

SECTION 22: HEATING AND AIR CONDITIONING

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1. HEATING AND AIR CONDITIONING

The coach's interior is pressurized by its Heating, Ventilation, Air Conditioning (HVAC) units. Air flow and controls divide the vehicle in two sections: driver's and Central (passenger) sections.

The interior of vehicle should always be slightly pressurized to prevent dust and moisture from entering vehicle. Each section has its own fresh air, returning air and discharge air ducting. The exhaust is mainly done through the lavatory ventilator and through normal air-tightness losses.

2. AIR CIRCULATION WITH CENTRAL SYSTEM

2.1 DRIVER'S AREA

Fresh air is taken from a plenum behind the front bumper and enters the mixing box through an ON/OFF damper. Returning air is taken through a front dash panel into the mixing box. The driver's REcirculation button is located on the R.H. dashboard control panel (Fig. 4). Mixed air goes through cooling and heating coils, fans and discharge ducts.

Both right and left discharge ducts defrost one half of the windshield. The driver can also, with the "Main Windshield Defroster" control divert his air flow to the console, from which he can direct vent to his knees and/or upper body with adjustable HVAC register and to his feet with the appropriate button (see Fig. 1 and Operator's manual or Owner's manual).

2.1.1 Coaches

Two additional air outlets are supplied by the Central HVAC ducting system. One is located in the stepwell. The flow comes from the left side and is drawn from the first step riser. The other air outlet is located behind the driver, on his L.H. side. The air outlets can be rotated to direct Air flow.

2.1.2 VIP

VIP vehicles equipped with a central system have two additional registers located near the entrance door, at bottom of first lateral window.

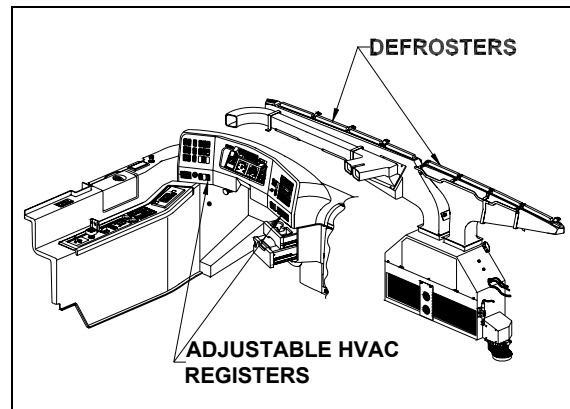


FIGURE 1: DRIVER'S AIR CIRCULATION

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2.2 CENTRAL AREA (Passenger/Cabin)

Fresh air is taken from the left side of vehicle through a two-position damper located at the left of the HVAC compartment. The thermal control damper can be fully opened for normal operation or partially closed for extreme weather or highly polluted areas. The "Recirc." push-button switch is located on the HVAC control unit. Press down the push-button to partially close the fresh air damper.

Note: *Opening the entrance door also partially close the fresh air damper.*

Return air is drawn through the last entrance step riser and from the lower section of the floor ducts in two locations: one in the rear section of vehicle and the other in the front section of vehicle on the L.H. side (Fig. 2).

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 (upper section) along the walls, and finally exhausts it at the bottom of the windows.

On coaches, the HVAC system includes a parcel rack ventilation system equipped with adjustable registers in the parcel racks to control air flow for the passenger seats. One register per seat direct air flow by pointing or rotating register. Open or close register to adjust air flow (Fig. 3).

Also on coaches, the lavatory ventilator acts as the main exhaust for the whole vehicle,

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eliminates odors, and finally heats or cools the lavatory with the vehicle's ambient air.

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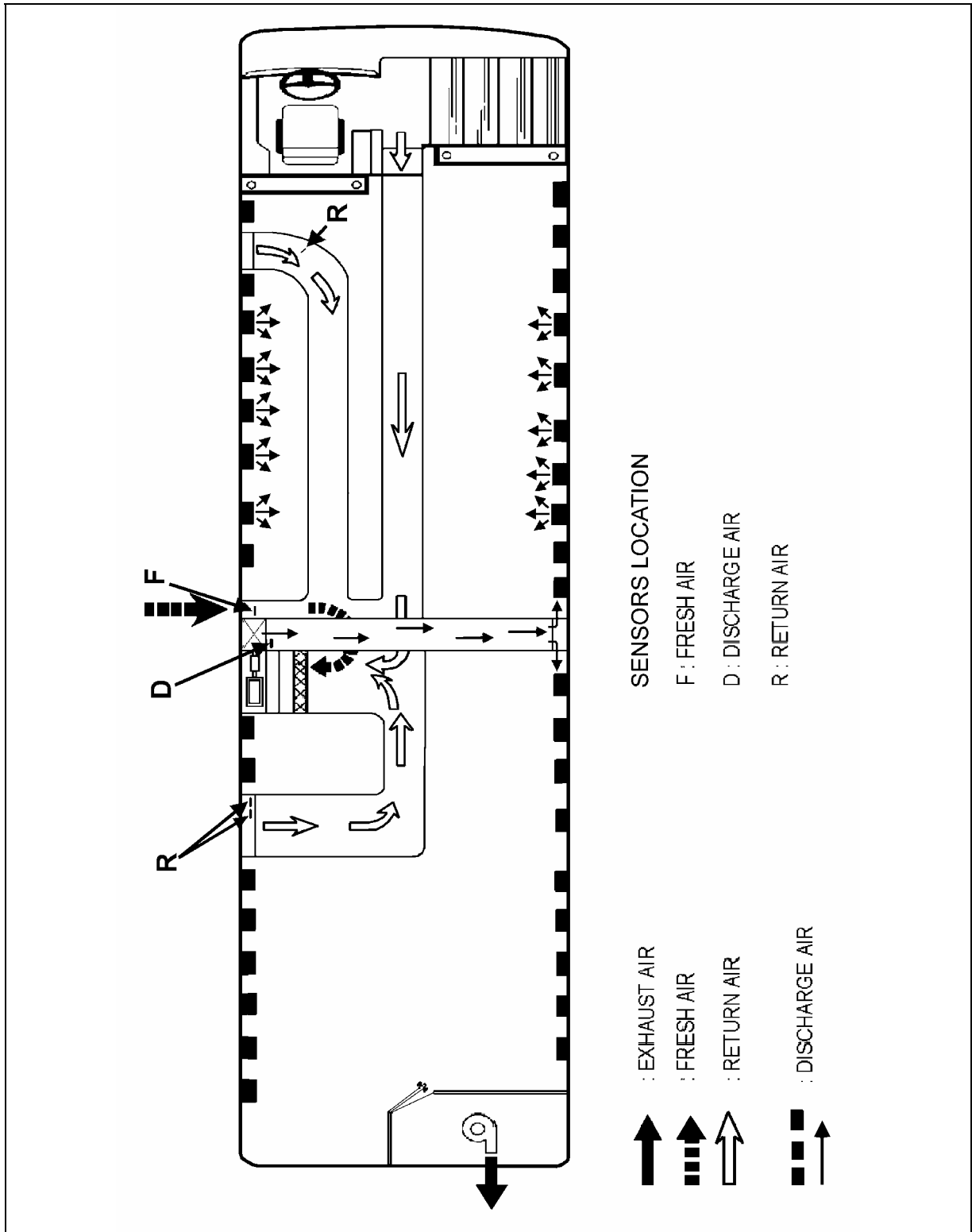


FIGURE 2: CENTRAL HVAC SYSTEM AIR CIRCULATION

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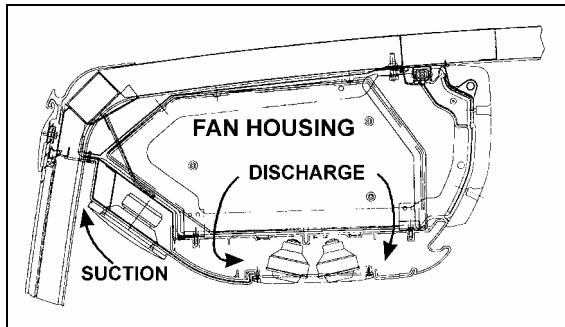


FIGURE 3: PARCEL RACK VENTILATION SYSTEM

3. AIR CIRCULATION WITH SMALL SYSTEM

Fresh air is taken from a plenum behind the front bumper and enters the mixing box through an adjustable damper. Returning air is taken through a front dash panel into the mixing box. The driver's RECirculation button is located on the R.H. dashboard control panel (Fig. 4). Mixed air goes through cooling and heating coils, fans and discharge ducts.

Both right and left discharge ducts defrost one half of the windshield. The driver can also, with the "Main Windshield Defroster" control divert his air flow to the console, from which he can direct vent to his knees and/or upper body with adjustable HVAC register and to his feet with the appropriate button (see Fig. 1 and Owner's manual).

4.2 CONTINUITY CHECK

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

Circuit	Switch LED or Display
F/A damper driver	Driver Rec
Driver Footwell damper	2 nd and 3 rd button
Damper mix	Driver air 4 th button
Driver "Liquid Solenoid Valve"	Driver display "Set Point" (AC)
Driver "Hot Water Valve"	Driver display "Set Point" (HE)
Liquid solenoid valve	LED 1 st speed
Recirculation pump relay	Rcirculation pump
A/C Clutch Relay	A/C Clutch
Exterior Probe	Display "Text". (---)
Driver interior probe	Driver display "Set Point" (---)

3.1 AUXILIARY SYSTEM

VIP vehicles are equipped with an auxiliary system that provides five additional registers. Three are located behind the driver's seat and the other two are located near the entrance door, at bottom of first lateral window.

4. SMALL HVAC SYSTEM OPERATION

The temperature control in the driver's area is provided directly by the HVAC control unit mounted on the dashboard R.H. side.

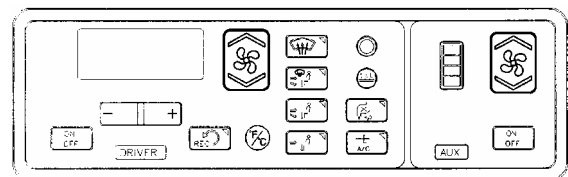


FIGURE 4: HVAC DASHBOARD CONTROL UNIT 22184

Using the Up/Down type switch sets the fan speed and the speed chosen is illustrated on the window display.

4.1 AUXILIARY SYSTEM OPERATION

The temperature control is provided by the small system HVAC control unit. The R.H. portion of the HVAC control unit enables to actuate the Aux. System and to regulate the fan speed. Using the Up/Down type switch sets the fan speed and the speed chosen is illustrated on the window display.

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5. CENTRAL HVAC SYSTEM OPERATION

5.1 DRIVER'S AREA

The temperature control in the driver's area is provided directly by the L.H. portion of the HVAC control unit mounted on the dashboard R.H. side.

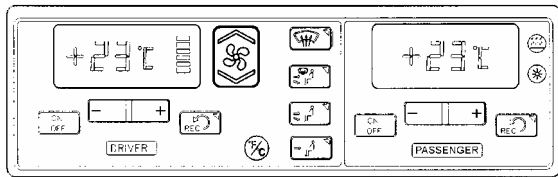


FIGURE 5: HVAC DASHBOARD CONTROL UNIT 22184

Using the Up/Down type switch sets the fan speed and the speed chosen is illustrated on the window display.

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

5.2 CENTRAL AREA

The R.H. portion of the HVAC control unit located on the dashboard R.H. side, enables the selection of the temperature in the main section (Refer to the H3 Owner's or Operator's Manual for details). The evaporator motor installed in HVAC compartment on the L.H. side of vehicle is protected by a 150 amp, manually-resettable (CB8) circuit breaker mounted in the main power compartment (refer to Section 06, "Electrical System" in this manual for details).

The condenser mounted on the opposite side of the evaporator is ventilated by two axial fans. Each axial fan motor is protected by a manually-resettable 40 amp circuit breaker (CB 77 & CB 78) mounted in the main power compartment on rear R.H. side of vehicle. (Fig. 6) Furthermore, the following relays and resistors are located in the Heating, Ventilation and Air Conditioning Compartment (HVAC) (Fig. 7). They are mounted on the control panel located on the R.H. side wall when facing the compartment:

- R39 – Condenser fan motor
- R40 – Condenser speed control HI
- R41 – Condenser speed control HI
- RS36 – Current limit for relay
- RS37 – Current limit for relay

To operate the air conditioning system when coach is stationary, engine should run at fast idle. During operation of the air conditioning system, windows should be kept closed and door not left open longer than necessary. In order to prevent battery discharge, A/C-heating system will not operate if vehicle charging system is not working properly.

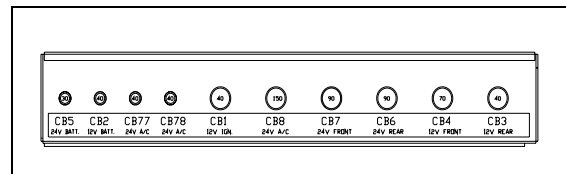


FIGURE 6: MAIN BREAKERS

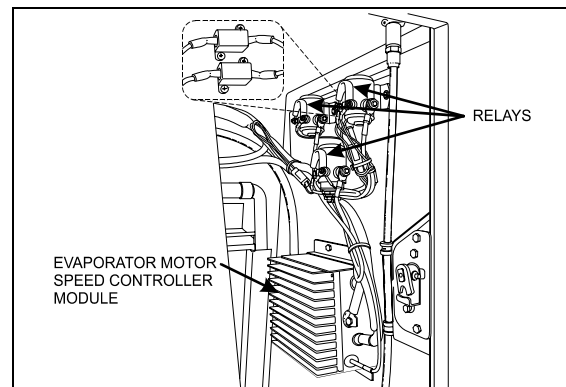


FIGURE 7: LOCATION OF RELAYS AND RESISTORS

The heating and cooling components (water recirculating pump, main hot water valve actuator, A/C compressor clutch and unloaders, etc) are connected to the HVAC logic panel mounted in the rear electrical compartment and junction box (Fig. 8).

Air temperature is picked up by four identical sensors, three in rear return and by another sensor located in the discharging air duct (Fig. 2). As shown on the wiring diagram, the sensors are series-parallel connected. The electronic transmitter (Fig. 8) detects the sensor signal and then compares it with the driver's setpoint ("Main A/C – Heating Temperature" control, which is mounted in R.H. dashboard control panel).

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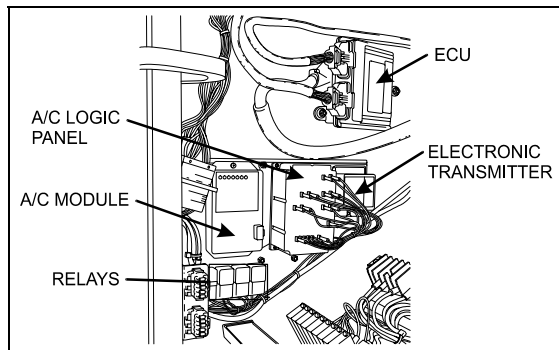


FIGURE 8: HVAC LOGIC PANEL (REAR ELECTRICAL COMPARTMENT)

This will result in a voltage range (Fig. 9) for the HVAC logic panel. At this point, a fresh air sensor located in the fresh air damper on L.H. side of vehicle can modify this range to anticipate any major change in the outside temperature. Afterwards, the HVAC logic panel will select the appropriate heat or cooling contact and staging according to the actual conditions. On the HVAC logic panel, there are three heat and three cooling contacts.

5.3 HEAT MODE

Heat in the system varies with the restricted opening of the linear main hot water valve actuator, the bypass solenoid valve and the action of the water recirculating pump.

If the preheater is switched “ON”, the bypass solenoid water valve opens and the main hot water valve actuator should be fully “CLOSE”, except if **heat contact 3** is “ON” the main hot water valve actuator should be fully “OPEN”.

The main hot water valve actuator is controlled by the heat voltage ramp (Fig. 9).

The **heat contact 1** starts the water recirculating pump and turn “ON” LEDs for diagnosis (see paragraph “5. DIAGNOSIS OF CENTRAL HVAC UNIT PROBLEMS”).

The **heat contact 2** controls nothing.

5.4 COOLING MODE

Contact will vary with the number of active cylinders in the compressor by means of electric unloaders. Staging will be defined as follows:

No cooling contact: Compressor clutch is disengaged.

Cooling contact 1: Compressor clutch is engaged and 2 compressor active cylinders.

Cooling contact 2: Compressor clutch is engaged and 4 compressor active cylinders.

Cooling contact 3: Compressor clutch is engaged and 6 compressor active cylinders.

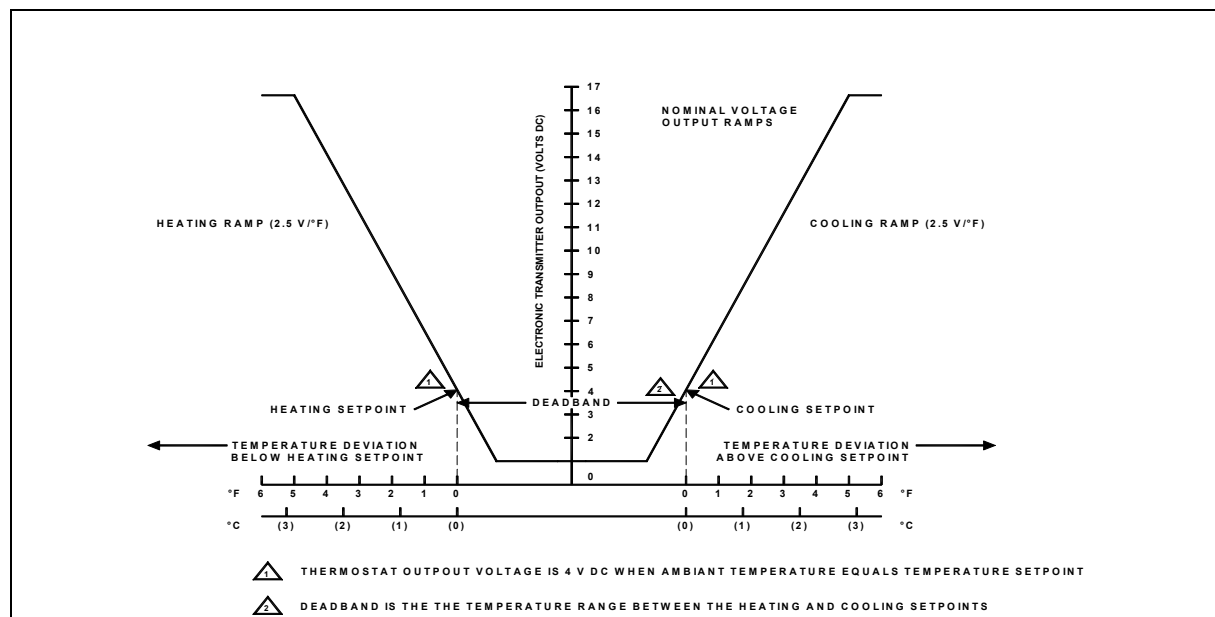


FIGURE 9: ELECTRONIC TRANSMITTER OUTPUT VOLTAGE RAMPS

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5.5 PARCEL RACK A/C (H3 COACHES)

Optional small A/C evaporator coils may be added to both parcel racks existing air system. This air system permits a wider temperature range in the passenger's area.

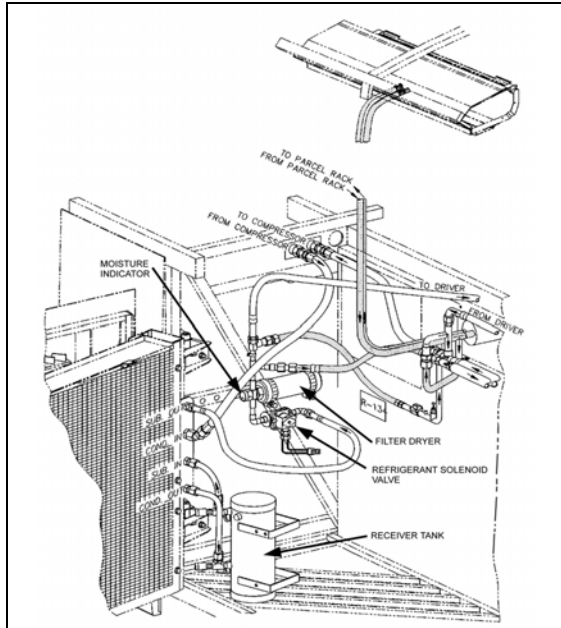


FIGURE 10: PARCEL RACK A/C INSTALLATION

6. DIAGNOSIS OF CENTRAL HVAC UNIT PROBLEMS

Troubleshooting the HVAC system is made easier with the LEDs (light-emitting diodes) integrated in the system, and acting as indicator lights.

The central HVAC unit is equipped with three LEDs to indicate the heating mode and are located as follows:

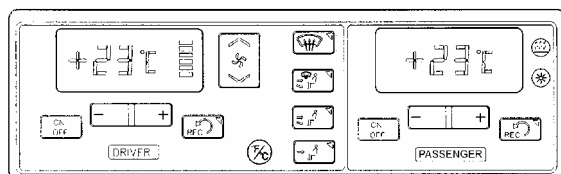


FIGURE 11: HVAC DASHBOARD CONTROL UNIT 22184

One **red LED** is located on the L.H. side of the **electronic transmitter** when facing the transmitter to indicate the heating mode (Fig. 12). The electronic transmitter picks up the

sensor signal and compares it with the setpoint established by the driver ("Main A/C – Heating Temperature" control). After analysis, a voltage signal, of which value is proportional to the analysis result (sensor vs driver's setpoint), is transmitted to the HVAC logic panel. The red LED on the electronic transmitter will be illuminated according to the voltage value, i.e. red LED may not be illuminated at first, and then will gradually reach its maximum brightness or vice versa.

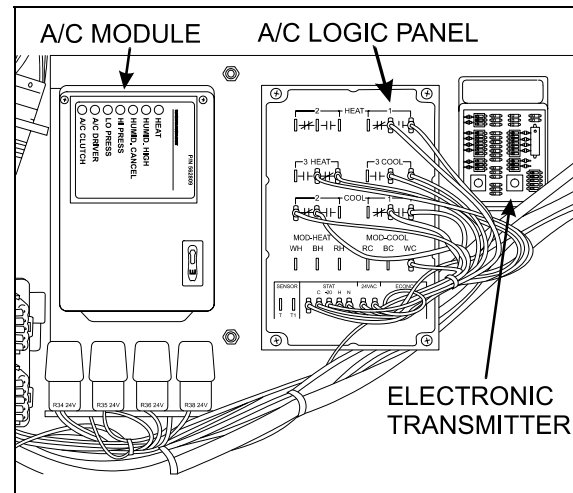


FIGURE 12: HVAC LOGIC MODULE AND TRANSMITTER

Two other red LEDs connected in parallel are located as follows:

One red LED is located on the driver's dashboard control unit, while the other red LED is located on the HVAC module (Fig. 12). The two red LEDs operate simultaneously; unlike the LED mounted on the electronic transmitter, they may be illuminated or not ("ON" or "OFF") their function is to indicate the output of the HVAC logic panel.

The HVAC logic panel reads the voltage from the electronic transmitter. As soon as the voltage reaches 4.6 volts, the HVAC logic panel opens the normally-closed **heat contact 1**. At this stage, the two red LEDs will illuminate to indicate that the HVAC logic panel has sent a signal to activate the heating system. If the other stages are activated, the two LEDs will remain illuminated.

Section 22: HEATING AND AIR CONDITIONING

The red LED on the driver's dashboard control unit and the red LED mounted on the HVAC module enables the technician to quickly diagnose the problem.

As for the A/C mode, it is almost the same installation, except that the red LED on the electronic transmitter is located on the R.H. side of the transmitter and indicates cooling mode. Its operation is, however, identical.

The significant difference lies in the fact that the two other LEDs connected in parallel are green. One green LED is located in the driver's dashboard control unit, while the other one is located on the HVAC module. These two LEDs indicate the operation of the A/C system.

The HVAC system has been set to allow the driver to activate the A/C until the temperature fall down to 25° F. Then, the A/C shuts down. On ascending temperature, the A/C will turn on from temperature 35° F and up. Therefore, it is normal for the driver who requests heat by means of the "Main A/C – Heating Temperature" control, that the red and green LEDs be illuminated simultaneously. This corresponds to the operation of the heating system to heat the vehicle, and to the operation of the A/C system to dry air (dehumidification).

Note: *The dehumidifying function will operate only when the ambient temperature inside vehicle is less than 4°F (2°C) from the temperature selected with "Main A/C – Temperature" control. If transmitter output voltage is higher than 15 volts (Heat or A/C), dehumidifying function is cancelled.*

In addition to the two LEDs on the electronic transmitter and to the four other ones used to indicate the output of HVAC logic panel, four other LEDs described hereafter have been added on the HVAC module and on the dashboard to help the technician to quickly diagnose problems.

6.1 HIGH PRESSURE ORANGE LED

This LED mounted on the HVAC module (Fig. 12), is designed to light up when the pressure inside the A/C system (high pressure side) is too high. If this occurs, perform the following checks:

- Too high air inlet temperature to the condenser;
- Dirty condenser;
- Faulty condenser fans; or
- Refrigerant overcharge.

Note: *Another indicator light, "High A/C Pressure Indicator", mounted in the dashboard will also illuminate in order to inform the driver of this abnormal situation.*

Note: *If the A/C pressure is too high, the compressor clutch is disengaged, but the fan remains active.*

6.2 LOW PRESSURE ORANGE LED

This LED, also mounted on the HVAC module (Fig. 12), is designed to light up when the pressure inside the A/C system (low pressure side) is too low. If this occurs, perform the following checks.

- Too low air inlet temperature to condenser and/or evaporator;
- Dirty evaporator air filter;
- Dirty evaporator;
- Low refrigerant charge; or
- Expansion valve freeze up.

Note: *Another indicator light "Low Conditioning A/C Pressure Indicator", mounted in the dashboard will also illuminate in order to inform the driver of this abnormal situation.*

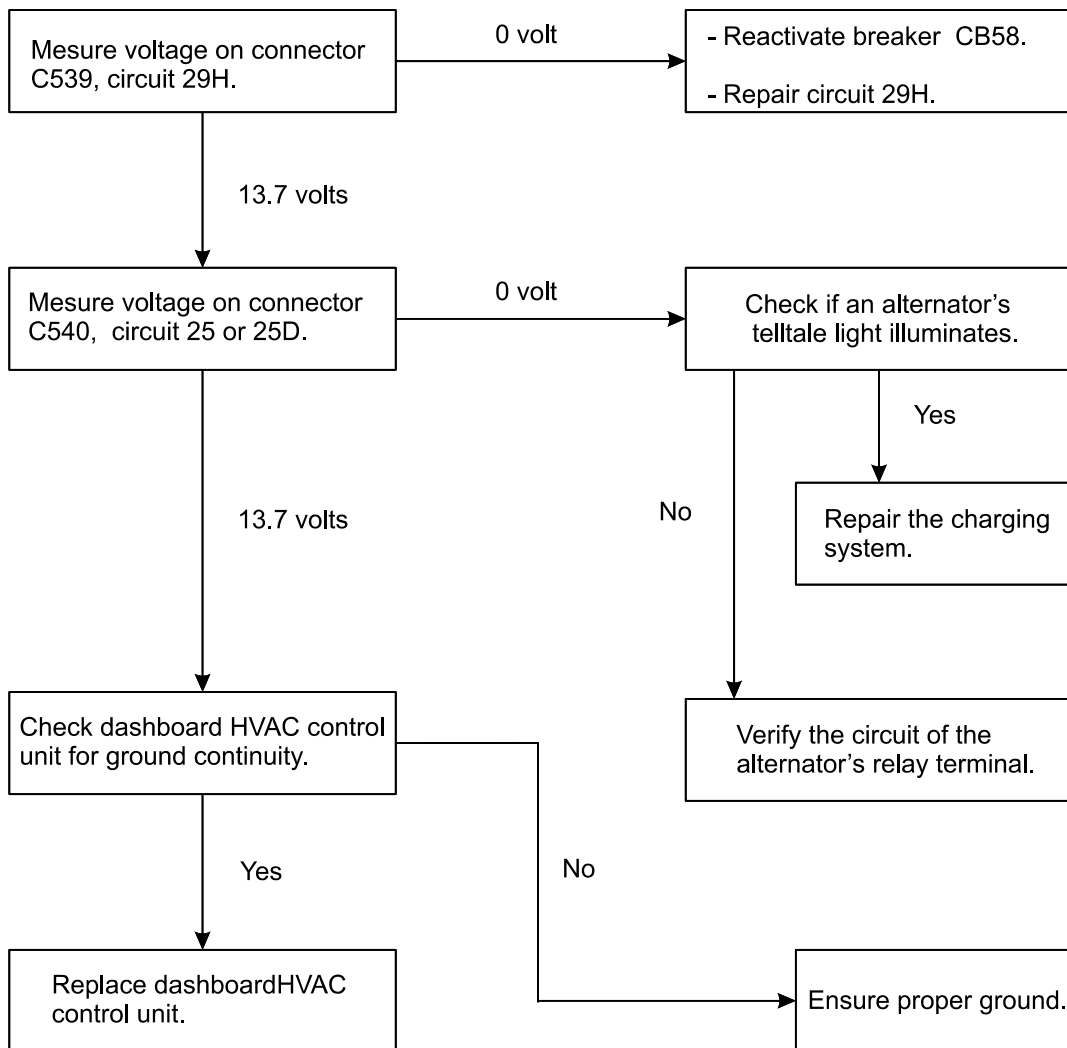
Note: *If the A/C pressure is too low, the compressor clutch is disengaged and the fan is deactivated.*

Section 22: HEATING AND AIR CONDITIONING

7. CENTRAL HVAC UNIT TROUBLESHOOTING GUIDES

GUIDE 1: DEFECTIVE DRIVER'S AREA HVAC MAIN SWITCH

Perform test with engine running.



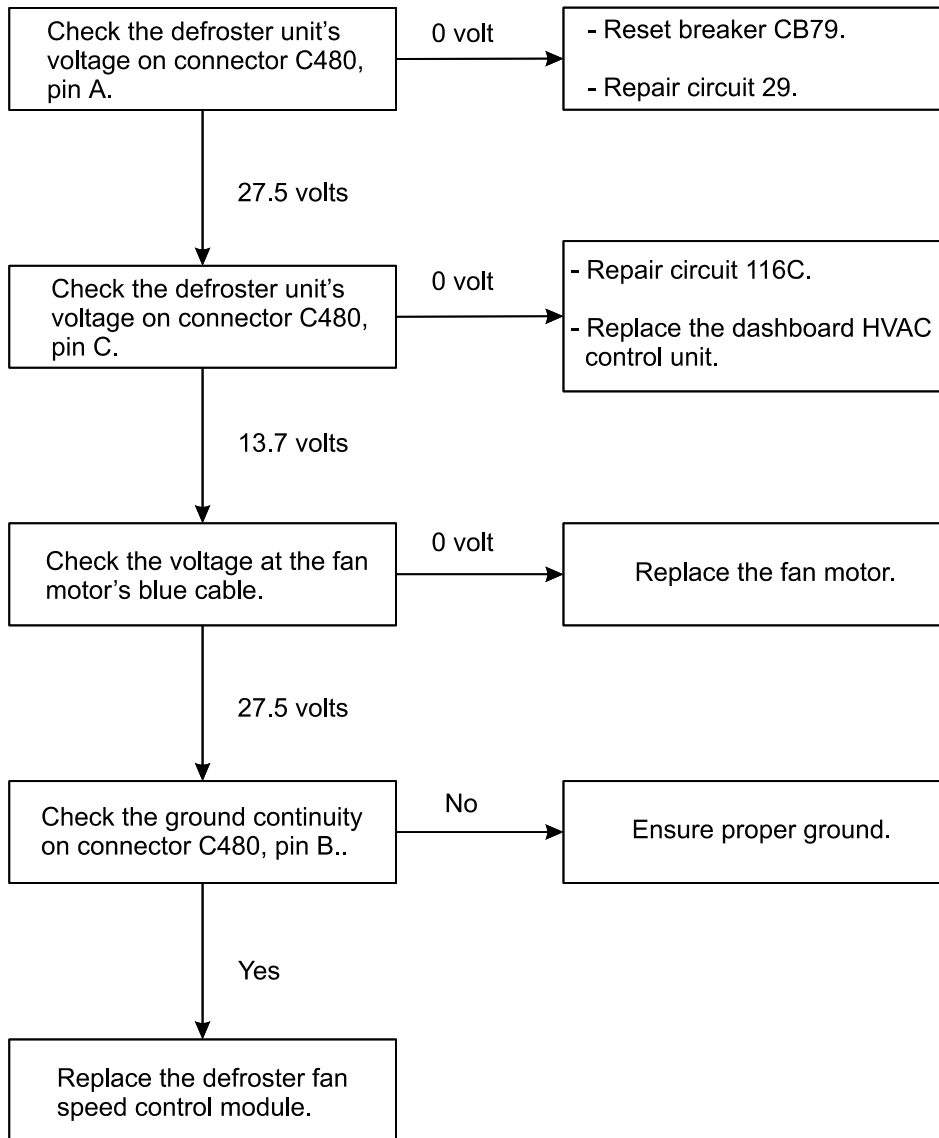
GUIDE 2: BUTTON FLASHES OR MESSAGE APPEARS ON THE HVAC CONTROL UNIT DISPLAY

ALARM MESSAGE APPEARS ON HVAC MODULE DISPLAY WINDOW FOR 10 SECONDS OR BUTTON FLASHES FOR 10 SECONDS WHEN UNIT IS TURNED ON

Diagnostic Code	Description	Potential problem
3 horizontal lines on outside temperature display.	Incorrect electrical continuity with the outside temp. sensor located behind front bumper.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective sensor.
3 horizontal lines on driver set point temperature display.	Incorrect electrical continuity with the driver inside temp. sensor located in the defroster discharge.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective sensor.
Driver REC flashes.	Incorrect electrical continuity on the driver gas cylinder (damper) located under the R.H. console.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective damper.
Passenger REC flashes.	Incorrect electrical continuity on the passenger gas cylinder (damper) located in the evaporator compartment.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective damper.
HE on driver display.	Incorrect electrical continuity with the heater solenoid valve located in front bumper compartment.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective solenoid valve.
AC on driver display.	Incorrect electrical continuity with the liquid solenoid valve located in front bumper compartment.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective solenoid valve.
Panel selector button flashes.	Incorrect electrical continuity on the damper mix (motor) located in the dashboard.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective sensor.
All vents open and Panel and Footwell buttons flash.	Incorrect electrical continuity on the foot damper (solenoid) located under the dashboard.	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire. - Defective solenoid valve.
Passenger REC light stays ON	Entrance door open	<ul style="list-style-type: none"> - Bad contact. - Connector disconnected. - Broken wire - Defective entrance module.

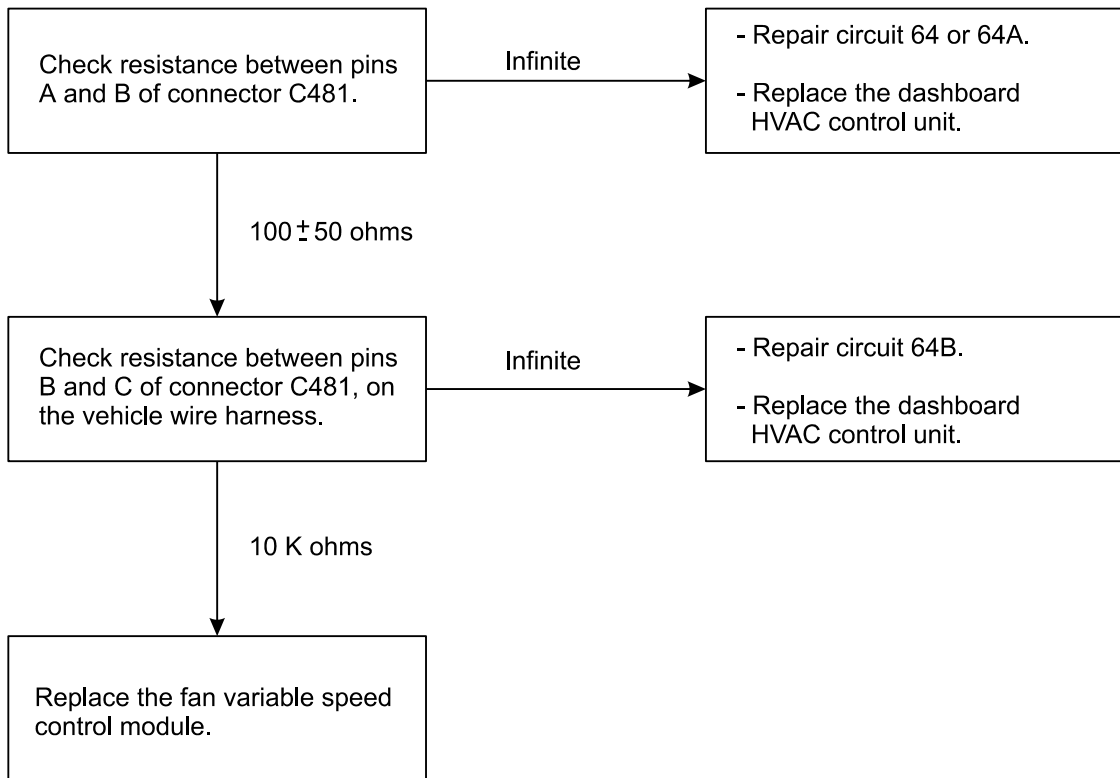
Section 22: HEATING AND AIR CONDITIONING

GUIDE 3: DRIVER'S AREA NOT VENTILATED



GUIDE 4: THE VARIABLE FAN SPEED SYSTEM DOES NOT FUNCTION IN THE DRIVER'S AREA

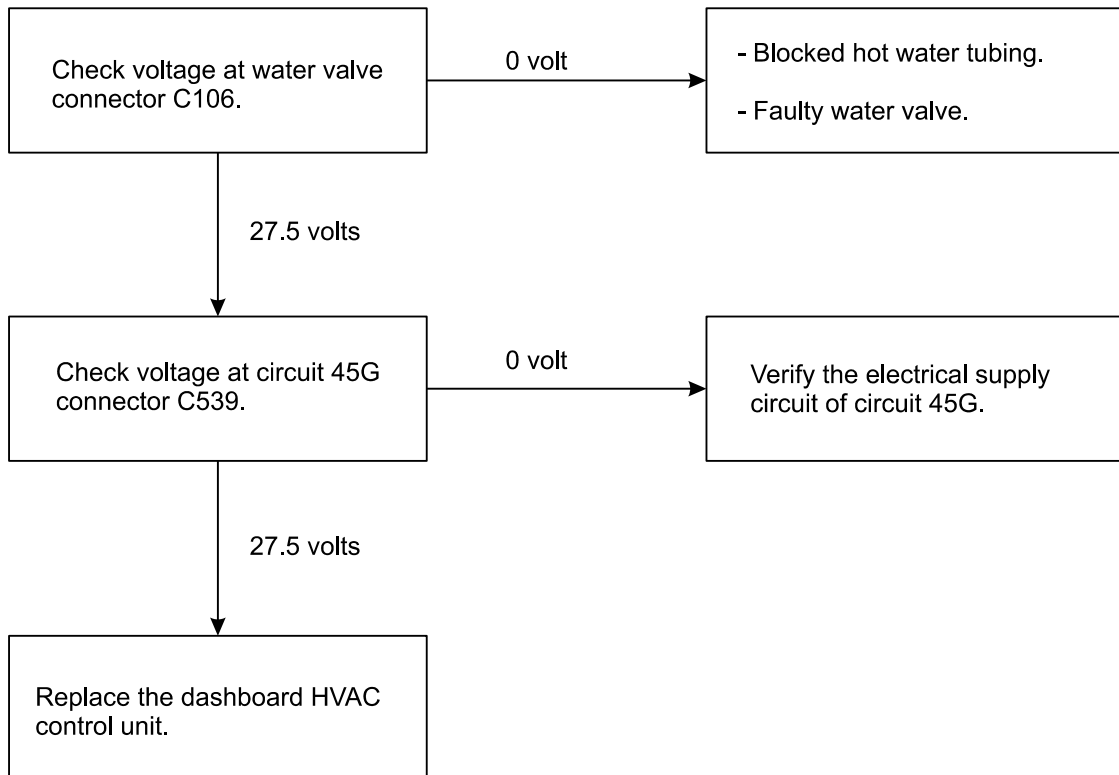
Test with the HVAC dashboard control switched ON and with fan speed at maximum setting.



Section 22: HEATING AND AIR CONDITIONING

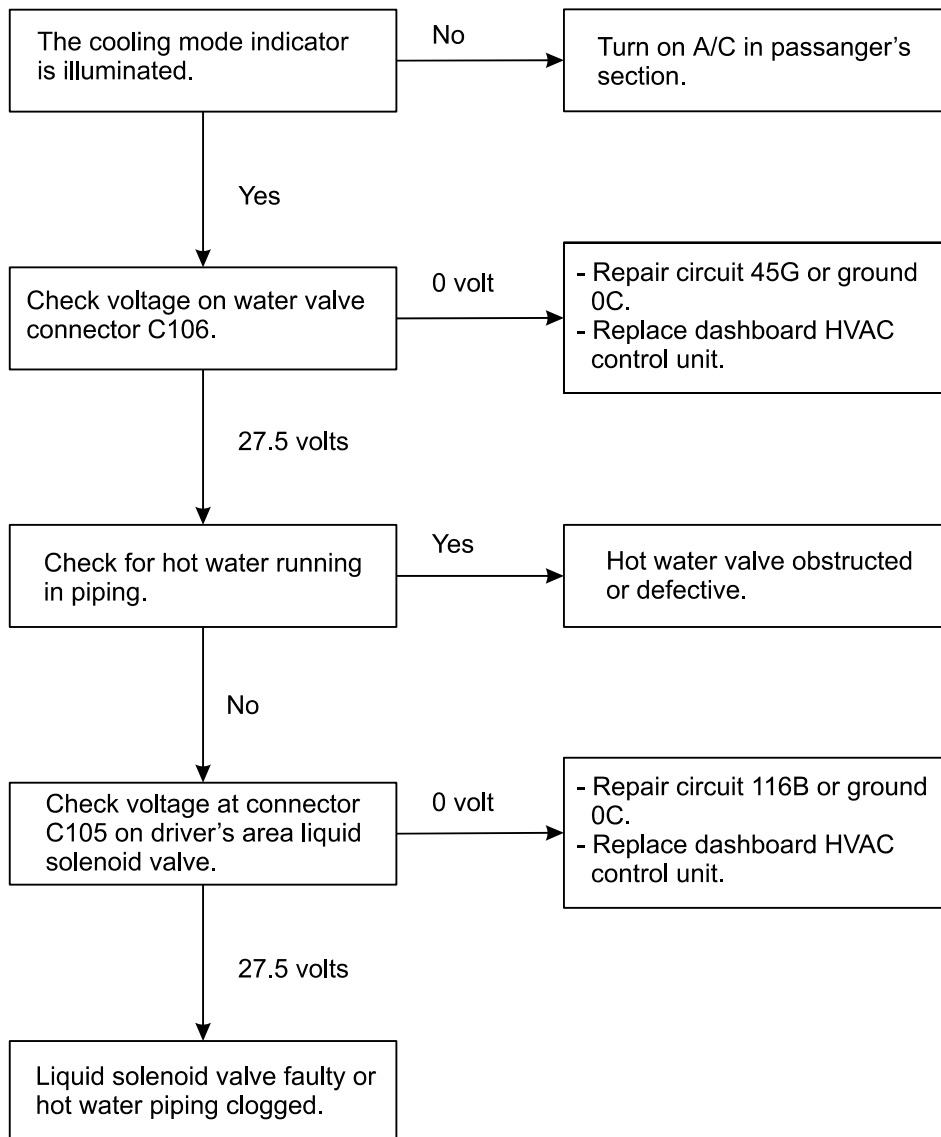
GUIDE 5: NO HEAT AT THE WINDSHIELD DEFROSTER

Perform test with the driver's area temperature set to maximum.



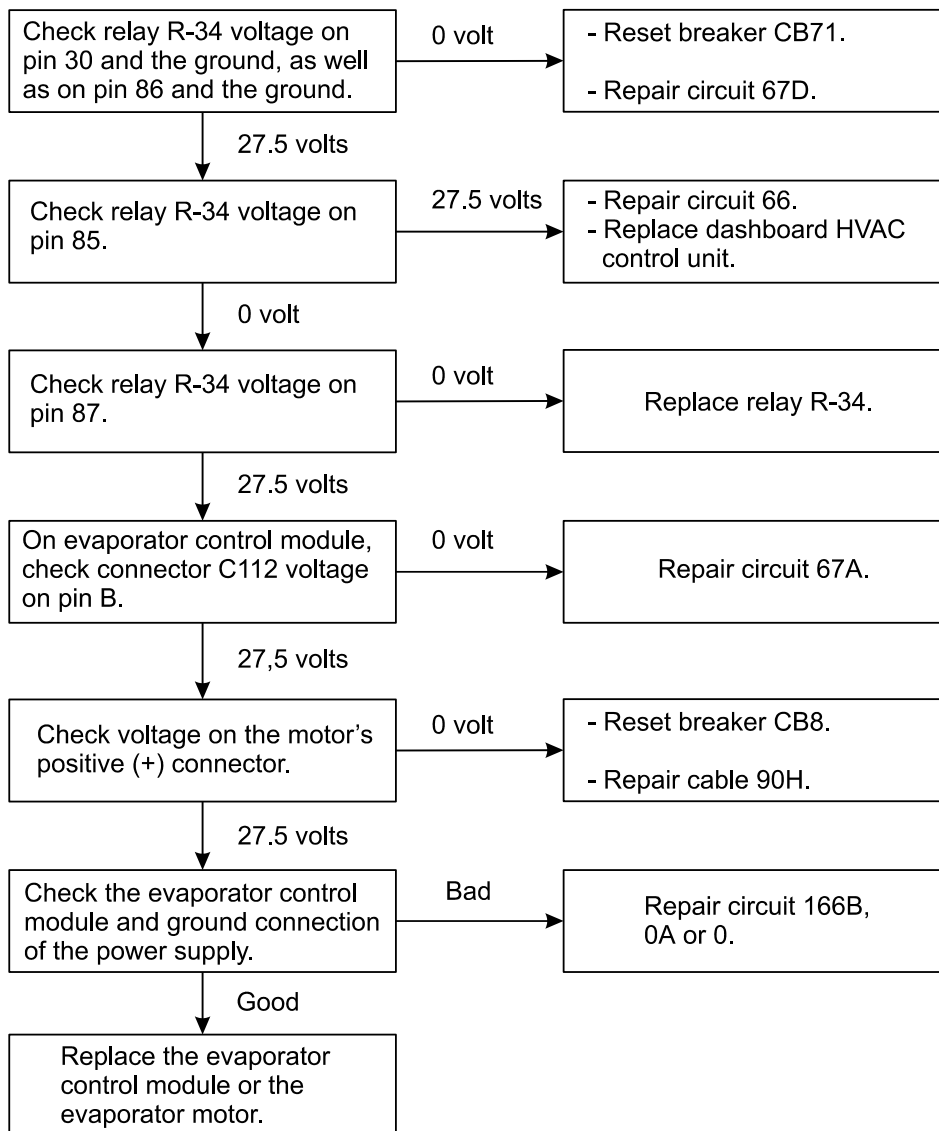
GUIDE 6: NO A/C AT THE WINDSHIELD DEFROSTER

Perform this test with the driver's area temperature control set to minimum.

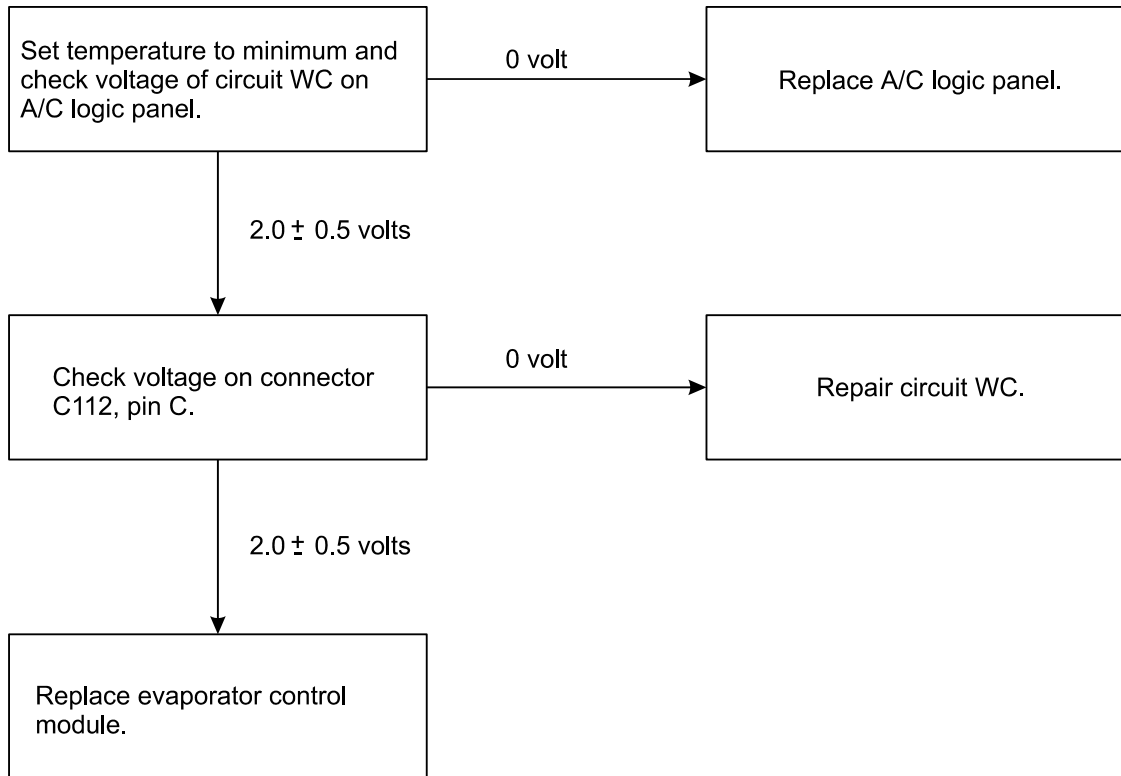


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GUIDE 7: NO VENTILATION IN THE PASSENGER AREA (CABIN)

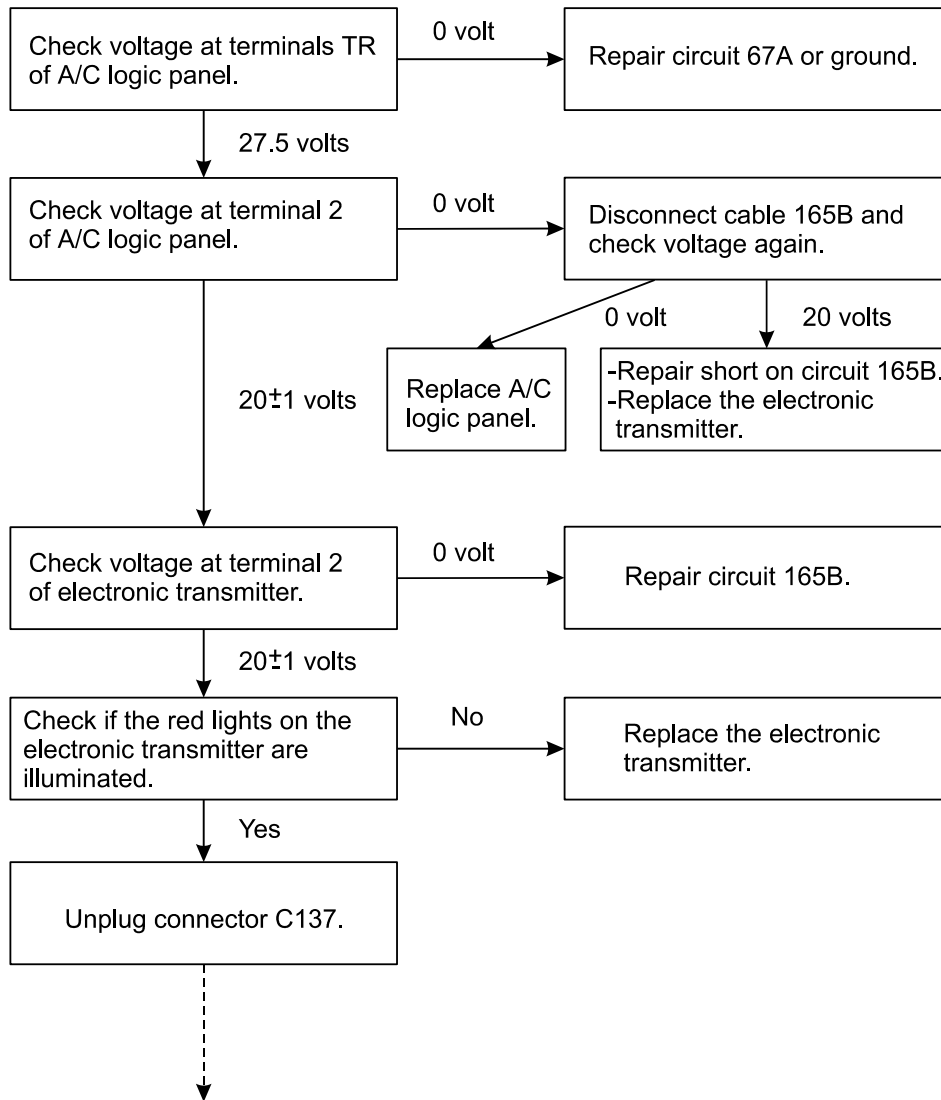


GUIDE 8: IN A/C MODE, NO FAN SPEED VARIATION IN PASSENGER AREA (CABIN)



Section 22: HEATING AND AIR CONDITIONING

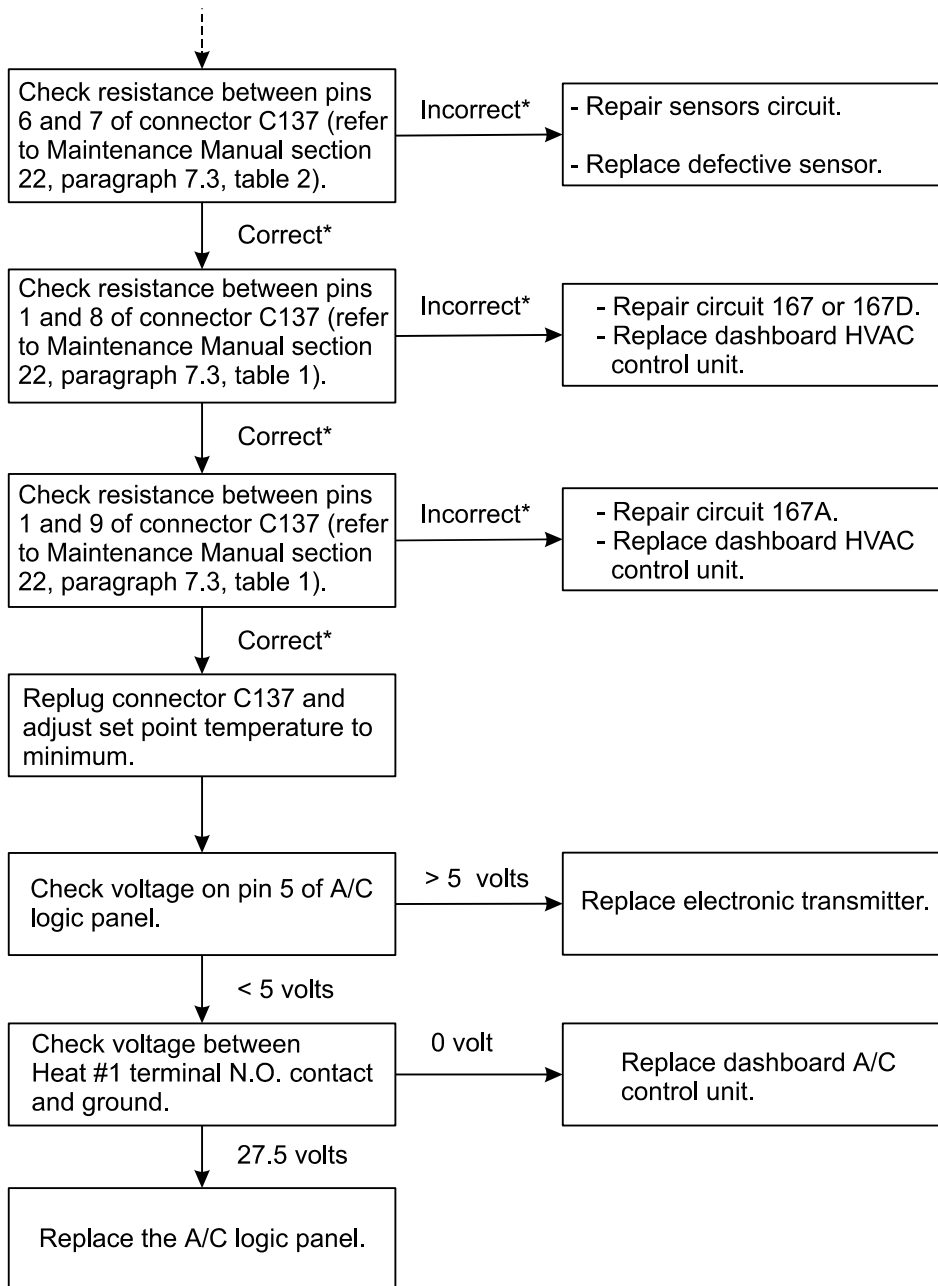
GUIDE 9: THE HEATING MODE INDICATOR LIGHT ON THE HVAC CONTROL UNIT IS ALWAYS ILLUMINATED OR NEVER ILLUMINATES



(Continued on the following page)

Section 22: HEATING AND AIR CONDITIONING

(Continued from previous page)

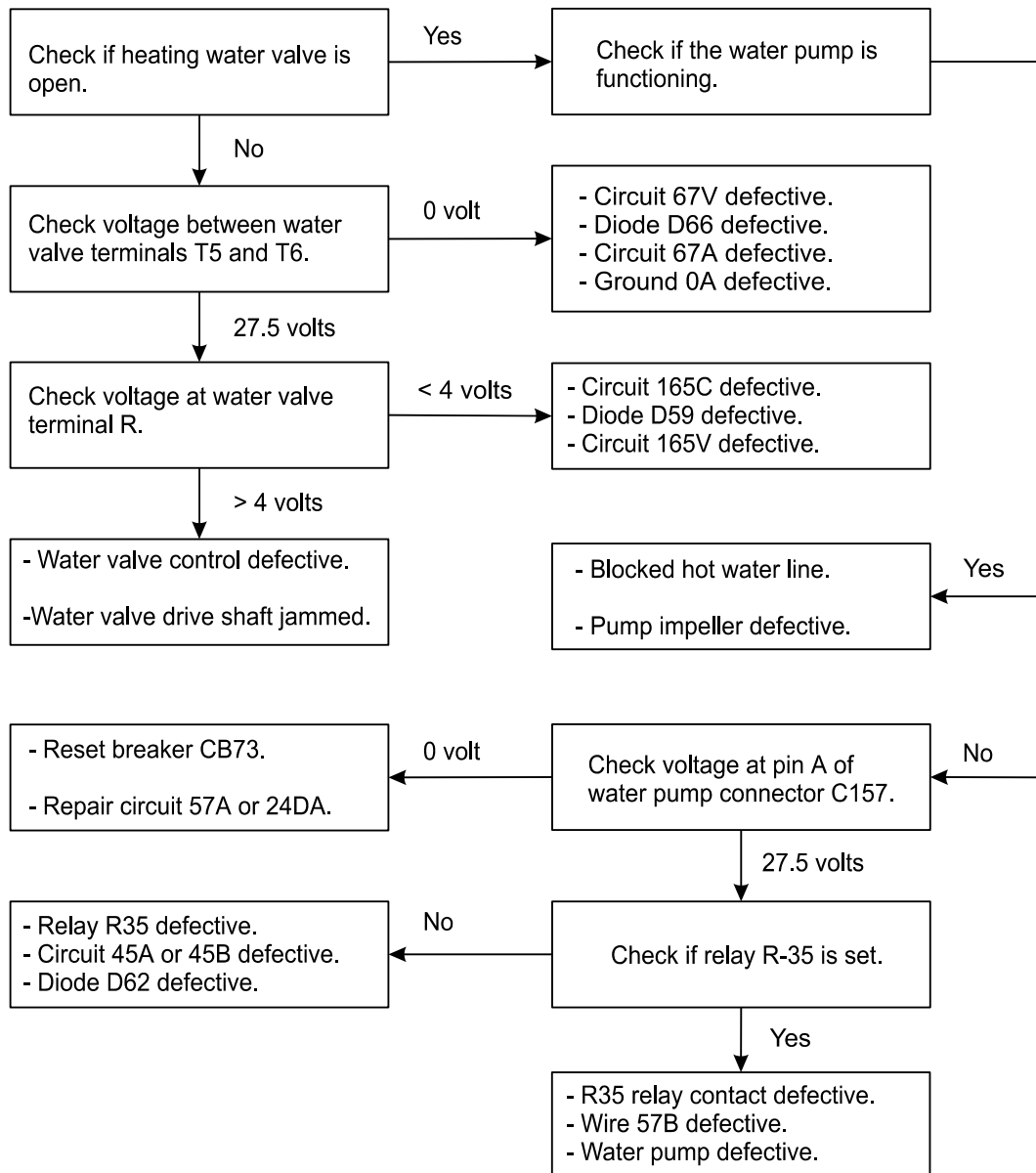


(*) Refer to Maintenance Manual, section 22, paragraph 7.3.

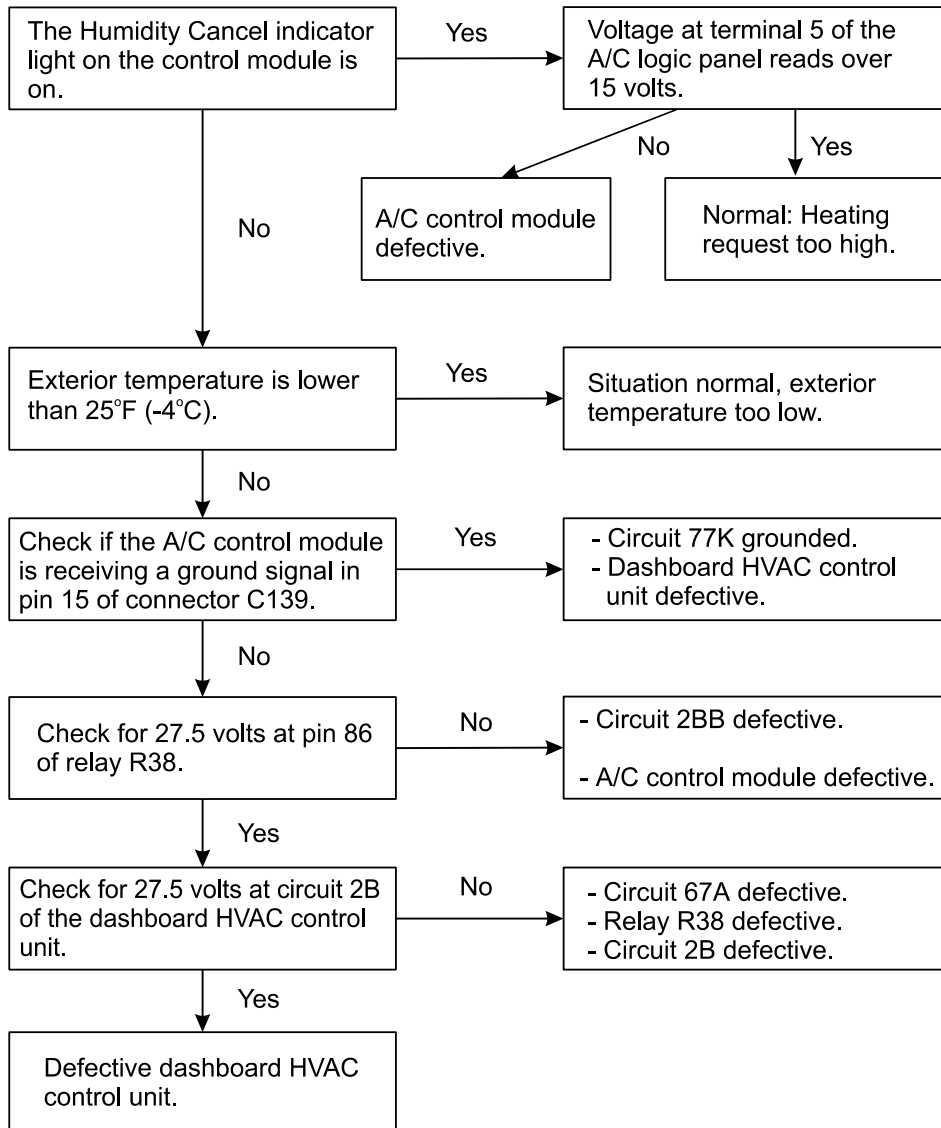
Section 22: HEATING AND AIR CONDITIONING

GUIDE 10: THE HEATING MODE INDICATOR LIGHT ON THE HVAC CONTROL UNIT IS ILLUMINATED BUT THE TEMPERATURE IN PASSENGER AREA REMAINS TOO LOW

Perform test with dashboard temperature control set to maximum heating.



GUIDE 11: THE COOLING MODE INDICATOR LIGHT ON THE HVAC CONTROL UNIT NEVER ILLUMINATES



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GUIDE 12: THE COOLING MODE INDICATOR LIGHT ON THE HVAC CONTROL UNIT IS ALWAYS ILLUMINATED

Note: The A/C system functions permanently. Only extremely low exterior temperatures or an extremely high heating request can cause the A/C to stop.

Chart 12a

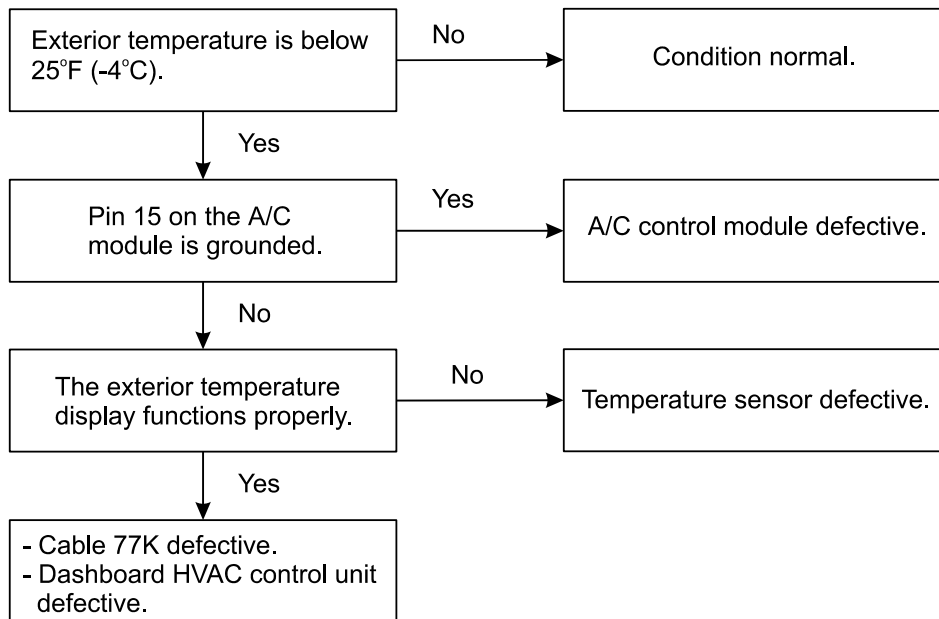
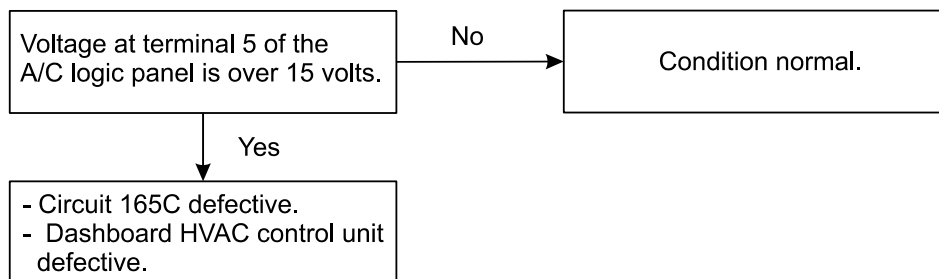
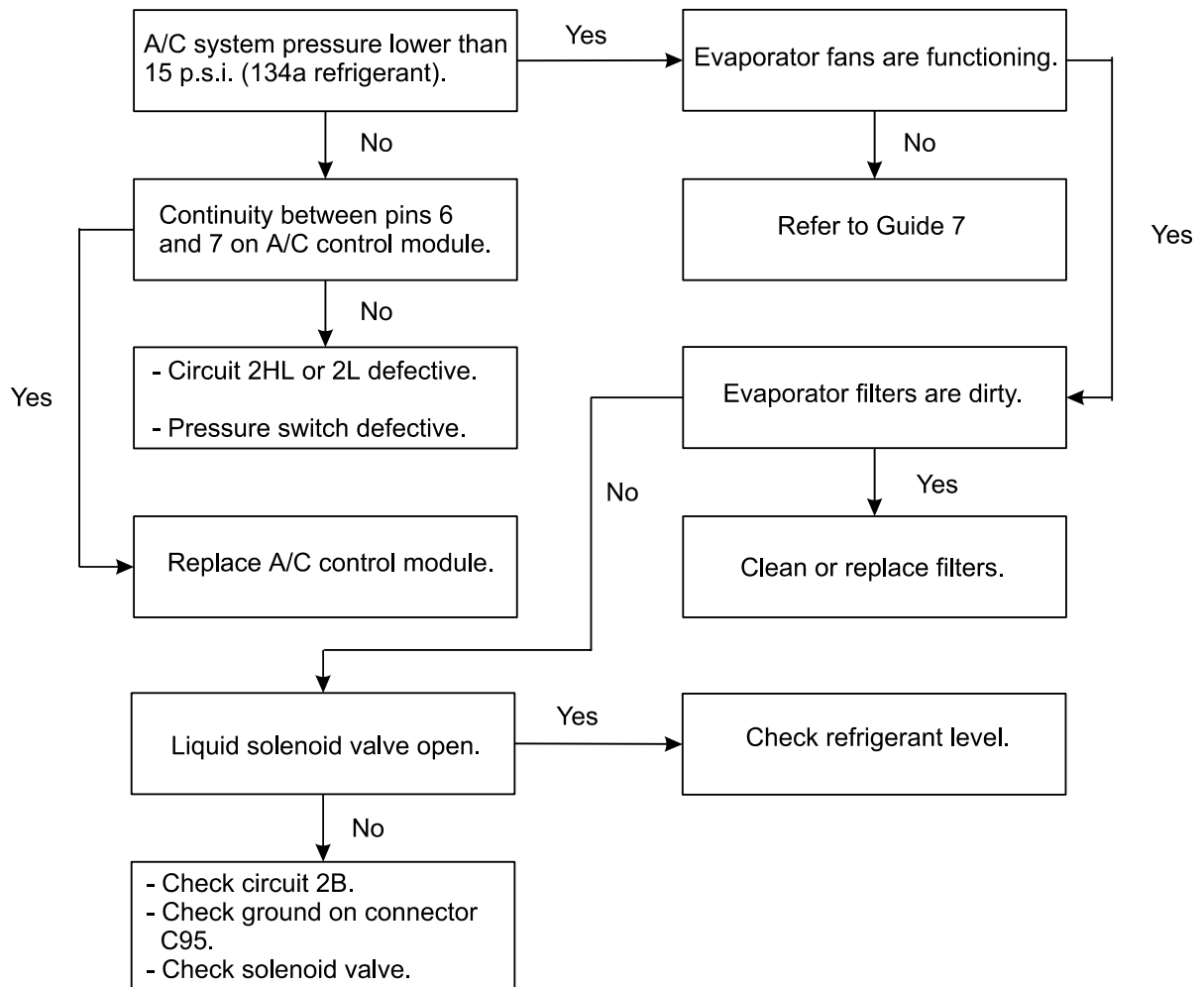


Chart 12b

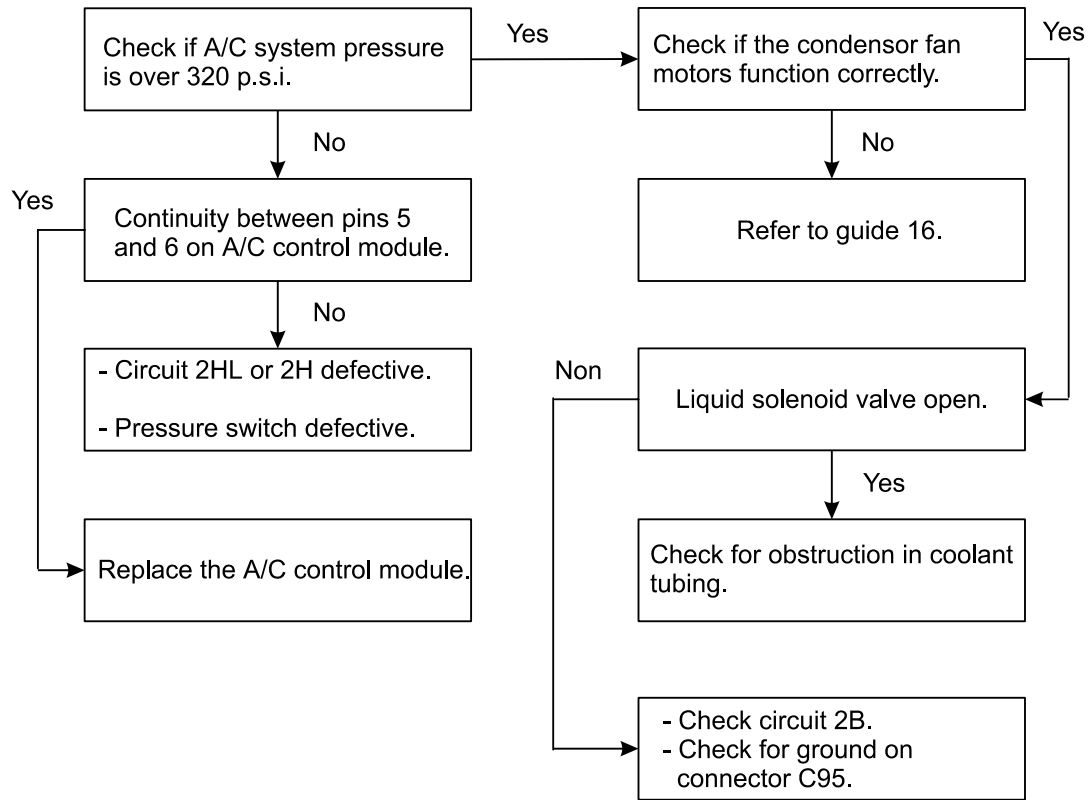


GUIDE 13: THE "A/C LO-PRESS" LIGHT IN THE TELLTALE PANEL IS ILLUMINATED



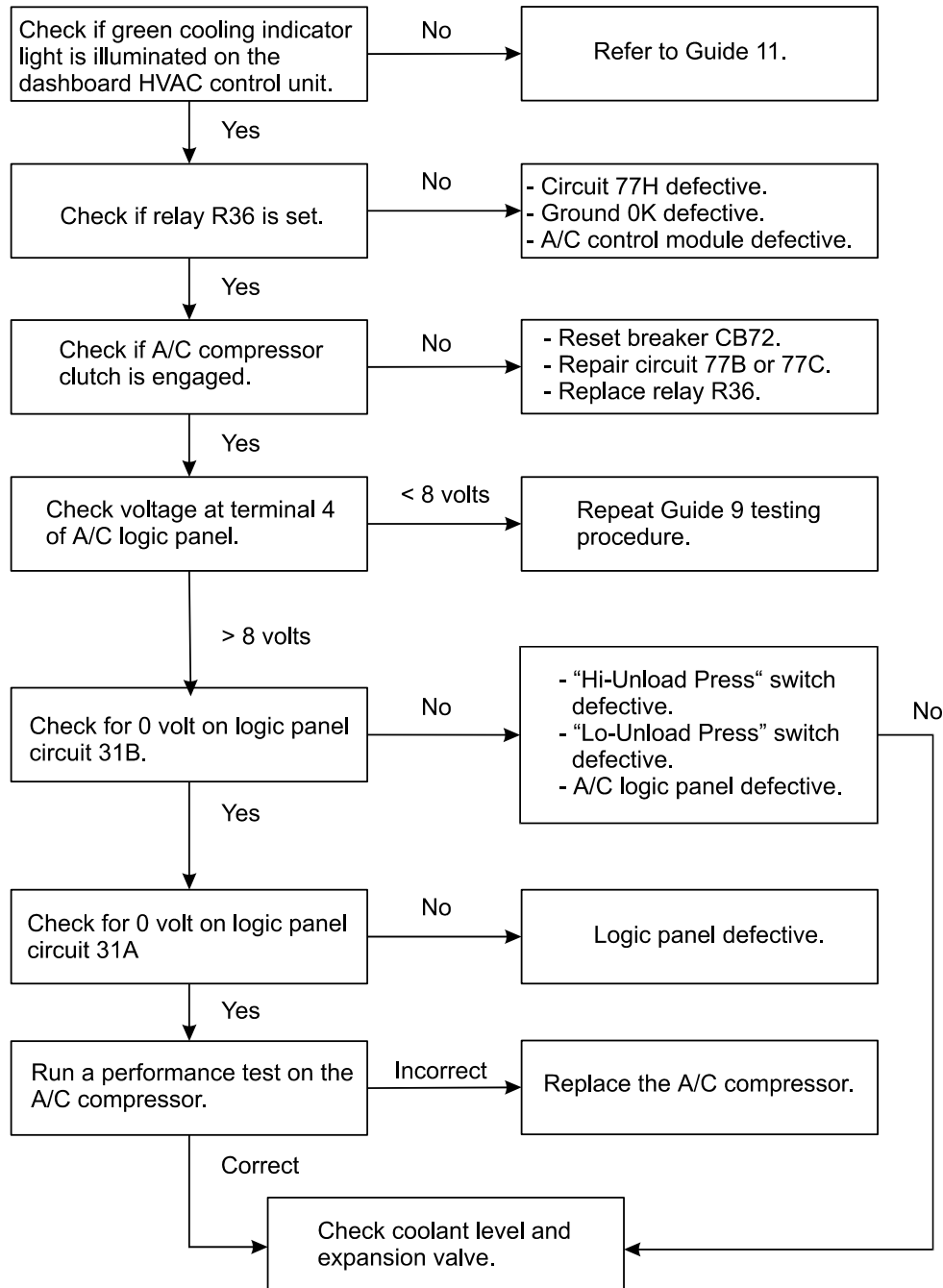
Section 22: HEATING AND AIR CONDITIONING

GUIDE 14: THE "A/C HI-PRESS" LIGHT IN THE TELLTALE PANEL IS ILLUMINATED



GUIDE 15: THE COOLING MODE INDICATOR LIGHT IS ILLUMINATED BUT THE AIR CONDITIONING DOES NOT FUNCTION SUFFICIENTLY

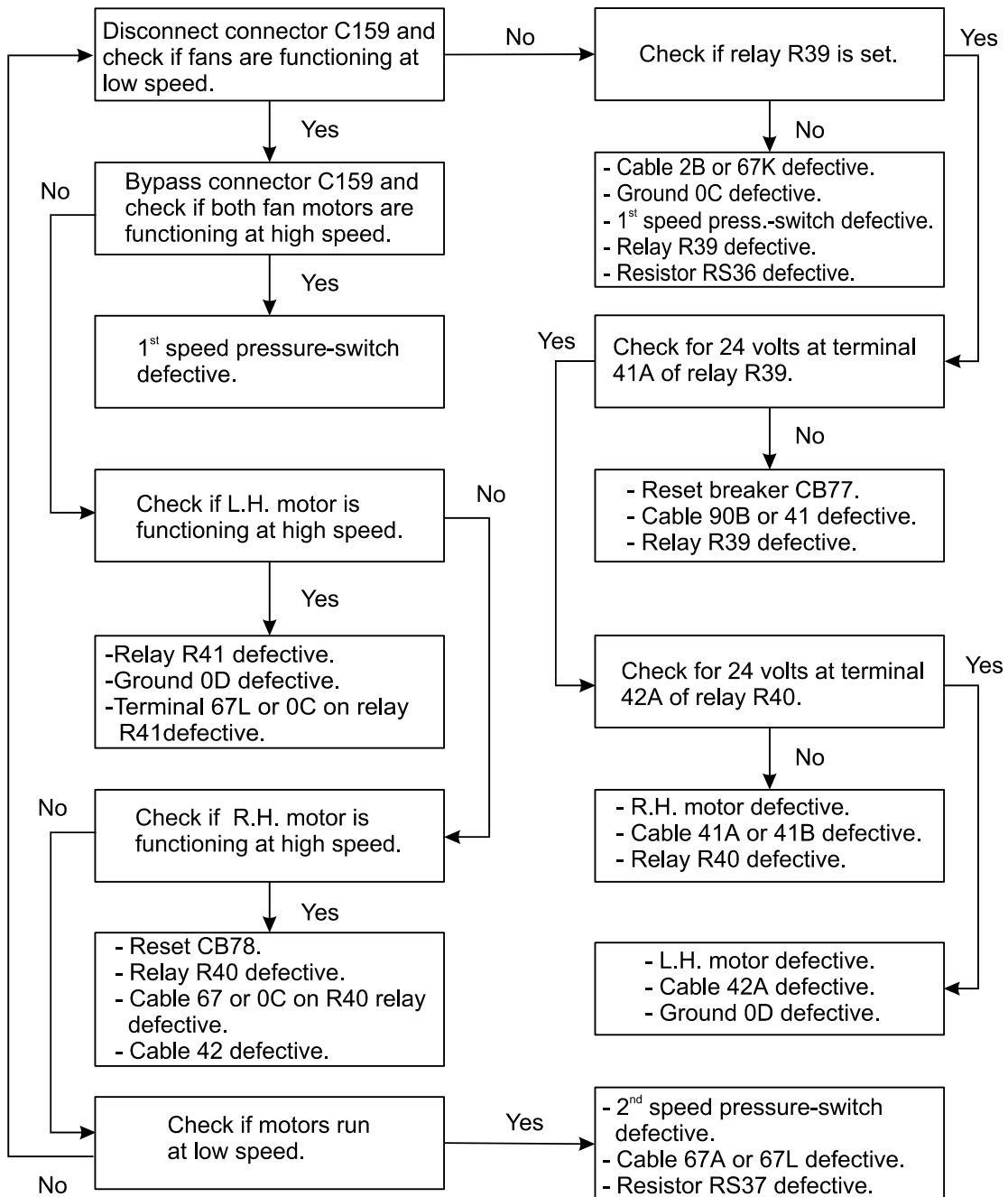
Perform this test with temperature control set to minimum. Be sure indicator lights "A/C LO-PRESS" and "A/C HI-PRESS" are OFF. If not, refer to guides 13 and 14.



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GUIDE 16: THE CONDENSER FANS DO NOT FUNCTION OR THEY FUNCTION IN ONLY ONE SPEED OR ONLY ONE FAN FUNCTIONS.

Perform this test with temperature control set to minimum.



Section 22: HEATING AND AIR CONDITIONING

7.1 CHECKING POTENTIOMETER RESISTANCE VALUES

Disconnect the 2-pin C-137 connector located on the A/C and heating junction box sliding drawer behind the electronic transmitter. Locate the corresponding female contact pins for wires #167 and #167a, and using an ohmmeter, check if readings match with data in Table 1. At location #165D, place the ohmmeter probe on head of screw 1 of electronic transmitter.

Note: Readings may be slightly higher than those in Table 1 due to the length of the wires routed between the electronic transmitter and the potentiometer.

If reading does not match, proceed as follows to check if potentiometer or wiring between potentiometer and electronic transmitter is defective:

Disconnect the 3-pin connector C-355 located under the dashboard, right behind the potentiometer. Identify male contact pins corresponding to the green, brown or black, and pink or red wires from potentiometer. Using an ohmmeter connected according to the indications given in Table 1 (refer to the following cross-reference between wire color and wire number), check if readings match with data in Table 1.

If readings match, trouble is located in wiring between connector C-355 and electronic transmitter. If reading does not match, potentiometer is defective.

WIRE COLOR & NUMBER CROSS REFERENCES	
Between connector C-355 and potentiometer	Between C-355 connector and electronic transmitter
Green	165D
Brown or black	167A
Pink or red	167

7.2 CHECKING THE SENSOR RESISTANCE VALUES

Locate pins #6 and #7 on connector C137, and using an ohmmeter, note the reading between these two pins. Compare reading with data of Table 2 given in the "Recirculated Air Sensor" curve. Temperature at the bottom of Table 2 is the temperature picked up by the sensor at the time of verification.

Reading between terminals 6 and 7 corresponds to the total resistance of the four paralleled series sensors. Thus, if reading does not match with Table 2, check if problem is located at sensors or wiring.

7.3 TESTING EACH SENSOR

Disconnect each connector from its respective sensor (refer to Fig. 2 for sensor location), then with an ohmmeter, note each sensor reading.

Compare each reading with data of Table 2 given in the "Recirculated Air Sensor" curve. The four sensor curves are used again, since each sensor, taken individually, has the same resistance as the four paralleled series sensors taken together. If all sensors check good, the problem is located in wiring between terminals 6 and 7 and the sensors.

Wire Connections Selected Temperature		C540 pin 5 C137 pin 1	C540 pin 15 C137 pin 8	C540 pin 5 C137 pin 1	C540 pin 16 C137 pin 9	C540 pin 16 C137 pin 9	C540 pin 15 C137 pin 8
		165D	167	165D	167A	167A	167
Heating ↓ Min. Max.	Cooling ↑ Max. Min.	534 ohms		515 ohms		1046 ohms	
		493		473		964	
		426		402		825	
		352 ohms		325 ohms		673 ohms	
		284		252		532	
		210		176		383	
		143 ohms		104 ohms		243 ohms	
		76		31		103	

TABLE 1: CIRCUIT DIAGRAM OF DUAL POTENTIOMETER (A/C-HEATING TEMPERATURE CONTROL)

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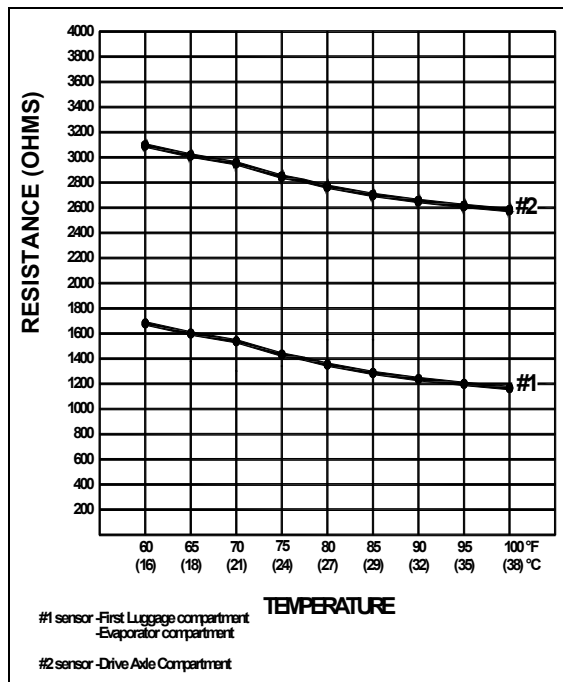


TABLE 2: RESISTANCE RANGE ACCORDING TO AMBIENT TEMPERATURE SENSORS 22032

8. HVAC UNIT MAINTENANCE

No special maintenance is required on the main and driver's units, with the exception of cleaning their respective coil air filters.

Note: Squeeze rubber hose located under the concerned compartment, to eliminate water and dirt when you make routine maintenance.

8.1 COIL CLEANING

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

For the driver's HVAC unit, remove the grill and the access panels and back flush the evaporator coil from inside (Fig. 15 & 16).

For the central system evaporator coil, back flush the coil (Fig. 13) every 12,500 miles (20 000 km) or once a year whichever comes first and for the condenser, back flush the coil (Fig. 14) every 6,250 miles (10 000 km) or twice a year, whichever comes first.

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

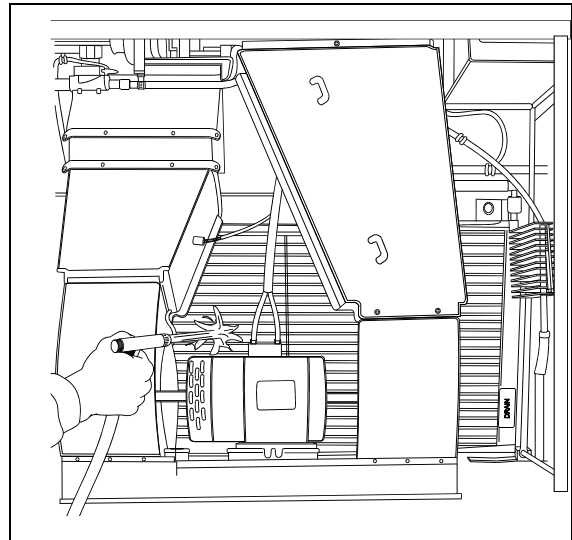


FIGURE 13: EVAPORATOR COIL

22122

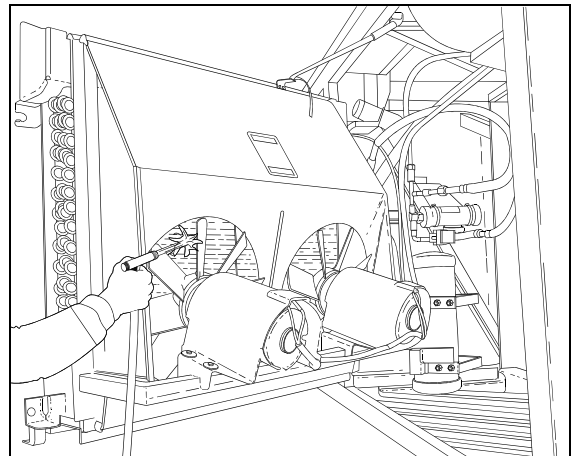


FIGURE 14: CONDENSER COIL

22170

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.

8.2 DRIVER'S HVAC UNIT AIR FILTERS

The driver HVAC system is located behind the dashboard's R.H. side lateral plastic panel. To gain access to the A/C filters, unscrew the R.H. lateral console's grill located at the top step of the entrance door steps. Slide out the R/A and F/A filters. To clean filter back flush with water, then dry with air, every 12,500 miles (20 000 km) or once a year, whichever comes first (Fig. 15 & 16).

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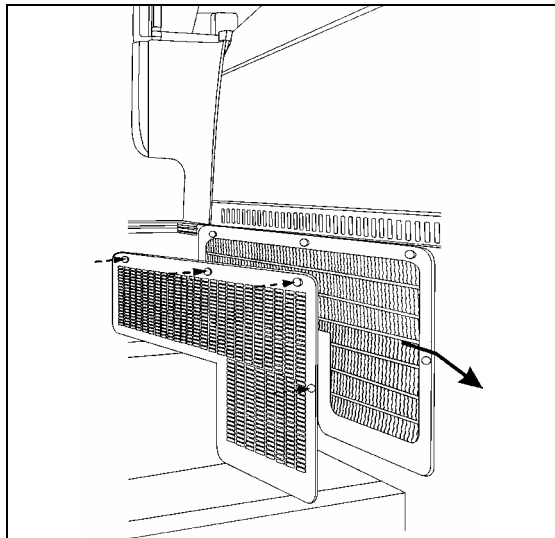


FIGURE 15: DRIVER'S CONSOLE ACCESS GRILL 22193

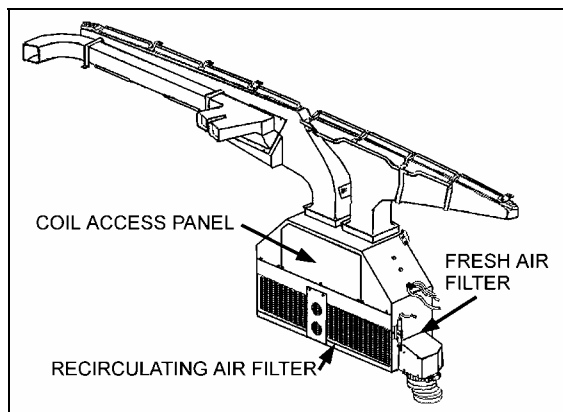


FIGURE 16: DRIVER'S AREA AIR FILTERS 22171

8.3 CENTRAL HVAC UNIT AIR FILTER

The main air filter is located in the HVAC compartment (Fig. 17). To access the filter, locate access panels in one of the baggage compartments adjacent to the HVAC compartments (L.H. side). Open panels by turning the three screws of either panel $\frac{1}{4}$ of a turn, unsnap both fasteners on top of filter, and slide out filter. To clean filter, back flush with water or soapy water, then dry with air every 12,500 miles (20 000 km) or once a year, whichever comes first.

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

Caution: Be sure not to reverse filter upon installation.

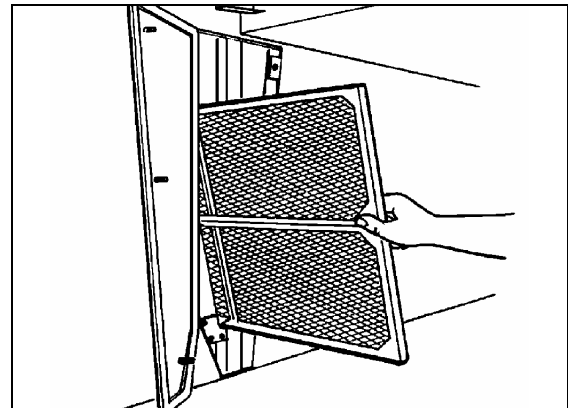


FIGURE 17: MAIN HVAC UNIT AIR FILTER 22100

8.4 PARCEL RACK FAN AIR FILTER

A/C evaporator coils may be installed in both parcel rack air systems. Only the air filters are serviceable. The air filters are accessible from inside the parcel racks. Slide out the filters, then back flush with water, dry with air and replace. This procedure should be done every 12,500 miles (20,000 km) or once a year, whichever come first.

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

9. EVAPORATOR MOTOR

The evaporator motor is installed in the HVAC compartment (L.H. side of vehicle) (Fig. 18). It is a 28.5 volt, 2HP (1,5 kW) motor which activates a double blower fan unit. An evaporator motor speed controller is installed in the HVAC compartment as standard equipment.

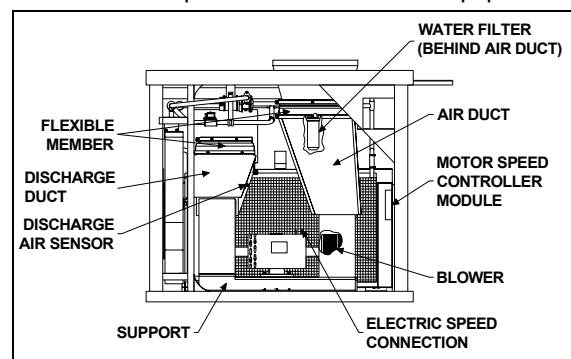


FIGURE 18: HVAC COMPARTMENT 22125

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9.1 REMOVAL

1. Set the battery safety switch to the "OFF" position.
2. Open the last L.H. side baggage compartment door. Pull the black release button located on the L.H. side in order to unlock and open the HVAC compartment door.
3. Identify the L.H. side discharge duct inside compartment and remove the Phillips head screws retaining the flexible member to duct. Separate the adhesive tape (680453) on the duct.
4. Repeat step 3 for the R.H. side discharge duct.
5. Disconnect the discharge air sensor connector. Remove the cable tie securing wire.
6. Disconnect electrical speed control connection on the motor plate.
7. From under the vehicle, remove the eight bolts retaining the evaporator fan motor support. Remove the complete unit from the HVAC compartment (Fig. 19).
8. On a work bench, unscrew the fan square head set screws, the Phillips head screws retaining cages to support and slide out the assemblies from the evaporator motor output shaft.

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

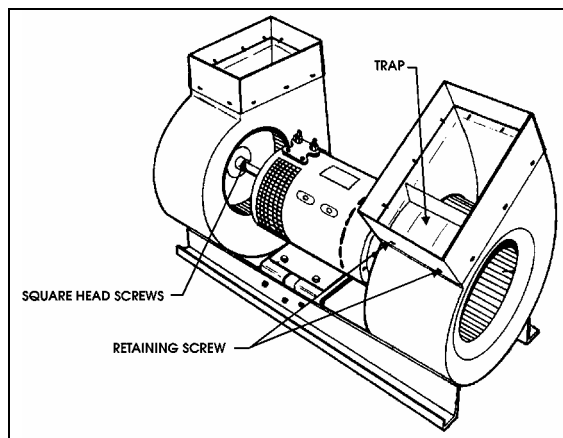


FIGURE 19: EVAPORATOR MOTOR ASSEMBLY 22036

9.2 INSTALLATION

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

9.3 CHECKING OPERATION OF BRUSH IN HOLDER

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

9.4 BRUSH WEAR INSPECTION AND REPLACEMENT

Replace the brushes if less than 3/4 inch (19 mm). New brush length is 1-1/4 inch. Clean brushes with a clean cloth impregnated with gasoline or alcohol.

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

To replace brushes, proceed as follows:

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

9.5 CHECKING COMMUTATOR

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

9.6 SPEED CONTROLLER MODULE

The standard evaporator motor speed controller module is mounted on the R.H. side wall inside the HVAC compartment (Fig. 18). The purpose of this electronic module is to limit the evaporator motor speed to 75% of its full rated speed throughout the heating mode and during the first stage of the cooling mode. The module will then gradually increase the motor speed as the cooling demand increases.

9.7 TROUBLESHOOTING

Refer to guides #7 and #8 (in this section).

10. AIR CONDITIONING SYSTEM PRINCIPLES OF OPERATION

10.1 A/C CYCLE

Refrigeration may be defined as "the transfer of heat from a place where it is not wanted to a place where it is unobjectionable". Components required for a closed circuit refrigeration system are shown in figure 21.

The air conditioning system used in the H3 series vehicle is the "Closed" type using "R-134a".

1. The refrigerant flowing to the compressor, is compressed to high pressure and reaches a temperature higher than the surrounding air. It is passed through the air-cooled fins and tubes of the condenser causing the hot, high pressure gas to be condensed into a liquid form.
2. The liquid refrigerant flows to the receiver tank, then through a filter dryer where moisture, acids and dirt are removed. It is passed through a moisture indicator which indicates if any moisture is present in the system.
3. By its own pressure, the liquid refrigerant flows through a thermal expansion valve where the pressure drop causes the refrigerant to vaporize in a vapor-liquid state at a low temperature pressure.
4. The cold low pressure refrigerant passes through the main and the driver's evaporator coils which absorb heat from the air passing over the fins and tubes, and changes into gas. In this form, the refrigerant is drawn into the compressor to repeat the air conditioning cycle.
5. The success of the air conditioning system depends on retaining the conditioned air within the vehicle. All windows and intake vents should be closed. An opening of approximately 8 in² (5162 mm²) could easily neutralize the total capacity of the system.
6. Other causes of inadequate cooling are dirty coils or filter. Dirt acts as an insulation and is also serves as a restriction to the air flow.
7. The refrigeration load is not constant and varies. It is also affected by outside

temperature, relative humidity, passenger load, compressor speed, the number of stops, etc.

8. The compressor will load depending on operating conditions.

10.2 REFRIGERANT

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

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

10.2.1 Procurement

Refrigerant is shipped and stored in metal cylinders. It is serviced in 30 and 100 pound (13,6 and 45 kg) cylinders. Approximately 25 pounds (11,4 kg) are used in the central 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.

10.2.2 Precautions in Handling Refrigerant

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

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

For the same reason, the refrigerant cylinder should never be subjected to excessive

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temperature when charging a system. The refrigerant cylinder should be heated for charging purposes by placing it in 125°F (52°C) water. Never heat above 125°F (52°C) or use a blowtorch, radiator, or stove to heat the cylinder.

Welding or steam cleaning on or near any refrigerant line or components of the A/C system could build up dangerous and damaging pressures in the system.

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

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

10.2.3 Treatment in Case of Injury

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

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

10.2.4 Precautions in Handling Refrigerant Lines

1. All metal tubing lines should be free of kinks, because of the resulting restrictions on the flow of refrigerant. A single kink can greatly reduced the refrigeration capacity of the entire system.

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

Warning: Always wear safety goggles when opening refrigerant lines.

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

Section 22: HEATING AND AIR CONDITIONING

connection must be disassembled and the cause of the leak (damaged O-ring, defective lines, etc.) corrected. Use new O-ring.

10.3 REFRIGERANT SYSTEM CLEAN-OUT AFTER COMPRESSOR FAILURE

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

10.3.1 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.

10.3.2 Clean-out after Minor Compressor Failure

1. Be sure to correct the problem which caused the failure.
2. Change liquid line filter dryer.

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

10.3.3 Clean-out After Major Compressor Failure

1. Reclaim the refrigerant into a refrigerant bottle through a filter dryer to filter out contaminants.
2. Remove the failed compressor and repair it if possible.
3. Install new or repaired compressor.
4. Change the filter dryer.
5. Circulate clean R-134a with the reclaimer to clean out many of the contaminants collected in the coil valves, TXV (Thermal Expansion Valve), solenoid valves, check valves, and any other mechanical component that may have collected contaminants.
6. Evacuate and charge the system normally.
7. Run the unit for 8 hours and monitor the pressure drop across the filter dryer. Also check the liquid line dryer for signs of restriction. If the pressure drop across the filter dryer exceeds 12 to 14 psig (82,75 to 96,5 kPa) with a 40°F (5°C) evaporator coil temperature, stop the unit and change the liquid line and suction line filter dryer. After 4 or 5 hours of operation, stop the unit and replace the filter dryer.

Section 22: HEATING AND AIR CONDITIONING

- 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.

11. CENTRAL A/C SYSTEM

The schematic of Figure 21 shows the central 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. The fuel filler door is a small door located at left of A/C condenser compartment door, allowing viewing of the filter dryer and the moisture indicator.

Note: For opening of the A/C condenser door, open the baggage compartment door at the right of the A/C condenser compartment door. The condenser compartment door must be unbolted to fully swing open.

11.1 PUMPING DOWN

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

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

Warning: When air conditioning system must be opened, refer to previous paragraph "Precautions In Handling Refrigerant" to prevent any injury.

Procedure

- Close the receiver tank outlet valve by turning it clockwise, backseat the suction service valve on the compressor, install an

appropriate pressure gauge set, and turn the valve forward ¼ turn to enable a visual check of the suction pressure.

- Disconnect the "Low Pressure Switch" connector (mounted near the A/C compressor, and install a jumper wire.

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

- Open the rear electrical compartment. Locate the **cooling contact 3** on the HVAC logic panel. Install a jumper wire between the central terminal of this stage and its normally-closer contact terminal as illustrated in Fig. 20. Locate the **cooling contact 2**. Install a jumper wire between the central terminal of this stage and its normally-closed contact terminal as illustrated in Fig. 20.

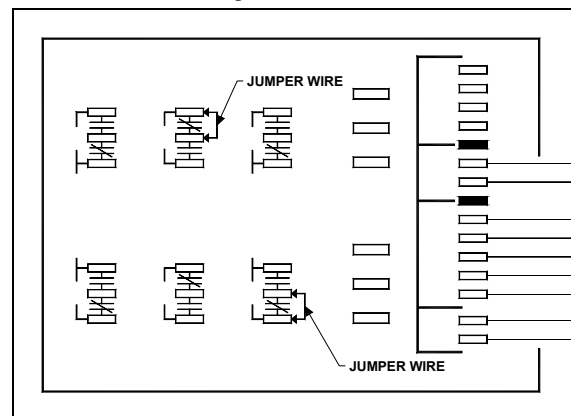


FIGURE 20: HVAC LOGIC PANEL

22038

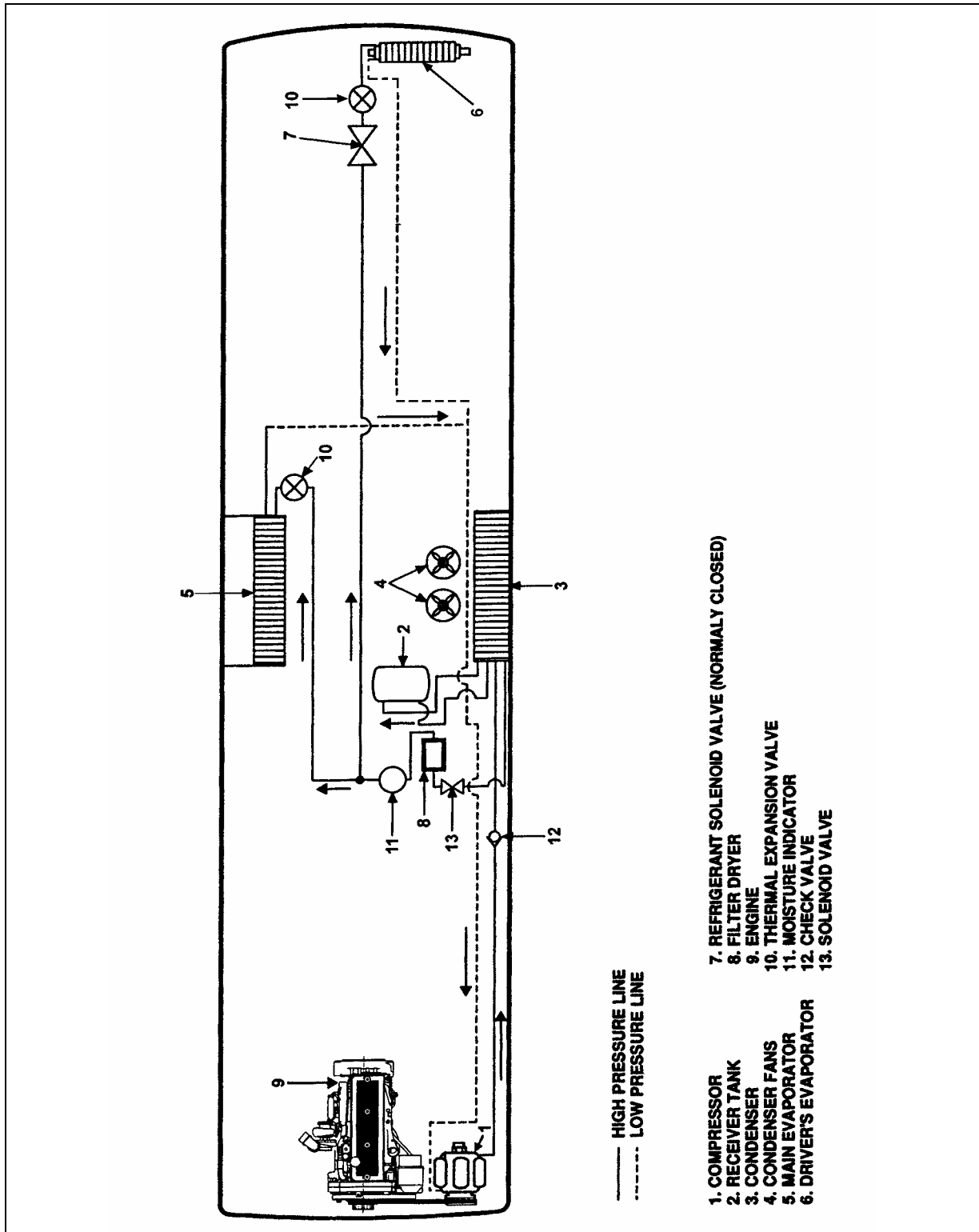
Note: No wire has to be disconnected. In fact, wires #31A and 31B will be connected to wire #67A. This temporary connection will restrict compressor operation to two cylinders.

- Start the engine, turn on the "Main A/C-Heating" switch, and adjust "A/C-Heating Temperature" controls to maximum A/C position.
- Run the compressor until pressure reaches 1-2 psi (7-14 kPa).

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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.*

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— HIGH PRESSURE LINE
 - - - LOW PRESSURE LINE

- 1. COMPRESSOR
- 2. RECEIVER TANK
- 3. CONDENSER
- 4. CONDENSER FAN
- 5. MAIN EVAPORATOR
- 6. DRIVER'S EVAPORATOR
- 7. REFRIGERANT SOLENOID VALVE (NORMALLY CLOSED)
- 8. FILTER DRYER
- 9. ENGINE
- 10. THERMAL EXPANSION VALVE
- 11. MOISTURE INDICATOR
- 12. CHECK VALVE
- 13. SOLENOID VALVE

FIGURE 21: CENTRAL A/C SYSTEM COMPONENTS

22200

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6. Stop engine, and close compressor outlet valve by turning it clockwise until valve is properly seated.
7. Close compressor suction valve by turning it clockwise until it is properly seated.

11.2 ADDING REFRIGERANT (VAPOR STATE)

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

11.3 EVACUATING SYSTEM

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

7. Backseat the compressor valves by turning "out" all the way.
8. Shut down the vacuum pump.
9. Remove the hoses.
10. Reinstall the caps at the suction valve take-off points.

11.4 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.

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

1. Backseat the two compressor shutoff valves ("out").
2. Install the test gauges at the shutoff valves noting that the 400 psi (2758 kPa) gauge is connected to the discharge.
3. Turn in the two shutoff valves 3 to 4 turns.
4. Open the lower receiver valve by turning "out" all the way.
5. Backseat the upper receiver valve by turning out all the way.
6. Remove the cover cap from the service fitting in the top receiver valve.
7. Attach a charging hose to the R-134a tank. Open the tank valve slightly permitting R-134a to escape thus purging the hose of air.
8. Connect the charging hose to the service fitting.
9. Open the R-134a tank valve.
10. To build up pressure in the receiver tank, heat the receiver tank with a heating blanket.

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11. Turn in the upper receiver valve several turns. The R-134a will now enter the system.
12. The proper charge of R-134a is 24 lbs (10.89 kg). When the scale indicates this amount of charge, backseat the receiver valve and close the R-134a tank valve.
13. Disconnect the charging hose. Replace the cover caps.
14. The system is now ready for operation.

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

12. CENTRAL A/C SYSTEM COMPONENTS

12.1 COMPRESSOR

12.1.1 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.

1. Open engine compartment rear doors and locate the belt tensioner two-way control valve (Fig. 22), 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.
2. Slip the old belts off and the new ones on.
3. Reset belt tensioning pressure control valve (Fig. 22). Pressure is factory set to 50 psi (345 kPa), periodically check proper pressure.

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

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. 23).

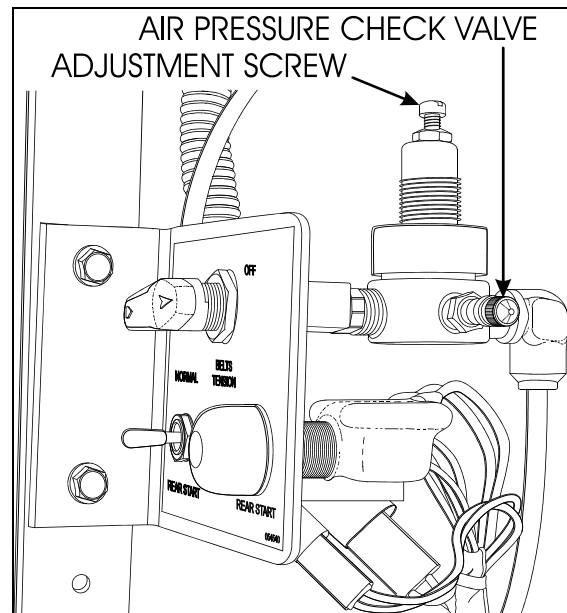


FIGURE 22: TENSIONING VALVE

01058

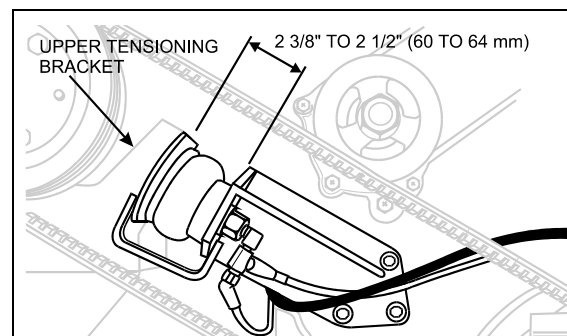


FIGURE 23: TENSIONING AIR BELLOWS

01059

12.1.2 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. After completing these procedures reset belt tensioning pressure control valve to 50 psi (345kPa).

12.1.3 Longitudinal Compressor Alignment

1. Rest an extremity of a straight edge of approximately 46 inches (117 cm) against the upper part of the outer face of crankshaft

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pulley, positioning the other end close to the compressor clutch pulley (Figs. 24 & 25).

2. Check the distance between each extremity of straight edge (1, Fig. 25) 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.

12.1.4 Horizontal Compressor Alignment

1. Rest an extremity of the straight edge against the upper part of the outer face of compressor pulley, positioning the other end close to the crankshaft pulley.
2. Check the distance between each extremity of straight edge (1, Fig. 25) 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.

12.1.5 Vertical Compressor Alignment

Rest a short "angle and level indicator" on the outer side face of the crankshaft pulley, adjust the level indicator inclination at 0° and check if the compressor pulley is at same angle (Figs. 24 & 25). If it is not the same, shim under the appropriate pillow block in order to obtain the correct angle.

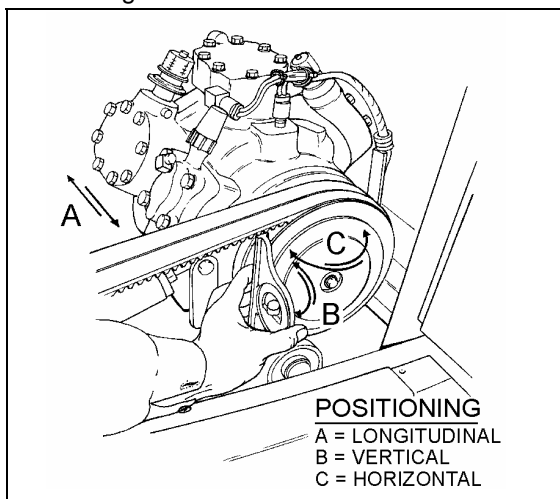


FIGURE 24: COMPRESSOR ALIGNMENT

22072

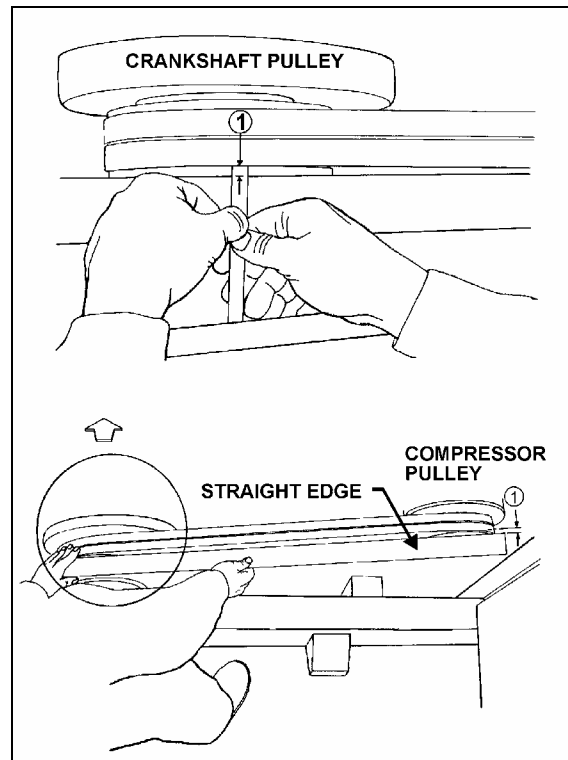


FIGURE 25: COMPRESSOR ALIGNMENT

22040

12.1.6 Compressor Maintenance

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

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

12.1.7 Troubleshooting Guide

A preliminary check may be made by simply feeling the cylinder heads with the unit in operation at ambient temperatures of 35°F (2°C) and over. The cylinder heads are internally divided into suction and discharge valves. The lower half of the cylinder head is the suction side, and it should be relatively cool to the touch, as opposed to the hot upper discharge side. If a valve plate or head gasket is blown, or a compressor unloader is stuck open, partially compressed refrigerant vapor will be circulated between the suction and discharge sides of the head. The affected cylinder head will then have

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a relatively even temperature across its surface and be neither as hot as the normal discharge temperature nor as cool as the normal suction temperature.

Blown Head Gaskets

Symptom:

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

Cause:

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

Blown Valve Plate Gaskets

Symptom:

- Loss of unit capacity at medium and low temperatures.
- Very hot cylinder head surface.
- Higher than normal suction pressure.

Cause:

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

Broken Suction Valves

Symptom:

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

Cause:

- Repeated liquid refrigerant floodback.
- Flooded starts.

- Overcharge of oil.
- Discharge valves not seated properly (liquid drainback during shutdown).
- Expansion valve not controlling properly.

Unloader Valve Stuck Open

Symptom:

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

Cause:

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

12.2 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.

12.2.1 Time Delay Module

A time delay module integrated in the HVAC module is connected in series with the relay coil feeder circuit of the compressor magnetic clutch. This module allows approximately one minute delay following a compressor clutch request and its actual application, to avoid continuous engaging and disengaging (cycling) of clutch.

This time delay will be effective each time A/C system is actuated (Main A/C-Heating Switch), or upon restarting of compressor, when the latter has previously stopped due to an excessive high pressure (over 320 psi (2206, 4 kPa)) or very low pressure (under 15 psi (103,5 kPa)) in the system.

However, a time delay will be inoperative and restarting of the compressor will be immediate following a regulated interruption by the system, i.e. when temperature inside the coach is equal to the selected temperature.

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12.3 CONDENSER

The condenser coil is hinge mounted on the R.H. side of the vehicle on the A/C condenser door. 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.

12.3.1 Condenser Fan Motors

Two axial fan motors are installed in condenser compartment on R.H. side of vehicle in order to ventilate the condenser coil. The fans pull outside air through the condenser coil and discharge it through an opening at bottom of compartment. Depending on pressure in receiver tank (Fig. 26), the fan motors may be operated at full rpm, half rpm or not operated at all. With low pressure in receiver tank, both fan motors are connected in series and then operate at half rpm and, with a high pressure in receiver tank, both fan motors are connected in parallel and operate at full rpm. For details about electrical wiring, refer to "A/C and Heat system" in the master wiring diagram.

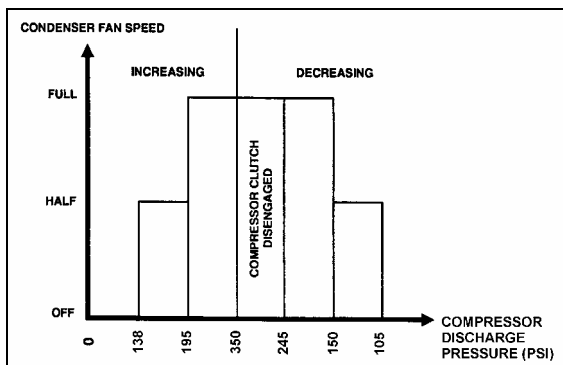


FIGURE 26: CONDENSER FAN SPEED IN RELATION WITH HIGH SIDE PRESSURE

22041

12.3.2 Condenser Fan Motor Removal

1. Set the main battery disconnect switch to the "Off" position.
2. Remove the two "Phillips" head screws retaining the fan motor protective cover to the square tubing.

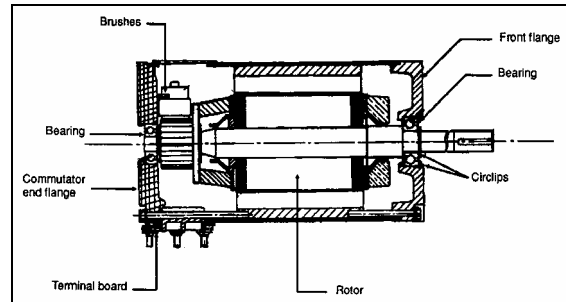


FIGURE 27: CONDENSER FAN MOTOR

22042

3. Disconnect wiring from terminals on motor. Tag each wire to aid in identification at time of reconnection.
4. Support motor, and remove bolts which attach motor to mounting bracket. Remove the motor.

12.3.3 Preliminary Disassembly

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

12.3.4 Disassembly

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

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12.4 RECEIVER TANK

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

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

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

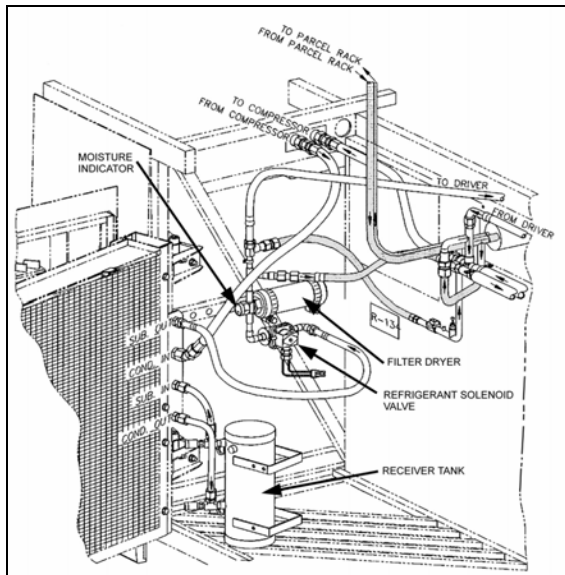


FIGURE 28: A/C CONDENSER COMPARTMENT

12.5 FILTER DRYER

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

The filter should be replaced if the system has been opened to prolonged exposure as shown by the moisture indicator sight glass.

12.5.1 Replacement

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

1. Isolate the refrigerant in the receiver tank by following the "Pumping Down" procedure explained in this section

Change the filter dryer as a unit.

1. 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.

12.5.2 Moisture Indicator

The moisture sensitive element consists of a color changing ring which is reversible from yellow to green and vice versa as the moisture content in the refrigerant changes. Yellow indicates a wet refrigerant, yellow green (caution) and green 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	GREEN (ppm)	YELLOW GREEN (ppm)	YELLOW (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)			

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A moisture level of 15 p.p.m. for R-134a indicated in the green color range of the above table is generally considered dry and safe. A color indication of yellow green 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 dark green.

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 eventually failure of the system. Uncontrolled moisture in the system can result in 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.

12.6 LIQUID REFRIGERANT SOLENOID VALVE

The flow of liquid refrigerant to both driver's and central evaporators is controlled by a normally-closed solenoid valve. The driver's solenoid valve is located on the ceiling of the spare wheel compartment and is accessible through the reclining bumper while the central system solenoid valve is located in the condenser compartment.

12.6.1 Manual Bypass

This type of solenoid valve is equipped with a manual operating stem. The 3/16" square stem located on the bonnet is exposed when the seal cap is removed. To manually open valve, turn stem 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

12.6.2 Coil Replacement

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

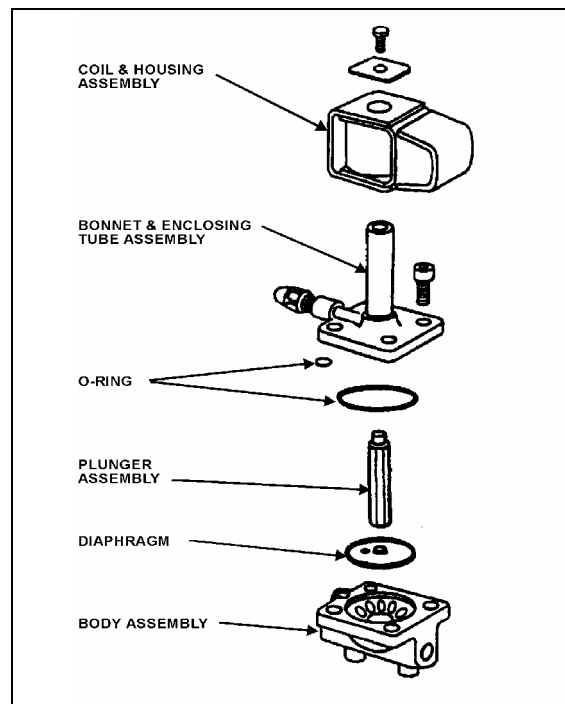


FIGURE 29: REFRIGERANT SOLENOID VALVE 22044

12.6.3 Valve Disassembly

1. Remove the coil as stated previously.
2. Pump down the system as stated earlier in this section.
3. Remove the four socket head screws which hold the body and bonnet together (Fig. 29).

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- 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.

12.6.4 Valve Reassembly

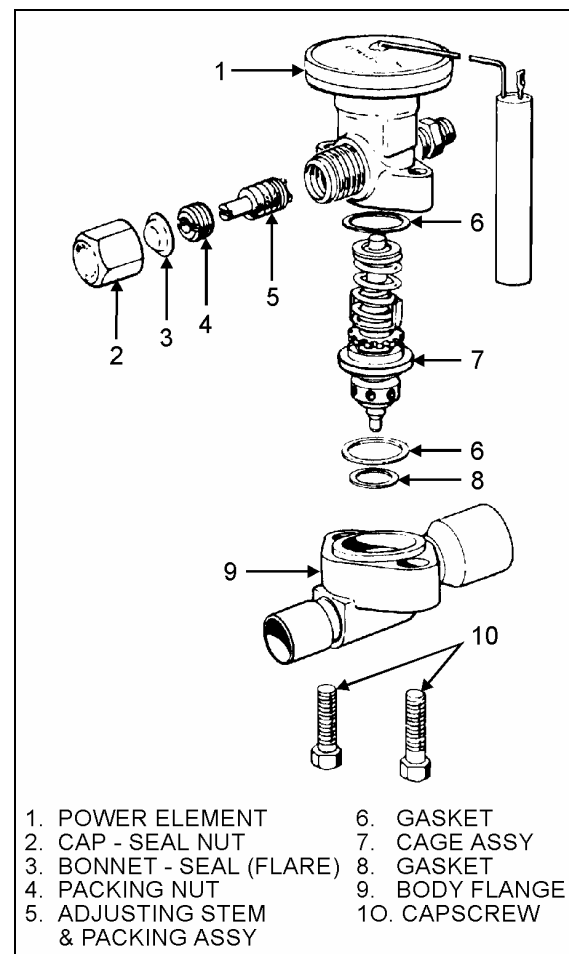
- Place the diaphragm in the body with the pilot port extension up.
- Hold the plunger with the synthetic seat against the pilot port.
- Make sure the bonnet O-rings are in place. Lower the bonnet assembly over the plunger, making sure that the locating sleeve in the bonnet enters the mating hole in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

12.7 EXPANSION VALVE

The expansion valve for the main 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 (Fig. 21 & 30). The valve regulates the flow of refrigerant liquid into the evaporator coils and is controlled by the suction gas temperature leaving the evaporator. The bulb head senses the refrigerant gas temperature as it leaves the evaporator. High temperature will cause expansion and pressure on the power head and spring. Such action causes the assembly valve to open, allowing a flow of refrigerant liquid into the evaporator.

The remote bulb and power assembly is a closed system. The pressure within the remote bulb and power assembly corresponds to the saturation pressure of the refrigerant temperature leaving the evaporator and moves

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



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FIGURE 30: EXPANSION VALVE

22045

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

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

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

Superheat Adjustment

The easiest method of adjusting the superheat is to unscrew completely the main evaporator expansion valve adjusting screw, and screw in 13 turns clockwise for 134A (Fig. 31). If this

method does not provide an accurate superheat, the following procedure should be followed:

1. Operate coach for at least one-half hour at fast idle with temperature control set at 82°F (27,7°C), Then set temperature to minimum to keep the compressor on 6 cylinders.

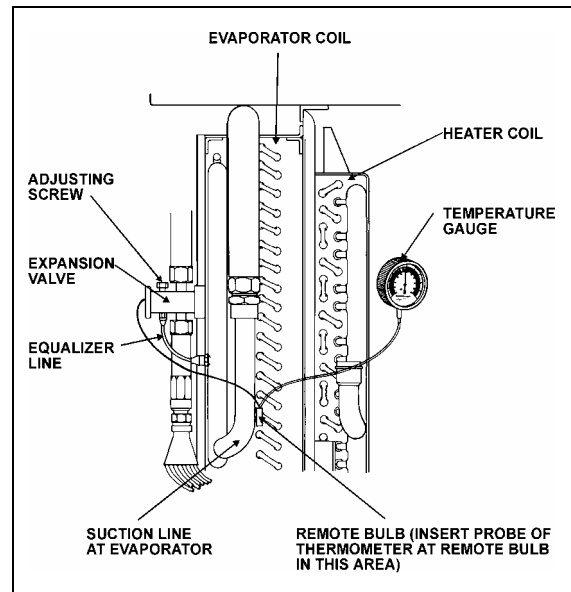


FIGURE 31: SUPERHEAT ADJUST. INSTALLATION 22046

2. Install pressure gauge at the evaporator suction header. You may install the pressure gauge at compressor suction, but then add 3 psi to reading.
3. Install a remote reading thermometer to the evaporator outlet line near the existing remote bulb (Fig. 31).
4. Apply thermostatic tape around the bulb and evaporator outlet line to get a true reading of the line temperature.
5. Block condenser if necessary to keep pressure over 150 psi.
6. Check approximately 5 readings of pressure at 2-minute intervals and convert to temperature using the vapor-pressure table (page 52). Likewise check the temperature reading at the remote bulb at the same 2-minute intervals and record the low and high swing readings of the needle (refer to Fig. 32).

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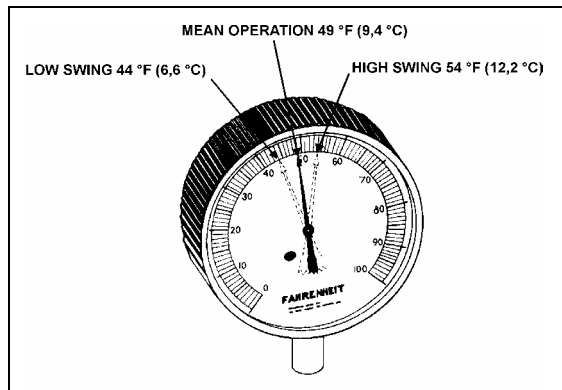


FIGURE 32: HIGH & LOW SWING TEMPERATURE AT REMOTE BULB 22047

Example of readings taken at fig. 32:

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

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

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

- 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 with 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

- Pump down the system as previously indicated in this section.
- 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.
- Remove the two cap screws holding the power assembly to the valve body flange. Lift off the power assembly and remove the cage assembly.
- 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.
- Check for leaks.

Safety Instructions

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

12.8 TORCH BRAZING

Use an electrode containing 35% silver.

Note: A 3.5% silver low temperature brazing electrode can be used on low side pressure and liquid high side.

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

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

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12.9 TROUBLESHOOTING

12.9.1 Expansion Valve

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

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

12.9.2 A/C

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

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TROUBLE	CAUSE
b. Evaporator motor inoperative; or c. Plugged return air ducts.	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.
Non-condensable in the refrigeration system.	<p>Leak on system, system in vacuum in low temp. Specific symptom, pressure in system will not correspond to ambient temperature on shutdown. Only non-condensable will cause this.</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.
<p>Testing condenser pressure.</p> <p>Note: R-134A pressure is function of the temperature variation.</p> <p>Example, for an exterior temperature of 100°F. Exterior temperature (100°F) + 30°F = 130°F. Refer to paragraph "10.11 Temperature & Pressure". Note the corresponding pressure for a temperature of 130°F., 199.8 psi. Read the condenser pressure, example 171.9 psi. 171.9 psi 199.8 psi, the pressure in the condenser is inferior to the pressure corresponding to the exterior temperature, then condenser pressure may be to low. Check for refrigerant leaks and add refrigerant if necessary. If the pressure corresponding to the condenser temperature is superior to the pressure corresponding to the exterior temperature, then air cooled condenser pressure may be to high. Most frequent causes are:</p> <p>Reduced air quantity. This may be due to:</p> <ul style="list-style-type: none"> • Non-condensable in system; • Dirt on the coil; • Restricted air inlet or outlet; • Dirty fan blades; • Incorrect rotation of fan; • Fan speed too low; • Fan motor going out on overload; or • Prevailing winds. • Too much refrigerant in system. Remove refrigerant if necessary. 	

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12.10 TEMPERATURES & PRESSURES

VAPOR-PRESSURE			
TEMPERATURE		PRESSURE	
°F	°C	psi	kPa
-100	-73.3	27.8	191.7
-90	-67.8	26.9	185.5
-80	-62.2	25.6	176.5
-70	-56.7	23.8	164.1
-60	-51.1	21.5	148.2
-50	-45.6	18.5	127.6
-40	-40.0	14.7	101.4
-30	-34.4	9.8	67.6
-20	-29	3.8	26.2
-10	-23	1.8	12.4
0	-18	6.3	43.4
10	-12	11.6	80
20	-7	18.0	124.1
30	-1	25.6	176.5
40	4	34.5	237.9
50	10	44.9	309.6
60	16	56.9	392.3
70	21.1	70.7	487.5
80	27	86.4	595.7
90	32.2	104.2	718.5
100	38	124.3	857.0
110	43.3	146.8	1012.2
120	49	171.9	1185.3
130	54.4	199.8	1377.6
140	60	230.5	1589.3
150	65.6	264.4	1823.0
160	71	301.5	2078.8
170	76.7	342.0	2358.1
180	82.2	385.9	2660.8

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VAPOR-PRESSURE			
TEMPERATURE		PRESSURE	
°F	°C	psi	kPa
190	87.8	433.6	2989.7
200	93.3	485.0	3344.1
210	98.9	540.3	3725.4

12.11 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.

13. VEHICLES EQUIPPED WITH SMALL A/C SYSTEM ONLY

13.1 COMPRESSOR

Clutch Pulley Installation

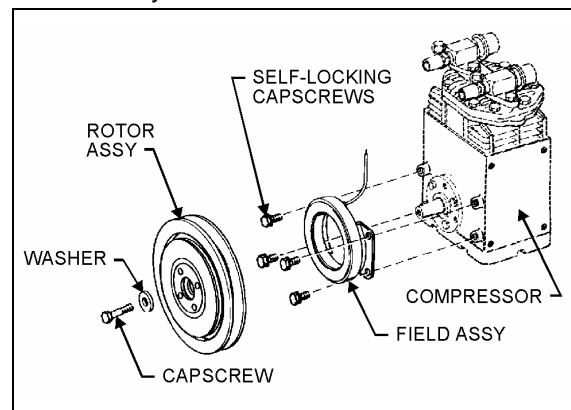


FIGURE 33: PULLEY INSTALLATION

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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 (Fig. 33). 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.

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- Slide the rotor pulley assembly onto the tapered shaft (aligning the keyway with the Woodruff key in the shaft). Secure the rotor pulley assembly with the washer and self-locking cap screw to a wrench torque of 15/20 lbf•ft (20/27 N•m).
- 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.

13.1.1 Clutch Pulley Removal

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

13.1.2 Clutch Maintenance

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

13.1.3 Belt Replacement

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

- Open engine compartment rear doors.
- Loosen tension retaining bolt.
- Replace compressor belt.
- Tighten belt to 60/65 lbf•in (6,5/7 N•m) (Fig. 34), 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.

13.1.4 Pulley Alignment

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

- 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.
- 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.

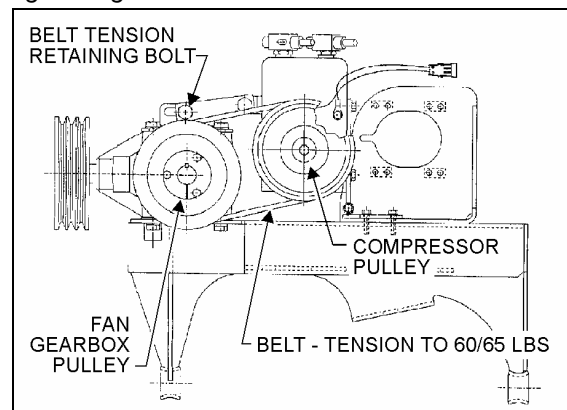


FIGURE 34: SMALL A/C COMPRESSOR INST. 05018A

13.2 DRIVER'S EXPANSION VALVE

The function and operation of the expansion valve for the driver" system are similar to the central system, but no superheat adjustment is required (see Fig. 35).

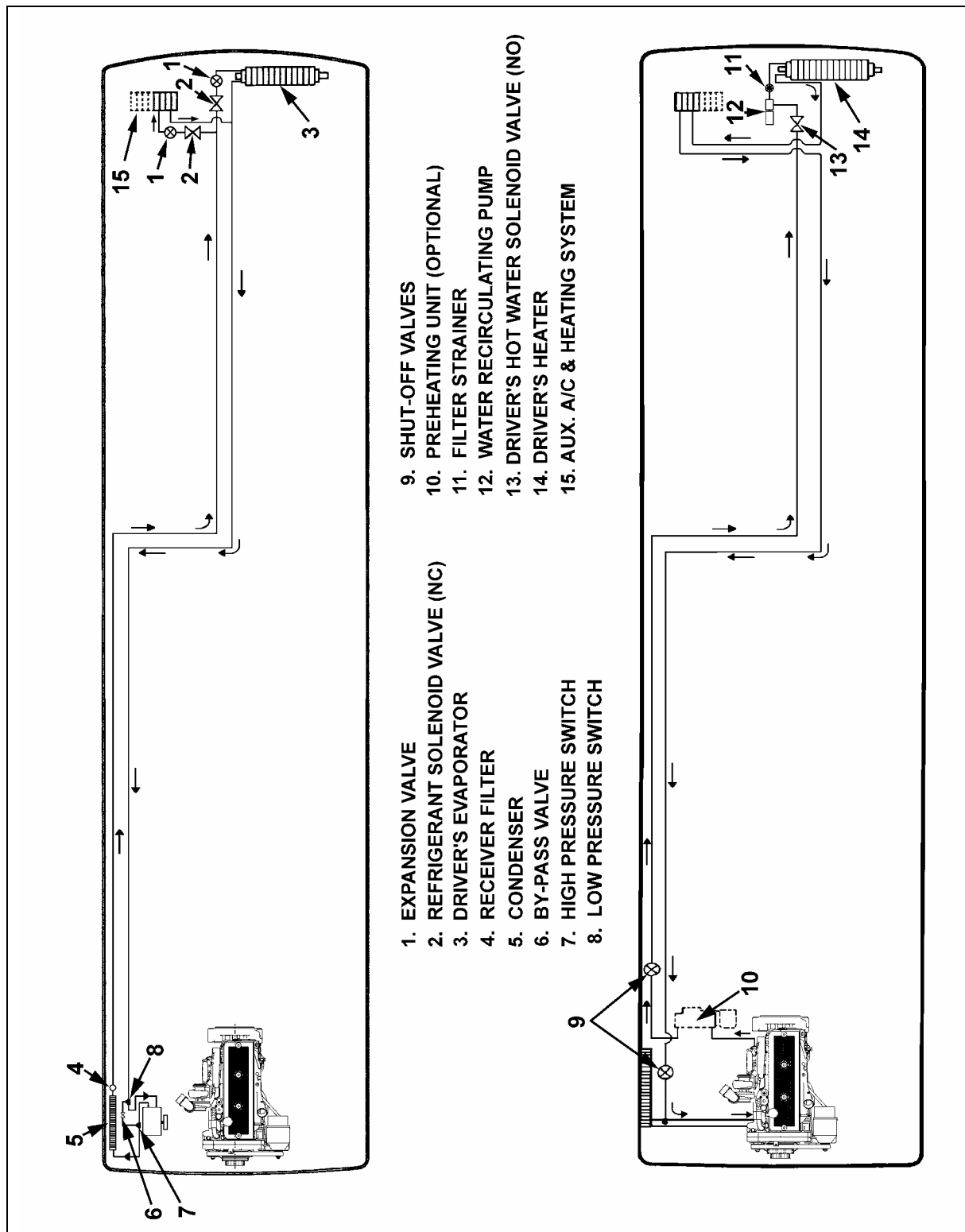


FIGURE 35: SMALL A/C & HEATING SYSTEMS PLUS AUXILIARY SYSTEM COMPONENTS

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14. SMALL HEATING & AUX. SYSTEM

For vehicles equipped with small heating & auxiliary systems only, refer to figure 35. The small system is similar to the driver's portion of central system, except that the recirculating pump and the strainer are located on the ceiling of the spare wheel compartment. For more information on components, refer to paragraph 15: CENTRAL HEATING SYSTEM.

Furthermore, an auxiliary system is added in series on the return line of the small system, it increases the whole system heating capacity and gives the driver more options.

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

15. CENTRAL HEATING SYSTEM

The schematic of Figure 38 shows the central heating system and its components.

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

15.1 DRAINING HEATING SYSTEM

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

15.1.1 Draining Driver's Heater Core

1. Stop engine and allow engine coolant to cool.
2. Locate the normally open water solenoid valve on the ceiling of the spare wheel compartment (Fig. 36), disconnect its wiring connector, then connect a 24-volt external power source, using jumper cables, to close valve.

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

3. Loosen hose clamp, install an appropriate container to recover coolant, and disconnect silicone hose from water solenoid valve.

4. From inside of vehicle, remove the grill and the access panels. Open the manual vent located inside the HVAC unit on the driver's side (Fig. 37) to ensure an efficient draining.

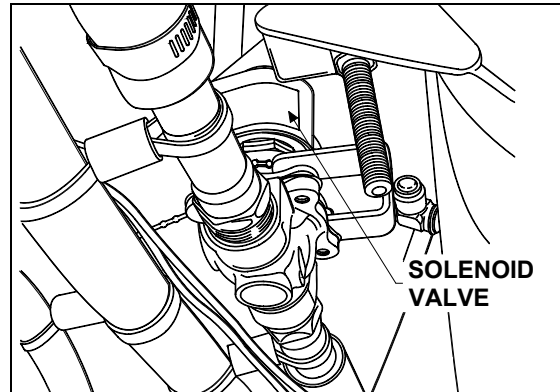


FIGURE 36: CEILING OF SPARE WHEEL COMPART. 22127

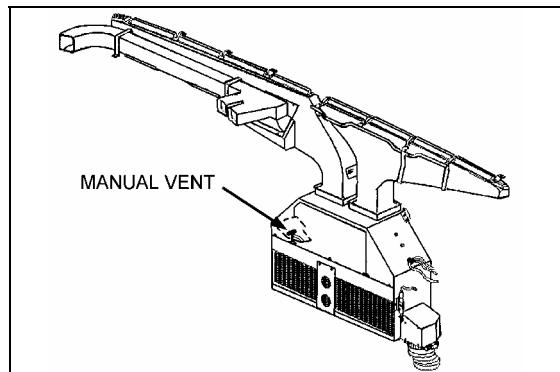


FIGURE 37: DRIVER'S HVAC UNIT

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15.1.2 Draining Main Heater Core

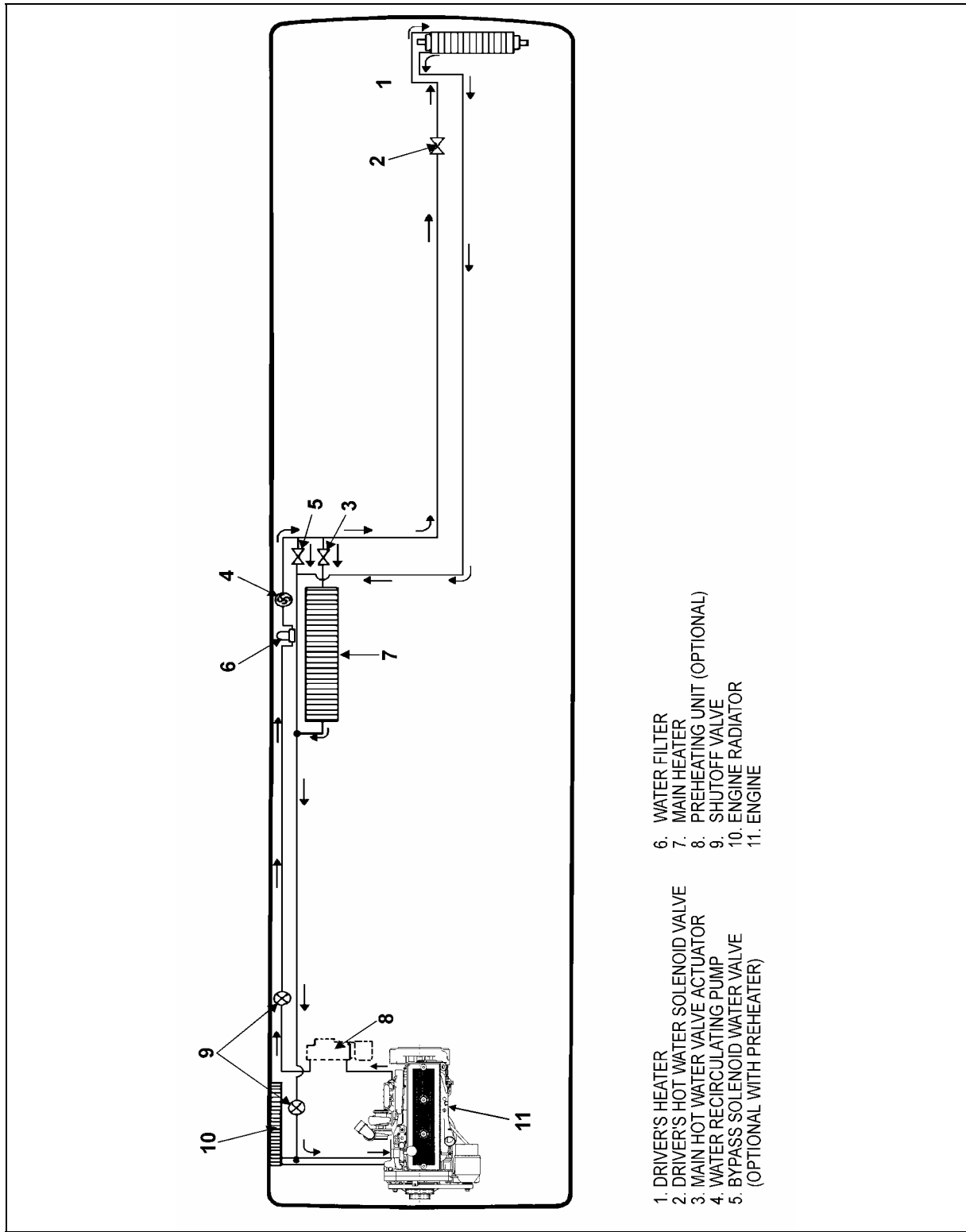
1. Stop engine and allow engine coolant to cool.
2. Close both heater line shutoff valves. One is located in the engine compartment under the radiator fan gearbox, while the other one is located in the L.H. rear electric compartment near the preheater. Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.
3. Open the last L.H. side baggage compartment door, then pull the black release button located on the L.H. side in order to unlock and open the HVAC compartment door.

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

4. Open drain cock in bottom of heater core, then open manual vent located on top of

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heater core (Fig. 39) in order to allow air to enter while draining.



- 1. DRIVER'S HEATER
- 2. DRIVER'S HOT WATER SOLENOID VALVE
- 3. MAIN HOT WATER VALVE ACTUATOR
- 4. WATER RECIRCULATING PUMP
- 5. BYPASS SOLENOID WATER VALVE (OPTIONAL WITH PREHEATER)

- 6. WATER FILTER
- 7. MAIN HEATER
- 8. PREHEATING UNIT (OPTIONAL)
- 9. SHUTOFF VALVE
- 10. ENGINE RADIATOR
- 11. ENGINE

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FIGURE 38: CENTRAL HEATING SYSTEM COMPONENTS

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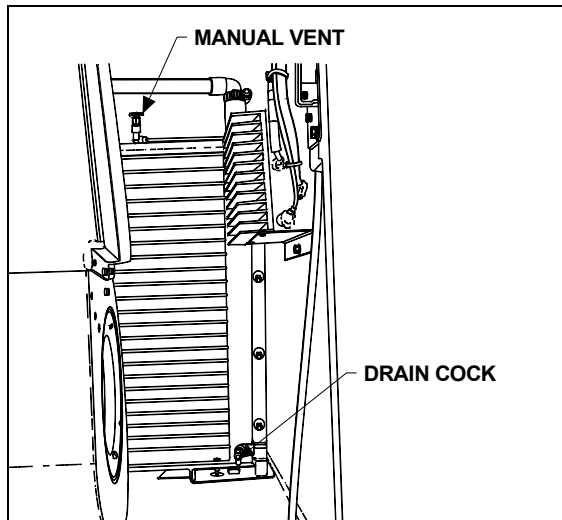


FIGURE 39: HVAC COMPARTMENT

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15.2 FILLING HEATING SYSTEM

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

15.3 BLEEDING HEATING SYSTEM

Whenever the heating system has been drained and refilled, or the system has run low on coolant and coolant has been added, it is necessary to bleed air from heating system. Locate the manual vents illustrated in Figures 37

and 39, and open them momentarily until no air escapes from the lines

15.4 SOLDERING

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

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

15.5 DRIVER'S WATER SOLENOID VALVE

A two-way normally open, internal pilot-operated solenoid valve designed for smooth closing is used to control the coolant flow through the driver's heating unit. It is mounted on the coolant inlet line of the driver's heating unit, and is accessible through the spare wheel compartment (see fig. 36). The valve cannot be manually bypassed.

15.5.1 Improper Operation

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

15.5.2 Coil Replacement

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

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1. Remove retaining cap or clip, spacer, name plate and housing.
2. Slip spring washer, insulating washer, coil and insulating washer off the solenoid base sub-assembly. Insulating washers are omitted when a molded coil is used.
3. Coil is now accessible for replacement. Reassemble by reversing sequence of disassembly. Refer to exploded view (Fig. 40) for identification and location of parts.

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

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

15.5.3 Valve Disassembly

1. Drain driver's heating unit as previously explained in this section under paragraph "Draining Heating System".
2. Disconnect connector from coil connector.
3. Disassemble valve in an orderly fashion paying careful attention to exploded view (Fig. 40) provided for identification of parts.
4. Remove retaining cap and slip the entire solenoid enclosure off the solenoid base subassembly.

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

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

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

15.5.4 Valve Reassembly

1. Reassemble in reverse order of disassembly, paying careful attention to exploded view provided for identification and placement of parts (Fig. 40).
2. Replace body gasket and diaphragm/spring subassembly. Locate bleed hole in diaphragm/spring subassembly, located approximately 45° from valve outlet.
3. Replace disc holder spring and holder subassembly.
4. Replace valve bonnet screws. Torque bonnet screws in a criss-cross manner to 95 ± 10 inch-pounds.
5. Install solenoid base gasket, plugnut assembly and plugnut gasket. Position core (small end up for A-C construction) on plugnut assembly. For D-C construction, be sure plugnut assembly and core are installed with mated ends together.
6. Replace solenoid base subassembly and torque to 175 ± 25 inch-pounds.
7. Refill heating system as previously stated under paragraph "Filling Heating System", then bleed air from the driver's heating unit as stated previously under paragraph "Bleeding heating system".
8. After maintenance, operate the valve a few times to be sure of proper opening and closing.

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

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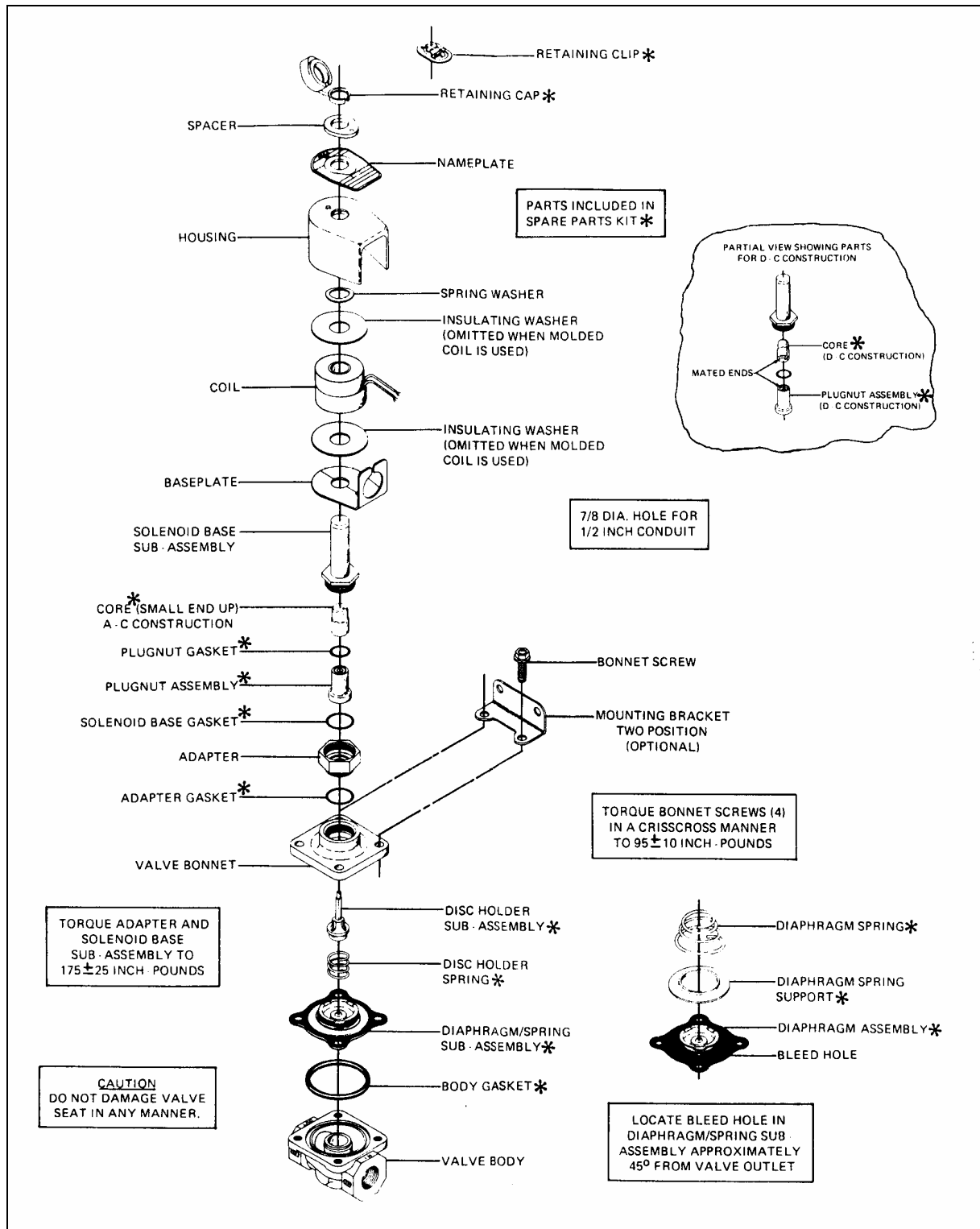


FIGURE 40: DRIVER'S WATER SOLENOID VALVE

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15.6 MAIN HOT WATER SOLENOID VALVE ACTUATOR

The flow of hot water to the vehicle main heater core is controlled by an electric water valve. The valve is located in the HVAC compartment (Fig. 18 and 41). This valve is self-adjusting and linear motorized.

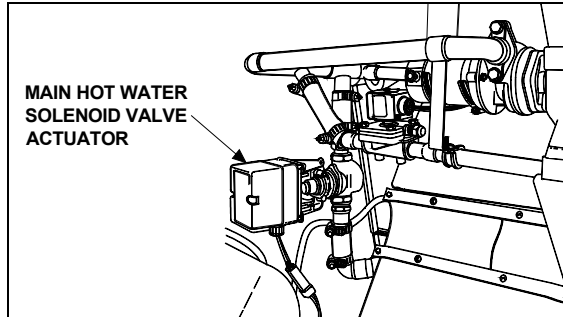


FIGURE 41: HVAC COMPARTMENT

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If leakage occurs after several years of operation, check stem and seat for wear. If either is worn, completely rebuild the valve, replacing all parts subject to wear. This normally includes replacing packing, stem, disc, internal springs, seats or seat rings, O-rings, and gaskets as applicable to the valve being rebuilt.

Any valve with a stem in good condition may be repacked without further repair. It is not necessary to remove the bonnet to repack the valve. Great care should be taken not to damage the valve stem or cause leakage after the packing is installed.

After repairing, use pipe sealing compound or tape on bonnet threads and threaded piping connections. Restore hot water pressure to test for leaks before reinstalling actuator. Remember that pressure forces the valve open during testing when actuator is off. Reinstall the actuator and check operation to be certain valve closes completely against normal operating pressures.

15.6.1 Valve Actuator

1. Stop engine and allow coolant to cool.
2. Close shutoff valve on the line located in the rear electric compartment to relieve water pressure from system. Refer to "Preheater

System" in this section to gain access to the heater line shutoff valve.

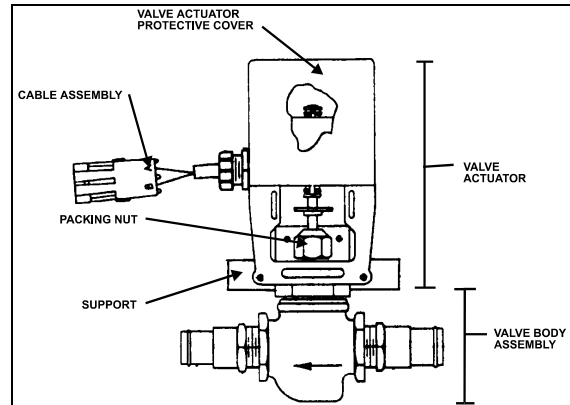


FIGURE 42: MAIN HOT WATER SOLENOID VALVE 22054

3. Disconnect cables and the fresh air sensor. Remove the main hot water solenoid valve actuator (Fig. 42) from the line by removing connectors at pipe outlets and removing screws on the support.
4. Remove the two screws retaining the valve actuator protective cover.
5. Remove the four screws retaining the collar.
6. Remove the stem button.
7. Remove the actuator valve.

15.6.2 Valve repacking

1. Hold stem by inserting a 1/16 inch diameter rod or nail in hole near the top of the stem. Unscrew the stem button. Do not tamper with the top locking set screw in stem button.
2. Remove packing nut, old packing, packing follower, and spring. Install new spring and packing follower. Use a small amount of lubricant Amoco H-100 and thread new packing very carefully over the stem with concave side down for 250 psi (1724 kPa) rubber packing.
3. Reinstall packing nut by pushing down to compressed spring until threads engage, and tighten until snug. Be certain the valve stem moves up and down. Reinstall stem

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button, stem extension (if applicable), and actuator.

15.6.3 Valve Rebuilding

Follow disassembly procedures as applicable. Replace all parts subject to wear and damage. Reassemble in reverse order using new parts.

Note: Run down all bonnet cap screws until finger-tight, and proceed to torque down evenly using a reduced torque. Space successive tightening at 180 degrees, etc, until the bonnet raised face contacts the body on all sides. Then apply torque as specified.

15.6.4 Disassembly Procedures

1. Relieve water pressure from system and remove actuator.
2. Hold stem by inserting a 1/16 inch diameter rod or nail in the hole near the top. Partially unscrew set screw inside the motor actuator. Do not tamper with locking set screw in the top of the stem button. Remove motor.
3. Remove packing nut and all parts down to the bonnet.
4. Remove stem and plug. Direct acting threaded body valves (Fig. 43). Unscrew the bonnet. Lift out the stem and disc holder assembly and the plug.
5. Disassemble stem and plug. Threaded body valves. Unscrew plug (Fig. 43) from stem to remove disc and spring. The disc may have to be pried from the disc holder with a screwdriver. The valves have a staked stem and disc holder assembly (Fig. 43). The stem and plug cannot be disassembled on some valves with metal-to-metal seats.

15.6.5 Maintenance

Using solvent, remove all dirt and grease accumulation around the packing nut and stem.

Warning: Permanent damage to respiratory system or skin tissue can result from careless handling of solvents. Special care should be taken to avoid prolonged inhalation and/or contact with the skin.

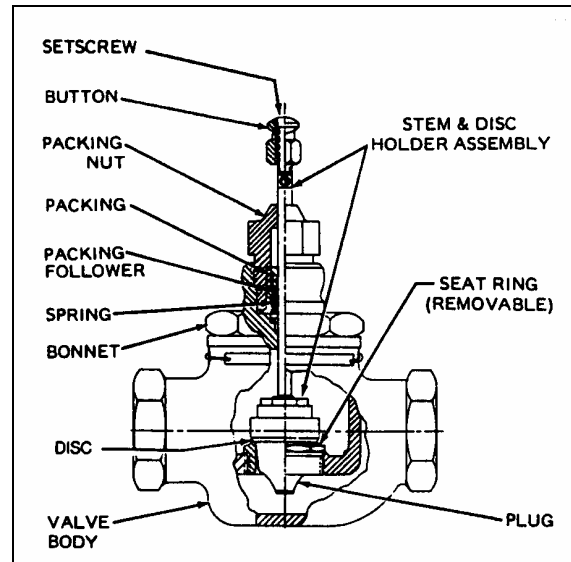


FIGURE 43: VALVE BODY ASSEMBLY

22055

15.7 WATER RECIRCULATING PUMP

This vehicle is provided with a water recirculating pump which is located in the HVAC compartment (Fig. 45) or on the ceiling of the spare wheel compartment for VIP converted vehicles equipped with a small A/C. The water recirculating pump consists of a centrifugal pump and an electric motor which are mounted on a common shaft in a compact assembly.

The motor is equipped with pre-lubricated 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.**

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 should be made while the pump is in operation to determine if the shaft seal is intact. If there is

Section 22: HEATING AND AIR CONDITIONING

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.

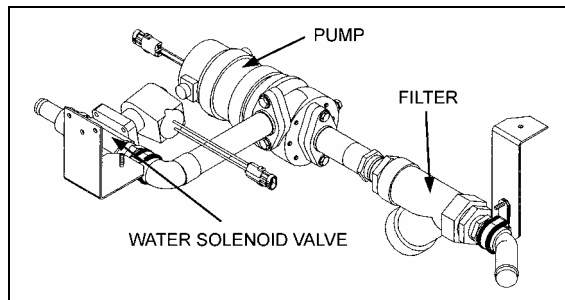


FIGURE 44: VIP WATER RECIRCULATION PUMP INSTALLATION

15.7.1 Removal

1. Stop engine and allow engine coolant to cool.
2. Close shutoff valves on the line located in the rear electric compartment. Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.
3. Disconnect the electrical wiring from the motor.

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

4. Remove the drain plug at the bottom of the pump and place a container to recover the residual coolant in the line.
5. Disconnect water lines from the pump at the flange connections.
6. Remove the two clamps holding the pump motor to its mounting bracket. Remove the pump with the motor as an assembly.

15.7.2 Disassembly

Refer to figure 45

1. 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. Remove the pump cover (2) by removing eight head screws. Remove cover carefully to prevent damage to gasket (3).
3. Remove gasket (3).
4. Remove two hex nuts and lock washers which hold pump assembly to the motor.
5. 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.
6. Remove the puller tool.
7. 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.

15.7.3 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

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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.

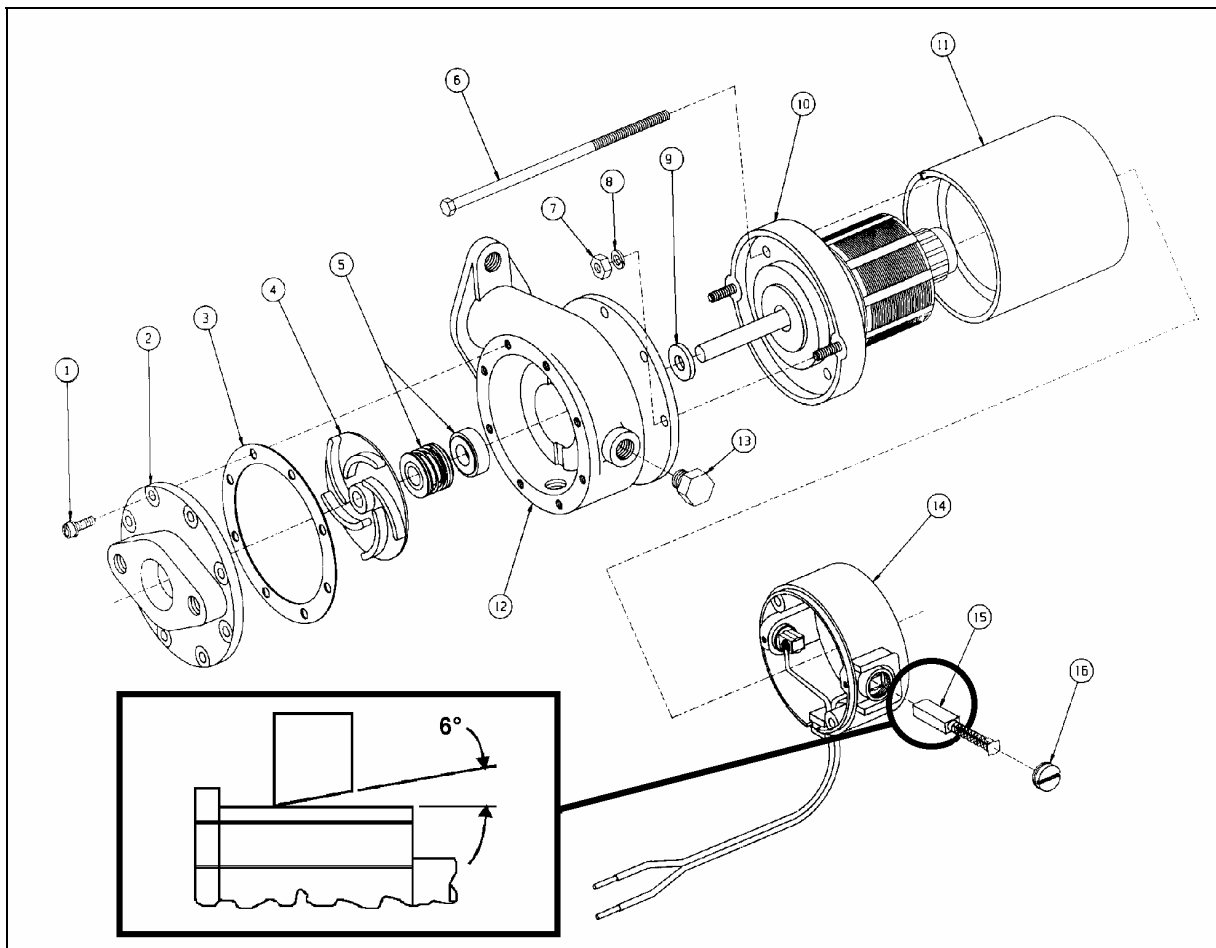


FIGURE 45: WATER RECIRCULATING PUMP

22056

- 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
- The face of a new brush is carefully cut to cause proper seating during the "wear-in" period.
 - Improper installation can harm both the brush and the commutator.
 - Replacement brushes should be of the proper grade.
 - New brushes have a six- (6) degree angle. The brush should always be inserted so that the angle is open away from the pump end of the assembly (inset, Fig. 45)
 - 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.

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15.7.4 Bearings

Refer to figure 45.

1. Rotate the motor shaft. If the ball bearings show evidence of wear, they should be replaced.
2. To use of a bearing puller is recommended when removing the bearings to help prevent damaging the armature winding or the commutator.
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.

15.7.5 Commutator

1. The commutator is a precise assembly. Although it is solidly built and made of a fairly tough material, careless handling can easily ruin it.
2. The commutator should be refinished only on equipment that 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 inch (4,7 mm) or more.
4. The commutator should be carefully undercut with a 0.025 inch (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.

15.7.6 Miscellaneous

Refer to figure 45.

1. 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. 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. 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.

15.7.7 Assembly

Refer to figure 45.

1. Install slinger (9) on the motor shaft.
2. Assemble body (12) to the motor.
3. Install seal assembly (5).
4. 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. 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. Attach cover (2) to the pump body using eight head screws (1).
7. Install motor brushes assembly (15) and brush caps (16).

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15.7.8 Installation

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 from 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 located in the rear electric compartment (near the preheater). Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.
5. Fill the cooling system as previously instructed in this section under "*Filling Heating System*", then bleed the system as previously instructed in this section under "*Bleeding Heating System*".

15.8 WATER FILTER

This vehicle is provided with a cleanable water filter, which is located in the HVAC compartment (refer to Fig. 18 and 38 (behind the right air duct)).

15.8.1 Maintenance

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

Note: *Each time soldering is performed on any water pipe of the heating system, operate heating system a few minutes so that any foreign matter will be routed to the filters. Clean filters.*

15.8.2 Filter Servicing

1. Stop engine and allow engine coolant to cool.

2. Close shutoff valve on the line located in the rear electric compartment. Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.

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

3. Rotate bowl (6) counterclockwise and remove.
4. Remove element (5) from housing. Discard all disposable elements. These elements are not cleanable (Fig. 46).
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*".

15.9 BYPASS SOLENOID WATER VALVE (OPTIONAL)

This valve is optional and is installed on the vehicle equipped with a preheater. The valve is located in the HVAC compartment (Fig. 18). This valve is similar to the driver's liquid solenoid valve. Refer to Fig. 46 for part names.

15.9.1 To Remove or Change the Coil

- Stop engine and allow engine coolant to cool.
- Close shutoff valve on the line located in the rear electric compartment. Refer to "Preheater System" in this section to gain access to the heater line shutoff valve.

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:

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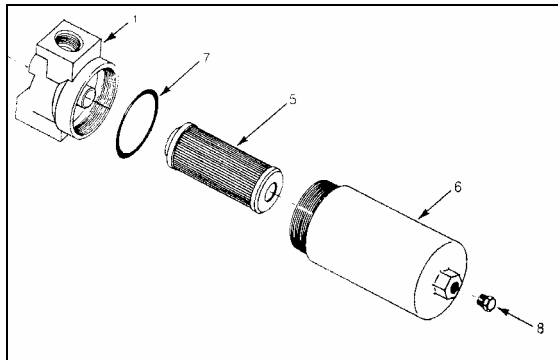


FIGURE 46: WATER FILTER

22057

Be sure to change electrical data plate according to coil specifications change.

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

15.9.2 Valve disassembly and Reassembly

Disassembly:

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.

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, 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.

16. PREHEATING SYSTEM (OPTIONAL)

The preheater is located in the rear electrical compartment.

To gain access to the preheater and the heater line shutoff valve, remove the preheater access panel screws. Remove the panel (Fig. 47).

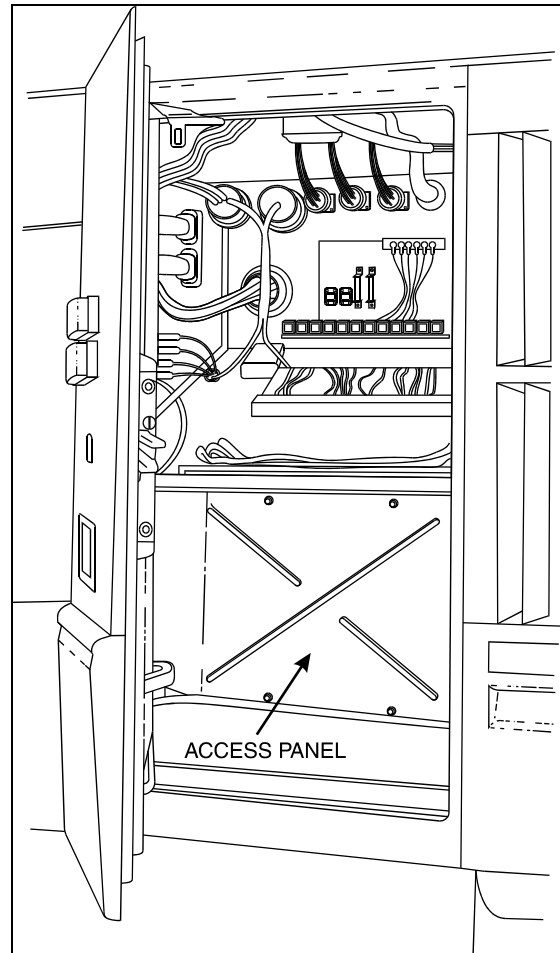


FIGURE 47: REAR ELECTRICAL COMPARTMENT

18325

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

The heater operates independently from the vehicle engine. It is connected to the cooling

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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.

16.1 OPERATION

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

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

If the heater is not switched off by the on/off switch, the control thermostat will switch off the heater when coolant temperature reaches $165^{\circ} \pm 6^{\circ}\text{F}$ ($75^{\circ} \pm 3^{\circ}\text{C}$) 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.

16.2 PREHEATING SYSTEM TIMERS

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

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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.

16.2.1 Timer Operating Instructions (Espar)

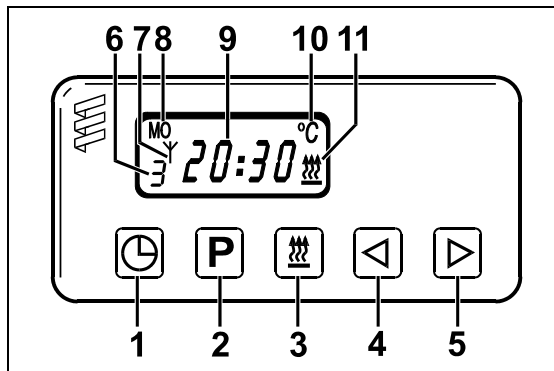


FIGURE 48: ESPAR

18326

These Instructions refer to the timer illustrated in figure 48.

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

11. Status display

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

Setting Time and Weekday for the First Time

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

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

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

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

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

Changing Time and Weekday

Press and hold (1) until the time flashes.

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

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

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

HEATING WITHOUT PROGRAMMING (IGNITION "OFF")

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

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

Temporarily Setting Heating Time

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

Permanently Setting Heating Time

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

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

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

Switching Off Heating

Briefly press (3).

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

System switches to automatic after-run for cooling.

HEATING WITHOUT PROGRAMMING (IGNITION "ON")

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

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

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

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

Switching Off Heating

Briefly press (3).

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

System switches to automatic after-run for cooling.

PROGRAMMING START OF HEATING

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

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

First memory – press (2) once.

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

Second memory – press (2) twice.

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

Third memory – press (2) three times.

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

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

Start of heating within 24 hours

Set the starting time:

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

To select another memory, press (2).

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

Set the starting time:

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

Set the program day:

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

Checking activated memory

The program time of the displayed memory is displayed for about 5 seconds. The display then

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disappears or then switches to current time (if the ignition is "ON").

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

Temperature display

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

PLEASE NOTE

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

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

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

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

If faults occur, we recommend the following:

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

16.2.2 Timer Operating Instructions (Webasto)

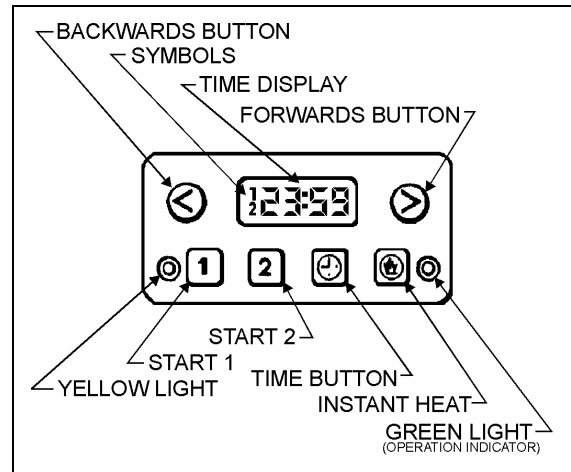





FIGURE 49: WEBASTO

18046


These instructions refer to the timer illustrated in figure 49.

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


To Set the Clock

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


Present Time Display

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

Manual Heating Start-Up

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

Programming Heating Start Time

Press  and the display shows the time at which the heater will start. You can alter the

starting time by pressing either ⏪ (backwards) or ⏩ (forwards) button. The longer you hold the button down, the faster the display changes. The last few minutes are set accurately by quick pushes. The display fades after 20 seconds. Start time 1 remains on the display, and the yellow light stays on. Starting time #1 is now activated.

Button 2 allows you to program a second starting time:

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

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

To Check (or activate) Start Time

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

To Cancel Heating Start Time

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

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

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

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

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

16.2.3 Timer operating instructions (Webasto)

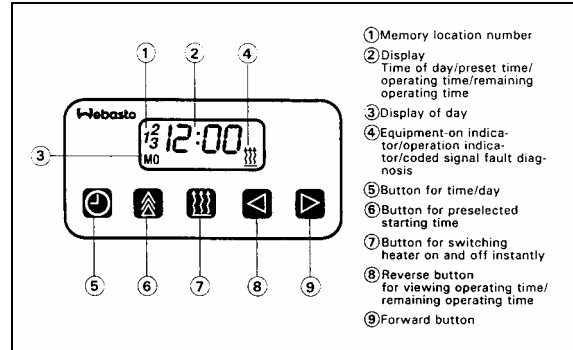


FIGURE 50: WEBASTO 18327

These instructions refer to the timer illustrated in figure 50. They are the same instructions provided in the Webasto 1529 instruction booklet, provided with your vehicle.

Remaining Operating Time

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

Setting the Digital Timer

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

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

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

Setting the Time and Day of the Week

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

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Viewing the Time (Ignition ON)

Continuous display of current time and day of the week.

Viewing the Time (Ignition OFF)

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

Switching Heater ON (Instant Heating)

With Ignition ON:

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

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

With Ignition OFF:

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

Switching Heater OFF

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

Presetting Operating Duration

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

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

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

The number of memory location remains on the display. The timer is now in the programmed

mode and will switch the heater in a the preset time.

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

Recalling Preset Times

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

Canceling Preset Time

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

Setting Operating Time

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

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

Setting the Remaining Operating Time

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

Fault Diagnosis by Coded Light Signals

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

16.3 TROUBLESHOOTING AND MAINTENANCE

The Espar preheater has a diagnostic code system to warn the driver when something goes wrong. Codes are listed below.

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Refer to the Webasto and Espar manuals for more information.

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

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

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

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

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

Number codes and faults are as follows:

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

Section 22: HEATING AND AIR CONDITIONING

17. SPECIFICATIONS

HVAC Logic panel

Make..... Honeywell
Model..... W973B
Voltage rating24 volts
Switching (on-off stages)Pilot duty spdt relays
Input signal (from electronic transmitter) 1 to 16 V DC
Supplier number..... W973B1016
Prevost number..... 561805

Electronic transmitter

Make.....POCATEC
Model.....Prévost
Voltage rating 20 volts (from HVAC logic panel)
Current draw20 milliamperes
Output signals Two 1-16 volt signals (one each for cooling and heating) to HVAC logic panel
Output signal rate of change (upon deviation from set point)..... 2.5 V DC/1 °F (0,5°C)
Supplier number..... 381787
Prevost number..... 381787

Discharge air sensor and front return air sensor

Make.....MEGATECH
Type Thermistor NTC
Supplier number.....064651
Prevost number.....064651

Main evaporator motor

Make.....US MOTOR
Type T-17
Voltage 28.5 V DC
Current draw 69 amps
Horsepower..... 2
Revolution 1750 rpm

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Insulation Class F
Motor Life 20 000 hours
Brush life 10 000 hours
Motor supplier number D509WAPRC5
Motor Prevost number 562375
Brush supplier number EPB125BC0077
Brush Prevost number 562951

Condenser fan motors

Make US MOTOR
Type TF-12
Voltage 28.5 V DC
Current draw 25 amps
Horsepower 0.57
Revolution 1950 rpm
Insulation Class F
Motor 20 000 hours
Brush life 10 000 hours
Qty 2
Supplier number D591Y440PRC2
Prevost number 562579
Brush supplier number 9DB21003
Brush Prevost number 561914

Main evaporator air filter

Make Permatron Corp.
Type Washable 1" X 23 3/8" X 43 1/2" Polypropylene filter
Supplier number MODEL IN-1
Prevost number 871051

Driver's unit evaporator motors

Make MCC
Voltage 24 V DC
Quantity 1

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Supplier number 25-0250
Prevost number 871135

Driver's unit evaporator air filter

Make MCC
TYPE Recirculating air 6-1/4" x 28" Washable
Supplier number 260593
Prevost number 871147

Make MCC
TYPE Fresh air 3-5/8" X 5-1/4" Washable
Supplier number 260594
Prevost number 871144

Refrigerant

Type Optional R-22 and Standard R-134a
Quantity (standard) 24 lbs (10.89 Kg)
Quantity (with A/C unities Parcel Rack) 26 lbs (11.82 Kg)

Compressor (Central system)

Make Carrier Transicold
Capacity, option R-134a 41 CFM
Capacity, option R-22 37 CFM
Model, option R-134 05G-134A
Model, option R-22 05G-22
No. of cylinders 6
Bore 2" (50,8 mm)
Operating speed 400 to 2200 rpm (1750 rpm. Nominal)
Minimum speed (for lubrication) 400 rpm
Nominal horsepower 15
Oil pressure at 1750 rpm 15 to 30 psi (103-207 kPa)
Oil capacity 1.13 U.S. gal (4,3 liters)
Weight 142 lbs (64,5 kg)
Approved oils

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-Castrol..... SW 68 (POE)
Supplier number, option R-134a..... 68PD541-104-38
Supplier number, option R-22..... 68PD537-104-39
Prevost number, option R-134a..... 950314
Prevost number, option R-22..... 950207

A/C Compressor (Small system)

Make.....Tecumseh
Model.....HGB-
1000
Factory oil charge* 10 US oz (295 ml)
System oil charge** (driver's system only) 16 US oz (473 ml)
Weight 24 lbs (10,9 kg)
Supplier number.....99242-5
Prevost number..... 950219

Approved oils

- Castrol SW 68 (POE)
- MobilArctic 1 (POE)

Compressor unloader valve

Make..... Carrier Transicold
TypeElectric (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

Make..... Carrier Transicold
TypeHousing mounted 9" dia., 2-B grooves
Voltage 24 V DC
Coil resistance at 68 °F (20 °C) 5.15 – 5.69 ohms

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Supplier number..... 50-01122-90
Prevost number..... 950204

Compressor V belts

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

Compressor V belt

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

Condenser coil

Make..... Carrier Transicold

Aluminium

Supplier number..... 68BC-509-114
Prevost number..... 452968

Copper

Supplier number..... 68BC-509--104-1
Prevost number..... 453013

Receiver tank (with sight glasses)

Make..... HENRY
Maximum pressure..... 450 psig
Supplier number..... ARL-1217
Prevost number..... 950261

Filter Dryer assembly

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

Moisture indicator

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

Driver's refrigerant liquid solenoid valve

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

Driver's hot water solenoid valve

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

Main hot water valve actuator

Make..... Honeywell
Model..... ML 784

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Voltage 24 V DC
Type Linear
Prevost number 641238
Supplier number ML784A207a
Repair kit Prevost number (packing, follower, spring stem assembly and disc) 641261
Repair kit supplier number 14 00 2695-005

Single-seated valve

Model V5011F
Prevost number 641239

Water recirculating pump

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

Water filter (standard system)

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

Water filter (small A/C system)

Make BRAUKMANN
Supplier number T300B
Prevost number 870807

Driver's expansion valve

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

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Main expansion valve (with R-134A)

Make.....CARRIER
Supplier number 14-01104-43
Prevost number..... 95316

Main expansion valve (with R-22 option)

Make.....ALCO
Supplier numberTCLE 10HW55
Prevost number..... 950292

Bypass solenoid water valve

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

Preheating system

Make.....Espar
Model..... D 12 W
Capacity41 000 Btu/h (12 kW)
Heating mediumCoolant
Rated voltage 24 V DC
Operating voltage..... 20-28 V DC
Electric power consumption (without coolant recirc. Pump).....55 watts
Fuel consumption..... 0,8 US gallons/hr (1.65 liters/hr)
Supplier number 25 1860 05
Prevost number..... 871077

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Preheating system

Make..... WEBASTO
Model.....DBW 2010
Capacity45 000 Btu/h (12 kW)
Heating mediumCoolant
Rated voltage 24 V DC
Operating voltage..... 20-28 V DC
Electric power consumption (without coolant recirc. Pump)60 watts
Fuel consumption.....0,4 US gallons/hr (1.5 liters/hr)
Supplier number.....
Prevost number.....871085

Preheating system

Make..... WEBASTO
Model.....DBW 2020
Capacity80 000 Btu/h (23,3 kW)
Heating mediumCoolant
Rated voltage 24 V DC
Operating voltage..... 20-28 V DC
Electric power consumption (without coolant recirc. Pump)120 watts
Fuel consumption.....0,8 US gallons/hr (3 liters/hr)
Supplier number.....666.640
Prevost number.....871036