



# ENGINEERING BULLETIN

## OPERATION & MAINTENANCE

**JOB NAME: HAT CREEK RADIO OBSERVATORY**  
**HAT CREEK, CA**  
**FOR: PO# PTS 066988**

Model PCP-100-10A-WP-HA-SSC-LAC-HGBP-CTC  
Serial No. 6406/95

**Filtrine Manufacturing**  
15 Kit Street  
Keene, NH 03431  
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Fax: 603-352-0330



# INSTALLATION INSTRUCTIONS FOR MODEL PCP-100-10A-WP-HA-SSC-LAC-HGBP-CTC Serial No. 6406/95

**A. PCP-CLOSED LOOP CHILLERS:** PCP chillers are designed to pump a coolant (water or water and ethylene glycol solution) from the cooling tank through a closed cooling loop and back to the cooling tank. The cooling tank is usually not under pressure.

1. Open fill port on top of cabinet and air vent.
2. Make plumbing connections to pipe connections tagged 'Discharge' and 'Return'. Coolant flow will be out of the 'Discharge' connection.
3. Fill up cooling tank through fill port using a hose or bucket and funnel. Fill until coolant is visible at least 3/4 of the way up the liquid level sight glass.
4. If recirculating pump is supplied with a bleed plug in pump housing, loosen plug until water begins to drip out, then retighten.
5. Check all piping for leaks and make repairs necessary.
6. Close air vent and replace plug in fill port.
7. After all electrical connections are made, turn on pump and pump liquid through complete cooling loop.
8. Turn off pump.
9. Open air vent and fill port.
10. Add more liquid as necessary to fill sight glass.
11. Close air vent and fill port.
12. Check coolant level periodically by shutting off pump and then opening air vent. Add more coolant as necessary.

**B. OPERATING PRESSURES:** Your Filtrine chiller is set at the factory to operate at the following freon pressure:

Operating Pressure	R22	PRESSURE SWITCH SETTINGS		
			Cut In R22	Cut Out 22
Compressor Discharge	180-350	High Press. Cut Out	275	350
Compressor Suction	50-85	Low Press. (pump down)	40	15
** Subject to time delay program menu.		Low Press. (safety)	**	35-45

Pressure switch settings are dependent upon application of equipment.

**C. OPTIONS:** This chiller is supplied with the following options. Be sure to understand how the chiller functions before operating.

WP- Weather-Proof/Low-Ambient Controls - Weatherproof design protects switches, motors, controls from direct exposure to elements and allows outdoor installation.

HA - High ambient Condenser - Oversized condenser to permit compressor to run at normal head and suction pressures in high ambient conditions.

Stainless Steel Cabinet- Cabinet and frame constructed throughout of stainless steel.

LAC-LOW AMBIENT CONTROL-- The chiller is outfitted with a refrigerant side head pressure control so that the chiller will function satisfactorily during periods of low ambient temperature.

This head pressure control is a non-adjustable, sealed valve that will maintain a nearly constant receiver pressure for normal system operation.

The valve has three connections on it -- (1) hot gas; (2) liquid drain from condenser; (3) receiver.

During periods of low ambient temperature, the receiver pressure falls until it approaches the control point of the ambient control. At this time, the valve starts to throttle, restricting the liquid flow from the condenser, causing liquid refrigerant to back up in the condenser, thus reducing the active condenser surface. This will raise the condenser pressure. At the same time the other side of the valve will start to bypass hot gas to the receiver. The bypass hot gas mixes with the cold liquid from the condenser, warming it up and making sure there is sufficient pressure in the receiver for proper expansion valve operation. As long as there is sufficient refrigerant charge in the system, the ambient control will automatically modulate the refrigerant flow to maintain proper receiver pressure, regardless of outside temperature.

Sufficient charge of refrigerant means that there must be enough liquid refrigerant in the receiver during lowest ambient conditions, to maintain a liquid seal for the liquid line. If there is too little refrigerant and there is no liquid seal, then hot gas can enter the liquid line and the expansion valve and cooling will stop. The hot gas entering the evaporator, through the expansion valve, will actually cause the water in the tank to heat up.

Because it may be difficult to tell by looking at the sight glass whether it is full of liquid or just hot gas, a few other things should be checked to make sure that it is liquid:

- (1) Suction and head pressures will be low with high superheat.
- (2) Check outlet of expansion valve. If it is hot, there is hot gas in the liquid line and the charge is low.

If the compressor is allowed to run under a low charge condition with the ambient control, it can be seriously damaged.

If there has been a loss of refrigerant, it is better to completely empty the charge and recharge to the original amount on the nameplate of the chiller.

The charge is very critical. Too much charge and the refrigerant will back up into the condenser, causing high pressure in high ambient conditions. Too little refrigerant and the chiller and the chiller won't operate properly in low ambient conditions.

The chiller also utilizes a time delay low pressure operating control. This pressure control has a 90 second delay off function. This is done to eliminate short cycling on low pressure on start-up during low ambients. The pressure control keeps the compressor running for 90 seconds before tripping out

to help the build system up to operating pressure.

## HOT GAS BYPASS OPERATION

The hot gas bypass option is designed to help the chiller maintain close temperature control without short-cycling the compressor.

### Sequence of Operation

1. Pump must be running - interlocked with refrigeration.
2. Set the setpoint thermostat at the desired temperature.
3. Set the low temperature cutout thermostat a few degrees lower than the setpoint. The low temperature cutout thermostat is in series with the setpoint thermostat, so it must be calling for cooling before the system can run.
4. When the water temperature is above the setpoint, the chiller will be fully loaded and cooling. When the water temperature reaches setpoint, the setpoint thermostat will open up, de-energizing the liquid line solenoid and causing the suction pressure to drop. As the pressure drops, the hot gas pressure regulator will open and start passing hot gas into the liquid side of the evaporator. This pressure will be regulated at approximately 15-20 psi lower than the normal suction pressure at the temperature being maintained. The hot gas gives the compressor a false load and can actually warm the water temperature back up. When the water temperature rises above the setpoint, the liquid line solenoid is re-energized, allowing the flow of liquid refrigerant to enter the evaporator. This causes the suction pressure to rise which closes the hot gas regulator, putting the chiller into its cooling mode again.
5. If under low load conditions the temperature continues to drop below the setpoint even while the chiller is hot gassing, the low temperature thermostat will de-energize the hot gas solenoid as well as the liquid line solenoid. This will cause the unit to pump down and turn off until the temperature rises again.

CTC- Close Temperature Control: This option is designed to allow the chiller to maintain a smaller than normal temperature differential without short-cycling the compressor. It involves the addition of a solid state temperature controller rated typically at  $\pm 5^{\circ}\text{F}$  and a hot gas bypass solenoid.

Set the solid state temperature controller at the desired outlet water temperature. When the water temperature exceeds this set point, the compressor will operate at full capacity to bring the temperature down. When the set point is reached, the controller will open the hot gas solenoid valve which allows hot refrigerant gas to bypass the condenser. This in effect unloads the refrigeration without turning off the compressor.

There is also a low temperature thermostat (usually mounted inside the cabinet) which should be set about  $5^{\circ}$  lower than the set point controller. If under no-load conditions, the temperature drops below the desired set point even though the chiller is in hot gas bypass, the low temperature thermostat will shut the compressor off until the load increases, raising the water temperature.

## D. SPARE PARTS LIST

### PART NUMBER

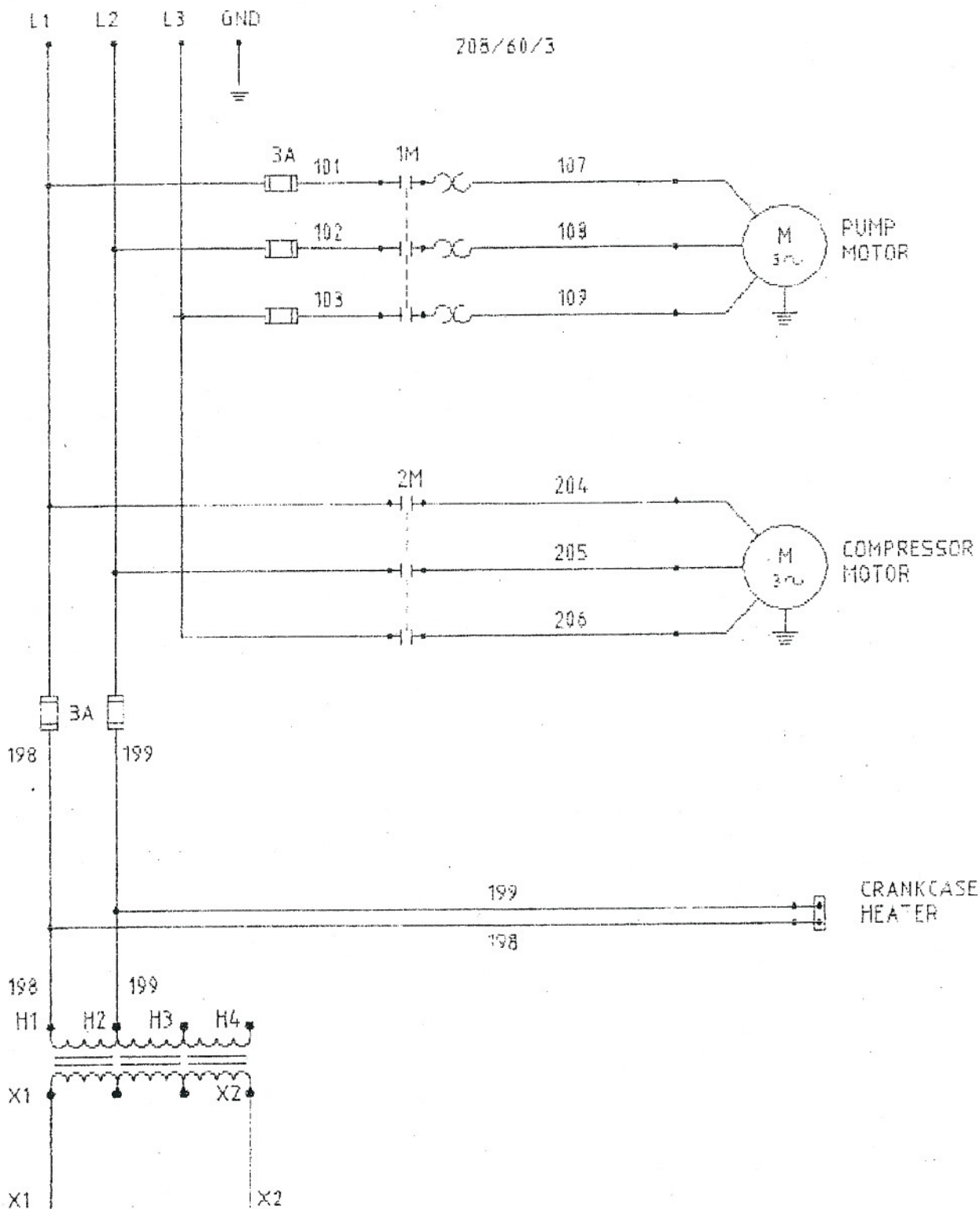
- 168-6406/95-\*Automatic expansion valve
- 176-6406/95-\*Thermostat
- 196-6406/95-\*Compressor starting relay
- 224-6406/95-\*Fan motor (air cooled models)
- 233-6406/95-\*Compressor overload

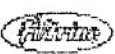
The above spare parts are the major components for your chiller. Those with suffix "\*" are recommended to be kept in stock at all times.

- E. Engineering Bulletin:** Attached is engineering bulletin for your type of chiller.
- F. Wiring Diagram:** Attached is the wiring diagram for your chiller, please notify factory if this is not enclosed.
- G. Refrigeration/Plumbing Schematic :** Attached is the refrigeration/plumbing schematic for your chiller, please notify factory if this is not enclosed.
- H. Chiller Warranty Form** - Be sure to have a qualified refrigeration mechanic complete and return one copy to Filtrine. Start-up by anyone other than a qualified refrigeration mechanic will void warranty.
- I. Chiller Test Report** - Available upon request.
- J. Selected Maintenance Manuals**
  - 1. Compressor Manual - Copeland KAR1-0100-TAC
  - 2. Pump Manual - G&L 1ST

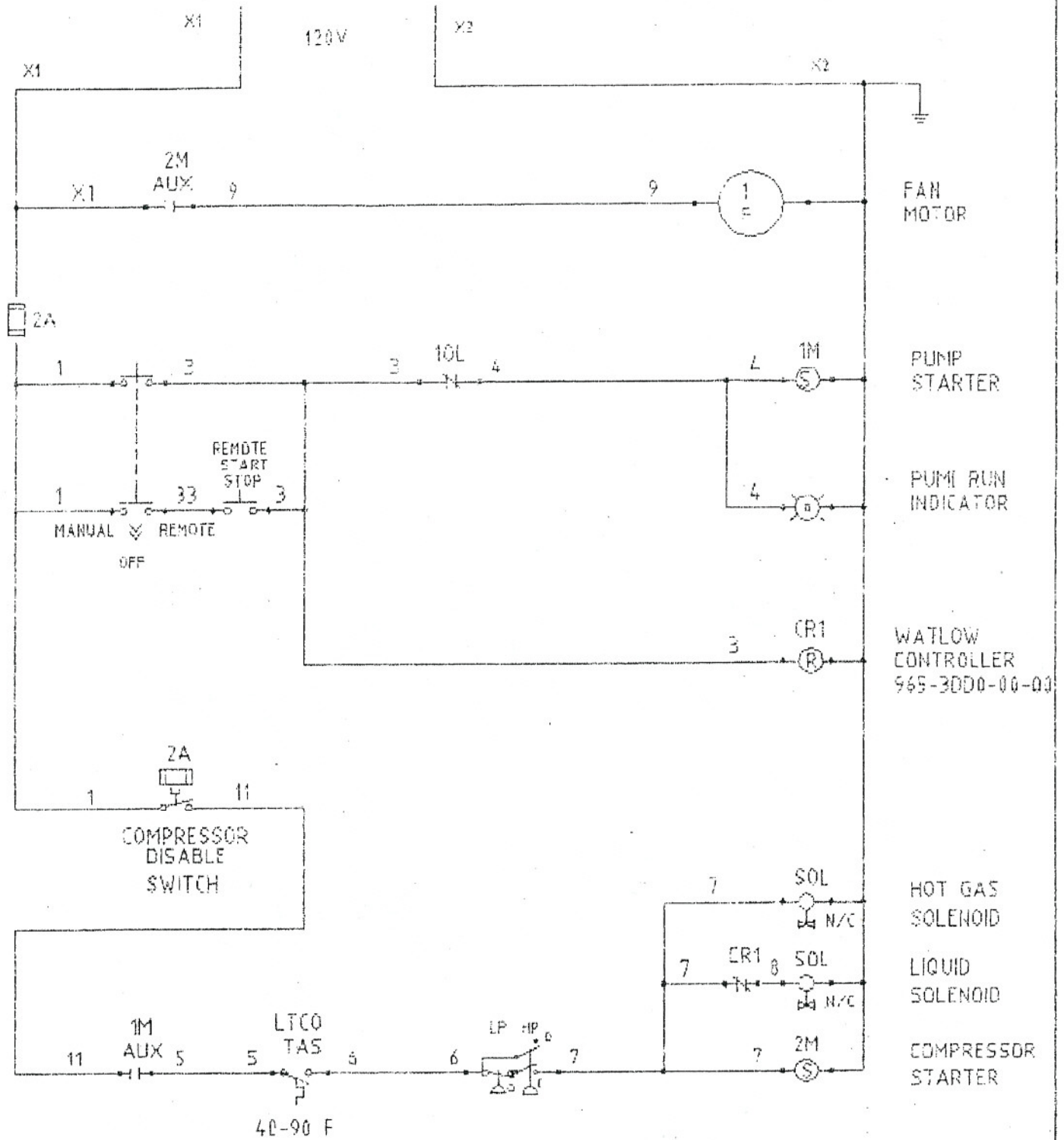
# ELECTRICAL DIAGRAM

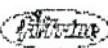
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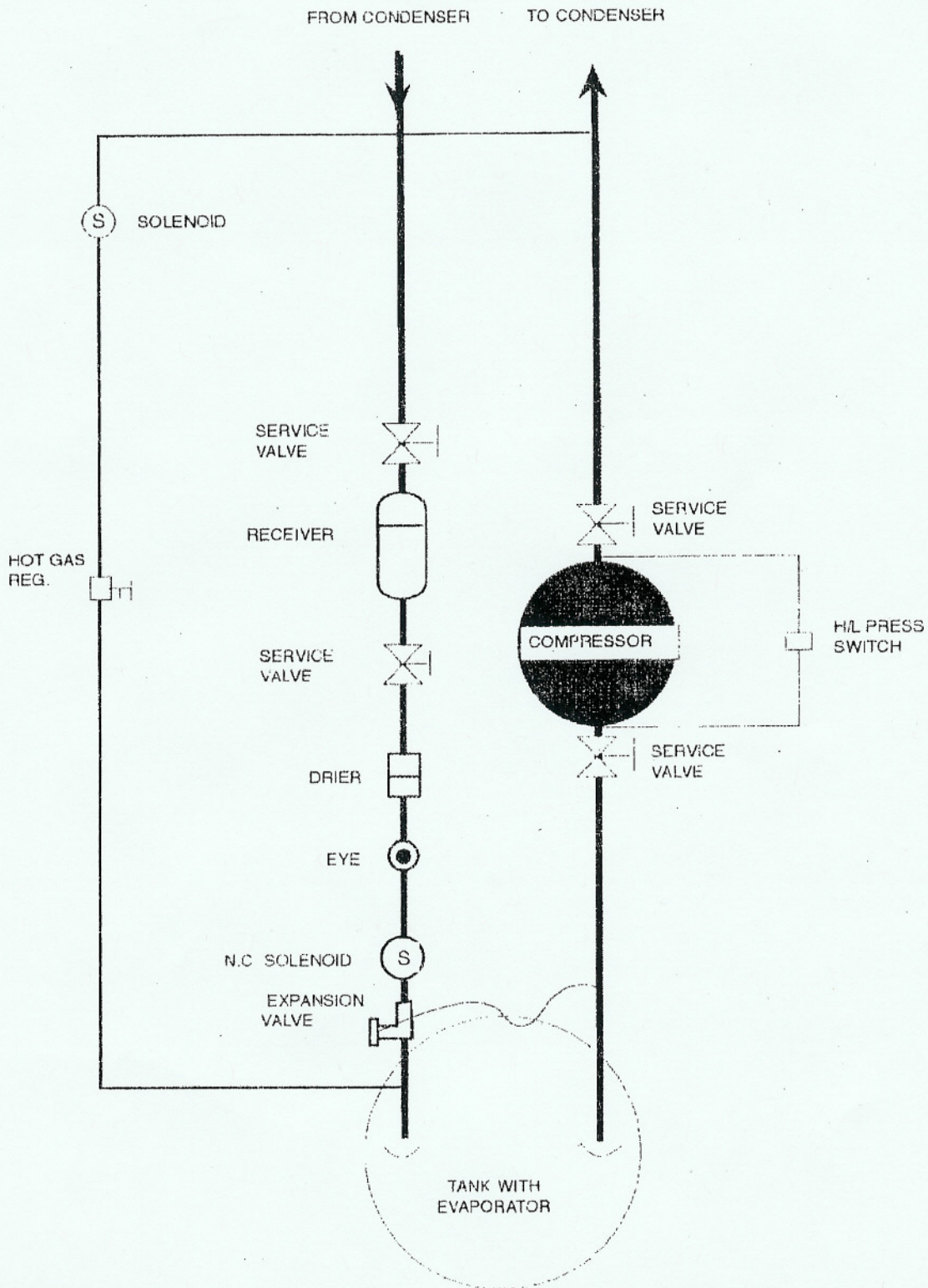


 <b>FILTRINE MFG CO.</b> HARRISVILLE, NH 03450	JOB NAME: HAT CREEK OBSERVATORY	SERIAL NUMBER 6406/95
	MODEL: PCP-100-10A-WP	
	CUSTOMER: UNIV CALIFORNIA/HAT	SHEET 1 OF 2

# ELECTRICAL DIAGRAM



 <b>FILTRINE MFG CO.</b> HARRISVILLE, NH 03450	JOB NAME: HAT CREEK OBSERVATORY	SERIAL NUMBER
	MODEL: PCP-160-10A-WP	6406/95
	CUSTOMER: UNIV CALIFORNIA/HAT	SHEET 2 OF 2

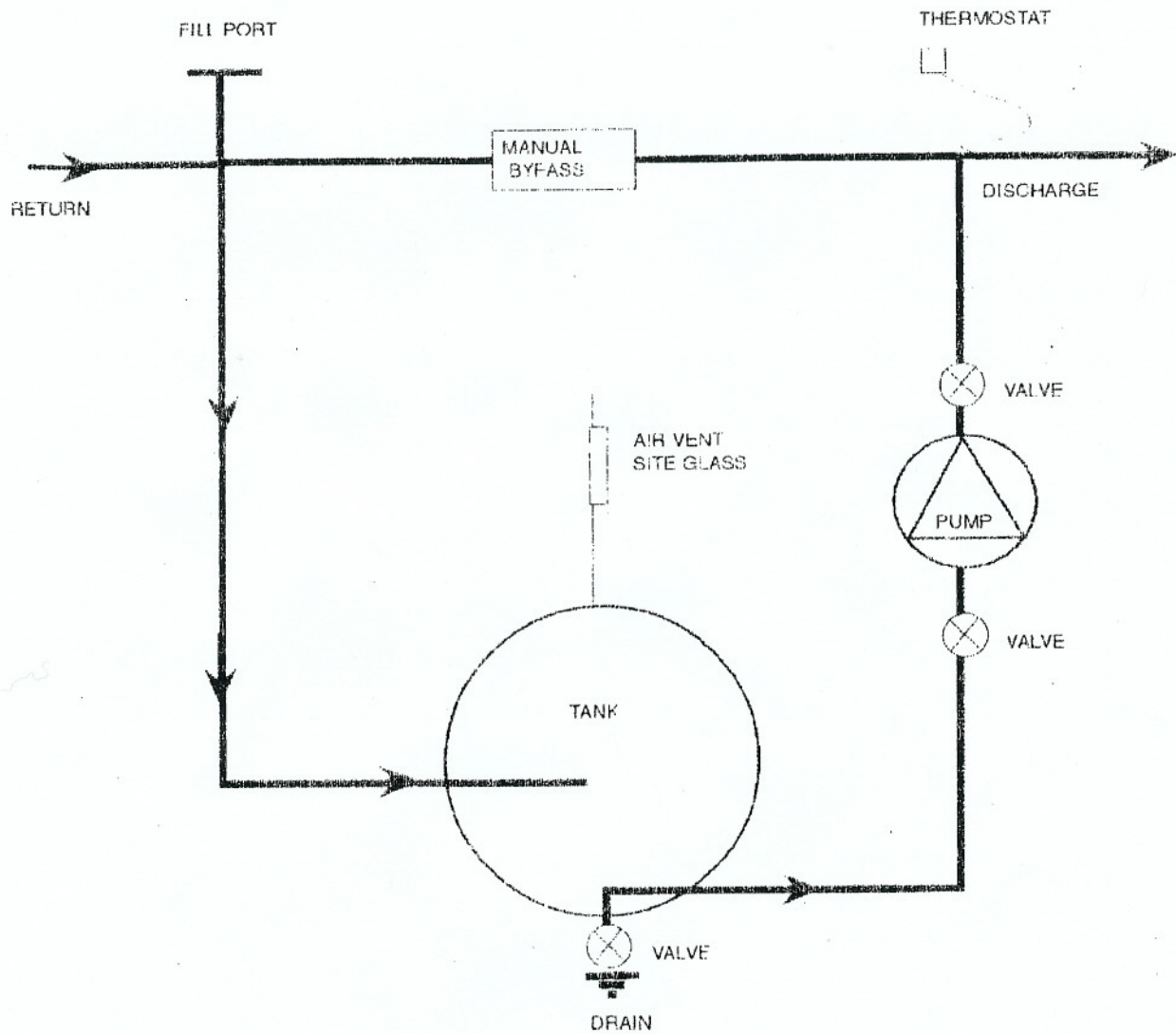


FILTRINE MFG. CO.  
Harrisville, NH 03450

REFRIGERATION SCHEMATIC  
PCP-100-10A-WP-HA-SSC-LAC-HGBP-CTC  
HAT CREEK RADIO OBSERVATORY, HAT CREEK, CA; FOR: PO# PTS  
066988

S# 6406/95





FILTRINE MFG. CO.  
Harrisville, NH 03450

PLUMBING SCHEMATIC  
PCP-100-10A-WP-HA-SSC-LAC-HG8P-CTC  
HAT CREEK RADIO OBSERVATORY, HAT CREEK, CA; FOR: PO# PTS  
066998

S# 6406/95

## REFRIGERATION SYSTEM - THEORY OF OPERATION

A refrigeration system is a closed loop circuit in which a fluid, the refrigerant, is caused to absorb heat at the point where cooling is desired, and to release heat at some other point enabling re-use of the refrigerant.

The process depends upon the property of fluids known as latent heat of vaporization. If a fluid changes from the liquid to the vapor state, it must absorb heat in order to maintain its original temperature. If the needed heat is not available at the point of vaporization, there will be a substantial drop in the temperature of the vaporized fluid. The process may be reversed by increasing the pressure of the vapor. This causes the temperature to rise and if heat is allowed to dissipate from the system, the vapor will return to the liquid state.

Starting with the compressor, the refrigerant, Freon R-12, is pumped to a higher pressure. The compression of the gas causes a sharp rise in temperature. In a properly operating system, only gaseous refrigerant is pumped through the compressor.

The hot, high pressure gas, passing through the condenser, a heat exchanger, is cooled, causing it to condense to liquid. Fans draw air over the condenser coils to speed heat removal.

The high pressure liquid collects in the receiver tank which also traps any remaining gas. The trapped gas condenses as it cools further, thus no gas accumulation occurs. High pressure liquid leaving the receiver passes through a drier cartridge which removes any water that may be trapped in the refrigerant system.

It then passes through a sight glass which includes an indicator used to detect excessive water contamination of the refrigerant. The indicator should be green in color. If it is yellow, the refrigerant is contaminated with water and requires service by an experienced refrigeration technician.

The sight glass also indicates insufficient freon charge. When the compressor is operating, the sight glass should be completely filled with clear liquid. After the compressor has been running for a short time, however, a small amount of bubbling is normal. Foaming indicates the presence of oil in the refrigerant. Both of these conditions require service by an experienced refrigeration technician.

From the sight glass, the liquid freon passes through an anti-migration solenoid valve. This valve closes whenever the compressor shuts off. Its purpose is to prevent liquid freon from filling the low pressure portion of the refrigeration circuit during compressor off-periods. Without this valve, heat from the atmosphere would cause expansion of the gas in the receiver tank and resulting flow of liquid freon through the system to the compressor inlet. Pumping of liquid by the compressor is harmful and must be prevented.

From the solenoid valve, the liquid freon passes to a thermostatically controlled expansion valve. This valve is controlled by a temperature sensing bulb fastened to the evaporator. It opens on demand when the evaporator temperature rises above a preset temperature, causing the high pressure liquid to flow into an area of low pressure, resulting in immediate vaporization of most of the liquid and a sharp drop in refrigerant temperature.

Modulation of the expansion valve by the evaporator temperature sensing bulb assures that excessive refrigerant will not flow into the evaporator coils. The pressure in these coils is thereby kept at a relatively low value so that the refrigerant in this area remains primarily in the gaseous state.

The cold refrigerant gas in the evaporator coils removes heat from the chiller water reservoir before passing out of the evaporator. This is, of course, the ultimate purpose of the machine. The low pressure gas is then passed through a filter to remove any particulate contaminants before returning to the compressor inlet.