped with the Central HVAC ducting system. One is located in the stepwell for snow melting. The other air outlet is located behind the driver, on his L.H. side. This air outlet can be rotated to direct Air flow.

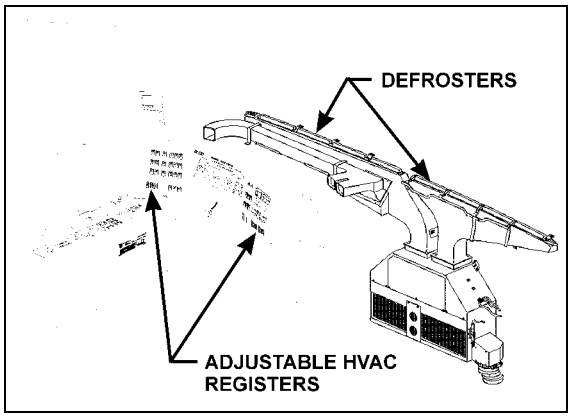


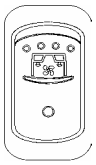

**FIGURE 2: DRIVER'S AIR CIRCULATION** 22171

2.2 CENTRAL AREA

(Passenger/Cabin)

Fresh air enters the vehicle on the L.H. side, through the manually adjustable damper (Fig. 1) located in evaporator compartment. The damper can be fully opened for normal operation or closed for extreme weather or highly polluted areas (Refer to the XL2 Operator's Manual for more details). Return air is drawn from inside the vehicle through the register duct (Fig. 3).

A double blower fan unit, which is activated by the evaporator motor, draws mixed air through an air filter, cooling and heating coils, then forces this air in the ventilation ducts along the walls, and finally exhausts it just below side windows.

XL2 coaches are also equipped with a parcel rack ventilation system, a three-position rocker switch  (0FF - 1st speed - 2nd speed) located on R.H. dashboard panel controls the speed of both fans. Return air is drawn just below the middle side windows through an air filter into the parcel rack fan; discharge air is fed to the rotating registers through the ventilation duct.

The parcel rack registers are used to control air flow for the passenger seats. One register per seat direct air flow by pointing or rotating register. Open or close register to adjust air flow.

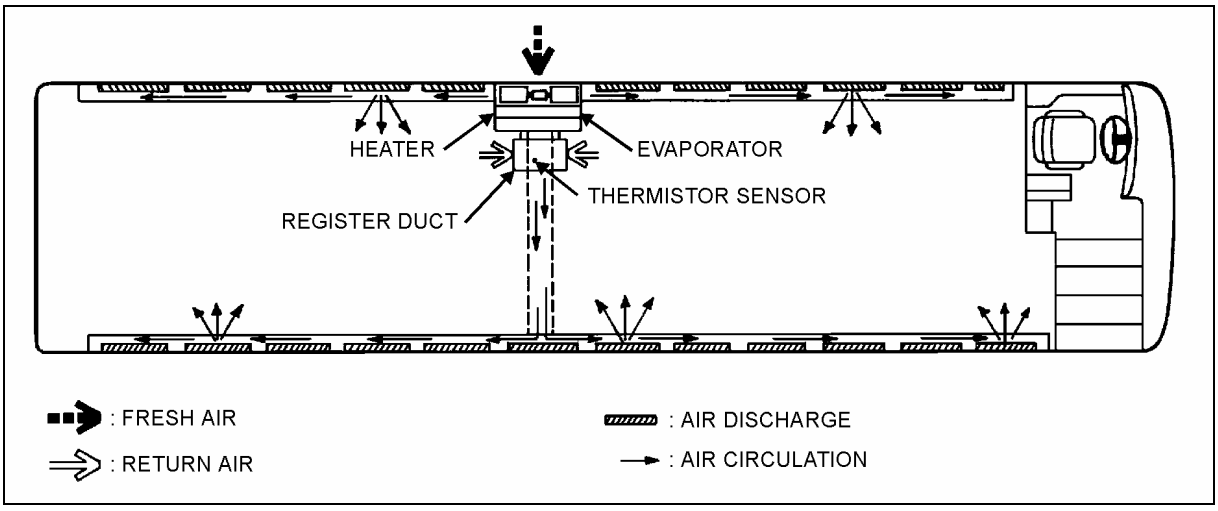



**FIGURE 3: CENTRAL HVAC SYSTEM AIR CIRCULATION** 22063

## 3. DRIVER'S HVAC SYSTEM OPERATION

The temperature control in the driver's area is provided directly by the HVAC control unit mounted on the dashboard R.H. panel (Fig. 4 and 5).

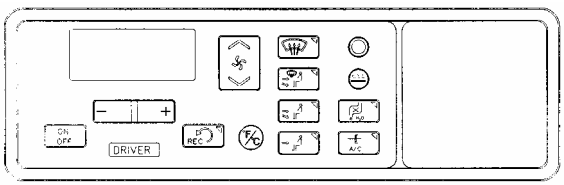



**FIGURE 4: DRIVER'S HVAC SYSTEM CONTROL UNIT** 22184

***Note:*** *The driver's area air temperature sensor is located behind the grill of the R.H. side console or inside the footwell, at the ceiling at the right of the steering column (Refer to fig.12).*

3.1 VEHICLES EQUIPPED WITH A HGB-1000 TECUMSEH COMPRESSOR

This system is completely independent, it has its own condenser, evaporator and compressor.

3.2 VEHICLES EQUIPPED WITH A CENTRAL SYSTEM

The driver's HVAC unit piping is paralleled with the main HVAC unit piping. Both units use the same refrigerant and coolant, and are linked to the same condenser and compressor, even if they are individually controlled. It requires the main HVAC unit to engage the A/C compressor magnetic clutch. Consequently, the driver's unit cannot be operated in the A/C mode alone.

## 4. CENTRAL HVAC SYSTEM OPERATION

The HVAC control unit located on the dashboard R.H. panel, enables the selection of the temperature in the passenger area (or the living space for a converted vehicle) (refer to the Operator's Manual for details).

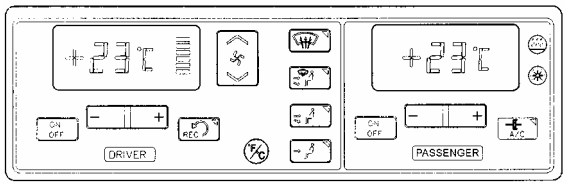



**FIGURE 5: CENTRAL HVAC SYSTEM CONTROL UNIT** 22184

Temperature control is provided in conjunction with a thermistor sensor inside register duct, located amidships on L.H. side of vehicle (Figs. 3 & 6).

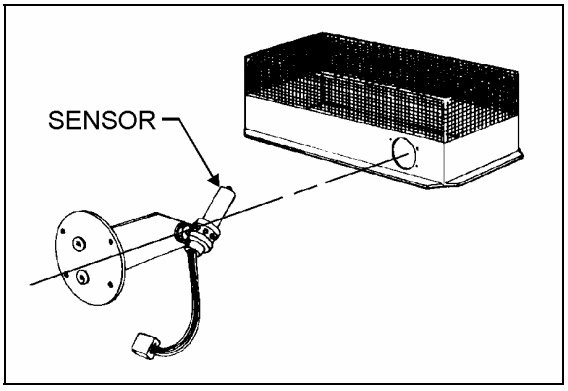



**FIGURE 6: THERMISTOR SENSOR** 22064

The flow of water to the vehicle's main heater core is controlled by an electric water valve which is open or closed depending on selected temperature. A red LED, located on HVAC control unit, illuminates when heating mode is selected. A green LED illuminates when compressor clutch is in operation.

The evaporator fan motor, located in evaporator compartment, is protected by a 120 amps, manually resettable circuit breaker. The condenser fans, located in the condenser compartment, also have circuit protection via 40 amps manually resettable circuit breakers. The breakers are located in the A/C junction box in the evaporator compartment.

***Note:*** *The outside temperature sensor is located behind the front bumper on the L.H. side.*

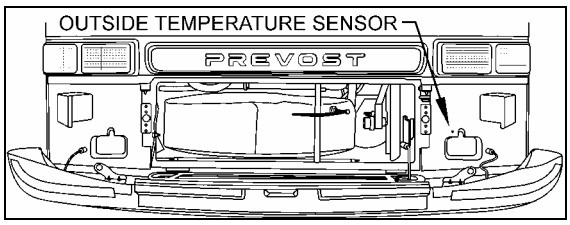



**FIGURE 7: LOCATION OF OUTSIDE TEMPERATURE SENSOR** 22195

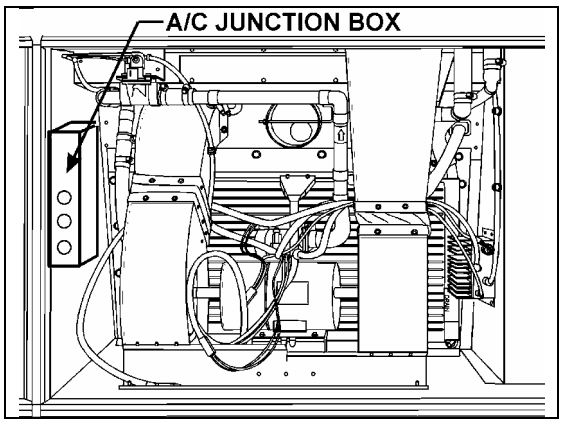



**FIGURE 8: LOCATION OF A/C JUNCTION BOX IN EVAPORATOR COMPARTMENT** 06414

To operate A/C system when vehicle is stationary, run engine at fast idle. During operation of A/C system, windows should be kept closed and door(s) not left open longer than necessary. In order to prevent battery discharge, A/C & heating system will not operate when charging system is malfunctioning.

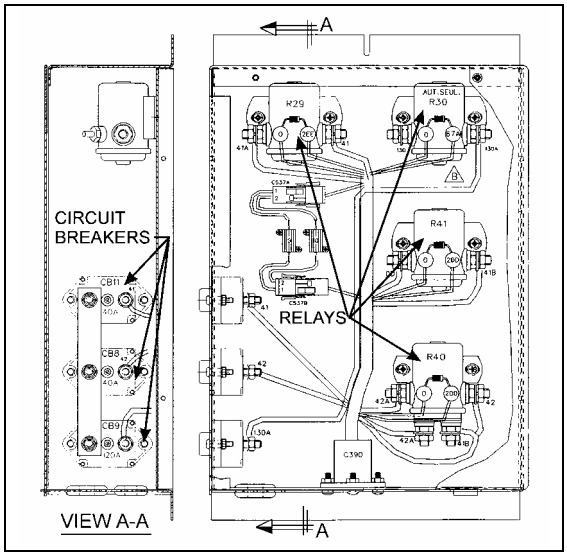



**FIGURE 9: A/C JUNCTION BOX** 06317

4.1 PARCEL RACK A/C (XL2 COACHES)

Optional small A/C evaporator coils may be added to both parcel racks existing air system. These auxiliary A/C system components are separate and completely independent of driver's and central systems and permits a wider temperature range in the passenger's area. The three-position rocker switch used to control the fans, also controls the A/C system.

## 5. HVAC UNIT MAINTENANCE

No special maintenance is required on the central, driver's and auxiliary HVAC units, with the exception of cleaning their respective coils and air filters, plus periodic inspection for broken drains, hoses and charging of system.

5.1 COIL CLEANING

***Note:*** *Squeeze rubber hose located underneath the appropriate compartment to eliminate the accumulated water and dirt when you make routine maintenance.*

Check the external surface of the coil at regular intervals for dirt or any foreign matter.
For the driver's HVAC unit, flush the coil from inside. For the evaporator, back flush the coil (Fig. 10) every 12,500 miles (20 000 km) or once a year, whichever comes first.

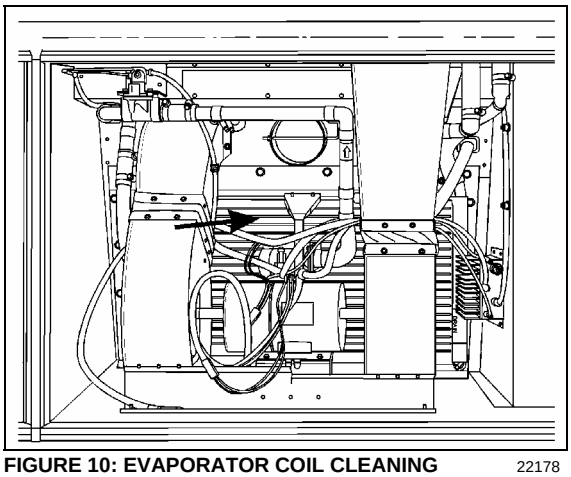


**FIGURE 10: EVAPORATOR COIL CLEANING** 22178

For the condenser coil, back flush the coil (Fig. 11) every 6,250 miles (10 000 km) or twice a year, whichever comes first.

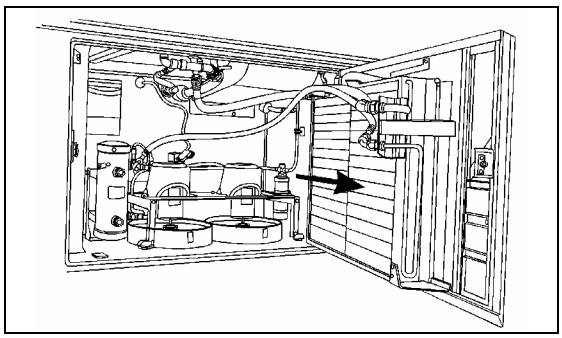


**FIGURE 11: CONDENSER COIL CLEANING** 22174

***Caution:*** *Use a water jet or water mixed with low air pressure to clean the coil.*

***Caution:*** *Direct the pressure straight through the coil to prevent bending of fins and do not use extremely high pressure. Do not use hot water, steam or caustic soap.*

5.2 DRIVER'S HVAC UNIT AIR FILTER

The driver HVAC system is located behind the dashboard's R.H. side lateral plastic panel. To gain access to the A/C filters, unscrew the R.H. lateral console's grill located at the top step of the entrance door steps. Slide out the R/A and F/A filters. To clean filters back flush with water, then dry with air, every 12,000 miles (20 000 km) or once a year, which-ever comes first (Fig. 12).

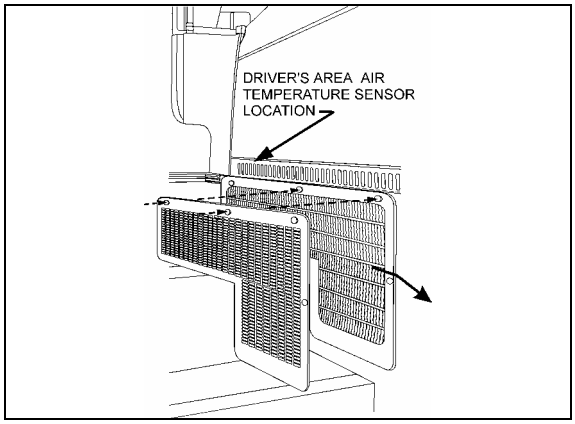



**FIGURE 12: DRIVER'S AREA AIR FILTERS** 22193

5.3 MAIN HVAC UNIT AIR FILTER

The main or cabin air filter is located in the evaporator compartment. To access the filter on XL2 coaches, open baggage compartment door located in front of the evaporator compartment (L.H. side). Open access panel by turning the

three screws of panel ¼ of a turn, unsnap both fasteners on top of filter, and slide out filter (Fig. 13). On MTH, to gain access, open evaporator compartment door. Remove filter panel by unscrewing the six fixing screws. Slide out the filter for cleaning (Fig. 14). To clean filter, back flush with water or soapy water, then dry with air every 12,000 miles (20 000 km) or once a year, whichever comes first.

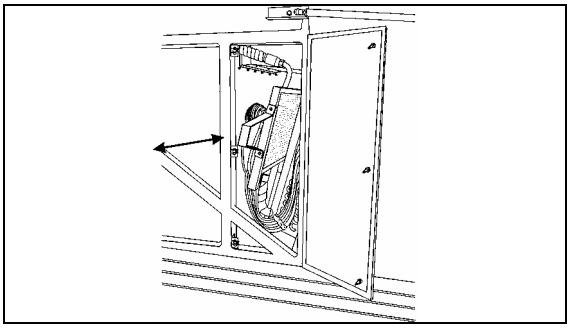


**FIGURE 13: MAIN HVAC UNIT AIR FILTER** 22179

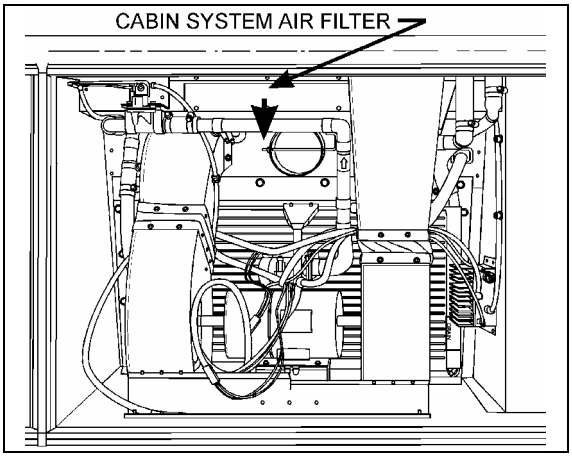



**FIGURE 14: CABIN SYSTEM AIR FILTER REMOVAL** 22178

***Caution**: Do not use high pressure water jet to avoid damaging filter.*

***Caution:** Be sure not to reverse filter upon installation*

5.4 PARCEL RACK FAN AIR FILTER

A/C condenser coils may be installed in both parcel rack air systems. Only the air filters are serviceable. The air filters are accessible from inside the parcel racks. Slide out the filters, then back flush with water, dry with air and replace. This procedure should be done every 12,000 miles (20,000 km) or once a year, whichever come first.

For A/C unit, ball valves are added on supply and return lines in the condenser compartment. They have service port to evacuate the A/C parcel rack circuit. When work has to be done on a evaporator coil unit, it will be easier to remove it and repair it on a bench.

## 6. DIAGNOSIS OF MAIN HVAC UNIT PROBLEMS

### 6.1 TROUBLESHOOTING MODE

Troubleshooting the HVAC system is made easier when entering the *"Troubleshooting Mode"*. The Troubleshooting Mode is used while driving the vehicle to diagnose a low or high pressure in the HVAC system.

To enter the Troubleshooting Mode, proceed as follows:

1. Check that HVAC system in passenger section is OFF.
2. First press A/C and hold, then press ON OFF and hold both buttons for 2 seconds.
3. Passenger section display should indicate 00 to show that Troubleshooting Mode is activated.

***Note:** To return to Normal Operating Mode, turn the HVAC system OFF in the passenger section.*

**Low Pressure**

The Telltale panel located in center dashboard should indicate LO PRESS when pressing A/C on the passenger section panel if a low pressure condition is present.

***Note:** The telltale indicator will only illuminate if Troubleshooting Mode was entered and a low pressure condition is present.*

**High Pressure**

The Telltale panel located in center dashboard should indicate HI PRESS when pressing A/C on the passenger section panel if a high pressure condition is present.

***Note:*** *The telltale indicator will only illuminate if Troubleshooting Mode was entered and a high pressure condition is present.*

6.2 CONTINUITY CHECK

A continuity check is automatically performed at HVAC system start-up. If an open or short-circuit occurs, the corresponding switch LED or the display will blink for 10 seconds. The probes are checked at least every 5 minutes.

| Circuit | Switch LED or Display |
|---|---|
| F/A damper driver | Driver Rec |
| Damper mix<br>Driver "Liquid Solenoid Valve" | Driver air 4th switch<br>Driver display "Set Point" (AC) |
| Driver "Hot Water Valve" | Driver display "Set Point" (HE) |
| Passenger "Hot Water Valve" | Passenger display "Set Point" (HE) |
| A/C Clutch Relay | A/C Clutch |
| Exterior Probe | Display "Text". (---) |
| Driver interior probe | Driver display "Set Point" (---) |
| Passenger interior probe | Passenger display "Set Point" ( |

## 7. EVAPORATOR MOTOR

(Central HVAC system only)

The evaporator motor is installed in the evaporator compartment (L.H. side of vehicle) (Fig. 15). It is a 28.5 volt, 1.5 HP (1.1 kW) motor which activates a double blower fan unit. An evaporator motor speed controller is installed in the evaporator compartment as standard equipment (MTH only).

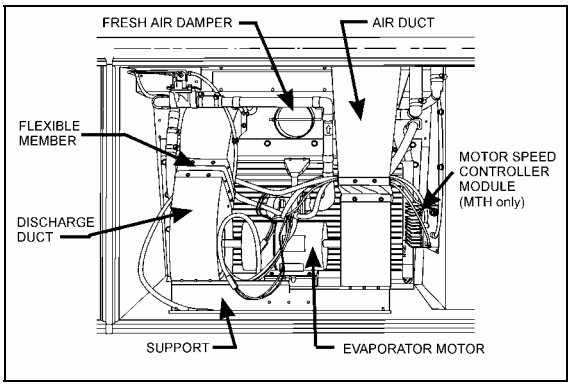



**FIGURE 15: HVAC COMPARTMENT** 22178

7.1 REMOVAL

1. Set the battery master switch to the *"OFF"* position.
2. Open the last L.H. side baggage compartment door. Pull the black release button located on the L.H. side in order to unlock and open the evaporator compartment door.
3. Identify the L.H. side discharge duct inside compartment and remove the Phillips head screws retaining the flexible member to duct.
4. Repeat step 3 for the R.H. side air duct.
5. Disconnect the discharge air sensor connector. Remove the cable tie securing wire.
6. From under the vehicle, remove the eight bolts retaining the evaporator fan motor support. Remove the complete unit from the evaporator compartment (Fig. 16).

***Caution:*** *Never support evaporator motor by its output shafts while moving it.*

7. On a work bench, unscrew the fan square head set screws, the Phillips head screws retaining cages to support and slide out the assemblies from the evaporator motor output shaft.

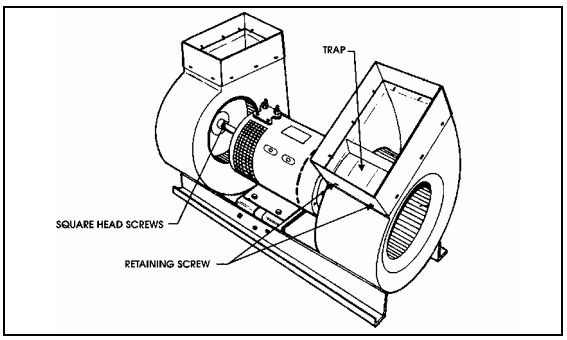



**FIGURE 16: EVAPORATOR MOTOR ASSEMBLY** 22036

7.2 INSTALLATION

To reinstall the evaporator motor, reverse "Evaporator Motor Removal" procedure.

7.3 CHECKING OPERATION OF BRUSH IN HOLDER

Lift brush slightly 1/8 inch (3 mm) and release it. Brush must produce a dry noise.

7.4 BRUSH WEAR INSPECTION AND REPLACEMENT

Replace the brushes if less than ¾ inch (19 mm). New brush length is 1-¼ inch. Clean brushes with a clean cloth impregnated with gasoline or alcohol.

***Warning:*** *Cleaning products are flammable and may explode under certain conditions. Always handle in a well ventilated area.*

To replace brushes, proceed as follows:

1. Set battery master switch to the “OFF” position.
2. Remove the protective screen band from the motor housing by pulling down the spring loaded fastener.
3. Remove and replace brushes as per the standard procedure.
4. Reverse installation procedure.

7.5 CHECKING COMMUTATOR

The surface must be polished. A brown-black colored surface is normal and indicates a good switching. Ensure there is no evidence of arcing or metal chips.

7.6 SPEED CONTROLLER MODULE

The evaporator motor speed controller module is mounted on the R.H. side wall inside the evaporator compartment (MTH only) (Fig. 15). The purpose of this electronic module is to limit the evaporator motor speed to 75% of its full rated speed throughout the heating mode and cooling mode. The module will then gradually increase the motor speed.

## 8. AIR CONDITIONING SYSTEM

The schematic of Figure 17 shows the central and auxiliary A/C system and its components. The central system is equipped with a 6 cylinder, 05G-134A Carrier compressor with an air conditioning capacity of 7½ tons. The receiver tank and filter dryer are mounted inside the condenser compartment.

XL2 Coaches may be supplied with central and auxiliary A/C system (Fig. 17). XL2 Converted vehicles (Shells) may be supplied with central or driver's A/C system only (Fig. 17 and 18). Auxiliary and driver's A/C systems come with a 2 cylinder, HGB-1000 Tecumseh compressor with an air conditioning capacity of 2 tons.

8.1 A/C CYCLE

Refrigeration may be defined as "the transfer of heat from a place where it is not wanted to a place where it is unobjectionable". Components required for a closed circuit refrigeration system are shown in Figures 17 and 18.

The air conditioning system used on XL2 series vehicle is of the *"Closed"* type using *"R-134a".*

1. The refrigerant flowing to the compressor, is compressed to high pressure and reaches a temperature higher than the surrounding air. It is passed through the air-cooled fins and tubes of the condenser causing the hot, high pressure gas to be condensed into a liquid form.
2. The liquid refrigerant flows to the receiver tank, then through a filter dryer where moisture, acids and dirt are removed. It is passed through a moisture indicator which indicates if any moisture is present in the system.

3. By its own pressure, the liquid refrigerant flows through a thermal expansion valve where the pressure drop causes the refrigerant to vaporize in a vapor-liquid state at a low temperature pressure.
4. The cold low pressure refrigerant passes through the main and the driver's evaporator coils which absorbs heat from the air passing over the fins and tubes, and changes into gas. In this form, the refrigerant is drawn into the compressor to repeat the air conditioning cycle.
5. The success of the air conditioning system depends on retaining the conditioned air within the vehicle. All windows and intake vents should be closed. An opening of approximately 8 $in^2$ (5162 $mm^2$) could easily neutralize the total capacity of the system.
6. Other causes of inadequate cooling are dirty coils or filter. Dirt acts as an insulation and is also serves as a restriction to the air flow.
7. The refrigeration load is not constant and varies. It is also affected by outside temperature, relative humidity, passenger load, compressor speed, the number of stops, etc.
8. The compressor will load or unload depending on operating conditions.

## 8.2 REFRIGERANT

The A/C system of this vehicle has been designed to use Refrigerant 134a as a medium. Regardless of the brand, only R-134a must be used in this system. The chemical name for this refrigerant is Ethane, 1, 1, 1, 2-Tetrafluoro.

***Warning:*** *Refrigerant in itself is nonflammable, but if it comes in contact with an open flame, it will decompose.*

### 8.2.1 Procurement

Refrigerant is shipped and stored in metal cylinders. It is serviced in 30 and 100 pound (13,6 and 45 kg) cylinders. Approximately 24 pounds (10,9 kg) are used in the system. If vehicle is equipped with only a driver's A/C system, then 5.6 lbs (2,6 kg) are used and approximately 4 lbs (1,8 kg) are used in an auxiliary A/C system.

It will be impossible to draw all the refrigerant out of the cylinder. However, the use of warm water when charging the system will assure the extraction of a maximum amount of refrigerant from the cylinder.

### 8.2.2 Precautions in Handling Refrigerant

1. Do not leave refrigerant cylinder uncapped.
2. Do not subject cylinder to high temperatures, do not weld or steam clean near system or cylinder.
3. Do not fill cylinder completely.
4. Do not discharge vapor into an area where a flame is exposed.
5. Do not expose the eyes to liquid refrigerant.

All refrigerant cylinders are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is a good practice to replace the cap after each use of the cylinder for the same reason. If the cylinder is exposed to the sun's radiant heat pressure increase resulting may cause release of the safety plug or the cylinder may burst.

For the same reason, the refrigerant cylinder should never be subjected to excessive temperature when charging a system. The refrigerant cylinder should be heated for charging purposes by placing it in 125°F (52°C) water. Never heat above 125°F (52°C) or use a blowtorch, radiator, or stove to heat the cylinder. Welding or steam cleaning on or near any refrigerant line or components of the A/C system could build up dangerous and damaging pressures in the system.

If a small cylinder is ever filled from a large one, never fill the cylinder completely. Space should always be allowed above the liquid for expansion. Weighing cylinders before and during the transfer will determine the fullness of the cylinders

***Warning:*** *One of the most important precautions when handling refrigerant consists in protecting the eyes. Any liquid refrigerant which may accidentally escape is approximately -40°F (-40°C). If refrigerant comes in contact with the eyes, serious injury could result. Always wear goggles to protect the eyes when opening refrigerant connections.*

8.2.3 Treatment in Case of Injury

If liquid refrigerant comes in contact with the skin, treat the injury as if the skin was frost-bitten or frozen. If liquid refrigerant comes in contact with the eyes, consult an eye specialist or doctor immediately. Give the following first aid treatment:

1. Do not rub the eyes. Splash eyes with cold water to gradually bring the temperature above the freezing point.
2. Apply drops of sterile mineral oil (obtainable at any drugstore) in the eyes to reduce the possibility of infection. The mineral oil will also help in absorbing the refrigerant.

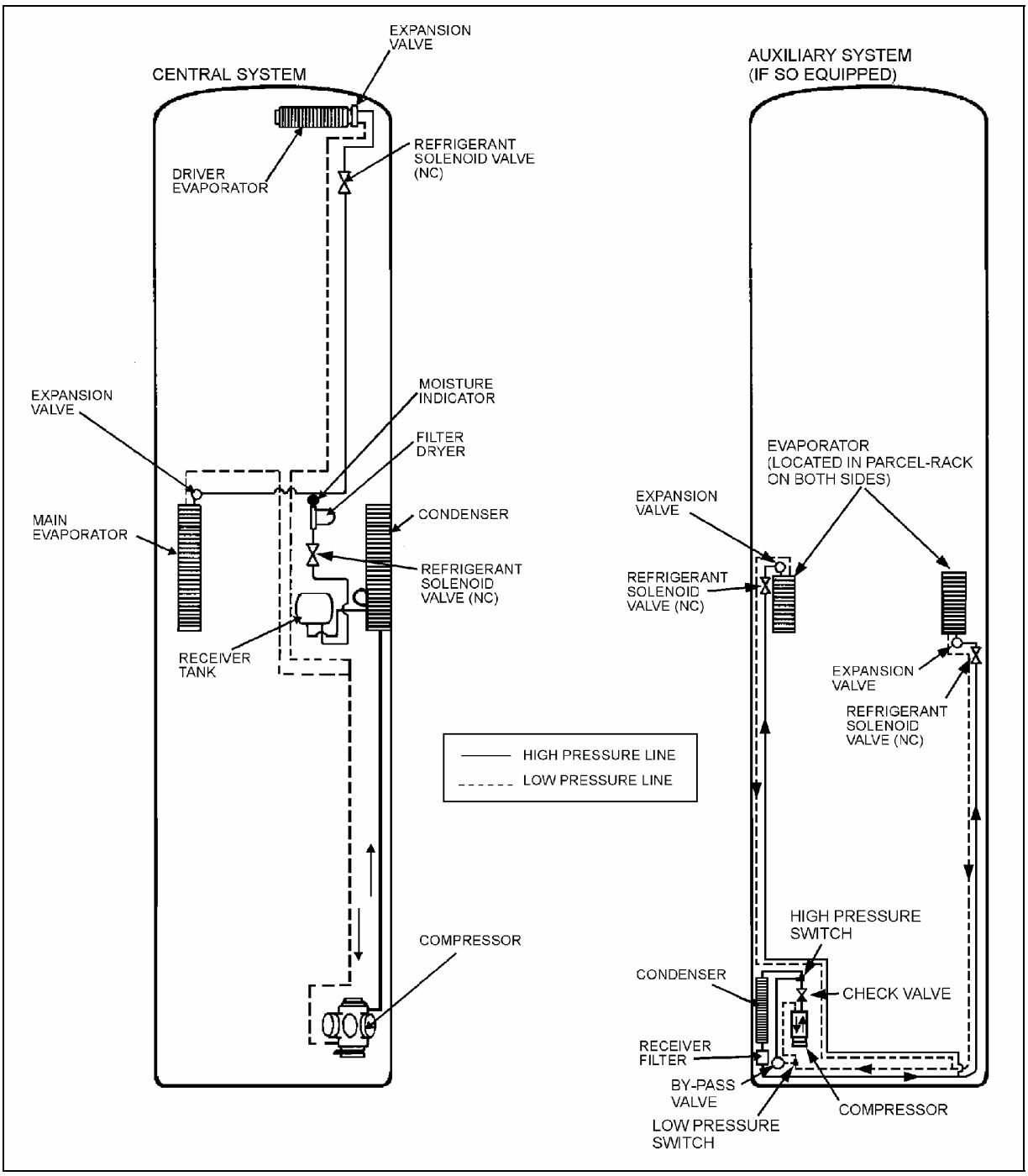



**FIGURE 17: REFRIGERANT CIRCUIT (CENTRAL AND AUXILIARY SYSTEMS)** 22196

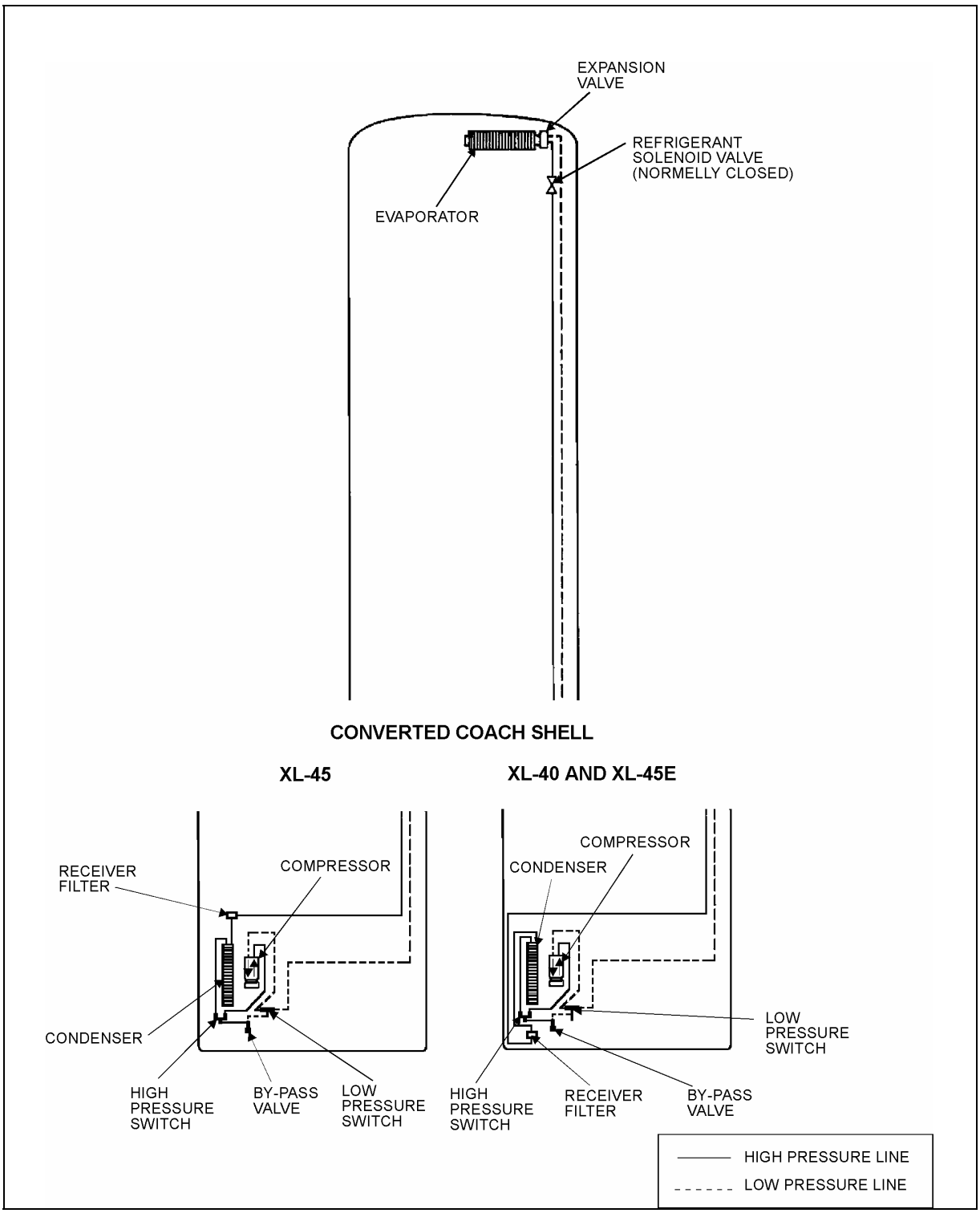



**FIGURE 18: REFRIGERANT CIRCUIT (DRIVER'S AUXILIARY SYSTEM)** 22071

8.2.4 Precautions in Handling Refrigerant Lines

1. All metal tubing lines should be free of kinks, because of the resulting restrictions on the flow of refrigerant. A single kink can greatly reduced the refrigeration capacity of the entire system.
2. The flexible hose lines should never be allowed to come within a distance of 2-½" (6,3 cm) from the exhaust manifold.
3. Use only sealed lines from parts stock.
4. When disconnecting any fitting in the refrigeration system, the system must first be discharged of all refrigerant. However, proceed very cautiously, regardless of gauge readings. If there happens to be liquid refrigerant in the line, disconnect fittings very slowly, keeping face and hands away so that no injury can occur. If pressure is noticed when fitting is loosened, allow it to bleed off very slowly.

***Warning**: Always wear safety goggles when opening refrigerant lines.*

5. In the event that any line is opened to the atmosphere, it should be immediately capped to prevent entrance of moisture and dirt.
6. The use of the proper wrenches when making connections on O-ring fittings is important. The use of improper wrenches may damage the connection. The opposing fitting should always be backed up with a wrench to prevent distortion of connection lines or components. When connecting the flexible hose connections, it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three different wrenches to prevent turning the fitting and damaging the ground seat.
7. The O-rings and seats must be in perfect condition. The slightest burr or piece of dirt may cause a leak.
8. O-rings should be coated with refrigeration oil and installed on the line before the line is inserted into the fitting to prevent damaging the O-ring. If leaks are encountered at the couplings or connectors, no attempt should be made to correct the leaks by tightening the connections beyond the recommended torque. The O-rings are designed to seal at the specified torque and overtightening the connection does not result in a satisfactory and permanently sealed connection. The connection must be disassembled and the cause of the leak (damaged O-ring, defective lines, etc.) corrected. Use new O-ring.

8.2.5 Auxiliary System Refrigerant Lines

- From the inside of the coach, remove the mirror located inside the lavatory to access the Y connector separating the system two sides. Also a small access panel located in front of the lavatory entrance door, near the ceiling enables to reach the R.H. side supply and return line fittings.
- The L.H. side supply and return line fittings are accessible by removing the rearmost overhead storage compartment separator.

8.3 PUMPING DOWN

This procedure is intended to reduce refrigerant loss, on central system only, by isolating it in the compressor and the receiver tank, as well as in their connecting line, in order to carry out repairs on other sections of the air conditioning system (lines and components).

***Note:** Before attempting any repair between compressor and receiver tank, use a recovery unit to remove refrigerant from the system.*

***Note:** On vehicles equipped with an auxiliary or driver's A/C system only, it is not possible to isolate refrigerant except to add oil. See Tecumseh compressor "Oil Verification", further in this section.*

***Warning:** To prevent any injury, when air conditioning system must be opened, refer to previous paragraph "PRECAUTIONS IN HANDLING REFRIGERANT".*

***Caution:** The filter dryer must be changed each time a line in the system is opened.*

**Procedure**

1. Energize passenger side liquid solenoid valve.
2. Run the system for 10 minutes, shut it OFF, then close the receiver tank outlet valve by turning it clockwise, backseat the suction service valve on the compressor, install an appropriate pressure gauge set, and turn the valve forward ¼ turn to enable a visual check of the suction pressure.
3. Disconnect the *"Low Pressure Switch"* connector (mounted near the A/C compressor, and install a jumper wire.

***Note:*** *This jumper wire will allow the clutch to remain engaged after pressure drops below 15 psi (103,5kPa).*

4. Start the engine, press the *"Passenger ON/OFF"* switch then the A/C switch, adjust *"A/C Temperature"* control to maximum A/C.
5. Run the compressor until pressure reaches 1-2 psi (7-14 kPa).

***Note:*** *During this operation, care must be taken not to fill the receiver tank over the upper sight glass. If so, stop process immediately. Always allow refrigerant piping and units to warm up to the ambient air temperature before opening system or sweating will take place inside the lines.*

5. Stop engine, and close compressor outlet valve by turning it clockwise until valve is properly seated.
6. Close compressor suction valve by turning it clockwise until it is properly seated.
7. Wait until pressure gauge reaches 1 to 2 psi (7 to 14 kPa). To accelerate procedure, lightly open compressor suction valve until pressure reaches this value.

### 8.4 ADDING REFRIGERANT (VAPOR STATE)

Use the suction service valve on the compressor to add a small quantity of refrigerant to the system. Backseat the valve and connect a charging line from the refrigerant cylinder to the valve. Tighten connection at level of refrigerant cylinder and open tank end slightly to purge air from the charging line. Tighten the charging line at the compressor. Screw in the stem of suction valve approximately two turns. Start the engine and run at fast idle. Add sufficient refrigerant to bring the level in lower sight glass of receiver tank to mid-point. Always charge the system with the cylinder upright and the valve on top to avoid drawing liquid out of the cylinder.

### 8.5 EVACUATING SYSTEM

1. Open both receiver valves by turning "out" (normal position).
2. Remove the caps from the two 90° adapters on the suction, discharge valves and connect two hoses to the vacuum.
3. Place the two compressor valves, suction and discharge, in neutral position by turning each one 3 to 4 turns "in" from the "out" position.
4. Open the solenoid valve by energizing or manually bypass.
5. Start the vacuum pump. Open the large (suction) shutoff valve and close the small vacuum gauge valve.
6. The pressure will drop to approximately 29 inches vacuum (14.2 psi or 97,9 kPa) (the dial gauge only gives a general idea of the absolute system pressure.
7. Backseat the compressor valves by turning "out" all the way.
8. Shut down the vacuum pump.
9. Remove the hoses.
10. Reinstall the caps at the suction valve take-off points.

#### 8.5.1 Double Sweep Evacuation Procedure

1. Remove any remaining refrigerant from the system using a refrigerant recovery machine.
2. Connect the evacuation manifold, vacuum pump, hoses and micron gauge to the unit.
3. With the unit service valves closed (back seated) and the vacuum pump and the thermistor valves open, start the pump and draw the manifold and hoses into a very

deep vacuum. Shut the vacuum pump off and see if the vacuum holds. This is to check the setup for leaks.

4. Midseat the system service valves.
5. Open the vacuum pump and the thermistor valves. Start the pump and evacuate to a system pressure of 2000 microns.
6. Close the vacuum pump and the thermistor valves, turn off the vacuum pump (closing the thermistor valve protect the valve from damage).
7. Break the vacuum with clean refrigerant (or dry nitrogen) and raise the pressure to approximately 2 PSIG. Monitor the pressure with the compound gauge.
8. Remove the refrigerant with the recovery machine.
9. Repeat steps #5 – 8 one time.
10. After the second “sweep”, change the filter drier (if you have not done so) and evacuate to 500 microns.
11. Evacuating the system below 500 microns on systems using the Carrier 05G compressor may risk drawing air into the system past the carbon shaft seal.
12. Check to insure that vacuum holds. (If the pressure continues to rise, it indicates a leak or moisture in the system).
13. Charge the system with the proper amount of refrigerant using recommended charging procedures.

***Note:*** *This method will aid in preventing unnecessary system failures by ensuring that the refrigeration system is free of contaminants.*

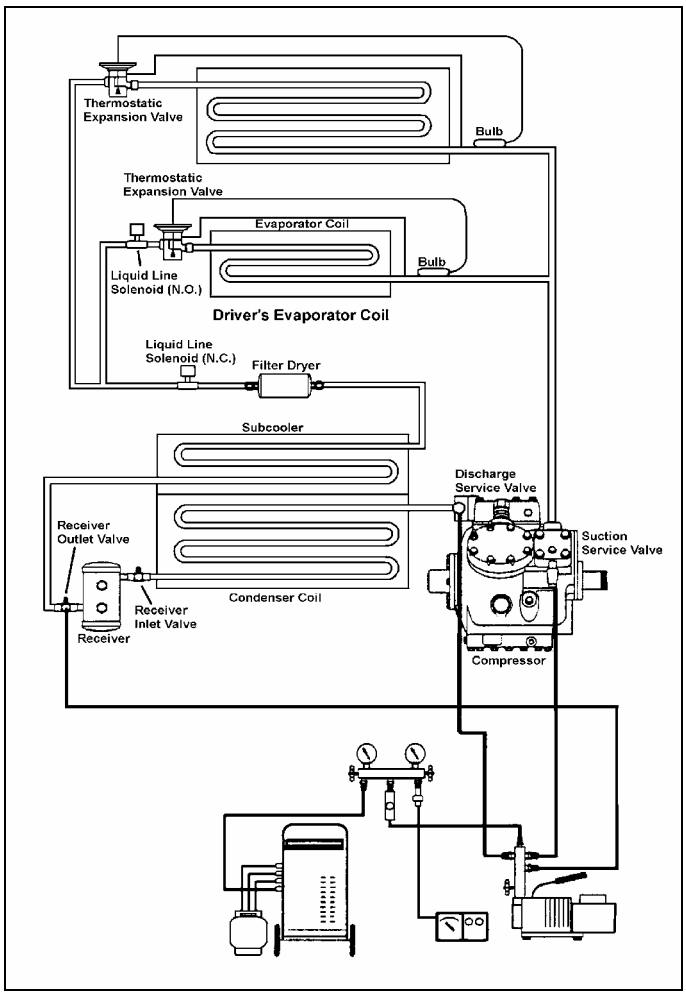



**FIGURE 19: DOUBLE SWEEP EVACUATION SET-UP**

8.5.2 Evacuating System Before Adding Refrigerant (Driver's or Auxiliary System)

When a system has been opened, to check for leaks or if there are any questions about the air or moisture in the system, evacuate the system. XL2-40 Coaches, XL2 MTH-40 and 45E equipped with a driver's or auxiliary system must use the service port located just above rear L.H. side door in engine compartment to perform the evacuation (Fig. 20).

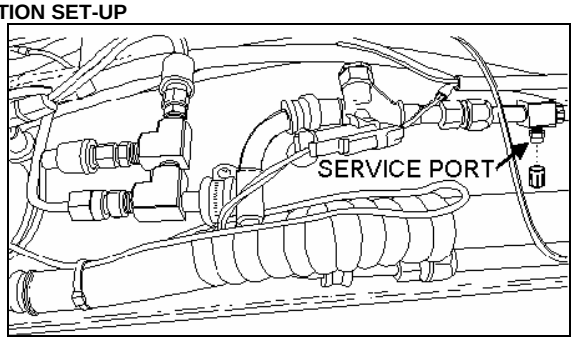



**FIGURE 20: LOCATION OF SERVICE PORT** 22194

1. Connect two hoses equipped with a micron gauge between the compressor suction valve, the service port and the vacuum pump.
2. With the unit service valves closed (back seated) and the vacuum pump valves open, start the pump and draw the manifold and

hoses into a very deep vacuum. Shut the vacuum pump off and see if the vacuum holds. This is to check the setup for leaks.

3. Place the compressor suction valve and service port in neutral position by turning each one 3 to 4 turns “in” from the “out” position.
4. Start the vacuum pump and evacuate to a system pressure below 500 microns.
5. Shut down the vacuum pump.
6. Check to insure that vacuum holds. (If the pressure continues to rise, it indicates a leak or moisture in the system).
7. Backseat the compressor suction valve and service port by turning “out” all the way.
8. Charge the system with the proper amount of refrigerant through the service port near the check valve using recommended charging procedures.
9. Remove the hoses.

## 8.6 CHARGING SYSTEM

When a system has been opened or if there are any questions about the air or moisture in the system, evacuate the system. Charging of an evacuated system may be accomplished by forcing liquid R-134a directly into the receiver tank. This may be accomplished by placing the refrigerant cylinder upside down on a scale with the valves at the bottom. This ensures that only liquid will enter the receiver tank.

When charging an empty system, weigh the amount of refrigerant put into the system. This will eliminate any possibility of overfilling. A nominal charge requires 24 pounds (10,9 kg). If the vehicle is equipped with an auxiliary system, a full charge requires 5.6 lbs (2,6 kg), if the vehicle is equipped with a driver's system only, the system requires 4 lbs (1,8 kg).

1. Backseat the two compressor shutoff valves ("out").
2. Install the test gauges at the shutoff valves noting that the 400 psi (2758 kPa) gauge is connected to the discharge.
3. Turn in the two shutoff valves 3 to 4 turns.
4. Open the lower receiver valve by turning “out” all the way.
5. Backseat the upper receiver valve by turning out all the way.
6. Remove the cover cap from the service fitting in the top receiver valve.
7. Attach a charging hose to the R-134a tank. Open the tank valve slightly permitting R-134a to escape thus purging the hose of air.
8. Connect the charging hose to the service fitting.
9. Open the R-134a tank valve.
10. To build up pressure in the receiver tank, heat the receiver tank with a heating blanket.
11. Turn in the upper receiver valve several turns. The R-134a will now enter the system.
12. The proper charge of R-134a is 24 lbs (10.89 kg). When the scale indicates this amount of charge, backseat the receiver valve and close the R-134a tank valve.
13. Disconnect the charging hose. Replace the cover caps.
14. The system is now ready for operation.

***Caution:*** *The evacuation of the system must be made by authorized and qualified personnel only. Refer to local laws for R-134a recuperation.*

## 8.7 REFRIGERANT SYSTEM CLEAN-OUT AFTER COMPRESSOR FAILURE

Although the vast majority of reciprocating refrigerant compressors manufactured today are extremely reliable, a small percentage do fail. These failures usually result in minor or extensive system contamination depending on the severity of the failure. When an open type compressor becomes damaged internally, this provokes small particles of bearings, steel, brass, copper, and aluminum and, in severe cases, carbonized oil, which could contaminate the system. To prevent repeated failures, the problem which caused the failure should be

corrected, and depending upon the severity of the failure, the system should be thoroughly cleaned out using one of the clean-out procedures mentioned.

8.7.1 Determining Severity of Failure

The severity of compressor failure can be categorized as minor or major. A failure is considered minor when the contamination is limited to the compressor with little or no system contamination. A major failure, or burnout, results in extensive system contamination as well as compressor damage. Extensive system contamination can be determined by withdrawing a small sample of compressor oil and checking its color, odor and acidity. A Virginia Chemical "TKO" one step acid test kit is one of several compressor oil test kits that may be used. A high acid content would indicate a major failure or burnout. A small amount of refrigerant gas may be discharged. A characteristic burned odor would also indicate severe system contamination.

8.7.2 Clean-out after Minor Compressor Failure

1. Be sure to correct the problem which caused the failure.
2. Change liquid line filter dryer
3. Run the unit for 2 hours on high speed cool only.
4. Check compressor oil level to ensure compressor is not overcharged with oil. Sometimes a significant amount of oil is pumped out of the compressor to other parts of the system when a compressor fails. This oil will return to the replacement compressor when it is started, causing an overcharge of oil in the sump of the replacement compressor. In this case, it is important that the oil level be adjusted to the proper level.
5. Withdraw a sample of the compressor oil and check its color, odor, and acidity, using instructions supplied above. If the oil is contaminated, change the oil and filter dryer, and repeat the procedure until the system is clean.

8.7.3 Clean-out After Major Compressor Failure

1. Reclaim the refrigerant into a refrigerant bottle through a filter dryer to filter out contaminants.
2. Remove the failed compressor and repair it if possible.
3. Install new or repaired compressor.
4. Change the filter dryer.
5. Circulate clean R-134a or nitrogen with the reclaimer to clean out many of the contaminants collected in the coil valves, TXV (Thermal Expansion Valve), solenoid valves, check valves, and any other mechanical component that may have collected contaminants.
6. Evacuate and charge the system normally.
7. Run the unit for 8 hours and monitor the pressure drop across the filter dryer. Also check the liquid line dryer for signs of restriction. If the pressure drop across the filter dryer exceeds 12 to 14 psig (82,75 to 96,5 kPa) with a 40°F (5°C) evaporator coil temperature, stop the unit and change the liquid line and suction line filter dryer. After 4 or 5 hours of operation, stop the unit and replace the filter dryer.
8. After 8 hours of operation, stop the unit and remove a sample of the compressor oil and check its color, odor, and acidity, using instructions supplied above. If the oil is contaminated, replace the oil and repeat step 7. If the oil is not contaminated, change the filter dryer again and replace the moisture-liquid indicator.
9. After approximately 7 days of operation, recheck the compressor oil for cleanliness and acidity.

## 9. A/C SYSTEM COMPONENTS

### 9.1 COMPRESSOR (CENTRAL SYSTEM)

#### 9.1.1 Belt Replacement

***Warning:*** *Set the battery master switch to the "Off" position. For greater safety, set the engine starter selector switch in engine compartment to the "Off" position.*

1. Open engine compartment rear doors and locate the belt tensioner pressure releasing valve (Fig. 21), mounted above the engine R.H. side door next to the air pressure regulator, then turn handle counterclockwise in order to release pressure and tension on belts.
2. Slip the old belts off and the new ones on.
3. Reset belt tensioner pressure releasing valve (Fig. 21) to 55 psi (380 kPa) for Series 60 engines to apply tension on the new belts as explained in Section 12.

***Note:*** *Both belts must always be replaced simultaneously to ensure an equal distribution of load on each of them.*

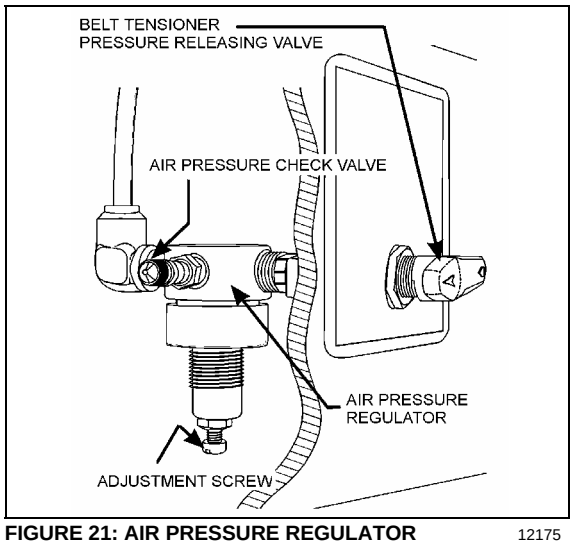



**FIGURE 21: AIR PRESSURE REGULATOR** 12175

***Note:*** *For proper operation of the air bellows, adjust the* ***upper*** *tensioning bracket to provide a "2 3/8 - 2 ½" (60-64 mm) extension with the pneumatic system under normal pressure and the air pressure regulator set as per paragraph #3 (Fig. 22).*

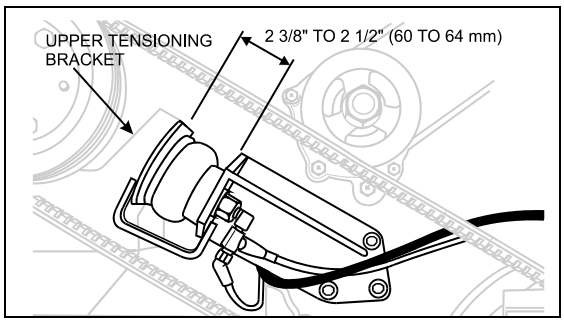



**FIGURE 22: BELT TENSIONER** 01059

#### 9.1.2 Pulley Alignment

In order to avoid skipping, disengagement and a premature wear of compressor belt, it is necessary to align compressor pulley with the crankshaft pulley. Before performing the following procedure, release air from belt tensioners by means of the air pressure releasing valve. After completing these procedures reset belt tensioner air pressure regulator to 55 psi (380 kPa) for Series 60 engines.

#### 9.1.3 Longitudinal Compressor Alignment

1. Rest an extremity of a straight edge of approximately 46 inches (117 cm) against the upper part of the outer face of crankshaft pulley, positioning the other end close to the compressor clutch pulley (Figs. 23 & 24).
2. Check the distance between each extremity of straight edge (1. Fig. 24) and the first drive belt. If they are different, loosen the compressor support bolts and with a hammer, knock support to slide it in order to obtain the same distance; then tighten bolts.

#### 9.1.4 Horizontal Compressor Alignment

1. Rest an extremity of the straight edge against the upper part of the outer face of compressor pulley, positioning the other end close to the crankshaft pulley.
2. Check the distance between each extremity of straight edge (1, Fig. 24) and drive belt. If they are different, loosen the pillow block compressor bolts and with a hammer, knock compressor pillow block to slide it, in order

to obtain the same distance; then tighten bolts.

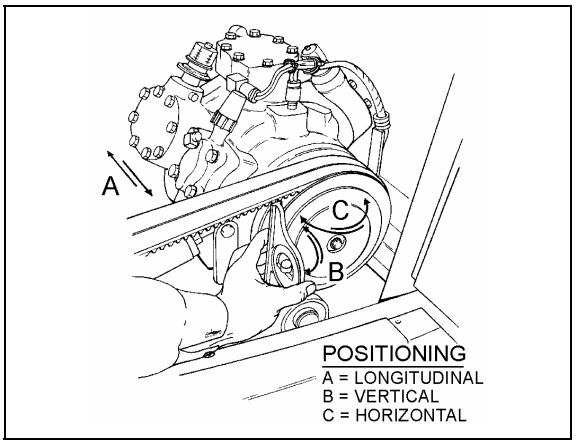



**FIGURE 23: COMPRESSOR ALIGNMENT** 22072

9.1.5 Vertical Compressor Alignment

Rest a short "angle and level indicator" on the outer side face of the crankshaft pulley, adjust the level indicator inclination at 0° and check if the compressor pulley is at same angle (Figs. 23 & 24). If it is not the same, shim under the appropriate pillow block in order to obtain the correct angle.

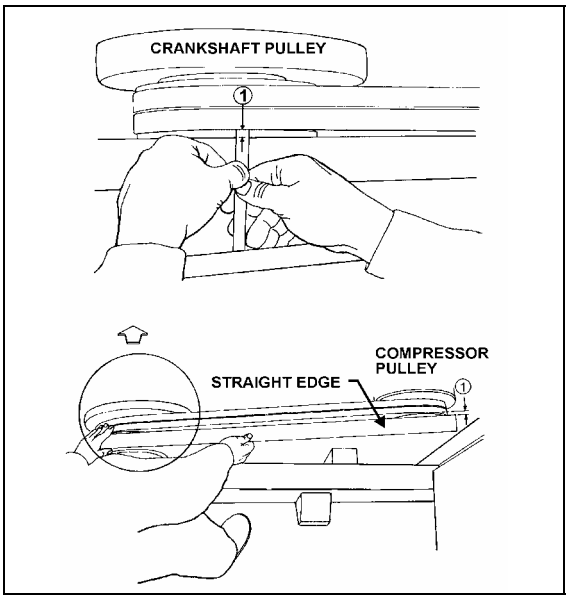



**FIGURE 24: COMPRESSOR ALIGNMENT** 22040

9.1.6 Compressor Maintenance

For the maintenance of the A/C compressor, see the *"Carrier Compressor Operation and Service Manual"* included at the end of this section.

***Caution:*** *Use only Castrol SW 68 (POE) oils with refrigerant 134a.*

9.1.7 Troubleshooting Guide

A preliminary check may be made by simply feeling the cylinder heads with the unit in operation at ambient temperatures of 35°F (2°C) and over. The cylinder heads are internally divided into suction and discharge valves. The lower half of the cylinder head is the suction side, and it should be relatively cool to the touch, as opposed to the hot upper discharge side. If a valve plate or head gasket is blown, or a compressor unloader is stuck open, partially compressed refrigerant vapor will be circulated between the suction and discharge sides of the head. The affected cylinder head will then have a relatively even temperature across its surface and be neither as hot as the normal discharge temperature nor as cool as the normal suction temperature.

**Blown Head Gaskets**

Symptom:

- Loss of unit capacity at low temperature.
- Even cylinder head temperature.

Cause:

- Improperly torqued cylinder head bolts.
- Improperly positioned gasket at assembly.
- Warped cylinder head.
- Severe liquid refrigerant floodback.

**Blown Valve Plate Gaskets**

Symptom:

- Loss of unit capacity at medium and low temperatures.

- Very hot cylinder head surface.
- Higher than normal suction pressure.

Cause:

- Improperly torqued cylinder head bolts.
- Severe liquid refrigerant floodback.
- Oil slugging caused by an overcharge of oil or flood starts.
- Discharge valves not seated properly (liquid drainback during shutdown).

**Broken Suction Valves**

Symptom:

- Loss of unit capacity at all temperatures.
- Compressor unable to pull extremely low vacuum with suction service valve frontseated.

Cause:

- Repeated liquid refrigerant floodback.
- Flooded starts.
- Overcharge of oil.
- Discharge valves not seated properly (liquid drainback during shutdown).
- Expansion valve not controlling properly.

**Unloader Valve Stuck Open**

Symptom:

- Loss of unit capacity at all temperatures.
- Higher than normal suction pressure.
- Even cylinder head temperature.

Cause:

- Unloader body stem bent.
- Foreign material binding unloader piston or plunger.

9.2 MAGNETIC CLUTCH

Refer to Carrier service information entitled "Housing-Mounted Electric Clutch" at the end of this section for the description and maintenance of the magnetic clutch.

9.2.1 HVAC Control Unit and Clutch Operation

When A/C system is actuated using switch, the corresponding switch LED will turn on, the A/C ON indicator LED will turn on and the clutch will engage.

***Note:*** *If the outside temperature is inferior to 25°F (-4°C), the A/C ON indicator LED will turn off and the clutch will disengage. The indicator LED will turn back on and the clutch will reengage when the outside temperature reaches 35°F (2°C).*

The A/C ON indicator LED will also turn off and the clutch will disengage if a low (5 – 30 psi) or a high pressure (350 – 245 psi) condition is present.

***Note:*** *You must first enter the Troubleshooting Mode to be able to visualize on the telltale panel the low or high pressure condition (refer to paragraph 6.1).*

***Note:*** *The indicator LED will turn back on and the clutch will reengage 45 seconds after the low or high pressure condition was corrected.*

9.3 COMPRESSOR (DRIVER'S SYSTEM ONLY)

Clutch Pulley Installation

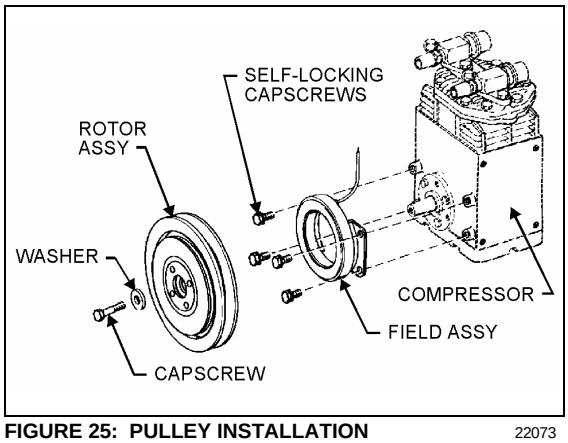



**FIGURE 25: PULLEY INSTALLATION** 22073

To install the clutch pulley, proceed as follows:

1. Position the field assembly against the compressor bosses, aligning the field

mounting holes with the bolt holes in the bosses (Fig. 25). Insert four (4) self-locking cap screws, supplied with the clutch, into the bolt holes of the compressor. Tighten the cap screws to a wrench torque of 7/10 lbf•ft (9,5/13,5 N•m). Take care not to strip the threads in the compressor body.

2. The compressor shaft must be clean and free of burrs. Check the Woodruff key for proper position and seating.
3. Slide the rotor pulley assembly onto the tapered shaft (aligning the keyway with the Woodruff key in the shaft). Secure the rotor pulley assembly with the washer and self-locking cap screw to a wrench torque of 15/20 lbf•ft (20/27 N•m).
4. Rotate the pulley assembly manually to ensure that there is no interference between the field and rotor. If interference is present, a rubbing noise can be heard as the pulley rotates. If interference is present, disassemble the clutch and repeat the installation of the field assembly.

#### 9.3.1 Clutch Pulley Removal

To disassemble the rotor-pulley assembly from the compressor, remove the self-locking cap screw and washer and insert a 5/8-11 UNC-2B cap screw in the threaded portion of the hub. The pressure exerted by the cap screw on the end of the compressor shaft will force off the rotor pulley assembly without damaging the clutch or compressor. ***DO NOT USE*** a wheel puller on the outer diameter of the pulley, since this can result in damage to the clutch bearing.

#### 9.3.2 Clutch Maintenance

The compressor clutch automatically compensates for wear, requiring no adjustment throughout the life of the clutch. ***DO NOT*** lubricate the unit. If the clutch should fail to operate, check the electrical circuit.

#### 9.3.3 Belt Replacement

***Warning:*** *Set the battery master switch to the "OFF" position, then for greater safety, set the engine starter selector switch in engine compartment to the "OFF" position.*

1. Open engine compartment rear doors.
2. Loosen tension retaining bolt.
3. Replace compressor belt.
4. Tighten belt to 60/65 lbf•in (6,5/7 N•m) (Fig. 26), using a belt tension gauge, as per *"Instruction Sheet IS94056"*, then tighten tension retaining bolt.

***Note:*** *Since new belts stretch with normal wear, readjust tension after a run-in period of 500 miles (800 km), if necessary.*

#### 9.3.4 Pulley Alignment

In order to avoid skipping, disengagement or premature edge wear of compressor belt, it is necessary to align fan gearbox and compressor pulleys.

1. Rest an extremity of a straight edge on fan gearbox pulley's flat surface, then place the other end of straight edge near compressor clutch pulley.
2. Check the distance between the straight edge and the belt at both pulleys *(Take note that pulleys outer edges do not have the same thickness)*. If they do not match, loosen fan gearbox pulley and adjust accordingly.

***Note:*** *Fan gearbox pulley is of the "Tapered" type and will move out 1/16" (2 mm) after tightening.*

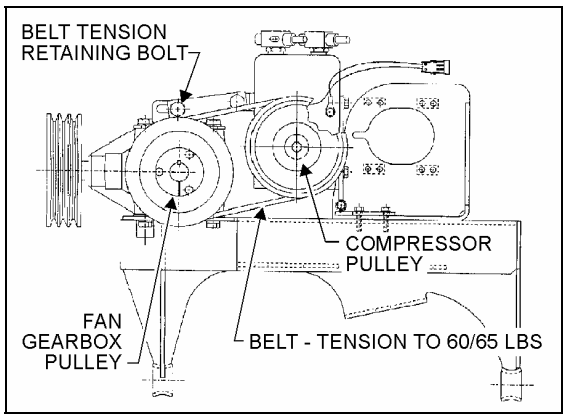



**FIGURE 26: A/C COMPRESSOR (DRIVER'S OR AUXILIARY SYSTEM)** 05018A

9.3.5 Oil Verification (Tecumseh Compressor)

To add oil, first evacuate the compressor as per the following instructions:

1. Backseat the suction and discharge valves on the compressor, install an appropriate pressure gauge set, then turn the valve clockwise until it is properly seated and also to enable a visual check of the suction pressure.
2. Evacuate the system through the pressure gauge set tube.
3. Unscrew oil fill plug (identified *"OIL"*) and insert a slightly arced, disposable gauge (wood, cardboard, etc.) down to the bottom. The oil level must be ½" (13 mm) from the bottom. This level is equivalent to 10 US oz (295 ml) of oil. For more information, see *"11. SPECIFICATIONS"* at the end of this section.
4. Backseat the suction and discharge valves, remove the pressure gauge set, then turn both valves clockwise, midway between frontseated and backseated position.

9.4 CONDENSER

The central A/C system condenser coil is hinge mounted on the R.H. side of the vehicle on the A/C condenser door (Fig. 28). The condenser coil for vehicles equipped with an auxiliary or a driver's A/C system only, is mounted on the outer face of engine radiator. Since condenser's purpose is to dissipate heat from the hot refrigerant, it is important to keep the cooling coils and fins clean. A clogged coil will cause high discharge pressure and insufficient cooling.

9.4.1 Condenser Fan Motors

Two fan motors (Fig. 27), 28.5 V - (0.6 HP - 0.42 kW) and cages are installed in the condenser compartment on R.H. side of vehicle in order to ventilate the condenser coil. They are mounted on a support, fastened to the floor. The fans pull outside air through the condenser coil and discharge it through an opening at bottom of compartment. When temperature drops inside condenser, the pressure in the refrigerant line also drops and it is, therefore, no longer required to cool condenser. Consequently, when pressure drops to 130 psi, the motors will run at low speed and if the pressure continues to drop to 90 psi, a pressure switch stops the motors so that fans do not operate needlessly. When pressure rises to 120 psi, the pressure switch reactivates the motors. If the pressure rises to 170 psi, the motors will switch to high speed.

For details about electrical wiring, refer to *"A/C and Heat system"* in the master wiring diagram.

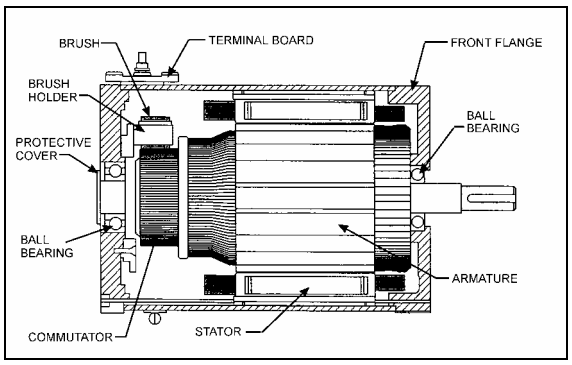



**FIGURE 27: CONDENSER FAN MOTOR** 22180

9.4.2 Condenser Fan Motor Removal

1. Set the battery master switch to the *"Off"* position.
2. Remove the two *"Phillips"* head screws retaining the fan motor protective cover to the square tubing. Remove the protective grill from mounting support.
3. Disconnect wiring from terminals on motor. Tag each wire to aid in identification at time of reconnection.

4. Support motor, and remove bolts which attach motor to mounting bracket. Remove the motor.

9.4.3 Preliminary Disassembly

1. Remove the brushes.
2. Unscrew the flange retaining screws on the shaft end side (opposite to the commutator end frame), and separate flange from frame (Fig. 27).
3. Remove flange and armature assembly by pushing bearing shaft toward the commutator end frame.
4. Separate flange from armature.

9.4.4 Disassembly

1. Perform preliminary disassembly.
2. Carefully note the position of the brush holder ring and the connections on the flange support.
3. Unscrew and remove the flange on the commutator end frame.
4. Remove the brush holder ring.
5. Finally, separate the following parts: brush holders, brush boxes, terminal board, bearings, etc…

9.5 RECEIVER TANK

The receiver tank is located in the condenser compartment (Fig. 28). The function of the receiver tank is to store the liquid refrigerant. During normal operation, the level of the refrigerant should be approximately at the mid-point of the lower sight glass.

In case of extreme pressure there will be a rise in the liquid receiver tank. A pressure relief valve will break at 450 psi (3103 kPa) and relieve the receiver tank pressure.

The receiver tank incorporates an inlet valve on the inlet side (upper section) which allows the tank to be isolated or serviced. An outlet valve on the outlet side (lower section) permits complete isolation from the rest of the system.

***Note:*** *For vehicles equipped with an auxiliary or driver's A/C system only, see receiver-filter, as described below under "Filter Dryer".*

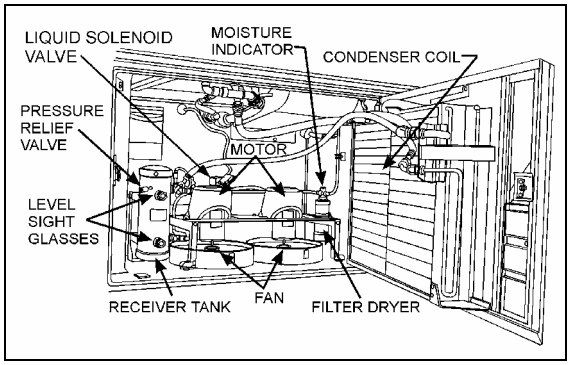



**FIGURE 28: A/C CONDENSER COMPARTMENT** 22174

9.6 FILTER DRYER

A filter dryer, also located in the condenser compartment, is installed on the liquid refrigerant line after the receiver tank. It is used to absorb moisture and foreign matter from refrigerant before it reaches the expansion valves.

The filter should be replaced if the system has been opened or after a prolonged exposure, when the moisture indicator sight glass turns to pink.

A receiver-filter, located close to engine compartment L.H. side rear door, is installed on vehicles equipped with an auxiliary A/C system or a driver's system only. Its function is similar to that of filter and receiver used on main systems. Replace only when system is opened or a problem occurs.

***Note:*** *On XL2-45 vehicles, the receiver-filter is installed on wheel housing, inside L.H. side rear service compartment (Fig. 29).*

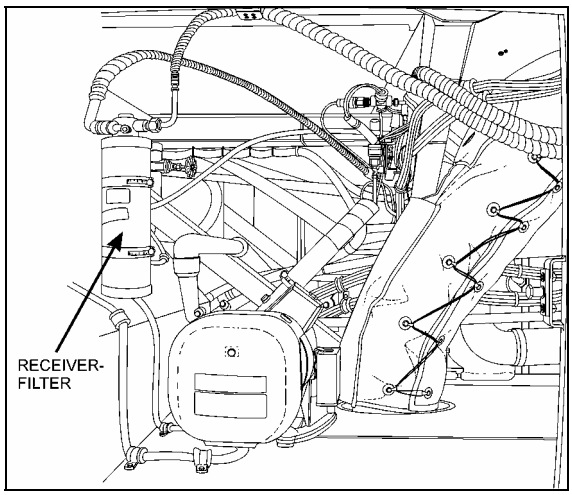



**FIGURE 29: RECEIVER-FILTER LOCATION (XL2-45)** 22176

9.6.1 Replacement

The filter is of the disposable type. When replacement is required, remove and discard the complete unit and replace with a new unit of the same type according to this procedure:

1. Isolate the refrigerant in the receiver tank by following the "Pumping Down" procedure explained in this section
2. Change the filter dryer as a unit.
3. Add a small quantity of refrigerant R-134a to the low side of the system. Check for leaks. Return the system to normal operation.

***Caution:*** *Do not use carbon tetrachloride or similar solvents to clean parts. Do not use steam guns. Use mineral spirits or naphtha. All parts should be thoroughly cleaned. Use a stiff brush to wash dirt from grooves, holes, etc.*

***Warning:*** *Cleaning products are flammable and may explode under certain conditions. Always handle in a well ventilated area.*

9.6.2 Moisture Indicator

The moisture sensitive element consists of a color changing ring which is reversible from pink to blue and vice versa as the moisture content in the refrigerant changes. Pink indicates a wet refrigerant, light violet (caution) and blue indicates a dry refrigerant.

Since temperature changes affect the solubility, color change will also vary with the refrigerant temperature. The following table shows the color change for R-134a at various moisture levels and liquid line refrigerant temperatures.

| COLOR INDICATOR | | | |
|---|---|---|---|
| TEMPERATURE | BLUE (ppm) | LIGHT VIOLET (ppm) | PINK (ppm) |
| 75°F (24°C) | Below 5 | 5-15 | Above 15 |
| 100°F (38°C) | Below 10 | 10-30 | Above 30 |
| 125°F (52°C) | Below 15 | 15-45 | Above 45 |
| p.p.m.= parts per million (moisture content) | | | |

A moisture level of 15 p.p.m. for R-134a indicated in the blue color range of the above table is generally considered dry and safe. A color indication of light blue to light violet indicates the caution range of moisture level. For positive protection, the drying of the system should be continued until the color of the element turns to deep blue.

The liquid refrigerant is readily visible through the center opening of the moisture element where the presence of bubbles indicates a shortage of refrigerant or restriction in line.

Moisture is one of the main causes of chemical instability or contamination in air conditioning systems. If moisture is present, it can corrode the valves, condenser and evaporator coils, compressor and other components causing a malfunction and eventual failure of the system. Uncontrolled moisture in the system can result in very expensive multiple component replacements if not corrected at an early stage. The moisture indicator permits an early detection of moisture in the system and when corrected by a desiccant charge, system contamination is greatly minimized.

9.7 LIQUID REFRIGERANT SOLENOID VALVE

The flow of liquid refrigerant to the driver's and main evaporators is controlled by a normally-closed solenoid valve. The driver's liquid solenoid valve is located on the ceiling of the

spare wheel and tire compartment and is accessible through the reclining bumper.

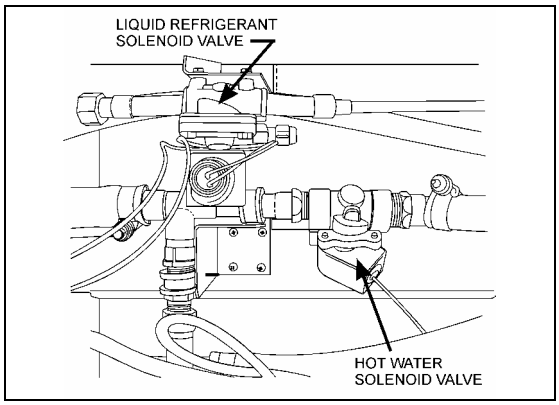



**FIGURE 30: DRIVER'S EVAPORATOR LIQUID SOLENOID VALVE** 22181

***Note:*** *An identical refrigerant solenoid valve is used on the auxiliary A/C system and is located near the auxiliary A/C unit.*

9.7.1 Manual Bypass

This type of solenoid valve is equipped with a manual operating stem. The 3/16" square stem located on the bonnet is exposed when the seal cap is removed. To manually open valve, turn stem ½ turn counterclockwise. To manually close valve, turn stem clockwise until tight against seat. Manual stem must be in closed position for automatic electric operation.

9.7.2 Coil Replacement

1. Disconnect connector from the coil connector.
2. Take out the retaining screw at the top of the coil housing. The entire coil assembly can then be lifted off the enclosing tube.
3. Place the new coil and yoke assembly on the enclosing tube. Lay data identification plate in place.
4. Insert the coil retaining screw, rotate housing to proper position and tighten screw securely.
5. Connect connector from coil connector.

9.7.3 Valve Disassembly

1. Remove the coil as stated previously.
2. Pump down the system as stated earlier in this section.
3. Remove the four socket head screws which hold the body and bonnet together (Fig. 31).
4. Carefully lift off the bonnet assembly (upper part of the valve) so that plunger will not fall out. The diaphragm can now be lifted out.

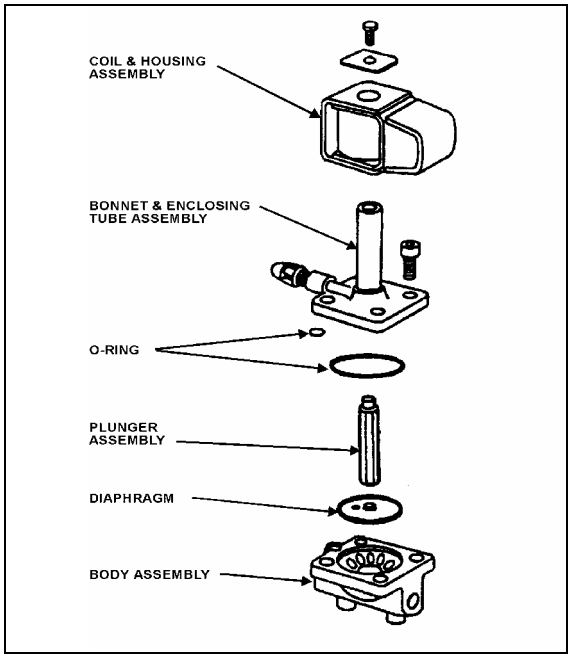



**FIGURE 31: REFRIGERANT SOLENOID VALVE** 22044

***Note:*** *The above procedure must be followed before brazing solder-type bodies into the line.*

***Caution:*** *Be careful not to damage the machined faces while the valve is apart.*

9.7.4 Valve Reassembly

1. Place the diaphragm in the body with the pilot port extension up.
2. Hold the plunger with the synthetic seat against the pilot port.
3. Make sure the bonnet O-rings are in place. Lower the bonnet assembly over the plunger, making sure that the locating sleeve in the bonnet enters the mating hole in the body.
4. Insert the four socket head screws and tighten evenly.

5. Replace the coil as stated previously.
6. Add a small quantity of refrigerant R-134a to the low side of the system. Check for leaks. Return the system to normal operation.

## 9.8 BY-PASS VALVE

A by-pass valve, used on auxiliary or driver's system only, is located just above rear L.H. side door in engine compartment (Fig. 32 and 33).

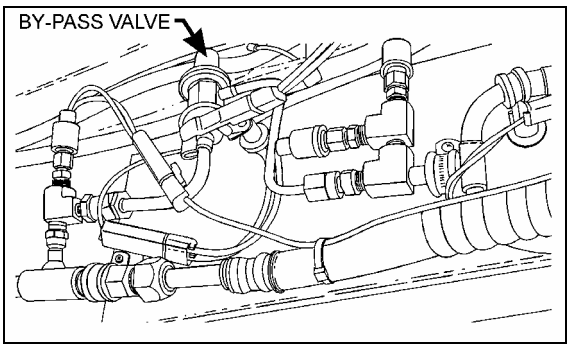



**FIGURE 32: BY-PASS VALVE LOCATION** 22182

Its function is to balance the Lo-side line and Hi-side line. The by-pass valve is factory adjusted but when valve is replaced, proceed as follows for adjustment:

1. Loosen jam nut.
2. Tighten adjusting screw flush to jam nut.
3. Tighten jam nut.

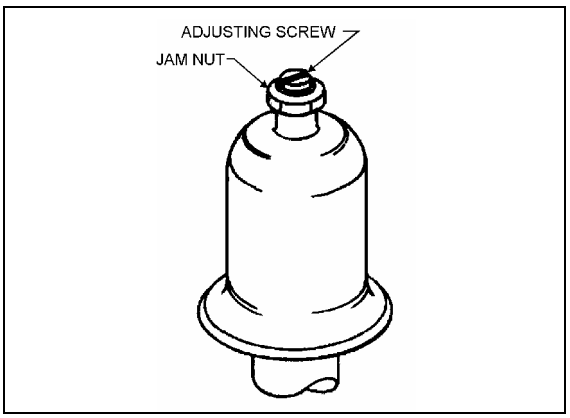


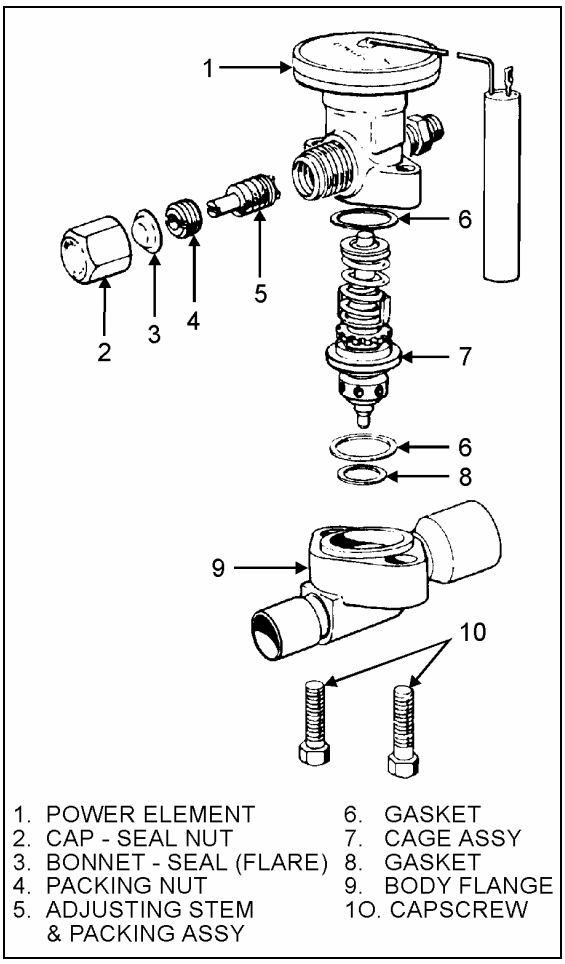

**FIGURE 33: BY-PASS VALVE** 22079

## 9.9 EXPANSION VALVE

### 9.9.1 Central System

The expansion valve for the central system is a thermo-sensitive valve with a remote control bulb head attached to the evaporator outlet line and is accessible by the evaporator coil access door (Fig. 10 & 34). The valve regulates the flow of refrigerant liquid into the evaporator coils and is controlled by the suction gas temperature leaving the evaporator. The bulb head senses the refrigerant gas temperature as it leaves the evaporator. High temperature will cause expansion and pressure on the power head and spring. Such action causes the assembly valve to open, allowing a flow of refrigerant liquid into the evaporator.

The remote bulb and power assembly is a closed system. The pressure within the remote bulb and power assembly corresponds to the saturation pressure of the refrigerant temperature leaving the evaporator and moves the valve pin in the opening direction. Opposed to this force, on the under side of the diaphragm and acting in the closing direction, is the force exerted by the superheat spring. As the temperature of the refrigerant gas at the evaporator outlet increases above the saturation temperature corresponding to the evaporator pressure, it becomes superheated. The pressure thus generated in the remote bulb and power assembly surpasses the combined pressures of the evaporator pressure and the superheat spring, causing the valve pin to move in the opening direction. Conversely, as the temperature of the **refrigerant** gas leaving the evaporator decreases, the pressure in the remote bulb and power assembly also decreases and the combined evaporator and spring pressures cause the valve pin to move in the closing position.




1. POWER ELEMENT
2. CAP - SEAL NUT
3. BONNET - SEAL (FLARE)
4. PACKING NUT
5. ADJUSTING STEM & PACKING ASSY
6. GASKET
7. CAGE ASSY
8. GASKET
9. BODY FLANGE
1O. CAPSCREW

**FIGURE 34: EXPANSION VALVE** 22045

As the operating superheat is raised, the evaporator capacity decreases, since more of the evaporator surface is required to produce the superheat necessary to open the valve. It is obvious, then, that it is most important to adjust the operating superheat correctly and that a minimum change in superheat to move the valve pin to full open position, is of vital importance because it provides savings in both initial evaporator cost of operation. Accurate and sensitive control of the refrigerant liquid flowing to the evaporator is necessary to provide maximum evaporator capacity under load conditions. The spring is adjusted to give 12 to 16° F (-11.1 to -8.8 ° C) of superheat at the evaporator outlet. This ensures that the refrigerant leaving the evaporator is in a completely gaseous state when drawn into the suction side of the compressor. Liquid would damage the compressor valve, piston and heads if allowed to return in the suction line.

A vapor is said to be superheated when its temperature is higher than the saturation temperature corresponding to its pressure. The amount of the superheat is, of course, the temperature increase above the saturation temperature at the existing pressure.

As the refrigerant moves along in the evaporator, the liquid boils off into a vapor and the amount of liquid decreases until all the liquid has evaporated due to the absorption of a quantity of heat from the surrounding atmosphere equal to the latent heat of vaporization of the refrigerant. The gas continues along in the evaporator and remains at the same pressure. However, its temperature increases due to the continued absorption of heat from the surrounding atmosphere. The degree to which the gas refrigerant is superheated is related to the amount of refrigerant being fed to the evaporator and the load to which the evaporator is exposed.

### Superheat Adjustment

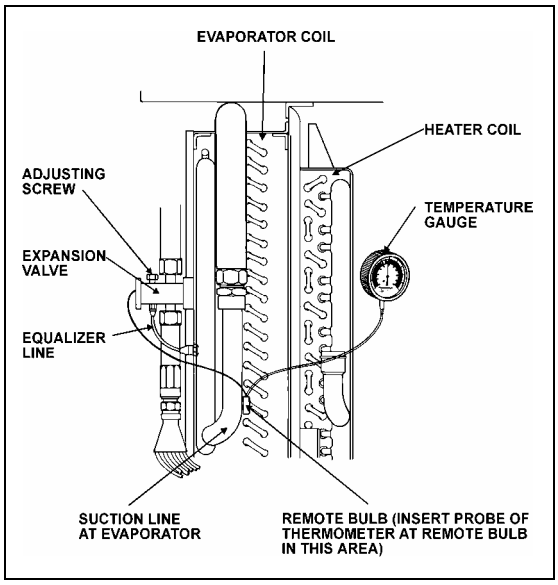



**FIGURE 35: SUPERHEAT ADJUSTMENT INSTALLATION** 22046

The starting method of adjusting the superheat is to unscrew completely the main evaporator expansion valve adjusting screw, then screw in 13 turns clockwise for 134A (Fig. 35). Afterwards, the following procedure should be followed:

1. Operate coach for at least one-half hour at fast idle with temperature control set at 82°F (27,7°C), Then set temperature to minimum to keep the compressor on 6 cylinders.
2. Install pressure gauge at the evaporator suction header. You may install the pressure gauge at compressor suction, but then add 3 psi to reading.
3. Install a remote reading thermometer to the evaporator outlet line near the existing remote bulb (Fig. 35).
4. Apply thermostatic tape around the bulb and evaporator outlet line to get a true reading of the line temperature.
5. Block condenser if necessary to keep pressure over 150 psi.
6. Check approximately 5 readings of pressure at 2-minute intervals and convert to temperature using the temperatures & pressures table (page 35). Likewise check the temperature reading at the remote bulb at the same 2-minute intervals and record the low and high swing readings of the needle (refer to Fig. 36).

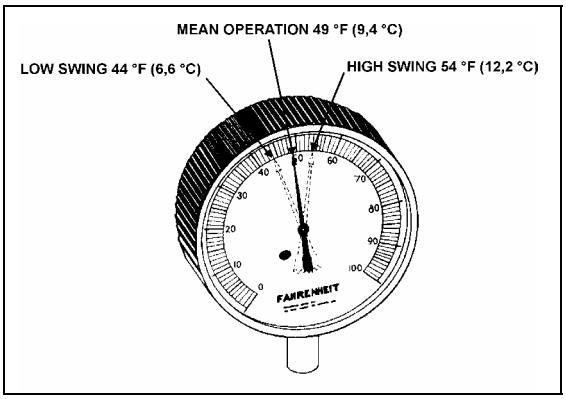



**FIGURE 36: HIGH & LOW SWING TEMPERATURE AT REMOTE BULB** 22047

Example of readings taken at fig. 36:

| A/C pressure gauge converted to temperature at expansion valve fitting | Temperature on remote bulb | |
|---|---|---|
| 40°F(4,4°C) | Low-swing 44°F (6,6°C) | High swing 54°F (12,2°C) |
| Formula for superheat 49°F-40°F=9°F (9,4°C-4,4°C = 5°C) | Average of low and high swing is 49°F (9,4°C) | |

***Note:*** *The low swing of the superheat should be a minimum of 4°F (2,2°C) higher at the remote bulb and have an average of 8 to 12°F (4 to 6°C) higher range at the bulb than the fitting at the expansion valve.*

***Note:*** *To reduce the superheat, flow of refrigerant is increased by turning adjusting screw of expansion valve lower evaporator temperature counterclockwise. To increase temperature or increase superheat, flow of refrigerant is reduced by turning adjustment screw of expansion valve clockwise.*

6. Regulate suction pressure to temperature reading according to temperature chart or to the R-134a temperature scale on the pressure gauge.

***Example:*** Suction pressure 30 psi (207 kPa) converted to 32°F (0°C) on chart. If temperature reading is 40°F (4,4°C), subtract 32°F (0°C) and the result will be 8°F (4,4°C) of superheat.

***Caution:*** *Before proceeding to the expansion valve adjustment, check for restriction on suction side for plugged filter dryer and partially open valves. These conditions will give a high superheat.*

**Maintenance**

1. Pump down the system as previously indicated in this section.

2. Disconnect the external equalizer line from the under side of the power head, and unclamp the remote control bulb from the evaporator coil outlet line.

3. Remove the two cap screws holding the power assembly to the valve body flange. Lift off the power assembly and remove the cage assembly.

4. When reassembling, replace with the new gaskets in proper location. Make sure the two lugs on the cage assembly fit into grooves provided in the power assembly. Do not force the valves together. The cage must fit properly before tightening the body flange. Tighten bolts evenly.

5. Check for leaks.

**Safety Instructions**

1. Make sure the valve is installed with the flow arrow on the valve body corresponding to the flow direction through the piping system.

2. Before opening any system, make sure the pressure in the system is brought to and remains at the atmospheric pressure. Failure to comply may result in system damage and/or personal injury.

9.9.2 Driver's System

The function and operation of the expansion valve for the driver'' system are similar to the main system, but no superheat adjustment is required (see figures 17 and 18).

9.10 TORCH BRAZING

Use an electrode containing 35% silver.

***Caution:*** *When using heat near a valve, wrap with a water saturated rag to prevent overheating of vital parts.*

***Warning:*** *Before welding any part of refrigeration system, make sure the area is well ventilated.*

9.11 TROUBLESHOOTING

9.11.1 Expansion Valve

| PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| **LOW SUCTION PRESSURE-HIGH SUPERHEAT** | |
| EXPANSION VALVE LIMITING FLOW: | |
| Gas in liquid line due to pressure drop in the line or insufficient refrigerant charge. | Locate cause of line flash and correct by use of any of the following methods. Add R-134a. Replace or clean filter dryer. |
| Inlet pressure too low from excessive low condensing temperature. Resulting pressure difference across valve too small. | Increase head pressure. Verify pressure switch for fan speed control. |
| Superheat adjustment too high. | Adjust superheat as outlined under "Superheat Adjustment". |
| Power assembly failure or partial loss of charge. | Replace power assembly or replace valve. |
| Air filter screen clogged. | Clean or replace air filter screen. |
| Plugged lines. | Clean, repair or replace lines. |
| **LOW SUCTION PRESSURE-LOW SUPERHEAT** | |
| Uneven or inadequate evaporator loading due to poor air distribution or liquid flow. | Balance evaporator load distribution by providing correct air or liquid distribution. |
| **HIGH SUCTION PRESSURE-HIGH SUPERHEAT** | |
| Compressor discharge valve leaking. | Replace or repair valve. |
| **HIGH SUCTION PRESSURE-LOW SUPERHEAT (DEFECTIVE UNLOADER)** | |
| Valve superheat setting too low. | Adjust superheat as outlined under "Superheat Adjustment". |
| Compressor discharge valves leaking. | Replace or repair discharge valve. |
| Incorrect superheat adjustment. | Superheat adjustment 12 to 16°F. |
| **FLUCTUATING DISCHARGE PRESSURE** | |
| Insufficient charge. | Add R-134a to system. |
| | |

| PROBABLE CAUSE | PROBABLE REMEDY |
|---|---|
| **HIGH DISCHARGE PRESSURE** | |
| Air or non-condensable gases in condenser. | Purge and recharge system. |
| Overcharge or refrigerant. | Bleed to proper charge. |
| Condenser dirty. | Clean condenser. |

9.11.2 A/C

| TROUBLE | CAUSE |
|---|---|
| Low suction pressure and frosting at dryer outlet. | Clogged filter. |
| Low Oil Level. | Check for oil leaks and for leaking oil seal. Do not attempt to check oil level unless system has been stabilized at least 20 minutes. See oil level verification. |
| Excessively cold suction line. | Loss of contact between the expansion valve bulb and the suction line or sticking of the expansion valve.<br>Check for foreign matter and clean, repair or replace the valve. |
| Excessively cold suction line and noisy compressor. | Check superheat adjustment. Check remote bulb contact. Check expansion valve for sticking. |
| Compressor squeaks or squeals when running. | Check oil level. Replace oil seal. |
| Noisy or knocking compressor. | Check for broken internal parts. Overhaul if required. |
| Compressor vibrates. | Check and tighten compressor mounting bolts and belt tension. |
| Low refrigerant level | Check for refrigerant leaks and add refrigerant if required. |
| Suction pressure rises faster than 5 pounds per minute after shutdown. | Check compressor valve for breakage or damage. |
| Insufficient cooling. | Check for refrigerant leaks. Check condition of air filter and motors. |
| Insufficient air flow. | Dirty or iced evaporator. Dirty air filter. Blowers inactive. Clogged ducts. |
| No flow of refrigerant through expansion valve. | Filter dryer is clogged. Remote bulb has lost charge or expansion valve is defective. |
| Expansion valve hisses. Bubbles in moisture and liquid indicator. | Gas in liquid line. Add refrigerant. |
| Loss of capacity<br><br>Superheat too high. | Clogged filter. Obstructed or defective expansion valve.<br>Reset superheat adjustment. Check for clogged external equalizer line, or filter dryer. |
| | |

| TROUBLE | CAUSE |
|---|---|
| Reduced air flow:<br>a. Dirty or clogged air filter;<br>b. Evaporator motor inoperative; or<br>c. Plugged return air ducts. | Dirty or iced evaporator coil. Clean air filter screen. Check return ducts for obstructions. Check blower motor. |
| Frequent starting and stopping on low pressure control switch. | Lack of refrigerant. Check for leaks. Recharge. |
| Compressor intermittently starts and stops. | Intermittent contact in electrical control circuit. Compressor valves not in operating position. |
| Non-condensable in the refrigeration system. | Leak on system, system in vacuum in low temp. Specific symptom, pressure in system will not correspond to ambient temperature on shutdown. Only non-condensable will cause this.<br><br>(Example: Pressure of idle R-134a system in 80°F (26.6°C) room should be 86.4 psi (595.7 kPa). See temperature chart in this section.)<br><br>An evaporator just does a proper cooling job without sufficient air. Shortage of air can be caused by the following:<br><br>• Dirty filters; or<br>• Dirty coils. |

Testing condenser pressure.

Note: R-134A pressure is function of the temperature variation.

Example, for an exterior temperature of 100°F.
Exterior temperature (100°F) + 30°F = 130°F. Refer to paragraph "10.11 Temperature & Pressure".
Note the corresponding pressure for a temperature of 130°F., 199.8 psi.
Read the condenser pressure, example 171.9 psi.
171.9 psi  199.8 psi, the pressure in the condenser is inferior to the pressure corresponding to the exterior temperature, then condenser pressure may be to low. Check for refrigerant leaks and add refrigerant if necessary. If the pressure corresponding to the condenser temperature is superior to the pressure corresponding to the exterior temperature, then air cooled condenser pressure may be to high. Most frequent causes are:

Reduced air quantity. This may be due to:

- Non-condensable in system;
- Dirt on the coil;
- Restricted air inlet or outlet;
- Dirty fan blades;
- Incorrect rotation of fan;
- Fan speed too low;
- Fan motor going out on overload; or
- Prevailing winds.
- Too much refrigerant in system. Remove refrigerant if necessary.

9.12 TEMPERATURES & PRESSURES

| VAPOR-PRESSURE | | | |
|---|---|---|---|
| TEMPERATURE | | PRESSURE | |
| °F | °C | psi | kPa |
| -100 | -73.3 | 27.8 | 191.7 |
| -90 | -67.8 | 26.9 | 185.5 |
| -80 | -62.2 | 25.6 | 176.5 |
| -70 | -56.7 | 23.8 | 164.1 |
| -60 | -51.1 | 21.5 | 148.2 |
| -50 | -45.6 | 18.5 | 127.6 |
| -40 | -40.0 | 14.7 | 101.4 |
| -30 | -34.4 | 9.8 | 67.6 |
| -20 | -29 | 3.8 | 26.2 |
| -10 | -23 | 1.8 | 12.4 |
| 0 | -18 | 6.3 | 43.4 |
| 10 | -12 | 11.6 | 80 |
| 20 | -7 | 18.0 | 124.1 |
| 30 | -1 | 25.6 | 176.5 |
| 40 | 4 | 34.5 | 237.9 |
| 50 | 10 | 44.9 | 309.6 |
| 60 | 16 | 56.9 | 392.3 |
| 70 | 21.1 | 70.7 | 487.5 |
| 80 | 27 | 86.4 | 595.7 |
| 90 | 32.2 | 104.2 | 718.5 |
| 100 | 38 | 124.3 | 857.0 |
| 110 | 43.3 | 146.8 | 1012.2 |
| 120 | 49 | 171.9 | 1185.3 |
| 130 | 54.4 | 199.8 | 1377.6 |
| 140 | 60 | 230.5 | 1589.3 |
| 150 | 65.6 | 264.4 | 1823.0 |
| 160 | 71 | 301.5 | 2078.8 |

| VAPOR-PRESSURE | | | |
|---|---|---|---|
| TEMPERATURE | | PRESSURE | |
| °F | °C | psi | kPa |
| 170 | 76.7 | 342.0 | 2358.1 |
| 180 | 82.2 | 385.9 | 2660.8 |
| 190 | 87.8 | 433.6 | 2989.7 |
| 200 | 93.3 | 485.0 | 3344.1 |
| 210 | 98.9 | 540.3 | 3725.4 |

9.13 LEAK TESTING

Some methods such as nitrogen pressure and soap, and electronic sniffer can be used for leak testing. However, the most common method used is a "Halide" torch consisting of an acetylene tank, a burner and a suction test hose. Proceed as follows:

***Warning:*** *Do not inhale fumes from leak detector.*

The flow of acetylene to the burner causes a suction in the test line. Any gas refrigerant present will be drawn through the hose and into the burner where it decomposes into free acids.

These acids come in contact with the hot copper reaction plate in the burner, causing color reaction in the flame. A small concentration is indicated by a green tint and a large concentration by an intense blue. Do not confuse this change in color with the change caused by shutting off the air supply through the hose by holding the end too close to an object.

The procedure for testing is:

1. Adjust flame so that the top of the cone is approximately level or within one-half inch above the plate.

2. Probe end of suction test tube around all joints, valves, etc. When a leak has been found at a soldered joint, that section of the system must be pumped down. Do not solder as pressure will force hot solder out. If the system is empty, it is more economical to put in just enough R-134a to produce about 15 psi (103 kPa). The pressure can be raised to about 150 psi (1034 kPa) with dry nitrogen.

***Note:*** *This gas is put into the suction and discharge shutoff valves at the compressor. The receiver valves must be opened. If no leaks are found, dump this mixture, evacuate the system and fill with refrigerant.*

## 10. HEATING SYSTEM

The schematics of Figures 37 and 38 show respectively, the central heating system and the driver's heating system with their components.

In addition to the normal heating provided by the engine, an optional preheating system (41 000 Btu/hr, 45 000 Btu/hr or 80,000 Btu/hr) may have been installed in the vehicle.

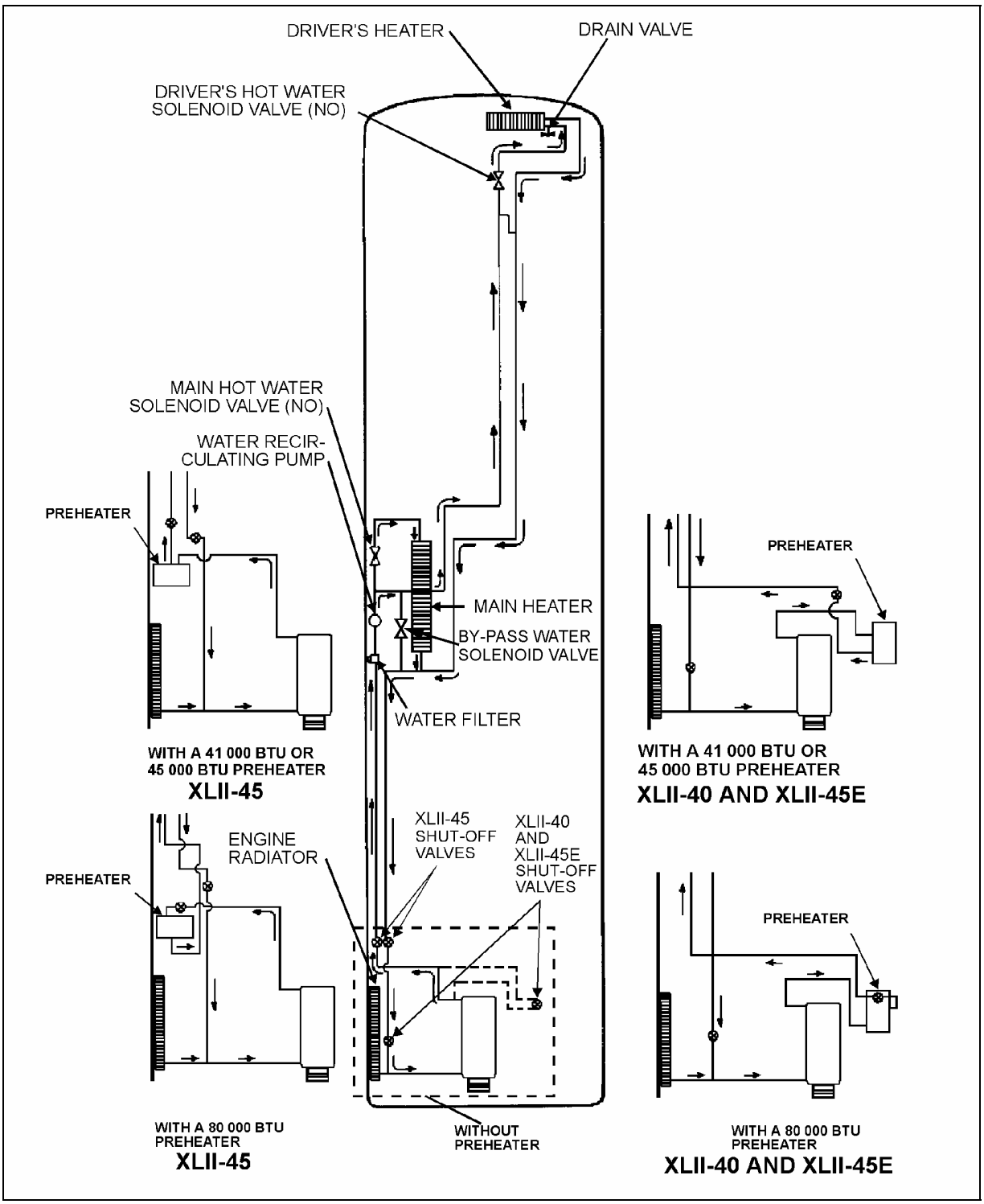



**FIGURE 37: CENTRAL HEATING SYSTEM COMPONENTS** 22197

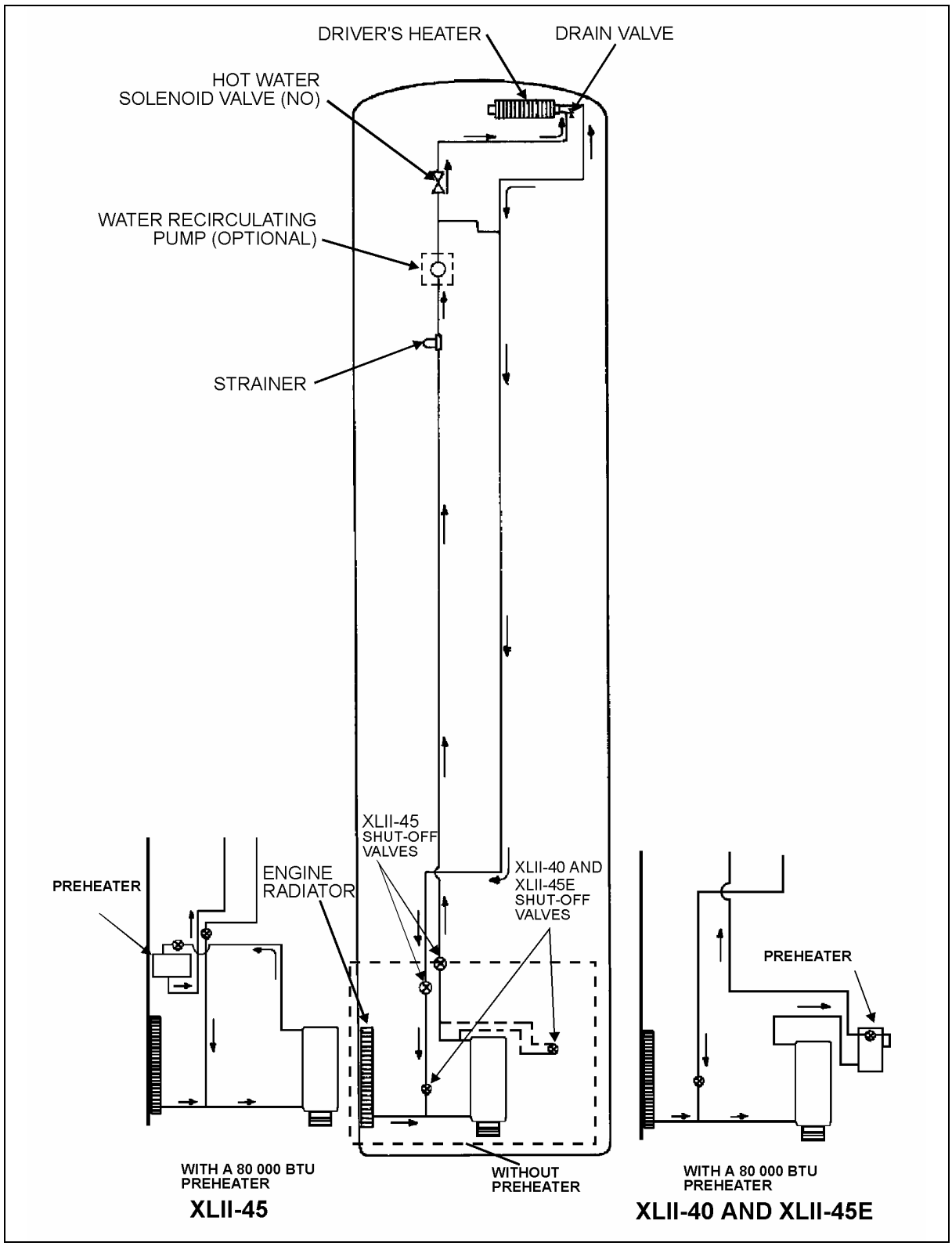



**FIGURE 38: DRIVER'S HEATING SYSTEM COMPONENTS (VEHICLES EQUIPPED WITH DRIVER'S SYSTEM ONLY)** 22198

## 10.1 DRAINING HEATING SYSTEM

To drain the entire system, refer to Section 05, *"Cooling"*. If only the driver's or main heater core must be drained, refer to the following instructions.

### 10.1.1 Draining Driver's Heater Core

1. Stop engine and allow engine coolant to cool.
2. Locate the normally open water solenoid valve on the ceiling of the spare wheel compartment (Fig. 39), disconnect its wiring connector, then connect a 24-volt external power source, using jumper cables, to close valve.

***Warning:*** *Before proceeding with the following steps, check that coolant has cooled down.*

3. Loosen hose clamp, install an appropriate container to recover coolant, and disconnect silicone hose from water solenoid valve.
4. From inside of vehicle, remove the two finishing panels in front of unit. Remove the three screws fixing the unit front panel. Open the manual vent located inside the HVAC unit, on the driver's side (Fig. 40) to ensure an efficient draining.

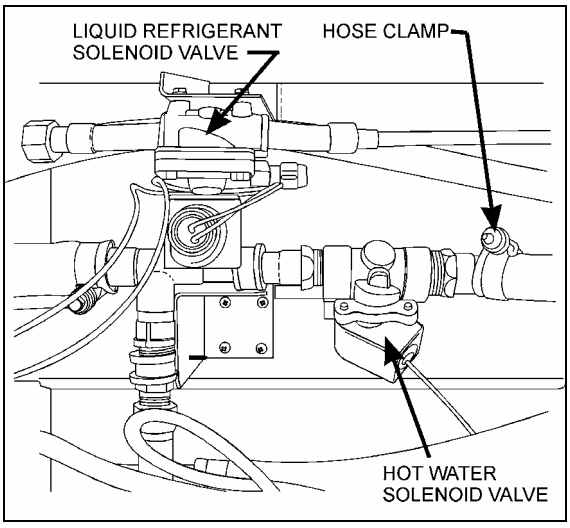



**FIGURE 39: CEILING OF THE SPARE WHEEL COMPARTMENT** 22181

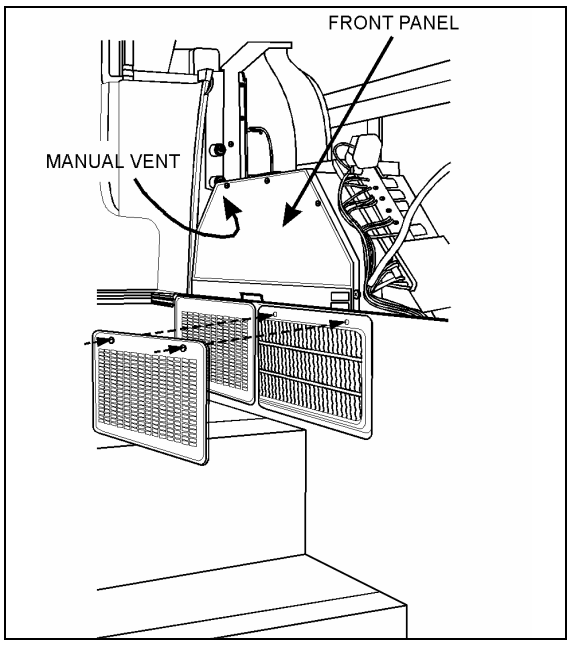



**FIGURE 40: DRIVER'S HVAC UNIT** 22172

### 10.1.2 Draining Main Heater Core

1. Stop engine and allow engine coolant to cool.
2. Close both heater line shutoff valves.

**On XL2-40 & 45E vehicles**, the valves are located in engine compartment. One is on the R.H. side of compartment and is accessible through engine compartment R.H. side door (Fig. 41).

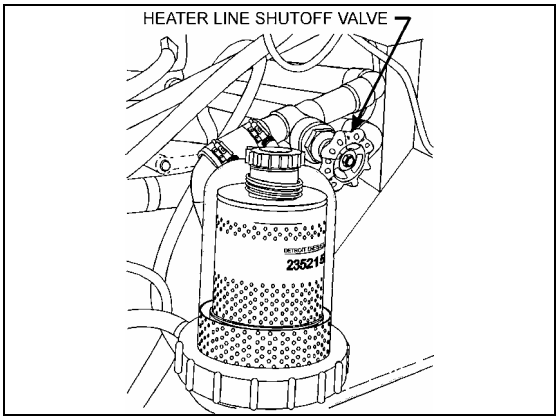



**FIGURE 41: HEATER LINE SHUTOFF VALVE** 05070

Another valve is located in the engine compartment under the radiator fan gearbox (Fig. 42).

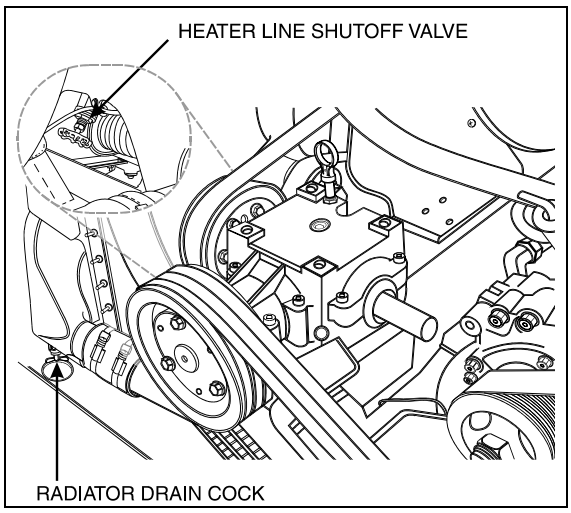



**FIGURE 42: ENGINE COMPARTMENT** 05078

**On XL2-45 vehicles**, the valves are located in the engine compartment, on the L.H. side of engine and are accessible through L.H. side rear service compartment (Fig. 43).

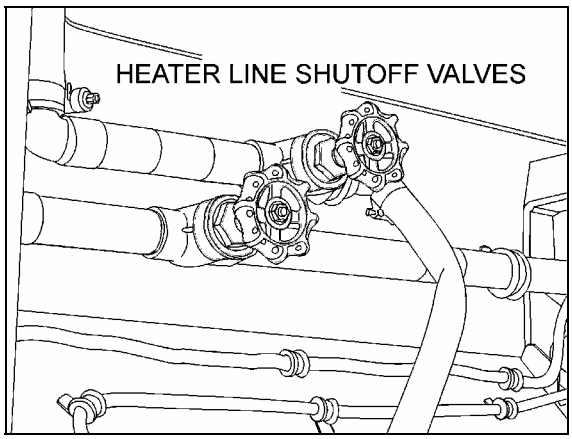



**FIGURE 43: HEATER LINE SHUT-OFF VALVES** 05067

3. Open the last L.H. side baggage compartment door, then pull the black release button located on the L.H. side in order to unlock and open the evaporator compartment door.

***Warning:*** *Before proceeding with the following step, check that coolant has cooled down.*

4. Open drain cock in bottom of heater core, then open manual vent located on top of heater core (Fig. 44) in order to allow air to enter while draining.

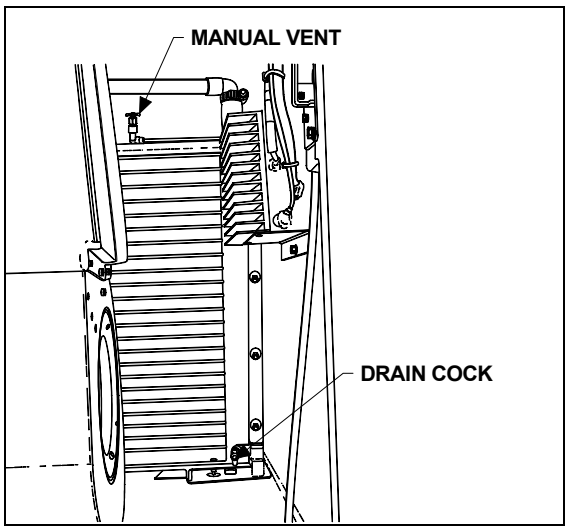



**FIGURE 44: EVAPORATOR COMPARTMENT** 22128

10.2 FILLING HEATING SYSTEM

1. Ensure that the drain hose is reconnected and the manual vents and drain cock are closed.
2. Open the surge tank filler cap and slowly fill the system to level of filler neck.
3. After initial filling, the water valves should be open and the water recirculating pump should be energized to assist in circulating coolant through the heating system. To perform this operation, start the engine, switch on the HVAC control unit, both driver and passenger sections, and set temperature to their maximum positions in order to request the heating mode in each of these sections.
4. When coolant level drops below the surge tank filler neck, slowly fill the system to level of filler neck.
5. Once the level has been stabilized, replace cap.

10.3 BLEEDING HEATING SYSTEM

Whenever the heating system has been drained and refilled, or the system has run low on coolant and coolant has been added, it is necessary to bleed air from heating system. Locate the manual vents illustrated in Figures 40 and 44, and open them momentarily until no air escapes from the lines.

10.4 SOLDERING

Before soldering any part of the system, make sure the area is well ventilated. Use (stay clean) flux sparingly and apply solder (95-5 round wire 1/8 inch [3,1 mm]). After completing repairs, test for leaks.

When using heat at or near a valve, wrap with a water saturated rag to prevent overheating of vital parts.

10.5 DRIVER'S WATER SOLENOID VALVE

A two-way normally open, internal pilot-operated solenoid valve designed for smooth closing is used to control the coolant flow through the driver's heating unit. It is mounted on the coolant inlet line of the driver's heating unit, and is accessible through the spare wheel compartment (see fig. 39). The valve cannot be manually bypassed.

10.5.1 Improper Operation

1. Faulty control circuit: Check the electric system by energizing the solenoid. A metallic clicking noise indicates that the solenoid is operating. Absence of clicking indicates a loss of power or a defective solenoid. Check for open breaker, open-circuited or grounded coil, broken lead wires.
2. Burned-out coil: Check for open-circuited coil. Replace coil if necessary.
3. Low voltage: Check voltage across the coil leads. Voltage must be at least 85% of nameplate rating.
4. Excessive leakage: Disassemble valve and clean all parts. Replace worn or damaged parts with a complete spare part kit for best results.

10.5.2 Coil Replacement

Turn off electrical power supply and disconnect lead wires. Proceed in the following manner:

1. Remove retaining cap or clip, spacer, name plate and housing.
2. Slip spring washer, insulating washer, coil and insulating washer off the solenoid base sub-assembly. Insulating washers are omitted when a molded coil is used.
3. Coil is now accessible for replacement. Reassemble by reversing sequence of disassembly. Refer to exploded view (Fig. 35) for identification and location of parts.

***Note:*** *Solenoid must be completely reassembled, as the housing and internal parts complete the magnetic circuit.*

***Caution:*** *When metal retaining clip disengages, it springs upwards.*

10.5.3 Valve Disassembly

1. Drain driver's heating unit as previously explained in this section under paragraph *"Draining Heating System".*
2. Disconnect connector from coil connector.
3. Disassemble valve in an orderly fashion paying careful attention to exploded view (Fig. 45) provided for identification of parts.
4. Remove retaining cap and slip the entire solenoid enclosure off the solenoid base subassembly.

***Caution:*** *When metal retaining clip disengages, it springs upwards.*

5. Unscrew solenoid base sub-assembly and remove core, plugnut gasket, plugnut assembly and solenoid base gasket.
6. Remove the four bonnet screws and valve bonnet, disc holder subassembly, disc holder spring, diaphragm/spring subassembly and body gasket.
7. All parts are now accessible for cleaning or replacement. Replace worn or damaged parts with a complete spare part kit for best results.

***Caution:*** *Do not damage valve seat in any manner, as its sealing feature will be affected, thus resulting in continuous leakage.*

10.5.4 Valve Reassembly

1. Reassemble in reverse order of disassembly, paying careful attention to

exploded view provided for identification and placement of parts (Fig. 45).

2. Replace body gasket and diaphragm/spring subassembly. Locate bleed hole in diaphragm/spring subassembly, approximately 45° from valve outlet.
3. Replace disc holder spring and holder subassembly.
4. Replace valve bonnet screws. Torque bonnet screws in a criss-cross manner to 95 ± 10 inch-pounds.
5. Install solenoid base gasket, plugnut assembly and plugnut gasket. Position core (small end up for A-C construction) on plugnut assembly. For D-C construction, be sure plugnut assembly and core are installed with mated ends together.
6. Replace solenoid base subassembly and torque to 175 ± 25 inch-pounds.
7. Refill heating system as previously stated under paragraph *"Filling Heating System*", then bleed air from the driver's heating unit as stated previously under paragraph *"Bleeding heating system".*
8. After maintenance, operate the valve a few times to be sure of proper opening and closing.

***Note:*** *Should diaphragm/spring subassembly become disassembled, be sure to replace the diaphragm/spring support with lip facing upward towards the valve bonnet.*

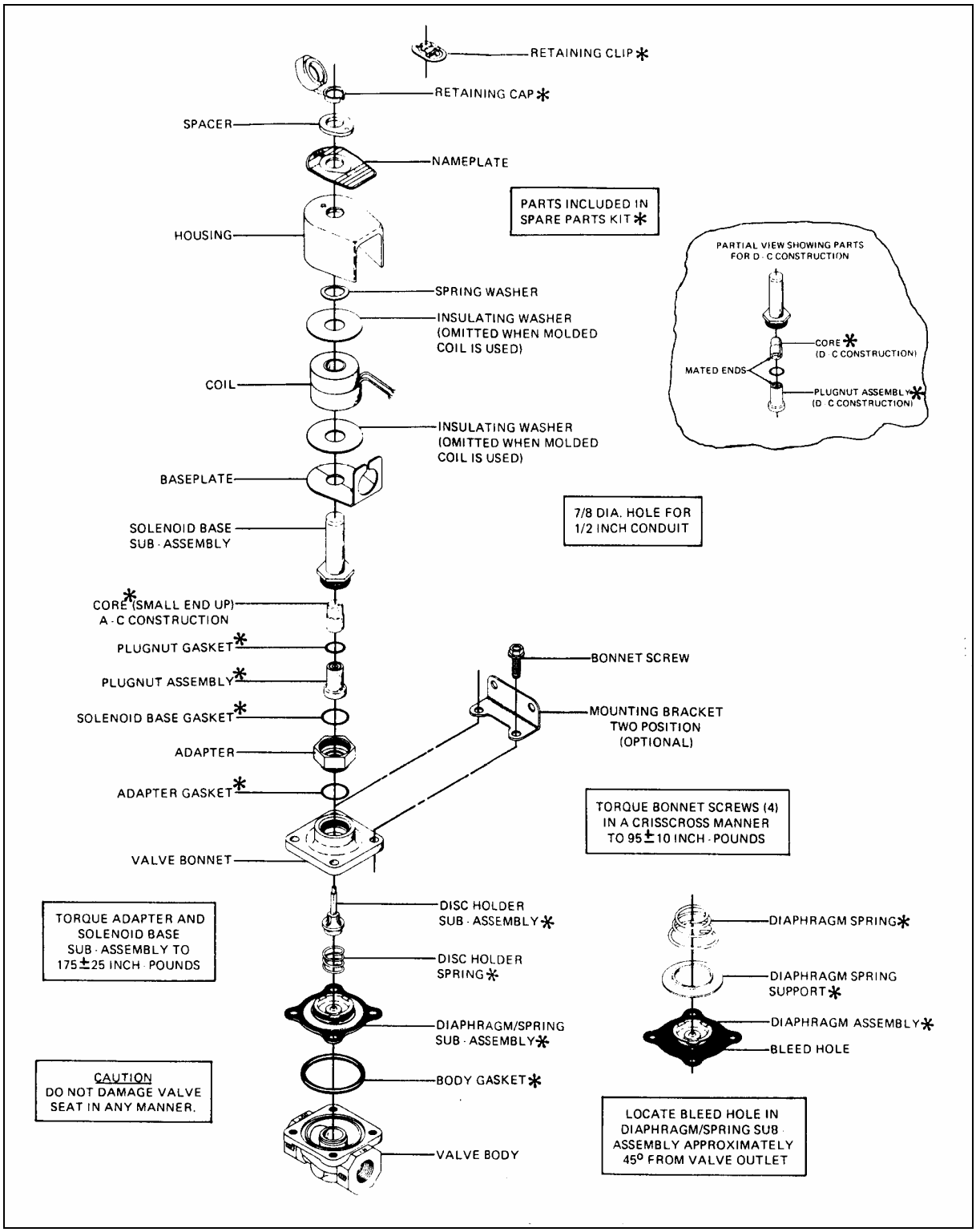



**FIGURE 45: DRIVER'S WATER SOLENOID VALVE** 22052

## 10.6 CENTRAL HOT WATER SOLENOID VALVE ACTUATOR

### 10.6.1 Description

The flow of hot water to the vehicle's central heater core is controlled by an electric water valve. The valve, located in the evaporator compartment, is designed so that the pilot valve within the assembly opens and closes a port which directs pressure to either the top or bottom of the valve diaphragm, thereby opening or closing the valve.

A delay action is built into the water valve through an orifice in the valve body and a modulating cup on the diaphragm assembly. When the vehicle is operating with no current to the water valve solenoid, inlet water pressure is directed to the upper side of the diaphragm, thereby keeping it open.

The pilot light closes, water pressure builds up through the orifice to the underside of the diaphragm and keeps the valve in closed position.

The central heater water valve requires a minimum amount of maintenance. The valve should be free of dirt sediment that might interfere with its operation. The diaphragm should be replaced once a year, before the heating season begins. No other maintenance is needed unless a malfunction occurs.

### 10.6.2 Valve Disassembly

1. Shut off supply pressure and electrical current to valve. The valve need not be removed from the line.
2. Disconnect wires. Unscrew housing nut. The nameplate, coil housing, flux plate, wave spring and coil can be removed (Fig. 46).
3. Unscrew the sleeve flange using a *Skinner wrench nut* while ensuring that wrench nut does not slip out of spanner holes.
4. From the sleeve, remove the retainer and seal assembly, stop assembly, plunger assembly and snubbers.
5. To disassemble the body cover, first remove the flange screws. Remove the spring, diaphragm and seal assembly, and O-ring from the body. If it is necessary to disassemble diaphragm assembly, remove lock nut, seal, diaphragm support plate, O-ring and screw.

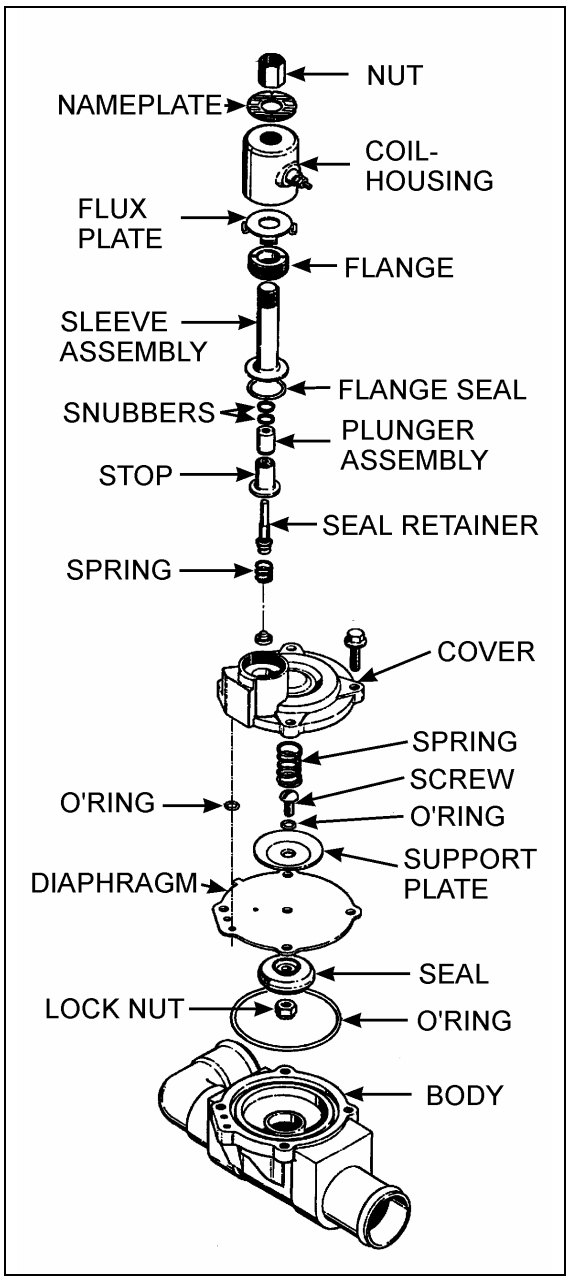



**FIGURE 46: CENTRAL WATER SOLENOID VALVE** 22183

10.6.3 Valve Reassembly

1. Assemble the diaphragm to the seal by placing the O-ring on the screw, then the support plate, the diaphragm and seal (Fig. 46). Add the nut, tighten and torque to 45-55 lbf•in (61-75 N•m).
2. Place the O-ring in the body cavity and add the diaphragm assembly, seal side facing down. Line up the diaphragm with the hole in the body. The diaphragm has three (3) holes in a row; one is a bolt hole, the middle hole is not used and the third hole is used as a passageway on the body. Make sure holes are aligned correctly. The correct position will have the diaphragm tab over the "A" port. Also ensure that O-ring is added to the passageway hole in the diaphragm.
3. Assemble the body cover, while observing pilot passageway: it must line up with diaphragm hole and body passageway. Add the diaphragm spring, ensuring that it sits on the spring seat. Add screws, tighten and torque to 80-110 lbf•in (108-149 N•m). Make sure O-ring is seated over diaphragm passageway hole.
4. Assemble stop, retainer and seal assembly, then add plunger assembly and snubbers. Place assembly in sleeve. Place seal in operator cavity in body cover. Place pilot spring on retainer with seal assembly and place in body cover.
5. Add flange over sleeve and using a wrench and *"Skinner"* wrench nut, tighten and torque to 130-150 lbf•in (176-203 N•m).
6. Place the coil in the housing. Pull the wires through the conduit . Mate the flux plate to the coil housing and place assembly over sleeve. Add the nameplate and nut. Tighten and torque to 30-43 lbf•in (41-58 N•m).

10.6.4 Valve Troubleshooting

| PROBLEM | PROCEDURE |
|---|---|
| Valve fails to operate. | 1. Check electrical supply with a voltmeter. It should agree with nameplate rating.<br>2. Check coil with an ohmmeter for shorts or open coil.<br>3. Check pressure at valve inlet. It must be at least equal to the minimum pressure stamped on the nameplate. It should not go below minimum while valve is operating. |
| Valve is sluggish or inoperative - voltage check out. | 1. Check diaphragm for tears or abrasions. Replace if torn or abrased.<br>2. Check diaphragm for obstructed bleed holes. Wash with mild soap and water.<br>3. Check for clogged or obstructed bleed passageways. Passageways must be clean and free from all obstructions that restrict internal flow. Clean with solvent and compressed air. Do not put wire into passageway. |
| External leakage - valve leaks around sleeve assembly. | 1. Remove flange seal and check for imperfections. Replace if defective.<br>2. Tighten and torque sleeve, using a wrench nut, to 130-150 lbf•in (176-203 N•m). |
| External leakage - valve leaks at flange joint between body and cover. | Retighten cover screws and torque to 80-110 lbf•in (108-149 N•m). If leakage persists, replacement of diaphragm assembly or flange O-ring may be required and/or bodies or covers with damaged sealing surfaces may have to be repaired or replaced. |

| | |
|---|---|
| Internal leakage - sticking valve leaks internally or plunger sticks in energized position. | 1. Disassemble valve. Inspect plunger, stop & retainer, and seal assembly. Remove all dirt that may have collected or imbedded.<br>2. If seal is conspicuously swollen or hardened, replace retainer and seal assembly. (It is possible that a different type of insert material be used on application - submit complete details of application to factory).<br>3. Inspect diaphragm for dirt or imbedded material. If dirty, remove, wash in warm water and mild soap solution.<br>4. Inspect pilot and main orifices for leaks. If parts are found to be pitted, nicked or excessively worn, they should be replaced. |
| Valve fails to close. | 1. Check that the plunger assembly, and the retainer & seal assembly, are free to travel.<br>2. Make sure that the plunger is free to travel to the end of its stroke and apply force on the retainer and seal assembly to seal the pilot orifice. |
| Buzzing noise. | 1. Check voltmeter reading to make sure it corresponds with the nameplate rating.<br>2. Check pressure against nameplate rating.<br>3. Inspect for loose housing nut. Tighten and torque to 30-43 lbf•in (41-58 N•m).<br>4. Inspect the face of the plunger assembly and of the stop assembly. If there is a sign of damage, replace both assemblies. |

## 10.7 WATER RECIRCULATING PUMP

### 10.7.1 Description

This vehicle is provided with a water recirculating pump which is located in the evaporator compartment (vehicles with central system) (Fig. 47) or in the reclining bumper compartment (optional with driver's system). The water recirculating pump consists of a centrifugal pump and an electric motor which are mounted on a common shaft in a compact assembly. A pilot between the pump end and motor cover ensures proper alignment of the complete assembly.

The motor is equipped with prelubricated sealed ball bearings which require no maintenance. A self-adjusting mechanical shaft seal is incorporated in this assembly to prevent coolant leakage between the pump cavity and armature shaft. This seal derives its lubrication from the liquid pumped, and **it will be destroyed if permitted to operate dry.**

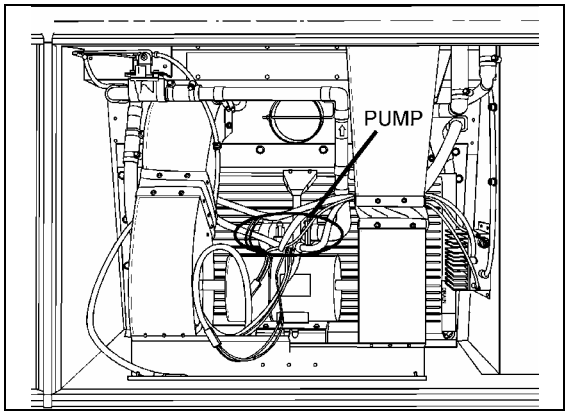



**FIGURE 47: PUMP LOCATION (SHELL)** 22178

The pump requires no periodic maintenance other than replacement of motor brushes. Replacement of motor brushes can be performed without removing the pump assembly. Visual inspection of the pump, to determine if the shaft seal is intact, should be made while the pump is in operation. If there is evidence of coolant leakage, the unit must be disassembled for corrective measures. Disassembly of the pump will be necessary only

in the case of a seal leak, bearing failure, or motor failure.

10.7.2 Removal

1. Stop engine and allow engine coolant time to cool.
2. Close shutoff valves. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.
3. Disconnect the electrical wiring from the motor.

***Warning:*** *Before proceeding with the following steps, make sure that coolant has cooled down.*

4. **Fig. 49 only:** Remove the drain plug at rear of pump and place a container to recover the residual coolant in the line.

***Note:*** *On driver's A/C system, remove residual coolant through coolant strainer. Also check strainer's condition; clean or replace if necessary.*

5. **Fig. 49:** Disconnect water lines from pump at flange connections.
6. **Fig. 48:** Disconnect water lines from pump at connections between hoses and copper pipes (leave hoses connected to pump).
7. Remove the two clamps holding the pump motor to its mounting bracket. Remove the pump with the motor as an assembly.

10.7.3 Disassembly

-For converted vehicle (shell) central A/C pump, see Fig. 48.
-For coach central A/C pump, or driver's A/C pump, see Fig. 49.

1. **Fig. 48:** Remove two brush caps (5) and two brush assemblies (4). When removing brushes, note the position of the brush in the tube. Brush life is significantly decreased if brushes are not replaced properly.

1. **Fig. 49:** Remove two brush caps (16) and two brush assemblies (15). When removing brushes, note the position of the brush in the tube. Brush life is significantly decreased if brushes are not replaced properly.

2. **Fig. 48:** Remove the pump cover (item #11) by first removing the 4 head screws. Remove cover carefully to prevent damaging the O-ring (12) (disconnect hoses from cover only if required).

2. **Fig. 49:** Remove the pump cover (item #2) by first removing the 8 head screws. Remove cover carefully to prevent damaging the gasket (3).

3. **Fig. 48:** Remove O-ring (12).

3. **Fig. 49:** Remove gasket (3).

4. **Fig. 48:** Remove two hex nuts (7) retaining pump assembly to motor.

4. **Fig. 49:** Remove two hex nuts and lock washers (7 & 8) retaining pump assembly to motor.

5. **Fig. 49 only:** Remove the pump from the motor as follows:
   a. Install puller tool assembly (MP Co. Part No. 24702 or equivalent) to pump body (12) using four screws removed from the pump cover (2).
   b. Tighten the puller screw to press the motor shaft out of the impeller hub. The pump is now free from the motor.
   c. Remove the puller tool.

6. **Fig. 48:** Remove acorn nut (9) and gasket (10), then remove impeller (8) and components of the pump seal assembly (14).

6. **Fig. 49:** Remove impeller (4) and components of the pump seal assembly (5).

***Caution:*** *Do not scratch or mar the sealing surface of this seat, as its sealing feature will be affected, thus resulting in continuous leakage.*

**Inspection**

Components removed from the recirculating pump and motor assembly should be compared with new parts to determine the degree of wear.

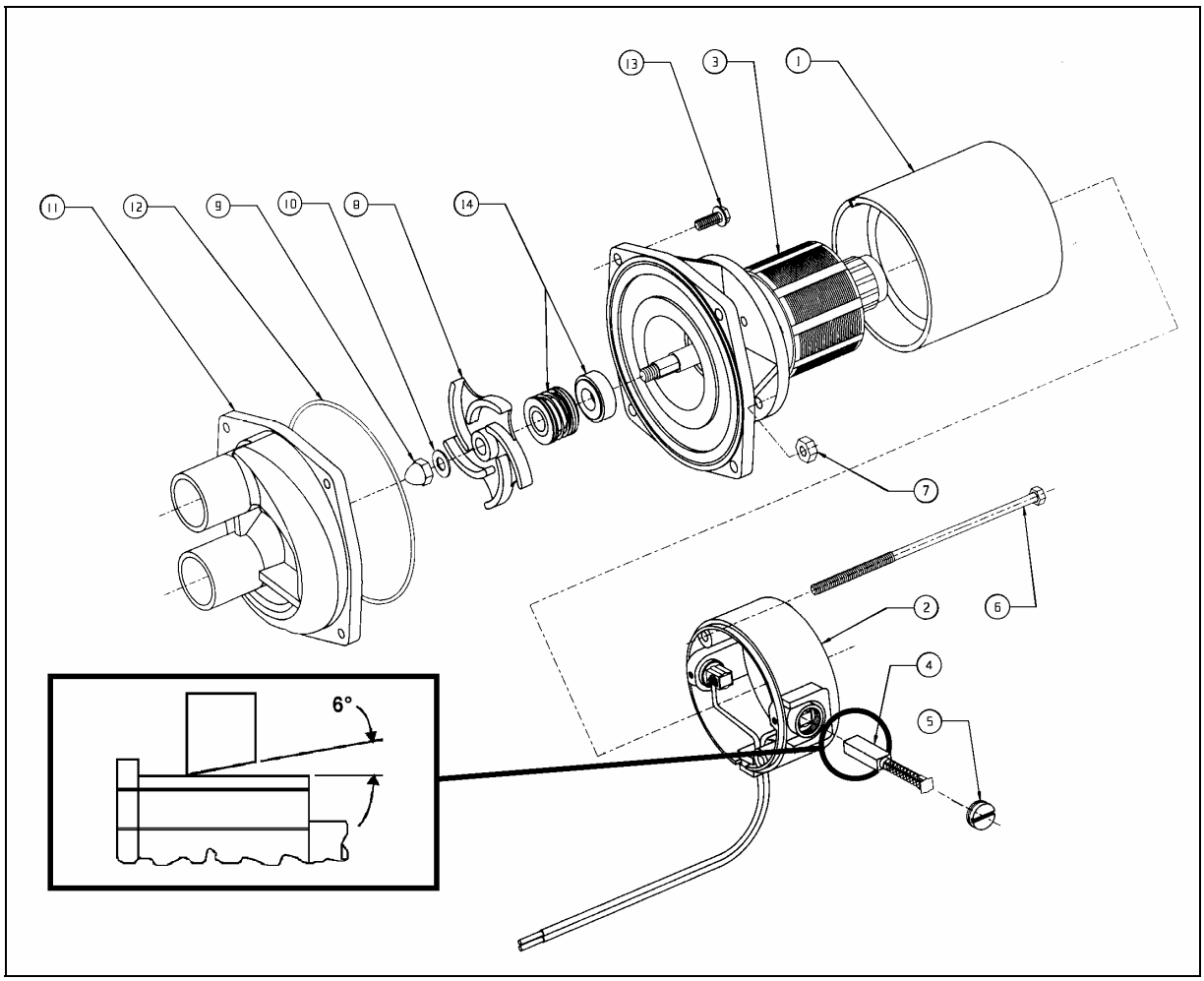



**FIGURE 48: WATER RECIRCULATING PUMP (CONVERTED VEHICLE - CENTRAL A/C)** 22091

| ITEM | DESCRIPTION | QTY. | ITEM | DESCRIPTION | QTY. |
|---|---|---|---|---|---|
| | **MOTOR** | | | **IMPELLER** | |
| | Motor Ass'y - Items 1-7 | 1 | 8 | Impeller | 1 |
| 1 | Stator | 1 | 9 | Acorn Nut | 1 |
| 2 | End Frame Assembly | 1 | 10 | Gasket | 1 |
| 3 | Armature adapter Ass'y | 1 | | **COVER** | |
| 4 | Brush Assembly | 2 | 11 | Cover - Housing | 1 |
| 5 | Cap (brush holder) | 2 | 12 | O-ring | 1 |
| 6 | Case bolt 10-32 X 5 | 2 | 13 | Screw | 4 |
| 7 | 10-32 Hex Nut | 2 | | **SEAL** | |
| | | | 14 | Seal Assembly | 1 |

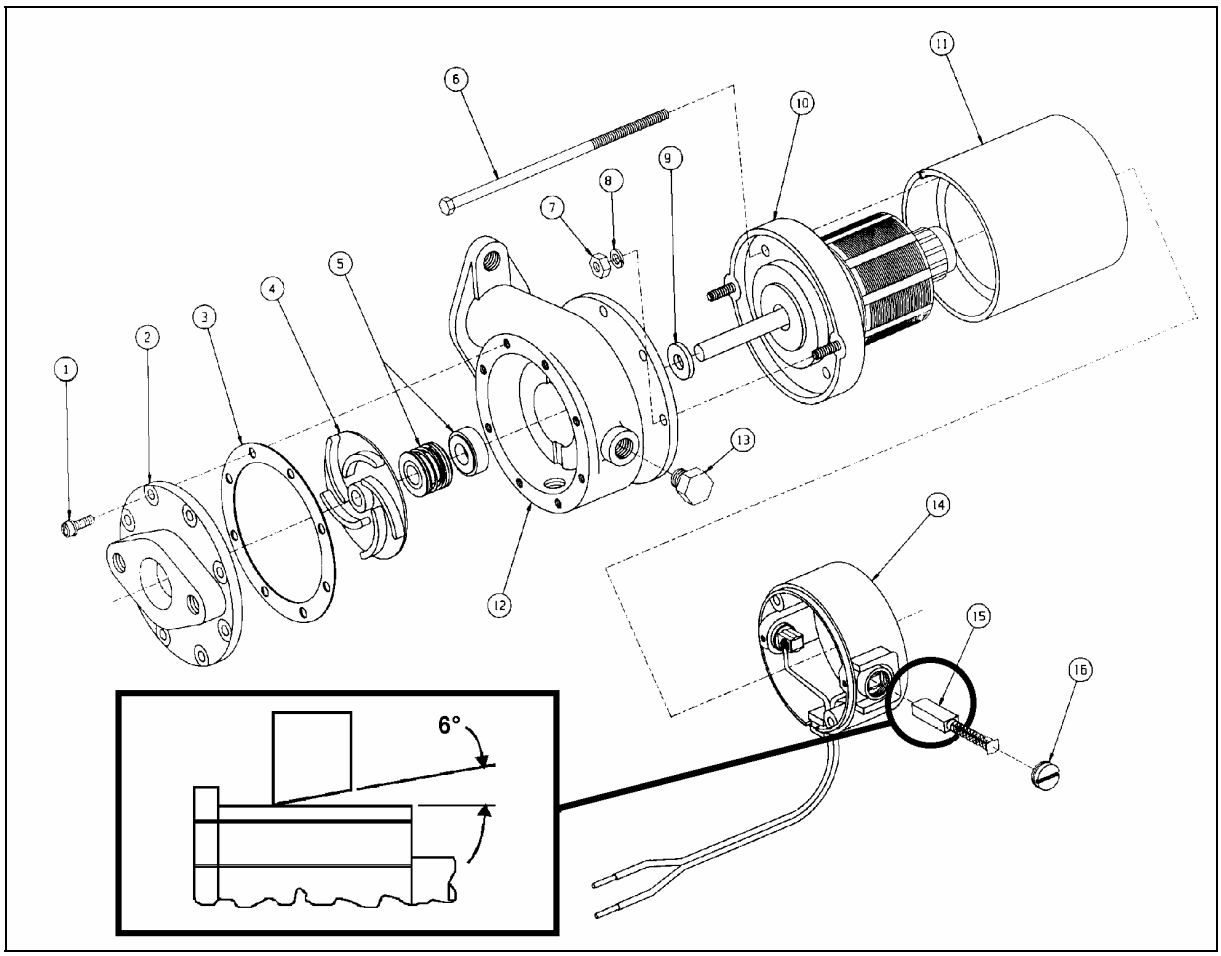



**FIGURE 49: WATER RECIRCULATING PUMP (COACH - CENTRAL A/C OR DRIVER'S A/C)** 22056

| ITEM | DESCRIPTION | QTY. | ITEM | DESCRIPTION | QTY. |
|---|---|---|---|---|---|
| | **MOTOR** | | | **IMPELLER** | |
| | Motor Assembly | 1 | 4 | Impeller - Brass | 1 |
| 11 | Stator | 1 | | **HOUSING** | |
| 14 | End Frame Assembly | 1 | 12 | Body - Brass | 1 |
| 10 | Armature adapter Assembly | 1 | 2 | Cover - Brass | 1 |
| 15 | Brush Assembly | 2 | 1 | Screw and Washer Assembly | 8 |
| 16 | Cap (brush holder) | 2 | 3 | Gasket | 1 |
| 6 | Case bolt 10-32 X 5 | 2 | 9 | Slinger | 1 |
| 7 | 10-32 Hex Nut | 2 | 13 | Drain Plug - 1/8" NPT Brass | 2 |
| 8 | #10 Lock Washer | 2 | | **SEAL** | |
| | | | 5 | Seal Ass'y - Silicon Carbide/Carbon | 1 |

10.7.4 Brushes

1. When removing brushes, note the position of the brush in the tube. Brush life is shortened if the brushes are not replaced properly.
2. Examine brushes for the following:

   a. Wear

      Replace the brushes if less than 25% of the usable brush is left (less than 0.300 inch [8 mm]).

   b. Chipped edges

      Chips can be caused by improper handling or installation. Badly chipped brushes should be replaced regardless of their length.

   c. Annealed brush spring

      This can be detected by noting the resiliency of the spring. Annealing is caused by failing to tighten the brush caps properly, thus not providing a good low resistance contact between the terminal and the brush tube. Replace brushes showing evidence of annealed springs.

   d. Frayed or broken pigtail

      An improperly installed brush may have the pigtail (shunt) pinched under the terminal or between the coils of the spring. If the pigtail is badly frayed or broken, replace the brush.

3. Observe the following factors when replacing brushes:

   a. The face of a new brush is carefully cut to cause proper seating during the *"wear-in"* period.

   b. Improper installation can harm both the brush and the commutator.

   c. Replacement brushes should be of the proper grade.

   d. New brushes have a six (6) degree angle. The brush should always be inserted so that the angle is open away from the pump end of the assembly (inset, Figs. 48 & 49).

   e. Brush performance will be affected if the spring and terminal are not properly placed in the brush tube. The spring should be free over its entire length and the terminal should make good contact with the metal brush tube insert.

10.7.5 Bearings

1. Rotate the motor shaft. If the ball bearings show evidence of wear, they should be replaced.

***Note:*** *When removing the armature from the motor, the number of washers and their arrangement should be noted. Improper numbers and/or installation of washers can cause improper tracking of brushes, which will result in excessive preloading of bearings and noisy operation.*

2. To help prevent damaging the armature winding and/or the commutator, when removing the bearings, the use of a bearing puller is recommended.
3. Replacement bearings should be pressed into the same exact location as the original bearings.
4. It is recommended that a suitable sealant (such as Loctite or equivalent) be used between the shaft and the bearing, if the fit is not tight enough to prevent the shaft from spinning inside the inner race.
5. After replacing the bearings, check the position of the commutator in the motor by looking down into the brush tube. Neither the riser nor the edge of the commutator should be visible.

10.7.6 Commutator

1. The commutator is a precise assembly. Although it is solidly built and made of a fairly tough material, it can be easily ruined by careless handling.
2. The commutator should be refinished only on equipment which provides good concentricity and the proper finish.

3. The commutator should be refinished if a micrometer reading shows a difference between *"in track"* and *"off track"* diameter of 0.187" (4,7 mm) or more.
4. The commutator should be carefully undercut with a 0.025" (0,6 mm) or less slot width.
5. A 25 to 50 micromesh finish is desirable on a new or refinished commutator.
6. The commutator should not be touched with the fingers since sweat and body oils will rapidly discolor and oxidize its surface.

10.7.7 Miscellaneous

1. **Fig. 49 only:** Check the shaft slinger (9) to make sure it is tight on the motor shaft. If the slinger slips on the shaft, it should be replaced.
2. **Fig. 48:** Inspect seal assemblies (14) to determine wear. If the seal has leaked, or is badly worn, it is recommended that a complete new seal assembly be installed.
2. **Fig. 49:** Inspect seal assemblies (5) to determine wear. If the seal has leaked, or is badly worn, it is recommended that a complete new seal assembly be installed.
3. **Fig. 49 only:** The impeller (4) is a press fit on the armature shaft. This press fit must be maintained to prevent the impeller from slipping. Install a new impeller if necessary.

10.7.8 Assembly

1. **Fig. 49 only:** Install slinger (9) on the motor shaft.
2. **Fig. 49:** Assemble body (12) to the motor.
3. **Fig. 48:** Install seal assembly (14).
3. **Fig. 49:** Install seal assembly (5).
4. **Fig. 48:** Insert impeller (8) and secure with acorn nut (9) and gasket (10).
4. **Fig. 49:** Install impeller (4) in the following manner:
   a. Place the impeller on a flat surface with the vanes against the flat surface.
   b. Invert the motor and pump body assembly, then pilot the pump shaft into the impeller bore. **DO NOT HAMMER** on the motor shaft extension at rear of motor.
   c. Press on motor and pump body until the machined face of the pump body is flush with the face of the flat surface on which the impeller is resting. The face of the impeller vanes must now be flush with the machined face of the pump body.
5. **Fig. 48:** Install O-ring (12).
5. **Fig. 49:** Install gasket (3). This gasket serves both to seal the cover and to establish the proper clearance between the face of the impeller and the pump cover.
6. **Fig. 48:** Attach cover (11) to the pump body using four screws (13).
6. **Fig. 49:** Attach cover (2) to the pump body using eight screw and washer assembly (1).
7. **Fig. 48:** Install motor brushes assembly (4) and brush caps (5).
7. **Fig. 49:** Install motor brushes assembly (15) and brush caps (16).

10.7.9 Installation

**Figure 48 pumps:**

1. Connect water lines to pump (hoses to copper pipes). Use a soapy water solution to help insert water lines.
2. Position the pump and motor assembly on the mounting bracket. Position the mounting clamps over the motor and secure with mounting bolts.
3. Connect electrical wiring to the pump motor.

4. Open shutoff valves. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.
5. Fill the cooling system as previously instructed in this section under *"10.2 Filling Heating System"*, then bleed the system as previously instructed in this section under *"10.3 Bleeding Heating System"*.

**Figure 49 pumps:**

1. Apply gasket cement to the pump body line adapter and to the line flanges, put the two gaskets in place, and connect water lines to the pump at the flange connections. Position the pump and motor assembly on the mounting bracket. Position the mounting clamps over the motor and secure with mounting bolts.
2. Apply pipe sealant on threads of drain plug, and screw it in place.
3. Connect electrical wiring to the pump motor.
4. Open shutoff valve. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.
5. Fill the cooling system as previously instructed in this section under *"10.2 Filling Heating System"*, then bleed the system as previously instructed in this section under *"10.3 Bleeding Heating System"*.

## 10.8 WATER FILTER

### 10.8.1 Description

This vehicle is provided with a cleanable water filter, which is located in the evaporator compartment behind the R.H. side air duct. The filter uses the micronic principle of filtration which utilizes an accordion -pleated design for a maximum filtering area. A relief valve integrated to the filter element allows bypass of the filter in case of heavy restrictions.

Vehicles equipped with driver's A/C system only are provided with a water filter located in reclining bumper compartment.

### 10.8.2 Maintenance

Filter maintenance consists in changing the element at break-in 3000 miles (4 800 km), and subsequently every 50,000 miles (80 000 km) or once a year, whichever comes first.

***Note:*** *Service water filter each time soldering is performed at any point on coolant piping; operate heating system a few minutes first, so that soldering residues are routed to the strainer.*

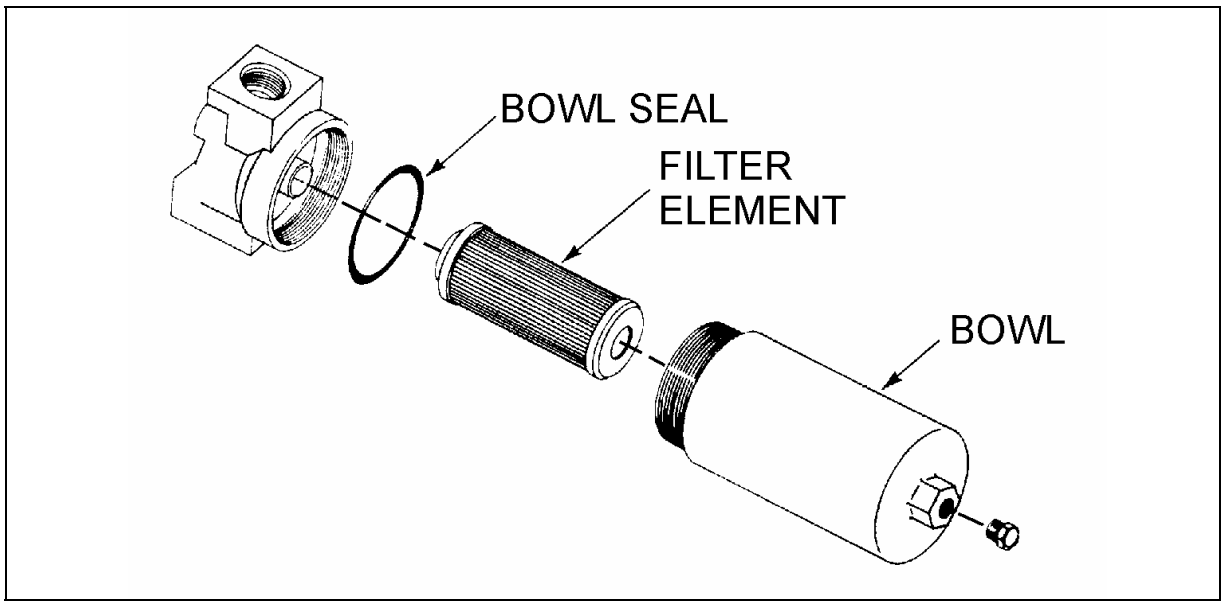



**FIGURE 50: WATER FILTER** 22057

10.8.3 Servicing (Vehicles with central A/C system)

1. Stop engine and allow engine coolant time to cool.
2. Close shutoff valves. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.

***Warning:*** *Before proceeding with the following steps, make sure that coolant has cooled down.*

3. Rotate bowl (Fig. 50) counterclockwise and remove.
4. Remove filter element (Fig. 50) from housing. Discard all disposable elements. These elements are not cleanable.
5. Place new, clean element in housing, centering it on location in the head.
6. Inspect bowl seal and replace if necessary.
7. Replace bowl. Rotate clockwise and hand tighten.
8. Correct coolant level in surge tank as instructed previously in this section under *"Filling Heating System"*.

10.8.4 Servicing (Vehicles with driver's A/C system)

1. Stop engine and allow engine coolant time to cool.
2. Close shutoff valves. Refer to *"05 COOLING"* under heading *"Draining Cooling System"* for location of valves.

***Warning:*** *Before proceeding with the following steps, check that coolant has cooled down.*

3. Unscrew the filter retaining plug.
4. Remove strainer, then clean inside strainer housing.
5. Using water under pressure, flush the strainer from the outside.
6. Reinstall strainer, then tighten the retaining plug.
7. Open shut-off valves.
8. Correct coolant level in surge tank as instructed previously in this section under *"10.2 Filling Heating System"*.

10.9 BY-PASS SOLENOID WATER VALVE (OPTIONAL)

This valve is optional and is installed only on vehicles equipped with a preheater. The valve

is located in the evaporator compartment. This valve is similar to the driver's solenoid valve (refer to Fig. 45 for part names).

10.9.1 To Remove or Change the Coil

- Stop engine and allow engine coolant time to cool.
- Close shutoff valves. Refer to *"05 COOLING"* under heading *"4.7 Draining Cooling System"* for location of valves.

To remove the solenoid coil:

First take out the retaining screw at the top of the coil housing. The entire coil assembly can be lifted off the enclosing tube.

To reassemble:

Make sure that the parts are placed on the enclosing tube in the following order:

1. Be sure to change electrical data plate according to coil specifications change.
2. Place coil and yoke assembly on the enclosing tube. Lay data identification plate in place.
3. Insert the coil retaining screw, rotate housing to proper position and tighten screw securely.

10.9.2 To Take the Valve Apart

To disassemble:

This valves may be taken apart by removing the socket head screws which hold the body and bonnet together. After removing the screws, carefully lift off the bonnet assembly (upper part of the valve). Don't drop the plunger. The diaphragm can now be lifted out. Be careful not to damage the machined faces while the valve is apart.

***Note:*** *The above procedure must be followed before brazing solder type bodies into the line.*

To reassemble:

Place the diaphragm in the body with the pilot port extension up. Hold the plunger with the synthetic seat against the pilot port. Make sure the bonnet O-rings are in place, the bonnet assembly over the plunger, and that the locating sleeve in the bonnet enters the mating hole in the body. Insert body screws and tighten uniformly.

10.10 PREHEATING SYSTEM (OPTIONAL)

On XL2-45 vehicles, the preheater is located inside engine compartment and is accessible through L.H. side rear service compartment (refer to figure 51). On XL2-40 and 45E vehicles, the preheater is located next to engine (curb side) and is accessible through engine R.H. side door.

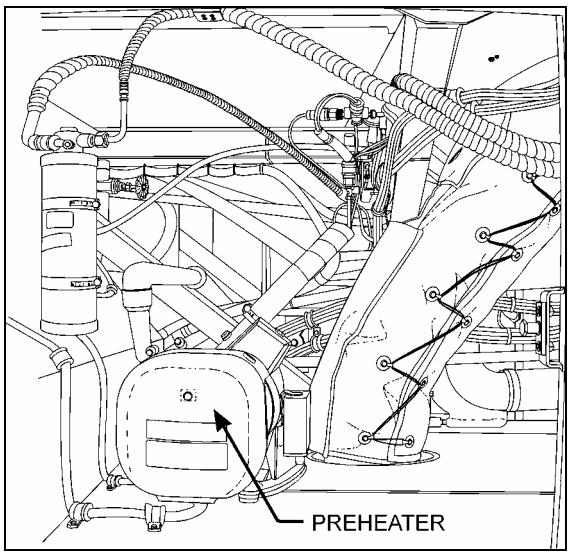



**FIGURE 51: L.H. SIDE REAR SERVICE COMPART.** 22176

This Auxiliary Preheating System is used for preheating and retaining the heat of water-cooled engines. It can be used before starting the engine to ease it's starting and to provide immediate inside heat upon operation of the heating system. It can also be used with engine running to maintain coolant heat and maintain the set temperature inside vehicle.

The heater operates independently from the vehicle engine. It is connected to the cooling and heating circuits, the fuel system and the electrical system of the vehicle.

The pilot lamp turns on when the heater is switched on. Combustion air flows in to flush out the combustion chamber and the water circulation pump is put into operation. The fuel metering pump conveys fuel in precise doses to

the combustion chamber where fuel and combustion air form a combustible mixture which is ignited by the glow plug.

Once the flame sensor has signaled to the control unit that combustion has taken place correctly, the glow spark plug and ignition coil are switched off.

The hot combustion gases are diverted at the end of the flame pipe, then pass through the indirect heating surfaces of the heat exchanger and transmit their heat to the water passing through the heat exchanger.

The heat is thermostatically controlled and operates intermittently, i.e. the switched-on times of the burner vary depending on the heat requirement. The water temperature depends on the setting of the built-in water thermostat.

The water circulation pump remains in operation as long as the heater is operating, even in the regulation intervals and during the delayed cutout of the switched-off heater. The pump can also be operated independently from the heater by means of an appropriate circuit. The heater can be switched on at any time, even during the delayed cutout period. Ignition takes place once this delay time is over.

When the heater is switched off, the fuel supply is interrupted. The flame goes out, and at the same time a delayed cutout of some 2.5 minutes begins. The combustion air still flowing flushes the remaining combustion gases out of the chamber and cools off the hot parts on the exhaust side of the heat exchanger, while the water circulation pump, still running, transmits the heat present in the heat exchanger, thus preventing local overheats. Once the delayed cutout time is over, both the combustion air blower and the water circulation pump switch off automatically. A cutout will take place in case of any failure of the preheater.

10.10.1 Operation

Switch on the heater. The operation indicator lamp comes on and the heater motor and circulating pump begin to run. After about 10-25 seconds the solenoid valve opens and fuel is sprayed into the combustion chamber. At the same time, the electronic ignition unit produces high voltage (8000 V) and the mixture of fuel and air in the combustion chamber is ignited by the spark on the ignition electrodes. The flame is indicated by the flame detector, then the electronic ignition unit stops producing high voltage and combustion continues by itself (spark on electrodes is required only to ignite the flame). At this moment, the heater is working and producing heat.

If the heater is switched off by the on/off switch, the solenoid valve interrupts fuel supply, combustion stops and indicator lamp turns off. Combustion air fan still blows air, cleaning the combustion chamber of any fumes and cooling down the combustion chamber. Coolant circulation pumps coolant, making a purge cycle for approximately 2-3 minutes, thus protecting the heater against overheating.

If the heater is not switched off by the on/off switch, the control thermostat will switch off the heater when coolant temperature reaches 165° ± 6°F (75° ± 3°C) and turns it on at 154° ± 9°F (68° ± 5°C). During this time, the heater (combustion) is off and the indication lamp and coolant pump are on. Combustion air fan blows air for 2-3 minutes and then turns off.

10.10.2 Preheating System Timers

The timer, located on L.H. lateral console is used to program the starting and stopping time of the preheating system. One of three possible timers may be installed in your vehicle (refer to the three following images). The system indicator light, located on the timer, illuminates when the system is functional.

***Caution:*** *The preheating system should not operate for more than one hour before starting engine as this could discharge batteries.*

***Warning:*** *Preheating system must not operate when vehicle is parked inside or during fuel fill stops.*

***Note:*** *Preheating system uses the same fuel as the engine.*

In case of failure:

1. Shut off and turn on again.

2. Check main circuit breaker and overheating switch (Espar) or overheat fuse (Webasto).
3. Have system repaired in a specialized shop.

10.10.3 Timer Operating Instructions (Espar)

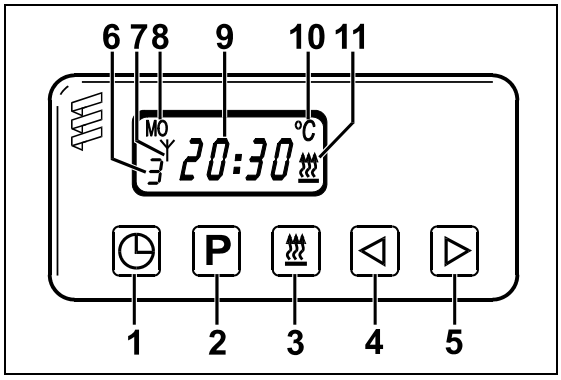



**FIGURE 52: ESPAR** 18326

These Instructions refer to the timer illustrated in figure 52.

1. Time
2. Program
3. Heating ON
4. Backwards
5. Forwards
6. Memory indicator
7. Symbol for remote control
8. Weekday/program day
9. Current time/program time
10. Temperature display
11. Status display

When the power supply has been connected, all the elements in the display flash - the time must be set. Heating cannot start until the time is set.

**Setting Time and Weekday for the First Time**

Briefly press (1). The time display 12:00 flashes.

Set the current time using (4) or (5). When the time display stops flashing, the time has been stored.

The weekday begins to flash. Set the current weekday using (4) or (5). When the weekday stops flashing, the weekday has been stored.

If the ignition is “ON”, the display continues to be displayed.

If the ignition is “OFF”, the display disappears after 10 seconds.

**Changing Time and Weekday**

Press and hold (1) until the time flashes.

Proceed as per instructions for setting time and day for the first time.

If only the time is to be set, you may skip setting the weekday by pressing (1) twice.

When the weekday has been set, press (1) to stop the display from flashing and to store the time and day.

**HEATING WITHOUT PROGRAMMING (IGNITION “OFF”)**

Press (3). The status display (11) will show heating symbol.

The default heating time is set to 120 minutes. It can be changed temporarily or permanently.

**Temporarily Setting Heating Time**

With heater on, press (4) to decrease time (minimum 1 minute) or (5) to increase time (maximum 120 minutes).

**Permanently Setting Heating Time**

With heater “OFF” (do not press (3), press and hold (4) (approx. 3 seconds), until display appears and flashes.

Set heating time (from 10 to 120 minutes) using (4) or (5).

When display disappears, the new heating time has been stored.

**Switching Off Heating**

Briefly press (3).

The heating symbol will disappear from status display (11).

System switches to automatic after-run for cooling.

**HEATING WITHOUT PROGRAMMING (IGNITION "ON')**

To switch heating "ON", press (3). The status display (11) will show heating symbol, as well as time and weekday.

Heating will remain "ON" until ignition is switched "OFF".

If the ignition is switched "OFF", the heating remains switched on for 15 minutes.

This time can be increased (max. 120 minutes) by pressing (5) or decreased (min. 1 minute) by pressing (4).

**Switching Off Heating**

Briefly press (3).

The heating symbol will disappear from status display (11).

System switches to automatic after-run for cooling.

**PROGRAMMING START OF HEATING**

3 switch-on times within the following 24 hours or one switch-on time in 7 days can be programmed. Only one switch-on time can be activated at one time.

**Selecting and activating memory:**
(starting from neutral status with display visible)

First memory – press (2) once.

Memory display: 1 (default time setting 12:00)

Second memory – press (2) twice.

Memory display: 2 (default time setting 12:00)

Third memory – press (2) three times.

Memory display: 3 (default time setting 12:00)

Neutral status (no memory activated) – press (2) repeatedly until memory display disappears.

**Start of heating within 24 hours**

Set the starting time:

1. Press (2) repeatedly until the desired memory display (1, 2 or 3) flashes.
2. Briefly press and release either (4) or (5). The program time flashes.
3. Set the heating start time using (4) or (5) (Setting is only possible if the program time is flashing).

To select another memory, press (2).

**Start of heating after 24 hours (max. 7 days)**

Set the starting time:

1. Press (2) repeatedly until the desired memory display (1, 2 or 3) flashes.
2. Briefly press and release either (4) or (5). The program time flashes.
3. Set the heating start time using (4) or (5) (Setting is only possible if the program time is flashing).

Set the program day:

4. The program day begins to flash approximately 5 seconds after the time has been set.
5. Set the heating day using (4) or (5).
6. The program time and day are stored when the time display disappears or when the current time appears.
7. The memory display indicates the activated memory. The flashing "heat-on" symbol (11) also indicates that a memorized start time is activated.

**Checking activated memory**

The program time of the displayed memory is displayed for about 5 seconds. The display then disappears or then switches to current time (if the ignition is “ON”).

The programmed time (and day) can be displayed by holding (2) down for five seconds.

Temperature display

If an ambient temperature sensor is connected (Espar # 25 1482 89 41 00) and the ignition is activated, the temperature can be permanently displayed by pressing (1) briefly. If the ignition is deactivated, the time temperature is displayed for 15 seconds when (1) is pressed twice.

**PLEASE NOTE**

Voltage dips are bridged by the heating time switch. After electrical failures, all elements of the display flash. Complete resetting is necessary.

If the ignition is activated, the current time and weekday are displayed permanently. If the time switch is deactivated, the display disappears after 15 seconds.

The remote control can also be operated with the use of an additional unit (receiver module).

If a fault occurs when heating is switched on and the diagnostic circuit is connected, the operating display shows a flashing heating symbol (11) and the fault code number is displayed (see table at the end of this section and contact a specialized shop).

If faults occur, we recommend the following:

1. Switch off and on (max. twice);
2. Check main fuse;
3. Check air channels for blockages;
4. Consult a specialized workshop.

10.10.4 Timer Operating Instructions (Webasto)

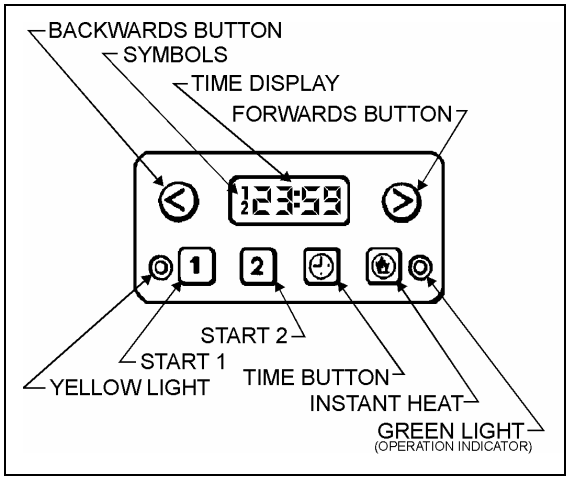



**FIGURE 53: WEBASTO** 18046

These instructions refer to the timer illustrated in figure 53.

***Note:*** *Heater timer control pad may differ from the one described. Refer to your manufacturer's instruction booklet for detailed operating instructions.*

**SETTING THE CLOCK**

If the time display e.g. 18:33 is wrong, or if it flashes 8:88, hold ⏲ and press either ⏴ (backwards) or ⏵ (forwards). The longer you hold the button down, the quicker the display changes. The last few minutes are set accurately by quick pushes. Adjust to get exact time, e.g. 23:59. The display fades after 20 seconds.

**Present Time Display**

Press ⏲ at any time. Present time appears on the screen.

**Manual Heating Start-Up**

Press 🔥 to switch the heater on or off immediately. The green light illuminates when the heater is on.

**Programming Heating Start Time**

Press [1] and the display shows the time at which the heater will start. You can alter the starting time by pressing either ⟨ (backwards) or ⟩ (forwards) button. The longer you hold the button down, the faster the display changes. The last few minutes are set accurately by quick pushes. The display fades after 20 seconds. Start time 1 remains on the display, and the yellow light stays on. Starting time #1 is now activated.

Button [2] allows you to program a second starting time:

Press button [2] which de-activates starting time 1, then proceed as with [1].

The activation of the second starting time is indicated by the symbol 2.

**To Check (or activate) Start Time**

Press button [1] or [2] briefly. The display shows the programmed starting time for 20 seconds. This also programs the timer to start the heater at the time shown.

**To Cancel Heating Start Time**

Press button [1] or [2] briefly. The appropriate number in the display goes out, together with the yellow light.

***Note:*** *Switch on the preheating system briefly about once a month, even during the warm season.*

***Caution:*** *When welding on the vehicle, disconnect the preheater module connector in order to protect this system from voltage surges.*

***Caution:*** *To avoid running down the batteries, do not turn on the preheating system for more than one hour before starting the engine.*

***Warning:*** *The preheating system uses the same fuel as the engine. Do not operate in a building or while refueling. Operate only in a well-ventilated area.*

10.10.5 Timer Operating Instructions (Webasto)

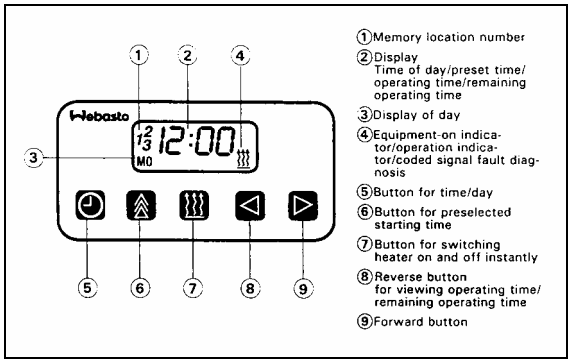



**FIGURE 54: WEBASTO** 18327

These instructions refer to the timer illustrated in figure 54. They are the same instructions provided in the Webasto 1529 instruction booklet, provided with your vehicle.

**Remaining Operating Time**

The remaining operating time refers to the period of time the heater still continues to remain in operation. It may be changed while the heater is in operation.

**Setting the Digital Timer**

After the power has been connected, all symbols on the digital display are flashing. The time of the day and the day of the week must be set.

All flashing symbols of the timer can be set by means of the Forward (9) or Reverse (8) buttons.

When buttons (8) and (9) are pressed for more than 2 seconds, the quick digit advance mode is activated.

**Setting the Time and Day of the Week**

1. Press button (5) for more than 2 seconds (time display flashes).
2. Press (8) or (9) button to set the time of day.
3. Wait 5 seconds. The time of day is stored (time of week flashes).
4. Press (8) or (9) button to set the correct day of week.
5. Wait 5 seconds. The day of week is stored.

**Viewing the Time (Ignition ON)**

Continuous display of current time and day of the week.

**Viewing the Time (Ignition OFF)**

Briefly press button (5) to display current time and day for 5 seconds.

**SWITCHING HEATER ON (INSTANT HEATING)**

**With Ignition ON:**

Press button (7). Heater is switched on (continuous operation) and continues to operate until button (7) is pressed again or ignition is switched off.

***Note:*** *If the ignition is switched off while heater is in operation, the remaining operating time of 5 minutes flashes on the display and the heater will continue to operate for this period of time.*

**With Ignition OFF:**

Press button (7). Heater is switched on for preset operating time (the factory-set heater operating duration is 60 minutes)

**SWITCHING HEATER OFF**

Press button (7). The heater starts its after-run cycle and switches off thereafter.

**Presetting Operating Duration**

1. Press button (6). Memory location number flashes.

***Note:*** *By repeatedly pressing button (6), starting time 2 or 3 can be preset.*

2. Press button (8) or (9) until correct startup time is set.
3. Wait 5 seconds. Preset starting time is stored and day of week flashes.
4. Press button (8) or (9) to select the correct startup day of week.
5. Wait 5 seconds. The startup day of week is stored.

The number of memory location remains on the display. The timer is now in the programmed mode and will switch the heater in a the preset time.

***Note:*** *We recommend that memory locations 1 and 2 be used for presetting times within 24 hours of setting the timer. Memory location 3 can be used for a starting time within the next 7 days of setting the timer.*

**Recalling Preset Times**

Press (6) repeatedly until the desired memory location number and preset time are displayed.

**Canceling Preset Time**

Press button (6) repeatedly until no more memory location number is visible on the display.

**Setting Operating Time**

1. With heater off, press button (8). Operating time flashes.
2. Press button (8) or (9) to set the operating time (between 1 and 120 minutes)
3. Wait 5 seconds. Operating time is stored.

The heater remains in operation for the preset time (except for continuous operation).

**Setting the Remaining Operating Time**

1. With heater in operation, press button (8). Remaining operating time flashes.
2. Set remaining time with button (8) or (9).
3. Wait 5 seconds. Remaining operating time is stored.

**Fault Diagnosis by Coded Light Signals**

On heaters equipped with a fault diagnosis system using coded light signals, the equipment-on indicator/operation indicator flashes. Please consult your Webasto dealer.

10.10.6 Troubleshooting and Maintenance

The Espar preheater has a diagnostic code system, so the driver is prevented when something goes wrong. Codes are listed below.

Refer to the Webasto or Espar manuals for more information.

***Note:*** *If there are no heater faults, the heater will go through a normal start cycle and regulate based on thermostat setting.*

***Note:*** *Switch on the preheating system briefly about once a month, even during the warm season.*

***Caution:*** *When welding on the vehicle, disconnect the preheater module connector in order to protect this system from voltage surges.*

***Caution:*** *To avoid running down the batteries, do not turn on the preheating system for more than one hour before starting the engine.*

***Warning:*** *The preheating system uses the same fuel as the engine. Do not operate in a building or while refueling. Operate only in a well-ventilated area.*

***Number codes and faults are as follows:***

| ESPAR PREHEATER DIAGNOSTIC CODE LIST | | | |
|---|---|---|---|
| ***Code #*** | ***Description*** | ***Code #*** | ***Description*** |
| 000 | Normal Operation – No Faults | 001 | Warning – Over Voltage |
| 002 | Warning – Under Voltage | 010 | Over Voltage Shutdown |
| 011 | Under Voltage Shutdown | 012 | Overheat Switch Opened |
| 013 | Temperature at the Heat Exchanger Too High | 020 | Glow Plug Defective |
| 022 | Short Circuit in Glow Plug Relay | 023 | Open Circuit to Voltage Regulator |
| 024 | Short Circuit in Voltage Regulator | 025 | Short in Diagnostic Pins |
| 032/033 | Blower Motor Is Not Turning<br>Blower Speed Control Relay Defective | 034 | Open Circuit To Water Control Relay |
| 035 | Open in Parts Control Relay | 036 | Short in Part Control Relay |
| 037 | Coolant Pump Motor Not Turning | 038 | Open in Fan Motor Relay |
| 039 | Short in Fan Motor Relay | 040 | Short Circuit in Water Control Relay |
| 047 | Short in Fuel Metering Pump | 051 | Flame Sensor Defect |
| 052 | No Start – Safety Rime Exceeded | 053 | Flame Out During Start Cycle |
| 054 | Flame Out in "High" Output Setting | 055 | Flame Out in Low Heat |
| 056 | Flame Out in Middle Heat | 057 | Flame Sensor Defect – Harness |
| 060 | Open Circuit in Air Temp. Sensor | 061 | Short Circuit in Air Temperature Sensor |
| 062 | Open Circuit, Operating Unit | 063 | Short Circuit, Operating Unit |
| 064 | Open Circuit to Flame Sensor | 065 | Short Circuit in Flame Sensor |
| 090 | Control Box Defective | 091 | External Power Supply Erratic |

## 11. SPECIFICATIONS

**Main evaporator motor**

| | |
|---|---|
| Make | US MOTOR |
| Type | T-17 |
| Voltage | 28.5 V DC |
| Current draw | 57 amps |
| Horsepower | 1.5 |
| Revolution | 1750 rpm |
| Insulation | Class F |
| Motor Life | 20 000 hours |
| Brush life | 10 000 hours |
| Motor supplier number | D599V54PRC4 |
| Motor Prevost number | 562374 |
| Brush supplier number | 1197 |
| Brush Prevost number | 561202 |

**Condenser fan motors**

| | |
|---|---|
| Make | US MOTOR |
| Type | TF-12 |
| Voltage | 28.5 V DC |
| Current draw | 20 amps |
| Horsepower | 0.57 |
| Revolution | 1950 rpm |
| Insulation | Class F |
| Motor | 20 000 hours |
| Brush life | 10 000 hours |
| Qty | 2 |
| Supplier number | D591Y440PRC2 |
| Prevost number | 562579 |
| Brush supplier number | 9DB21003 |
| Brush Prevost number | 561914 |

**Evaporator air filters (Central system)** (Coach)

Make..... Permatron Corp.
Type ..... Polypropylene
Supplier number.....IN 1X10X37 EXACT
Prevost number..... All vehicles (Top) 373336
Prevost number..... XL-40 vehicles (Bottom) 373338
Prevost number..... XL-45 vehicles (Bottom) 373337

**Evaporator air filters (Central system)** (Shell)

Make..... Permatron Corp.
Supplier number.....IN 13X21X1 NOMINAL
Prevost number.....(Qty = 3) 871034

**Driver's unit evaporator motors**

Make.....MCC

Voltage ..... 24 V DC

Quantity ..... 1

Supplier number.....25-0250

Prevost number.....871135

**Driver's unit evaporator air filter**

Make.....MCC

TYPE..... Recirculating air 6-¼" x 28" Washable

Supplier number.....260593

Prevost number.....871147

Make.....MCC

TYPE..... Fresh air 3-5/8" X 5-1/4" Washable

Supplier number.....260594

Prevost number.....871144

**Refrigerant**

Type .....Optional R-22 and Standard R-134a

Quantity (standard) ..... 24 lbs (10.89 Kg)

Quantity (A/C Aux. system located in overhead compartments).....4 lbs (1.8 Kg)

**Compressor (Central system)**

Make..... Carrier Transicold
Capacity, option R-134a ..... 41 CFM
Capacity, option R-22 ..... 37 CFM
Model, option R-134.....05G-134A
Model, option R-22..... 05G-22
No. of cylinders ..... 6
Bore..... 2” (50,8 mm)
Operating speed.....400 to 2200 rpm (1750 rpm. Nominal)
Minimum speed (for lubrification).....400 rpm
Nominal horsepower ..... 15
Oil pressure at 1750 rpm ..... 15 to 30 psi (103-207 kPa)
Oil capacity..... 1.13 U.S. gal (4,3 liters)
Weight ..... 142 lbs (64,5 kg)
Approved oils
-Castrol..... SW 68 (POE)
Supplier number, option R-134a ..... 68PD541-104-38
Supplier number, option R-22 ..... 68PD537-104-39
Prevost number, option R-134a ..... 950314
Prevost number, option R-22 ..... 950207

**A/C Compressor (Driver's and auxiliary systems)**

Make……..Tecumseh
Model……HGB-1000
Factory oil charge* ..... 10 US oz (295 ml)
System oil charge** (driver's system only) ..... 16 US oz (473 ml)
Weight ..... 24 lbs (10,9 kg)
Supplier number..... 99242-5
Prevost number..... 950219
Approved oils
- Castrol ..... SW 68 (POE)
- Mobil ……Arctic 1 (POE)

**Compressor unloader valve**

Make..... Carrier Transicold
Type .....Electric (AMC)
Voltage ..... 24 V DC)
Watts ..... 15
Supplier number (without coil) ..... 17-40407-20
Prevost number (without coil) ..... 950095
Coil supplier number ..... 22-50030 (1)
Coil Prevost numbert..... 950096

**Magnetic clutch**

Make..... Carrier Transicold
Type .....Housing mounted 9” dia., 2-B grooves
Voltage ..... 24 V DC
Coil resistance at 68 °F (20 °C) ..... 5.15 – 5.69 ohms
Supplier number..... 50-01122-90
Prevost number..... 950204

**Compressor V belts**

Make.....Dayco
Model (matching set of 2) ..... BX97
Prevost number (with Delco 270/300 Amp Alternator) .....506664

**Compressor V belt**

Make.....Dayco
Model..... BX100
Prevost number (with two BOSH Alternators) .....506681

**Condenser coil (Driver's and auxiliary systems)**

Make..... Harrison division
Supplier number.....3037438
Prevost number..... 950018

**Condenser coil (Central system)** (XL2-40 vehicles and, XL2-45 & 45E Shells)

Make..... Carrier Transicold

Aluminum

Supplier number.....68GF67-194-2

Prevost number..... 870654

Copper

Supplier number.....68GF67-194-3

Prevost number..... 870729

**Condenser coil (Central system)** (XL2-45 Coach)

Make..... Carrier Transicold

Aluminum

Supplier number.....68BC2-107

Prevost number..... 950259

Copper

Supplier number.....68BC2-107-1

Prevost number..... 950260

**Evaporator coil (Central system)**

Make..... Carrier Transicold

Supplier number..... 68BE2-105

Prevost number..... 871070

**Receiver tank (with sight glasses)**

Make..... HENRY

Maximum pressure..... 450 psig

Supplier number.....ARL-1217

Prevost number..... 950261

**Receiver - dryer (Auxiliary system)**

Make.....Arctic Traveler

Model..... 402566

Supplier number..... 74R1706

Prevost number..... 950048

**Filter Dryer assembly**

Make..... AC&R HENRY
Supplier number.....815031-XH9
Prevost number..... 950262

**Moisture indicator**

Make..... Henry
Supplier number..... MI-30-7/8S
Prevost number..... 950029

**Driver's refrigerant liquid solenoid valve**

Make..... Parker
Type ..... Normally closed with manual bypass
Voltage ..... 24 V DC
Amperage draw..... 0.67 amps
Watts ..... 16
Supplier number (without coil) ..... RB9MP3-MM
Prevost number (without coil) .....95-0054
Coil supplier number ..... R23MM 24 V DC-CB
Coil Prevost number..... 950055
Repair kit Prevost number ..... 950056

**Driver's hot water solenoid valve**

Make..... Asco
Type ..... Normally open (without manual bypass)
Voltage ..... 24 V DC
Current draw ..... 0.47 amp.
Watts ..... 11.2
Pressure range..... 0 to 100 psi
Max. temperature..... 220°F
Supplier number (with coil) .....106-269-1
Prevost number (with coil) ..... 870812
Coil Prevost number..... 870960
Repair kit Prevost number ..... 870872

**Hot water solenoid valve (Central system)**

Make..... Honeywell
Type .....Normally open
Voltage ..... 24 V DC
Supplier number..... LH1C13024VDC
Prevost number..... 870873
Coil, supplier number .....AVD-D130-EA22
Coil, Prevost number..... 870865
Repair kit, Prevost number ..... 870876

**Water recirculating pump (Central system - Coach) & (Driver's system - Coach & Shell)**

Make.....M.P. pumps
Voltage ..... 24 V DC
Supplier number..... 28689
Prevost number..... 871052

**Water recirculating pump (Central system - Shell)**

Make.....M.P. pumps
Voltage ..... 24 V DC
Housing ..... Aluminum
Supplier number..... 29232
Prevost number..... 871032

**Water filter (Central system)**

Make..... Parker
Supplier number (with element) .....15CN1238WP
Prevost number (with element) ..... 871028
Element supplier number ..... 925566
Element Prevost number ..... 871029

**Water filter (small A/C system)**

Make.....BRAUKMANN
Supplier number..... T300B
Prevost number..... 870807

**Driver’s expansion valve**

Supplier number, option R-134a ..... 26-0190
Supplier number, option R-22 ..... 26-0384
Prevost number, option R-134a ..... 950221
Prevost number, option R-22 ..... 950282

**Expansion valve (Central system)**

Make ..... Alco
Model ..... TCLE 5-1/2
Supplier number ..... 21059366
Prevost number ..... 950320

**By-pass valve (Driver's and auxiliary systems)**

Make ..... Alco
Model ..... ACP-5
Supplier number ..... 047284
Prevost number (Shell) ..... 452586
Prevost number (Coach) ..... 452512

**Bypass solenoid water valve**

Make ..... Parker Hanninfin
Bypass supplier number ..... RB21ME7-MM
Bypass Prevost number ..... 870886
Coil supplier number ..... R-23MM24VDC-CB
Coil Prevost number ..... 870886
Repair kit supplier number ..... 76754
Repair kit Prevost number ..... 870980

**Preheating system**

Make ..... Espar
Model ..... D 12 W
Capacity ..... 41 000 Btu/h (12 kW)
Heating medium ..... Coolant
Rated voltage ..... 24 V DC
Operating voltage ..... 20-28 V DC

Electric power consumption (without coolant recirc. Pump) ..... 55 watts
Fuel consumption ..... 0,8 US gallons/hr (1.65 liters/hr)
Supplier number ..... 25 1860 05
Prevost number ..... 871077

**Preheating system**

Make ..... WEBASTO
Model ..... DBW 2010
Capacity ..... 45 000 Btu/h (12 kW)
Heating medium ..... Coolant
Rated voltage ..... 24 V DC
Operating voltage ..... 20-28 V DC
Electric power consumption (without coolant recirc. Pump) ..... 60 watts
Fuel consumption ..... 0,4 US gallons/hr (1.5 liters/hr)
Supplier number .....
Prevost number ..... 871085

**Preheating system**

Make ..... WEBASTO
Model ..... DBW 2020
Capacity ..... 80 000 Btu/h (23,3 kW)
Heating medium ..... Coolant
Rated voltage ..... 24 V DC
Operating voltage ..... 20-28 V DC
Electric power consumption (without coolant recirc. Pump) ..... 120 watts
Fuel consumption ..... 0,8 US gallons/hr (3 liters/hr)
Supplier number ..... 666.640
Prevost number ..... 871036