

SECTION 22: HEATING AND AIR CONDITIONING

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1. HEATING AND AIR CONDITIONING

1.1 Description

The vehicle's interior is pressurized by the Heating, Ventilation and Air Conditioning (HVAC) system(s). Driver should always try to introduce as much circulation of outside fresh air as possible without hampering HVAC system(s). 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.

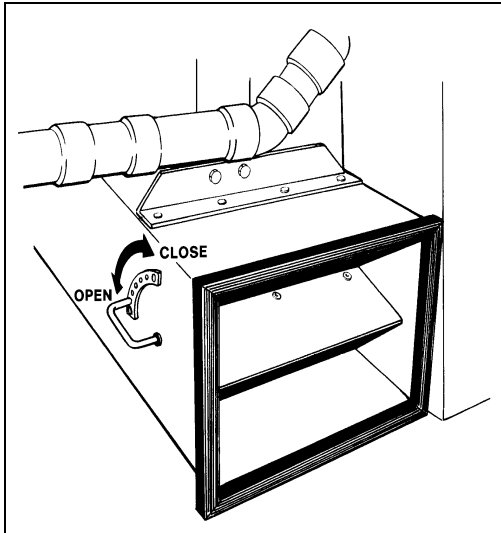


FIGURE 1: ADJUSTABLE AIR DUCT

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The adjustable air intake damper is located in the A/C & heating compartment (see "18. BODY" for compartment location). The damper should normally be left open. However, under extreme temperature conditions, it can be closed or partially 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.

It should be remembered that the inside of vehicle should always be slightly pressurized to minimize the influx of dust and moisture.

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 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. console in driver's area. Mixed air goes through cooling and heating coils, fans and discharge ducts. The L.H. discharge duct, directs air flow to four (4) different locations i.e.: driver's feet, driver's window, driver's chest and L.H. windshield. The R.H. discharge duct also has four (4) outlet's, all of which are directed towards windshield.

Note: *In the case of a converted vehicle, the hose furthest to the right, separates into two (2), directing air flow to the windshield/entrance door and to the entrance steps.*

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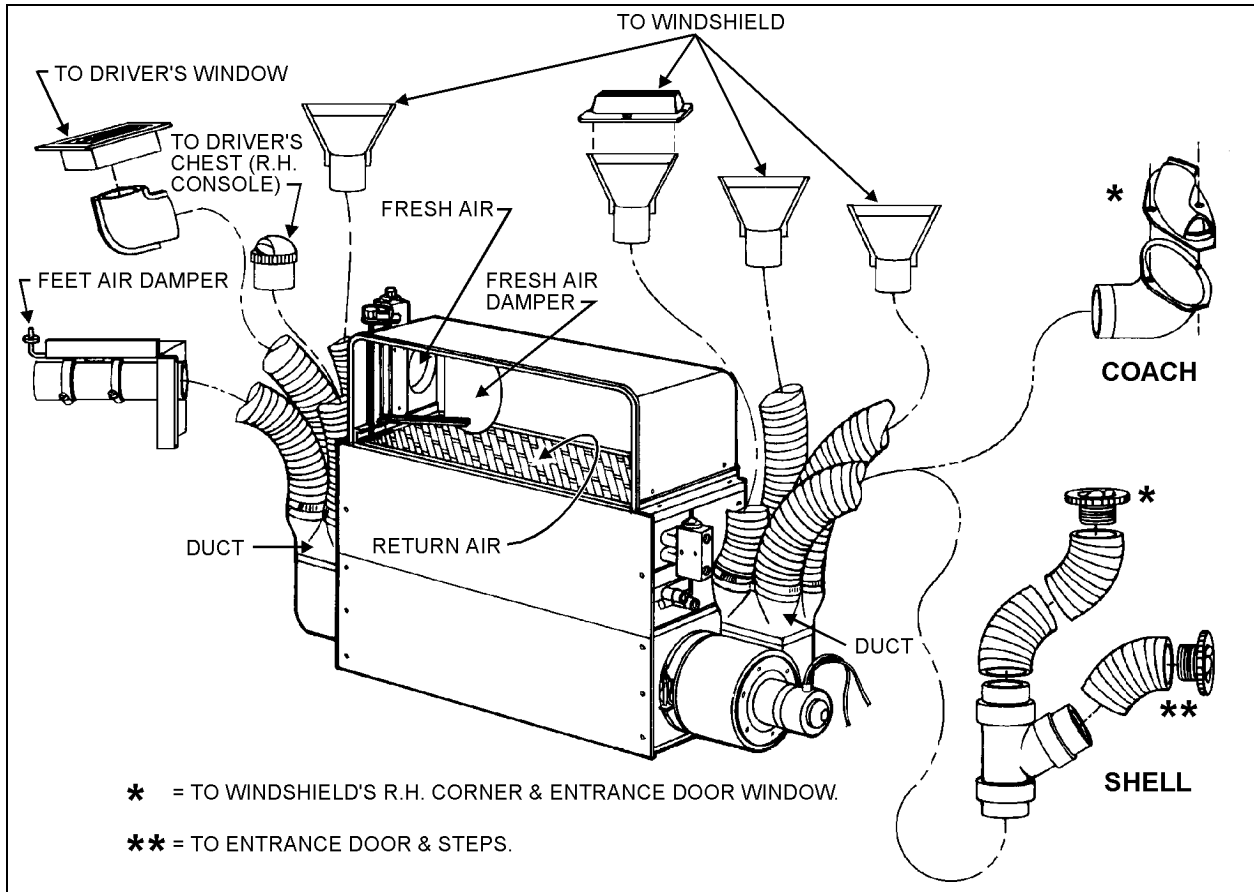


FIGURE 2: DRIVER'S AIR CIRCULATION

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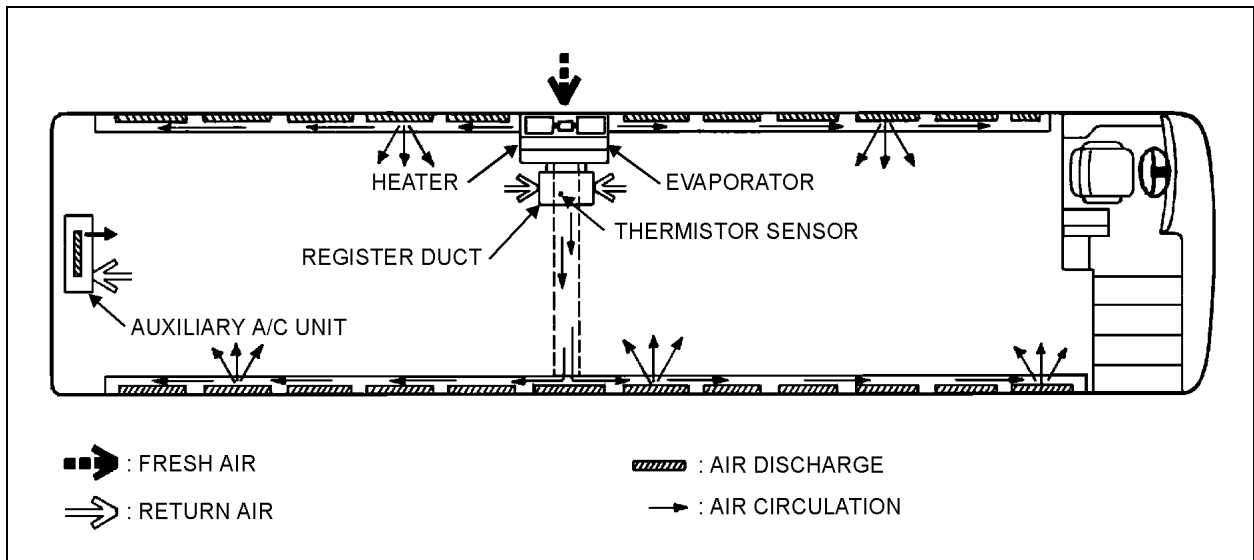


FIGURE 3: CENTRAL HVAC SYSTEM AIR CIRCULATION

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2.2 Central Area (Passengers/Living)

Fresh air enters the vehicle on the L.H. side, through the manually adjustable damper (Fig. 1) located in A/C & heating compartment. The damper can be fully opened for normal operation or partially closed for extreme weather or highly polluted areas (Refer to the 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.

On vehicles equipped with an auxiliary A/C system, return air is drawn through an air filter into the auxiliary A/C unit at rear of vehicle; discharge air enters the vehicle through the grill just above the unit.

3. HVAC SYSTEM OPERATION - DRIVER'S SYSTEM

Temperature control in the driver's area is provided by the "Temperature" control (which is in fact a potentiometer), mounted on the R.H. console in conjunction with a thermistor sensor located underneath console. At extreme clockwise position, the temperature control will deliver full heat. The "Temperature" control button is protected by a 1.5 amp fuse located just behind it.

Warning: *Excessive high temperature in driver's area could induce drowsiness, affecting driver's ability to operate the coach safely.*

The fan speed is set by the position of the "Fan Speed" control, also mounted on the R.H. console. The clicking noise produced while turning the control activates the heating or A/C system depending on the "Temperature" control's posi-

tion; "Temperature" control also acts as a potentiometer. Consequently, it is possible to gradually increase speed of fan motor from 25% to maximum speed. An electronic module, mounted on the driver's HVAC unit, analyzes the value sent to the potentiometer, and thus sets the motor speed. This installation ensures economical operation, and a wide range of speeds.

The piping for driver's HVAC unit is paralleled with that of main HVAC unit. Both units use the same refrigerant and coolant, and are linked to the same condenser and compressor, but are individually controlled. The A/C compressor magnetic clutch is engaged only when the main HVAC unit is activated. Consequently, the main HVAC unit must be functional in order for the driver's unit to operate in the A/C mode.

4. HVAC SYSTEM OPERATION - CENTRAL SYSTEM

The "A/C - Heat" switch, located on the R.H. console, operates the A/C-heating and ventilation system (HVAC) in the passenger area (or the living space for a converted vehicle). The "Temperature" control, located on the R.H. console, enables you to select the desired temperature in the passenger area (refer to the Operator's Manual for details). This control is protected by a 1.5 amp fuse located just behind it. Temperature control is provided in conjunction with a thermistor sensor inside register duct, located amidships on L.H. side of vehicle (Figs. 3 & 4).

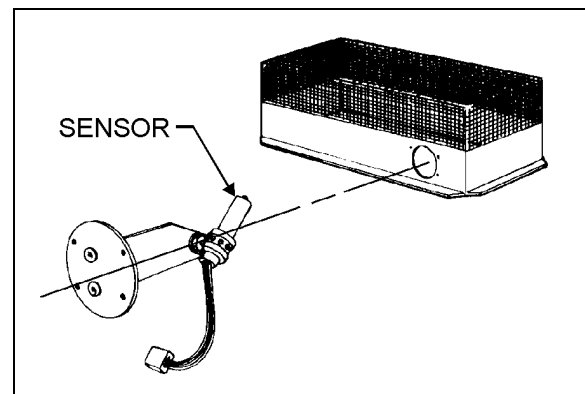


FIGURE 4: THERMISTOR SENSOR

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In addition to the central system, an auxiliary A/C system may be installed as optional equipment. The control switch is located on R.H. lower switch panel while the temperature control is located on the unit itself. Temperature control is factory set and protected by a 1 amp fuse located next to it.

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 "Heat" indicator light, located on R.H. console, illuminates when hot water circulates through the valve, no matter what mode was selected. Moreover, an A/C "Warning" light, located next to "Heat" indicator light, illuminates when the main A/C system is not working properly.

The evaporator fan motor, located in A/C & heating compartment, is protected by a 105 amp, manually resettable circuit breaker. The condenser fans, located in the condenser compartment, also have circuit protection via manually resettable circuit breakers. The location of breakers varies with each type of XL vehicle; see "06. ELECTRICAL" for locations on your vehicle.

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.

The auxiliary A/C system components are separate and completely independent of driver's and central systems.

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.

5.1 Coil Cleaning

Note: After cleaning coils with water, squeeze discharge tubes (rubber hoses) located underneath the appropriate compartment, to eliminate the accumulated water and dirt.

Check the external surface of the coil at regular intervals for dirt or any foreign matter.

For the driver's and auxiliary HVAC units, flush the coil from inside. For the evaporator, back flush the coil (Fig. 5) every 12,500 miles (20 000 km) or once a year, whichever comes first.

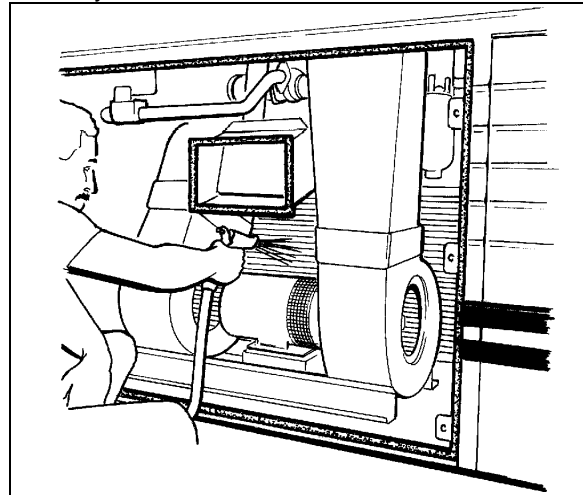


FIGURE 5: EVAPORATOR COIL

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

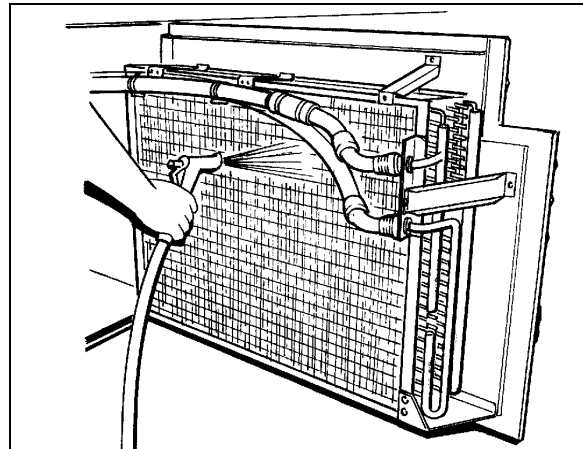


FIGURE 6: CONDENSER COIL

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Note: For vehicles with fans installed on condenser, first separate fans from condenser by unscrewing the Phillips screws securing them together, then proceed with the cleaning process.

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 air filter is located underneath dashboard (Fig. 7). To gain access, turn counterclockwise both 3/4 turn knurled fasteners of A/C & heating unit access panel, located over entrance door steps, then lift and remove panel. Clean filter by first lifting and removing it from unit, then back flush with water, and then dry with air. This procedure should be done every 12,000 miles (20 000 km) or once a year, whichever comes first.

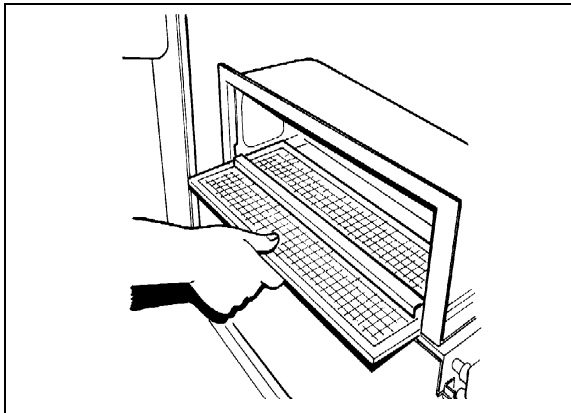


FIGURE 7: DRIVER'S HVAC UNIT AIR FILTER 22011

5.3 Auxiliary HVAC Unit Air Filter (where applicable)

The air filter is located in the rear cap and is accessible from inside the vehicle. To gain access, remove access panel located on back wall, on R.H. side of lavatory. Clean filter by first lifting and removing it from unit, then back flush with water, and then dry with air (Fig. 7). This procedure should be done every 12,000 miles (20 000 km) or once a year, whichever comes first.

5.4 Main HVAC Unit Air Filter

The main HVAC system uses two (2) or three (3) air filters, depending on vehicle.

On converted vehicles (Shells), the three (3) filters are located in A/C & heating compartment. To gain access, open compartment door, and then remove the six (6) outer screws ("Phillips") retaining the air filter panel (Fig. 8). Slide out panel c/w one (1) filter, then slide out the other two (2) filters.

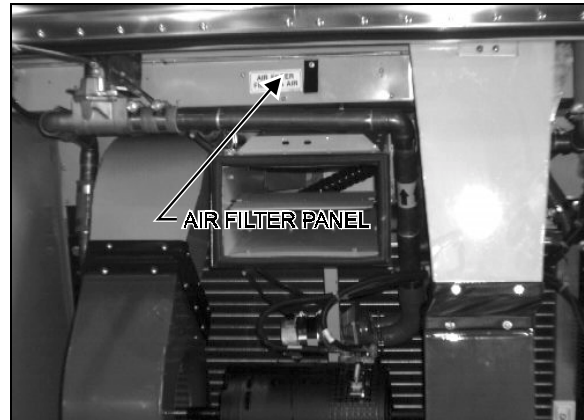


FIGURE 8: ACCESS TO FILTERS (SHELL) 22013

To clean filters, back flush with water, then dry with air every 12,000 miles (20 000 km) or once a year, whichever comes first.

On coaches, the two (2) filters are located in A/C & heating compartment. To gain access, open driver's side baggage compartment, forward of A/C & heating compartment, and open the air filter access panel by unscrewing the three (3) retaining screws (Fig. 9). Slide out the upper filter first, then slide out the other.

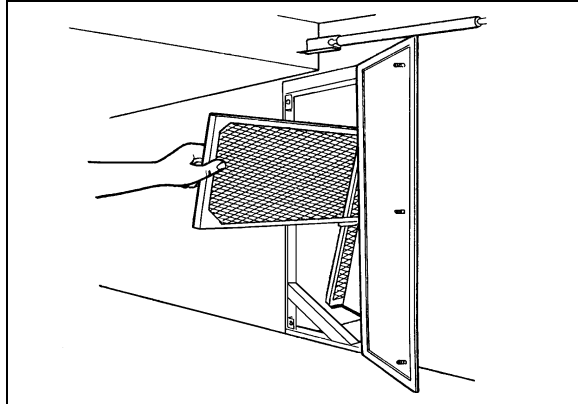


FIGURE 9: ACCESS TO FILTERS (COACH) 22012B

To clean filters, back flush with water, then dry with air every 12,000 miles (20 000 km) or once a year, whichever comes first.

The A/C & heating compartment door is also fitted with an air filter. It should be cleaned in the same manner as the other filters and at the same intervals (Fig. 10).

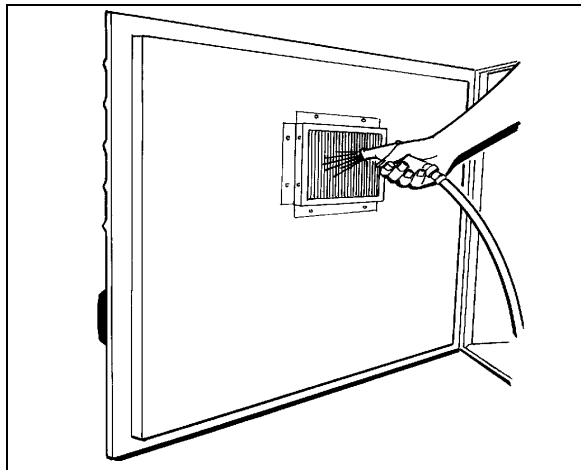


FIGURE 10: A/C & HEATING DOOR FILTER 22068

6. EVAPORATOR MOTOR (Central system vehicles only)

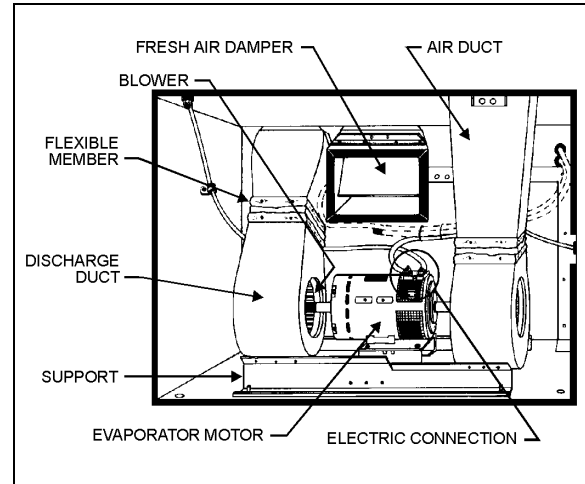


FIGURE 11: EVAPORATOR MOTOR INSTALLATION 22069

The evaporator motor is installed in the A/C & heating compartment (see Operator's Manual) (Fig. 11). It is a 27.5 volt, 1.5 HP motor which activates a double blower fan unit.

6.1 Removal

1. Set main battery disconnect switch(es) to the "OFF" position.
2. Open the evaporator compartment door.
3. Disconnect electric connection on motor plate.
4. Identify the L.H. side discharge duct inside compartment and remove the "Phillips" head screws retaining the flexible member to duct. Repeat procedure for R.H. side.
5. From underneath vehicle, remove the eight (8) bolts retaining the evaporator fan motor support, then remove the complete unit from the compartment.

Caution: Never use the motor output shafts to transport the assembly.

- On a work bench, unscrew the fan set screws, the "Phillips" head screws retaining discharge ducts to supports, then slide out assemblies from the evaporator motor output shaft. Remove support and fan discharge ducts from the unit.

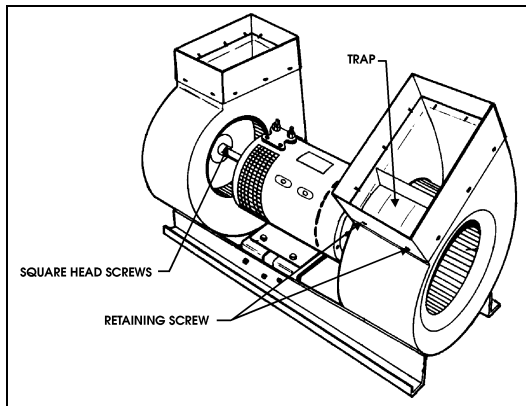


FIGURE 12: EVAPORATOR MOTOR ASSEMBLY 22036

- Separate fan from discharge duct by first removing the two (2) retaining screws, then remove trap and fan from assembly (Fig. 12).

Note: Position of the fans should be indexed with the motor in order to keep proper fan alignment at reassembly.

6.2 Installation

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

6.3 Maintenance

6.3.1 Checking Operation of Brush in Holder

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

6.3.2 Brush Wear Inspection and Replacement

Replace the brushes if less than 3/4" (19 mm). New brush length is 1-1/4" (32 mm). 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:

- Set main battery disconnect switch(es) to the "OFF" position.
- Remove the protective screen band from the motor housing by pulling down the spring loaded fastener.
- Remove and replace brushes as per the standard procedure.
- Reverse installation procedure.

6.3.3 Checking Commutator

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

7. AIR CONDITIONING SYSTEM

7.1 Description

The schematic of Figure 13 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 9 tons. The receiver tank and filter dryer are mounted inside the condenser compartment.

XL Coaches may be supplied with central and auxiliary A/C system (Fig. 13). XL Converted vehicles (Shells) may be supplied with central or driver's A/C system only (Fig. 13 and 14). Auxiliary and driver's A/C systems come with a 2 cylinder, HGB-1000 Tecumseh compressor with an air conditioning capacity of 2 tons.

7.2 Main System 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 13 & 14 .

The air conditioning system used on an XL 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 the condenser coil tubes 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 vaporizes in a vapor-liquid state at a low temperature pressure.

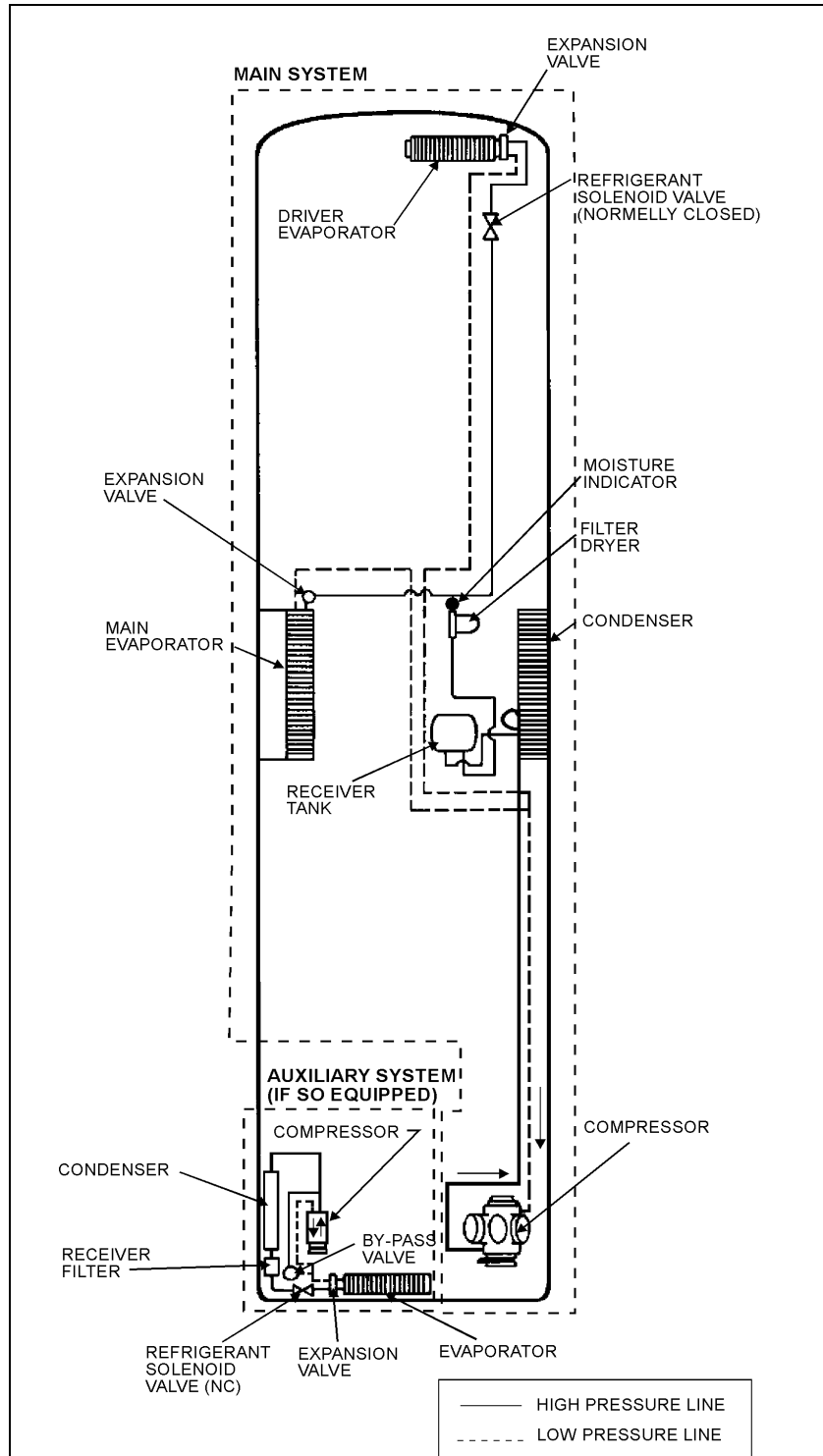


FIGURE 13: REFRIGERANT CIRCUIT (CENTRAL AND AUXILIARY SYSTEMS) 22070

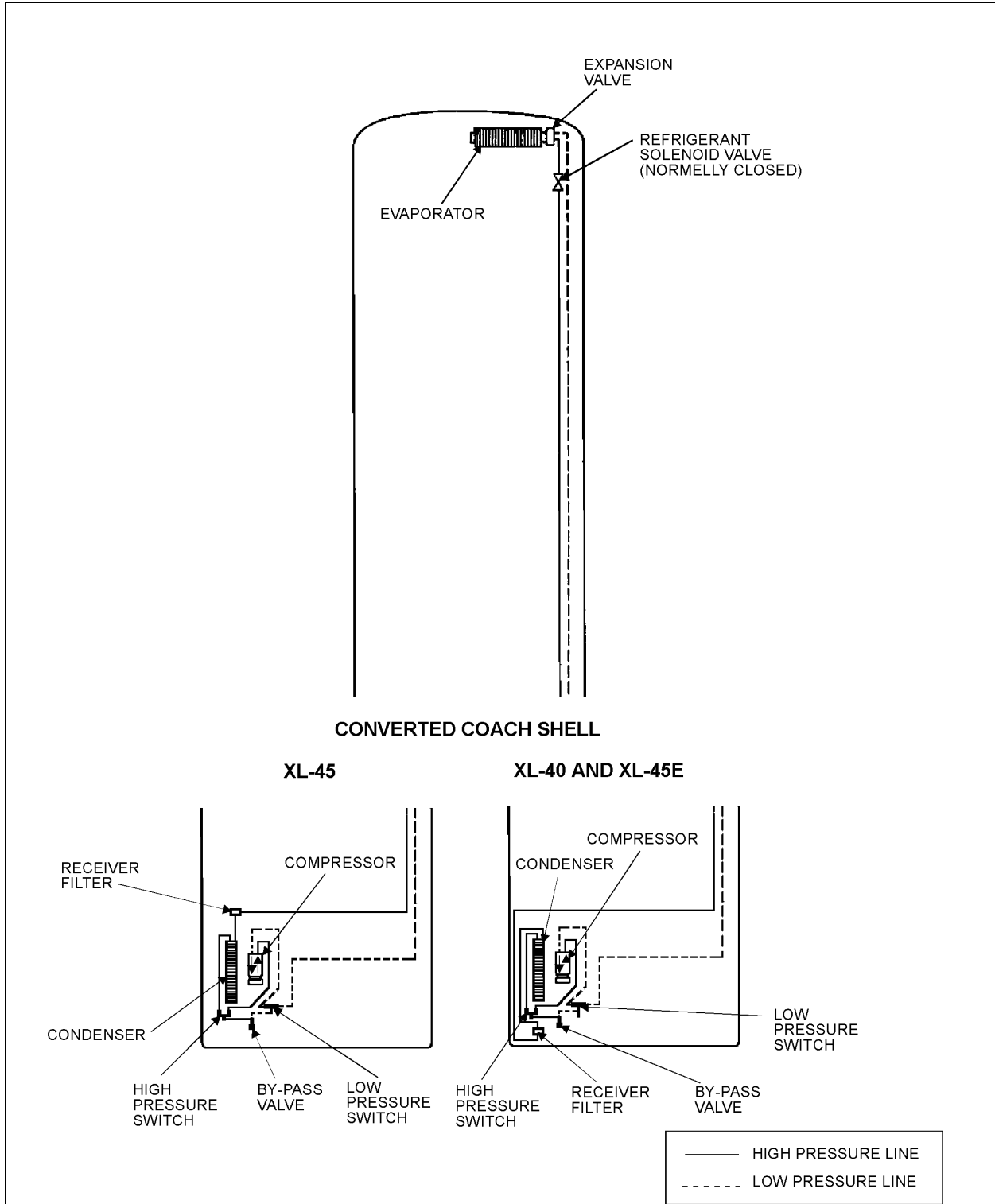


FIGURE 14: REFRIGERANT CIRCUIT (DRIVER'S SYSTEM)

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4. The cold low pressure refrigerant passes through the evaporator coil, 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.

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 in² (203 mm²) could easily neutralize the total capacity of the system.

Other causes of inadequate cooling are dirty coils or filter. Dirt acts as an insulation and also restricts the air flow.

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. The compressor will load or unload depending on operating conditions.

7.3 Refrigerant

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

Note: *Refrigerant 134a in itself is nonflammable, but if it comes in contact with an open flame, it will decompose.*

7.3.1 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 8 lbs (3,6 kg) are used. Approximately 5 lbs (2,3 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.

7.3.2 Precautions in Handling Refrigerant

1. Do not leave refrigerant cylinder uncapped.
2. Do not subject the cylinder to high temperatures.
3. Do not weld or steam clean on or near the system.
4. Do not completely fill cylinder.
5. Do not discharge vapor into an area where a flame is exposed.
6. 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 also good practice to replace the cap after each time the cylinder is used. If the cylinder is exposed to the sun's radiant heat, the resulting pressure increase 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; liquid refrigerant, which can accidentally escape, is approximately -40°F (-40°C). If refrigerant comes in contact with eyes, serious injury can result. When opening refrigerant connections, always wear goggles to protect your eyes.*

7.3.3 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.

7.3.4 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 reduce the refrigeration capacity of the entire system.
2. The flexible hose lines should never be allowed to come within a distance of 2-1/2" (6,3 cm) from the exhaust manifold.
3. Use only sealed lines from parts stock.
4. Discharge the system of all refrigerant (with a recovery or reclaiming medium) before disconnecting any fitting in the refrigeration line. 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 to prevent injuries. 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 a line is opened to the atmosphere, it should be immediately

capped to prevent entrance of moisture and dirt.

6. The use of 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.

7.4 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 repairs between compressor and receiver tank, use a recovery unit to remove refrigerant from the system.

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 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

run the system 10 minutes, shut it off, then:

1. Close the receiver tank's outlet service valve by turning it clockwise until the valve is frontseated, backseat the suction service valve on the compressor, install an appropriate pressure gauge set, and turn the valve forward 1/4 turn to enable a visual check of the suction pressure.
2. 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 (103,5 kPa).

3. Start the engine, turn on the "Central A/C - heating switch", then adjust "A/C - heating temperature" controls to maximum A/C position.
4. Run the compressor until pressure reaches approximately -5 psi (-35 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.

7.5 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 loosely 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 suction valve stem 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. When charging an empty system, weigh the amount of refrigerant put into system; this will eliminate any possibility of overfilling. A full charge requires 24 lbs (10.9 kg).

Fill liquid refrigerant at the receiver tank and completely charge, if necessary, using previous procedure.

Note: If the vehicle is equipped with an auxiliary system, a full charge requires 8 lbs (3,6 kg). if the vehicle is equipped with a driver's system only, the system requires 5 lbs (2,3 kg).

7.6 Evacuating System

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

7.7 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 tank upside down on a scale (bathroom type) with the valving at the bottom. This ensures that only liquid enters the reservoir.

When charging an empty system, weigh the amount of refrigerant put into the system. This will eliminate any possibility of overfilling. A full charge requires 24 pounds (10,9 kg). If the vehicle

is equipped with an auxiliary system, a full charge requires 8 lbs (3,6 kg). If the vehicle is equipped with a driver's system only, the system requires 5 lbs (2,3 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 all the way "out".
5. Backseat the upper receiver valve by turning all the way "out".
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 (10.9 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 done by authorized and qualified personnel only. Refer to local laws for R-134a recuperation.

7.8 Refrigerant System Cleanout 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 cleanout procedures mentioned.

7.8.1 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.

7.8.2 Cleanout 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 two (2) hours on high speed cool only. If a unit with a hot gas heating

system is allowed to operate in heat or defrost, the refrigerant will not all flow through the liquid line filter dryer for cleaning and some parts of the system which were not previously contaminated, may become contaminated.

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.

7.8.3 Cleanout 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 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 restric-

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tion. 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.

- 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.
- After approximately 7 days of operation, recheck the compressor oil for cleanliness and acidity.

8. A/C SYSTEM COMPONENTS

8.1 Compressor (Central System)

8.1.1 Belt Replacement

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

- Open engine compartment rear doors and locate the belt tensioner two-way control valve (Fig. 15), mounted above the engine R.H. side door next to the pressure regulating valve, then turn handle counterclockwise in order to release pressure and tension on belts.
- Slip the old belts off and the new ones on.

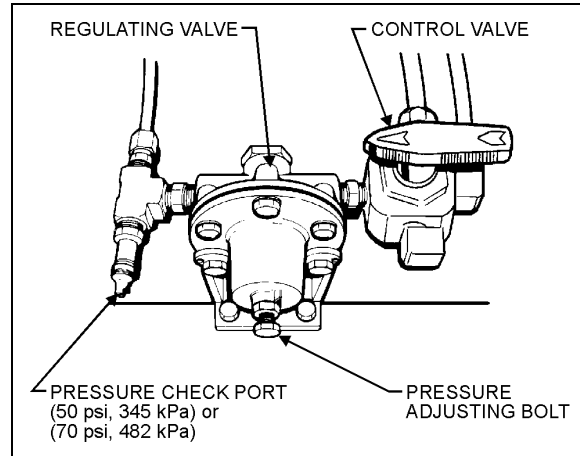


FIGURE 15: TENSIONING VALVE

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

- Reset belt tensioning pressure control valve (Fig. 15) to 50 psi (345 kPa) for Series 60 engines and to 70 psi (482 kPa) for Series 50 engines, to apply tension on the new belts as explained in Section 12.

Note: For proper operation of the air bellows, adjust the upper tensioning bracket to provide a 2 3/8"-2 1/2" (60-64 mm) extension with the pneumatic system under normal pressure and the pressure regulating valve set as per item #3 (Fig. 16).

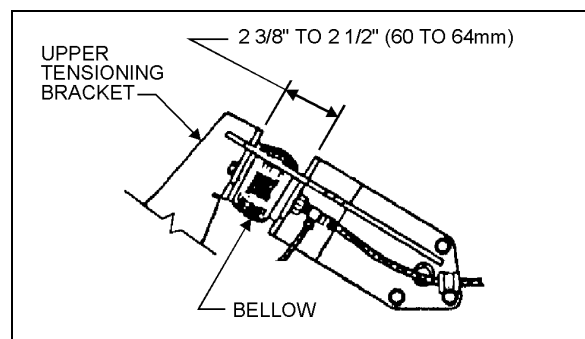


FIGURE 16: TENSIONING AIR BELLOW

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8.1.2 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 two-way control valve, remove belts from radiator fan pulley and crankshaft pulley; then reset belt tensioning pressure control valve to 50 psi (345 kPa) for Series 60 engines and to 70 psi (482 kPa) for Series 50 engines.

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. 17 & 18).
2. Check the distance between each extremity of straight edge (1. Fig. 18) 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.

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. 18) 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.

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. 17 & 18). If it is not the same, shim under the appropriate pillow block in order to obtain a correct angle.

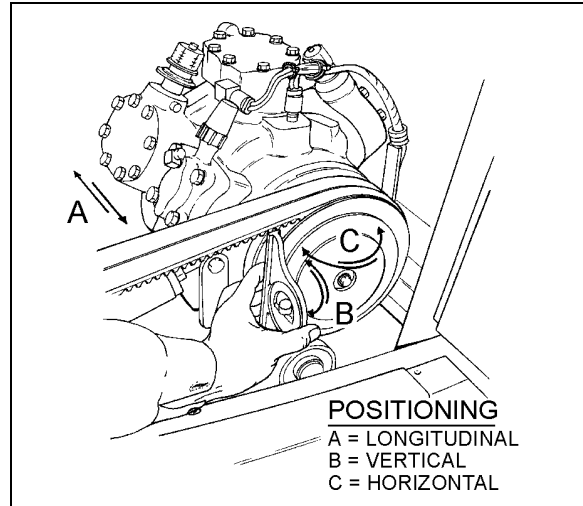


FIGURE 17: COMPRESSOR ORIENTATION 22072

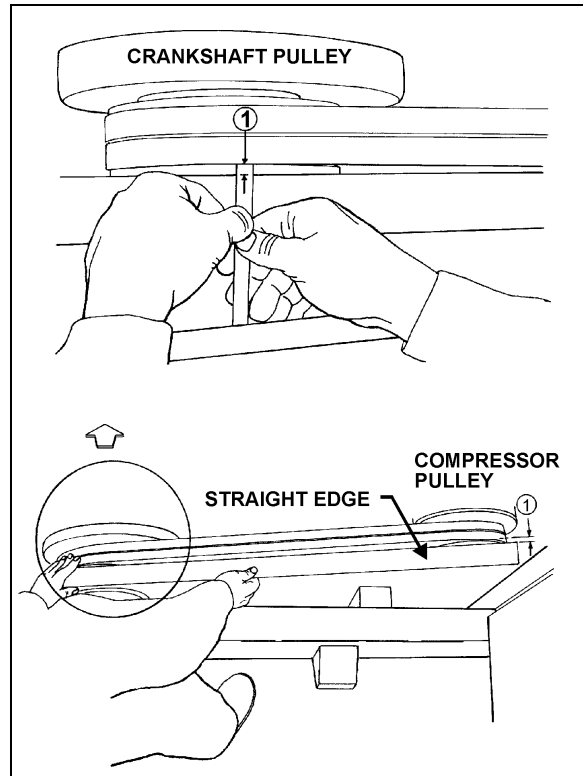


FIGURE 18: COMPRESSOR ALIGNMENT 22040

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8.1.3 Compressor Maintenance

For A/C compressor maintenance, see "Carrier Compressor - Operation and Service Manual" annexed to this section.

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

8.1.4 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.

Broken suction valves are probably the most difficult fault to detect without opening the compressor. Depending on the condition of the cylinder walls and piston rings, a compressor in good condition should be able to pull a vacuum of 20" Hg (9.8 psi - 67,6 kPa) with the suction service valve frontseated. Failure to reach this value would require disassembly of the compressor to determine actual component conditions.

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.

8.1.5 Oil Verification

The level is acceptable when the oil is visible through sight glass on R.H. side of compressor. For an accurate reading, release air in belt tensioning system, then level compressor. The oil level should be in center of sight glass. To add oil, isolate the refrigerant in the receiver tank by following the procedure at step "7.4 Pumping Down".

8.2 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.

8.3 Compressor (Driver's system only or auxiliary system)

8.3.1 Clutch Pulley Installation

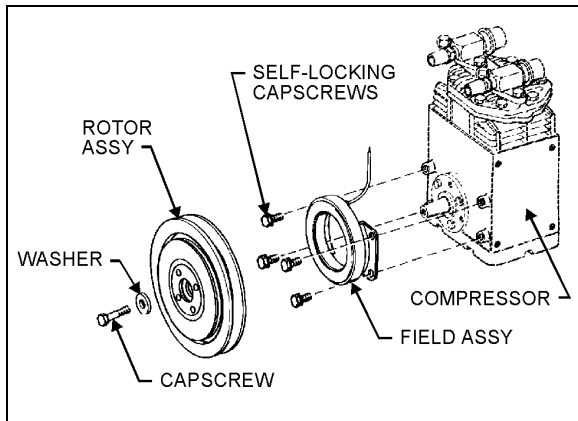


FIGURE 19: PULLEY INSTALLATION

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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. 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 on to 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.

8.3.2 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.

8.3.3 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.

8.3.4 Belt Replacement

Warning: Set the main battery disconnect switch(es) 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.

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3. Replace compressor belt.
4. Tighten belt to 60/65 lbf•in (6,5/7 N•m) (Fig. 20), 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.*

8.3.5 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.*

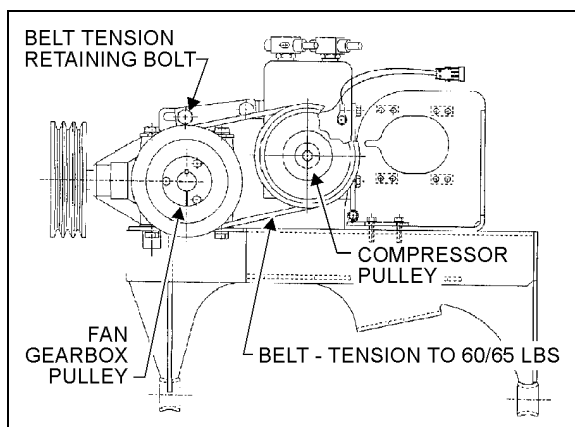


FIGURE 20: A/C COMPRESSOR (DRIVER'S OR AUXILIARY SYSTEM)

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8.3.6 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 1/2" (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.

8.4 Condenser (All vehicles, except for XL-45 Coach)

The main A/C system's condenser coil is hinge mounted on the inner face of condenser compartment door. 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.

8.4.1 Condenser Fan Motor (on vehicles with central system)

The central A/C system's condenser motor is located inside condenser compartment. Motor, fans (qty=2) and cages are mounted on a support, fastened to the floor. The receiver-filter is located on the R.H. side wall of the compartment and the receiver tank is affixed to rear wall.

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 90 psi, a pressure switch stops the motor so that fans do not operate needlessly. When pressure rises to 120 psi, the pressure switch reactivates the motor.

8.4.2 Motor Removal

To remove the condenser motor, proceed as follows:

1. Set the main battery disconnect switch(es) to the "OFF" position.
2. Open condenser compartment door, locate motor and disconnect electrical wiring at motor plate.
3. Loosen motor support from the floor then remove the motor assembly from the compartment.
4. On a workbench, remove support and fan cages from the unit; then remove fans.

Note: Position of the fans should be indexed with the motor in order to keep proper fan alignment at reassembly.

Caution: Never use the motor output shafts to transport the assembly.

8.4.3 Motor Installation

To reinstall the condenser motor, reverse the removal procedure.

8.4.4 Maintenance

Refer to "EVAPORATOR MOTOR - 6.3 Maintenance".

8.5 Condenser (XL-45 coach)

The central A/C system's condenser coil is hinge mounted on the inner face of condenser compartment door. The receiver-filter is located on the R.H. side wall of the compartment and the receiver tank is affixed to rear wall. 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.

8.5.1 Condenser Fan Motors

The four (4) condenser fans are also hinge mounted on condenser compartment door, just behind condenser coil. They are powered by 15 amp-24 volt electrical motors connected directly to four (4) breakers (CB134 to CB137), located inside A/C junction box in condenser compartment (Fig. 21).

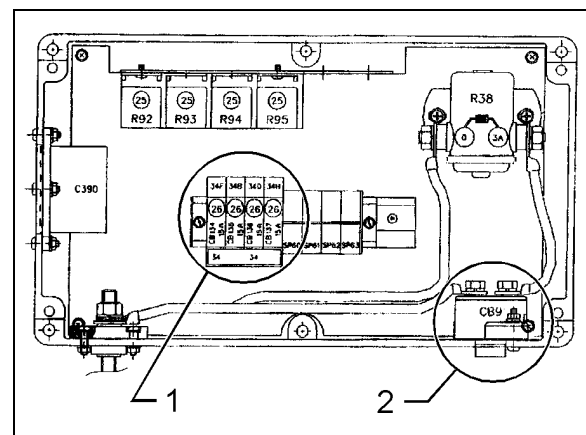


FIGURE 21: A/C JUNCTION BOX

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1.(From left to right)

CB134: Condenser fan motor 15 amps- 24 volts
 CB135: Condenser fan motor 15 amps- 24 volts
 CB136: Condenser fan motor 15 amps- 24 volts
 CB137: Condenser fan motor 15 amps- 24 volts

2.CB9: Evaporator fan motor 105 amps-24 volts

The fans pull outside air through the condenser coil and discharge it through compartment floor opening. 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 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 two (2) forward fan motors. When pressure rises above 170 psi the two (2) rear fan motors are activated and are disengaged only when pressure drops below 130 psi.

8.6 Receiver tank

The receiver tank is located in the condenser compartment (Figs. 22 & 23). 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.

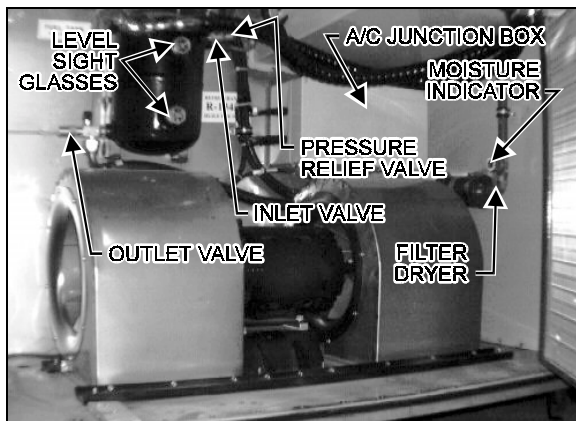


FIGURE 22: CONDENSER COMPARTMENT (XL VEHICLES, EXCEPT FOR XL-45 COACHES)

22074

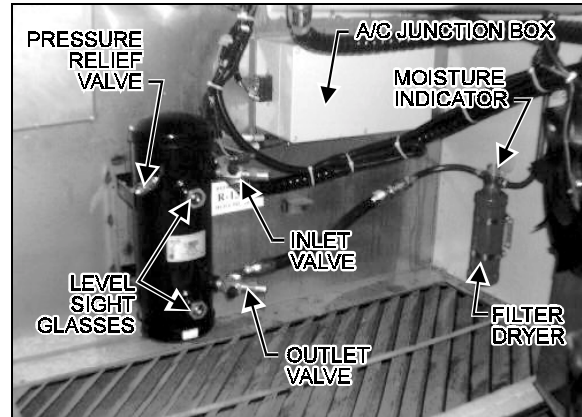


FIGURE 23: CONDENSER COMPARTMENT (XL-45 COACHES ONLY)

22075

In case of extreme pressure 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 - 8.7.1 Description".

8.7 Filter Dryer

8.7.1 Description

A filter dryer, 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 every time a line in the system is opened (see "7.4 Pumping Down") 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.

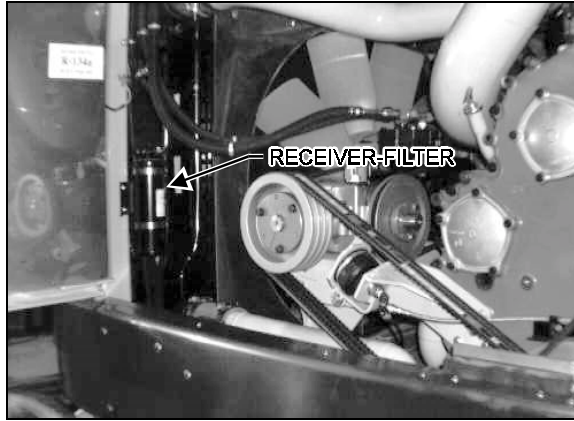


FIGURE 24: ENGINE COMPARTMENT 22076

Note: On XL-45 vehicles, the receiver-filter is installed on wheel housing, inside L.H. side rear service compartment.

8.7.2 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 procedure in "7.4 Pumping Down".
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.

8.7.3 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.

8.8 Liquid Refrigerant Solenoid Valve

8.8.1 Description

The flow of liquid refrigerant to the driver's evaporator is controlled by a normally closed solenoid valve located at ceiling of spare wheel and tire compartment (reclining bumper compartment for converted vehicles) and is accessible through the reclining bumper (Figs. 13, 14 & 25).

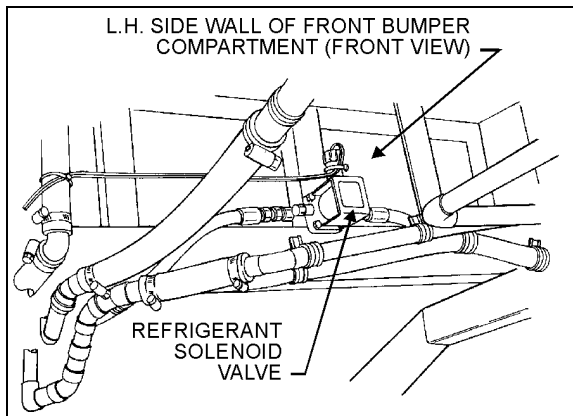


FIGURE 25: DRIVER'S LIQUID REFRIGERANT SOLENOID VALVE 22077

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

8.8.2 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 1/2 turn counterclockwise. To manually close valve, turn stem clockwise until tight against seat. Manual stem must be in closed position for automatic electric operation.

8.8.3 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.

8.8.4 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. 26).

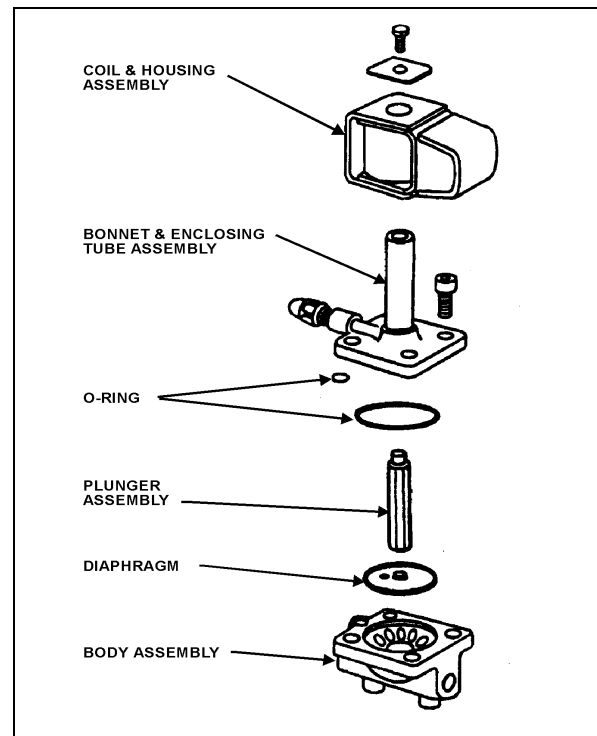


FIGURE 26: REFRIGERANT SOLENOID VALVE 22044

- 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.

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.*

8.8.5 Valve Reassembly

- 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. Lower the bonnet assembly over the plunger, making sure that the locating sleeve in the bonnet enters the mating hole in the body.
- Insert the four socket head screws and tighten evenly.
- Replace the coil as stated previously.
- Add a small quantity of refrigerant R-134a to the low side of the system. Check for leaks. Return the system to normal operation.

8.9 By-Pass Valve



FIGURE 27: BY-PASS VALVE LOCATION 22078

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. 27).

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:

- Loosen jam nut.
- Tighten adjusting screw flush to jam nut.
- tighten jam nut.

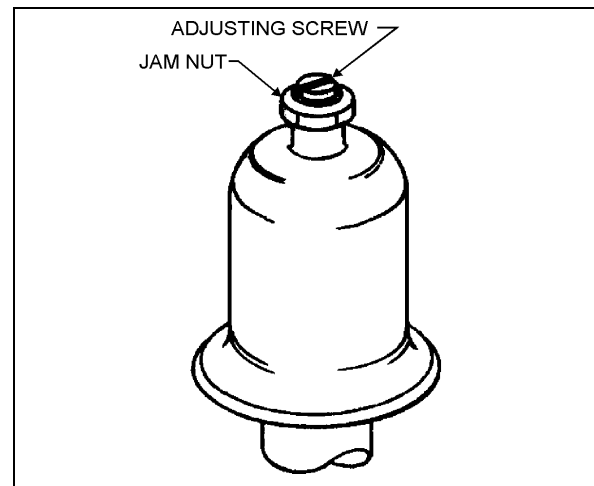


FIGURE 28: BY-PASS VALVE 22079

8.10 Expansion Valve

8.10.1 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 filter access door (Figs. 13 & 29). 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

Section 22: HEATING AND AIR CONDITIONING

to open, allowing a flow of refrigerant liquid into the evaporator.

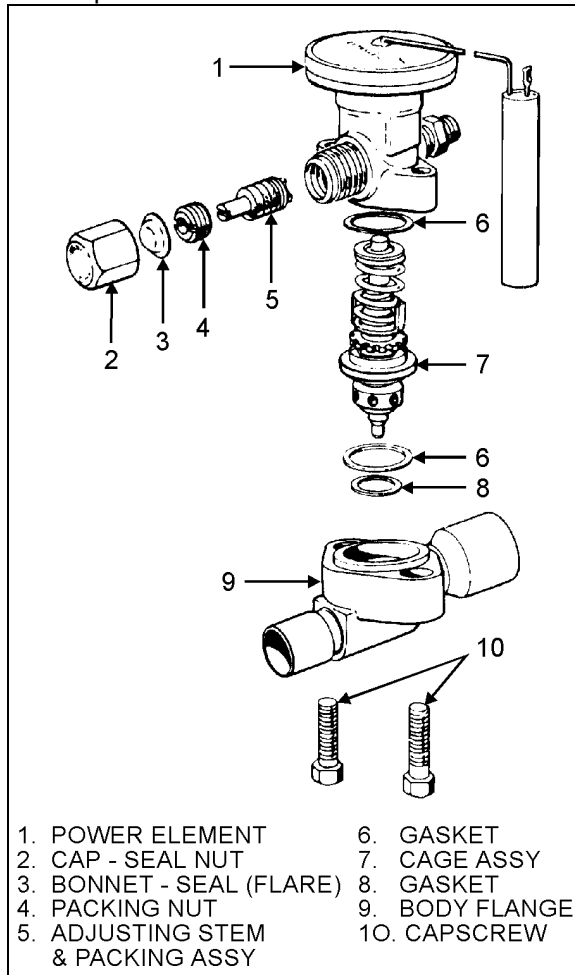


FIGURE 29: EXPANSION VALVE

22045

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.

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 8 to 12°F (-13,3 to -11,1°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

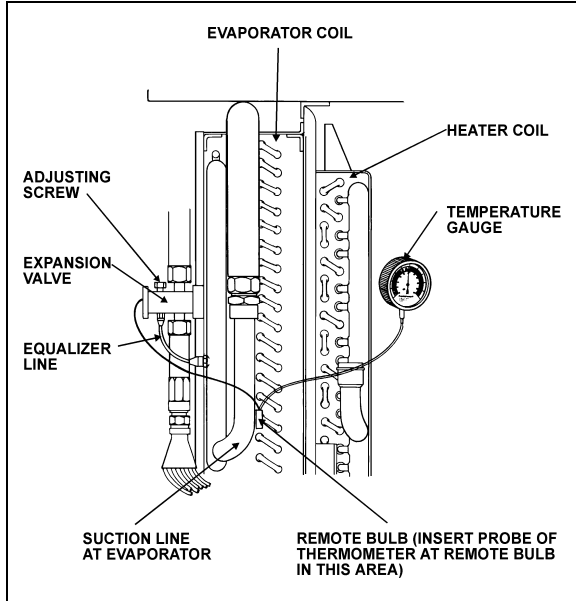


FIGURE 30: SUPERHEAT ADJUSTMENT INSTALLATION
22046

The easiest method of adjusting the superheat is to backseat the main evaporator expansion valve adjusting screw, and screw in 5-1/2 turns clockwise (Fig. 30). If this method does not provide an accurate superheat, the following procedure should be followed:

1. Operate vehicle for at least one-half hour at fast idle with temperature control set at 82°F (27,7°C).
2. Install pressure gauge at the evaporator suction header.
3. Install a remote reading thermometer to the evaporator outlet line near the existing remote bulb (Fig. 30).
4. Apply thermostatic tape around the bulb and evaporator outlet line to get a true reading of the line temperature.

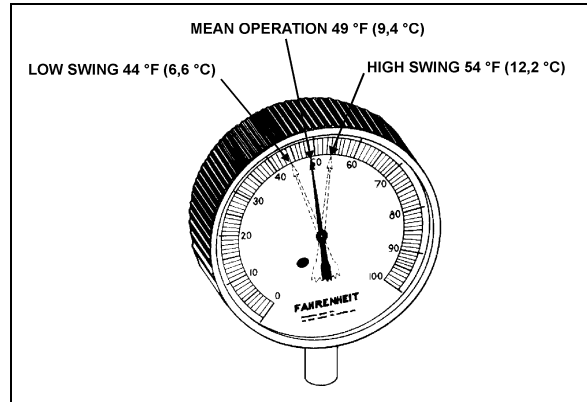


FIGURE 31: HIGH & LOW SWING TEMPERATURE AT REMOTE BULB
22047

EXAMPLE OF READINGS TAKEN AT FIG. 31:

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)	

5. Check approximately 5 pressure readings at 2 minute intervals and convert to temperature using chart at "8.13 Temperatures & Pressures". 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 (Fig. 31).

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.

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Note: To lower evaporator temperature or reduce the superheat, flow of refrigerant is increased by turning adjusting screw of expansion valve 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.

8.10.2 Driver's System

The function and operation of the expansion valve for driver's or auxiliary systems are similar to main system's, but no superheat adjustment is required (Figs. 13 & 14).

8.11 Torch Brazing

Use an electrode with 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.

8.12 Troubleshooting

8.12.1 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 vertical lift, undersize liquid line or excessive low condensing temperature. Resulting pressure difference across valve too small.	Increase head pressure. If liquid line is too small, replace with proper size.
Gas in liquid line due to pressure drop in line or insufficient refrigerant charge.	Locate cause of liquid line flash and correct by use of any of the following methods. Add R-134a. Replace or clean filter dryer. Check for proper line size.
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 8 to 12°F (4 to 6°C).

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PROBABLE CAUSE	PROBABLE REMEDY
FLUCTUATING DISCHARGE PRESSURE	
Insufficient charge.	Add R-134a to system.
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.
Insufficient cooling air distribution over air cooled condenser.	Properly locate condenser to freely dispel hot discharge air.

8.12.2 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.
Excessively cold suction line.	Loss of contact between the expansion valve bulb and the suction line or sticking of the expansion valve. 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.
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 filter screens 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	Clogged filter. Obstructed or defective expansion valve.

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TROUBLE	CAUSE
Superheat too high.	Reset superheat adjustment. Check for clogged external equalizer line, or filter dryer.
Reduced air flow: a. Dirty or clogged air filter; b. Evaporator motor inoperative; or c. Plugged return air ducts.	Dirty or iced evaporator coil. Clean air filter screen. Check return ducts for obstructions. Check blower motor.
Frequent startings and stoppings 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.
<p>The most common problem of air cooled condenser is high head pressure. Most frequent causes are:</p> <p>1. Reduced air quantity. This may be due to:</p> <ul style="list-style-type: none"> • 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. <p>2. Non-condensable in the refrigeration system. This may be due to:</p> <p>Leak on low side system, system in vacuum.</p> <p>Specific symptom, pressure in system will not correspond to ambient temperature on shutdown.</p> <p>Only non-condensable will cause this.</p> <p>(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.)</p> <p>An evaporator just does a proper cooling job without sufficient air. Shortage of air can be caused by the following:</p> <ul style="list-style-type: none"> • Dirty filters; or • Dirty coils. 	

8.13 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

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VAPOR-PRESSURE			
TEMPERATURE		PRESSURE	
°F	°C	psi	kPa
-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
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

8.14 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.

9. HEATING SYSTEM

9.1 Description

The schematics of Figures 32 & 33 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 (40,000 Btu/hr or 80,000 Btu/hr) may have been installed in the vehicle.

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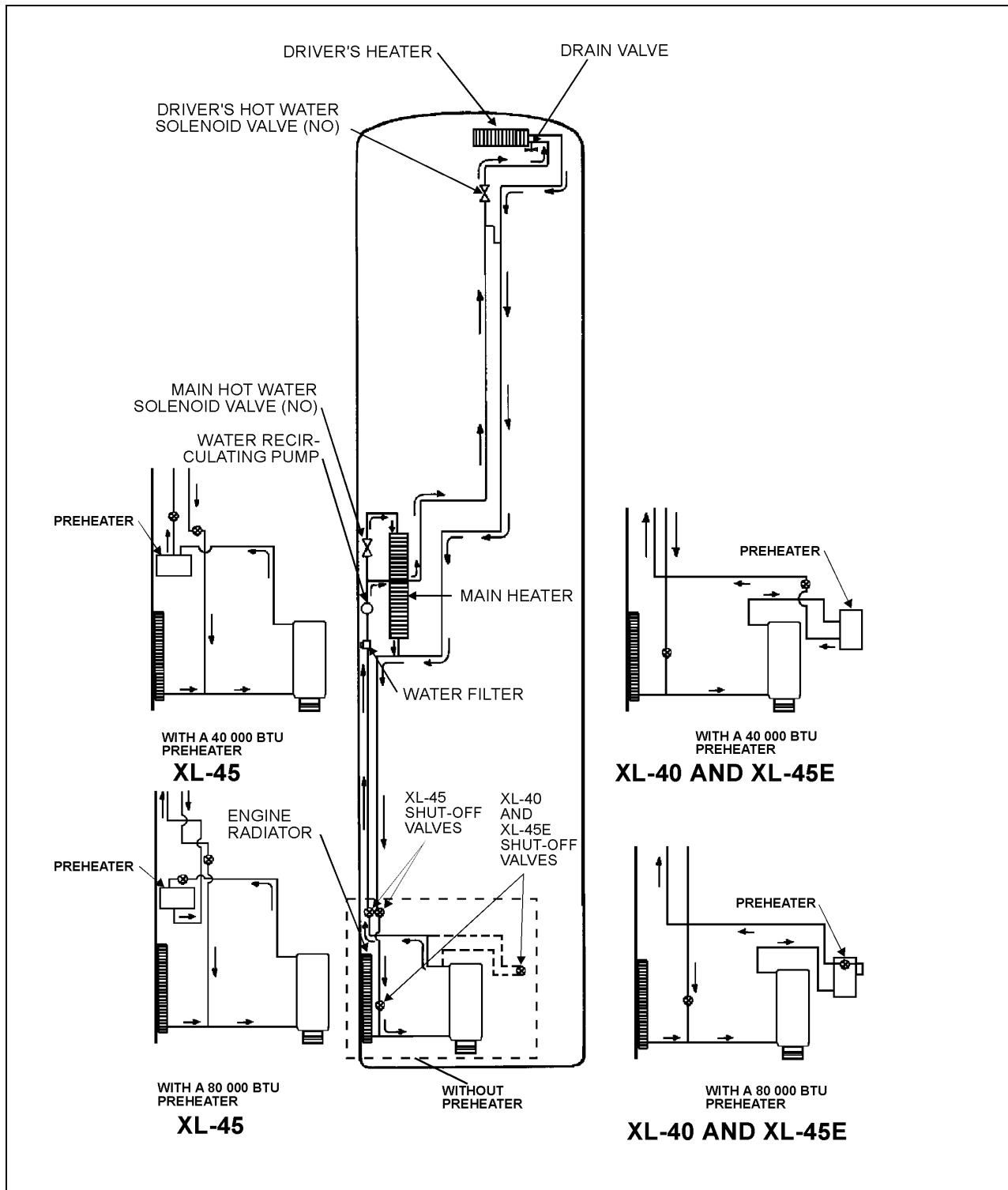


FIGURE 32: CENTRAL HEATING SYSTEM COMPONENTS

22080

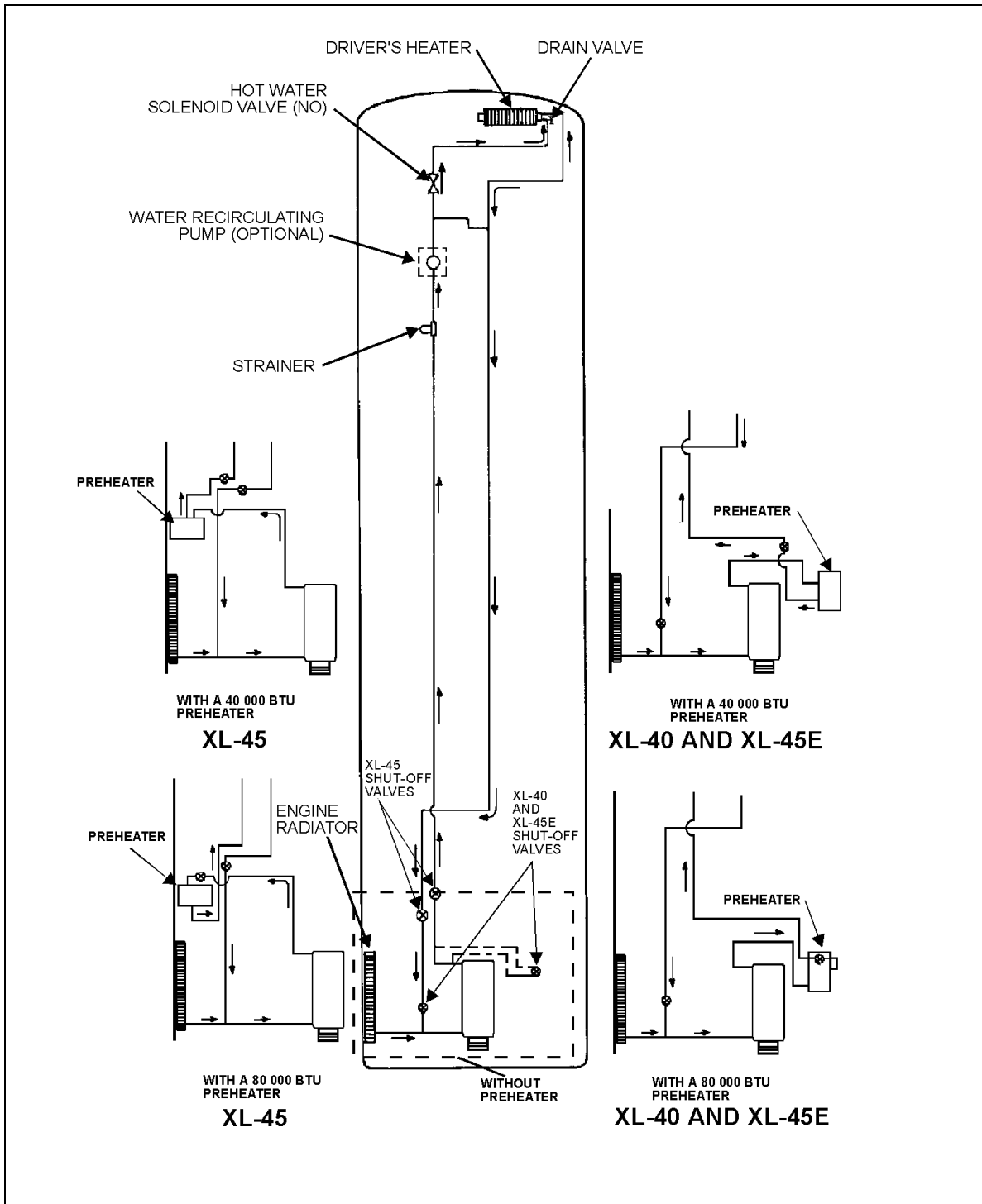


FIGURE 33: DRIVER'S HEATING SYSTEM COMPONENTS (VEHICLES EQUIPPED WITH DRIVER'S SYSTEM ONLY)

22081

9.2 Draining Heating System

To drain the entire system, refer to "05 COOLING" under heading "4.7 Draining Cooling System". If only the driver's or central heater core must be drained, refer to the following instructions.

9.2.1 Driver's Heater Core

1. Stop engine and allow engine coolant time to cool.
2. Locate the normally open water solenoid valve on the ceiling of the spare wheel compartment (Figs. 34 & 35) (reclining bumper compartment for converted vehicles), 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, make sure coolant has cooled down. The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury (scalding) from the hot liquid.

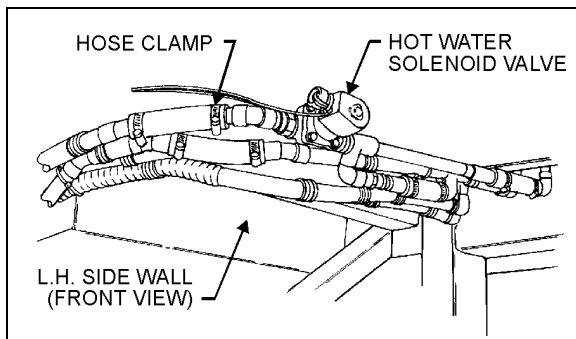


FIGURE 34: DRIVER'S WATER SOLENOID VALVE 22082
(VEHICLES EQUIPPED WITH DRIVER'S SYSTEM ONLY)

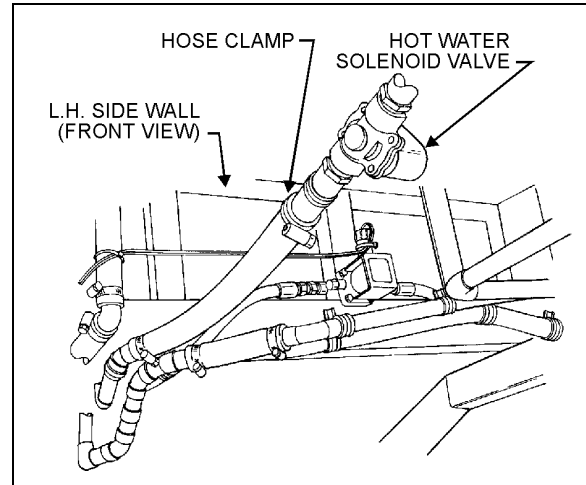


FIGURE 35: DRIVER'S WATER SOLENOID VALVE
(VEHICLES EQUIPPED WITH CENTRAL SYSTEM) 22083

3. Loosen hose clamp, install an appropriate container to recover coolant, and disconnect silicone hose from water solenoid valve.
4. From inside of vehicle, open the manual vent on the coolant inlet line near the driver's unit (Fig. 36) to ensure an efficient draining.

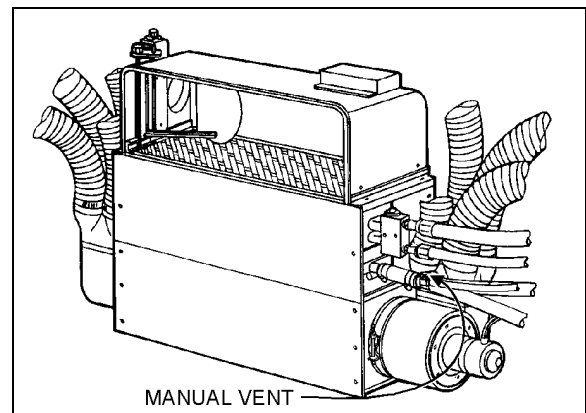


FIGURE 36: DRIVER'S HEATER UNIT 22084

9.2.2 Central Heater Core

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

Refer to figures 32 and 33 for heater line shutoff valves location. Valves location change according with vehicle and preheater models.

On XL-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.

For example see figure 37.

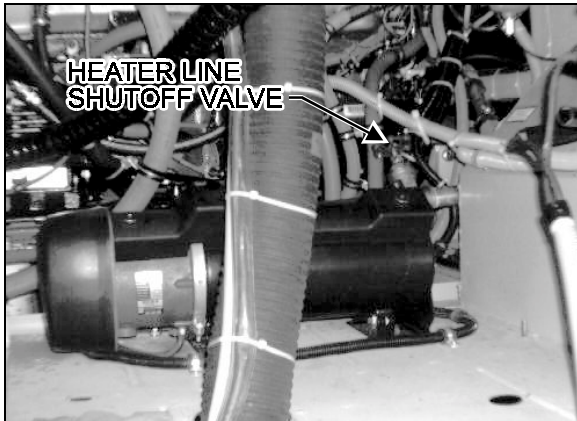


FIGURE 37: HEATER LINE SHUTOFF VALVE WITH A 40000 BTU PREHEATER 05039

The other is located on the L.H. side of engine underneath fan gearbox and is accessible through engine compartment rear doors (Fig. 38).

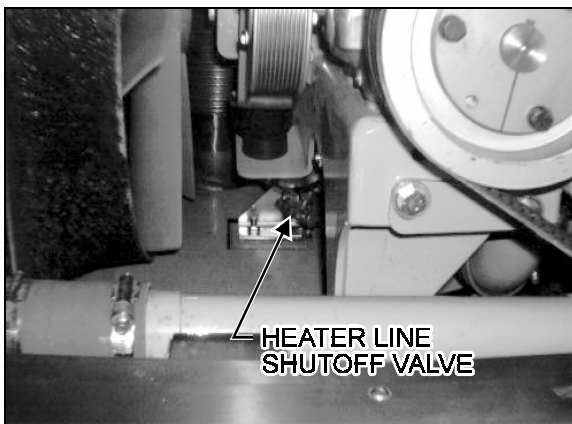


FIGURE 38: HEATER LINE SHUTOFF VALVE 05040

On XL-45 vehicles, the valves are located in engine compartment, on the L.H. side of engine and are accessible through L.H. side rear service compartment.

For example see figure 39.



FIGURE 39: HEATER LINE SHUTOFF VALVES WITHOUT PREHEATER 05041

3. Open the A/C & heating compartment door.

Warning: Before proceeding with the following steps, make sure the coolant has cooled down. The sudden release of pressure from a heated cooling system can result in loss of coolant and possible personal injury (scalding) from the hot liquid.

4. Open drain cock at bottom of heater core, then open manual vent located on top of heater core (Fig. 40) in order to allow air to enter while draining.

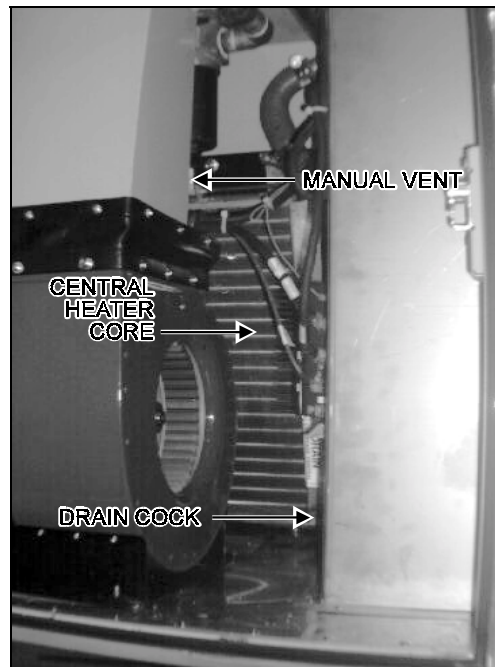


FIGURE 40: A/C & HEATING COMPARTMENT 22085

9.3 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 "*Main A/C-Heating*" switch, and turn the "*Main and Driver's A/C-Heating Temperature*" controls clockwise 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 surge tank filler cap.

9.4 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 36/40, and open them momentarily until no air escapes from the lines.

9.5 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" [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. HEATING SYSTEM COMPONENTS

10.1 Driver's Water Solenoid valve

10.1.1 Description

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. The valve is made of forged brass with internal brass or stainless steel parts. It is mounted on the coolant inlet line of the driver's heating unit, and is accessible through the spare wheel compartment (Fig. 41). The valve cannot be manually bypassed.

10.1.2 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 21 volts.
4. Excessive leakage: Disassemble valve and clean all parts. For best results, replace worn or damaged parts with a complete spare parts kit.

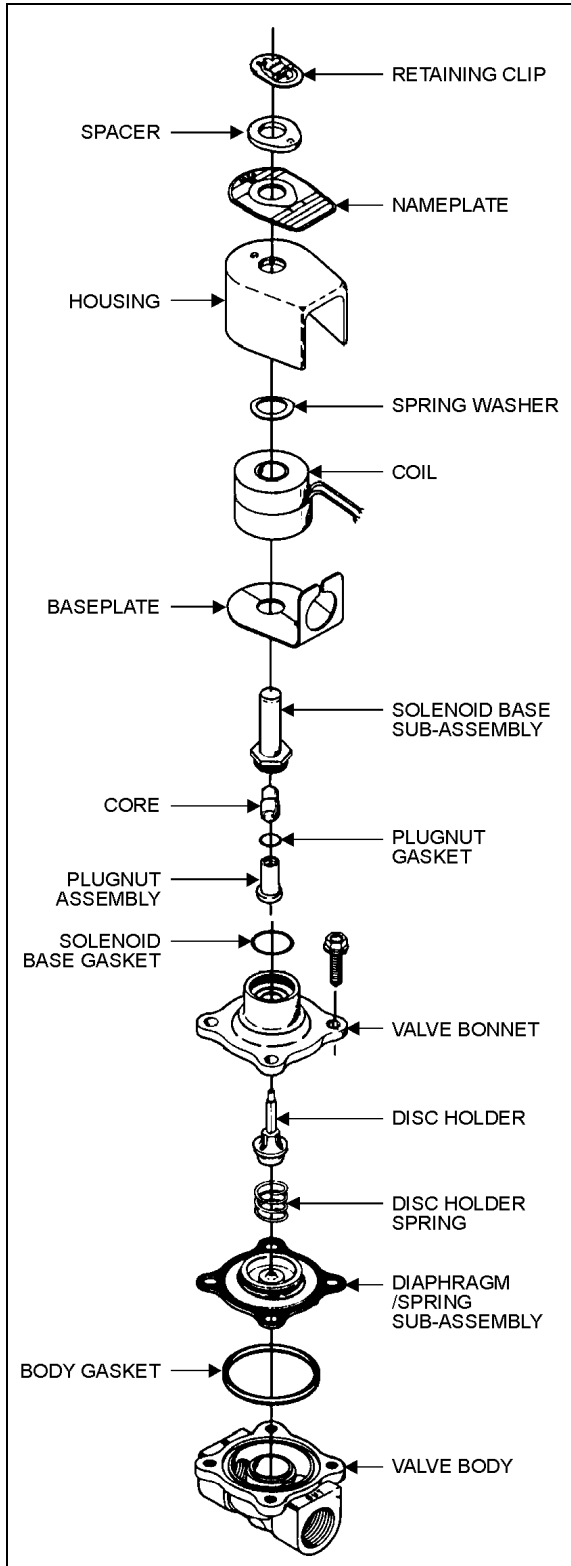


FIGURE 41: DRIVER'S WATER SOLENOID VALVE 22086

10.1.3 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.

Warning: When metal retaining clip disengages, it will spring upwards.

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 the disassembly sequence. Refer to exploded view (Fig. 41) for identification and location of parts.

Caution: Solenoid must be fully reassembled, since the housing and internal parts are part of, and complete the magnetic circuit. If required, place an insulating washer at both ends of the coil.

10.1.4 Valve Disassembly

1. Drain driver's heating unit as per "9.2 Draining Heating System".
2. Disconnect connector from coil connector.
3. Disassemble valve in an orderly fashion paying careful attention to exploded view (Fig. 41 - provided for identification of parts).
4. Remove retaining cap and slip the entire solenoid enclosure off the solenoid base subassembly.

Warning: When metal retaining clip disengages, it will spring upwards.

Section 22: HEATING AND AIR CONDITIONING

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. For best results, replace worn or damaged parts with a complete spare parts kit.

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

10.1.5 Valve Reassembly

1. Reassemble in reverse order of disassembly, paying careful attention to the exploded view (Fig. 41 - *provided for identification and placement of parts*).
2. Replace body gasket and diaphragm/spring subassembly. Locate bleed hole in diaphragm/spring subassembly, approximately 45° from valve outlet.

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

3. Replace disc holder spring and holder subassembly.
4. Replace valve bonnet screws. Torque bonnet screws in a criss-cross manner to 95 ± 10 lbf•in (129 ± 14 N•m).

5. Install solenoid base gasket, plugnut assembly and plugnut gasket. Position core on plugnut assembly. Be sure plugnut assembly and core are installed with mated ends together.
6. Replace solenoid base subassembly and torque to 175 ± 25 lbf•in (237 ± 34 N•m).
7. Replace solenoid enclosure and retaining cap or clip. Reconnect the coil connector.
8. Refill heating system as per "9.3 Filling Heating System", then bleed air from the driver's heating unit as per "9.4 Bleeding Heating System".
9. After reassembly, operate the valve a few times to make sure it opens and closes properly.

10.2 Central Hot Water Solenoid Valve Actuator

10.2.1 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.

10.2.2 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. 42).
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.

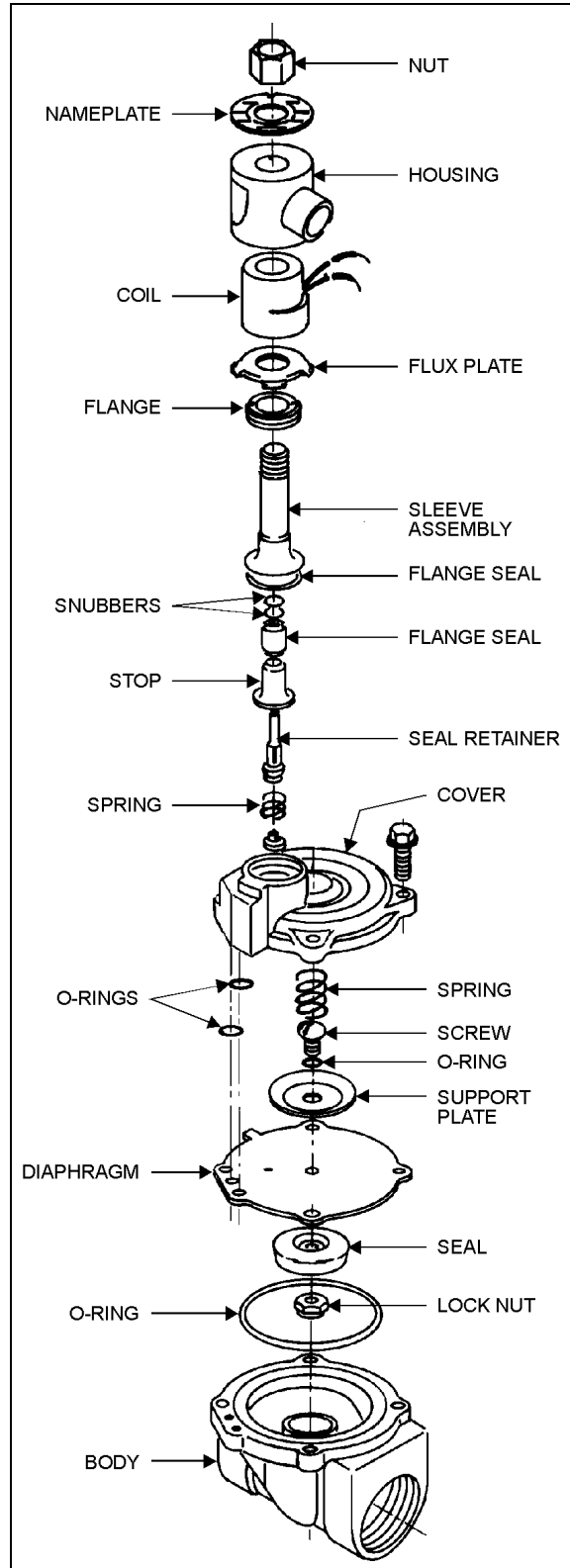


FIGURE 42: CENTRAL WATER SOLENOID VALVE 22087

Section 22: HEATING AND AIR CONDITIONING

10.2.3 Valve Reassembly

Tighten and torque to 30-43 lbf•in (41-58 N•m).

1. Assemble the diaphragm to the seal by placing the O-ring on the screw, then the support plate, the diaphragm and seal (Fig. 42). 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.

10.2.4 Valve Troubleshooting

PROBLEM	PROCEDURE
Valve fails to operate.	<ol style="list-style-type: none"> 1. Check electrical supply with a voltmeter. It should agree with nameplate rating. 2. Check coil with an ohmmeter for shorts or open coil. 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.	<ol style="list-style-type: none"> 1. Check diaphragm for tears or abrasions. Replace if torn or abraded. 2. Check diaphragm for obstructed bleed holes. Wash with mild soap and water. 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.	<ol style="list-style-type: none"> 1. Remove flange seal and check for imperfections. Replace if defective. 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.	<ol style="list-style-type: none"> 1. Disassemble valve. Inspect plunger, stop & retainer, and seal assembly. Remove all dirt that may have collected or imbedded. 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). 3. Inspect diaphragm for dirt or imbedded material. If dirty, remove, wash in warm water and mild soap solution. 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.	<ol style="list-style-type: none"> 1. Check that the plunger assembly, and the retainer & seal assembly, are free to travel. 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.	<ol style="list-style-type: none"> 1. check voltmeter reading to make sure it corresponds with the nameplate rating. 2. Check pressure against nameplate rating. 3. Inspect for loose housing nut. Tighten and torque to 30-43 lbf•in (41-58 N•m). 4. Inspect the face of the plunger assembly and of the stop assembly. If there is a sign of damage, replace both assemblies.

10.3 Water Recirculating Pump

10.3.1 Description

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This vehicle is provided with a water recirculating pump which is located in the A/C & heating compartment (vehicles with central system) (Figs. 43 & 44) or in the reclining bumper compartment (optional with driver's system) (Fig. 45). 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.

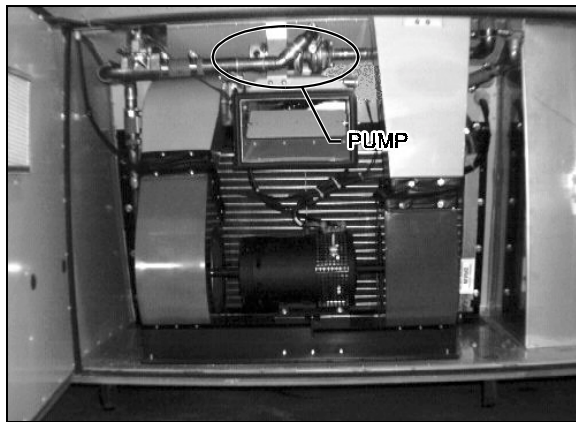


FIGURE 43: PUMP LOCATION (COACH)

22088

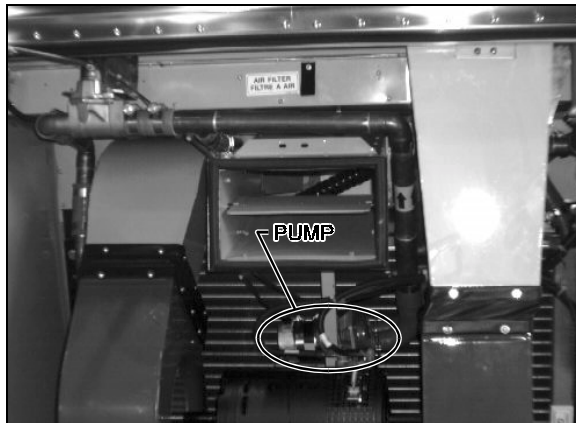


FIGURE 44: PUMP LOCATION (SHELL)

22089

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.**

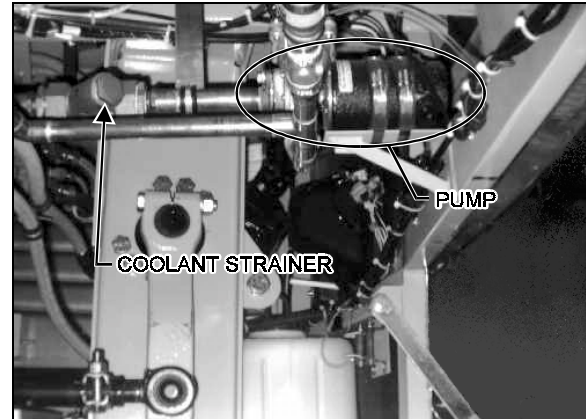


FIGURE 45: PUMP LOCATION (DRIVER'S A/C ONLY)

22090

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.

10.3.2 Removal

1. Stop engine and allow engine coolant time to cool.
2. Close shutoff valves. Refer to "05 COOLING" under heading "4.7 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. 43 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 (Fig. 45). Also check strainer's condition; clean or replace if necessary.

5. **Fig. 43:** Disconnect water lines from pump at flange connections.
5. **Fig. 44:** Disconnect water lines from pump at connections between hoses and copper pipes (leave hoses connected to pump).
6. Remove the two clamps holding the pump motor to its mounting bracket. Remove the pump with the motor as an assembly.

10.3.3 Disassembly

-For converted vehicle (shell) central A/C pump, see Fig. 46. -For coach central A/C pump, or driver's A/C pump, see Fig. 47.

1. **Fig. 46:** 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. 47:** 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. 46:** 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. 47:** Remove the pump cover (item #2) by first removing the 8 head screws. Remove cover carefully to prevent damaging the gasket (3).
3. **Fig. 46:** Remove O-ring (12).
3. **Fig. 47:** Remove gasket (3).

4. **Fig. 46:** Remove two hex nuts (7) retaining pump assembly to motor.
4. **Fig. 47:** Remove two hex nuts and lock washers (7 & 8) retaining pump assembly to motor.
5. **Fig. 47 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. 46:** Remove acorn nut (9) and gasket (10), then remove impeller (8) and components of the pump seal assembly (14).
6. **Fig. 47:** 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.

Section 22: HEATING AND AIR CONDITIONING

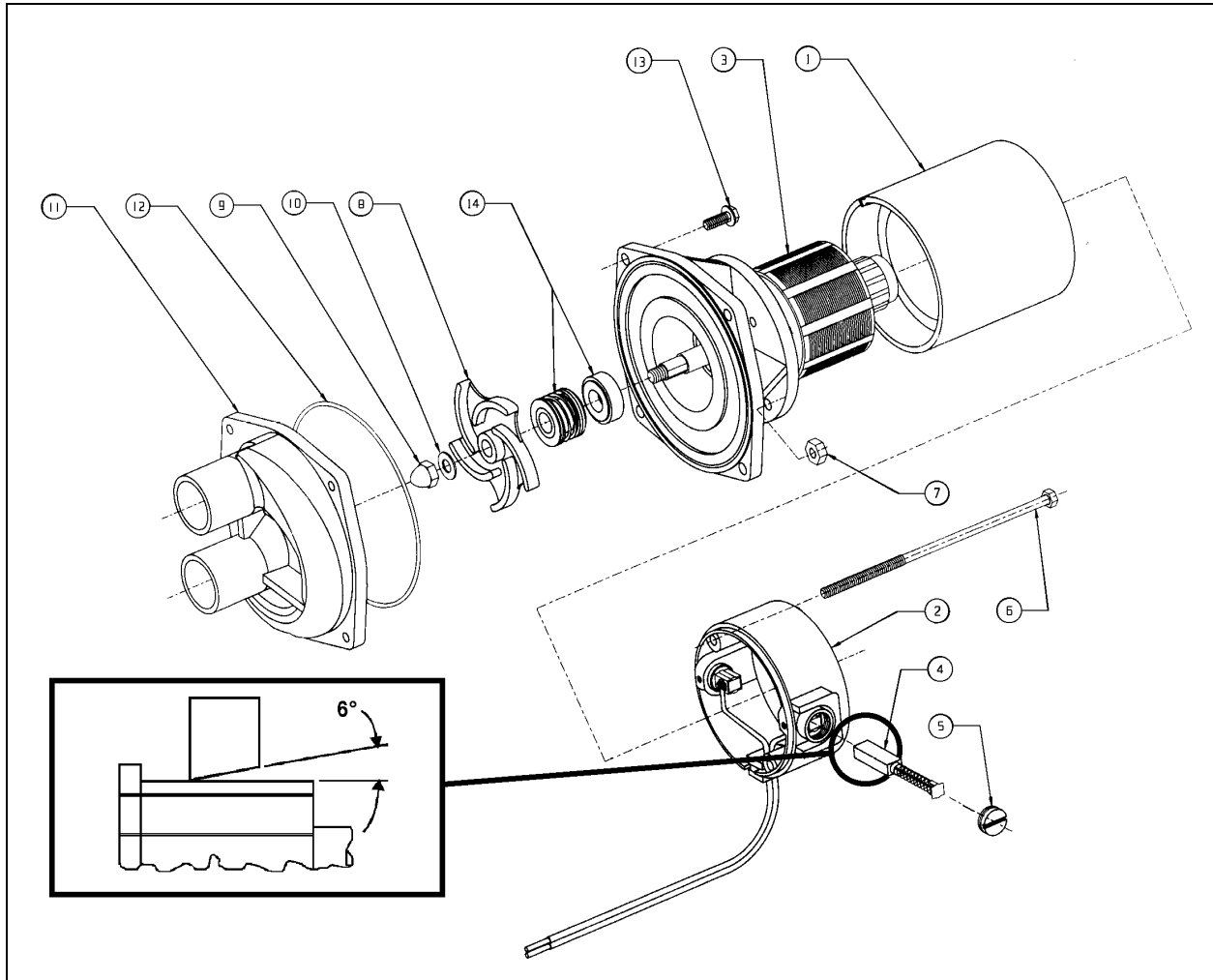


FIGURE 46: WATER CIRCULATING PUMP (CONVERTED VEHICLE - CENTRAL A/C)

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 Ass'y	1	10	Gasket	1
3	Armature adapter Ass'y	1		COVER	
4	Brush Ass'y	2	11	Cover - Housing	1
5	Cap (brush holder)	2	12	O-ring	1
6	Casebolt 10-32 X 5	2	13	Screw	4
7	10-32 Hex Nut	2		SEAL	
			14	Seal Ass'y	1

Section 22: HEATING AND AIR CONDITIONING

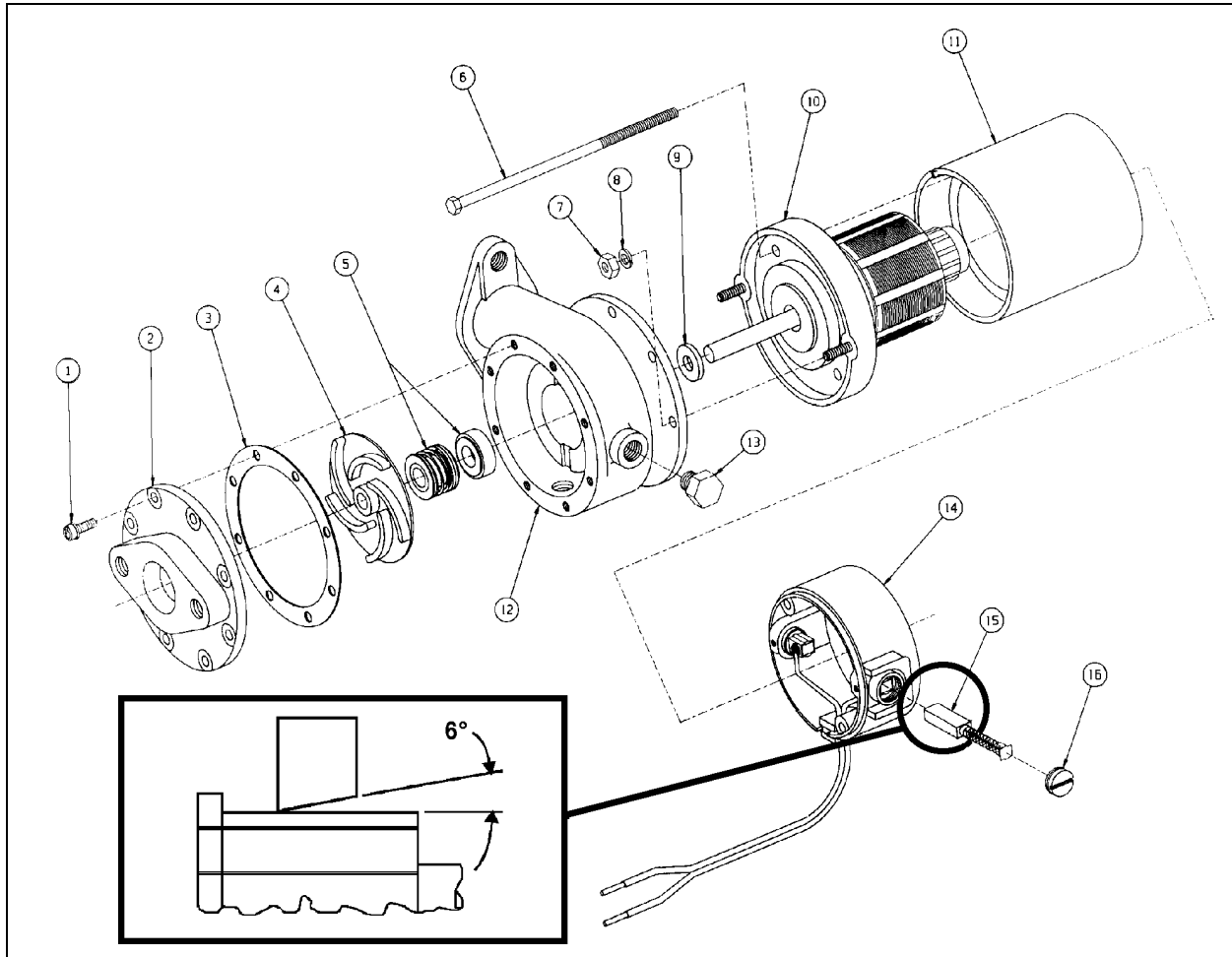


FIGURE 47: WATER CIRCULATING PUMP (COACH - CENTRAL A/C OR DRIVER'S A/C)

22056

ITEM	DESCRIPTION	QTY.	ITEM	DESCRIPTION	QTY.
	MOTOR			IMPELLER	
	Motor Ass'y	1	4	Impeller - Brass	1
11	Stator	1		HOUSING	
14	End Frame Ass'y	1	12	Body - Brass	1
10	Armature adapter Ass'y	1	2	Cover - Brass	1
15	Brush Ass'y	2	1	Screw and Washer Ass'y	8
16	Cap (brush holder)	2	3	Gasket	1
6	Casebolt 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

Section 22: HEATING AND AIR CONDITIONING

10.3.4 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 in-

serted so that the angle is open away from the pump end of the assembly (inset, Figs. 46 & 47).

- 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.

10.3.5 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.

10.3.6 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.

10.3.7 Miscellaneous

1. **Fig. 47 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. 46:** 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. 47:** 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. 47 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.

10.3.8 Assembly

1. **Fig. 47 only:** Install slinger (9) on the motor shaft.
2. **Fig. 47:** Assemble body (12) to the motor.
3. **Fig. 46:** Install seal ass'y (14).
3. **Fig. 47:** Install seal ass'y (5).
4. **Fig. 46:** Insert impeller (8) and secure with acorn nut (9) and gasket (10).
4. **Fig. 47:** 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. 46:** Install O-ring (12).
5. **Fig. 47:** 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. 46:** Attach cover (11) to the pump body using four screws (13).
6. **Fig. 47:** Attach cover (2) to the pump body using eight screw and washer ass'y (1).

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7. **Fig. 46:** Install motor brushes assembly (4) and brush caps (5).
7. **Fig. 47:** Install motor brushes assembly (15) and brush caps (16).

10.3.9 Installation

Figure 46 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 "4.7 Draining Cooling System" for location of valves.
5. Fill the cooling system as previously instructed in this section under "9.3 Filling Heating System", then bleed the system as previously instructed in this section under "9.4 Bleeding Heating System".

Figure 47 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 "4.7 Draining Cooling System" for location of valves.

5. Fill the cooling system as previously instructed in this section under "9.3 Filling Heating System", then bleed the system as previously instructed in this section under "9.4 Bleeding Heating System".

10.4 Coolant Strainer

10.4.1 Description

This vehicle is provided with a cleanable coolant strainer, which is located in the A/C & heating compartment. The strainer 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.



FIGURE 48: COOLANT STRAINER LOCATION

05021

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

10.4.2 Maintenance

Strainer 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 coolant strainer 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.

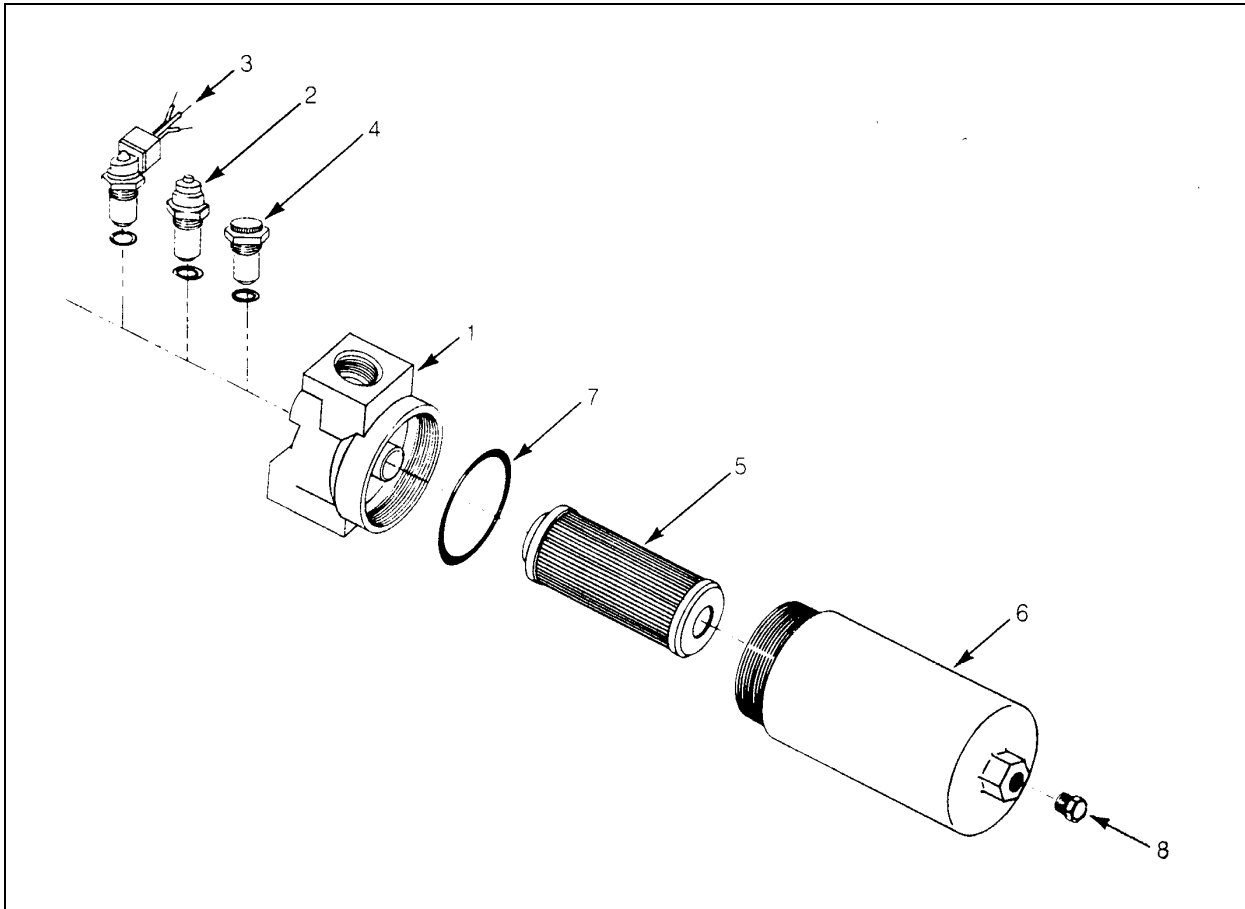


FIGURE 49: WATER FILTER

22057

10.4.3 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 "4.7 Draining Cooling System" for location of valves.

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

3. Rotate bowl (6, Fig. 49) counterclockwise and remove.
4. Remove element (5, Fig. 49) 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".

10.4.4 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 "4.7 Draining Cooling System" for location of valves.

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

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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 "9.3 Filling Heating System".

10.5 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 A/C & heating compartment (Fig. 50). This valve is similar to the driver's solenoid valve (refer to Fig. 41 for part names).

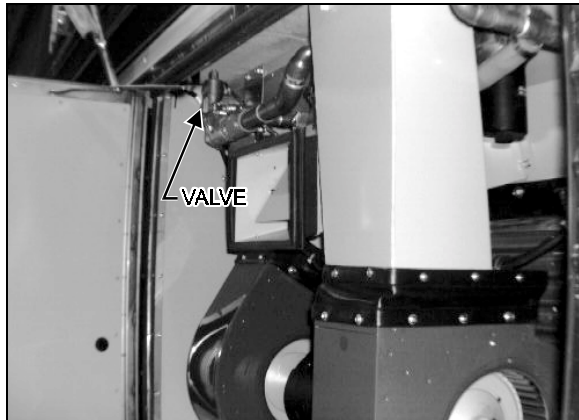


FIGURE 50: BY-PASS VALVE LOCATION

22092

10.5.1 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.

10.5.2 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.

10.6 Preheating System (Optional)

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

10.6.1 Espar (Eberspächer)

Description of Operations

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 its 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.

10.6.2 Webasto

Description of Operations

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

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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 $165^{\circ} \pm 6^{\circ}\text{F}$ ($75^{\circ} \pm 3^{\circ}\text{C}$) and turns it on at $154^{\circ} \pm 9^{\circ}\text{F}$ ($68^{\circ} \pm 5^{\circ}\text{C}$). 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.

10.6.3 Preheating System Timers - Auxiliary (Optional)

The timer, located on L.H. lateral is used to program the starting and stopping time of the preheating system. One of two optional Timers may be installed in your vehicle, Espar (40 000 BTU) (Fig. 40) or Webasto (80 000 BTU) (Fig. 41). The system indicator light, located on the dashboard, illuminates when the system is functional. The following offers system descriptions for both timers.

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.

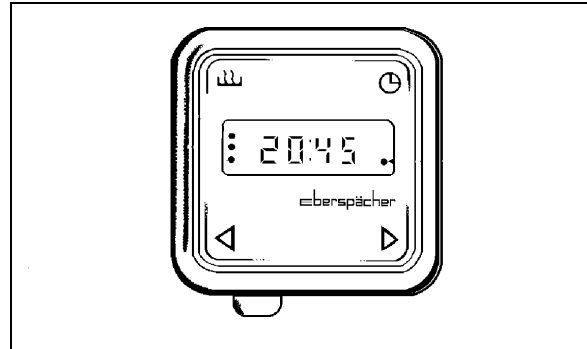


FIGURE 51: ESPAR (40 000 BTU)

18045

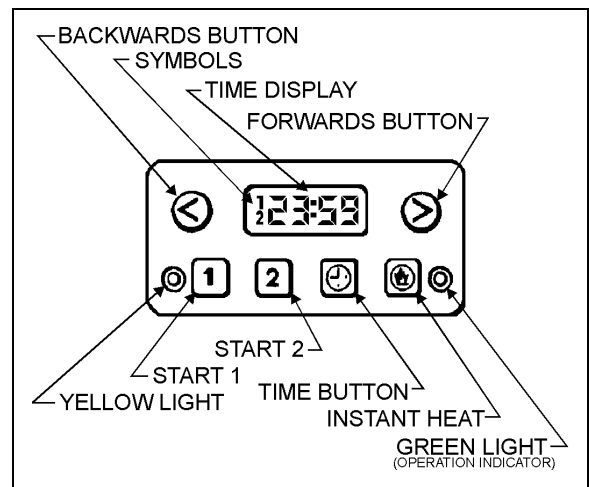


FIGURE 52: WEBASTO (80 000 BTU)

18046

10.6.4 Troubleshooting and Maintenance

Refer to the Webasto and Espar manuals annexed to the end of this section.

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

Caution: *During welding procedure on the vehicle, disconnect the preheater module*

connector in order to protect this system from voltage surges.

11. SPECIFICATIONS

Evaporator motor (Central system) (Prior 2PCM33495T10125780)

Make	Prevost
Type.....	T-19A
Voltage.....	27.5 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.....	D599V54APRCAR
Motor Prevost number	561112
Brush supplier number.....	1197
Brush Prevost number	561202

Evaporator motor (Central system) (From 2PCM33495T10125780)

Make	Prevost
Type.....	T-17
Voltage.....	27.5 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.....	D599V54APRC4
Motor Prevost number	562374
Brush supplier number.....	1197
Brush Prevost number	561202

Condenser fan motor (Central system) (XL-40 and 45E only) (Prior 2PCM33495T10125780)

Make	Prevost
Type.....	T-19A
Voltage.....	27.5 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.....	D599V54APRCAR
Motor Prevost number	561112

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Brush supplier number..... 1197
Brush Prevost number..... 561202
Condenser fan motor (Central system) (XL-40 and 45E only) (From 2PCM33495T10125780)
MakePrevost
Type..... T-17
Voltage..... 27.5 V DC
Current draw 57 amps
Horsepower 1.5
Revolution..... 1750 rpm
InsulationClass F
Motor life 20 000 hours
Brush life..... 10 000 hours
Motor supplier number..... D599V54APRC4
Motor Prevost number 562374
Brush supplier number..... 1197
Brush Prevost number..... 561202

Condenser fan c/w motor (Central system) (XL-45 Coach)

Make Aurora
Voltage..... 24 V DC
Weight..... 2,5 kg
Max vent 5.286
Quantity 4
Supplier number 134-702-0002
Prevost number 871071

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

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Evaporator motors (Driver's and auxiliary systems)

Make Mobile Climate Control
Voltage..... 24 V DC
Supplier number25-0135
Prevost number 562167

Evaporator air filter (Driver's and auxiliary systems)

Make Permatron
Type..... Washable 8"X18 3/4"X1/4" Polypropylene filter
Supplier number MODEL "R"
Prevost number 871049

A/C Compressor (Central system)

Make Carrier Transicold
Capacity..... 41 CFM
Model..... 05G-134A
No. of cylinders 6
Bore 2" (50,8 mm)
Operating speed 400 to 2200 rpm (1750 rpm, nominal)
Minimum speed (for lubrication) 400 rpm
Nominal horsepower..... 15
Oil pressure at 1750 rpm 15 to 30 psi (103-207 kPa)
Oil capacity 1.13 US gal (4,3 liters)
Weight..... 142 lbs (64,5 kg)
Supplier number 68PD541-104-6
Prevost number 950238

Approved oils

- Castrol SW 68 (POE)
- Mobil Arctic 1 (POE)

Note: *The above mentioned oils are suitable for use with reciprocating compressors using refrigerant R-134A and with evaporator temperatures above -40°F (-40°C).*

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)
System oil charge** (auxiliary system) 14 US oz (414 ml)
Weight..... 24 lbs (10,9 kg)
Supplier number 99242-5
Prevost number 950219

Approved oils

- Castrol SW 68 (POE)
- Mobil Arctic 1 (POE)

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* - The "Factory oil charge" is the quantity of oil the compressor contains for shipping. This is also the quantity of oil the compressor must contain once the system is in service, when all lines are lubricated.

** - The "System oil charge" is the total quantity of oil needed to fill the compressor and the system lines.

A/C Compressor pulley - includes magnetic clutch (Driver's and auxiliary systems)

Make Warner Electric
Type 1C
Coil 24 Volt
Supplier number 1436-48
Prevost number 950079

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

Make Gates
Model A35
Supplier number 9002-2035
Prevost number 506685

Compressor unloader valve (Central system)

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 number 950096

Magnetic clutch (Central system)

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

A/C Compressor belt (Central system)

Make Gates
Model Dayco BX 97
Supplier number 9013-20973
Prevost number 506664
Quantity 2

Refrigerant

Type R-134a
Quantity Central system - 24 lbs (11 kg)
Quantity Driver's system only (XL-40 & 45E) - 6 lbs (2,7 kg)
Quantity Driver's system only (XL-45) - 6.5 lbs (3 kg)

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QuantityAuxiliary system - 24 lbs (11 kg)

Condenser coil (Driver's and auxiliary systems)

Make Harrison division

Supplier number3037438

Prevost number950018

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

Make Carrier Transicold

Aluminum

Supplier number 68GF67-194-2

Prevost number870654

Copper

Supplier number 68GF67-194-3

Prevost number870729

Condenser coil (Central system) (XL-45 Coach)

Make Carrier Transicold

Aluminum

Supplier number68BC2-107

Prevost number950259

Copper

Supplier number 68BC2-107-1

Prevost number950260

Evaporator coil (Central system)

Make Carrier Transicold

Supplier number68BE2-105

Prevost number871070

Receiver tank (Central system) (XL-40 vehicles and, XL-45 & 45E Shells)

Make Standard refrigeration

Maximum pressure 450 psig

Material ASTM A-515

Supplier number8409-19M

Prevost number871045

Receiver tank (Central system) (XL-45 Coach)

Make Henry

Maximum pressure 450 psig

Material ASTM A-515

Supplier numberALR1217

Prevost number950261

Receiver - dryer (Driver's and auxiliary systems)

MakeArctic Traveler

Model402566

Supplier number74R1706

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Prevost number 950048

Filter dryer assembly (Central system) (XL-40 vehicles and, XL-45 & 45E Shells)

Make Alco
Supplier number EKH 307S
Prevost number 950231

Filter dryer assembly (Central system) (XL-45 Coach)

Make Henry
Supplier number 815031-XH9
Prevost number 950262

Moisture indicator (Central system)

Make Henry
Supplier number MI-30-7/8S
Prevost number 950232

Thermistor sensor c/w suppresser (Central system)

Make Pocatec Ltée
Supplier number 9000044
Prevost number 870868

Refrigerant liquid solenoid valve (Driver's and auxiliary systems)

Make Parker
Type Normally closed with manual bypass
Nominal Capacity with R-129 Tons
Voltage 24 V DC
Amperage draw 0.67 amps
Watts 16
Supplier number (without coil) RB9MP3-MM
Prevost number (without coil) 950054
Coil supplier number R23MM-CB 24 V DC
Coil Prevost number 950055
Repair kit Prevost number 950056

Hot water solenoid valve (Driver's system)

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)

MakeM.P. pumps
Voltage..... 24 V DC
Supplier number28689
Prevost number871052

Water recirculating pump (Central system - Shell)

MakeM.P. pumps
Voltage..... 24 V DC
Housing..... Aluminum
Supplier number29232
Prevost number871032

Coolant strainer (Central system)

Make Parker
Relief valve setting..... 10 psi
Supplier number (with element)..... 15CN1238WP
Prevost number (with element)..... 871028
Element type..... Stainless steel
Element size 238 mesh
Element supplier number.....92-5566
Element Prevost number 871029

Coolant strainer (Driver's system)

Make Deschênes & fils Ltée
Type..... Bronze
Size..... 24 mesh
Supplier number 13-13-00740
Prevost number 870807

Expansion valve (Driver's and auxiliary systems)

Make Mobile Climate Control
Supplier number26-0190
Prevost number 950221

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Expansion valve (Central system)

Make Alco
Model TCLE 7-1/2 MW55-65
Supplier number 058613
Prevost number 950237

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

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

By-pass solenoid water valve (with preheater only)

Make Parker-Hannifin
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 0,4 US gallons/hr (1,65 liters/hr)
Supplier number 25 1656 05 00 00
Prevost number 870969

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

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Fuel consumption 0,8 US gallons/hr (3 liters/hr)
Supplier number 666.640
Prevost number 871036

Evaporator unit thermostat (Auxiliary system)

Make Thermo King
Supplier number 44-3961
Prevost number 950035

Spacer (Shims) for compressor's vertical adjustment (Central system)

Prevost number (thickness 24 GA - 0,61 mm) 481131
Prevost number (thickness 1/16" - 1,59 mm) 505213
Prevost number (thickness 1/8" - 3,18 mm) 505193