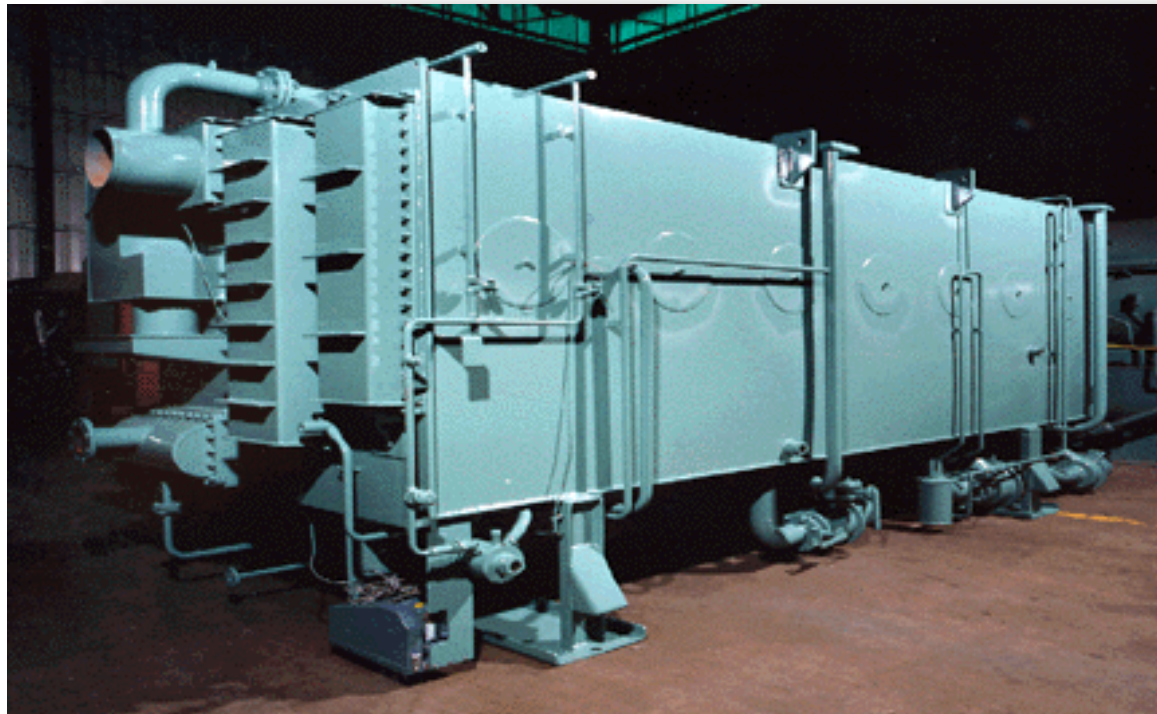
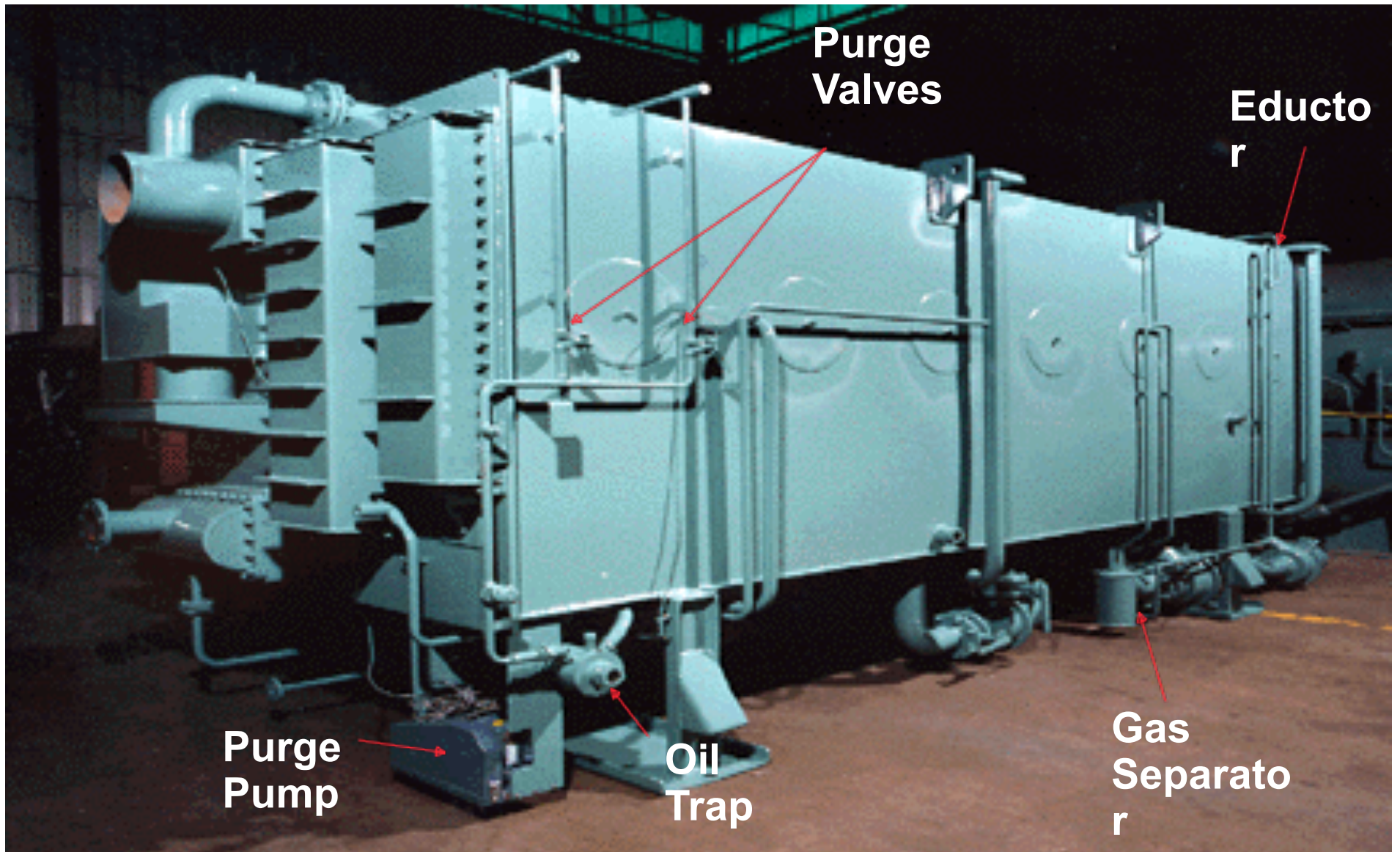


ParaFlow Purge System

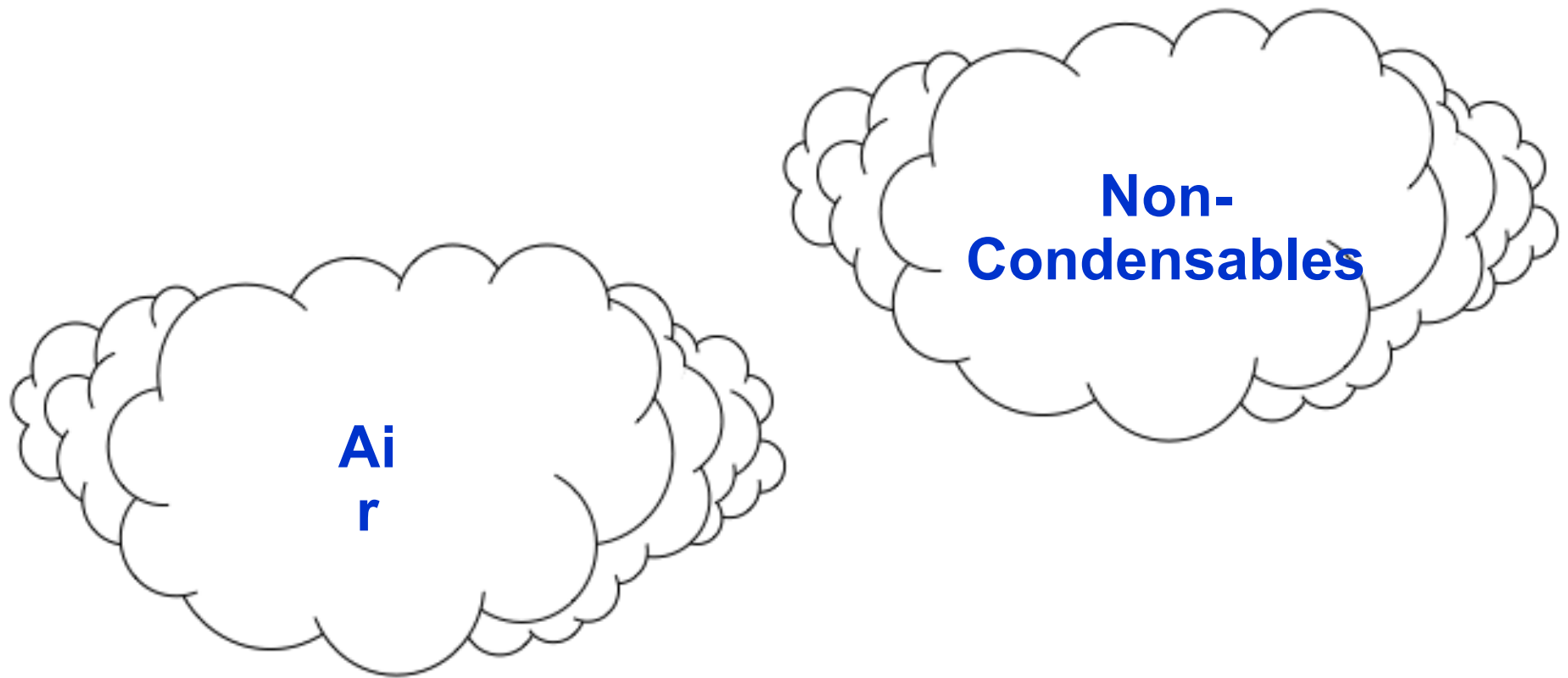


Purge System (G-Series)



Why Purging is Necessary

- Air leakage into unit
- Internal Generation of Non-Condensables



Effects of Non-Condensables

- **Higher Operating Pressures and Temperatures**
- **Loss in Performance**
- **Rapid Breakdown of Corrosion Inhibitors**
- **Decreased Unit Life**

Non-Condensable Types

Internally Generated

- **Hydrogen - H₂ - Product of Corrosion**
- **NO_x Gases - Typically formed due to rapid depletion of inhibitor.**
- **Ammonia - NH₃ - Indicative of an air leak in the system. Has been linked to corrosion stress cracking in copper.**

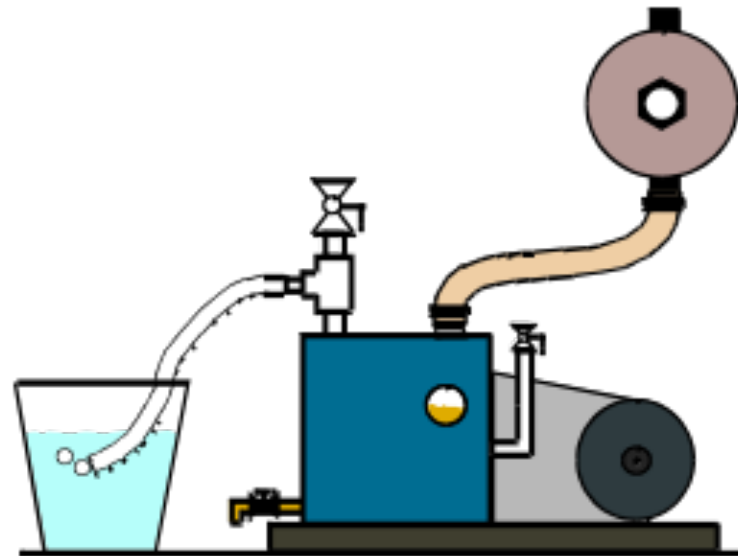
Non-Condensable Types

Gases drawn into machine due to a leak.

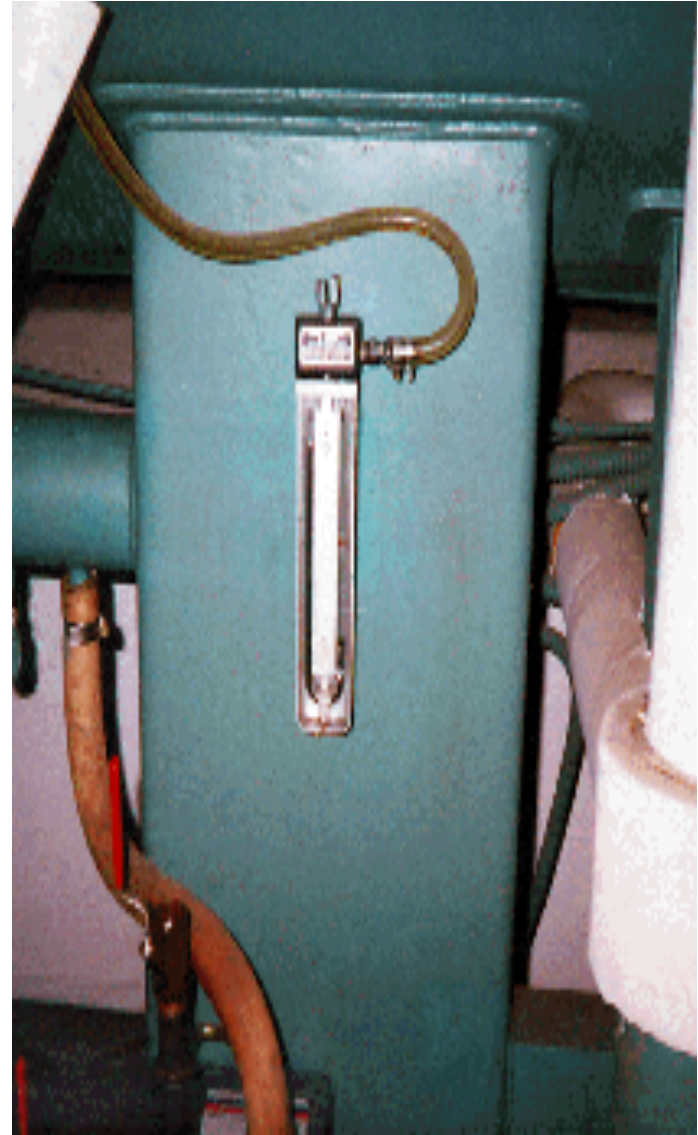
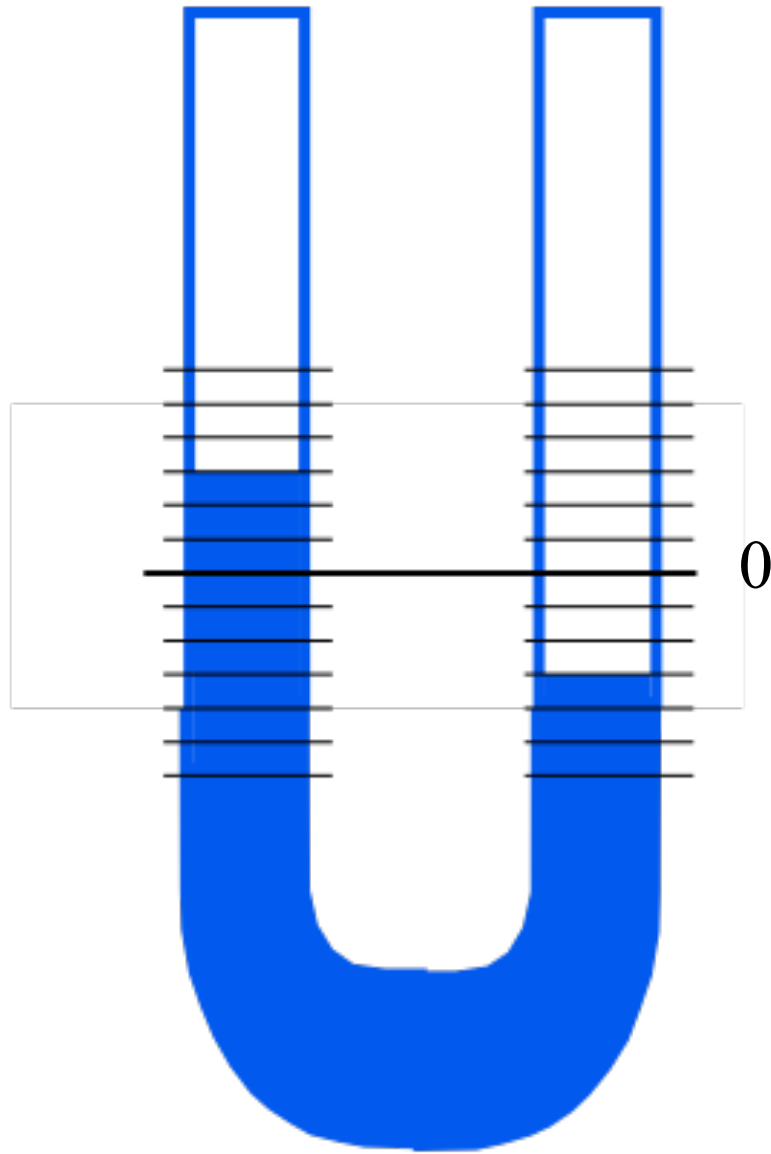
- **Nitrogen - Main constituent of air.**
- **Oxygen - O₂ - Greatly increases internal corrosion rates, which in turn produce a greater number of internally generated non-condensables.**
- **Any gas that may be present around the leak will also be drawn into the machine.**

Purge System Components

- Absolute Pressure Gauge (Manometer)
- Vacuum Pump
- Eductor
- Solution Pump
- Gas Separator
- Oil Trap
- Various Hand Valves
- Automatic Valves
- Check Valve
- Purge Tank
- Purge Tree/Piping



Manometer



Purge Pump

- **Removes accumulated non-condensables from purge tank, absorber, condenser and hot water heat exchanger (where applicable).**
- **5.6 CFM Welsh Pump can also be used to evacuate the machine on initial start-up.**

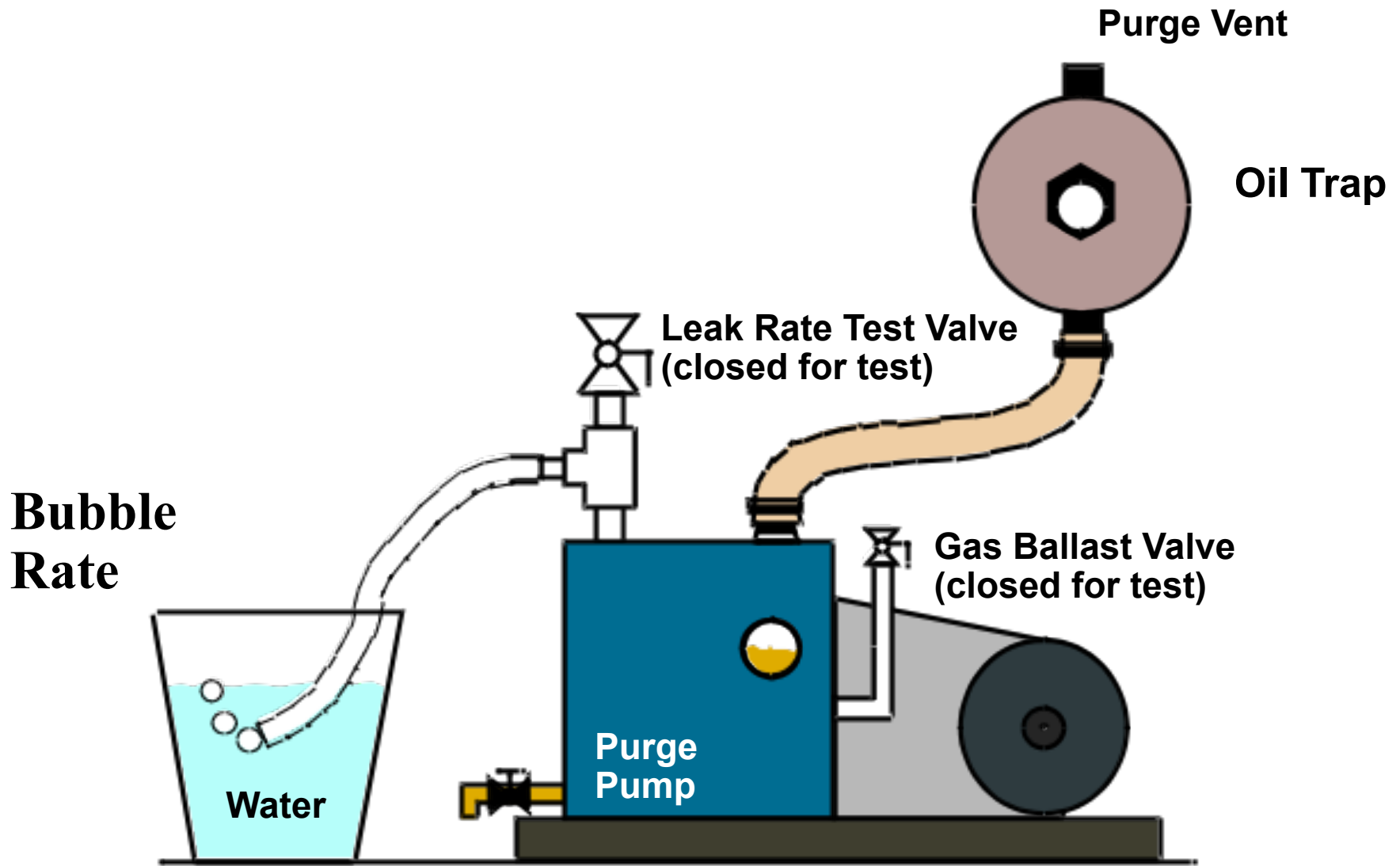
Purge Pump Specifications

- **“G” Series units use a 5.6 cfm 2-stage Welch Pump**
- **“S” Series units use a .7 cfm Welch Pump**

General Purge Pump Maintenance

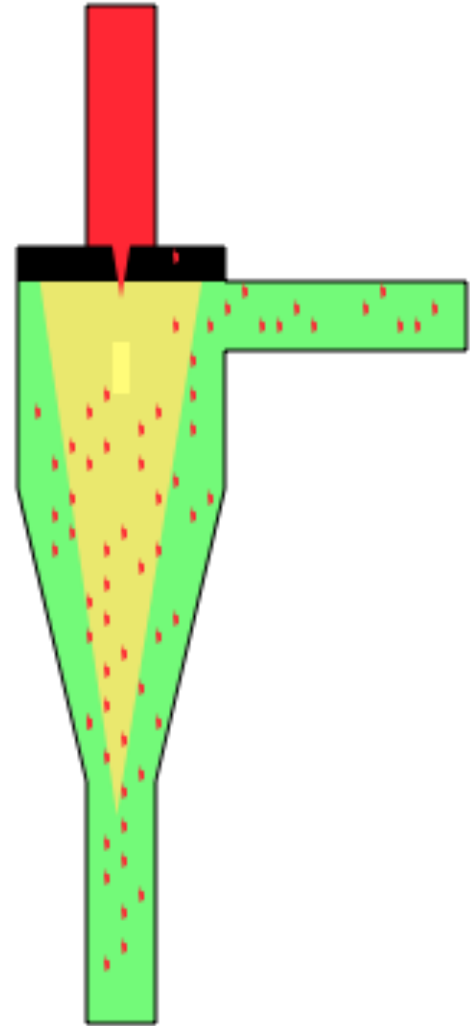
- **Check belt condition. Belt deflection should be approximately 1/2”**
- **Check hose condition and clamps for tightness.**
- **Oil should be changed regularly.**

Purge Pump Set-Up

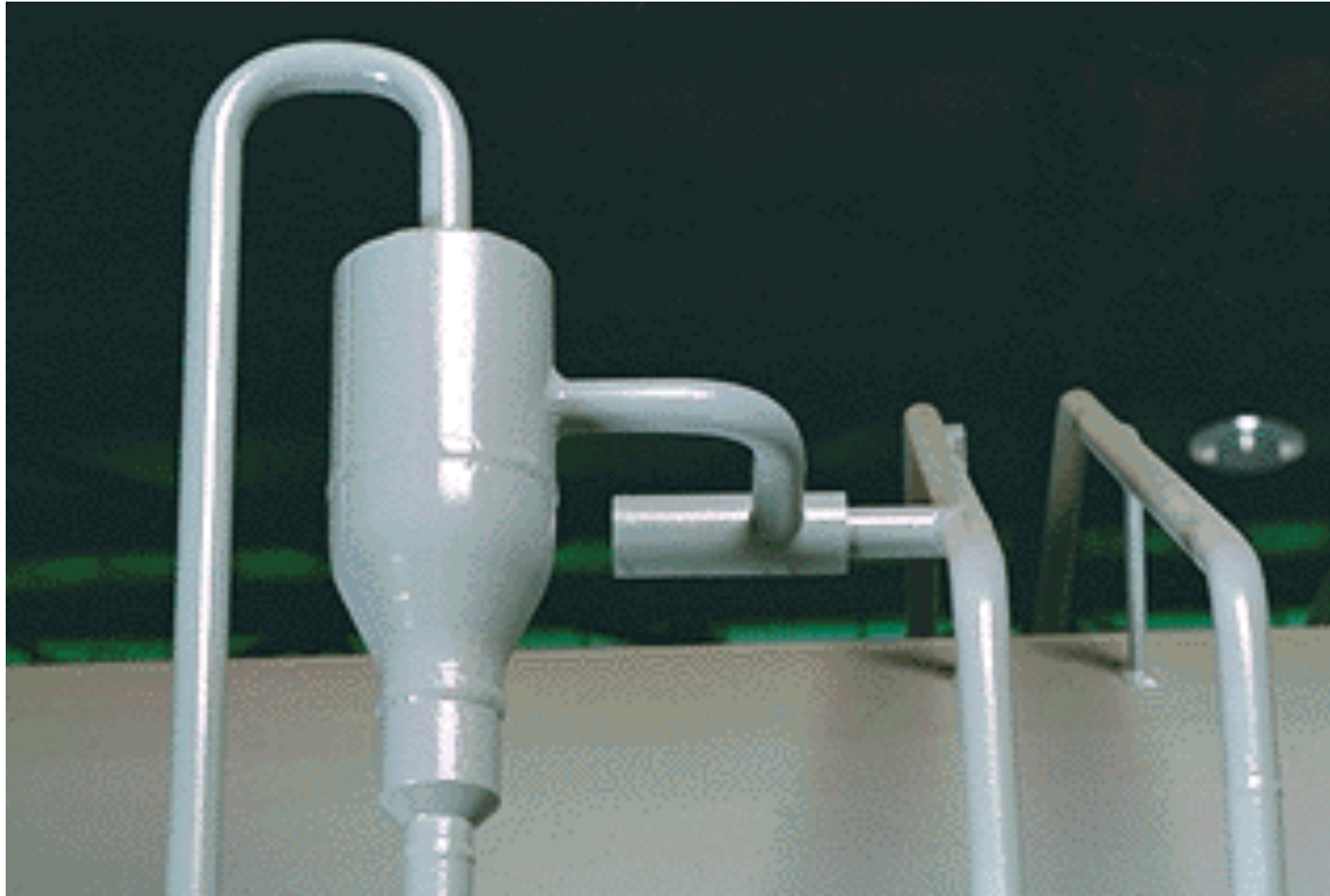


Purge Eductor

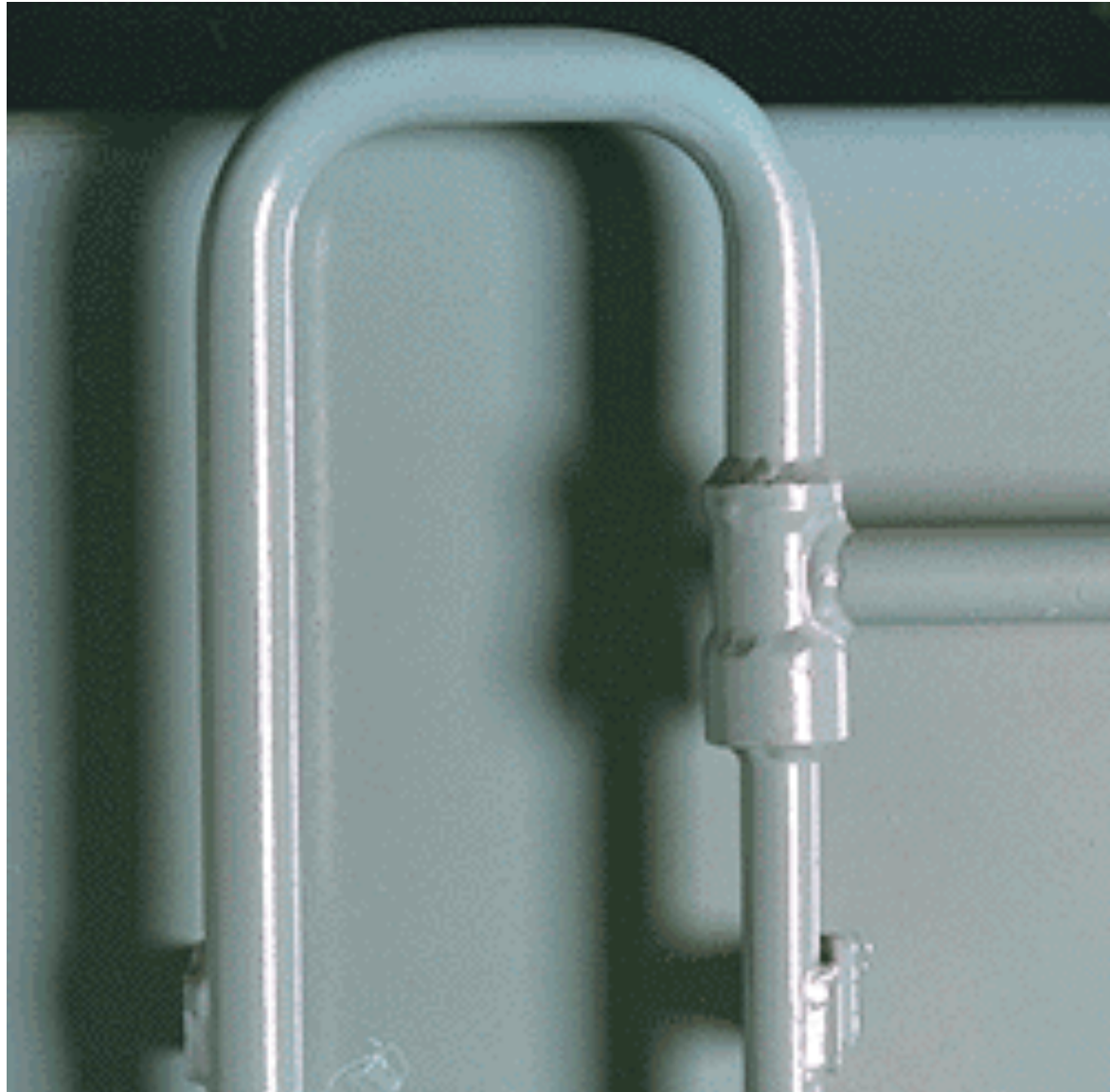
- **Solution flows through orifice creating a low pressure area.**
- **Induces flow of non-condensable entrained refrigerant vapor from the condenser.**
- **Solution pump must be operating for this component to function.**
- **Solution temperature out of eductor will be higher due to the heat of dilution (Typically around 5 - 10 deg. F).**



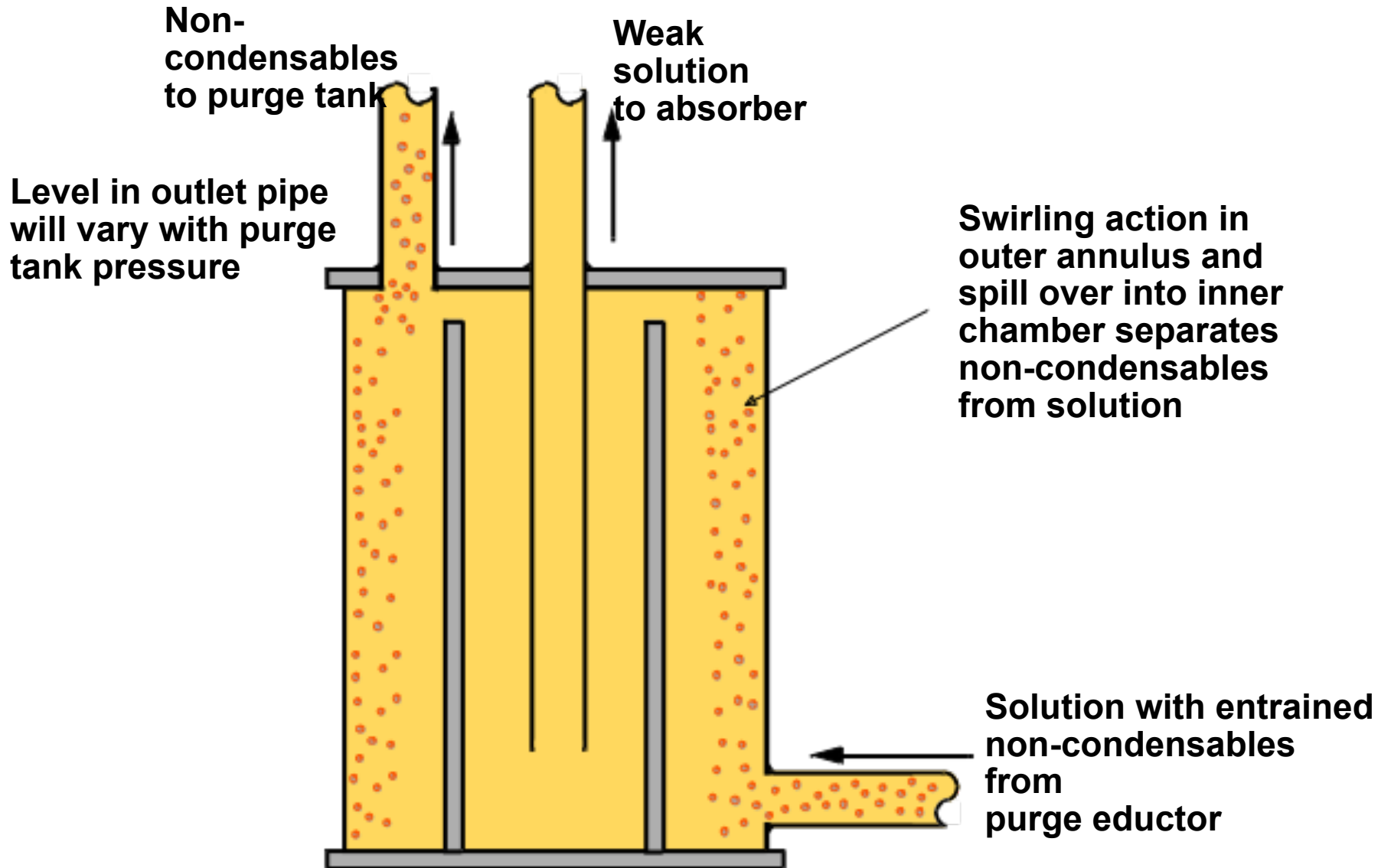
Purge Eductor "G" Unit



Purge Eductor "S" Unit



Gas Separator



Check Valve

Prevents the back-flow of air into the machine during a power failure.

Oil Trap

Prevents the back-flow of oil into the machine during a power failure. Trap is sized to hold the entire pump oil charge.

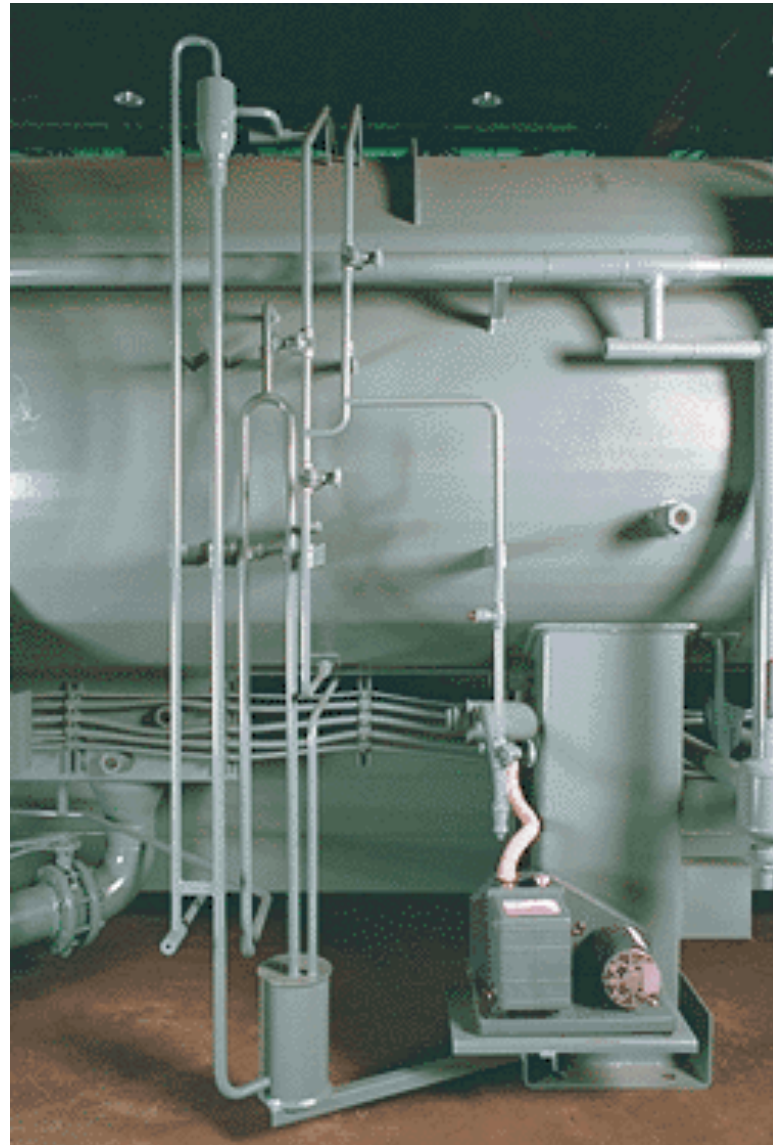
Hand Valves

Diaphragm type valves used to isolate or establish a connection between the purge pump and various sections of the unit.

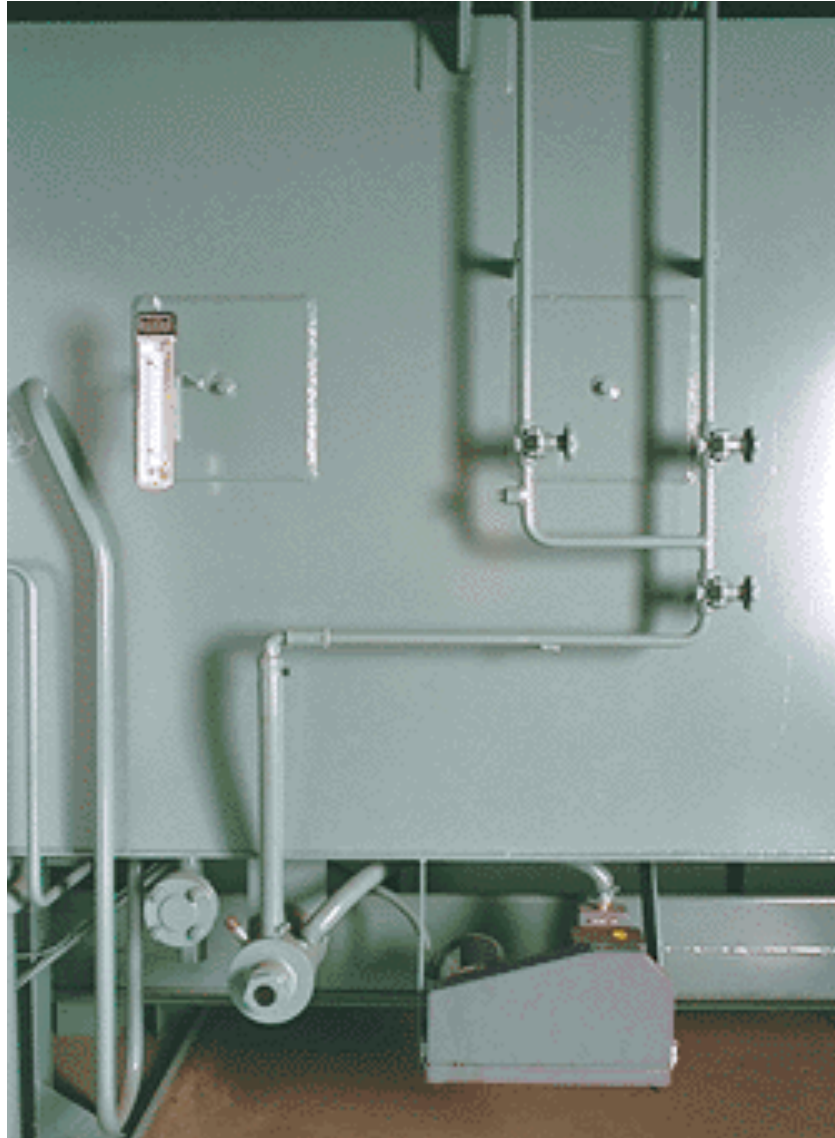
Automatic Valves

Used to automatically purge the purge tank. Present only when the Smart-Purge option is installed.

Purge Tree "G" Unit

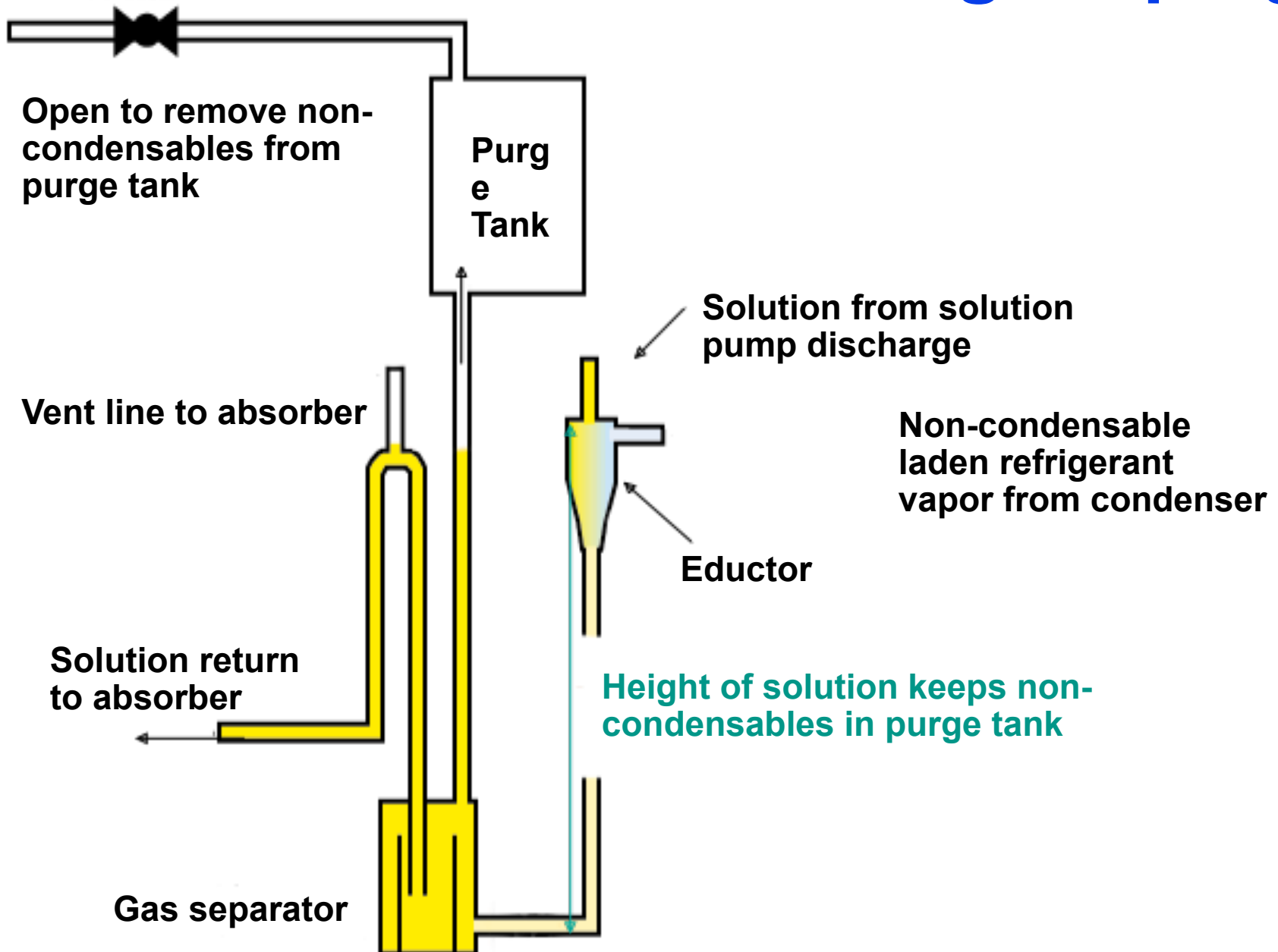


Purge Tree "S" Unit



Purge Operation

Purge Piping

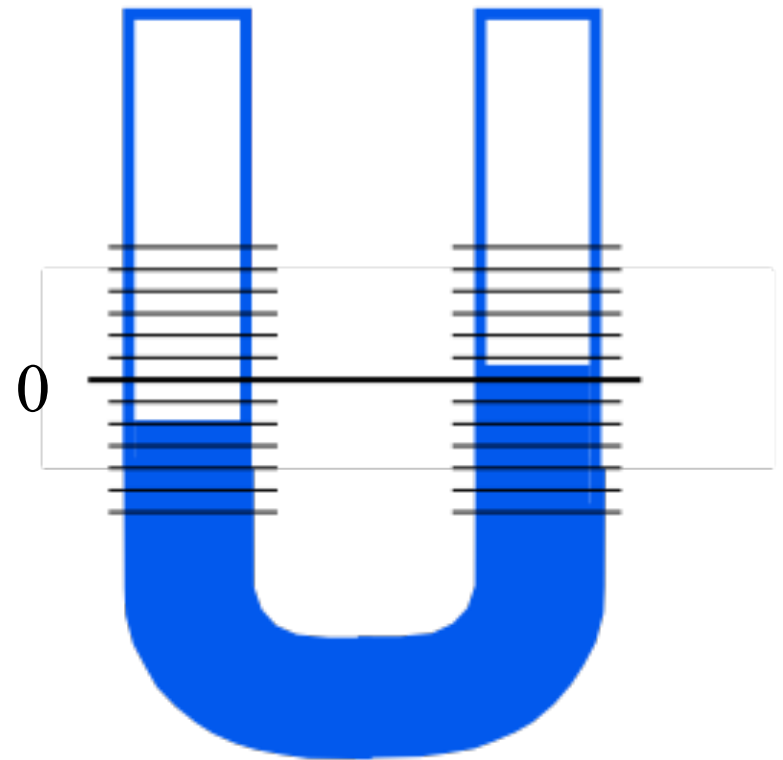


“G” Unit Purge Schematic

“S” Unit Purge Schematic

Starting the Vacuum Pump - Manually

- Start pump with gas ballast closed (prevent oil spatter)
- Open gas ballast fully
- Warm up pump for 20 minutes
- Open VP5
- Confirm pump is capable of pulling to 3mm Hg absolute.



Millennium Absorption Chiller

STATUS

UNIT READY TO START - NO MALFUNCTIONS DETECTED

DISPLAY

CHILLED LIQUID TEMPS	CONDENSER LIQUID TEMPS
1ST STAGE GEN PRESS/TEMP	PRINT
REFRIGERANT / SOL	HOT WATER TEMPS
OPTIONS	OPERATING HRS. START COUNTER
PUMP STATUS	

ENTRY

1	2	3	ENTER
4	5	6	CANCEL
7	8	9	DISPLAY HOLD
*	0	ampm	ADVANCE DAY SCROLL

SETPOINT

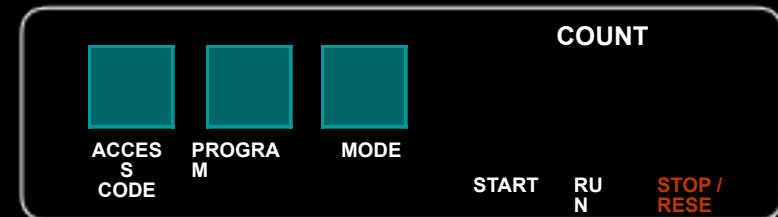
LEAVING LIQUID TEMP	DAILY SCHEDULE
COOL/HEAT CHANGEOVER	HOLIDAY
SPRAY SOLN PUMP DELAY	REMOTE RESET TEMP RANGE
CLOCK	DATA LOGGER
	PULL DOWN DEMAND

SERVICE

E



WARNING RESET MANUAL PUMP DISPLAY DATA HISTORY PRINT



Millennium Absorption Chiller

STATUS

PURGE PUMP - OFF

DISPLAY

CHILLED LIQUID TEMPS	CONDENSER LIQUID TEMPS
1ST STAGE GEN PRESS/TEMP	PRINT
REFRIGERANT / SOL	HOT WATER TEMPS
OPTIONS	OPERATING HRS. START COUNTER
PUMP STATUS	

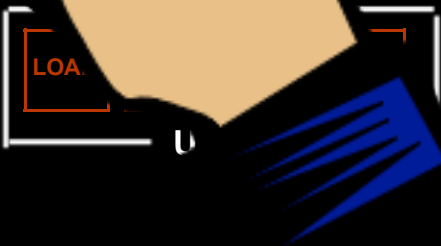
ENTRY

1	2	3	ENTER
4	5	6	CANCEL
7	8	9	DISPLAY HOLD
*	0	ampm	ADVANCE DAY SCROLL

SETPOINT

LEAVING LIQUID TEMP	DAILY SCHEDULE
COOL/HEAT CHANGEOVER	HOLIDAY
SPRAY SOLN PUMP DELAY	REMOTE RESET TEMP RANGE
CLOCK	DATA LOGGER
	PULL DOWN DEMAND

SE
E



WARNING RESET MANUAL PUMP DISPLAY DATA HISTORY PRINT

COUNT

ACCESS CODE	PROGRAM	MODE	START	RUN	STOP / RESE
-------------	---------	------	-------	-----	-------------

Millennium Absorption Chiller

STATUS

PURGE PUMP - ON

DISPLAY

CHILLED LIQUID TEMPS	CONDENSER LIQUID TEMPS
1ST STAGE GEN PRESS/TEMP	PRINT
REFRIGERANT / SOL	HOT WATER TEMPS
OPTIONS	OPERATING HRS. START COUNTER
PUMP STATUS	

ENTRY

1	2	3	ENTER
4	5	6	CANCEL
7	8	9	DISPLAY HOLD
*	0	ampm	ADVANCE DAY SCROLL

SETPOINT

LEAVING LIQUID TEMP	DAILY SCHEDULE
COOL/HEAT CHANGEOVER	HOLIDAY
SPRAY SOLN PUMP DELAY	REMOTE RESET TEMP RANGE
CLOCK	DATA LOGGER
	PULL DOWN DEMAND

SERVICE

E

LOAD	UNLD	HOLD	AUTO
------	------	------	------

UNIT

WARNING RESET



MANUAL PUMP

STOP

			COUNT		
ACCESS CODE	PROGRAM	MODE	START	RUN	STOP / RESE

Manually Purging the Purge Tank

- Purge when the purge tank pressure is > 60 mmHg.
- Purge down to 30 mmHg.

Absorber Purging

- **Normally not required**
- **Indicative of an air leak**
- **Should only be performed to keep unit operating until repair or service is performed or during the initial evacuation of the machine.**

Absorber Purging

Caution (G-series only): Solution level in absorber shell must not be above the upper sight glass. If the level is too high, solution may be sucked into vacuum pump.

Purging During Heating Cycle

(Units equipped with high temperature hot water heat exchanger)

- **The unit doesn't automatically purge during heating operation. If the high temperature generator's pressure increases over time, purging may be necessary.**
- **Purge only when necessary.**
- **Open VP6 for no more than 3 minutes per month**

Purging the Condenser

- **The condenser should never be purged while the unit is hot.**
- **Typically purged only during initial start-up or after a repair.**
- **The handle of the condenser purge valve is typically locked, so it is not accidentally opened during operation.**

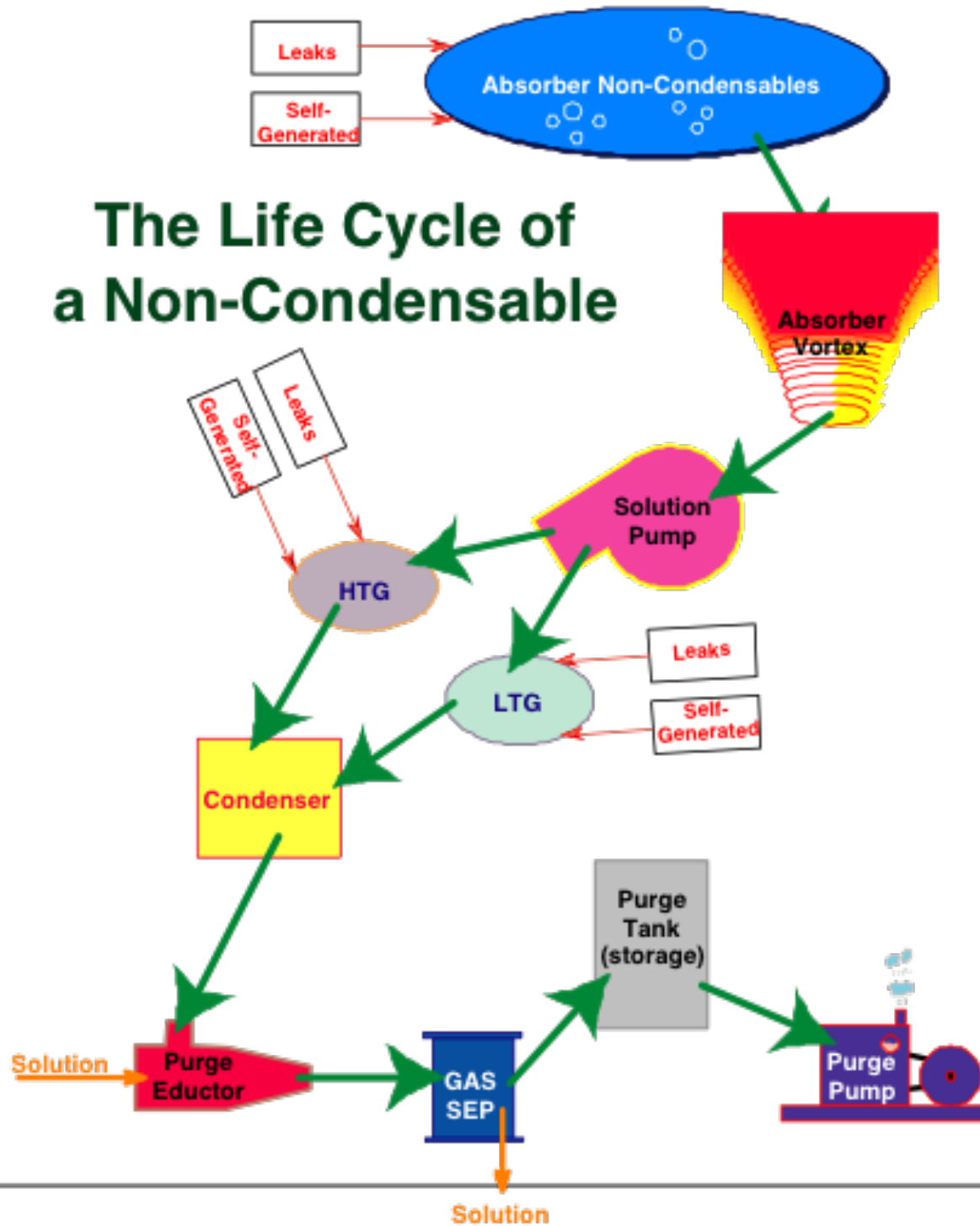
Absorber Self-Purging

- Absorber section is automatically purged during full load operation (low solution level).
- A vortex is formed which pumps the non-condensables from the absorber purge header to the generators.

Condenser Self-Purging

- **Condenser is purged automatically by the purge eductor.**
- **The solution pump must be running for the purge eductor to function.**
- **Efficiency of purging is increased at low load conditions.**

The Life Cycle of a Non-Condensable



Smart-Purge System

- **Automatically purges purge tank.**
- **VP2 and VP5 (if present) must always remain open.**
- **Monitors the frequency of purges.**
- **If the frequency becomes excessive, a warning will be displayed on the micro-panel.**
- **All units should be equipped with a Smart-Purge system.**
- **A retrofit kit is available.**

Smart-Purge System

System consists of the following components:

- **Purge Tank Pressure Transducer (PT-4).**
- **Purge Pump Pressure Transducer (PT-3).**
- **Purge Pump Motorized Ball Valve (2SOL).**
- **Purge Tank Solenoid Valve (1SOL).**

Smart-Purge System Operation

- **Cycle begins when the purge tank pressure reaches 60 mmHg.**
- **Vacuum pump is started and allowed to warm up.**
- **The purge pump motorized ball valve is energized.**
- **When the purge pump pressure decreases to 15 mmHg, the purge tank solenoid valve is energized.**
- **When the purge tank pressure reaches 30 mmHg, the cycle ends.**
- **The automatic valves are de-energized.**
- **After a clean-up period, the purge pump is shut off.**

Non-Condensable Monitoring

- **An estimated 90% of all absorption problems can be directly attributed to non-condensables.**
- **Monitoring the non-condensable production gives the operator an early warning that problems are about to develop in the machine.**
- **An increase in the non-condensable production is indicative of a solution chemistry imbalance, an air leak, or a combination of the two.**
- **Simply put, monitoring the non-condensable production and if necessary taking prompt corrective action, will extend the life of an absorption unit.**

Non-Condensable Monitoring

- **A ParaFlow Purge Log Form should be filled out by the operator on a daily basis unless the unit is equipped with a Smart-Purge System.**
- **A Baseline should be determined for every unit.**
- **The Purge Tank Pressure Difference should be trended over time.**

Determining the Baseline Pressure Difference

- Inhibitor levels must be in there specified ranges.
- Unit must be “leak free”
- Unit must operate for several days at full load conditions.
- Trend as normal on the ParaFlow Purge Log Form.

Typical Baseline Pressure Differences

- **S-Units - Molybdate Inhibited = 1 - 2 mmHg / 24Hrs**
Nitrate Inhibited = 2 - 5 mmHg / 24Hrs
- **G - Units - Molybdate Inhibited = 1 - 4 mmHg / 24Hrs**
Nitrate Inhibited = 3 - 8 mmHg / 24Hrs

Note: All values are at full load operating conditions.

Solution Chemistry Problem or Air Leak?

- **Take a solution sample and send to lab for analysis**
- **Make chemical adjustments as required.**
- **Monitor non-condensable production.**
 - **If production drops to baseline and remains there, the problem was simply related to solution chemistry.**
 - **If the production drops and then increases again, a leak is present. Leak test the unit according to factory recommendations.**

Leak Test Methods

Leak Test Methods

- **The following methods may be used to leak test an absorption unit. The best method depends on several factors.**
 - **Size of Leak**
 - **Does the leak get worse when the machine heats up?**
 - **Will the customer allow the unit to be shut down?**

Leak Location Techniques

Detector-Probe Method

- Tracer gas is charged into the vessel to be tested. The leak is then searched for using an external sensing device.
 - **Soap Bubble Test**
 - **Refrigerant Leak Test**
 - **Helium Leak Detection - Sniff Test**

Leak Location Techniques

Tracer-Probe Method

- The tracer gas is sprayed externally on the unit. A detector then samples the purge gas.
- **Helium Leak Detection - While unit is operating**

Leak Location Techniques

Soap Bubble Test

Unit can be charged with dry nitrogen or argon to the following maximum pressures:

- 5 PSIG - With carbon rupture disk installed
 - 8 PSIG - With metal rupture disk installed
 - 12 PSIG - With rupture disk blanked off or equalized.
- Will have to remove solution if testing under the solution level.

Leak Location Techniques

Refrigerant Leak Test

Unit can be charged with dry nitrogen or argon to the following maximum pressures:

- 5 PSIG - With carbon rupture disk installed
- 8 PSIG - With metal rupture disk installed
- 12 PSIG - With rupture disk blanked off or equalized.
- Will have to remove solution if testing under the solution level.
- Unit can be charged with no more than 5% R-22
- Use halide leak detector to sniff joints.

Leak Location Techniques

Helium Leak Test - Sniffer

Unit can be charged with dry nitrogen or argon to the following maximum pressures:

- 5 PSIG - With carbon rupture disk installed
- 8 PSIG - With metal rupture disk installed
- 12 PSIG - With rupture disk blanked off or equalized.
- Will have to remove solution if testing under the solution level.
- Charge unit with approximately 25% helium
- Use helium mass spectrometer to sniff joints.

Leak Location Techniques

Helium Leak Test

- Performed while unit is operating
- Finds leaks under the solution level
- Finds hot leaks
- Finds one way leaks
- Finds leaks under the insulation
- Helium is sprayed on components. If helium is sensed (with a helium mass spectrometer) coming out of the purge tank, a leak is present.

Questions?

