# Servicing Dealer Contents

# 1.0 Service Tools Normally Req'd.

Hand Tools & Materials
- 5/16" AND 1/4" nut drivers
- #2 Phillips head screw driver
- flat blade screw driver
- thin flat blade screw driver
- needle nose pliers
- standard pliers
- small and medium size crescent wrenches
- wire cutters/crimpers
- alligator clips or jumper wires
- PVC glue/ primer
- teflon tape

Instrumentation
- volt-ohm meter
- continuity tester
- amprobe or ammeter
- set of refrigeration pressure gages

Refrigeration System Repair
- approved refrigeration recovery system
- vacuum pump
- charging flask or system
- Sta-Brite #8 solder & flux
- acetylene or propane torch set

# 2.0 Description of Heat Siphon System

THERE ARE THREE SUB SYSTEMS IN ALL HEAT SIPHONS:

1. Refrigeration System Compressor-motor w/ capacitor on 1 phase units, crankcase heater) evaporator, condenser, and thermo-expansion valve/ filter dryer

2. Electrical Controls- contactor, 24v Transformer Thermostat, Time delay, Refrigerant Low & High Pressure switches, Water Flow switch

3. Air Moving System- Fan motor w/run capacitor on I phase units), fan blade

## 2.1 Refrigeration System

The REFRIGERANT SYSTEM uses a standard HERMETIC CANNED MOTOR COMPRESSOR or the new Scroll Compressor and an EXPANSION VALVE regulated EVAPORATOR with a tube in shell CONDENSER. Both heat exchangers are oversized. Based on the compressor manufacturer's recommendations for this system freon charge level and the excess heat exchanger volume, there is no need for suction accumulators or receivers,.

The COMPRESSOR crankcase capacity is more than sufficient in all models to prevent liquid slugging and the extra condenser tube length provides sufficient receiving freon storage capacity. The compressor requires power line voltage (usually single phase 220 volt 60 cycle) and has a built in thermal overload protector which will trip on excess current draw and prevent rapid cycling and possible damage to the compressor.

A DRYER STRAINER is used in the liquid line to eliminate chips or burrs Which may have been introduced at assembly or opened for field service. Except for the exclusive Titanium Condenser. the refrigerant piping is all copper including the evaporator which has aluminum fins and copper tubes. High temperature silver braze joints are used throughout except for dryer strainer, expansion valve and pressure switch joints which are silver Soldered to facilitate ease of replacement in the field and to minimize heat damage in production.

## 2.2 Electrical control system

Low Voltage Transformer

The control system is supplied by a low voltage 24 volt AC transformer which is connected to the supply line high voltage so it is ALWAYS energized when power is delivered to the unit This provides 24 volts to the control circuit at all times. The transformer is a current limiting type with 40 VA output.

### 2.2.1 Contactor

One of the two 24 volt lead wires (blue and yellow normally) of the transformer is connected to the MAIN CONTACTOR and the other 24 volt lead wire goes to one of the controls. The points of the main contactor are normally

opened and are closed by applying 24 volts to the contactor's coil.

Since all of the controls are connected in series with the 24 volt CONTACTOR, they ALL MUST be closed to deliver 24 volts from both transformer leads to both sides of the contactor coil. Once 24 volts is applied to the coil, it then pulls in (and closes) the CONTACTOR points and thus provides line voltage power to the fan and compressor motors. - All controls are found in the control box which is located behind the door with the thermostat knob.

The controls are as follows:

### Low Pressure Switch

(normally opened)

**LOCATION:** Switch has a white body and is in the control box on left side service port.

**OPERATION:** This switch is closed by freon pressure in the evaporator and opens at a suction pressure (48 psig) corresponding to an air temperature of approx. 42° F with an automatic reset point when the suction pressure reaches (81 psig) corresponding to approximately 48° F air temperature. Three things cause it to open:

1. Low suction pressure due to a leak in the system
2. Low suction pressure due to a low air temperature or
3. Low suction pressure due to lack of air circulation (fan motor failure or air blockage).

The lead wires on this switch have BLUE (suction) insulation.

### High Pressure Switch

(normally Closed)

LOCATION

Switch has a red body and is in the control box on right side service port.

OPERATION

This switch is opened by freon pressure in the discharge side at 355 psig which corresponds to a water temperature of approximately 114° F and are set point of 255 psig. Three conditions can cause it to open:

1. High head pressure due to low or no water flow, and
2. High head pressure due to excessive water temperature above approximately 114° F

I High head pressure due to restriction in the discharge line such as expansion valve seat blockage or valve malfunction.

The lead wires on this switch have RED (discharge) insulation.

### Water Flow Switch

(normally Opened)

LOCATION:

Inside control box on the lower right hand comer.

OPERATION:

This pressure switch senses the pool pump flow by sensing pool water backpressure in the condenser through a capillary tube. The switch is adjustable by a thumb wheel from 0 to 5 psid to correct for static pressure should the pool water level be higher than the pressure switch.

### Pool Water Themostat

(normally opened)

LOCATION

Inside control box mounted on lower right.

OPERATION

This temperature sensing switch uses a remote bulb to sense pool water temperature. A small diameter capillary tube runs between the thermostat switch body (in the control box) and the bulb which is inserted inside a well (sealed tube that extends into the bottom of the Titanium Heat Exchanger) where it senses water temperature. The thermostat has a control range from OFF to 112 degrees Fahrenheit and maintains the set point temperature within a 1.5 degree differential.

### Time Delay

(normall yClosed / Opened for five, minutes when power is REMOVED from unit).

LOCATION

Inside control box, mounted on the lower left wall.

OPERATION

This 2" x 2" x 1/2" cube shaped solid state device will conduct 24 volts until the voltage is removed at which time it becomes an open circuit and will not conduct electricity for five minutes, whether or not power is applied. This delay on break action prevents the compressor from restarting immediately after shutting off. This is done to allow the refrigerant pressure to equalize between the evaporator and condenser and thus eliminates compressor startup under a load. It also eliminates contactor chatter, by cutting out if power is interrupted even for a very short duration.

## 2.3 Air Moving System

In order to pick up a large amount of heat from the air, a large volume of air must be forced through the finned tubes of the Heat siphon's refrigerant evaporator. A totally enclosed non ventilated permanent split capacitor single phase unit or three phase induction 3 phase unit fan motor with an internal thermal overload and sleeve bearings is used with a three blade fan. The fan motor is positioned with shaft up and has a full size plastic rain slinger disc installed on the shaft to prevent rain water from entering the motor through the upper bearing and possibly washing out bearing lubrication.

This motor is energized by the contactor in parallel with the refrigerant compressor on

the load side of the main contactor and on single phase units the fan motor requires its own capacitor.

The fan motor is grounded by a separate ground wire to the metal evaporator flange. Approximately 4000 to 5000 cubic feet per minute of air is pulled through the evaporator by this fan assembly. If the fan motor fails and air flow is stopped, then the compressor suction will pulled down the evaporator, dropping the suction pressure, increasing the compressor watts and most likely the unit will be shut off by the refrigerant low pressure switches.

After approximately 5 minutes the pressure switches will reset and the unit will restart and repeat the sequence cycling on/off. Heat output will be minimal.

Note: If the unit is place in a confined area where very little or no fresh air is provided then it will recycle the air and cycle on and off in the same manner perhaps with longer cycle time.

# 3.0 Sequence of NORMAL Operation

(What Happens Inside Heat Siphon)

Before the Heat Siphon® controls energize the compressor and fan motor, the entire refrigerant system is essentially a large static container of freon (liquid and gas). The liquid


freon will settle or condense at the coldest area in the unit. This would be the evaporator if the air has been colder than the water or the water heat exchanger if the water is colder. Both heat. exchangers will be at the same (system) pressure, UNLESS THE AIR TEMPERATURE AND WATER TEMPERATURE ARE CHANGING. This pressure can be measured at both refrigeration service ports (located inside the control box) an will always be the same for a given freon temperature (the air temperature will roughly equal the freon temperature unless the pool pump is running and the water is at a much higher or lower temperature.)

Refrigeration Pressure Heat Siphon® Shut Off
Temperature
(Fahrenheit) 40° F
80

System Pressure (psig) Suction 68 psig 84 101 121 143 168 196
Discharge 68 psig 84 101 121 143 168 196

When the compressor start up, it sucks gas from the evaporator side, which drops the suction pressure and causes' the liquid freon in the evaporator to change to gas producing a tremendous cooling effect. The fan moves a high volume of air over the outside of the evaporator tubes to provide a continuous supply of heat to evaporate more freon (without this air, evaporation would be limited and the suction pressure would drop off).

The compressor then squeezes the gas to a high pressure which causes it to get very hot and forces this hot gas into the condenser which raises the discharge pressure. Since the only restriction between the evaporator and the condenser is the expansion valve, this high pressure is felt from the compressor discharge to the valve. The pool water circulating pump forces pool. water over the outside of the condenser tubes which cools the hot gas down -and causes it to form a liquid again.

At the expansion valve the warm liquid freon backs up and is forced by the high pressure, though the valve to the low pressure evaporator side. This sudden drop in pressure chills the liquid freon back down and it begins evaporating again as it is sucked to the compressor inlet, thus completing the cycle.

Thus when operating, the unit's suction pressure is more or less a function of the air temperature and the discharge pressure is a function of the water temperature.

THE GRAPH, WHICH IS FOUND ON THE INSIDE OF THE CONTROL BOX DOOR OF EACH HEAT SIPHON@, shows expected suction pressure vs. air temperature and discharge pressure vs. water temperature.

Effects of Low Water or Air Flow

Lack of sufficient air flow will cause the suction pressure to drop well below these values and lack of sufficient water flow will cause the discharge pressure to climb well above the graph. In each case, the appropriate pressure switch will cut out until water or air flow is restored.

Since the switch breaks the 24 volt contactor coil supply, it shuts off the compressor and the system pressures begin to equalize and return to the static pressure within about five minutes. As soon as the switch reset pressure is reached, the switch closes, which is usually much less than five minutes. However the time delay relay prevents restarting for five minutes after the initial shutdown no matter how many times voltage is reapplied during the five minute delay. Thus a low air or water flow will cause the unit to cycle on briefly and off every five minutes.

# 4.0 Dealer Troubleshooting

***FOR QUALIFIED SERVICEMAN ONLY

READ THIS FIRST: This Troubleshooting Section ASSUMES that you have ALREADY COMPLETED ALL CHECKS IN "Owner Troubleshooting" SECTION (there is power, flow, clean filter, thermostat all the way up, etc.) *if YOU HAVE NOT, THEN STOP HERE AND GO TO "Owner Troubleshooting" Section in your Heat Siphon Owners Manual

The purpose of this section is to provide the trained serviceman or Heat Siphon (& dealer with troubleshooting steps to be taken AFTER "Owner Troubleshooting" has been followed and the problem still exists.

## For Servicing Dealer

WARNING: DO NOT ATTEMPT ANY OF THE REPAIR PROCEDURES IN THIS SECTION UNLESS YOU ARE FULLY QUALIFIED TO PERFORM THEM. IF YOU ARE A HOME OWNER OR POOL OWNER STOP READING HERE AND CALL YOUR DEALER

TROUBLE SHOOTING Procedures

Four basic Heat Siphon@ fault conditions are covered:

(1) IT DOES NOT START

(2) IT CYCLES ON & OFF

(3) IT RUNS BUT DOESN'T HEAT

(4) IT DOES NOT SHUT OFF

NOTE: STOP AND VERIFY WITH THE POOL OWNER THAT ALL FAULTS EXIST AND REPERFORM THE CHECKS BEFORE THE FOLLOWING STEPS:

## 4.1 If Unit Won't Start

(Fan and compressor not running)

ASSUMPTIONS: Adequate Line voltage & Water Flow to unit confirmed, Thermostat all the way up, and the air temperature above evaporator frost point 45OF-48OF

At this point the main contactor points are not closingPOSSIBLE CAUSES (check for each in order give):

1. Transformer not supplying 24 volts-Remove from circuit & check for 24 volts

SOLUTION: Replace transformer if no output.

2. Contactor is defective - apply 24 volt transformer output directly to contactor coil (eliminate all controls from circuit)

SOLUTION: Replaced contactor defective

I One of control switches is open-jump out each control until the open control is found

SOLUTION: Replace/adjust defective control

4. Loose wire in 24 VOLT circuit-check all connections

5. Loose wire in POWER line supply-check all connections

SOLUTION: Correct wiring

## 4.2 If Unit Cycles On & Off

ASSUMPTIONS.- Power & Water Flow to unit confirmed and cycling is NOT due to low air temperature and not due to low erratic water flow.

Cycling is caused by a self correcting fault condition somewhere along the 24 volt control circuit or atone of the control switches. The fault condition can. be either something outside the control which senses it or may be the control switch itself that is defective.

### General Guidelines on Cycling

A. IF THE UNIT IS COOLING THE AIR WHEN RUNNING THEN CYCLING MOST LIKELY IS A MALFUNCTIONING CONTROL SWITCH

B. IF FAN AND COMPRESSOR ARE BOTH RUNNING AND AIR IS NOT COOLER THEN CYCLING MOST LIKELY IS A RESULT OF A FREON LEAK CAUSING THE LOW PRESSURE SWITCH TO TRIP WHEN THE COMPRESSOR COMES ON

### Cycling at Regular Intervals

POSSIBLE CAUSES (check for each in order given):

1. TIME DELAY MALFUNCTION -jump out time delay and if cycling eliminated AND COOL AIR COMES OUT OF UNIT THEN:

SOLUTION: replace time delay

2. BAD CONTACTOR-contactor with weak coil or corroded contacts can cause the five minute time delay to cycle unit. jump out all controls, apply 24 volt transformer directly across contactor coils and watch for contactor chatter and arcing.

SOLUTION: Change contactor

3. FAN MOTOR FAILURE-Unit cycles off for five minutes then restarts briefly. Fan does not run while compressor will run briefly and shut off. As describe above cycling will occur due to the low pressure switch sensing the drop in suction pressure when the compressor comes on.

SOLUTION: replace fan motor

At this point a set of refrigerant gages should be put on the unit's service ports inside the control box and pressures should be checked against the graph on the door

4. EXPANSION VALVE BAD /BULB or CAPILLARY LEAK-if the expansion valve loses the gas charge in its sensing bulb, it will close shut and the unit's pressure switches will cycle it on and off. Discharge pressure will be very high and suction will drop during on cycle

SOLUTION: change expansion valve and dryer (SEE REFRIGERATION SYSTEM REPAIRS BELOW)

5. FREON LEAK IN SYSTEM-both suction and discharge pressures will be very low but just enough freon will remain to reset the low pressure switch thus unit will cycle on low

pressure. Usually a slow leak shows up first as low heat output without cycling. if the leak is large enough not enough freon will remain to reset the low pressure switch and the unit will not run at all. if cycling is due to a leak, it will usually be discovered at start-up after a lengthy shutdown period.

SOLUTION: FIND AND REPAIR LEAK

### Cycling at Irregular Intervals

POSSIBLE CAUSES (check for each in order given)

ASSUMPTIONS.- Power and adequate Air &

Water flow to unit confirmed

1. LOOSE WIRES ON POWER OR 24 VOLT

SOLUTION: Correct wiring

2. TIME DELAY MALFUNCTION-jump out time delay to see if cycling is eliminated

SOLUTION: replace time delay

3. WATER PRESSURE SWITCH CAPILLARY TUBE CLOGGED-jump out water pressure switch to see if cycling is eliminated

SOLUTION: clean/replace capillary

4. WATER PRESSURE SWITCH OUT OF ADJUSTMENT-If the pool water surface is several feet above the unit, then the static water pressure will cause the pressure sensing flow switch to remain closed even when the pool pump shuts off. This will result in on off cycling of the unit by repeated tripping of the high pressure switch

SOLUTION: adjust the water pressure switch

5. BAD THERMOSTAT-jump out thermostat to see if cycling is eliminated

SOLUTION: replace thermostat

6. OTHER CONTROL MALFUNCTIONS-jump out each control and check

SOLUTION: replace as necessary

7. FAN MOTOR RUN CAPACITOR FAILURE-fan will run slow or overheat or not run at all while compressor will run briefly and shut off. Cycling will occur due to the low pressure switch sensing the drop in suction pressure when the compressor comes on.

SOLUTION: check with known to be good capacitor / replace (see "checking capacitors with ohmmeter" in this section)

## 4.3 Unit Runs But Doesn't Heat

ASSUMPTIONS: Power and adequate Air &Water flow to unit confirmed Unit did heat pool or spa adequately before.

At this point a set of refrigerant gages should be put on the unit's service ports inside the control box and pressures should be checked against the graph on the door

POSSIBLE CAUSES (check for each in order given):

1. REFRIGERANT LEAK-both suction and discharge pressures are low, compressor

amp draw is below nameplate rating and compressor operation is relatively quiet with no unusual or rattling noises.

SOLUTION: Add freon to unit to see if suction and discharge pressures restore to normal. if so find and repair leak.

2. COMPRESSOR MALFUNCTION

## 4.4 Unit Won't Shut Off

POSSIBLE CAUSES (check for each in order given):

1. THERMOSTAT BULB OUT OF WELL -if the thermostat bulb is jarred and pulled from the well in the bottom of the condenser, it will sense air temperature instead of water and will normally keep the unit running until the water temperature causes the high pressure switch to trip out at approximately 114°F (if the air temperature is well above the thermostat setting the unit may never come on)

SOLUTION: replace bulb into tstat well

2. CONTACTOR POINTS WELDED SHUT-an uncommon fault, if the contactor has experienced severe chatter or some power line malfunction, it may fail in this mode causing the unit. to continue running regardless of any controls being opened.

SOLUTION: Disconnect all power and replace the contactor

# 5.0 Changing Out Refrigeration Parts

if it has been determined that a refrigeration system part is defective and requires replacement, then the following guideline MUST BE FOLLOWED to preserve warranty:

1. USE ONLY STA-BRITE #8 SILVER-SOLDER OR EQUIVALENT DO NOT USE TIN-LEAD OR OTHER LOW MELTING POINT, LOW STRENGTH PLUMBING SOLDERS.

NOTE: The Low & hi pressure switches, Thermo expansion valve, filter dryer, and service fittings have been silversoldered into the system to ease replacement by soldering.

2. USE ONLY FACTORY SUPPLIED REPLACEMENT PARTS. NON FACTORY PARTS WILL VOID THE WARRANTY

NOTE: The Thermo-Expansion Valve (TXV) is a special valve with a proprietary charge in the bulb and a factory set superheat manufactured specifically for Heat Siphon. Standard replacement valves WILL NOT WORK PROPERLY AND WILL VOID THE WARRANTY

3. DOUBLE OR TRIPLE EVACUATE THE SYSTEM BEFORE RECHARGING WITH FREON

4. CHANGE THE FILTER DRYER ANY TIME SYSTEM IS BREACHED

5. USE AN ELECTRONIC SCALE OR CHAR61NG FLASK OR WEIGHT SCALE TO ACCURATELY MEASURE FREON WHEN RECHARGING SYSTEM

# Additional Technical Data

The purpose of this section is to provide miscellaneous additional technical info on specific models and special repair procedures which maybe helpful or required in some situations during troubleshooting. It is intended to supplement the basic information contained elsewhere in this manual.

Compressor Troubleshooting

(Reprinted with permission from COPELAND Corp. Electrical Handbook) The following section contains excerpts from the compressor manufacturer, Copeland Corp. Electrical Handbook revised July , 1983, copyright 1983. United States ThermoAmp Inc. thanks Copeland for permitting its use.

## if Compressor Won't Run

If a motor compressor fails to start and run properly it is important that the compressor be tested to determine its condition. It is possible that external electrical components may be defective, the protector may be open, a safety device may be tripped, or other conditions may be preventing compressor operating. If the motor compressor is not the source of malfunction, replacing the compressor will only result in the unnecessary expenditure of time and money, while the basic problem remains.

1. if there is no voltage at the compressor terminals follow the wiring diagram and check back from the compressor to the power supply to find where the circuit is interrupted.

Check the controls to see that the contact points are closed. If a contactor is used check to see if the contacts are closed. Check for a blown fuse, open disconnect switch or loose connections.

2. if power is available at the compressor terminals, and the compressor does not run, check the voltage at the compressor terminals while attempting to start the compressor,

if the voltage is below 90% of the nameplate voltage, it is possible that the motor my not develop sufficient torque to start. check to determine if wire sizes are adequate, electrical connections are loose, the circuit overloaded, or if the power supply is adequate.

3. On units with single phase a PCS motors (All single phase Heat Siphon® models use psc motors), the suction and discharge pressures must be equalized before starting because of the low starting torque of the motor. Any change in the refrigerant metering device (ALL HEAT SIPHONS USE AN EXTERNALLY EQUALIZED THERMOEXPANSION VALVE WITH A bleed AND a factory equipped DRYER) the addition of a drier or other changes in the system may delay pressure equalization and create starting difficulties. If PSC motor starting problems are encountered, the addition of a capacitor start kit (or FTC device approved by Copeland) is recommended.

4. on single phase compressors, a defective capacitor or relay (not used on Heat Siphon's) may prevent starting. Any capacitor found to be bulging, leaking or damaged should be replaced.

5. if the correct voltage is available at the compressor terminals, and no current is drawn, remove all wires fro the terminals, and no current is drawn , remove all wires from the terminals and check for continuity through the motor windings:

ON SINGLE PHASE COMPRESSORS-Check for continuity from terminal C to R and C to