PURGER JUNIOR INSTALLATION AND OPERATION
BULLETIN PURJR-SB19-01
SERVICE BULLETIN

Phillips REFRIGERATION
VALVES • VESSELS • SYSTEMS • CONTROLS

System drawings shown in this bulletin are for illustration purposes only. Refrigeration systems should only be serviced by a qualified technician. Always observe proper safety procedures when servicing a refrigeration system. For more information see the latest revision of Phillips Safety Bulletin SGRV.

GENERAL INFORMATION

Pressure Rating: 300 psig [20.6 bar, gauge]

For System Suction: -50ºF to +35ºF [-45ºC to +2ºC]

Cold Liquid Supply Req'd: Approx. 0.57 TR [2 kW]

Approximate Weight: 30 lb [13.6 kg]

Overall Dimensions: See figure 1

Main Vessel: 4-1/2" dia x 8-1/2" OAL SS [114mm x 216mm]
Net Volume: 0.057 ft^3 [0.0016 m^3]
Excluding Coil & Collection Chamber

Connections: Foul Gas In –1/4" Connection
Non Condensable Vent – 3/8" SW
Wet Suction – 3/8" Connection
Chamber Drain – 1/4'' FPT
Vessel Drain – 3/8" FPT
Cold Liquid Feed – 3/8'' SW

Refrigerants: Ammonia or halocarbons
This Bulletin focuses on ammonia applications.
Halocarbon refrigerants are discussed briefly.

The Phillips Purger JR is a simple, robust device that removes non-condensable gases from the refrigerant vapor in a system. The unit operates by condensing foul gas (the mixture of refrigerant vapor and non-condensables) from one or more purge points, metering the purified liquid refrigerant back to the system through a protected suction connection, and venting the non-condensables to atmosphere.

Although only extremely small traces of refrigerant are present with the vented non-condensable gases, it is recommended that vented gas be "bubbled" through a liquid reservoir or bubbler. The reservoir should be filled with water for ammonia applications, or oil for halocarbons. Due to the fact that halocarbon refrigerants are difficult to detect (compared to ammonia) it is recommended that a gas detector be installed near the non-condensable vent for added safety when the purger is applied to R-22 or other halocarbons.

The primary component of the Phillips Purger JR is a stainless-steel main vessel that contains a separate inner stainless-steel collection chamber and a condensing coil. A probe responds to the liquid level inside the collection chamber. An electrical control panel provided with the purger includes connections for electrical power and control of the vent solenoid, with provisions for up to (3) purge points. Purge solenoids are not included with the purger.

The Purger includes brackets for mounting on a wall or other structure capable of safely supporting the unit weight.

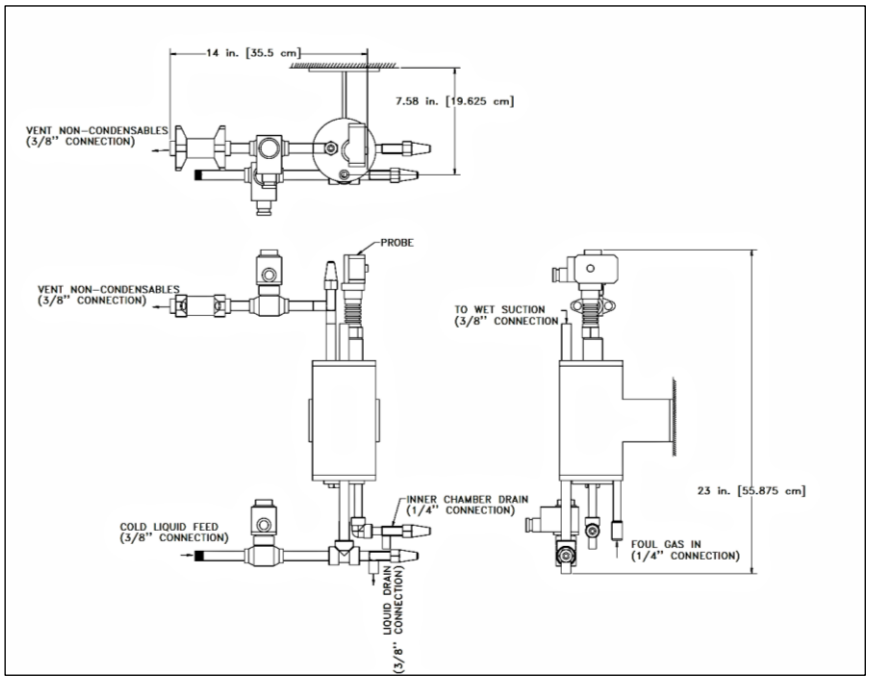

Figure 1: Overall dimensions and major connections shown

OPERATION

The unit consists of a 4-1/2" dia. x 8-1/2" long [114mm x 216mm] insulated main vessel which contains a condensing coil and small collecting chamber, as shown in Figure 2. (Note that control devices have been omitted from the figure for clarity but are fully discussed in this bulletin.) The following discussion focuses on ammonia, but the operating principles are the same for halocarbons.

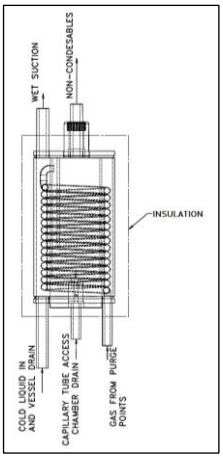

Figure 2: Basic flow through the Purger

During operation, gas inlet from the purge point is drawn into the condensing coil at a rate of about 14.33 lb/hr [6.5 kg/hr]. Ammonia vapor condenses into liquid and flows into the collecting chamber along with any non-condensable gases. The pure liquid ammonia exits through the bottom of the chamber and is returned to the system through a filtered special expansion orifice. The expansion orifice is sized so that the liquid generated by the condensing coil is always greater than that which can flow out through the expansion orifice. In this way, the presence of liquid inside the chamber is assured. Safe purger operation is maintained by a level probe, temperature sensors, and control scheme that prevents the vent solenoid from opening until safe conditions are met.

BASIC OPERATION

To understand the interactions between the unit components, first consider a purger connected to a single purge point with almost no foul gas present in the inner chamber. (Refer to Figures 2 and 3 for relevant components). The following conditions exist:

- No compressors are running
- The main purger vessel is flooded with refrigerant, and suction connection lowers the temperature in the vessel.
- The purge point is feeding foul gas to the condensing coil.
- The vent solenoid is closed (de-energized).

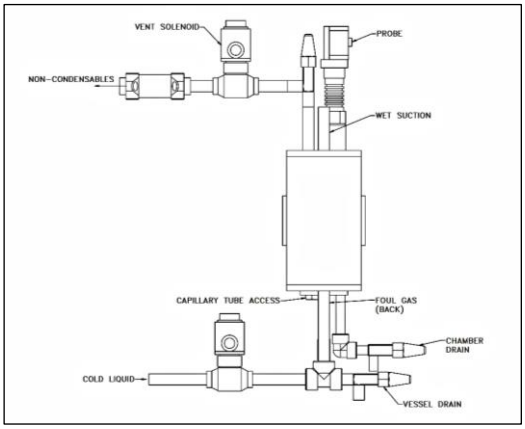

Figure 3: Purger Control Components

As ammonia in the foul gas condenses inside the coil, it flows into the collecting chamber. Any non-condensables also flow to the collecting chamber and rises to the top, and liquid fills the collecting chamber. When the Purger JR receives a "run" signal indicating that at least one compressor is running it starts a delay timer. The liquid passing through the expansion orifice travels back into the outer chamber and out through the protected wet suction line. There is an initial startup 5 minute delay set to allow enough time for the system to establish conditions that ensure that all condensables condense. When it times out, and a sufficient temperature difference has been achieved, the purger can run safely, and the liquid level probe is allowed to open the air vent solenoid valve if the liquid level in the inner chamber is low.

Because the temperature inside the purger is close to suction and the pressure in the collecting chamber is near condensing, the liquid ammonia and non-condensable gases continue to flow into the collecting chamber via the condensing coil. Eventually, enough non-condensable gas accumulates in the inner chamber to force the liquid level in the chamber down. As a result, the probe will read a low-level. Since the delay timer, coil length, thermostat, and expansion orifice ensure that the temperature and suction pressure is near condensing, the low liquid level indicates that the gas in the chamber must be highly concentrated non-condensables. The vent solenoid is therefore signaled to open, and the non-condensables are expelled through the vent orifice and into a bubbler or water reservoir. Cold liquid ammonia continues to accumulate in the chamber until the probe detects high liquid level again, at which time the vent solenoid is signaled to close.

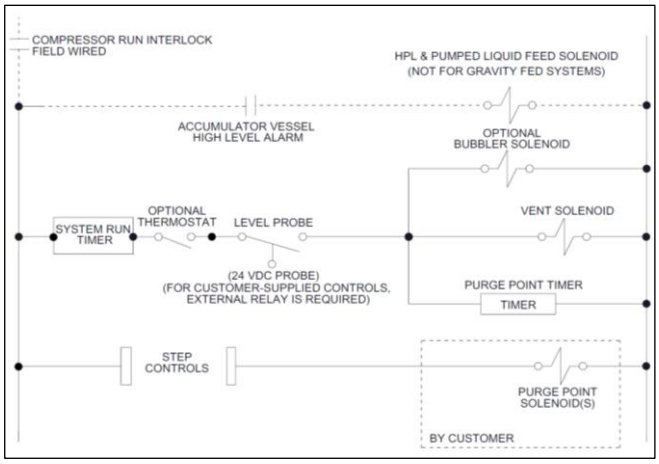

Figure 4: Basic Purger Control

TYPICAL OPERATING CONDITIONS
Before reviewing the safety-related components of the purger, consider two circumstances (1) with almost no ammonia present, and (2) with almost no air present at the purge point.

1. Almost no ammonia in the foul gas

   With the vent solenoid closed, only cooled non-condensable gas will collect in the chamber because the small amount of condensed ammonia will flow through the expansion orifice back to the main chamber. As the probe is at a low-level, the vent solenoid will open and blow the non-condensable gas out through the bubbler.

   The condensed liquid ammonia will flow through the expansion orifice back to the system, and the air (and other non-condensables) will flow through the vent orifice. Flow from the purge point will continue to feed the inner chamber, and eventually the ammonia concentration will provide enough liquid to raise the level on the probe. At this point the probe de-energizes the vent solenoid and the flow of chilled air through the vent solenoid ceases. Only liquid ammonia is permitted to leave the inner chamber via the expansion orifice.

2. Almost no air in the foul gas

   With the vent solenoid closed, ammonia vapor will condense in the coil, and begin collecting in the inner chamber. Because the probe is at high position, the vent solenoid will not open.

Liquid will continue collecting in the chamber, ultimately reaching the vent solenoid. Liquid ammonia from the purge point will begin backing up in the foul gas line, (we will still have a flow of foul gas of 14.33 lb/h [6.5 kg/hr] in the foul gas line as this corresponds to the liquid capacity of the expansion orifice). This condition is acceptable.

SAFETY FEATURES
Safety features of the Purger JR are shown in Figure 5. A check valve is located after the solenoid valve to prevent water from being drawn into the unit from a water reservoir/bubbler. Two valves are mounted on the bottom of the vessel to allow draining of both the inner and outer chamber to allow periodic maintenance of the unit.

Temperature sensors are provided to ensure that the minimum 24°F temperature difference is achieved between the suction and condensing temperatures. These sensors work in conjunction with the set delay. If for any reason during operation the temperature difference becomes less than 24°F, the control will not allow the purger to vent non-condensables until the temperature difference is achieved again. The user can set this to a larger temperature difference, which will make the separation of non-condensables more efficient and will reduce the possibility of venting ammonia vapor. The temperature sensors should be attached to the outside surface of the wet suction line on the purger and the foul gas inlet.

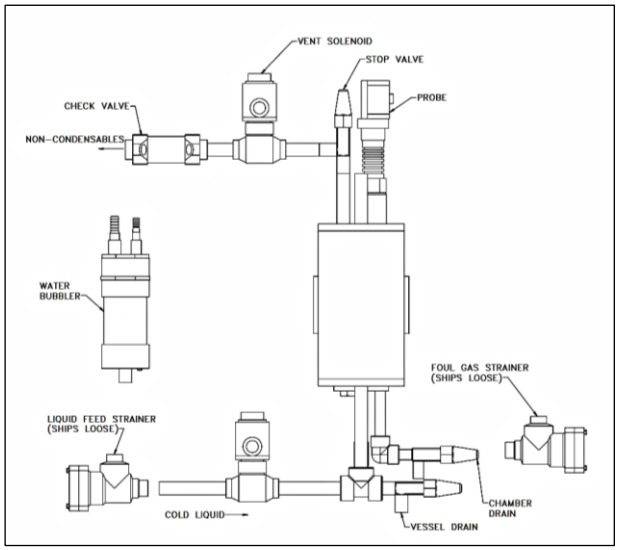

Figure 5: Purger Safety and Maintenance

APPLICATION

The purger can be fed by either pumped recirculation liquid, high pressure liquid or it can be gravity fed. Application in a pumped overfeed system is shown in Figure 6. A liquid feed EVM solenoid and orifice is supplied with the unit to provide between 3 and 4:1 overfeed for pumped liquid at 20 to 30 psi [1.5 to 2 bar] above suction. This solenoid will close when power to the purger is off or high-level alarm on the liquid separator is giving a high alarm.

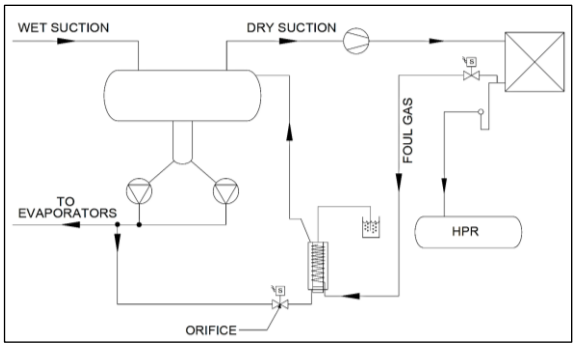

Figure 6: Recirc System Installation Example

Application in a gravity feed system is shown in Figure 7. On a gravity flooded system, the liquid feed solenoid and orifice is omitted, and the unit must be situated lower than the liquid level of the source vessel. The entire purger main vessel must be filled with liquid (covering the collecting chamber), and sufficient static head be available to provide good circulation.

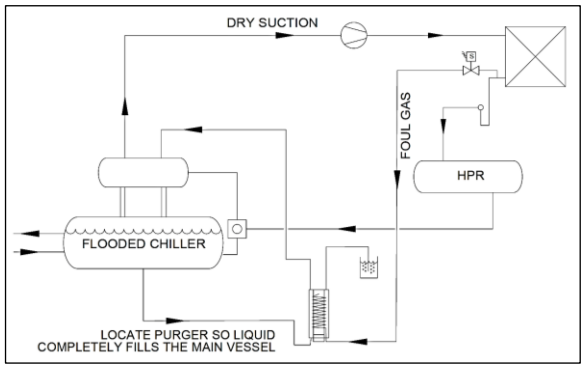

Figure 7: Flooded System Installation Example

Application in a high-pressure liquid feed system is shown in figure 8. An EVM solenoid and orifice will be supplied with the unit to change from high pressure, high temperature liquid to low temperature liquid at suction pressure. This solenoid must close when power to the purger is off, or if the high-level alarm on the liquid separator triggered.

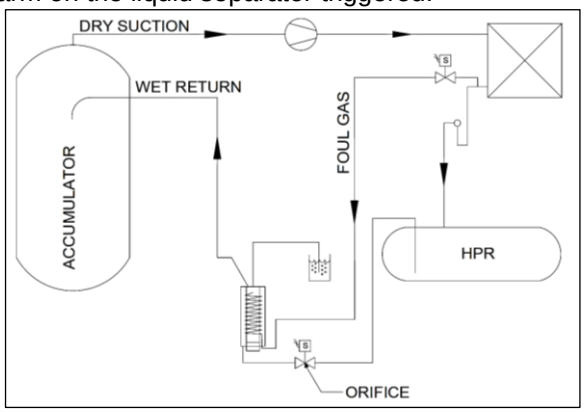

Figure 8: HPL Feed System Installation Example

Any equipment in a refrigeration system that can accumulate non-condensable gas should be periodically purged. This includes equipment on the high side of the system such as condensers and high pressure receivers. Multiple purge points (up to a maximum of 3) may be connected to a single purger, as shown in Figure 9. (Note that on halocarbon systems the optimal purge point locations may differ somewhat.) The control provided by Phillips allows each purge point to open individually for up to 60 minutes. Foul gas flow should be continuous to maintain pressure inside the collecting chamber. A brief "overlap" time when two purge points are open simultaneously is permissible. However, because slight pressure differences between purge points could enable air or non-condensable gases to pass from one purge point to another, overlap time should be limited to ten seconds or less. Aside from this brief overlap, at least one purge point must be open whenever the purger is running.

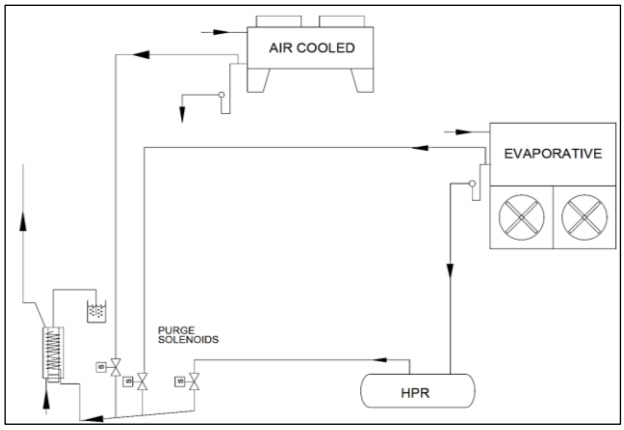

Figure 9: Multiple Purge Points (Ammonia application)

The purge solenoids are preferably placed close to the purge points and may be arranged on a manifold connected to the purger. Condensed liquid ammonia in the foul gas lines is permissible since the liquid is quickly sucked into the collecting chamber. However individual purge points should be left open for sufficient duration in order for all this liquid plus any air to reach the purger before switching to another purge point. To assure proper flow the minimum foul gas line size ⅜" is recommended. The line size should not exceed ½" pipe and not smaller than ⅜". Velocity through a ½" Schedule 80 purge line is about 6.5 ft/s [2 m/s], so it will take about 8 seconds to clear 50 ft [15 m] of pipe. The purge point should be open for another 30 to 40 minutes to assure that any non-condensable gas makes its way into the collecting chamber. Once a majority of non-condensables have been evacuated from the system, this time can be reduced to 10-15 minutes.

INSTALLATION

The purger should be located in a safe place where it will not be damaged by material handling equipment, but where it is accessible to service personnel. The unit should be secured to a wall or other structure capable of supporting the weight of the unit. A minimum ½ gallon [2 liter] water bubbler should be provided for venting the unit. (Ambient temperatures should therefore not drop below 32ºF [0ºC].) The location should have good ventilation to permit safe dispersal of non-condensables leaving the water reservoir. Locate the electrical control panel away from the area where non-condensables are vented.

As discussed in the previous section, pipe size between the purge points and the unit are recommended to be size ⅜". The line size should not exceed ½" pipe or be smaller than ⅜". Purge solenoids should have ½" [15 mm] ports for maximum flow and be of the direct operated type (not requiring pressure drop to operate). Purge solenoids are not included with the purger as standard; however, purge solenoids can be supplied by Phillips.

Two ½" angle strainers are included with the PURJR air purger assembly as loose items. One should be installed in the liquid feed line before the orifice and the other in the foul gas line before entering the vessel. These are included to prevent any debris build-up in front of the orifices, potentially clogging them and causing the unit to malfunction.

Before welding any connections to the purger, be sure to temporarily remove any nearby solenoids and orifices from the housing. Replace the solenoids after welding is complete (Figure 10). A liquid feed orifice is located in the EVM solenoid connection which ships loose with the unit (See Figure 1), for both HPL fed systems and pumped liquid systems.

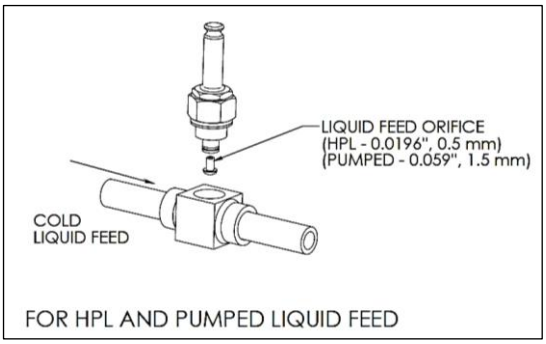

Figure 10: Temporarily Remove Orifice before Welding

Do not install a stop or check valve on the foul gas inlet (Figure 11). Closing such a valve in combination with a closed isolation or suction solenoid valve could result in trapped liquid.

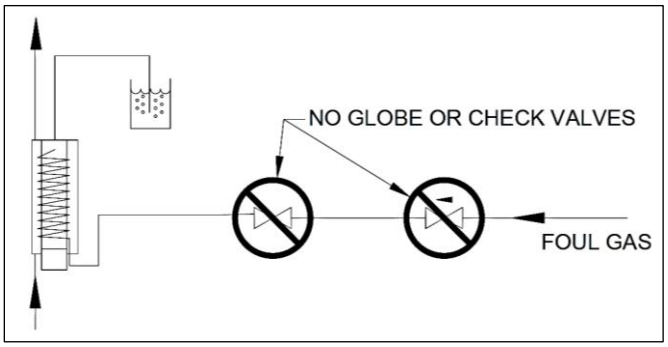

Figure 11: Do not trap liquid

The Phillips Purger JR is typically provided with the following items shipped loose (see figure 12):

- Probe
- Liquid Feed and vent Solenoids
- Check valve
- Temperature Sensors (2)
- Liquid Feed Strainer
- Foul Gas Strainers
- Drain valves
- Control Panel
- Bubbler
- Optional Purge Solenoids

Install the Probe, liquid feed (if necessary) and vent solenoids, temperature sensors, strainers drain valves and check valve in the locations indicated in figure 12.

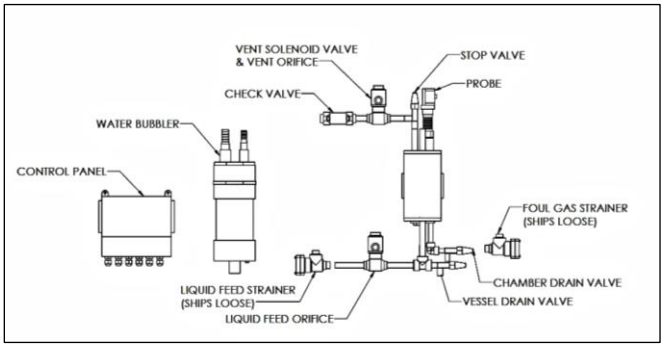

Figure 12: Major Components

The Purger JR is supplied with the following factory components: Insulation, Electrical Controls, and Water bubbler.

ELECTRICAL CONTROL PANEL

The 3-point control panel is a smart control using the Danfoss MCX controller. This panel is a NEMA 4 enclosure and has UL and CSA approval. This control must be interlocked with the compressor run

signal to prevent purger operation when the compressors are not running. Controls require the use of 110/230 VAC. The 3 control panel purge points can be programmed to open for different lengths of time. The main controller has a resettable clock that sums the running total purge vent time. The electrical control panel should be located away from the area where non-condensables gases will be vented. Wire the components to the electrical system as shown in the electrical control drawing.

BUBBLER:
The Phillips bubbler is supplied with the purger as a safety feature which will allow any vented ammonia gas to be absorbed by the water in the bubbler before being disposed into an approved waste location. The bubbler has three connections: 3/8'' vent gas inlet, 3/4'' water inlet and 3/4'' drain. The bubbler should be filled with water prior to initial startup through the top water connection with external water source. The customer supplied water feed solenoid should be wired to the vent solenoid to allow fresh water or oil if halocarbon refrigerant, to enter the bubbler each time the purger vents. We recommend a minimum flow rate of approximately 1/2 gpm, to allow complete absorption of any ammonia vapor released in an unforeseen failure. If the purger has not vented over a two week period we recommend running water through the bubbler to add fresh water, removing any possible contaminants that may still exist.

While running, the purger imposes a maximum 0.57TR (2kW) load on the system. If there is little or no non-condensables in the foul gas, this represents an unnecessary operating cost. This unnecessary cost may be eliminated by stopping the purger over periods of time. This is done by cutting the "run" signal to the purger, which will stop the purger. Depending on the size of the refrigeration system and the amount of air coming into the system the customer can decide how often and how long to run the purger. However, the capacity of the purger is high enough that it will easily be able to handle refrigeration systems with high amounts of air and or non-condensable gases, with up to three purge points, if it runs whenever the refrigeration system is running.

Phillips can assist with additional enhancements and modifications of the purger controls.

BENEFITS OF A TIME COUNTER
An additional benefit of the air purger cumulative time counter is that it allows estimates of the actual amount of air being vented from the system. Because the air is being released at approximately condensing pressure through a known orifice, the volume of air being purged can be determined by reading the curve in Figure 13.

For example, consider a system operating at 90ºF condensing. If the time counter indicates that the vent solenoid was open for a total of 5 minutes, then about 4 cubic feet (4 cfm x 5 minutes) of air was purged from the system. This example illustrates the enormous effectiveness of the purger.

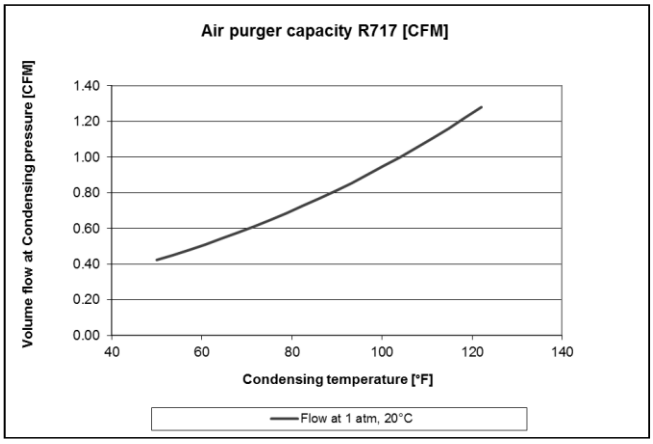

Figure 13: Purger Capacity

START-UP OF PURGER WITH STANDARD PHILLIPS CONTROLLER

1. Close the vent stop valve. (Refer to Figure 12)
2. Make sure there is an open connection to at least one purge point. Open all stop valves, and if there is a solenoid valve in the line between purge points and air purger this must be open. **Note: The air purger must never be allowed to run if there is not an open connection to at least one purge point.**
3. Open the suction globe valve. Allow cold liquid ammonia to slowly fill the main vessel with cold liquid through the liquid feed connection. If Purger JR is fed by HPL or pumped liquid, liquid feed will not start until power is turned on to the Purger JR which takes place in step 6. Evaporated ammonia will leave the main vessel through the top wet suction connection.
4. Make sure bubbler is full of water before first start-up of the purger.
5. Open the vent stop valve.
6. Power on the control panel and reference the control panel start up guide. Condensed refrigerant gas will start flowing to the suction side through the expansion orifice. If HPL or pumped liquid fed, the liquid feed solenoid will open and slowly fill the main vessel during this step. Non-condensables will begin collecting in the collecting chamber.
7. When the temperature difference has been achieved, and the liquid level measured by the level probe is low inside the collecting chamber, the vent solenoid valve will open. When the liquid level measured by the level probe is high the vent solenoid valve will close.

8. The purger is not allowed to vent air if the difference between suction temperature and condensing temperature is lower than 24°F. (13°C) This condition is ensured by the controls, and temperature sensors which will only allow the vent valve to open after the delay (5 minute default time) times out and required temperature difference has been met.

The vent solenoid will open if a considerable amount of non-condensables have collected inside the chamber (purge indicator light will illuminate). Venting will cease when liquid ammonia has displaced the non-condensables.

UNIT PUMP DOWN

1. Shut-off the suction globe valve
2. Shut-off the stop valve in the air vent line.
3. Shut-off liquid feed to the main vessel. If HPL or pumped liquid fed, then this will be done when power is turned off to purger control panel.
4. Mount a hose to each of the needle valves on the bottom of the unit and run the hoses into a bucket of water. One connection is ¼" and the other is ⅜". One of the valves drains the inner chamber and the other drains the outer vessel. Once the hoses are in the bucket of water open the needle valves and begin to drain.
5. When the liquid in the main vessel has been drained (frost clears from main suction pipe), the temperature will rise in the vessel. To clear ammonia from the foul gas lines and prevent ammonia from accumulating in the collecting chamber close the purge point solenoid(s).

MAINTENANCE

Change or Renew Water in Reservoir or Bubbler

A strong ammonia odor indicates that water in the reservoir or bubbler has absorbed all the ammonia that it can from the vented gas. The water solenoid can be activated manually through the controls to flush the bubbler. Please dispose of the water following your organization's established guidelines.

- Reservoir- Empty reservoir and refill with fresh water.
- Bubbler- Drain through drain plug or by removing top cap assembly and dumping water out. Refill with fresh water. This process occurs with the use of water solenoid when purger is venting. If the purger has not vented over a two-week period we recommend running water through the bubbler to add fresh water, removing any possible contaminants that may still exist.

Clean Orifice

1. If the Purger JR expansion orifice gets clogged, first pump down the unit following the directions previously noted.
2. Once the vessel has been fully pumped down and drained unscrew the center plug on the bottom of the vessel.
3. After the plug is unscrewed the operator should be able to use a ⅜" Alan wrench to unscrew the orifice and filter assembly from the purger. **Note: Very minor amounts of refrigerant may still be in the inner chamber, proper safety equipment is necessary.**
4. Once the assembly is removed either clean the filter and orifice using compressed air or replace the whole assembly. Replacement assemblies can be purchased from Phillips.
5. After the assembly has been properly cleaned screw the assembly back into position until the screw seats on the shoulder in the fitting and proceed to start-up again.

Preventive Maintenance Cleaning Strainers

Strainers should be installed on both the liquid feed and foul gas lines. During normal operation these strainers should help catch any debris that might have a chance of clogging the orifices. If the liquid feed orifice gets clogged the unit will not be able to get down to temperature, which is indicated by lack of frost on the suction line, and the purger will not be able to condense the ammonia out of the foul gas. If the expansion solenoid were to get clogged, liquid ammonia will back up in the collection chamber and open the vent solenoid in the presence of air. Cleaning these strainers should be done on an as needed basis during normal operation.

TROUBLESHOOTING

CONDITION:	CAUSE / SOLUTION
Unit does not reach suction temperature	• Main suction valve not open • Liquid feed orifice clogged
Ammonia escapes through vent solenoid	• The foul gas connection to purge points is not open to at least one purge point • Probe incorrectly reading low position • Vent solenoid leaks • Liquid feed orifice clogged
Vent solenoid energizes (vent light illuminates), but no gas vents	• Vent orifice clogged • Faulty vent solenoid coil
Vent solenoid never opens (Vent light never illuminates)	• No air in system • Probe stuck in high position
Liquid feed solenoid never opens (only necessary on HPL or Pumped Liquid Feed)	• Missing “compressor running” signal from refrigeration system • Faulty liquid feed solenoid coil

- Small orifices are key components used in the air purger. Any debris getting past the strainers has the potential to clog these and impede performance of the unit.

- For suspected issues with the controller please call H.A. Phillips

REPLACEMENT PARTS NUMBERS

PART	PART NUMBER
Probe	PUR-PROBE
Vent Orifice	1208
Capillary assembly	PURJR-CAP
HPL & Pumped Liquid Feed - Housing Solenoid Coil (110V) Orifice	 027F1047 027B1120 018F7991 HPL -1208 Pumped - 1209
Temperature Sensor (Foul Gas & Suction	084N3210
Strainer Insert (250 Micron)	148H3126

PURGER MODEL NUMBERS

DESCRIPTION	MODEL NUMBER
Purger with control valves, insulation, bubbler and control panel	PURJR

OPTIONAL PART NUMBERS

PART	PART NUMBER
Purge point EVRAT Solenoid With strainer	027X0142 006-1012
Purge point ICF Valve Station	027L4527
Coil 220 VAC w/terminal box	018F6814

Ordering Instructions:
-Specify liquid supply source (HPL, Pumped Liquid, or Gravity)

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