ClimateMaster®

APR CP Series

Dehumidification System

Installation and Operation Reference Manual

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APPENDICES

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 CP Series Units.

The APR CP 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 CP Series Unit contains the following major components:

- Φ ***Compressor:*** A heavy duty, multi- cylinder, serviceable compressor with removable crankcase heater and optional three stage unloading
- Φ ***Suction Gas Accumulator***
- Φ ***Hot Gas Discharge Muffler***
- Φ ***Pool Water Condenser/Heater:*** A high efficiency coaxial heat exchanger with carbon steel jacket and cupronickel inner tube assembly
- Φ ***Air Cooled Condenser/Air Re-heat Coil:*** A high efficiency enhanced tube and fin condenser
- Φ ***Evaporator:*** A high efficiency, multi-circuited enhanced tube and fin evaporator
- Φ ***Thermostatic Expansion Valves:*** On evaporator circuits to control refrigeration system
- Φ ***Sight Glass***
- Φ ***Solenoid Valve:*** For pump down
- Φ ***Liquid Line Filter:*** With replaceable core
- Φ ***Auxiliary Air Heating Coil:*** A high efficiency enhanced tube and fin coil controlled by a 3-way modulating valve
- Φ ***Supply Air Blowers:*** Blowers driven by an open, drip-resistant motor
- Φ ***Auxiliary Pool Heater:*** Using stainless steel heat exchangers
- Φ ***Optional Remote Air Cooled Condenser***
- Φ ***Air Filters:*** Four 2" throwaway filters each for the evaporator and the condenser
- Φ ***Controls:*** Controls on CP Series Units are integrated microprocessor systems isolated from the air stream in a separate compartment on the unit

Introduction (Con't)

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

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

The following readouts are available:

- Space Temperature
- Space Relative Humidity
- Pool Water Temperature
- Compressor Circuit Fault
- Heat mode
- Dehumidification Mode
- Auxiliary Heating Mode
- Pool Water Heating

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 CP 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 CP Series Units without appropriate equipment such as dollies, hoists, hand trucks or fork lifts. (See Figure 1 - page 5).

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.**

Handling and Storage (Con't)

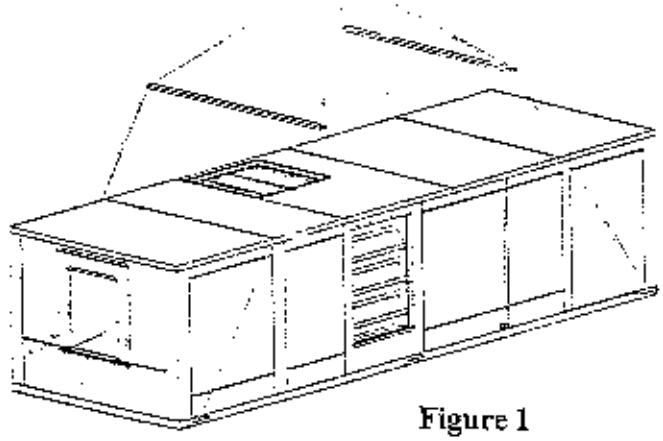


Figure 1

Pre-Installation

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

Prepare for CP 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.

6. On units installed outdoors, insulate all pipes and completely drain the water system

Pool Piping

Refer 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 CP 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 CP Series Unit is connected to the pool return line upstream of the pool heater.

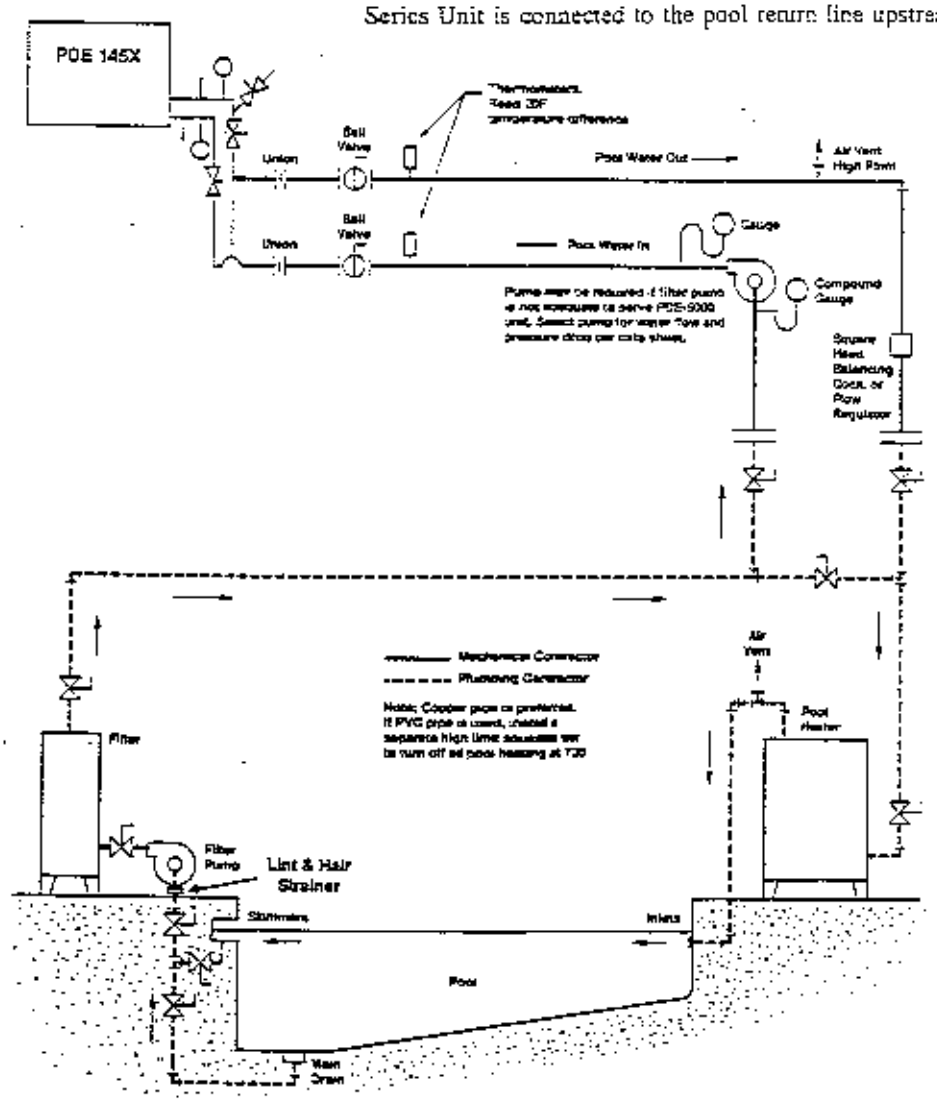


Figure 2

Installation

Installation of the CP 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 CP 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.

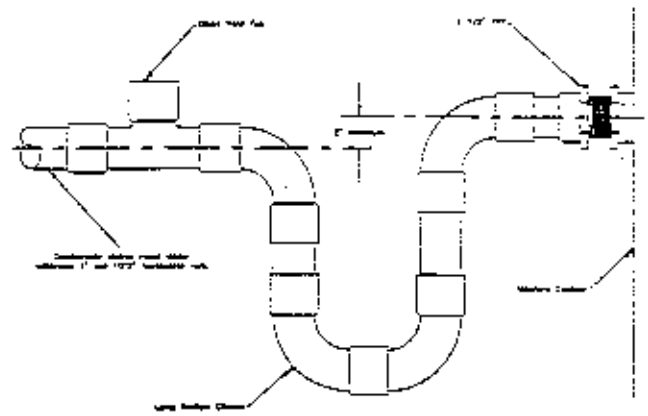


Figure 3

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. On outdoor units, wrap the condensate line with heat tape connected to a freeze stat, then insulate with 1" closed cell insulation.

CP Series Units are equipped with copper sweat unions for water supply and

Pool Water Heating Piping

water return. PVC can be used for pool water supply and discharge piping to the CP 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 the DDC 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 CP) and return (on the line from the CP 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 CP systems.

Refrigerant Piping

Refrigerant piping is only necessary on split system CP 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)

used on all joints. **The use of soft solder may void equipment warranty.**

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 S GS refrigerant oil for each 10.0 feet of refrigerant line over a total of 35.0 feet.

7. Insulate all refrigerant lines.

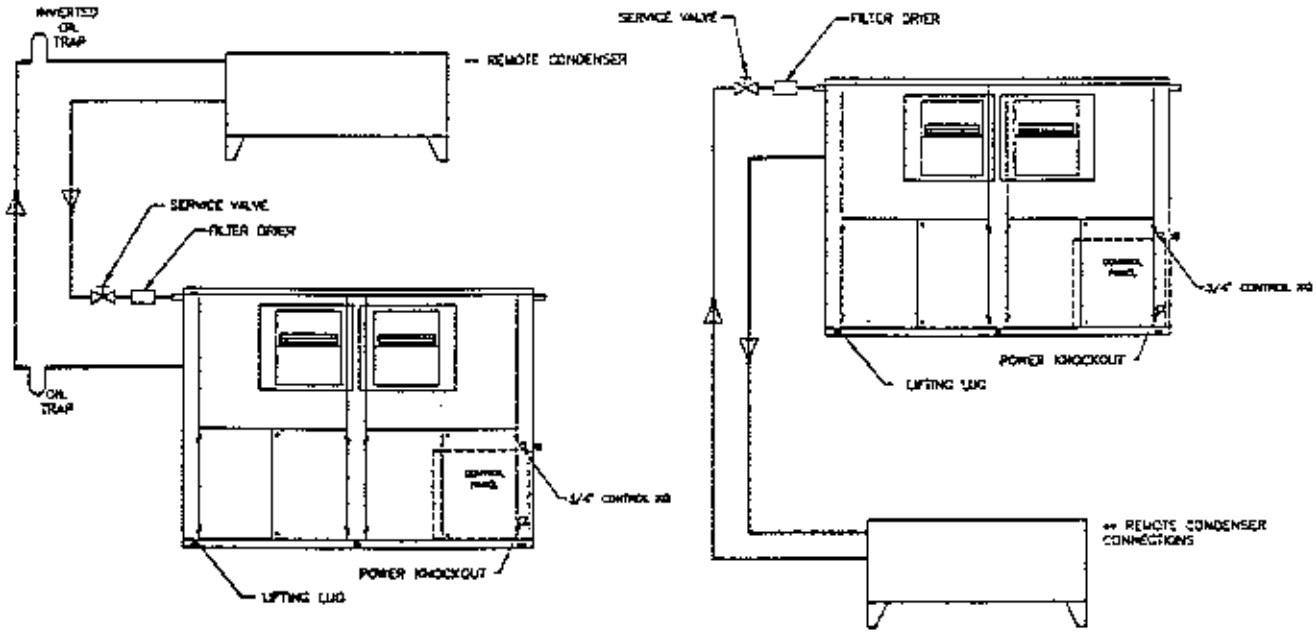


Figure 4

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. Refer to the unit wiring diagrams to ensure proper electrical hookup.

Main Power Wiring

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

Operating Conditions

The CP Series Unit is designed for indoor or outdoor 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 CP is shipped with the following factory installed control sensors:

- *Return dry bulb temperature sensor*
- *Return humidity sensor*
- *Pool water temperature sensor*

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

The CP Unit is designed to operate under the control of a DDC system.

DDC Controls

The DDC provided has three stages of heating and a single stage cooling. The third stage controls emergency heat. The cooling stage controls the liquid line solenoid and the air cooled condenser.

Pool Heater Interlock

CP Series units have normally open (N.O.), interlocking, dry contacts for pool pump control which are located on the control terminal strip. These contacts are closed based on compressor operation. Provide an external power source for these controls.

Auxiliary Heat Interlock

CP Series Units have dry contacts for auxiliary hot water pump control which are located on the control terminal strip. Provide an external power source for these controls.

Remote Air Cooled Condenser (Optional)

The CP Series Unit may be supplied with an optional remote air cooled condenser to reject excess heat outside during periods of mild weather or other times when pool heat and space heat are 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 CP 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 counter-clockwise. 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 required pool temperature
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

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

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

Unit Checkout

- θ Unit is installed completely level and within ambient space. All doors are accessible
- θ Blower belts are adjusted to the proper tension. Fan and motor sheaves are securely tightened.
- θ All braces and straps are removed from the unit
- θ All construction debris is removed from the blower compartment and the condensate pan.
- θ All blower fans rotate in the correct direction.
- θ Refrigerant receiver valves are open.
- θ All refrigerant gauges, temperature probes and amp probes on the main compressor terminal are correctly installed.
- θ All filters are installed and are clean.
- θ 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 .
2. Pump down unit by turning off switch .
3. Verify that the fan runs 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. (Pool heat does not activate if there is no flow.)
6. Verify that the unit is operating in full recirculation mode and that fresh air damper is fully closed. (If damper is not fully closed, adjust time clock to unoccupied mode to close.)
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 controller 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. When the compressor starts, set the thermostat and humidistat to desired room temperature.
4. Assure that power is within range shown on nameplate (+/- 10%).
5. Assure that amperage draw on the compressor(s) 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)

Auxiliary Heating Stage II

1. Lower pool aquastat at a temperature below pool water to turn off pool heater. When the compressor starts, set thecontroller until stage II auxiliary heating is activated. Test stage II auxiliary heating for 15 minutes.

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

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

Emergency Heating - Stage III

1. Set the thermostat and humidistat to maximum. Set aquastat to 80° F. Test stage III emergency heating for 15 minutes.

2. Verify that the emergency air heating electric heaters come on.

3. Complete *Heat-Stage III* on Start-up Data Sheet .

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 Controller 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 South West 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 second stage control for heating 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 contact with moving parts, open unit disconnect switch before servicing unit.

CP 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:

GENERAL UNIT DATA

θ Yes θ No Crank case heater is installed?

θ Yes θ No DDC is installed?

θ Yes θ No Domestic hot water is installed?

θ Yes θ No Pool heating is required?

θ Yes θ No Spa heating is required?

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

θ Yes θ No Drain is properly trapped and pitched?

θ Yes θ No Sheave screws are tight?

θ Yes θ No Fan belts are adjusted?

θ Yes θ No Unit has been flushed?

θ Yes θ No Filters are installed & clean?

θ Yes θ No Wiring conforms to all codes?

θ Yes θ No Ducting conforms to ASHRAE

θ Yes θ No Motor current is in balance?

θ Yes θ No Volts & amps conform to nameplate?

θ Yes θ 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:_____

θ Yes θ No Condensate drains are installed?

θ Yes θ No Ducts are insulated?

θ Yes θ No Ducts are lined?

θ Yes θ No Grilles located as recommended?

θ Yes θ No Grilles & Vents are adjusted?

θ Yes θ No Dampers are adjusted?

HEATING STAGE 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: θ 1/4 θ 1/2 θ 3/4 θ Full Liquid Temperature:

HEATING STAGE 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: θ 1/4 θ 1/2 θ 3/4 θ Full Liquid Temperature:

CP Series Start-up Data Sheet

AUXILIARY HEATING-STAGE III

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: θ 1/4 θ 1/2 θ 3/4 θ Full

θ Yes θ No Boiler operates upon demand?

COOLING-STAGE 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:_____

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

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

Type Cooling Condenser θ Air θ Water θ N/A Aquastat Setting:_____

θ Yes θ No Cooling Condenser operates? Pool Temperature:

POOL 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:_____ θ Yes θ No Field piping is insulated?

Differential:_____ θ Yes θ No Strainers are installed?

θ Yes θ No Circulation pump operates?

ENVIRONMENT

Outdoor Wet Bulb:_____ Dry Bulb:_____ θ Yes θ No Manual control switch is reset to DDC?

Outdoor RH:_____ θ Yes θ No DDC control sequences are tested?

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

θ Yes θ No Additional information is 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 CP Unit is equipped with a Fan ON/Auto switch located on the side of the CP 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 authorized by the factory.**

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.

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

Maintenance and Operation

Refrigerant Recharging

Complete the following steps when recharging the refrigerant system of the CP 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 DEHYDRATED.**
3. Add 3GS oil (or equivalent) to fill the sight glass 1/2 full. Do not overfill compressor.

Control Sequencing

Space Heating

The air temperature in the natatorium is controlled by a three stage thermostat. The first stage controls the refrigeration heat recovery section which gives priority to air heating. The second stage controls the modulating valve for the hot water coil. This stage is set 2 degrees F below stage I. The third stage brings on the emergency electric heat.

Once air temperature has been satisfied, recovered heat is put into the pool water when dehumidification is required. This sequence provides the fastest response to heating demand and is the most economical way to operate the unit.

Space Cooling

Space cooling control is maintained by the the controller furnished with the unit. The set point should be set 4 degrees F higher than pool water temperature.

When space temperature rises above the setpoint, the thermostat signals the compressor to start and cools the air. Excess heat is rejected first to the pool water (if pool water heat is required) then to the remote air cooled condenser

Automatic change over from heating or air conditioning as a function of dry bulb cooling demand in the natatorium.

Humidity Control

The humidistat is part of the controller and is one of the primary operating controls. It should be set to maintain minimum space relative humidity conditions at 50%.

On a call for humidity control, the humidistat signals the compressor to start to dehumidify the air. Heat captured during the dehumidification process is diverted to the hot gas reheat coil, or to the pool heat exchanger (if pool heat is required and space heat temperature is satisfied). Both provide full condensing.

Pool Water Heating

The pool water is heated by the unit reheat once the demand for space heat has been satisfied. Auxiliary pool heat is provided by integral stainless steel heat exchangers fed with hot water from a three way modulating valve from the same supply as the hot water coil. The pool aquastat is set 2 degrees F below the maximum space temperature setting.

Night Time Setback

During periods when the pool is unused for any length of time, it is advisable to cover it with a thermal blanket. This reduces evaporation rate and heat loss. The remote operator panel has (2) sets of adjustable setpoints: (1) for occupied mode and (1) for unoccupied mode.

Frost Protection

The pool dehumidification unit heating water pump (P-2) is interlocked with an outdoor air temperature sensor. P-2 activates when outside temperature drops below an adjustable setpoint.

The CP 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 CP Units. Repair torn insulation immediately. Touch-up paint dings and scratches before rusting occurs.

Filters: The CP is equipped with 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.

Blowers/Motors: Adjust blower and motor belts and replace as needed.

Monthly Maintenance (Con't)

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 CP 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.

Troubleshooting Guide

SYMPTOM	CAUSE	REMEDY
A. Compressor does not run	1. Disconnect switch open	1. Determine why switch was open If everything OK, 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	9 Reset oil pressure failure control switch. Check oil level, oil pressure, wiring and control for faulty control. Restart system.
	10. Defective starting component (1 phase compressors only)	10.Locate and replace
B. Unit short cycles	1. Space thermostat sensor fault	1. Replace sensor
C. Compressor will not start-hums intermittently (cycling on overload	1. Improper wiring	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 only)	3. Replace start capacitor
	4. Relay contacts not closing	4. Check by operating manually Replace defective relay
	5. Open circuit in starting winding (1 phase only)	5. Check stator leads. If leads OK replace stator, or compressor
	6. Stator winding grounded	6. Check stator leads. If leads OK 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

SYMPTOM	CAUSE	REMEDY
D. Compressor starts but motor does not get off start winding	1. Low line voltage	1. Correct low voltage
	2. Improper wiring	2. Check wiring against diagram
	3. Defective relay (1 phase only)	3. Check operation manually. Replace relay if defective.
	4. Running capacitor shorted (1 phase only)	4. Check capacitor with OHM meter. Replace if defective
	5. Start and run windings shorted (1 phase only)	5. Check resistances. If defective, replace stator or compressor
	6. Start capacitor weak (1 phase only)	6. Check capacitance, replace if low
	7. High head pressure	7. See Symptom I
	8. Tight compressor	8. Check oil level and binding.
E. Start relay burned out (1 phase units only)	1. Low line voltage	1. Increase voltage to nameplate rating
	2. Excessive line voltage	2. Replace 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. Replace with proper relay for motor characteristics
F. Start Capacitors burn out (1 phase units only)	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. Replace with capacitor properly rated for voltage and mfd
G. Run Capacitors burn out (1 phase units only)	1. Excessive line voltage	1. Reduce voltage to no more than 10% over nameplate
	2. Wrong capacitor voltage rating	2. Replace with capacitor properly rated for voltage and mfd

SYMPTOM	CAUSE	REMEDY
H. Unit runs continually	1. Thermostat set too high (heat) or too low (cool). Humidistat set too low	1. Adjust control settings
	2. Dirty condenser (air cooled)	2. Clean condenser
	3. Shortage of gas	3. Repair leak and recharge
	4. Dirty filters	4. Replace filters
	5. Overcharge of refrigerant	5. Purge excess
	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 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. Condenser water too little or too warm (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 cool	3. Raise space temperature above 70° F
	4. Leak valves in compressor	4. Overhaul or replace compressor
	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

SYMPTOM	CAUSE	REMEDY
K. Suction pressure too high	1. Excessive load on evaporator	1. Reduce air flow
	2. Expansion valve overfeeding	2. Adjust superheat - min 17° F at compressor. Check that remote bulb is secure
	3. Broken suction valve	3. Overhaul or replace compressor
	4. Unit too small	4. Add unit or replace
L. Suction pressure too low	1. Lack of refrigerant	1. Repair leak and recharge
	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 a 20° F temperature rise
	7. Condenser check valve leaking	7. See diagnostic 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. Mounting loose	3. Tighten mountings
	4. Oil slugging	4. Adjust oil
	5. Internal parts of compressor broken	5. Overhaul or replace compressor
	6. Expansion valve stuck open	6. Repair or replace
	7. Dry or scored bearings	7. Correct 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

SYMPTOM	CAUSE	REMEDY
N. System short of capacity	1. Flash gas in liquid line	1. Add refrigerant, insulate liquid line
	2. Clogged liquid line filter drier	2. Replace
	3. Reduced air flow	3. Adjust
	4. Dirty condenser	4. Clean condenser
	5. Expansion valve stuck or obstructed	5. Repair or replace
	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 2/25 psi differential
	4. Insufficient oil charge	4. Replenish compressor oil. Refer to start-up manual
	5. Refrigerant lines improperly sloped	5. Repitch lines. Slope in the direction of refrigerant flow
	6. Check valves leaking	6. See diagnostic section
	7. Liquid flooding back to condenser	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 lines	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	3. Open valve or remove restriction
	2. Plugged liquid line filter drier	2. Replace

Plugged Filter/Drier

The liquid line filter drier may become plugged with dirt or foreign material left in the system during the installation f the remote air cooled condenser or split system components. When this happens, the liquid line leaving the filter drier feels 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, replace the drier.

Thermostatic Expansion Valve Stuck Open

If the expansion valve is stuck in the open position, there is 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 does not stop the excess liquid, take the valve apart and clean it or replace the valve.

The power element of an expansion valve consists of the remote bulb, a capillary tube and the bellows or diaphragm which actuates the valve cage. If the power element is inoperative or has lost is charge, the valve either maintains an almost closed position or closes completely. To test for an 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
f. Warm bulb in the hand
g. Check the suction line for rapid temperature. This indicates flood through of liquid refrigerant and proper operation of the power assembly

CAUTION: Avoid an extended period of flood back through the suction line. Excess liquid flood back can cause sever damage to the compressor.

Thermostatic Expansion Valve Improperly Adjusted

When the expansion valve is adjusted for too low a superheat, too much liquid passes through the evaporator. The suction line is abnormally cold and liquid may slug back to the compressor. If the expansion valve is adjusted for too high superheat, too little liquid passes to the evaporator and the suction line is abnormally warm. Superheat should be set no less than 17° F at the compressor.

Thermostatic Expansion Valve Obstructed

When the thermostatic expansion valve has a small obstruction, it cannot pass sufficient amount of liquid refrigerant to satisfy the evaporator. The superheat becomes too high and the system loses capacity. Suction pressure is low. If the obstruction is large, only a small amount of liquid can pass. This causes the compressor to cut-out on low pressure. An obstructed expansion valve is usually indicated by a partly warm evaporator and frosting at the evaporator inlet

Liquid Line Solenoid Valve Leaks

When the liquid line solenoid valve leaks, the compressor short cycles on pump down control. The liquid line leaving the solenoid valve feels colder than the liquid entering the valve and in some cases sweating or frost on the solenoid valve may occur.

Solenoid Valve Obstructed

When the solenoid valve is obstructed, the operation is much the same as if the valve were obstructed. An obstructed valve can be detected by a temperature change in the refrigerant line through the valve. The liquid line leaving the valve is colder than the liquid line entering the valve and may sweat or frost. Usually, if the solenoid valve is obstructed, it cannot close and the compressor short cycles on the pump down control.

Refrigerant Shortage

Sufficient liquid should be present in the receiver to completely submerge the inlet to the liquid line pipe. When there is a shortage of refrigerant, the liquid level falls below the line inlet and bubbles appear in the sight glass The larger the bubbles the more severe the refrigerant shortage. This condition may also be indicated by a hissing or a whistle at the expansion valve. The coil and suction line is warm to the touch .When the condition is sever, suction pressure is low because of little or no liquid is being supplied to the evaporator.

Refrigerant Overcharge

An overcharge of refrigerant causes high head pressure. Liquid backs up in the condenser and decreases the amount of surface available for condensing. As a result, head pressure rises. In extreme cases, head pressure may rise to the point where the thermal overload elements in the starter or the high pressure cut-out switch stops the compressor

Air in System

When air or other non-condensable gasses are present in the system, they tend to move toward and collect at the condenser. The head pressure rises to a point above the pressure at which vapor condenses. The pressure may rise to a point where either the high pressure cut-out or the thermal overload elements in the starter stop the compressor.

To determine if there is air in the system, the compressor must be allowed to stand idle until the entire system is as cool as ambient conditions. At that time, the high pressure gauge reading should not be more than 10 lbs greater than the saturation pressure of the surrounding air.

Broken Valves in Compressor

Broken suction valves, or broken or leaky discharge valves in the compressor are generally indicated by a rapid rise in suction pressure when the machine is stopped. If the suction pressure rises faster than 5 lbs per minute, check for all possible causes of pressure rise including a leaky solenoid valve. Close the suction service valve and run the compressor until a vacuum of 22 in Hg is reached. When the compressor is stopped, it should hold vacuum. If it does not hold, or cannot reach vacuum, valves are leaking.

Head Pressur Control Valve Malfunction

When a head pressure control valve is utilized on the system, enough refrigerant must be present to flood the condenser at the lowest expected ambient temperature with enough additional system charge for proper operation. A shortage of gas can cause hot gas to enter the liquid line and the expansion valve. Refrigeration then ceases.

All APR units are factory charged and tested before shipping and receivers are sized to handle the additional charge required for remote condensers.

Head Pressur Control Valve Malfunction (con't)

The following chart lists the most common malfunctions when a head pressure control valve is used and possible remedies.

POSSIBLE CAUSE	REMEDY
Low Head Pressure	
1. Insufficient refrigerant charge to flood condenser	1. Add charge
2. Head control valve fails to close due to foreign material in valve	2. Cause valve to open by raising condenser/receiver pressure above valve setting by cycling condenser fan. If foreign material does not pass through valve, replace valve
3. Head control valve fails to close due to loss of air charge in element	3. Replace valve
High Head Pressure	
1 Dirty condenser coil	1. Clean coil
2. Air on condenser blocked	2. Clear area around coil
3. Too much refrigerant charge	3. Remove charge until proper head pressure is maintained
4. Non-condensable gas in system	4. Purge air from system
5. Restricted due to stopped inlet strainer	5. 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*	6. Replace valve with one with higher pressure differential or install a pressure differential valve in series with the bypass port of the valve (which serves to increase the pressure differential

*This can occur if the remote condenser is installed below the unit. 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, take corrective action.

Leaking Check Valves

When the liquid line check valves leak, the system is short on capacity. It may even trip out on oil pressure failure control. If the leak is sever, the liquid line to the idle condenser is cold with signs of sweating or frost. Check for a leaking check valve by one of two methods.

Take a reading across the check valve on the liquid line to the idle condenser. Both entering and leaving temperatures should be the same.

Leaking Check Valves(con't)

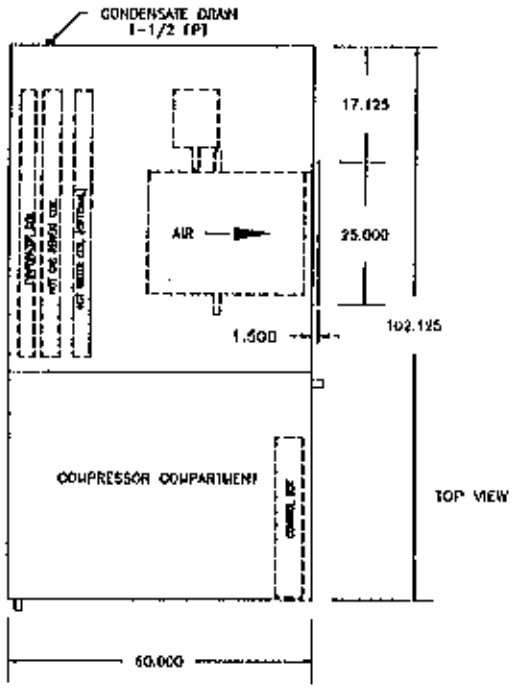
The second method is more accurate. Since APR units recover refrigerant from the inactive condenser, the condenser should reach suction pressure within 10 minutes. If the check valve is leaking, part of the refrigerant flows to the expansion valve and part to through the leaky check valve to the idle condenser. Since the expansion valve only receives part of the refrigerant, the coil is warm and the superheat at the coil is high. If the superheat at the compressor is less than the superheat at the evaporator, the check valve is leaking. This test is only accurate if ample time is given for the idle condenser to bleed off its charge.

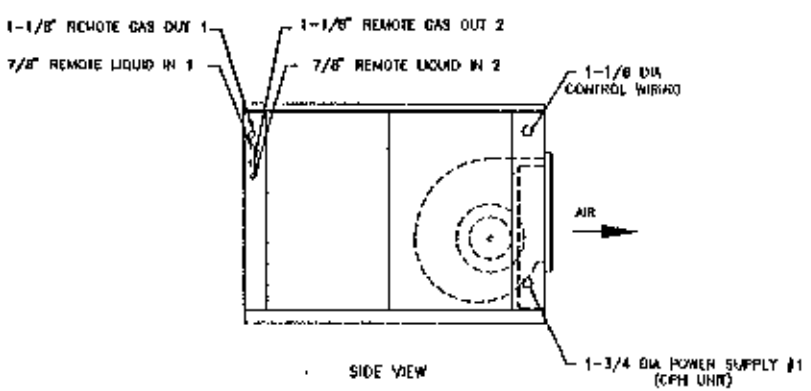
If a check valve in the hot gas line is leaking, the unit is short of capacity and may trip out on oil pressure failure control. To determine if a check valve is leaking, take a temperature on the inlet side of the valve as far as possible from the check valve. If the temperature is close to that of the hot gas discharge temperature, it is a good indication that the check valve is leaking.

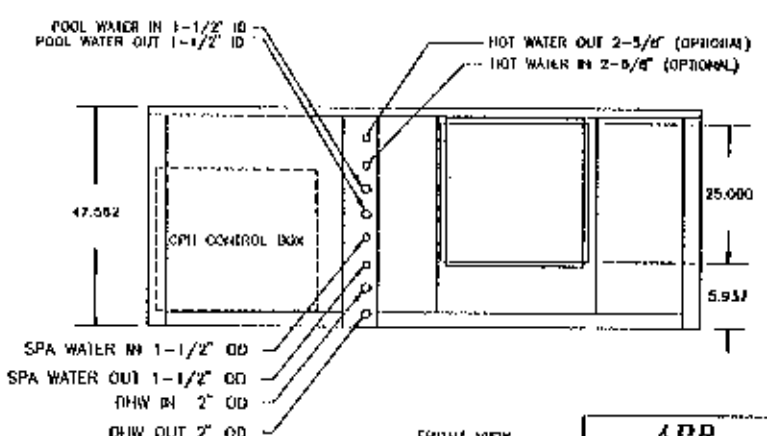
Another method is to inspect the bleed port of the pool heat valve, domestic hot water valve or spa heat valve for signs of condensation. Condensation is a good indication that the check valve is leaking.

A final method is to satisfy the water heat exchanger and measure the entering and leaving water temperature. If there is a temperature rise on any of the heat exchangers, there is a possibility that a check valve is leaking, however, it can also indicate that the heat valve didn't shift and is stuck in the heat position.

When a leaking valve is found, clean the valve of foreign material or replace it.







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CPH085/095

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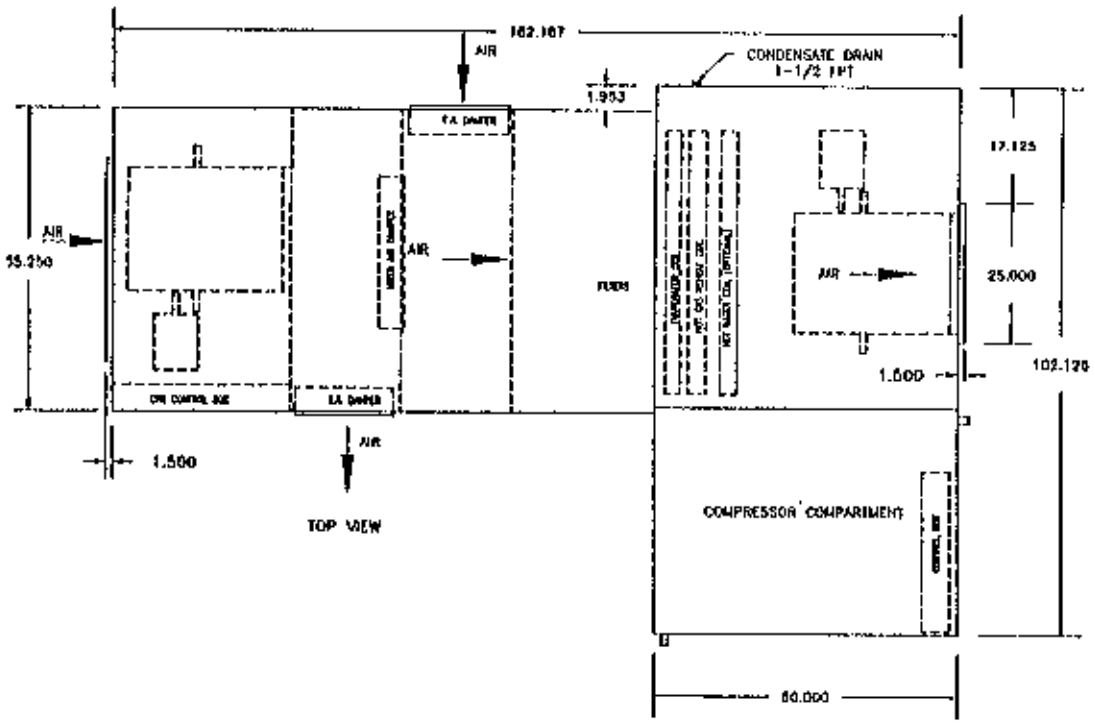

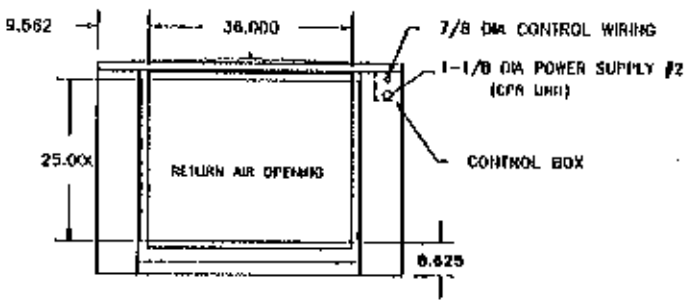

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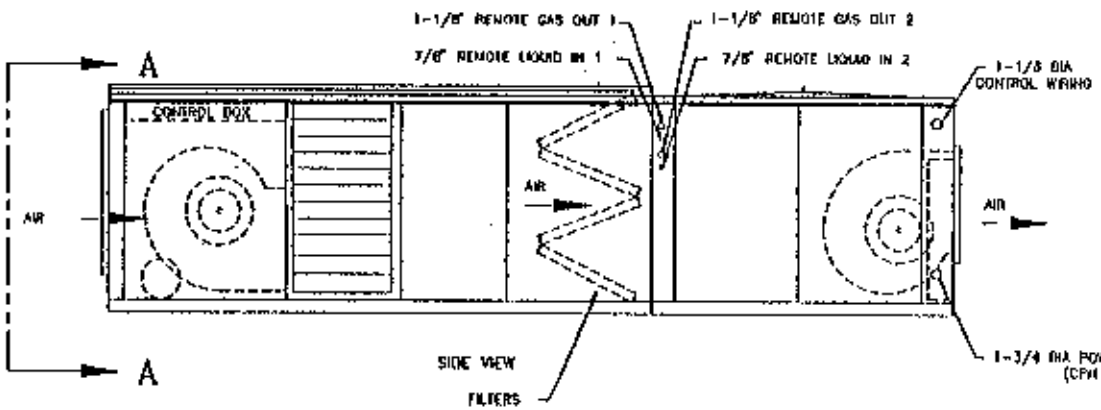

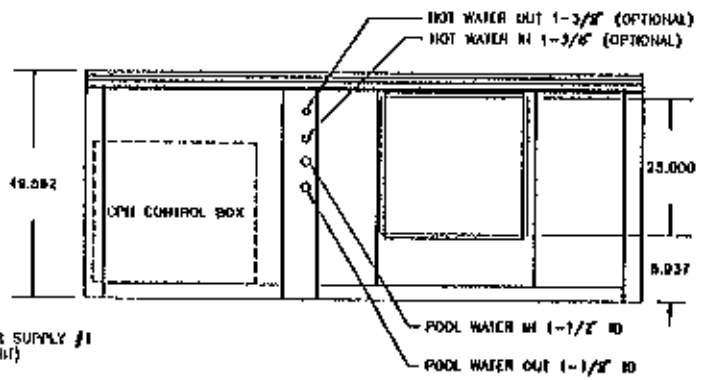

FRONT VIEW

APR CORPORATION

CPM095 WITH CPR POWER RETURN (WEATHERPROOF)

CP-095	HORIZONTAL
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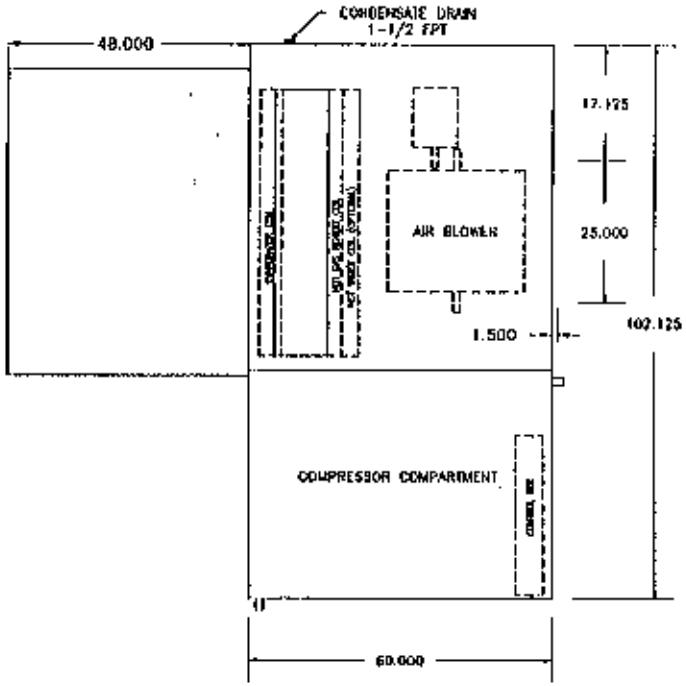

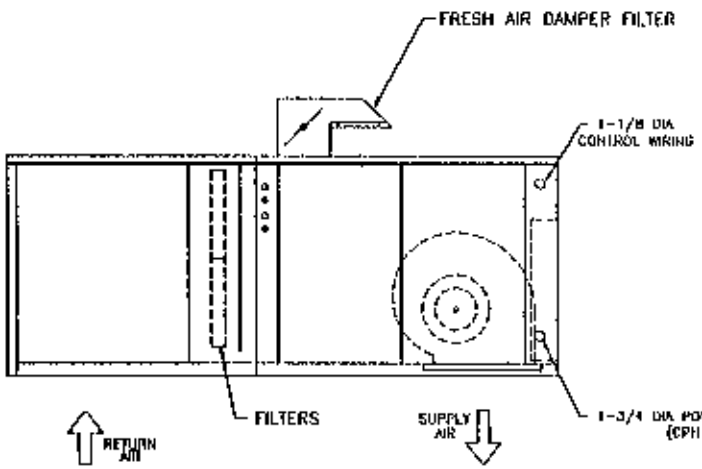

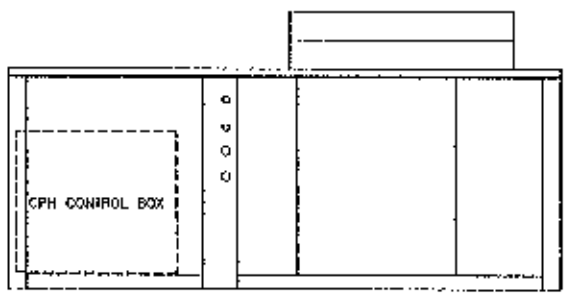

APR CORPORATION

CN1085/095 WITH FRESH/RETURN AIR PLENUM (WEATHERPROOF)

CP-085/095 | HORIZONTAL

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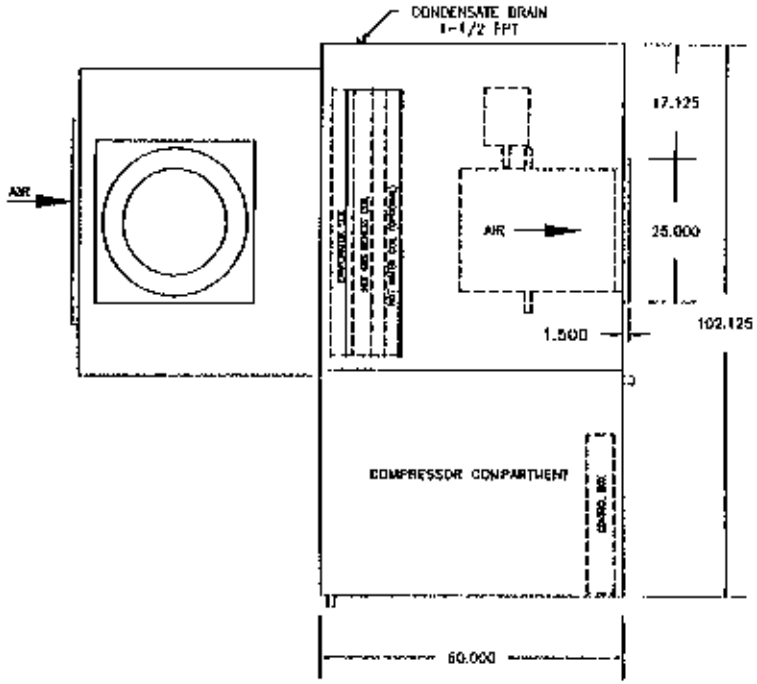
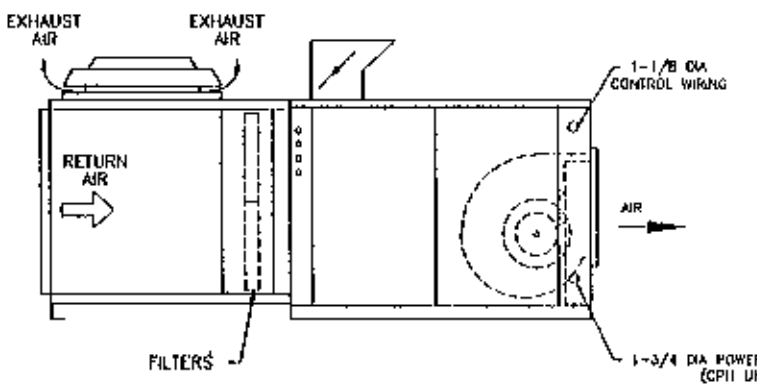
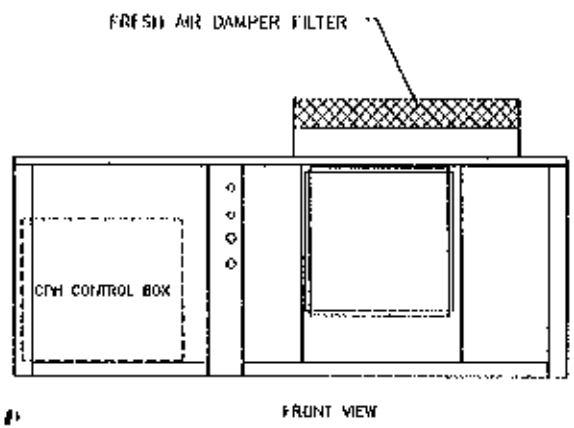


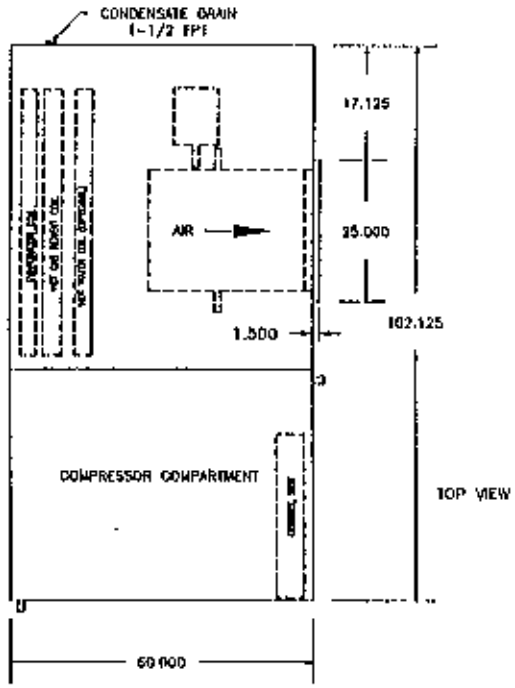


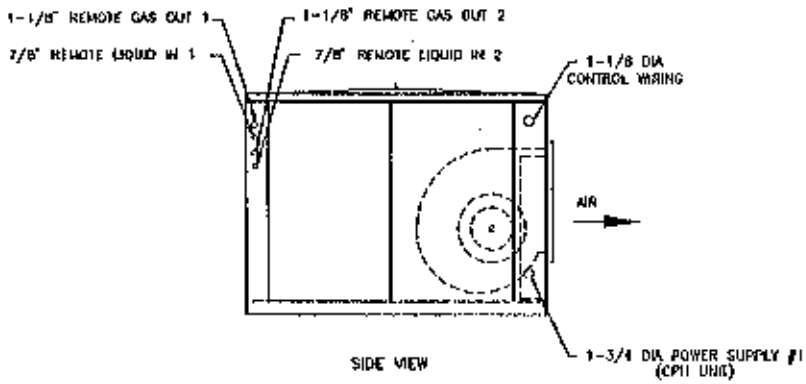


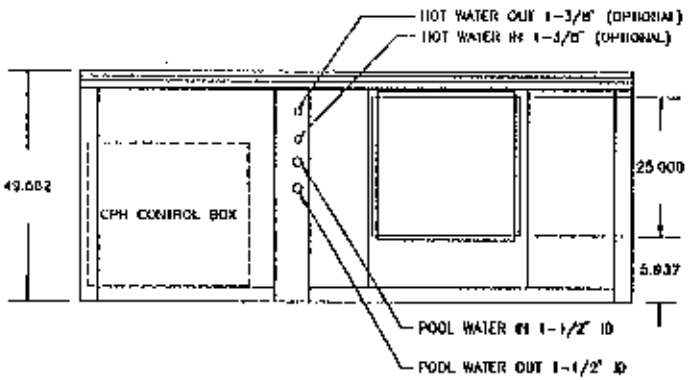
APR CORPORATION

CP1085/085 WITH FRESH/EXHAUST PACKAGE (WEATHERPROOF)

MODEL CP-085/085	DRAW HORIZONTAL
DATE 11 MAR 94	SCALE NTS
	DRAWING NO. CP095PR1





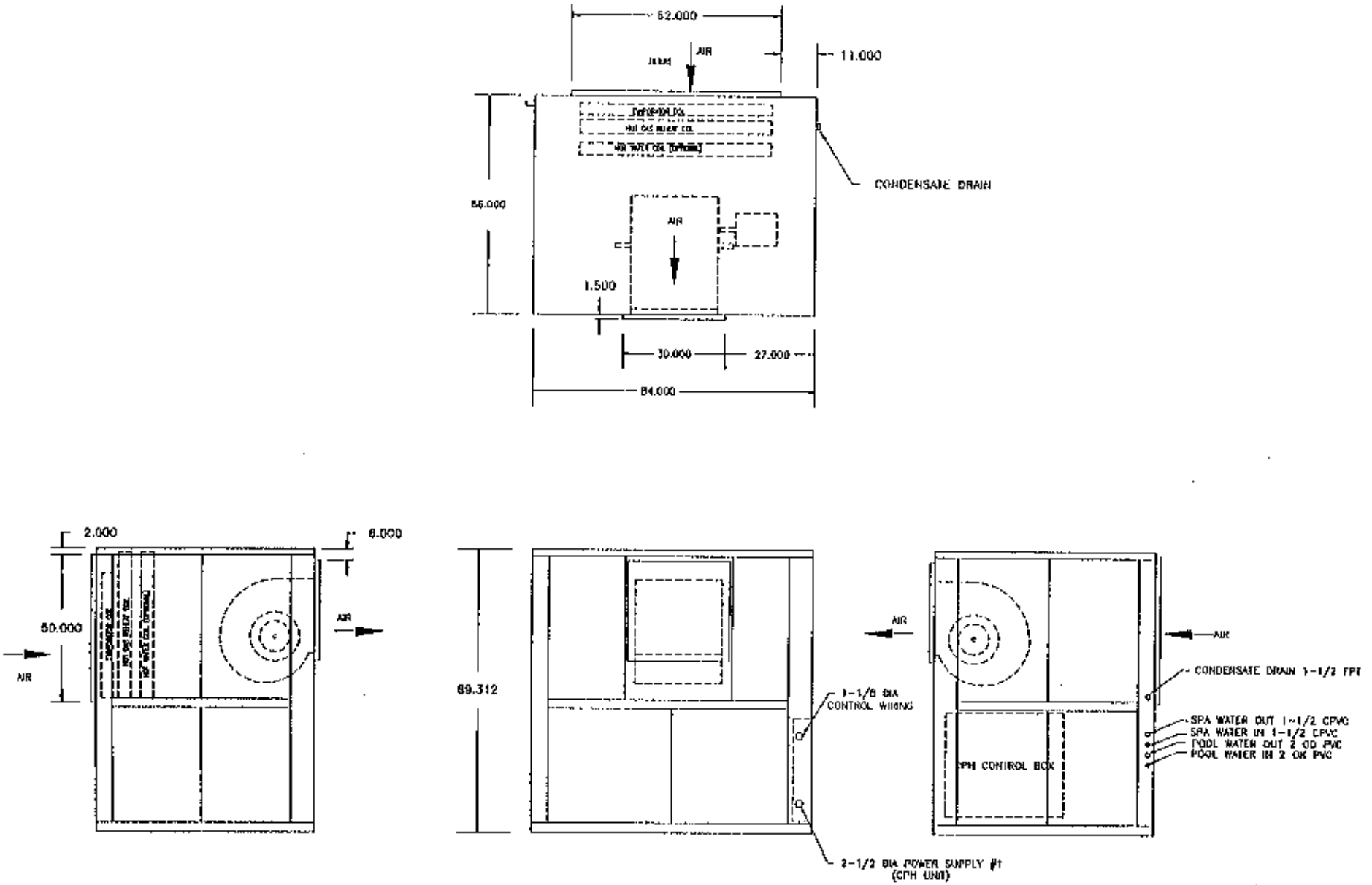


APR CORPORATION

CPH085/095
(WEATHERPROOF)

MODEL CPH-085/095 | BASE HORIZONTAL

DATE 07 JUL 94 | SCALE NTS | DRAWING NO. CPH095

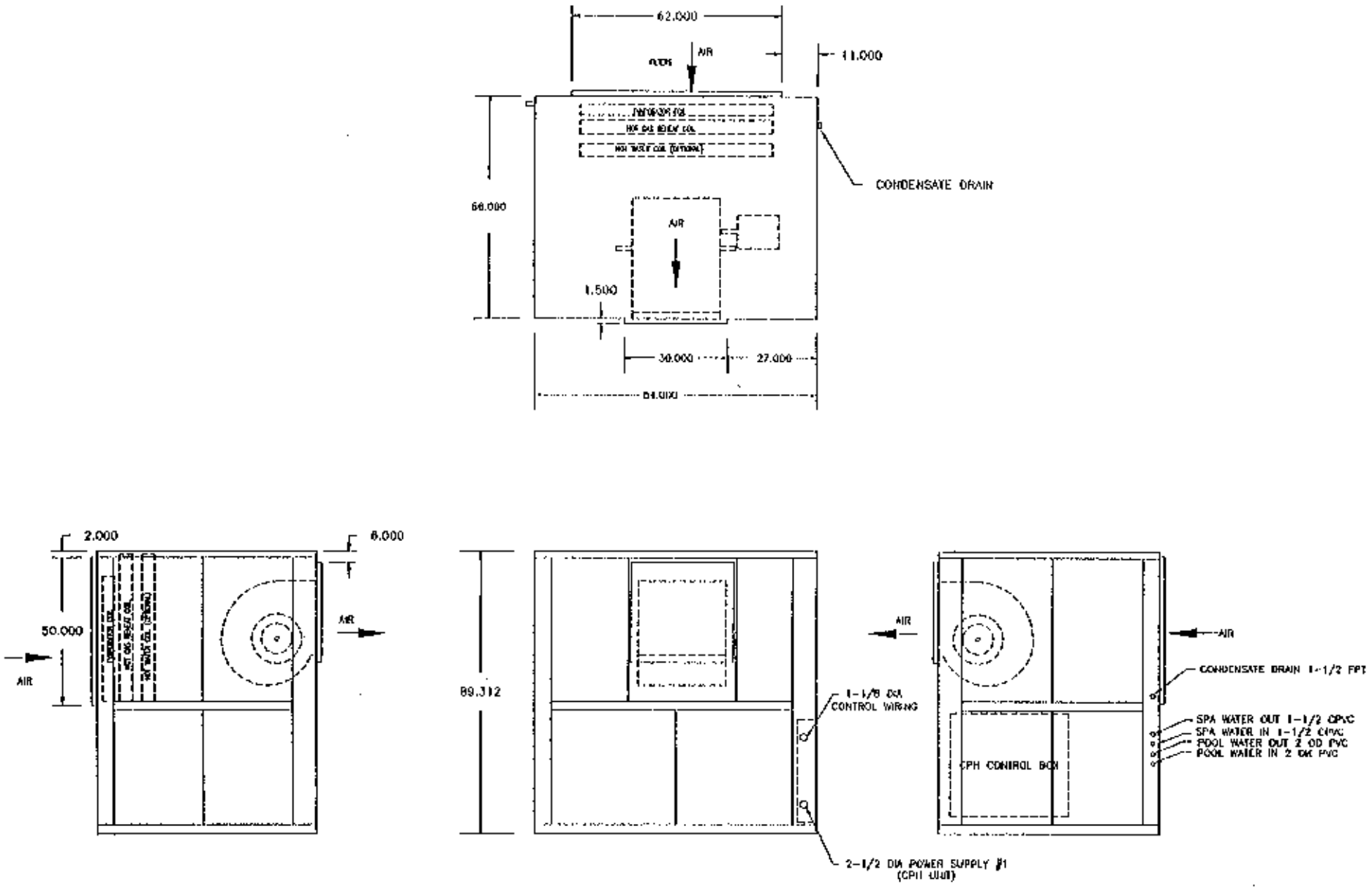


APR CORPORATION

CPV120/140

CPV140 | VERTICAL

16 MAR 95 | NTS | CPV1200

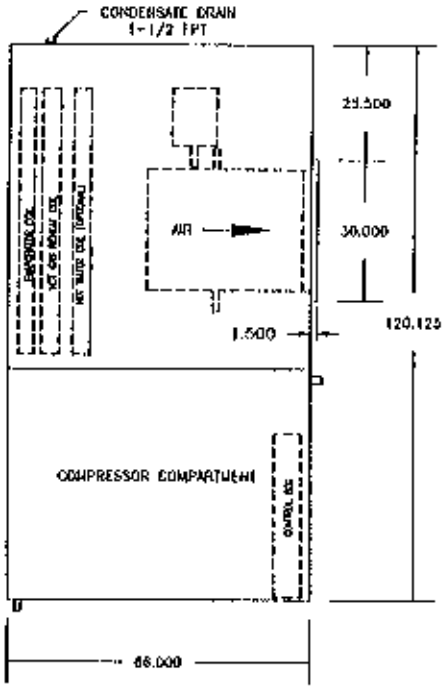


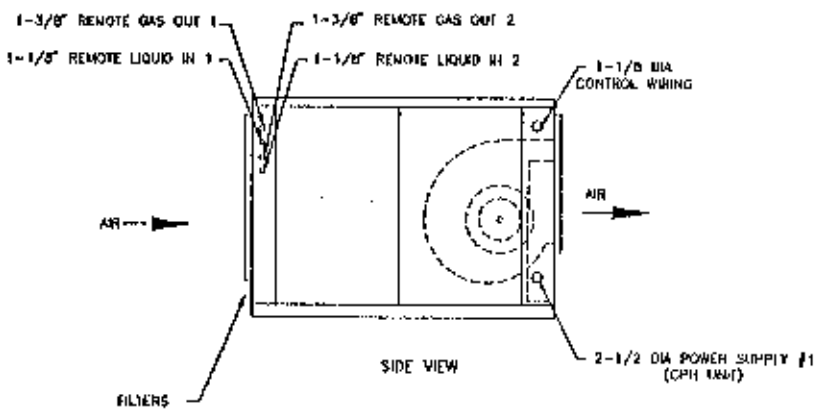
APR CORPORATION

CPV120/140

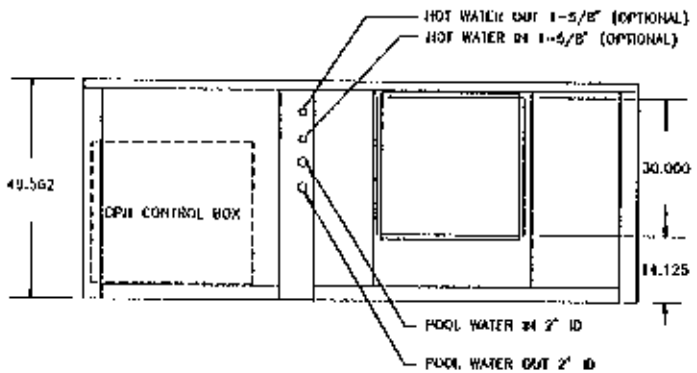
CPV120 | VERTICAL

06 JAN 95 | NTS | CPV12001





SIDE VIEW



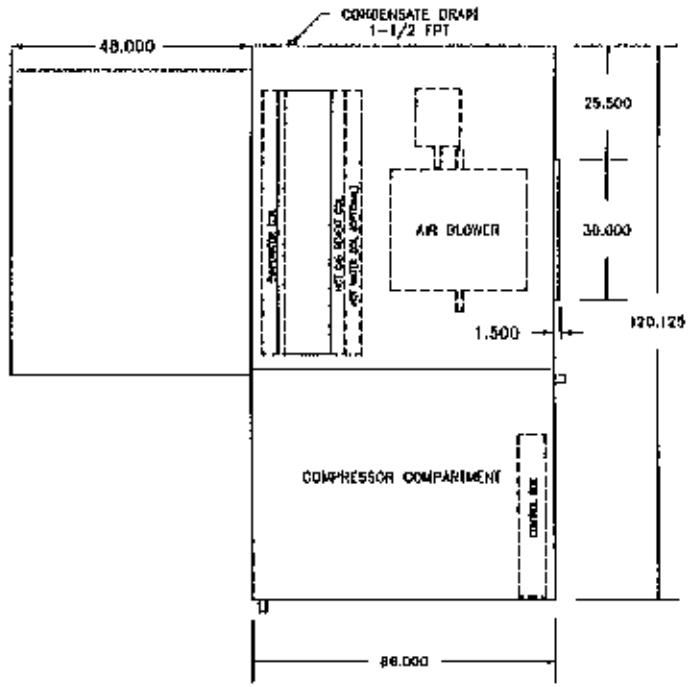
FRONT VIEW

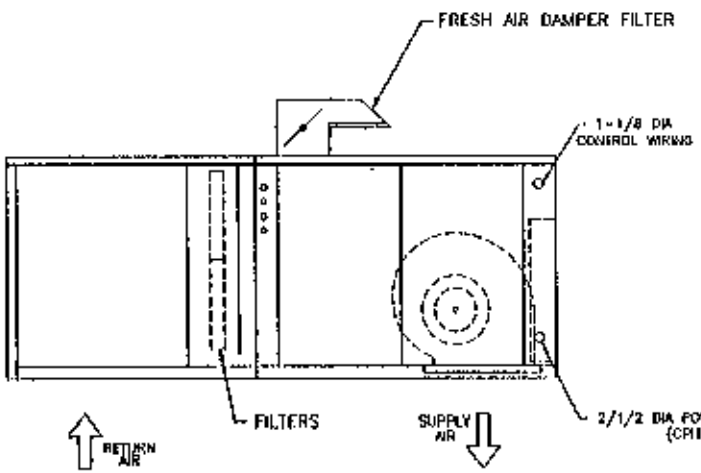
APR CORPORATION

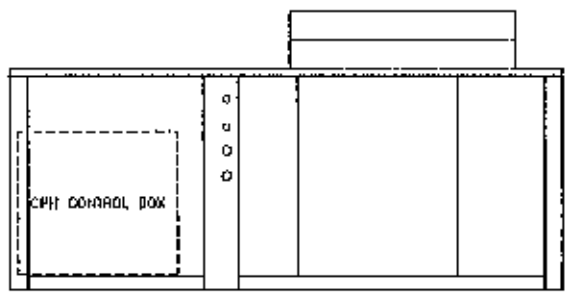
CPH120/140

CPH120/140 HORIZONTAL

30 NOV 94 NTS CPH120







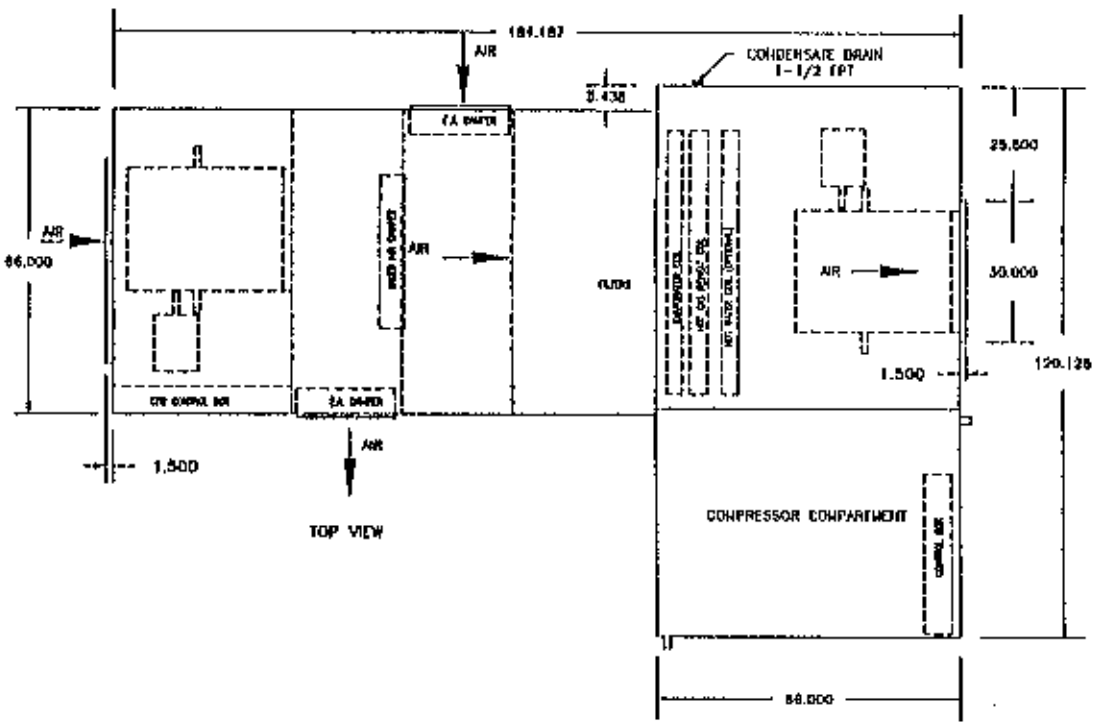
FRONT VIEW

APR CORPORATION

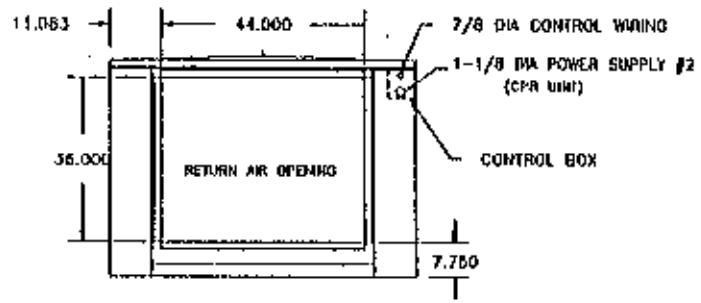
CPH120/140 WITH FRESH/RETURN AIR PLENUM (WEATHERPROOF)

MODEL CP-120/140 STYLE HORIZONTAL

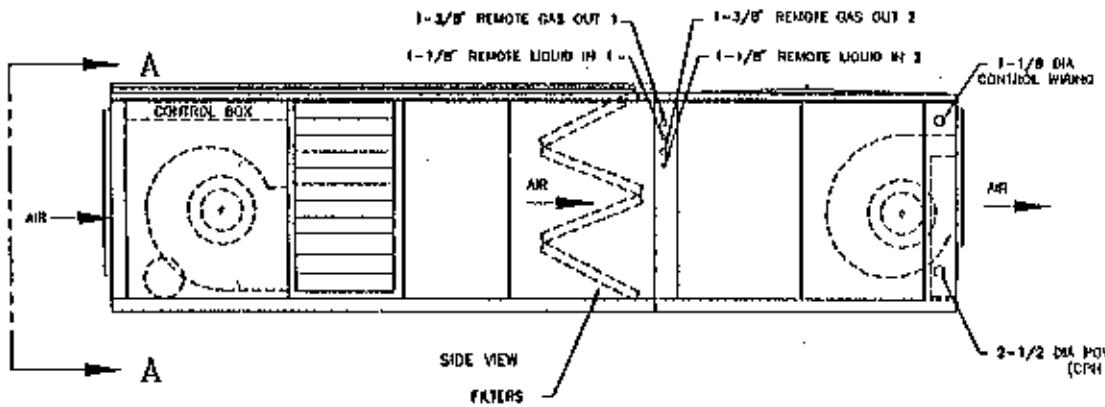
DATE 08 AUG 94 SCALE NTS DRAWING NO SK080894

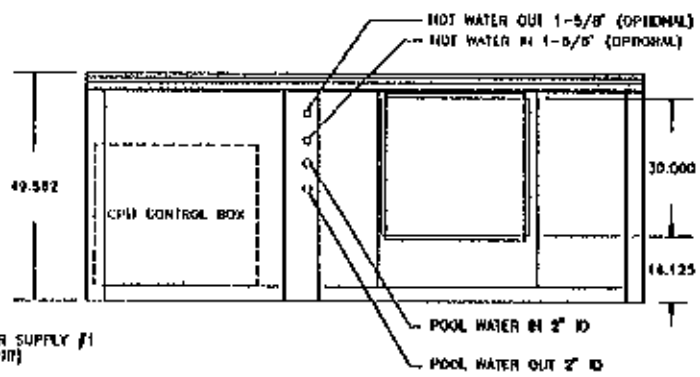


TOP VIEW



VIEW A-A





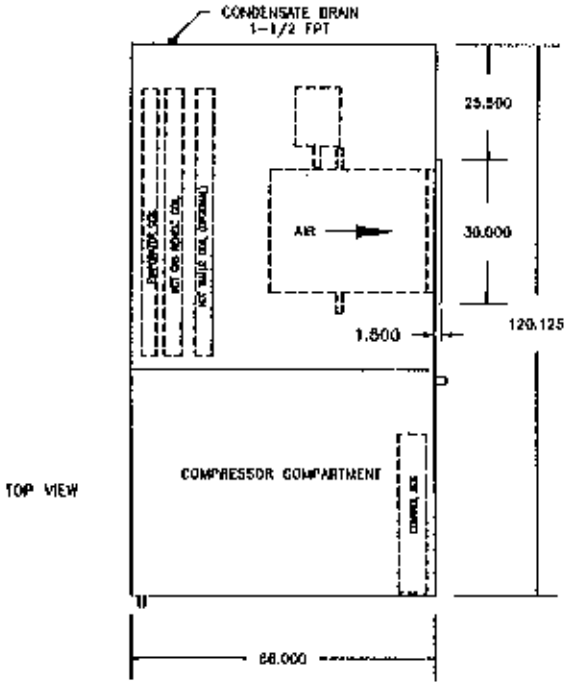
FRONT VIEW

APR CORPORATION

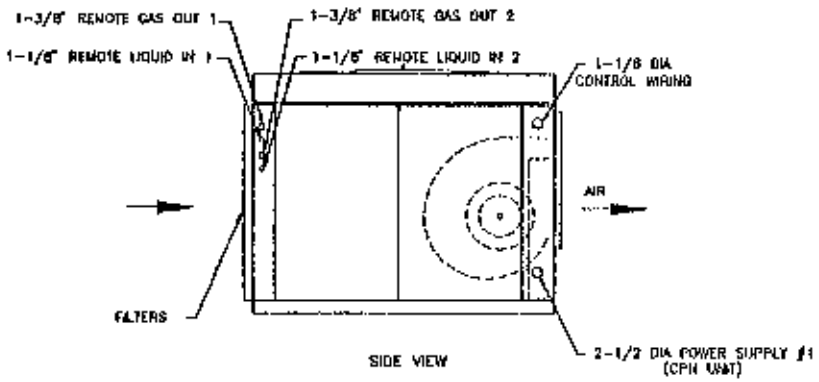
CPH120 WITH CPR POWER RETURN (WEATHERPROOF)

CP-120PR | HORIZONTAL

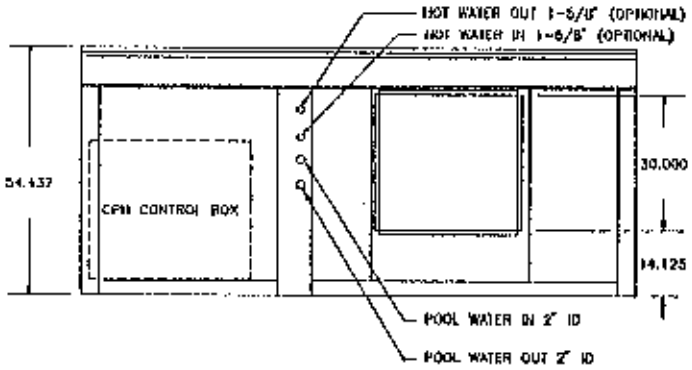
09 MAR 94 | NTS | CP120PR



TOP VIEW



SIDE VIEW

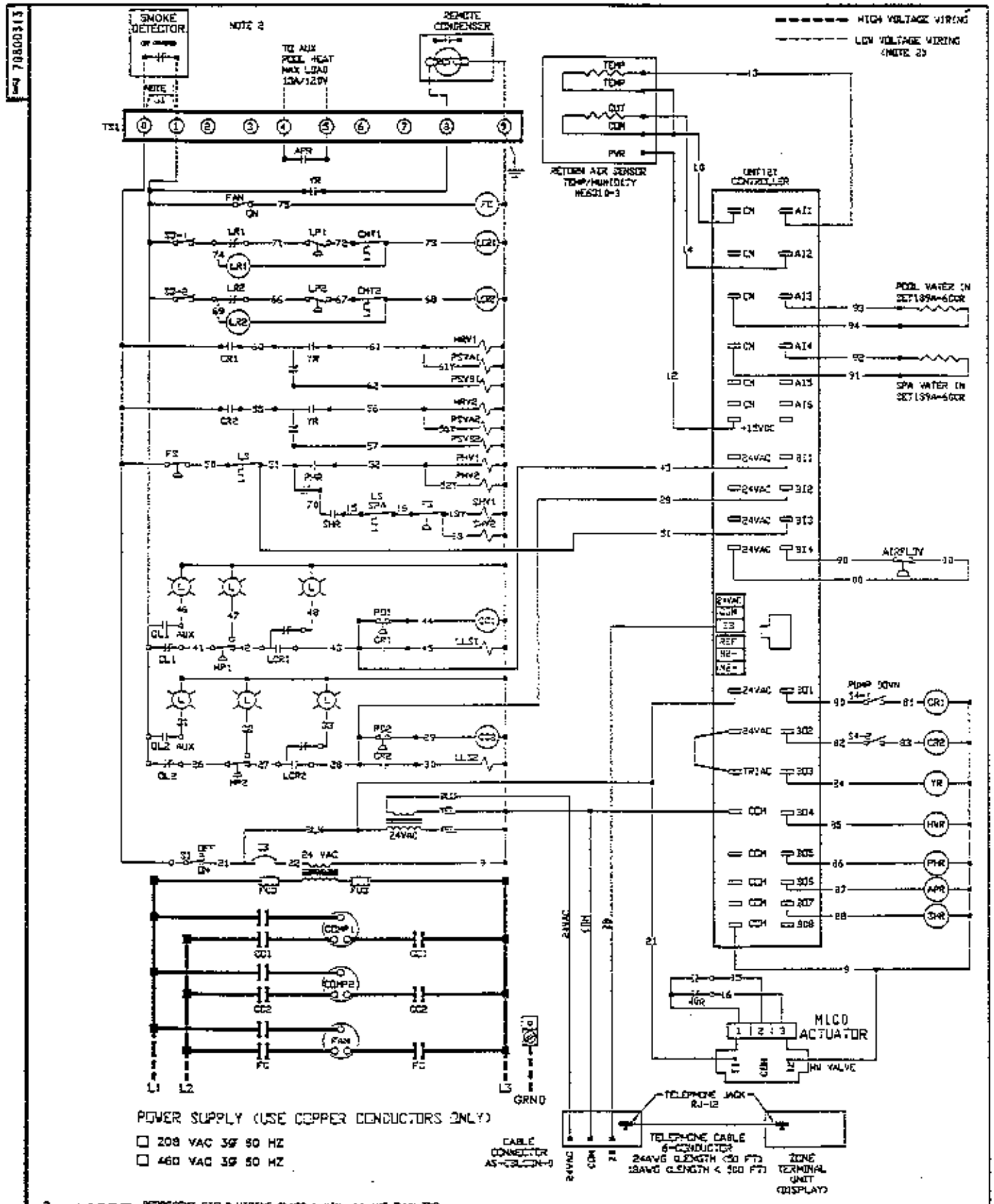


FRONT VIEW

APR CORPORATION

CPH140
(WEATHERPROOF)

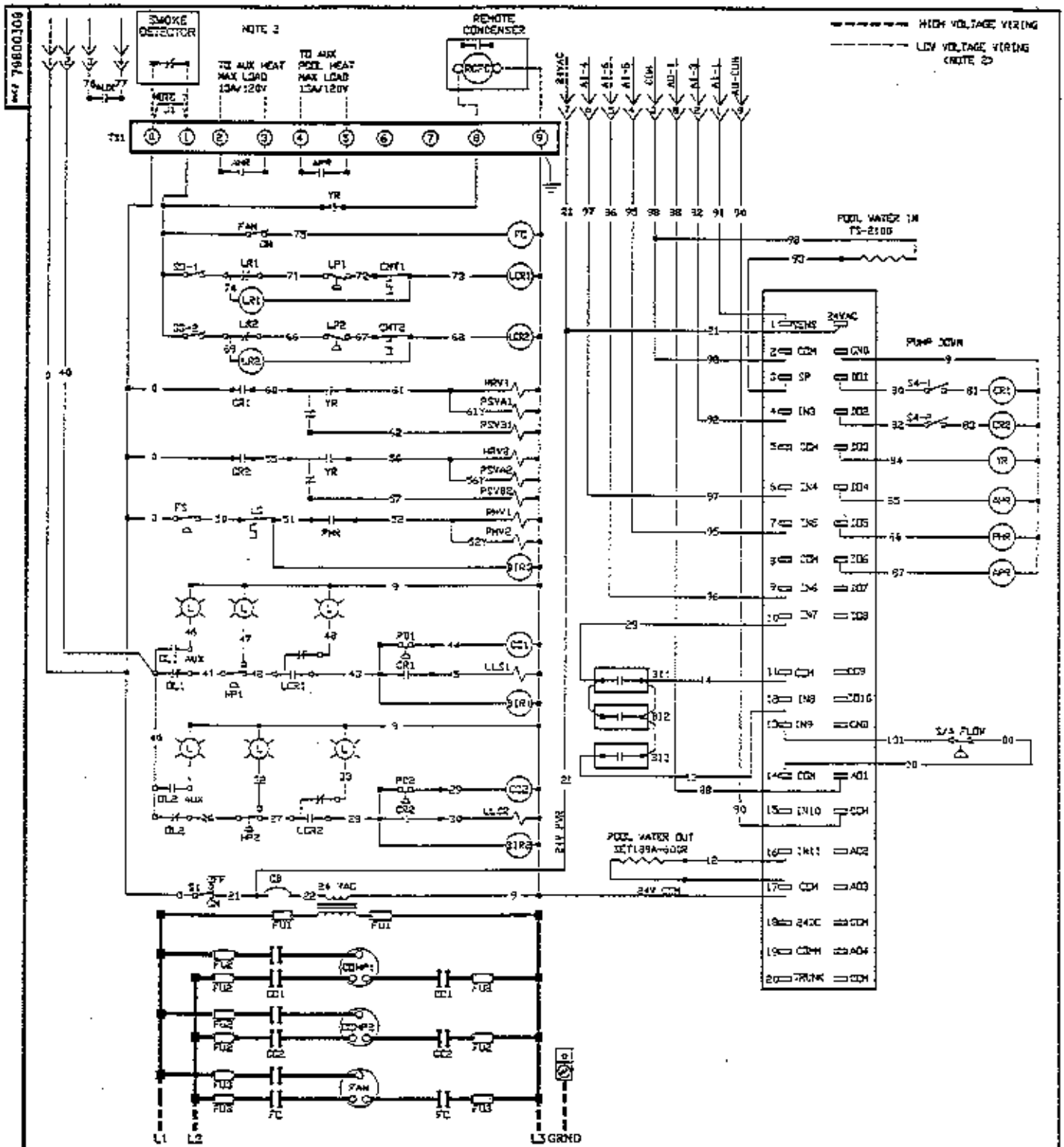
MODEL CPH140	STYLE HORIZONTAL
DATE 21 JUL 94	DRAWN BY MTS
	DRAWING NO. CPH140



2. ——— REPRESENT FIELD WIRING CLASS 1 MIN. 14 AWG THHN TYP.
1. REMOVE JUMPER J1 AND REPLACE WITH SMOKE DETECTOR (BY OTHERS).

NOTES:

APR Corporation	MODEL NUMBER	DRAWING #	SHEET #
	CPV/H 085/095/120 RC + PH (PARTIAL) + SPA + HW HEAT (ON/OFF-M100 ACT)	79800313 08/FEB/95	1



POWER SUPPLY (USE COPPER CONDUCTORS ONLY)

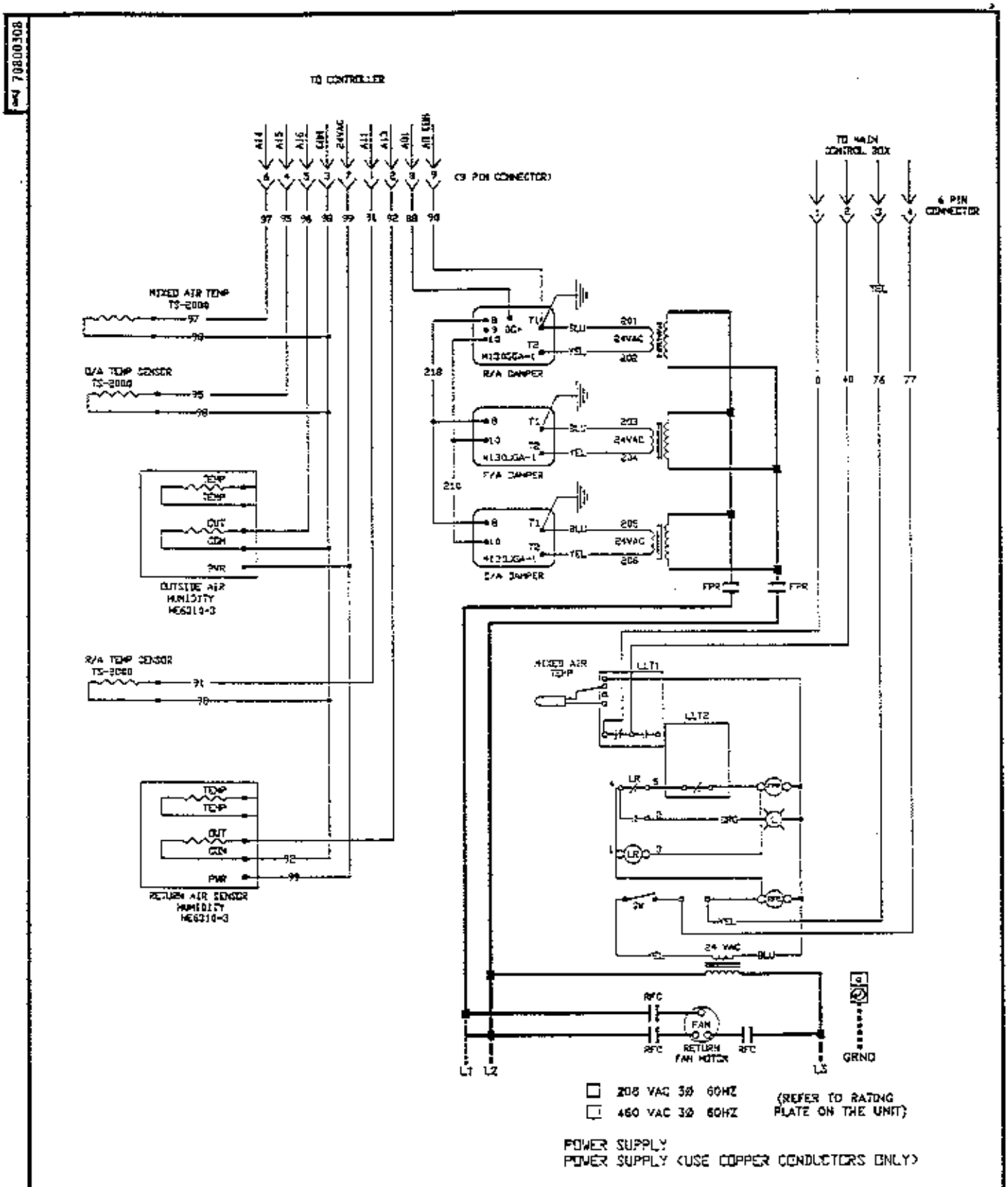
	CPH085	CPH095	CPH120	CPH085	CPH120
☐ 208 VAC 3Ø 60 HZ	FU1 = 3.5A	FU2 = 55A	FU2 = 88A	FU3 = 38.7A	FU3 = 44.2A
☐ 460 VAC 3Ø 60 HZ	FU1 = 1.6A	FU2 = 25A	FU2 = 40A	FU3 = 17.5A	FU3 = 20A

(REFER TO RATING PLATE ON THE UNIT)

2. ——— REPRESENT FIELD WIRING CLASS 1 MIN. 14 AWG 75deg TYP.
1. REMOVE JUMPER J1 AND REPLACE WITH SMOKE DETECTOR (BY OTHERS).

NOTES:

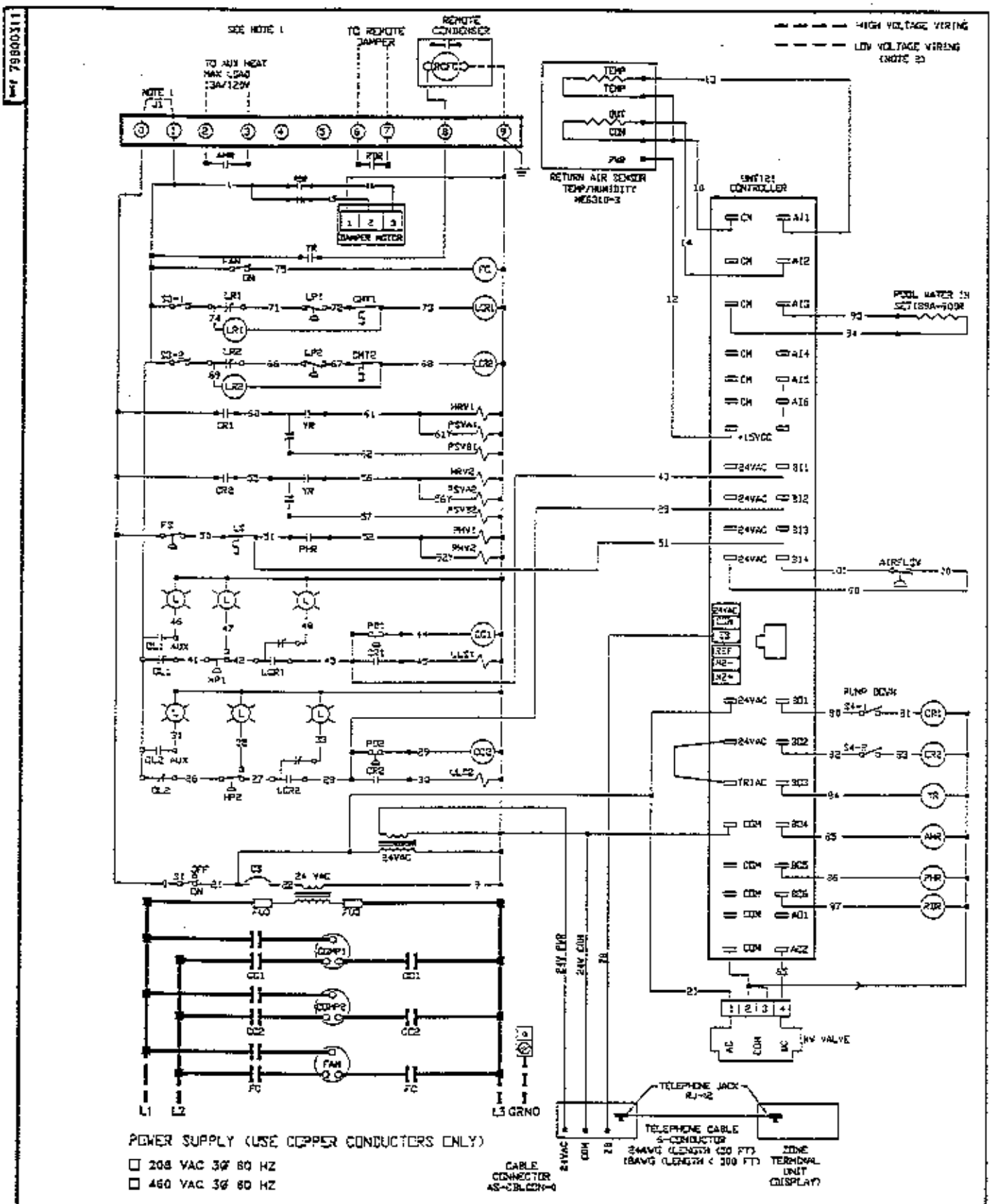
	MODEL NUMBER	DRAWING #	SHEET #
APR Corporation	CPV/H 085/095/120 W/ALERTON RC + PH (PARTIAL) + AUX HT + ECONOMIZER	79800309 29 SEPT 94	1



1. DASHED LINES REPRESENT FIELD WIRING CLASS I MIN. 14 AWG THHN TYP.

NOTES:

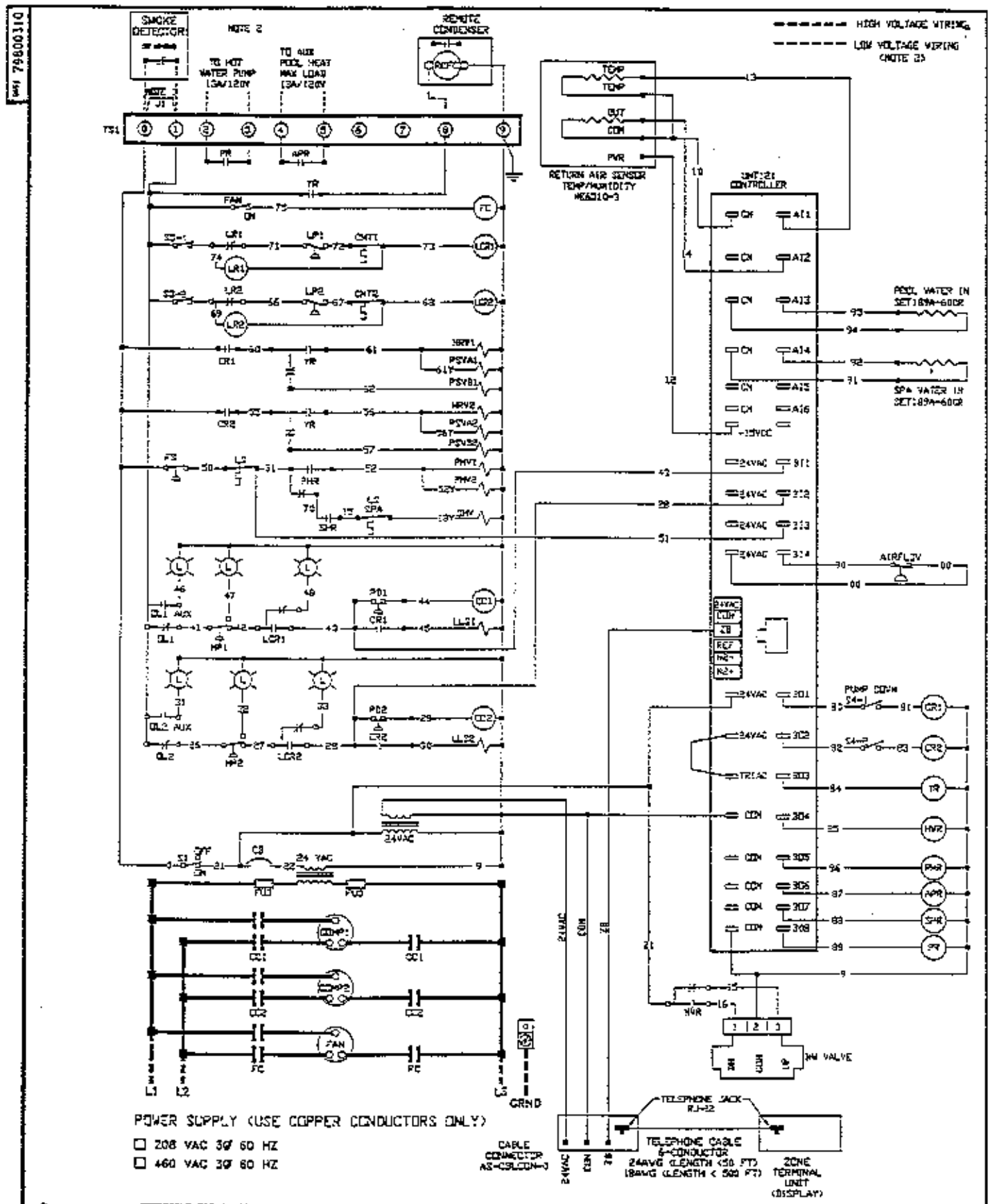
	MODEL NUMBER	DRAWING #	SHEET #
APR Corporation	CPR POWER RETURN—ECONOMIZER W/ ALERTON WIRING DIAGRAM	79800308 29 AUG 94	1



APR Corporation	MODEL NUMBER	DRAWING #	SHEET #
	CPV/H 085/095/120 RC + PH (PARTIAL) + HW HEAT (MOD) + RDR W/ MTR DAMPER	79800311 21 JAN 95	1

LEGEND

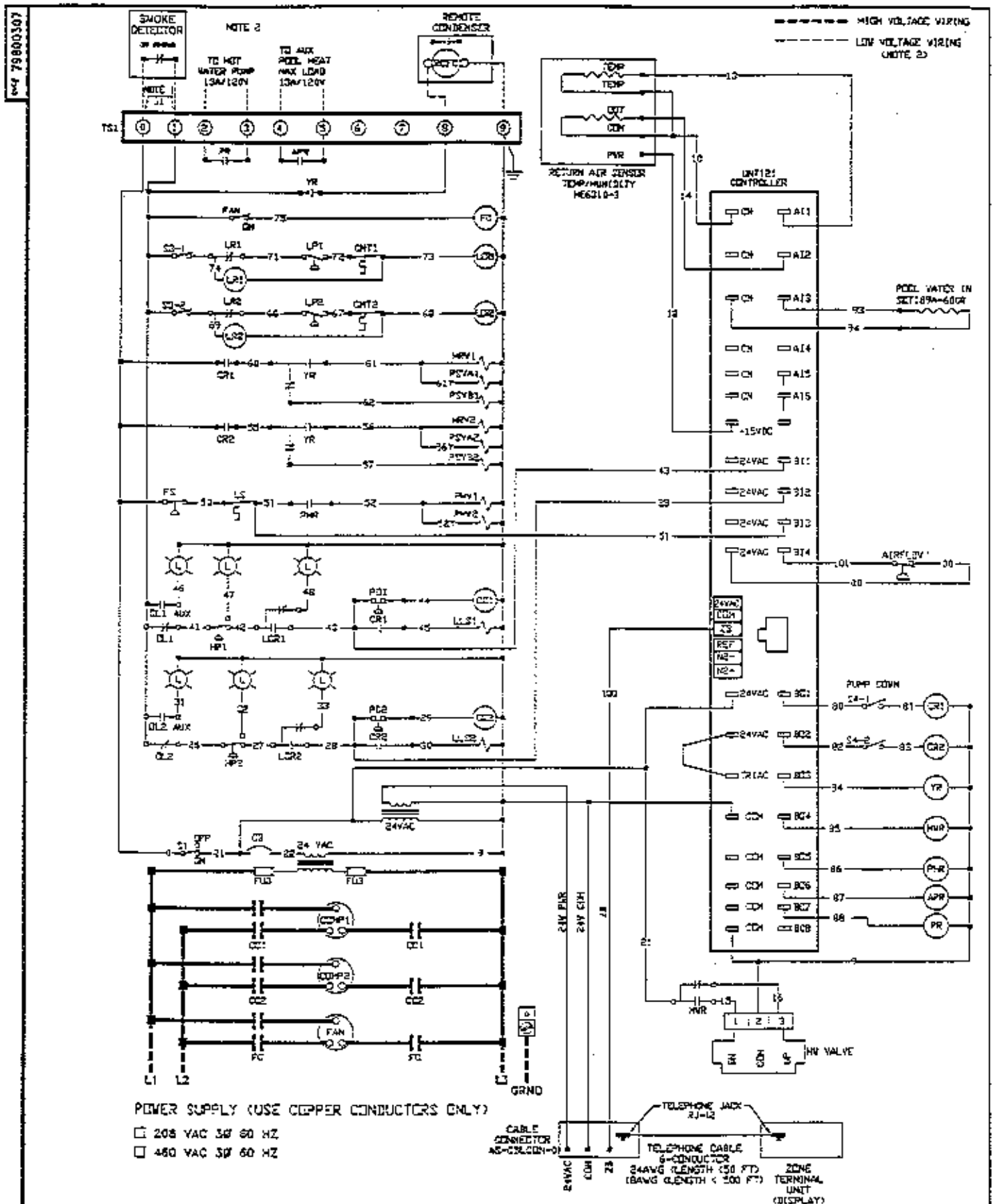
AHR - AUXILIARY HEATING RELAY
APR - AUXILIARY POOL HEAT RELAY
CB - CIRCUIT BREAKER
CC - COMPRESSOR CONTACTOR
CMT - COMPRESSOR MOTOR THERMOSTAT
COL - COMPRESSOR OVERLOAD RELAY
CR - COMPRESSOR RELAY
E/A EXHAUST AIR
F/A - FRESH AIR
FC - FAN CONTACTOR
FPR - FREEZE PROTECTION RELAY
FS - FLOW SWITCH
FU - FUSE
HP - HIGH PRESSURE SWITCH
HRV - HEAT REJECTION VALVE
HWR - HOT WATER RELAY
L - LIGHT, INDICATOR
LCR - LOSS OF CHARGE RELAY
LLS - LIQUID LINE SOLENOID
LP - LOW PRESSURE SWITCH
LR - LOCKSOUT RELAY
LS - LIMIT SWITCH
PD - PUMP DOWN SWITCH
PHR - POOL HEAT RELAY
PHV - POOL HEAT VALVE
PR - PUMP RELAY
PSVA- PUMPOUT SOLENOID VALVE (REHEAT COIL)
PSVB- PUMPOUT SOLENOID VALVE (RC)
R/A - RETURN AIR
RC - REMOTE CONDENSER
RCFC- REMOTE CONDENSER FAN CONTACTOR
RFC - RETURN FAN CONTACTOR
S1 - SYSTEM ON/OFF SWITCH
S2 - FAN ON/OFF SWITCH
S3 - LCR RESET SWITCH
S4 - PUMP DOWN SWITCH
TS - TERMINAL STRIP
YR - COOLING RELAY
SHR - SPA HEAT RELAY
SHV - SPA HEAT VALVE



2. ———— REPRESENT FIELD WIRING CLASS 1 MIN. 14 AWG THHN TYP.
1. REMOVE JUMPER J1 AND REPLACE WITH SMOKE DETECTOR (2W CONTACT).

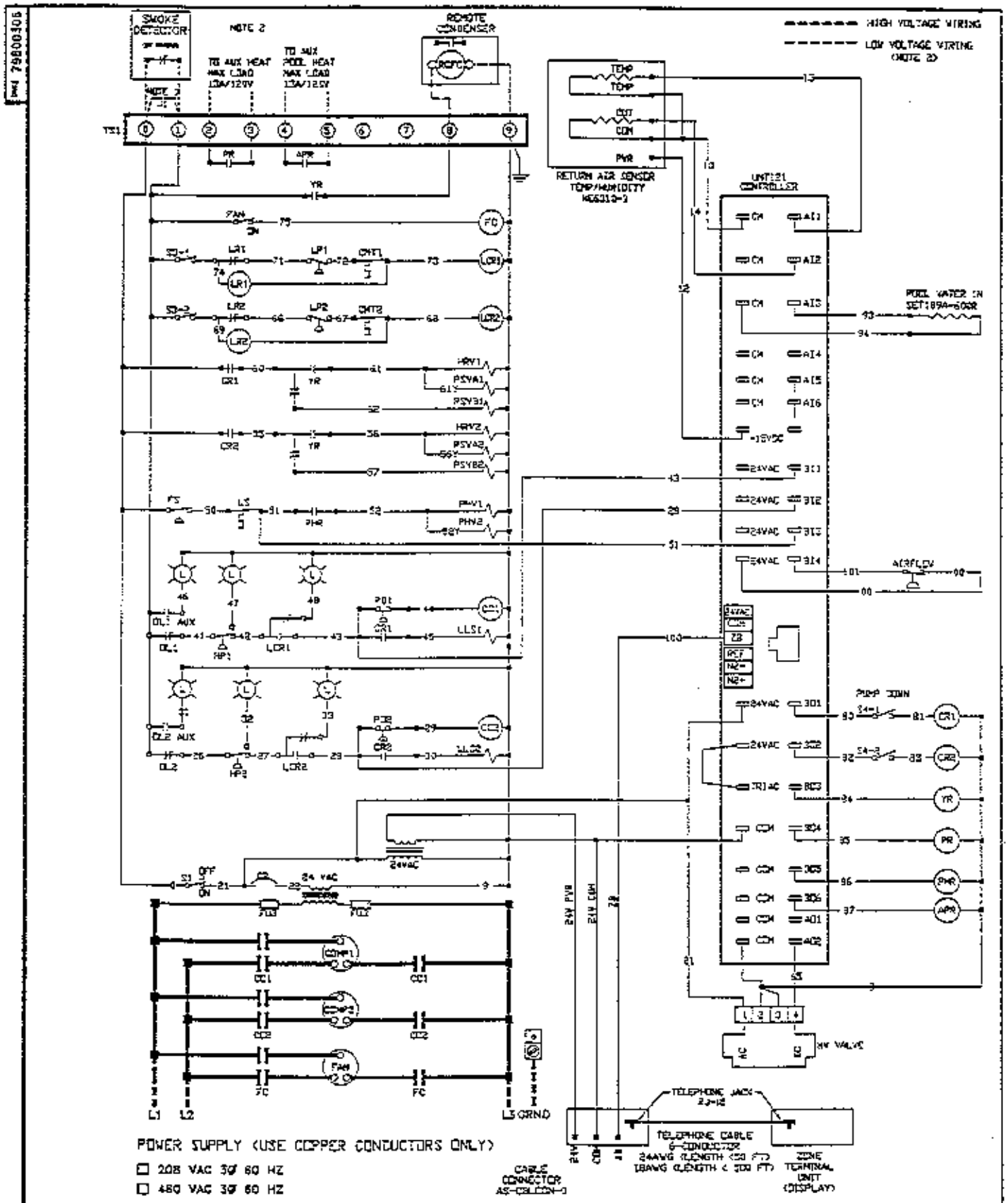
NOTES:

	MODEL NUMBER	DRAWING #	SHEET #
APR Corporation	CPV/H 085/095/120 RC + PH (PARTIAL) + SPA + HW HEAT (ON/OFF)	79800310 21 JAN 95	1



NOTES:

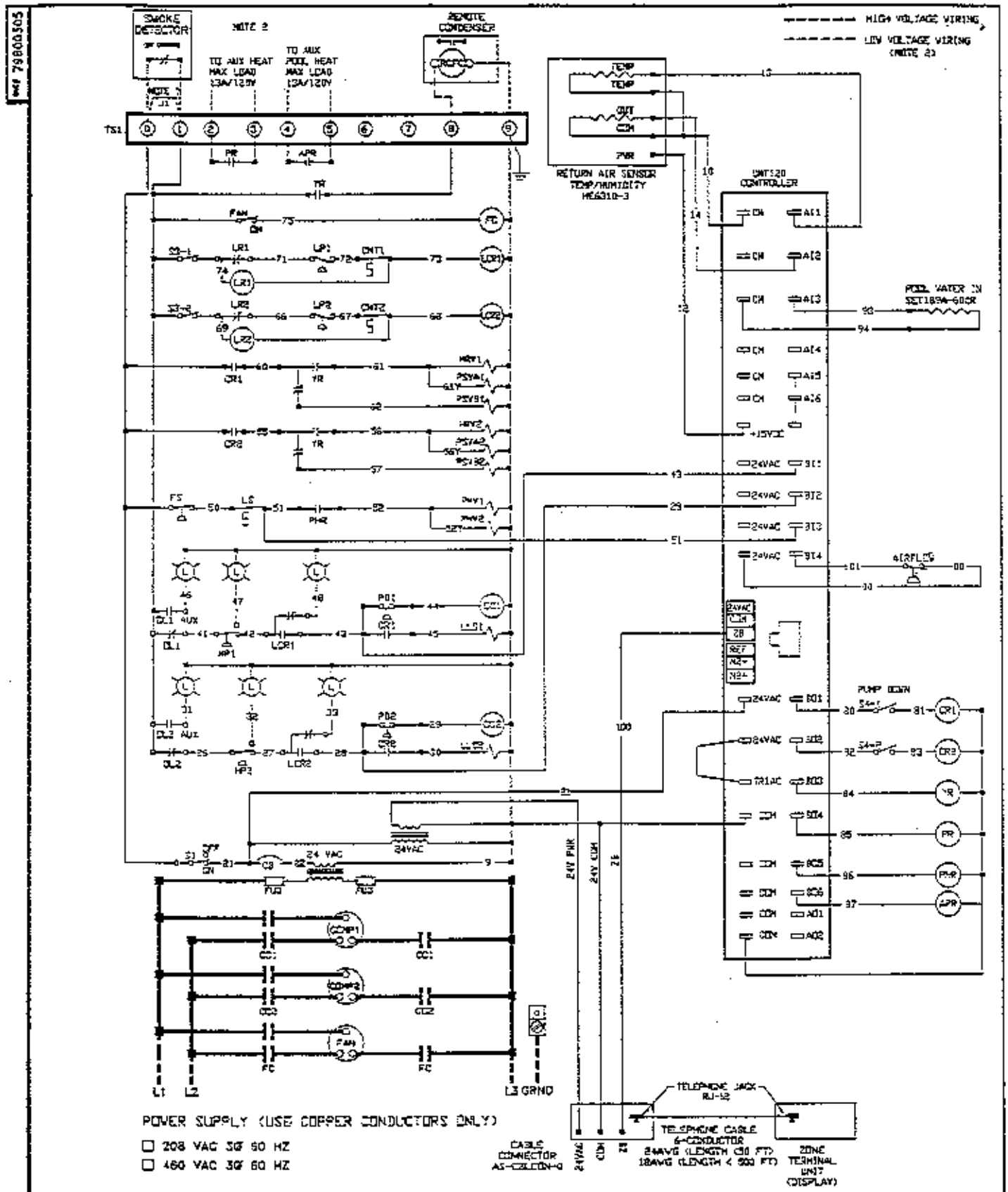
	MODEL NUMBER	DRAWING #	SHEET #
APR Corporation	CPV/H 085/095/120 RC + PH (PARTIAL) + HW HEAT (ON/OFF)	79800307 21 JAN 95	1



2. ——— REPRESENT FIELD WIRING CLASS 1 MIN. 16 AWG THHN TYP.
1. REMOVE JUMPER J1 AND REPLACE WITH SMOKE DETECTOR (2W CONTACT).

NOTES:

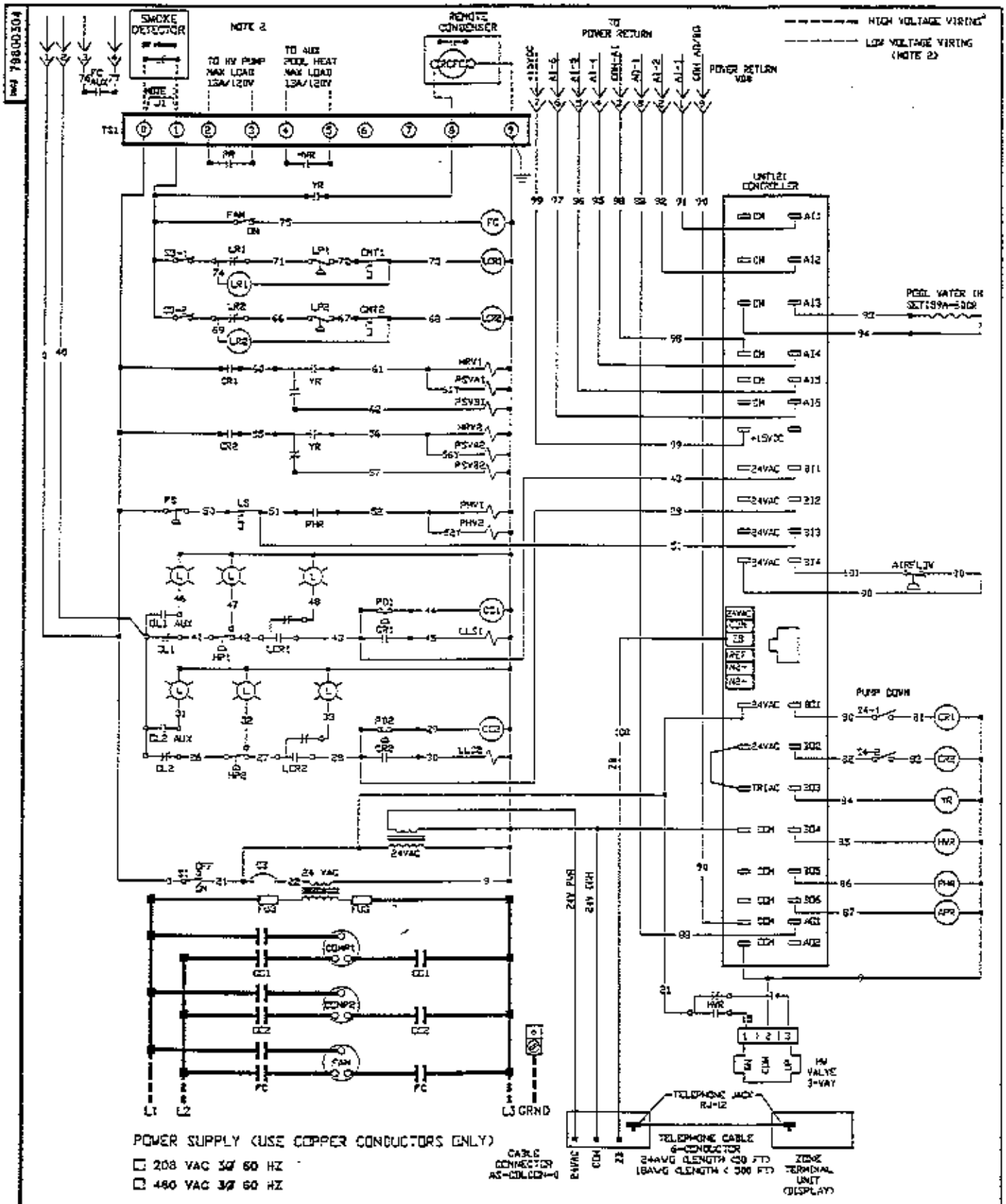
	MODEL NUMBER	DRAWING #	SHEET #
APR Corporation	CPV/H 085/095/120 RC + PH (PARTIAL) + HW HEAT (MOD)	79800306 21 JAN 95	1



2. ---------- REPRESENT FIELD WIRING CLASS 1 MIN. 14 AWG THHN 75°.
1. REMOVE JUMPER J1 AND REPLACE WITH SMOKE DETECTOR (BY OTHERS).

NOTES:

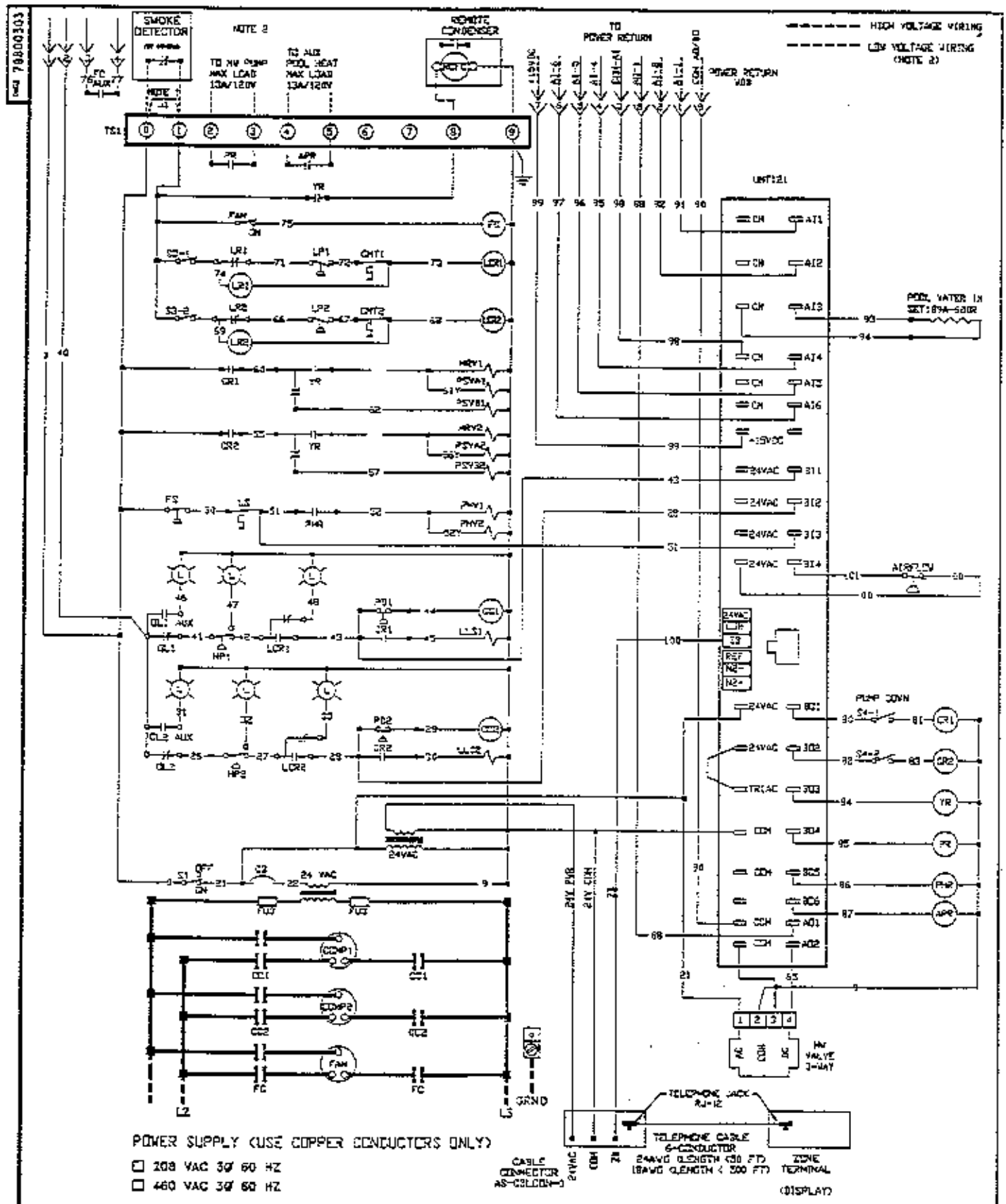
APR Corporation	MODEL NUMBER: CPV/H 085/095/120 RC + PH (PARTIAL) + AUX HT	DRAWING # 79800305 21 JAN 95	SHEET # 1



2. ———— REPRESENT FIELD WIRING CLASS 1 MIN. 14 AWG THWN TYP.
1. REMOVE JUMPER J1 AND REPLACE WITH SMOKE DETECTOR (BY OTHERS).

NOTES:

APR Corporation	MODEL NUMBER	DRAWING #	SHEET #
	CPV/H 085/095/120 RC + PH (PARTIAL) + HW HEAT (ON/OFF) + ECONOMIZER	79800304 21 JAN 95	1

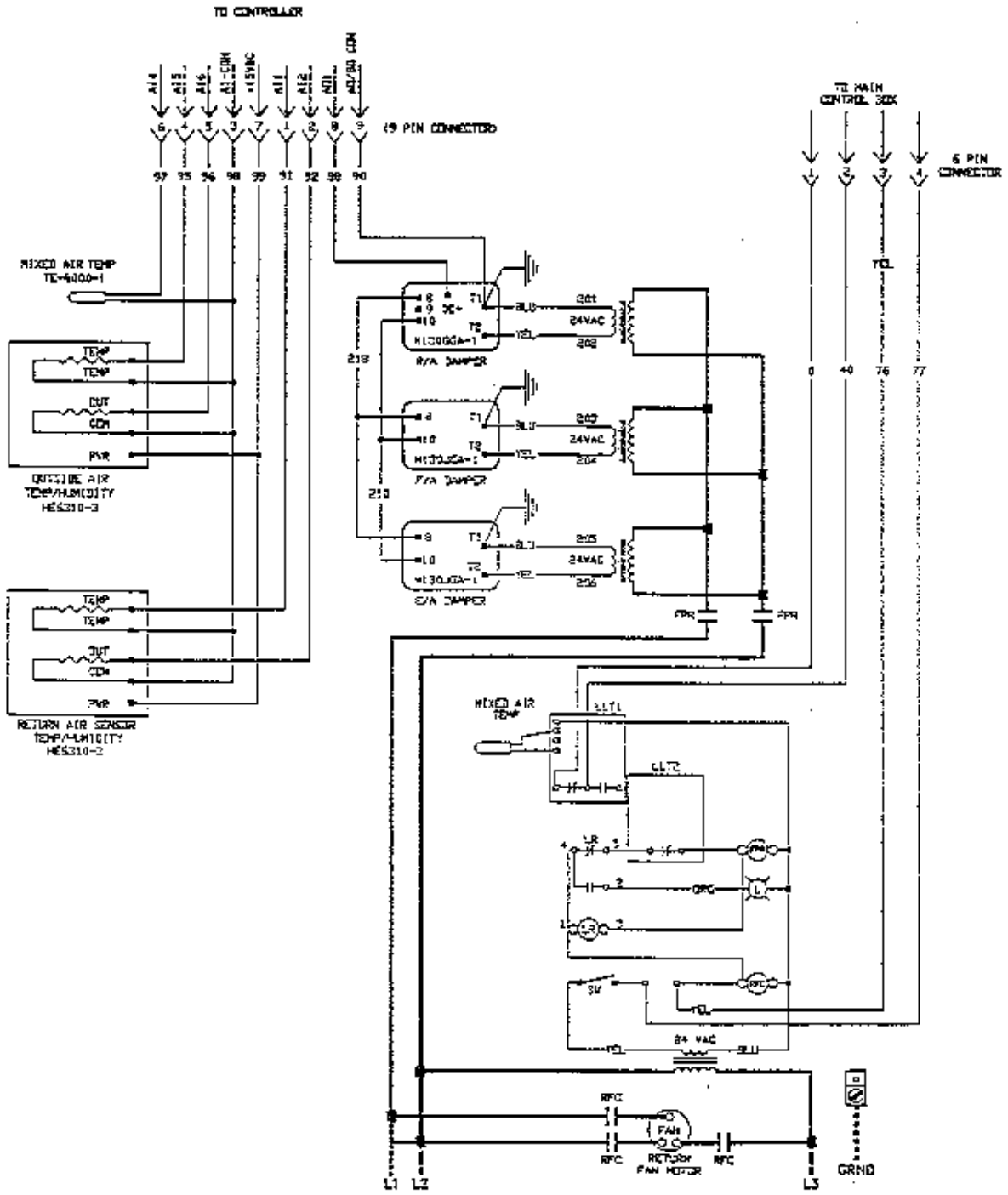


2. ——— REPRESENT FIELD WIRING CLASS 1 MIN. 14 AWG THHN TYP.
1. REMOVE JUMPER J1 AND REPLACE WITH SMOKE DETECTOR (BY OTHERS).

NOTES:

	MODEL NUMBER	DRAWING #	SHEET #
APP Corporation	CPV/H 085/095/120 RC + PH (PARTIAL) + HW HEAT (MOD) + ECONOMIZER	79800303 21 JAN 95	1

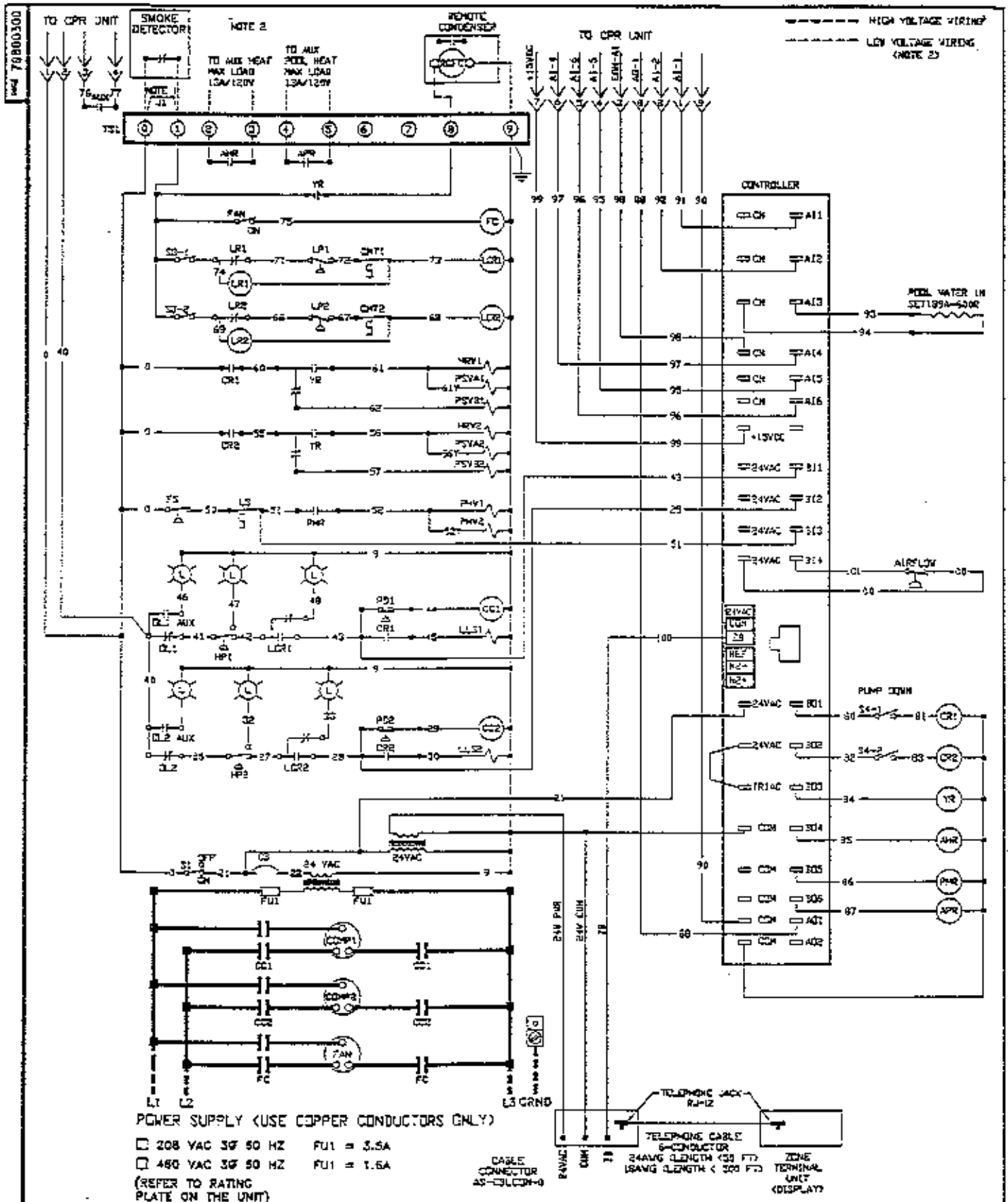
79800302



1. DASHED LINES REPRESENT FIELD WIRING CLASS 1 MIN. 14 AWG THHN TYP.

NOTES:

	MODEL NUMBER	DRAWING #	SHEET #
APR Corporation	CPR POWER RETURN–ECONOMIZER WIRING DIAGRAM	79800302 16 MAY 94	1



APR Corporation	MODEL NUMBER	DRAWING #	SHEET #
	CPV/H 085/095/120 RC + PH (PARTIAL) + AUX HT + ECONOMIZER	79800300 21 JAN 95	1

DWG 79800301

LEGEND

AHR - AUXILIARY HEATING RELAY
APR - AUXILIARY POOL HEAT RELAY
CB - CIRCUIT BREAKER
CC - COMPRESSOR CONTACTOR
CMT - COMPRESSOR MOTOR THERMOSTAT
COL - COMPRESSOR OVERLOAD RELAY
CR - COMPRESSOR RELAY
E/A EXHAUST AIR
F/A - FRESH AIR
FC - FAN CONTACTOR
FPR - FREEZE PROTECTION RELAY
FS - FLOW SWITCH
FU - FUSE
HP - HIGH PRESSURE SWITCH
HRV - HEAT REJECTION VALVE
HWR - HOT WATER RELAY
L - LIGHT, INDICATOR
LCR - LOSS OF CHARGE RELAY
LLS - LIQUID LINE SOLENOID
LP - LOW PRESSURE SWITCH
LR - LOCKOUT RELAY
LS - LIMIT SWITCH
PD - PUMP DOWN SWITCH
PHR - POOL HEAT RELAY
PHV - POOL HEAT VALVE
PR - PUMP RELAY
PSVA- PUMPOUT SOLENOID VALVE (REHEAT COIL)
PSVB- PUMPOUT SOLENOID VALVE (RC)
R/A - RETURN AIR
RC - REMOTE CONDENSER
RCFC- REMOTE CONDENSER FAN CONTACTOR
RFC - RETURN FAN CONTACTOR
S1 - SYSTEM ON/OFF SWITCH
S2 - FAN ON/OFF SWITCH
S3 - LCR RESET SWITCH
S4 - PUMP DOWN SWITCH
TS - TERMINAL STRIP
YR - COOLING RELAY

APR Corporation	MODEL NUMBER	DRAWING #	SHEET #
	CPV/H 085/095/120	79800301 16 MAY 94	1

Appendix C

Sequence of Operation

for the

Packaged Energy Recovery System for Swimming Pool Environmental Control

manufactured by

APR Corporation

The unit shall be capable of providing dehumidification, pool water heating, space heating and space cooling as controls demand.

Dehumidification Only. The compressor(s) will be activated, rejecting the recovered heat into the pool and the air until the humidity is satisfied, or the temperature of the pool has risen one degree above the set point. The heat being rejected into the pool will then be rejected to the optional condenser until the humidity is satisfied or the temperature falls below set point, at which time it will revert back to rejecting heat into the pool.

Dehumidification and Space Heating. The compressor(s) will be activated, rejecting all the heat into the reheat coil sized for full condensing. If the space temperature continues to drop, the controller will bring on the auxiliary heat to provide the space heating.

Dehumidification and Pool Heating. The compressor(s) will be activated, rejecting heat into the pool water condensers and into the reheat coil. When the space temperature reaches three degrees above set point, the controller will direct that portion of the heat of rejection to the optional condenser. The compressor(s) will continue to run until both conditions are satisfied.

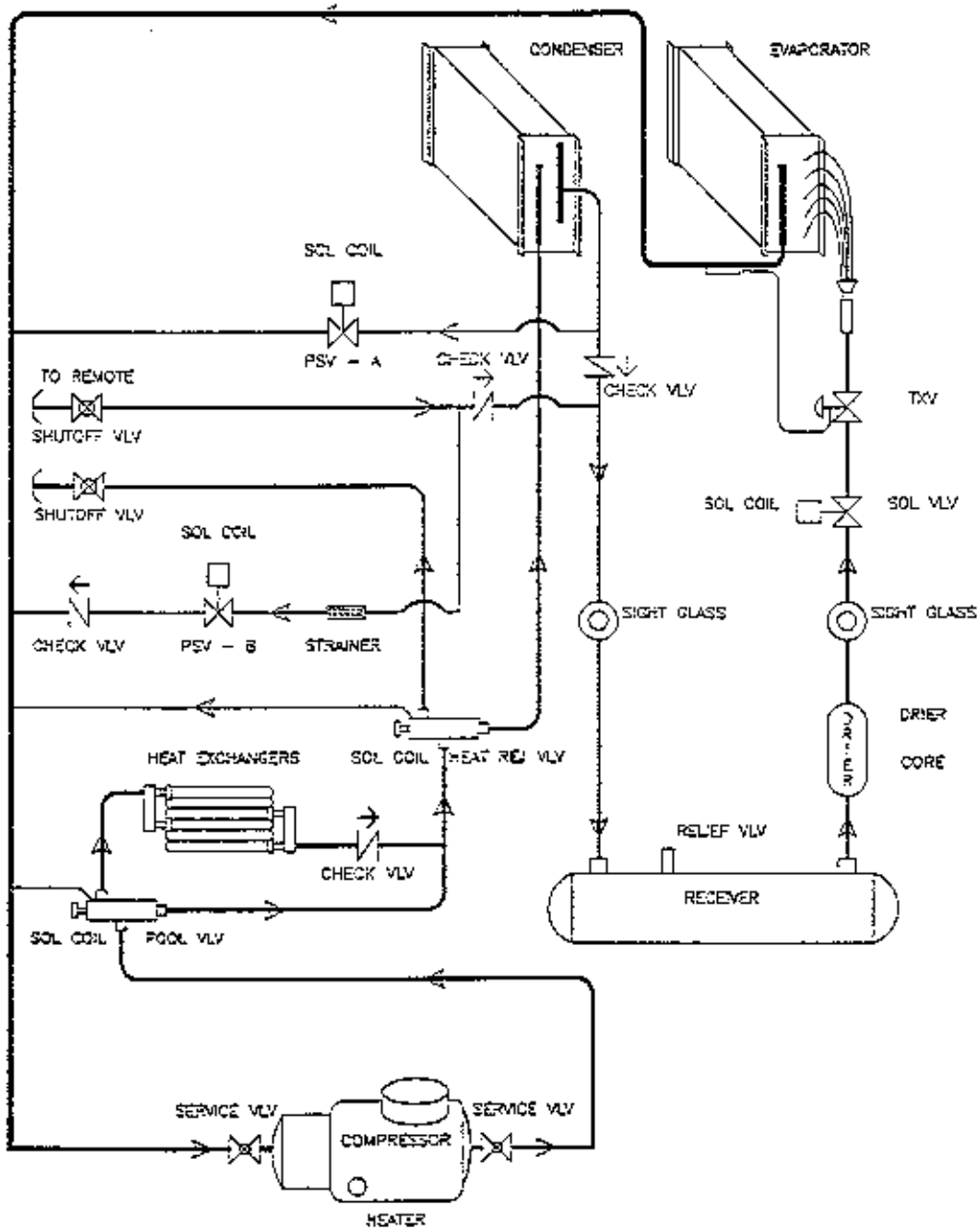
Dehumidification, Space and Pool Heating. The compressor(s) will be activated, rejecting heat into the reheat coil and the pool water condensers. If the space temperature continues to fall, the auxiliary heater will be activated until the air is up to temperature.

Dehumidification and Cooling. The compressor(s) will be activated, rejecting heat to the optional condenser while supplying the space with cool dry air.

Cooling Only. On a rise in temperature of three degrees above set point, the cooling demand will activate the compressor(s). The recovered heat will be rejected into the optional condenser and cool dry air will be supplied to the space.

Pool Heating Only. On a call for pool heating, the compressor(s) will be activated, sending the recovered heat into the pool and the air. Once the air temperature has reached three degrees above set point, that portion of heat will be directed into the remote condenser.

Cooling and Pool Heat. The compressor(s) will be activated, rejecting heat to the optional condenser and to the pool.



NOTE:
CPV/H 085/095/120 ARE TWO COMPRESSOR MACHINES WITH TWO INDEPENDENT REFRIGERATION CIRCUITS. EACH CIRCUIT IS IDENTICAL. ONLY ONE CIRCUIT IS SHOWN ABOVE.

	P&E MODEL NUMBER	DRAWING #	SHEET #
APR Corporation	CPV/H 085/095/120 PIPING (RC + PH)	79810200 9/23/94	0

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 humidity
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.

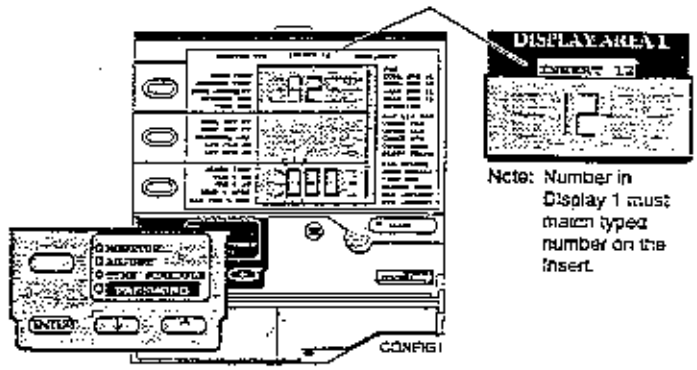


Figure 8: Matching the Insert Number

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

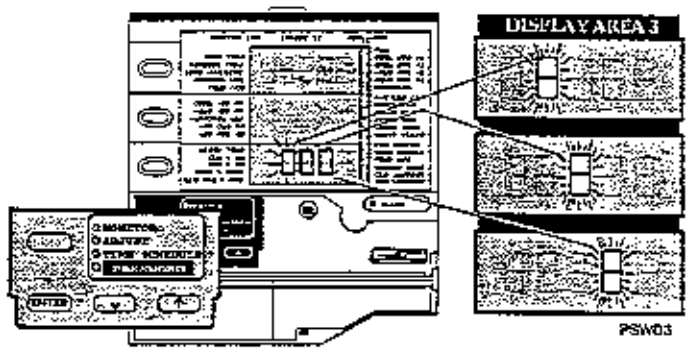


Figure 9: Entering Password

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.

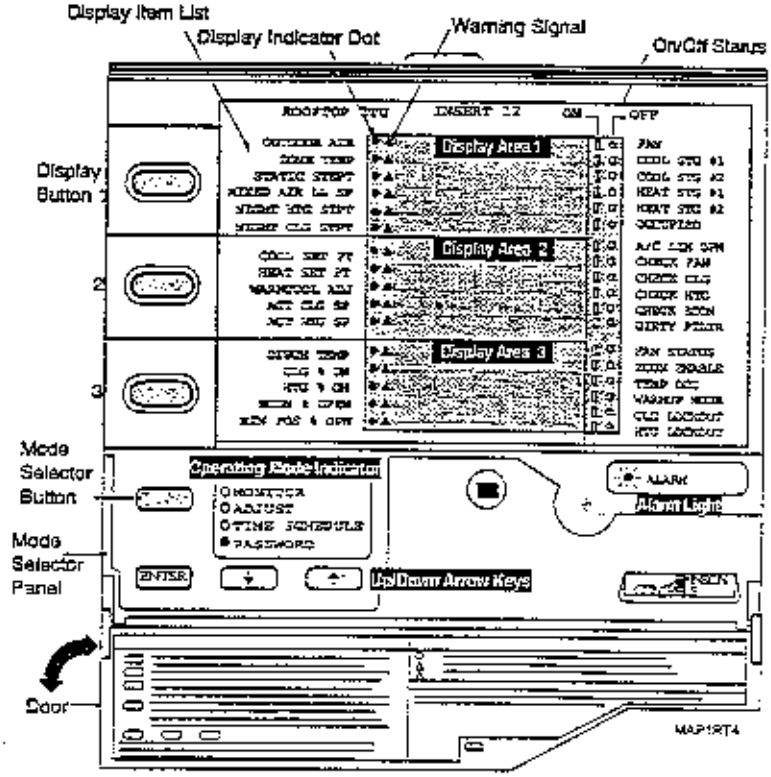


Figure 7: Connected ZT, Insert in Place

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 ○ 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.

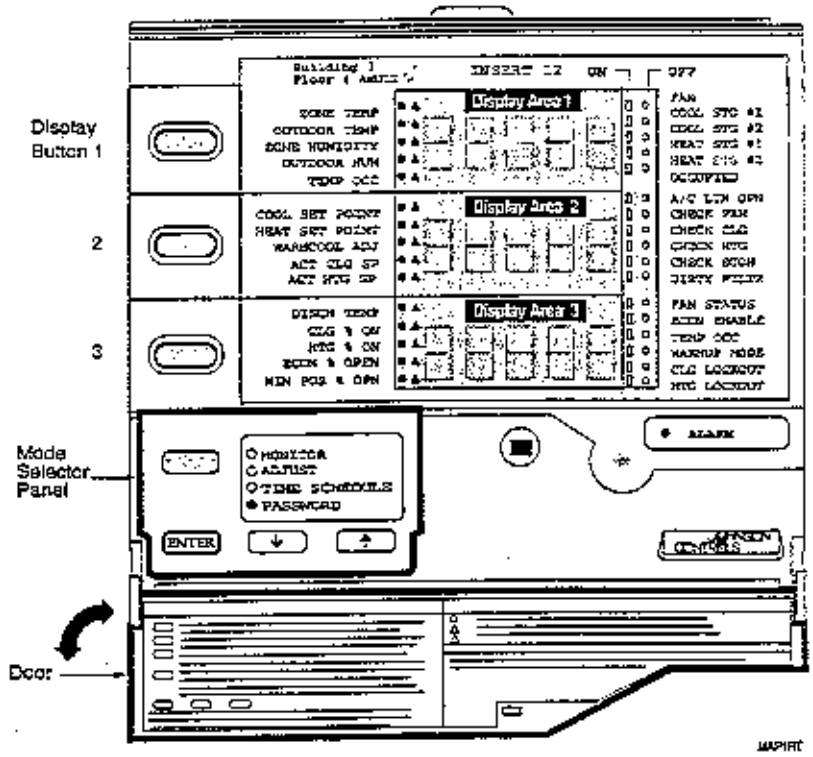


Figure 1: Zone Terminal with Door Open

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

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