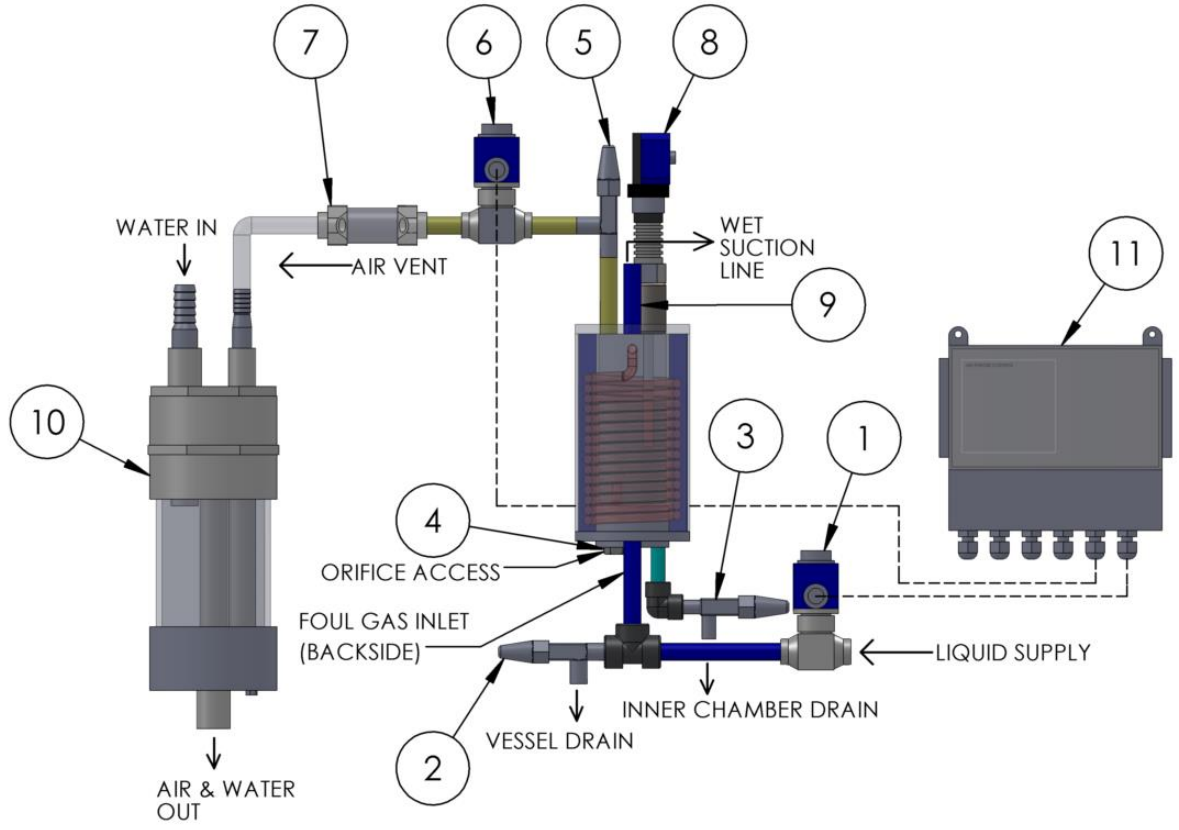

Figure 1: PURJR Air Purger General Layout

The general layout of the Phillips PURJR Purger and all relevant components are shown in Figure 1.

Description of positions

1) **Orifice:** For pumped circulation the diameter of orifice hole is 0.059” [1.5mm]. This orifice is made from a stainless steel screw. For high pressure feed systems this orifice is changed to a 0.0196’’ [0.5mm] stainless steel screw.
   Function: The orifice limits the amount of refrigerant that is fed from the refrigerant pumps to a circulation rate of approximately 3:1 in the evaporative part of the purger.
   Note: When the air purger is used on gravity fed systems (no refrigerant pumps), this orifice needs to be removed and the air purger should be mounted a minimum of 20” [500mm] lower than the lowest liquid level in the separator feeding it in order to ensure sufficient gravity feed. When fed by high pressure liquid or pumped liquid the union is replaced by a 110 VAC solenoid valve and orifice.
   Note: Unless fed with high pressure liquid or pumped liquid, solenoid valves must not be fitted in the liquid supply line as this could make the air purger vent refrigerant during startup or standby.

2) **Vessel Drain:** Danfoss SNV-ST – 3/8’’
   Function: This needle valve will allow the user to empty the vessel of any remaining refrigerant prior to servicing the expansion orifice (pos. 4).

3) **Chamber Drain:** Danfoss SNV-ST – ¼’’
   Function: This needle valve will allow the user to empty the inner chamber of any remaining refrigerant prior to servicing the expansion orifice (pos. 4).

4) **Expansion Orifice Access:**
Function: This allows the user to access for expansion orifice assembly inside the vessel. The expansion orifice assembly consists of a filter, 3/8'' hex head screw and orifice with 0.012'' [0.3 mm] hole.
Note: The operator must first remove any liquid from the vessel and inner chamber through vessel drain (pos. 2) and chamber drain (pos. 3) before removing this orifice assembly in the event of a clog.

5) **Stop valve:** Danfoss SNV-ST – 3/8''
Function: Needle valve allows service of the solenoid (pos. 6) and check valve (pos. 7).

6) **Solenoid valve with built in orifice:** Danfoss EVM pilot solenoid valve, with orifice bolt with 0.0196" [0.5mm] diameter orifice hole mounted in a Danfoss CVH pilot valve housing.
Function: The solenoid allows air purging. The solenoid opens when the liquid level in the separation chamber is depressed below the lowest switch point of the level probe by the presence of non-condensables above the liquid surface. The solenoid valve closes again when enough air has been purged to allow the liquid level to reach the upper switch point on the level probe.
Regulation: When air purger is running and level probe (pos. 8) indicates low level, this solenoid valve (pos. 6) opens. This solenoid valve is kept open until level probe (pos. 8) indicate a high level, as long as the air purger is running.
Note: A purge time counter is included in the controller, which counts how many seconds the purge solenoid (pos. 6) has been open. This gives a fairly accurate representation of how much air has been purged from the system.

7) **Check Valve:** Danfoss NRVA 15 or similar – 3/8''
Function: The check valve ensures that ambient air or water from a bubbler is not drawn into the purger in the event of a malfunction where the air purger pressure drops below atmospheric pressure.

8) **Capacitive liquid level probe:** HB Products HBLC special calibrated level control rod with two pre-set switch points, one for low level and one for high level.
Function: When the volume of non-condensables (air) in the separator chamber increases, it will displace the volume of condensed refrigerant in the separation chamber and the liquid level will drop. When the level drops below the lowest switch point on the level probe (pos. 8), the air purge solenoid (pos. 6) opens and the non-condensables purge at condensing pressure through the purge solenoid and its built-in orifice (pos. 6). When the liquid level reach the upper switch point on the level probe (pos. 8) the air purge solenoid (pos. 6) closes.
Regulation: When the air purger active and the level probe (pos. 8) indicates low liquid level, then the air purge solenoid (pos. 6) opens and is kept open until the level probe (pos. 8) indicate a high liquid level.

9) **Wet Suction Line:**
Function: Return liquid to low temp accumulator or other low side vessel.

10) **Bubbler**
Function: Absorption of any ammonia gas that might be purged with the non-condensable gases. Bubbles that pass through the water to the surface are non-condensable, while bubbles that disappear in the water will be ammonia gas. The water supply should be run whenever the air purge solenoid is energized.
Note: The user must make sure that a minimum of 1 GPM of water is being pumped through the bubbler per every 1 lb. of vent gas.
Note: The ammonia content in the purged air will depend on the difference between the saturated condensing temperature and the saturated evaporating temperature. A large difference will result in a very low content of ammonia, while a low difference will result in a somewhat higher content. For this reason the purger is limited to temperature differences above 23°F [13°C].

11) **Control Panel**
Function: The control system ensures correct operation of the air purger within the limitations described above. The control system contains a timer that will delay the possible air venting from the air purger,

adjustable between 10 to 120 minutes, after the RUN signal is received from the refrigeration system. This is to ensure the air purger is in pressure / temperature balance after start-up of the refrigeration system making sure it is non-condensables which is purged out of the vent line. We recommend a delay time of approximately 15 minutes to insure the conditions are met for non-condensables to condense. The control also contains a purge time counter that tracks the total amount of time that the air purge solenoid (pos. 6) has been open. Using the formulas and table supplied below, the amount of purged air can be determined. On the display on the controller the liquid level in the inner vessel during operation will be monitored and is shown in % of the whole length of the level probe.

Capacity and Performance

The heat exchanger in the air purger has a design refrigerant condensing capacity of 0.57 TR [2kW], however the actual air purging capacity is dependent on the amount of non-condensable gases in the condenser. The low pressure side connected to the air purger needs to be able to deliver the 0.57 TR [2kW] capacity. On the high pressure side the air purger draws refrigerant gas and non-condensable gases into the purger with 0.57 TR [2kW] capacity, ensuring that the purger gets the maximum volume of non-condensable gases during operation. Due to its high capacity it is recommended that the purger is only run for a short period of time each day once the general level of non-condensable gases have been brought down to a low level. One hour once or twice a day is often appropriate.

It is recommended to compare the time the air purger is in operation with the time it vents. If the purger vents during most of the time in operation, it will most likely be possible to get more air out by increasing the operating time. On the other hand, if the air purger vents for a small portion of the operating time, it is recommended to decrease the operation time, thereby saving the 0.57 TR [2kW] of heat load.

Once the air purger gains access to large pockets of air its capacity will be very large and not limited to the condensing capacity of the coil, as illustrated in diagram below.

Figure 2 outlines the amount of air purged per hour from the purger as a function of the condensing pressure. The dashed curve shows the volumetric flow of purged air out of the air purger at condensing pressure while the solid curve illustrates the volume flow out of the air purger (atmospheric pressure). By using the solid curve the total volume of the purged air at atmospheric pressure can be determined. This shows how much air that came into the refrigeration system.

By using the dashed curve the total volume of the purged air at condensing pressure can be determined. This shows how much space (volume) the purged air had occupied in the condenser/receiver and can give an idea about how much less condensing capacity the system would have if the air was not purged out of the system.

By using Figure 2 the purged volume of air can be calculated from the total time the purge solenoid valve has been opened.

Example:

If the purge solenoid valve has been open 10.25 seconds and the average condensing temperature has been 72°F [22°C], the purged volume will be:

$$\frac{10.25\text{s}}{60\frac{s}{\text{min}}} = 0.1708 \text{ min}$$

Volume at condensing pressure (dashed curve):

$$\frac{0.188 \text{ ft}^3}{\text{min}} \times 0.1708 \text{ min} = 0.0321 \text{ ft}^3 \qquad \left[\frac{0.00531 \text{ m}^3}{\text{min}} \times 0.1708 \text{ min} = 0.0009 \text{ m}^3\right]$$

Volume at atmospheric pressure (solid curve):

$$\frac{2.443 \text{ ft}^3}{\text{hr}} \times 0.1708 \text{ min} = 0.417 \text{ ft}^3 \qquad \left[\frac{0.06917 \text{ m}^3}{\text{min}} \times 0.1708 \text{ min} = 0.0118 \text{ m}^3\right]$$

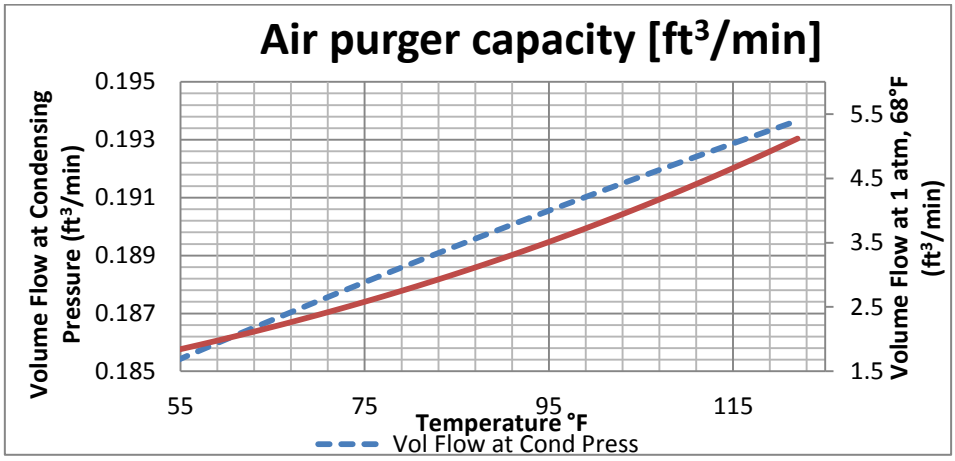

Figure 2: Purger Capacity

Safety

- The costumer/user must ensure that the air purger cannot be activated without access to an open purge point. If this condition is not met it can result in refrigerant in the purge line.
- It is not possible to trap liquid in the air purger as the solenoid valves can open backwards allowing liquid to escape.

Note:

It is recommended to check the refrigeration system water content on the low pressure side. When air is found in the system, it is certain that moisture is also in the system. As with air, water is a pollutant of the system with serious consequences for the system capacity, power consumption, efficiency and maintenance cost.

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