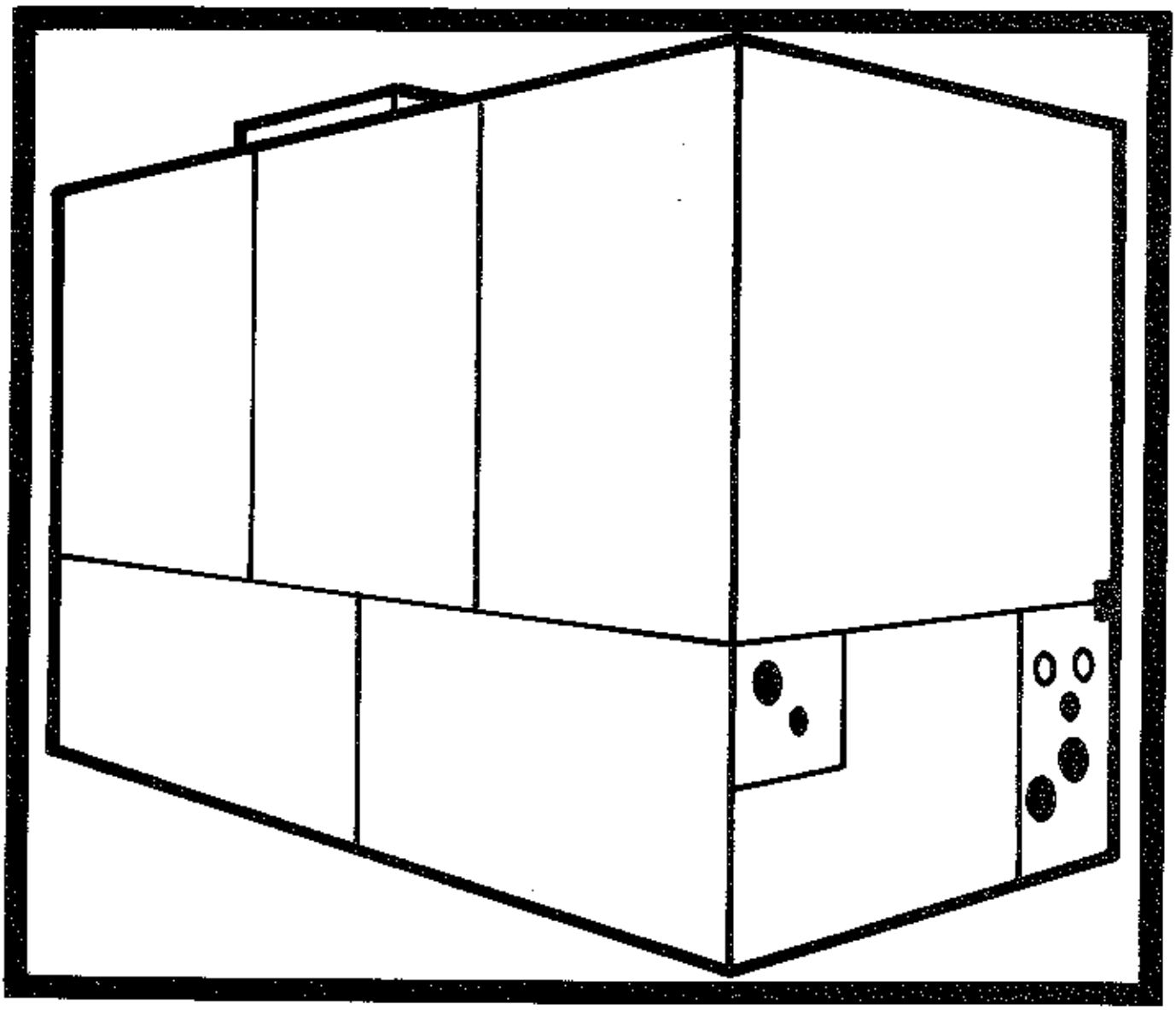
INSTALLATION, OPERATION, MAINTENANCE INSTRUCTIONS



Vari-Master

SERIES

LARGE COMMERCIAL WATER SOURCE AIR CONDITIONERS AND HEAT PUMPS

ClimateMaster
A COMBINATION OF CHP CORP AND FRIEDRICH* CLIMATE MASTER, INC.

ClimateMaster
A COMBINATION OF CHP CORP. AND FRIEDRICH™ CLIMATE MASTER, INC.

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ClimateMaster
A COMBINATION OF CHP CORP. AND FRIEDRICH™ CLIMATE MASTER, INC.

SECTION I

Installation

1–1 Safety

Servicing of Friedrich Climate Master air conditioning systems should be performed only by qualified personnel because of safety hazards from electrical components and systems pressures. Basic maintenance such as cleaning coils and the replacing of filters can be performed by supervised unskilled personnel. When performing service or maintenance on the system, power to the unit must be off. Wear safety goggles and gloves when working with refrigerants. Do not attempt to braze on a system which is under pressure; remove refrigerant first. Keep a fire extinguisher nearby during all brazing operations.

When using nitrogen and refrigerant for leak testing, always charge the refrigerant in first. Always use a pressure regulator on a nitrogen cylinder; never exceed data plate system pressures.

1–2 Description

The Vari-Master Series, Commercial Units, are self-contained heat/cool or cooling units, designed for both commercial and industrial buildings. They provide complete individualized air conditioning for multiple zone applications with nominal capacities from 20 to 40 tons.

The 803 Series (heat pump version) will operate with modulating air volume when the unit is in the cooling mode and constant air volume when the unit is in the heating mode.

903 Series (cooling only version) operates with continuous modulating air volume.

Each unit is assembled, wired and factory-tested before delivery.

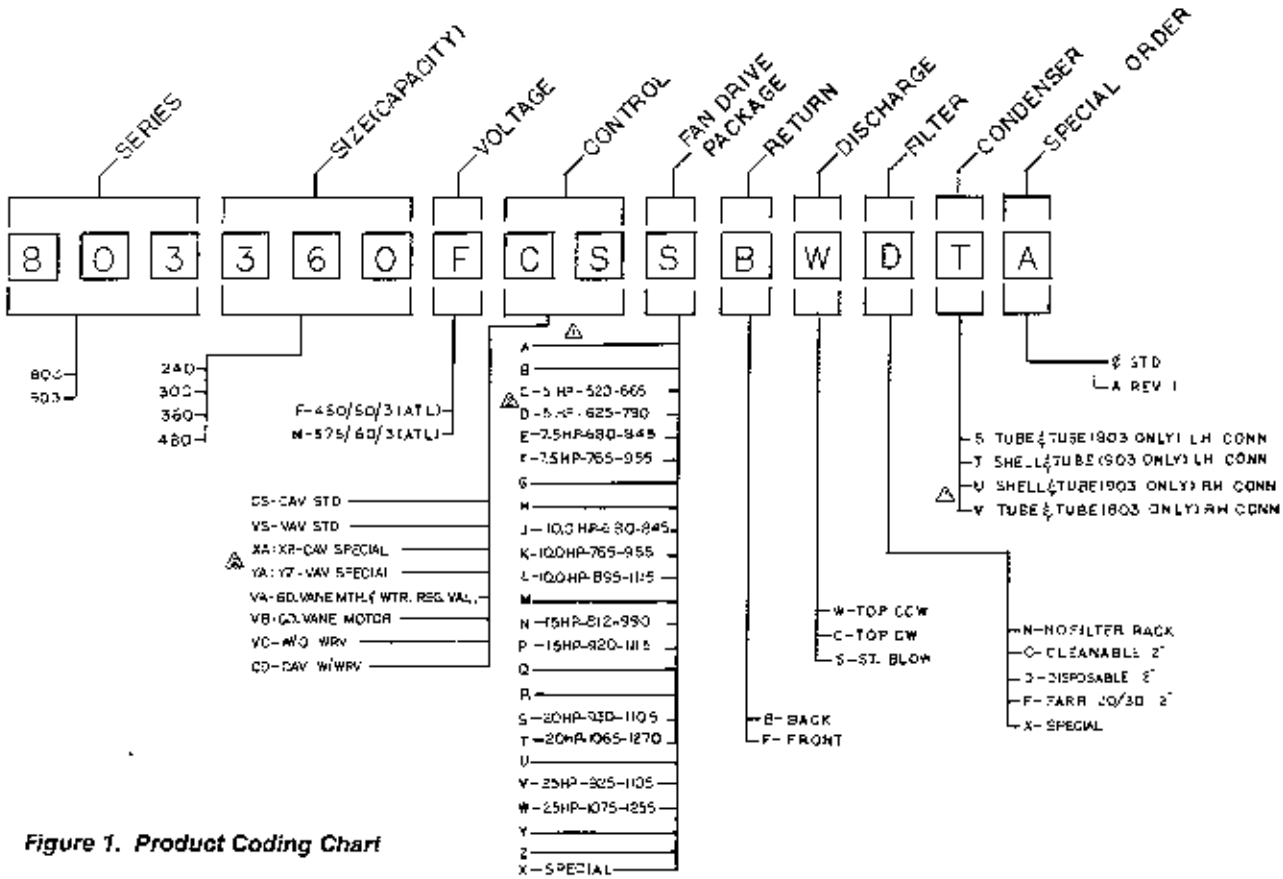

Figure 1. Product Coding Chart

1–3 Pre-Installation Notes

Inspect the unit for any damage or missing parts.

Check the data plate located on the water in-out condenser panel of the unit to make sure that it matches your specific application. See Product Coding Chart (Fig. 1), and Typical Installation (Fig. 3).

1–4 Location and Mounting of the Unit

The unit is to be mounted inside the building. Adequate space should be allowed for the unit, to insure that the access panels may be removed and the unit can be serviced easily.

The unit must be level to allow proper drainage of condensate. If isolation springs are used, see installation instructions shipped with the springs.

After the unit is securely mounted, the compressor mounting studs are to be loosened and the shipping spacer removed (See Fig. 2). Rubber spacers (shipped in the high voltage control compartment) are to be inserted into the compressor mounting holes.

1–5 Ductwork Connections

To isolate sound and vibration from the ductwork, flexible duct connectors should be used between the unit and the supply and return air ducts. (See Fig. 3).

Ducts passing through an unconditioned space must be insulated and covered with vapor barrier in accordance with the latest issue of SMANCA (Sheet Metal and Air Conditioning Contractors of America) and NESCA (National Environmental Contractors Association) minimum installation standards.

1–6 Water Regulating Valve

The water regulating valve is shipped separately for VAV units and must be field-mounted by the installer. A globe valve should be installed on the water inlet and also after the water regulating valve on the outlet. See typical installation diagram (Fig. 3). The flanges and gaskets at the water "out" connection and also the globe valves are not supplied by Friedrich.

1–7 Drain Piping

The drain pipe should be pitched 1/4" per foot for proper draining of condensate. The condensate drain trap must be filled with water prior to the start-up of the unit. *Differential trapping is required (see Fig. 3).*

1–8 Electrical Connections

All wiring should be in accordance with the national electric code and local building codes.

Check the electrical specifications in Fig. 4 or 5. A straight EMT connector for power supply conduit connection is provided within the control box.

Each unit must have a separate branch circuit fused disconnect mounted nearby for easy access when servicing. Refer to the electrical specifications (Fig. 5) for proper wire and fuse sizes.

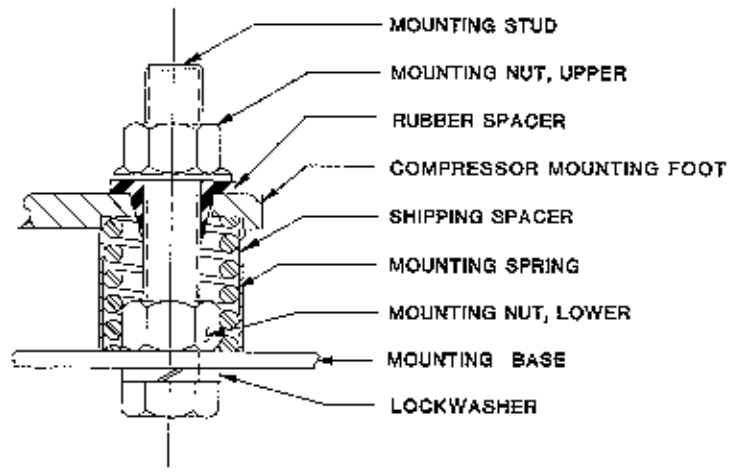

Figure 2. Compressor Mounting Assembly

TYPICAL INSTALLATION
SELF–CONTAINED VAV UNITS
VARI-MASTER SERIES (WITHOUT ECONOMIZER)

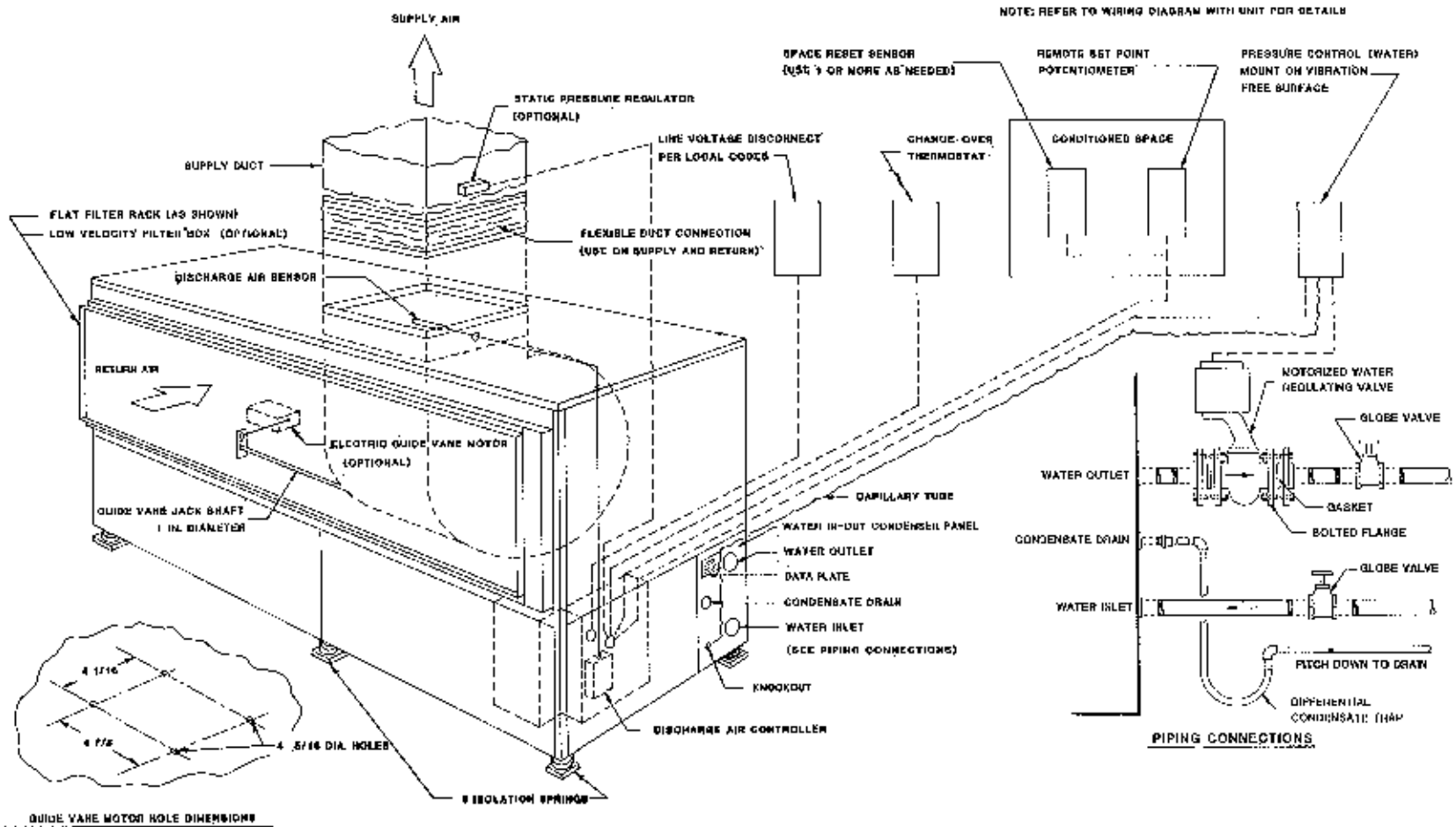

Figure 3. Top CW Supply-Front Return Unit as Shown

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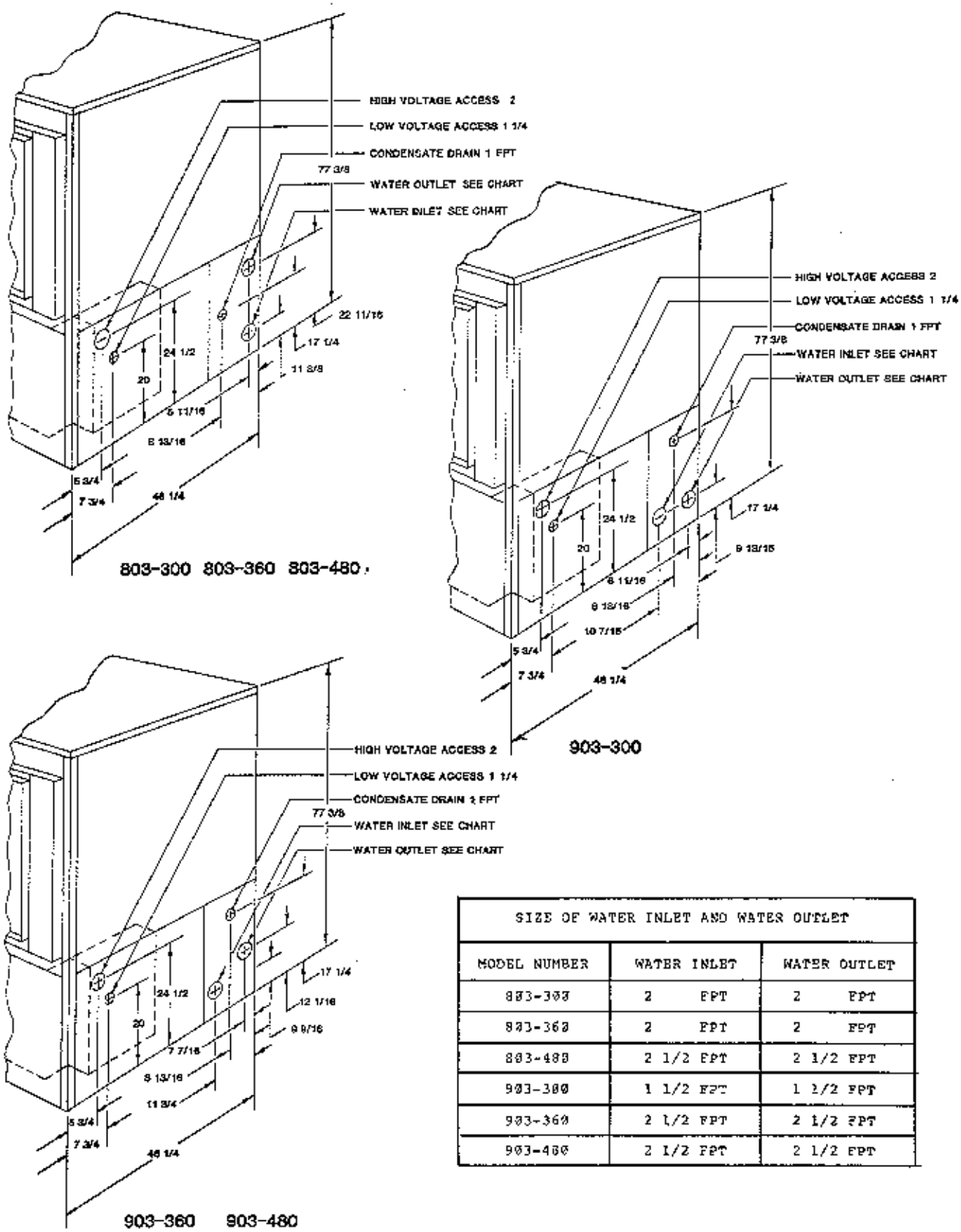

SIZE OF WATER INLET AND WATER OUTLET		
MODEL NUMBER	WATER INLET	WATER OUTLET
803-300	2 FPT	2 FPT
803-360	2 FPT	2 FPT
803-480	2 1/2 FPT	2 1/2 FPT
903-300	1 1/2 FPT	1 1/2 FPT
903-360	2 1/2 FPT	2 1/2 FPT
903-480	2 1/2 FPT	2 1/2 FPT

Figure 4. Electrical Specifications

B:VARIELEC
A1:X75 CRUN2 178

ELECTRICAL DATA VARI-MASTER SERIES
(APPLIES TO CAV & VAV UNITS)

MODEL NO.	MOTOR HP	ELECTRICAL SERVICE VOLT	HZ	PH	COMPRESSOR RLA	LRA	QTY	BLOWER MOTOR HP	FLA	QTY	MIN CKT AMPS	WIRE SIZES POWER(1) SUPPLY	GRND(2) COND.	MAX FUSE
803/903-240-F	3	460	60	3	35	154	1	3	5	1	49	6 AWG	8 AWG	80
803/903-240-F	5	460	60	3	35	154	1	5	7.3	1	51	6	8	80
803/903-240-F	7.5	460	60	3	35	154	1	7.5	10.5	1	54	6	8	80
803/903-240-F	10	460	60	3	35	154	1	10	12.5	1	56	4	8	90
803/903-240-F	15	460	60	3	35	154	1	15	20	1	64	4	8	90
803/903-240-N	3	575	60	3	28	135	1	3	3.8	1	39	8	10	60
803/903-240-N	5	575	60	3	28	135	1	5	5.9	1	41	6	10	60
803/903-240-N	7.5	575	60	3	28	135	1	7.5	8.5	1	44	6	8	70
803/903-240-N	10	575	60	3	28	135	1	10	10.4	1	45	6	8	70
803/903-240-N	15	575	60	3	28	135	1	15	16	1	51	6	8	70
803/903-300-F	5	460	60	3	40	214	1	5	7.3	1	57	4	8	90
803/903-300-F	7.5	460	60	3	40	214	1	7.5	10.5	1	61	4	8	100
803/903-300-F	10	460	60	3	40	214	1	10	12.5	1	63	4	8	100
803/903-300-F	15	460	60	3	40	214	1	15	20	1	70	4	6	110
803/903-300-F	20	460	60	3	40	214	1	20	25	1	75	3	6	110
803/903-300-N	5	575	60	3	32	160	1	5	5.9	1	46	6	8	70
803/903-300-N	7.5	575	60	3	32	160	1	7.5	8.5	1	49	6	8	80
803/903-300-N	10	575	60	3	32	160	1	10	10.4	1	50	6	8	80
803/903-300-N	15	575	60	3	32	160	1	15	16	1	56	4	8	90
803/903-300-N	20	575	60	3	32	160	1	20	20	1	60	4	8	90
903-360-F	7.5	460	60	3	47	235	1	7.5	10.5	1	69	4	6	110
903-360-F	10	460	60	3	47	235	1	10	12.5	1	71	3	6	110
903-360-F	15	460	60	3	47	235	1	15	20	1	79	3	6	125
903-360-F	20	460	60	3	47	235	1	20	25	1	84	3	6	125
903-360-F	25	460	60	3	47	235	1	25	31.5	1	90	2	6	125
903-360-N	7.5	575	60	3	38	200	1	7.5	8.5	1	56	4	8	90
903-360-N	10	575	60	3	38	200	1	10	10.4	1	58	4	8	90
903-360-N	15	575	60	3	38	200	1	15	16	1	64	4	8	100
903-360-N	20	575	60	3	38	200	1	20	20	1	68	4	8	100
903-360-N	25	575	60	3	38	200	1	25	25	1	73	3	6	110
803-360-F	7.5	460	60	3	60	283	1	7.5	10.5	1	86	2	6	125
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803-360-F	15	460	60	3	60	283	1	15	20	1	95	2	6	150
803-360-F	20	460	60	3	60	283	1	20	25	1	100	1	6	150
803-360-F	25	460	60	3	60	283	1	25	31.5	1	107	1	6	150
803-360-N	7.5	575	60	3	48	230	1	7.5	8.5	1	69	4	6	110
803-360-N	10	575	60	3	48	230	1	10	10.4	1	70	4	6	110
803-360-N	15	575	60	3	48	230	1	15	16	1	76	3	6	110
803-360-N	20	575	60	3	48	230	1	20	20	1	80	3	6	125
803-360-N	25	575	60	3	48	230	1	25	25	1	85	3	6	125
803/903-480-F	7.5	460	60	3	65	297	1	7.5	10.5	1	92	2	6	150
803/903-480-F	10	460	60	3	65	297	1	10	12.5	1	94	2	6	150
803/903-480-F	15	460	60	3	65	297	1	15	20	1	101	2	6	150
803/903-480-F	20	460	60	3	65	297	1	20	25	1	106	2	6	150
803/903-480-F	25	460	60	3	65	297	1	25	31.5	1	113	2	6	175
803/903-480-N	7.5	575	60	3	52	225	1	7.5	8.5	1	74	3	6	125
803/903-480-N	10	575	60	3	52	225	1	10	10.4	1	75	3	6	125
803/903-480-N	15	575	60	3	52	225	1	15	16	1	81	3	6	125
803/903-480-N	20	575	60	3	52	225	1	20	20	1	85	3	6	125
803/903-480-N	25	575	60	3	52	225	1	25	25	1	90	2	6	125

NOTES:-

(1) COPPER CONDUCTORS, INSULATION RATING= 60 DEG. C FOR AMPACITY (=100 AMPS
= 75 DEG. C FOR AMPACITY) 100 AMPS

(2) COPPER CONDUCTOR , USE ONE SIZE LARGER FOR ALUMINUM OR COPPER CLAD ALUMINUM.

(3) WIRE SIZES ARE FOR REFERENCE ONLY; REFER TO LATEST ISSUE OF NATIONAL ELECTRICAL CODE AND APPLICABLE LOCAL CODES FOR CURRENT REQUIREMENTS.

Figure 5. Electrical Specifications

1–9 Water Pressure Regulator

(See Fig. 6) Mount on a vibration free location, where the cap tube may be easily routed from the control, to the port on the liquid line shut-off valve (803 Series) or the access valve on the refrigerant/water heat exchanger (903 Series), whichever is applicable. The knockout located on the water connections panel (See Fig. 3) is to be used for routing the cap tube to the port location. A protective insulator is to be used to protect the cap tube from the edges of the knockout. A pressure regulator is provided with a 36" long cap tube. For longer lengths, add an extension piece. Note: 903 Series unit—use 1/4" flare swivel nut with core depressor between the pressure regulator cap tube and the access valve on the refrigerant/water heat exchanger. For electrical installation, refer to the wiring diagram located on the access panel of the control box. Set the pressure regulator at 210 PSI and the differential at minimum.

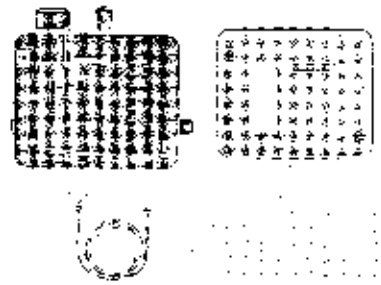
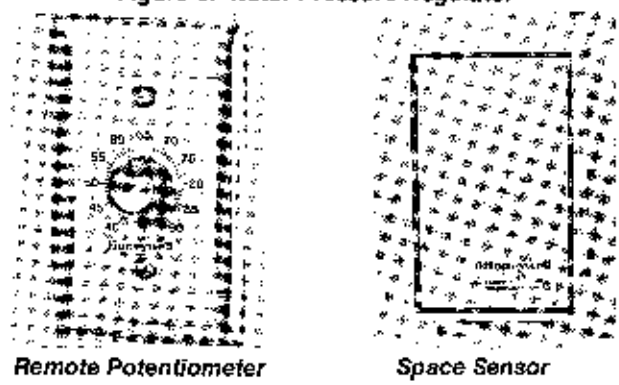


Figure 6. Water Pressure Regulator

1–10 Remote Potentiometer and Space Sensors

Mount the remote potentiometer in a location where the settings will not be subject to tampering by unauthorized personnel. Install in a standard 2 × 4 outlet box at the location selected. The box may be surface mounted or recess mounted for flush mounting of the control. The box must be at least 1-3/4 inches deep.

The space sensors are to be located on an inside wall about 5 feet from the floor. The location should be in an area where freely circulating air of average room temperatures will be sensed. One or more sensors may be used to provide a signal proportional to the average building temperature. (Refer to Fig. 7 for hookup of more than one sensor.) Use the diagram shown in Fig. 7 with the wiring diagram located on the inside panel of the control box. Do not locate space sensors in return air duct. For return air duct applications, contact the factory for recommended sensor model.



Remote Potentiometer *Space Sensor*

1–11 Changeover Thermostat (See Fig. 8)

The thermostat may be mounted in a convenient position that provides easy mounting of the sensing element. The element is to be exposed to the average temperature of the return air or in a location applicable to the setting of the controller where changeover from heating to cooling is to take place. The sensing element is to be held in place with a capillary holder or compression fitting. Sharp bends or kinks in the capillary tubing affect the efficiency of the controller and must be avoided. Excess capillary should be carefully coiled and left directly beneath the controller. (Refer to the electrical diagram on the access panel of the unit control box for wiring.)

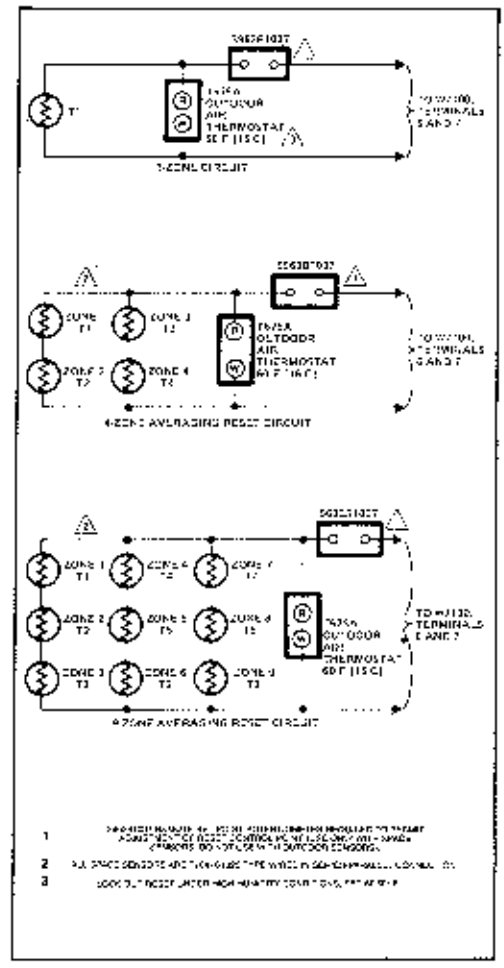


Figure 7. Remote Potentiometer and Space Sensor

1–12 Static Pressure Regulator

The static pressure regulator may be provided by Friedrich; if so, it shall be field installed and wired. (Refer to the wiring diagram located on the access panel to the control box of the unit).

1–13 Damper Motor Installation

Friedrich provides the blower guide vane linkage, including the jack shaft. Friedrich does not provide the damper motor as standard equipment; however, if specified, a factory mounted damper motor is available.

When installing a motor in the field, other than the Friedrich electric motor option, mounting adaptors may be needed (see Fig. 3 for existing mounting holes). Linkage from the motor to the jack shaft must be provided by the installer.

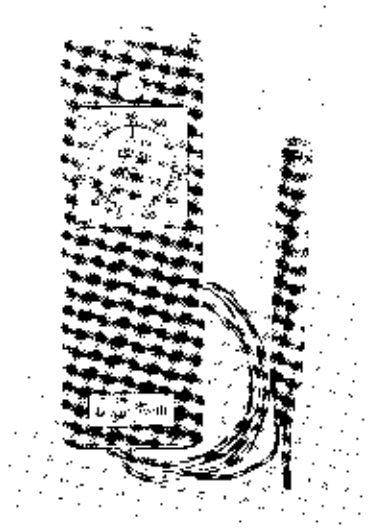


Figure 8. Changeover Thermostat

SECTION II

Operation

2–1 Discharge Air Controller (D.A.C.)

The discharge air controller is a microprocessor based controller that maintains average discharge air temperatures by sequencing stages of mechanical cooling and heating. L.E.D.'s on the D.A.C. indicate what stages of heating or cooling are activated. The operating sequence of the D.A.C. is as follows:

Beginning at point A in Fig. 9, as the building load increases, the discharge temperature floats to the upper limit of the control band at point B. At this time, the first stage of cooling energizes for a minimum period of 4 minutes. This brings the discharge air temperature within the control band region. After 4 minutes, the first stage turns off (point C), and the temperature begins to rise again. At least 4 additional minutes have elapsed at point D, and the first stage turns on again. This time, however, the building load has increased until the space temperature rises to the outer limit at point E. At this point (E), the first stage locks on and the second stage cycles on, pulling the discharge temperature back within the control band region. This process continues through all connected stages. The highest number active stage is always the cycling stage. In this way, the equipment is always matched to the required load as closely as possible.

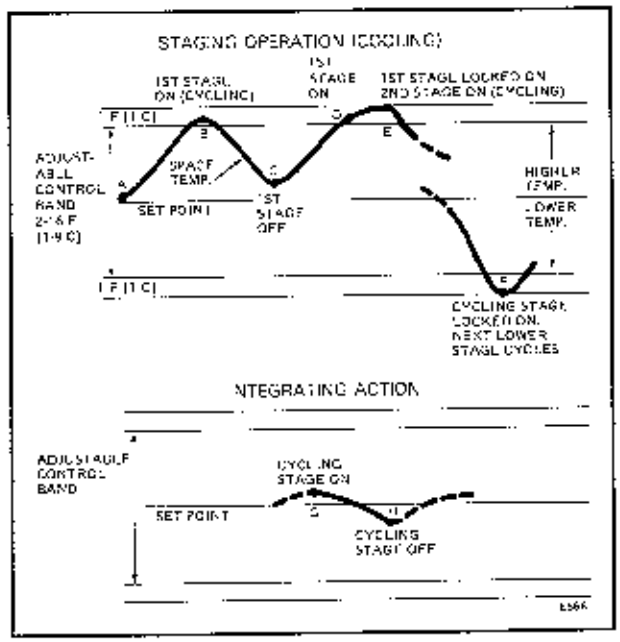


Figure 9. W7100 Discharge Air Temperature Control Operation

2–2 Reset

Reset is accomplished by the use of the space reset sensors, in conjunction with the remote potentiometer. The space sensors respond to space temperature. The remote potentiometer is needed to permit adjustment of the reset control point.

When the average temperature (sensed by the reset sensors) drops to 3° F or more below the set point of the reset sensors (potentiometer setting), the mechanical cooling setpoint (D.A.C. setting) is reset upward by the amount set at the reset adjustment of the D.A.C. If the average temperature is less than 3° F below the setpoint, the mechanical cooling setpoint is reset upward by a percentage of the amount set at the reset adjustment of the D.A.C. (see Fig. 10) for the space reset algorithm.

The reset circuit is very important for the heating mode, because it is the control that will increase the D.A.C. setpoint temperature upward to a temperature that is applicable for heating. The reset circuit works the same for cooling as it does for heating; however, the amount that is reset for heating is four times the amount that would be reset for cooling. For example, if the reset is set at 10° F for cooling, the reset will be 40° F in the heating mode. When the D.A.C. setpoint is at 60° F and the average temperature at reset sensor is more than 3° F below the setting on the potentiometer, the D.A.C. setpoint will be reset to 60° F plus 10° F (70° F) in the cooling mode and will be reset to 60° F plus 40° F (100° F) in the heating mode. If the average temperature is less than 3° F below the setting on the potentiometer, see the space reset algorithm (Fig. 10) to determine the amount of reset.

2–3 Safety Lights

Safety light (red), safety circuit (PL1)—this light is on when the safety circuit lockout relay is energized.

Safety light (red), low oil pressure (PL2)—this light is on when the unit is off because of low oil pressure.

Safety light (white), compressor (PL3)—this light is on when the compressor contractor is energized.

2–4 Freezestat (Low Temp Switch)

The Freezestat monitors water temperatures leaving the unit. This control is used only on heat pump models (803). When the water temperature falls to 35° F or below, the switch will open. This will lockout the compressor. When the temperature rises to 45° F, the control will close. The circuit will remain locked out until manually reset. This is done by setting the system fan/compressor switch (SW2) to the "OFF" position and then back to "ON." See Fig. 11.

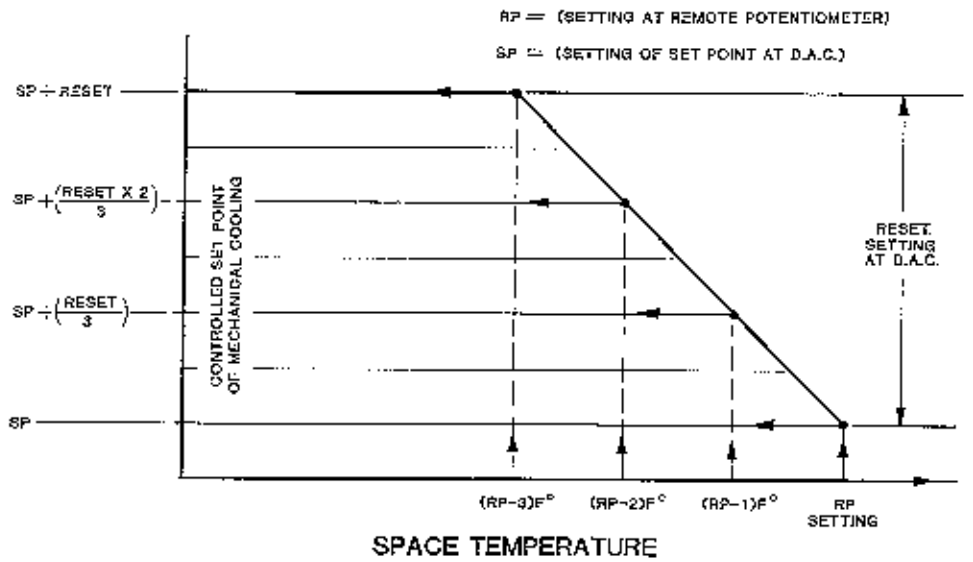


Figure 10. Space Temperature

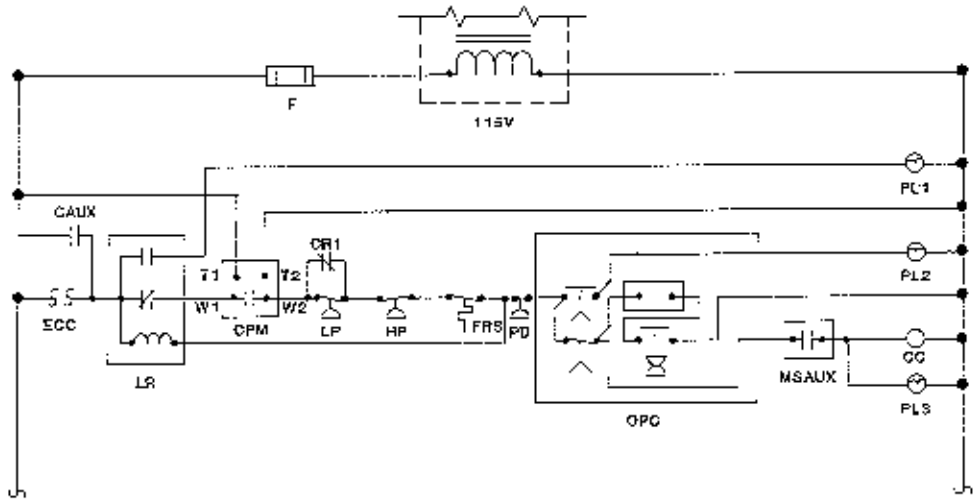


Figure 11. Safety Circuit Schematic

LEGEND
CAUX = COMPRESSOR CONTACTOR AUXILIARY CONTACT
CC = COMPRESSOR CONTACTOR
CPM = COMPRESSOR PROTECTION MODULE
CR1 = CIRCUIT RELAY
ECC = ELECTRICAL CONTROL CIRCUIT
F = FUSE
FRS = FREEZESTAT
HP = HIGH PRESSURE SWITCH
LP = LOW PRESSURE SWITCH
LR = LOCKOUT RELAY
MSAUX = MOTOR STARTER AUXILIARY CONTACT
OPC = OIL PROTECTION CONTROL
PD = PUMP DOWN SWITCH
PL-1, PL-2, PL-3 = SAFETY LIGHTS
T1, T2 = TERMINALS
USED ON 903 SERIES ONLY
W1, W2 = TERMINALS

2–5 Pressure Switches

The low pressure switch (LP) monitors suction pressure. When the suction pressure decreases below the cut-out pressure setting (non-adjustable) of the switch, it will open. This action will lockout the compressor via the lockout relay (LR). When the suction pressure increases to the cut-in point of the switch, it will close; however, the control circuit will stay locked out keeping the compressor off until manually reset. The reset is accomplished by setting the system fan/compressor switch (SW2) to "OFF" and then back to the "ON" position.

The pump down switch (PD) used only on 903 cooling units monitors suction pressure. When the suction pressure decreases below the cut-out point of the switch, it will open, breaking the circuit to the compressor contactor. This switch will not lock out the compressor. It is primarily used for compressor pump down. See the pump down circuit section for an explanation.

The high pressure switch (HP) monitors discharge pressure. When the discharge pressure increases to the cut-out pressure setting (non-adjustable) of the switch, it will open. This action will lock out the compressor via the lockout relay (LR). When the discharge pressure decreases to the cut-in point of the switch, it will close; however, as in the low pressure switch, the compressor will stay locked out until it is manually reset. See Fig. 11 for safety circuit schematic. See Fig. 12 for cut-in and cut-out pressures.

2–6 Pump Down Circuit

On 903 (cooling only) units, a pump down circuit is used to decrease the chance of liquid migration to the compressor. Pump down is achieved by allowing the compressor to run after first stage cooling cycles off. Power remains on to the compressor contactor (CC) by the use of the auxiliary contacts (CAUX) on the compressor contactor (CC). The low pressure switch is jumped out of the circuit with the (CR1) contacts to allow the compressor suction to go below 35 lbs. When the suction pressure reaches 10 PSI, which is the cut-out point of the pump down switch (PD), the compressor will stop. The compressor will not be able to start until first stage cooling is called for. Refer to the Safety Circuit Schematic Diagram Fig. 11.

2–7 Compressor Protection Module

See Fig. 11 for safety circuit schematic

(Reprinted from Copeland Application Engineering Bulletin AE-1264-R2)

Switch	Unit Model	Function	Pressure Setting Cut-In PSI	Pressure Setting Cut-Out PSI
Low pressure (LP)	803/903	Open on pressure decrease	35 ± 3	57 ± 7
Low pressure (LP)	903 pump down	Open on pressure decrease	10 ± 3	32 ± 3
High pressure (HP)	803	Open on pressure increase	350 ± 10	280 ± 20
High pressure (HP)	903	Open on pressure increase	300 ± 10	233 ± 15

Figure 12. Cut-In Cut-Out Pressure Chart

CONTROL SPECIFICATION

1. **Sensor Resistance**
   The resistance of the T.I. sensor will vary from 500 ohms (cold) to 20,000 ohms (hot). Reset values after a protector trip are from 2700–4500 ohms. Three sensors are wired in parallel to one common terminal.

2. **Low Voltage Cut-Out**
   208/240 volt module
   170 ± 8 volts in normal ambients
   Cut-in voltage—5 volts above cut-out

   120 volt module
   85 ± 4.5 volts in normal ambients
   Cut-in voltage—4 volts above cut-out
   Low voltage response delay 0.2 ± .15 seconds

3. **Off Cycle Timer**
   120 second ± 15% at normal ambients

BASIC MOTOR PROTECTION

The combination of low voltage sensing and time delay provides for the first time positive protection against low voltage conditions which can occur on the pilot circuit in the event of a single phase condition on a three phase power supply.

The low voltage protection feature will act to remove the compressor from the line in the event of dangerously low voltage conditions, the module locking the compressor off the line until the voltage rises to the cut in setting.

The time delay acts to provide a minimum of two minutes off time each time the power circuit is opened, providing protection against "blips" in the power supply, or any chatter condition originating in the line power circuit.

Service and test personnel must be alert to this feature since it is possible in checking the compressor or system, power may be applied, disconnected, and reapplied in less than two minutes. In such case, the time delay feature will prevent operation until the time delay has expired, and this may be misinterpreted by service personnel as a module malfunction.

Note: The solid state module cannot be repaired in the field, and if the cover is opened or the module physically damaged, the warranty on the module is voided. No attempt should be made to adjust or repair this module, and if it becomes defective, it must be returned intact for replacement.

HIGH-POTENTIAL TESTING (HI-POT)

The solid state sensors and the electronic components in the solid state module are delicate, and can be damaged by exposure to high voltage. Under no circumstances should a high potential test be made at the sensor terminals with the sensor leads connected to the solid state module. Even though the power and pilot circuit leads are not connected, the module can be damaged.

The sensor leads and motor are subjected to a high potential test at the Copeland factory, and the field high potential testing of the sensor circuit is not recommended unless absolutely required. If a test must be made, the sensor leads must first be disconnected from the module and shorted together.

FIELD TROUBLE SHOOTING

In the event the motor compressor is inoperable or is not operating properly, the solid state control circuit may be checked as follows:

1. If the compressor has been operating and has tripped on the protector, allow the compressor to cool for at least one hour before checking to allow time for the motor to cool and the control circuit to reset.

2. Connect a jumper wire across the "control circuit" terminals on the terminal board. This will bypass the "control circuit" terminals on the module.

   If the compressor will not operate with the jumper wire installed, then the problem is external to the solid state protection system. If the compressor operates with the module bypassed, but will not operate when the jumper wire is removed, then the control circuit relay in the module is open for some reason.

3. If after allowing time for motor cooling the protector still remains open, the motor sensors may be checked as follows:

   a. Remove wiring connections from the sensor and common terminals on the terminal board.

   b. WARNING: Use Ohmmeter only (6 volt maximum) for checking. The sensors are sensitive, easily damaged, and no attempt should be made to check continuity through them. Any external voltage or current applied to the sensors may cause damage necessitating compressor replacement.

   c. Measure the resistance from each sensor terminal to the common terminal. The resistance should be in the following range:

      500 ohms (cold) to 20,000 ohms (hot)

      Resistance readings in this range indicate the sensors are good. A resistance approaching zero would indicate a short; a resistance approaching infinity would indicate an open connection. Proper operation of the control system is dependent on a continuous parallel circuit through all three sensors with no individual resistance reading higher than 10,000 ohms.

      On initial start-up, and after any module trip due to high temperatures, the resistance of the sensors must be below the reset point before the module relay contacts will close. Reset values are 2700—4500 ohms.

4. If the sensors have the proper resistance, and the compressor will run with the control circuit bypassed, but will not run when connected properly, the solid state module is defective, and must be replaced. The replacement module must be the same voltage and made by the same manufacturer as the original module on the compressor.

EMERGENCY BYPASS OF A DAMAGED SOLID STATE SENSOR

In the unlikely event that one sensor may be damaged, and have an open circuit, the control module will prevent compressor operation even though the motor may be in perfect condition. If such a situation should be encountered in the field, as an emergency means of operating the compressor until such time as a replacement can be made, a properly sized resistor can be added between the terminal of the open sensor and the common sensor terminal in the compressor terminal box. This then indicates to the control module an acceptable resistance in the damaged sensor circuit, and the compressor operation can be restored.

The specifications for the emergency resistor are as follows:

One watt, 2200 ohm ± 10% resistor

If an internal sensor is shorted, the wire from the sensor to the sensor terminal should be disconnected when installing the resistor. In effect, the compressor will continue operation with two leg protection rather than three leg protection. While this obviously does not provide the same high degree of protection, it does provide a means of continuing compressor operation with a reasonable degree of safety. The protector cut-in and cut-out points will be reduced by approximately 7 ° F to 10° F, but under normal operating conditions, this should present no problem. See Fig. 13.

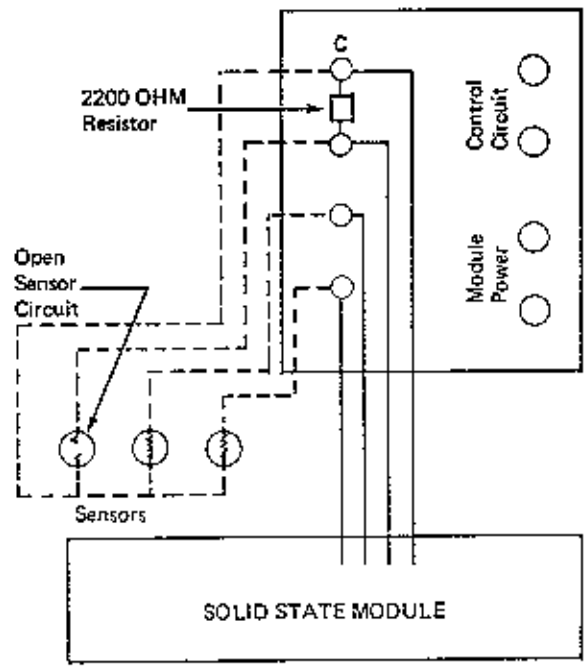


Figure 13. Emergency Bypass of Damaged Solid State Sensor

REPLACEMENT COMPRESSORS

It is presently planned that wholesalers will stock replacement TSK compressors with 220 volt modules only, but will maintain a stock of 120 volt modules. In the event a replacement is required with a 120 volt module, it will be necessary for the wholesaler to change the module.

2–8 Oil Protection Control

See Fig. 11 for safety circuit schematic

The solid state control is a Robertshaw LG Series Gard–Pak IV. The control monitors the pressure at the crankcase port (suction pressure) and oil pump port simultaneously. The control operates on the difference in pressure between the high pressure line (marked "Lube") and the low pressure line (marked "Suction"). Note: Pressure differential is not oil pressure gauge reading—it is the oil pump pressure minus the crankcase pressure (suction pressure). When the differential is reduced to a preset trip point of 9 PSI, the control will shut down the compressor after the time delay of 120 seconds has elapsed.

Under normal conditions, the control is "closed" and the compressor is running. The solid state network is energized. If oil pressure differential drops below 9 PSI., the pressure transducer will "open" and start the time delay. If proper pressure is not resumed within the time delay period, the compressor is stopped.

To start the compressor after a lock-out occurs, the manual reset button must be pushed. If oil pressure is not adequate, the compressor will operate only for the duration of the time delay setting.

If the reset button is pushed during normal operation, the compressor will stop and remain off until the reset button is released. Upon release, the compressor will restart.

TESTING CONTROLS FOR PROPER OPERATION

The time delay mechanism of Gard-Pak IV controls should be tested at installation and periodically thereafter to assure proper operation. The test: pull line power, disconnect switch. Remove Gard-Pak control module cover. One screw, located on the top of the cover, locks the cover in position.

The Gard-Pak module is equipped with a terminal and a jumper wire—as shown in the illustration. The terminal is found on all Gard-Pak modules; it is intended for the control testing both at receiving inspection and in the field.

For field testing, first turn off line power. Next, disconnect the jumper terminal. Close the line switch to start the compressor. If the Gard-Pak IV module is operating correctly, the compressor will stop after the factory-set time delay (or field-selected time delay on applicable models). Allow minor timing variations because of tolerances of the various components. AFTER TESTING, REPLACE THE JUMPER TO ITS ORIGINAL POSITION FOR NORMAL OPERATION.

For receiving inspection, follow the same procedure as listed above for checking timing. This same jumper feature will allow easy electrical monitoring for checking differential pressure settings.

2–9 Operation of the Water Valve

In the cooling mode, the modulating water valve regulates flow of water to the heat exchanger controlled by the water pressure regulator.

The water pressure regulator senses pressure at the liquid line service valve, which in turn opens and closes the motorized water valve in order to maintain a constant liquid line pressure.

In the heating mode, the water valve will be in the full open position and during the off cycle it will close.

The linkage at the motorized water valve is factory-adjusted. The installer should not have to adjust it. See Fig. 14 for proper setting of the water pressure regulator.

Discharge Air Controller	
Setpoint	60°F
Reset	10°/40°F
Control Band	16°F
Remote Potentiometer	75°F
Water Regulating Valve	210°F, Minimum Differential
Change Over Thermostat	70°F, Differential (10°F)

Figure 14. Suggested Control Settings

2–10 Changeover Thermostat

The changeover thermostat has an adjustable setpoint from 0° F to 100° F and a 3° F to 10° F differential. The contacts between R and B will close when the temperature falls below the setpoint minus the differential, thus changing the unit into the heating mode. The contacts will open at the setpoint changing the unit back into the cooling mode. See the wiring diagram for field connections.

Note: The maximum safe bulb temperature is 125° F.

2–11 Model VAV Startup

Checklist before Start-Up

- ✓ CORRECT VOLTAGE AND FUSES FOR UNIT
- ✓ FILTERS IN PLACE
- ✓ WATER SYSTEM CLEAN, FLUSHED AND PURGED OF AIR
- ✓ GLOBE VALVES ADJUSTED FOR REQUIRED G.P.M.
- ✓ WATER TEMPERATURE BETWEEN 60° F and 95° F
- ✓ PROPER CONDENSATE TRAP (BE SURE TO ADD WATER FOR START-UP)
- ✓ COMPRESSOR HOLD DOWN CLAMPS REMOVED
- ✓ GUIDE VANE CONTROL AND VAV BOXES IN OPERATION

Start-Up Procedure

NOTE: ALL SAFETY PRECAUTIONS SHOULD BE TAKEN DURING START-UP BECAUSE OF SAFETY HAZARDS FROM ELECTRICAL COMPONENTS, SYSTEM PRESSURES AND MOVING PARTS. START-UP SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY!

1. The crankcase heater is to be energized 24 hours prior to start-up. To energize the crankcase heater without starting the unit, connect the main power and set system switch 1 (SW1) to "ON." System switch 2 (SW2) is to remain "OFF."

2. Disconnect power at the main disconnect. Remove the blower panels and inspect the belts, pulleys and blower wheels for loose connections. Record the full load amps from the blower motor nameplate.

3. With the blower panels off, reconnect power at the main disconnect and set system switch 1 (SW1) to "ON." Set system switch 2 (SW2) to the "FAN" position. The blower motor will now run. Check motor for proper rotation and correct if necessary.

4. With the blower motor off and the system switch 2 (SW2) "OFF," replace the blower panels. Restart the blower and check the amperage. Be sure that the VAV boxes are fully open so that the amperage can be checked at full air flow. If the amps are higher than the rated full load amps of the motor, adjust the motor pulleys to slow down the blower. This is done by loosening the set screw on the motor pulley and unscrewing the adjustable end. The blower belts will now need to be retightened. Repeat this until blower motor amperage is acceptable.

5. The system is now ready to be started. All the controls should be properly set at this time. Refer to the suggested control setting in this section. See Fig. 14. For start-up purposes, the changeover thermostat can be adjusted to initiate heating or cooling mode. To start the compressor, set system switch 1 (SW1) to "ON" and system switch 2 (SW2) to the "FAN/COMP." position. There will be a 4 minute delay before the compressor will start. To force all the stages of cooling to sequence, adjust the set-point of the discharge air controller (DAC) to below 60°F. Remember that there will be a 4 minute time delay between each stage. For heating, set the set-point of the discharge air controller to 60°F and adjust the remote potentiometer until it is 3°F or more above the space temperature sensed by the space sensor. To check for proper operation, refer to sequence of operation section of this manual. See Fig. 16. For approximate pressures, refer to Fig. 15.

Note: The control adjustments mentioned are for start-up purposes only. After start-up, the controls should be readjusted to the suggested control settings. Because air conditioning systems in buildings vary, deviations from these suggested settings can be made, but only after careful consideration.

MODE	SUCTION	DISCHARGE
*COOLING	70 to 80 PSI	225 to 240 PSI
*HEATING	45 to 70 PSI	210 to 240 PSI

*BASED ON STANDARD ARI CONDITIONS

HEATING	COOLING
70°F RETURN AIR	80°/67°F RETURN AIR
70°F ENTERING WATER	85°F ENTERING WATER, 95°F LEAVING WATER
400 CFM/TON	

Figure 15. Pressure Chart

2–12 General Maintenance

Note: Safety precautions should be taken when any maintenance is performed because of safety hazards from electrical components, system pressures and moving parts. Power at the main disconnect is to be "Off," together with system switch 1 (SW1) and system switch 2 (SW2) at the unit.

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Motor Bearings

The motor bearings are factory lubricated and will *not* need additional lubrication upon start-up. However, a yearly inspection should be made and grease added if necessary.

Blower Shaft Bearings

The blower shaft bearings are factory lubricated with high quality grease and should require no further lubrication. However, a yearly inspection should be made and grease added if necessary.

Filters

The filters should be checked every six months after start-up and replaced when needed. They should be checked more often if conditions require.

Dear Customer,

We welcome your comments and suggestions for improving this publication. Your assistance is greatly appreciated and will enable us to provide better technical information for you.

SEQUENCE OF OPERATION

Model No.	Mode	Heating Relay HR	Cooling Relay CR	Unloading Solenoid US1	Unloading Solenoid US2	Liquid Line Solenoid LLS	Reversing Valve Solenoid RVS	Hot Gas Bypass HGB	Relay R	Compressor Contactor CC	Crankcase Heater CCH
	Cooling 1st stage	O	X	X	O	O	X	X	O	X	O
803-	Cooling 2nd stage	O	X	X	O	X	X	O	O	X	O
	Cooling 3rd stage	O	X	O	O	X	X	O	O	X	O
300	Heating 1st stage	X	O	X	O	O	O	O	O	X	O
	Heating 2nd stage	X	O	O	O	O	O	O	O	X	O
	Off	O	O	O	O	O	O	O	O	O	X
	Cooling 1st stage	O	X	X	X	O	X	X	O	X	O
803-	Cooling 2nd stage	O	X	O	X	X	X	O	X	X	O
	Cooling 3rd stage	O	X	O	O	X	X	O	X	X	O
360	Heating 1st stage	X	O	O	X	O	O	O	O	X	O
	Heating 2nd stage	X	O	O	O	O	O	O	O	X	O
	Off	O	O	O	O	O	O	O	O	O	X
	Cooling 1st stage	O	X	X	X	O	X	X	O	X	O
803-	Cooling 2nd stage	O	X	O	X	X	X	O	X	X	O
	Cooling 3rd stage	O	X	O	O	X	X	O	X	X	O
480	Heating 1st stage	X	O	O	X	O	O	O	O	X	O
	Heating 2nd stage	X	O	O	O	O	O	O	O	X	O
	Off	O	O	O	O	O	O	O	O	O	X

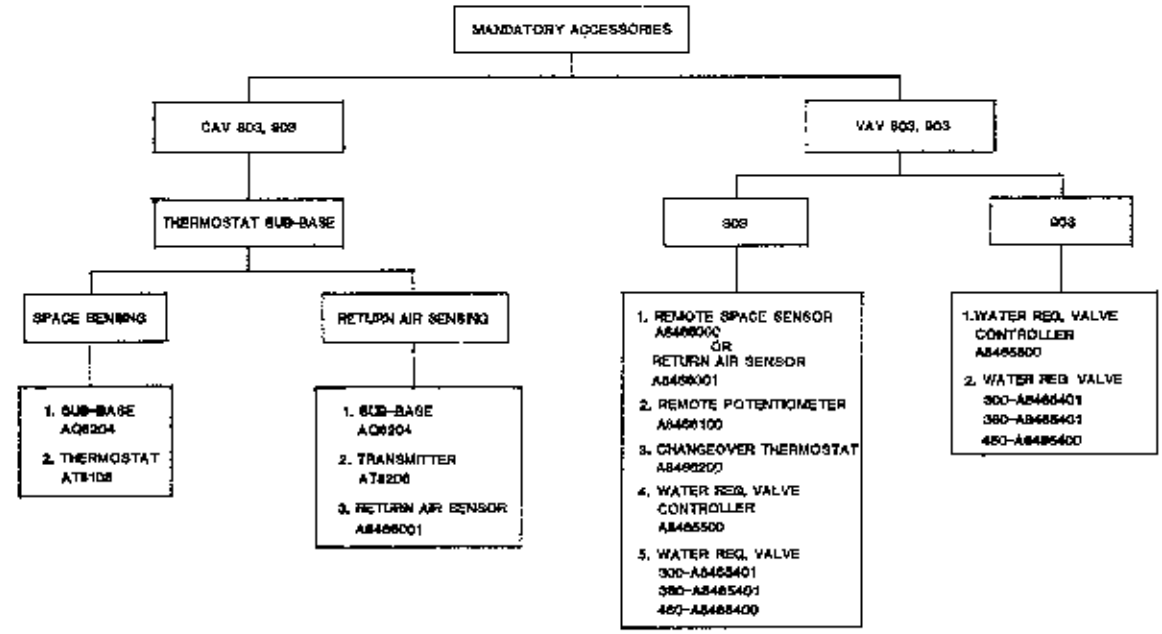
Figure 16. Sequence of Operation

Notes: When the Liquid Line Solenoid is energized it will be in the "open" position.

Symbols: X – Indicated control *is* energized.
O – Indicates control *is not* energized.

MANDATORY & OPTIONAL ACCESSORIES

CAV & VAV UNITS



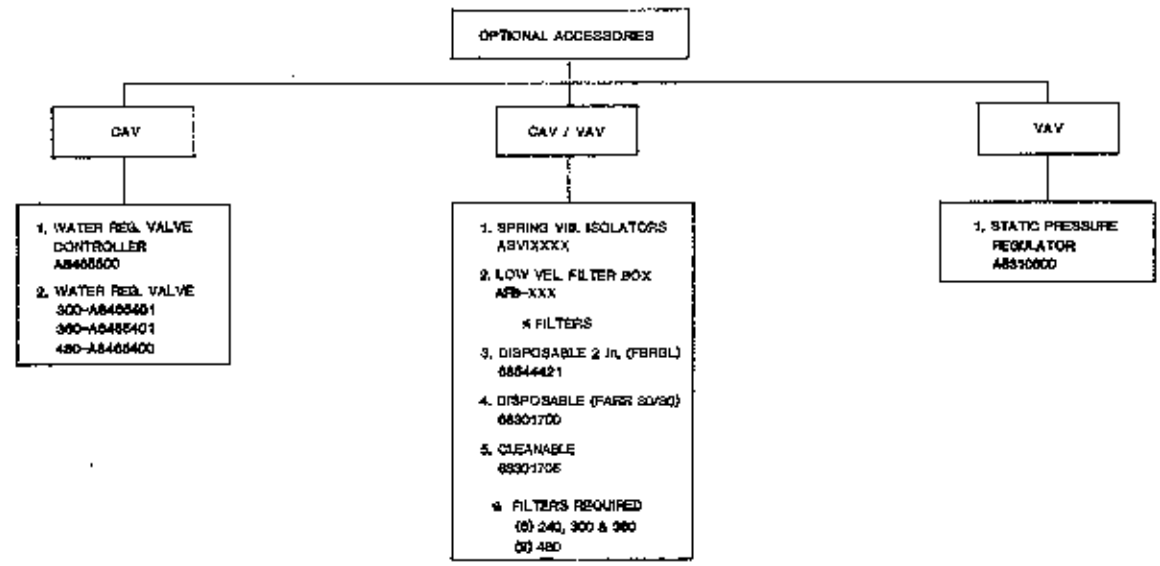


Figure 17. Mandatory and Optional Accessories

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