APR PDE Series

Dehumidification System With Power Return

Installation and Operation Reference Manual

APR Corporation

Table of Contents

Shipping Inspection

Upon receipt of shipment at the job site, carefully check the shipment against the bill of lading. Verify that all units have been received in operating condition. Check the exterior for damage and verify that all internal components and coils have not broken loose during shipping. Assure that the carrier makes proper notation of any shortages or damage on all copies of the freight bill and that he completes a carrier inspection Report. Concealed damage not discovered during unloading must be reported to the carrier within 15 days of receipt of shipment. It is the responsibility of the purchaser to file all necessary claims with the carrier. Notify APR Corporation Customer Service of all damage within fifteen (15) days of shipment.

Introduction

This Installation and Operation Reference Manual is applicable to APR PDE Series Units with optional power return.

The APR PDE Series Unit is a state of the art dehumidification and heat recovery system designed to provide complete environmental control of enclosed pool and spa areas (Natatorium). Heat recovered from the dehumidification process is used to heat pool water and for space heating. Excess heat is rejected outside the pool area.

The PDE Series Unit contains the following major components:

- ***Compressor:*** A heavy duty, six cylinder, serviceable compressor with removable crankcase heater and optional three stage unloading
- ***Suction Gas Accumulator***
- ***Hot Gas Discharge Muffler***
- ***Pool Water Condenser/Heater:*** A high efficiency shell and tube heat exchanger with carbon steel jacket and cupronickel inner tube assembly
- ***Air Cooled Condenser/Air Re-heat Coil:*** A high efficiency enhanced tube and fin condenser
- ***Evaporator:*** A high efficiency, multi-circuited enhanced tube and fin evaporator
- ***Thermostatic Expansion Valves:*** On evaporator circuits to control refrigeration system
- ***Sight Glass***
- ***Solenoid Valve:*** For pump down
- ***Liquid Line Filter:*** With replaceable core
- ***Auxiliary Air Heating Coil:*** A high efficiency enhanced tube and fin coil controlled by a 3-way modulating valve
- ***Optional Cooling Tower Condenser:*** A high efficiency carbon steel shell and copper tube condenser controlled by a 3-way modulating valve
- ***Supply and Return Air Blowers:*** Blowers driven by totally enclosed fan cooled induction motors
- ***Mixing Box:*** A 3 damper mixing box for exhaust, outside and recirculated air

Introduction (Con't)

- ✦ ***Optional Remote Air/Water Cooled Condenser***
- ✦ ***Air Filters:*** Four 2" throwaway filters each for the evaporator and the condenser
- ✦ ***Controls:*** Controls on PDE Series Units are integrated microprocessor systems isolated from the air stream in a separate compartment on the unit

The following setpoints are provided and may be programmed on the DDC Control panel:

- Space Temperature
- Space Relative Humidity
- Pool Water Temperature
- Occupied/Unoccupied Damper Position Schedule

The following readouts are available:

- Space Temperature
- Space Relative Humidity
- Pool Water Temperature
- Outside Temperature
- Outside Relative Humidity
- Compressor Circuit Fault
- Compressor Pump Down
- Time of Day/Day of Week
- Heat mode
- Dehumidification Mode
- Auxiliary Heating Mode
- Pool Water Heating
- Economizer On
- Humidity Override (Wall Humidistat Override)

Blower motors and compressors are controlled by motor starters with three leg overload protection. Overloads are adjustable trip with push button resets.

See *APR Direct Digital Controller: Operation and Manual* for more information.

Handling and Storage

Upon arrival of equipment at the job site, immediately store units on their shipping pallets in their original shipping material in a clean, dry area. Store units in an upright position at all times.

⚠ CAUTION

To avoid equipment damage while moving, DO NOT tilt or drop Units.

To avoid equipment damage during storage, DO NOT Stack Units. DO NOT store PDE Series Units in corrosive environments or in locations subject to extremes of temperature or humidity. Corrosive conditions and high temperature or humidity during storage can significantly reduce performance, reliability and service life.

DO NOT Puncture cardboard on the air coil side of the equipment.

To avoid bodily harm, DO NOT attempt to move or lift PDE Series Units without appropriate equipment such as dollies, hoists, hand trucks or fork lifts. (See Figure 1 - page 5).

Handling and Storage (Con't)

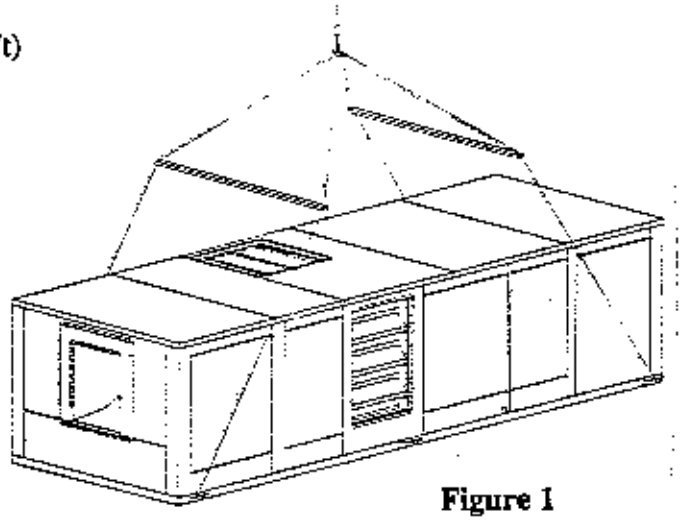

Figure 1

Cover Unit while on the job site. Cap open ends of pipes . In areas where painting, plastering or the spraying of fireproof material has not been completed, all due precautions must be taken to avoid physical damage to the unit and contamination by foreign material. **Physical damage and contamination may prevent proper start-up and may result in costly equipment clean-up.**

Pre-Installation

An *Installation and Operation Reference Manual* is provided for the PDE Series Unit. Before unit start-up, read all manuals and become familiar with the unit and its operation.

Prepare for PDE Series Unit installation as follows.

1. Select an installation site which allows adequate clearance for maintenance and servicing of the unit. A minimum of 2 feet of clearance is required on all four sides of the unit.

2. Examine all pipes, fittings, valves and components before installing the system. Remove any dirt found on or in these components and assure that all components are securely fitted.

3. Properly size and install supply and return ductwork as necessary. Insulate all ductwork which must be run through unconditioned areas. Seal all duct joints to prevent air leakage. Install according to the latest ASHRAE standards.

4. Locate supply registers along outside walls. Place supply registers to blanket all areas of glass and areas subject to condensation. DO NOT direct supply air over pool surface.

5. Locate return air grilles as high as possible within the pool and spa area. Do not allow return air to drop below 70° F. Provision should be made to drain any condensate which might occur.

Pool Piping

Referring to Figure 2 below, pipe Pool Water according to the following recommendations:

1. Install a pool filter pump designed for high volume circulation of water at low pressure. Size the pump to accommodate the pressure drop through valves, filters and pool water heat exchanger in the PDE Series Unit and any other head losses from axillary equipment through which pool water must flow. Consult with design engineer to determine total losses for installed auxiliary equipment.

2. Install a fine mesh strainer in the suction line of the pump with a compound gauge to indicate a plugged strainer.

3. Install corrosion resistant, full flow, ball, butterfly or gate valves to allow proper servicing of pool piping components.

4. Connect the pump as shown in Figure 2 below. The return line from the PDE Series Unit is connected to the pool return line upstream of the pool heater.

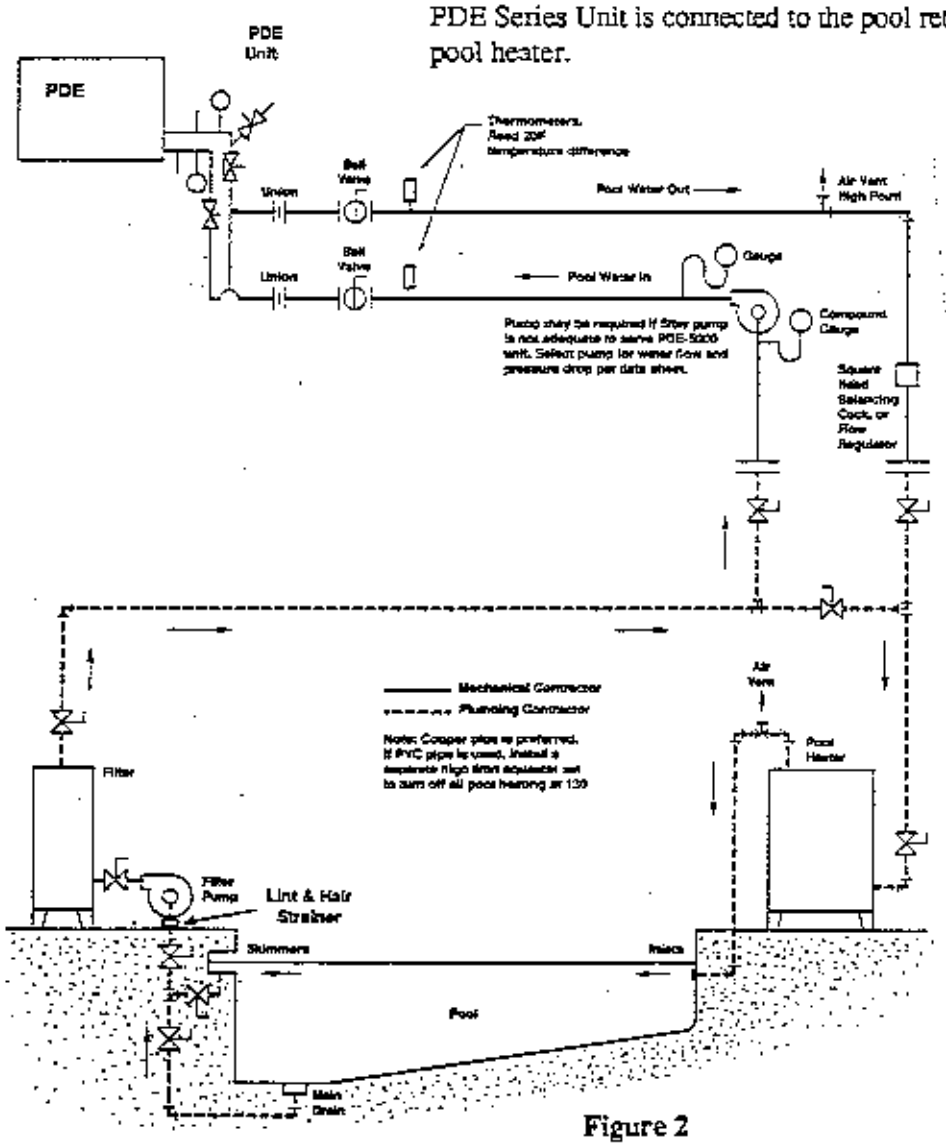

Figure 2

Installation of the PDE Series Unit and all associated components, parts and accessories that make up the installation shall be in accordance with the regulations of ALL Authorities having jurisdiction and MUST conform to all applicable Code. It is the responsibility of the Installing Contractor to determine and comply with ALL applicable Codes and Regulations.

Connecting Ductwork

Install ductwork according to current ASHRAE guidelines. Connect ductwork to the PDE Series Unit with approved, flexible connectors.

Condensate Piping

Pipe the unit condensate line as follows:

1. Attach the condensate drain to the connection tapping on the outside of the equipment.

2. Connect the unit condensate drain to the building condensate drain with a flexible, non-pressure rated hose. Ensure that the hose is without kinks to maintain an unobstructed flow of condensate from the unit to the drain. Horizontal runs must be pitched at 1 inch per 10 feet of drain line.

3. Install a condensate trap in the drain line following approved practices as shown in Figure 3 below. Design the length of the trap based upon the amount of external static pressure anticipated. As a rule, 1" of trap is required for each inch of negative pressure on the unit.

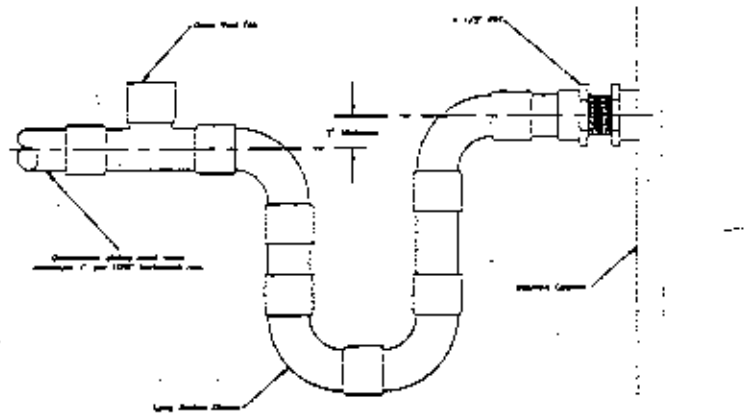

Figure 3

4. Provide a means to flush or blow-out the condensate line.

5. Provide a vent in the drain line located after the trap in the direction of condensate flow.

6. Install each unit with its own condensate trap and connection to the drain line when two or more units are installed..

7. Where codes permit, condensate may be returned to the pool. A condensate pump may be required for this purpose.

Pool Wer Heating Piping

PDE Series Units are equipped with copper swear unions for water supply and water return. PVC or copper pipe can be used for pool water supply and discharge piping to the PDE Unit.

NOTE: DO NOT use PVC pipe for spa and domestic hot water applications. Use copper or iron pipe for domestic hot water applications and copper or CPVC for spa applications. When CPVC is used on the return piping, install a high limit aquastat on the return piping set at 130° F to prevent damage to the pipe should water flow be interrupted.
The pool heat exchanger is controlled by an internal aquastat which reads the temperature of the water from the pool, and controls the operation of the pool heat exchanger to heat the pool water as required.

Install pool water heater piping according to the following recommendations.

1. Install pressure and vacuum gauges on the circulating pump to assure proper pump operation and to detect leaks in the piping system.

2. Install full flow gate valves or ball valves on the inlet line for total water shut off.

3. Install a bypass valve between the pool water supply (on the line from the filter to the PDE) and return (on the line from the PDE to the Pool).

4. Install a ball valve on the outlet piping.

5. Insulate hot water piping to and from the unit to prevent unnecessary heat loss and to prevent accidental burns.

6. Install a priming tee on the pump water inlet piping.

7. Use a back-up wrench when tightening or loosening union to hold the ground joint.

8. Avoid high pipe runs and loose piping joints to avoid knocking and leakage in the piping line.

9. Eliminate all air leaks in the pump suction to assure proper water circulation.

10 Flush out and leak test all piping prior to start up. Failure to properly flush the system is the primary cause of incidental damage to PDE systems.

Refrigerant Piping

Refrigerant piping is only necessary on split system PDE Units or when remote condensers are installed. Refrigerant piping is provided by the installing contractor. Referring to Figures 4 (Pages 9), pipe air cooled condenser or split system according to proven refrigeration practices.

Refrigerant Piping (con't)

1. When copper piping is installed, sil-phos, phos-copper or silver solder must be used on all joints. **The use of soft solder may void equipment warranty.**

2. When brazing piping, purge the piping with inert gas such as dry nitrogen to prevent oxidation.

3. Install an oil trap at the base of all hot gas risers. An additional trap is required for every 8.0 feet of rise. (See Figure 4 below.)

4. Pitch all refrigerant lines 1/2" per 10.0 feet of run in the direction of refrigerant flow.

5. Assure that the horizontal dimension of the trap is as small as possible.

6. Add 3 fluid ounces of Type 5 GS refrigerant oil for each 10.0 feet of refrigerant line over a total of 35.0 feet.

7. Insulate all refrigerant lines.

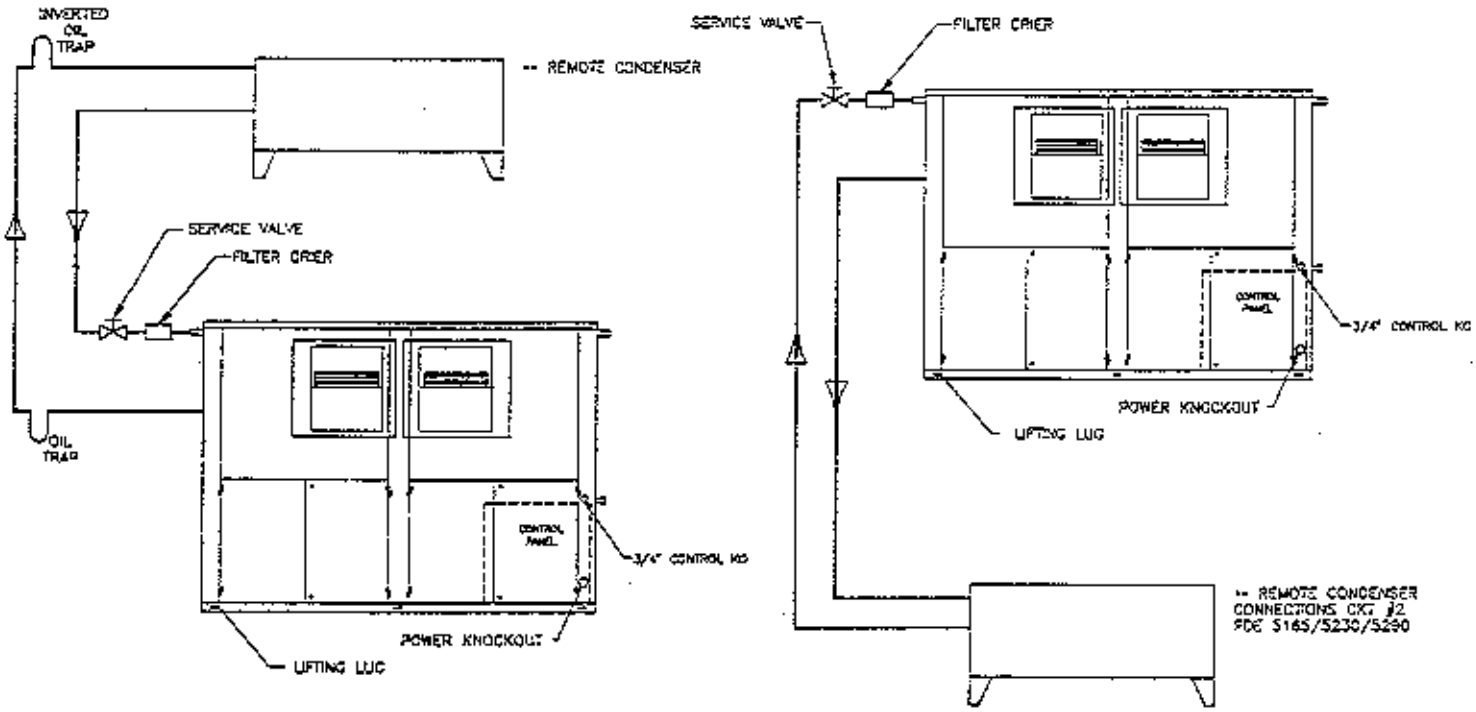

Figure 4

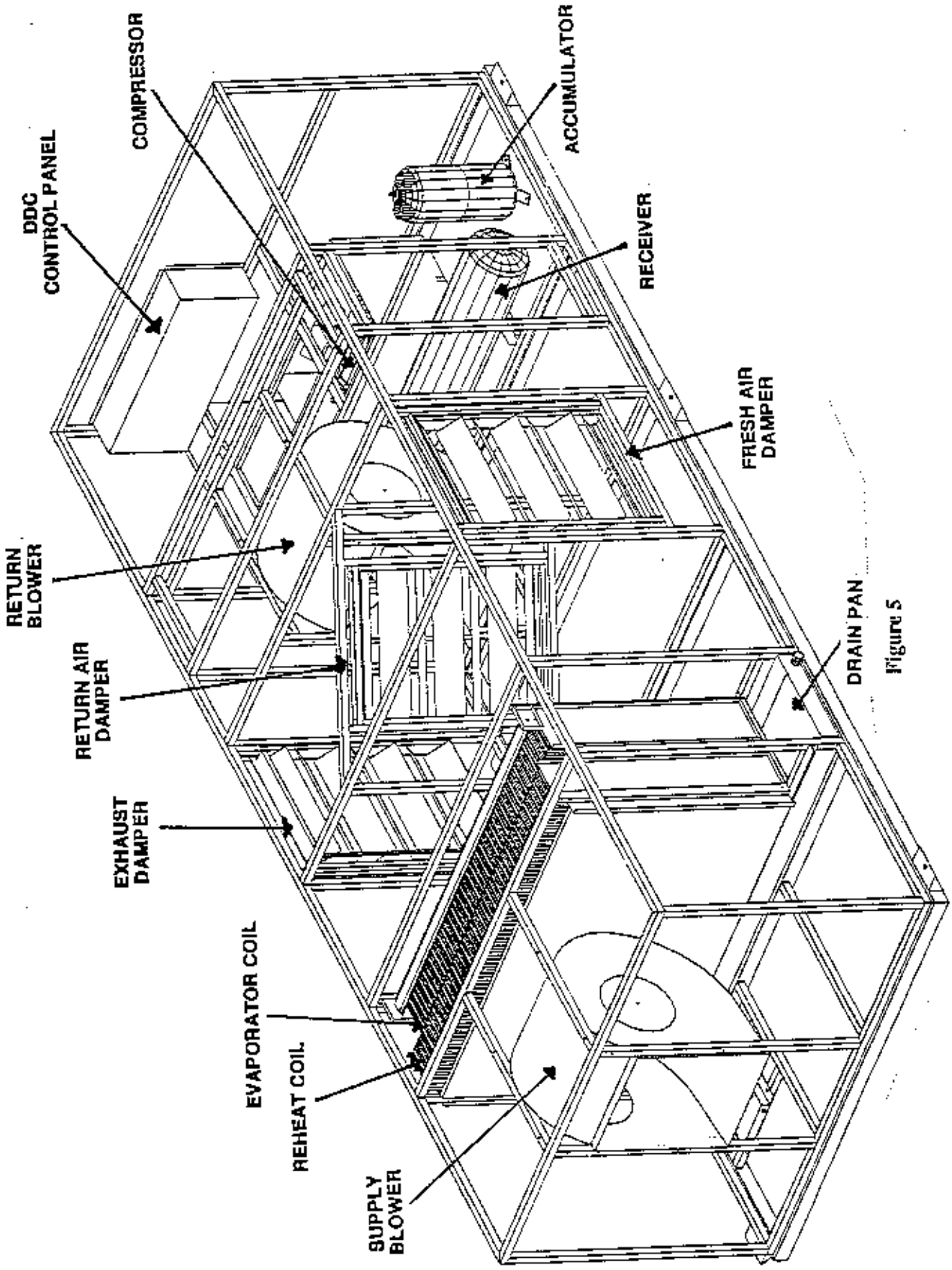
COMPRESSOR
ACCUMULATOR
DDC CONTROL PANEL
RECEIVER
FRESH AIR DAMPER
RETURN BLOWER
RETURN AIR DAMPER
DRAIN PAN
EXHAUST DAMPER
EVAPORATOR COIL
REHEAT COIL
SUPPLY BLOWER

Figure 5

Field Wiring

⚠ WARNING

To avoid possible injury or death due to electrical shock, open the power supply disconnect switch and secure it in an open position during installation.

CAUTION: Use only copper conductors for field installed electrical wiring. Unit terminals are not designed to accept other types of conductors.

All field installed wiring, including electrical ground, must comply with the National Electrical Code as well as all applicable local codes. In addition, all field wiring must conform to Class II temperature limitations described in the NEC.

Refer to the unit wiring diagrams included with the submittal drawing for fuse sizes and a schematic of the field connections which must be made by the installing (or electrical) contractor.

All final electrical connections must be made with a length of flexible conduit to minimize vibration and sound transmission to the building.

Install field wiring to the room thermostat, humidistat, smoke detector, pool heater, system alarm and all sensors including the outside sensor and the inside wall sensor. Refer to the unit wiring diagrams to ensure proper electrical hookup.

Main Power Wiring

Install the power supply which provides power to the compressors, the main controls and the blowers. Equip the power supply with a correctly sized fused disconnect.

Operating Conditions

The PDE Series Unit is designed for indoor installation.

A voltage variation of +/- 10% of nameplate utilization voltage is acceptable. Three-phase system imbalance should not be allowed to exceed 2%.

Control Sensors

The PDE is shipped with the following factory installed control sensors:

- ✦ *Space dry bulb temperature sensor*
- ✦ *Space relative humidity sensor*
- ✦ *Evaporator air dry bulb temperature sensor*
- ✦ *Pool water temperature sensor*

The following control sensors must be field installed:

- ✦ *Outside air dry bulb temperature sensor* To be installed in the fresh air duct

Control Sensors (Con't)

- ✦ ***Outside air relative humidity sensor:*** To be installed in the fresh air duct
- ✦ ***Wall thermostat***
- ✦ ***Wall humidistat***

All operating and logic controls are factory installed and wired into the PDE Series Unit. Controls automatically operate dehumidification, space and pool water heating, and heat recovery based on desired conditions.

The PDE Unit is designed to operate under the control of a DDC system. However, in the event that computer control is not desirable or not possible, the PDE can operate in a manual mode. To facilitate both modes of operation the PDE Unit is supplied with both space temperature and humidity sensors and wall mount thermostat and humidistat.

Thermostat and Humidistat

The thermostat provided has three stage heating and single stage cooling. The first and second heating stages control the first and second stage heating operation of the PDE compressor. The third stage (optional) controls auxiliary heat and boiler functions. The cooling stage controls the liquid line solenoid and the air/water cooled condenser.

Install the thermostat and humidistat (modules) following the recommendations below:

1. Locate modules within the pool area and near a return grille for the dehumidification equipment
2. Locate modules away from drafts, heat discharge or direct sunlight
3. Install modules on an insulated wall and parallel with the floor
4. Install modules approximately 5 feet above the floor.
5. Set the adjustable heat anticipators to the longest setting.
6. Set thermostat to maintain space temperature approximately 2° F above desired pool water temperature. For pool water temperatures greater than 86° F, set thermostat to maintain space temperature at the desired pool temperature.
7. Set relative humidity to maintain space between 55% and 60%

Pool/Spa Heater Interlock

PDE Series units have normally open (N.O.), interlocking, dry contacts for pool/spa pump control which are wired to terminals #10 and #11 on the control terminal strip. These contacts are closed based on compressor operation. Provide an external power source for these controls.

Auxiliary Heat Interlock

PDE Series Units have dry contacts for auxiliary hot water pump control which are wired to terminals #12 and #13 on the control terminal strip. Provide an external power source for these controls.

Remote Air Cooled Condenser (Optional)

The PDE Series Unit may be supplied with an optional remote air cooled condenser to reject excess heat outside during periods of mild weather or other timers when pool heat and space heat is not required. The remote air cooled condenser utilizes a combination of fan cycling control and fan speed control to reject excess heat. Interlock wiring must be provided between the PDE and the remote condenser.

The remote condenser is energized when space heat requirements are satisfied and when either the humidistat calls for dehumidification or the room thermostat is set to cooling. Pressure switches must be set to the pressures shown in the chart below.

No. Condenser Fans	ON/DIF Settings P.S. 1	ON/DIF Settings P.S. 2
1	N/A	N/A
2	260/40	N/A
3	260/40 (1 Fan)	270/70 (1 Fan)
4	260/40 (1 Fan)	270/70 (2 Fans)

Before Start-up

Before Start-up, complete the following:

1. Completely install the unit
2. Install all piping and strainers. ***CAUTION: Flush out system thoroughly before making final water connections***
3. Open service valves on refrigerant receivers. Valves open counterclockwise. Replace caps on receivers. (NOTE: refrigerant is pumped into liquid receivers at the factory prior to shipping.)
4. Clean and flush each unit. Refill the unit and bleed all air from the system.
5. Check piping and components for leaks.
6. Install and check all ductwork
7. Check power and control wiring for proper operation. Energize power to crankcase heaters for 24 hours before attempting to operate system.
8. Install clean fresh air and return air filters
9. Adjust dampers. Set the fresh air damper to the minimum setting required by code. Set damper linkages for proper operation.
10. Bring pool water to 5° below operating temperature using the auxiliary pool heater..
11. Prime and test all pumps attached to the system
12. Adjust aquastat to lowest settings on the differential adjustment
13. Check rotation of blower by starting and stopping fan motor. Rotation may be changed by switching any two of the three motor leads from the magnetic starter to the motor.
14. Check current balance of all motors including the condenser motors. Verify that current balance between any two legs of each motor does not exceed 2%.
15. If equipment must be started when the room is below operating conditions, start the system in heating mode. If equipment must be started when the room is above operating temperatures, start the system in cooling mode.
16. Place manual override switch (located on the main control panel) in the BYPASS position.

Start-up Checklist

When the installation is complete and the system is cleaned and flushed, check out the system using the following checklist.

To avoid start-up delays, all trades involved in the equipment installation should be represented during start-up including the heating contractor, a certified air balancer, the electrical contractor, the plumbing contractor, the swimming pool contractor and the general contractor.

Electrical/Controls Checkout

- ☐ Wiring is properly installed and grounded. Installation complies with the National Electric Code. All conductors are copper.
- ☐ All equipment is protected by time delay fuses or ACR type circuit breakers. Conductors are properly sized to hold voltage drop to below 2%.
- ☐ All connections in the electrical control panel are tight.
- ☐ The control panel is wired according to the wiring schematic. All control connections are tight.
- ☐ System controls are functioning, calibrated and sequencing is correct.
- ☐ Power voltage at the disconnect switch is within the range shown on the nameplate (+/- 10%).

Unit Checkout

- ☐ Unit is installed completely level and within ambient space. All doors are accessible
- ☐ Blower belts are adjusted to the proper tension. Fan and motor sheaves are securely tightened.
- ☐ All braces and straps are removed from the unit
- ☐ All construction debris is removed from the blower compartment and the condensate pan.
- ☐ All blower fans rotate in the correct direction.
- ☐ Refrigerant receiver valves are open.
- ☐ All refrigerant gauges, temperature probes and amp probes on the main compressor terminal are correctly installed.
- ☐ All filters are installed and are clean.
- ☐ Temperature probes are installed at the following points:
  - Hot gas discharge (at compressor)
  - Liquid line entering thermostatic expansion valve
  - Suction line near the TXV sensing bulb
  - Entering and leaving pool water lines
  - Entering and leaving space water lines (When installed)
  - Entering and leaving DHW lines (When installed)

Start-up Instructions

General Start-up

1. Complete *General Unit Data* on Start-up data Sheet (Page 19)
2. Pump down unit by turning off switch S-4.
3. Verify that both fans run and that the control circuit is energized.
4. Open all valves.
5. Turn on circulating pump and fill system with pool water. Repair leaks immediately.
6. Verify that the unit is operating in full recirculation mode and that fresh air and exhaust dampers are fully closed. (If dampers are not fully closed, adjust dry bulb to maximum position.)
7. Remove access panel and verify that recirculation dampers are fully open. (If dampers are not open, adjust damper linkage before proceeding.)
8. Check all registers and verify proper air distribution. Adjust all grilles and registers and assure that all grilles and registers are unobstructed.
9. Have external static pressure (ESP) and CFM measured by a Certified Air Balancer.
10. Measure and report on Start-up Data Sheet operating voltage, amperage, and fan and motor RPM.

Heating Stage I

1. Replace all panels. Record pool starting data.
2. Set thermostat to heating mode. Test in heating mode for at least fifteen (15) minutes.
3. Set system switch to ON. (If power has been off to the unit, press RESET). Set blower switch to ON. Set pumpdown switch to ON. When the compressor starts, set the thermostat and humidistat to desired room temperature. Set pool aquastat to a temperature above pool temperature to force a call for pool heat.
4. Assure that power is within range shown on nameplate (+/- 10%).
5. Assure that amperage draw on the compressor(s) and all pumps matches nameplate.
6. Assure that refrigerant pressure is within operating range.
7. Complete *Heating Stage I Data* on Start-up Data Sheet.

Start-up Instructions (Con't)

Heating Stage II

1. Set system switch to ON. Turn pool aquastat to a temperature below pool water to turn off pool heater. When the compressor starts, set the thermostat until stage II heating is activated. Test stage II heating for 15 minutes

2. Complete *Heating Stage II Data* on Start-up Data Sheet.

Auxiliary Heating - Stage III

1. Set system switch to ON. When the compressor starts, set the thermostat and humidistat to maximum. Set aquastat to 80° F. Test stage III auxiliary heating for 15 minutes.

2. Verify that the auxiliary air heating coil is activated and that the boiler turns on.

3. Complete *Auxiliary Heat-Stage III* on Start-up Data Sheet (Page 20).

Cooling Stage

1. Set thermostat to 5° F below actual room temperature (but not below 70° F). Set aquastat 2° below actual pool temperature. Set humidistat to its lowest setting. Test in cooling mode for at least 15 minutes.

2. Verify that the remote condenser (optional) functions when pool heat is satisfied.

3. Complete *Cooling Stage Data* on Start-up Data Sheet.

Pool Heating

1. Set Aquastat to maximum to activate pool heater. Adjust water flow rate for the correct temperature difference between supply and return water (20°) and readjust flow rate when operating temperature is reached. Test pool heat for at least 30 minutes.

2. Check circulating pump gauges for pressure and vacuum. Verify correct water flow rate. Check pumps for cavitation.

3. Complete *Pool Heat Data* on Start-up Data Sheet.

Environment Data

1. Record *Environment Data* on Start-up Data Sheet.

2. Use this sheet as a guide for troubleshooting. Warranty will commence when one copy of the data sheet is returned with the warranty registration to APR Corporation, 7300 44th St., Oklahoma City, OK. 73179.

Start-up Notes

1. To avoid system freeze-up during a winter start-up, complete all phases of the installation before start-up. Room temperature must be 70° F.

2. The third stage of the thermostat energizes heat relay (HR-2) and initiates an N.O. dry contact to activate the auxiliary heating circuit and the boiler.

⚠ WARNING

To avoid invalidation of warranty and possible equipment damage, DO NOT use equipment to heat or cool pool/spa area when area is under construction. DO NOT operate with dirty filters. DO NOT operate without filters.

If unit fails to operate, conduct the following checks:

1. **Check the voltage and current.** They must comply with the electrical specifications described on the nameplate.

2. **Look for wiring errors.** Check for loose terminal screws where wire connections have been made on both the line and low-voltage terminal boards.

3. **Check for dirty filters.** A clogged filter may cause safety cutouts to stop unit operation or coil damage.

4. **Check the supply and return piping.** Piping must be properly connected to the inlet and outlet connections on the unit.

5. **Check the Fan.** If the fan fails to operate, verify that the blower rotates freely and that the fan sheaths are firmly tightened. Verify that the fan operates in both heating and cooling mode.

6. If equipment still fails to operate, consult Troubleshooting Guide (Pages 25-32) before consulting authorized service representative.

⚠ WARNING

High voltage is present in some areas of the electrical panel. Exercise caution when working with energized equipment.

To prevent injury or death due to electrical shock or contract with moving parts, open unit disconnect switch before servicing unit.

PDE Series Start-up Data Sheet

Complete one sheet for each unit installed

PROJECT DATA

Project Name: _____ Sales Order No: _____

Address: _____ Model No: _____

Address: _____ Serial No: _____

City/St/Zip: _____ Contractor: _____

Sales Rep: _____ City/St/Zip: _____

Install Date: _____ Test Date: _____ Phone: _____ Fax: _____

GENERATION DATA

❑ Yes ❑ No Crank case heater is installed?

❑ Yes ❑ No DDC is installed?

❑ Yes ❑ No Domestic hot water is installed?

❑ Yes ❑ No Pool heating is required?

❑ Yes ❑ No Spa heating is required?

❑ Yes ❑ No Ambient temp may fall below 50°?

❑ Yes ❑ No Drain is properly trapped and pitched?

❑ Yes ❑ No Sheave screws are tight?

❑ Yes ❑ No Fan belts are adjusted?

❑ Yes ❑ No Unit has been flushed?

❑ Yes ❑ No Filters are installed & clean?

❑ Yes ❑ No Wiring conforms to all codes?

❑ Yes ❑ No Ducting conforms to ASHRAE

❑ Yes ❑ No Motor current is in balance?

❑ Yes ❑ No Volts & amps conform to nameplate?

❑ Yes ❑ No Unit is properly grounded?

Unit Location: _____

Required Wet Bulb: _____ Dry Bulb: _____

Required RH: _____ Req. Pool Temp: _____

DUCTWORK

Duct Material: _____

Return Duct Size: _____

Supply Duct Size: _____

System EPS (Wet Coil): _____

Air Discharge CFM: _____

Fresh Air CFM: _____

❑ Yes ❑ No Condensate drains are installed?

❑ Yes ❑ No Ducts are insulated?

❑ Yes ❑ No Ducts are lined?

❑ Yes ❑ No Grilles located as recommended?

❑ Yes ❑ No Grilles & Vents are adjusted?

❑ Yes ❑ No Dampers are adjusted?

HEATING STG I

Test Duration: _____ Volts: _____ Amps: _____ Watts: _____

Thermostat Start Temp: _____ End Temp: _____ Superheat: _____

Humidistat Start RH: _____ End RH: _____ Subcooling: _____

Actual End WB: _____ End DB: _____ Suction Pressure: _____

Actual End RH: _____ Discharge Pressure: _____

Blower Speed: _____ Blower Amps: _____ Suction Temperature: _____

Air Temp In: _____ Air Out: _____ Saturation Temperature: _____

Differential: _____ Condensing Temperature: _____

Sight Glass: ❑ 1/4 ❑ 1/2 ❑ 3/4 ❑ Full Liquid Temperature:

HEATING STG II

Test Duration: _____ Volts: _____ Amps: _____ Watts: _____

Thermostat Start Temp: _____ End Temp: _____ Superheat: _____

Humidistat Start RH: _____ End RH: _____ Subcooling: _____

Actual End WB: _____ End DB: _____ Suction Pressure: _____

Actual End RH: _____ Discharge Pressure: _____

Blower Speed: _____ Suction Temperature: _____

Air Temp In: _____ Air Out: _____ Saturation Temperature: _____

Differential: _____ Condensing Temperature: _____

Sight Glass: ❑ 1/4 ❑ 1/2 ❑ 3/4 ❑ Full Liquid Temperature:

PDE-145 Start-up Data Sheet

AUXILIARY HEATING

Test Duration: _____ Volts: _____ Amps: _____ Watts: _____

Thermostat Start Temp: _____ End Temp: _____ Superheat: _____

Humidistat Start RH: _____ End RH: _____ Subcooling: _____

Actual End WB: _____ End DB: _____ Suction Pressure: _____

Actual End RH: _____ Discharge Pressure: _____

Blower Speed: _____ Blower Amps: _____ Suction Temperature: _____

Air Temp In: _____ Air Out: _____ Saturation Temperature: _____

Differential: _____ Condensing Temperature: _____

Water Temp In: _____ Water Out: _____ Liquid Temperature: _____

Differential: _____ Sight Glass: ☐ 1/4 ☐ 1/2 ☐ 3/4 ☐ Full

☐ Yes ☐ No Boiler operates upon demand?

COOLING SYSTEM

Test Duration: _____ Volts: _____ Amps: _____ Watts: _____

Thermostat Start Temp: _____ End Temp: _____ Superheat: _____

Humidistat Start RH: _____ End RH: _____ Subcooling: _____

Actual End WB: _____ End DB: _____ Suction Pressure: _____

Actual End RH: _____ Discharge Pressure: _____

Blower Speed: _____ Suction Temperature: _____

Air Temp In: _____ Air Out: _____ Saturation Temperature: _____

Differential: _____ Condensing Temperature: _____

Water Temp In: _____ Water Out: _____ Liquid Temperature: _____

Differential: _____ Sight Glass: ☐ 1/4 ☐ 1/2 ☐ 3/4 ☐ Full

☐ Yes ☐ No Water cooled condenser operates? Aquastat Setting: Pool Temp:

HYDRONIC HEATING

Test Duration: Number Flow Valves: _____ Manufacturer: _____

Pool Aquastat Setting: _____ Spa Setting: _____ Control Valve Type: _____ Manufacturer: _____

Pool Start Temp: _____ End Temp: _____ Length of Field Piping Run: _____

Spa Start Temp: _____ End Temp: _____ Piping Type: _____ Size: _____

Pump Discharge PSIG: _____ Water Source: _____ Hardness: _____

Pump Return PSIG: _____ Water PH: _____ Chlorine Level: _____

Vertical lift (ft): _____ Pool Pump Model: _____ Manufacturer: _____

Condenser Water Temp In: _____ Pool Pump HP: _____ Pool Pump GPM: _____

Condenser Water Temp Out: _____ ☐ Yes ☐ No Field piping is insulated?

Differential: _____ ☐ Yes ☐ No Strainers are installed?

☐ Yes ☐ No Circulation pump operates?

ENVIRONMENT

Outdoor Wet Bulb: Dry Bulb: ☐ Yes ☐ No Manual contol switch is reset to DDC?

Outdoor RH: ☐ Yes ☐ No DDC control sequences are tested?

☐ Yes ☐ No Thermostat, Aquastat, Humidistat are returned to normal operating settings ☐ Yes ☐ No All sensors verified and calibrated?

☐ Yes ☐ No Additional test results/comments are attached

All testing has been completed and results represent actual testing conditions.

Authorized Signature: _____

Title: _____

Company: Date:

Maintenance and Operation

Manual Fan On/Auto Switch

The PDE Unit is equipped with a Fan ON/Auto switch (S-2) located on the side of the PDE electrical control panel.

When the fan switch is in AUTO position, the fan will run only when the compressor is running. **CAUTION: Only set switch in AUTO position when the system is in DDC Bypass mode.**

When the fan switch is in ON position, power is supplied to the fan relay. N.O. fan relay contacts close to activate the fan motor. The fan will run continuously when the fan switch is ON.

Operating Pressures and Temperatures

The following pressures are based on 82° F air at 50% RH and may be used as a guide. Since indoor temperature and RH may vary, actual readings may be slightly different. Refer to the Trouble Shooting Guide for exceptional deviations from this table.

	Stage 1 Heat w/ Pool Heat	Stage 1 Heat w/o Pool heat
Suction Pressure	60-65 PSIG	60-65 PSIG
Discharge Pressure	200-265 PSIG	225-275 PSIG
Discharge Temperature	160° - 180° F	180° - 200° F
Liquid Temperature	+90° F	100° - 100° F

Condenser Operation

The PDE Unit is equipped with a pool heating condenser and an optional air or water cooled condenser. The following are typical operating conditions for these PDE condensers.

	Pool Heating Condenser	Optional Water Cooled Condnsr	Optional Air Cooled Condnsr
Refrigerant	R-22	R-22	R-22
Condensing Temperature	110° F	114° F	154° F
Tubeside Fluid	H_2O	H_2O	H_2O
Water In/Water Out	80° / 90° F	85° / 96° F	N/A
Ambient Air Temperature	N/A	N/A	95°
Fouling Factor	.0005 (std)	.0005 (std)	N/A
Pressure Drop	3.2 PSI	4.2 PSI	N/A
Max Tubeside Working Pressure	150 PSIG	150 PSIG	350 PSIG / 300°F
Max Shellside Working Pressure	350 PSIG / 300° F	350 PSIG / 300°F	N/A

Refer to product specifications for more information.

Refrigerant Recharging

Complete the following steps when recharging the refrigerant system of the PDE Series Unit. NOTE: Each component of the system must be evacuated individually.

Refrigerant

1. Use an approved Refrigerant Reclaimer to remove refrigerant

2. With an appropriate vacuum pump, evacuate the system to 700 microns.

3. Break the vacuum with dry refrigerant.

4. Connect the high pressure side of the charging manifold to the outlet valve on the receiver.

5. Totally close the valve on the receiver and add liquid refrigerant through the valve. **DO NOT add liquid refrigerant through the suction port on the compressor.**

6. When suction pressure reaches 40 PSI, activate the compressor.

7. Continue to add liquid refrigerant until head pressure climbs abruptly.

8. Fully open the valve causing suction pressure to climb.

Refrigerant Oil

Add refrigerant oil after recharging refrigerant or when oil level in the oil sight glass falls below the half-way mark

1. Pump down the system until suction pressure drops to 2 PSI.

2. Add oil to semi-hermetic compressors through the oil charge port. Add oil to hermetic compressors through the suction port. **OIL MUST BE CLEAN AND DRY.**

3. Add 3GS oil (or equivalent) to fill the sight glass 1/2 full. Do not overfill compressor.

Control Sequencing

Space Heating

Two stage heating thermostat or DDC controlled. Auto switching to auxiliary heat coil upon demand.

At setpoint	Economizer if outdoor temperature is higher than return air temperature
At drop from setpoint	Valve directing hot gas to air condenser energized. Compressor energized
At further drop from setpoint	Second stage of heat energized. All heat diverted to hot gas coil
At further drop from setpoint	Auxiliary heat energized (third stage)

Smart Economizer Operation

Heating is required - outside air is warmer and dryer than air off evaporator coil	100% of the air from the evaporator is exhausted. 100% fresh air is drawn into the unit by the supply fan. Fresh air is heated by the condenser reheat and supplied to space
Cooling is required - outside air is cooler and dryer than air off evaporator coil	100% of the air from the evaporator is exhausted 100% fresh air is drawn into the unit by the supply fan and supplied to space

Air Cooling with Water/Air Cooled Condenser and Cooling Tower (Optional)

Automatic change over from heating or air conditioning as a function of dry bulb cooling demand in the natatorium. Sensible and latent heat recovered in air conditioning mode is rejected to pool water if pool water heating is required, or to cooling tower or optional remote condenser.

1 degree above set-point	Economizer if outside air temperature allows Hot gas directed to water condenser Valves set to reject heat to pool or cooling tower or remote condenser depending upon pool water temperature

Control Sequencing

Humidity Control

Humidity control energizes the compressor and directs hot gas to the air condenser if space heating is required or to the pool condenser if pool water temperature is below setpoint. When dehumidification is required and air and water temperatures are satisfied and outside air cannot be used to dehumidify the natatorium, then hot gas is directed to the optional air/water cooled condenser (cooling tower). The economizer is activated if dehumidification is required and air and water temperature is satisfied. Humidity of the natatorium and outside air temperature does not affect pool room air temperature.

At setpoint	Economizer if outdoor RH lower than return air
On rise from setpoint	Compressor Energized. Valve directing hot gas to air reheat condenser, pool water condenser or remote air/water cooled condenser

Wall humidistat reset to eliminate condensate

When temperature of interior surfaces at the wall humidistat drops to within 5° F of the dewpoint of the natatorium, the RH setpoint is set to manual operation. This causes the dehumidification system to activate humidity control until condensate is eliminated at which time control is returned to the control system.

Occupied/Unoccupied Mode

Time clock for 7-day/24 hour operation with night operation during heating season. During unoccupied periods, outside air and exhaust dampers remain in closed position to minimize space heating load.

Pool Water Heating

When space temperature is at or above setpoint and pool water temperature is below setpoint, hot gas and pool water are directed to the pool water condenser when the compressor is activated. When the pool requires heat, the control panel signals the pool heat relay to start compressor operation.

Operating/Safety Controls

The PDE Series Unit is provided with an operating and safety logic control system which shuts down under conditions of high refrigerant pressure, low refrigerant pressure and oil failure conditions. The control system includes relays, contactors, sensors, switches, gauges for high and low refrigerant pressure and oil pressure.

Maintenance

Perform the maintenance procedures outlined below periodically as indicated. It is the responsibility of the owner to provide routine maintenance. Failure to perform routine maintenance may void warranty.

⚠ WARNING

To prevent injury or death due to electrical shock or contact with moving parts, open unit disconnect switch before servicing unit.

Monthly Maintenance

Unit Inspection: Visually inspect the unit monthly. Pay special attention to hose assemblies. Repair any leaks and replace deteriorated hoses immediately. DO NOT use Stop Leak type products in PDE Units. Repair torn insulation immediately. Touch-up paint dings and scratches before rusting occurs.

Filters: The PDE is equipped with eight (8) throwaway filters. Inspect filters and replace dirty filters monthly. **CAUTION: Operating with dirty filters may damage coils and may void unit warranty. DO NOT operate unit without ALL filters in place.**

Condensate Pans: Check condensate pans for algae growth monthly. If algae growth is apparent, consult a water treatment specialist for proper chemical treatment. The application of an algaecide every three months typically eliminates algae problems in most installations.

Check condensate drain line monthly. Clear line and trap as necessary to facilitate unobstructed condensate flow.

Compressor Oil: Check compressor oil levels monthly. Oil levels are visible through the oil sight glass provided. Check oil levels after the unit has been in operation at least 1/2 hour. Refer to the *Maintenance and Operation Section* of this manual for instructions on replacing compressor oil.

Refrigerant: Check refrigerant levels monthly. Refrigerant levels are visible through the sight glass provided on the evaporator. Refer to the *Maintenance and Operation Section* of this manual for instructions on recharging refrigerant.

Dampers: Check dampers monthly and adjust as necessary. Set fresh air damper to the minimum setting required by code. Set damper linkages for proper operation. Linkages must open and close without binding.

Suction and Discharge Operating Pressure: Check suction and discharge pressure while unit is in operation. Compare with start-up data. If significant deviations are noted, refer to the Troubleshooting Guide in this manual for more information.

Monthly Maintenance (Con't)

Blowers/Motors: Adjust blower and motor belts and replace as needed. Belt inflection must not exceed 1/2". Check that all blower fans rotate freely in the correct direction. Lubricate fan bearings with a high grade bearing grease monthly. Replace belts every six (6) months.

Pool Strainer: Check and clean pool strainers monthly or as required.

Pool Water: Maintain pool water PH between 7.2 and 7.6. **Failure to maintain pool Ph within this range may void unit warranty.** Maintain chlorine at the levels required by code.

Annual Maintenance

Annually, have unit inspected by a certified service technician. During service, clean heat exchangers, lubricate fan motors and complete all testing listed in the *Start-up Section* of this manual.

Safety Reset

The PDE Unit is equipped with a Safety/Control system which protects the unit against damage from high and low refrigerant pressure and oil failure. Should the lockout relay which is electrically linked with these cutouts interrupt unit operation, the unit must be reset manually.

If the unit must be reset more than twice, check the unit for a dirty filter, abnormal entering water temperature, inadequate or excessive water flow and internal malfunction. Refer to the Troubleshooting Guide for further diagnostics.

SYMPTOMS	CAUSE	REMEDY
A. Compressor does not run.	1. Disconnect switch open.	1. Determine why switch was open. If everything okay, close switch.
	2. Fuse blown.	2. Replace fuse.
	3. Tripped overload.	3. See diagnostic section.
	4. Control contacts dirty or stuck in open position.	4. Repair or replace.
	5. Piston seized.	5. Semi-hermetic compressor. Remove compressor head. Look for broken valve and jammed parts.
	6. Frozen compressor motor bearings.	6. Repair or replace.
	7. Loss of charge switch open.	7. Check for refrigerant leak. Repair leak and recharge. Reset loss of charge switch.
	8. Discharge pressure above cut-in setting of high pressure switch.	8. See symptom I.
	9. Oil pressure-failure control switch has cutout.	9. System will restart by resetting oil pressure failure control switch. Check oil level, oil pressure, wiring and control for faulty control.
	10. Defective starting component (1 phase compressors only).	10. Locate and replace.
B. Unit short cycles.	1. Space thermostat heat anticipator set incorrectly.	1. Set anticipator to longest setting.
C. Compressor will not start - hums intermittently (cycling on overload).	1. Improperly wired.	1. Check wiring against diagram.
	2. Low line voltage.	2. Check main line voltage. Determine location of voltage drop.
	3. Open start capacitor (1 phase units).	3. Replace start capacitor.
	4. Relay contacts not closing.	4. Check by operating manually. Replace relay if defective.
	5. Open circuit in starting winding.	5. Check stator leads. If leads okay, replace stator, or replace compressor.
	6. Stator winding grounded.	6. Check stator leads. If leads okay, replace stator, or compressor.
	7. High discharge pressure.	7. Eliminate cause of high pressure. Make sure discharge service valve is open.
	8. Tight compressor.	8. Check oil level - correct binding.

SYMPTOMS	CAUSE	REMEDY
D. Compressor starts but motor will not get off start winding.	1. Low line voltage.	1. Correct low voltage.
	2. Improperly wired.	2. Check wire against diagram.
	3. Defective relay.	3. Check operation manually. Replace relay if defective.
	4. Running capacitor shorted.	4. Check capacitor with ohm meter, replace if defective.
	5. Start and run windings shorted.	5. Check resistances. If defective, replace stator, or compressor.
	6. Start capacitor weak.	6. Check capacitance, replace if low.
	7. High head pressure.	7. See symptom I.
	8. Tight compressor.	8. Check oil level. Check binding.
E. Start relay burn out (1 phase units).	1. Low line voltage.	1. Increase voltage to nameplate rating.
	2. Excessive line voltage.	2. Reduce voltage to maximum of 10% over nameplate rating.
	3. Incorrect run capacitor.	3. Replace with correct mfd capacitor.
	4. Short cycling.	4. Check differential on pump down control. Check for leaky liquid line solenoid valve.
	5. Incorrect mounting.	5. Mount relay in correct position.
	6. Relay vibrating.	6. Mount relay in rigid location.
	7. Incorrect relay.	7. Use relay properly selected for motor characteristics.
F. Start capacitors burn out (1 phase units).	1. Short cycling.	1. Replace capacitor. Check differential on pump down control. Check for leaking liquid line solenoid valve.
	2. Start relay contacts sticking.	2. Replace start relay. Install bleed resistor (2 watt, 15000 ohm) across start capacitor terminals.
	3. Improper capacitor.	3. Check parts list for proper capacitor rating-voltage and mfd.
G. Run capacitors burn out (1 phase units).	1. Excessive line voltage.	1. Reduce voltage to not more than 10% over nameplate rating.
	2. Wrong capacitor voltage rating.	2. Check parts list for proper capacitor rating mfd and voltage.

SYMPTOMS	CAUSE	REMEDY
H. Unit runs continuously.	1. Thermostat set too high (heat) or too low (cool). Humidistat set too low.	1. Check control settings, adjust as required.
	2. Dirty condenser.	2. Clean condenser.
	3. Shortage of gas.	3. Repair leak and recharge.
	4. Dirty filters.	4. Replace filters.
	5. Overcharge of refrigerant.	5. Purge.
	6. Dirty evaporator.	6. Clean coil.
	7. Loose blower belts.	7. Tighten or replace.
	8. Leaky valves in compressor (high suction, low head).	8. Overhaul compressor or replace.
	9. Unit too small.	9. Add unit or replace.
I. Head pressure too high.	1. Overcharge of refrigerant.	1. Purge out excess.
	2. Air in system.	2. Purge.
	3. Dirty filters.	3. Replace filters.
	4. Loose blower belts.	4. Tighten or replace.
	5. Dirty condenser (air cooled).	5. Clean condenser.
	6. Condenser fan motors not operating.	6. Check voltage, check fan cycling control - adjust or replace, check fan motor rotation (3 phase).
	7. Too little or too warm condenser water (water cooled condenser).	7. Provide adequate cool water, adjust water regulating valve.
	8. Restricted water cooled condenser.	8. Clean or replace condenser.
	9. Head pressure control valve not operating.	9. Refer to diagnostic section of this manual.
	10. Heat rejection valve not shifting.	10. Refer to diagnostic section of this manual.
J. Head pressure too low.	1. Too much water flow through pool heat exchanger.	1. Adjust water flow for 20° F temperature rise.
	2. Lack of refrigerant.	2. Repair leak and recharge.
	3. Space temperature too cold.	3. Raise space temperature above 70° F.
	4. Leaky valves in compressor.	4. Overhaul compressor or replace.
	5. Head pressure control valve not working.	5. Refer to diagnostic section of this manual.
	6. Fan cycling control pressure switches not set properly.	6. Refer to start-up manual for correct settings.
K. Suction pressure too high	1. Excessive load on evaporator.	1. Airflow too high - reduce.

SYMPTOMS	CAUSE	REMEDY
K. Suction pressure too high.	2. Expansion valve overfeeding.	2. Adjust superheat - min. 17°F at compressor. Check to see remote bulb is secure.
	3. Broken suction valve.	3. Overhaul compressor or replace.
	4. Unit too small.	4. Add unit or replace.
L. Suction pressure too low.	1. Lack of refrigerant.	1. Repair leak and charge.
	2. Return air too cold.	2. Raise space temperature and/or reduce fresh air quantity.
	3. Clogged liquid line filter drier.	3. Replace.
	4. Expansion valve power assembly has lost charge.	4. Replace expansion valve power assembly.
	5. Obstructed expansion valve.	5. Clean valve or replace.
	6. Too much water flow through pool heat exchanger.	6. Adjust pool water flow for 20°F temperature rise.
	7. Condenser check valve leaking.	7. See disgnostic section. Repair or replace.
	8. Fan cycling control pressure switches not properly set.	8. Refer to start-up manual for correct settings.
	9. Superheat too high.	9. Adjust for min. 17°F at compressor.
M. Noisy unit.	1. Insufficient compressor oil.	1. Add oil to proper level (refer to start-up manual).
	2. Tubing rattle.	2. Bend tubes away from contact.
	3. Mountings loose.	3. Tighten.
	4. Oil slugging.	4. Adjust oil.
	5. Internal parts of compressor broken.	5. Overhaul compressor or replace
	6. Expansion valve stuck open.	6. Repair or replace.
	7. Dry or scored bearings.	7. Check oil level.
	8. Loose or broken fan belt.	8. Tighten or replace.
	9. Refrigerant flooding back.	9. Check and adjust superheat. Return air too cold.
N. System short of capacity.	1. Flash gas in liquid line.	1. Add refrigerant. Insulate liquid lines.
	2. Clogged liquid line filter/ drier.	2. Replace.
	3. Reduced air flow.	3. Adjust.
	4. Dirty condenser.	4. Clean.
	5. Expansion valve stuck or obstructed.	5. Repair or replace.

SYMPTOMS	CAUSE	REMEDY
N. System short of capacity.	6. Improper superheat.	6. Adjust superheat.
	7. Check valves leaking.	7. See diagnostic section.
O. Compressor loses oil.	1. Shortage of refrigerant.	1. Repair leak and recharge.
	2. Plugged liquid line filter/drier.	2. Replace.
	3. Pump down control cut-out setting too low.	3. Set pump down cut-out at 30 psi w/25 psi differential.
	4. Insufficient oil charge.	4. Add sufficient amount of proper compressor oil. Refer to start-up manual.
	5. Refrigerant lines improperly sloped.	5. Repitch lines. Slope in direction of refrigerant flow.
	6. Check valves leaking.	6. See diagnostic section.
	7. Liquid flooding back to compressor.	7. Check superheat. Check sensing bulb contact.
	8. No oil traps in risers.	8. Install traps per piping diagram.
	9. Superheat too high.	9. Check and adjust.
	10. Return air temperature too low.	10. Mixed air temperature must be 70°F or above.
P. Frosted suction line.	1. Expansion valve admitting excess refrigerant.	1. Adjust expansion valve.
Q. Hot liquid line.	1. Shortage of refrigerant.	1. Repair leak and recharge.
	2. Expansion valve open too wide.	2. Adjust expansion valve.
R. Frosted or sweating liquid line.	1. Receiver shut-off valve partially closed or restricted.	1. Open valve or remove restriction.
	2. Plugged liquid line filter/drier.	2. Replace.

Diagnostic Section

1. *Plugged Filter / Drier.*
The liquid line filter/drier may become plugged with dirt or foreign material left in the system during the installation of remote air cooled condenser or split system components. When this happens, the liquid line leaving the filter/drier will feel cooler than the liquid entering. If it is badly plugged, some sweat or frost may appear at the filter/drier outlet. If the temperature difference across the drier is greater than 2°F, then replace the drier.

2. *Thermostatic Expansion Valve Stuck Open.*
If the expansion valve is stuck in the open position, there will be an excessive amount of sweating on the compressor crankcase due to the large amount of liquid being passed into the suction line. If increasing the superheat setting on the expansion valve doesn't stop the excess liquid, either take the valve apart and clean, or replace the valve.

3. *Thermostatic Expansion Valve Has Lost Its Charge.*
The power element of an expansion valve consists of the remote bulb, capillary tube and the bellows or diaphragm, which actuates the valve cage. If the power element is inoperative or has lost its charge, the valve will either maintain an almost closed position or may close completely. To test for inoperative power element:

   a. Stop compressor.

   b. Remove remote bulb from the suction line.

   c. Place bulb in ice water.

   d. Start compressor.

   e. Remove bulb from the ice water and warm in hand. At the same time check the suction line for rapid temperature change which indicates

flood through of liquid refrigerant. If refrigerant floods through valve, power assembly operates properly.

CAUTION: Do not flood back through the suction line for too long a period. Excessive liquid flood back can cause severe damage to the compressor.

4. *Thermostatic Expansion Valve Improperly Adjusted.*
If the expansion valve is adjusted for too low a superheat, too much liquid will pass through the evaporator. The suction line will be abnormally cold and liquid may slug back to the compressor. If the expansion valve is adjusted for too high a superheat, too little liquid will be passed to the evaporator and the suction line will be abnormally warm. Superheat should be set no less than 17°F at the compressor.

5. *Thermostatic Expansion Valve Is Obstructed.*
If the obstruction is small, the thermostatic expansion valve cannot pass a sufficient amount of liquid refrigerant to satisfy the evaporator. The superheat will be high and the system will lose capacity. Suction pressure will be low. If the obstruction is large and only a small trickle of liquid can pass, the compressor will cut-out on low pressure. An obstructed expansion valve is usually indicated by a partly warm evaporator and frosting at the evaporator inlet.

6. *Liquid Line Solenoid Valve Leaks.*
If the liquid line solenoid valve leaks, the compressor will short cycle on pump down control. The liquid line leaving the solenoid valve will feel colder than the liquid entering the valve, and in some cases there may be evidence of sweating or frost on the solenoid valve.

7. *Solenoid Valve Obstructed.*
If the solenoid valve is obstructed, the resulting operation will be much the same as though the thermostatic expansion valve was obstructed. The obstructed solenoid valve can be detected by a temperature change in the refrigerant line through the valve. The liquid line leaving the valve will be colder than the liquid line entering and may eventually sweat or frost up. Usually, if the solenoid valve is obstructed, then it cannot close, and the operation will be similar to that described in item 6.

8. *Shortage Of Refrigerant.*
There should always be sufficient liquid in the receiver to completely submerge the inlet to the liquid line pipe. If there is a shortage of refrigerant, the liquid level will fall below the inlet to the liquid line. Bubbles will appear in the sight glass; the larger the bubbles the more severe the shortage. Thee may be a hissing or whistle at the expansion valve. The coil and suction line will be warm while the suction pressure will be low due to little or no liquid being supplied to the evaporator if the shortage is severe.

9. *Overcharge Of Refrigerant.*
An overcharge of refrigerant will cause high head pressure. Liquid will back up in the condenser and decrease the amount of surface available for condensing and as a result, the head pressure will rise. In extreme cases, it may rise to a point where the thermal overload elements in the starter or the high pressure cut-cut switch will stop the compressor.

10. *Air In System.*
If air or other non-condensible gases are present in the system, they will tend to move toward and collect at the condenser. The head pressure will rise to a point above the pressure corresponding to the temperature at which the vapor is condensing. The pressure may rise to a point where either the high presure cut-out or thermal overload elements in the starter may stop the compressor.

To determine whether or not there is air in the system, the compressor must be allowed to stand idle long enough for the entire system to cool down to the temperature of the surrounding air. After the entire system has attained the same temperature as the surrounding air, the reading of the high pressure gauge should not be more than 10 lbs. above the saturation pressure corresponding to the surrounding air temperature.

11. *Broken Valves In Compressor.*
Broken suction valves or broken or leaky discharge valves in a compressor are generally indicated by the suction pressure rising rapidly as soon as the machine is stopped. If the suction pressure rises faster then 5 lbs. per minute, it should be determined that the pressure rise is not due to other causes such as leaky solenoid valves. Close the suction service valve. Run the compressor until a vacuum of 22 inHg is reached. Stop the compressor. It should hold vacuum. If it doesn't hold or cannot reach the vacuum, valves are leaking.

12. *Head Pressure Control Valve Malfunctions.*
When the head pressure control valve is utilized on a system, there must be enough refrigerant to flood the condenser at the lowest ambient temperature expected and still have enough charge in the system for proper operation. A shortage of gas will cause hot gas to enter the liquid line and the expansion valve, and the refrigeration effect will cease.

Since all packaged "Recovery 5000" System units are charged and tested before they are shipped, the only units that require refrigerant charging are split systems and units with remote condensers. The receivers installed in the PDE's are sized to handle the additional charge required for remote condensers.

There are several causes for system malfunction when head pressure control valves are used and these may be difficult to isolate from each other. As with any form of system troubleshooting, it is

necessary to know the existing operating temperatures and pressures before system problems can be determined. Once the actual malfunction is established, it is easier to pinpoint the cause and then take suitable corrective action. The following chart lists the most common malfunctions, the possible causes, and the remedies.

Malfunction - Low Head Pressure

POSSIBLE CAUSE	REMEDY
1. Insufficient refrigerant charge to flood condenser.	1. Add charge.
2. ORCA or HEADMASTER fails to close due to: a. Foreign material in valve.	2. See below: a. Cause ORCA or HEADMASTER to open by raising condenser/receiver pressure above valve setting by cycling condenser fan. If foreign material does not pass through valve, replace.
b. Loss of air charge in element.	b. Replace valve.

Malfunction - High Head Pressure

POSSIBLE CAUSE	REMEDY
1. Dirty condenser coil.	1. Clean coil.
2. Air on condenser blocked.	2. Clear area around unit.
3. Too much refrigerant charge.	3. Remove charge until proper head pressure is maintained.
4. Non-condensibles (air) in the system.	4. Purge from system.
5. Restricted due to inlet strainer being plugged.	5. Open inlet connection to clean strainer.
6. Bypassing hot gas when not required due to high pressure drop across condenser and associated piping which exceeds 14 psi under full load conditions. This can occur if the remote condenser is installed below the PDE. Each foot of rise in the liquid line is equivalent to .5 psi pressure drop. Add the pressure drop due to vertical lift to the pressure drop of the condenser to determine the total pressure drop. If the total pressure drop exceeds 14 psi, then corrective action is required.	6. Either replace OROA-5-180 valve with an OROAB, OROAC, or OROAD-5-180, which have higher pressure differentials, or install ORD (pressure differential valve) in series with the bypass port of the OROA valve (which will increase the pressure differential).

13. *Leaking Check Valves.*
If the liquid line check valves are leaking, the system will be short on capacity. It may even be possible that the unit trips on oil pressure failure control. If the leak is severe enough, the liquid line to the idle condenser will be cold with possible signs of sweating or frost. To check for a leaking check valve, two methods can be used. Take a temperature reading across the check valve on the liquid line to the idle condenser. Both the entering and leaving temperatures should be the same.

The second method is an accurate way to verify if the check valve is leaking whether the leaking is large or small. All PDE's recover the refrigerant from the inactive condenser. After approximately 10 minutes, the idle condenser should reach the suction pressure of the system. If the check valve is leaking, part of the liquid refrigerant will flow to the expansion valve, and part will migrate through the leaky check valve to the idle condenser. With the expansion valve only getting part of the refrigerant, the coil will be warm and the superheat at the coil will be high. If the superheat at the compressor is less than the superheat at the evaporator, then the check valve is leaking. Be sure to wait ample time for the idle condenser to bleed off its charge.

If a check valve in the hot gas line is leaking, the unit will be short on capacity and may even trip out on oil pressure failure control. To diagnose a

leaking check valve in the hot gas line is more difficult that one in the liquid line. Hot gas temperatures can conduct easily through copper tubing, making the temperature method difficult. To determine if a check valve is leaking, take a temperature on the inlet side of the check valve as far as possible from the check valve itself. If it is near the hot gas discharge temperature, it is a good indication that the check valve is leaking. Another method is to inspect the bleed port of the pool heat valve, DHW heat valve or spa heat valve for signs of condensation. If moisture forms on the bleed line, it is an indication that the check valve is leaking. The final way to determine if the check valve is leaking is to satisfy all the water heat exchangers and measure the entering and leaving water temperatures. If there is a temperature rise on any of the heat exchangers, then there is a possibility that the check valve is leaking. However, it can also mean that the heat valve didn't shift and is stuck in the heat position.

If a check valve is found to be leaking, either clean out any foreign material or replace the check valve.

DDC Control Panel

The controller is an integral part of the unit located in a compartment isolated from the air stream. The compressors are controlled by NEMA starters and protected on all three phases by fixed magnetic trip overloads. The overload reset button is accessible without removing the electrical panel cover.

The controller is a microcomputer-based system mounted in the control panel. A control panel with LCD readouts which can be remotely mounted up to 500 feet away from the unit via an RS232 connection will be supplied. The panel accesses the controller and allows the following set point changes and also displays the following system status and sensor readings:

SENSOR READINGS
Return air temperature
Return air relative humidity
Pool water temperature

SET POINT ADDRESSABILITY
Room temperature
Room relative humicity
Pool water temperature occupied/unoccupied time schedule
Pool water temperature auxiliary heat set point

SAFETY STATUS
Compressor 1 safety
Compressor 2 safety
Pool water safety (low flow and/or high temperature)
Supply fan air flow
Blinking overall alarm

OPERATING STATUS
Compressor 1 on
Compressor 2 on
Humidification on
Auxiliary heat on
Pool heat on
Cooling mode on
Auxiliary pool heat on

In addition to the LCD readouts on the microcomputer panel, status lights will be provided on the unit cabinet indicating power on, high pressure cut off, overload cutout and loss of refrigerant charge for each compressor. Each refrigerant circuit will be supplied with a manual pump down switch.

A power block is provided to facilitate electrical connections and is equipped with lugs for proper wire sizes.

Blower motors and compressor(s) are controlled by motor starters with three-leg overload protection. The overloads are adjustable trip with push button resets.

Making ZT Adjustments

Adjusting Control Settings

This section of the manual is for users who have Password access to the Adjust Mode.

If you haven't already entered your Password, you must do so. See *Entering Your Password*.

You can adjust only a flashing number with the ZT. If the number does not flash, that item is a monitor only item.

Adjust Control Settings in Display 1, 2, or 3 as follows:

1. Press the Mode Selector Button until the green Mode Indicator Light moves next to the word `Adjust`.
2. Press either Display Button 1, 2, or 3 to locate adjustable items, which are indicated by flashing numbers.

   If you continue pressing the display buttons, the dot ● in each display changes positions and the corresponding number appears.
3. Press the Up ↑ or Down ↓ Arrow key until you reach the number you want to enter. If you hold down the Up ↑ or Down ↓ Arrow keys, you can speed through the numbers more quickly. Press Enter.

   After you press Enter, the numbers stop flashing for a few seconds. This pause tells you the ZT has processed your adjustment.
4. Press any of the Display Buttons to make other adjustments, and repeat Steps 2 and 3.

Notes: Some adjustable set points have high and low limits beyond which you cannot adjust them. For example, a heating set point may have an upper limit of 86°F (30°C).

When you make adjustments, they become permanent in the ZT. To make a temporary change, write down the original value before making the change so you can re-enter it later.

5. Press the Up ↑ or Down ↓ Arrow key until the last number of your Password appears in the flashing position.

   Press Enter.

   You must press Enter for *each* of the three numbers in your Password in order for the ZT to recognize it as a valid Password. If you do not press Enter *each* time, the ZT ignores your Password entry and you cannot gain access to Adjust Mode or Time Scheduling Mode.

After you press Enter for the last number of your Password, the green Mode Indicator Light moves next to the word `Adjust` in the Mode Selector Panel. If it does not go to this position, the Password is incorrect.

You can now begin changing values or set points in the Adjust Mode, or press the Mode Selector Button to move the green Mode Indicator Light to the Time Schedule position. Time Scheduling may require a different Password.

Note: The ZT is preset to time out after a 1 to 15-minute interval between entries. If you wait too long to enter an adjustment, you must re-enter your Password. This prevents unauthorized use of the ZT if you forget to cancel your Password.

Cancel Password

After entering the Password, you can easily cancel without waiting for the Zone Terminal to time out.

1. Press the Mode Selector Button until the green Mode Indicator Light moves next to the word `Password`.
2. Press Enter three times. In doing this, you have entered zeroes as the Password. Access is immediately canceled because 000 is not a valid Password.

Entering Your Password

If your system uses the Password feature, you must enter the Password before you can make changes to the set points, or before you gain access to Time Scheduling.

To enter your Password:

1. Open the Mode Selector Panel by pulling the door down.
2. Press the Mode Selector Button until the green Mode Indicator Light moves next to the word Password. When the Mode Selector Button is in the Password position, a number appears in Display 1. This number *must match* the number on the top, center of your Insert. If the numbers do not match, the data that appears in the displays will not match the description on the Insert. Replace the incorrect Insert.

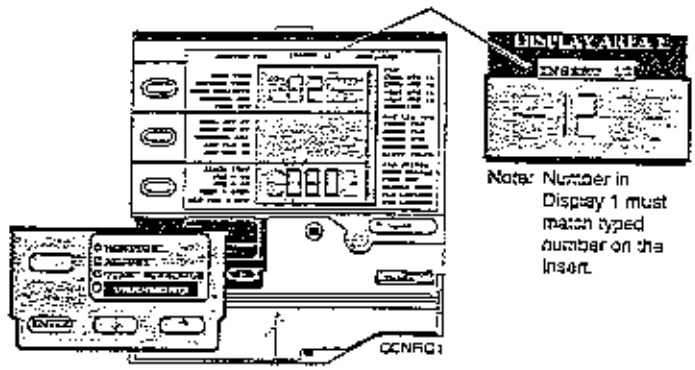

Figure 8: Matching the Insert Number

Three numbers appear in Display 3. The number in the left position flashes.

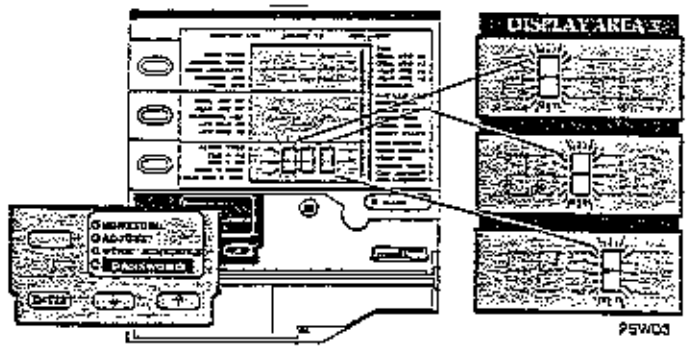

Figure 9: Entering Password

3. Press the Up ↑ or Down ↓ Arrow key until the first number of your Password appears in the flashing position. Press Enter.

   The middle number in Display 3 begins flashing.

4. Press the Up ↑ or Down ↓ Arrow key until the middle number of your Password appears in the flashing position. Press Enter.

   The third, or far right number, begins flashing.

Zone Terminal After Connection

Figure 7 shows an example of the ZT and its displays after connection.

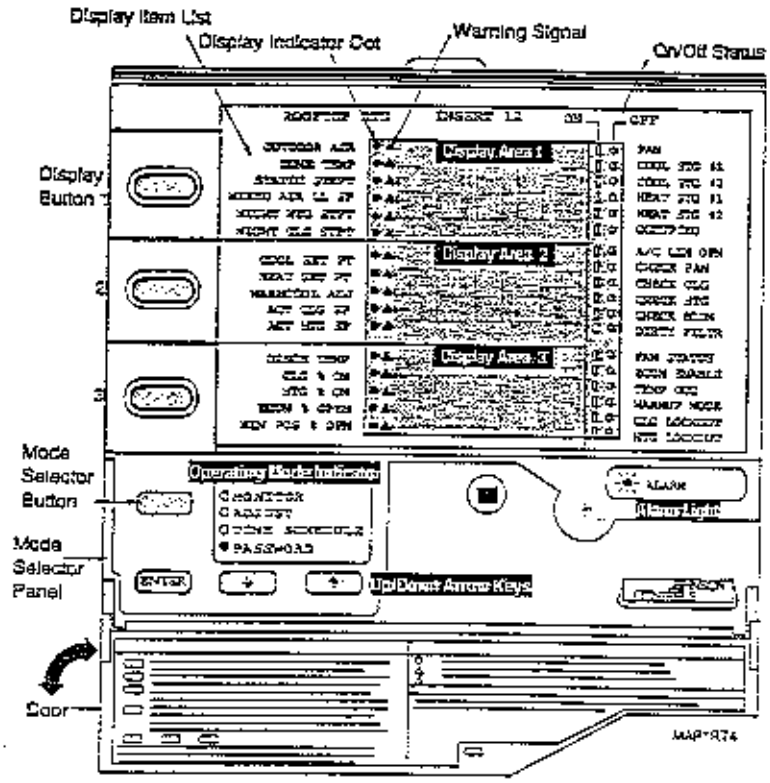

Figure 7: Connected ZT, Insert in Place

Alarm Status

The ZT indicates an alarm as follows (Figure 7):

- The warning signal ▲ flashes to the right of the point name if the system operating values are in alarm.
- The On/Off Status bar | or circle O flashes when an On/Off status is in alarm.
- The red alarm light to the right of the Mode Selector Panel flashes when any of the above items are in alarm.

Alarms cannot be cleared with the ZT. The problem must be corrected by maintenance or repair of the affected item.

Time Schedule Mode

In the Time Schedule Mode, you can monitor or adjust the days and Begin/End times for Occupied, Warmup, and Shutdown conditions. You can also set up holiday and temporary schedules.

Time Schedule Mode is available to those who have appropriate Password Access.

Getting Started

Displays, Symbols, Keys, and Buttons

The Zone Terminal simultaneously displays three set points or sensed values. In addition, flashing symbols indicate when items are in a state of alarm. The keys, buttons, displays, and symbols are explained below.

Table 1: Displays, Symbols, Keys, and Buttons

Displays, Symbols, Keys, Buttons	Description
Display Button 1, 2, 3	Select the value you want to monitor or adjust.
Enter Key	Use to commit your changes. Adjustments are not processed unless you press Enter.
Flashing Numbers	Appear in Display 1, 2, or 3 to indicate numbers you can adjust. Numbers that do not flash are monitor only numbers.
Flashing ▲, O, I	Shows an item is in alarm.
Mode Selector Button	Press this button to select Operating Modes: Monitor, Adjust, Password, Time Scheduling. A green Mode Indicator light moves through the modes.
On/Off Status Symbols I for On or O for Off	Observe On/Off conditions of a point in the HVAC controller with these symbols. A bar I for On, a circle O for Off. These are always monitor only items. If the symbol flashes, the item is in alarm.
Red Alarm Light	Flashes anytime a problem exists regardless of which Operating Mode you have entered.
Up ↑ or Down ↓ Arrow Keys	Use these keys to adjust a flashing number.
■	Appears in the value displays, and corresponds to the item you are monitoring or adjusting.

Operating Modes

Four Operating Modes—Monitor, Password, Adjust, and Time Schedule—provide security and allow you to monitor, adjust, and set time schedules for an individual zone.

Monitor Mode

As soon as the ZT is connected, it completes a self-check, and then starts up in the Monitor Mode. The Monitor Mode allows you to view up to three settings, or sensed values, at one time for your HVAC system.

To monitor your system, you must use a clear plastic Insert (a custom-made label) to relate the ZT's output to your particular system. (See the *Installing the Plastic Labels--Insert* section.)

You can simultaneously monitor your HVAC system in three different ways:

- Monitor up to three different settings or sensed values. A maximum of six items are accessible in each of the three displays.
- Read the symbols to the right of the display numbers to learn the on/off status of various inputs, outputs, or modes (| = On status; O = Off status). This provides continuous monitoring of 18 different statuses (on/off).
- Monitor alarm status--a flashing red alarm light and any flashing symbol (|, O, ▲--visually notifies you when your HVAC system has an alarm condition.

Password Mode

The Password Mode allows users with the proper access rights to adjust system set points and time scheduling. There are three levels of password access:

- Monitor and adjust--password allows user access to adjust only system set points
- Monitor, adjust and time scheduling--password allows user access to all ZT features and capabilities, but the system is still password protected
- No password--user is allowed to access all ZT features and capabilities without entering a password

Adjust Mode

In the Adjust Mode, the ZT displays information in each of the three numerical displays. Typically, the displays are set up so that the relationship between the values can be viewed simultaneously. For example:

Display 1 = Room Temperature

Display 2 = Room Set Point

Display 3 = Output Command

This operating mode allows you to adjust any flashing set points that are authorized by your Password. Set points adjusted by the ZT remain in effect until you change them.

Capabilities

With the ZT, you can:

- quickly identify an alarm and its location
- monitor and adjust up to 18 different settings
- extend a daily time schedule with the Occupied Extend feature
- add or modify daily, holiday, and temporary time schedules

To familiarize yourself with the ZT, refer to Figure 1.

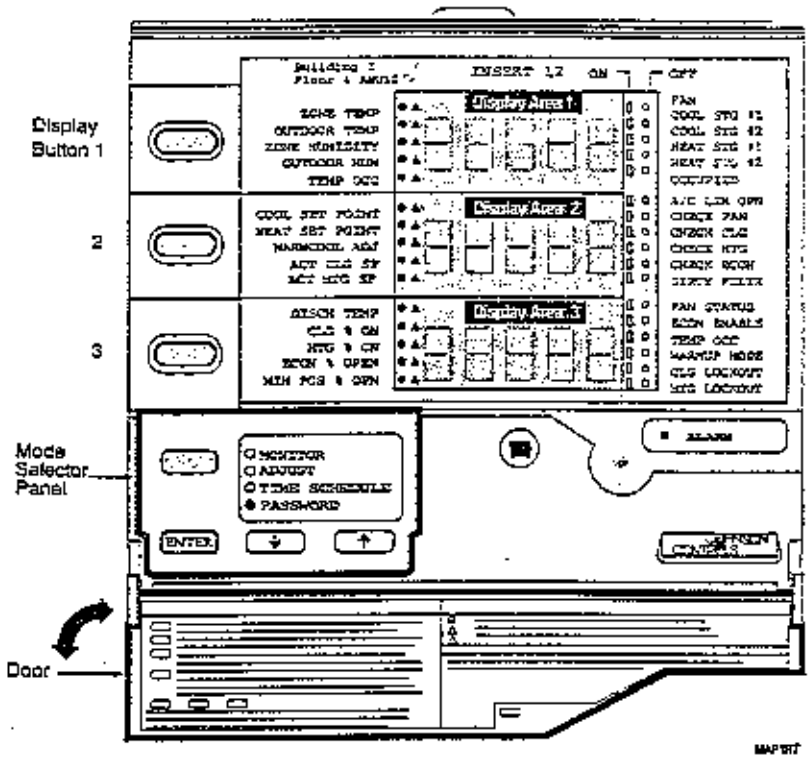

Figure 1: Zone Terminal with Door Open

APR PRODUCT
LIMITED EXPRESS WARRANTY / LIMITATION OF REMEDIES AND LIABILITY

It is expressly understood that unless a statement is specifically identified as a warranty, statements made by ClimateMaster, Inc.,("CM") or its representatives relating to APR's products, whether oral, written, or contained in any sales literature, catalog or agreement, are not express warranties and do not form a part of the basis of the bargain, but are merely CM's opinion or commendation of APR's products. **THERE IS NO EXPRESS WARRANTY AS TO ANY OF APR'S PRODUCTS. CLIMATEMASTER MAKES NO WARRANTY OF MERCHANTABILITY OF THE GOODS OR OF THE FITNESS OF THE GOODS FOR ANY PARTICULAR PURPOSE.**

GRANT OF LIMITED EXPRESS WARRANTY

ClimateMaster warrants APR products purchased and retained in the United States and Canada to be free from defects in material and workmanship under normal use and maintenance as follows: (1) All complete dehumidification, air conditioning and heating units built or sold by CM for 12 months from date of unit start-up or 18 months from date of shipment (from factory), whichever comes first; and, (2) Repair and replacement parts, which are not supplied under warranty, for 90 days from date of shipment. Extended warranties on compressors or refrigerant circuit parts are available for an additional price; however, no extended warranty shall apply to any order unless such extended warranty is specifically referenced in ClimateMaster's acknowledgment. Any extended warranty is subject to the provisions, limitations and exclusions of these terms and conditions.

All parts must be returned to ClimateMaster's factory in Oklahoma City, Oklahoma, freight prepaid, no later than 60 days after the date of the failure of the part; if ClimateMaster determines the part to be defective and within APR's Limited Express Warranty, ClimateMaster shall, when such part has been either replaced or repaired, return such to a factory recognized dealer, contractor or service organization, F.O.B. CM's factory, Oklahoma City, Oklahoma, freight prepaid. The warranty on any part repaired or replaced under warranty expires at the end of the original warranty period.

This warranty does not apply to: (1) Drier core, Fan belts, air filters, fuses, refrigerant, fluids, oil; (2) Products relocated after initial installation; (3) Any portion of the system that is not supplied by CM; (4) Products on which the tags or labels have been removed or defaced; (5) Products on which payment to CM is or has been in default; (6) Products which have defects or damage which result from improper installation, wiring, electrical imbalance characteristics or maintenance; or are caused by accident, misuse or abuse, fire, flood, alteration or misapplication of the product; (7) Products which have defects or damage which result from a contaminated or corrosive air or liquid supply, operation at abnormal temperatures or unauthorized opening of refrigerant circuit; (8) Corrosion or abrasion; (9) Products manufactured or supplied by others; (10) Products which have been subjected to misuse, negligence or accidents; (11) Products which have been operated in a manner contrary to APR's printed instructions; or, (12) Products which have defects, damage or insufficient performance as a result of insufficient or incorrect system design or the improper application of APR's products.

ClimateMaster is not responsible for: (1) the costs of labor, refrigerant, materials or service incurred in removal of the defective part, or in obtaining and replacing the new or repaired part; or, (2) transportation costs of the defective part from the installation site to ClimateMaster or of the return of any part not covered by APR's Limited Express Warranty.

LIMITATION; This Limited Express Warranty is given in lieu of all other warranties. If, notwithstanding the disclaimers contained herein, it is determined that other warranties exist, any such warranties, including, without limitation, any express warranties or implied warranties of fitness for a particular purpose and merchantability shall be limited to the duration of the Limited Express Warranty.

LIMITATION OF REMEDIES

In the event of a breach of the Limited Express Warranty, ClimateMaster will only be obligated to ClimateMaster's option to repair the failed product or to furnish a new or rebuilt product in exchange for the product which has failed. If after written notice to ClimateMaster's factory in Oklahoma City, Oklahoma of each defect, malfunction or other failure and a reasonable number of attempts by CM to correct the defect, malfunction or other failure and the remedy fails of its essential purpose, ClimateMaster shall refund the purchase price paid to ClimateMaster in exchange for the return of the sold good(s). Said refund shall be the maximum liability of APR. **THIS REMEDY IS THE SOLE AND EXCLUSIVE REMEDY OF THE BUYER AGAINST APR FOR BREACH OF CONTRACT, FOR BREACH OF ANY WARRANTY OR FOR CM'S NEGLIGENCE OR IN STRICT LIABILITY.**

LIMITATION OF LIABILITY

CM shall have no liability for any damages occasioned by any delay in performance or any default caused by war, government restrictions or restraints, strikes, material shortages, acts of God or any other reason beyond the sole control of CM. **CM EXPRESSLY DISCLAIMS AND EXCLUDES ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGE IN CONTRACT, FOR BREACH OF ANY EXPRESS OR IMPLIED WARRANTY, OR IN TORT, WHETHER FOR NEGLIGENCE OR AS STRICT LIABILITY. CM MAKES NO WARRANTY AGAINST LATENT DEFECTS.**

OBTAINING WARRANTY PERFORMANCE

Normally, the contractor or service organization who installed the products will provide warranty performance for the owner. Should the installer be unavailable, contact any APR recognized dealer, contractor or service organization. If assistance is required in obtaining warranty performance, write or call:

ClimateMaster, Inc. • Customer Service • 7300 S.W. 44th Street • Oklahoma City, Oklahoma, 73179 • (405) 745-6000 • FAX (405) 745-6058

NOTE; Some states or Canadian provinces do not allow limitations on how long an implied warranty lasts, or the limitation or exclusions of consequential or incidental damages, so the foregoing exclusions and limitations may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state and from Canadian province to Canadian province.

Please refer to the APR Installation, Operation and Maintenance Manual for operating and maintenance instructions.