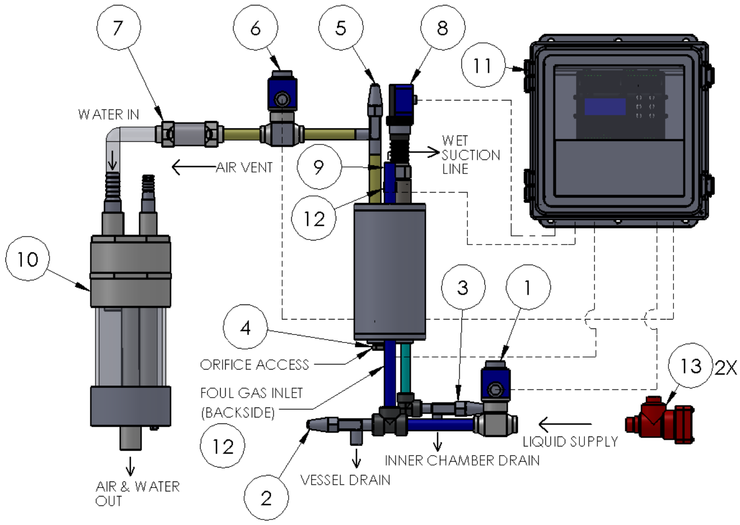


Figure 1: PURJR Air Purger General Layout

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 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 the air purger is running and the level probe (pos. 8) indicates low level, this solenoid valve (pos. 6) opens. This solenoid valve is kept open until the level probe (pos. 8) indicates a high level, if the air purger is running.
Note: The purge time is included and stored in the controller, which counts how many minutes the purge solenoid (pos. 6) has been open. This helps provide an 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 reaches 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 24°F [13°C].

11) **Control Panel**
Function: The smart control offered can purge up to 3 purge points and utilize the Danfoss MCX programmable control platform. Using this platform integrated with the temperature sensors and level probe the controls open and close the vent solenoid allowing purging to take place. The sensors also control the sequencing of the purge point solenoids, water solenoid, liquid feed solenoid, and expansion solenoid as needed. The controls allow the user to set different purge point times, isolate purge points, and keeps an accurate count of the time each purge point has been open. Estimates of the ammonia loss and volume of air removed are automatically calculated and stored in the controller. A smart detect feature is implemented into the controls that automatically skip over a purge point if it has not seen a significant increase in air/non-condensables over a user defined period. RS485 communication capabilities are included.

12) **Temperature Sensors:** Danfoss temperature sensors

Function: The temperature sensors makes sure the difference between the suction and condensing temperature is a minimum 24°F [13°C]. The temperature sensors will work with the delay timer to make sure the temperature difference is met. If that difference is not met during operation, the vent solenoid (pos. 6) will not be allowed to open, preventing any non-condensables from being vented. Temperature sensors are mounted on the wet suction piping and foul gas inlet.

13) **Liquid Feed and Foul Gas Strainer:** Danfoss FIA 15 or Similar

Function: The two strainers are used to prevent the small liquid feed and foul gas orifices from clogging. The strainer insert is 250 microns [72 mesh], that is sized small enough that it will catch any debris large enough to clog the orifices during normal operation. If these orifices are clogged the unit will not be able to function properly. Both strainers ship loose.

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.

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 75°F [24°C], the purged volume will be: $\frac{10.25s}{60\frac{s}{min}} = 0.1708min$

Volume at condensing pressure (dashed curve):

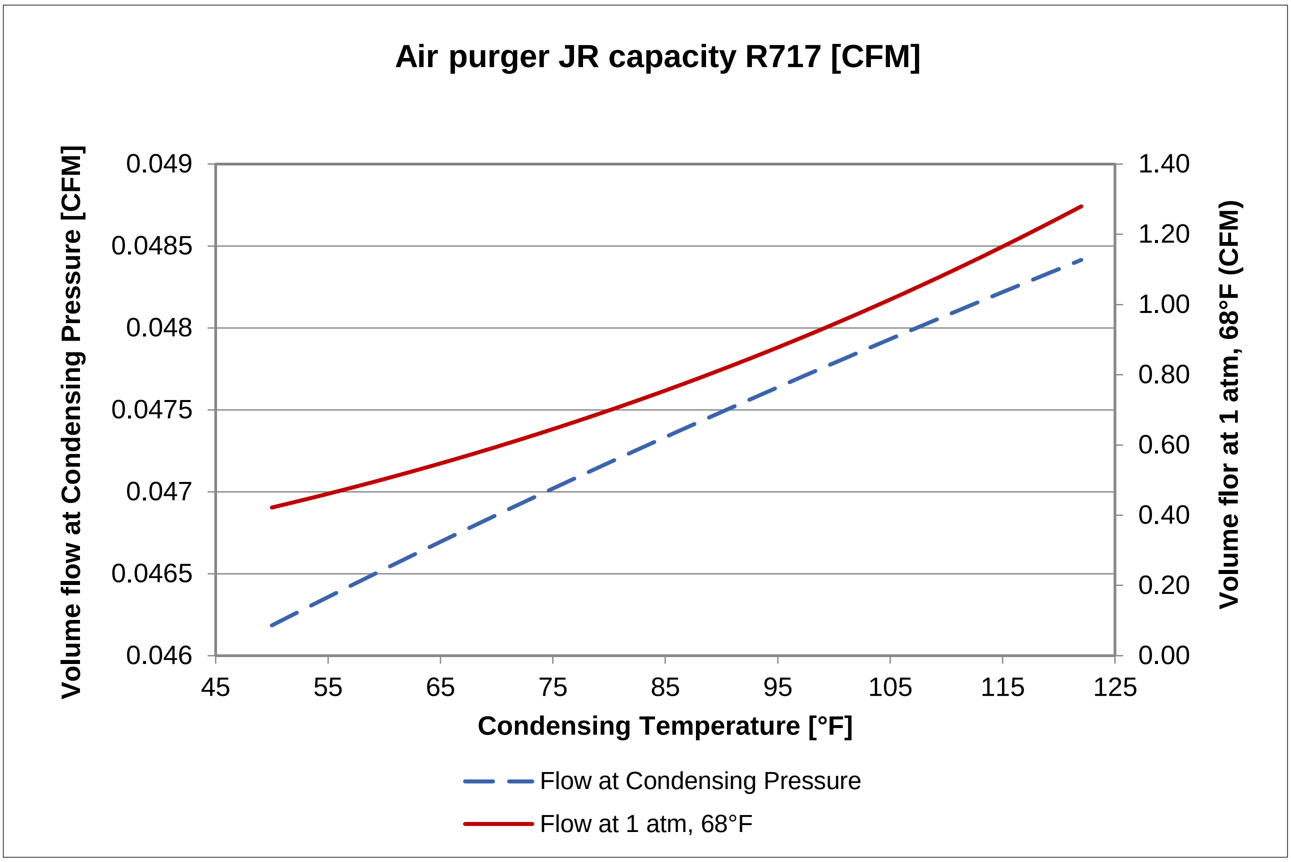
$\frac{0.047ft^3}{min}\ x\ 0.1708\min = 0.008\ ft^3$

$\frac{0.0013\ m^3}{min}\ x0.01708\min = 0.00022m^3$

Volume at atmospheric pressure (solid curve):

$\frac{0.65ft^3}{min}\ x\ 0.1708\min = 0.11ft^3$

$\frac{0.018m^3}{min}\ x\ 0.1708\min = 0.003m^3$



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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