



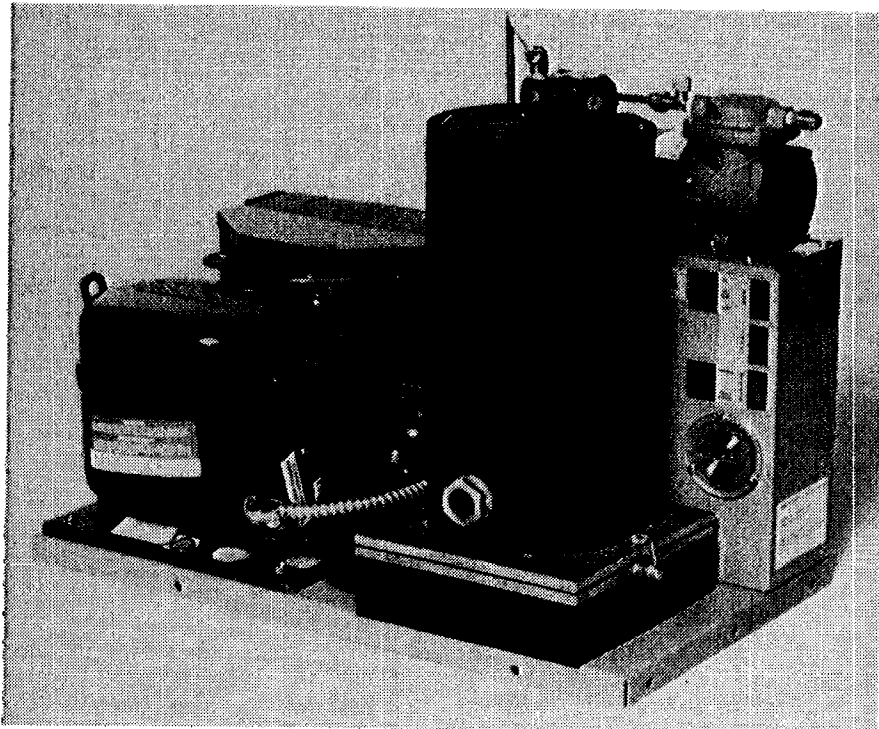
TRANE™

Operation Maintenance

PRG-OM-2

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Trane "Purifier Purge"



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Since The Trane Company has a policy of continuous product improvement, it reserves the right to change specifications and design without notice. The installation and servicing of the equipment referred to in this booklet should be done by qualified, experienced technicians.

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Notice

The Trane Company urges that all HVAC servicers working on Trane equipment, or any manufacturer's products, make every effort to eliminate, if possible, or vigorously reduce the emission of CFC, HCFC and HFC refrigerants to the atmosphere resulting from installation, operation, routine maintenance, or major service on this equipment. Always act in a responsible manner to conserve refrigerants for continued use even when acceptable alternatives are available.

Conservation and emission-reduction can be accomplished by following recommended Trane service and safety procedures published in Trane General Service Bulletin CTV-SB-81. The information and procedures provided in CTV-SB-81 supersedes those published in this manual. Copies of this bulletin may be obtained by contacting your local Trane commercial product representative.

General Information

Purge Start-Up

Before the Purifier Purge is operated for the first time be sure to perform the following procedures:

1. Remove the purge tank body from its base and install the two (2) filter-drier cores that shipped with the purge on the purge base.

2. Install the copper cap on top of the upper drier core. This is shown in the "Operation" section of this manual.

3. Replace the purge tank and torque the tank mounting bolts to 8 ft./lbs.

Note: Be sure purge tank gasket is in proper position when replacing purge tank.

4. Perform the "Purge Pumpout Check" as described in the "Maintenance" section of this manual.

5. Open the purge tank isolation valves on the purge tank inlet and liquid return lines.

6. Switch the purge control switch to the AUTO position for normal operation.

Literature Change History

PRG-OM-2 (May 1990)

Original issue of manual. Describes operation, control, start-up, maintenance and troubleshooting of the Trane Purifier Purge unit. This manual applies design sequence "1B" purge units only.

Proper chiller performance and the personal safety of operating and service personnel depend upon strict observance of these precautions. The Trane Company assumes no liability for installation or service procedures performed by unqualified personnel.

Purge Nameplate

The purge unit nameplate is located on the purge control panel. Always provide the model number, serial number and "product description" information from the nameplate (Figure 1) when making inquiries, or ordering parts or literature for the purge unit.

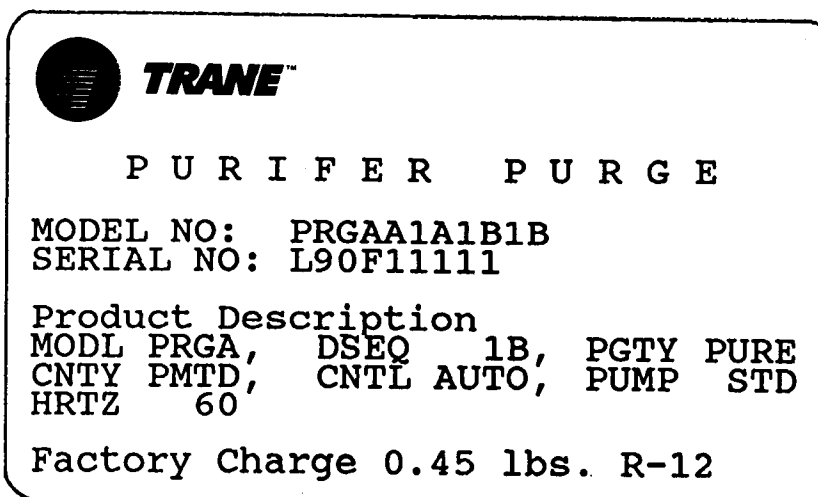
About this Manual

This manual discusses the "Purifier Purge" system operating concepts, electrical control, operator interface, maintenance requirements and procedures, and; presents basic purge troubleshooting procedures.

Warnings and Cautions

Notice that warnings and cautions appear at appropriate intervals throughout this manual. Warnings are provided to alert installing contractors and other personnel to potential hazards that could result in personal injury or death, while cautions are designed to alert personnel to conditions that could result in equipment damage.

Figure 1
Typical Purge Unit Nameplate



Purge System Overview

Introduction

A purge system is provided on all Trane CenTraVac units to remove moisture and other non-condensibles that may leak into the machine. The "Purifier Purge" system is designed to accomplish this task efficiently.

The CenTraVac utilizes the low pressure refrigerant R-11 and operates at less than atmospheric pressure. This is in contrast to the "high" pressure refrigerants R-12 and R-22 which are used in refrigeration systems that operate above atmospheric pressure. Figure 2 compares the pressure/temperature relationship between R-11 and the high pressure refrigerants and indicates the temperatures at which R-11 system pressures are negative with respect to atmosphere.

Figure 3 illustrates the low pressure areas of a typical Trane CenTraVac (model CVHE shown) when the unit is running. Air and moisture may leak into the machine through these low pressure areas. Once it enters the chiller, the air will accumulate in the condenser during machine operation. The air in the condenser increases condensing pressure, increases compressor power requirements, and reduces the chiller's efficiency and cooling capacity.

The Purifier Purge utilizes a minute-meter to serve as an indicator of air leakage into the chiller. This feature is provided to inform the machine operator of purge activity. The ability to monitor purge operation is an important feature of the "Purifier Purge" unit.

IMPORTANT: If average accumulated pump-out time exceeds five minutes per day over any one-week time period, the chiller should be leak-tested and repaired. Purge operating time for the typical Trane CenTraVac will be less than this rate.

"Purifier Purge" Components

Purge system components are illustrated and identified in Figure 4. The four major parts of the system are:

1. Air-cooled condensing unit;
2. Purge condensing tank;
3. Pump-out compressor, and;
4. Controls.

Figure 2
Temperature Vs. Pressure
for R-11, R-12, R-22

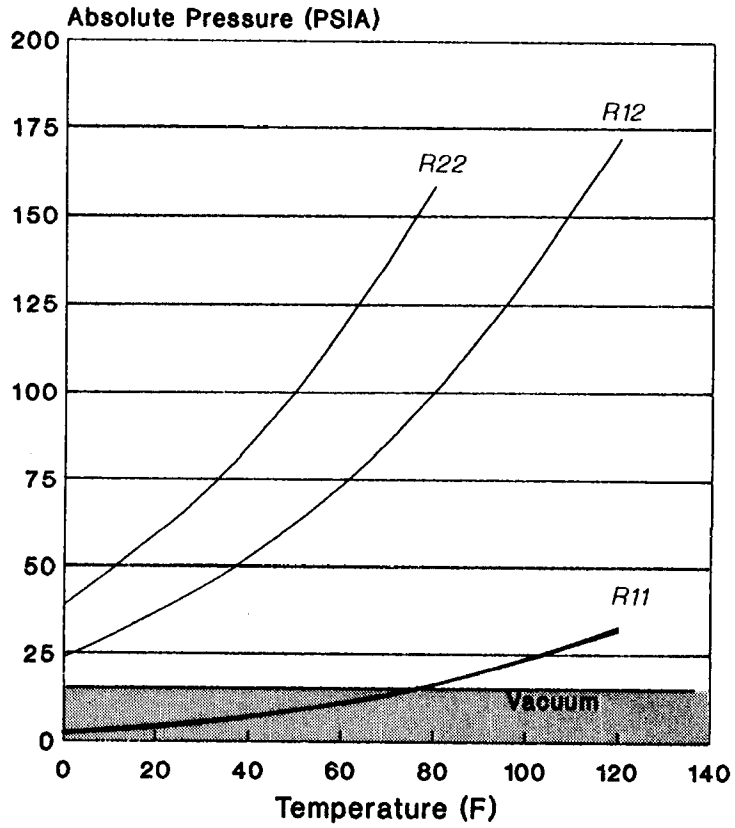


Figure 3
Low Pressure Areas of Operating
CVHE Unit

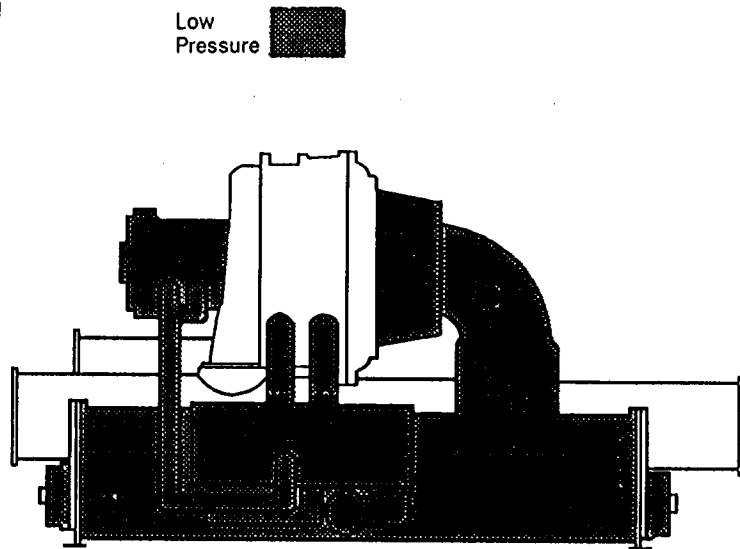
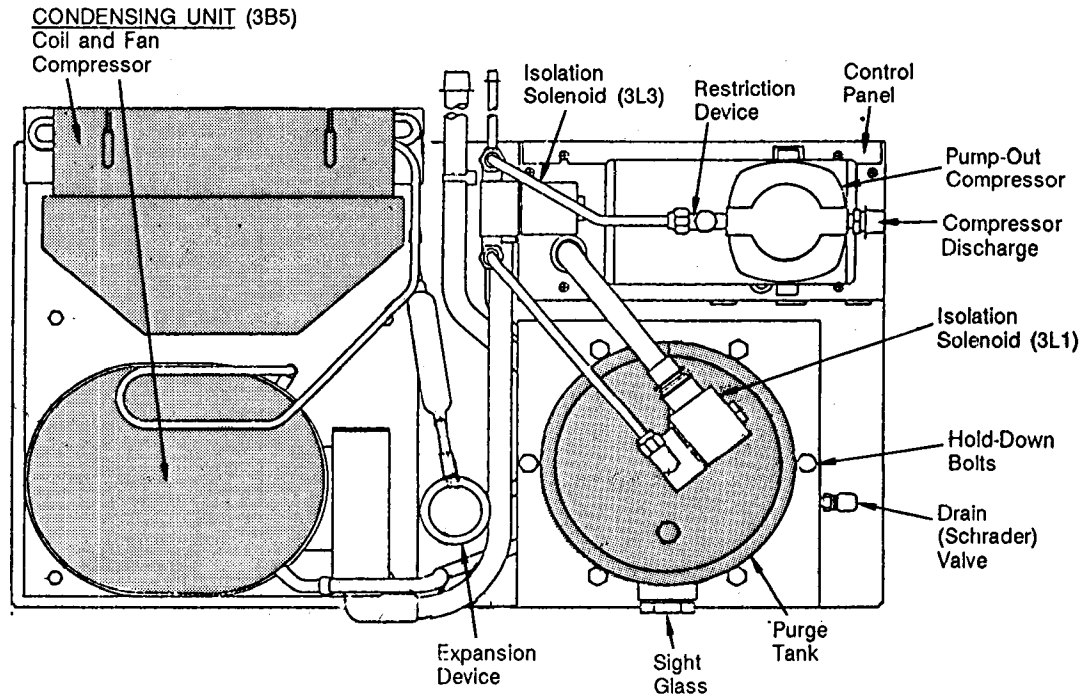
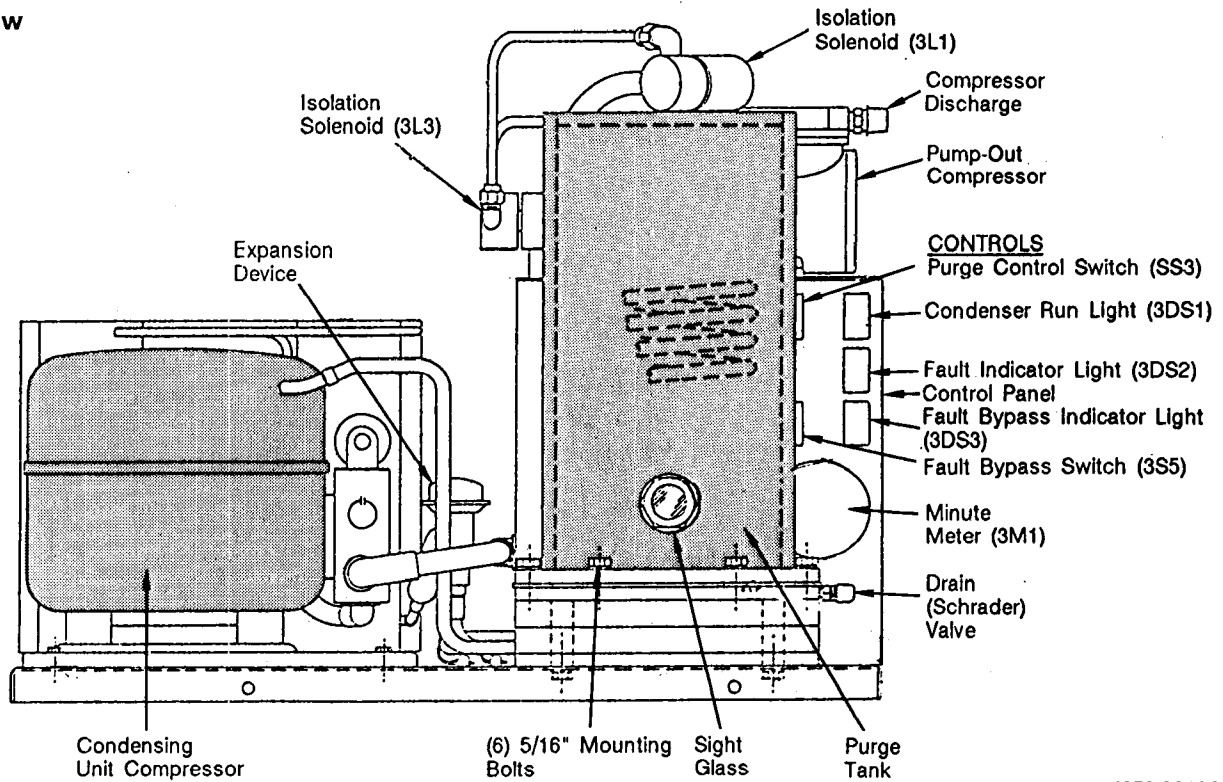


Figure 4
"Purifier-Purge" Unit Components

Top View



Side View



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Air-Cooled Condensing Unit

The air-cooled condensing unit, provides cooling for the purge coil (3/8-inch copper tubing coil in the purge tank). It and the purge coil are the cooling source that draws the refrigerant (R-11) from the chiller.

The portion of the purge that removes heat from the circulating R-11 and transfers it to the atmosphere is the heat transfer circuit. This is an enclosed refrigerant circuit consisting of an air-cooled condensing unit (compressor, fan and condensing coil), a fixed expansion device and a coil in the purge tank (evaporator).

The condensing unit operates effectively over an ambient temperature range of 40-120 F. As ambient temperature increases, condensing unit capacity decreases, also reducing the rate at which the purge will remove air from the CenTraVac (Figure 5).

Note: Because the "Purifier Purge" utilizes an air-cooled condenser, it is operable whether the chiller is running or not. No additional cooling source is required (e.g. water hookup).

IMPORTANT: No water connections to the "Purifier Purge" are required.

purge system. The standard pump-out compressor is compatible with both R-11 and R-123.

Note: Trane recommends using 3/8-inch copper tubing to connect the purge pump-out compressor exhaust to the chiller rupture disc vent line.

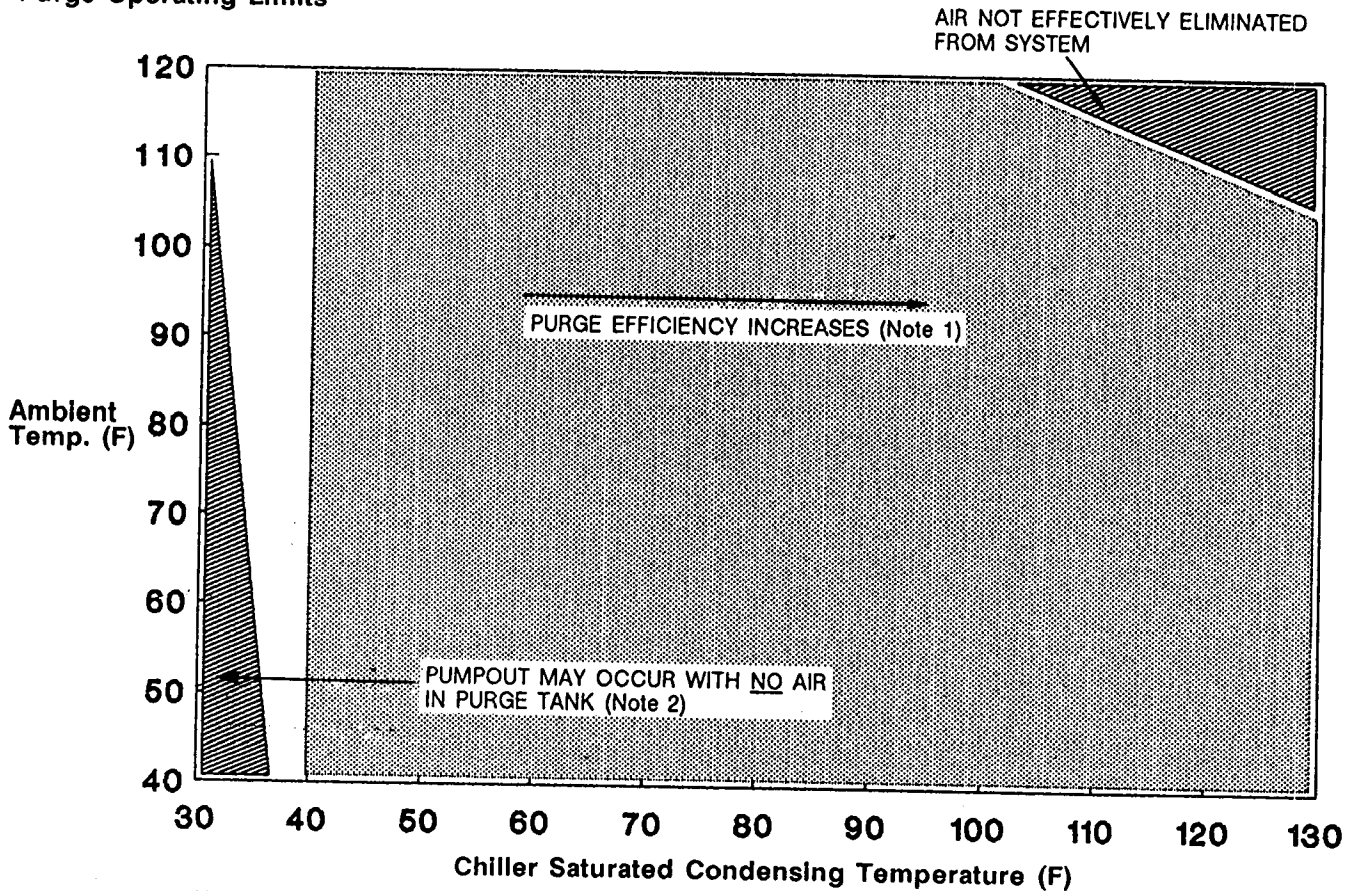
Pump-Out System

The pump-out system consists of a small compressor (pump-out compressor), two isolation solenoids and a restriction device located at the pump-out compressor suction connection. When the purge control system detects the presence of air in the purge tank, the isolation solenoids are opened and the pump-out compressor is turned on. The compressor and a restriction device shown in Figure 4, cause the purged air to be removed slowly. This slow air removal process enhances the efficiency of the

Purge Tank

The purge tank utilizes a cooling coil, filter-drier cores, water separation tube, sight glass, connections for the R-11 gas from the CenTraVac condenser and a liquid refrigerant return line to the CenTraVac condenser, a tank drain, and air discharge port. Air and water are separated from the R-11 vapor and accumulated in the purge tank.

Figure 5
Purge Operating Limits



Notes:

1. Least amount of refrigerant loss during pumpout.
2. 5-minute fault timer 3DL2 protects against extended operation under these conditions.

Purge Controls

The operation of the "Purifier Purge" unit is controlled at the purge control panel and not at the CenTraVac control panel. Purge operating controls accessed from the outside of the purge control panel (Figures 4 and 6) are:

- Purge Control switch 3S3;
- Service switch 3S4;
- Fault Bypass switch 3S5;
- Condenser Run light 3DS1;
- Fault Indication light 3DS2;
- Fault Bypass light 3DS3;
- Minute Meter 3M1.

Purge operating controls located in the the purge control panel (Figure 4) are:

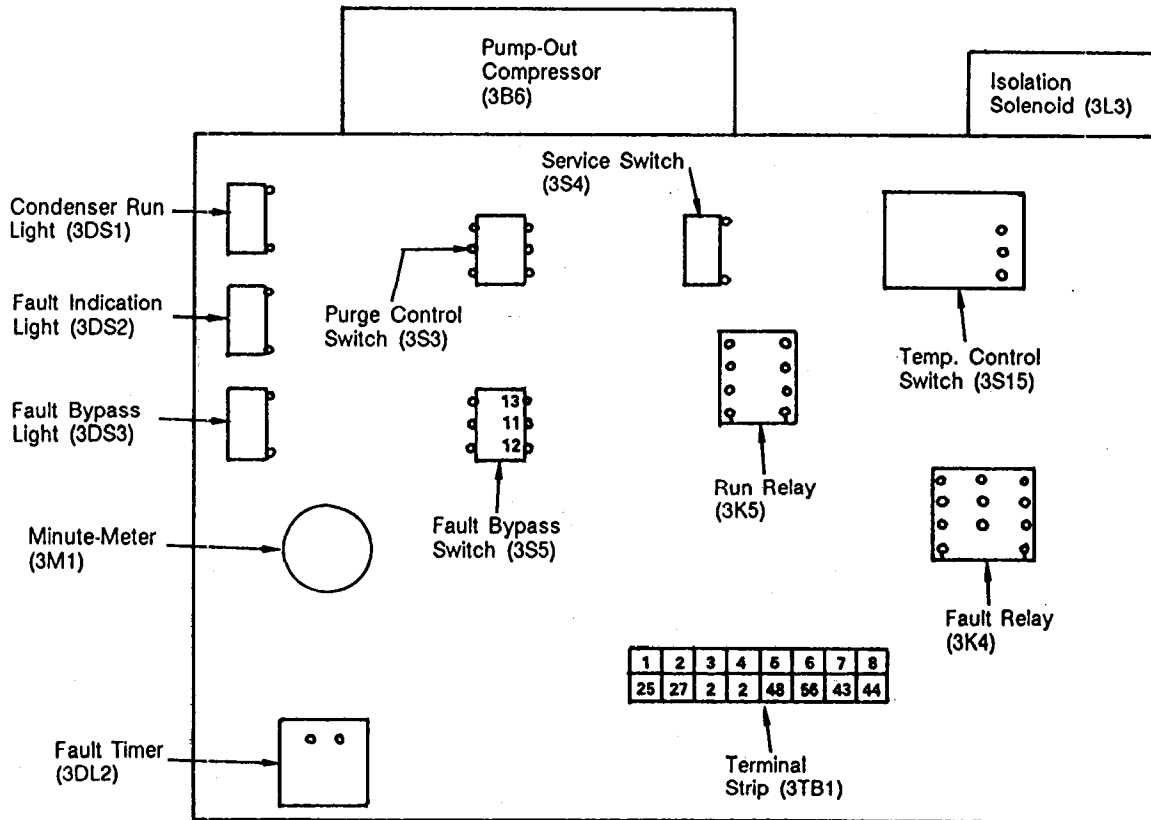
- Temperature Control switch 3S15
- Time Delay Relay (Fault Timer) 3DL2;
- Control Relays 3K4 and 3K5, and;
- Terminal strip 3TB1;

Purge operating controls that are not located in the purge control panel are:

- Isolation solenoid valves 3L1 and 3L3;

The location of 3L1 and 3L3 is shown in Figure 4.

Figure 6
Purge Control Panel



Operation

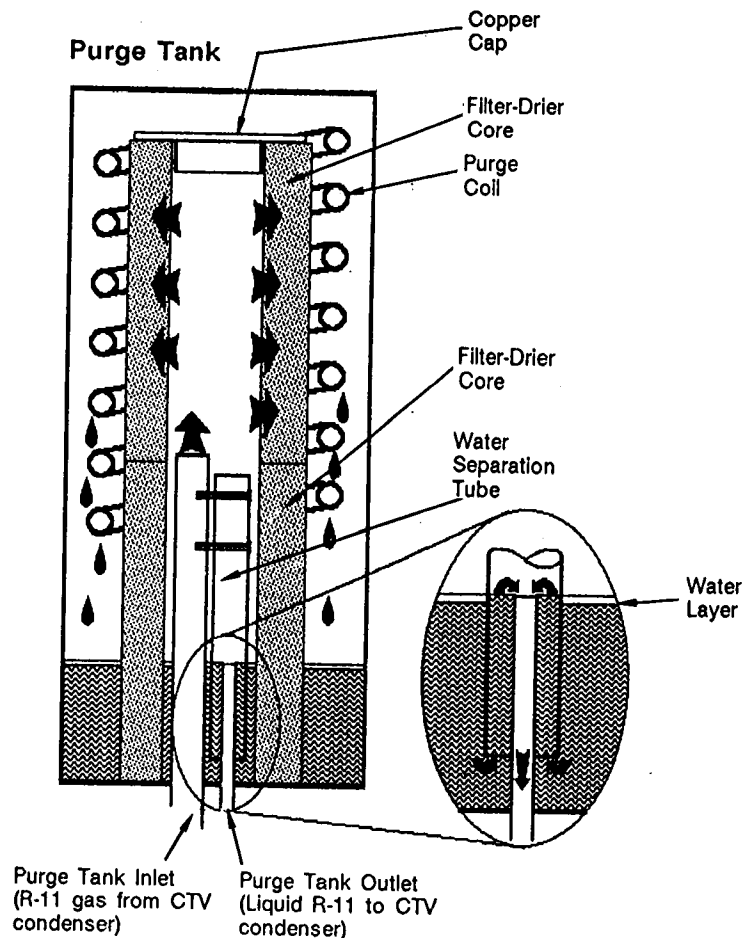
General

The purge is active when the purge condensing unit is powered. The condensing unit is used to condense R-11 vapor in the purge tank. The condensing refrigerant lowers the pressure in the tank, drawing R-11 vapor from the CenTraVac condenser. The R-11 vapor carries non-condensibles and moisture into the purge tank.

Refrigerant vapor enters the purge tank through a 5/8-inch line connected at the bottom of the purge tank (Figure 7). Once inside the tank, the refrigerant vapor passes through the filter-driers, removing the moisture. The refrigerant vapor then condenses on the purge tank coil and falls to the bottom of the tank. Non-condensibles accumulate in the purge tank only when there is air in the CenTraVac condenser.

A layer of liquid refrigerant is maintained in the bottom of the purge tank during purge operation. The refrigerant liquid level is determined by the height of the liquid refrigerant return line in the purge tank. When the purge is running, the liquid level is visible in the purge tank sight glass. If the filter-drier cores are saturated with moisture, water will collect on top of the liquid refrigerant (Figure 7). A water separation tube prevents the water from returning to the unit when the purge is operational.

Figure 7
Purge Tank Refrigerant
Flow



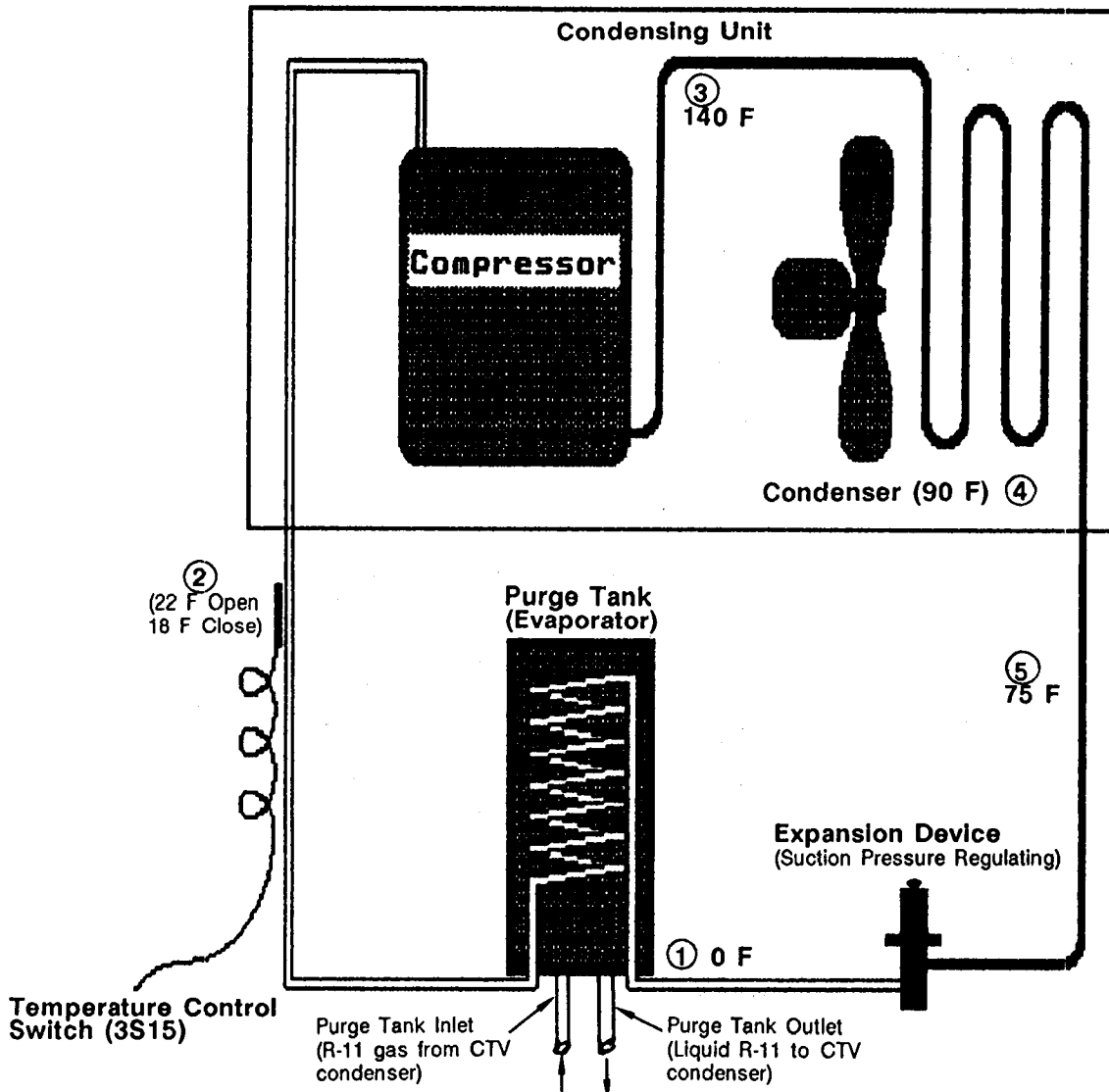
Operating Cycle

The following discussion describes the "Purifier Purge" unit operating cycle at typical conditions (70 F ambient, 8 psig CenTraVac condensing pressure). Figure 8 illustrates the cycle of the active purge (condensing unit compressor running). The conditions that should exist at points 1 through 5 in Figure 8 are:

- Point 1 = 0 F;
- Point 2 = greater than 22 F;
- Point 3 = 140 F;
- Point 4 = 90 F;
- Point 5 = 75 F

The purge condensing unit compressor suction temperature varies with the amount of air in the purge tank. When the amount of air present in the purge tank limits the available condensing surface in the tank, the condensing unit compressor suction temperature will fall. This activates temperature control switch 3S15 at 18 F (Figure 8), initiating a pumpout cycle. The air in the purge tank is then vented to the atmosphere. As air is removed from the purge tank, condensing unit compressor suction temperature increases to open 3S15 which completes the cycle.

Figure 8
Purifier Purge Refrigerant Circuit Schematic



Operating Limits

Purge efficiency is dependent upon the CenTraVac condenser pressure. Purge efficiency increases as the CenTraVac condenser pressure increases. Figure 5 illustrates the purge operating limits and relative efficiency.

The Trane "Purifier Purge" purge can operate with a CenTraVac saturated condensing temperature anywhere from 40-130 F (Figure 5).

Higher saturation temperatures and corresponding higher CenTraVac condensing pressures result in less refrigerant lost to the atmosphere when air is purged. For maximum purge efficiency, operate the purge during CenTraVac powered cooling mode. The purge will operate in this mode when the purge control switch is in the AUTO position. "Manual" purge operation (control switch in MANUAL position) is available primarily for use during various service procedures as described in "Maintenance Procedures". If the chiller will start and run, it is recommended that purge operation be limited to "automatic" mode (control switch in AUTO position).

Caution: Do not operate the purge at the lower saturation temperatures that may occur when ice storage units are turned off or when a CenTraVac is operating in free-cooling mode.

Air Removal

Figure 9 illustrates the air removal cycle as air accumulates in the purge tank. When there is no air in the purge tank, the refrigerant returning to the purge condensing unit compressor suction has a high superheat. As air accumulates in the tank, displacing the R-11 vapor, the effective coil surface exposed to R-11 vapor decreases, reducing available superheat at the purge condensing unit compressor suction.

**Table 1
Refrigerant Moisture Content
As Determined By Moisture
Indicator (See Note)**

Refrig. Moisture Level	Temperature (F)		
	75 F	100 F	125 F
Dry	Below 5	Below 10	Below 20
Normal	5-15	10-30	20-50
Wet	Above 15	Above 30	Above 50

Note: Refrigerant moisture content given in parts per million (ppm).

When condensing unit compressor suction temperature approaches 18 F, temperature control switch 3S15 activates the isolation solenoids and the pump-out compressor to remove the accumulated non-condensibles. As air is removed from the purge tank, the coil is once again exposed to R-11 vapor. The purge condensing unit compressor suction temperature rises and turns off the pump-out system. Pump-out cycle duration is approximately 30 seconds.

Moisture Monitoring and Removal

A moisture indicator is provided in the liquid return line from the purge tank to the CenTraVac condenser. This allows the machine operator to monitor the quality of the liquid R-11 in the chiller.

Inspect the moisture indicator periodically. It will indicate "wet" if the CenTraVac refrigerant is too moist or if the drier-cores in the purge tank are saturated with water. Operating conditions dictate the moisture indicator's reaction to moisture. The indicator element is both moisture and temperature sensitive; becoming more sensitive to moisture as temperature decreases (Table 1).

Consult the moisture indicator only under these conditions:

1. The chiller is operating;
2. The purge unit is operating and has been allowed sufficient time to remove system moisture properly (minimum of 30 hours after replacing filter-drier cores.)

Table 1 shows refrigerant moisture content and typical moisture indicator response at various temperatures. The moisture indicator will normally be operating at equipment room ambient temperature.

When the drier cores are saturated and the moisture indicator shows "wet" refrigerant, water will accumulate in the purge tank and will be visible in the purge tank sight glass.

A water separation tube is located over the liquid-return line inside the purge tank to insure that water, collected in the purge tank, does not return to the chiller when the purge is operating. The purge could be operated in "manual" mode with filter-drier cores removed to eliminate accumulated water that may be present in the chiller.

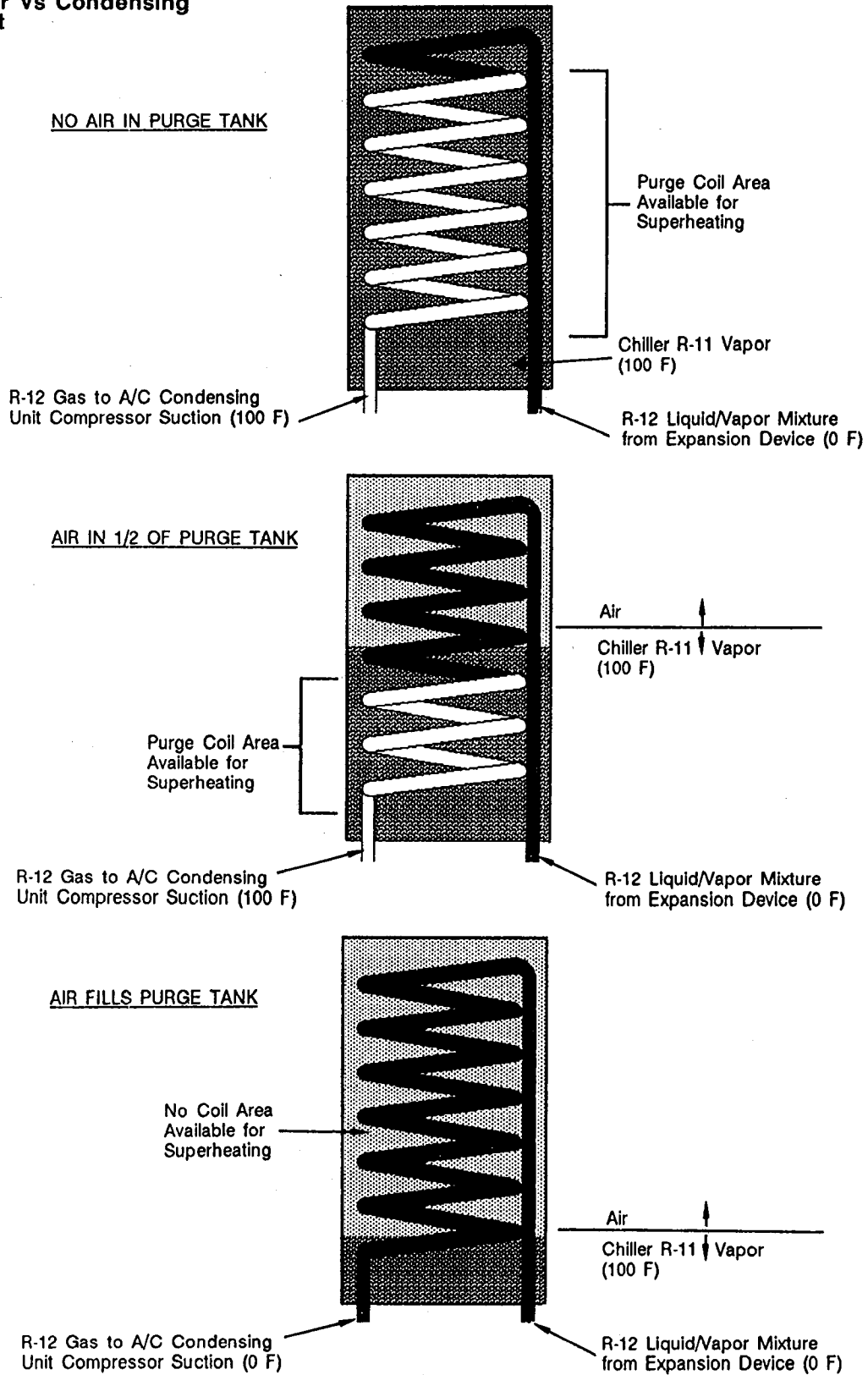
Caution: Water accumulated in the purge tank may evaporate and return to the unit when the purge is turned off if drier cores are not in place.

Do not operate the purge system without the filter-driers in place except when performing certain chiller service procedures. Normally, the purge unit must operate with filter-drier cores installed. The drier cores dehydrate the refrigerant passing through the purge and prevent moisture from re-entering the chiller during the purge off-cycle. The drier cores will absorb the moisture of normal humid-air infiltration for a one-year period. This assumes a "tight" machine, free of tube leaks.

If the drier cores are removed from the purge tank, the moisture indicator will probably indicate "wet" refrigerant while the purge is running even though this moisture level may be acceptable for proper chiller operation.

Caution: To avoid saturating the filter-drier cores, add dry nitrogen only to the system when servicing it. Do not introduce humid air into the chiller. To determine if the filter-drier cores are saturated, check the purge sight glass and the moisture indicator.

Figure 9
Purge Tank Air Vs Condensing
Coil Superheat



Periodic Maintenance

The following information describes the maintenance requirements of the "Purifier Purge". To assure efficient and reliable purge operation, perform all inspections and procedures at the prescribed intervals. Keep a record of all inspection results to establish proper service intervals and document changes that occur in purge activity that could reflect on CenTraVac performance.

WARNING!

To avoid injury or death due to inhalation of, or skin exposure to refrigerant, closely follow all safety procedures described in the Material Safety Data Sheet for the refrigerant and to all labels on refrigerant containers. Certain procedures common to refrigeration system service may expose operating and/or servicing personnel to liquid and/or vaporous refrigerant.

Weekly

[] With the purge unit operating, check the purge tank condensing activity at the sight glass. A continuous flow of refrigerant droplets should be observed when air is not being purged from the tank. When air is being purged, the level of condensing activity in the purge tank will vary. No R-11 droplets (no condensing taking place) in the sight glass indicates:

- a pump-out cycle is necessary;
- a problem exists with the purge heat removal circuit (air-cooled condensing unit, expansion device or purge tank coil), or;
- a problem exists with the purge control circuit.

[] Check the moisture indicator on the purge liquid return line. If moist refrigerant is indicated, replace the purge tank filter-drier cores. Refer to "Service Procedures" in this section.

[] Check refrigerant in the purge tank sight glass for water. If water is present, there will be a visible line of separation between the water and the refrigerant in the tank. Remove any water from the purge tank (Refer to "Service Procedures" in this section).

Semi-Annually

[] Inspect the air-cooled condenser coil and clean as needed. Clean the coil from the fan-side using compressed air or coil cleaner. A fouled coil will reduce purge efficiency and capacity.

Annually

[] Perform the purge system control check described in the "Electrical Controls" section of this manual.

[] Perform "purge tank service" as described in the "Maintenance" section of this manual.

Service Procedures

This section describes specific procedures that must be performed as part of the maintenance program of the purge system. Before conducting these procedures, shut the purge unit off.

Purge Tank Service

Checkout and Water Removal

Note: Before dismantling the purge tank, the purge pump-out and control system should be checked for proper operation.

[] Isolate the purge tank by closing the valves on the purge tank inlet and liquid return lines (between the CenTraVac condenser and the purge tank).

[] With the purge condensing unit turned off, pressurize the purge tank through the Schrader valve (purge tank drain valve) at the base of the purge tank to a maximum of 15 psig. This will test the solenoid valves to insure they seal properly.

[] Check the purge tank sight glass to determine if there is water in the purge tank.

If the R-11 level is visible in the sight glass but there is no water in the tank:

a. Connect a refrigerant hose from the purge tank Schrader valve to an access valve on the CenTraVac evaporator. Drain the refrigerant from the purge tank into the evaporator.

b. Disconnect the refrigerant hose. Proceed with service procedure.

If there is a layer of water on the refrigerant in the purge tank sight glass:

a. Connect a refrigerant hose from the purge tank Schrader valve to a container.

b. Disconnect the 1/4-inch line at the pump-out compressor.

c. Hold the service switch (3S4) in the ON position. This will energize the solenoids and allow the purge tank to fill with air. The liquid refrigerant will drain into the container.

d. Pour or siphon the water from the top of the refrigerant in the container. Seal the refrigerant in the container for later use.

Filter-Drier Core Replacement

1. With the purge tank empty of refrigerant and test pressure relieved, lift the purge tank body from the base plate by removing the six (6) 5/16-inch bolts that secure it.

2. Remove the copper cap from the top of the upper filter-drier core (Figure 7). Then remove the two filter-drier cores from inside the purge tank.

3. Visually inspect the coil and all internal parts. Clean where necessary.

4. Inspect the tank drain valve and line to insure it is free of any debris.

5. Replace the tank gasket.

6. Install new filter-drier cores and replace the copper cap on top of the upper drier core (Figure 7).

Note: The drier-cores absorb water vapor from ambient air, so they are shipped in sealed containers. Do not open them until the cores can be installed and sealed in the purge tank.

7. Put the tank back in place using a new gasket and replace the six (6) 5/16-inch bolts that secure it to the base plate. Torque the bolts to 8 ft./lbs.

8. Reconnect the 1/4-inch pumpout line and solenoid valve.

9. Pressurize the purge tank to 10 psig thru the isolation solenoids, with the solenoids energized. Check for leaks. Release the pressure.

10. Switch the purge system to the manual ON position and wait for the pump-out compressor to start.

11. If refrigerant needs to be returned to the system, remove the cap from the purge tank drain valve and connect a hose from the drain valve to the container. As the pump-out compressor operates, a vacuum is created in the purge tank, drawing the liquid refrigerant from the container into the purge tank. Disconnect the hose when completed and replace the valve cap.

12. Open the valves on the purge tank inlet and liquid return lines.

13. Turn the purge control switch (3S3) OFF and back ON to reset the fault timer if needed.

Purge Pump-Out Check

This procedure tests the ability of the purge to remove non-condensibles from the CenTraVac. This is done by isolating the purge from the CenTraVac, adding air to the purge tank and then using the purge compressor to remove the air again. Perform the following procedure to verify proper purge pumpout sequencing.

CHECKOUT PROCEDURE:

1. Switch purge control switch 3S3 on the purge control panel to OFF and then to MANUAL ON. This will reset the fault timer and turn on the purge condensing unit.

2. Close the shutoff valves on the purge tank inlet and liquid return lines to isolate the purge tank from the CenTraVac.

3. Disconnect the 1/4-inch line from the inlet of the pump-out compressor.

4. Press and hold service switch 3S4 in the MOMENTARY ON position for approximately five seconds, energizing the pumpout solenoids and pump-out compressor. The purge will draw air into the purge tank back through the isolation solenoid valves.

Within approximately five minutes, the pump-out compressor should start. It should run for five minutes (fault timer setting) and then shut down.

Note: Step 4 may have to be repeated two or three times until sufficient air is drawn into the purge tank to energize 3S15 and initiate a pump-out sequence.

5. De-energize the purge by turning the purge control switch (3S3) to OFF.

6. Reconnect the 1/4-inch line at the inlet of the pump-out compressor.

7. Reset the purge fault indication circuit and restart the purge by turning the purge control switch 3S3 to AUTO or ON. The pump-out compressor will start and remove the air from the purge system

8. Open the shutoff valves on the purge tank inlet and liquid return lines.

9. Turn the purge control switch (3S3) on the purge control panel to AUTO.

Purge Tank Service After Internal Chiller Repairs

This section describes specific procedures that must be performed when the CenTraVac refrigerant system has been opened to atmosphere. Before conducting these procedures, shut the purge unit off.

Following any machine repair that requires opening the CenTraVac refrigerant system to atmosphere, the purge will have to remove large quantities of air and/or nitrogen before the chiller can be started. The purge will do this in two stages; the "continuous-operation" stage and the "intermittent-operation" stage.

When large amounts of air or nitrogen are involved, the purging efficiency can be enhanced by increasing refrigerant pressure in the purge tank. This can be done by operating the chiller as soon as practical or by circulating warm water through the chiller evaporator tube bundle.

The amount of time that the purge pump-out compressor operates continuously will vary, depending on the initial pressure level and quantity of air/nitrogen in the chiller. Initially, the pumpout compressor operates continuously due to the large amount of non-condensibles and relatively small amount of R-11 being drawn into the purge tank. It may be several hours before the pump-out compressor cycles off for the first time.

Note: The restriction device may be bypassed to decrease required pump-out time. Refer to "Bypassing Pump-Out Compressor Restrictor" that follows this procedure.

Once the level of non-condensibles present in the chiller falls to a point where increasing amounts of refrigerant are entering the purge tank, the temperature switch in the purge control system begins to cycle the pumpout compressor on and off. As the refrigerant in the system becomes less contaminated with non-condensibles, purge pumpout is activated less frequently.

The CenTraVac refrigerant will be contaminated by excessive moisture. The purge should be run continuously (control switch in ON position) for 24 to 48 hours with filter-drier cores installed. This is done to circulate the refrigerant through the purge and concentrate all moisture in the purge tank. At the end of this run time, check the purge tank for water. If water is present in the purge tank, perform "Purge Tank Checkout and Water Removal Procedure" in this section. Replace the filter-drier cores. Refer to "Filter-Drier Core Replacement" in this section.

Bypassing Pump-Out Restrictor

The pumpout restrictor can be bypassed to accelerate non-condensable removal. However, this is a manual operation which can cause CenTraVac refrigerant loss if left unattended. To bypass the restriction device, proceed as follows:

- Temporarily connect a bypass hose from isolation solenoid valve 3L3 to the auxiliary port on the pump-out compressor inlet. This is shown in Figure 4.

- Cap the open port on the pump-out compressor inlet.

Note: This should be done for only a short period since this operation will cause additional system refrigerant to be lost during purging.

Note: The fault bypass switch must be turned to ON to allow the purge to operate in the "continuous pumpout" model.

Troubleshooting

Troubleshooting Procedures Troubleshooting Chart

If operational difficulties are encountered, utilize the checkout procedures and diagnostic chart provided in this manual to determine the cause and correct the problem. Refer also to the "Refrigerant System Diagnostic Procedure" in this section and to the "Electrical Control Checkout" procedure in the "Electrical Control" section of this manual.

WARNING!

To avoid injury or death due to inhalation of, or skin exposure to refrigerant, closely follow all safety procedures described in the Material Safety Data Sheet for the refrigerant and to all labels on refrigerant containers. Certain procedures common to refrigeration system service may expose operating and/or servicing personnel to liquid and/or vaporous refrigerant.

The chart that follows is provided to help identify malfunctions that could occur. The chart has three columns:

- the Symptom column describes what the unit is doing;
- the Cause column identifies the most likely sources of the problem, and;
- the Solution column describes what must be done to correct the problem.

WARNING: To avoid injury or death due to electrical shock never open access panels to inspect or service the unit without first opening all disconnect switches.

Refrigeration System Diagnostic Procedure

If there is concern that one of the components in the purge refrigeration system is not operating correctly, troubleshoot the system by taking surface temperature measurements.

Caution: To avoid refrigerant charge loss, do not attempt to measure purge system discharge or liquid line pressure.

Refer to Figure 8 in this manual. With the purge condensing unit operating, the expansion device will reliably regulate the low side of the purge refrigerant system, even with a relatively wide range variation in refrigerant charge. Suction pressure is not a good indicator of proper charge. The best method to determine charge level is to measure surface temperature at various points on the refrigerant circuit. These points are shown in Figure 8 in this manual.

The condenser temperature (Point 4 on Figure 8), can be measured by reading the surface temperature of the second or third condenser tubing U-bend (from the top) on the side of the coil opposite of the discharge gas inlet.

Note: Use an accurate (± 1 F) temperature probe (Range = 0-200 F) to take temperature readings. Fasten the sensor of the probe tightly against the tubing surface. Insulate around the probe for accurate results.

The critical temperature measurements needed to diagnose the system properly are Points 1, 2, 4, and 5 as shown in Figure 8. Temperatures at Points 1 and 2 can be obtained by pushing aside a small portion of the insulation covering the tubing at these points. At Point 2, take temperature measurement approximately 2-3 inches away from the capillary temperature sensor. Do not disturb the temperature sensor.

With the purge condensing unit running, take temperature measurements at Points 4 and 5. The difference between these two values is the subcooling. This value should be between 5 and 20 F with the proper refrigerant charge in the system.

- A temperature reading of less than 5 F indicates a refrigerant undercharge.
- A temperature reading greater than 20 F indicates a refrigerant overcharge.

The purge refrigerant system must have a proper R-12 charge before any other refrigerant circuit components can be evaluated.

The purpose of the expansion valve (TEV) is to regulate refrigerant flow to maintain a constant pressure within the purge tank coil. To determine if the TEV is operating properly, measure temperature at Point 1 in Figure 8. An optimum constant temperature of 0 F should be measured at this point. However, a measurement between -5 and 10 F is acceptable.

The operation of temperature control switch 3S15 can be checked by measuring the temperature at Point 2 in Figure 8. Perform the "Purge Pump-Out Check" procedure in the "Maintenance" section. Continuously monitor suction temperature at Point 2. After sufficient air has been drawn into the purge tank, the temperature at Point 2 will fall. Within approximately five minutes, the temperature at Point 2 should approach 0 F. When the temperature at Point 2 approaches 18 F, the pump-out system should energize. If pump-out does not start and Point 2 temperature reading remains below 10 F, a problem exists with temperature control switch 3S15 or with the pump-out system.

**Chart 1
Troubleshooting the "Purifier Purge"**

Symptom	Cause	Solution
Fault light 3DS2 ON, purge not running, purge condensing unit OFF (pumpout operates too long).	Air infiltration rate into unit too high. Excessive purging required.	Leak-check CenTraVac. Repair leaks.
	Fault timer 3DL2 duration set too low.	Reset to factory setting of 5 minutes.
	Fault timer 3DL2 failed closed.	Replace fault timer.
	CenTraVac refrigerant temperature too low. (Purge can lock out below 40 F saturation temperature.)	Do not operate purge unit at or below 40 F saturated refrigerant temperature.
	Ambient temperature too low (below 30 F)	Do not operate purge unit below 30 F ambient temperature.
	Temperature control switch 3S15 failed closed.	Replace switch 3S15.
	Isolation solenoids 3L1, 3L3 <u>both</u> fail to <u>open</u> . Air is not removed.	Repair or replace solenoid coils or valves.
	Isolation solenoids 3L1, 3L3 <u>both</u> fail to <u>close</u> and CenTraVac is at a low temperature (air leaks into CenTraVac).	Repair or replace solenoid coils or valves.
Pumpout compressor fails: a. electrically - b. diaphragm fails -		Repair or replace pumpout compressor.
Fault light 3DS2 ON, but pump-out continues, condensing unit ON.	Fault relay 3K4 fails to energize (Purge fails to fault-out.)	Replace fault relay 3K4.
Fault light 3DS2 OFF, but pump-out continues beyond fault time.	Fault light 3DS2 failed and purge is in BYPASS mode.	Replace fault light 3DS2. Turn off BYPASS mode.
	Time delay relay 3DL2 fails to close after delay period.	Replace time delay 3DL2.
Purge fails to pump-out noncondensibles. CenTraVac indicates high head-pressure fault. *Refer to "Refrigerant System Diagnostic Procedure" in the "Troubleshooting" section.	Purge condensing unit: *a. is overcharged. *b. is undercharged (reduced cooling capacity. c. condenser fan failed. *d. regulating valve failed (low pressure). e. Condensing unit compressor motor winding temp. sensor opened (may go out on high winding temperature).	Replace condensing unit or service as needed.
	*Regulator valve failed (regulating too high.) Condensing unit will flood until corrected.	Measure condensing unit compressor suction temperature.
	*Temperature control switch 3S15 failed to close.	Check 3S15 capillary tube routing and insulation. Replace 3S15 if required.
Purge continues when CTV is OFF.	Purge in MANUAL mode.	Normal operation for MANUAL mode.
	Auto-Run relay 3K5 failed closed.	Check RUN signal and relay. Replace 3K5 if required.
Purge runs when RUN light is OFF.	RUN light 3SD1 failed.	Replace bulb or replace 3SD1.
Minute-Meter does not advance.	Minute-Meter failed.	Check for power during pump-out. Replace if required.

Continued next page....

Chart 1 (Continued)

Symptom	Cause	Solution
Refrigerant expelled through pump-out compressor discharge.	Isolation solenoid 3L1 failed in open position. Liquid refrigerant accumulates in line ahead of 3L3. When 3L3 opens, liquid is pumped out.	Repair or replace 3L1 coil or entire valve.
Purge tank sight glass:		
No refrigerant in sight glass	Liquid refrigerant may evaporate and migrate back into the CenTraVac with purge OFF.	Liquid should return within 20 min- of continuous purge operation.
Refrigerant level rises above sight glass.	During CenTraVac cooling cycle, refrigerant may rise above sight glass once purge pump-out cycle is complete.	<p>If this conditions lasts more than 5 minutes:</p> <ol style="list-style-type: none"> Check for restrictions in the 5/8" purge tank inlet line and in the 1/4" liquid liquid return line. Shutoff valves for these lines must be fully open. There can be <u>no</u> liquid traps in these lines.

Electrical Control

Control Components

This section identifies and explains the operation of the individual components of the "Purifier Purge" electrical control circuit.

Purge Control Switch (3S3)

Description. The purge control switch (3S3) is the three-position (ON/OFF/AUTO) control switch located on the outside of the purge control panel which controls purge operation.

Function. With the switch in the ON position, the purge will run continuously. Use of the ON switch position is recommended only for certain service procedures. Turning the switch to the OFF position will deenergize purge system operation and reset the fault indication circuit. The AUTO position interlocks purge operation with a chiller-generated "cooling/run" signal. This signal energizes auto relay 3K5 in the purge control panel. The AUTO position is the recommended normal purge operating mode.

Temperature Control Switch (3S15)

Description. Temperature control switch 3S15 senses the presence of air in the purge system by monitoring the suction temperature of the purge condensing unit.

Function. When suction temperature falls to the switch setpoint, this indicates that an excessive amount of air is entrained in the purge tank. 3S15 is factory set to close its contacts on a fall in suction temperature at 18 F, which opens isolation solenoid valves 3L1 and 3L3, starts pump-out compressor 3B6 and energizes minute-meter 3M1.

When sufficient air and non-condensibles have been removed from the purge circuit, compressor suction temperature for the air-cooled condenser will begin to rise. When suction temperature rises to 22 F, 3S15 contacts open, closing pump-out solenoid valves 3L1 and 3L3 and stopping pump-out compressor 3B6. Minute-meter 3M1 de-energizes.

Note: The temperature control switch (3S15) setpoints are calibrated at the factory. Do not alter the switch setpoints.

Isolation Solenoids (3L1, 3L3)

Description. The isolation solenoid valves are used to control air discharge from the purge tank.

Function. The operation of 3L1 and 3L3 is controlled by temperature control switch 3S15. Two pump-out solenoid valves (connected in opposite directions) are provided since their function in the system is a critical factor.

Minute-Meter (3M1)

The minute-meter (3M1), connected in the pump-out compressor circuit, indicates total pump-out compressor operating time. The amount of pump-out compressor run time should be recorded periodically in order to determine if the unit leak rate has increased.

Fault Timer (3DL2)

Fault timer 3DL2 is used to sense an extended pump-out cycle. (The fault timer delay setting is adjustable from one-half minute through 10 minutes.) If pump-out compressor operating time exceeds the fault timer factory setting of five minutes, the purge will shut down in a fault mode by activating fault relay 3K4.

Note: Fault timer delay setting can be altered for service checkout but must be returned to the factory setting of five minutes when testing is complete.

Fault timer data is given in Figure 10.

IMPORTANT: To resume operation after a fault condition, reset the purge run circuit by turning the purge control switch 3S3 to OFF and back to ON or AUTO.

Fault Relay (3K4)

Fault relay 3K4 controls the following:

- Provides the fault latching function for the fault timer (3DL2) and turns on fault indicator 3DS2.
- De-energizes the condensing unit and condenser run light 3DS1.
- De-energizes the pump-out system components (compressor 3B6 and isolation solenoids 3L1 and 3L3).

Indicator Lights

Three indicator lights display the operation and diagnostic condition of the purge. When energized, the "condenser run" light (3DS1) indicates that the purge is energized and the condensing unit is operating.

When energized, the "fault" light (3DS2) indicates a fault mode (extended pump-out compressor operating cycle). The fault is cleared when the power to the unit is turned off or the purge control panel switch is set to the OFF position.

The "fault-bypass" light (3DS3) indicates that the fault bypass switch (3S5) is in the FAULT BYPASS ON position to enable service pumpout.

Fault Bypass Switch (3S5)

Two-position (FAULT BYPASS ON/FAULT BYPASS OFF) switch used to bypass fault timer 3DL2 during purge unit service procedures.

Service Switch (3S4)

A two-position (OFF/MOMENTARY ON), spring-return switch (3S4) is provided on the purge control panel. This switch is used to open the solenoid valves and energize the pump-out compressor when conducting service procedures or operational checks of the purge system.

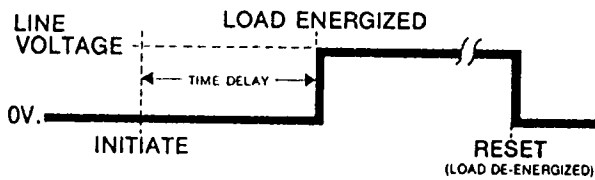
Figure 10
Fault Timer (3DL2)

Timer Connection

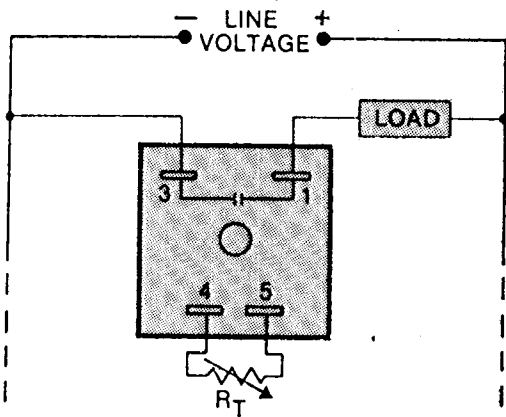
Delay on Make: Upon application of power the time delay is initiated. On completion of the delay period, the load becomes energized.

To reset, remove power.

Time Diagram



Timer Operation



Fault Timer Specifications

TIME DELAY

Type: Adjustable Delay - Delay On Make
 Range: 5 - 600 seconds (1 Meg. = 60 sec.)
 Repeat Accuracy: $\pm 2\%$ (fixed conditions)
 Tolerance: $\pm 10\%$ max.
 Recycle Time: 16 milliseconds max. after timing; During Timing - 0.1% of time delay or 75 milliseconds, whichever is greater.
 Time Delay Vs. Temp. & Voltage: $\pm 10\%$ max.

INPUT

Operating Voltage: 120V
 Tolerance: $\pm 20\%$ nom. voltage
 Line Frequency: 60 Hz.

OUTPUT

Type: Solid-state
 Form: Normally open; series connection
 Rating: Max. - 1 amp steady-state, 10 amps inrush @ 60 F. Min. - 5 milliamps.
 Voltage Drop: 2.5V @ 1 amp.

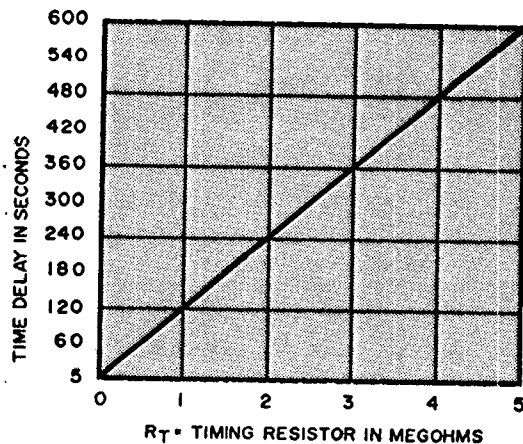
PROTECTION

Transient Protected
 Dielectric: 1500V RMS min.
 Insulation Resistance: 100 meg. min.
 DC Units: Reverse-polarity protected

ENVIRONMENTAL

Operating Temperature: -40 C to +80 C
 Storage Temperature: -40 C to +85 C
 Humidity: 95% relative

External Resistance Vs. Time Delay



Electrical Sequence of Operation

The following is a technical description of the purge electrical circuit operation under normal conditions. Refer to the electrical schematic shown in Figure 11.

Electrical Sequence

In normal operation, service switch 3S4 and fault bypass switch 3S5 are OFF.

120 VAC is applied from TB1-1 (L1) to TB1-3 (L2) and a CHILLER RUN signal is supplied to TB1-2 through switch 3S3 to energize control relay 3K5 while the CenTraVac is operating. Normally, purge control switch 3S3 is in the AUTO position. A normally-open set of 3K5 contacts must close for the purge to operate. In the MANUAL position, the purge will operate without the CenTraVac operating.

In AUTO mode, when RUN signal is present, a circuit is completed thru the 3K5 closed (normally-open) contacts, position to Terminal 1 of temperature switch 3S15.

At this point, there are two current paths:

1. From Terminal 1 of 3S15 thru 3K4 normally-closed contacts to TB1-6 where condensing unit 3B5 and condenser run light 3DS1 are connected. 3B5 and 3DS1 are energized.

2. From Terminal 1 of 3S15 to 3S15 normally-open temperature switch contacts. When non-condensibles are introduced into the purge tank, 3S15 will see a falling condensing unit suction temperature. At 3S15 setpoint (18 F), its normally-open contacts close, completing a circuit from the 3K5 contacts thru 3S15 closed (normally-open) contacts thru 3K4 normally-closed contacts to TB1-5, energizing pump-out.

Pump-Out Operation

Pump-out operation starts when TB1-5 is energized. This energizes isolation solenoids 3L1 and 3L3, pump-out compressor 3B6 and minute-meter 3M1 which are all connected in parallel. Pump-out operation is timed by the circuit from 3S15 thru fault bypass switch 3S5 closed contacts to fault timer 3DL2, which energizes. 3DL2 normally-open contacts will close if it remains energized over the preset timing period (five minutes).

Normally, all non-condensibles are pumped out during this period and 3S15 will see a rising condensing unit suction temperature. 3S15 closed temperature contacts will open on a rise in temperature at 22 F, completing the pump-out cycle. This cycle will repeat whenever temperature control switch 3S15 senses falling condensing unit suction temperature to 18 F.

If, for some reason, the pump-out cycle lasts longer than 3DL2 setting of five minutes, 3DL2 normally-open contacts close, energizing fault relay 3K4 and fault indicator light 3DS2. 3K4 has three sets of contacts:

- 3K4 normally-closed contacts in the pump-out path open, stopping pump-out;

- 3K4 normally-open contacts close, latching 3K4 closed through a second set of purge control switch (3S3) contacts.

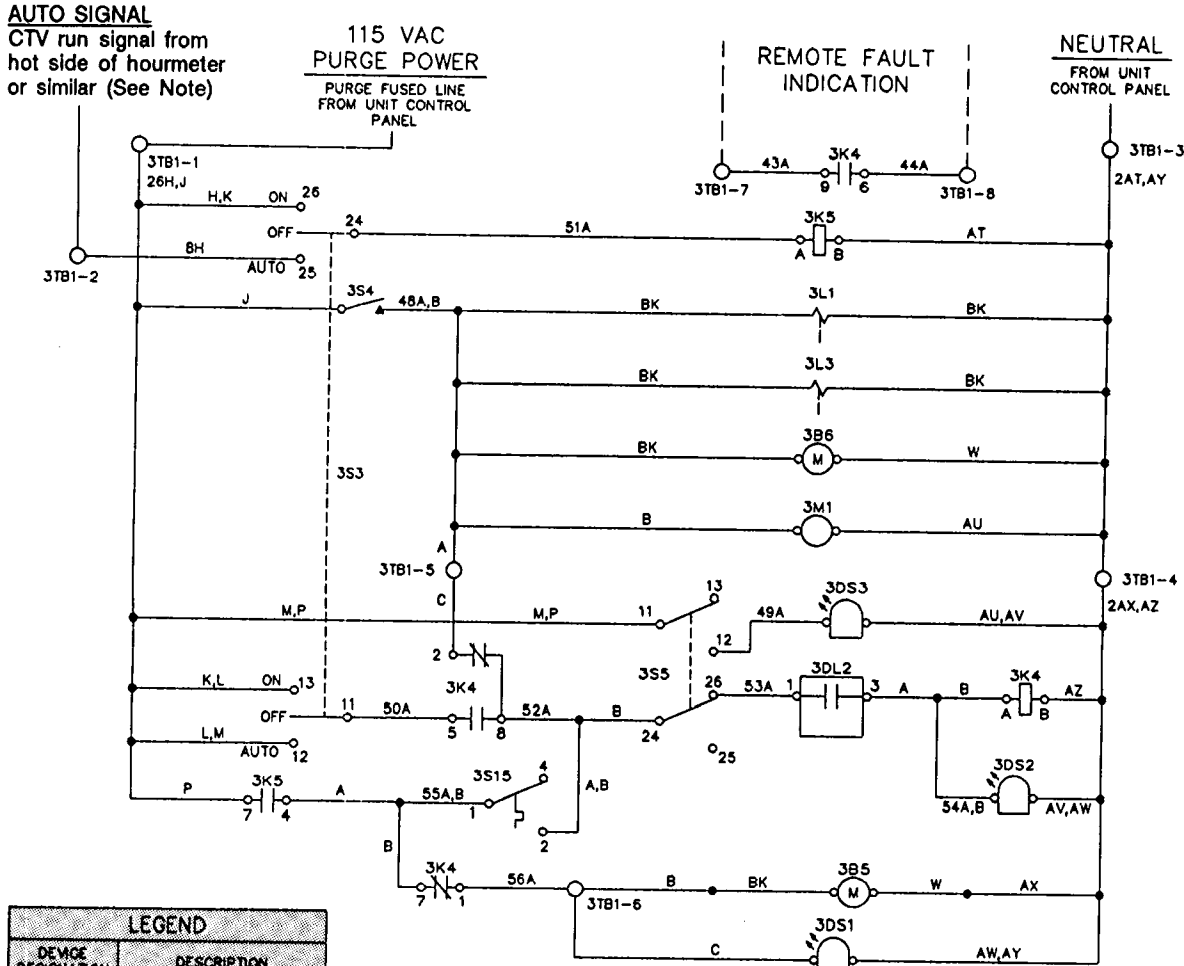
- 3K4's second set of normally-closed contacts open, de-energizing condensing unit 3B5 and condenser run light 3DS1. The purge will remain latched OFF until manually reset by turning purge control switch 3S3 to OFF and back again to ON.

If an extended pump-out cycle is required (service work, etc.) the fault system can be bypassed by turning the fault bypass switch 3S5 to BYPASS. This energizes fault bypass indicator light 3DS3 and opens the circuit from temperature control switch 3S15 to fault timer 3DL2, disabling the fault circuit.

Switching service switch 3S4 to MOMENTARY, tests purge pump-out components 3B6 (pump-out compressor), 3M1 (minute-meter) and pump-out solenoids 3L1 and 3L3.

Caution: To prevent reenergizing the fault circuit during MOMENTARY test procedures, do not allow 3S4 to remain in MOMENTARY position longer than the fault timer timing period (five minutes).

Figure 11
Typical Electrical Schematic for Purifier Purge System



LEGEND	
DEVICE DESIGNATION	DESCRIPTION
3B5	CONDENSING UNIT
3B6	PUMPOUT COMPRESSOR
3DL2	TIME DELAY RELAY
3DS1	CONDENSOR RUN LIGHT
3DS2	FAULT INDICATION LIGHT
3DS3	FAULT BYPASS LIGHT
3K4 & 5	CONTROL RELAYS
3L1 & 3	SOLENOID VALVES
3M1	MINUTE METER
3S3	MAIN PURGE SWITCH
3S4	SERVICE SWITCH
3S5	FAULT BYPASS SWITCH
3S15	TEMPERATURE SWITCH
3TB1	TERMINAL STRIP

<p>⚠ WARNING DISCONNECT ELECTRIC POWER SUPPLY BEFORE SERVICING TO PREVENT INJURY OR DEATH DUE TO ELECTRICAL SHOCK.</p> <p>AVERTISSEMENT DEBRANCHER DU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN POUR EVITER BLESSURE OU MORT PAR ELECTROCUTION.</p>	<p>⚠ CAUTION USE COPPER CONDUCTORS ONLY TO PREVENT EQUIPMENT DAMAGE. UNIT TERMINALS ARE NOT DESIGNED TO ACCEPT ANY OTHER WIRING.</p> <p>ATTENTION UTILISER SEULEMENT DES CONDUCTEURS EN CUIVRE POUR EVITER D'ENDOMMAGER L'EQUIPEMENT. LES BORNES NE SONT PAS PREVUES POUR AUTRES TYPES DE FILS CONDUCTEURS.</p>
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Note: Failure to disconnect and isolate this RUN signal lead will cause the CenTraVac to start during purge control test procedure.

Electrical Control Checkout

Use this procedure to test the functioning of the electrical control circuit. Refer to Figures 11 and 12.

WARNING!

To avoid injury or death due to inhalation of, or skin exposure to refrigerant, closely follow all safety procedures described in the Material Safety Data Sheet for the refrigerant and to all labels on refrigerant containers. Certain procedures common to refrigeration system service may expose operating and/or servicing personnel to liquid and/or vaporous refrigerant.

Test Setup

WARNING! To prevent injury or death due to electrical shock, exercise extreme caution when servicing unit with circuits energized.

1. Turn the CenTraVac OFF and remove the purge power fuse located in the CTV control panel.

a. Confirm that there is no power between:

- 3TB1-1 to 3TB1-3;
- 3TB1-2 to 3TB1-3;

b. Remove power from 3TB1-7 and 3TB1-8. This will disable the "Remote Fault Indication" circuit, if used.

2. Disconnect and isolate the RUN signal lead that connects the CenTraVac control panel to 3TB1-2.

Caution: Failure to disconnect and isolate the RUN signal lead will cause the CenTraVac to start during testing procedure.

3. Connect a test switch between terminals 3TB1-1 and 3TB1-2 in the purge control panel to simulate a CenTraVac RUN signal during testing. Turn this switch OFF.

4. Turn purge control switch 3S3 and fault bypass switch 3S5 to OFF.

5. Reset fault timer 3DL2 time setting to approximately 30 seconds (minimum setpoint).

6. Manually close the shutoff valves on both the purge tank inlet (suction) line and the liquid return line to isolate the purge tank from the CenTraVac condenser.

7. Disconnect the 1/4-inch copper line between the pump-out compressor (3B6) and isolation solenoid valve 3L3.

Disconnect the line that vents the pump-out compressor discharge to the rupture disc vent line at the pump-out compressor outlet.

Using a temporary line (1/4-inch minimum), connect the vent line to the outlet of solenoid valve 3L3 (on top of control panel). This will vent the purge tank to outside atmosphere during testing.

8. Replace the purge power fuse and confirm power across terminals 3TB1-1 to 3TB1-3.

Test Procedure

WARNING! To prevent injury or death due to electrical shock, exercise extreme caution when servicing unit with circuits energized.

Test Conditions:

- Control power ON;
- All purge indicator lights OFF.

1. Purge control switch 3S3 function test.

a. "ON" MODE CHECKOUT

Turn purge control switch 3S3 to ON position:

- Purge condensing unit 3B5 starts;
- Purge condensing unit RUN light 3DS1 lights.

Turn purge control switch 3S3 to OFF position:

- Purge condensing unit 3B5 stops;
- Purge condensing unit RUN light 3DS1 goes off.

b. "AUTO" MODE CHECKOUT

Turn purge control switch 3S3 to AUTO position:

- No change.

Turn CTV RUN signal test switch (installed during setup procedure) to ON position.

Note: This simulates a CTV RUN signal by energizing run relay 3K5 and starting purge operation again.

- Purge condensing unit 3B5 starts;
- Purge condensing unit RUN light 3DS1 lights.

Allow condensing unit to operate 1-2 minutes to cool the purge tank coil.

2. Service switch 3S4 function test.

Press and hold service switch 3S4 in ON position for approximately 20 seconds:

- Isolation solenoids 3L1 and 3L3 energize;
- Pump-Out Compressor 3B6 starts;
- Minute-meter 3M1 starts.

Air will be drawn into the purge tank through the open isolation valve (3L3) outlet. Check to insure minute-meter is operating.

Note: If 3S4 is held in longer than fault timer (3DL2) setting (30-seconds), a fault will occur.

Release service switch 3S4; it will return to OFF position:

- Isolation solenoids 3L1 and 3L3 de-energize;
- Pump-Out Compressor 3B6 stops;
- Minute-meter 3M1 stops.

With air in the purge tank, the purge condensing unit suction temperature will fall because there is no R-11 entering the purge tank. When temperature switch 3S15 contacts close due to the falling suction temperature, pump-out is activated:

- Isolation solenoids 3L1 and 3L3 energize;
- Pump-out compressor 3B6 starts;
- Minute-meter 3M1 starts;
- Fault timer 3DL2 starts timing (set at 30 seconds).

3. Fault timer 3DL2 function test.

a. When fault timer 3DL2 time setting is exceeded (pump-out time greater than 30 seconds) it should detect a fault and:

- Energize fault relay 3K4;
- Turn on fault indicator light 3DS2;
- Stop purge unit operation as follows:

- Isolation solenoids 3L1 and 3L3 de-energize;
- Pump-out compressor 3B6 stops;
- Minute-meter 3M1 stops.
- Purge condensing unit 3B5 stops;
- Purge condensing unit RUN light 3DS1 goes off.

b. Turn purge control switch 3S3 to OFF. This resets the fault circuit:

- Fault relay 3K4 de-energizes;
- Fault indicator light 3DS2 turns off.

4. Fault bypass switch 3S5 function test.

a. Turn fault bypass switch 3S5 to ON:

- Fault bypass indicator light 3DS3 lights;
- Fault timer 3DL2 is disabled;
- Fault relay 3K4 is disabled;
- Fault indicator light 3DS2 is disabled.

b. Turn purge control switch 3S3 to AUTO position. The CTV RUN signal test switch (installed during setup procedure) is still ON:

- Purge condensing unit 3B5 starts;
- Purge condensing unit RUN light 3DS1 lights;
- Purge pump-out operation begins as follows:

- Isolation solenoids 3L1 and 3L3 energize;
- Pump-out compressor 3B6 starts;
- Minute-meter 3M1 starts.

Pump-out is not being timed because fault timer 3DL2 is bypassed, so fault circuit relay 3K4 and fault indicator light 3DS2 will not light. Pump-out operation must continue even when fault timer setting (30 seconds) is exceeded. If it does, proper bypass circuit operation is verified.

c. Turn purge control switch 3S3 to OFF.

- Purge condensing unit 3B5 stops;
- Purge condensing unit RUN light 3DS1 goes off.
- Isolation solenoids 3L1 and 3L3 de-energize;
- Pump-out compressor 3B6 stops;
- Minute-meter 3M1 stops.

5. Temperature switch 3S15 function test.

a. Disconnect the temporary 1/4-inch line installed during setup to vent the purge tank to outside atmosphere. Replace the 1/4-inch copper line between the pump-out compressor (3B6) and isolation solenoid valve 3L3.

Reconnect the line that vents the pump-out compressor discharge to the rupture disc vent line at the pump-out compressor outlet.

b. Turn purge control switch to AUTO. The CTV RUN signal test switch (installed during setup procedure) is still ON:

- Purge condensing unit 3B5 starts;
- Purge condensing unit RUN light 3DS1 lights.

When temperature switch 3S15 contacts close due to the falling suction temperature, pump-out is activated:

- Isolation solenoids 3L1 and 3L3 energize;
- Pump-out compressor 3B6 starts;
- Minute-meter 3M1 starts.

c. Manually open the shutoff valves on both the purge tank inlet (suction) line and the liquid return line.

Pump-out continues until temperature switch 3S15 contacts open. This occurs when most of the air has been pumped out of the purge tank and purge condensing unit suction temperature rises as R-11 vapor enters the purge tank. When 3S15 contacts open:

- Isolation solenoids 3L1 and 3L3 de-energize;
- Pump-out compressor 3B6 stops;
- Minute-meter 3M1 stops.

The air that was introduced into the purge tank during the test procedure has been removed.

6. Turn CTV RUN signal test switch (installed during setup procedure) to OFF position.

Note: This simulates a CTV OFF signal. Purge unit operation will stop at this time:

- Run relay 3K5 de-energizes.
- Purge condensing unit 3B5 stops;
- Purge condensing unit RUN light 3DS1 goes off.

7. Turn fault bypass switch 3S5 to OFF.

- Fault bypass indicator light 3DS3 goes off.

8. Turn purge control switch 3S3 to OFF.

- No change.

Post-Test Procedure

1. Again, remove the purge power fuse located in the CTV control panel.

a. Confirm that there is no power between:

- 3TB1-1 to 3TB1-3;
- 3TB1-2 to 3TB1-3;

b. Enable the "Remote Fault Indication" circuit, if used.

2. Disconnect the test switch between terminals 3TB1-1 and 3TB1-2 in the purge control panel that was used to simulate a CenTraVac RUN signal during testing.

3. Confirm that there is no power at the RUN signal lead. Reconnect this lead (connects CenTraVac control panel to 3TB1-2).

4. Reset fault timer 3DL2 time setting to approximately 5 minutes (factory setpoint).

5. Replace the purge power fuse located in the CTV control panel.

6. Check flare connections for tightness on the 1/4-inch copper line between the pump-out compressor (3B6) and isolation solenoid valve 3L3.

All test procedures are complete and the CenTraVac is ready to be restarted and/or purged as needed.