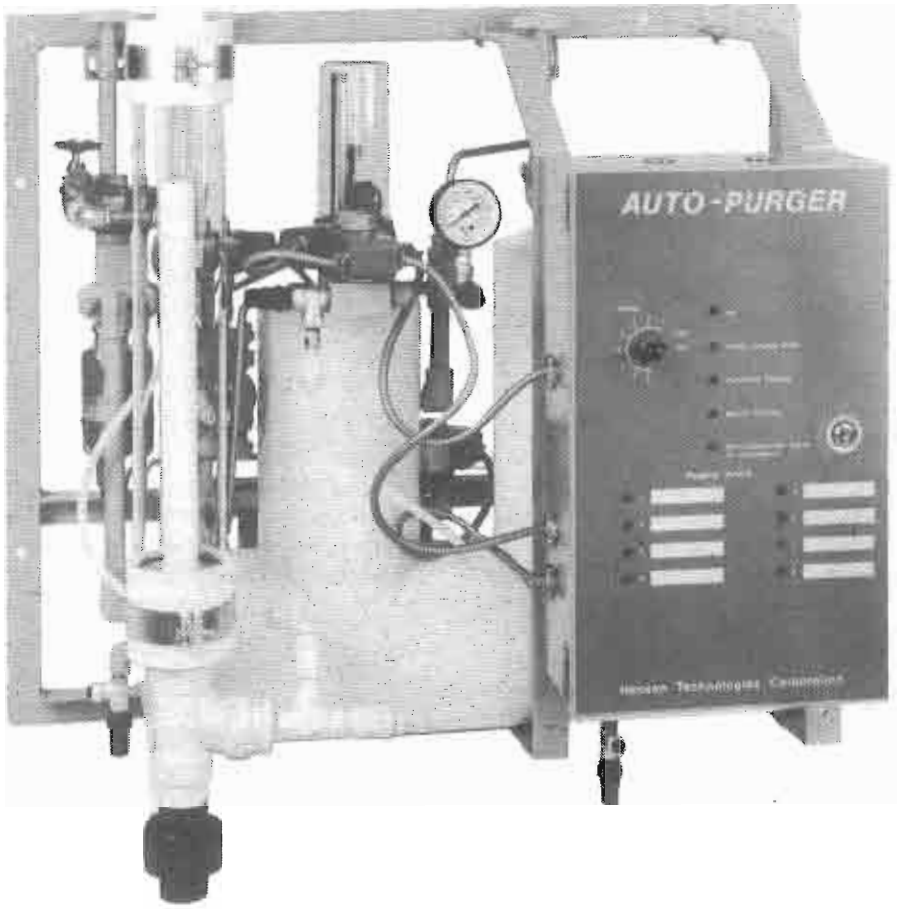
AUTO-PURGER®

Non-Condensible Gas Refrigerant Purger



Model AP08

OPERATOR INSTALLATION & INSTRUCTION MANUAL

For Models: AP01, AP08, AP16, AP24, and APC

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SECTION I MOUNTING & PIPING INSTALLATION

INTRODUCTION

The AUTO-PURGER is a totally automatic electronically-controlled non-condensible gas refrigerant purger for reducing condensing pressure. The Deluxe Models AP08, AP16, and AP24 are pre-assembled, pre-wired, insulated and include an automatic water bubbler. Installation requires piping the "foul gas" line, liquid line, suction line, water line, drain line, power connection and wiring the remote half inch port purge point solenoid valves, which must be purchased separately.

In addition, a "computerized" Model APC is available where a separate plant computer or programmable controller is used to start and stop the AUTO-PURGER and independently operate the various remote purge point solenoid valves.

The basic AUTO-PURGER, Model AP01, is the same construction less insulation, automatic water bubbler, water solenoid valve, 7-day time clock, and sequence timer for remote multi-point purge solenoid valves. Insulation and automatic Water Bubbler Flush System may be factory added or field upgraded.

Because of its internal surface area and flooded evaporator efficiency, the AUTO-PURGER has two to three times the "foul gas" condensing capacity of an Armstrong Purger and 10 times the capacity of purgers having small electric hermetic compressors. All models with normal non-condensible loads will handle a 750 ton plant at suction pressures below atmospheric pressure or a 1500 ton plant at positive suction pressures. The amount of non-condensibles in the system is based on many factors including age, maintenance practices, operating temperature, etc.

The number of purgers required is dependant on the number of purge points of the system. Generally, 24 purge points is the maximum practical number. For example, a 24 purge point system set to purge for 10 minutes on each point requires a 240 minute (4 hour) cycle. Each purge point may be purged 6 times a day which, depending on the amount of non-condensibles in the system, may or may not be adequate. Therefore, a second purger should be used and the purge points divided equally between the two purgers.

Because of its design, the AUTO-PURGER can operate over a wide condensing pressure range. This is especially important for refrigeration systems that operate at low condensing pressures during cold ambient conditions.

MOUNTING INSTRUCTIONS

Mount the AUTO-PURGER securely on a wall or sturdy steel channels. Eight mounting holes in the frame may be used to support the unit. (See Figure 1.) The unit should be located in an accessible area, but away from the movement of equipment that could accidentally come in contact with the purger. Elevation with respect to condensers or high pressure receivers is not critical.

The AUTO-PURGER is normally installed in the compressor room where it can be monitored, but also may be installed outdoors where temperatures below freezing are not anticipated. For outdoor use or areas near falling or spraying water, or constant high humidity, an optional NEMA 4 enclosure with sealed conduit wiring is recommended. Unused electrical entrances to the enclosure should be sealed to protect the controls from moisture.

PIPING INSTRUCTIONS

"FOUL GAS" LINES

(Model AP01)

For the single point purger, Model AP01, the "foul gas" line is brought directly from the purge point on the condenser or receiver to the purger. During operation, the AUTO-PURGER's "foul gas" solenoid valve (#4) located on the purger, energizes when the purger's evaporator chamber is cooled to approximately 20F.

"FOUL GAS" PIPING FOR MULTI-POINT PURGING

(Models AP08, AP16, AP24, and APC)

Purging at several points on the high pressure side of the system is the best method for removing "foul gas" from the system, because it is nearly impossible to predict where non-condensible gas will accumulate.

Even for multi-point purging only one purge point should be purged at a time. Connecting two purge points from two condensers or receivers may result in gas flowing from one condenser to another due to unequal pressure drop, even though the differences in pressure drop are very small, for example ¼ psi. The result would be, that even in the best of circumstances, only one point would be effectively purged. The best practice is to purge each condenser and receiver circuit separately.

It is important that one purge point solenoid valve is open at all times to prevent losing "foul gas" pressure to the purger. If "foul gas" pressure is lost, ammonia vapor may be released to the water bubbler. A differential pressurestat sensing "foul gas" pressure and pressure in the float switch chamber can be installed to prevent loss of refrigerant and signal a malfunction in the system.

For multi-point purgers, the solenoid valves may be manifolded into one line to the purger. A ½" size line is the minimum and should be pitched towards the purger to drain any condensed liquid. Also, no liquid traps are desirable either before or after purge point solenoid valves. (See Figure 2.) This line from the purge point on the condenser to the AUTO-PURGER should not pass through cold areas where further condensing of the saturated gas can occur. If this cannot be avoided the purge line must be insulated, because flooded purge point lines result in flooding the AUTO-PURGER with liquid, resulting in a temporary halt of non-condensibles being removed.

EVAPORATIVE CONDENSER PIPING

Typically, evaporative condenser outlet liquid drain lines on each circuit must drop a minimum of 4 feet for ammonia (6 feet on large condensers) from centerline of the evaporative condenser outlet to the centerline of highest elevation of the liquid line manifold to receiver. For halocarbon systems, the height is double that for ammonia. Preferably each circuit should have a P-trap to balance variations in pressure drop in each circuit to prevent liquid from backing up into one or more condensers and flooding the purge point. Also, a properly sized equalizer line from the receiver will help drain condenser circuits into the receiver. Refer to ASHRAE GUIDELINES or recent IIAR Papers on condenser piping design. Hansen Technologies can provide copies of these articles. Also, consult condenser manufacturers installation instructions for additional piping and sizing information.

On evaporative condensers, avoid using one purge point solenoid valve to purge two circuits. This practice negates the P-trap on the condenser drain line and may back liquid up into one circuit.

"FOUL GAS" FROM OIL SEPARATOR

For certain types of oil separators where very low velocities may exist near the top of the vessel, purging may be advisable from a top fitting.

PURGE POINT CONNECTIONS

"Foul gas" lines from condensers should be purged at points recommended by the condenser manufacturer. Usually, this is at the top of each circuit's outlet header.

In some cases a small high pressure auxiliary receiver is located at the outlet of one or more condensers, this receiver should have a purge point at the top.

Where a high pressure float regulator is used to drain one or more condensers, the top of the float valve chamber should also be a purge point.

Horizontal shell and tube water-cooled condensers, and heat exchangers should be purged at the top, usually at the point or points furthest from the compressor discharge main inlet.

Vertical condensers should be purged near the top of the vessel if possible.

It is not necessary to purge control pressure receivers, high pressure thermosyphon vessels, or vessels located on the low side of the system.

SUCTION LINE

A ¾" suction line should be connected to a protected main suction line or can be piped to a suction accumulator. Excess amounts of liquid from the liquid drainer may occasionally be transmitted through the suction line. The suction temperature should be 20F or less to close the thermostat which switches the AUTO-PURGER from its "PURGER COOLING DOWN" mode to its "AUTOMATIC" or "MANUAL PURGING" mode. The purger thermostat is factory set at 30F. Therefore, the purger evaporator temperature must be 20F to activate the thermostat. For higher suction temperatures, consult factory.

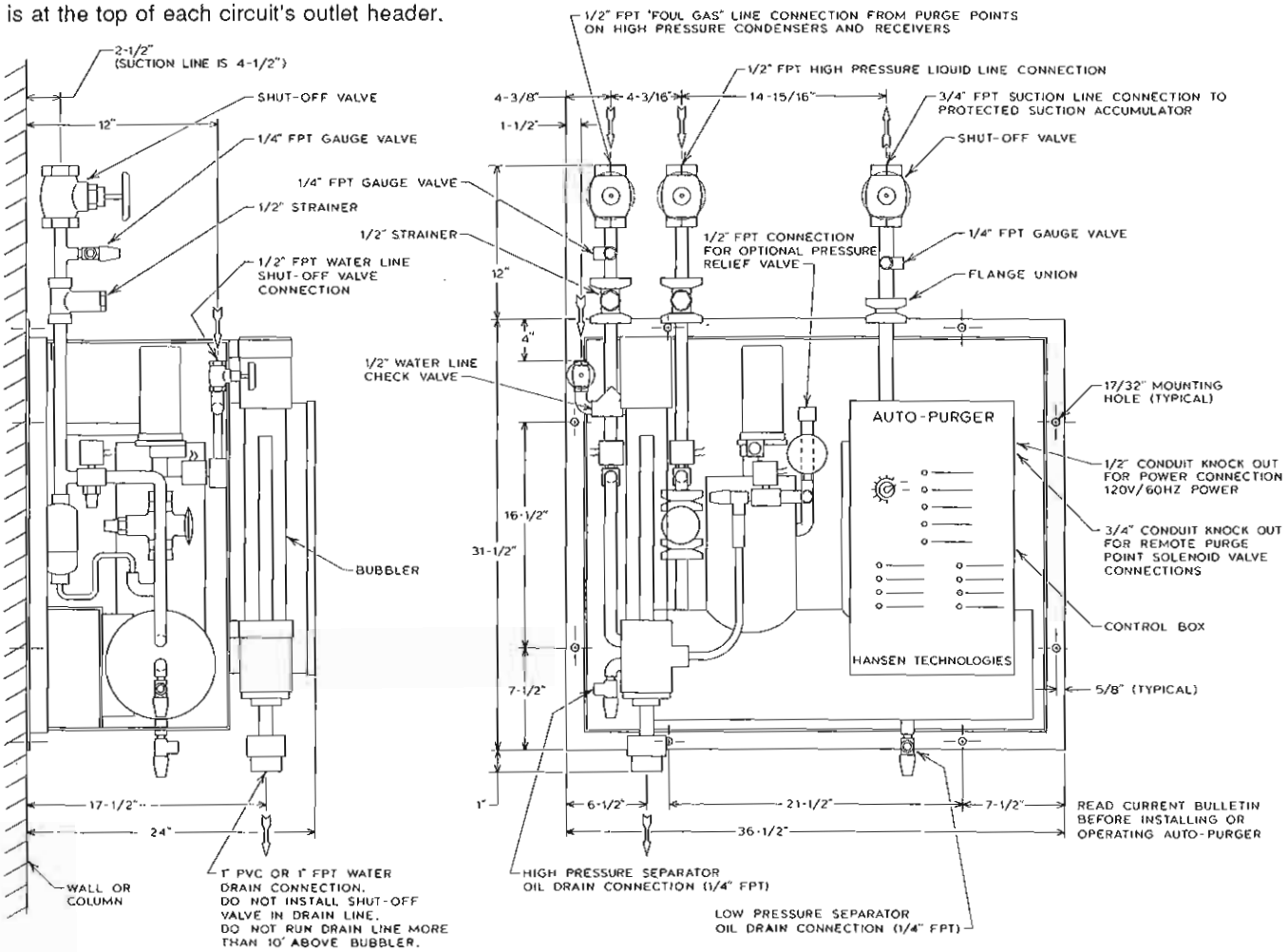


Figure 1 - AUTO-PURGER Dimensions (Drawing #2000-14)

WATER LINE

Models APC, AP08, AP16, and AP24 are provided with an automatic Water Bubbler Flush System. A water line must be connected to the water solenoid valve (#6). The connection is ½" FPT. The water supply pressure should be between 30 and 80 psig.

The clear tube of the water bubbler may become coated with mineral deposits after a period of time. These deposits can be removed by adding a cup of vinegar to the water in the bubbler and cleaning the clear tube through the top plastic fitting with the brush supplied. A water conditioning filter housing and cartridge are available for abnormally hard water.

For basic Model AP01, a plastic hose and fitting are supplied for a one gallon, or larger, glass or plastic container (not supplied). This container must be refilled when the water becomes ammonia saturated. The automatic Water Bubbler Flush System may be added to Model AP01.

OIL DRAINS

The purger has two connections for draining oil. Excess oil could reduce the purger capacity by lowering the evaporating or condensing rate.

Any oil that collects in the purger can be drained off through the two capped ¼" valves installed on the purger. (See Figure 1.) Before draining oil, shut-off the purger and the liquid and "foul gas" valves. Allow it to pump out, then close the suction line valve. Use normal oil draining precautions to prevent human or property damage. Typically, oil is not a problem unless the liquid line is connected to a vessel or line where oil can drain into the purger.

LIQUID LINE

One high pressure ½" liquid line is required for the AUTO-PURGER. The connection to the high pressure liquid source should be a location where oil would not be directed into the purger. The liquid line supplies refrigerant during start-up and feeds make-up liquid as required during purging. The liquid line solenoid valve (#1) on the AUTO-PURGER closes when the AUTO-PURGER is off. (See Figure 7.) The exact supply pressure is not critical for proper operation of the purger. The only requirement is that the pressure be sufficiently above the purger evaporator pressure to insure proper operation of the level control valve which, except for start-up, supplies only 5% of the liquid refrigerant required for cooling. The remainder of the refrigerant is condensed from the "foul gas" line, which is fed to the evaporator through the metering valve which is located downstream of the liquid metering solenoid valve (#3).

CHECK VALVES

There are four check valves on the purger. A 1 psi differential check valve with $^{1}/_{32}$" diameter metering orifice is installed on the purge gas line to prevent reverse flow of water into the purger. A 30 psi differential check valve is installed in the liquid line to the float chamber, which limits the liquid line pressure at the purger to 30 psi less than the "foul gas" pressure and allows non-condensibles into the purger. The third check valve is a 200 psi differential relief check valve from the float chamber to suction line. Finally, the water line has a ½" check valve.

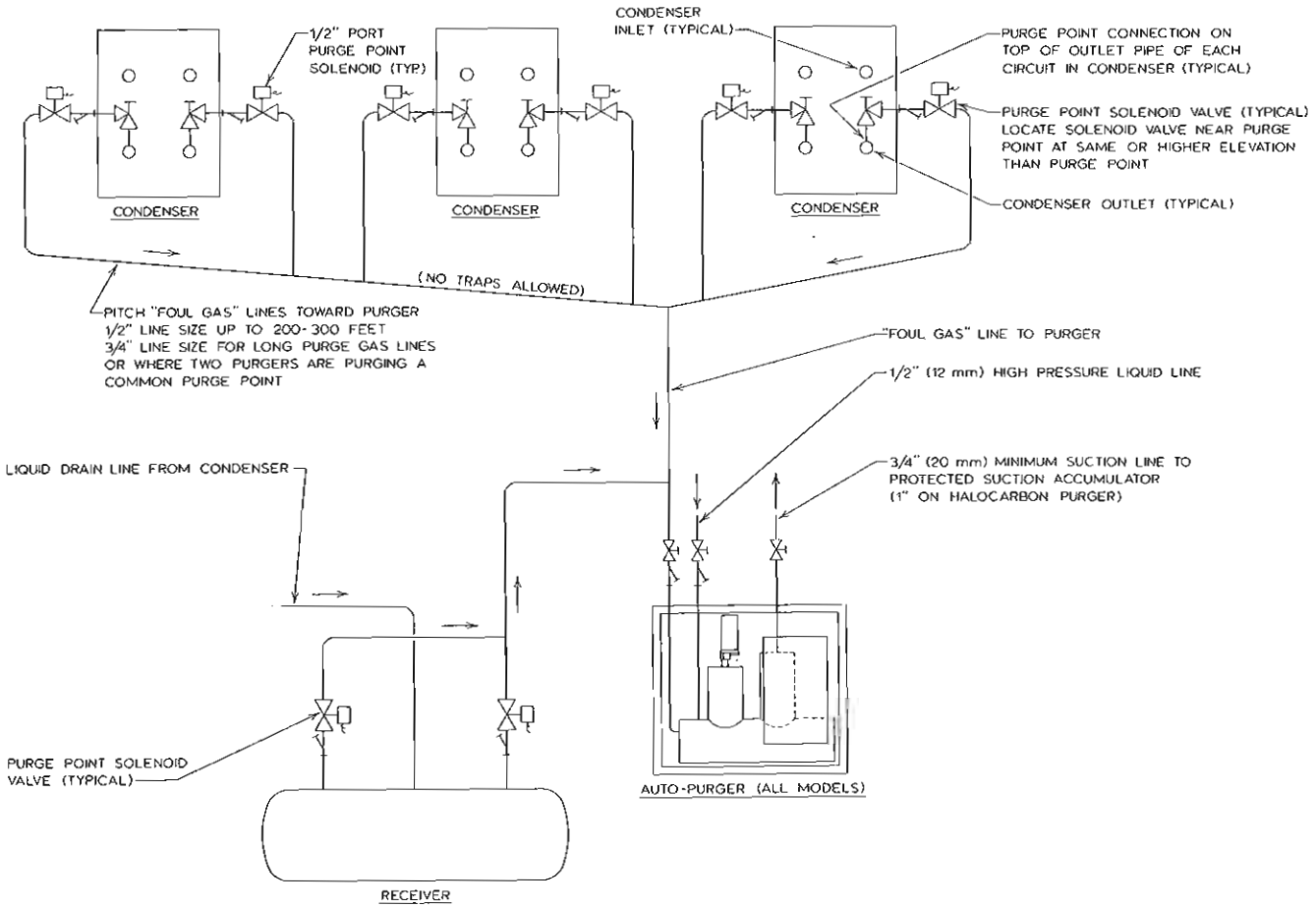


Figure 2 - Purge Point Connections

DRAIN LINE

A 1" PVC socket/1" FPT water drain connection is located at the bottom of the bubbler. The water should flow to a suitable drain, container or may be piped up to 10 feet above water bubbler if the line is kept free of accumulation of dirt and mineral deposits, and a protective mesh is installed around the clear tube. If the drain line is run overhead, the fitting on the top of the water bubbler must be sealed (including the ¼" NPT vent connection in the fitting). Do not run the line 10 feet above the height of the bubbler, because the pressure on the water bubbler could be excessive. Also, do not install a shut-off valve in this line. For Model AP01, less bubbler, no drain is necessary.

Initially, fill water bubbler through the 3" plug located on top of the tube with water. Keep plug lubricated and hand tight. Check for leaks at hose fittings. Support the drain line to prevent undue stress on water bubbler.

MODEL APF AUTO-PURGERS

The installation and operation of Model APF AUTO-PURGER, for use in halocarbon refrigeration systems, is similar to an ammonia purger.

PIPING HALOCARBON AUTO-PURGERS

The halocarbon liquid line and "foul gas" line piping and sizing details are the same as an ammonia purger. However, the suction line size for halocarbon purgers should be 1" for suction temperatures down to -20F, and 1¼" for -20F to -60F suction temperatures. Please note the condenser drain lines on evaporative condensers must be trapped and dropped vertically 8 feet, per manufacturers recommendation, to prevent possible backflow of liquid into one or more condenser circuits resulting in a flooded purge point.

While the air indicating column (Water Bubbler Flush System) is included, the water line and drain line are not required. Purge points are at the same locations as an ammonia purger. (See Figure 2.) On evaporative condensers, the purge points are on the top of the outlet drain line. Although non-condensibles are lighter than halocarbon gas, they still collect at or near the outlet.

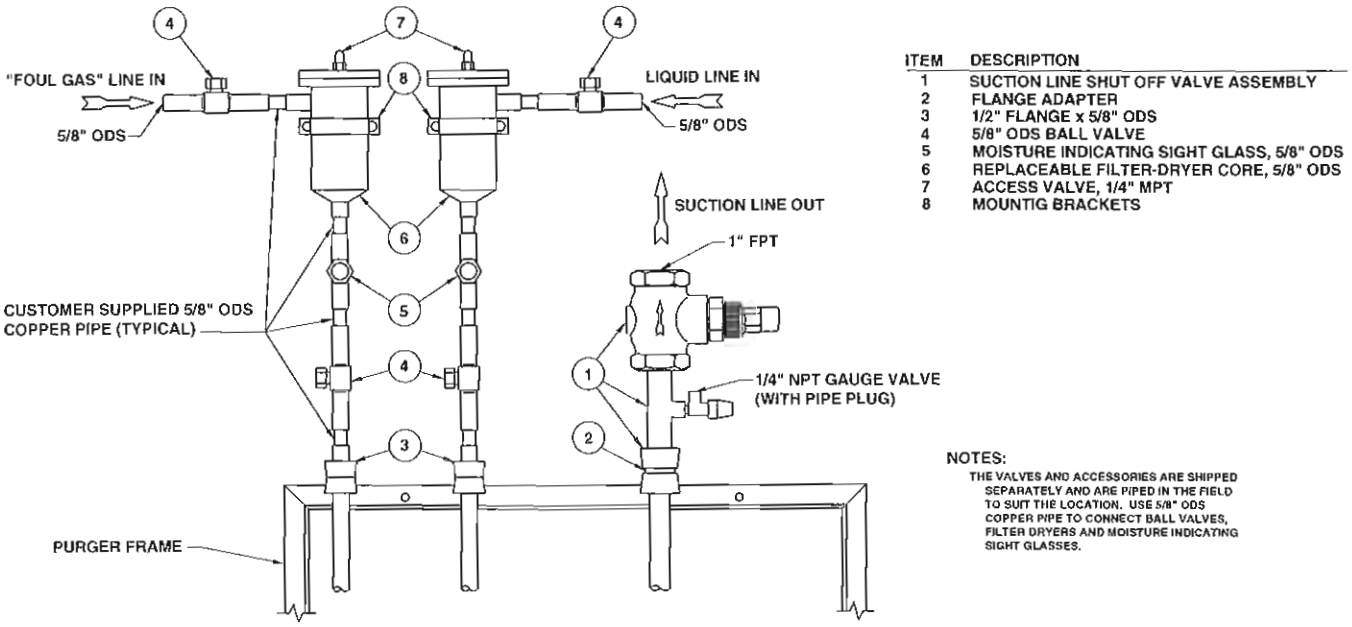
FILTER-DRYER CONDITIONING SYSTEM

The special construction for the APF series purger includes a filter-dryer conditioning system for the "foul gas" and liquid line. (See Figure below) Water vapor, as well as non-condensible gas may be present at each purge point. The filter-dryers remove this moisture prior to entering the purger. Both dryers are used to protect the purger from water freezing, but they also act as a supplemental water removal to the primary refrigeration system liquid line dryers. Moisture indicating sight glasses located downstream of the filter-dryers indicate when they are saturated with water and require new filter-dryer cores. Isolation shut-off valves are included for changeout of the filter-dryer cores, and access valves allow evacuation of the refrigerant from the filter-dryer shell. Another feature is a small filter-dryer, in place of the strainer prior to the liquid metering valve. This small filter-dryer captures particles and residual moisture present in the purger, and should be replaced during normal maintenance.

The metering valve is sized for halocarbon. The normal setting is 6 turns open. On purgers shipped prior to 1/91, the metering valve setting is 2 turns, and may be verified by a small green metering knob.

AIR INDICATING COLUMN

The Model APF purger is equipped with an air indicating column which replaces the ammonia water bubbler. Fill the clear tube to the marked line with a light weight clear oil or water. Non-condensibles expelled from the purger bubble up through the column as an indication of proper operation. As with ammonia purgers, the counter keeps a record of how many times the purge gas solenoid valve (#5) opens to release non-condensibles into the air indicating column.



ITEM	DESCRIPTION
1	SUCTION LINE SHUT OFF VALVE ASSEMBLY
2	FLANGE ADAPTER
3	1/2" FLANGE x 5/8" ODS
4	5/8" ODS BALL VALVE
5	MOISTURE INDICATING SIGHT GLASS, 5/8" ODS
6	REPLACEABLE FILTER-DRYER CORE, 5/8" ODS
7	ACCESS VALVE, 1/4" MPT
8	MOUNTIG BRACKETS

NOTES:

THE VALVES AND ACCESSORIES ARE SHIPPED SEPARATELY AND ARE PIPED IN THE FIELD TO SUIT THE LOCATION. USE 5/8" ODS COPPER PIPE TO CONNECT BALL VALVES, FILTER DRYERS AND MOISTURE INDICATING SIGHT GLASSES.

Figure 3 - Model APF Conditioning System (Drawing #2000-89)

SECTION II ELECTRICAL INSTALLATION & OPERATION

ELECTRICAL CONNECTIONS

The standard electrical requirement for the AUTO-PURGER is a 115V/60Hz supply. Also, 230V/60Hz, 220V/50Hz, and 110V/50Hz are available. The circuit should be fused to 15 amperes. The single point purger, Model AP01, provides a ½" knockout on the side of the control cabinet to access the power connection terminal strip. Any unused knockout holes must be sealed to prevent splashing water, dust and debris from entering the control cabinet.

Multi-point purgers, Models AP08, AP16, AP24, and APC, in addition to the electrical connection above, provide a ¾" knockout for individual purge point solenoid valves. Wires from each purge point solenoid valve should be brought to the purger control cabinet. Any additional knockouts should be made on the side of the control cabinet. When available, knockouts in the top of the cabinet must be sealed to prevent the possibility of condensed moisture dripping down through the conduit into the control cabinet.

One line from each purge point solenoid is connected to a numbered screw terminal located near the top of the control cabinet. The numbers on the terminal strip correspond to the numbers on the lights located on the door of the control cabinet. The voltage of the remote purge point solenoid valve is identical as the supplied voltage to the purger. The electronic control circuits as well as the door panel wiring is 12V D.C. This 12V circuit is internally wired to a transformer from the power source and normally does not need to be serviced.

PURGE GAS SOLENOID VALVE TIME DELAY CUTOUT

The AUTO-PURGER is equipped with a one hour fixed time delay-relay which controls the purge gas solenoid valve (#5) that meters non-condensibles to the water bubbler when the purger is operating. (See Figure 7.) This relay closes the purge gas solenoid valve (#5) after one hour of continuous purging of non-condensible gas into the water bubbler. This is to prevent excess amounts of refrigerant from being released in the unlikely event of a float switch mechanical malfunction, electrical fault, or system malfunction. However, during start-up of a new purger or under high non-condensible removal conditions, it is sometimes advantageous for the purge gas solenoid valve (#5) to remain open continuously due to large amounts of non-condensibles in the system. The delay-relay is equipped with an on/off switch to by-pass the time delay function. Simply turn the relay to "OFF" until the initial volume of non-condensible gas is removed when commissioning a new plant. Later, when non-condensibles are being removed at short intervals, the time delay-relay should then be switched "ON" for normal operation.

If during normal operation the delay-relay time is exceeded, the magnet will not make contact with the float switch tube but no gas will be escaping into the water bubbler. To reset the time delay-relay, momentarily turn the switch to "OFF" and back to "ON". This will reset the time delay-relay for another hour of continuous purging of non-condensibles into the water bubbler.

SETTING THE GRASSLIN TIME CLOCK

The time clock used in the AUTO-PURGER control cabinet is a Grasslin 7-Day Time Clock. To set the time and day, rotate the minute hand on the circular dial. Once the correct day and time are set, the amount of run time per day must be determined and set. Quite often the purger is run 24 hours per day so no settings are required. Just pull all the red pins from the circular dial to leave the time clock on continuously. A small knob in the upper right hand corner of the time clock can be turned manually to turn the purger on and off.

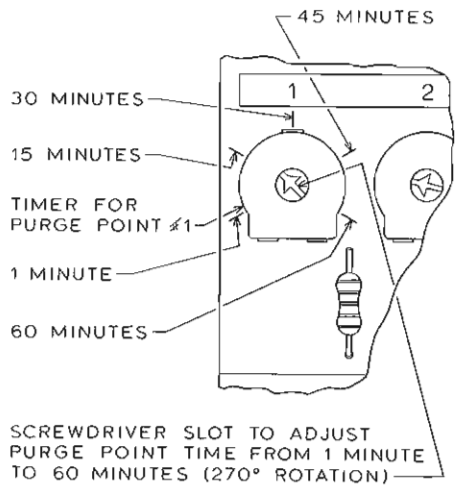
If the purger is to run on an intermittent basis, then set the "ON" time using the green tabs and the "OFF" time using the red tabs. Use a green tab and red tab for each day of the week. If very little non-condensibles are being removed during the week, the purger can be operated fewer hours.

The purger should operate simultaneously with the refrigeration compressors. Terminal connections are provided for an interlock to shut down the purger while the Grasslin Time Clock continues to operate.

MANUAL OPERATION FOR PURGE POINTS

The purger switch located on the front panel of the AP08, AP16, and AP24 AUTO-PURGERS can be used to manually select the purge point location as well as turn the purger to "AUTO" and "OFF". If it is desired to purge only one point continuously, due to a large volume of non-condensible gas, turn the purger switch to that purge point (points 1 through 8 on AP08, points 1 through 16 on AP16, and points 1 through 24 on AP24).

The AUTO-PURGER will go through automatic start-up with the switch in either the "AUTO" or "MANUAL" position. Even in "MANUAL", non-condensibles must be present for the purger to purge.



DETAIL SHOWING ADJUSTMENT OF PURGE POINT TIMER

Figure 4 - Purge Point Timer

SETTING PURGE POINT TIMER

Each purge point timer board contains eight relays which energize the remote purge point solenoid valves. These relays operate in sequence when the AUTO-PURGER is set to "AUTOMATIC PURGING". Wire remote purge point solenoids in sequence. Do not skip any purge point terminals.

The time each purge point relay operates may be adjusted from one to sixty minutes. To adjust the purge time, a screw, with an arrow head, rotates approximately 270 degrees with linear increases in time with clockwise rotation. (See Figure 4.)

When on "AUTOMATIC PURGING", the purge sequence will begin at purge point #1, and continue to purge point #2 and so on. When purge point #8 is completed, the timer circuit will jump back to purge point #1 and repeat the sequence. This will continue as long as the purger front panel switch is set to the "AUTO" position. When less than eight purge points are needed, the "jumper select" connector shall be installed on the two pins corresponding to the number of purge points desired. (See Figure 5a.) In Figure 5a, six purge points are desired. The purge point sequence will continue from purge point #6 to purge point #1 and repeat the purge cycle, while omitting purge points #7 and #8. For models AP16 and AP24, jumpers, "A" and "B" are used to "electronically" tie the purge point timer boards together. On Model AP08, the jumpers remain in both the "A" and "B" positions. While on Models AP16 and AP24, the "A" jumper is located on the final timer board to electronically signal the purge point sequence to the initial timer board, and the "B" jumper is located on the initial timer board to signal the purge sequence to the next timer board. (See Figure 5b and 5c.) If a timer board is temporarily not used, the "A" jumper and "jumper select" connector are moved to the preceding timer board. Also, disconnect the timer cable, part number 20-1349, from the unused timer board. (i.e. AP24 becomes an AP16, AP16 becomes an AP08).

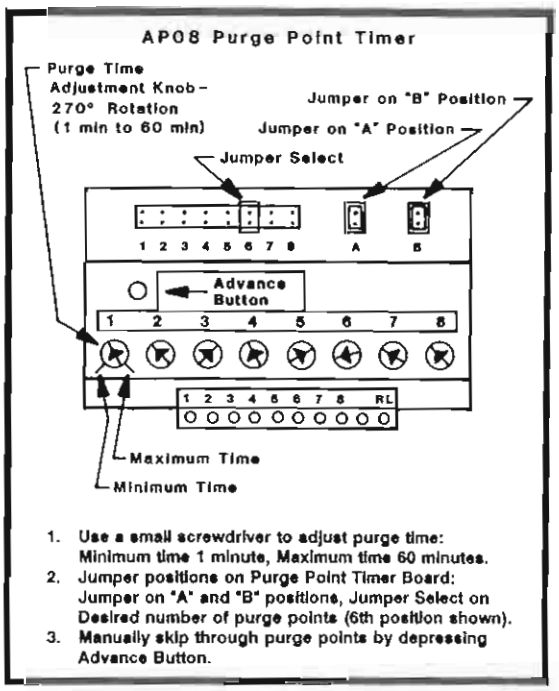


Figure 5a - Model AP08 Purge Point Timer Board

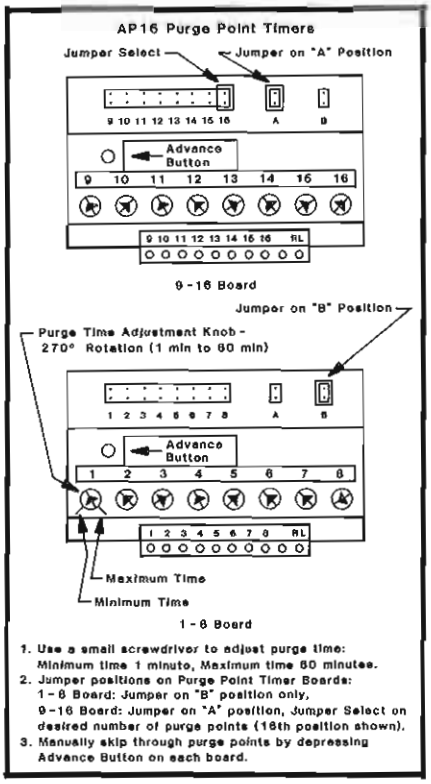


Figure 5b - Model AP16 Purge Point Timer Boards

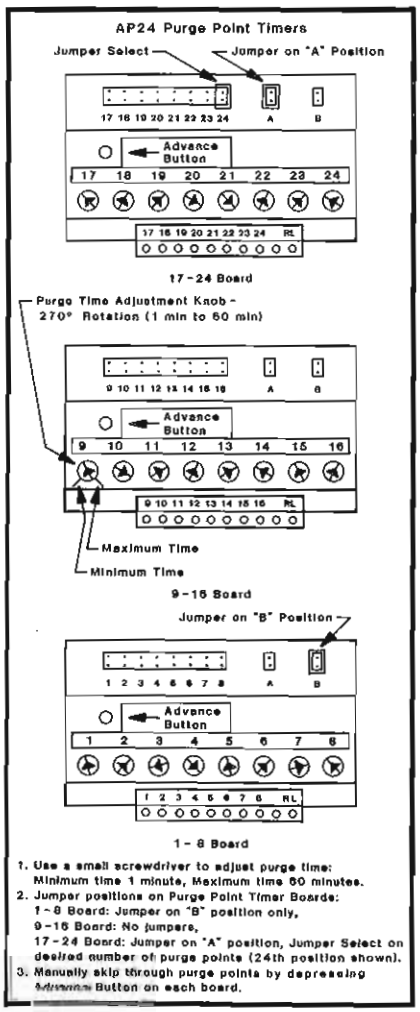


Figure 5c - Model AP24 Purge Point Timer Boards

OPERATION OF METERING VALVE

The operation of the metering valve is to meter condensed liquid refrigerant from the high pressure side of the purger into its flooded evaporator. The flow to the metering valve, part number 20-1714, is controlled by the ¼" liquid metering solenoid valve (#3) which is energized when the purger is in "AUTO" or "MANUAL" operation. The refrigerant is filtered through a small flanged strainer, prior to the metering valve, which removes any particles that might block the orifice.

An indication of proper operation of the metering valve is a frosted line from the float switch chamber through the solenoid valve, strainer, metering valve, and to the evaporator. If the stainless steel line is not frosted when the purger is in the "AUTO" or "MANUAL" operation, then the flow of refrigerant through the line may be blocked due to dirt in the metering valve, strainer, or solenoid valve.

To clean the orifice of the metering valve, fully open the metering valve to flush out any particles. The metering valve is set and held in place by a locking knob. This knob may be unlocked by using the hex key wrench (.035 inch) provided inside the purger control cabinet. Unlock the knob before making any adjustments. Next, open valve fully to flush dirt particles through, then close the valve and re-open six turns. This is the proper operating setting for both the ammonia and halocarbon metering valve. On halocarbon purgers shipped prior to 1/91, the proper setting is two turns and may be indicated by a small green metering knob.

If the line still does not frost, check the liquid metering solenoid valve (#3) for operation. If the solenoid valve appears to be operating normally then pump out the purger and inspect the solenoid, strainer, and metering valve.

OPERATION OF COUNTER

The purpose of the counter is to count the number of times purge gas solenoid valve (#5) opens to bleed non-condensibles into the water bubbler. It does not monitor the duration of the purge time but the number of times the solenoid valve is operated. To reset the counter to zero, push the knob on the face of the counter.

The counter can be used to measure non-condensible gas activity. If a daily or weekly record is logged, then any abnormal increases in the amount of non-condensible gases can be noted and corrective measures can be taken to determine the source. Little or no activity compared to normal operation, may indicate a problem with the purger.

OPERATION OF PURGE GAS ORIFICE

All purgers shipped after January 3, 1989 incorporate a metering orifice disc in the purge gas line to the water bubbler, located inside the 1 psid check valve. This $^{1}/_{32}$" diameter orifice meters the non-condensible gas into the water bubbler to prevent over or under feeding. The ¼" NPT gauge valve should be opened fully during operation and closed for pump out or when maintenance work is performed. (Purgers shipped prior to 1989 use the gauge valve, set at 1/8 turn open, as an orifice to bleed adequate non-condensibles to the water bubbler; more than 1/8 turn open causes excessive action.) The orifice is sized to remove approximately 2 cubic feet of non-condensible gas per minute. (See Figure 6.)

OPERATION OF LEVEL CONTROL VALVE

The purpose of the level control valve is to maintain the liquid level in the evaporator chamber. During start-up, liquid line solenoid valve (#1) energizes to feed liquid refrigerant to the level control valve, which will feed until the level in the flooded evaporator reaches the level of the sensor. During operation of the purger, the level control valve acts as a make-up device to maintain the liquid level. However, approximately 95% of the liquid used in the evaporator is from the condensed liquid that is fed through the liquid line metering valve from the "foul gas" line.

LIQUID DRAINER

The liquid drainer is used to remove any condensed liquid that trickles from the purge lines into the purger. Therefore, the purger is always condensing gas rather than having liquid entering the condensing section of the purger and preventing proper operation. However, if too much liquid comes down the "foul gas" line due to improperly piped condensers, corrective action must be taken. Too much liquid can be determined by noticing the condition of the stainless steel line running from the outlet of the liquid drainer into the purger's flooded evaporator. The stainless steel line shall frost and defrost as small amounts of liquid are released into the flooded evaporator. If the line is continuously frosted, then it is an indication one or more purge points are flooded with liquid.

WATER BUBBLER

Models AP08, AP16, AP24, and APC AUTO-PURGERS are equipped with a water bubbler. Non-condensible gas from the AUTO-PURGER flow through the water bubbler where residual ammonia is absorbed into water. The water, with absorbed ammonia, flows to a drain. The water solenoid valve (#6) opens to automatically replenish water to the bubbler each time the purge gas solenoid valve (#5) energizes. A 30 second time delay permits the water solenoid valve (#6) to remain energized after the purge gas solenoid valve (#5) de-energizes (float switch magnet pulls in). Proper operation may be indicated by small, one inch diameter bubbles.

LEAK TEST

Use standard refrigeration procedures to check an AUTO-PURGER for leaks before placing it in service. To confirm a leak-free AUTO-PURGER, manually open the "foul gas" solenoid valve (#4) on the purger by removing the lower seal cap and turning the stem in (clockwise). Next, manually open one remote purge point solenoid valve, if there is one. Manually open the "foul gas" shut-off valve and allow pressure to build to condensing pressure as shown on the pressure gauge, then turn valve off. Turn front panel purger switch to "AUTO". This will open vent solenoid valve (#2) and pressurize the evaporator section of the purger. Check for leaks. Return all solenoid manual opening stems to the automatic position.

START-UP

Check piping and electrical connections. (Read sections on "Piping Instructions" and "Electrical Connections" from this bulletin.) Open "foul gas", liquid and suction line shut-off valves. Open purge gas gauge valve and water shut-off valve. On Models AP08, AP16, and AP24 turn the purger switch located on the front panel of the control cabinet to the "AUTO" position. Be sure Grasslin 7-Day Time Clock is "ON".

The AUTO-PURGER will begin a with "COOL DOWN" stage. The "PURGER COOLING DOWN" light on the front panel will indicate correct operation. This stage is necessary to allow the purger to cool to a temperature where efficient separation of non-condensible gas and refrigerant will occur. The AUTO-PURGER will not condense nor allow any "foul gas" into the water bubbler until the temperature of the purger evaporator reaches approximately 20F, which should take 5 to 15 minutes, depending on suction line temperature.

OPERATION

A thermostat with a sensor located on the horizontal portion of the flooded evaporator chamber actuates when the temperature reaches 20F, then condensing of "foul gas" begins. This is indicated by the "AUTOMATIC PURGING" light located on the control panel. The thermostat energizes solenoid valves (#3) and (#4) and allows solenoid valves (#5) and (#6) to open when the float ball is down (magnet away from tube). The thermostat also energizes the timer board to operate the first purge point solenoid valve.

If the switch on the front panel of control cabinet is set to a "MANUAL" purge point, then that purge point solenoid valve will energize. The purger will purge only from that point as long as the switch is positioned to that purge point.

For Model AP01, the "foul gas" solenoid valve (#4) located on the purger will energize and "foul gas" from a single purge point will flow to the purger. If several points are to be purged, then a plant operator must, from time to time, manually open and close the shut-off valve for each purge point. Only one purge point should be open at a time.

PURGER PUMP-OUT PROCEDURE, WITH PURGER ON

1. Close purge gas gauge valve to water bubbler
2. Close liquid line shut-off valve
3. Close "foul gas" line shut-off valve
4. Close water line valve

Purger will pump down in several hours. To accelerate process, attach ammonia hoses to oil drain valves and pumpout into suction line. Close suction line to isolate purger. With electricity on, pressure gauge on purger should remain at zero psi. This process should be completed only by knowledgeable refrigeration mechanics.

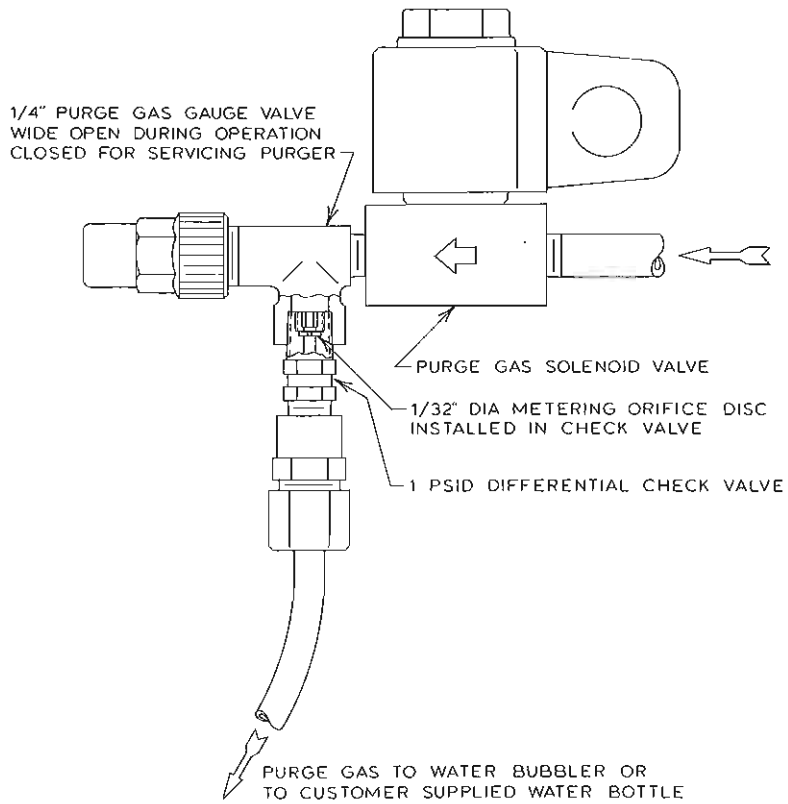


Figure 6 - Purge Gas Solenoid Valve (#5)

SECTION III AUTO-PURGER OPERATION

The AUTO-PURGER is designed to automatically start-up and operate without the assistance of plant personnel. Beginning at start-up, the following is a description of the refrigerant flow through a purger.

START-UP

On start-up, the AUTO-PURGER first enters a "COOLING DOWN" stage. In this stage, liquid refrigerant fills and cools the purger. Both the flooded evaporator and high pressure air separator chamber are filled simultaneously. The liquid line solenoid valve (#1) energizes to feed refrigerant to the liquid level control valve, which opens to fill the low pressure flooded evaporator. The liquid level sensor located in the suction separator chamber senses when the flooded evaporator is full and closes the liquid level control valve.

At the same time the flooded evaporator is filling, liquid refrigerant fills the float ball chamber and the air separator chamber through the liquid line and 30 psid check valve. The refrigerant gas that is formed is vented to suction through the vent solenoid valve (#2), which de-energizes when the float switch chamber fills with liquid refrigerant which causes the float ball to rise and pull in the float switch magnet.

The purger continues to cool down. A thermostat with a sensor bulb attached to the flooded evaporator senses temperature. At approximately 20F, evaporator temperature, the factory set thermostat switches from the "COOLING DOWN" stage to an "AUTOMATIC" or "MANUAL" stage as indicated by the purger switch and lights on the control cabinet.

OPERATION

The thermostat switches the AUTO-PURGER to "AUTOMATIC" when the evaporator temperature reaches 20F. This energizes "foul gas" solenoid valve (#4) and liquid metering solenoid valve (#3) and allows non-condensible gas and refrigerant mixture into the purger.

The "foul gas" carries a certain amount of condensed refrigerant which is captured by the liquid drainer before it enters the purger's condenser coil and then by-passed directly to the flooded evaporator chamber. Otherwise, the liquid refrigerant would fill the purger's condenser and limit the condensing capacity of the purger.

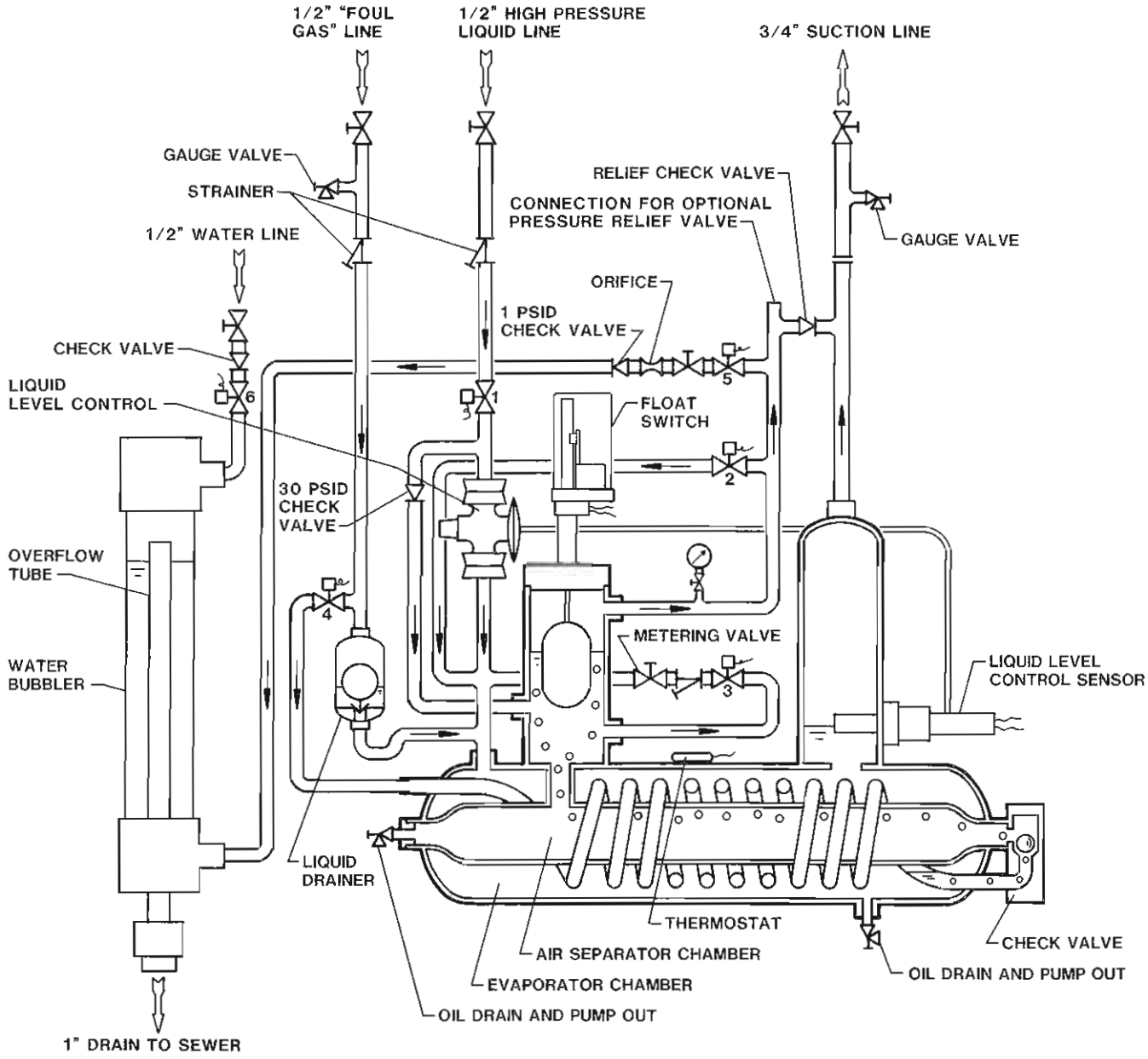
The liquid-free "foul gas" enters the purger condensing coil which is submerged in the flooded evaporator. The refrigerant condenses inside the coil as it proceeds to the other end. The now condensed refrigerant and non-condensible gas pass through a check valve and back into the air separator chamber. The condensed liquid refrigerant is removed from the high pressure air separator chamber through the liquid metering solenoid valve (#3), strainer, and metering valve, then into the flooded evaporator.

Meanwhile, the non-condensible gas travels along the top of the air separator chamber, into the float ball chamber, where it is collected. The collected non-condensible gas gradually depresses the liquid level causing the float ball to fall. This changes the SPDT switch position of the liquid level float switch and energizes purge gas solenoid valve (#5) and water solenoid valve (#6) and allows the non-condensible gas to bleed through the orifice plate into the water bubbler (except Model AP01).

For Models AP08, AP16, and AP24, in addition to the above, the purger timer board will energize the remote purge point #1 solenoid valve. (See "Setting Purge Point Timer" section for details.) The purger timer board will operate each remote purge point solenoid valve in sequence, as long as the purger switch on the front control cabinet is on "AUTO" and the 7-day time clock is "ON".

WATER BUBBLER FLUSH SYSTEM

The water flush system consists of the factory mounted water bubbler, water solenoid valve (#6), water check and shut-off valve. Water is automatically fed to the water bubbler through the water solenoid valve (#6), where non-condensible gas and water mix, so residual amounts of ammonia can be absorbed. The ammonia ladened water is flushed to the drain through the overflow tube. The water solenoid valve (#6) remains energized an additional 30 seconds after the float switch magnet pulls in. This fills the water bubbler with fresh water for the next purge cycle.



SOLENOIDS: #1 Liquid Line, #2 Vent, #3 Liquid Metering, #4 Foul Gas, #5 Purge Gas, #6 Water

Figure 7 - AUTO-PURGER

SECTION IV TROUBLE SHOOTING PURGER OPERATION

Purger does not operate when switch is turned on ("AUTO" or "MANUAL" selection).

REASON 1: No power to purger.
SYMPTOM: "ON" and "PURGER COOLING DOWN" lights off.
CHECK: 115 volts at "LINE" and "NEUTRAL" terminal in control cabinet (230V for 230V purger).

REASON 2: 7-Day timer not "ON".
CHECK: Time setting on timer.
ACTION: Set time per instructions, page 6.

REASON 3: No power to purger board 20-1773.
SYMPTOM: Red LED light on purger board not lit.
CHECK: Voltage to board. Voltage between terminal "RL" and "COMMON" should be 115V (230V for 230V purger).

REASON 4: Fault in wiring to purger board.
CHECK: Leads 36, 37, 39, and 46 for continuity.
ACTION: Repair if defective.

REASON 5: Transformer faulty.
SYMPTOM: Red LED light on purger board off but power at terminal "RL".
CHECK: 24V A.C. between leads 43 and 44.
ACTION: No voltage, replace transformer. If voltage, go to reason 6.

REASON 6: Short in 12V D.C. circuit.
SYMPTOM: Red LED light on purger board 20-1773 will go out if there is a short. On purgers shipped between 7/88 and 11/91, purger board has a built-in fuse. If fuse blown, replace after completing following "CHECK" step.
CHECK: Disconnect purger cables 20-1195, 20-1197 and terminal plug connections 22 through 26. Red LED light on purger board should now be lit.
ACTION: If LED does not light, replace purger board 20-1773. If LED is lit, plug in each cable separately to determine which circuit has ground short. (Red LED light will go out).

REASON 7: Fault in purger cable 20-1195.
SYMPTOM: "ON" light off but red LED light on purger board on.
CHECK: Voltage at terminal 1 on door should be 12V D.C. Terminal 7 on door is neutral.
ACTION: No voltage, check continuity of cable 20-1195 and repair. If voltage, go to reason 8.

REASON 8: Faulty rotary switch (purger switch).
SYMPTOM: No voltage at door terminal 2 when rotary switch set to "AUTO" position.
ACTION: No voltage, check wiring leads 1, 2 and rotary switch. If voltage, go to reason 9.

REASON 9: Fault in purger cable 20-1195.
SYMPTOM: "ON" light and red LED on purger board are lit but purger not operating.
CHECK: Continuity of lead 2 on purger cable 20-1195.
ACTION: If voltage to purger board through lead 2 is 12V D.C., then fault on purger board. Replace purger board 20-1773.

Purge point not operating properly.

REASON 1: No voltage to timer board.
SYMPTOM: Red LED light on timer board not lit.
CHECK: Voltage on cable 20-1197 leading from purger board. White wire is neutral, and black and gray wires are 12V D.C. when purger is in "AUTO" position.
ACTION: Repair discontinuity.
CHECK: If cable 20-1197 is okay, check for 12V D.C. at terminal 4 on door panel. Terminal 7 on door is neutral.
ACTION: If no voltage, check wire 4 for continuity.

REASON 2: Fault in timer board cable 20-1196.
SYMPTOM: In "AUTOMATIC PURGING" purge point lights do not operate, but purge point solenoids are operating.
CHECK: Continuity of each lead from timer cable, 20-1196.
ACTION: Repair fault.

REASON 3: Fault in purger board to timer board cable 20-1197.
SYMPTOM: In "AUTOMATIC PURGING" either all purge point lights dimly lit or none lit.
CHECK: Continuity of each lead.
ACTION: Repair fault.

REASON 4: Purge point solenoid valve does not operate.
CHECK: Two amp fuse (one amp for 230V purger).
ACTION: If faulty, replace.
CHECK: Voltage at terminal "RL". Voltage should be 115V (230V for 230V purger). If no voltage, check continuity of lead 42.

Purger does not switch from "PURGER COOLING DOWN" to "AUTOMATIC" or "MANUAL PURGING".

REASON 1: Suction temperature too high, must be below 20F.
CHECK: Suction pressure at purger suction line connection.
ACTION: Move suction line to lower temperature suction, or reset thermostat to higher temperature. (Call factory before changing thermostat setting.)

REASON 2: Restriction in suction pressure.
CHECK: Line size and shut-off valves. Suction line should be a minimum of ¾" size for ammonia, 1" for halocarbons. On new installations, check for plastic shipping cap in suction line flange.
ACTION: Remove restriction.

REASON 3: Evaporator not filled with refrigerant.
CHECK: Float switch magnet should pull in 5 to 15 minutes after turning purger on.
ACTION: If magnet does not pull in, check liquid line shut-off valve; liquid line solenoid valve (#1) voltage (115V at terminal 28 or 230V for 230V purger); continuity of liquid line solenoid coil; liquid line strainer; plastic shipping cap left in liquid line flange.

REASON 4: Liquid level control not working.
CHECK: Frost at outlet flange of liquid level control valve. If no frost, check for 115V at terminal 35 or 230V for 230V purger. Check continuity of heater. Proper resistance of 115V heater is 900 ohms, and resistance of 230V heater is 3600 ohms, ±10%. Check for broken or pinched capillary tube.
ACTION: Replace power element 20-1441 (115V), if capillary tube is damaged. Replace heater if resistance is not proper (120V heater, 20-1752; 230V heater, 20-1753).

Non-Condensibles are not being released from purger.

REASON 1: No non-condensibles in system.
CHECK: Compare refrigerant liquid temperature from condenser with condensing pressure. The pressure/temperature relationship should be within 2 to 3 psi.

REASON 2: Time delay-relay time limit exceeded.
SYMPTOM: Magnet on float switch away from steel tube, water solenoid energized and "NON-CONDENSIBLE GASES TO ATMOSPHERE" light is on.
CHECK: One hour time delay limit for purge gas solenoid valve (#5) exceeded.
ACTION: Turn delay-relay off momentarily to reset one hour time delay. For more information see Section II, Purge Gas Solenoid Valve Time Delay Cutout.

REASON 3: Liquid feed line plugged.
SYMPTOM: Purger appears to be operating properly. Liquid feed line not frosted.
CHECK: Metering valve 20-1714 for restriction.
ACTION: Unlock metering valve knob using .035" hex key wrench, taped inside control cabinet, and open wide to clear any dirt plugging orifice. Close metering valve and re-open to 6 turns (2 turns for halocarbon purgers shipped prior to 1/91 with a small green metering knob).
CHECK: Liquid line solenoid valve (#1).
ACTION: Check liquid line solenoid to see if it is energized. If liquid line does not frost, strainer or line is plugged and must be disassembled to find cause of blockage. See Section II, Purger Pump-Out Procedure.

REASON 4: "Foul gas" line not open.
SYMPTOM: Pressure gauge on purger reading 20-30 psi below system condensing pressure.
CHECK: Close "foul gas" line shut-off valve. If pressure falls 20-30 psi at pressure gauge located on purger, "foul gas" line was open. If pressure remains the same, then:
ACTION: Check for individual purge point solenoids not electrically energized or stuck closed. Check for shut-off valves not open. Check "foul gas" solenoid valve (#4) on purger for proper operation. To check for sticking solenoid valve, use manual opening stem to open valve. Observe if pressure increases to condensing pressure. Check for plastic shipping cap in "foul gas" line flange.

REASON 5: "Foul gas" line is flooded with liquid.
SYMPTOM: Stainless steel line from bottom of liquid drainer to inlet of purger evaporator is always frosted. During proper operation, line should periodically frost and defrost.
CHECK: Refer to Section I, Piping Instructions.

REASON 6: Liquid line pressure at purger higher than condensing pressure.
SYMPTOM: Liquid line pressure at purger 20 psi or higher than condenser pressure.
CHECK: Pressure at liquid line and "foul gas" line with pressure gauges. Check for high static head of liquid and/or pump boosted liquid line pressure.
ACTION: For high static head, install a pressure reducing Differential Pressure Regulator (HA2BL) in the liquid line. For boosted pump liquid, take liquid line before pump.

REASON 7: Purge point solenoid coil burnt.
SYMPTOM: 2 amp fuse blown (do not increase ampacity of fuse).
CHECK: Coil resistance in each coil for shorted coil.
QUICK CHECK: Replace blown 2 amp fuse (1 amp for 230V purger). Advance purge points with advance button until fuse blows. Faulty coil or wiring is now pinpointed.
ACTION: Replace coil or repair wire, and 2 amp fuse (1 amp for 230V purger).

REASON 8: 30 psid check valve stuck open.
CHECK: Close liquid line shut-off valve. Pressure gauge on purger should read close to condensing pressure and should not change when liquid line is closed, insuring "foul gas" line is open. Next, open liquid line shut-off valve and close "foul gas" line. Pressure should drop 20-30 psi. If not, 30 psid check valve is stuck open.
ACTION: Pump out purger and clean or replace 30 psid check valve 20-1184.

REASON 9: Metering orifice in 1 psid check valve is plugged. See figure 6.
CHECK: Purge gas solenoid valve (#5) is energized and non-condensibles are not released.
ACTION: Clean or replace 1 psid check valve, 20-1183.

Ammonia instead of non-condensibles released from purger.

SYMPTOM: This symptom can be seen for the following reasons: small bubbles and a violent shaking of the water bubbler assembly.
REASON 1: "Foul gas" line not open.
SYMPTOM: Pressure gauge on purger should read same as condensing pressure within 2-5 psi.
CHECK: Close "foul gas" line shut-off valve. Pressure should fall 20-30 psig as shown by pressure gauge on purger.
ACTION: Check for blown 2 amp fuse (1 amp for 230V purger) in control cabinet. This indicates a burned out purge point solenoid coil. Next, check for closed valve, and plugged strainer in "foul gas" line. Check for plastic shipping cap in "foul gas" line flange.

REASON 2: Purge point or purge point solenoid not connected.
SYMPTOM: "Foul gas" pressure being lost.
CHECK: Physical connections to purge points. Electrical wiring to purge solenoid valve remote line connections on control cabinet, and continuity to assure wiring to coil.
ACTION: Connect purge point, refer to Section I, Purge Point Connections. Connect purge point solenoids, refer to Section II, Electrical Connections.

REASON 3: Purge gas solenoid valve (#5) seat leaking.
SYMPTOM: Slow leak of non-condensibles, "NON-CONDENSIBLE GASES TO ATMOSPHERE" light is not on and float switch magnet is pulled in against tube.
CHECK: Solenoid valve for dirt or worn seat.
ACTION: Lift float switch assembly momentarily to open valve to clear dirt on seat. If this fails, pump out purger and repair valve.

REASON 4: "Foul gas" solenoid valve (#4) not open.
SYMPTOM: "Foul gas" line frosted or cold where line enters insulated purger vessel.
CHECK: Check voltage to "foul gas" solenoid coil (#4) at terminal 32.
CHECK: Manually open "foul gas" solenoid valve (#4) and observe if pressure rises 20 to 30 psi (as shown on pressure gauge on purger).
ACTION: Clean or replace solenoid valve.

REASON 5: Oil in purger.
SYMPTOM: No frost around bottom oil drain valve.
ACTION: Drain oil through valves on bottom and left end of purger, per recommended oil removal instructions on page 4.

REASON 6: Liquid level control valve not operating.
SYMPTOM: Suction line and outlet flange of liquid level control valve not frosted.
CHECK: Resistance of heater. Resistance of 115 volt heater is 900 ohms, and resistance of 230 volt heater is 3,600 ohms ±10%.
ACTION: Replace if circuit is open.
CHECK: Power element charge is lost. Check capillary tube for breaks.
ACTION: Replace power element. Purger must be isolated from refrigeration system, and refrigerant removed from purger before replacing power element. Follow recommended pump out procedures. See Section II, Purger Pump-Out Procedure.

Water bubbler develops excessive mineral coating.

REASON 1: Hard water.
ACTION: Switch water line to softened water. Use water conditioning housing and cartridge.

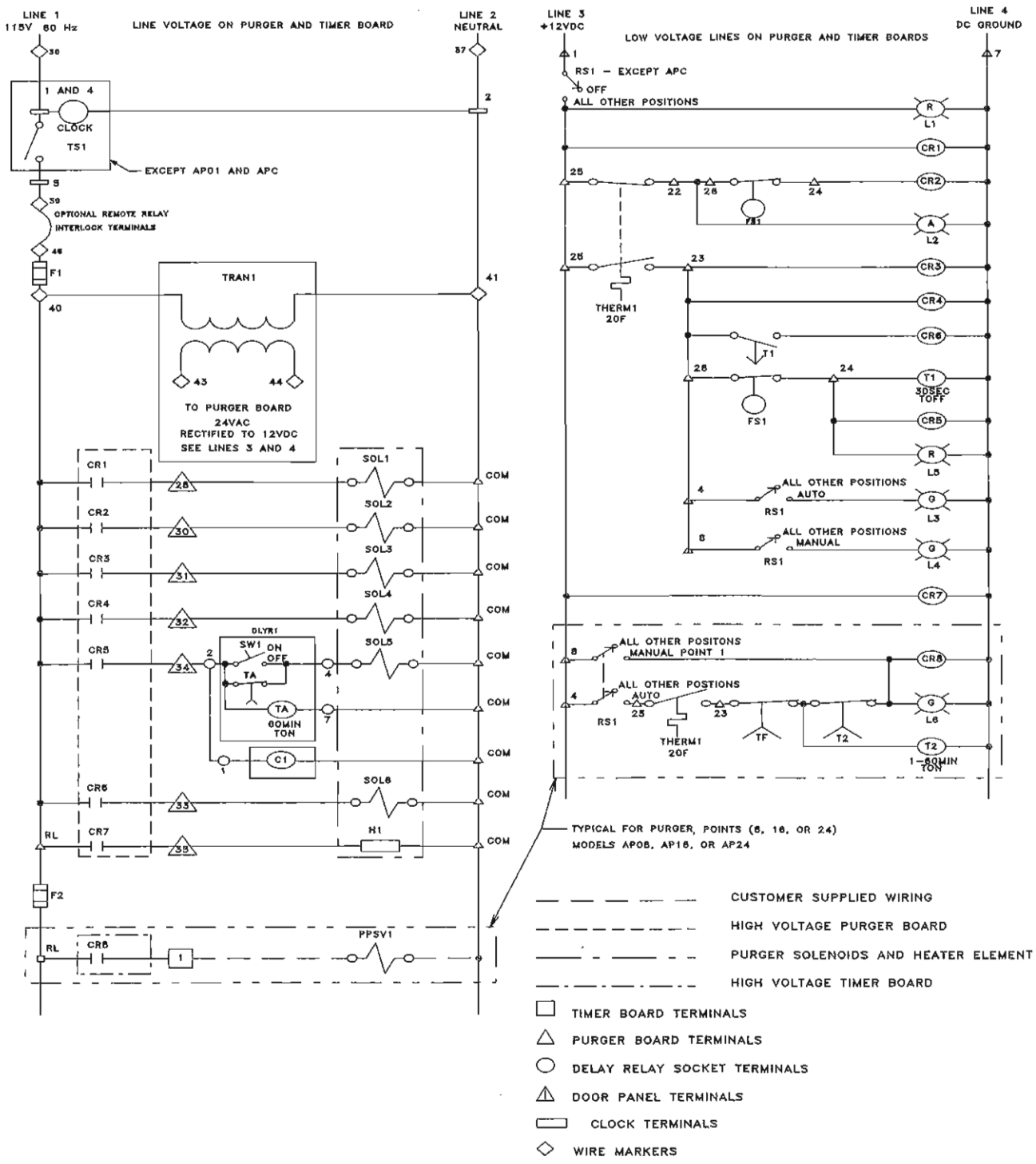
SECTION V SPARE PARTS

Electrical

Part No.	Description
20-1202	LED Light-Red
20-1203	LED Light-Yellow
20-1204	LED Light-Green
70-1064	Solenoid Coil-115V, 50/60HZ, 16 Watt
70-1063	Solenoid Coil-230V, 50/60Hz, 16 Watt
20-1424	7-Day Time Clock (115 Volt/60Hz)
20-1573	7-Day Time Clock (230 Volt, 50/60Hz)
20-1773	Purger Control Board Less Plug-in Connector (115 Volt or 230 Volt) Replaces 20-1130 & 20-1536
20-1499	Purger Control Board w/Plug-In Connectors (Replaces Older Boards with Screw Terminals)
20-1131	8-Point Timer Board, Less Plug-In Conn.
20-1500	8-Point Timer Board w/Plug-In Conn. (Replaces Older Boards w/Screw Terminal)
20-1205	Transformer (115V/24VAC)
20-1307	Thermostat
20-1498	Time Delay-Relay, 1 Hour Fixed, Off Switch (115 Volt)
20-1528	Time Delay-Relay, 1 Hour Fixed, Off Switch (230 Volt)
20-1280	4-Digit Counter with Reset, 115 Volt
20-1473	4-Digit Counter with Reset, 230 Volt
HS2B(10)	HS2 (Brass) Water Solenoid Valve Only-Less Coil, ¼" FPT (#6)
HS2(10)	HS2 Solenoid Valve Only-Less Coil, ¼" FPT (#2 and #3)
HS2(30)	HS2 Liquid Line Solenoid Valve Only-Less Coil, ½" FPT (#1)
HS2N(10)	HS2 Purge Gas Solenoid Only-Less Coil with Neoprene Seat ¼" FPT (#5)
HS8(10)	HS8 "foul gas" Solenoid Valve Only-Less Coil (#4)
20-1182	Asco Solenoid #8262C80N, ¼" Connection 115 Volt (Older Model) (Green Coil Housing)
20-1538	Repair Kit for Asco Solenoid, Asco Part #302-020 (Older Model) (Green Coil Housing)

Mechanical

Part No.	Description
20-1179	Level Control Valve w/Power Element (115 Volt)
20-1647	Level Control Valve w/Power Element (230 Volt)
20-1441	Power Element, Level Control (115 Volt)
20-1739	Power Element, Level Control (230 Volt)
20-1752	15 Watt Heater for Level Control (115V)
20-1753	15 Watt Heater for Level Control (230V)
HLLSW	Float Switch Assembly
20-1738	Float Ball Assembly Kit, includes: 20-1142 Float Ball Assembly 20-1212 Gasket-Top Adapter 77-0037 Screws (2)
20-1772	Water Bubbler Assembly, anti-syphon (w/end connections)
20-1714	Metering Valve
20-1198	Metering Valve Seal Kit
20-1648	Metering Valve Strainer
20-1737	Screen Assembly Replacement Kit for above, includes: 20-1535 Screen Assembly 78-0016 Strainer Gasket
70-1059	Plunger Kit-Teflon Seat (for solenoid valves 1, 2, 3, and 4)
70-1066	Plunger Kit-Neoprene Seat (solenoid valves #5 and 6)
20-1183	Check Valve, 1 PSID
20-1184	Check Valve, 30 PSID
20-1185	Check Valve, 200 PSID
20-1214	Check Valve Seal Kit, for 1, 30, and 200 PSID check
20-1776	Air Indicating Column for halocarbon purger
20-1311	Liquid Drainer



TS1 7–DAY TIME CLOCK
F1 FUSE MAIN 5 AMP
F2 FUSE FOR REMOTE PPSV 2 AMP
TRAN1 TRANSFORMER 115V/24VAC
SOL1 LIQUID LINE S.V.
SOL2 VENT S.V.
SOL3 LIQUID METERING S.V.
SOL4 FOUL GAS S.V.
SOL5 PURGE GAS S.V.
SOL6 WATER S.V. – OPTIONAL AP01

L1 LIGHT FRONT PANEL "ON"
L2 LIGHT FRONT PANEL "PURGER COOLING DOWN"
L3 LIGHT FRONT PANEL "AUTOMATIC PURGING"
L4 LIGHT FRONT PANEL "MANUAL PURGING"
L5 LIGHT FRONT PANEL "NON–CONDENSIBLE GASES TO ATMOSPHERE"
L6 LIGHT PURGE POINT 1
SW1 SWITCH TIME DELAY RELAY
TA DELAY ON, 60 MINUTE FIXED DELAY RELAY
RS1 ROTARY SWITCH FRONT PANEL (3 LEVELS)
(1 LEVEL) AP01

PPSV1 PURGE POINT S.V. 1
H1 SPORLAN HEATER ELEMENT
DLYR1 60 MINUTE TIME DELAY RELAY
C1 COUNTER
THERM1 THERMOSTAT, SET AT 20 DEG F (FIELD ADJUSTABLE)
FS1 FLOAT SWITCH
T1 TIMER WATER S.V., TIME OFF DELAY, 30 SECONDS
T2 TIMER POINT 1, TIME ON DELAY, 1–60 MINUTES
TF FINAL PURGE POINT TIMER, TIME ON DELAY, 1–60 MINUTES

Figure 8 - Ladder Diagram for AUTO-PURGERS (Drawing #2001-19)
See also wiring schematic for purger control cabinet supplied with purger.