TM-53005-120
Operation & Maintenance Manual
Rev D
30 January 2009

ENVIRONMENTAL CONTROL
UNIT, HORIZONTAL W/ VERTICAL INTAKE & DISCHARGE
120,000 BTU/HR COOLING CAPACITY
12 KW TOTAL HEATING
208 VOLT, 3 PHASE, 50/60 Hz
REFRIGERANT – R22

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1. INTRODUCTION

1.1 Forward

This air conditioner system is a custom environmental control unit (ECU) designed for installation on a mobile utility trailer. It will provide years of trouble-free service if installed, operated, and maintained in accordance with this manual. This manual provides user level maintenance information for operation, servicing, troubleshooting, and repair of the system. Damage to the unit from improper installation, operation, or maintenance is not covered by the warranty.

Study the instructions contained in this manual. They must be followed to avoid difficulties. Spare parts are available from Applied Companies and it is the responsibility of the user to maintain the recommended inventory of spare parts to insure continuous unit operation. Using substitute parts, or bypassing electrical or refrigeration components is not recommended and will VOID THE WARRANTY.

1.2 Notice to User

This is not a Commercial Air Conditioner

This is an Environmental Control Unit (ECU); it incorporates several self-contained safety and control features that are factory set and MUST NOT BE ADJUSTED. ANY ADJUSTING OF CONTROL DEVICES WITHOUT APPLIED COMPANIES' APPROVAL WILL VOID THE WARRANTY. Due to the extended range of operating temperatures, this ECU incorporates a compressor unloader. Air temperature is controlled via the monitoring of the return air temperature, which in turn controls the unloading of the compressor. Safety thermostat switches are installed to prevent icing on the evaporator coil in the event the return air falls below a predetermined set point. These safety switches do not affect the normal operation of the ECU, and the factory settings must not be altered. The ECU's manually adjusted thermostat provides a limited range of operator adjustment and must not be forced beyond its stop. This ECU uses R22 refrigerant; the refrigerant charge is based on weight and must not exceed the weight specified on the ECU data plate. This ECU is equipped with dual sight glasses. Paragraph 5.2.3 and Paragraph 6.2.4 provide an explanation of how the dual sight glasses function and how they help the user determine if the ECU's refrigerant charge is accurate.

1.3 Safety Summary

Thoroughly read all instructions in this manual prior to operating or servicing this ECU. Carefully read and understand all notes, cautions, and warnings contained in this manual that pertain to the intended task.

WARNING
This note alerts the operator of hazardous conditions that may result in injury or death.

CAUTION
This note warns operator of situations that could result in damage to the equipment.

Never operate the ECU with any cover, screen, or panel removed unless specified by the instructions in this manual. When required to operate the ECU with any cover, screen, or panel removed, do so with extreme caution and follow all procedures as outlined in the safety summary.

1.4 Warnings and Cautions

The following is a condensed list of WARNINGS and CAUTIONS that are noted throughout this manual. All personnel operating, servicing, and maintaining this ECU should read and understand these WARNINGS and CAUTIONS.

NOTE
Use of Term:
The following definitions apply to words “Must”, “Shall”, “Will”, and “May”:

- Must, Shall, and Will – Used to indicate mandatory requirements.
- May – Indicates an acceptable or suggested means of accomplishment.

WARNING
When possible, disconnect input power to ECU before performing any maintenance to electrical system. Voltages used can be deadly. Shutting unit off at the control panel DOES NOT disconnect power to various components of the ECU.

WARNING
HIGH VOLTAGE is used in the operation of this equipment. Death on contact or severe injury may result if you fail to observe safety precautions. Always disconnect the ECU from the power source before working on it. Do not operate the ECU without panels and grilles in place and tightly secured.

WARNING

REFRIGERANT UNDER PRESSURE is used in the operation of this equipment. Death on contact or severe injury may result if you fail to observe safety precautions. Never use a heating torch on any part that contains refrigerant. Do not let liquid refrigerant touch you and do not inhale refrigerant gas.

WARNING

ROTATING FAN BLADES are used in this equipment. Severe injury on contact may result if you fail to observe precautions. Always disconnect power source before working on fans. Do not operate fans without panels and grilles in place and secured.

WARNING

DANGEROUS CHEMICAL, Refrigerant R22 HCFC is used in this equipment.

WARNING

Do not allow anyone under equipment suspended from a sling device. Do not allow unit to swing while suspended from a sling device. Failure to observe warning may result in serious injury to personnel and damage to equipment.

WARNING

DEATH OR SERIOUS INJURY may result if personnel fail to observe safety precautions.

- **Great care must be exercised to prevent liquid refrigerant, or refrigerant gas discharged under high pressure, from coming into contact with any part of the body. Extremely low temperature resulting from rapid expansion of liquid refrigerant, or refrigerant gas discharged from under high pressure, can cause sudden and irreversible tissue damage through freezing.**

- **All personnel must wear thermal protective gloves and a face shield or goggles when working in any situation where refrigerant contact with skin or eyes is possible. Application of excessive heat to any component in a charged system will cause extreme pressure that may result in a rupture, possibly explosive in nature.**

- **Exposure of certain CFC (chlorofluorocarbon) and HCFC (halogenated chlorofluorocarbon) refrigerants to extreme heat or a very hot surface will cause a chemical reaction in the gas to form carbonyl chloride (phosgene), a highly poisonous and corrosive gas.**

- **Generally, in their natural states, CFC and HCFC refrigerants are colorless, odorless vapors with no toxic characteristics, are heavier than air, and will disperse rapidly in a well-ventilated area. However, in an unventilated area, these refrigerants present a danger as an asphyxiate by displacing oxygen in the area.**

WARNING

Allow heaters to cool before touching. Severe burns can result from touching hot elements.

WARNING

Compressed air used for cleaning purposes should not exceed 30 psig (2.1 kg/cm^2). Do not direct compressed air against skin. Use goggles or a full-face shield.

WARNING

Heater elements present an ELECTRICAL SHOCK HAZARD. 120/208 VAC. Keep hands away from heater coils when ECU is in the heat mode. Failure to observe this warning could result in serious burns or death.

CAUTION

Do not use steam, open flame, heat gun, or any other source of concentrated heat to thaw an iced evaporator coil. Thaw an iced coil by one of the following methods, which best suits the conditions:

1. **Operate the unit in a high heat mode (unless coil is more than 50% iced over). Air must be able to circulate through the coil.**
2. **Use a lamp bulb of 75 watts maximum. Heat from the operating bulb will thaw the coil. Protect the bulb and electrical connection from dripping water.**
3. **Use a commercial hair dryer or an electrical fan to blow air at the coil.**
4. **Shut the unit down until the ice has melted.**
5. **Run vent fan only until coil is defrosted**

WARNING

Be sure the refrigeration system is fully discharged and purged by running dry nitrogen through the system at a rate of not less than 1-2 cfm before brazing or de-brazing operations.

CAUTION

Do not energize the ECU unless the condensate drains have been equipped with a "p-trap" of at least 5 inches to prevent air, water, and other debris from being drawn back into the ECU.

CAUTION

Restrictive or kinked ductwork, high pressure drop air filters, supply and return vents blocked by equipment, diverters, etc. Will reduce air volume and cooling capacity.

Placement of supply air vents too close to the return will cause cold air to feed directly back through the return; this will cause the compressor to unload as it senses the demand for cooling has been satisfied.

To insure proper operation and full capacity, the condenser air intake and discharge openings must be completely free of obstructions.

Consult factory for no cost engineering assistance.

2. GENERAL INFORMATION

2.1 Equipment Description

The ECU is a packaged system designed to operate on a mobile utility trailer, providing conditioned air to a shelter via ducting. The ECU is controlled by a built-in control box on the ECU. The ECU operates using 208VAC (180v to 255v), 3-phase 50/60Hz power supplied by a trailer-mounted generator or shore power via an auxiliary power plug located on the ECU. The refrigeration system uses R-22 refrigerant and has a cooling capacity of 120,000 Btu/hr. The heating system is furnished with a 10kW resistive type heater. In addition, fan heat contributes an additional 2kW to the heat output.

2.2 Design Features

2.2.1 Operational

Capacity	120,000 Btu/hr
Nominal Air Flow	3,800 CFM
Heating Capacity	12.00kW, 208 VAC, 3 Phase
Maximum Design Ambient Temperature	131 °F (55 °C)
Minimum Design Ambient Temperature	-24 °F
Minimum Ambient Cooling	to +50 °F
Minimum Ambient Heating	to –24 °F
Maximum Storage Temperature	160 °F
Minimum Storage Temperature	–24 °F
Refrigerant	R22, 13.0 lbs

2.2.2 Physical Characteristics

Height	39.00”
Width	78.00”
Depth	34.00”
Weight	690 lbs (312.98 kilos)
Finish	Polyurethane Chemical Agent Resistant Coating (CARC) Paint per MIL-C-53039A

2.3 Special Features

2.3.1 Salt Spray Protection

The cabinet is constructed of welded aluminum and aluminum alloy sheet, primed and painted in accordance with (IAW) the specification. All external hardware and all internal hardware are stainless steel or have been protected against corrosion IAW the specification. The condenser coil is constructed from aluminum tubes and aluminum fins. The evaporator coil is constructed from copper tubes and aluminum fins. Both the condenser coil and the evaporator coil are coated with a protective Teflon® coating. The steel motor shafts are coated with molycoat (molybdenum disulfide).

2.3.2 Maintenance Features

2.3.2.1 Sight Glasses

A sight glass with a moisture indicator is provided to detect any contamination in the refrigeration circuit and low refrigerant levels. An additional sight glass is provided as a visual indicator of refrigerant charge. These features are located on the curb side of the ECU. Refer to Paragraph 5.2.3 and Paragraph 6.2.4 for a detailed description of the sight glasses and how to use them.

2.3.2.2 Service Valves

Suction and discharge service Schrader valves have been provided to enable servicing of the ECU. These features are located on the curb side of the ECU.

NOTE
All major components are easily accessible for ease of maintenance.

2.3.2.3 Diagnostic Lamps

The ECU is also equipped with a series of diagnostic lamps located on the electrical panel. These are intended to assist the operator in quickly locating and correcting any potential problems. Refer to Paragraph 5.2.1 for detailed information.

2.3.3 Safety Features

2.3.3.1 Low/High Pressure Switches

Low and high pressure switches are provided. They are factory set for the application. The low pressure switch will disengage control power to the compressor contactor if suction pressure drops below a specific pressure. The high pressure switch will shut off the compressor if the discharge pressure rises above a specific pressure and requires a manual

reset of the safety switch. The manual reset switch is located in the electrical controls panel of the ECU. These pressure switches are installed as safety devices and will help prevent compressor failure or other serious damage to the system components.

2.3.3.2 Overheat Safety Switch

The ECU heater section is equipped with an overheat safety switch. If the temperature should exceed the set point of the switch (140 °F), it will remove power to the heater.

2.4 Major Components

Major components for the ECU listed in Table 2-1 are detailed in Paragraph 2.4.1 through Paragraph 2.4.7 and illustrated in Figure 2-1 through Figure 2-4. Safety and control components are detailed in Table 2-2.

Table 2-1 Environmental Control Unit and Accessories

NOMENCLATURE	PART NUMBER
ENVIRONMENTAL CONTROL UNIT	53005
FLEXIBLE AIR DUCTS ASSEMBLY, 50’ OR 25’ SET	51983 or 51983-1
ECU MAIN POWER ASSEMBLY	52594
LOAD SHED CABLE ASSEMBLY	51865

2.4.1 Electrical Control Box and Control Panel

All of the major electrical control components are mounted in a control box on the end of the ECU in the compressor compartment. A control box, located on the lower left rear (evaporator end) is furnished with a hinged door for easy access, and is weather sealed. The controls and electrical components are physically separated for safety.

2.4.2 Evaporator Compartment

Contains the evaporator coil, expansion valve, motor, blower, and some refrigeration components. Access to the compartment is gained by removing cover panels on the front, rear, and/or top of the unit.

2.4.3 Condenser Compartment

Contains the condenser fan, motor, compressor, and service features. Access to the compartment is gained by removing cover panels on the end, sides, and/or top of the unit.

2.4.4 Filters

The air conditioner contains a return air filter located in the return air plenum. Access to the return air filter is gained by removing the filter cover plate on the side of ECU return air plenum. The ECU also contains a fresh air filter, located on the forward side of the evaporator compartment. Access to the fresh air filter is gained by removing the fresh air filter cover.

2.4.5 Lifting Eyes

The ECU is equipped with four (4) shoulder pattern lifting eyes, located at each corner. The lifting eyes have a load rating of 1800 pounds each and are provided for vertical and angled lifting applications up to a maximum of 45°. Eyebolt shoulder must be installed flush with the mounting surface. Workload limits are based on a straight vertical lift and are to be used as a guide only. Lifting at an angle significantly reduces the workload limit. Lifting at 45° reduces the workload limit by 75%.

2.4.6 Flexible Air Ducts Assembly

Supply (conditioned) and return air is provided to the shelter via a flexible ducting kit. The ducts are provided in a 12 inch diameter by 25 foot length for the supply air, and 18 inch diameter by 25 foot length for the return. The kit is made up of four (4) 12 inch ducts, two (2) 18 inch ducts, for a total duct ECU to shelter of 50 foot; two 12 inch duct covers; one (1) 18 inch duct cover; and a cover net for the 18 inch return duct (to keep large debris out of the duct). Each duct is equipped with an over center clamping mechanism encased in the soft collar, helical wear strips, and an integral storage bag with draw rope closure.

2.4.7 Power Cable Assembly

Main power to the ECU is provided via a weatherproof, jacketed cable with a Military Standard (MS) connector.

Figure 2-1 Major Components (Curbside)

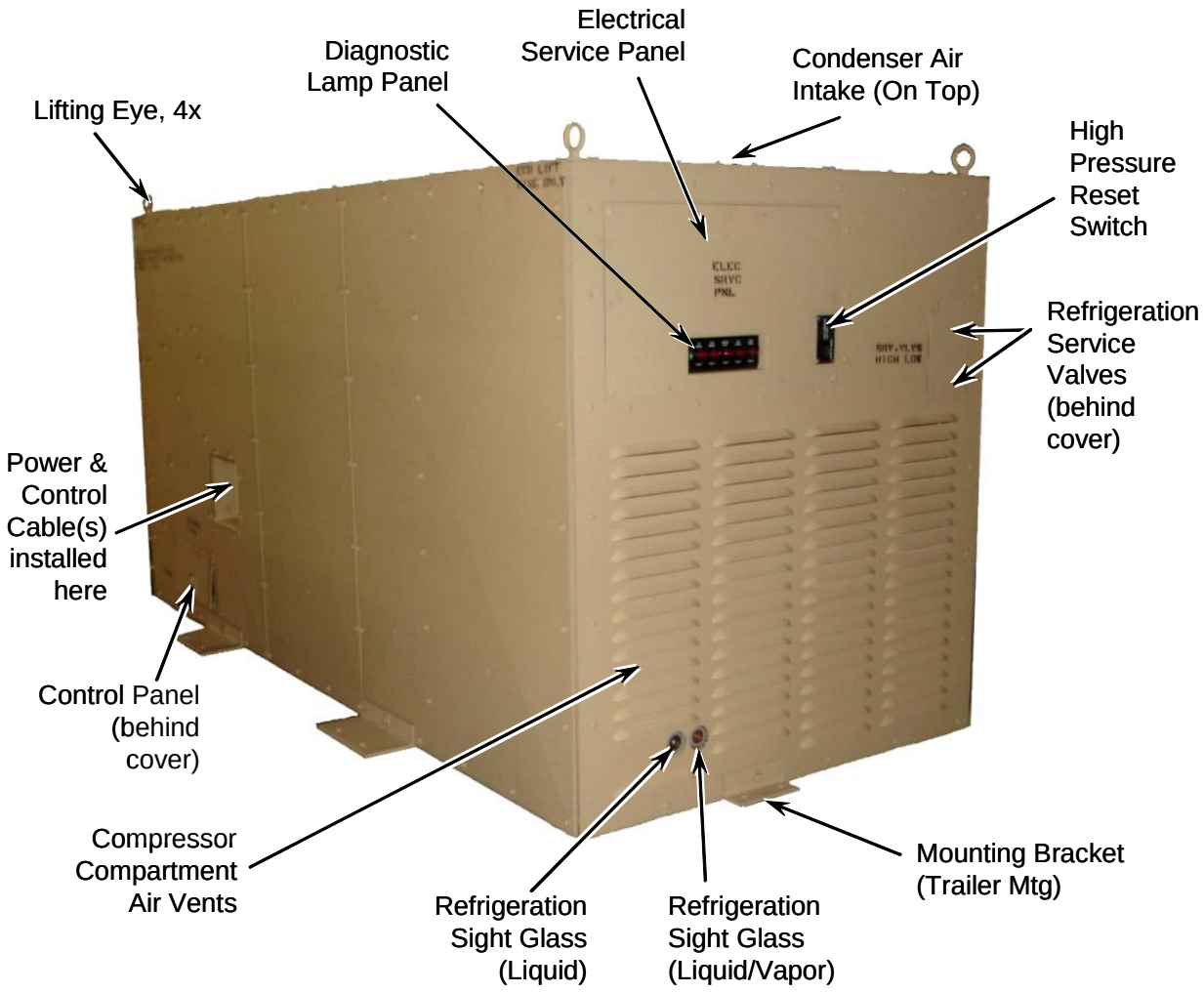


Figure 2-2 Major Components (Roadside, Forward)

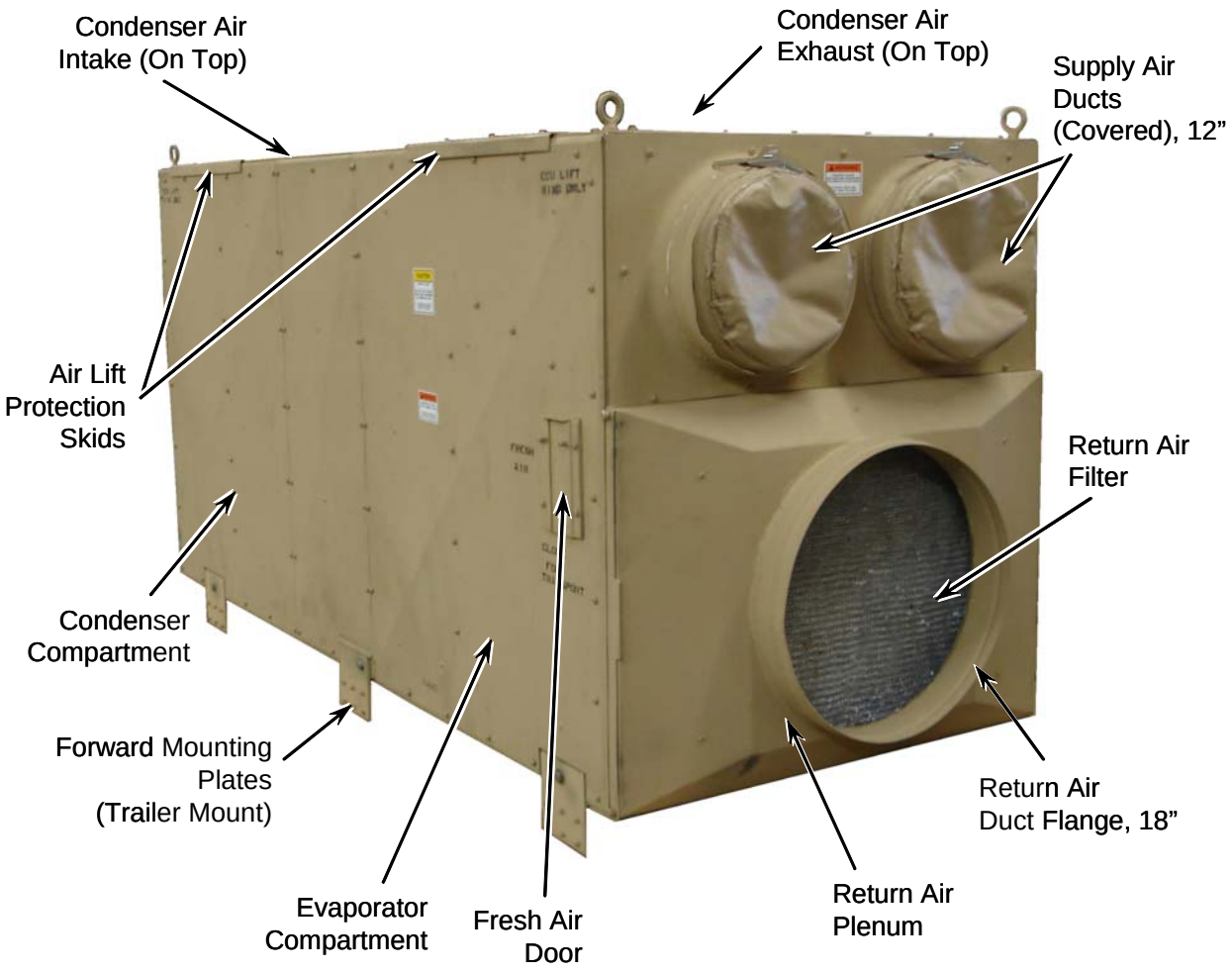


Figure 2-3 Major Components (Roadside, Aft)

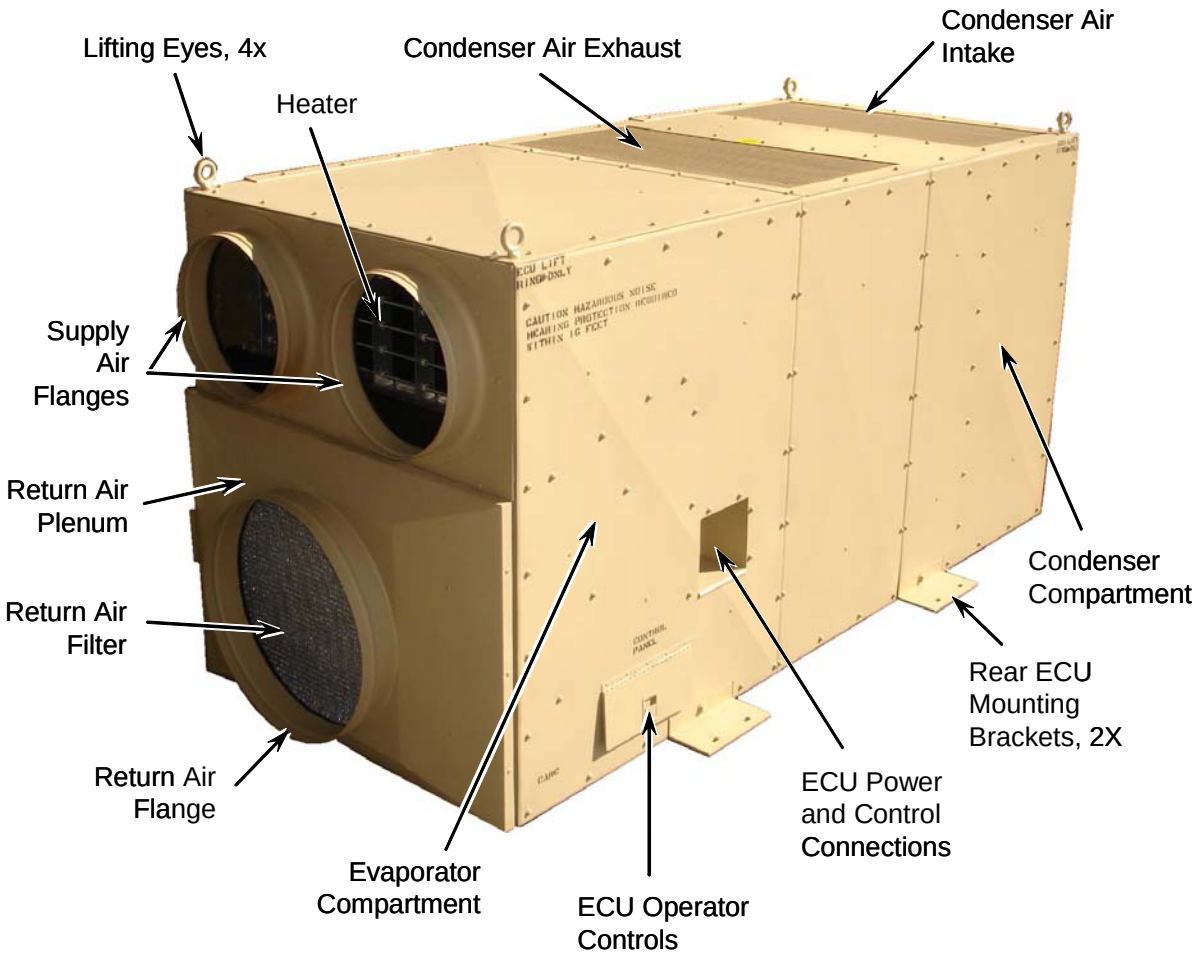


Figure 2-4 Major Components (Fresh Air Filter)

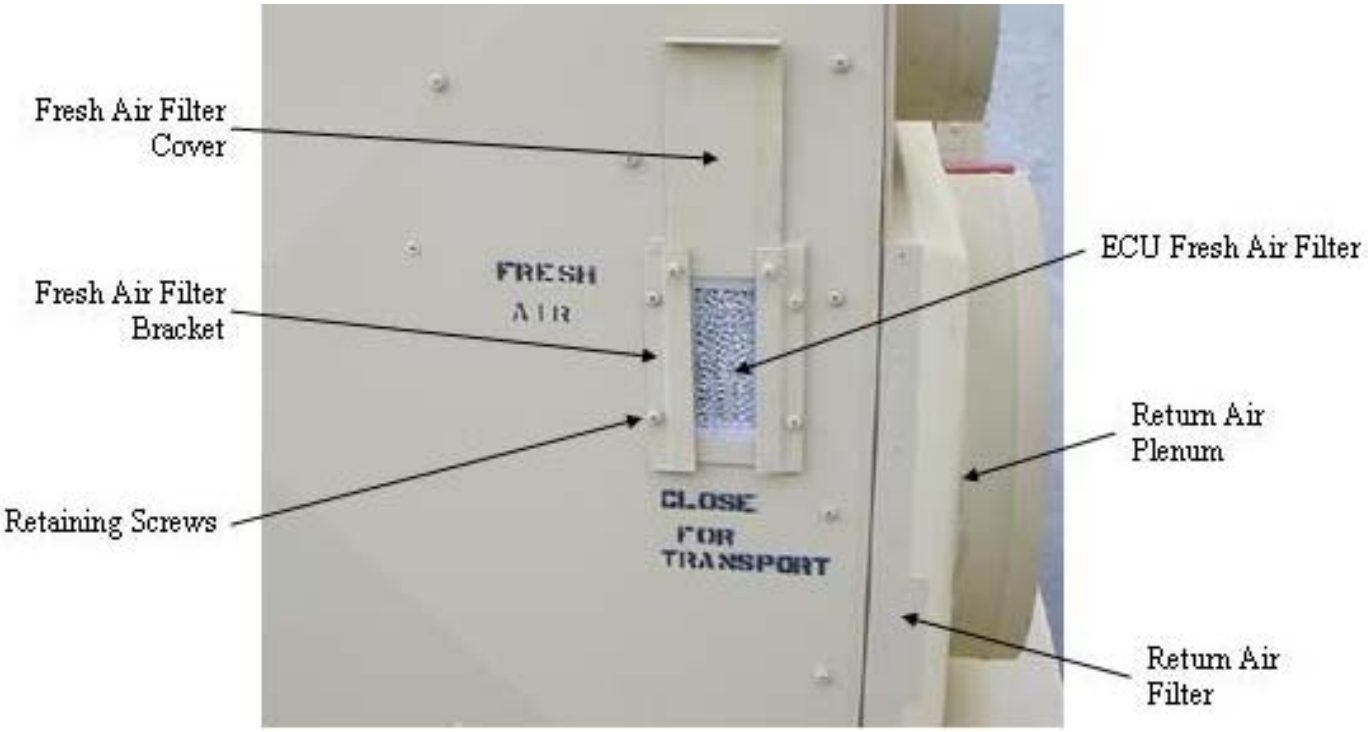


Table 2-2 Safety and Control Components Description

CONTROL	FUNCTION
FILTER/DRIER	Filters impurities and absorbs moisture from liquid refrigerant.
SIGHT GLASS (S/G), 2 USED	Provides means to monitor system charge, contamination, and operation.
HIGH PRESSURE SWITCH (HPS)	High Pressure Switch (HPS) set to break on excess refrigeration system pressure (manual reset).
LOW PRESSURE SWITCH (LPS)	Shuts down the AC when refrigeration system pressure falls too low. Equipped with automatic reset.
SOLENOID VALVE	Cycle for temperature control.
COMPRESSOR UNLOADING VALVE	For temperature control.
HEATER SAFETY SYSTEM	High Limit Trip Switch (HLS) set to break on electric heater temperature rising above 140 °F.
HIGH SIDE SERVICE VALVE	To service unit.
LOW SIDE SERVICE VALVE	To service unit.
CONTROL PANEL	System ON/OFF power switch, HEAT/VENT/COOL mode selection switch, WARMER/COOLER temperature control knob.
TIME DELAY RELAY	Prevents compressor from short-cycling.
FREEZESTAT	Prevents ECU from icing evaporator coil when air is restricted.
TEMPERATURE CONTROL	Thermostat.
THERMOSTATIC EXPANSION VALVE (TXV)	TXV set to maintain superheat of 10 – 15 °F.
COMPRESSOR	Scroll type.
CONDENSER COIL	Aluminum construction throughout, Teflon® coated for corrosion protection.
EVAPORATOR COIL	Copper tubing and aluminum fins, Teflon® coated for corrosion protection.

FAN CYCLE SWITCH	Works off system pressure to turn condenser fan ON and OFF as required to maintain head pressure.
DIAGNOSTIC LAMPS	Assist in operator identification of potential problems.

3. FUNCTIONAL DESCRIPTION

3.1 Introduction

This chapter describes the functions of the ECU system in the cooling and heating modes, as well as the operation of the refrigeration, heating, and electrical sub-systems.

3.2 Principles of Operation

The refrigeration system is a closed-loop circuit in which refrigerant is continuously re-circulated by the pressure differential created by the compressor.

The compressor maintains high side condensing pressure, and the thermostatic expansion valve separates the high pressure side from the low pressure side at the evaporator coil inlet.

The compressor is designed to increase refrigerant pressure (temperature) to a level high enough for it to be cooled and condensed into liquid by the ambient air being drawn over the condenser coil. The thermostatic (liquid) expansion valve is a pressure-reducing device metering high pressure refrigerant into the low pressure evaporator coil at the amount required. The high pressure liquid refrigerant is forced out of the sub-cooler as a result of the pressure differential created by both the compressor and the liquid expansion valve. It flows through the sight glass, a device for visual inspection of the refrigerant, and continues through the filter/drier, where moisture and other impurities are removed.

The liquid then flows through the thermostatic expansion valve, which meters the high pressure liquid into the low pressure refrigerant circuit. The liquid then enters the low pressure side of the circuit; it flows through the evaporator coil, boils by absorbing the latent heat of vaporization at this low pressure, and evaporates into a low pressure (and low temperature) gas. Heat from the surrounding air is extracted through the finned tubing of the coil by the refrigerant. The gas then returns to the compressor, where it is compressed and forced into the condenser coil. At this point, the high pressure (and high temperature) gas is condensed into high pressure liquid. Ambient air drawn over the condenser coil extracts the heat at the higher pressure from the refrigerant, causing condensation. The high pressure liquid flows from the condenser coil, thus completing the cycle.

3.3 Operational Description

- Evaporator fan motor circulates air.
- Compressor starts after 3 minute time delay. Time delay protects the compressor from cycling on and off too quickly.
- The Compressor takes low pressure, low temperature gas and compresses it to a high temperature, high pressure gas.

- The refrigerant then flows to the condenser coil. The condenser fan draws outside ambient air in through the condenser coil. The high temperature, high pressure gas from the compressor is cooled by the flow of air over the condenser coil and is changed into a low temperature, high pressure liquid.

- The refrigerant then flows through the liquid/vapor sight glass. This device indicates the presence of moisture and state of refrigerant in the system.

- The refrigerant then flows through the sub cooler and through a second liquid sight glass. These system devices will indicate a proper charge and presence of moisture in the system. A proper charge will show bubbles in the first sight glass and liquid ONLY in the second sight glass. The sub cooler also acts as a liquid reservoir.

- The refrigerant filter/drier removes any moisture (water vapor) or impurities that may be carried by the liquid refrigerant.

- The expansion valve senses the temperature of the refrigerant as it leaves the evaporator coil. By use of a sensing bulb and an external equalizer line, the valve constantly adjusts the flow of liquid refrigerant to the evaporator coil.

- As the liquid refrigerant leaves the expansion valve, it passes through a distributor and distribution tubes and enters the evaporator coil as a low pressure saturated vapor. Warm air being drawn across the fins and tubes of the coil causes the refrigerant to boil and change to a gas (vapor). The evaporator fan draws the warm air from the conditioned space through the evaporator coil. As the air from the conditioned space comes in contact with the evaporator coil, the air is cooled and de-humidified.

- The refrigerant gas is then drawn back to the compressor and the cycle is repeated.

4. INSTALLATION

4.1 Environmental Control Unit Leveling

When preparing the ECU for operation, ensure the ECU is level within +/- 10 degrees.

4.2 Ducting Installation

CAUTION

Both sets of ducts must be in place before operating the ECU. Operating the ECU without ducting may damage the equipment.

CAUTION

When installing flex duct, observe the following guidelines/precautions:

- **Take care to avoid dips, sags, and bends as much as possible, since poorly installed ductwork will reduce performance of the heating, cooling, or ventilation system. This is particularly important with longer duct runs, as flex duct has twice the resistance to air flow compared to rigid duct.**

- **Always opt for the minimum length of flexible duct. Any necessary bends should be made with not less than one duct diameter centerline radius. Ducting should extend a few inches beyond the end of a sheet metal connection before bending. When bending the duct, be careful not to compress it.**

a. Attach ducting to the return and supply air flanges. As needed, adjust fit of duct end over flange using duct clamp force adjustment screw. (See Figure 4-1 and Figure 4-2.)

b. Stretch duct to its full length so air passages are as smooth as possible. Ensure ducts are free of kinks and other obstructions, and are placed to prevent short-cycling (air flowing directly from supply air into return air duct). (See Figure 4-3.)

c. Make all bends gradual—not less than one duct diameter centerline radius—so air flow is not restricted. (See Figure 4-4.)

d. Make connections between sheet metal and flex ducts with metal or nylon clamps.

e. Support flex duct so it does not sag (restricting airflow), using supports at least one inch wide.

Figure 4-1 Duct Attachment, Open

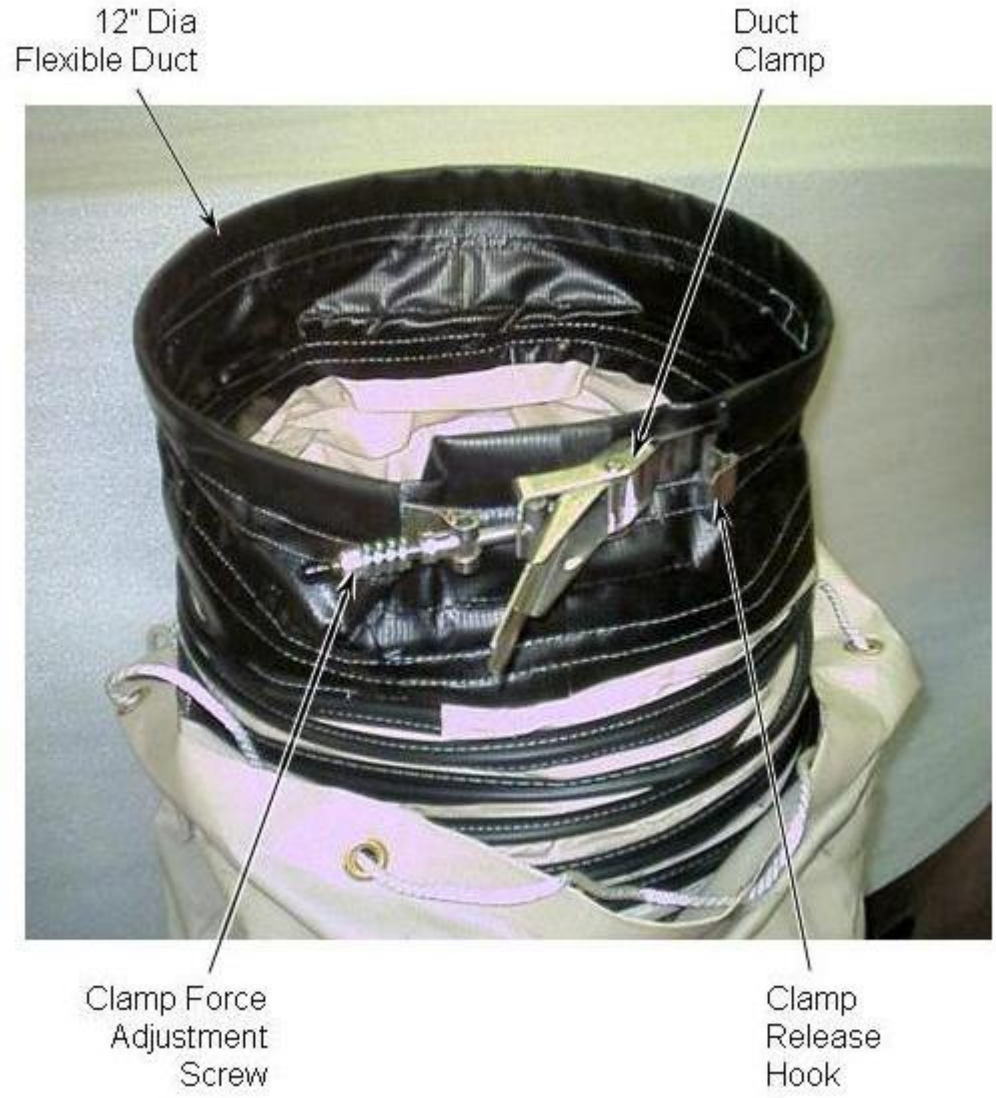


Figure 4-2 Duct Attachment, Closed

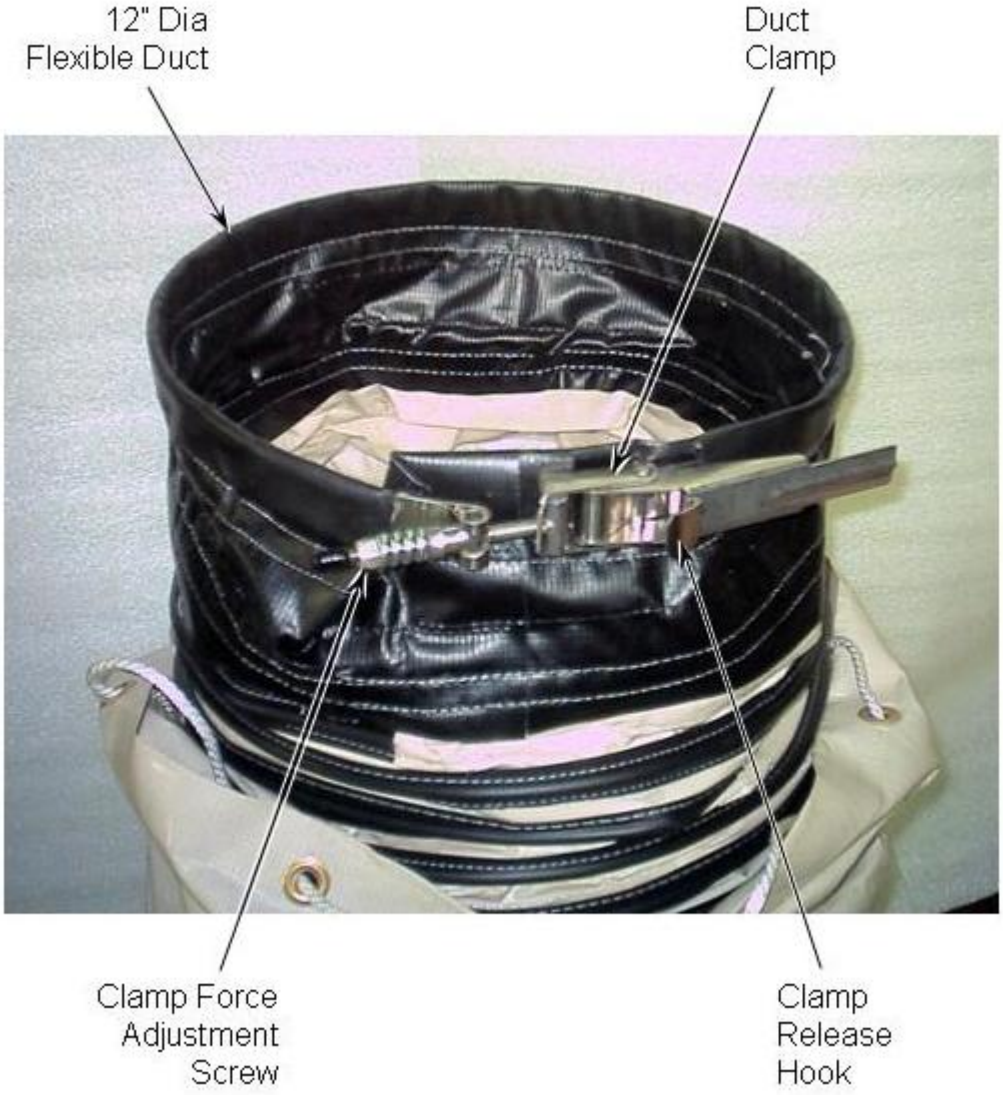


Figure 4-3 Typical Duct Deployment (ECU Shown Mounted On a Trailer)

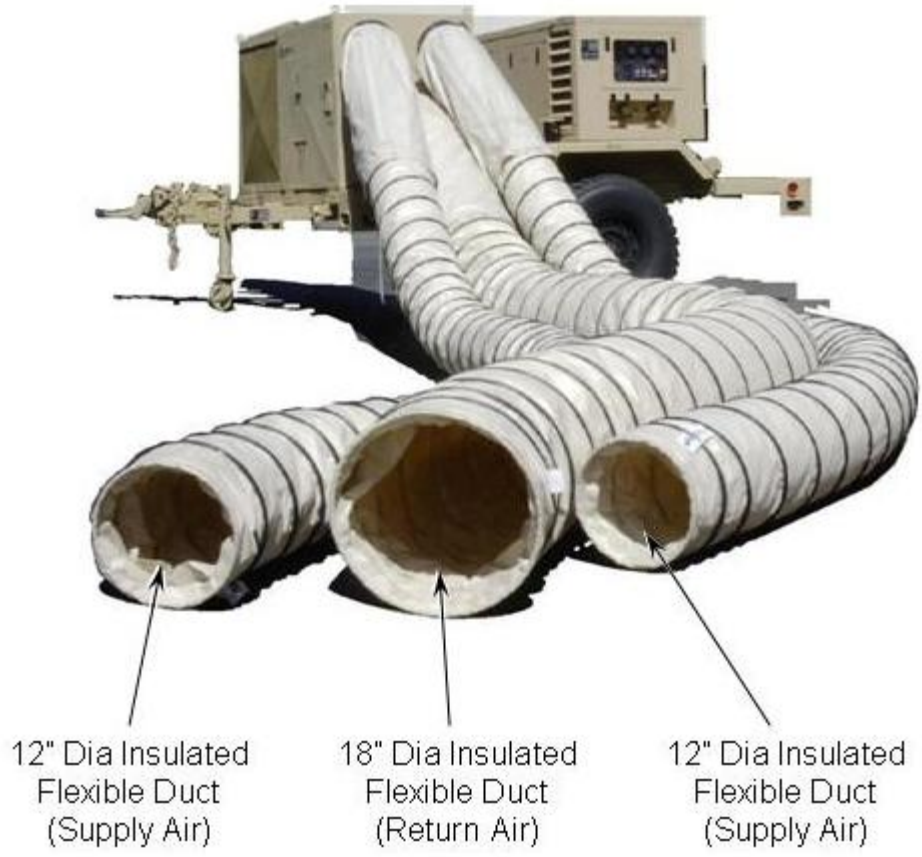
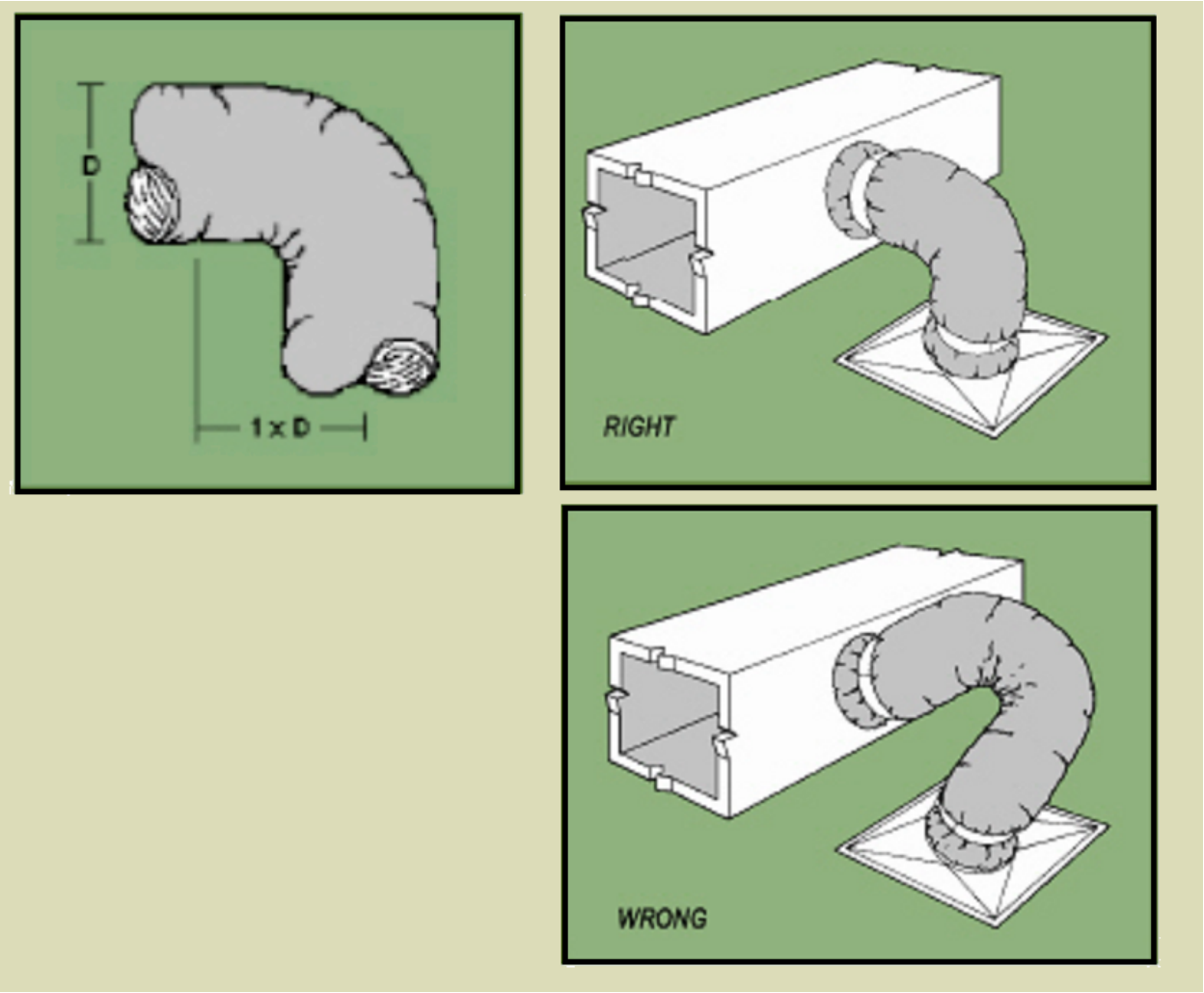


Figure 4-4 Correct Bending of Ducts



5. OPERATION

5.1 General

This section will provide operational instruction for the 53005 120k Btu/hr Horizontal Environmental Control Unit. Review and understand these instructions before operating the unit.

5.2 Controls and Indicators

5.2.1 Electrical Control Box

Refer to Table 8-2 and Figure 8-8 for the arrangement and identification of the electrical control components. The electrical control box contains the following indicators:

- ***COOL MODE TIME DELAY (Green) –*** ON when cooling system (compressor) is in 3 minute time delay. Time delay engages when COOL mode is selected by mode switch (HEAT/VENT/COOL toggle). Time delay allows pressure to equalize before energizing compressor. This is a protection device for the compressor to prevent short-cycling. DOES NOT INDICATE A FAULT.

- ***HIGH PRESS FAULT (Red) –*** ON if refrigerant pressure at output of compressor is too high. May indicate an over charge of refrigerant or blocked condenser coil. High Pressure cut-out switch requires a manual reset.

- ***LOW PRESS FAULT (Red) –*** ON if refrigerant at input of compressor is too low. Indicates a possible leak in the refrigerant system, iced evaporator coil, or insufficient airflow (evaporator fan rotating backward). Lamp turns OFF when pressure rises.

- ***FREEZESTAT FAULT (Red) –*** ON when evaporator air falls below 29 °F (moisture forms ice on the evaporator fins and tubes). Turns OFF when temperature is above 55 °F.

- ***AIR PRESS FAULT (Red) –*** Normally OFF, monitored by air differential switch. ON indicates a fault resulting from: Fan rotating backward; restrictive ductwork, including kinked air ducts or other blockage; or dirty air filter.

- ***LOW TEMP FAULT (Red) –*** Normally OFF, unless temperature falls below 56 °F. Compressor will not start, and lamp illuminates. DOES NOT INDICATE A FAULT.

5.2.2 Control Panel

Refer to Table 8-3 and Figure 8-9 for the arrangement and identification of the ECU controls. The ECU control panel contains the following switches and indicators:

- ***ON/OFF Switch -*** An ON-OFF toggle, this system power switch turns on power to the ECU. In the ON position, all functions of the ECU will be available.

- ***SYSTEM ON Indicator (Green) –*** System power indicator is ON when power is applied to the ECU.

- ***HEAT/VENT/COOL Switch-*** An ON-OFF-ON toggle, this switch selects the operating mode for the ECU.
  - Cool Mode - Compressor runs continually and the thermostat will cycle the compressor solenoid valve for temperature control.
  - Vent mode - Evaporator fan will run continually for air circulation. No heating or cooling will take place.
  - Heat mode - Thermostat will cycle the heater for temperature control.

- ***WARMER/COOLER Knob -*** This thermostat control knob allows user to control air temperature from the ECU over a temperature range of 65 °F to 100 °F.

5.2.3 Sight Glasses

Refer to Table 8-1 and Figure 8-1 for part number and location of sight glasses. The sight glasses have a color-coded moisture indicator:

Green	=	Dry system
Chartreuse	=	Caution
Yellow	=	Wet (water is present in the system)

The sight glass moisture indicator MUST be green before operating the system.

5.3 Operational Procedures

CAUTION

Always ensure the top condenser air intake and exhaust panels are unobstructed prior to operation. The ECU will not function if these mesh panels are obstructed (refer to Figure 2-3).

CAUTION

Always verify proper phasing when applying power to the ECU (ABC).

5.3.1 Sequence of Operation

a. Verify ON/OFF switch is in the OFF position.

b. Verify 208VAC, 3 Phase, 50/60 HZ power to air conditioner.

c. Select mode option for ECU.
- HEAT mode furnishes heat controlled by the thermostat.
- VENT mode circulates air without heating or cooling.
- COOL mode selects cooling as required by the thermostat. The compressor will run continually.

d. Turn ON/OFF switch to ON.

NOTE:
The compressor is protected by a time delay relay and will energize after the 3 minute delay has been satisfied.

5.3.2 Shutdown Procedure

a. Turn ON/OFF switch to OFF.

b. Verify fan and compressor stop.

5.3.3 Emergency Shutdown Procedure

a. Turn ON/OFF switch to OFF.

b. Disconnect ECU power cable or turn OFF power supply.

6. TROUBLESHOOTING

6.1 General

The following table provides the technician with a basic guide to troubleshoot common problems with the ECU. While this table is not intended to be all-encompassing, it does list the more common problems that may be encountered along with the possible causes and the suggested remedies. Refer to Paragraph 5.2.1 for use of diagnostic lamps.

Table 6-1 Troubleshooting

Symptom	Possible Cause	Remedy
ECU fails to start.	Incorrect voltage.	Correct voltage.
	Power failure.	Check power source, power input, and circuit breaker. Check control cables and connections.
Compressor fails to start.	Defective contactor.	Repair or replace. Check for overload.
	Head pressure too high (high pressure switch open).	Reset high pressure switch. Check for condenser blockage. Check condenser fan motor contactor (K2).
	Loss of refrigerant (low pressure switch open).	Repair leak, recharge system.
	Defective time delay relay.	Replace relay.
	Defective compressor.	Replace compressor.
Noisy compressor.	Worn or failed compressor bearings (indicated by excessive knocking).	Replace compressor.
	Compressor running backward.	Check line power phasing.
No condenser airflow.	Overload trip.	Determine cause and repair.
	Defective head pressure fan switch.	Replace switch.
	Defective Thermal cut-out switch (TCO).	Replace switch.

Head pressure too high.	Low condenser airflow (indicated by excessively warm air leaving the condenser fan). Air or other non-condensable gas in system. Over charge of refrigerant.	Open air passages. Clean coil. Check condenser fan(s). Reclaim system and recharge. Install new filter/drier. Reclaim excess refrigerant from unit.
Head pressure too low.	Loss of refrigerant (indicated by bubbles in both sight glasses). Cold ambient temperature.	Repair leak and recharge system. Pressure will come up as temperature increases.
Suction pressure too low.	Expansion valve stuck in the open position (indicated by abnormally cold suction line). Low charge, flash gas in liquid line (indicated by bubbles in both sight glasses). Clogged filter/drier. Obstructed expansion valve (indicated by loss of capacity). Loss of control fluid from expansion valve control head (indicated by bubbles in the sight glass).	Repair or replace valve. Repair leak and recharge system. Replace filter/drier. Replace valve. Replace valve or control head.
Heater fails to operate.	Overload trip. Defective over-temp switch. Defective contactor.	Determine cause and repair. Replace switch. Replace contactor.

6.2 Diagnostic Checks

6.2.1 Power Supply Check

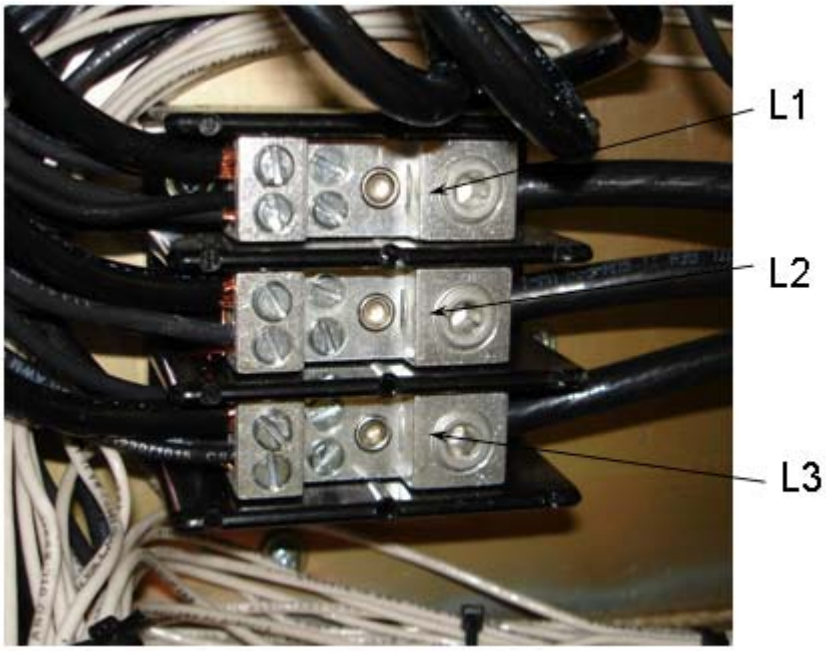
a. Ensure J1 (Figure 8-4, item 20) is connected to source power but ECU ON/OFF switch is set to OFF (so power is supplied to unit but unit is not running while making the following checks).

b. On the power distribution block (see Figure 6-1), use voltmeter and check for proper voltage (208V +/- 10%) across:
   L1 to L2
   L1 to L3
   L2 to L3

c. Check to see if there are any other switches or problems at main panel.

d. If no voltage, correct the problem.

Figure 6-1 Power Distribution Block TB1



6.2.2 Unit Voltage Check

If there is a problem with a unit starting, or the compressor is cycling on its overload, the trouble may be due to improper electric service being supplied to the unit. It will be necessary to check the voltage in the unit power connections.

a. Shut off current by opening the disconnect switch or circuit breaker.

b. Connect voltmeter to L1 and L2 terminals on contactor (K1) (see Figure 6-2).

c. Turn the thermostat so it does not call for cooling.

d. Turn on the disconnect switch.

e. Read the voltage (should be 208V +/- 10%). This is called “idle” voltage.

f. Turn the thermostat to call for cooling.

g. With unit running, read the voltmeter (should be 208V +/- 10%). This is called “running voltage”.

h. Check idle and running voltage across L2 to L3 and L1 to L3 also (should be 208V +/- 10%).

Figure 6-2 Contactor K1

Some common causes of voltage drop include service transformers that are overloaded, and service wiring that is too small, or too small a generator.

a. Check the main circuit breaker on the supply power line and the one on the ECU and switch it OFF and back to ON.

b. Check the secondary side of transformer T1 for supply voltage (should be 25 VAC) (see Figure 6-3).

Figure 6-3 Transformer T1

6.2.3 Scroll Compressor Check

NOTE:
The following procedure must be performed by a journeyman, refrigeration mechanic, or an air conditioning technician.

Scroll compressors do not have internal suction valves or dynamic discharge valves that can be damaged, so it is not necessary to perform functional compressor tests where the compressor is turned on with the suction service valve closed to check how low the compressor will pull suction pressure. In fact, this type of test may actually damage a Scroll compressor (and other types of compressors). The following diagnostic procedure should be used to evaluate whether a Scroll compressor is functioning properly.

a. **Verify proper voltage to the unit** – If the compressor will not run, the normal checks of motor winding continuity and short to ground should be made to determine if the inherent internal overload motor protector has opened or if an internal short to ground has developed. If the protector has opened, the compressor must be allowed to cool sufficiently to allow it to reset.

b. **Verify proper indoor and outdoor fan/blower operation (rotation) –** With service gauges connected to suction and discharge pressure fittings, energize the compressor. If suction pressure falls below normal levels (see Table 9-1) the system is either too low on charge or there is a flow blockage in the system (refrigerant or air). If suction pressure does not drop and discharge pressure does not rise to normal levels the compressor is faulty.

6.2.4 Use of Sight Glasses

The sight glasses provide a means to indicate low charge by showing continuous excess bubbles of flash gas within the liquid line after the system has run for 30 minutes to stabilize, which is helpful in determining if the system is adequately charged with refrigerant. Although bubbles of flash gas in the glass are usually an indication of a low refrigerant charge, this is not always the case. Other conditions that can cause bubbles to appear are:

- A restriction in the liquid line upstream of the sight glass, such as a clogged filter/drier.
- Erratic thermostatic expansion valve operation.
- Rapid fluctuation in discharge pressure.
- Low ambient conditions.

The above conditions are often temporary or fluctuating. Prolonged observation (30 minutes or more) of sight glass bubbles combined with other symptoms such as low suction pressure and/or insufficient cooling are good indications that the system is low on refrigerant.

The sight glasses also have a color-coded moisture indicator:

Green	=	Dry system
Chartreuse	=	Caution
Yellow	=	Wet (water is present in the system)

The sight glass moisture indicator MUST be green before operating the system.

6.2.5 Checking Refrigerant Charge

WARNING

Adhere to the following precautions:

- **Always wear safety glasses when working with refrigerant.**
- **Beware of refrigerant burn when removing hoses.**
- **Use caution when working with pressurized hoses.**
- **Use only hoses with side wall designed for high pressure.**

a. Install gauge manifold to unit.

   1) Turn ECU ON/OFF switch to OFF.

   2) Put high pressure hose on first.

   3) Put low pressure hose on second.

b. Turn the thermostat to call for cooling.

c. Turn ECU ON/OFF switch to ON.

d. Check the unit operating pressures at gauge manifold with the normal operating pressure curve for this unit (see Table 9-1).

e. If the system is operating properly, disconnect gauge manifold, and reinstall all gauge port caps and system service valve caps.

6.2.6 Icing or Frosting of Evaporator Coil

A condition often encountered in the field is icing or frosting of the evaporator coil. Since there are several causes for this condition, it can sometimes be difficult to diagnose. Icing and frosting are two separate and distinct conditions:

- **ICING** - A covering of slick, smooth ice on the surface. This can be a very thin coat or it may become quite thick. It may further build up over a fairly large area.

- **FROSTING** - Has a snowy, crystal-like appearance. It is generally confined to a very small area.

Generally the cause:

a. Low suction pressure.
b. Air volume through the evaporator coil is low.
c. Air filters restricted or plugged.
d. Small or restricted ductwork.

Occasionally the cause:

a. Refrigerant charge is low.
b. General restrictions.
c. Air stratification in conditioned space.

7. MAINTENANCE

7.1 Maintenance Instructions

Preventive Maintenance Checks and Services (PMCS) are essential to ensure that the unit is ready for operation at all times. They correct defects and deficiencies before they can cause serious damage or complete failure of the equipment. Any effective preventive maintenance program must begin with the indoctrination of operators to report all unusual conditions noted during daily checks or actual operation to the appropriate maintenance personnel.

A system should be established to record all problems, defects, and deficiencies noted by operators and discovered during maintenance inspections together with the corrective actions taken.

A schedule for preventive maintenance inspection and service should be established immediately after installation of the unit. Refer to PMCS Table (Table 7-1) for recommended service intervals. When operating under unusually adverse conditions, such as an extremely dusty, dirty, or sandy environment, it may be necessary to reduce the interval to monthly or less depending on the severity of the environmental conditions.

Stand-by, non-operating units should be rotated on a last in, last out basis. Any unit not operating for one (1) year should be tested. A walk-by, visual inspection should be done monthly. Look for physical damage due to material handling and evidence of oil leakage around the unit. Any unit that shows evidence of physical damage or oil leakage must be tested.

The refrigerant compressor and its drive motor are hermetically sealed. The compressor crankcase has a lifetime supply of oil and is pressure lubricated by an internal oil pump. If compressor failure or motor burnout occurs, the compressor must be replaced. Refer to the Parts List for the correct replacement part. The evaporator blower motor and the condenser fan motor are permanently lubricated.

The PMCS Table (Table 7-1) lists the preventive maintenance checks and services that should be performed at quarterly (or otherwise established) intervals. The PMCS items in the table have been arranged in a logical sequence to provide for greater personnel efficiency and least amount of required maintenance downtime.

Table 7-1 Preventive Maintenance Checks and Services (PMCS)

COMPONENT	PROCEDURES	SERVICE INTERVAL
Return Air / Fresh Air Filters	➢ Remove, Clean, Inspect, and Service. ➢ Discard/replace damaged or unserviceable filter.	Monthly
Evaporator and Condenser Coils	➢ Check for secure mounting. Secure as needed. ➢ Check for bent fins. Straighten with tongue depressor, coil fin comb, or plastic sheet. ➢ Clean coils as needed. ➢ Re-coat with Teflon ®spray.	Quarterly
Outside Surfaces	➢ Check outside surfaces for accumulations of dust, dirt, or salt. Clean as required.	Quarterly
Fan Motors	➢ Check for loose electrical connections. Secure as needed. ➢ Check for loose mounting hardware. Secure as needed. ➢ Check for accumulated dust/dirt. Clean as required.	Semi-Annually
Compressor	➢ Check for loose electrical connections. Secure as needed. ➢ Check for loose mounting hardware. Secure as needed. ➢ Check for accumulated dust/dirt. Clean as required.	Semi-Annually
Refrigeration Components	➢ Check for loose mounting. Tighten as needed. ➢ Check tubing attachments. Repair as needed. ➢ Inspect for bent or damaged equalizer tubing. Replace as needed. ➢ Check expansion valve bulbs insulation. Replace as needed. ➢ Check insulation. Repair as needed.	Semi-Annually
Condensate Drain Pan and Hoses	➢ Check evaporator compartment for evidence of moisture. ➢ Blow out drain line if necessary. (A quart of clean water poured into the condensate pan provides a visual check of the drain line condition.)	Semi-Annually
Refrigerant Charge	➢ Using the sight glass, inspect refrigerant while unit is running in COOL mode and at high temperature (>100 °F). One will “flash” bubbles and one should be clear. ➢ If low on charge, check for refrigerant leaks, recover refrigerant, repair leak, and recharge system.	Semi-Annually
Electrical Panel / Interconnect Wiring	➢ Inspect for damaged insulation, broken connection to lugs, and indications of deterioration. Replace and repair as needed.	Semi-Annually

Brackets, Mounts, Hardware, etc	➢ Examine for loose or missing attaching hardware or other obvious damage.	Semi-Annually
Sight Glasses	➢ Clean both top and bottom sight glasses. ➢ Inspect condition of glass. Replace if cracked.	Semi-Annually
Reassemble	➢ Install all components and panels removed during PMCS. ➢ Ensure all items are back in place and secure.	As Required

WARNING

De-energize the air conditioner by disconnecting the power cord from the power source and removing the power cord from the power connector, as a first step to all removal and replacement procedures. Lethal voltages are present even when the ON/OFF switch is in the OFF position.

CAUTION

Air pressure not to exceed 35 psig (2.5 kg/cm^2). Recommended pressure should be between 25-35 psig (1.75-2.5 kg/cm^2). Coil Cleaner such as Hydro Balance Corp Enviro-Coil may be used. If coil cleaner is unavailable, mild soap and water may be used.

7.2 Cleaning Procedures

7.2.1 Evaporator Coil Cleaning

a. Remove panels.

b. Blow dirt from between fins with air nozzle pointing out.

c. Use coil cleaner where you can see foreign material left in the coil after being blown out.

d. With damp cloth, clean debris from side filter compartment.

e. Reinstall removed panels.

f. Re-coat coil with Teflon®.

7.2.2 Condenser Coil Cleaning

a. Remove panels.

b. Blow out debris between fins from inside – out, pointing the air nozzle up.

c. Use coil cleaner where you can see foreign material left in the coil after being blown out.

d. Reinstall removed panels.

e. Re-coat coil with Teflon®.

7.3 Repair Procedures

NOTE:
All refrigeration work must be in compliance with EPA Section No. 608 and all applicable local air quality standards.

7.3.1 Major Overhaul

Under normal operating conditions and with the proper preventive maintenance, the unit should provide excellent service for many years. After this time, the ECU should be returned to the manufacturer or a suitably qualified depot for major overhaul and refurbishment. All work must be performed by qualified refrigeration and electrical technicians and should include replacement of compressors, motors, starters, contactors, bearings, and other accessories as necessary.

NOTE:
REFER TO SAFETY SUMMARY SECTION OF THIS MANUAL. FAILURE TO ADHERE TO THESE RECOMMENDATIONS COULD RESULT IN SERIOUS INJURY.

7.3.2 Field Repairs

It may be necessary from time to time to perform field repairs on the refrigeration system. If field repairs are necessary, the following procedures apply:

7.3.2.1 Leak Detection

a. Pressurize the system – In order to check a system for leaks it is necessary that the system or portion of the system first be pressurized. This will

naturally be true of a new system prior to evacuating and charging, or an old system that has lost its charge.

1) If the system has been in operation and has lost its entire charge, it is desirable to pressurize the entire system to find the leak or leaks.

2) When the entire unit is to be pressurized, it is usually desirable to pressurize the system through both the suction and discharge service valves. In this manner, the pressure is supplied to both the high and low sides of the system.

b. Refrigeration systems are commonly pressurized for purposes of leak checking with refrigerant and dry nitrogen. Test pressures should be adjusted to 10 psig or higher (max 150 psig). (Recover all refrigerant.)

- The advantages of the refrigerant/nitrogen mix are:
  - It is less expensive than refrigerant.
  - Nitrogen will leak approximately twice as fast as refrigerant from the same size hole at the same pressure.
  - The valve and pressure gauge arrangement on a nitrogen bottle provides an excellent means of checking if a leak exists.
  - Nitrogen will not be absorbed by refrigerant oil, thereby causing a misleading pressure drop.
  - Test procedures are easier to obtain.
  - Nitrogen is not ozone depleting.

- The advantages of refrigerant are:
  - Refrigerant leaks can be detected with an electronic leak detector. Nitrogen cannot be detected unless it is used with a portion of refrigerant.
  - Refrigerant may be more readily available for field repairs as it is needed for the ECU in any event.

c. Test for leaks – Use one of the following two methods to leak test a system charged with refrigerant.

- ***Electronic leak detector –*** An electronic leak detector is the preferred tool for leak checking. It is highly sensitive and measures the electronic resistance of gas samples.

  1) Turn detector on and attach proper probe.

  2) Pass probe along the lines going around the joints and connections. Be sure to check all points.

3) Presence of a leak will be indicated by either a buzzing or beeping sound.

- ***Soap Solution –*** Apply a solution of soapy water with a brush or sponge to the joints and connections in the refrigeration line(s). A leak in the lines will cause bubbles to form.

NOTE:
On existing systems which have been in operation, it is usually wise to make a visual check of the system piping since a refrigerant leak will often be indicated by the presence of oil. This is because some of the oil in the system will escape through the leak with the refrigerant.

7.3.2.2 Leak Repair

a. When a leak is located, properly reclaim the remaining refrigerant charge before attempting repairs.

b. Adjacent piping must be thoroughly cleaned by removing all paint, dirt, and oily film. Use a wire brush, sand cloth, or sandpaper and wipe the area with clean, dry cloths.

c. Protect nearby parts from heat damage by wrapping with water-soaked cloths.

d. For copper-to-copper (piping) repairs, use a 15%/80%/5% silver/copper/phosphorous brazing alloy (Sil-Fos 15). No flux is required with Sil-Fos 15. Silver solder (Stay-Silv #45) and flux are to be used on copper-to-brass or copper-to-steel repairs. In an emergency, a 95%/5% tin/antimony solder may also be used with flux for repairs. When repairs are completed, remove all traces of flux.

e. After any repair, check for leaks prior to system use.

NOTE:
Damaged or leaking coils require replacement. The coils are supplied with factory-installed copper stubs for integration into the refrigeration system. Aluminum coils cannot be repaired in the field due to the high temperatures required to make repairs.

WARNING

DEATH or serious injury may result if personnel fail to observe the following safety precautions.

- **Great care must be exercised to prevent contact of liquid refrigerant or refrigerant gas discharged under pressure, with any part of the body. The extremely low temperature resulting from the rapid expansion of liquid refrigerant, or refrigerant gas released under pressure, can cause sudden and irreversible tissue damage through freezing.**
- **As a minimum, all personnel must wear thermal protective gloves and face shield or goggles when working in any situation where refrigerant contact with the skin or eyes is possible. Application of excessive heat to any component in a charged system will cause extreme pressure that may result in a rupture, possibly explosive in nature.**
- **Exposure of Refrigerant R-22 to extreme heat or a very hot surface will cause a chemical reaction in the gas to form carbonyl chloride (phosgene), a highly poisonous and corrosive gas.**
- **In its natural state, Refrigerant R-22 is a colorless odorless vapor with no toxic characteristics. It is heavier than air and in a well-ventilated area will disperse rapidly. However, in an unventilated area it will displace oxygen and presents a danger as a suffocative.**

CAUTION

Do not attempt to make any adjustments without the proper tools. Refer to Table 8-6 **for Recommended Common Support Tools.**

7.4 Attaching Manifold Hose to Schrader Valve

a. Remove cap from valve.

b. Make sure gauge manifold valves are closed.

c. If hose does not have an unseating pin, unseating coupler must be used. Make sure coupler is lined up straight with Schrader valve. Screw coupler on to valve.

d. Open gauge manifold valve slightly and purge air from hose with refrigerant.

e. Read the suction pressure on compound gauge and head pressure on pressure gauge.

f. To remove, push end of coupler tight against end of Schrader valve and hold in place while quickly unscrewing coupler nut from Schrader valve. Remove coupler from Schrader valve.

g. Reinstall cap on valve.

7.5 Evacuation Procedure

CAUTION

AT NO TIME USE THE COMPRESSOR TO EVACUATE THE SYSTEM OR ANY PART OF IT.

NOTE:

A refrigeration system should be evacuated whenever the system has been open in such a manner that there is a possibility that air and moisture could have entered the system. The evacuation process is intended to remove non-condensable gases and moisture from the portion of the system to be evacuated. The most important contaminant to be removed is moisture. To remove moisture from the system, it must first be boiled into vapor. Before water will boil at ordinary room temperature, for example, at 70 °F the vacuum must be 29¼ inches of mercury at 30 inches of mercury barometric pressure. This means that the system must be within ¾ inches of mercury of absolute zero pressure. This low vacuum should be measured by using standard commercial practices, an absolute pressure gauge, or an electronic gauge. For this reason, a good vacuum pump must be used to accomplish good dehydration.

a. Evacuate the system to less than 500 microns, using a good vacuum pump and an accurate high vacuum gauge. Operate the pump at 500 microns, or less, for several hours and then allow the system to stand for several additional hours to be sure the vacuum is maintained.

b. An alternate method of removing moisture and non-condensables from the system is:

1) Evacuate the system to 29 inches mercury for ten minutes per ton of system. Break the vacuum with refrigerant to be used for final charging of system and vapor charge in system for a minimum of five minutes.

2) Repeat Step 1) two more times.

3) Evacuate system to 29 inches mercury for twenty minutes per ton. Charge system with the specified kind and quantity of refrigerant (charge into vacuum).

c. Disconnect charging line at vacuum and connect to refrigerant supply. Crack valve and purge charging line at center on manifold. Then close valve.

d. The system is now ready for the correct operating charge of refrigerant.

7.6 Charging Procedure

7.6.1 Preliminary Charging Steps

If the system has been open to the atmosphere, it should be first evacuated, and then proceed as follows:

a. Attach a drum of proper, clean refrigerant to the center port of the charging manifold with one of the charging hoses.

b. Attach a second charging hose to the suction gauge (low pressure) side of the gauge manifold.

c. Remove the cap from the suction line valve.

d. Loosely attach the suction gauge hose to the line valve. Open the valve on the refrigerant drum and the suction valve on the charging manifold slightly to purge the air from the manifold and hoses before tightening the fitting.

e. Attach the third hose to the high pressure side of the manifold and the liquid line valve. Repeat Steps c and d above.

7.6.2 Charging the System by Weight

a. Connect the manifold as instructed.

b. Place the refrigerant drum on a scale and determine exact weight of refrigerant and cylinder or use a Charging cylinder. Refer to Data Plate for proper charge.

c. With manifold suction valve closed and manifold discharge valve open, open refrigerant cylinder valve and allow pressure in system to balance with pressure of cylinder.

d. When there is approximately a full charge (gas for R22), close the discharge manifold valve and let the system stabilize for about five minutes.

e. Start compressor by setting thermostat.

f. When the correct weight of refrigerant has been added to the unit, close refrigerant cylinder valve and allow unit to run for 30 minutes. Check the charge against the allowable head pressure as shown in Table 9-1 (REFRIGERANT TEMPERATURE/PRESSURE CHART) and correct if needed.

g. Front seat gauge manifold valves, disconnect charging and gauge hoses, and reinstall all valve caps.

7.7 Component Replacement Procedures

WARNING

HIGH VOLTAGE is used in the operation of this equipment. Death on contact or severe injury may result if you fail to observe safety precautions. Always disconnect the ECU from the power source before working on it. Do not operate the ECU without panels and grilles in place and tightly secured.

WARNING

ROTATING FAN BLADES are used in this equipment. Severe injury on contact may result if you fail to observe precautions. Always disconnect power source before working on fans. Do not operate fans without panels and grilles in place and secured.

7.7.1 General

Refer to the wiring diagram and refrigeration schematic in the Appendix of this manual for the location of the system components and their relationship to each other. Refer to any adjustments and settings that may be required before or after installation.

For copper-to-copper (piping) discharge or suction line, use a 15%/80%/5% silver/copper/phosphorous brazing alloy (Sil-Fos 15). No flux is required with Sil-Fos 15. Silver solder (Stay Silv #45) and flux are to be used on copper-to-brass or copper-to-steel repairs. When repairs are complete, remove all traces of flux. After any repair, pressure-check system with refrigerant, checking for leaks prior to recharging the system.

NOTE:
Damaged or leaking coils require replacement. The coils are supplied with factory installed copper stubs for integration into the refrigeration system. Aluminum coils cannot be repaired in the field due to the high temperatures required to make repairs.

7.7.2 Compressor (Table 8-1, item 2)

The compressor is the most important component of the air conditioner. Numerous safety devices are provided to protect the compressor from contamination damage and burnout. **When replacing a burned-out compressor, it is mandatory that the refrigeration system be thoroughly cleaned before operating the replacement compressor.** When a compressor burnout occurs, acid is created as a result of refrigerant-oil mixture being exposed to the extreme high temperatures the motor burnout generates. The acid diffuses throughout the refrigeration system and must be removed before a new compressor is placed in service, or the acid will attack the windings of the new compressor motor. Any dirt, scale, air, or water vapor also drastically shortens the operating life of the new compressor.

NOTE:
The following procedure must be performed by a journeyman, refrigeration mechanic, or an air conditioning technician.

a. Un-sweat suction and discharge lines from compressor.

b. Remove wires from compressor. Note where each wire is installed.

c. Remove and retain hardware that mounts compressor to ECU.

d. Remove compressor from ECU.

e. Install new compressor using hardware removed from defective compressor.

f. Braze suction and discharge lines.

g. Reinstall wires on new compressor per notes from removal step.

h. Replace liquid line filter/drier and add a suction line filter/drier. Test only after running for one (1) hour. If clear of acid, system is okay to return to service.

i. Purge system with dry nitrogen then add a holding charge of Refrigerant R-22. Refer to leak detection section of this manual (see Paragraph 7.3.2.1) and perform leak check.

j. Once unit has passed leak detection test, evacuate refrigeration system to 500 microns of vacuum. Then break vacuum with R-22 refrigerant. Do this three (3) times.

k. Charge and operate unit.

l. After installation and start-up are complete, the following tests should be performed on the replacement compressor and the information recorded.
   1) Suction pressure
   2) Discharge pressure
   3) Amp draw

7.7.2.1 Compressor Burn-Out Cleanup Procedure

When a motor burnout occurs in the compressor, the resulting high temperature arc causes a portion of the refrigerant/oil mixture to break down into carbonaceous sludge, corrosive acid, and water. Contamination resulting from a burnout can result in repeat failures if the contaminants are allowed to reach and remain in the crankcase of the replacement compressor. This situation can be prevented by following the proper clean-up procedures after a burnout. We recommend the filter/drier cleaning procedure. This involves the use of approved filter/driers incorporating an adequate desiccant (not a filter only) in both the liquid and suction lines.

WARNING

Use rubber gloves and safety glasses and ventilate the workspace. The oil from a burnout could cause serious skin irritation and possibly burns. In some cases, the fumes are toxic.

a. In order to avoid losing refrigerant to the atmosphere, you must recover refrigerant using standard recovery procedures and equipment. At that point, remove the inoperative compressor and install the replacement.

b. Since the normal color of refrigerant oil varies from oil to oil, take a sample of oil from the replacement compressor and seal in a small glass bottle for comparison purposes after the cleaning operation is complete. Suitable two-ounce bottles are obtainable at any drug store.

c. Inspect all system controls such as expansion valves, solenoid valves, check valves, reversing valves, contactors, etc. Replace any filter/driers previously installed in the system, and clean or replace any filters or strainers. Install a good quality moisture indicator if the system does not have one.

d. Install the recommended size filter/drier in the suction line, and an oversized filter/drier in the liquid line. Charge unit with a fresh can of refrigerant. Do not reuse contaminated refrigerant.

e. Start the compressor and put the system in operation. As the contaminants in the system are filtered out, the pressure drop across the filter/drier will increase. Observe the pressure differential across the filter/driers for a minimum of four (4) hours, preferably by means of one gauge and a manifold to eliminate gauge error. If the pressure drop exceeds seven (7) pounds, replace both filter/driers and restart the system.

f. After the completion of Step e, allow the unit to operate for 48 hours. Check the odor (warning: smell cautiously) and compare the color of the oil with the sample taken in Step b. If an acid test is available, test for acid content. If the oil is discolored, has an acrid odor, is acidic, or if the moisture indicator indicates high moisture content in the system, change the filter/driers. The compressor oil can be changed if considered desirable. Allow the system to operate for an additional 48 hours, and recheck as before. Repeat until the oil remains clean, odor free and the color approaches that of the original sample.

g. Replace the liquid line filter/drier with one of the normally recommended size. Remove the suction line filter/drier and replace with a permanent type suction line filter/drier.

h. After the cleaning procedure is completed, recheck in approximately two (2) weeks to insure that the system condition and operation is completely satisfactory.

7.7.3 Thermostat Knob (Table 8-3, item 49)

a. Use 1/16 Allen key to remove knob from control panel.

b. Install new knob using Allen key.

7.7.4 System ON/OFF Switch S1 (Table 8-3, item 46) HEAT/VENT/COOL Switch S7 (Table 8-3, item 47)

a. Use 1/16 Allen key to remove thermostat knob from control panel. Set knob aside.

b. Remove control panel from ECU by removing two Phillips screws.

c. Lift out control panel for access to switches and wires.

d. Remove leads from switch. Note where each lead is installed.

e. With 9/16 open-end wrench, loosen one of the thin nuts that hold switch to panel. Remove outer nut and remove switch. Place to one side.

f. Turn rear nut down on new switch. Install new switch in panel. Install front nut and turn until five or six threads show above nut. Tighten rear nut to secure switch.

g. Reinstall leads on new switch per notes from removal step.

h. Reinstall control panel.

i. Use Allen key to reinstall knob.

7.7.5 Indicator Lamp, Green (Table 8-3, item 48)

a. Use 1/16 Allen key to remove thermostat knob from control panel. Set knob aside.

b. Remove control panel from ECU by removing two Phillips screws.

c. Lift out control panel for access to lamp and wires.

d. Pull female push-on terminals off back of lamp. Note where each is installed.

e. Depress lamp retaining tabs and pull lamp out from front of control panel. Set lamp aside.

f. Install new lamp into control panel. Verify retaining tabs are engaged and lamp is secure.

g. Push female push-on terminals back on tabs per notes from removal step.

h. Reinstall control panel.

i. Use Allen key to reinstall knob.

7.7.6 Switch, Thermostat S8 (Table 8-3, item 50)
Switch, Freezestat S5 (Table 8-3, item 51)
Switch, Safety Thermostat (Table 8-1, items 17, 19)

a. Use 1/16 Allen key to remove thermostat knob from control panel. Set knob aside.

b. Remove control panel from ECU by removing two Phillips screws.

c. Lift out control panel for access to switches and wires.

d. Remove leads from switch. Note where each lead is installed.

e. Remove two screws (three for thermostat) holding switch to control panel.

f. Remove 18-inch return air duct (center bottom duct) and return air filter.

g. Trace capillary lead to switch's sensing bulb located on mounting bar in front of evaporator coil. This bar is accessible through the return air flange.

h. Cut cable ties and loosen clamp screw. Slide bulb out of clamp.

i. Retract capillary tube and bulb through grommets in filter frame. It may be necessary to remove grommets to get bulb through. Grommets may be cut if necessary.

j. Remove switch and its sensing bulb and set aside.

k. Feed capillary tube of new switch through filter frame grommets. If grommets were removed, reinstall.

l. Insert bulb in clamp and tighten clamp screw. Check that bulb is securely held.

m. Install new switch.

n. Reinstall leads on new switch per notes from removal step.

o. Reinstall control panel.

p. Use Allen key to reinstall knob.

q. Reinstall filter and duct.

7.7.7 Switch, High Pressure S3 (Table 8-2, item 44)
Switch, Low Pressure S4 (Table 8-2, item 45)

a. Remove electrical control box cover and condenser aft side panel.

b. Remove two screws securing switch to electrical control box.

c. Remove electrical leads from switch. Note where each lead is installed.

d. Trace capillary tube through electrical control box into condenser compartment. Capillary tube expands to ¼ inch and is secured with a Schrader valve fitting to another ¼-inch tube.

e. Remove capillary tube from Schrader valve fitting. Retract capillary tube through grommets.

f. Remove switch and set aside.

g. Feed capillary tube of new switch through grommets.

h. Attach capillary tube of new switch to Schrader valve fitting.

i. Leak test in accordance with Paragraph 7.3.2.1.

j. If leak test is satisfactory, evacuate in accordance with Paragraph 7.5.

k. Charge in accordance with Paragraph 7.6.

l. Reattach leads to switch per notes from removal step.

m. Install new switch.

n. Reinstall electrical control box cover, condenser aft side panel, and service port cover.

7.7.8 Timer TM1, TM2 (Table 8-2, item 38)

a. Remove electrical control box cover.

b. Depress retaining clips securing timer to its socket and remove timer. Note timer settings, then set timer aside.

c. Install new timer. Ensure retaining clips are engaged and timer is secure.

d. Set timer per notes from removal step.

e. Reinstall electrical control box cover.

7.7.9 Socket, Timer (Table 8-2, item 39)

a. Remove electrical control box cover.

b. Depress retaining clips securing timer to socket and remove timer. Note timer settings and set timer aside.

c. Remove wires from timer socket. Note where each wire is installed.

d. Insert flat head screwdriver into latch on bottom of socket and pull down to disengage latch from DIN rail.

e. Lift up and then out to remove socket from DIN rail. Set socket aside.

f. Install new socket on DIN rail: hook socket on top of rail, then push bottom of socket until it clicks onto rail. Ensure latch is engaged and socket is secure.

g. Reattach wires per notes from removal step.

h. Reinstall timer. Ensure settings are correct per notes from removal step.

i. Reinstall electrical control box cover.

7.7.10 Contactors K1 to K4 (Table 8-2, items 31, 32)

a. Remove electrical control box cover.

b. Remove all wires from contactor. Note where each wire is installed.

c. Remove mounting screws. Remove contactor and set aside.

d. Install new contactor.

e. Reattach all wires per notes from removal step. Tighten screw as each set of wires is reinserted.

f. Reinstall electrical control box cover.

7.7.11 Relays, Time Delay TD1 to TD4 (Table 8-2, item 37)

a. Remove electrical control box cover.

b. Remove all wires from relay, including jumper wire connecting A1 and 15. Note where each wire is installed.

c. Insert flat head screwdriver into latch on bottom of relay and pull down to disengage latch from DIN rail.

d. Lift up and then out to remove relay from DIN rail. Set relay aside.

e. Install new relay on DIN rail: hook relay on top of rail, then push bottom of relay until it clicks onto rail. Ensure latch is engaged and relay is secure.

f. Reinstall wires, including jumper wire, per notes from removal step.

g. Ensure that all time delay settings are correct per notes from removal step.

h. Reinstall electrical control box cover.

7.7.12 Relay, DPDT R1 (Table 8-2, items 41)

a. Remove electrical control box cover.

b. Pull female push-on terminals off bottom of relay. Note where each is installed.

c. Loosen bottom mounting screw. Remove top screw and remove relay. Set aside.

d. Slide bottom tab of relay under washer on lower screw. Reinstall upper screw and tighten both screws.

e. Push female push-on terminals back on tabs per notes from removal step.

f. Reinstall electrical control box cover.

7.7.13 Transformer T1 (Table 8-2, item 35)

a. Remove electrical control box cover and condenser forward side panel.

b. Remove all wires from transformer. Note where each wire is installed.

c. Remove four screws and backing nuts securing transformer to electrical control box. Backing nuts are located on back side of electrical control box.

d. Remove transformer and set aside.

e. Install new transformer.

f. Reinstall all wires on new transformer per notes from removal step.

g. Reinstall electrical control box cover and condenser forward side panel.

7.7.14 Terminal Block TB1, (Table 8-2, item 34)

a. Remove electrical control box cover.

b. Loosen setscrews in top of terminal block, and slide wires out of their recesses. Masking tape may be used to hold wires in relationship to each other before loosening screws. Note where each wire is installed.

c. Remove mounting screws and terminal block. Set terminal block aside.

d. Holding new terminal block in hand, look into recesses (holes) where wires are inserted. Back out setscrews until screws clear holes.

e. Install new terminal block with mounting screws.

f. Insert wires into appropriate recesses per notes from removal step. Tighten setscrew as each wire is inserted.

g. Reinstall electrical control box cover.

7.7.15 Terminal Block TB2 (Table 8-2, item 36)

a. Remove electrical control box cover.

b. Remove screws down both sides of terminal block that have a terminal under them. Masking tape may be used to hold wires in relationship to each other before removing screws. Note where each wire is installed.

c. Remove mounting screws and terminal block. Set terminal block aside.

d. Install new terminal block with mounting screws.

e. Insert terminal block screws through terminal rings and reinstall on block per notes from removal step.

f. Reinstall electrical control box cover.

7.7.16 Indicator Lamps, Green and Red (Table 8-2, items 42, 43)

a. Remove electrical control box cover.

b. If necessary, remove screws securing lamp plate to electrical control box and lift out plate for access to lamps and wires.

c. Pull female push-on terminals off back of lamp. Note where each is installed.

d. Depress lamp retaining tabs and pull lamp out from front of plate. Set lamp aside.

e. Install new lamp into plate. Verify retaining tabs are engaged and lamp is secure.

f. Push female push-on terminals back on tabs per notes from removal step.

g. If removed, reinstall lamp plate.

h. Reinstall electrical control box cover.

7.7.17 Switch, Fan Cycle S2 (Table 8-1, item 15)

a. Remove condenser forward side panel or end panel, and electrical control box cover.

b. Remove leads from switch. Note where each lead is installed.

c. Unscrew switch from service valve it is mounted on. There is a 5/8 hex on the end of the switch's capillary tube, where it screws on to service port. Use a 7/16 backing wrench when removing switch from Schrader valve. There is a Schrader (tire) valve inside service port, which prevents refrigerant loss when switch is removed. Cut cable ties to free capillary tube.

d. Screws securing switch to electrical control box are located inside the box. If necessary, remove timer(s) and time delay relay(s) to access screws. If removed, note settings of timer(s) and relay(s) and set aside.

e. Remove screws securing switch to box. Remove switch and set aside.

f. Install new switch on service port.

g. Reattach leads to new switch per notes from removal step.

h. Install new switch in electrical control box.

i. If removed, reinstall timer(s) and relay(s), and ensure settings are correct per notes from removal step.

j. Replace cable ties.

k. Reinstall condenser forward side panel or end panel, and electrical control box cover.

7.7.18 Switch, Differential Pressure S10 (Table 8-1, item 18)

a. Remove evaporator aft side panel.

b. Remove two mounting screws and pull switch away from the panel on which it is mounted.

c. Loosen screw retaining cover and remove cover.

d. Remove electrical leads. Note where each lead is installed.

e. Remove barbed fitting from switch with ½-inch open-end wrench. Set switch aside.

f. Install barbed fitting on new switch and tighten to secure.

g. Reattach electrical leads to new switch per notes from removal step.

h. Reinstall cover on switch.

i. Install new switch onto panel.

j. Reinstall evaporator aft side panel.

7.7.19 Switch, Head Pressure (Table 8-1, item 16)

a. Remove condenser aft side panel and electrical control box cover.

b. Loosen screw and remove switch cover.

c. Remove leads from switch. Note where each lead is installed.

d. Unscrew switch from service port it is mounted on. There is a 5/8 hex on the end of the switch's capillary tube, where it screws on to service port. Use a 7/16 backing wrench when removing switch from Schrader valve. There is a

Schrader (tire) valve inside service port, which prevents refrigerant loss when switch is removed. Cut cable ties to free capillary tube.

e. Screws securing switch to electrical control box are located inside the box. Remove screws securing switch to box. Remove switch, note settings, and set switch aside.

f. Install new switch on service port.

g. Reattach leads to new switch per notes from removal step.

h. Install new switch in electrical control box.

i. Replace cable ties.

j. Set high pressure cut-out and differential per notes from removal step. (Refer also to refrigeration diagram note 7).

k. Reinstall condenser aft side panel and electrical control box cover.

7.7.20 Switch, Current Sensing Relay (Table 8-1, item 22)

a. Remove evaporator aft side panel.

b. Remove two screws and remove switch box.

c. Remove leads. Note where each lead is installed.

d. Remove two screws securing switch to box.

e. Remove switch, note settings, and set switch aside.

f. Install new switch into box and secure with screws.

g. Ensure settings on new switch are correct per notes from removal step.

h. Reattach leads to switch per notes from removal step.

i. Reinstall switch box and secure with screws.

j. Reinstall evaporator aft side panel.

7.7.21 Heater HR1 (Table 8-1, item 10)

a. Remove evaporator cover.

b. Remove nuts from terminals on side of heater and remove all leads. Also remove push-on leads from top of heater. Note where each lead is installed.

c. Remove supply air plenum to access screws. Remove six screws securing heater to ECU frame.

d. Remove heater and set aside.

e. Lower new heater into evaporator compartment. Reinstall screws securing heater to ECU frame.

f. Reinstall supply air plenum.

g. Reinstall heater leads per notes from removal step.

h. Reinstall evaporator cover.

7.7.22 Valve, Service Port and Cap P1, P2 (Table 8-1, item 12)

The valve and cap perform the same function with the refrigerant as the same valve and cap do with automotive tires.

a. Remove service port cover.

b. Caps are unscrewed and removed to attach manifold gauge lines to service port for service.

c. Valve problems are most likely to occur when attaching manifold gauges. If refrigerant starts leaking from the service port, immediately insert Schrader valve tool into service port and tighten valve.

d. If leak stops, no further action is required.

e. If leak does not stop, refrigerant will have to be recovered using standard recovery procedures and equipment.

f. Using Schrader valve tool, unscrew valve. Loosen backing nut behind valve.

g. Un-sweat tube and pull valve straight out. Set valve aside.

h. Remove Schrader core from new valve and set core aside. Install new valve and braze onto tube. When done, reinstall Schrader core and tighten valve backing nut.

i. Leak test in accordance with Paragraph 7.3.2.1.

j. Evacuate system in accordance with Paragraph 7.5.

k. Recharge system in accordance with Paragraph 7.6.

l. Screw caps onto service ports.

m. Reinstall service port cover.

7.7.23 Filter/drier F1 (Table 8-1, item 14)

a. Recover refrigerant using standard recovery procedures and equipment.

b. Remove evaporator forward side panel.

c. Un-sweat tubes on either end of filter/drier.

d. Loosen clamp screw to remove filter/drier. Note direction of arrow on body of filter/drier, then remove filter/drier and set aside.

e. Install new filter/drier with arrow pointing in same direction as noted in removal step.

f. Insert tubes into inlets on both ends of filter/drier and braze tubes. Filter/drier must be wrapped with a wet cloth while brazing. Do not overheat filter/drier. Cool with wet cloth when done.

g. Leak test in accordance with Paragraph 7.3.2.1. Tighten clamp.

h. Evacuate ECU in accordance with Paragraph 7.5.

i. Charge in accordance with Paragraph 7.6.

j. Reinstall evaporator forward side panel and service port cover.

7.7.24 Receiver, Refrigeration FC1 (Table 8-1, item 3)

a. Recover refrigerant using standard recovery procedures and equipment.

b. Remove condenser aft side panel and end panel.

c. Un-sweat tubes on top of refrigeration receiver.

d. Loosen clamp screw to remove refrigeration receiver. Note how refrigeration receiver is oriented in condenser compartment, then remove refrigeration receiver and set aside.

e. Install new refrigeration receiver. Ensure orientation is the same as noted during removal step.

f. Insert tubes into inlets on top of refrigeration receiver and braze tubes.

g. Leak test in accordance with Paragraph 7.3.2.1. Tighten clamp.

h. Evacuate ECU in accordance with Paragraph 7.5.

i. Charge in accordance with Paragraph 7.6.

j. Reinstall condenser aft side panel, end panel, and service port cover.

7.7.25 Sight Glass D1, D2 (Table 8-1, item 11)

a. Recover refrigerant using standard recovery procedures and equipment.

b. Remove condenser end panel.

c. Remove two screws securing sight glass bracket and remove bracket.

d. Un-sweat top and bottom tubes on sight glass.

e. Remove sight glass and set aside.

f. Install new sight glass. Insert tubes into top and bottom inlets of sight glass and braze tubes. Sight glass must be wrapped with a wet cloth while brazing. Do not overheat sight glass. Cool with wet cloth when done.

g. Leak test in accordance with Paragraph 7.3.2.1. Reinstall sight glass bracket.

h. Evacuate ECU in accordance with Paragraph 7.5.

i. Charge in accordance with Paragraph 7.6.

j. Reinstall condenser end panel and service port cover.

7.7.26 Valve, Thermo Expansion TXV1 (Table 8-1, item 13)

a. Recover refrigerant using standard recovery procedures and equipment.

b. Remove evaporator side panels.

c. Cut cable ties holding capillary tube, trace tubing to bulb, loosen clamp and slide bulb out.

d. Un-sweat tubes going into valve. Remove valve and set aside.

e. Insert three tubes into new valve and braze tubes. Valve must be wrapped with a wet cloth while brazing. Do not overheat valve. Cool with wet cloth when done.

f. Leak test in accordance with Paragraph 7.3.2.1.

g. Evacuate ECU in accordance with Paragraph 7.5.

h. Charge in accordance with Paragraph 7.6.

i. Unwind capillary tube enough that bulb can be placed in its original position. Tighten clamp.

j. Install cable ties to restrain capillary tube.

k. Reapply cork insulation.

l. Reinstall evaporator and service port covers.

7.7.27 Coil, Condenser (Table 8-1, item 4)

a. Recover refrigerant using standard recovery procedures and equipment.

b. Remove condenser covers while unit is being evacuated.

c. Remove brackets securing coil to ECU frame.

d. After completion of refrigerant recovery, flood system with nitrogen.

e. Un-sweat upper line of condenser coil and remove section of line with valve body. A wet cloth must be used on condenser coil inlet/outlet. Do not overheat aluminum fittings on condenser coil.

f. Un-sweat lower line of condenser coil at elbow. A wet cloth must be used on condenser coil inlet/outlet. Do not overheat aluminum fittings on condenser coil.

g. Tilt top of coil away from frame and lift out.

h. Reassemble new coil and refrigeration lines in reverse order. Braze with wet cloths wrapped around aluminum fittings of condenser coil.

i. Leak test in accordance with Paragraph 7.3.2.1.

j. Evacuate ECU in accordance with Paragraph 7.5.

k. Charge in accordance with Paragraph 7.6.

l. Reinstall condenser and service port covers.

7.7.28 Coil, Evaporator E1 (Table 8-1, item 5)

a. Recover refrigerant using standard recovery procedures and equipment.

b. Remove evaporator side panels.

c. Remove return air plenum and supply air plenum.

d. Remove two front screws behind supply plenum securing evaporator fan bulkhead. Lift evaporator fan bulkhead up and bend back out of the way.

e. Un-sweat thermo expansion valve from coil distributor. Valve must be wrapped with a wet cloth while brazing. Do not overheat valve. Cool with wet cloth when done.

f. Un-sweat suction line from coil.

g. Remove side brackets securing coil to angled frame.

h. Push bulkhead back and remove coil through side of ECU.

i. Reassemble new coil and refrigeration lines in reverse order. Braze with wet cloth wrapped around thermo expansion valve. Do not overheat valve. Cool with wet cloth when done.

j. Leak test in accordance with Paragraph 7.3.2.1.

k. Evacuate ECU in accordance with Paragraph 7.5.

l. Charge in accordance with Paragraph 7.6.

m. Pull evaporator fan bulkhead back into position and reinstall screws behind supply plenum.

n. Reinstall supply air plenum, return air plenum, and evaporator side panels.

7.7.29 Motor, Evaporator Fan B2 (Table 8-1, item 8)
Motor, Condenser Fan B3 (Table 8-1, item 6)

a. Remove evaporator or condenser side panels and electrical control box cover.

b. For evaporator motor only, loosen side screws on vertical panel in front of blower wheel and pull panel away from blower wheel. Slide blower wheel off cone in order to access motor.

c. Loosen two setscrews in fan hub with 5/32 hex key from hex key set. Take at least two turns on setscrews.

d. Spray fan hub shaft interface with WD-40 or other penetrating oil if available. Let set for 15 minutes. Pull fan off shaft. Retain square key.

e. Record distance from end of shaft to side of ECU.

f. Trace motor leads to contactor in electrical control box.

g. Remove leads from contactor. Note where each lead is installed.

h. Pull wires out of grommets etc. until they are hanging loose from motor.

i. Remove four bolts holding motor base to its support using ½-inch socket with ratchet and ½-inch wrench.

j. Lift motor out of ECU. Set aside.

k. Place new motor on the motor support and reinstall four bolts.

l. Wrap leads with spiral wrap. Reinsert through grommets etc. to the electrical control box.

m. Cut all leads to length. Strip ends ¼ inch.

n. Reinstall leads on contactor per notes from removal step.

o. Check bore of fan hub for burrs caused by removal. If burrs are found, remove with round file or sandpaper wrapped around a dowel.

p. Reinstall fan on motor shaft. With the motor and inlet ring securely mounted to the ECU place the key on the motor shaft keyway, and slide the fan wheel on the motor shaft. Key should be flush with fan and fan should be distance from side of ECU recorded in Step e. above.

q. Position the fan wheel so that there is a ¼ to 3/8 inch overlap of the fan wheel to the inlet ring. Install the motor shaft set screw into the fan hub and tighten securely. Spin the fan wheel to ensure that the fan wheel does not rub against the inlet ring and a concentric clearance has been established.

r. Locate the setscrew hole adjacent to the keyway set screw previously installed. Use a center punch to mark the center of the setscrew hole on the motor shaft. If motor shaft length is excessive, mark the shaft so that excess maybe removed. Note: The motor shaft is not to be recessed into the fan wheel hub.

s. Remove the fan wheel and using a 7/32 drill, drill a hole 3/16 inch deep. Remove any excess motor shaft, if required. Coat the motor shaft completely using #238 dry film lubricant or equivalent.

t. Install the fan wheel and key onto the motor shaft, aligning the fan wheel to the inlet ring and the hole drilled for the setscrew. Lightly spin the fan wheel to ensure proper engagement and that the fan does not rub the inlet ring.

u. Place Loctite No. 242 or equivalent on the setscrews. Torque the setscrews to 125-inch pounds. Cover the setscrews with anti-tamper paint or torque seal.

v. Reinstall all covers.

7.7.30 Filter, Return Air (Table 8-1, item 1)

a. Remove two thumbscrews securing side panel on return air plenum.

b. Remove side panel.

c. Spring-load mechanism inside return air plenum should pop filter out as soon as side panel is removed. If necessary, push in on filter and let go to release springs. Remove filter.

d. Install new filter.

e. Reinstall side panel and tighten thumbscrews.

7.7.31 Filter, Fresh Air (Table 8-1, item 25)

a. Remove four screws securing fresh air filter door bracket to side panel.

b. Pull off bracket and door assembly.

c. Remove filter.

d. Install new filter.

e. Reinstall bracket and door assembly.

8. PARTS LIST

ECU parts are listed in Table 8-1 through Table 8-5. See Figure 8-1 through Figure 8-10 for illustration. (Fig No. column in Table 8-1 through Table 8-5 lists first figure occurrence only.) Recommended common support tools are listed in Table 8-6.

Table 8-1 Environmental Control Unit Parts List

FIND NO.	FIG NO.	REF	CAGEC	PART NO.	DESCRIPTION	QTY
1	8-7		54080 2R728	70726	FILTER, RETURN AIR (ALTERNATE PART)	1
2	8-1	B1	54080 NOTE 1	71563 ZRD125 KC-TF5-250	COMPRESSOR, DIGITAL SCROLL 125K WITH SCREW ON TERMINALS (ALTERNATE PART)	1
3	8-1	FC1	54080	71662	RECEIVER, REFRIGERATION	1
4	8-1		54080	72010	COIL, CONDENSER, ALUMINUM	1
5	8-4	E1	54080	72448	COIL, EVAP, 30.00 X 29.00 COPP	1
6	8-1		54080	70849	MOTOR, 2.5HP, 208-3Ø-60HZ 7.8 AMP, 56Z, TEAO (CONDENSER MOTOR)	1
7	8-1	B3	54080 NOTE 2	72371 30/7-7/25/PA G/4ZR/5/8X3/16A	FAN, PROP. 30” 7 BLADES, 25 DEGREES (CONDENSER FAN) (ALTERNATE PART)	1
8	8-4		54080	71836	MOTOR, 3HP, 208V, 3Ø, 1725RP (EVAPORATOR MOTOR)	1
9	8-4	B2	54080 62814	71889 12-2060-6N CCW	BLOWER WHEEL, 20” X 4.5” W/ 5/8” SHAFT HUB (EVAPORATOR FAN) (ALTERNATE PART)	1
10	8-4	HR1	54080	72230	HEATER, 10.0 KW, 208V 3Ø, SINGLE STAGE	1
11	8-1	D1, D2	54080 NOTE 3	70072 SA-15S	SIGHT GLASS .625 (ALTERNATE PART)	2
12	8-1	P1, P2	54080 53104	70823 CD3604	VALVE, SERVICE, WITH BRAZED 1/4” COPPER TUBE (ALTERNATE PART)	2
13	8-4	TXV1	54080 NOTE 3	71425 SVE-10-GA	THERMO EXPANSION VALVE (ALTERNATE PART)	1
14	8-6	F1	54080 NOTE 3	71087 C-165-S	FILTER DRIER, 5/8” X 5/8” ODF (ALTERNATE PART)	1
15	8-1	S2	54080	71251	SWITCH, FAN CYCLE W/ SCHRADER VALVE FITTING	1

16	8-3		54080	52725	ALTERED PART, SWITCH, HEAD PRESSURE W-SCHRADER	1
17	8-10		54080	71522	SWITCH, SAFETY THERMOSTAT	1
18	8-4	S10	54080 NOTE 4	71525 P32AC-1	PRESSURE SWITCH, SENSITIVE, DIFFERENTIAL, SPDT, ADJ. SET POINT (ALTERNATE PART)	1
19	8-10		54080	71919	SWITCH, SAFETY THERMOSTAT	1
20	8-4	J1	54080 0B1C1	MS3102 A32-17P	CONNECTOR, POWER INPUT (ALTERNATE PART)	1
21	8-4	J2	54080 3FXU2	MS3102 E18-10S	RECEPTACLE, LOAD SHED (ALTERNATE PART)	1
22	8-4		54080 0SFN7	71724 CR4395-EH-240-101-A-CD-ELR-R	RELAY, CURRENT SENSING, 10-100 (ALTERNATE PART)	1
23	8-1		54080	52596	ASSEMBLY, ELECTRICAL CONTROL ENCLOSURE (See Table 8-2 for parts breakdown)	1
24	8-4		54080	52564	ASSEMBLY, ELECTRICAL CONTROL BOX, GETT 1C (See Table 8-3 for parts breakdown)	1
25	8-7		54080	50028	FILTER, FRESH AIR	1
26	8-7		54080 39428	70200-4 3014T48 1	EYEBOLT, 7/16-14 X 1 1/6", 180 (ALTERNATE PART)	4
ACCESSORY PARTS:						
27	none		54080	51983	FLEXIBLE AIR DUCTS ASSEMBLY, 50' SET (See Table 8-4 for parts breakdown)	1
28	none		54080	51983-1	FLEXIBLE AIR DUCTS ASSEMBLY, 25' SET (See Table 8-5 for parts breakdown)	1
NOTE: EITHER ITEM 27 –OR– ITEM 28 IS USED ON THE ECU, NOT BOTH ITEMS.						
29	none		54080	52594	CABLE ASSY, MAIN POWER, ECU	1
30	none		54080	51865	CABLE ASSY, LOAD SHED	1

NOTES

1. Emerson Climate Technologies, P.O. Box 730020, Dallas, TX 75373-0020.
2. Multi-Wing America, Inc., P.O. Box 425, Burton, OH 44021.
3. Parker Hannifin/Sporlan Division, 13557 Collection Center Drive, Chicago, IL 60693.
4. Johnson Controls, P.O. BOX 93107, Chicago, IL 60673-3107.

Table 8-2 Electrical Control Enclosure Assembly Parts List

FIND NO.	FIG NO.	REF	CAGEC	PART NO.	DESCRIPTION	QTY
31	8-8	K1	54080 2X175	71126 CDP-C3P60-24	CONTACTOR, 60 AMP, 3 POLE (ALTERNATE PART)	1
32	8-8	K2-K4	54080 3EKU4	72845 HCC-3XQ04CG	CONTACTOR, 40 AMP, 3 POLE (ALTERNATE PART)	3
33	8-8	(P/O K3)	54080 2X175	72874 CDP-B-1SPDT	AUX CONTACT, 15A, NO-NC, 24VAC (ALTERNATE PART)	1
34	8-8	TB1	54080 71400	70001 16220-3	BLOCK, POWER DISTRIBUTION, 175A (ALTERNATE PART)	1
35	8-8	T1	54080	71001	TRANSFORMER, 150VA, 50/60HZ, 25.5V SECONDARY	1
36	8-8	TB2	54080 71785	71233-10 10-141	TERMINAL BLOCK, 10 POLE, DOUBLE ROW (ALTERNATE PART)	1
37	8-8	TD1-TD4	54080 2X175	71007 D6M	RELAY, TIMED DELAY, D6M (ALTERNATE PART)	4
38	8-8	TM1, TM2	54080 61964	71716 H3CR-F8-24VAC/DC	TIMER (ALTERNATE PART)	2
39	8-8		54080 61964	71717 P2CF-08E	SOCKET, TIMER (ALTERNATE PART)	2
40	8-8		54080	71718	RETAINING CLIP, TIMER	4
41	8-8	R1	54080 0PJN9	70227 3-1393117-0	RELAY, DPDT, 10 AMP, 24VAC (ALTERNATE PART)	1
42	8-8		54080 8Z410	71663-2 PF50CG5-0005	LAMP, GREEN 24V AC/DC LED MINIATURE (ALTERNATE PART)	1
43	8-8		54080 8Z410	71663-1 PF50CR5-0003	LAMP, RED 24V AC/DC LED MINIATURE (ALTERNATE PART)	5
44	8-8	S3	54080	71677	SWITCH, HIGH PRESSURE, MANUAL RESET, W/SCHRADER VALVE, 480 PSI	1
45	8-8	S4	54080	52593	SWITCH, LOW PRESSURE, AUTOMATIC RESET, W/SCHRADER VALVE	1

Table 8-3 GETT 1C Electrical Control Box Assembly Parts List

FIND NO.	FIG NO.	REF	CAGEC	PART NO.	DESCRIPTION	QTY
46	8-9	S1	54080 3EKU4	70760 7200019	SWITCH, TOGGLE, ON-OFF (ALTERNATE PART)	1
47	8-9	S7	54080 3EKU4	70761 73022	SWITCH, TOGGLE, ON-OFF-ON (ALTERNATE PART)	1
48	8-9		54080 71744	70009 1090QC5 -28V	LAMP, GREEN, 28V (ALTERNATE PART)	1
49	8-9		54080 23480	70020 EH71- 1C2S	KNOB, ROUND W/ INDICATOR LINE (ALTERNATE PART)	1
50	8-10	S8	54080	70584	THERMOSTAT	1
51	8-10	S5	54080	70430	SWITCH, FREEZSTAT, LOW CLOSE	1

Table 8-4 Flexible Air Ducts Assembly, 50’ Set Parts List

FIND NO.	FIG NO.	REF	CAGEC	PART NO.	DESCRIPTION	QTY
52	none		54080	70707	AIR DUCT, FLEXIBLE, 12” DIA X 25’	4
53	none		54080	70708	DUCT, INSULATED, 18” RETURN X 25’	2
54	none		54080	70709	COVER, AIR DUCT, 12” DIA	2
55	none		54080	70710	COVER, AIR DUCT 18” DIA	1
56	none		54080	71676	COVER, NET, RETURN AIR DUCT	1

Table 8-5 Flexible Air Ducts Assembly, 25’ Set Parts List

FIND NO.	FIG NO.	REF	CAGEC	PART NO.	DESCRIPTION	QTY
52	none		54080	70707	AIR DUCT, FLEXIBLE, 12” DIA X 25’	2
53	none		54080	70708	DUCT, INSULATED, 18” RETURN X 25’	1
54	none		54080	70709	COVER, AIR DUCT, 12” DIA	2
55	none		54080	70710	COVER, AIR DUCT 18” DIA	1
56	none		54080	71676	COVER, NET, RETURN AIR DUCT	1

Figure 8-1 Compressor Compartment Components

Figure 8-2 Condenser Side Components, Forward

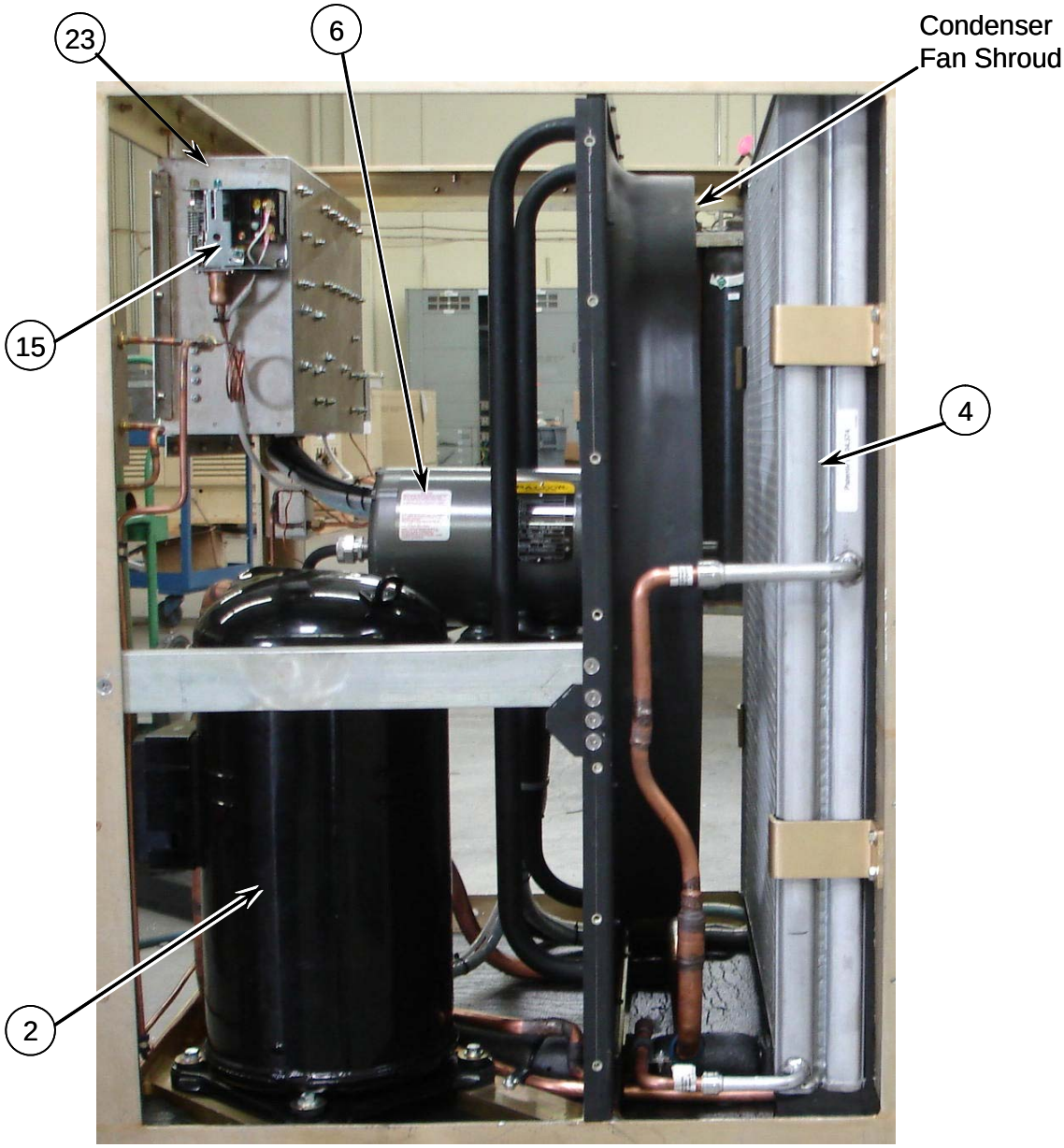
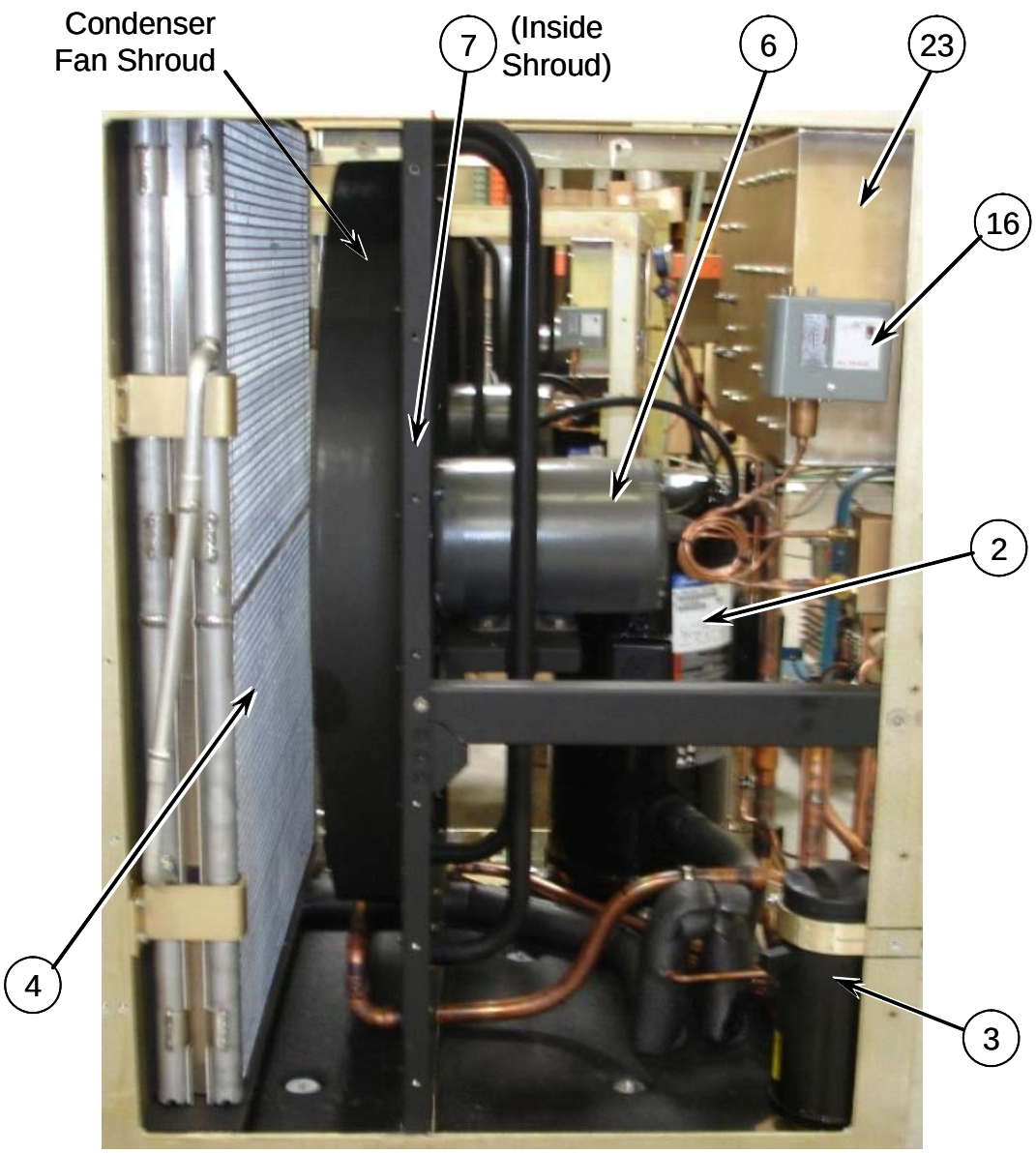


Figure 8-3 Condenser Side Components, Aft



WARNING

Heater Elements (Item 10 below) present an ELECTRICAL SHOCK HAZARD. 120/208 VAC and a BURN HAZARD. Keep hands away from heater coils when ECU is in the heat mode. Allow heater to cool before touching. Failure to observe this warning could result in serious burns or death.

Figure 8-4 Evaporator Side Components, Aft

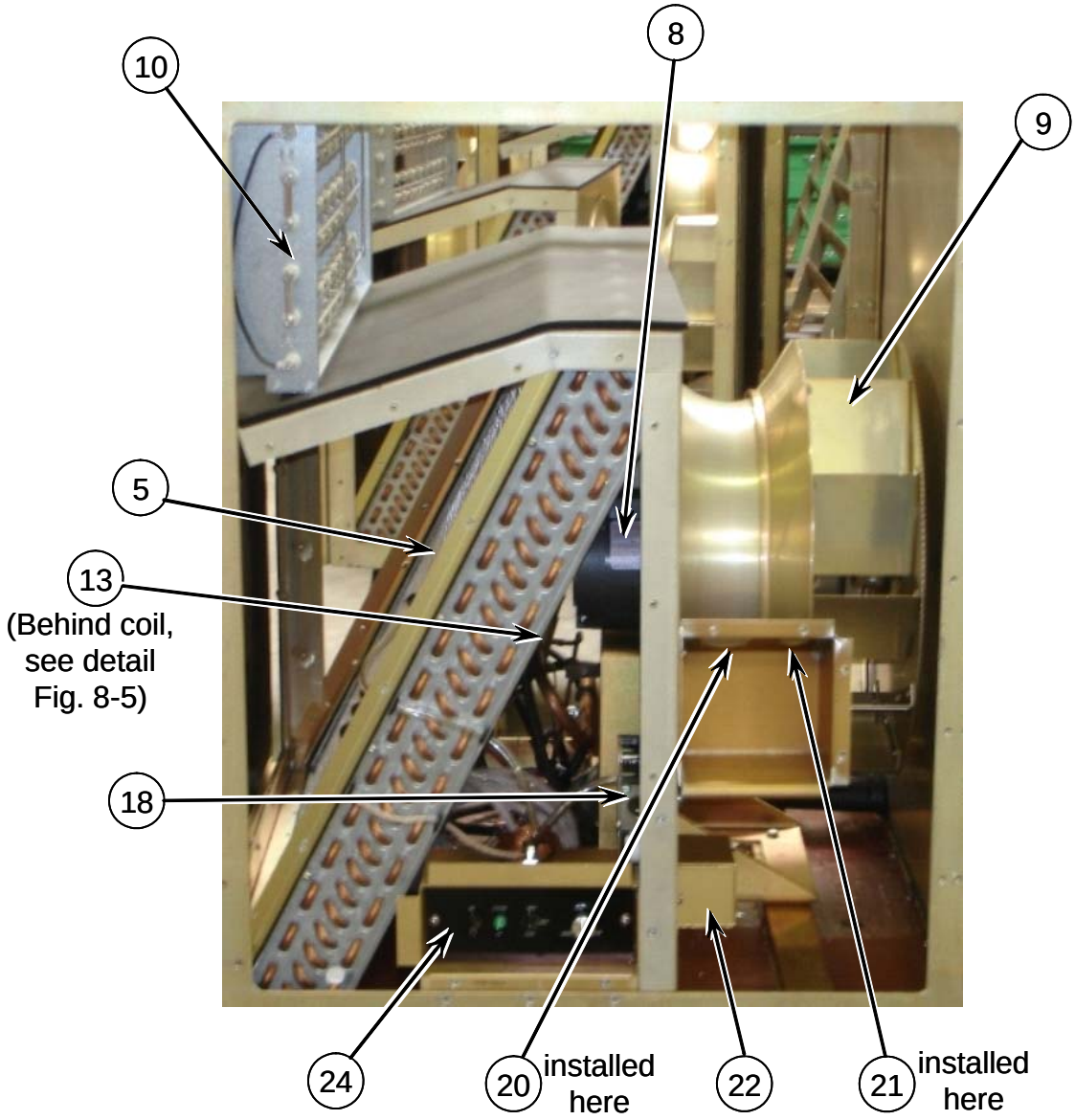


Figure 8-5 Evaporator Side Components, Aft, Detail

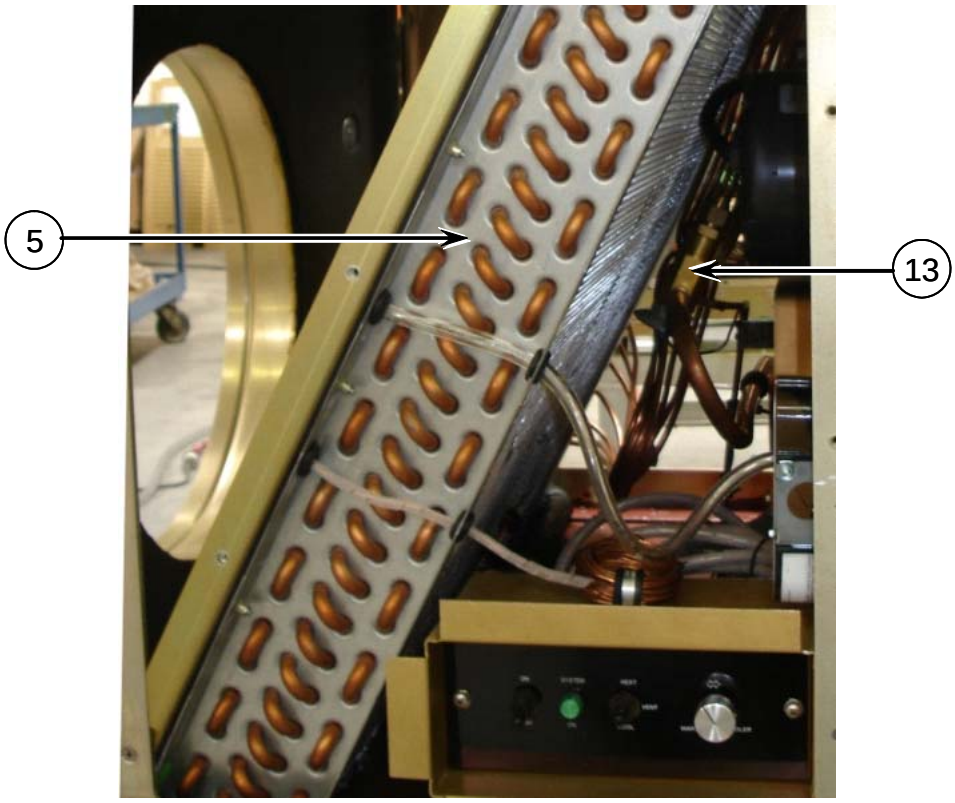


Figure 8-6 Evaporator Side Components, Forward

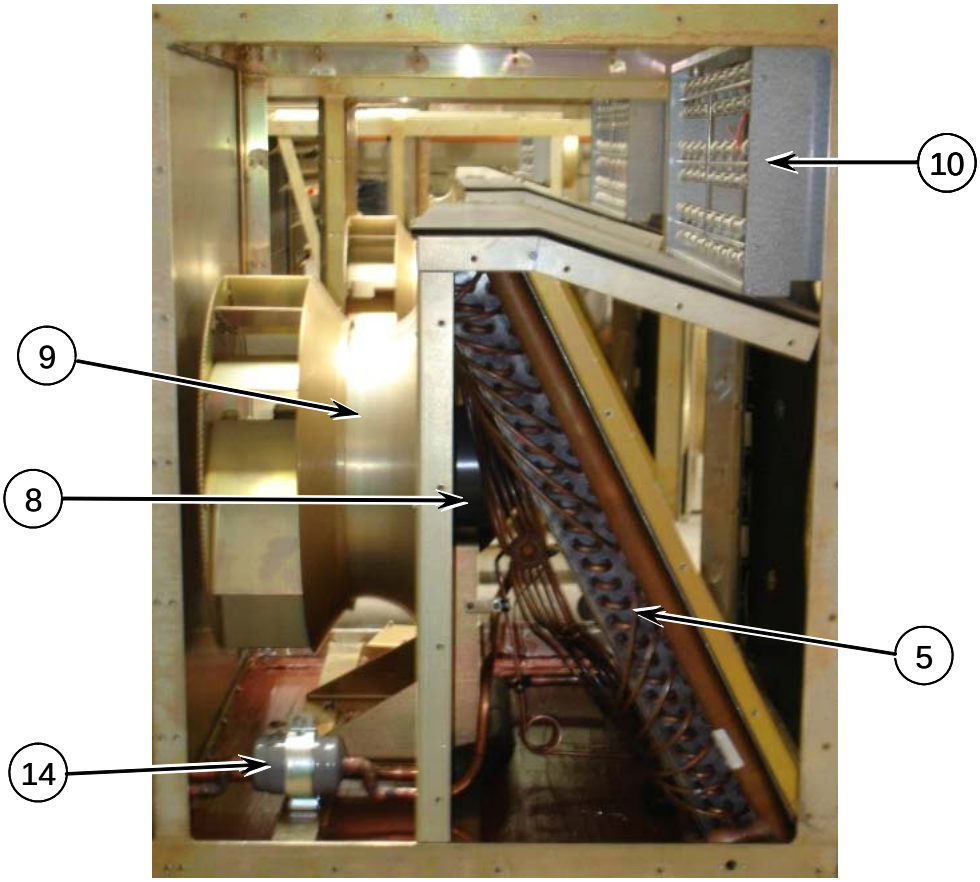


Figure 8-7 ECU Roadside

Figure 8-8 Electrical Control Box

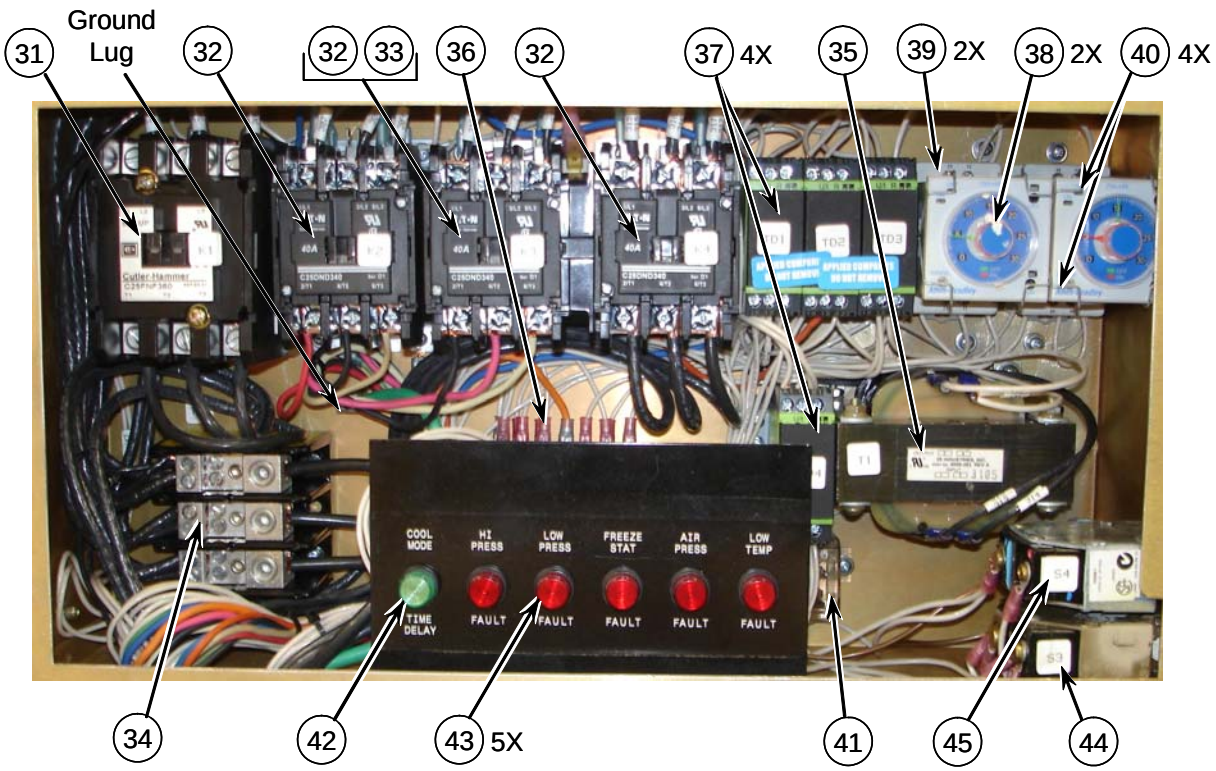


Figure 8-9 ECU Control Panel

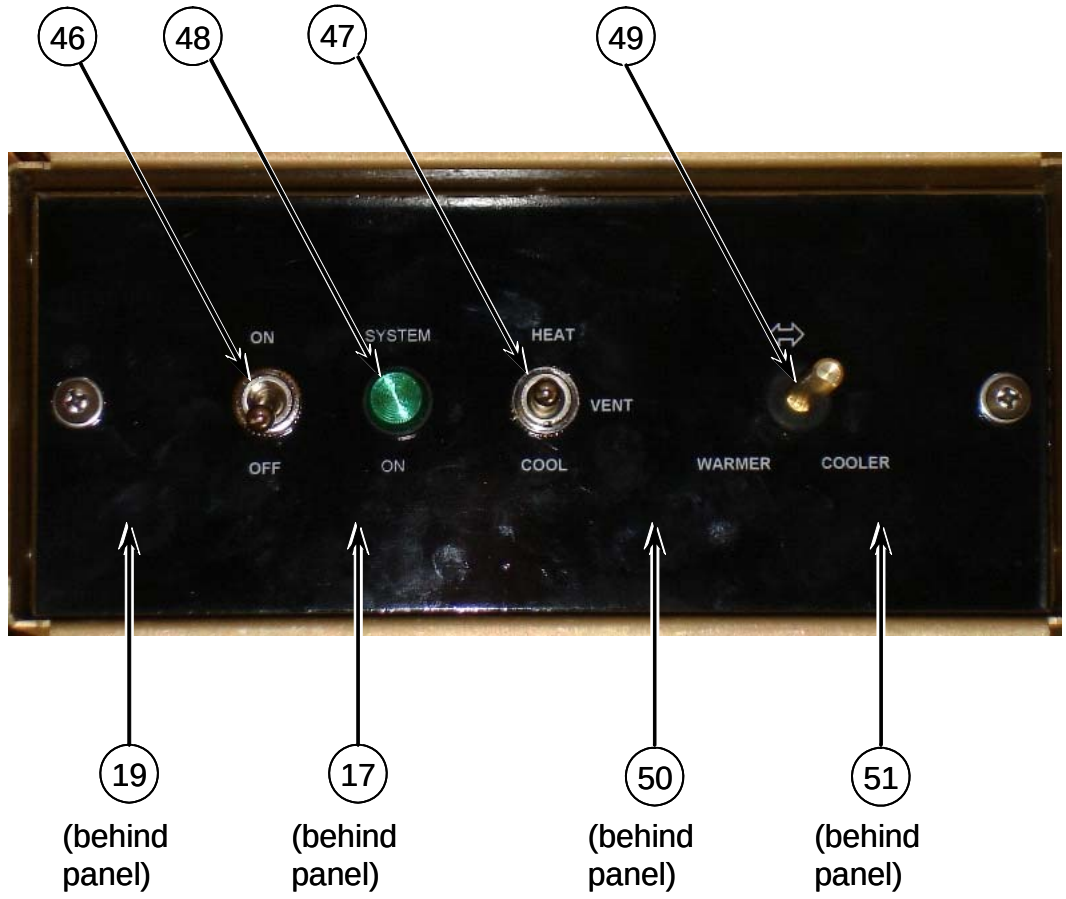


Figure 8-10 ECU Control Panel Box (Panel Removed)

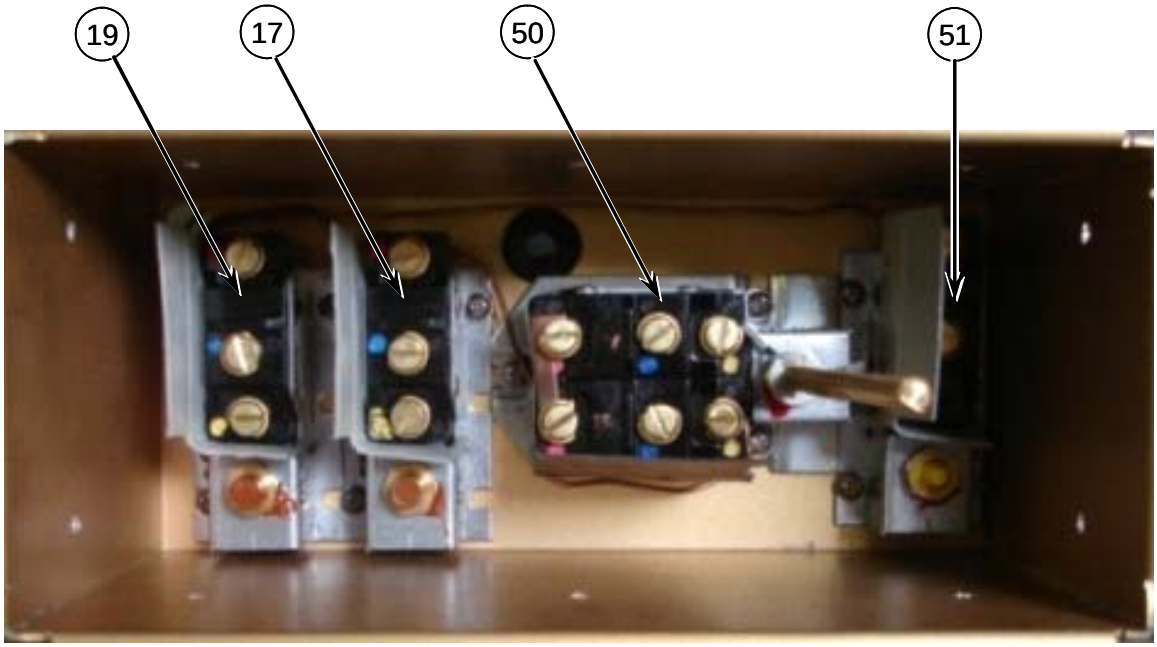


Table 8-6 Recommended Common Support Tools and Equipment

Item No.	Description	Type
1	Crimper, Multi-Purpose	VACO 1900
2	Hex Key Set	5/64-/14, 12” Arms
3	Screwdriver Set, 6 Piece Screwdriver	Slot 3/16x6, 3/16x3, 1/4x4, 5/16x6, Phillips #1x3, #2x4 Phillips #2x10
4	Socket Wrench Set	3/8 Drive ¼ to 7/8, 3” & 6” Extension, Ratchet, Box
5	Wrench Set, Comb. 9 pc.	¼ to ¾ Allen 29013
6	Wrench, Adjustable (Crescent)	6” 10”
7	Meter, Analog Clamp-On	VAO Amprobe, ACD 12 Carrying Case, SV-12 Test Leads, DTL-12
8	Manifold Set (Gages)	J/13 M7-5GY5
9	Meter, Phase	Amprobe, PRM-1
10	Pump, Vacuum	Dayton
11	Refrigerant Recovery Unit	Yellow Jacket R60
12	Oxy-Acetylene Brazing Kit (without cylinders)	Turbo Torch CWK-57
13	Drill Bit	7/32
14	Torque Wrench	5/32 hex, range to include 125-inch pounds
15	Electronic Refrigerant Leak Detector	Johnson Controls RLD-H10PM

Table 8-7 Expendable and Durable Items List

Item No.	Description	U/I
1	Cloth, Cleaning (for cleaning external surfaces, wiping down internal components, and wet-wrapping while brazing)	AR
2	Sponge	AR
3	Mild Soap (e.g. dish soap)	AR
4	Compressed Air	CN
5	Cleaner, Coil: Hydro-Balance Corp. Enviro-Coil Concentrate (CAGEC 0W3W7, p/n H-EC01)	CS
6	Bottle, Spray (for diluting Enviro-Coil)	AR
7	Coil Fin Comb	EA
8	Teflon® Spray: Nu-Calgon Cal-Shield (CAGEC 0XX75, p/n 4148-32)	QT
9	Brush, Wire	EA
10	Sandpaper	PG
11	Brazing Alloy, Copper-Phosphorous (for copper-to-copper brazing): Lucas-Milhaupt Inc., Sil-Fos 15 (CAGEC 91874, p/n Sil-Fos 15)	AR
12	Solder, Silver (for copper-to-brass brazing): J.W. Harris Co. Inc., Stay-Silv 45 (CAGEC 27911, p/n Stay-Silv 45)	AR
13	Flux (for copper-to-brass brazing)	AR
14	1/4” Copper Tubing	AR
15	Tape, Cork	AR
16	Electrical Wire, 18 Gauge	AR
17	Electrical Wire, 16 Gauge	AR
18	Electrical Wire, 12 Gauge	AR
19	Electrical Wire, 14 Gauge	AR
20	R22 Refrigerant	AR
21	Dry Nitrogen	AR
22	Bottle, 2oz glass (for oil samples)	EA
23	Filter/Drier, Oversized (CAGEC 54080, p/n 70283)	EA
24	Gloves, Rubber	PR
25	Gloves, Thermal Protective	PR
26	Goggles, Safety Eye	EA
27	WD-40	CN
28	Spiral Wrap	FT
29	Air Dry Solid Film Lubricant (CAGEC 34227, p/n 238 Dry Lube, or equivalent)	CN
30	Threadlocker, general purpose, removable, medium strength (CAGEC 12405, p/n Loctite 242, or equivalent)	BT

9. APPENDIX

9.1 Appendix Contents

- Table 9-1 Refrigerant Temperature/Pressure Chart
- AC310-120-110 Rev D, Electrical Schematic
- AC310-120-120 Rev A, Refrigeration Diagram

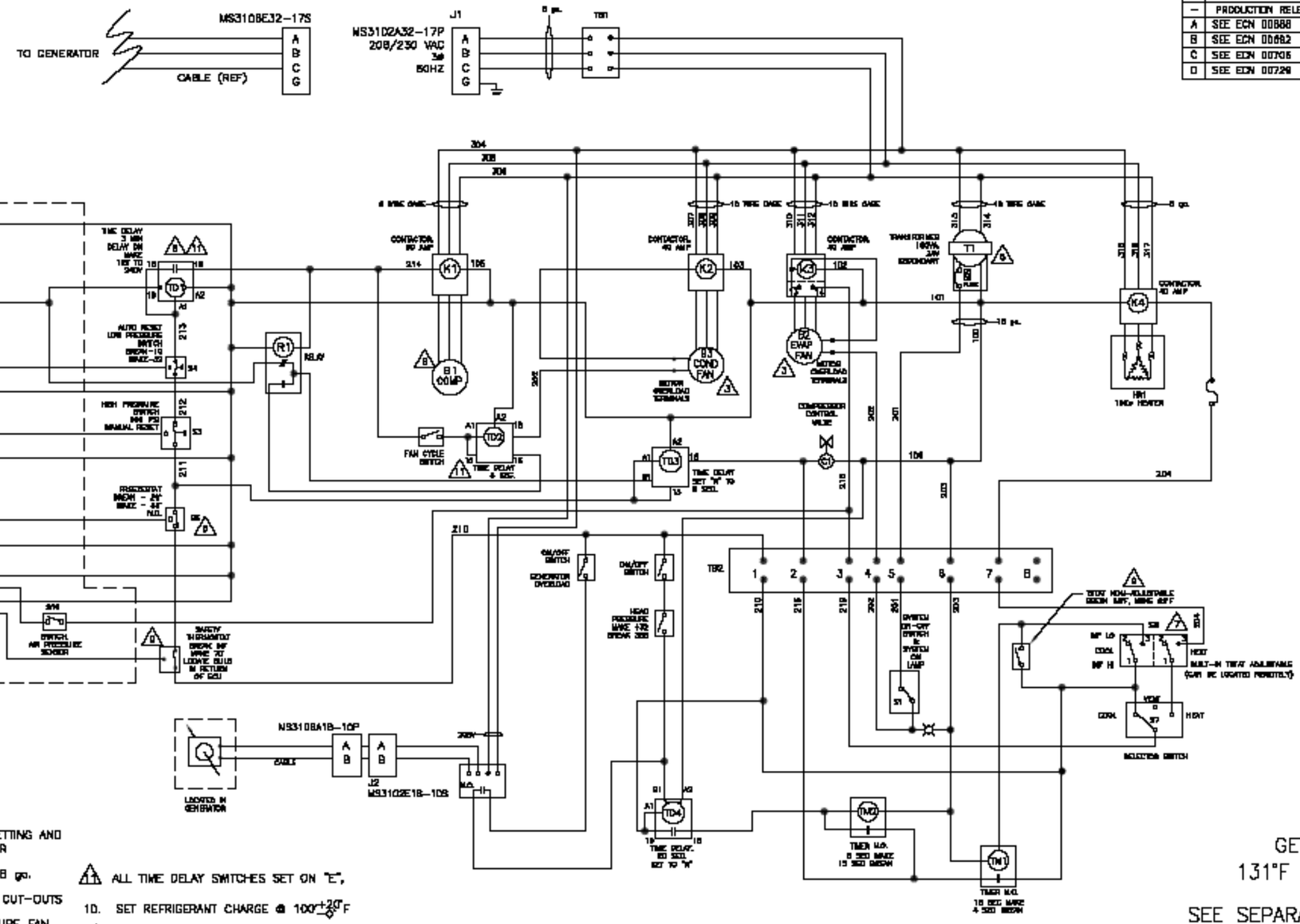
Table 9-1 Refrigerant Temperature/Pressure Chart

Temperature Pressure Chart for HFCs and HCFCs

Temp °F	R-22 Vapor Pressure	R-123 Vapor Pressure	R-134a Vapor Pressure	R-408A (FX-10) Liquid Pressure	R-404A (FX-70) Liquid Pressure	R-409A (FX-56) Liquid Pressure	R-409A (FX-56) Vapor Pressure	R-407C Liquid Pressure	R-407C Vapor Pressure	R-410A Liquid Pressure
-50	**6.2**	**29.2**	**18.7**	**1.6**	0.6	**12.4**	**17.2**	**2.9**	**11.4**	3.5
-45	**2.7**	**29.0**	**16.9**	1.1	2.7	**9.7**	**15.2**	0.4	**8.5**	8.5
-40	0.5	**28.9**	**14.8**	3.3	5.0	**6.8**	**13.1**	2.5	**5.2**	11.6
-35	2.6	**28.7**	**12.5**	5.6	7.6	**3.5**	**10.7**	4.8	**1.5**	14.9
-30	4.9	**28.4**	**9.8**	8.2	10.4	0.0	**8.1**	7.3	1.3	18.5
-25	7.4	**28.1**	**6.9**	11.0	13.4	2.0	**5.1**	10.1	3.6	22.5
-20	10.1	**27.8**	**3.7**	14.1	16.8	4.1	**1.9**	13.1	6.1	26.9
-15	13.2	**27.4**	**0.1**	17.5	20.5	6.5	0.8	16.5	8.8	31.7
-10	16.5	**27.0**	1.9	21.2	24.5	9.0	2.8	20.1	11.9	36.8
-5	20.0	**26.5**	4.1	25.2	28.8	11.8	4.9	24.0	15.2	42.5
0	23.9	**25.9**	6.5	29.5	33.5	14.8	7.2	28.3	18.9	48.6
5	28.2	**25.3**	9.1	34.2	38.6	18.1	9.7	33.0	22.9	55.2
10	32.8	**24.6**	11.9	39.3	44.0	21.7	12.5	38.0	27.3	62.3
15	37.7	**23.7**	15.0	44.8	49.9	25.5	15.4	43.5	32.0	70.0
20	43.0	**22.8**	18.4	50.7	56.2	29.6	18.7	49.3	37.2	78.3
25	48.7	**21.8**	22.1	57.0	63.0	34.0	22.2	55.7	42.7	87.3
30	54.9	**20.7**	26.0	63.7	70.3	38.7	26.0	62.5	48.7	96.8
35	61.5	**19.5**	30.3	71.0	78.1	43.8	30.1	69.8	55.2	107.0
40	68.5	**18.1**	35.0	78.7	86.4	49.2	34.5	77.6	62.1	118.0
45	76.0	**16.6**	40.0	87.0	95.2	54.9	39.2	86.0	69.5	129.7
50	84.0	**15.0**	45.4	95.8	104.7	61.0	44.3	94.9	77.5	142.2
55	92.5	**13.1**	51.1	105.1	114.7	67.6	49.8	104.5	86.0	155.5
60	101.6	**11.2**	57.3	115.1	125.3	74.5	55.6	114.6	95.1	169.6
65	111.2	**9.0**	63.9	125.6	136.6	81.8	61.9	125.4	104.8	184.6
70	121.4	**6.6**	71.0	136.8	148.6	89.5	68.6	136.9	115.2	200.6
75	132.2	**4.0**	78.6	148.7	161.2	97.7	75.8	149.1	126.2	217.4
80	143.6	**1.2**	86.6	161.2	174.6	106.4	83.4	162.1	137.8	235.3
85	155.7	0.9	95.1	174.4	188.8	115.5	91.5	175.8	150.2	254.1
90	168.4	2.5	104.2	188.4	203.7	125.2	100.2	190.2	163.4	274.1
95	181.8	4.2	113.8	203.1	219.4	135.3	109.4	205.5	177.4	295.1
100	195.9	6.1	124.1	218.7	235.9	146.0	119.2	221.6	192.1	317.2
105	210.7	8.1	134.9	235.4	253.4	157.2	129.6	238.5	207.8	340.5
110	226.3	10.3	146.3	252.1	271.7	169.0	140.6	256.4	224.4	365.0
115	242.7	12.6	158.4	270.2	290.9	181.4	152.3	275.1	241.9	390.7
120	259.9	15.1	171.1	289.1	311.1	194.4	164.7	294.7	260.5	417.7
125	277.9	17.7	184.5	308.9	332.3	208.0	177.8	315.2	280.1	445.9
130	296.8	20.6	198.7	329.7	354.5	222.3	191.6	336.7	300.9	475.6
135	316.5	23.6	213.6	351.5	377.8	237.2	206.3	359.2	322.9	506.5
140	337.2	26.8	229.3	374.3	402.2	252.9	221.8	382.6	346.2	539.0
145	358.8	30.2	245.7	398.1	427.7	269.3	238.2	407.0	370.8	572.8
150	381.5	33.8	263.0	423.0	454.4	286.4	255.5	432.4	396.9	608.1

Bold Numerals - Inches Hg. Below 1 ATM

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
–	PRODUCTION RELEASE	6/06/25	B.K.
A	SEE ECN 00888	6/07/25	B.K.
B	SEE ECN 00882	6/07/31	CWL
C	SEE ECN 00705	8/09/08	M.S.
D	SEE ECN 00729	8/10/09	M.S.



5. LOCK IN PLACE AFTER SETTING AND SECURE W/ BLACK COVER

4. ALL 24V WIRES TO BE 18 ga.

3. EQUIPPED WITH THERMAL CUT-OUTS

2. CONDENSER HEAD PRESSURE FAN CONTROL SET POINTS

   R22:
   CUT IN PRESSURE: 340 POUNDS
   CUT OUT PRESSURE: 160 POUNDS
   DIFFERENTIAL: 180 POUNDS

1. INTENTIONALLY LEFT BLANK

NOTES:

11. ALL TIME DELAY SWITCHES SET ON "E",

10. SET REFRIGERANT CHARGE @ 100°±20°F

9. TSTAT IN RETURN AIR PLENUM

8. EQUIPPED WITH INTERNAL OVER CURRENT AND TEMPERATURE PROTECTION

7. WHERE EVER POSSIBLE, INSTALL WITH COMMON AT 6 PM POSTION

6. SET DIFFERENTIAL TO MAX AND LOCK IN WITH EPOXY CEMENT

13. WHERE EVER POSSIBLE, USE FORMED TUBING INSTEAD OF FITTINGS

12. PLACE COMPESSOR, RECIEVER & SIGHT GLASSES AS CLOSE TO THE FLOOR AS POSSIBLE

GETT 1C
131°F (10 TON)

SEE SEPARATE PARTS LIST

53005	AC310-120
NEXT ASSY	REVISION
APPLICATION	DO NOT SCALE DWG

PARTS LIST

APPLIED COMPANIES

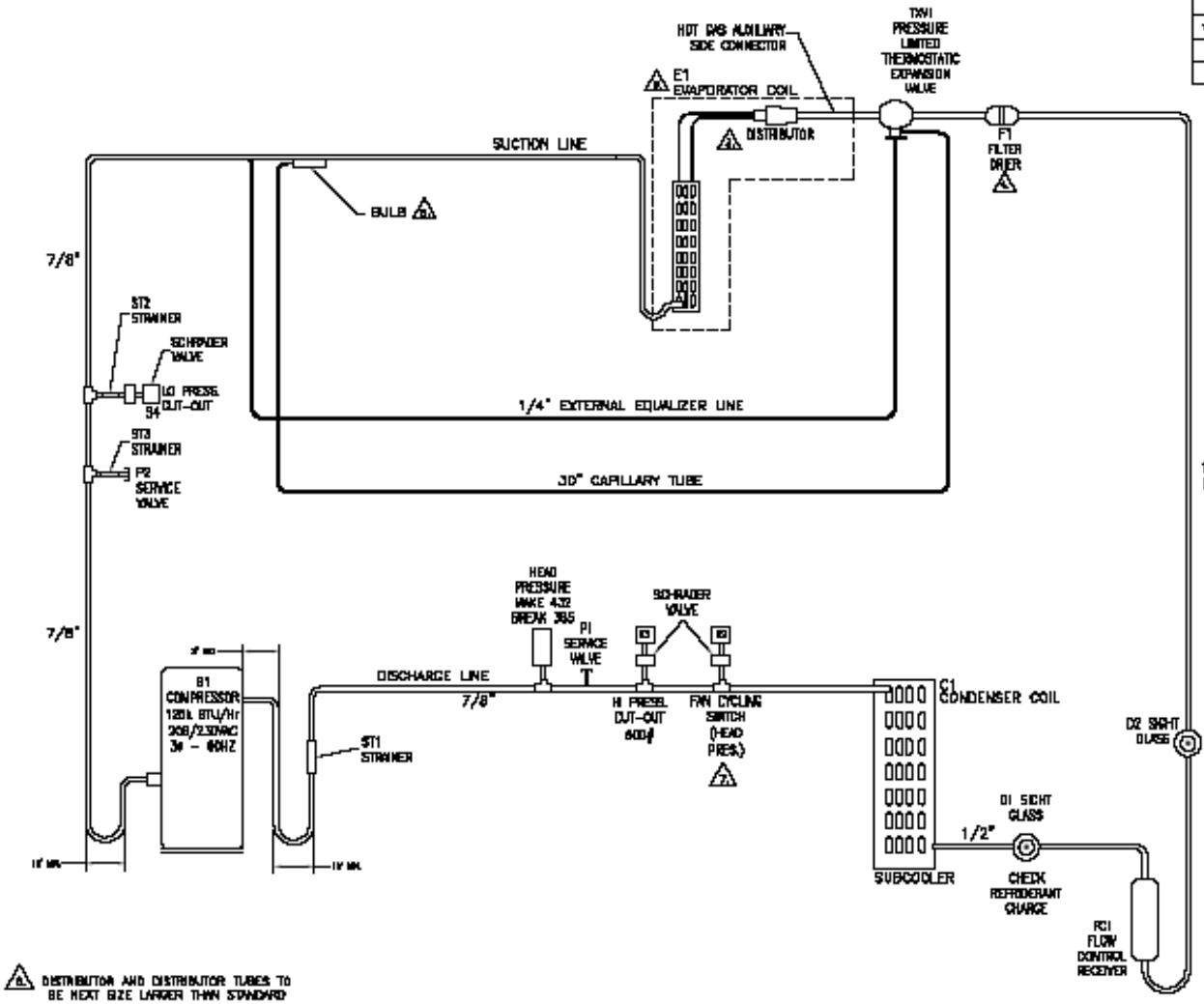
ELECTRICAL SCHEMATIC, 120k/BTU-Hr HORIZ ECU

SIZE D | AC310-120-110 | REV D

SCALE NTS | SHEET 1 OF 1

QF-250-122 REV A

REVISIONS			
–	PRODUCTION RELEASE	06/05/20	
A	SEE ECN 00729	8/10/09	M.S.



SEE SEPARATE PARTS LIST

GETT 1C
131°F (10 TON)

1. REMOVE ALL BURRS AND SHARP EDGES
2. INSTALL ALL COMPONENTS ON FLOOR OF ECU WHEREVER POSSIBLE.
3. MOVE DISTRIBUTOR ORIFICE TO AUXILIARY SIDE CONNECTOR
4. MOUNT FILTER DRIER IN LINE AS CLOSE TO THE THERMAL EXPANSION VALVE AS POSSIBLE
5. ALL TUBING SHALL BE CLEAN, NO FITTINGS, WHERE EVER POSSIBLE

NOTE:

6. DISTRIBUTOR AND DISTRIBUTOR TUBES TO BE NEXT SIZE LARGER THAN STANDARD

NOTE:

7. THERMAL EXPANSION VALVE BULB TO BE MOUNTED TIGHTLY AGAINST THE SUCTION LINE WITH HEAT TRANSFER PASTE, AND SECURED WITH TWO STRAPS AND COMPLETELY COVERED WITH INSULATED TAPE
8. CONDENSER HEAD PRESSURE FAN CONTROL SET POINTS

R32:
CUT IN PRESSURE: 320 lbs
CUT OUT PRESSURE: 140 lbs
DIFFERENTIAL: 180 lbs

53035	AC310-120
NEXT ASSY	USED ON
APPLICATION(S)	

PARTS LIST

APPLIED COMPANIES

REFRIGERATION DIAGRAM, 120K BTU/HR HORIZ. ECU

C | AC310-120-120 | A

SCALE: NTS | SHEET 1 OF 1

QF-280-120 A