DOE/NASA CONTRACTOR REPORT

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SOLAR HEATING AND COOLING DEMONSTRATION PROJECT AT THE FLORIDA SOLAR ENERGY CENTER

Prepared by

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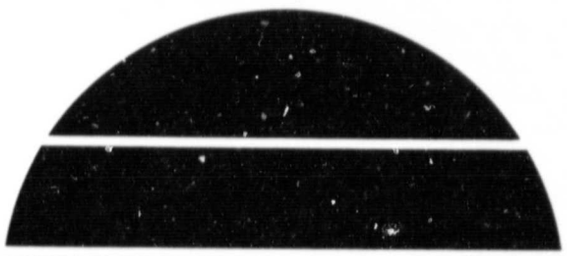
Monitored by

George C. Marshall Space Flight Center, Alabama
National Aeronautics and Space Administration

For the U. S. Department of Energy



U.S. Department of Energy

Solar Energy

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Final Report

INTRODUCTION

The Florida Solar Energy Center (FSEC) has retrofitted one of the Center's office buildings, approximately 5,000 square feet of space, with solar air conditioning and heating as a demonstration of the technical feasibility to the many visitors to the Center and the residents of East-Central Florida. The project provides a unique opportunity to compare high-temperature, non-imaging, non-tracking, evacuated-tube collectors with the imaging and tracking collectors used in the Disney World and the Florida Welcome Station solar heating and cooling (SHAC) demonstration projects, since the three projects are similar in environmental conditions, size and configuration. The project is part of the Department of Energy's Solar Heating and Cooling Demonstration Program Second Program Opportunity Notice (PON-2).

The project is situated just north of Port Canaveral and south of the Cape Canaveral Air Force Station and is visible to the hundreds of persons entering and leaving the Air Force Station each day. Percentage of available sunshine is nearly uniform at 60 to 70 percent throughout the year. Daytime temperatures average 86F in the summer and 65F in the winter, with overnight freezing extremely rare.

The building which is serviced by the SHAC project provides space for electronic data processing equipment and offices for 20 persons and also includes a small mechanical shop for prototype and maintenance functions and an electronics shop. The building is of single-story cement block construction on a concrete slab, with a flat roof of built-up tar and gravel on an insulating roof deck. Ceilings are fiberglass tiles suspended one or more feet below the roof. Building dimensions are approximately 50 feet by 100 feet by 12 feet high, with the length of the building oriented east-west. The roof has 6 foot overhangs on east, west and south sides. There is very little window area in the building.

DESIGN PHILOSOPHY

The system was originally designed to supply approximately 70 percent

of the annual cooling load for one building and 50 percent of the annual heating load for three buildings. This latter objective of providing 50 percent of the heating requirements for three buildings was changed to provide 100 percent of the heating load for one building (the one which is also cooled) as an economy measure.

The solar energy system for the Research, Development and Demonstration Division (RD&D) building is shown schematically in Figure 1. The design of the system was kept simple and employs five hydronic loops:

- Energy collection loop
- Chilled water production loop
- Space cooling loop
- Space heating loop
- Energy rejection loop

Use of both hot water storage and chilled water storage effectively decouples the loops, facilitating analysis and operating controls. Since cooling is the major energy consuming mode in Florida, the collectors are tilted to the south at 15 degrees (latitude minus $13\frac{1}{2}^{o}$), to maximize summertime collection. Pump head and pipe sizes were optimized (consistent with construction cost) to minimize parasitic power. Tank insulation was applied to limit unwanted thermal losses and gains to approximately 6 percent of the collected heat.

Collector

Absorption chillers available for use in SHAC systems typically require high-temperature (180F to 200F) water, and all such devices which may become available are expected to require relatively high-temperature water. Florida skies are frequently subject to intermittent cloud cover, so it was felt that an evacuated collector making use of diffuse insolation would be more effective than a concentrating collector for producing high-temperature water in the Florida environment. General Electric's TC-100 was the collector chosen. The collectors each have 10 evacuated tubes and employ a single "sawtooth" Coilzak reflector underneath the tubes. Total collector area was sized to match the building's normal maximum cooling load, 216,000 Btu/hr.

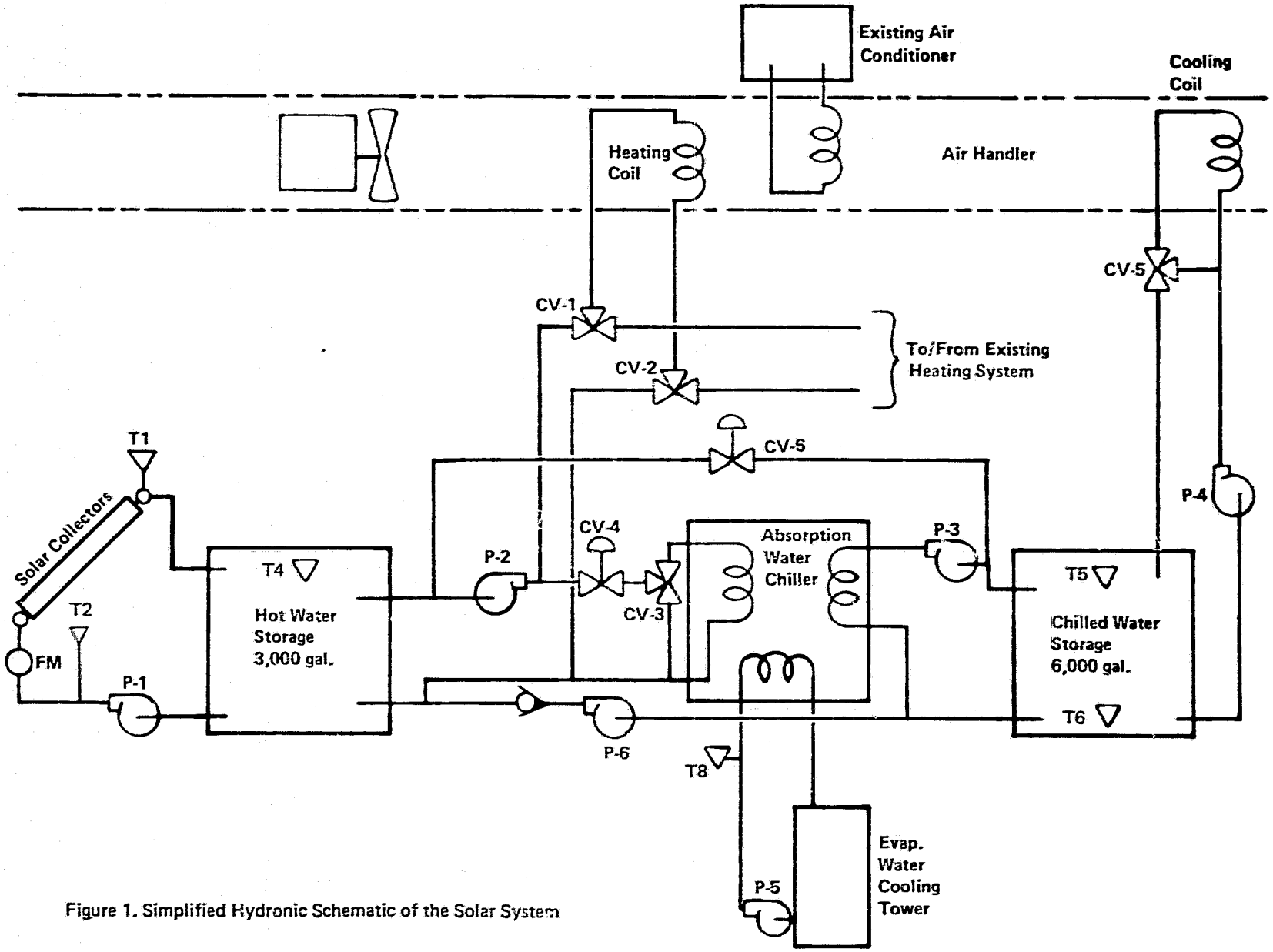


Figure 1. Simplified Hydronic Schematic of the Solar System

Chiller

The water chiller is the Arkla model WFB-300 which has a nominal rating of 25 tons. It is supplied with hot water from storage and delivers its chilled water to storage. The controls are arranged so that, for the chiller to turn on, there is sufficient thermal energy in hot water storage for approximately one hour's operation of the chiller and enough chilled water storage capacity to receive the chiller output for one hour. These operating conditions were chosen to prevent short-cycling of the chiller and the resulting lower COP.

Storage

In specifying storage it is important to consider the relationship between storage size and area of collectors, energy available for operation at night and on cloudy days, system thermal inertia, and cost. Considering these factors, design was established at 3,000 gallons for hot water storage and 6,000 gallons for chilled water storage. The energy budget allowed for 6 percent loss of heat collected from storage and piping. Comparative energy capacities of the system are shown in Table 1.

Table 1. Energy Capacities of SHAC System

Quantity	Capacity Millions of Btu's per day	
	Summer	Winter
Solar thermal energy collection	up to 1.9	up to 1.3
Hot water storage (ref. 165F)	up to 1.4	up to 1.4
Hot water demand	up to 2.6	up to 1.0
Chilled water production	up to 1.3	up to 0.8
Chilled water storage (ref. 53F)	up to 0.75	up to 0.75
Chilled water demand	up to 1.6	up to 0.5

Note that the maximum energy that can be stored as hot and chilled water combined is almost exactly that required for a day's cooling.

Controls

System controls are standard pneumatic devices. Exceptions are the solar intensity controller, the temperature differential controller and two time-out relays, which are all part of the collector pump controls. Figures 2 through 9 show each mode of operation and the logic statements by which the system is controlled for each mode.

Piping

All outdoor piping, except the small diameter tubing connecting the collectors to the headers, is copper pre-insulated with polyurethane foam and having an overall 60-mil white PVC jacket. It provides very good insulation, is well protected from weather and physical damage, is attractive in appearance, and seems to be cost-effective in its application.

PROBLEMS ENCOUNTERED AND THE SOLUTIONS

During evolution of the design, two significant details were changed. We were concerned about a high likelihood of air entrainment and/or entrapment in high points in the collectors. The General Electric TC-100 collector uses a continuous copper tube waterway which GE refers to as a serpentine and which contains, in each collector, 12 non-ventable high points (see Figure 10) when the collector is normally mounted tilted to the south from horizontal and the tubes and reflectors are oriented north-south as recommended by GE. It was concluded there was insufficient data to justify ignoring widely proven good engineering design practices by designing a system having 1,200 known non-ventable high points. This system, therefore, has the tubes oriented east-west to minimize the potential risk. (It should be noted that the risk cannot be eliminated, as the GE TC-100 uses a 360° loop in the copper tubing at each inlet and outlet.) Also, thermal perf. mance data later supplied by GE suggest performance may be improved when mounted with the tubes east-west.

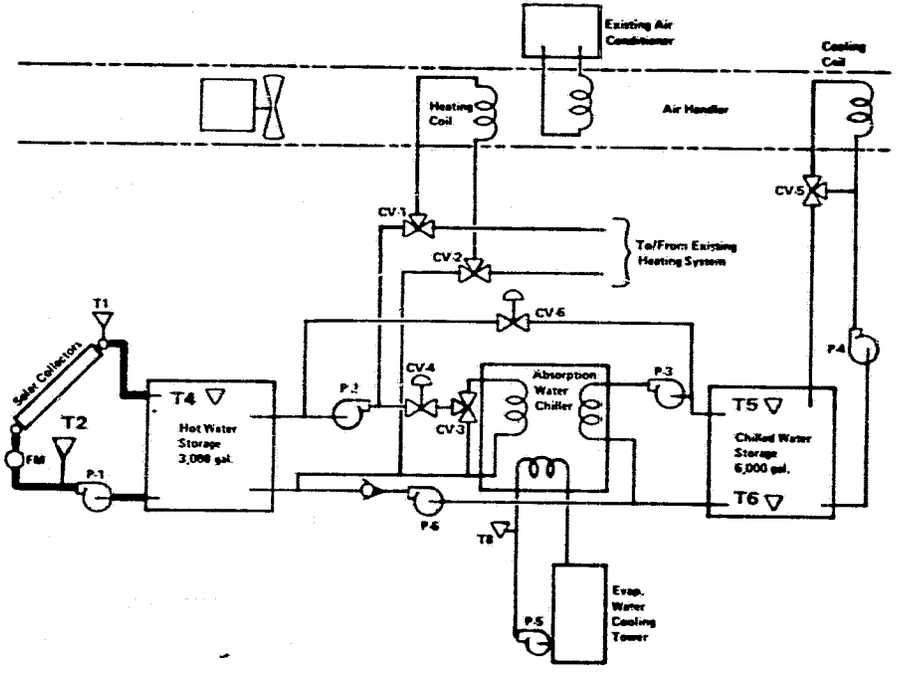


FIGURE 2. Solar Energy Collection / Conversion

- Insolation $\geqq$ 50 Btu/hr – ft^2 – ^0F incident on photocell PC–1 energizes cycle timers.
- Cycle timer CT–1 turns on P1 to establish flow.
- Cycle timer CT–2 turns off P1 after 3minutes and resets CT–1 to turn on again after 30 minutes.

OR

- T1–T2 $\geqq 10^0F$, a ΔT controller maintains P1 in operation. (This is usually established during the 3 minutes of P1 operation thru the cycle timers.)
- T1–T2 $\leqq 4^0F$ deenergizes ΔT controller.

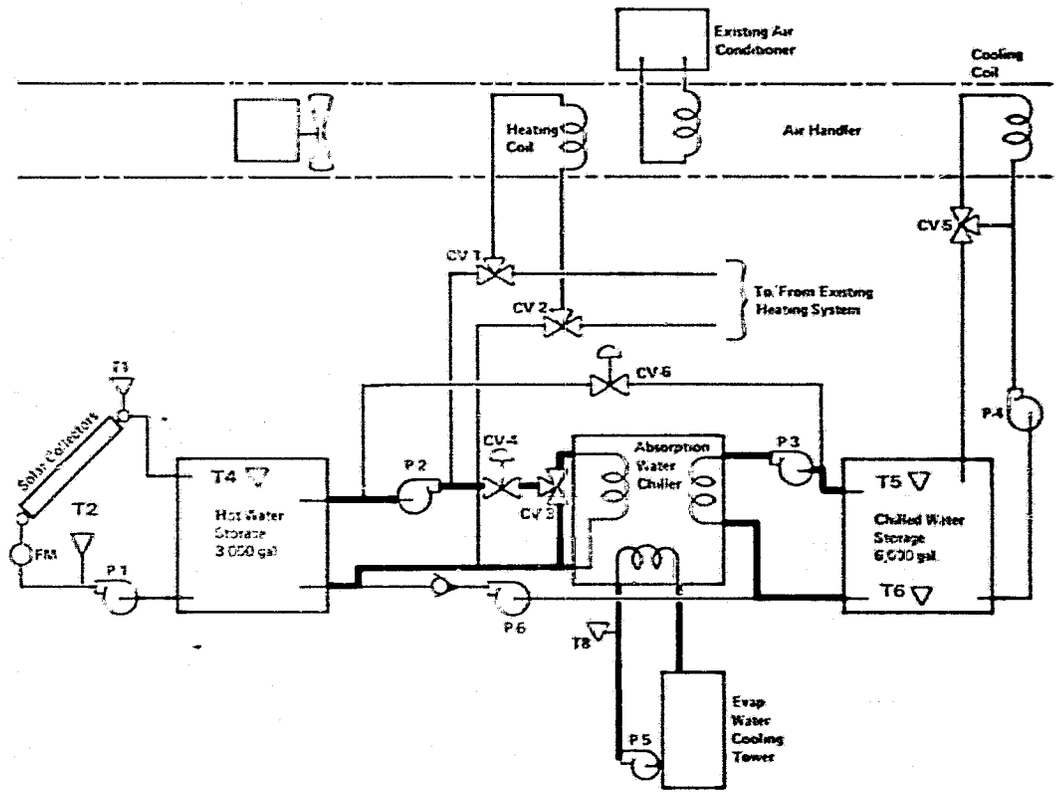


FIGURE 3. Chilled Water Production From Solar Energy

- Selector switch in "COOL" opens CV 4, closes CV1 and 2 to the flow of solar hot water, enables chiller controls.
- T4 ≥ 185F AND T5 ≥ 50F turns on P2, P3, and P5.
- T4 ≤ 175F OR Tevap = 38F turns off P2, P3, and P5.
- Tsump ≥ 85F turns on tower fan
- Tsump ≤ 80F turns off tower fan

(Note - Tevap and CV3 are supplied with and are part of the Arkla Chiller.)

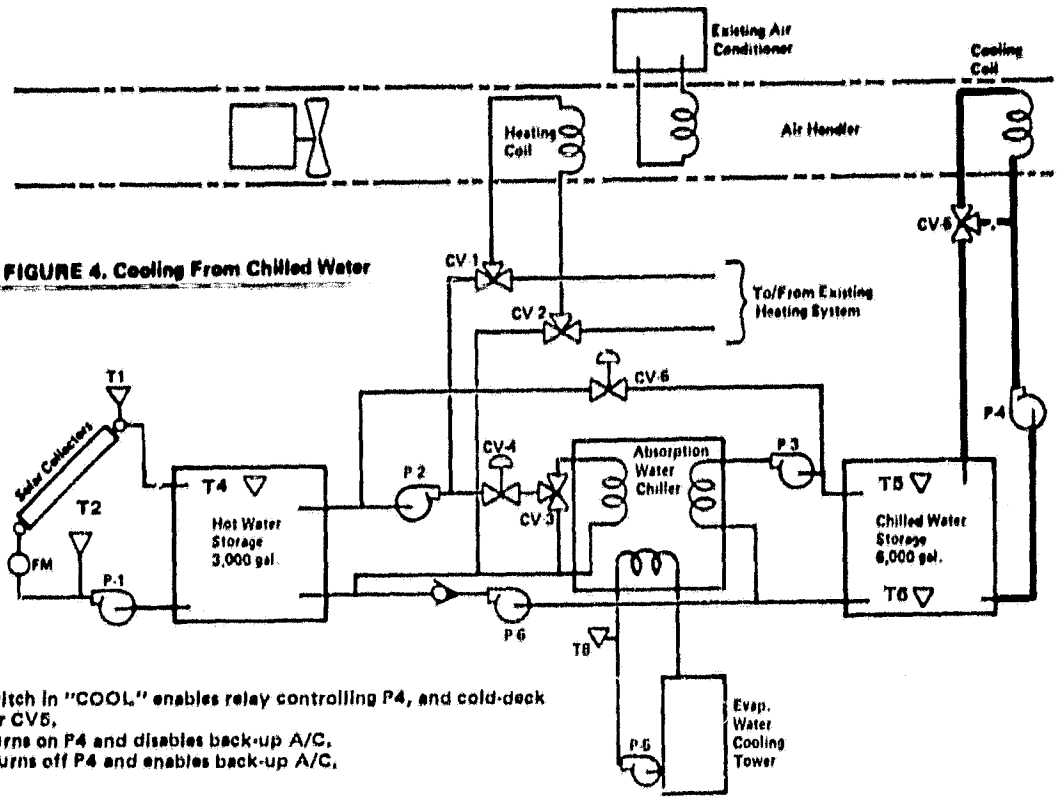


FIGURE 4. Cooling From Chilled Water

- Selector switch in "COOL" enables relay controlling P4, and cold-deck controls for CV5.
- T6 ≤ 52F turns on P4 and disables back-up A/C.
- T6 ≥ 57F turns off P4 and enables back-up A/C.

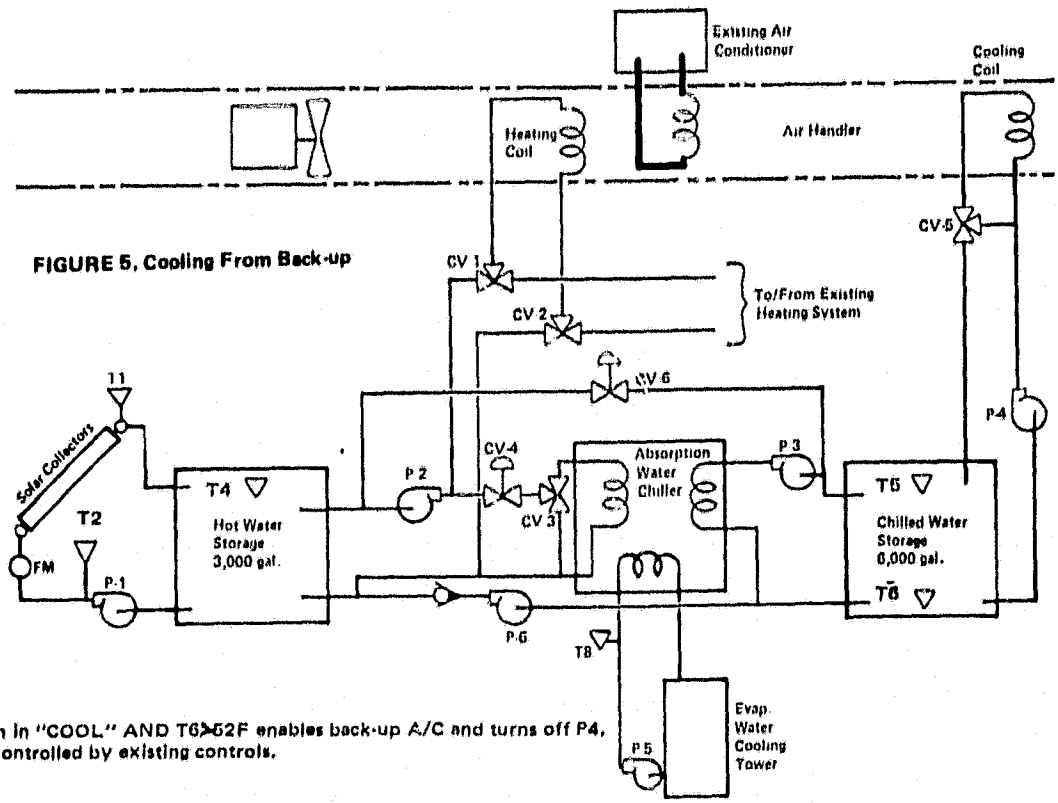


FIGURE 5. Cooling From Back-up

- Selector switch in "COOL" AND T6 > 52F enables back-up A/C and turns off P4.
- Back-up A/C controlled by existing controls.

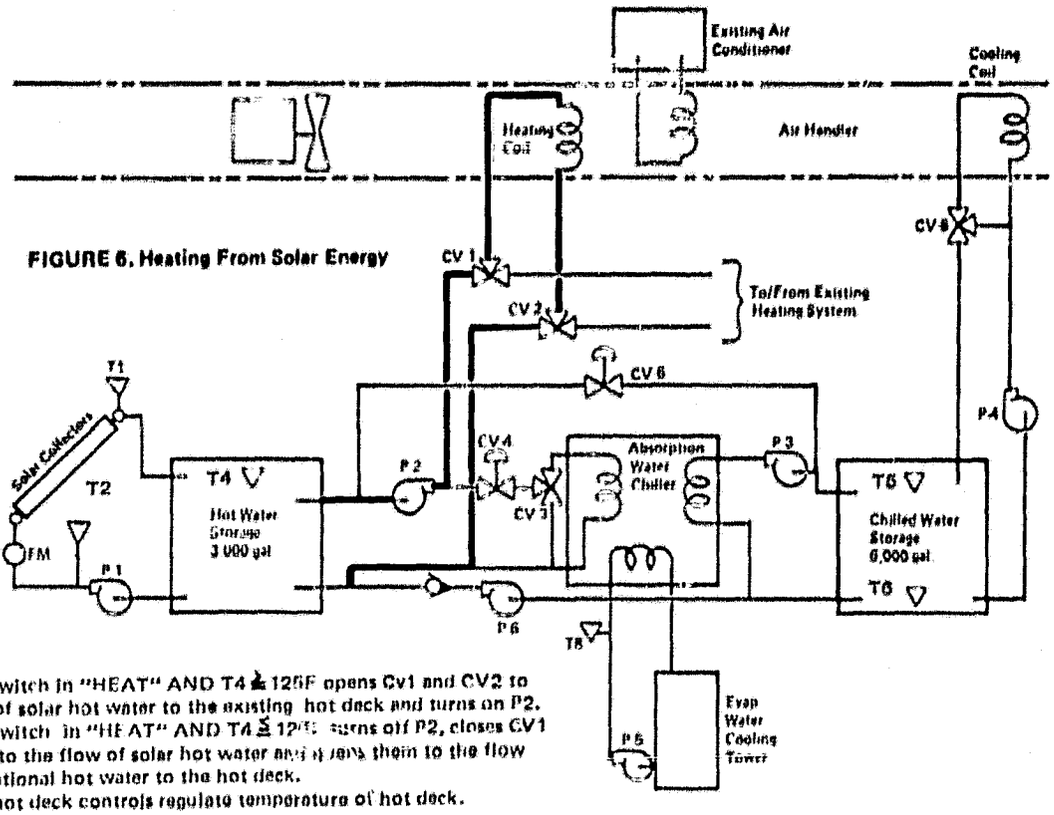


FIGURE 6. Heating From Solar Energy

- Selector switch in "HEAT" AND T4 ≥ 125F opens Cv1 and CV2 to the flow of solar hot water to the existing hot deck and turns on P2.
- Selector switch in "HEAT" AND T4 ≤ 120F turns off P2, closes CV1 and CV2 to the flow of solar hot water and opens them to the flow of conventional hot water to the hot deck.
- Existing hot deck controls regulate temperature of hot deck.

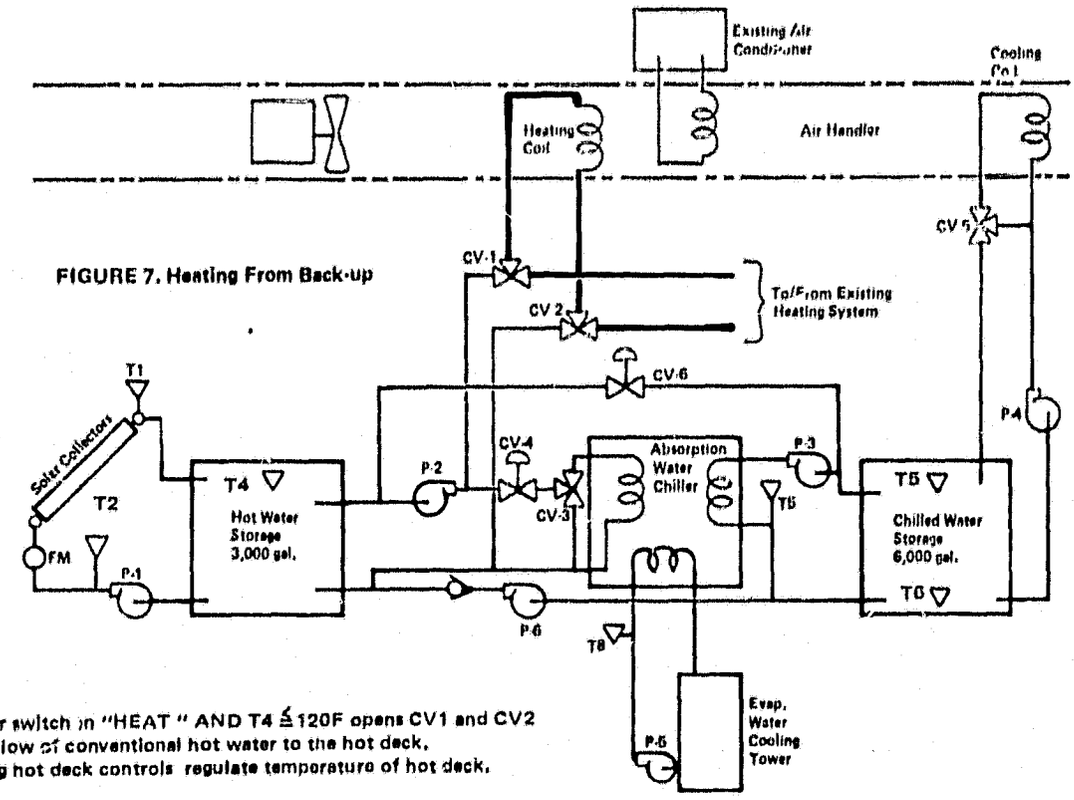


FIGURE 7. Heating From Back-up

- Selector switch in "HEAT " AND T4 ≤ 120F opens CV1 and CV2 to the flow of conventional hot water to the hot deck.
- Existing hot deck controls regulate temperature of hot deck.

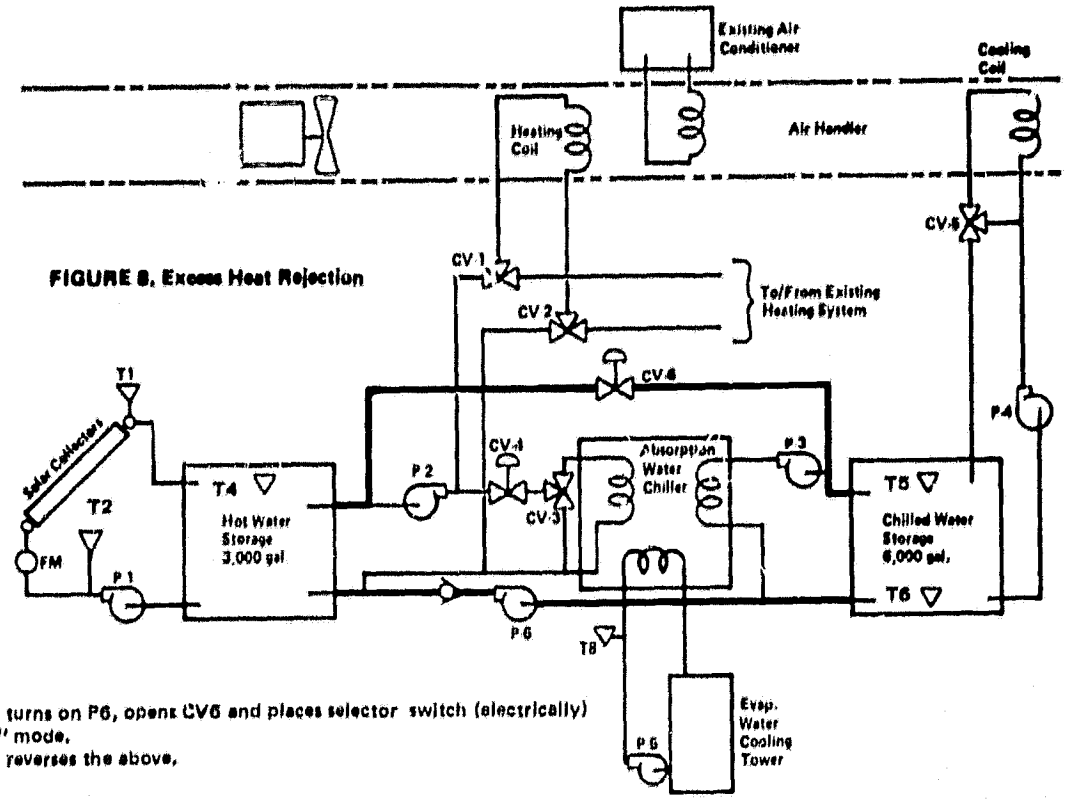


FIGURE 8. Excess Heat Rejection

- T4 ≥ 205F turns on P6, opens CV6 and places selector switch (electrically) in "COOL" mode.
- T4 ≤ 200F reverses the above.

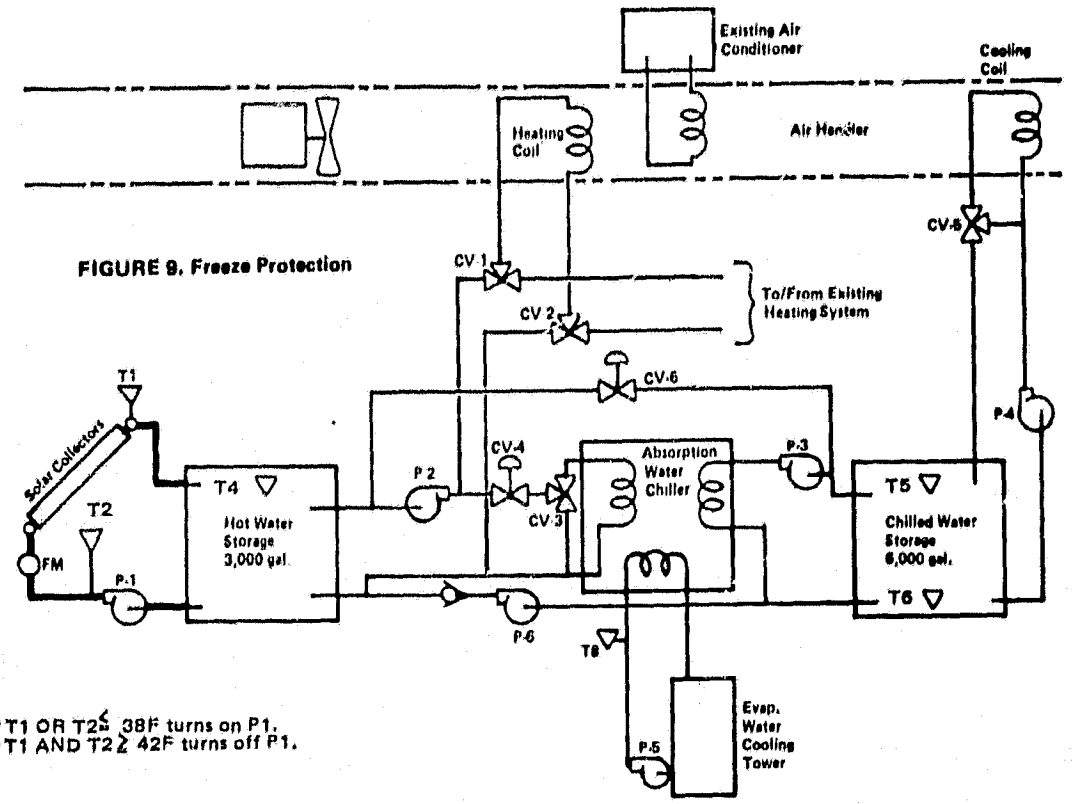


FIGURE 9. Freeze Protection

- T1 OR T2 ≤ 38F turns on P1.
- T1 AND T2 ≥ 42F turns off P1.

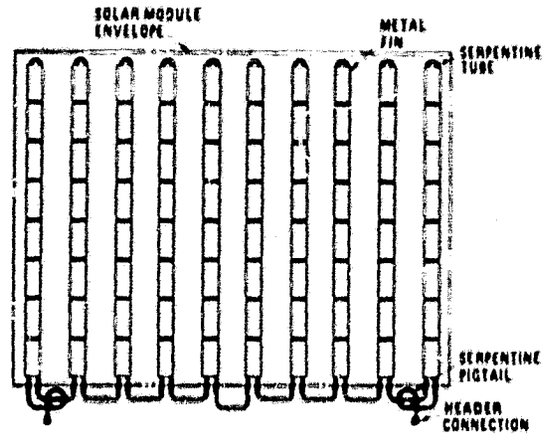


Figure 10
View of GE TC-100 Collector
Showing "Hair Pin" Waterways

Cost was the project's biggest problem. The proposal was submitted on November 17, 1976, and the signed contract was received in late September 1977. During that interval, construction activity greatly increased in Brevard County, and construction costs rose 20 to 25 percent. Steps taken to offset cost increases included:

- Eliminating a separate heat exchanger for rejecting thermal energy off the collectors when surplus heat is collected. Instead, excess heat is absorbed by chilled water from storage, which eventually rejects the excess heat through the absorption chiller and then through the water tower (see Figure 8).

- Equipment building was re-designed and reduced in size.

- FSEC constructed the building and concrete pads for storage tanks and water cooling tower.

- FSEC purchased and mounted the collectors, the chiller, and the cooling tower.

To be sure, the FSEC accepted greater risk than had a turn key construction contract been awarded, but the result was financially satisfying. The project met its re-estimated cost at completion of $220,800, compared with the negotiated estimated cost of $215,602 and an estimated cost without the cost reduction effort of more than $270,000.

Other problems encountered during construction and start-up included numerous late receipt of parts and a controls problem. Careful planning to assure solar-heated hot water to operate the chiller went for nought because of a misunderstanding between the detail design engineer and the contractor regarding operational controls on the chiller. The contractor believed he was following the engineer's instructions when he (a) disconnected the motor-operator of the hot water input diverting valve, (b) replaced the electric motor with a vacuum-operator, and (c) connected the vacuum-operator to the system controls. The chiller was not designed to operate in this way, and, in fact, will not operate when so disconnected. Consequently, the contractor had to reinstall the chiller controls and interface system controls and the chiller differently.

During installation, in early May, only three glass collector tubes were broken. An additional 36 tubes self-destructed by June 28, 1979. Since June 28, however, only one tube has self-destructed.

SUMMARY

The system has operated well, as planned, and without problems since the chiller was turned on May 24, 1979. It is not instrumented, so a quantitative performance evaluation is not possible. However, a count of the number of hours of space cooling from solar and a count of the total number of hours of space cooling indicates a solar fraction of about 50 to 60 percent during the summer cooling season.

Experience so far has been good with the collector tubes mounted in the east-west orientation, with both flow and performance seeming to be normal at all times. The reflector troughs have remained clean and clear, any dirt or debris being removed by rain. We think we made a good choice.

The problems encountered are considered to be typical in magnitude and were easily handled. System activation date of May 24, 1979, was 32 days late, primarily due to late parts delivery. Cost performance turned out well, too, as final project cost was just over the re-estimated figure of $220,800.

PROJECT COST SUMMARY

Cost Element	Materials	Labor	Total
Design	-	$14,438	$14,438
Construction & Installation			
Frames	$11,960	10,540	22,500
Collectors	38,688	720	39,408
Tanks	12,600	720	13,320
Chiller	18,595	-	18,595
Water Tower	1,794	62	1,856
Plumbing	32,880	21,795	54,675
Controls	6,690	6,585	13,275
Insulation	4,471	6,710	11,181
Pumps	4,200	1,200	5,400
Masonry	3,407	5,507	8,914
Other	6,710	4,540	11,250
Project Management	-	6,032	6,032
Total Project Cost	$142,307	$78,537	$220,844

PROJECT CHRONOLOGY

76 Nov 17	Technical Proposal submitted to Energy Research and Development Administration in response to PON DSE-76-2.
77 Mar 11	Cost Proposal submitted to ERDA.
77 June 22	Cooperative Agreement negotiated with ERDA.
77 Sept 20	Cooperative Agreement signed by the Contracting Officer.
77 Nov 14	Contract awarded to Stottler-Stagg and Associates to perform detailed construction drawings and specifications for the system.
78 June 16	Final design review with the government's Project Manager.
78 June 27	Construction drawings approved subject to the incorporation of comments.
78 Aug 24	Construction bids opening. Island Mechanical Contractor apparent successful (low) bidder. (Island Mechanical Contractor later changed name to S.I. Goldman Company.)
78 Sept 24	Contractor notified to proceed.
78 Nov 28	Chiller delivered.
79 Mar 8	Storage tanks delivered.
79 Mar 19-21	Collector frames installed.
79 Apr 30 - May 2	Evacuated glass tubes installed on collectors and energy collection begun.

79 May 24	Chiller activated with solar-heated water. Scheduled date was missed due to chiller controls being inadvertently disabled by contractor.
79 June 29	Dedication by DOE's Omi Walden, State Senator John Vogt and State Senator Clark Maxwell.
79 Aug 16	Acceptance Test complete.

SYSTEM ACCEPTANCE TEST DATA

LEGEND

T-1	:	SOLAR MANIFOLD OUTLET TEMPERATURE	
T-2	:	HOT WATER STORAGE TANK TEMPERATURE	(12" From Bottom of Tank)
T-3	:	HOT WATER SUPPLY TANK TEMPERATURE	(15" Below Top of Tank)
T-4	:	CHILLED WATER STORAGE TANK TEMPERATURE	(18" Below Top of Tank)
T-5	:	CHILLED WATER OUTLET FROM CHILLER TEMPERATURE	
T-6	:	COLD DECK TEMPERATURE	
T-7	:	CHILLED WATER TANK SUPPLY OUTLET TEMPERATURE	(Adjacent to Inlet, Pump P-4)
T-8	:	CONDENSING WATER SUPPLY TEMPERATURE	
P-1	:	COLLECTOR - HOT WATER TANK PUMP	
P-2	:	HOT WATER TO CHILLER PUMP	
P-3	:	CHILLED WATER FROM CHILLER PUMP	
P-4	:	CHILLED WATER TO AHU PUMP	
P-5	:	CONDENSING WATER PUMP	
P-6	:	HEAT REJECTION PUMP	

TEMPERATURE READINGS - FAHRENHEIT

TIME	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8
9:45	190	165	175	52	68	66	68	83
10:15	192	165	177	52	69	66	68	84
10:45	195	165	185	52	58	70	58	85
11:15	200	170	180	51	46	63	47	85
11:45	194	170	176	51	46	68	47	86
12:15	194	170	176	51	47	70	48	86
12:45	195	172	178	51	47	70	48	86
1:15	195	172	176	51	47	70	48	86
1:45	195	172	176	51	47	71	48	86
2:15	195	175	176	51	46	71	48	86
2:45	195	175	176	52	52	76	53	86
3:15	194	178	174	52	47	78	48	86
3:45	192	177	175	52	47	79	48	86
4:15	190	178	172	52	47	80	48	86
4:45	186	175	172	52	47	80	48	86
5:15	180	174	170	52	52	77	52	87
5:45	180	170	170	52	55	77	53	87

PUMP ACTUATION

TIME	P-1	P-2	P-3	P-4	P-5	P-6	CT-FAN	CHILLER
9:45	ON	-	-	-	-	-	- - -	- - -
10:15	ON	-	-	-	-	-	- - -	- - -
10:45	ON	ON	ON	-	ON	-	ON	ON
11:15	ON	ON	ON	ON	ON	-	ON	ON
11:45	ON	ON	ON	ON	ON	-	ON	ON
12:15	ON	ON	ON	ON	ON	-	ON	ON
12:45	ON	ON	ON	ON	ON	-	ON	ON
1:15	ON	ON	ON	ON	ON	-	ON	ON
1:45	ON	ON	ON	ON	ON	-	ON	ON
2:15	ON	ON	ON	ON	ON	-	ON	ON
2:45	ON	ON	ON	-	ON	-	ON	ON
3:15	ON	ON	ON	-	ON	-	ON	ON
3:45	ON	ON	ON	-	ON	-	ON	ON
4:15	ON	ON	ON	-	ON	-	ON	ON
4:45	ON	ON	ON	-	ON	-	ON	ON
5:15	-	-	-	-	-	-	- - -	- - -
5:45	-	-	-	-	-	-	- - -	- - -

CONTROL SYSTEMS CHECKOUT AND CALIBRATION

A. Solar Energy Collection, Conversion and Storage Subsystem

STEP		ACTION/RESPONSE
1.	Establish following conditions:	
1.1	PE-1 actuated (R and B contacts OPEN) because temperature at solar array supply (outlet)(T-1) not below 38°F. PE-1 purpose (array freeze protection) will be tested in Step 5.	PE-1 ACTUATED ok
1.2	R8 actuated (1 and 3 contacts CLOSED because water in HW storage tank is above low water level. HW low water level switch will be tested in Step _____. (Omega Mod. 2176A, W/'T' thermocouple digital thermometer used as standard at all dial thermometer locations.)	R8 ACTUATED P-1 running ok
1.3	Place hand-off-auto- switch on P-1 starter and P-1 on-off-auto switch on control panel in AUTO positions.	Switches in AUTO position yes
2.	Test timer control of subsystem:	
2.1	Turn solar controller OFF. NOTE - Step 2 accepted without test, timer having already proven itself.	R9 DEACTIVATED - Solar controller light OFF -
2.2	Check to see that R1 is deactivated (1 and 4 contacts CLOSED) because daylight is being detected by photocell (unless we are doing this at night). Photocell control will be tested in Step 4.	R1 DEACTIVATED -
2.3	Time operation of timer-1 and timer-2:	

2.3.1	Wait until P-1 is running. Then measure time between when P-1 STOPS and P-1 STARTS again.	Time between P-1 STOPPING and P-1 STARTING is__-__.
	NOTE - P-1 red and green indicating lights on control panel can be used as indicators of P-1 operation for this step and steps following for this subsystem.	Should be time set on timer-1 dial
2.3.2	Then measure time between when P-1 STARTS and P-1 STOPS again. (See 2.3.1 NOTE)	Time between P-1 STARTING and P-1 STOPPING__-__. Should be time set on timer-2 dial.
3.	Test solar controller control of subsystem:	
3.1	Calibrate T-1 transmitter, RC-1 receiver controller and T-1 temperature readout on control panel using dial thermometer near T-1 transmitter as standard:	
3.1.1	Note the input temperature to PORT #1 of receiver controller.	Input temperature 185 °F at dial thermometer location
	NOTE - Input temperature to PORT #1 of receiver controller is to be taken as temperature being read on dial thermometer near T-1 transmitter.	
3.1.2	Note temperature indicated on T-1 temperature readout on control panel. It should be same as input temperature to PORT #1 in Step 3.1.1.	Temperature on T-1 control panel readout 185 °F
	NOTE - If temperatures are not the same, remove cover from T-1 transmitter and turn adjustment screw until T-1 temperature readout on control panel is the same as the input temperature to PORT #1.	

3.1.3	Set the desired throttling range of RC-1 which is 21%.	TR at 21 %
3.1.4	Turn the control point adjustment screw on receiver controller CLOCKWISE until PE switch clicks or temperature scale rotates 1 1/2 revolution. Then turn contol point adjustment screw COUNTER-CLOCKWISE until PE switch clicks.	CW until click_____ -or- CW until 1 1/2 rev._____ CCW until click_____
3.1.5	Lift the control point scale on receiver controller to disengage the gear teeth and set the scale to the temperature noted at PORT #1 in Step 3.1.1. Release the control point scale so that it will reengage the gear teeth.	Control point scale reads 185 °F
3.1.6	Turn the control point adjustment screw on the receiver controller until the scale indicates the desired receiver controller set point. RC set point is 45°F.	Control point scale indicates 45 °F
3.2	Calibrate T-2 transmitter and T-2 temperature readout on control panel by repeating Step 3.1.2 substituting T-2 for T-1.	Temperature on dial thermometer near T-2 176.2 °F Temperature on T-2 control panel readout 176 °F
	NOTE - No receiver controller is used with T-2. Temperature to PORT #1 is taken to be temperature on dial thermometer near T-2 transmitter.	
3.3	Turn solar controller ON	Solar controller lights ON -
3.4	Wait for or cause solar controller to sense $T\Delta \geq 15^{\circ}F$. Solar controller will cause P-1 to run by actuating R9 when Δ of 15°F is reached. P-1 will continue to run until $T\Delta \geq 5^{\circ}F$. (See 2.3.1 NOTE)	T1 when P-1 STARTS - °F T2 when P-1 STARTS - °F T1/T2Δ - °F T1 when P-1 STOPS - °F T2 when P-1 STOPS - °F T1/T2Δ - °F
	NOTE - Steps 3.3 and 3.4 accepted without test, as solar controller was proven already through daily operation.	

4.	Test photocell control of subsystem:	
4.1	Repeat Step 2.3.2 and while P-1 is running place tape over photocell. P-1 should stop running after time delay. Removing tape from over photocell should cause P-1 to start running again after time delay. NOTE - Some delay in P-1 starting may occur due to timer actions.	P-1 STOPS with tape over photocell yes P-1 STARTS after tape is removed from photocell yes
5.	Test freeze protection of solar array:	
5.1	Turn OFF solar controller.	Solar controller lights OFF yes
5.1a	PULL R-9.	R-9 OUT yes
5.2	Remove T-1 transmitter from well. HOLD transmitter until reading on T-1 control panel readout settles.	T-1 transmitter removed yes T-1 control panel readout while T-1 air out of well not read °F
5.3	Place T-1 transmitter sensing element into an ice bath with a test electronic thermometer. Note that P-1 starts at 38°F and remains running as temperature drops further. If P-1 does not start at 38°F recalibrate RC-1 control point using test thermometer as standard. Set RC-1 control point dial at 38°F.	T-1 in ice bath test x thermometer in bath x P-1 STARTS: 38 °F on test thermometer P-1 STOPS: 45 °F on test thermometer
5.4	SLOWLY add tap water to ice bath and note that P-1 STOPS at 45°F and remains stopped as temperature rises.	
5.5	Remove T-1 from ice bath, reinstall T-1 in well, turn ON solar controller.	Install T-1 in well x Solar controller lights ON yes
5.6	Check calibration of T-1 transmitter, and T-1 temperature readout on control panel by repeating Step 3.1.1 and 3.1.2.	Input temperature 194 °F (ref. 3.1.1) Temperature on T-1 control panel readout 194 °F (ref. 3.1.2)

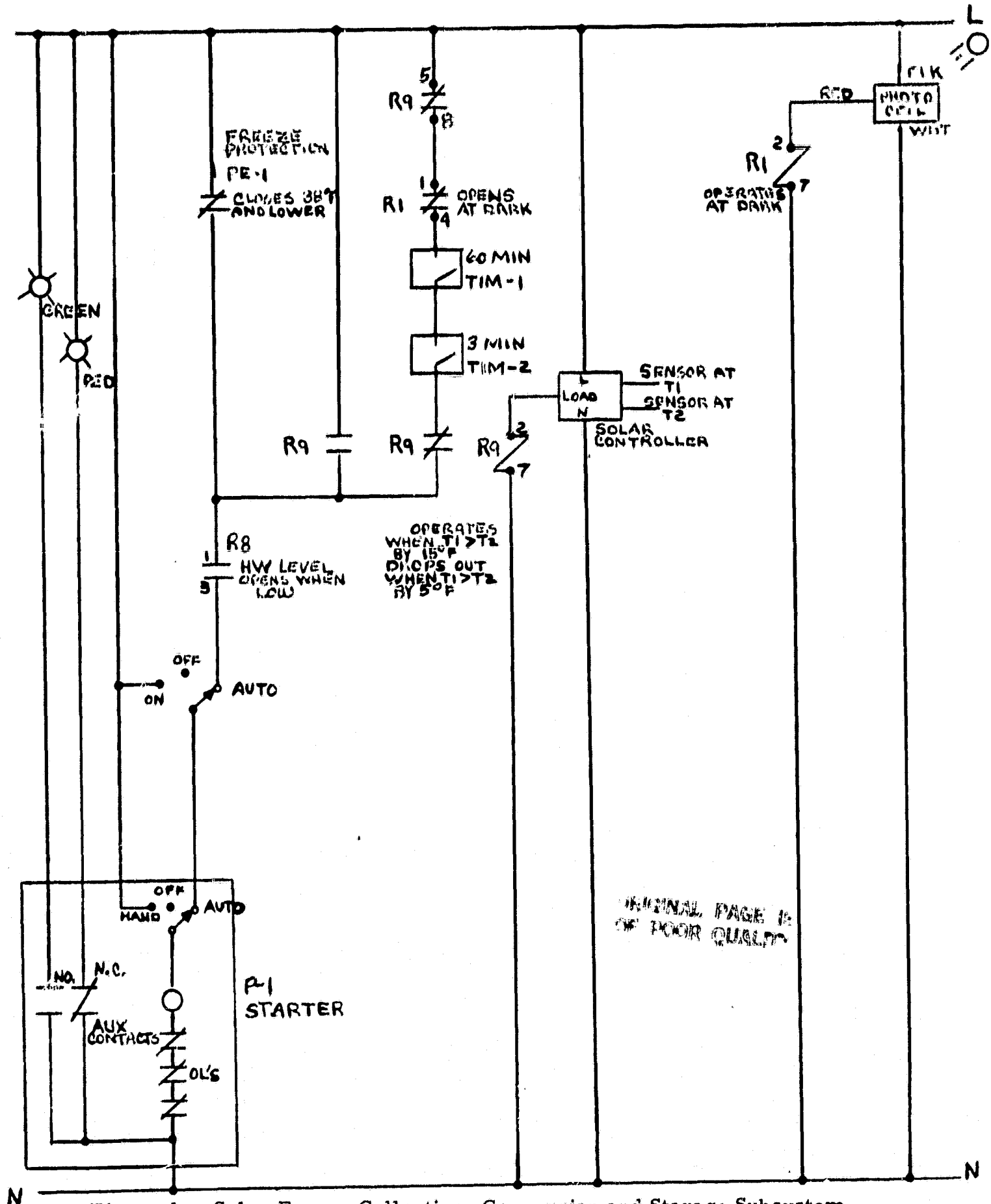


Figure 1. Solar Energy Collection, Conversion and Storage Subsystem

B. Excess Heat Rejection Subsystem

STEP		ACTION/RESPONSE
6.	Establish following conditions:	
6.1	R7 actuated (1 and 3 contacts CLOSED) because water in chilled water (CW) storage tank is above low water level. CW low water level switch will be tested at Step_____.	R7 ACTUATED yes
6.2	Place hand-off-auto switch on P-6 starter and P-6 on-off-auto switch on control panel in AUTO positions.	Switches in AUTO position yes
7.	Calibrate T-3 transmitter: RC-3A, RC-3B, RC-3C, RC-3D receiver controllers and T-3 temperature readout on control panel using dial thermometer near T-3 transmitter as standard:	
7.1	Note the input temperature to PORT #1 of receiver controllers. NOTE - Input temperature to PORT #1 of receiver controllers is to be taken as temperature being read on dial thermometer near T-3 transmitter.	Input temperature 181.6 °F
7.2	Note temperature indicated on T-3 temperature readout on control panel. It should be same as input temperature to PORT #1 of receiver controllers in Step 7.1. NOTE - If temperatures are not the same remove cover from T-3 transmitter and turn adjustment screw until T-3 temperature readout on control panel is the same as the input temperature to PORT #1 of receiver controllers.	Temperature on T-3 control panel readout 182 °F

7.3	Set the desired throttling range of RC-3A which is 15%.	RC-3A TR at 15 %
7.4	Set the desired throttling range of RC-3B which is 15%.	RC-3B TR at 15 %
7.5	Set the desired throttling range of RC-3C which is 15%.	RC-3C TR at 15 %
7.6	Set the desired throttling range of RC-3D which is 15%.	RC-3D TR at 30 %
7.7	Turn the control point adjustment screw on RC-3A CLOCKWISE until PE-3A clicks or temperature scale rotates 1 1/2 revolution. Then turn control point adjustment screw COUNTERCLOCKWISE until PE-3A clicks. NOTE - Control point scale turns in opposite direction from control point adjustment screw.	CW until click x -or- CW until 1 1/2 rev. x CCW until click x
7.7.1	Lift the control point scale on the receiver controller to disengage the gear teeth and set the scale to the temperature noted at PORT #1 in Step 7.1. Release the control point scale so that it will reengage the gear teeth.	Control point scale reads 184 °F
7.7.2	Turn the control point adjustment screw on receiver controller until scale indicates a 230°F set point.	Control point scale indicates 230 °F
7.8	Adjust RC-3B using click of PE-3B by repeating Steps 7.7, 7.7.1 and 7.7.2. In Step 7.7.2 set point is 205°F.	Ref. Step 7.7 CW until click -or- CW until 1 1/2 rev. x CCW until click x Ref. Step 7.7.1 Control point scale reads 183 °F Ref. Step 7.7.2 Control point scale indicates 205 °F

7.9 Adjust RC-3C using click of PE-3C by repeating Steps 7.7, 7.7.1 and 7.7.2. In Step 7.7.2 set point is 125°F.

Ref. Step 7.7
CW until click_____
-or-
CW until 1 1/2 rev. x
CCW until click x

Ref. Step 7.7.1
Control point scale reads 183 °F

Ref. Step 7.7.2
Control point scale indicates 125 °F

7.10 Adjust RC-3D using click of PE-3D by repeating Steps 7.7, 7.7.1 and 7.7.2. In Step 7.7.2 set point is 180°F.

Ref. Step 7.7
CW until click_____
-or-
CW until 1 1/2 rev. x
CCW until click x

Ref. Step 7.7.1
Control point scale reads 183 °F

Ref. Step 7.7.2
Control point scale indicates 180 °F

NOTE - RC-3A, RC-3B and RC-3D are not used in this subsystem but are now adjusted for other tests of other subsystems.

8. Test T-3 control of P-6 and CV-6:

NOTE - The approach to be used to demonstrate this control is that instead of the T-3 transmitter sensing the set point temperature, the set point of the receiver controller will be adjusted to the temperature being sensed by T-3 transmitter to prove that when T-3 transmitter temperature matches set point of receiver controller PE-3B will actuate.

8.1	Note temperature on T-3 temperature readout on control panel.	T-3 temperature on control panel 182 °F
8.2	Adjust RC-3B receiver controller control point by turning control point adjustment screw to indicate temperature read in Step 8.1. This simulates T-3 temperature moving to set point. PE-3B should actuate starting P-6 and opening CV-6.	Control point scale indicates 184 °F PE-3B ACTUATED yes P-6 RUNNING yes CV-6 OPEN yes
8.3	Increase RC-3B control point by 5°F simulating T-3 temperature decreasing 50°F. PE-3B should deactuate stopping P-6 and closing CV-6.	PE-3B DEACTUATED 191 °F P-6 STOPPED yes CV-6 CLOSED yes
8.4	Return RC-3B control point dial to RC-3B set point of 205°F.	RC-3B control point dial at 205 °F

C. Cooling From Chilled Water Subsystem

STEP		ACTION/RESPONSE
9.	Establish following conditions:	
9.1	Place heat-cool switch on control panel in COOL position.	Heat-cool switch in COOL position yes
9.2	Place hand-off-auto switch on P-4 starter and P-4 on-off-auto switch on control panel in AUTO position	In AUTO positions yes
10.	Calibrate T-7 transmitter, RC-7 receiver controller and T-7 temperature readout on control panel by repeating Steps 3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5 and 3.1.6 substituting T-7 for T-1.	Ref. 3.1.1 Input temperature 153.4 °F Ref. 3.1.2 Temperature on T-7 control panel readout 152.9 °F
	NOTES - Ref. Step 3.1.3 throttling range for RC-7 is 30%.	Ref. 3.1.3 TR at 30 %
	Ref. Step 3.1.6 set point for RC-7 is 55°F.	Ref. 3.1.4 CW until click _____ -or- CW until 1 1/2 rev. x CCW until click x

		Ref. 3.1.5 Control point scale reads 53 °F Ref. 3.1.6 Control point scale indicates 55 °F
11.	Calibrate T-6 transmitter, RC-6 receiver controller and T-6 temperature readout on control panel using a test thermometer (remove dial thermometer near T-4 and use as test thermometer) as standard:	
11.1	Insert test thermometer into AHU plenum adjacent to T-6 transmitter sensing element. Allow time for test thermometer to stabilize.	Test thermometer inserted yes
11.2	Repeat Steps 3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5 and 3.1.6 substituting T-6 for T-1 and test thermometer for dial thermometer.	Ref. 3.1.1 Input temperature 61 °F Ref. 3.1.2 Temperature on T-6 control panel readout 61 °F
	NOTES - Ref. Step 3.1.3 throttling range for RC-6 is 10%.	Ref. 3.1.3 TR at 10 %
	Ref. Step 3.1.4 Responsive item is CV-5 positioning to mid (approx.) position.	
	Ref. Step 3.1.6 set point for RC-6 is 55°F.	Ref. 3.1.6 Control point scale indicates 55 °F test thermometer out yes
11.3	Remove test thermometer.	
12.	Test T-7 control of chilled water circulation to cold deck and automatic changeover to existing backup DX system:	

12.1	Note temperature on T-7 temperature at RC-7 set point by adjusting RC-7 control point dial to T-7 temperature read in Step 12.1. PE-7 should actuate STOPPING P-4 and STARTING backup DX airconditioning system compressor.	T-7 temperature read-out on control panel 52 °F
*12.2	Simulate T-7 temperature at RC-7 set point by adjusting RC-7 control point dial to T-7 temperature read in Step 12.1. PE-7 should actuate STOPPING P-4 and STARTING backup DX airconditioning system compressor. NOTE - Backup DX system t'stat must be calling for COOLING for DX system to start during this test. *NOTE - In Steps 12.2, 12.3, 15.2, 15.3, 20.3, 20.5, 21.3 and 21.4, if the PE switch is already actuated, the simulated adjustment is equal to the PE switch differential from the activation set point. This results in actual "action/response" being opposite to that originally indicated.	RC-7 control point dial at 56 1/2 °F PE-7 DEACTUATES yes P-4 STARTED yes Backup DX system STOPPED yes
12.3	Decrease RC-7 control point by 5°F simulating T-7 temperature decreasing 5°F. PE-7 should deactuate STARTING P-4 and STOPPING backup DX airconditioning system compressor.	RC-7 control point dial at 51 1/2 °F PE-7 ACTUATES yes P-4 STOPPED yes Backup DX system STARTED yes
12.4	Return RC-7 control point dial to RC-7 set point of 55°F.	RC-7 control point dial at 55 °F
13.	Test T-6 control of CV-5 CV-5 NOT TESTED	

D. Heating From Solar Energy and Heating From Backup System Subsystem

STEP		ACTION/RESPONSE
14.	Establish following conditions:	
14.1	Place heat-cool switch on control panel in HEAT position.	In HEAT position yes
14.2	Turn set point on RC-4 "UP" to STOP chiller.	Chiller STOPPED yes
14.3	Place hand-off-auto switch on P-2 starter and P-2 on-off-auto switch on control panel in AUTO positions.	Switches in AUTO yes
14.4	R8 actuated (6 and 8 contacts CLOSED) because water in HW storage tank is above low water level. HE low water level switch will be tested in Step_____.	R8 ACTUATED yes
14.5	NOTE - T-3 transmitter, RC-3C receiver controller, PE-3C and T-3 temperature readout on control panel have been calibrated in Steps 7., 7.1, 7.2, 7.5, and 7.9.	
15.	Test T-3 control of P-2, CV-1A, CV-1B and CV-2 in this subsystem:	
15.1	Note T-3 temperature on T-3 temperature readout on control panel.	T-3 temperature on control panel 181 °F
15.2	Set RC-3C control point dial to T-3 temperature from Step 15.1 (simulating T-3 transmitter sensor moving to RC-3C set point). When RC-3C control point dial indicates T-3 temperature P-2 will start and CV-1A, CV-1B, CV-2 actuators will move full distance towards valve bodys. See NOTE after 12.2	RC-3C control point dial at 186 °F P-2 STOPPED yes CV-1A actuator full towards diaphragm yes CV-1B actuator full towards diaphragm yes CV-2 actuator full towards diaphragm yes

NOTE - Subsystem is now in heating from solar energy mode. These valve actuator positions will result in:

CV-1A CLOSING stopping HW from coil returning to existing HW boiler return.

CV-1B OPENING allowing HW from coil to return to hot water storage tank.

CV-2 OPENING between NC and C ports allowing supply hot water from hot water storage tank to flow to coil.

CV-2 CLOSING between NO and C ports stopping supply hot water from HW boiler supply to flow to coil.

15.3 Increase RC-3C control point dial 5°F (simulating T-3 temperature decreasing 5°F) causing a switchover to HEATING from backup system mode. When this happens P-2 will stop and CV-1A, CV-1B, CV-2 actuators will move full distance towards diaphragm.

P-2 STARTED yes
CV-1A actuator full towards body yes
CV-1B actuator full towards body yes
CV-2 actuator full towards body yes

See NOTE after 12.2.

NOTE - These valve actuator positions will result in:

CV-1A OPENING allowing HW from coil to return to existing HW boiler return.

CV-1B CLOSING stopping HW from coil to return to hot water storage tank.

CV-2 CLOSING between NC and C ports stopping supply hot water from hot water storage tank to flow to coil.

CV-2 OPENING between NO and C ports allowing supply hot water from HW boiler supply to flow to coil.

15.4	Return RC-3C control point dial to 125°F set point.	RC-3C control point scale reads 125 °F
15.5	RE-SET RC-4 set point to 50°F.	Set point 50 °F
15.6	Place heat-cool switch on control panel in COOL position.	In COOL position yes

E. Chilled Water Production From Solar Energy

STEP		ACTION/RESPONSE
16.	Establish following conditions:	
16.1	R8 actuated (6 and 8 contacts CLOSED) because water in HW storage tank is above low water level. HW low water level switch will be tested in Step_____.	R8 ACTUATED yes
16.2	R7 actuated (6 and 8 contacts CLOSED) because water in CW storage tank is above low water level. CW low water level switch will be tested in Step_____.	R7 ACTUATED yes
16.3	Place hand-off-auto switches on P-2, P-3, P-5 and CT-FAN starters in AUTO positions.	P-2 in AUTO yes P-3 in AUTO yes P-5 in AUTO yes CT-FAN in AUTO yes
16.4	Place P-2, P-3, P-5 and CT-FAN on-off-auto switches on control panel in AUTO position.	P-2 in AUTO yes P-3 in AUTO yes P-5 in AUTO yes CT-FAN in AUTO yes
16.5	Place chiller off-auto switch on control panel in AUTO position. Status of chiller indicating lights on control panel will depend on T-3 and T-4 temperatures disregard at this time.	Chiller switch in AUTO position yes
16.6	Place switch in "COOL" position	In "COOL" position? yes
16.7	Disregard flow switch FS-3. Contacts have been shorted out.	Ok ok

17. Calibrate T-4 transmitter, RC-4 receiver controller and T-4 temperature readout on control panel by REPEATING.

Steps 3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5 and 3.1.6 substituting T-4 for T-1 and RC-4 for RC-1.

NOTES -
Ref. Step 3.1.3 RC-4 throttling range is set at 30%.

Ref. Step 3.1.6 RC-4 set point is 50°F.

Ref. Step 3.1.1
Input temperature 53 °F

Ref. Step 3.1.2
Temperature on T-4 control panel readout 53.7 °F

Ref. Step 3.1.3
TR at 30 %

Ref. Step 3.1.4
CW until click x
-or-
CW until 1 1/2 rev. _____
CCW until click _____

Ref. Step 3.1.5
Control point scale reads 54 °F

Ref. Step 3.1.6
Control point scale indicates 50 °F

18. Calibrate T-8 transmitter, RC-8 receiver controller and T-8 temperature readout on control panel by REPEATING Steps 3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5 and 3.1.6 substituting T-8 for T-1 and RC-8 for RC-1.

NOTES -
Ref. Step 3.1.3 RC-8 throttling range is set at 30%.

Ref. Step 3.1.6 RC-8 set point is 85°F

Ref. Step 3.1.1
Input temperature 84.5 °F

Ref. 3.1.2
Temperature on T-8 control panel readout 84.2 °F

Ref. Step 3.1.3
TR at 30 %

Ref. Step 3.1.4
CW until click x
-or-
CW until 1 1/2 rev. _____
CCW until click x

Ref. Step 3.1.5
Control point scale reads 84 °F

Ref. Step 3.1.6
Control point scale indicates 85 °F

18a.	Calibrate T-5	Temperature gauge on control panel 49.6 °F Temperature at dial thermometer 49.2 °F
19.	NOTE - T-3 transmitter, RC-3D receiver controller, PE-3D and T-3 temperature readout on control panel have been calibrated in Steps 7., 7.1, 7.2, 7.6 and 7.10.	
20.	Test T-3 control of this subsystem:	
20.1	Set RC-4 control point dial to T-4 temperature on readout on control panel. This will actuate PE-4 so that PE-3D can be monitored. NOTE - Maintain PE-4 actuation by RESETTING RC-4 control point dial as required.	RC-4 control point dial reads 53 1/2 °F PE-4 ACTUATED yes
20.2	Note T-3 temperature on T-3 temperature readout on control panel.	T-3 temperature on control panel 177 °F
20.3	Set RC-3D control point dial to T-3 temperature from Step 19.2 (simulating T-3 transmitter sensor moving to RC-3D set point). Note when RC-3D control point dial indicates T-3 temperature; P-2 will start, CV-4 actuator will move full distance towards valve body opening valve to allow HW to circulate between HW storage tank and chiller which will be detected by flow switch FS-1 CLOSING its contacts. FS-1 closing will start P-3. Chiller is enabled by R5 actuating. See NOTE after 12.2	RC-3D control point reads 187 °F P-2 STOPPED yes CV-4 actuator full CLOSED yes P-3 STOPPED yes R5 DEACTUATES yes
	Green chiller indicating light on control panel will come ON. Red indicating light will be OFF.	Green light OFF yes Red light ON yes

20.4	Test T-8 control of CT-FAN at this point:	
20.4.1	Set RC-8 control point dial to T-8 temperature readout on control panel (simulating T-8 transmitter sensor moving to RC-8 set point).	RC-8 control point dial reads 84 °F
	When RC-8 control point dial indicates T-8 temperature CT-FAN will START.	CT-FAN STARTS yes
20.4.2	Increase RC-8 control point dial 5°F (simulating T-8 temperature decreasing 5°F) causing CT-FAN to STOP.	RC-8 control point dial reads 89 °F CT-FAN STOPS yes
20.4.3	Return RC-8 control point dial to 85°F set point	RC-8 control point dial reads 85 °F
20.5	Decrease RC-3D control point dial 10°F (simulating T-3 temperature decresing 10°F) causing PE-3D to deactuate. When PE-3D deactuates P-2 will stop, CV-4 actuator will move full distance towards diaphragm closing valve stopping HW circulation between HW storage tank and chiller which will be detected by FS-1 OPENING its contacts. FS-1 opening will stop P-3. Chiller will become disabled by R5 deactivating as chiller red indicating light on control panel will come ON and green go OFF.	RC-3D control point dial reads 177 °F P-2 STARTS yes CV-4 actuator full towards body yes P-3 STARTS yes R5 ACTIVATES yes Green light ON yes Red light OFF yes
20.6	Return RC-3D control point dial to 180°F set point.	RC-3D control point dial indicates 180 °F
20.7	Return RC-4 control point dial to 50°F set point.	RC-4 control point dial indicates 50 °F
21.	Test T-4 control of this subsystem:	
21.1	Set RC-3D control point dial to T-3 temperature on readout on control panel. This will actuate PE-3D so that PE-4 can be monitored.	RC-3D control point dial reads _____ °F PE-3D ACTUATED yes

NOTE - Maintain PE-3D actuation by RE-SETTING RC-3D control point dial as required.

21.2	Note T-4 temperature on T-4 temperature readout on control panel.	T-4 temperature on control panel 54 °F
21.3	Set RC-4 control point dial to T-4 temperature from Step 21.2 (simulating T-4 transmitter sensor moving to RC-4 set point). See Step 20.3 note for response. See NOTE after 12.2	RC-4 control point reads 59 °F P-2 STOPPED yes CV-4 actuator full CLOSED yes P-3 STOPPED yes R5 DEACTUATES yes Green light OFF yes Red light ON yes
21.4	Decrease RC-4 control point dial 5°F (simulating T-4 temperature decreasing 5°F) causing PE-4 to deactuate.	RC-4 control point reads 54 °F PC-2 STARTS yes CV-4 actuator full OPEN yes P-3 STARTED yes R5 ACTIVATES yes Green light ON yes Red light OFF yes
21.5	Return RC-4 control point dial to 50°F set point.	RC-4 control point dial indicates 50 °F
21.6	Return RC-3D control point dial to 180°F set point.	RC-3D control point dial indicates 180 °F
21.7	NOTE - P-5 started through 'CT' contacts in and under control ARKLA chiller.	P-5 cycling yes

SEQUENCE OF OPERATION

SEQUENCE OF OPERATION

(1) SOLAR ENERGY COLLECTION, CONVERSION AND STORAGE

WHEN TEMPERATURE (T-1) AT THE SOLAR COLLECTORS EXCEEDS THE TEMPERATURE (T-2) AT THE HOT WATER STORAGE TANK BY 15°F, PNEUMATIC-ELECTRIC SWITCH (PE-2) WILL MAKE, ALLOWING PUMP (P-1) TO OPERATE. PUMP (P-1) WILL CONTINUE TO RUN UNTIL THE DIFFERENCE IN TEMPERATURES (T-1) AND (T-2) DROPS TO 5°F. WHEN (PE-2) BREAKS, TIMER 1 ACTIVATES. WHEN TIMER 1 TIMES OUT TIMER 2 IS ACTIVATED AND TIMER 1 IS RESET, RE-STARTING TIMING SEQUENCE. TIMER 2 OVERIDES (PE-2) TO ACTIVATE PUMP (P-1) FOR SELECTED RUN TIME. (TIMER 2 SELECTS RUNNING TIME OF P-1; TIMER 1 SELECTS TIME BETWEEN RUNS) DURING NIGHT HOURS PHOTOCELL ENERGIZES RELAY (R-1) WHICH DE-ENERGIZES TIMERS . UPON RISE IN HOT WATER TEMPERATURE (T-3) ABOVE 230°F, PE SWITCH (PE-3A) WILL MAKE, OVERRIDING PE-2 AND TIMERS AND SHUTTING DOWN PUMP (P-1) UNTIL FALL IN (T-3) BELOW 225°F.

(2) EXCESS HEAT REJECTION

UPON RISE IN HOT WATER TEMPERATURE (T-3) ABOVE 235°F PE SWITCH (PE-3B) WILL CLOSE ENERGIZING PUMP (P-6) AND VALVE (CV-6) FOR EXCESS HEAT REJECTION UNTIL FALL IN (T-3) BELOW 230°F.

(3) ABSORPTION CHILLER, COOLING TOWER AND CHILLED WATER STORAGE

WITH THE CHILLER SELECTION SWITCH IN THE "AUTO" POSITION AND THE SYSTEM SELECTION SWITCH IN THE COOL POSITION THE FOLLOWING SEQUENCE IS ACTIVATED: UPON RISE IN HOT WATER TEMPERATURE (T-3) ABOVE 180°F AND RISE IN CHILLED WATER TEMPERATURE (T-4) ABOVE 50°F, PE SWITCHES (PE-3D)AND (PE-4) MAKE, OPENING VALVE (CV-4) TO ALLOW HOT WATER FLOW TO CHILLER AND ENERGIZING RELAY (R-4) WHICH ACTIVATES HOT WATER PUMP (P-2). THREE WAY CONTROL VALVE (CV-3) REGULATES THE FLOW OF

HOT WATER AS REQUIRED FOR CHILLER OPERATION TO PROVIDE A MINIMUM CHILLED WATER SUPPLY TEMPERATURE (T-5) OF 40°F. UPON RISE IN CONDENSER WATER TEMPERATURE (T-8) ABOVE 85°F PE SWITCH (PE-8) MAKES, ENERGIZING COOLING TOWER FAN UNTIL FALL IN (T-8) BELOW 80°F. UPON FALL IN HOT WATER TEMPERATURE (T-3) BELOW 170°F OR FALL IN CHILLED WATER TEMPERATURE (T-4) BELOW 45°F, PUMPS (P-2), (P-3), (P-5), CHILLER AND COOLING TOWER FAN ARE SHUT DOWN.

(4) AIR CONDITIONING SYSTEM CONTROL

WHEN SYSTEM SELECTION SWITCH IS IN COOL POSITION, UPON RISE IN CHILLED WATER TEMPERATURE (T-7) ABOVE 52°F, PE SWITCH (PE-7) WILL MAKE, ACTIVATING RELAY (R-2) WHICH ENABLES BACK-UP CHILLER TO OPERATE AND WHICH DE-ACTIVATES CHILLED WATER PUMP (P-4), STOPPING FLOW TO THE AHU. (PE-7), UPON RISE IN (T-7) ABOVE 52°F, ALSO DE-ACTIVATES PUMP (P-6) AND VALVE (CV-6) UNTIL FALL IN (T-7) BELOW 47°F. CONTROL VALVE (CV-5) IS MODULATED TO MAINTAIN A COLD DECK TEMPERATURE (T-6) OF 55°F.

(5) HEATING SYSTEM CONTROL

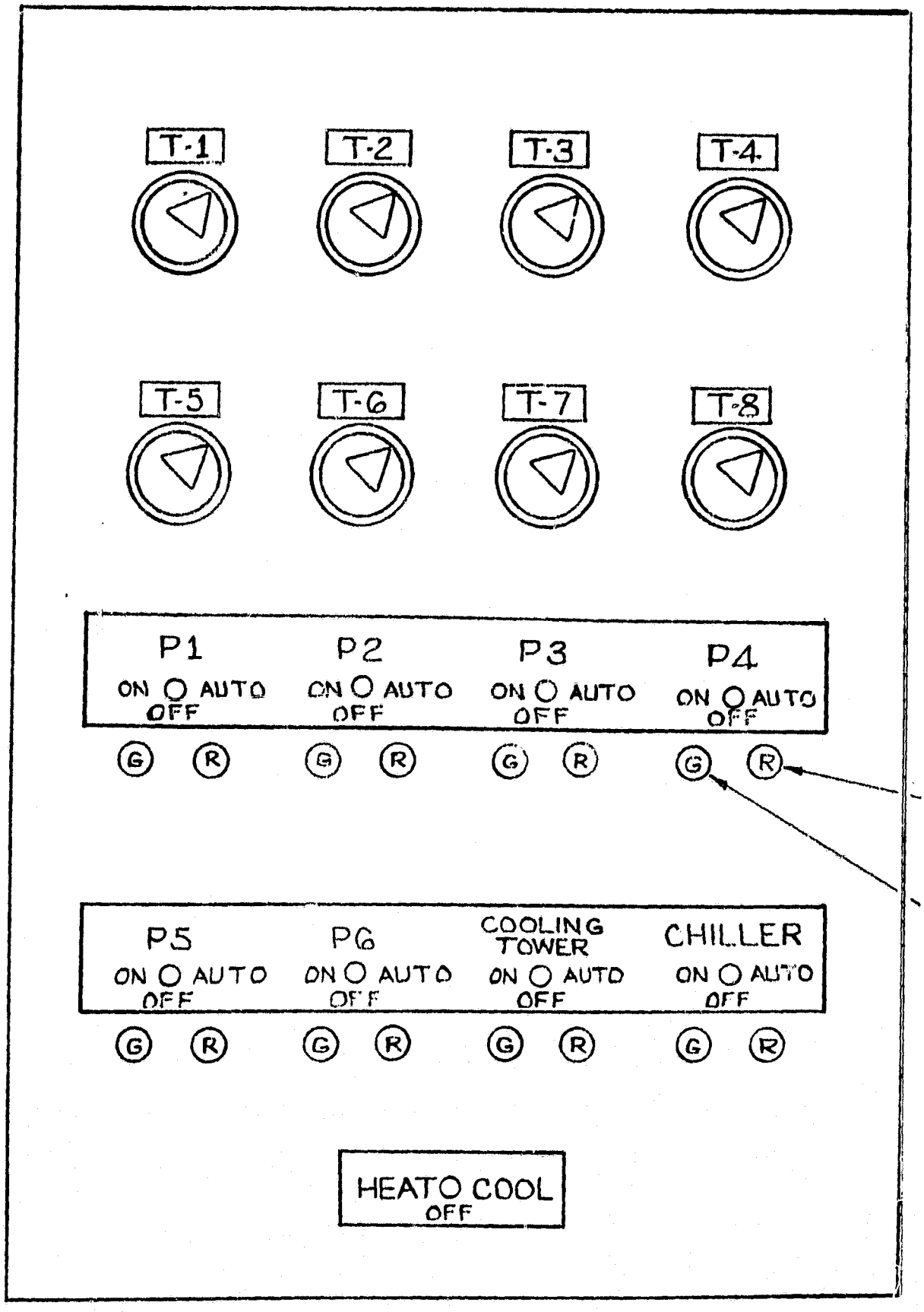
WHEN SYSTEM SELECTION SWITCH IS IN HEAT POSITION, UPON RISE IN HOT WATER TEMPERATURE (T-3) ABOVE 125°F, PE SWITCH (PE-3C) MAKES, ENERGIZING VALVES (CV-1A), (CV-1B), (CV-2) WHICH SWITCH THE AHU HOT WATER SOURCE FROM BOILER TO SOLAR HW STORAGE TANK. (PE-3C) ALSO ENERGIZES RELAY (R-3) WHICH ACTIVATES HW PUMP (P-2). (PE-3C) REMAINS ENERGIZED UNTIL FALL IN HOT WATER TEMPERATURE (T-3) BELOW 120°F. CONTROL VALVES (CV-1A), (CV-1B) AND (CV-2) ARE NORMALLY OPEN FOR FLOW OF HOT WATER THROUGH THE EXISTING BOILER SYSTEM.

(6) FREEZE PROTECTION CYCLE

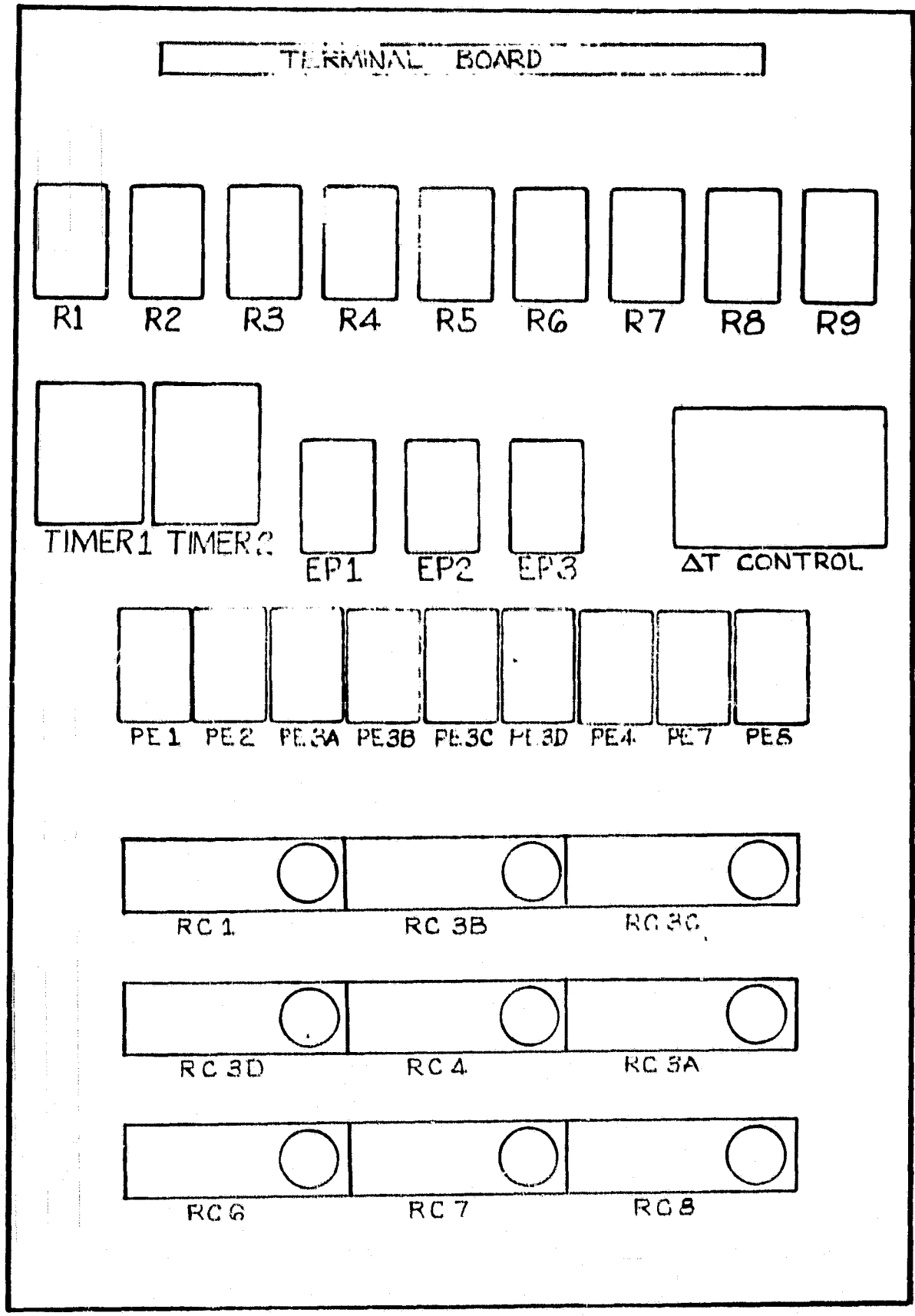
WHEN COLLECTOR TEMPERATURE (T-1) FALLS BELOW 38°F PE SWITCH (PE-1) WILL BREAK, ENERGIZING PUMP (P-1) FOR FREEZE PROTECTION CYCLE UNTIL RISE IN (T-1) ABOVE 45°F.

(7) LOW WATER CUT-OFF SWITCHES

TWO MCDONNELL MILLER MODEL 150 LOW-WATER CUT-OFFS ARE PROVIDED AS INDICATED. ONE LOW WATER CUT-OFF SHALL PREVENT PUMP (P-1) AND (P-2) FROM OPERATING WHEN THE WATER LEVEL IN THE SOLAR HOT WATER STORAGE TANK IS BELOW THE CUT-OFF POINT. THE OTHER LOW WATER CUT-OFF WILL PREVENT PUMP (P-3), (P-4), AND (P-6) FROM OPERATING WHEN THE WATER IN THE CHILLED WATER TANK IS BELOW ITS CUT-OFF POINT.



CONTROL PANEL



CONTROL PANEL
INTERIOR

Robertshaw

CONTROLS COMPANY
Uni-Line Division

AIR COMPRESSOR SIZING INFORMATION

In order to properly select an air compressor for use in our temperature control work it is necessary to consider a number of factors prior to making your final decision. You must make sure that the compressor has the capacity required to provide the operation desired. The speed of the compressor to be selected is an important factor since there is a tendency of the compressors to heat up and you will encounter oil carryover problems at faster compressor speeds. This can be detrimental to the temperature controls unless you provide additional oil removal devices downstream from the compressor. You also must consider the electrical power available in order to provide the proper motor. This knowledge of electrical power available also is necessary if you are to provide starters, contactors or alternators.

Your selection should be based upon three main factors as follows:

1. Total system air requirement
2. Percent of operating time of the compressor
3. Size of air receiver

In order to determine the total air requirement, it is necessary to add up the total air usage of all devices within the system. The air usage of each device is listed in Table I. You will note that the air usage is listed in two ways. The first and most accurate method is to use the CIM (cubic inches per minute) figures listed for each device. By using these figures and determining the total CIM you will be able to accurately calculate the required free CIM using the formula shown below Table I. This free CIM is the actual quantity of air available from a given compressor and should not be confused with higher piston displacement CFM listed by some manufacturers.

QUANTITY	UNI-LINE NUMBER	FACTORY MODEL	CIM	TOTAL
	TP2210-015	T15	17	
	TP2210-016	T16	17	
	TP2212-018, -118	T18	35	
	TP2212-019, -119	T19	35	
	TP2214	T21	30	
	TP2216	T26	30	
	TP2218-031	T31	35	
	TP2218-032, -132 (16 PSI)	T32	17	
	TP2218-032, -132 (25 PSI)	T32	30	
	TP2220-053	T53	30	
	HP2230-010	H10	17	
	HP2230-018 (RA @ 20 PSIG)	H18	30	
	HP2230-018 (OA @ 20 PSIG)	H18	17	
	HP2232-052	H52	30	
	TP2232-063	H53	30	
	HP2234	H100	78	
	TP2240	T100	35	
	TP2242	T101	35	
	TP2244	T110	35	
	TP2246	T130	35	
	TP2248	T131	35	
	TP2260	T140	35	
8	TP2252	T150 *	30	240
	TP2254	T151*	30	
	TP2260	T201	35	
	TP2262	T210	35	
	TP2264-701	T221	35	
	TP2264-711	T231	30	
	TP2298-060 (25 PSI)	T460	35	
	TP2298-060 (16 PSI)	T460	17	

TOTAL 240 CIM

SEE ADDITIONAL MODELS ON OTHER SIDE

PRINTED IN U.S.A.

QUANTITY	UNI-LINE NUMBER	FACTORY MODEL	CIM	TOTAL
	TP2298 061	[illegible]	[illegible]	
	TP2298 062 (20 PSI)	[illegible]	[illegible]	
	PP230	P [illegible]	[illegible]	
	PP2305	P305	[illegible]	
1	PP2310	P310	[illegible]	35
	PP2315	P315	[illegible]	
	PP2321	P321	[illegible]	
	PP2323	P323	[illegible]	
8	PP2341	P341	[illegible]	280
	RP2353 001, 002, 003	R403	[illegible]	
	RP2354 051	R404 101	[illegible]	
	RP2354-052	R404 201	[illegible]	
	RP2356	R405	[illegible]	
	RP2360	R410	[illegible]	
	RP2364-211	R471	[illegible]	
	RP2372 (USED AS VOLUME BOOSTER)	R432 1	[illegible]	
	RP2372-351	R432 1	[illegible]	
	RP2372-352	R432 2	[illegible]	
	RP2372-001	R433	[illegible]	
	RP2374	R435	[illegible]	
	RP2376	R440	[illegible]	
	RP2380	R450	0	
	RP2386	R470	0	
	SP2390	S10	34	
	SP2302	S20	0	
	SP2394	S30	0	
	SP2396	S40	0	
	MP2462 (W/P2 POSITIONER)	M662	[illegible]	
	MP2463 (W/P2 POSITIONER)	M663	[illegible]	
	MP2464 (W/P2 POSITIONER)	M664	[illegible]	
	MP2463 (W/P2 POSITIONER)	M663	[illegible]	
	MP2464 (W/P2 POSITIONER)	M664	[illegible]	
	MP2466-011 (W/POSITIONER)	M666	[illegible]	
7	VALVES		0	0
	VALVES WITH P20-372 POSITIONER		[illegible]	
	FULTON SYPHON DIVISION SINGLE PEN RECORDER		[illegible]	
	FULTON SYPHON DIVISION – 2-PEN RECORDER		140	
	ASPIRATING BOX P20-695 & P20-696		[illegible]	
	DAMPER ACTUATOR WITHOUT POSITIONER		0	

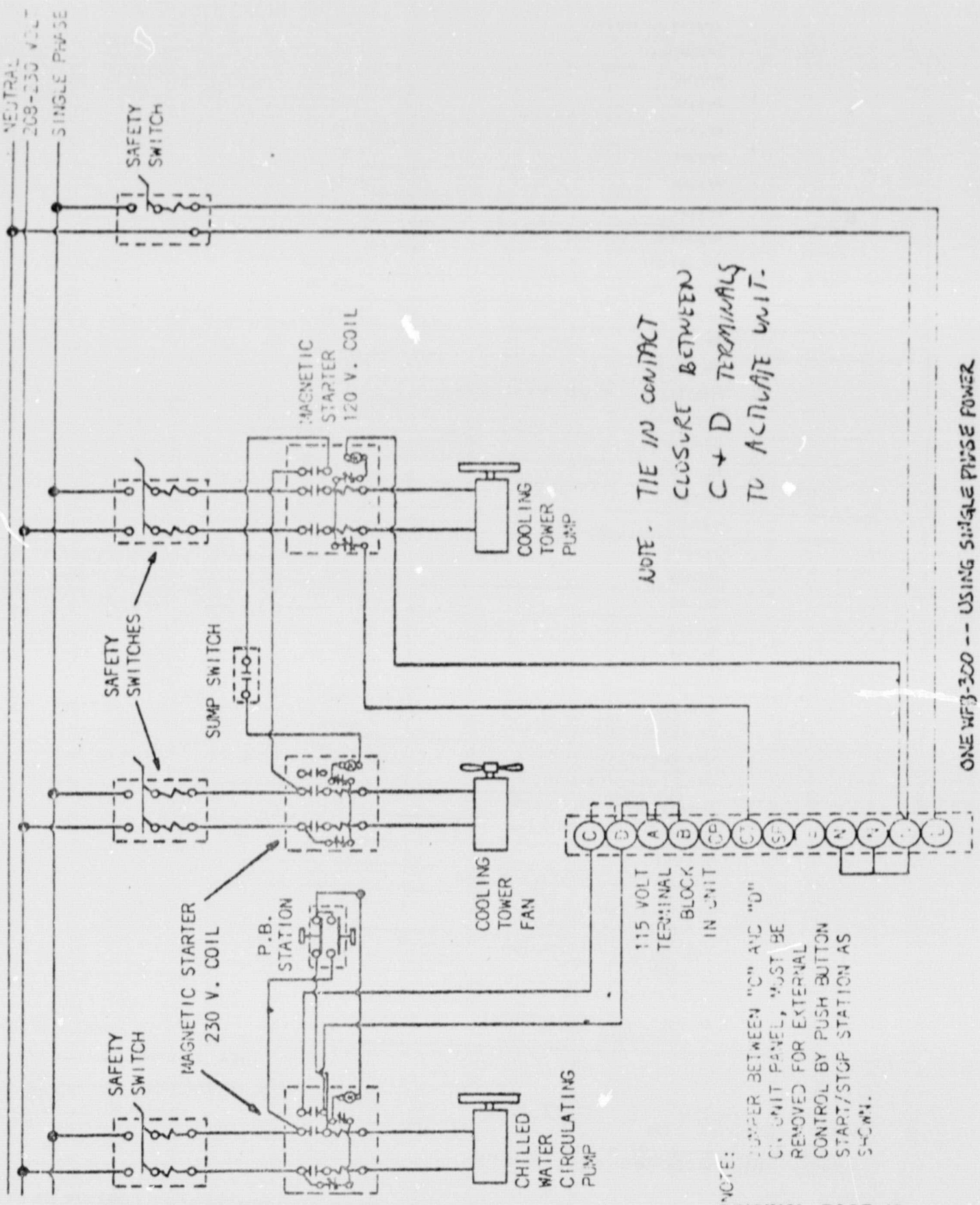
TOTAL THIS PAGE 315

TOTAL PREVIOUS PAGE 240

TOTAL 555 CIM

CFM = TOTAL CIM / % OPERATION × 1728 = 0.32 CFM

NOTE: PE Switches take 0 CFM



CIRCULATING PUMPS AND MOTORS

PUMP MOTOR DATA

	MODEL	FRAME	MANUF.	TYPE	SHAFT BEARING	CODE	OP BEARING	PHASE	HZ
P-1	M3558T	145T	Baldor	---	--------	K	----	3	60
P-2	HVJ145TTDR 7026CC-F1W	145T	Marathon	TDR-BE	77505	J	77503	3	60
P-3	HVN143TTDR 7026CC-F1W	143T	Marathon	TDR-b	205	K	203	3	60
P-4	HVN143TTDR 7026CC-F1W	143T	Marathon	TDR-B	205	K	203	3	60
P-5	6-322464-02	S182T	Gould	SC	206	J	204	3	60
P-6	5XBU019-E	---	G.E.	---	---	T	---	1	60

DATA CON'T

	V	A	RPM	S.F.	SERIAL	MAX AMB	INS	DUTY	HP
P-1	460	3.1	1725	1.15	35A01-872	40 °C	B	Cont.	2
P-2	460	3	1735	1.15	1494989	40 °C	B	Cont	2
P-3	460	1.8	1735	1.15	1543225	40 °C	B	Cont	1
P-4	460	1.8	1735	1.15	1543269	40 °C	B	Cont	1
P-5	460	5	1745	1.15	U-9	40 °C	B	Cont	3
P-6	115	3	1725	1 4	4385	40 °C	A	Cont	1/8

PUMP DATA

	MODEL	FRAME	DATE	CAP (GPM)	FT. HEAD	M.H.P.	RPM	MFG
P-1	BB2008-7.9 B5BZCZTLO	B-5	3-79	30	65	--	1750	TACO
P-2	BB2008-73 B5B202TLO	B-5	3-79	90	45	2	1750	TACO
P-3	BB2006-5.5 A5B2B2TLO	A-5	3-79	60	25	1	1750	TACO
P-4	BB2006-5.8 5B2B2TLO	A-5	3-79	38	34	1	1750	TACO
P-5	BB2508-7.7 B5B2D2TLO	B-5	3-79	90	65	3	1750	TACO
P-6	---	---	---	---	---	---	---	TACO

WATER BALANCING DATA

	RATED GPM	MEASURED GPM	VALVE SETTING	DIFF. PRES. FEET WATER	VALVE SIZE	DIFF. PRES. HEAD FEET WATER	MOTOR AMPS	RATED AMPS
P-1	3Ø	30	3½	22	2.5"	27	2.4	3.1
P-2	3Ø	85 (30thru AHU)	6	5	3"	18	2.6	3.0
P-3	6Ø	54	6½	5	2.5"	10.5	1.4	1.8
P-4	4Ø	41	6½	17	2"	14	1.4	1.8
P-5	9Ø	90	4½	32	3"	27.5	4.4	5.0
P-6	--	--	--	--	--	--	2.7	3.0
Chiller (North)	9Ø	80	8	23	2"	--	--	--
Collector 1	5.Ø	5.0	2½	28	1"			
Collector 2	5.Ø	5.0	2½	28	1"			
Collector 3	5.Ø	5.1	2 3/4	25	1"			
Collector 4	5.Ø	5.0	2½	28	1"			
Collector 5 (South)	5.Ø	5.1	2¼	30	1"			
Collector 6	5.Ø	5.0	2 3/4	23	1"			

BASE MOUNTED and CLOSE COUPLED PUMPS

2008
1750-3450 RPM

SUBMITTAL DATA

SD 300-3-8

EFFECTIVE: JULY 31, 1974 SUPERSEDES: SD 300-3-8 dated 10/31/72

JOB: [illegible]

DATE SUBMITTED: [illegible] BY: [illegible]

Location	Model No.	Pumpsize	Impeller Size	GPM	Head	Voltage	Phase
[illegible]-1	BB2008	2"	7.50	30	65	460/3/60	3
[illegible]-2	BB2008	2"	7.50	90	45	460/3/60	3

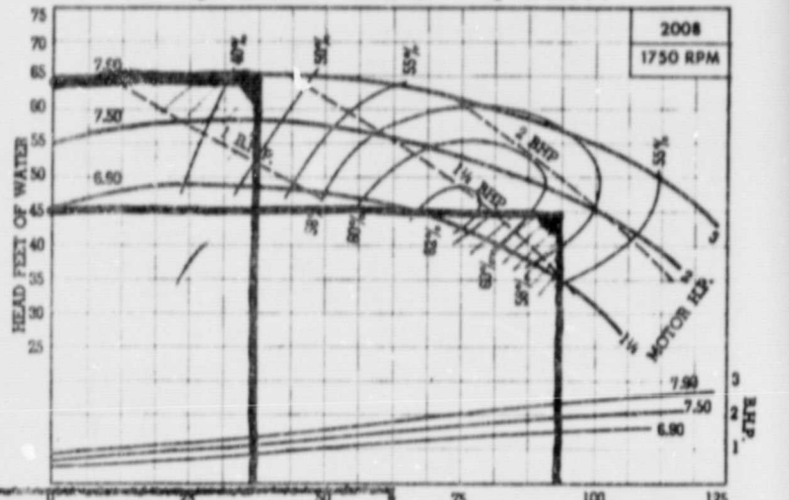
SPECIFICATIONS

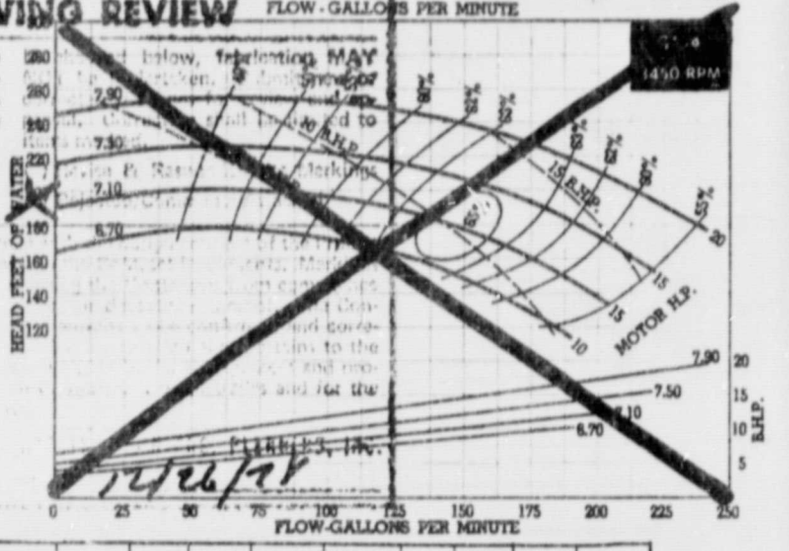
	STANDARD CONSTRUCTION			OPTIONS
Description	**Ball Bearing**	**Sleeve Bearing**	**Close Coupled**	
Frame	Ball Bearing	Sleeve Brng.	———	———
Coupler	4 Way Flex	4 Way Flex	———	———
Baseplate	Structural Steel	Structural Steel	———	———
Shaft-Pump	Alloy Stl	Alloy Stl	Alloy Stl (Mtr. Shaft)	☐ Stainless* Steel
Mech. Seal	Permalife 1 (250F)	Permalife 1 (250F)	Permalife 1 (250F)	Permalife 2* ☐ (300F)
Stuffing Box	250F	———	250F	☐ Yes
Bronze Gland w/ S.S. Studs & Nuts	with Stuff Box	with Stuff Box	with Stuff Box	———
Shaft Sleeve	Cupro Nickle	Cupro Nickle	Cupro Nickle	☐ St. Steel w/Stuff Box
Impeller	Cast Iron	Cast Iron	Cast Iron	☐ Cast Brz.
Special Imp. Cut	———	———	———	☐ Yes .....
Motor, O.D.P. 60 cycle, 3 phase 230/460	☐ 1750 BB ☐ 3450 BB	1750 SB	☐ 1750 BB ☐ 3450 BB	☐
Purecoil Filter	———	———	———	☐ YES*
Coupler Guard	———	———	———	☐ YES*
Brz. Const.	———	———	———	☐ YES*
Comp. Flanges ASA	———	———	———	☐ YES*
Bronze Wear Ring	———	———	———	☐ YES*
Working Pressure Test Pressure	175PSI** 250 PSI	175PSI 250 PSI	175PSI 250 PSI	

*Not Included in Standard Cost

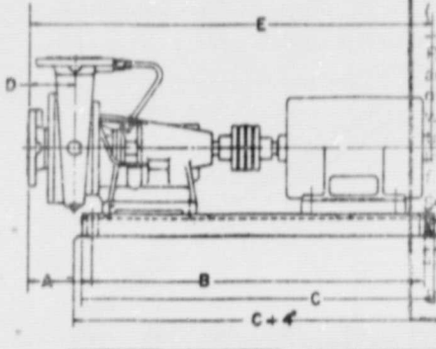
**In accordance with ASA B16.1

For Larger Performance Curves See Catalog No. 300-3-1





SIZES AND DIMENSIONS



	Product No.	Motor RPM	Motor HP	Suction & Dis. Conn.	G	C	K	F	B	J	H	A	D	X	N	M	E
Base Mounted	SB 2008 BB 2008	1750	1½ 2 3	2	12	27¾	9½	4¾	26½	3	⅝	6¾	4¼	8½	6¼ 7½	12¼ 13½	33¾ 33¾ 34¾
	BB2008	3450	10 15 20	2	13	35⅜ 35⅜ 41	10½	5¼	33⅜ 33⅜ 39½	4	⅝	6¾	4¼	8½	8½ 8½ 10¼	15 15 16¾	46½ 48 54
CLOSE COUPLED	CC2008	1750	1½ 2 3	2	12	6¼	6½	5¼	4½	1	⅝	7	4¼	8½	6 6 7	11¼ 11¾ 12¾	22½ 22½ 23½
	CC2008	3450	10 15 20	2	12 12 14	6¼ 6¼ 13	6½ 6½ 10	5¼ 5¼ 6	4½ 4½ 10¾	1 1 1¼	⅝ ⅝ ¾	6⅛	4¼	8½	8¼ 8¼ 10¼	14¼ 14¼ 15½	25¾ 27¾ 29¾

CLOSE COUPLED PUMPS

2006 1750-3450 RPM

EFFECTIVE: JULY 31, 1974 SUPERSEDES: SD 300-3-7 dated 10/31/72

SD 300-3-7

JOB:

DATE SUBMITTED: DEC. 12, 19[illegible] BY:

Location	Model No.	Pumpsize	Impeller Size	CPM	Head	Voltage	Phase
P-3	[illegible]		5.50	60	25	460/3/60	3/4 HP
P-4	BB2006		5.50	38	34	460/3/60	1 HP

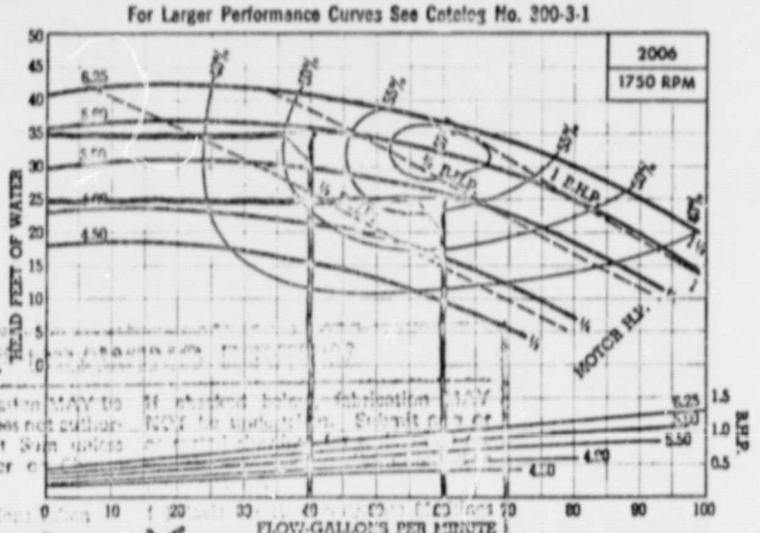
SPECIFICATIONS

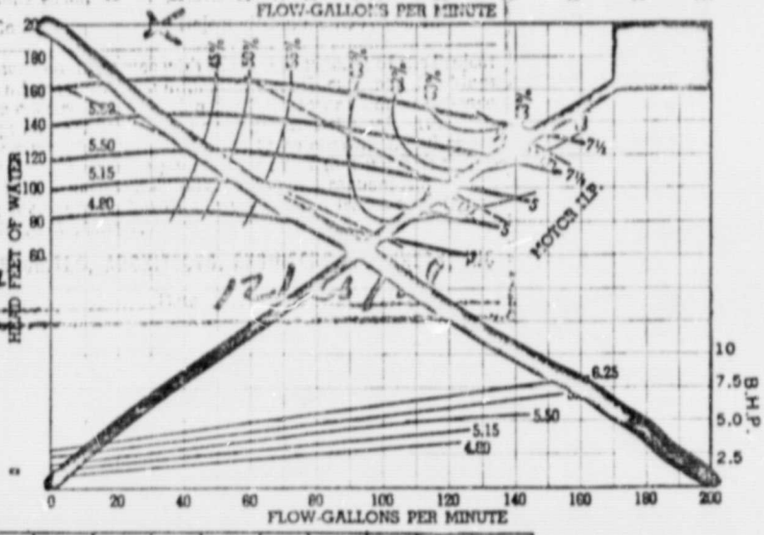
	STANDARD CONSTRUCTION			OPTIONS
Description	[illegible]	Sleeve Coupling	Close Coupled	
Frame	[illegible]	Sleeve Brng.	———	———
Coupler	[illegible]	4 Way Flex	———	———
Baseplate	[illegible]	Structural Steel	———	———
Shaft-Pump	[illegible]	Alloy Stl	Alloy Stl (Lthr. Shaft)	☐ Stainless* Steel
Mech. Seal	[illegible]	Permalite 1 (250F)	Permalite 1 (250F)	Permalite 2* ☐ (300F)
Stuffing Box	250F	———	250F	☐ Yes
Bronze Gland w/ S.S. Studs & Nuts	with Stuff Box	with Stuff Box	with Stuff Box	———
Shaft Sleeve	[illegible]	Cupro Nickle	Cupro Nickle	☐ St. Steel w/Stuff Box
Impeller	Cast Iron	Cast Iron	Cast Iron	☐ Cast Brz.
Special Impl. Cut	———	———	———	☐ Yes .....
Motor, O.D.P. 60 cycle, 3 phase 230/460	☐ [illegible]	1750 SD	☐ 1750 BB ☐ 3450 BB	☐
Purecell Filter	———	———	———	☐ YES*
Coupler Guard	———	———	———	☐ YES*
Brz. Contct.	———	———	———	☐ YES*
Comp. Flanges ASA	———	———	———	☐ YES*
Bronze Wear Ring	———	———	———	☐ YES*
Working Pressure Test Pressure	175PSI** 250 PSI	175PSI** 250 PSI	175PSI** 250 PSI	———

*Not included in Standard Cost

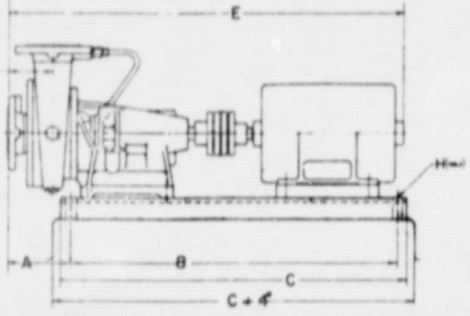
**In accordance with ASA B16.1

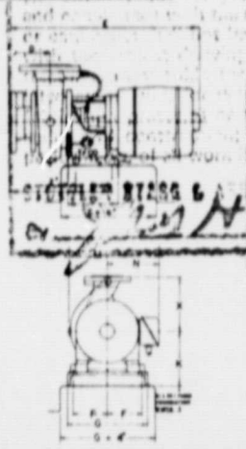
For Larger Performance Curves See Catalog No. 300-3-1





SIZES AND DIMENSIONS





	Product No.	Motor RPM	Motor HP	Suction & Dis. Conn.	G	C	K	F	B	J	H	A	D	X	N	M	E
BASE MOUNTED	sB2006 BB2006	1750	½ ¾ 1 1½	2	12	27¾	8¼	4¼	26½	3	⅜	6⅝	4	7½	6¼	12⅛	33 ⅝
	BB2006	3450	3 5 7½	2	12	27¾	8¼	4¼	26½	3	⅜	6⅝	4	7½	6¼ 7⅜ 7⅜	12¾ 13⅜ 13⅜	35 ⅝
CLOSE COUPLED	CC2006	1750	½ ¾ 1½	2	10	6¼	5¼	4¼	4½	1	⅜	6⅞	4	7½	6	10⅝	21
	CC2006	3450	3 5 7½	2	12	6¼	6½	5¼	4½	1	⅜	6⅞	4	7½	7	11⅝	22 23 24

BASE MOUNTED and CLOSE COUPLED PUMPS

2508
1750-3450 RPM

Taco SUBMITTAL DATA

SD 300-3-12

EFFECTIVE: JULY 31, 1974 SUPERSEDES: SD 300-3-12 dated 10/31/72

JOB: [illegible]

DATE SUBMITTED: [illegible] BY: [illegible]

Location	Model No.	Pumpsize	Impeller Size	GPM	Head	Voltage	Phase
[illegible]	BB-50B	2"	7.90	90	65	[illegible]	[illegible]

SPECIFICATIONS

Description	STANDARD CONSTRUCTION: Ball Bearing	Sleeve Bearing	Close Coupled	OPTIONS
Frame	Ball Bearing	Sleeve Brng.	———	———
Coupler	4 Way Flex	4 Way Flex	———	———
Baseplate	Structural Steel	Structural Steel	———	———
Shaft-Pump	Alloy Stl	Alloy Stl	Alloy Stl (Mtr. Shaft)	☐ Stainless* Steel
Mech. Seal	Permalife 1 (250F)	Permalife 1 (250F)	Permalife 1 (250F)	Permalite 2* ☐ (300F)
Stuffing Box	250F	———	250F	☐ Yes
Bronze Gland w/ S.S. Studs & Nuts	with Stuff Box	with Stuff Box	with Stuff Box	———
Shaft Sleeve	Cupro Nickle	Cupro Nickle	Cupro Nickle	☐ St. Steel w/Stuff Box
Impeller	Cast Iron	Cast Iron	Cast Iron	☐ Cast. Brz.
Special Imp. Cut	———	———	———	☐ Yes
Motor, O.D.P. 60 cycle, 3 phase 230/460	☐ 1750 BB ☐ 3450 BB	1750 SB	☐ 1750 BB ☐ 3450 BB	☐
Purocell Filter	———	———	———	☐ YES*
Coupler Guard	———	———	———	☐ YES*
Brz. Const.	———	———	———	☐ YES*
Comp. Flanges ASA	———	———	———	☐ YES*
Bronze Wear Ring	———	———	———	☐ YES*
Working Pressure Test Pressure	175PSI** 250 PSI	175PSI** 250 PSI	175PSI** 250 PSI	——— ———

*Not included in Standard Cost

**In accordance with ASA B16.1

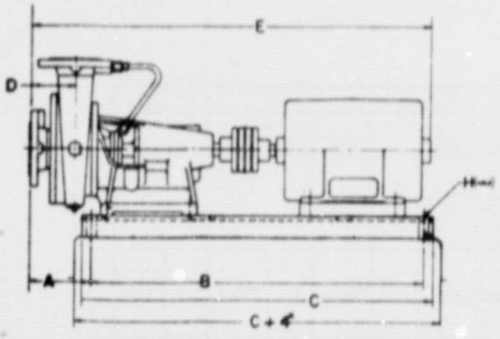
SHOP DRAWING REVIEW

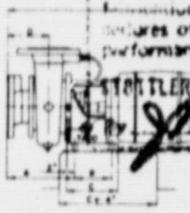
If checked below, fabrication MAY be [illegible] Submit new or [illegible] for review and approval. [illegible] shall be limited to [illegible] noted.

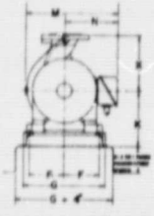
Approved [illegible] Approved as Noted [illegible] Submit/Note Item [illegible]

Comments Attached [illegible]

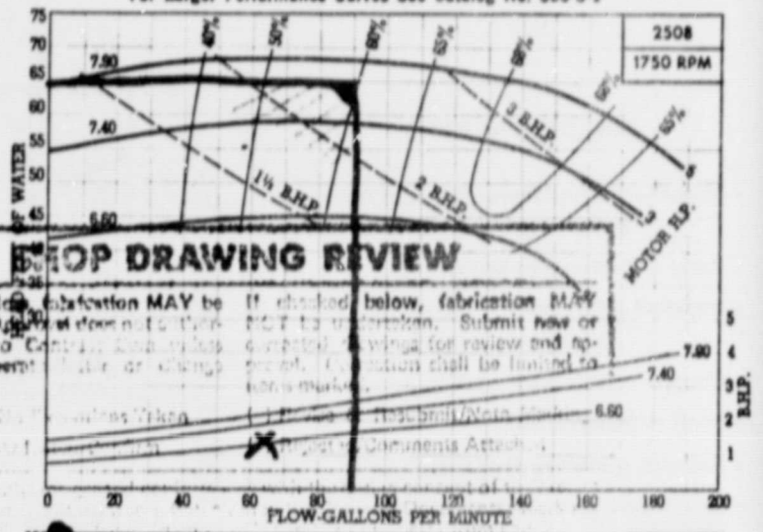
SIZES AND DIMENSIONS

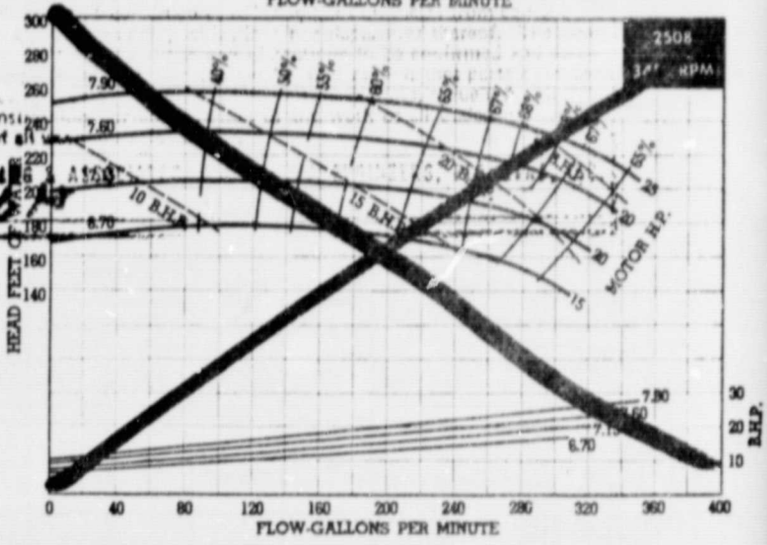






For Larger Performance Curves See Catalog No. 300-3-1





	Product No.	Motor RPM	Motor HP	Suction & Dis. Conn.	G	C	K	F	B	J	H	A	D	X	N	M	E
Base Mounted	SB 2508 BB 2508	1750	2 3 5	2½	12	27¾	9½	4¾	26½	3	⅝	7¼	4¾	8	6 15/16 7 23/32 7 31/32	12 15/16 13 23/32 13 31/32	34 1/4 34 7/8 35 7/8
	BB2508	3450	15 20 25	2½	13	35⅜	10½	5¼	33⅞	4	⅝	7¼	4¾	8	8½ 10 1/16 10 1/16	15 16 5/16 16 5/16	41⅛ 41⅞ 43⅜
CLOSE COUPLED	CC2508	1750	2 3 5	2½	12	6¼	6½	5¼	4½	1	⅝	7 11/16	4¾	8	6 7 7	11⅞ 12⅞ 12⅞	22 29/32 23 29/32 24 29/32
	CC2508	3450	15 20 25	2½	12 14 14	6¼ 13 13	6½ 10 10	5¼ 6 6	4½ 10¾ 10¾	1 1¼ 1¼	⅝ ¾ ¾	7 11/16	4¾	8	8 15/16 10 1/16 10 1/16	14 53/64 16 53/64 16 53/64	27 17/64 30 5/64 31 17/64

Taco

NUMBER
SD 100-15

Effective: March 15, 1978
Supersedes: SD 100-15
Dated 1/31/73

Job: SOLAR HEATING & COOLING DEMONSTRATI
PROJECT, FLA. SOLAR ENERGY C
Submittal Date: ILLUMINATION AND ASSOCIATES
By: DECEMBER 12, 1979

Location	Pump Size	Model Number	GPM	Head
P-6	1"	113D	20	8

110 RED BARON SERIES

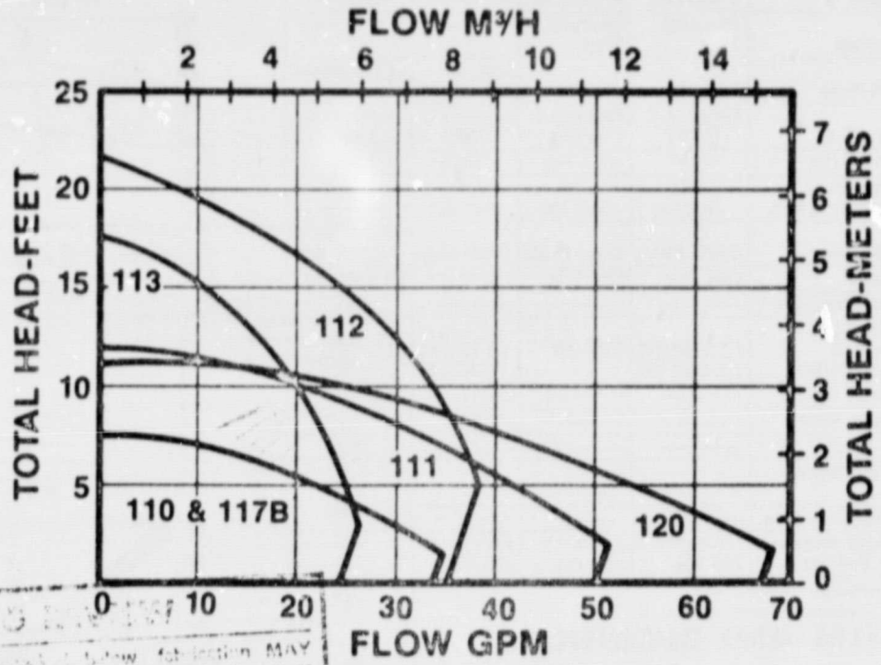
ALL BRONZE, 115/1/60

110, 111, 112, 113, 117B, 120

SPECIFICATIONS

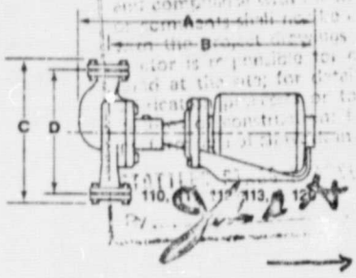
- Motor – Resilient mounted, split phase Built-in overload protector.
- Body – Cast iron or bronze
- Impeller – One piece, dynamically balanced, non-ferrous
- Coupler – One piece, spring
- Shaft – Stainless steel
- Bearings – Bronze sleeve type
- Seal – Two piece, carbon/ceramic
- Standard flanges – Cast iron or bronze
- Shut-off flanges – Cast iron, bronze ball

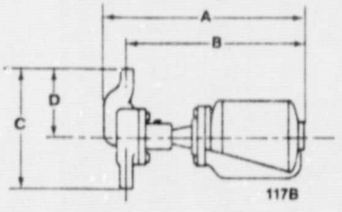
CURVES



DIMENSIONS

PRODUCT NUMBER[1]	FLANGE SIZE	MOTOR 115V 60C 1 PH[2]	MOTOR RPM	MAXIMUM TEMP.	PRESSURE RATING	DIMENSIONS A IN.	A MM	B IN.	B MM	C IN.	C MM	D IN.	D MM	APPROX. SHIPPING WEIGHT LBS	KG
110	¾", 1" 1¼", 1½"	1/12	1725	240° F	125 psi	14⅝	371.5	12⅝	320.7	7⅞	200				
111	¾", 1" 1¼", 1½"	1/8	1725	240° F	125 psi	16¼	412.8	13¾	352.4	10¼	260.4	8¾	222.3	26	11.8
112	¾", 1" 1¼", 1½"	1/3	3450	240° F	125 psi	16½	419.1	14½	368.3	7⅞	200				
113	¾", 1" 1¼", 1½"	1/8	1725	240° F	125 psi	16¼	412.8	14	355.6	10⅛	257.2	8½	215.9	27	12.2
117B	1" Sweat	1/12	1725	240° F	125 psi	14	355.6	12¾	323.8	17¾	450.9	4⅜	109.5	23	10
120	2"	1/6	1725	240° F	125 psi	16⅞	428.6	14¼	362	13½	342.9	11	279.4	46	20.9



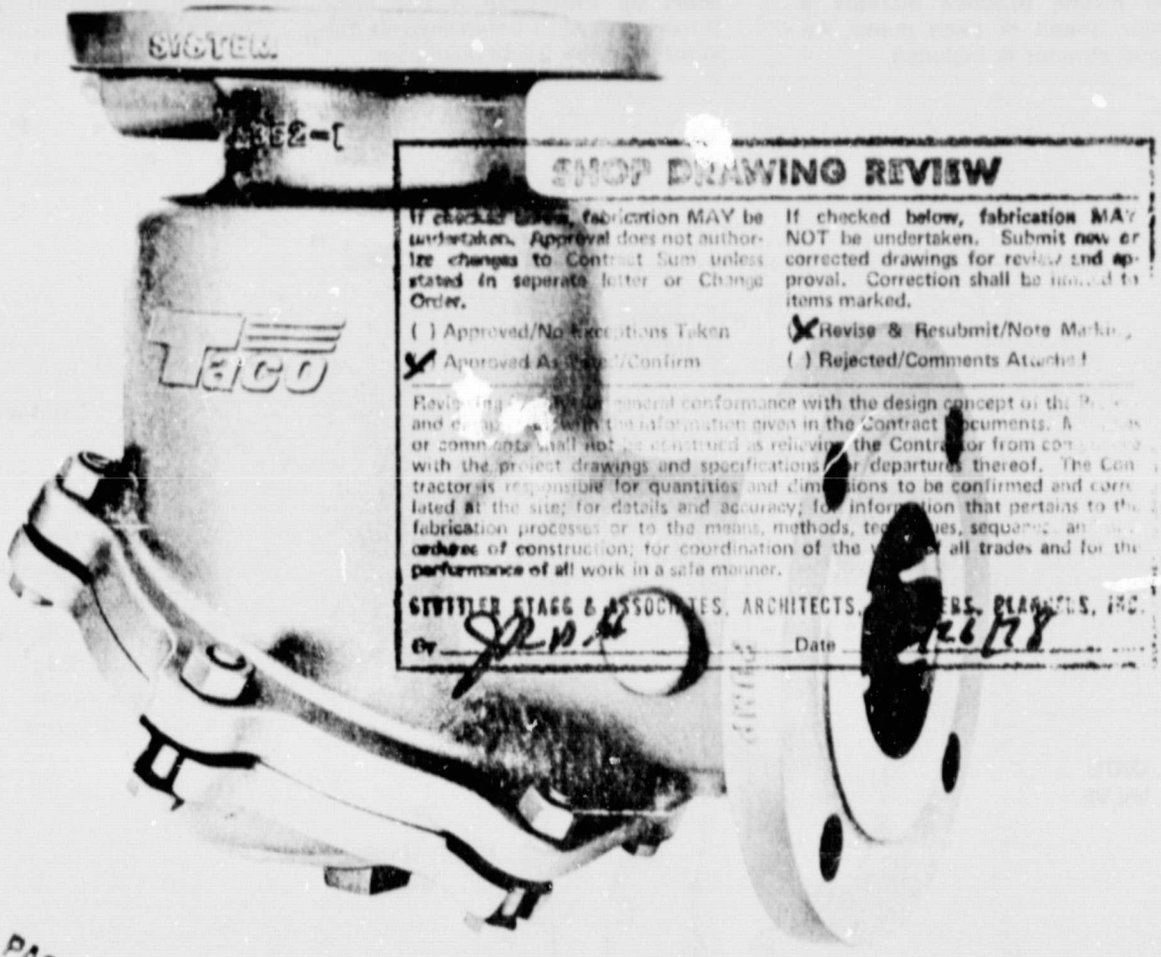


1. When specifying all bronze construction add letter "B" after product number, ie: 110B.
2. Motors are available with other electrical characteristics — consult your Taco representative.
3. 240° Intermittant; 200° Continuous.

Suction Diffuser

EFFECTIVE:	JUNE 15, 1973
SUPERSEDES:	400-5
Dated:	January 15, 1973

CATALOG
400-5



TACO, INC.
CRANSTON, RHODE ISLAND 02920

TACO HEATERS OF CANADA, LTD.
MISSISSAUGA, ONTARIO, CANADA

EFFICIENCY ENGINEERED PRODUCTS

SPACE SAVING

INCREASED PUMP EFFICIENCY from Taco

Taco Suction Diffuser

Saves Space For optimum pump efficiency, provision for straight pipe or straightening vanes ahead of the pump is required. The Suction Diffuser is an elbow with integral straightening vanes.

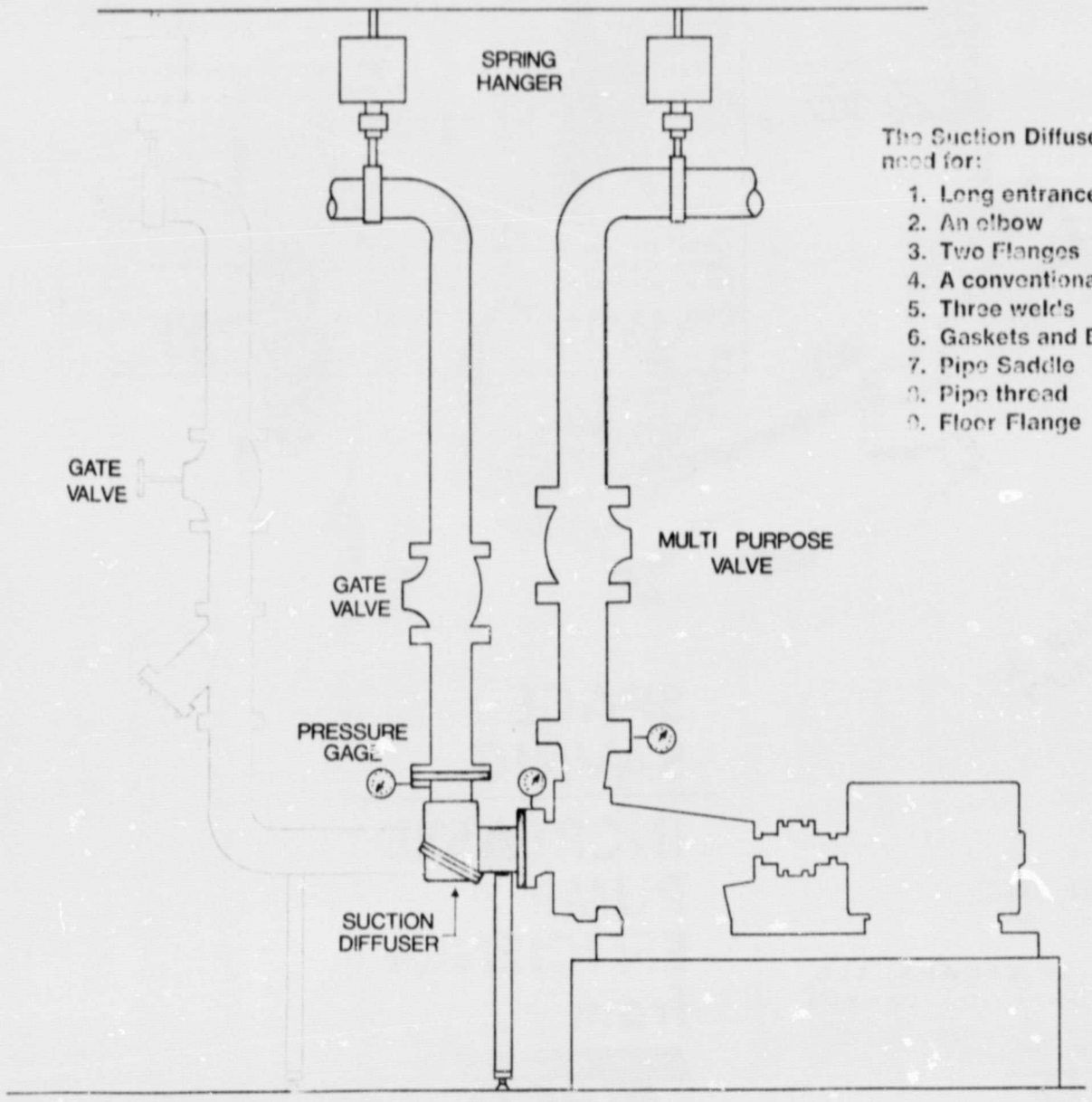
Good design practice dictates a strainer ahead of each pump. An integral strainer is included.

Flexibility Suction Diffusers are available with equal or reduced flange sizes.

Start Up Protection A fine mesh throw away start up strainer is provided with the Suction Diffuser.

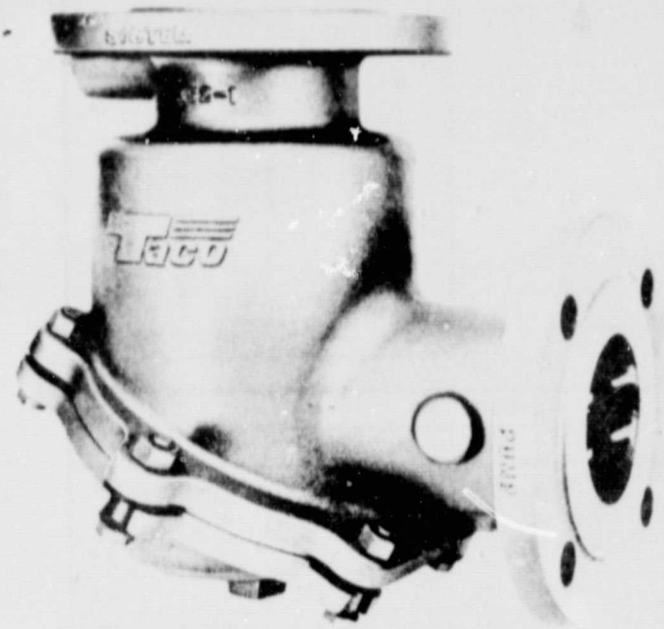
Permanent Strainer The permanent strainer provided has more free area than conventional strainers.

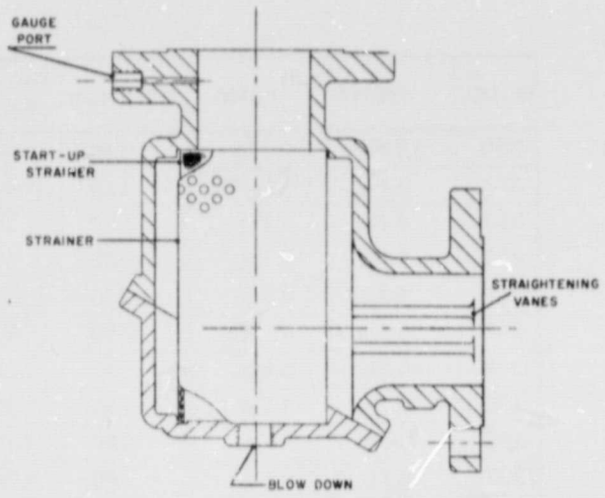
Serviceability Water flows from inside of the strainer to the outside, thus simplifying the cleaning and removal of the strainer.



The Suction Diffuser eliminates the need for:

1. Long entrance pipe
2. An elbow
3. Two Flanges
4. A conventional strainer
5. Three weld's
6. Gaskets and Bolting
7. Pipe Saddle
8. Pipe thread
9. Floor Flange





SPECIFICATIONS

BODY	Cast Iron
STRAIGHTENING VANES	Cast Iron
STARTUP STRAINER	Bronze
PERMANENT STRAINER	Stainless Steel
PRESSURE	up to 175 PSI in accordance with ASA B16.1
TEMPERATURE	up to 250°F

TYPICAL SPECIFICATIONS

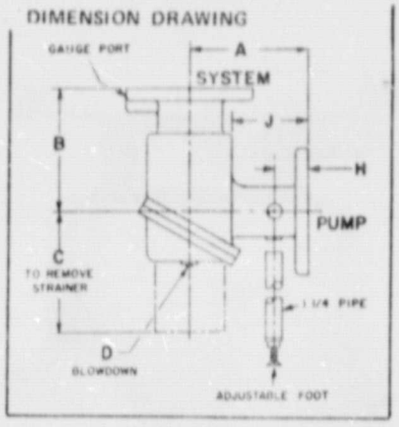
Provide at each pump a Suction Diffuser Taco Model(s) of size and type shown on drawings. Units shall consist of an angle type body with inlet vanes and a combination Diffuser strainer with 3/16" diameter openings for pump protection. (Unit shall be equipped with a disposable fine mesh start up strainer which shall be removable after 30 days). FLOW DIRECTION SHALL BE FROM INSIDE THE STRAINER TO OUTSIDE FOR EASE OF SERVICE AND CLEANING. The body shall fit the pump and connecting pipe size. The unit shall be provided with an adjustable support foot to relieve piping strains from the pump suction. The contractor shall provide valved gauge connections at diffuser inlet and pump suction to indicate when cleaning is needed.

Dimensions

P-1, P-2, P-3, P-4 #350

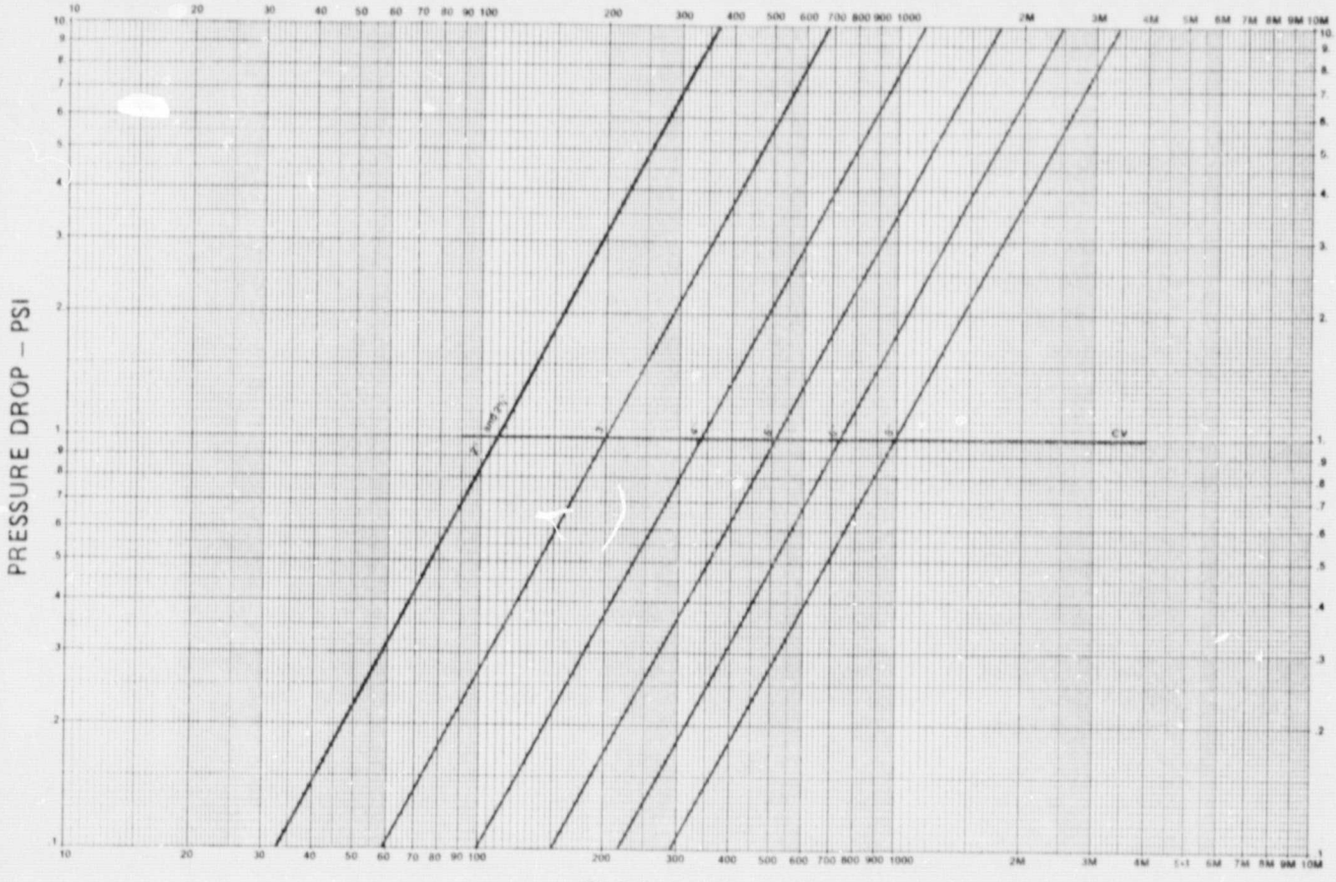
P-5 #351

DIMENSION DRAWING



MODEL	SYSTEM	PUMP	C.V. Factor	Free Area Sq. In.	DIMENSIONS						Ship. Wgt. Lbs.
					A	B	C	D	H	J	
350	3 Flg.	2 Flg.	110	40	7 1/16"	7 3/8	8 1/4"	3/4"	2 3/8"	4 5/8"	45
351	3 Flg.	2 1/2 Flg.	110	40	7 1/16	7 3/8	8 3/4	3/4	2 3/8	4 5/8	45
352	3 Flg.	3 Flg.	200	50	7 1/8	7 3/8	8 1/4	1	2 5/16	4 1/8	57
353	4 Flg.	3 Flg.	200	50	7 1/8	7 3/8	8 1/4	1	2 5/16	4 1/8	62
354	4 Flg.	4 Flg.	350	80	9 5/16	7 1/4	9 1/2	1	3 1/2	5 3/8	95
348	5 Flg.	4 Flg.	350	80	9 5/16	7 1/4	9 1/2	1	3 1/2	5 3/8	112
349	5 Flg.	5 Flg.	520	125	10	9 11/16	11 7/8	1	3	5 3/8	150
355	6 Flg.	4 Flg.	350	80	9 5/16	7 1/4	9 1/2	1	3 1/2	5 3/8	125
356	6 Flg.	5 Flg.	520	125	10	9 11/16	11 7/8	1	3	5 3/8	160
357	6 Flg.	6 Flg.	760	150	11	8 3/4	11 7/8	1	3	5 5/16	180
358	8 Flg.	6 Flg.	760	150	11	8 3/4	11 7/8	1	3	5 5/16	205
359	8 Flg.	8 Flg.	1000	275	11 3/4	13 11/16	16	1 1/4	2 3/4	5 1/4	280
370	10 Flg.	8 Flg.	1000	275	11 3/4	13 11/16	16	1 1/4	2 3/4	5 1/4	298

PRESSURE DROP CURVE



Pressure – up to 175 PSI in accordance with ASA B16.1

Temperature – up to 250° F.

Printed in U.S.A.

Taco

INSTRUCTION SHEET

NUMBER

IS100-21

HORIZONTAL & VERTICAL CIRCULATORS

Nos. 110 thru 120 and all Vertical Models

EFFECTIVE: JULY 1, 1968

SUPERSEDES: IS100-21 DATED 10/1/65 AND IS300-7 & 471503A

TO REPLACE MOTOR

1 — Disconnect wiring.
2 — Loosen the two set screws at pump end of spring coupling, remove bolts between bracket and motor and separate.
3 — Loosen other set screw of coupling and remove coupling from old motor.
4 — Slide coupler with single set screw over new motor shaft and tighten against flat surface of shaft.
5 — Place new motor assembly into bracket and replace bolts (also springs on Vertical Models).
6 — Extend pump end of spring coupling over impeller shaft 3/16" Horizontal Models or 5/16" on Vertical Models and tighten both set screws. If impeller and shaft move into body during this operation, water will flow from weep hole in bracket. If this does occur, extend spring coupler a little more or until water stops flowing. CAUTION: UNDER NO CIRCUMSTANCES SHOULD THE WEEP HOLE BE PLUGGED.
7 — Rewire motor.

TO REPLACE SPRING COUPLING

Follow same procedure outlined above.

REPLACING SEALS

Water flowing from weep hole in bracket normally indicates dirt on the seat or seal needs replacement. Before taking pump apart extend spring coupling and impeller shaft into body as far as it will go. This will separate the seal halves and permit a greater flow thru the weep hole and wash any foreign matter off the seats. Release and if flow stops, it indicates that the seals do not require replacement. If the flow does not stop, loosen the two set screws on the coupling and extend as far as it will go. If leak stops it means there was insufficient tension on the coupling. If leak continues, indications are that the seal needs replacement. Proceed as follows: —

1 — Disconnect wiring.
2 — Valve off or drain system.
3 — Remove body bolts and pull entire assembly out of body.
4 — Loosen the two set screws at pump end of spring coupler, file off any burrs on shaft and pull impeller and shaft from bracket.
5 — Pry out old seal seat from bracket with a screwdriver and old part from impeller shaft with a pair of pliers.
6 — Clean shaft and seal bearing surfaces thoroughly with clean cloth.
7 — Dip CARBON part of seal in water to lubricate, place on top of impeller shaft with carbon facing up. Push down on shaft with palm of hand as far as it will go. Then with both thumbs push all the way down making certain that prongs engage the two holes in the impeller. If there are no holes in the impeller, break off the prongs with a pair of pliers and smooth burrs with a file.
8 — Separate rubber from ceramic part, wet it and set into recess in bracket. Set ceramic seal into rubber with seat facing out by starting at a slight angle first, then pushing away and down simultaneously. The rubber ring should not be folded over during this operation. Make certain that both the rubber and ceramic are "bottomed" squarely.
9 — Clean both seal surfaces with a clean lintless cloth.
10 — Place a few drops of oil along the impeller shaft and push slowly with a twisting motion through ceramic part into bracket and spring coupling.
11 — While holding impeller and shaft with seal faces mating, insert an Allen wrench into one of the set screws in the coupling, extend spring — 3/16" for Horizontal Models or 5/16" for Vertical Models and tighten set screw. Then tighten the second set screw.
12 — Remove old body gasket, clean surfaces and replace with new gasket.
13 — Place entire assembly into body, replace and tighten bolts gradually and evenly all around.
14 — Refill system. If water leaks from weep hole in bracket increase tension on spring coupling slightly more or until leak stops.
15 — Rewire motor.

*CAUTION: The addition of certain chemical additives to systems utilizing TACO Equipment, voids the warranty.

Taco Heaters of Canada, Ltd.
3090 Lenworth Drive
Cooksville, Ontario

TACO, INC. 1160 Cranston Street, Cranston, Rhode Island 02920

Printed In U.S.A.

taco

NUMBER
IS 300-4

TACO BASE MOUNTED PUMPS (SLEEVE AND BALL BEARING)

EFFECTIVE: MARCH 31, 1968

Supersedes: No. IS300-4, 300-5 of 1 2 63 and 5. 1502

A—INSTALLATION

A1-LOCATION

Locate pump in an easily accessible place with sufficient space around it for maintenance and servicing. On larger pumps allow head room for the use of hoists or overhead cranes. Locate pump on a dry and clean place so that motor will be protected from moisture and dust.

On closed heating systems place compression tank at the suction side of the pump. When pump head is less than 20 feet, it is permissible to connect compression tank to discharge side of pump.

On open systems, install pump close to liquid supply and make suction piping as short and as straight as possible.

A2-FOUNDATION

The foundation serves to carry the pump weight and to absorb vibration. Normally, the foundation is made of concrete block, preferably tied in with the floor or ground. Make the foundation block about 4" longer and 4" wider than the base of the frame. Height of the block may vary from 2/3 to 1 times the *width* of the foundation (Fig. 1). When foundation is poured, provide a hole near each of the four (4) corners. To simplify installation and maintenance use lead Anchors. Place the front Anchor about 2" from the edge of the foundation to clear overhanging casings (Fig. 2).

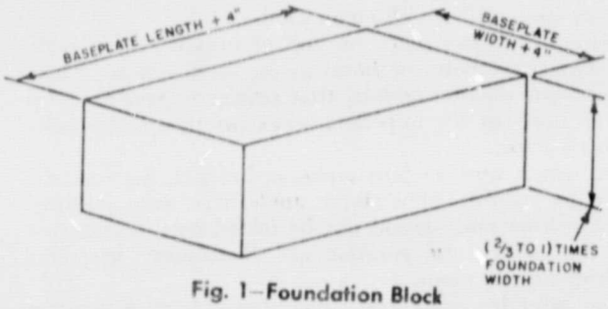


Fig. 1—Foundation Block

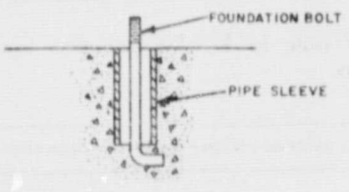


Fig. 2—Foundation Bolt

A3-PIPING

Correct piping is of prime importance for the proper operation and long life of the pump. Stresses induced by piping will cause excessive wear of seals, bearings, and couplings that could ultimately destroy these elements.

Both suction and discharge piping should be suspended close to the pump connections, so that no pipe weight rests on the pump. Pipe flanges and pump flanges should align perfectly before connections are made, piping should never be drawn by force into place.

Thermal expansion of piping requires special attention on heating installations. If no room is provided for pipe expansion, stresses are induced in the piping that will exert a load on the pump. Forces created by pipe stresses can exceed by far the load exerted through pipe and water weight. Stress forces can distort pump, bend shafts, wear out seals, and impeller wear rings, and ultimately burn out bearings. To protect pump from thermal pipe stresses, provide spring hangers and flexible connectors that are suitable to compensate for pipe expansion. (See Fig. 3).

Install gate valves on both suction and discharge side of the pump to allow servicing without draining the system. Also provide a flanged nipple (spool) between gate valve and suction end of the pump to enable you to take the pump apart without disturbing piping (Fig. 3). In order to have them easily accessible, the pump and flange nipples should not be covered with insulation.

On open pumping systems drawing water from a level below the pump (suction lift) install a foot valve with strainer. On open systems where the pump is located below the suction water level (suction head) install a check valve in the discharge line close to the pump.

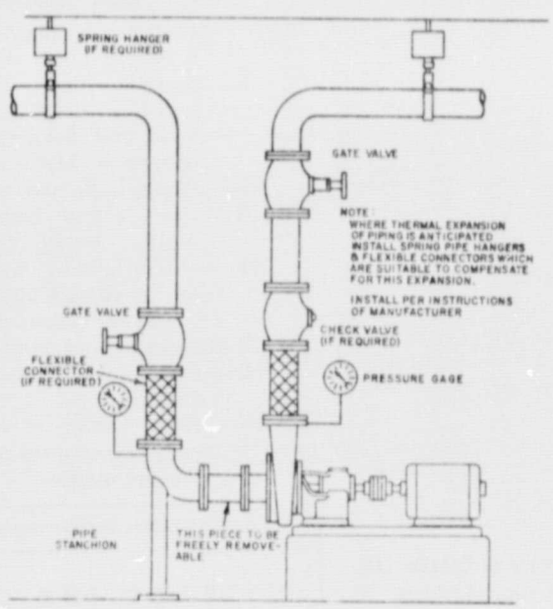


Fig. 3—Typical Installation—Vertical Piping

A—INSTALLATION-Continued

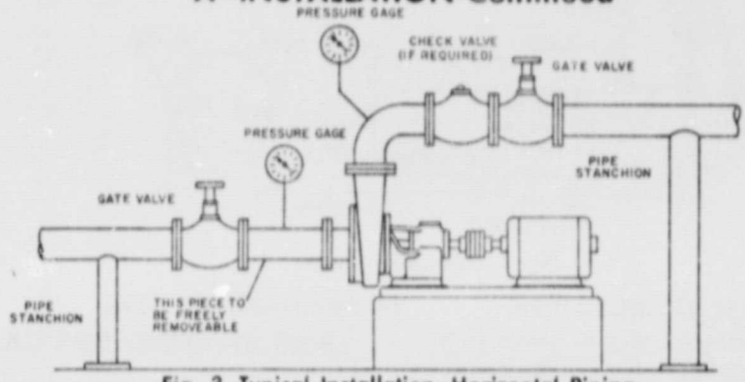


Fig. 3—Typical Installation—Horizontal Piping

A4-PUMP SETTING

When pump is set on its foundation, make sure to have it properly levelled. Place baseplate over foundation bolts provided for it, place shims at corners of baseplate when required and level with a spirit gauge. Tighten baseplate firmly to its foundations. Check also level of suction and discharge flanges.

A5-COUPLING ALIGNMENT

Proper alignment of pump and driver will assure trouble-free operation and long life of the pump. Misalignment will cause rapid wear of seals, couplings, and bearings. All pumps are carefully aligned before leaving the factory. However, experience indicates that alignment invariably changes in shipping and handling. Therefore, it is of utmost importance that alignment be checked at various steps of the installation process. i. e., **after leveling, after piping, and after first few weeks of operation.**

Check alignment by placing a slotted straight edge across the coupling halves at top, bottom, and at the sides. If any light is seen between the straight edge and one of the coupling flanges, it means the unit is out of alignment. (Fig. 4)

If light is seen at top and bottom position of the straight edge, alignment is out of height. Usually shims are placed under the motor feet. Loosen the four motor bolts, remove or add shims as required to correct proper height. Tighten the motor bolts and check to make sure alignment was corrected properly.

If alignment is out on the sides of the coupling, loosen the four motor bolts and lightly tap the motor in the direction required. Tighten the four motor bolts and check to make sure alignment was corrected properly.

As alignment in one direction may alter the alignment in another, be sure to check all alignments made.

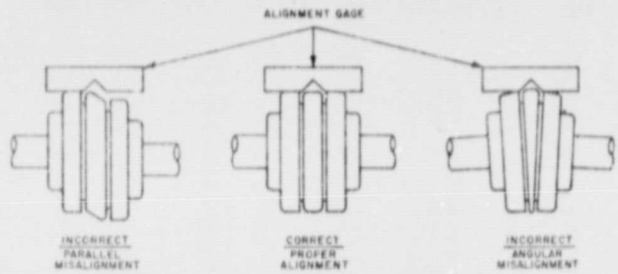


Fig. 4—Coupling Alignment

A6-CONNECTING PIPING

Piping may now be connected to pump. Make sure that pump and pipe flanges are strictly parallel and properly spaced for the gasket that will be used. Also check that pipes are supported properly and do not rest on pump flanges. Never draw pipes by force to pump flanges. Recheck alignment after piping connections are made. If misalignment was caused by piping, it is a sign that pipe stresses distorted the pump. Correct piping to relieve stresses.

B—PUMP START-UP & OPERATION

Before starting up pump for the first time several items are to be checked to avoid damaging pump.

B1-LUBRICATION

Sleeve Bearing pumps are filled with oil at the factory but some oil might be lost during shipment. As a matter of precaution, check oil level before starting up pump. Proper level is at the center of the sight glass. If oil level is too low, remove top cover (Fig. 5) and refill.

Drain and refill oil well once a year. Initial filling is Socony Mobil DTE Heavy Medium Oil, but any premium SAE Grade 20 Non-Detergent Motor Oil can be used.

Motor bearings also might loose oil during shipment. Check oil level as indicated on motor instruction. Electric motors have either an oil cup or a pipe plug for filling. An overflow is located at the side of the bearing area. Before starting unit, fill motor bearing with an oil can until oil flows out of overflow.

Ball Bearing pumps are greased at the factory. Grease will not flow out during shipment, so no checking will be required at startup.

Regrease ball bearings every two years or 3,000 hours of operation. Initial filling is LUBRIKO-grease, Density M31, manufactured by Master Lubricants Company, Philadelphia.

Any general purpose ball bearing grease No. 3 NLGI (National Lubricating Grease Institute) hardness may be used.

To grease bearings open side covers (Fig. 5), slide them about 1/2" to the side and introduce grease thru the opening with a putty knife. Fill grease chamber 2/3 high. Excessive grease causes unnecessary friction and will overheat bearing. If bearings run hot after regreasing, stop pump, open side cover, and wipe out excessive grease. Overheating will then cease.

Motor ball bearings also are greased at the factory. Grease should be replaced as indicated by motor manufacturer's instruction. Normally greasing is required every two years. On electric motors grease is usually introduced through a grease fitting with a grease gun.

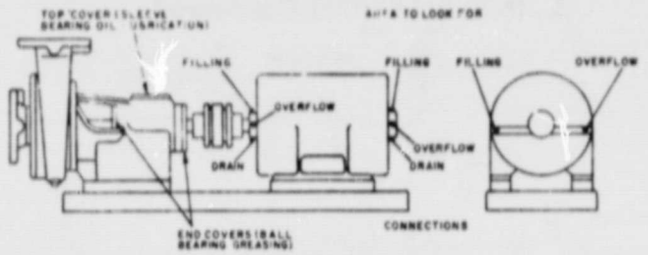


Fig. 5—Lubrication Points

B2-MOTOR WIRING & SENSE OF ROTATION

Check wiring of motor before starting to make sure that connections are wired properly for the voltage in use. Overvoltage can burn out motor windings. Check heater element in magnetic starter to see that it is rated the same as the motor.

AMP RATING FOR 3 PHASE SQUIRREL CAGE INDUCTION MOTORS

Motor HP	220 Volt 1750 RPM	220 Volt 3450 RPM	440 Volt 1750 RPM	440 Volt 3450 RPM
¼	1.0	–	.5	–
⅓	1.4	–	.7	–
½	1.8	–	.9	–
¾	2.4	2.2	1.2	1.1
1	3.6	3.4	1.8	1.7
1½	4.8	4.6	2.4	2.3
2	6.2	5.6	3.1	2.8
3	9.0	8.0	4.5	4.0
5	14.4	13.4	7.2	6.7
7½	20.0	19.2	10.0	9.6
10	26.4	25.6	13.2	12.8
15	39.0	38.0	19.5	19.0
20	51.0	50.0	25.5	25.0
25	62.0	60.0	31.0	30.0
30	74.0	72.0	37.0	36.0
40	96.0	–	48.0	–
50	120.0	–	60.0	–

Before attempting to check out sense of rotation of pump, fill pump with water to provide lubrication of the seal. Do not operate pump dry for motor checkout.

Next throw the switch and see if direction of rotation corresponds with arrows on frame of pump. The direction of rotation is counterclockwise facing the suction end of pump. Direction of rotation of three phase motors can be easily reversed by interchanging two of the three wires at the terminal board of the motor. Reversing of single phase motors is done by interchanging some internal wires or clamps. Instructions for reversing are found either on the motor nameplate or inside the motor terminal cover.

B3-PUMP START-UP

After you have checked lubrication and wiring you are ready to start the pump.

Open the gate valve in the suction side and close the valve on the discharge side. Start motor, wait until unit has come to full speed and then open discharge valve slowly. Do not run pump for more than a few minutes with completely shut valves. If system conditions call for part-time operation against shut valves, install a bypass line from discharge to suction.

B4-MECHANICAL SEAL AND STUFFING BOX CARE

Mechanical Seal (See caution below)*

Mechanical seals are the most delicate component of the pump. Special care has to be given to them to assure trouble-free operation.

The sealing element of a mechanical seal consists of a carbon washer rotating against a stationary ceramic ring.

Surfaces of both are highly lapped to assure sealing. Any dirt that penetrates between the two mating parts will cause a rapid wear of the seal faces and will ultimately result in seal leakage.

New heating systems are usually contaminated by various materials such as construction debris, welding slugs, pipe joint compound, mill scale, etc. It is of utmost importance that such systems be cleaned out thoroughly before putting pump into continuous operation.

Cleaning of a heating system is simple and easy. First flush out system with cold water at city pressure to remove all loose foreign matter that penetrated into the system. Afterwards boil out system with chemicals to remove dirt adhering to pipes.

Chemicals most commonly used for this procedure are sodium triphosphate, sodium carbonate, or caustic soda, but any nonfoaming detergents as used in dishwashers can be applied.

Fill system with clean water, add cleaning chemicals (1) lb. for every 40 to 50 gallons of water, (or Mfrs. Instruction) start pump and heat up system. Let system run for a few hours, then drain and refill with fresh water. Your pumps are now ready for continuous duty. (See caution below).*

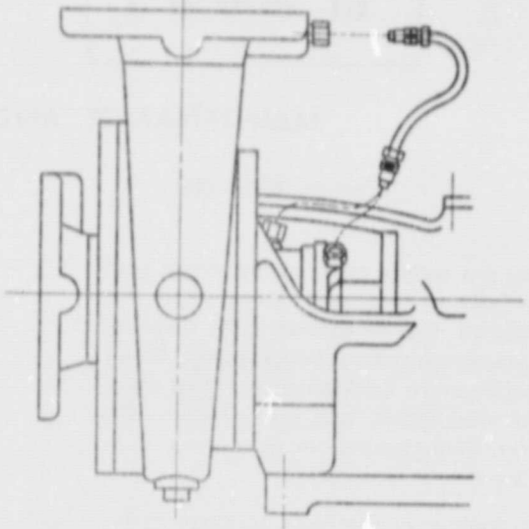
Stuffing boxes are less delicate in operation than mechanical seals. No chemical cleaning is necessary as on mechanical seal pumps, but flushing out with cold water is beneficial on this type of pump too.

After pump is started up adjust gland of stuffing box evenly so that it drips from one to three drops of water per minute. This drip is absolutely essential to prevent damage to packing and shaft sleeve. It also prevents overloading of motor. Excessive dripping may cause air to enter pump under certain conditions.

Sump of pump should be piped to any convenient sewer or drain. A pipe tapping is provided for this purpose at the side of the sump. Never plug this drain tapping.

*CAUTION: The addition of certain chemical additives to systems utilizing TACO Equipment, voids the warranty.

INSTALLATION OF EXTERNAL CIRCULATION TUBE

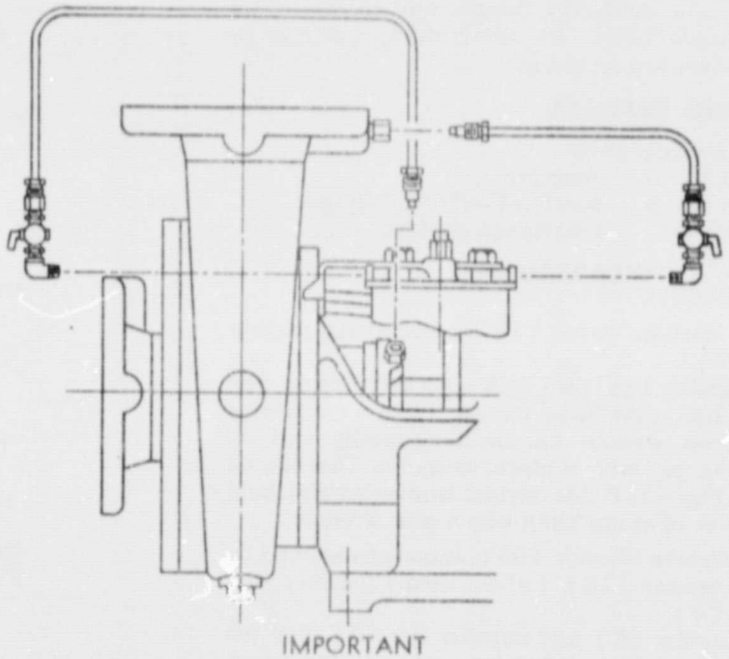


IMPORTANT

Before filling system with water, assemble external circulation tube to pump casing as follows:

1. Screw nut into body until hand tight.
2. With a wrench continue tightening for about one and one-half full additional turns. (It is not necessary to tighten nut all the way down)

INSTALLATION OF PUROCELL FILTER



IMPORTANT

1. Attach Filter to the pump by loosening the top bolt on the frame and casing and slip bracket under bolt and tighten.
2. If Recirculating line is installed — remove from frame and insert this end into inlet of Filter.
3. Attach line from outlet of the filter to seal retainer cap.

TACO "LP" SERIES

BALL & SLEEVE BEARING BASEMOUNTED AND CLOSE COUPLED

EFFECTIVE: 2/1/73
SUPERSEDES: IS 300-3-1
dtd. 3/31/68

MAINTENANCE AND SERVICING

Plant ID. No. 001-359

C1-GENERAL

Before undertaking any service work on the pump, read these instructions carefully to be readily prepared for the job. For your convenience TACO encloses with these instructions a list of replacement parts for each pump. Order parts required for maintenance work by listing item number, number required, description, and part number. Before taking pump apart, flange gaskets for pipe connections and a pump gasket kit should be available.

A step by step procedure of the most common maintenance jobs is given below. Follow it on the exploded views in the replacement parts list. In the description and on the drawings all parts are referred to by item numbers. To start any maintenance work stop pump and close suction and discharge lines. To gain access to internal parts of pump remove flanged nipple (spool piece) that has been provided on suction side of the pump.

If no freely removable piece is provided on suction side of pump, you can service the pump by disconnecting both suction and discharge flanges and removing the frame hold down bolts. The whole pump can now be moved for convenient servicing.

C2-REPLACING IMPELLER

Required replacement parts

Item No. 6	Impeller
Item No. 3	Suction Cover "O" Ring
1 Pair of	Pipe flange gaskets

DISASSEMBLY

Disconnect suction cover (1) by removing suction cover bolts (2).

Remove impeller bolt (4) with a socket or offset box wrench. Bolt has right hand thread. Place wrench over bolt head, hold wrench handle horizontally and hit handle end sharply with a plastic hammer. This should loosen bolt (Fig. 2). If this method is unsuccessful hold exposed section of motor shaft with a pipe wrench.

Remove Belleville Washer (66), impeller washer (5) and impeller spacer (18) (where used) together with impeller bolt (4).

Pull out impeller (6) and impeller key (7). The use of a wheel puller may be helpful in removing the impeller. If no wheel puller is available, insert impeller bolt (4) in shaft (42) and bring bolt head down on it. Hold a drift against the bolt head and hit it 2 or 3 times sharply with a hammer. This will normally loosen impeller from shaft (Fig 3). Next insert two screwdrivers, one on each side in the grooving of the impeller wear rings and pry out, taking care not to damage the wear rings (Fig. 4). If any burrs develop smooth out with emery cloth.

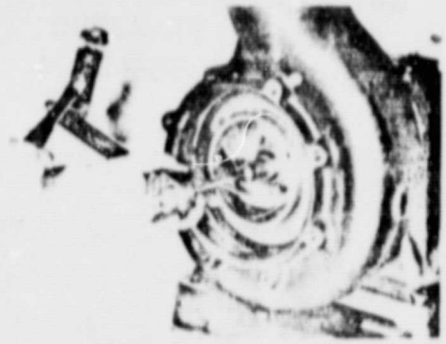
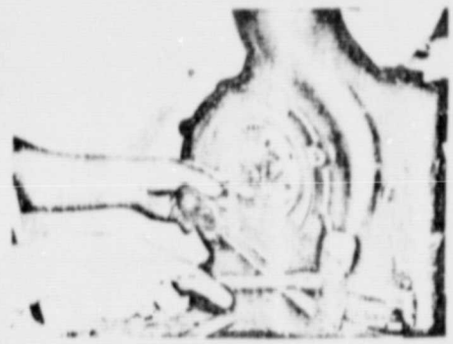


Fig. 1 — Disassembly



Reassembly

Fig. 2 Removing and Replacing Impeller Bolt

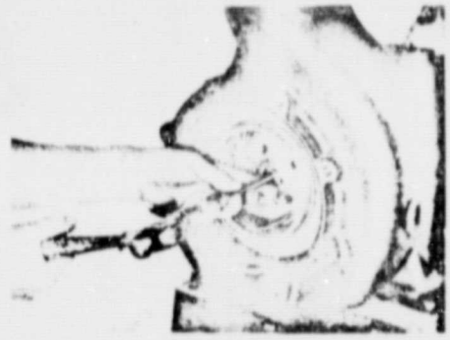


Fig. 3—Hitting on Drift—Impeller Bolt

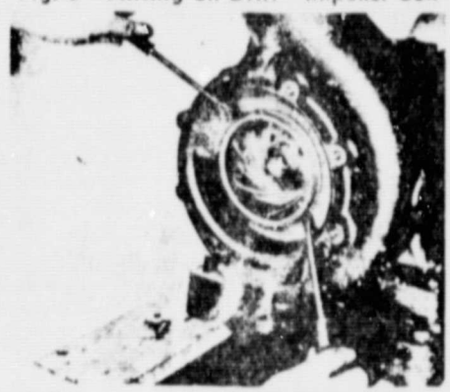


Fig. 4 — Prying Out of Impeller

C2-REPLACING IMPELLER -Continued

REASSEMBLY

Clean shaft end (42) and key slot. Apply some grease or oil and insert key in key way.

Apply grease to wear rings on both sides of replacement impeller (6) and slide over shaft end.

Apply grease or oil to the threads of impeller bolt (4), slide Belleville washer (66), impeller washer (5) and spacer (18) (where used) over it. Insert bolt (4) into shaft (42) and tighten firmly down by hitting sharply with a hammer on wrench handle end (Fig. 2).

Replace suction cover "O" ring (3) on suction cover (1).

Reassemble suction cover (1) to casing (8) and tighten cover bolts (2) evenly.

C3-REPLACING SEAL

Required replacement parts

Item No. 29	Waterseal
Item No. 90	Gasket Kit
Item No. 9	Impeller Spacer (if badly worn)
Item No. 35	Sleeve (if badly worn)
1 pair of	Pipe flange gaskets
Item No. 26	Cooling jacket "O" ring (where applicable)
Item No. 33	Casing "O" ring (where applicable)

It is difficult to determine which concealed parts are worn so it is recommended that if the pump has been in operation for some length of time that these concealed parts (item 9 & item 35) are also available before dismantling pump.

DISASSEMBLY

Follow disassembling steps of impeller replacement, paragraph C 2. Disconnect (where applicable) cooling jacket (27) pipe connections. Remove seal retainer cap bolts (30) with a ratchet type socket wrench. On larger models a 12 point box wrench may also be used. Tap seal retainer cap (32) to loosen it and slide it back on the shaft.

Remove casing (8) from frame (15) by taking casing bolts (16) out. Cooling jacket (27) (where used) will slide out with casing (8). Pry cooling jacket (27) off casing (8) by inserting screwdrivers in the casing "O" ring (33) slot. Slide impeller spacer (9), sleeve (35) with waterseal (29) on it, sleeve gasket (67) and seal retainer cap (32) off the shaft (42).

Remove spring retainer ring and spring of the seal from sleeve (35). To remove rotating seal part from sleeve, place sleeve (35) chamfered side down on a horizontal surface, slide seal retainer cap (32) over top of sleeve (35) and push down with both hands (Fig. 5).

Remove stationary seal seat from seal retainer cap (32). cap (32).

Discard old seal parts (29), sleeve gasket (67) and paper cap gasket (28). Discard also impeller spacer (9) and sleeve (35) if badly worn. Where cooling jacket is used, replace casing—and cooling jacket "O" rings (26,33).

REASSEMBLY

Clean, if necessary, with fine emery cloth, exposed shaft end (42), sleeve (35), impeller spacer (9) and seal retainer cap (32). Clean also portions of casing (8) which came in contact with seal (29) and throttle bushing (10) which is pressed into casing.

Place new seal seat in seal retainer cap (32). For ease of assembly, wet O.D. of seat with water. Hold the seal retainer cap (32) with both hands and press down on the seat with thumbs. Push alternately left and right hand side (Fig 6). Another method of placing the seat is to put the cardboard disc of the seal packaging on the top of the seal seat and then push down on it with a hammer handle (Fig.7). After the seat is placed on the seal retainer cap (32), check on the back side to see that the seal seat is properly seated against the seal retainer cap shoulder.

Apply some grease or oil to exposed shaft end (42). Slide sleeve gasket (67) and sleeve (35) over shaft. Chamfered side of sleeve should point toward impeller end (Fig.8). Place cap gasket (28) on seat retainer cap (32) and accurately line up bolt holes. Two drops of oil or grease on the contact face of the cap and gasket will hold these parts temporarily together. Slide seal retainer cap (32) with seal seat and cap gasket (28) over the sleeve (35) as far as it will go. Be careful not to damage seal seat.

Wet I.D. of rotating seal part (29 rubber) with water. Slide it, carbon washer facing seal seat, over sleeve. (35) Push seal (29) all the way back until it gently touches the seat. Slide the seal spring over the sleeve followed by the spring retainer ring with the raised portion toward the spring (Fig.8),

Clean—where applicable—cooling jacket (27) and replace "O" rings (26 & 33). Place cooling jacket over back of casing (8).

Assemble casing (8) to frame (15) and firmly tighten casing bolts (16) alternately.

Fig. 5 — PRESSING SEAL OFF SLEEVE

Fig. 6— PRESSING IN SEAL SEAT

Fig. 7—PRESSING IN SEAL SEAT WITH HAMMER HANDLE

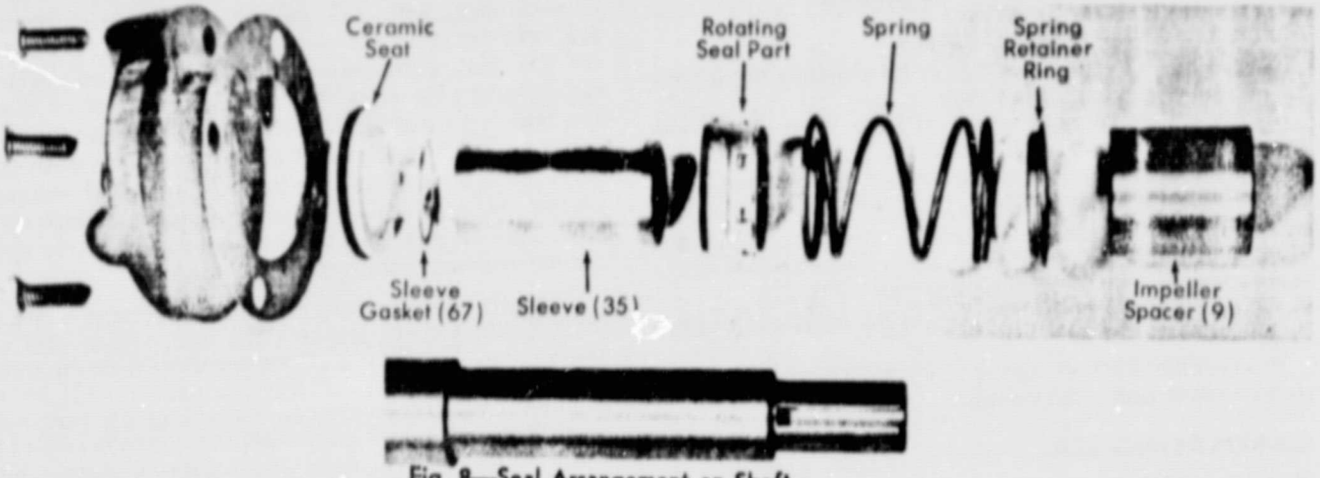


Fig. 8—Seal Arrangement on Shaft

C3–REPLACING SEAL-Continued

Place impeller spacer (9) on shaft (42) it will fit the space between throttle bushing (10) and shaft. Next follow reassembly directions for impeller.

Before reassembling suction cover (1) insert the two side cap bolts (30) through seal retainer cap (32) and cap gasket (28) and slide them towards rear end of casing (8) (Fig. 9). Start bolts in threaded holes and take up cap evenly by turning bolt (30) alternately on each side. Do this operation very carefully in order not to break seal. When cap reaches casing (8) insert also top and bottom bolt (30) and tighten all four alternately and evenly.

Reconnect (where applicable) cooling jacket (27) pipe connections.

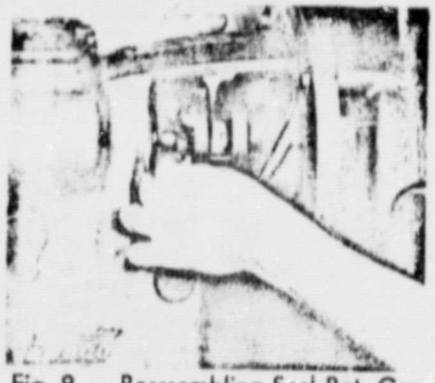


Fig. 9 — Reassembling Seal Ret. Cap

C4-REPLACING PACKING

Remove packing gland nuts (24) and slide gland (23) back as far as it will go.

Remove all old packing rings (20) with a flexible packing hook or one made from a piano wire with a short sharp hook.

Replace with graphite impregnated asbestos rings by a reliable packing manufacturer. Packing ring sizes are as follows:

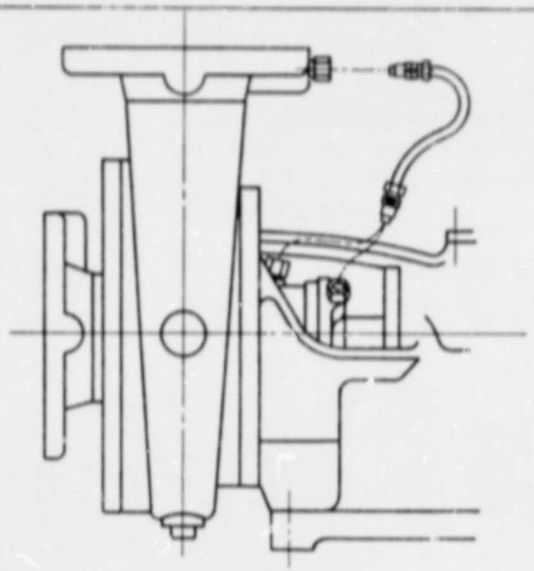
PUMP SIZE	NO. OF RINGS	RING SIZE I.D. O.D. Thickness
1¼-5, 1¼-6, 1½-5 1½-6, 1½-8, 2-5,2-6 2½-5, 2½-6, 3-5, 3-6	4	1¼"x1¾"x⅜"
2-8, 2½-8, 2½-10, 3-8 4-6	5	1¼"x2" x ⅜"
3-10, 4-8, 4-10, 4-12, 5-8 5-10, 5-12, 6-10	6	1½"x2¼"x ⅜"
6-12	5	2" x 3" x ½"

Solid rings should be split diagonally on one side. If a length of spiral packing is used, rings should be cut to ID's as shown above. Butts at joints should be made diagonally.

After rings (20) are ready to use, open first ring sufficiently to place around shaft (42) with opening at bottom and push into stuffing box chamber with the packing gland (23). Next, pull gland (23) back and insert next ring (20) with opening on top and again push into place with gland (23). Repeat this operation. alternating cuts in rings for the required number.

Slide gland (23) squarely up to the last packing ring (20) and hand tighten nuts (24) (Do not use a wrench at this time). Open discharge and suction valves. If packing does not leak or leaks slightly, pump may be started. If packing leaks excessively, tighten nuts (24) with a short wrench one or two turns, before starting pump. Permit more than normal (1 to 3 drops, per minute) leakage while pump is running for approximately 30 to 60 minutes. During this running in period, take up on the nuts (24) equally about one half (1/2) turn every five (5) minutes or so until at the end of the period you are getting a normal leak of 1 to 3 drops per minute. While pulling up on the nuts (24), make certain the gland (23) is being pulled up evenly.

INSTALLATION OF EXTERNAL CIRCULATION TUBE

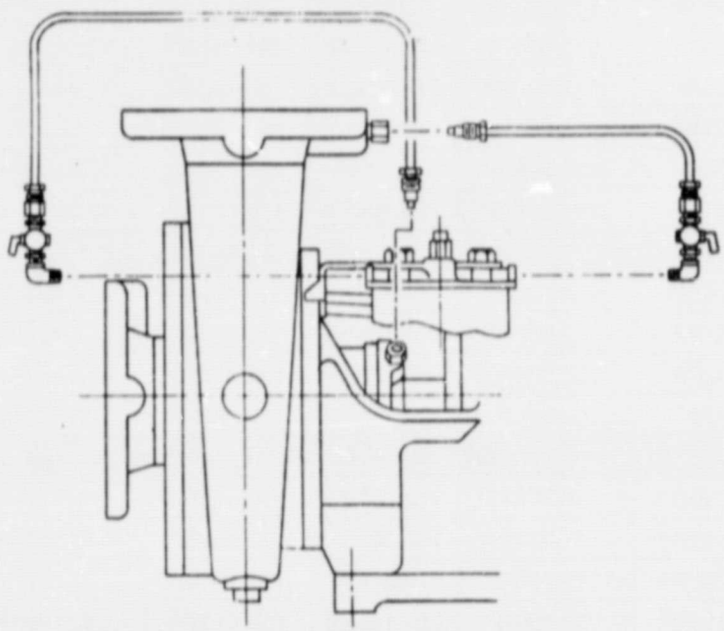


IMPORTANT

Before filling system with water, assemble external circulation tube to pump casing as follows:

1. Screw nut into body until hand tight.
2. With a wrench continue tightening for about one and one-half full additional turns. (It is not necessary to tighten nut all the way down)

INSTALLATION OF PUROCELL FILTER



IMPORTANT

1. Attach Filter to the pump by loosening the top bolt on the frame and casing and slip bracket under bolt and tighten.
2. If Recirculating line is installed — remove from frame and insert this end into inlet of Filter.
3. Attach line from outlet of the filter to seal retainer cap.

TACO, INC.
1160 Cranston Street, Cranston, Rhode Island 02920 Printed in U.S.A.

Taco

REPLACEMENT PARTS LIST

NUMBER 100PL-7

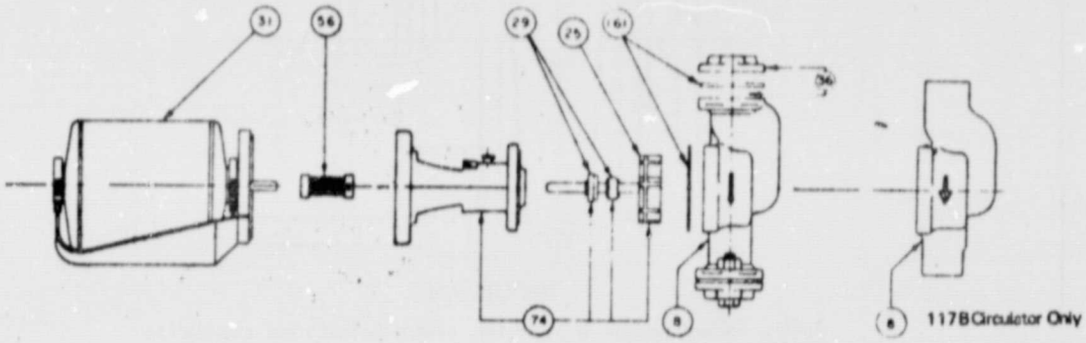
Effective: December 1, 1976
Supersedes: 100PL-7-775 dated 7/30/75

REPLACEMENT PARTS FOR 110 through 120 CIRCULATORS 007, 195, and 102B

Mechanical Equipment
Menauer and Associates
207 E. Lancaster Road
Orlando, Fl. 32809
Phone-305-855-2111

110 - 111 - 112 - 113 - 117B - 120

REFER TO 100RL-7 for LIST PRICES



PARTS FOR 110 to 120 CIRCULATORS

NAMEPLATE MODEL NO.	ITEM 8 BODY	ITEM 25 IMPELLER & SHAFT	ITEM 31 MOTOR	ITEM 74 BEARING BRACKET	ITEM 161 GASKETS
CAST IRON					
HC, 110, 110C	110-226RP(1)	110-207RP	110-223RP	110-361RP	110-127RP
HDH, 111, 111C	111-004RP	111-053RP	110-185RP	111-058RP	110-127RP
112	110-226RP	112-043RP	112-074RP	112-120RP	110-127RP
113	113-001RP	113-003RP	110-185RP	113-011RP	110-127RP
120-1 to 120-5	120-083RP	120-056RP	120-105RP	120-076RP	120-073RP
120-6 to 120-12	120-083RP	120-038RP	120-105RP	120-067RP	120-073RP
CAST IRON WITH NON-FERROUS IMPELLER					
112C	110-226RP	112-055RP	112-074RP	112-103BRP	110-127RP
113C	113-001RP	113-009RP	110-185RP	113-013RP	110-127RP
120C-1 to 120C-5	120-083RP	120-060RP	120-105RP	120-078RP	120-073RP
120C-6 to 120C-12	120-083RP	120-054RP	120-105RP	120-069RP	120-073RP
BRONZE					
HCB, 110B	110-226BRP	110-207RP	110-223RP	110-362BRP	110-127RP
111B	111-044BRP	111-053RP	110-185RP	111-059RP	110-127RP
112B	110-226BRP	112-055RP	112-074RP	112-103BRP	110-127RP
113B	113-001BRP	113-009RP	110-185RP	113-012RP	110-127RP
117B	117-001BRP	110-207RP	110-223RP	110-362BRP	110-127RP
117B-S2, -S3	117-002BRP	110-207RP	110-223RP	110-262BRP	110-127RP
120B-1 to 120B-5	120-083BRP	120-060RP	120-105RP	120-077RP	120-073RP
120B-6 to 120B-12	120-083BRP	120-054RP	120-105RP	120-068RP	120-073RP

Replacement Parts Kits Listed on this sheet fit all models, 110 – 120 Circulators except as noted.

ITEM 20 – Water Seal 110-275RP

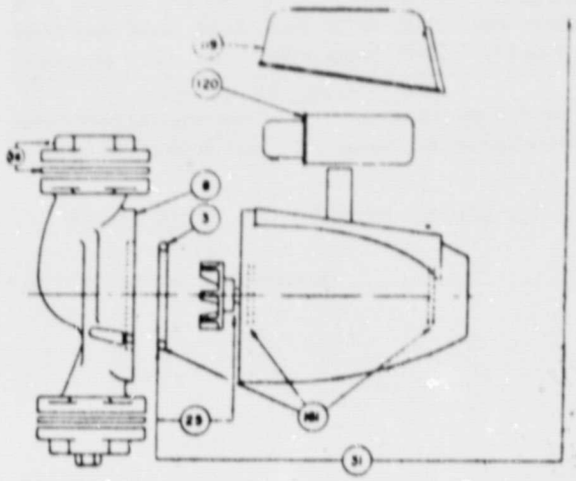
ITEM 66 – Coupler, 110-009RP

ITEM – Flange Set ¾", 1", 1¼", & 1½" Interchangeable. Refer to Price Sheets 100-T or 100-W. For 120 models with 2 holes, specify 1600-032BRP for Bronze, 1600-032RP for Cast Iron.

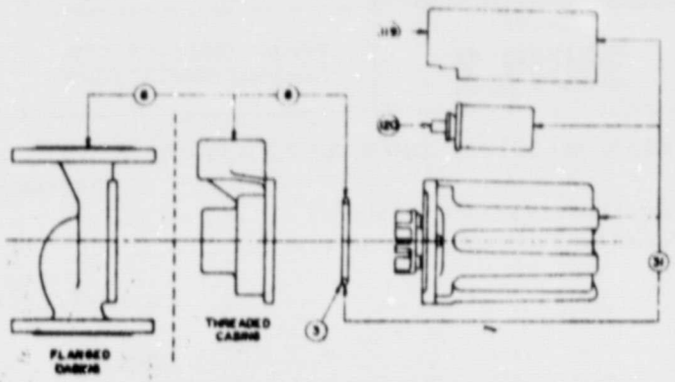
For 120 models with 4 holes, specify 120-044RP for Cast Iron, 120-044BRP for Bronze.

(1) For Model 110-JP, Part No. is 110-285RP Body Assembly

195



007

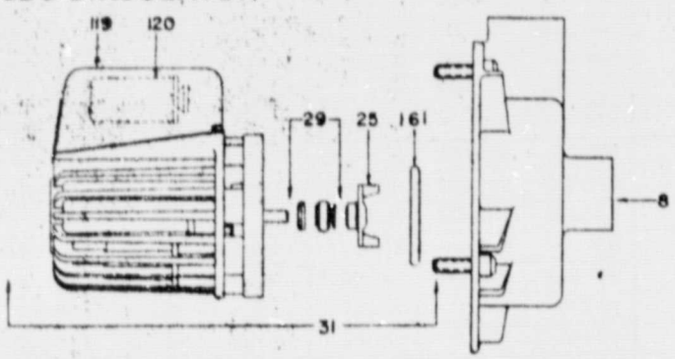


PARTS FOR 007 and 195 CIRCULATORS

[1] FOR THREADED BODY, SPECIFY PART NO. 007-005RP
FOR FLANGED BODY, SPECIFY PART NO. 007-006RP

PART NO.	DESCRIPTION	PART NO. 007	PART NO. 195
3	Body Gasket Only	007-003RP	151-009RP
8	Body with Gasket	[1]	152-012RP
25	Impeller	152-071RP	152-071RP
31	Motor & Impeller	007-004RP	195-001RP
36	Flange Sets – Same as 110-113	Refer to 100-T or 100-W Price Sheet	
119	Capacitor Cover	007-001RP	152-041RP
120	Capacitor Only	007-002RP	Consult Factory
161	"O" Ring Gasket Kit	Not Available	152-111RP

PARTS FOR NO. 102 B CIRCULATOR



PART NUMBER	REPLACEMENT PART NUMBER	DESCRIPTION
8	102-001 RP	Body
29	100-059 RP	Seal Assembly
161	100-060 RP	Gasket Kit
31	102-002 RP	Motor Assembly
25	100-029 RP	Impeller Assembly

Taco

NUMBER
300PL2

REPLACEMENT PARTS LIST

Effective: December 1, 1976
Supersedes: 300PL2, 7/30/75

FOR FOLLOWING MODEL NOS.

BM or CC: 2 - 5 2 - 6 2½ - 5 2½ - 6 3 - 5 and 3 - 6
BM or CC: 2005 2006 2505 2506 3005 and 3006
SB or BB: 2005 2006 2505 2506 3005 and 3006

REPLACEMENT PARTS FOR:
Close Coupled (CC) Pumps • Base Mounted (BM) Pumps
Sleeve Bearing (SB) Pumps • Ball Bearing (BB) Pumps

WHEN SELECTING AND ORDERING PARTS, ALWAYS REFER TO SERIAL NUMBER ON NAME PLATE

—Example—

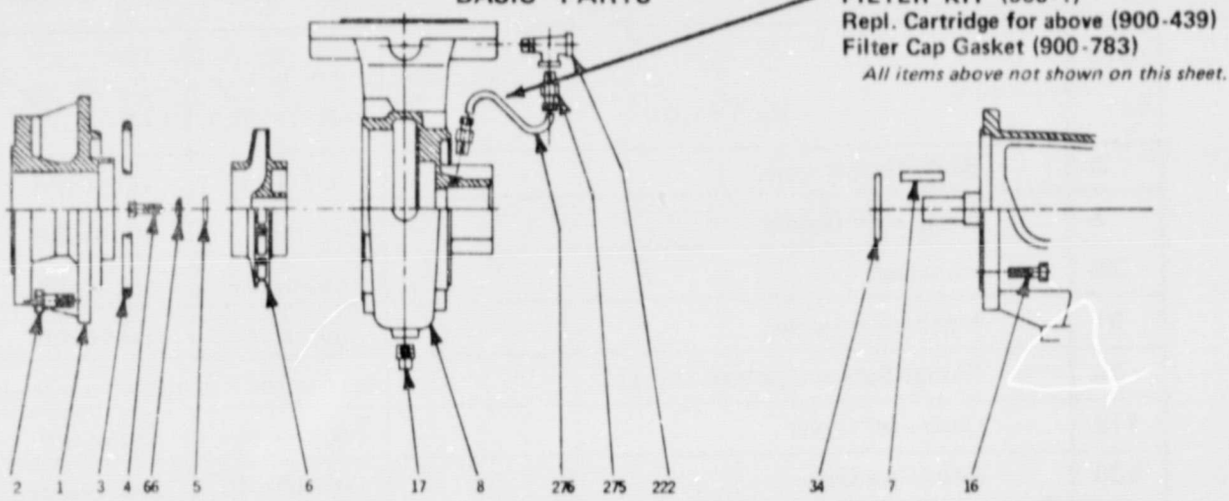
p. 1 ACTUAL IMPELLER DIAMETER
NOMINAL IMPELLER DIAMETER
FRAME SIZE & STYLE p. 2

2 - 6 - 5.9 — A1B1
OR
2006 - 5.9 — A5B1

p. 2 FRAME SIZE & STYLE
SEAL OR PACKING DESIGN p. 3

BASIC PARTS

FILTER KIT (900-1)
Repl. Cartridge for above (900-439)
Filter Cap Gasket (900-783)
All items above not shown on this sheet.



Item No.	No. Reqd.	DESCRIPTION	PART NO. PER PUMP SIZE						REMARKS
			2 - 5 2005	2 - 6 2006	2½ - 5 2505	2½ - 6 2506	3 - 5 3005	3 - 6 3006	
1	1	Suction Cover	917-003*	918-003	925-003*	926-003	930-003*	932-003	Add "B" after No. for Bronze
2		Suction Cover Bolt	10-230(4)	10-230(8)	10-230(4)	10-230(8)	10-230(4)	10-230(8)	3/8 - 16 x 1
3	1	Suction Cover 'O' Ring	903-005	918-005	903-005	918-005	903-005	918-005	
4	1	Impeller Bolt (SS)	10-258A	10-258A	N/A	N/A	N/A	N/A	3/8 - 16 x 5/8 St. Steel
4	1	Impeller Bolt (SS)	N/A	N/A	10-254A	10-254A	10-254A	10-254A	3/8 - 16 x 7/8 St. Steel
5	1	Impeller Washer	900-008	900-008	926-004	926-004	926-004	926-004	
6	1	Impeller	917-002*	918-002	925-002*	926-002	930-002*	932-002	Add "B" after No. for Bronze
7	1	Impeller Key (SS)	13-107A	13-107A	N/A	N/A	N/A	N/A	3/16 x 3/16 x 3/4 St. Steel
7	1	Impeller Key (SS)	N/A	N/A	13-105A	13-105A	13-105A	13-105A	3/16 x 3/16 x 1–1/8 St. Steel
8	1	Casing (1)	917-001*	918-001	925-001*	926-001	930-001*	932-001	Add "B" after No. for Bronze
16	4	Casing Bolt	10-201	10-201	10-201	10-201	10-201	10-201	3/8 - 16 x 1–1/8
17	1	Drain Plug	16-102	16-102	16-102	16-102	16-102	16-102	3/8 NPT Steel
18	1	Spacer	900-007	900-007	N/A	N/A	N/A	N/A	
34	1	Slinger Ring	900-040	900-040	900-040	900-040	900-040	900-040	For Close Coupled Only
34	1	Slinger Ring	900-044	900-044	900-044	900-044	900-044	900-044	For Base Mounted Only
66	1	Belleville Washer	900-053	900-053	900-053	900-053	900-053	900-053	
222	1	Fitting	900-566	900-566	900-566	900-566	900-566	900-566	
275	2	Fitting	900-798	900-798	900-798	900-798	900-798	900-798	
276	1	Tube	900-728	900-728	900-728	900-728	900-728	900-728	

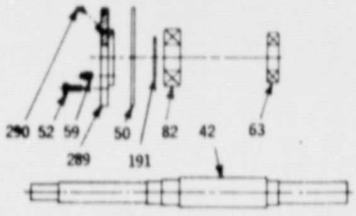
(1) Throttle Bushing (Item 10) four Pin Seal Section must be ordered with each casing.
* No longer available, consult factory for replacement

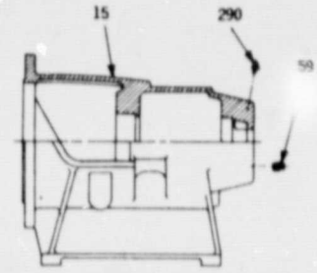
TACO, Inc., 1160 Cranston Street, Cranston, Rhode Island 02920 U.S.A. Tel: (401) 942-8000 Telex: 92-7627
Taco Heaters of Canada, Ltd., 3090 Lenworth Drive, Mississauga, Ontario Tel: (416) 625-2160 Telex: 06-961179

FRAME SIZE & STYLE – 0000-00-XX00

A1	BALL BEARING DESIGN:	Update pump with 820-795RP Complete frame assembly. Please furnish all nameplate data to insure proper updated nameplate.
A2	SLEEVE BEARING DESIGN:	Update pump with 820-797RP Complete frame assembly. Please furnish all nameplate data to insure proper updated nameplate.
A3	SLEEVE BEARING DESIGN:	Update pump with 820-797RP Complete frame assembly. Please furnish all nameplate data to insure proper updated nameplate.

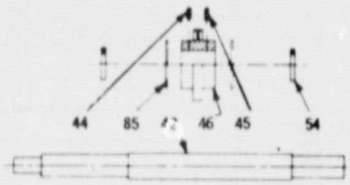
A5 BALL BEARING DESIGN:

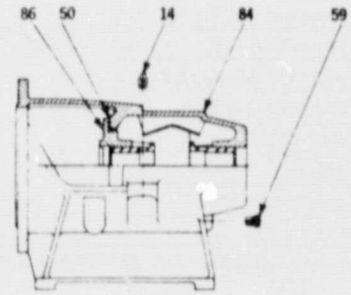




Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	820-795RP	
15	1	Frame	820-786	
42	1	Shaft	820-785	Add SS for Stainless Steel
50	1	Bearing Plate Gasket	820-791	
52	4	Bearing Plate Bolt	10-230	3/8 - 16 x 1
59	2	Drain Plug	16-111C	1/8 NPT Brass
63	1	Ball Bearing	820-784	
82	1	Ball Bearing	820-067	
191	1	Retainer Ring	15-103	
289	1	Bearing Cover Plate Assy.	820-788	
290	2	Lubrication Fitting	15-200	

A6 SLEEVE BEARING DESIGN:

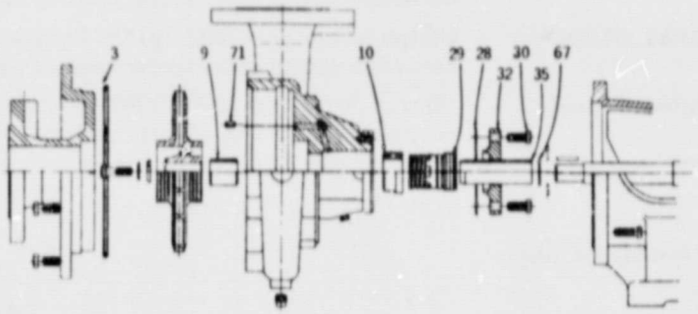




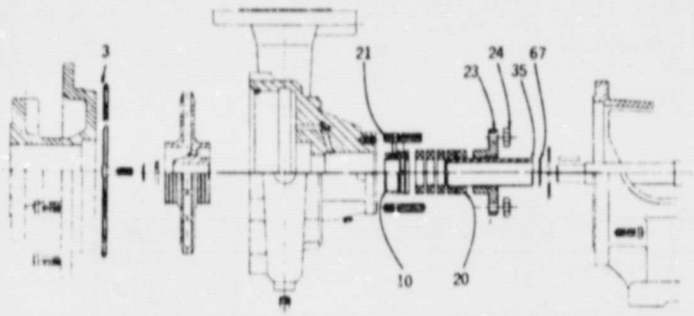
Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	820-797RP	
14	1	Pipe Plug	16-102	3/8 NPT Steel
42	1	Shaft	820-048	
44	1	Cone Point Set Screw	10-310	5/16 - 18 x 3/8 Steel
45	1	Cup Point Set Screw	10-301	5/16 - 18 x 5/16 Steel
46	1	Thrust Collar	820-423	
50	1	Bearing Plate Gasket	820-791	
54	1	Oil Seal	840-129	
59	1	Drain Plug	16-111C	1/8 NPT Brass
84	1	Frame Sub Assembly	820-798	
85	2	Thrust Washers	820-052	
86	1	Bearing Support Assembly	820-058	

SEAL OR PACKING DESIGN – 0000-00-00X0

MECHANICAL SEAL



PACKING



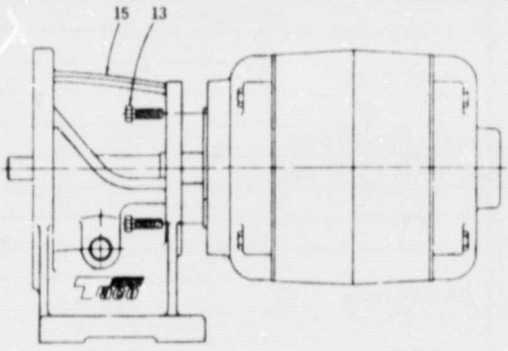
TYPE B STANDARD. TYPE D HI-TEMP. TYPE P PACKED. TYPE E CERAMIC.

Item No.	No. Reqd.	DESCRIPTION	SEAL OR PACKING DESIGN			REMARKS
			Type "B"	Type 'D'	Type 'P'	
3	1	Suction Cover 'O' Ring	*See Page 1*			
9	1	Impeller Spacer	900-026	900-026	Not Used	
10	1	Throttle Bushing	900-009	900-009	903-009	
20	1	Packing Set			900-240	
22	1	Filler Ring (Not shown)	Not Used	Not Used	905-007	
23	1	Gland			903-008	Add Suffix 'B' for Bronze
24	2	Hex Nuts			12-129	3/8 - 16
28	1	Retainer Cap Gasket	900-011	900-011		
29	1	Water Seal (1)	900-024	900-087		
91	1	WATER SEAL KIT (1)	840-128BRP	840-128DRP	Not Used	Incl. Items 28, 29, 35 & 67
30	4	Retainer Cap Bolts	10-208	10-208		3/8 - 16 x 7/8
32	1	Seal Retainer Cap	900-025	900-025		
35	1	Sleeve	900-027B	900-027B	920-006	
67	1	Sleeve Gasket	920-007	920-007	920-007	
21	2	Stud	Not Used	Not Used	900-029	

(1) For Ceramic Seal, order 900-215 or 840-128 ERP Kit.

CLOSE COUPLED (CC)

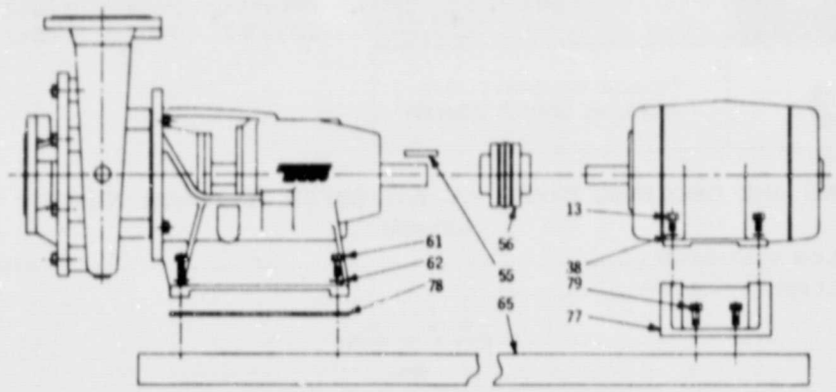
CC FRAMES A4



NEMA FRAME Size "T"	NEMA FRAME Size "U"	ITEM 13 FR. BOLT Part No.	ITEM 13 FRAME BOLT Size	ITEM 15 PUMP FRAME
	48	10-201	(4) 3/8 - 16 x 1-1/8	900-001
	56	10-201	(4) 3/8 - 16 x 1-1/8	900-001
143	182	10-201	(4) 3/8 - 16 x 1-1/8	900-001
145	184	10-201	(4) 3/8 - 16 x 1-1/8	900-001
182	213	10-201	(4) 3/8 - 16 x 1-1/8	900-001
184	215	10-201	(4) 3/8 - 16 x 1-1/8	900-001
213	254	10-201	(4) 3/8 - 16 x 1-1/8	900-001
215	256	10-201	(4) 3/8 - 16 x 1-1/8	900-001

Blumenauer and Associates
Mechanical Equipment
207 E. Lancaster Road
Orlando, Fl. 32809
Phone-305-855-2111

MOTOR PARTS – NOT PART OF SERIAL NUMBER
–Motor Frame Sizes Must be Specified When Ordering Parts Shown Below–



Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'T'						REMARKS
			143–145	182	184	213–215	254	256	
65	1	Base Plate (1)	820-090	820-090	820-090	820-109	820-109	820-109	Steel
77	2	Spacer	820-098	820-003	820-004	N/A	N/A	N/A	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	
56	1	Coupler	900-193	900-206	900-206	900-195	900-197	900-197	
38	4	Motor Lock Washer	14-104	N/A	N/A	N/A	N/A	N/A	5/16
38	4	Motor Lock Washer	N/A	14-101	14-101	14-101	N/A	N/A	3/8
38	4	Motor Lock Washer	N/A	N/A	N/A	N/A	14-100	14-100	7/16
62	4	Frame Lock Washer	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Motor Hex. Hd. Bolt	10-251	N/A	N/A	N/A	N/A	N/A	5/16 - 18 x 1¼
13	4	Motor Hex. Hd. Bolt	N/A	10-221	10-221	10-221	N/A	N/A	3/8 - 16 x 1¼
13	4	Motor Hex. Hd. Bolt	N/A	N/A	N/A	N/A	10-202	10-202	7/16 - 14 x 1¼
61	4	Frame Hex. Hd. Bolt	10-238	10-238	10-238	10-238	N/A	N/A	1/2 - 13 x 1–5/8
61	4	Frame Hex. Hd. Bolt	N/A	N/A	N/A	N/A	10-217	10-217	1/2 - 13 x 2½
79	4	Spacer Hex. Hd. Bolt	10-230	10-230	10-230	N/A	N/A	N/A	3/8 - 16 x 1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	1/4 x 1/4 x 1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	C.G. Rd. Hd. Screw	10-400	10-400	10-400	10-400	10-400	10-400	1/4 - 20 x 3/8
111	1	Coupler Insert	900-512	900-512	900-512	900-513	900-514	900-514	

(1) Add "A" to base plate number when coupler guard is to be used

Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'U'						REMARKS
			56	182	184	213–215	254	256	
65	1	Base Plate (1)	820-090	820-090	820-090	820-109	820-109	820-109	Steel
77	2	Spacer	820-103	820-003	820-004	N/A	N/A	N/A	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	
56	1	Coupler	900-192	900-193	900-193	900-206	900-195	900-195	
38	4	Motor Lock Washer	14-104	N/A	N/A	N/A	N/A	N/A	5/16
38	4	Motor Lock Washer	N/A	14-101	14-101	14-101	N/A	N/A	3/8
38	4	Motor Lock Washer	N/A	N/A	N/A	N/A	14-100	14-100	7/16
62	4	Frame Lock Washer	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Motor Hex. Hd. Bolt	10-251	N/A	N/A	N/A	N/A	N/A	5/16 - 18 x 1¼
13	4	Motor Hex. Hd. Bolt	N/A	10-221	10-221	10-221	N/A	N/A	3/8 - 16 x 1¼
13	4	Motor Hex. Hd. Bolt	N/A	N/A	N/A	N/A	10-202	10-202	7/16 - 14 x 1¼
61	4	Frame Hex. Hd. Bolt	10-238	10-238	10-238	10-238	N/A	N/A	1/2 - 13 x 1–5/8
61	4	Frame Hex. Hd. Bolt	N/A	N/A	N/A	N/A	10-217	10-217	1/2 - 13 x 2½
79	4	Spacer Hex. Hd. Bolt	10-230	10-230	10-230	N/A	N/A	N/A	3/8 - 16 x 1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	1/4 x 1/4 x 1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	C.G. Rd. Hd. Screw	10-400	10-400	10-400	10-400	10-400	10-400	1/4 - 20 x 3/8
111	1	Coupler Insert	900-512	900-512	900-512	900-512	900-513	900-513	

(1) Add "A" to Base Plate Number when Coupler Guard is to be used.

Taco

NUMBER
300PL3

REPLACEMENT PARTS LIST

Effective: December 1, 1976
Supersedes: 300PL3, 7/30/75

FOR FOLLOWING MODEL NUMBERS:

BM or CC: 2 - 8 2½ - 8 2½ - 10 3 - 8 & 4 - 6
BM or CC: 2008 2010 2012 2508 2510 3008 & 4006
SB or BB: 2008 2010 2012 2508 2510 3008 & 4006

WHEN SELECTING AND ORDERING PARTS, ALWAYS REFER TO SERIAL NUMBER ON NAME PLATE

—Example—

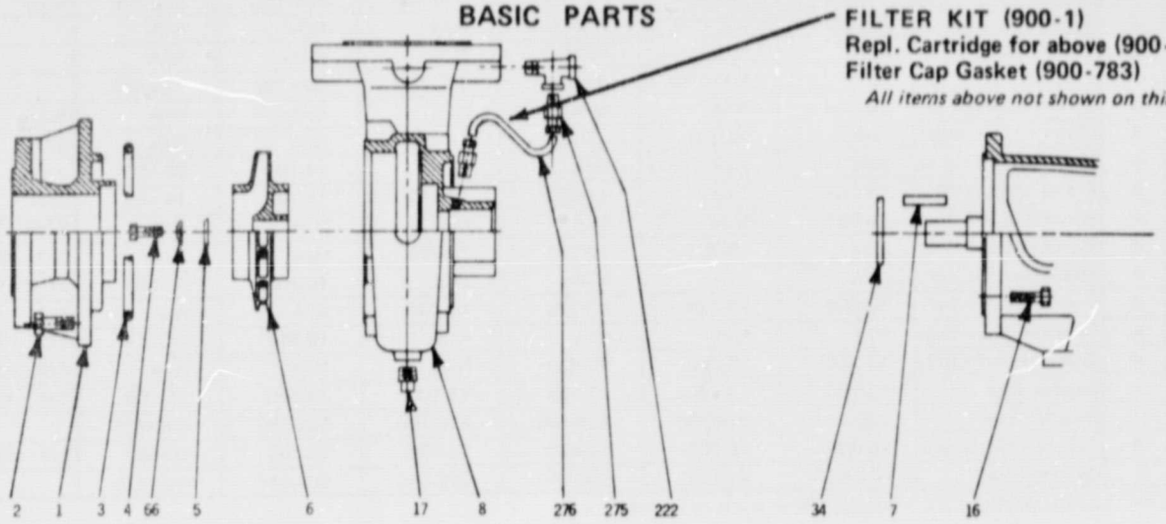
p. 1 ACTUAL IMPELLER DIAMETER
NOMINAL IMPELLER DIAMETER
FRAME SIZE & STYLE p. 2

2 - 8 - 7.9 — B1B1
OR
2008 - 7.9 — B6B1

p. 2 FRAME SIZE & STYLE
SEAL OR PACKING DESIGN p. 3

BASIC PARTS

FILTER KIT (900-1)
Repl. Cartridge for above (900-439)
Filter Cap Gasket (900-783)
All items above not shown on this sheet.



Item No.	No. Reqd.	DESCRIPTION	PART NO. PER PUMP SIZE						
			2 - 8 2008	2 - 10 2010	2 - 12 2012	2½ - 8 2508	2½ - 10 2510	3 - 8 3008	4 - 6 4006
1	1	Suction Cover (1)	920-003	883-003	884-003	928-003	922-003	934-003	938-003
2	8	Suction Cover Bolts	10-216	10-211	10-211	10-216	10-211	10-216	10-230
3	1	Suction Cover 'O' Ring	912-005	862-005	868-004	912-005	862-005	912-005	918-005
4	1	Impeller Bolt (SS)	10-257A	10-259A	10-259A	10-257A	10-257A	10-257A	10-257A
5	1	Impeller Washer	926-004	926-004	926-004	926-004	926-004	926-004	926-004
6	1	Impeller (1)	920-002	883-002	884-002	928-002	922-002	934-005	938-002
7	1	Impeller Key (SS)	13-104A	13-105A	13-105A	13-104A	13-104A	13-104A	13-104A
8	1	Casing (1) (2)	920-001	883-001	884-001	928-001	922-001	934-001	938-001
16	4	Casing Bolt	10-201	10-201	10-201	10-201	10-201	10-201	10-201
17	1	Drain Plug	16-102	16-104	16-104	16-102	16-102	16-102	16-102
34	1	Slinger Ring (3)	900-040	N/A	N/A	900-040	900-040	900-040	900-040
34	1	Slinger Ring (4)	900-044	900-044	900-044	900-044	900-044	900-044	900-044
66	1	Belleville Washer	900-053	900-053	900-053	900-053	900-053	900-053	900-053
222	1	Fitting	900-566	900-566	900-566	900-566	900-566	900-566	900-566
275	2	Fitting	900-798	900-798	900-798	900-798	900-798	900-798	900-798
276	1	Tube	900-728	900-728	900-728	900-728	900-728	900-728	900-728

(1) Add "B" after No. for Bronze.
(2) Throttle Bushing (Item 10), found in Seal Section, must be ordered with each casing.
(3) For Close Coupled Only.
(4) For Base Mounted Only.

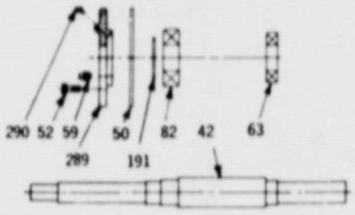
FRAME SIZE & STYLE – 0000-00-XX00

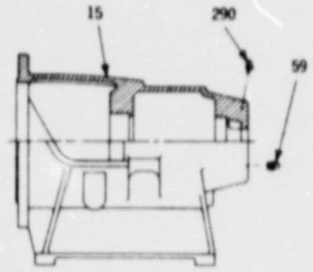
B1 **BALL BEARING DESIGN:** Update pump with 840-124RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B2 **SLEEVE BEARING DESIGN:** Update pump with 840-110RP Complete Frame Assembly. Please furnish all nameplate data to insure proper updated nameplate.

B3 **SLEEVE BEARING DESIGN:** *Same as B2 design.*

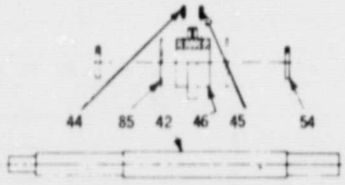
B5 BALL BEARING DESIGN:

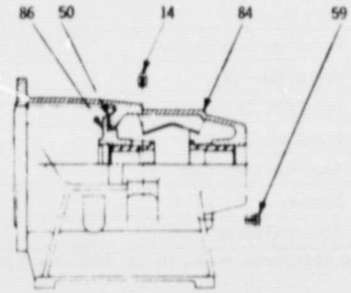




Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	840-124RP	
15	1	Frame	840-111	
42	1	Shaft	840-113	Add SS for Stainless Steel
50	1	Bearing Plate Gasket	840-123	
52	4	Bearing Plate Bolt	10-230	3/8 - 16 x 1
59	2	Drain Plug	16-111C	1/8 NPT Brass
63	1	Ball Bearing	840-114	
82	1	Ball Bearing	840-071	
191	1	Retainer Ring	15-105	
289	1	Bearing Cover Plate Assembly	840-120	
290	2	Lubrication Fitting	15-200	

B6 SLEEVE BEARING DESIGN:

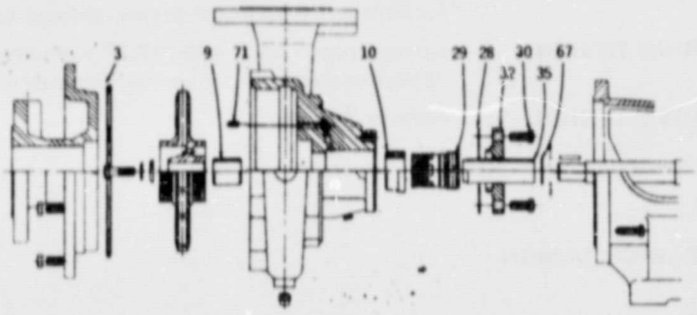




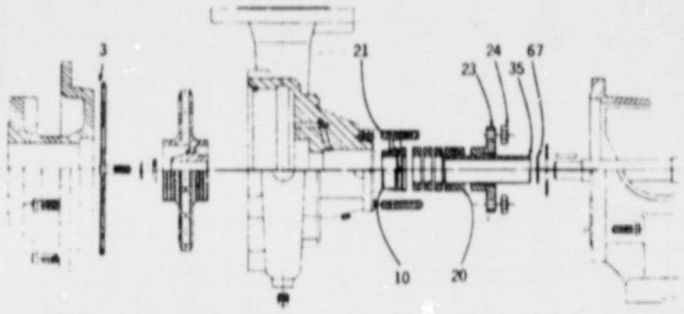
Item No.	No. Req.	DESCRIPTION	PART NO.	REMARKS
74	1	Frame Assembly (complete)	840-110RP	
14	1	Pipe Plug	16-102	3/8 NPT Steel
42	1	Shaft	820-048	Add SS for Stainless Steel
44	1	Cone Point Set Screw	10-310	5/16 - 18 x 3/8 Steel
45	1	Cup Point Set Screw	10-301	5/16 - 18 x 5/16 Steel
46	1	Thrust Collar	820-423	
50	1	Bearing Plate Gasket	840-123	
54	1	Oil Seal	840-129	
59	1	Drain Plug	16-111C	1/8 NPT Brass
84	1	Frame Sub Assembly	840-126	
85	2	Thrust Washers	820-052	
86	1	Bearing Sub Assembly	840-069	

SEAL OR PACKING DESIGN – 0000-00-00X0

MECHANICAL SEAL



PACKING

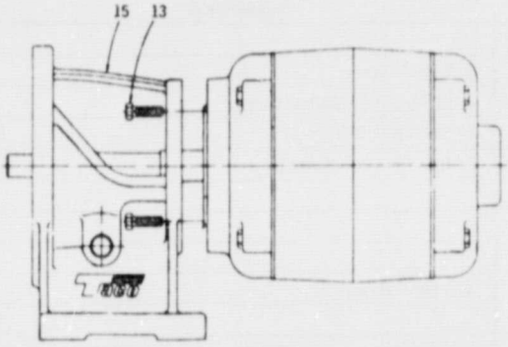


TYPE B STANDARD. TYPE D HI-TEMP. TYPE P PACKED. TYPE E CERAMIC.

Item No.	No. Reqd.	DESCRIPTION	SEAL OR PACKING DESIGN			REMARKS
			Type 'B'	Type 'D'	Type 'P'	
3	1	'O' Ring	*See Page 1*			
9	1	Impeller Spacer	900-026	900-026	Not Used	
10	1	Throttle Bushing	920-016	920-016	920-008	
20	1	Packing Set			900-241	
21	2	Studs			900-029	
22	1	Filler Ring (Not shown)	Not Used	Not Used	900-030	
23	1	Gland			920-015	Add "B" after No. for Bronze
24	2	Hex Nuts			12-129	3/8 - 16
28	1	Retainer Cap Gasket	920-014	920-014		
29	1	Water Seal (1)	900-024	900-087		
91	1	WATER SEAL KIT (1)	830-128BRP	840-128DRP	Not Used	Includes Items 28, 29, 35 & 67
30	4	Retainer Cap Bolts	10-208	10-208		3/8 - 16 x 7/8
32	1	Seal Retainer Cap	920-020	920-020		
35	1	Sleeve	900-027B	900-027B	920-006	
67	1	Sleeve Gasket	920-007	920-007	920-007	

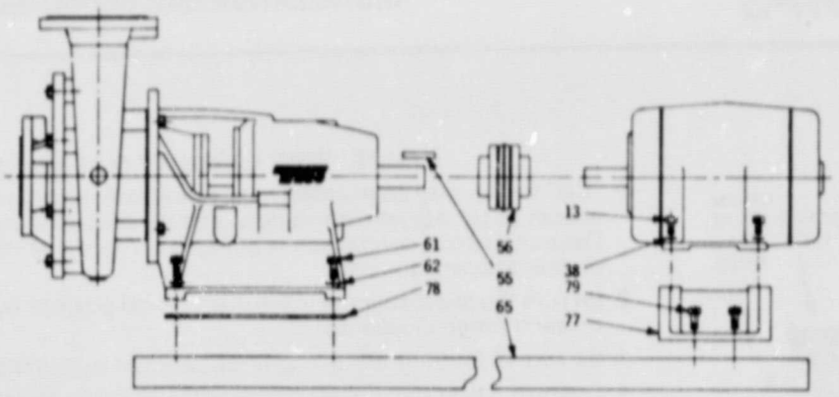
(1) For Ceramic Seal, order 900-215 or 840-128 ERP Kit.

CLOSE COUPLED (CC) FRAMES B4



NEMA FRAME Size "T"	NEMA FRAME Size "U"	ITEM 13 FR. BOLT Part No.	ITEM 13 FRAME BOLT Size	ITEM 15 PUMP FRAME
	48	10-223	(4) 1/2 - 13 x 1¼	920-004
	56	10-223	(4) 1/2 - 13 x 1¼	920-004
143	182	10-223	(4) 1/2 - 13 x 1¼	920-004
145	184	10-223	(4) 1/2 - 13 x 1¼	920-004
182	213	10-223	(4) 1/2 - 13 x 1¼	928 004
184	215	10-223	(4) 1/2 - 13 x 1¼	928-004
213	254	10-223	(4) 1/2 - 13 x 1¼	928-004
215	256	10-223	(4) 1/2 - 13 x 1¼	928-004
254	285	10-223	(4) 1/2 - 13 x 1¼	928-004T 900-126U
256	286	10-223	(4) 1/2 - 13 x 1¼	928-004T 900-126U
284		10-223	(4) 1/2 - 13 x 1¼	900-126

MOTOR PARTS – NOT PART OF SERIAL NUMBER
–Motor Frame Sizes Must be Specified When Ordering Parts Shown Below–



Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'T'									REMARKS
			143-145T	182T	184T	213T	215T	254T	256T	284T	284TS	286TS	
65	1	Base Plate (1)	820-090	820-090	820-090	820-109	820-109	820-109	820-109	820-790	820-790	820-790	
77	2	Spacer	840-098	840-003	840-004	840-005	840-006	840-041	840-040	N/A	N/A	N/A	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	840-106	840-106	840-106	
56	1	Coupler	900-193	900-206	900-206	900-195	900-195	900-197	900-197	900-538	900-197	900-199	
38	4	Mtr. Lck. Wshr.	14-104	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16
38	4	Mtr. Lck. Wshr.	N/A	14-101	14-101	14-101	14-101	N/A	N/A	N/A	N/A	N/A	3/8
38	4	Mtr. Lck. Wshr.	N/A	N/A	N/A	N/A	N/A	14-100	14-100	14-100	14-100	14-100	7/16
62	4	Frm. Lck. Wshr.	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Blt.	10-254	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5/16-18x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	10-221	10-221	10-221	10-221	N/A	N/A	N/A	N/A	N/A	3/8-16x1¼
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	10-209	N/A	N/A	N/A	N/A	7/16-14x1½
13	4	Mtr. Hx. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	10-202	10-202	10-202	10-202	7/16-14x1¼
61	4	Fr. Hex. Hd. Blt.	10-238	10-238	10-238	10-238	10-238	10-238	10-238	N/A	N/A	N/A	1/2-13x1-5/8
61	4	Fr. Hex. Hd. Blt.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10-217	10-217	10-217	1/2-13x2½
79	4	Spr. Hx. Hd. Blt.	10-230	10-230	10-230	10-230	10-230	N/A	N/A	N/A	N/A	N/A	3/8-16x1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	13-100	1/4x1/4x1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	CG. RdHd. Scw.	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	10-400	1/4-20x3/8
111		Coup. Insert	900-512	900-512	900-512	900-513	900-513	900-514	900-514	900-515	900-514	900-515	

(1) Add "A" to base plate number when coupler guard is to be used.

Item No.	No. Reqd.	DESCRIPTION	MOTOR FRAME SIZE (NEMA STD.) 'U'						REMARKS
			182U	184U	213U	215U	254U	256U	
65	1	Base Plate (1)	820-090	820-090	820-109	820-109	820-109	820-109	
77	2	Spacer	840-003	840-004	840-005	840-006	840-041	840-040	
78	2	Frame Spacer	N/A	N/A	N/A	N/A	N/A	N/A	
56	1	Coupler	900-193	900-193	900-206	900-206	900-195	900-195	
38	4	Motor Lock Wshr.	14-101	14-101	14-101	14-101	N/A	N/A	3/8
38	4	Motor Lock Wshr.	N/A	N/A	N/A	N/A	14-100	14-100	7/16
62	4	Frame Lock Wshr.	14-102	14-102	14-102	14-102	14-102	14-102	1/2
13	4	Mtr. Hx. Hd. Bolt	10-221	10-221	10-221	10-221	N/A	N/A	3/8 - 16 x 1¼
13	4	Mtr. Hx. Hd. Bolt	N/A	N/A	N/A	N/A	10-209	10-209	7/16 - 14 x 1½
61	4	Frm. Hx. Hd. Bolt	10-238	10-238	10-238	10-238	10-238	10-238	1/2 - 13 x 1-5/8
79	4	Spcr. Hx. Hd. Bolt	10-230	10-230	10-230	10-230	N/A	N/A	3/8 - 16 x 1
55	1	Coupler Key	13-100	13-100	13-100	13-100	13-100	13-100	1/4 x 1/4 x 1½
47	1	Coupler Guard	820-796	820-796	820-796	820-796	820-796	820-796	
48	4	C.G. Rd. Hd. Scrw.	10-400	10-400	10-400	10-400	10-400	10-400	1/4 - 20 x 3/8
111	1	Coupler Insert	900-512	900-512	900-513	900-513	900-514	900-514	

(1) Add "A" to base plate number when coupler guard is to be used.

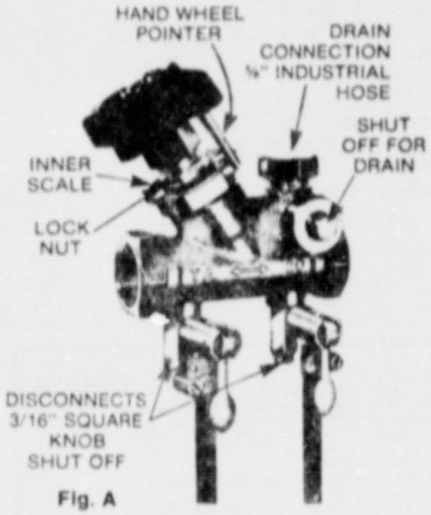


Fig. A

TYPICAL "CB" VALVE

TYPE "CB" CIRCUIT BALANCING VALVE

1. "CB" Valves may be installed in any direction. Install valve in a location allowing easy access to (a) Adjustment Handle, and (b) Disconnects.
   Caution: If drain connection is going to be used, the valve must be installed with drain on the downstream side.
2. Be sure the two disconnects are in a shut-off position by turning the 3/16" square knob on each fitting clockwise.
3. Be sure drain shut-off is in shut-off position by turning 5/16" square knob clockwise.
4. Connect meter quick-disconnect hoses to valve disconnects as follows:
   Green hose is connected to the downstream fitting
   Red hose is connected to the upstream fitting
5. Open disconnect shut-off valves by turning 3/16" square knob on each fitting counter clockwise.
6. Adjust the valve setting from 1 to 8 on the inner scale (not outer scale). Valve is in shut-off position when handwheel pointer is on "0" on the inner scale.
7. Read pressure drop of valve on CBM-60 meter. Locate meter reading on left side of capacity curve. Follow across chart to junction of valve setting indicator lines (diagonal lines). Then read GPM at bottom of curve, see Fig. "C". By using the capacity curve, adjust valve setting by turning handle of valve until desired flow rate is obtained.
8. Memory feature if desired
   Loosen lock nut which holds scale in position. Turn scale clockwise until stop rests against handle wheel pointer, then tighten locknut to secure scale. Now, if valve is closed, it can be opened to correct setting by just turning handle until pointer rests against stop. A small hole is provided in the stop to enable the handwheel pointer to be secured to the collar.
9. Close disconnect shut off valves. Remove meter quick-disconnect hoses and drain meter.

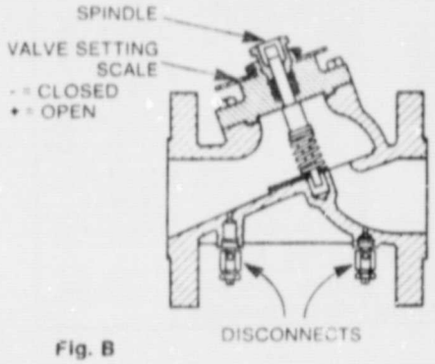


Fig. B

TYPICAL "RDB" VALVE

TYPE "RDB" CIRCUIT BALANCING VALVE

1. Install with arrow on valve body in same direction of flow in the pipe line and in a location allowing easy access to (a) Adjustment, and (b) Disconnects.
2. Be sure the two disconnects are in a shut off position by turning the 3/16" square knob on each fitting clockwise.
3. Connect meter quick-disconnect hoses to valve disconnects as follows:
   Green hose is connected to the downstream fitting
   Red hose is connected to the upstream fitting
4. Open disconnect shut off valves by turning 3/16" square knob on each fitting counter clockwise.
5. Adjust the valve setting from 2 thru 8 with special handle wrench. An arrow on the spindle indicates the setting.
6. Read pressure drop of valve on CBM-60 meter. Locate meter reading on left side of capacity curve. Follow across chart to junction of valve setting indicator lines (diagonal lines), then read GPM at bottom of curve (See Fig. 'C'). By using the capacity curve, adjust valve setting with special wrench until desired flow rate is obtained.
7. Remove handle.
8. Close disconnect shut off valves. Remove meter quick disconnect hoses and drain meter.

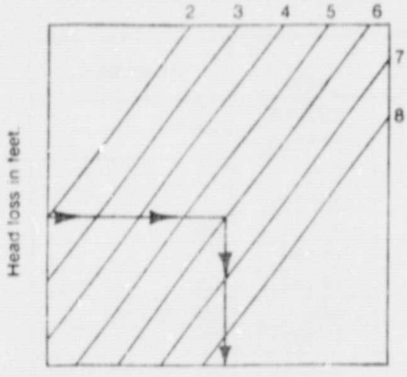
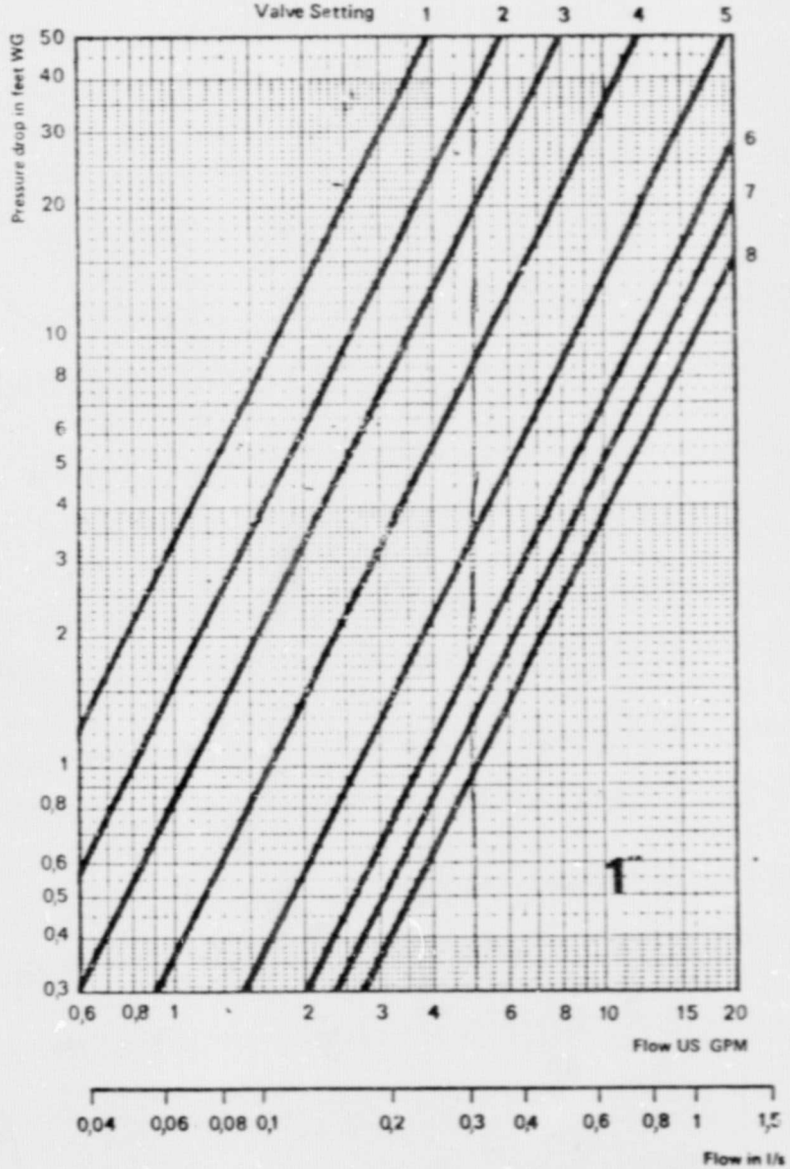
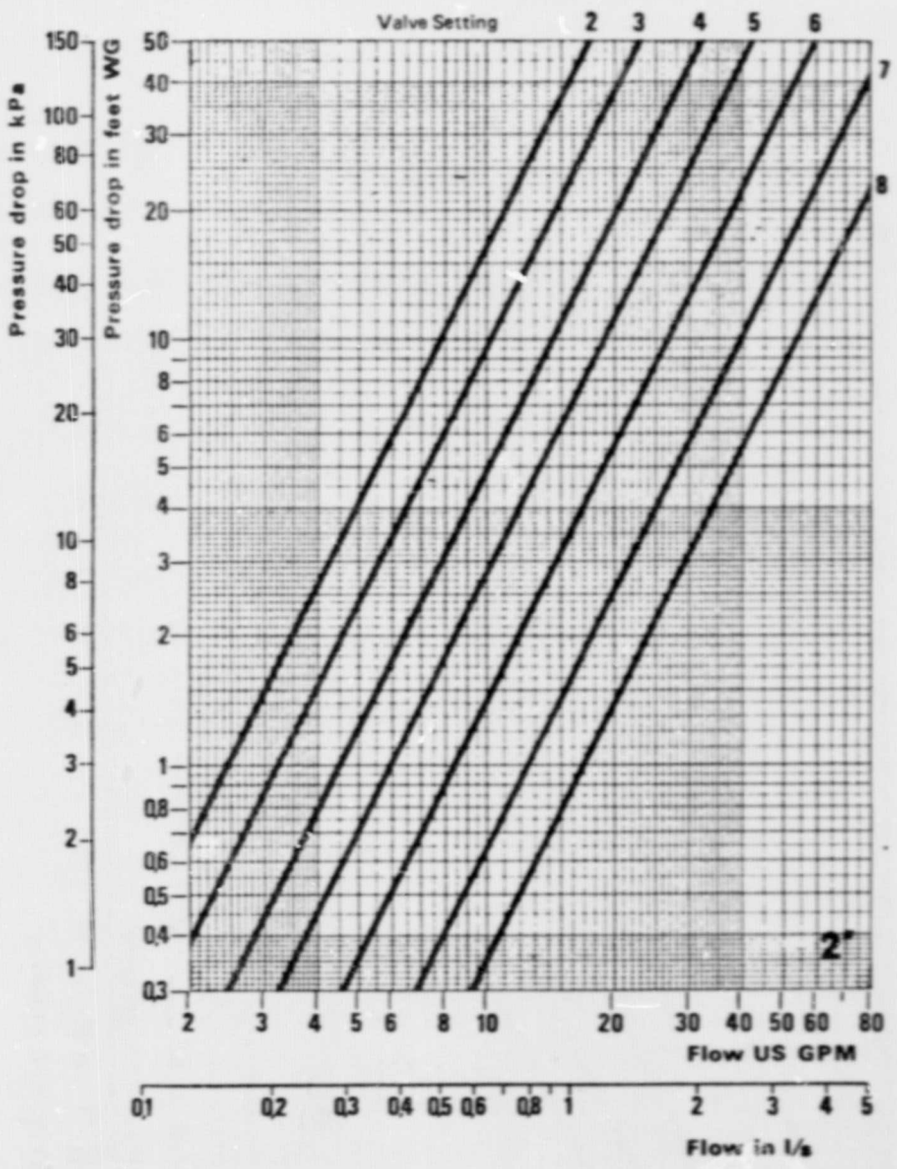


Fig. C

TYPICAL CAPACITY CURVE





MODEL "CB" CIRCUIT BALANCING VALVES

ARMSTRONG PUMPS INC., NORTH TONAWANDA, N.Y. 14120
Form No. 6584 - Page 4 of 4 -
Litho in Canada

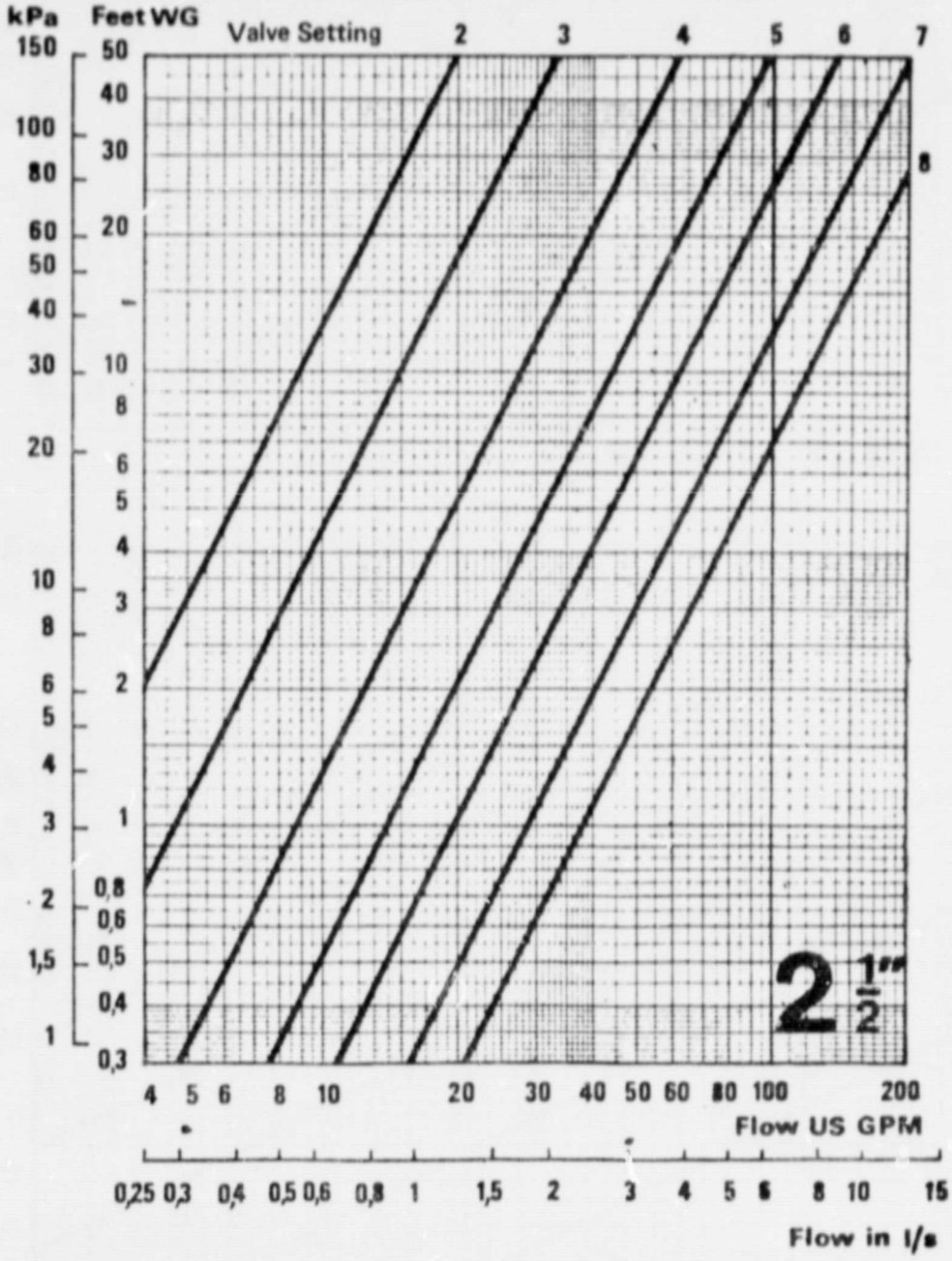
MODEL "CB" CIRCUIT BALANCING VALVES

ARMSTRONG
PERFORMANCE CURVES

FILE NO: 5098.938
DATE: Mar. 30, 1977
SUPERSEDES: New
DATE:

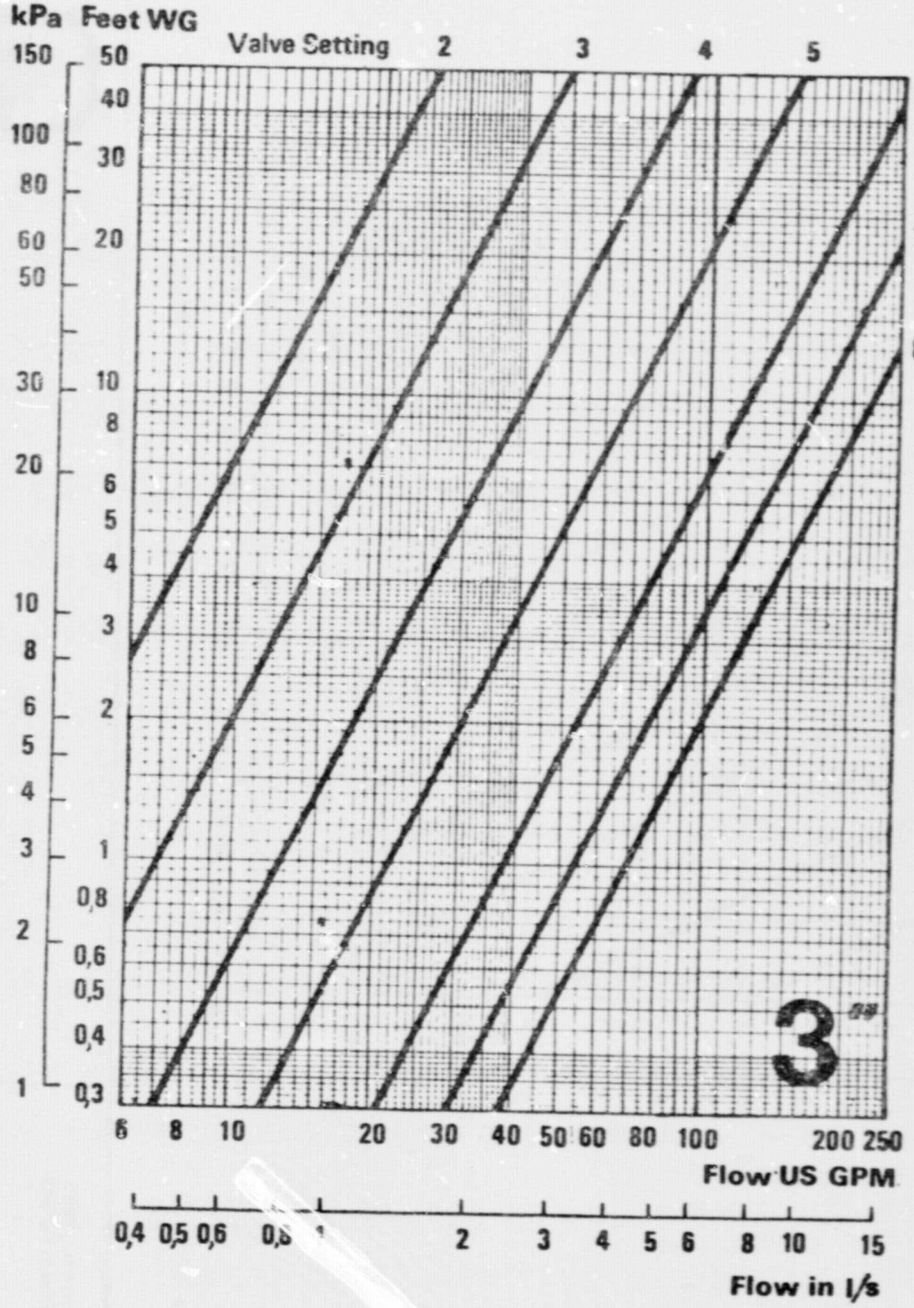
CIRCUIT BALANCING VALVES

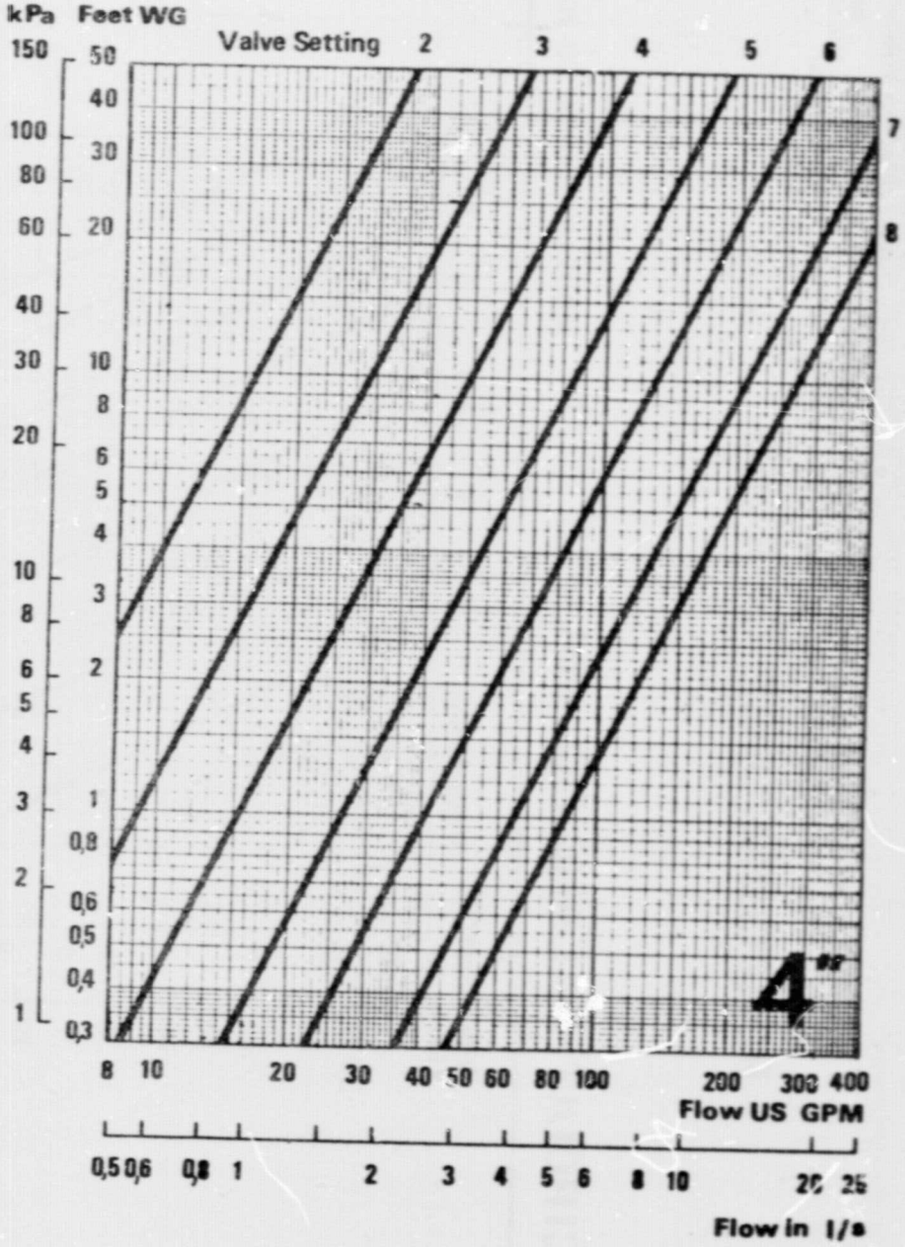
MODELS RDB-2½ TO RDB-6



Form No. 6585
Litho in Canada

ARMSTRONG PUMPS INC.
NORTH TONAWANDA, N.Y. 14120



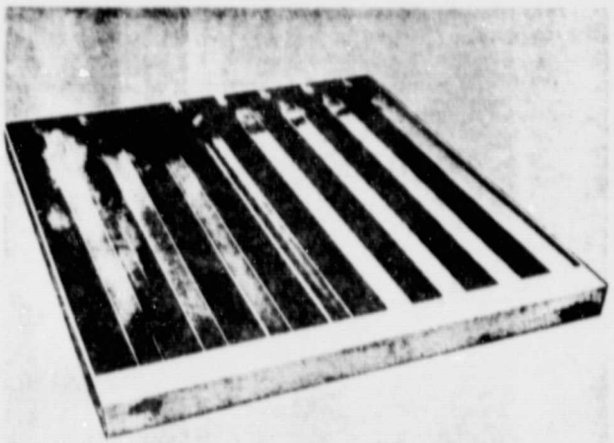


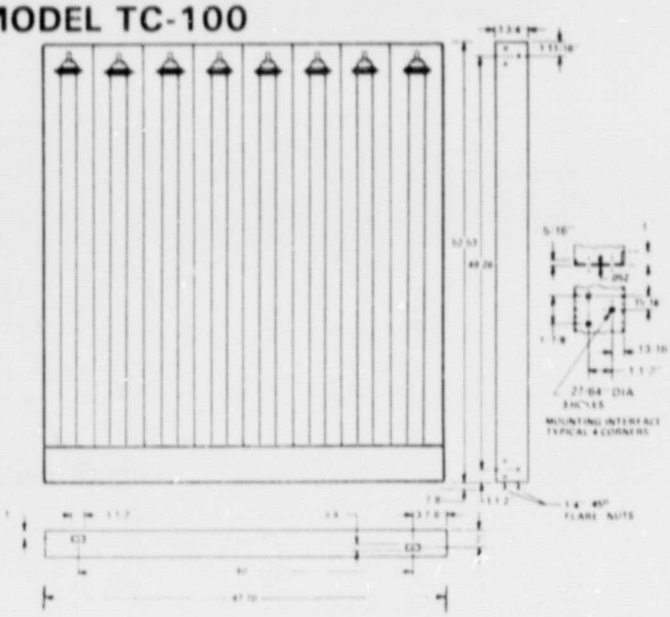
MODEL "RDB" CIRCUIT BALANCING VALVES

SOLAR COLLECTORS

GENERAL ELECTRIC

VACUUM TUBE SOLAR COLLECTOR SPECIFICATION DATA SHEET
SOLARTRON® MODEL TC-100





PHYSICAL

WEIGHTS

	British	SI
Frame Only	35 lbs.	16 kg
Glass Installed		
Dry	57 lbs.	26 kg
Wet	59 lbs.	27 kg

COMPOSITION

Frame	18 Ga aluminized steel (51.6 mil)
Reflector	Alglas (TM)
Insulation	Fiberglass
Fluid Lines	1/4" type L copper
Glass Tubes	008 soda lime

CONNECTIONS

Hydraulic	Brass 1/4" 45° Flare Nut
Structural Attachments	Stainless Steel or aluminum

EQUIPMENT SIZING GUIDELINES

Heat exchanger area		
Heating	.17 ft^2/module	.016 m^2/module
Cooling & Heating	.35 ft^2/module	.033 m^2/module
Storage Volume		
Heating Only	15 gallons/ module	56.8 liters/ module
Cooling & Heating	22 gallons/ module	83.3 liters/ module

OPERATIONAL

	British	SI
Insolation	0 to 400 BTU/ft^2/hr	0 to 108 langleys
Fluid		
Operating Temperature	100 to 300°F	38 to 149°C
Composition	(1) "Good" water with 35/50% Prestone II (TM)	

MODULE DESIGN CONDITIONS

	British	SI
Pressure Drop-Design	7.0 psi @ 180°F	48.2 kPa @ 82°C
Minimum	5.0 psi	34.5 kPa
Flow Rate	0.22 gpm @ 180°F	0.83 l/m @ 82°C
Wind Velocity (Max)	100 mph	161 km/hr
Ice Load (Max)	13 psf	63.5 kg/m^2
Snow Load (Max)	20 psf	97.6 kg/m^2
Combined Load (Max)	33 psf	161.1 kg/m^2
Minimum Array Pressure	45 psig	310 kPa

MODULE AREA

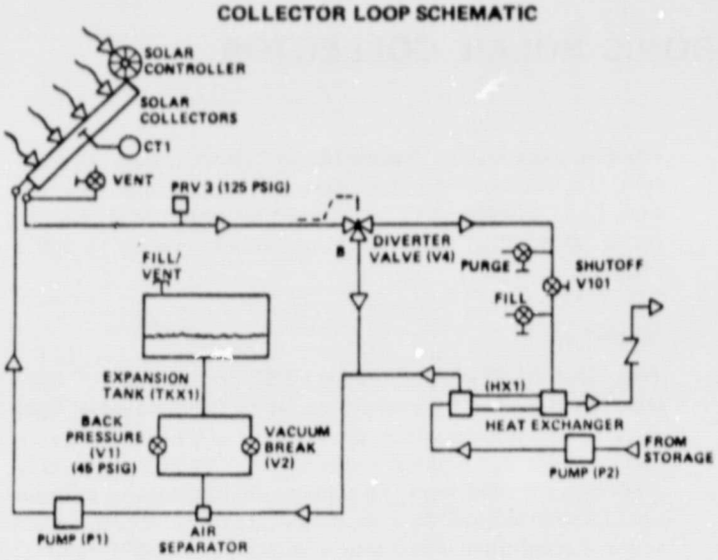
Gross (Frame)	17.4 ft^2	1.62/m^2
Net (Active)	14.8 ft^2	1.38/m^2

(1) "Good" Quality Water:

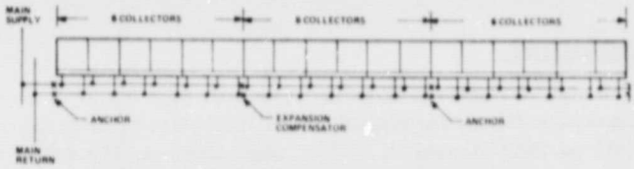
Chlorides	< 100 ppm
Sulfates	< 100 ppm
Bicarbonates	< 100 ppm
Total Hardness	< 250 ppm

TYPICAL DESIGN CONSIDERATION

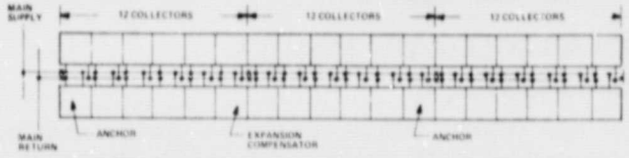
COLLECTOR LOOP SCHEMATIC



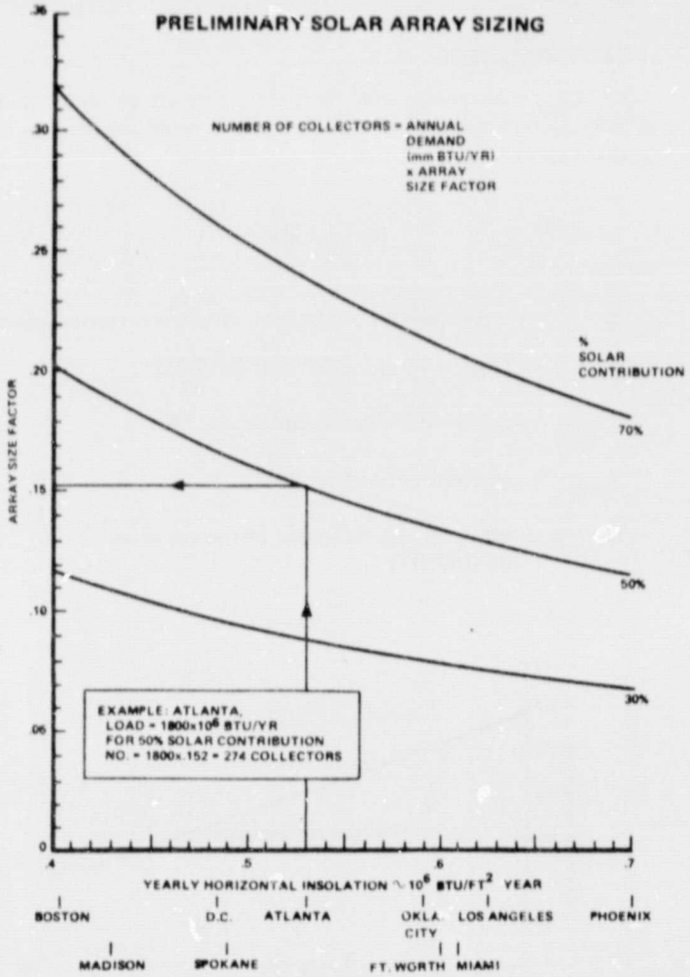
SINGLE ROW PLUMBING CONFIGURATION



DUAL ROW PLUMBING CONFIGURATION



PRELIMINARY SOLAR ARRAY SIZING



MODULE PRESSURE DROP (@ 180°F)

FLUID	Δ P (PSI)
100% water	5.3
35% glycol/water	6.2
50% glycol/water	7.0

HEADER

TUBE SIZE	TYPE COPPER	MAXIMUM NUMBER OF PANELS/ROW
3/4"	L	18
1"	L	36

OPTIONAL ACCESSORY HARDWARE

HEADER KIT
MOUNTING KIT
SOLAR CONTROLLER
LEXAN OR ACRYLIC WINDOW

For Further Information Contact:
Manager, Solar Heating and Cooling Marketing
General Electric Company,
P.O. Box 13601,
Philadelphia, PA. 19101
Phone – (215) 962-2112/2113

GENERAL ELECTRIC

SPECIFICATION

EVACUATED TUBE HYDRONIC SOLAR COLLECTOR

GENERAL

The solar collector shall be an evacuated tube liquid type designed for efficient operation at fluid temperatures ranging from 100 to 300° Farenheit (66 to 149° Celsius). The collector module shall be furnished with all the necessary components, excluding support attachments, ready for field attachment to support and piping systems. Specifications and requirements stated herein shall not supersede applicable Federal, State, or Local Codes and Regulations.

SOLAR COLLECTOR MODULE

General Construction

The solar collector shall be composed of standard manufactured modules which are designed for simple attachment to the support structure and piping system. The modular unit shall have a gross dimensions of approximately 4 feet by 4 feet (1.2 by 1.2 meters) with an active-to-gross area ratio greater than 0.85. The active (effective) area, as defined by the manufacturer, is the planar area onto which incident energy is directed to the absorber surface (s). The gross operating weight of the solar collector shall not exceed 4.0 pounds per square foot (19.5 kg/m^2) of gross area. The collector assembly shall be capable of withstanding wind velocities of up to 100 mph (161 km/hr) with an ice and snow load of 20 lb/ft^2 (97 kg/m^2) without structural damage.

Glass Tubes

The module shall consist of evacuated glass tubes which are composed of two concentric glass tubes separated by a vacuum of less than 10^{-4} Torr. The glass construction shall contain the vacuum without the usage of mechanical seals. The vacuum shall be maintained for the life of the tube at temperatures up to 650°F (343°C) with an active getter.

The outer radial surface of the inner glass tube shall have a coating with an average hemispherical emittance less than 0.05 at 212°F (100°C) and an absorptivity greater than 0.85. The solar absorptance of the glass shall be greater than 87 percent of the visible light spectrum.

Long-term degradation of coating and glass properties shall have a combined effect of less than 10 percent of the total absorbed energy.

Fluid Passages

The collector unit shall be suitable for use with water or a mixture of water and anti-freeze solution (up to 50 percent by volume) as the heat transfer fluid.

Fluid passages shall not be restricted, when the specified fluid quality is maintained, to the point that collection efficiency (as a function of fluid flow) is decreased by more than 5 percent over the design life of the collector.

Fluid passages shall be designed to withstand, without degradation, the effects of no fluid flow and high insolation condition. Fluid passages shall be designed for operational pressures up to 80 psi (551 kPa) and fluid temperatures up to 300°F (149°C).

Insulation

There shall be at least 1.5 inches (3.80 cm) of 3 lb/ft^3 fiberglass (48 kg/m^3) or equivalent insulation surrounding all fluid-carrying components which are not thermally protected by the vacuum from the ambient environment. The insulation will be properly protected from the ambient environment to preclude significant insulation performance degradation resulting from ambient conditions. Fluid temperatures up to 650°F (343°C) shall not affect the performance or integrity of the insulation.

PERFORMANCE

Collector performance shall be defined by its instantaneous efficiency based on active collector area in graphical (Figure 1) and equation form as

$$\eta = A - B\psi$$

where

η = instantaneous collection efficiency (active area)

ψ = $(T_{col} - T_{amb}) / Q_i$ °F-hr-ft^2/BTU

T_{col} = average collector temperature, °F

T_{amb} = ambient temperature, °F

Q_i = insolation on the plane of the collector BTU/hr-ft^2)

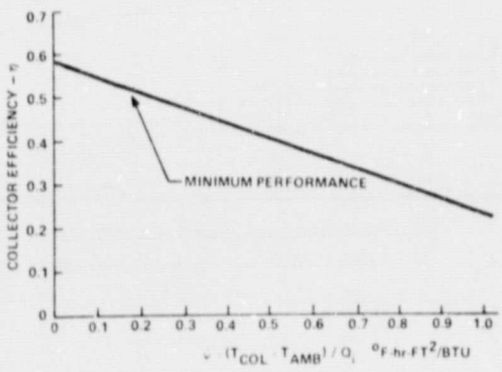


Figure 1. Instantaneous Collector Efficiency

The constants A and B are obtained by placing a least squared straight line through the data points located between $\psi = 0.0$ and $\psi = 1.0$. Certified test data from a recognized independent testing agency, along with manufacturer's test data, shall be identified on Figure 1 and utilized to define the constants A and B. Collector efficiency shall be determined in accordance with ASHRAE 93-77 test procedures.

The solar collector shall have an efficiency plot which is greater than the minimum performance line of Figure 1. The constant A shall be greater than 0.58 and B shall be less than 0.37 BTU/hr-ft^2-^{o}F.

QUALITY ASSURANCE

Manufacturer

The manufacturer of the solar energy collector shall be a recognized producer of said equipment and shall submit documentation demonstrating a high capability in design engineering, testing, fabrication, installation and maintenance of equipment the same as or similar to that called for on the drawings and in the specification(s).

All Other

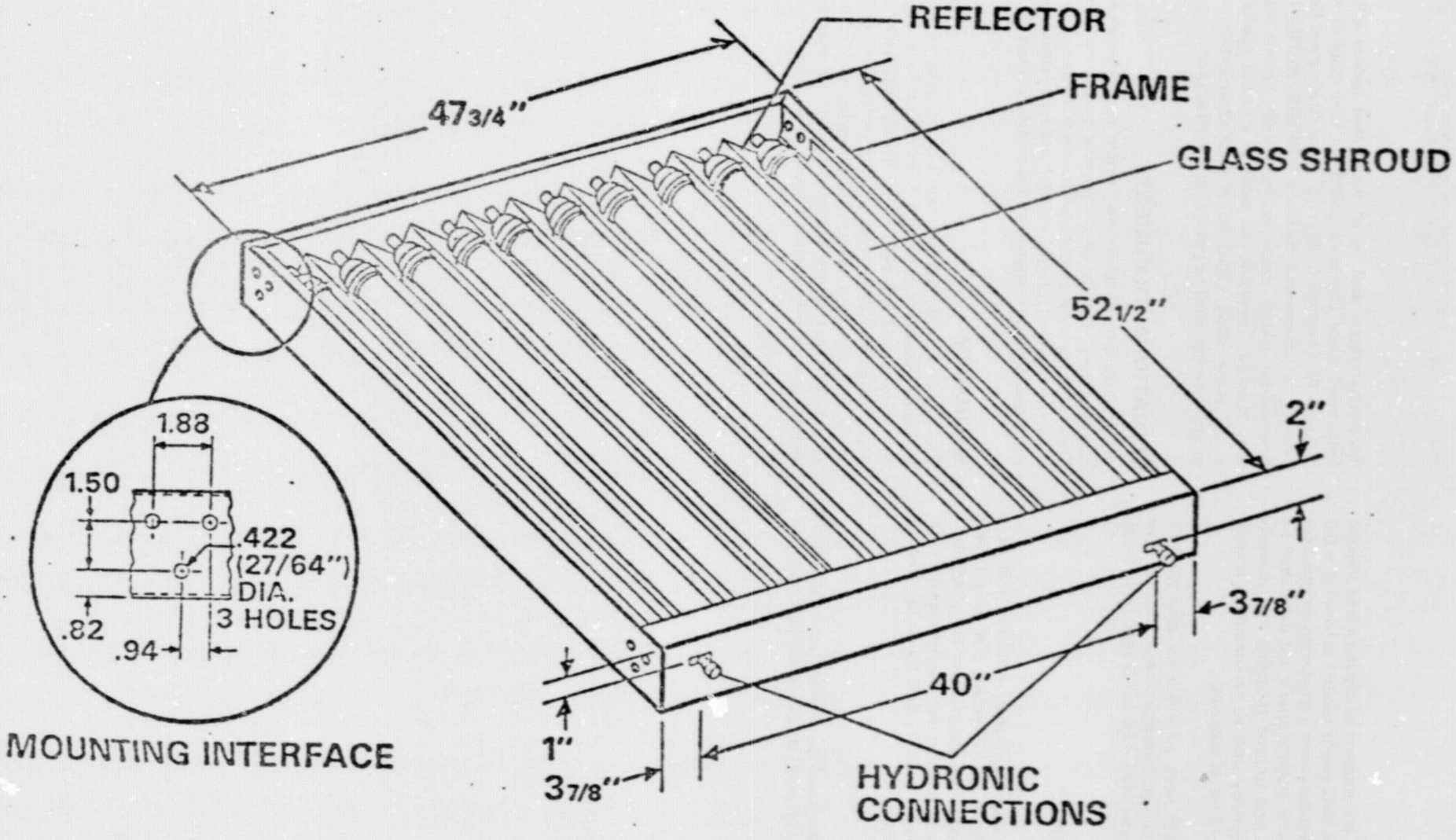
All materials, assemblies, coatings, thermal bond connection, fluid connections, vacuum seals, structural members and housing configurations shall be of the highest quality and shall fully meet those standards called for and required in the "Interim Performance Criteria for Solar Heating and Cooling Systems in Commercial Buildings" (NBSIR 76-1187-1976). Any change and/or deviation from these criteria must be fully clarified. Standards and work of a higher quality than in the above cited, called for in these specifications and/or on the drawings, shall be met by the manufacturer.

OPERATIONAL DOCUMENTS

The manufacturer shall provide, within one (1) week of collector delivery, installation documentation for the collector. These manuals shall describe preventive maintenance, general maintenance, fluid quality control and replacement requirements and material replacement and control instructions.

WARRANTY

The manufacturer shall warrant that at time of delivery, the solar collector will be free from defects in material and manufacture and will be of good quality and workmanship. This warranty shall provide for the replacement or repair, at the manufacturer's election, of the collector or parts thereof, provided that written notice of the defect shall be given to the manufacturer within one (1) year after collector delivery.



Mounting and Interconnection Interfaces for TC-100 Collector

AUTOMATIC CONTROL SYSTEM

KR[illegible] Series continued

KH11-E and KR14-E SERIES Hermetically sealed in a metal can. Has octal-type plug and gold-flashed silver contacts rated 5 amps @ 120V AC 80% P.F., or 28V DC, resistive. Suffix "G" denotes silver cadmium oxide contacts rated 10 amps @ 120V AC, 80% P.F., or 28V DC resistive.

KRP SERIES Versatile multi-contact arrangement. Enclosed in a clear polycarbonate dust cover. Standard 8-pin octal-type plug for KRP5 and KRP11, 11-pin for KRP-14. Weight: Approx. 3 ozs. Contacts 5 amp. Gold flashed silver. 10 amp silver-cadmium oxide. See KCP-KRP hold-down spring for special mounting applications. See KRP-N indicator lamp relay for current monitoring applications.

KRP-N INDICATOR LAMP RELAY A general purpose relay incorporating a lamp to indicate current or voltage availability in power circuit. Contacts: Silver-cadmium oxide rated 10 amps. Enclosures: Clear, polycarbonate dust cover. Mounting: Standard octal plug. Weight: Approximately 3 ozs. Hold-down spring (Please see Page 4).

"P" Case is a clear polycarbonate case for mounting rectifiers, capacitors, resistors or other components. Octal type termination. 8 pin, 35D017. 11 pin, 35D072. Comes with four screws. Weight, 0.5 oz.

35D070	LIST $.80
35D072	LIST $.96

Hold-down spring for "P" Case, and KRP series relays will accommodate machine screws or rivets.

20C176 **LIST $.20**

OCTAL-STYLE SOCKETS

For KRP, KRP3-H, KAP, KBP, KCP, EBT, and EBA relays. CD-21, CD-38, CH, CK, and CR time delays, and CS sensor.

Molded polycarbonate, 8-pin screw terminal socket, rated 10 amperes.

27E122 **LIST $2.83**

Molded polycarbonate, 11-pin screw terminal socket, rated 10 amperes.

27E123 **LIST $4.24**

TRACK MOUNT SYSTEM FOR SOCKETS

Extruded aluminum, three-foot section with slotted holes on 6" centers for #8 screws.

24A064 **NET $2.22**

Plastic clip for mounting sockets 27E122 and 27E123, above, and socket 27E166, page 4. Two clips required per socket.

24A072 **NET $.11**

Aluminum retainer with #6-40 tapped hole for mounting sockets 27E121 (page 7), 27E122, 27E123, and 27E166. Includes one #6-40 x [illegible]" screw. Two retainers and screws required per socket.

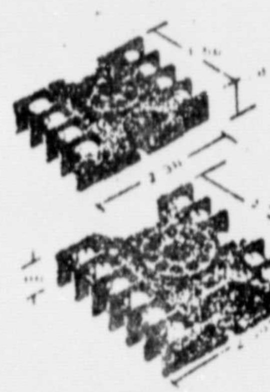
24AC71 **NET $.07**

Plastic twist clip requires no screws, will mount 27E121 only. Two required per socket.

24A067 **NET $.10**

Stainless steel hold-down clip restricts movement of relay mounted in socket 27E121. Two clips required per socket.

20C253 **NET $.09**



TRACK MOUNT SYSTEM

GENERAL PURPOSE RELAYS

TYPE	COILS Input	COILS Res in Ohms	COILS Nom. Power	CONTACTS Arrang.	CONTACTS Amp. Rating	SUGG. RE SALE PRICE
KRP5A§	6V 12V 24V 120V	6 [illegible] 85 2,250	2VA	SPDT	5	$7.50 7.50 7.50 7.50
KRP5AG§	6V 12V 24V 120V	6 21 85 2,250	2VA	SPDT	10	7.80 7.80 7.80 7.80
KRP5D§	6V 12V 24V 110V	32.1 120 472 10,000	1.2W	SPDT	5	7.45 7.45 7.45 8.35
KRP5DG§	6V 12V 24V 110V	32.1 120 472 10,000	1.2W	SPDT	10	7.70 7.70 7.70 8.50
KRP11A§	6V 12V 24V 120V 240V	6 21 85 2,250 9,110	2VA	DPDT	5	8.40 8.40 8.40 8.40 8.95
KRP11AG§	6V 12V 24V 120V 240V	6 12 85 2,250 9,110	2VA	DPDT	10	8.70 8.70 8.70 8.70 9.25
KRP11D§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	DPDT	5	8.35 8.35 8.35 8.80 9.20
KRP11DG§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	DPDT	10	8.65 8.65 8.65 9.15 9.50
KRP14A§	6V 12V 24V 120V 240V	6 21 85 2,250 9,110	2VA	3PDT	5	10.45 10.45 10.45 10.45 10.95
KRP14AG§	6V 12V 24V 120V 240V	6 21 85 2,250 9,110	2VA	3PDT	10	10.80 10.80 10.80 10.80 11.40
KRP14D§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	3PDT	5	10.35 10.35 10.35 10.75 11.10
KRP14DG§	6V 12V 24V 48V 110V	32.1 120 472 1,800 10,000	1.2W	3PDT	10	10.70 10.70 10.70 11.20 11.50
KRP11AN§	6V 12V 24V 120V 240V	6 21 85 [illegible] 9,110	2VA	DPDT	10	9.95 9.95 9.95 9.95 10.50
KRP11DN§	6V 12V 24V 110V	32.1 120 [illegible] 10,000	1.2W	DPDT	10	9.80 9.80 9.80 10.70
KRP14AN§	6V 12V 24V 120V 240V	[illegible] [illegible] [illegible] [illegible] 9,110	2VA	3PDT	10	12.10 12.10 12.10 12.10 12.60
KRP14DN§	24V	[illegible]	1.2W	3PDT	10	11.95

[illegible] ... IN ACCORDANCE WITH NO ORDERING

A Alternating Current, e.g. PRD3A
D Direct Current, e.g. PRD3D

§ Enclosed Relay ‡ Sealed Relay

ORIGINAL PAGE IS
OF POOR QUALITY

Pump Controllers and High Pressure Low Water Cut-offs

McDonnell Pump Controllers are float actuated electrical switches used to control boiler feed pumps as they should ideally be controlled—directly from the boiler water level. They represent the proven best method of keeping the boiler water level within the close limits recommended for maximum steaming efficiency and fuel economy. These controls also include a second switch, operating at a lower level which provides a circuit for stopping the automatic burner and sounding an alarm—the final safeguard for emergency conditions such as electrical current interruption to the pump or failure of make-up water supply.

McDonnell Pump Controllers can also be used on storage tanks and pressure vessels to start or stop pumps, or provide alarm or automatic cut-off, at high level and/or low level.

All McDonnell Pump Controllers have completely packless construction. Electrical operating parts are sealed from the float chamber. The controls have been designed for high pressure, high temperature service.

In addition to controllers listed in the table, the liquid level controls shown on page 12 can also be used on high pressure boilers—Model PCH and PCL for low water cut-off, and Model VFC for pump control and cut-off.

HOW TO SELECT

McDonnell Pump Controllers serve boilers of any size. Selection of proper control depends upon boiler operating pressure and method of installation.

Product No.	Maximum Pressure	Switches	Characteristics
No. 42	50 psi	Mercury tube	For boilers with separate water columns
No. 42-A	50 psi	Mercury tube	"Quick Hook-up" fittings
150 Series	150 psi	Mercury tube	For boilers with separate water columns
157 Series	150 psi	Mercury tube	Water column type body, with all tappings for steam trim
No. 93*	150 psi	Magnetic—open contact	Permits wider adjustment of operating levels
No. 193A*	150 psi	Magnetic—open contact	Water column type
No. 94*	250 psi	Magnetic—open contact	Similar to No. 93, but for higher pressure
No. 194*	250 psi	Magnetic—open contact	Water column type body

These controls have ¾" NPT opening in body and ½" NPT opening in head castings, for float blocking.

ELECTRICAL RATINGS

(Underwriters Listed)

For 150 Series, 157 Series, and 42 Series

Ampere Rating for Pump and Cut-off Circuits

Motor Duty	120VAC	240VAC	120VDC	240VDC
Full load	7.4	3.7	2.4	1.2
Locked Rotor	44.4	22.2	24.0	12.0

Pilot Duty Service: 345VA, 120 and 240VAC

Ampere Rating for Alarm Circuit

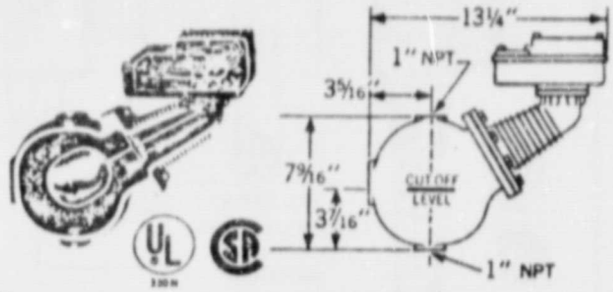
120VAC	240VAC	120VDC	240VDC
1	½	½	¼

For 93 Series and 94 Series

Pilot Duty Service: 120 or 240VAC, 345 VA

Note: For supply connections of 94 Series, use wire suitable for at least 75 C.

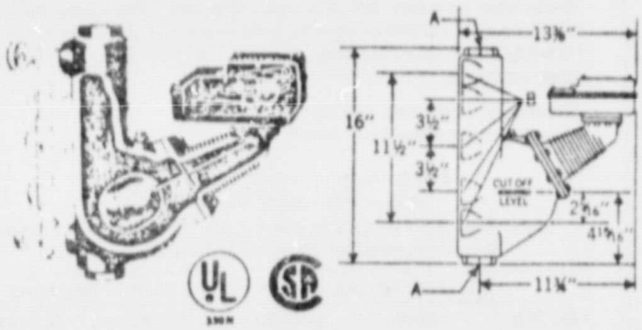
No. 150



The most widely used control of its kind. Packless construction utilizes Monel bellows. Has mercury tube type switches. Can also be used as a cut-off and alarm on many higher pressure hot water space heating boilers. Available with manual reset on cut-off switch; order No. 150-M.

For boilers of any size.
Maximum boiler pressure, 150 psi.

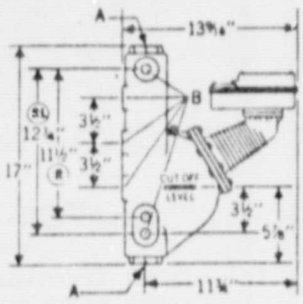
157 Series



No. 157 is basically the same as the No. 150, but has integral water column type of float chamber that simplifies installation and includes all necessary tappings for gauge glass and tricocks.

No. 157-A is same as No. 157 but with larger tappings for equalizing piping and steam trim (see table below).

No. 157R and No. 157RL—Gauge glass tappings in side of body. No. 157RL recommended for boilers where higher visible water line is required, or for boilers with both a feed pump and a combination water feeder cut-off.



All 157 Series also available with manual reset on cut-off switch: order No. 157-M, 157A-M, 157R-M or 157RL-M.

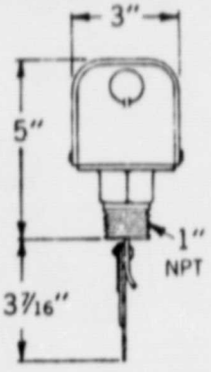
Product No.	No. 157	No. 157A	No. 157R or No. 157RL
Equalizing Tappings "A"	1" NPT	1¼" NPT	1¼" NPT
Gauge Glass and Tricock Tappings "B"	½" NPT	¾" NPT	½" NPT

Maximum boiler pressure, 150 psi.

Flow Switches

No. FS4-3 and No. FS4-3D

No. FS4-3
Extended paddle
for larger pipe
included.



Compact, moderately priced flow switch for service on water lines principally. Has single pole, double throw switch—can be wired to make one circuit, break a second, when flow or no-flow occurs. All parts in contact with liquid in pipe are of brass, solder and Monel. Features include completely packless construction, and easy adjustment of switch sensitivity. Individual paddles are adaptable for pipe 1" to 3" NPT; an extended paddle for larger pipe also included. Installs in tee or welding neck in horizontal pipe; has 1" NPT threaded connection.

No. FS4-3 has one SPDT switch. No. FS34-3D has two SPDT switches to handle two separate circuits. Electrical ratings page 15.

These flow switches are also available with time delay relays, to eliminate false signals caused by turbulence (see page 19). Order No. FS4-3-5R for 5-second delay on break, No. FS4-3-20 for 20-second delay on make.

Maximum pressure, 150 psi.
Maximum temperature, 300 F.

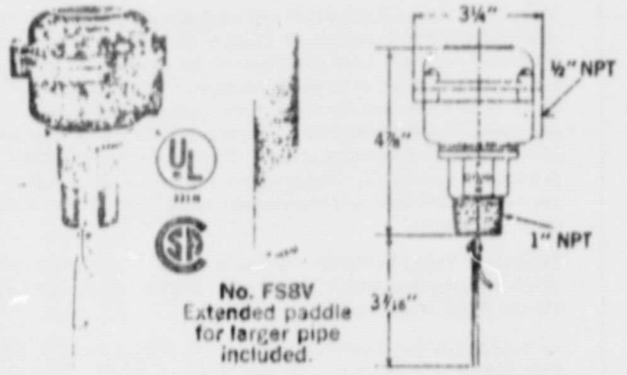
Flow Rates Required to Actuate No. FS4-3 and No. FS4-3D

Water flow rates in gallons per minute (GPM) shown in black.
Velocity in feet per second (FPS) shown in color.

Pipe Size	Factory or Minimum Adjustment				Maximum Adjustment			
	FLOW		NO FLOW		FLOW		NO FLOW	
	GPM	FPS	GPM	FPS	GPM	FPS	GPM	FPS
1"	6.0	2.24	3.6	1.34	10.2	3.91	9.2	3.43
1¼"	9.8	2.11	5.6	1.21	16.8	3.62	15.0	3.23
1½"	12.7	2.00	7.0	1.10	23.0	3.62	19.5	3.07
2"	18.8	1.80	9.4	0.90	32.8	3.14	24.0	2.29
2½"	24.3	1.63	11.6	0.78	42.4	2.74	37.5	2.51
3"	30.0	1.30	12.0	0.52	52.1	2.26	46.1	2.00
4"*	39.7	1.00	19.8	0.50	73.5	1.86	64.2	1.62
5"*	58.7	0.94	29.3	0.47	115.0	1.85	92.0	1.48
6"*	79.2	0.88	39.6	0.44	166.0	1.84	123.0	1.37

*Equipped with extended paddle (cut for 4" and 5" pipe).
Flow rates are averages which may vary ± 10% from tabulated values.

No. FS8V



No. FS8V
Extended paddle
for larger pipe
included.

Provides vapor-proof construction in an economically priced, compact-size flow switch. Particularly suited for use in areas of high humidity, and for out-of-doors installation. Has adjustment for sensitivity to flow, packless construction, wetted parts of brass, solder and Monel. Individual paddles are adaptable for pipe 1" to 3"; extended paddle for larger pipe is also included. Installs in tee or welding neck in horizontal pipe; 1" threaded connection.

Electrical ratings shown on page 15.

Time delay relays are available to eliminate false signals caused by turbulence; see page 19.

Maximum pressure, 150 psi.
Maximum temperature, 225 F.

Flow Rates Required to Actuate No. FS8V

Water flow rates in gallons per minute (GPM) shown in black.
Velocity in feet per second (FPS) shown in color.

Pipe Size	Factory or Minimum Adjustment				Maximum Adjustment			
	FLOW		NO FLOW		FLOW		NO FLOW	
	GPM	FPS	GPM	FPS	GPM	FPS	GPM	FPS
1"	4.9	1.82	3.4	1.25	17.6	6.53	15.0	5.56
1¼"	7.5	1.60	5.3	1.14	29.0	6.23	24.6	5.28
1½"	9.4	1.48	6.7	1.05	37.8	5.95	32.2	5.07
2"	13.7	1.31	9.4	0.90	56.4	5.39	47.4	4.53
2½"	17.9	1.20	12.1	0.81	71.3	4.78	59.2	3.97
3"	24.2	1.05	16.4	0.71	89.0	3.87	72.5	3.15
4"*	35.3	0.89	27.0	0.68	118.0	2.98	105.0	2.64
5"*	48.6	0.78	37.4	0.60	178.0	2.86	160.0	2.57
6"*	60.3	0.67	46.8	0.52	245.0	2.72	225.0	2.50

*Equipped with extended paddle (cut for 4" and 5" pipe).
Flow rates are averages which may vary ± 10% from tabulated values.

No. FS4-3F and No. FS7-4F
Waterflow Indicators

Listed by Underwriters Laboratories for service as a waterflow indicator on branch piping of fire sprinkler systems. Used to pinpoint location of open sprinkler heads—to speed fire fighting and minimize water damage. Construction dimensions and electrical ratings same as for No. FS4-3 (page 15) and No. FS7-4 (page 18).

No. FS4-3F can be furnished with time delay relay (see page 19); order No. FS4-3F-20. Time delay relay is also available for use with No. FS7-4F (see page 19).

Minimum Flow Rates Required to Actuate Waterflow Indicators

No. FS4-3F—For 1", 1¼" and 1½" branch piping.

No. FS7-4F—For 1¼", 1½", 2" and 2½" branch piping.

Both Waterflow Indicators are actuated by a flow rate of 4 to 10 gallons per minute (GPM) in all pipe sizes listed above.

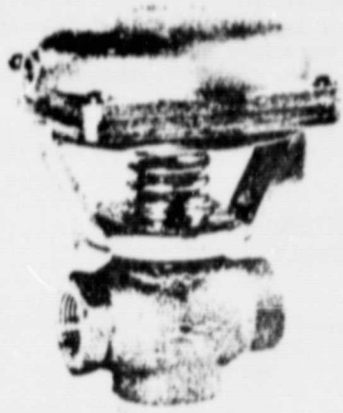
Maximum pressure: No. FS4-3F, 150 psi.
No. FS7-4F, 300 psi.
Maximum temperature, 300 F.

Robertshaw
Uni-Line Division

DATA SHEET

VP2567 & VP2568

DIAPHRAGM CONTROL VALVES



These valves are especially designed for the control of hot water, low pressure steam, or chilled water. The VP2567 series is a normally closed control valve and the VP2568 series is a normally open control valve. Sizes from ½" to 2" are available with equal percentage flow characteristics.

Two Rubber U-Cups plus two Teflon® spacers provide a positive self adjusting seal around the valve stem.

These valves are operated by pneumatic actuators, which include a die-cast aluminum yoke and case and a molded rubber diaphragm.

SPECIFICATIONS

VALVE ASSEMBLY

Action	VP2567 – normally closed VP2568 – normally open
Flow characteristics	equal percentage
Rating	300 psi., 35 to 250° F water or 15 psi steam on 1" thru 2" sizes. 250 psi., 35 to 250° F water or 15 psi steam on ½" and ¾" sizes.

BODY

Pattern	straight through
Sizes	1/2" thru 2" NPT
Connections	female NPT inlet and outlet
Material	brass
Seat	brass, integral with body
Packing	two Teflon® spacers plus two rubber U-cups

VALVE TRIM

Plug	brass
Disc	renewable EP rubber
Stem	silicon brass
Back seat	rubber O-ring

ACTUATOR ASSEMBLY

Action	direct acting
Size	10 sq. in. effective area
Actuator ranges	4 – 8 psi 2 – 13 psi 8 – 13 psi 2 – 6 psi (VP2568 only)
Maximum air pressure	30 psi
Ambient temperature rating	250° F max.
Diaphragm	molded rubber
Case & yoke	die-cast aluminum
Spring	alloy steel; cadmium plated

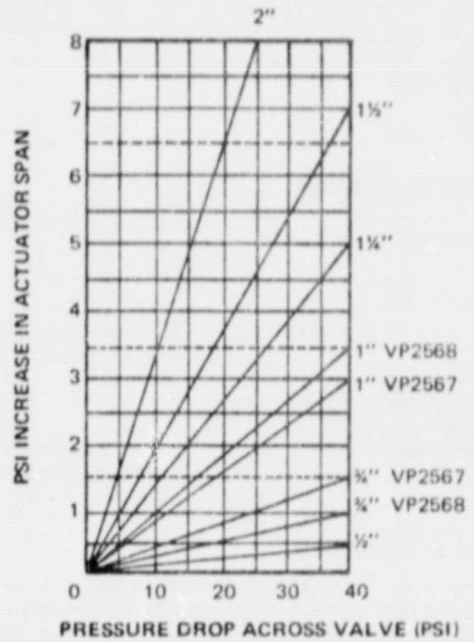


Figure 1 – CLOSE OFF RATINGS, VP2567 & VP2568 VALVES

CLOSE OFF RATINGS

Pressure drop acting against the unbalanced area of the valve produces a thrust. This thrust must be overcome by the actuator through the application of additional signal pressure above the top end of the signal range for normally open control valves, or by reducing the signal pressure below the bottom end of the range for normally closed control valves. In either case, the actuator span is increased.

For tight close off, the valve must not be operated at pressure drops greater than those designated by the intersections of the valve size curves with the appropriate line selected from Table I (See Fig. 1). Maximum allowable pressure drop for any valve (including other actuator ranges) is 40 psi.

TABLE I – CLOSE OFF LINES

ACTUATOR RANGE	VP2567	VP2568
4 - 8	LINE B	LINE C
2 - 13	LINE A	LINE A
8 - 13	LINE C	LINE A
2 - 6	–	LINE C

ORDERING INFORMATION

Refer to page 2

PRINTED IN U.S.A. 11/73

FORM NO. (820) VP2567, VP2568D

Robertshaw
CONTROLS COMPANY
Uni-Line Division

DATA SHEET

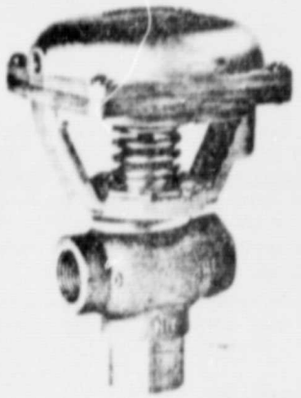
VP2566

DIAPHRAGM CONTROL VALVE 3-WAY MIXING

This valve is especially designed for the control of either hot water or chilled water, and is available in sizes 1/2" through 2" with linear flow characteristics.

Two Rubber U-Cups plus two Teflon® Spacers provide a positive self-adjusting seal around the valve stem. Service life of the seal is greatly extended by the use of a stem made of anti-fouling silicon brass.

The valve is operated by a pneumatic actuator, which includes a die-cast aluminum yoke and case and a molded rubber diaphragm.



SPECIFICATIONS

VALVE ASSEMBLY

Action	top port normally-closed bottom port normally-open
Flow characteristic	linear (constant total flow)
Rating	300 psi, 35 to 250° F water – 1" through 2" sizes. 250 psi, 35 to 250° F water – ½" and ¾" sizes.
BODY	
Pattern	3-way (integral bonnet on ½" and ¾" sizes)
Sizes	½" through 2" NPT
Connections	female NPT
Material	brass
Seat	brass
Packing	two rubber U-cups plus two Teflon® spacers
VALVE TRIM	
Plug	brass
Stem	silicon brass

ACTUATOR ASSEMBLY

Size	10 sq. in. effective area
Spring ranges	1 – 5 psi 4 – 8 psi 2 – 13 psi 8 – 13 psi 5 – 9 psi (½", ¾" & 1" sizes only – also supplied on valves with positive positioners)
Maximum air pressure	30 psi
Ambient temperature rating	225° F max.
Diaphragm	molded rubber
Case and yoke	die-cast aluminum
Spring	alloy steel, cadmium plated

CLOSE OFF RATINGS

Pressure drop acting against the unbalanced area of the valve produces a thrust. When the pressure in the normally-open port is greater than the pressure in the normally-closed port, the additional thrust must be compensated for by additional signal pressure applied at the top limit of the actuator range.

Conversely, when the pressure in the normally-closed port is greater than the pressure in the normally-open port, the additional thrust must be compensated for by a decrease in signal pressure at the low limit of the actuator range. (See Fig. 1)

For tight close off the valve must not be operated at pressure drops greater than those designated by the intersections of the valve size curves with the appropriate line selected from Table I (See Fig. 1). Maximum allowable pressure drop for any valve (including other actuator ranges) is 40 psi.

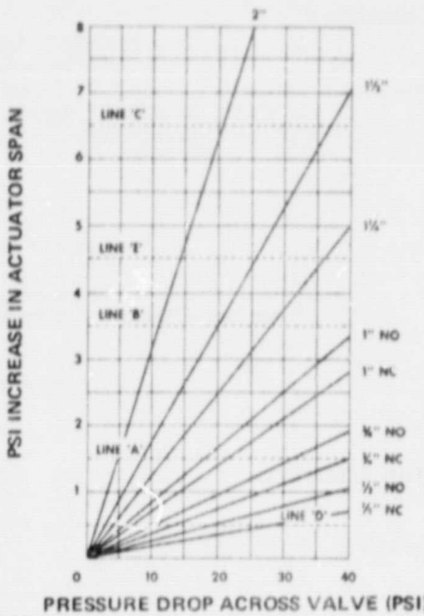


Figure 1 – CLOSE OFF RATING, VP2566 VALVE

TABLE I – CLOSE OFF LINES

ACTUATOR RANGE (PSI)	NORMALLY-OPEN PORT	NORMALLY-CLOSED PORT
1 - 5	LINE C	LINE D
4 - 8	LINE C	LINE B
8 - 13	LINE A	LINE C
2 - 13	LINE A	LINE A
5 - 9	LINE E	LINE E

ORDERING INFORMATION

Refer to page 2

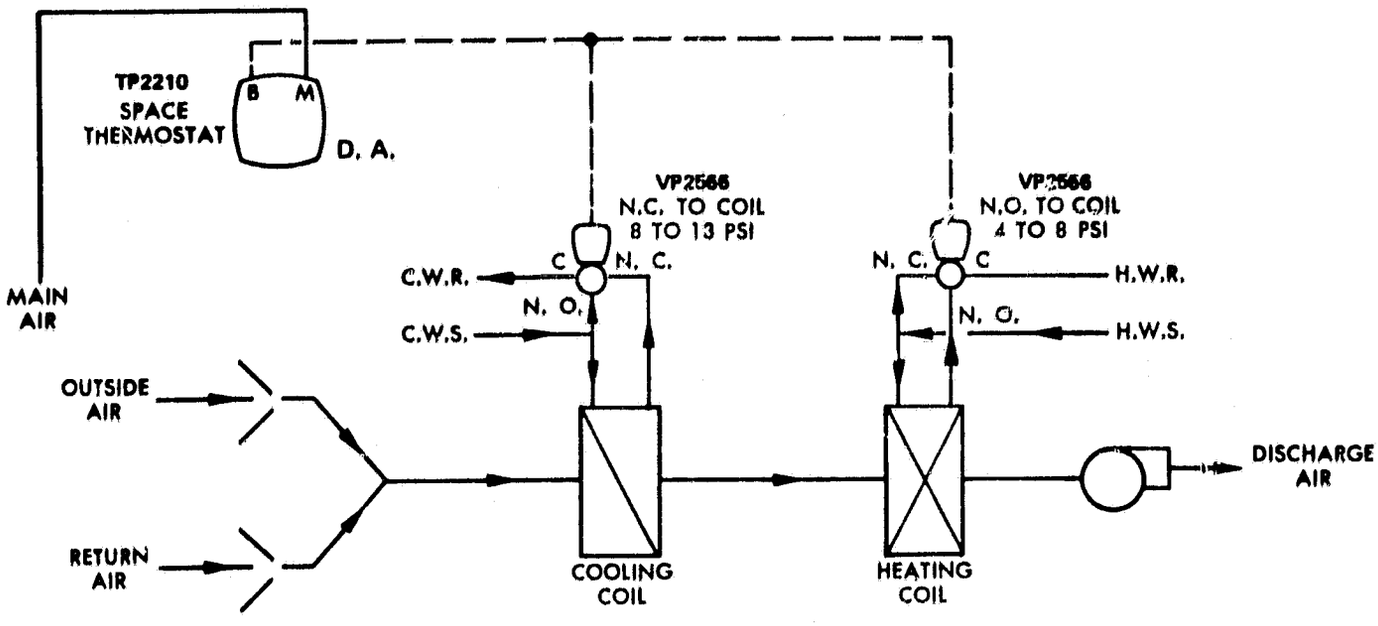
PRINTED IN U.S.A. 11/73

FORM NO. (820) VP2566D
1-560

VP2566 THREE-WAY MIXING VALVES

UNI-LINE NUMBER	FACTORY MODEL	REPLACES	SIZE (NPT) SCREWED	Cv	ACTUATOR	
					EFFECTIVE AREA (□")	SPRING RANGE (p.s.i.)
VP2566-001	V6600-04301	V6693-01	1/2"	2.2	10"	1 - 5
VP2566-002	V6600-04302	V6693-02				4 - 8
VP2566-003	V6600-04306	V6693-06				2 - 13
VP2566-004	V6600-04307	V6693-07				8 - 13
VP2566-005	V6600-04309	V6693-09				5 - 9
VP2566-006	V6600-04319	V6693-19				POSITIONER
VP2566-007	V6600-15301	V6607-01	3/4"	4.6		1 - 5
VP2566-008	V6600-15302	V6607-02				4 - 8
VP2566-009	V6600-15306	V6607-06				2 - 13
VP2566-010	V6600-15307	V6607-07				8 - 13
VP2566-011	V6600-15309	V6607-09				5 - 9
VP2566-012	V6600-15319	V6607-19				POSITIONER
VP2566-013	V6600-25301	V6610-01	1"	9.0		1 - 5
VP2566-014	V6600-25302	V6610-02				4 - 8
VP2566-015	V6600-25306	V6610-06				2 - 13
VP2566-016	V6600-25307	V6610-07				8 - 13
VP2566-017	V6600-253-09	V6610-09				5 - 9
VP2566-018	V6600-25319	V6610-19				POSITIONER
VP2566-019	V6600-30301	V6612-01	1-1/4"	18.0		1 - 5
VP2566-020	V6600-30302	V6612-02				4 - 8
VP2566-021	V6600-30306	V6612-06				2 - 13
VP2566-022	V6600-30307	V6612-07				8 - 13
VP2566-023	V6600-30319	V6612-19				POSITIONER
VP2566-024	V6600-35301	V6615-01	1-1/2"	25.0		1 - 5
VP2566-025	V6600-35302	V6615-02				4 - 8
VP2566-026	V6600-35306	V6615-06				2 - 13
VP2566-027	V6600-35307	V6615-07				8 - 13
VP2566-028	V6600-35319	V6615-19				POSITIONER
VP2566-029	V6600-40301	V6620-01	2"	40.0		1 - 5
VP2566-030	V6600-40302	V6620-02				4 - 8
VP2566-031	V6600-40306	V6620-06				2 - 13
VP2566-032	V6600-40307	V6620-07				8 - 13
VP2566-033	V6600-40319	V6620-19				POSITIONER

TYPICAL APPLICATION



A. H. UNIT HEATING AND COOLING COIL CONTROL

INSTALLATION

Control valves are sized to the demand of the system to be controlled and are frequently smaller than supply lines. They should be installed as close as possible to the coil being controlled. Preferably, a control valve should be installed in the vertical position so the actuator will be over the valve, but can be installed in any position if necessary.

When installing a valve, these simple precautions should be taken:

1. Install a pipeline strainer just ahead of the valve.
2. Allow sufficient clearance that the valve may be easily serviced if necessary.
3. A minimum clearance of 3½" must be allowed between the extreme top of the actuator and the nearest obstruction. This permits removal of actuator yoke and parts required to replace packing.

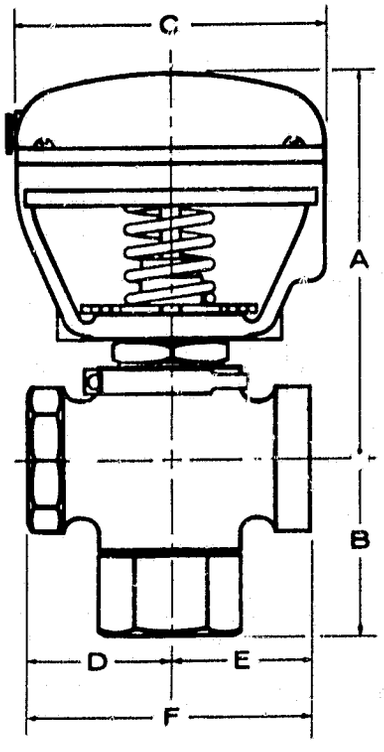
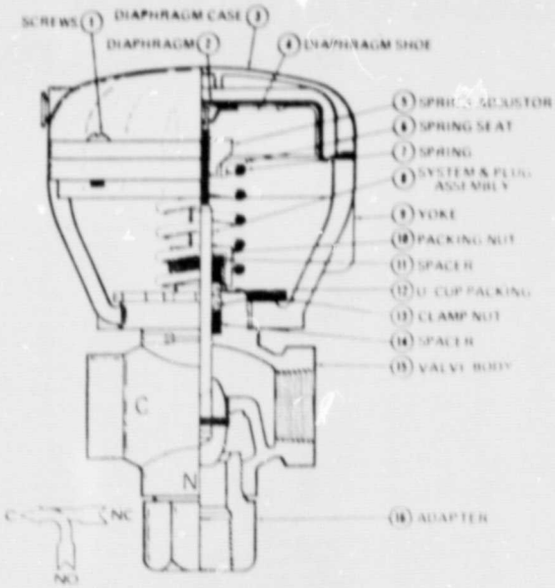


TABLE II – VP2566 DIMENSIONS AND WEIGHTS

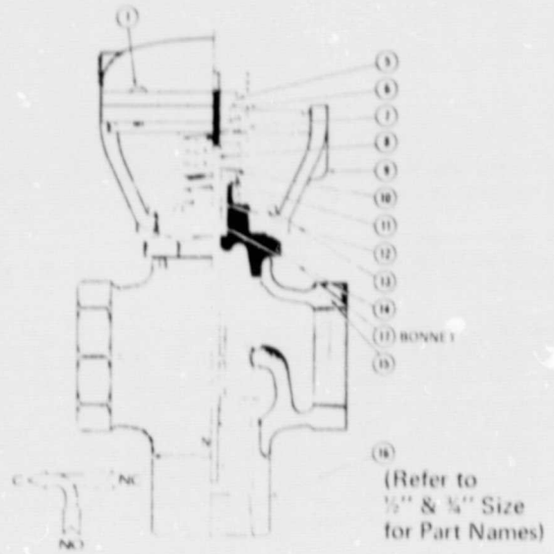
SIZE	DIMENSIONS IN INCHES						WEIGHT (LBS)
	A	B	C	D	E	F	
1/2	4-9/16	1-15/16	4-5/16	1-3/8	1-3/8	2-3/4	3.1
3/4	4-23/32	2-7/32	4-5/16	1-19/32	1-19/32	3-3/16	3.4
1	5-29/32	3-3/8	4-5/16	2-1/2	2-1/2	5	6.9
1-1/4	5-29/32	3-3/8	4-5/16	2-9/16	2-9/16	5-1/8	8.0
1-1/2	5-29/32	3-3/8	4-5/16	2-9/16	2-9/16	5-1/8	8.0
2	6-5/16	3-25/32	4-5/16	3-3/8	3-3/8	6-3/4	16.3

C-2

The VP2566 requires very little maintenance after proper installation. It is recommended that field repairs be limited to the following: (No Special Tools Required)



½" & ¾" SIZE



1" – 2" SIZES

Figure 2 – VP2566 VALVE ASSEMBLY

PACKING REPLACEMENT

If valve stem leakage is encountered, replace the U-Cup Packing (12) as follows:

1. Remove Clamp Nut (13) and lift Yoke (9) and Assembled Parts (2, 3 and 4) off valve.
2. Measure dimension "A" from the end of Stem and Plug Assembly (8) to top of Spring Adjustor (5) and record. During reassembly of the valve, this dimension must be reset ±1/64" so as not to change the actuator range.
3. Remove Spring Adjustor (5), Spring Seat (6) and Spring (7).
4. Remove Packing Nut (10), Spacer (11), U-Cup Packing (12) and Spacer (14). Be sure the packing cavity in the integral bonnet and the valve stem are clean.
5. Drop Spacer (14) over stem into bottom of packing cavity. Apply a bead of valve seal lubricant, Accessory Number N6-3, around the valve stem and push one U-Cup Packing (12) over stem and into packing cavity, thereby lubricating the inside diameter of the packing and filling the annular groove in the packing with lubricant. Repeat this procedure with a second U-Cup Packing (12), taking care with each U-Cup packing not to damage the sealing lip.

   Drop Spacer (11) over stem, and screw on Packing Nut (10) to a positive stop.
6. Reassemble Spring (7), Spring Seat (6) and Spring Adjustor (5). Reset dimension "A" as recorded in Step 2 above.
7. Replace Yoke (9) and Assembled Parts (2, 3 and 4) on Valve Body (15) and lock in place with Clamp Nut (13). Make sure that end of stem is engaged in shaped hole in center of Diaphragm Shoe (4) during this operation.

VALVE PLUG REPLACEMENT

If indications of excessive valve seat leakage are encountered, the Stem and Plug Assembly (8) may be replaced. The packing should be replaced any time the stem and plug assembly is replaced. Replacement of parts is accomplished as follows:

1. Perform Steps 1 through 4 as shown in "Packing Replacement" above.
2. Remove Adapter (16) from Valve Body (15). Remove old Stem and Plug Assembly (8).
3. Insert new stem and plug assembly into Valve Body (15) and replace Adapter (16).
4. Perform Steps 5, 6 and 7 as listed under "Packing Replacement".

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CONTROLS COMPANY
Uni-Line Division

DATA SHEET

VP2510 & VP2511

DIAPHRAGM CONTROL VALVES SINGLE SEATED

These Control Valves are especially designed for the control of hot water, low pressure steam or chilled water.

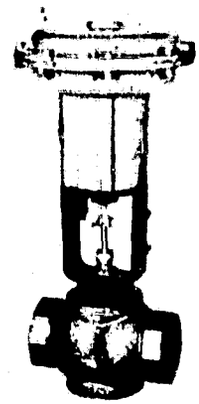
The valves are single seated with renewable discs. Sizes from 1-1/2" to 4" are available on the VP2510 Series, while the VP2511 Series is available in 2-1/2", 3" and 4" sizes.

On sizes through 2", the characterized plug is stem guided mounted by an antitorque swivel arrangement. The sizes 2-1/2", 3" and 4" are double guided. These features provide accurate seating alignment and quiet operation under high flow conditions. On sizes through 2" the valve body and bonnet are provided with conical seating surfaces to insure accurate alignment and to provide a leak-tight joint which can be readily loosened for servicing. On larger sizes the bonnet is bolted to the valve body. A locating boss on the bonnet insures accurate alignment.

The valve is operated either by a 30 square inch or an 80 square inch actuator assembly depending on valve size and type of service. The deeply convoluted molded diaphragm provides constant area characteristics throughout the stroke for excellent linearity.

The actuator assembly can be easily detached from the valve without affecting the valve body or its components.

All parts can be replaced without the use of special tools.



MODEL VP2510

SPECIFICATIONS

VALVE ASSEMBLY

Valve action . . . . . VP2510 — direct acting (N.O.)
VP2511 — reverse acting (N.C.)

Nominal size	1-1/2"—2"	2-1/2"—4"
Connection	NPT	Flanged
Service rating	300 psi for 250° F Water or 80 psi steam	125 psi for 250° F Water or 80 psi steam
Disc material	Renewable composition	Renewable hard rubber
Body material	Brass	Cast iron
Seat material	Brass (integral)	Brass
Valve stem material	Stainless steel	Stainless steel
Flow characteristics	Equal percent	Equal percent

STEM PACKING

Steam . . . . . Teflon, spring loaded
Water . . . . . Rubber U-Cup
Close off rating . . . . . see next page

ACTUATOR ASSEMBLY VP2510

ACTION ON SIZES

For use on VP2510
Direct acting 30 and 80 sq. in. effective area.
Reverse acting 30 sq. in. effective area.
For use on VP2511
Direct acting 80 sq. in. effective area.

VP2510 and VP2511 are available with positive positioning relays.

ACTUATOR RANGES	30 in.^{2} size	80 in.^{2} size
	2-13 psi	3-12 psi
	2-7 psi	3-7 psi
	8-13 psi	8-12 psi

Maximum air pressure . . . . . 35 psi
Ambient temperature rating . . . . . 200°F Max.
Diaphragm . . . . . Molded rubber, nylon reinforced
Case . . . . . Die cast aluminum on 30 sq. inch size
Pressed steel on 80 sq. inch size
Yoke . . . . . Cast iron
Spring . . . . . Alloy steel, Cadmium plated

ORDERING INFORMATION

Refer to pages 3 and 4

CLOSE OFF RATINGS AND ACTUATOR SPRING ADJUSTMENT

Pressure drop acting against the unbalanced area of the valve produces a thrust which must overcome the actuator as follows:

Normally-Open Control Valves: The thrust must be compensated for by additional signal pressure applied at the top limit of the actuator range.

Normally-Closed Control Valves: The thrust must be applied by additional spring load at the low limit of the actuator range.

Either of these conditions increases the actuator span when the valve is operating under a pressure differential. Figure 1 illustrates

For tight close-off, the valves must not be operated at pressure drops greater than those designated by the intersections of the valve size curves with Line A for an 11 psi or 9 psi actuator span or Line B for a 5 psi or 4 psi actuator span.

Normally Open Control Valves require an increase in signal above the top end of range to compensate for pressure drop across valve. Pressure drop across normally-closed control valves requires a decrease in signal below the low end of range, or an adjustment in spring loading.

TABLE I – ACTUATOR SPRING ADJUSTMENT DATA

ACTUATOR NOMINAL AREA ($in.^2$)	ALLOWABLE ADJUSTMENT OF STROKE STARTING POINT					
	2-13	2-7	8-13	3-12	3-7	8-12
30	0 to 4	0 to 8	0 to 10	–	–	–
80	–	–	–	0 to 6	0 to 4	0 to 11

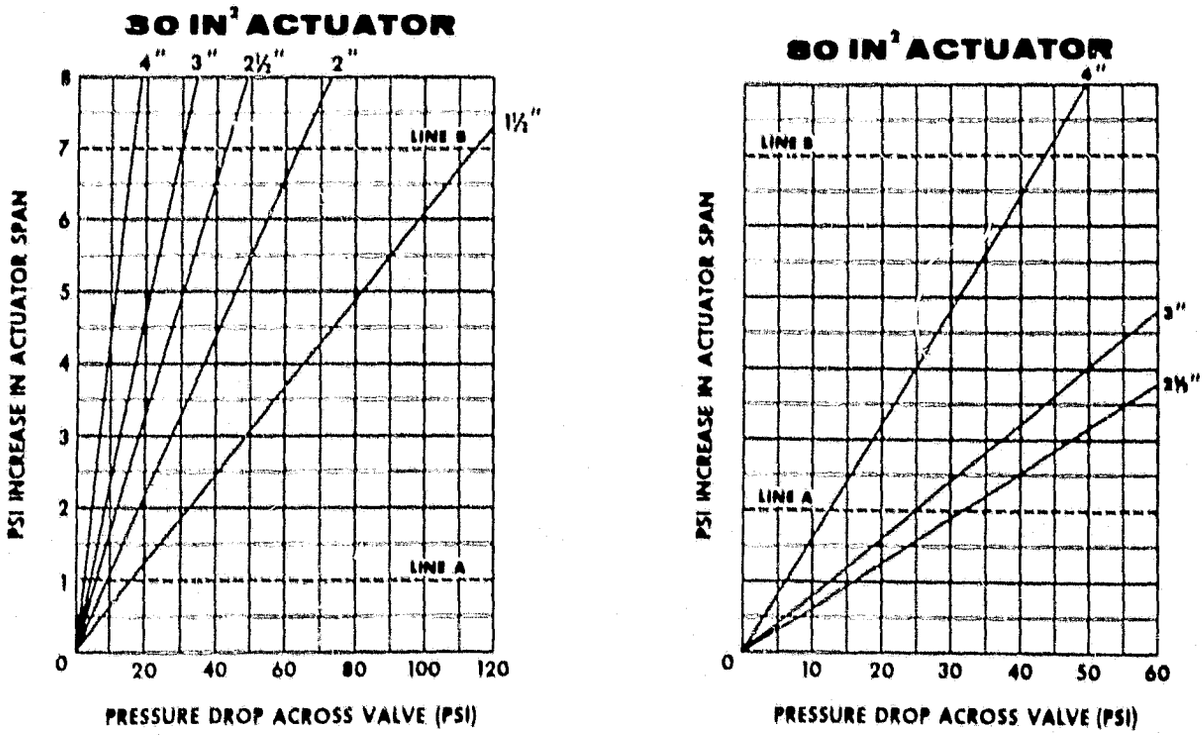


Figure 1 – CLOSE OFF RATINGS OF VP2510 & VP2511 VALVES

ORDERING INFORMATION

VP2510 SINGLE SEATED CONTROL VALVES -- EQUAL PERCENTAGE FLOW CHARACTERISTICS

UNI-LINE NUMBER	FACTORY MODEL	SIZE (NPT)	Cv	ACTION	ACTUATOR		TYPE PACKING
					EFFECTIVE AREA	SPRING RANGE OR POS. POSITIONER	
VP2510-001	V1002-35406	1-1/2"	25	AIR TO CLOSE	30	2 - 13 2 - 7 8 - 13 POSITIONER	TEFLON
VP2510-002	V1002-35404						
VP2510-003	V1002-35407						
VP2510-004	V1002-35419						
VP2510-005	V1002-35606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-006	V1002-35604						
VP2510-007	V1002-35607						
VP2510-008	V1002-35619						
VP2510-009	V1000-35406			AIR TO CLOSE		2 - 13 2 - 7 8 - 13 POSITIONER	U-CUP
VP2510-010	V1000-35404						
VP2510-011	V1000-35407						
VP2510-012	V1000-35419						
VP2510-013	V1000-35606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-014	V1000-35604						
VP2510-015	V1000-35607						
VP2510-016	V1000-35619						
VP2510-017	V1002-40406	2"	40	AIR TO CLOSE		2 - 13 2 - 7 8 - 13 POSITIONER	TEFLON
VP2510-018	V1002-40404						
VP2510-019	V1002-40407						
VP2510-020	V1002-40419						
VP2510-021	V1002-40606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-022	V1002-40604						
VP2510-023	V1002-40607						
VP2510-024	V1002-40619						
VP2510-025	V1000-40406			AIR TO CLOSE		2 - 13 2 - 7 8 - 13 POSITIONER	U-CUP
VP2510-026	V1000-40404						
VP2510-027	V1000-40407						
VP2510-028	V1000-40419						
VP2510-029	V1000-40606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-030	V1000-40604						
VP2510-031	V1000-40607						
VP2510-032	V1000-40619						
VP2510-033	V1002-45406	2-1/2" FLNGD.	72	AIR TO CLOSE		2 - 13 2 - 7 8 - 13 POSITIONER	TEFLON
VP2510-034	V1002-45404						
VP2510-035	V1002-45407						
VP2510-036	V1002-45419						
VP2510-037	V1002-45606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-038	V1002-45604						
VP2510-039	V1002-45607						
VP2510-040	V1002-45619						
VP2510-041	V1000-45406			AIR TO CLOSE		2 - 13 2 - 7 8 - 13 POSITIONER	U-CUP
VP2510-042	V1000-45404						
VP2510-043	V1000-45407						
VP2510-044	V1000-45419						
VP2510-045	V1000-45606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-046	V1000-45604						
VP2510-047	V1000-45607						
VP2510-048	V1000-45619						
VP2510-049	V1002-45515	2-1/2"		AIR TO CLOSE	80	3 - 12 3 - 7 8 - 12 POSITIONER	TEFLON
VP2510-050	V1002-45503						
VP2510-051	V1002-45517						
VP2510-052	V1002-45519						
VP2510-053	V1000-45515			AIR TO CLOSE		3 - 12 3 - 7 8 - 12 POSITIONER	U-CUP
VP2510-054	V1000-45503						
VP2510-055	V1000-45517						
VP2510-056	V1000-45519						
VP2510-057	V1002-51406	3"	102	AIR TO CLOSE	30	2 - 13 2 - 7 8 - 13 POSITIONER	TEFLON
VP2510-058	V1002-51404						
VP2510-059	V1002-51407						
VP2510-060	V1002-51419						
VP2510-061	V1002-51606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-062	V1002-51604						
VP2510-063	V1002-51607						
VP2510-064	V1002-51619						
VP2510-065	V1000-51406			AIR TO CLOSE		2 - 13 2 - 7 8 - 13 POSITIONER	U-CUP
VP2510-066	V1000-51404						
VP2510-067	V1000-51407						
VP2510-068	V1000-51419						
VP2510-069	V1000-51606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-070	V1000-51604						
VP2510-071	V1000-51607						
VP2510-072	V1000-51619						

ORDERING INFORMATION (Cont'd)

UNI-LINE NUMBER	FACTORY MODEL	SIZE FLNGD.	Cv	ACTION	ACTUATOR		
					EFFECTIVE AREA	SPRING RANGE OR POS. POSITIONER	TYPE PACKING
VP2510-073	V1002-51515	3"	102	AIR TO CLOSE	80	3 - 12 3 - 7 8 - 12 POSITIONER	TEFLON
VP2510-074	V1002-51503						
VP2510-075	V1002-51517						
VP2510-076	V1002-51519						
VP2510-077	V1000-51515			AIR TO CLOSE		3 - 12 3 - 7 8 - 12 POSITIONER	U-CUP
VP2510-078	V1000-51503						
VP2510-079	V1000-51517						
VP2510-080	V1000-51519						
VP2510-081	V1002-55406	4"	164	AIR TO CLOSE	30	2 - 13 2 - 7 8 - 13 POSITIONER	TEFLON
VP2510-082	V1002-55404						
VP2510-083	V1002-55407						
VP2510-084	V1002-55419						
VP2510-085	V1002-55606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-086	V1002-55604						
VP2510-087	V1002-55607						
VP2510-088	V1002-55619						
VP2510-089	V1000-55406			AIR TO CLOSE		2 - 13 2 - 7 8 - 13 POSITIONER	U-CUP
VP2510-090	V1000-55404						
VP2510-091	V1000-55407						
VP2510-092	V1000-55419						
VP2510-093	V1000-55606			AIR TO OPEN		2 - 13 2 - 7 8 - 13 POSITIONER	
VP2510-094	V1000-55604						
VP2510-095	V1000-55607						
VP2510-096	V1000-55619						
VP2510-097	V1002-55515			AIR TO CLOSE	80	3 - 12 3 - 7 8 - 12 POSITIONER	TEFLON
VP2510-098	V1002-55503						
VP2510-099	V1002-55517						
VP2510-100	V1002-55519						
VP2510-101	V1000-55515			AIR TO CLOSE		3 - 12 3 - 7 8 - 12 POSITIONER	U-CUP
VP2510-102	V1000-55503						
VP2510-103	V1000-55517						
VP2510-104	V1000-55519						

VP2511 SINGLE SEATED CONTROL VALVES – EQUAL PERCENT FLOW CHARACTERISTICS
DIRECT ACTING ACTUATORS NORMALLY CLOSED

VP2511-001	V1102-45515	2-1/2"	72	AIR TO OPEN	80	3 - 12 3 - 7 8 - 12 POSITIONER	TEFLON
VP2511-002	V1102-45503						
VP2511-003	V1102-45517						
VP2511-004	V1102-45519						
VP2511-005	V1100-45515					3 - 12 3 - 7 8 - 12 POSITIONER	U-CUP
VP2511-006	V1100-45503						
VP2511-007	V1100-45517						
VP2511-008	V1100-45519						
VP2511-009	V1102-51515	3"	102			3 - 12 3 - 7 8 - 12 POSITIONER	TEFLON
VP2511-010	V1102-51503						
VP2511-011	V1102-51517						
VP2511-012	V1102-51519						
VP2511-013	V1100-51515					3 - 12 3 - 7 8 - 12 POSITIONER	U-CUP
VP2511-014	V1100-51503						
VP2511-015	V1100-51517						
VP2511-016	V1100-51519						
VP2511-017	V1102-55515	4"	164			3 - 12 3 - 7 8 - 12 POSITIONER	TEFLON
VP2511-018	V1102-55503						
VP2511-019	V1102-55517						
VP2511-020	V1102-55519						
VP2511-021	V1100-55515					3 - 12 3 - 7 8 - 12 POSITIONER	U-CUP
VP2511-022	V1100-55503						
VP2511-023	V1100-55517						
VP2511-024	V1100-55519						

INSTALLATION

Control valves are sized to the demand of the system to be controlled and are frequently smaller than supply line sizes. They should be installed as close as possible to the coil being controlled. Preferably a control valve should be installed in the vertical position so the actuator will be over the valve, but can be installed in any position if necessary.

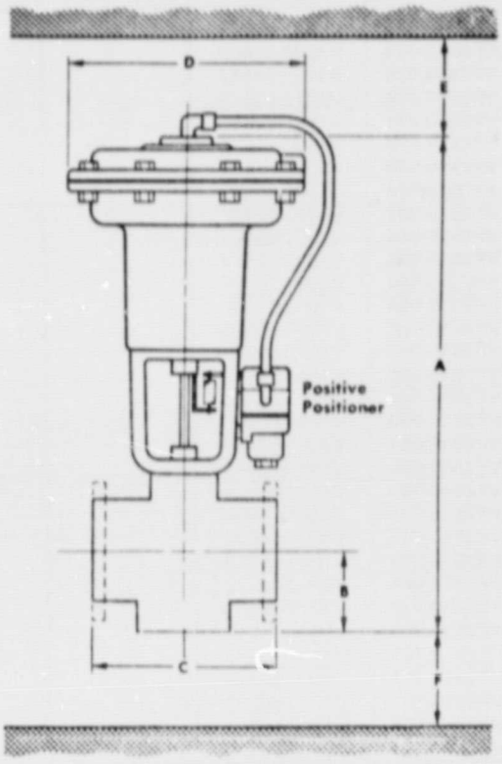
When installing a valve, these simple precautions should be taken:

1. Install a pipeline strainer just ahead of the valve.
2. Install the valve so it closes against the flow.
3. Allow sufficient clearance so that the valve may be easily serviced.

For a VP2510 Series Control Valve, clearance is required only above the actuator. With sufficient clearance above the actuator, both the actuator and valve plug can be easily removed. See Table II for required clearances (dimension E).

For a VP2511 Series Control Valve, the same clearance is required above the actuator as is required for VP2510 normally-open control valves. However, due to the fact that the valve plug assembly must be removed from the bottom of the valve body, clearance must be allowed for this purpose. See Table III for clearance (dimension F).

ACTUATOR SIZE (in.^{2})	NPT (Inches)
30	1/8
80	1/8



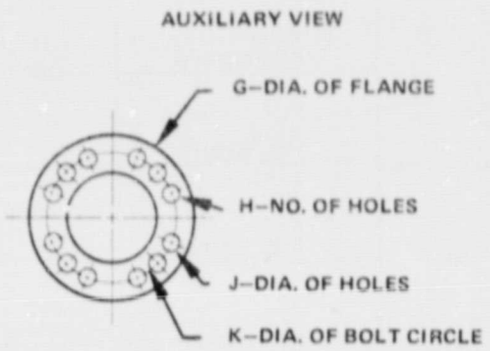


Figure 2 – DIMENSIONS

DIMENSIONS AND WEIGHTS FOR VP2510 VALVES WITH ACTUATORS TABLE II

SIZE	ACT. AREA	ACT. ACTION	DIMENSIONS IN INCHES										WT. (LBS.)
			A	B	C	D	E	F	G	H	J	K	
1-1/2	30	DA	17-7/16	1-7/8	5-1/8	9	3	1	–	–	–	–	21
1-1/2	30	RA	18-3/32	1-7/8	5-1/8	9	3	1	–	–	–	–	21
2	30	DA	17-3/4	2-1/8	6-3/4	9	3	1	–	–	–	–	28
2	30	RA	18-13/32	2-1/8	6-3/4	9	3	1	–	–	–	–	28
2-1/2	30	DA	23-13/32	3-5/8	10-7/8	9	6	1	7	4	3/4	5-1/2	51
2-1/2	30	RA	24-1/16	3-5/8	10-7/8	9	6	1	7	4	3/4	5-1/2	51
2-1/2	80	DA	24-25/32	3-5/8	10-7/8	13-5/8	6	1	7	4	3/4	5-1/2	96
3	30	DA	24-3/4	3-15/16	11-3/4	9	6	1	7-1/2	4	3/4	6	59
3	30	RA	25-13/32	3-15/16	11-3/4	9	6	1	7-1/2	4	3/4	6	59
3	80	DA	26-1/8	3-15/16	11-3/4	13-5/8	6	1	7-1/2	4	3/4	6	104
4	30	DA	25-31/32	4-23/32	13-7/8	9	6	1	9	8	3/4	7-1/2	83
4	30	RA	26-5/8	4-23/32	13-7/8	9	6	1	9	8	3/4	7-1/2	83
4	80	DA	27-11/32	4-23/32	13-7/8	13-5/8	6	1	9	8	3/4	7-1/2	128

DIMENSIONS AND WEIGHTS FOR VP2511 VALVES WITH ACTUATORS TABLE III

SIZE	ACT. AREA	ACT ACTION	DIMENSIONS IN INCHES										WT. (LBS.)
			A	B	C	D	E	F	G	H	J	K	
2-1/2	80	DA	24-31/32	4-21/32	10-7/8	13-5/8	6	13	7	4	3/4	5-1/2	96
3	80	DA	26-13/32	5-25/32	11-3/4	13-5/8	6	14	7-1/2	4	3/4	6	104
4	80	DA	27-11/16	6-7/32	13-7/8	13-5/8	6	15	9	8	3/4	7-1/2	128

NOTES: 1. Add 3/4" to dimension "A" when a Positive Positioning Relay is used.
2. Add 3-3/4" to dimensions "A" when 8–12 psi spring is used with 80 in.^{2} Actuator.

ADJUSTMENTS

Because of pressure conditions in the system, it may be necessary to adjust the actuator stroke starting point. To raise the start point, turn the Spring Adjustor clockwise, looking at the top of a DA actuator and counterclockwise on an RA actuator.

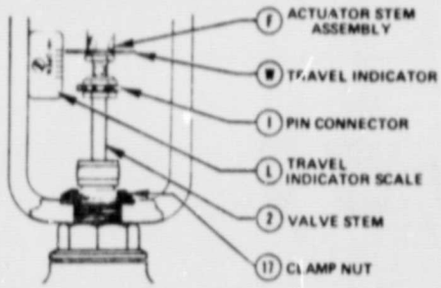
MAINTENANCE AND REPAIR

The VP2510 and VP2511 Series Valves require little maintenance after proper installation and adjustment. It is recommended that field repairs be limited to replacement of Packing and Valve Discs.

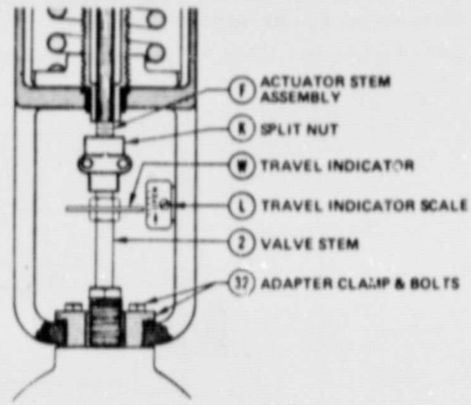
ACTUATOR REMOVAL (See Fig. 3)

To service the valve, remove the actuator as follows:

1. Disconnect Valve Stem (2) from Actuator Stem Assembly (F). On normally-closed valve-actuator assemblies, apply sufficient air pressure to move valve disc off seat. Remove Pin Connector (1) or Split Nut (K).
2. Where applicable remove Indicator (W). Remove Clamp Nut (17) or Adapter and Bolts (32), and disengage actuator assembly.

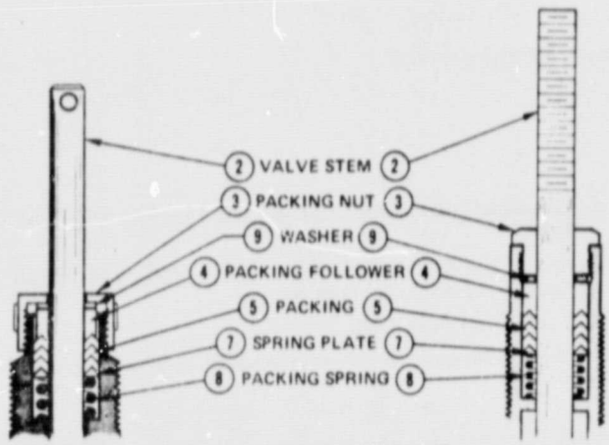


1-1/2" Through 2" Size



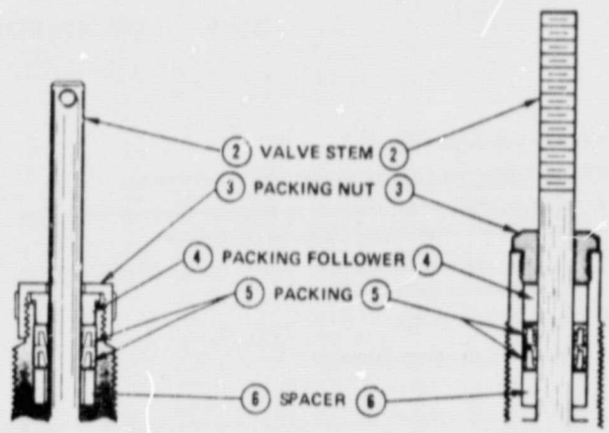
2-1/2" Through 4" Size

Figure 3 – ACTUATOR REPLACEMENT



1-1/2" Through 2" Size
TEFLON® V-RING PACKING

2-1/2" Through 4" Size
TEFLON® V-RING PACKING



1-1/2" Through 2" Size
U-CUP PACKING

2-1/2" Through 4" Size
U-CUP PACKING

Figure 4 – PACKING REPLACEMENT

PACKING REPLACEMENT (See Fig. 4)

If valve stem leakage is encountered, Packing (5) should be replaced as follows:

1. Remove actuator as outlined under "Actuator Removal."
2. Remove Packing Nut (3).
3. Remove all parts from packing cavity.
4. Be sure packing cavity in Bonnet and Valve Stem is clean.
5. Installation of new packing:
   a. Teflon V-Ring Packing:

      Install Packing Spring (8) and Spring Plate (7). Install new Packing (5), Packing Follower (4) and Washer (9). Before installing new Packing (5) apply a small amount of valve seal lubricant to valve stem under each V-Ring. When sliding Packing (5) over Valve Stem (2) DO NOT DAMAGE SEALING LIP. Install Packing Nut (3).

   b. Rubber U-Cup Packing:

      Install Spacer (6). Apply a bead of valve seal lubricant around valve stem and push a rubber U-Cup Packing (5) over stem and into packing cavity, thereby lubricating the inside diameter of the U-Cup and filling the annular groove in the U-Cup with lubricant.

      Repeat this procedure with a second U-Cup Packing (5), taking care with each U-Cup not to damage the sealing lip. Install Packing Follower (4) and Packing Nut (3).
6. Tighten Packing Nut (3) to positive stop.

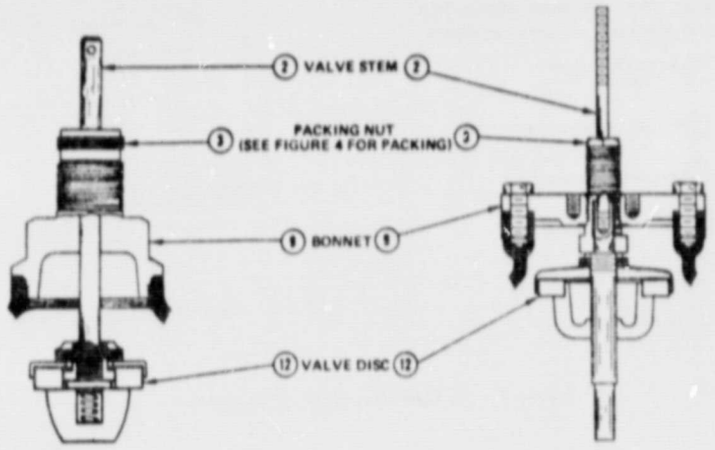
VALVE DISC REPLACEMENT

If indications of valve seat leakage are encountered, the Valve Disc (12) should be replaced as outlined below.

*NOTE: While handling the Valve Plug Assembly, care should be exercised to prevent damage to the highly finished packing and bearing surfaces.

A. VP2510 Valves (See Fig. 5):

1. Remove Actuator as outlined under Actuator Removal and remove Bonnet (9) with Valve Plug Assembly.
2. Loosen Packing Nut (3) to free Packing on Valve Stem (2).
3. Disengage Valve Plug Assembly from Bonnet (9).
4. Disassemble Valve Plug Assembly* and replace Valve Disc (12).
5. Reassemble all parts in reverse order using care not to damage sealing lip of Packing.
6. Tighten Packing Nut (3).
7. Check operation to be sure actuator will operate valve properly.



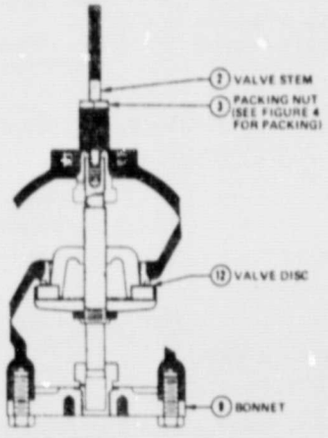
1-1/2" Through 2" Size 2-1/2" Through 4" Size

Figure 5 – VALVE DISC REPLACEMENT, VP2510 VALVES

B. VP2511 Valves (See Fig. 6)

NOTE: Actuator need not be removed from valve body.

1. Apply sufficient air pressure to actuator to move Valve Disc (12) off seat, and remove Split Nut Connector.
2. With no pressure on actuator, loosen Packing Nut (3) to free Packing on Valve Stem (2).
3. Remove Bonnet (9).
4. Remove Valve Plug Assembly.*
5. Disassemble Valve Plug Assembly* and replace Valve Disc (12).
6. Reassemble all parts in reverse order, taking care not to damage sealing lip of Packing.
7. Tighten Packing Nut (3).
8. Check operation to be sure actuator will operate valve properly.



2-1/2" Through 4" Size

Figure 6 – VALVE DISC REPLACEMENT, VP2511 VALVES

VALVE STROKE ADJUSTMENT

If, because of parts replacement, valve travel adjustment is required, it can be accomplished as follows:

A. VP2510 Valves

1. For sizes through 2" with 30 sq. inch DA actuator. (Fig. 7A)
   a. With no pressure on the actuator remove Pin Connector (1) and adjust position of Travel Indicator Scale (L) so the valve open mark is aligned with Travel Indicator (W).
   b. Raise Valve Stem (2) through rated stroke. When this is done, adjust Stem Connector to align holes in Stem (2) and Stem Connector. Replace Pin Connector (1).
2. For sizes through 2" with 30 sq. inch RA actuator. (Fig. 7A)
   a. Apply air pressure to the actuator until the Valve Plug moves off seat.
   b. Remove Pin Connector (1).
   c. With no pressure on actuator, move Valve Plug against seat. Adjust Stem Connector so that the hole through it is approximately 1/16" below hole in Valve Stem (2).
   d. Apply air pressure until the two holes are aligned and replace Pin Connector (1).
   e. Exhaust air from actuator and adjust position of Travel Indicator Scale (L) so "Valve Closed" mark is aligned with Travel Indicator (W).
3. For sizes 2-1/2"–4" with 30 sq. inch DA actuator or 80 sq. inch actuator (Fig. 7B)
   a. With no pressure on the actuator, disconnect Split Nut (K) and place Valve Plug Assembly on seat.
   b. Adjust the Travel Indicator (W) so it aligns with the "valve closed" mark on Travel Indicator Scale (L).
   c. Lift Valve Plug Assembly the rated lift (to valve open mark) and secure it to the Actuator Stem (F) with Split Nut (K). Fine stroke adjustment may be obtained by loosening the Split Nut (K) slightly and screwing the Valve Stem (2) in or out of the Split Nut as required and then retightening the Split Nut (K).
4. For sizes 2-1/2"–4" with 30 sq. inch RA actuator (Fig. 7B)
   a. Apply air to actuator until valve plug assembly lifts off seat.
   b. Disconnect Split Nut (K).
   c. Allow Valve Plug Assembly to rest on seat.
   d. Reduce air on actuator until actuator is approximately 1/16" off stop.
   e. Secure Valve Stem (2) to Actuator Stem (F) with Split Nut (K).
   f. Adjust Travel Indicator (W) so it aligns with "valve closed" mark on Travel Indicator Scale (L).

B. VP2511 Valves

1. For sizes 2-1/2"–4" with 80 sq. inch actuator only (Fig. 7B)
   a. Apply air pressure to the actuator until Valve Plug Assembly moves off seat.
   b. Disconnect Split Nut (K).
   c. With no pressure on the actuator, raise Valve Stem (2) until Valve Plug Assembly touches seat.
   d. Adjust Travel Indicator (W) so it aligns with "valve closed" mark on Indicator Scale (2).
   e. Apply air to move actuator about 1/16" off stop and secure Valve Stem (2) to Actuator Stem (F) with Split Nut (K).
   f. Exhaust air from actuator and readjust Indicator (W) if necessary.

NOTE: To be sure the above adjustments have not changed the intended operating ranges, recheck the operating pressures and readjust actuator range as necessary.

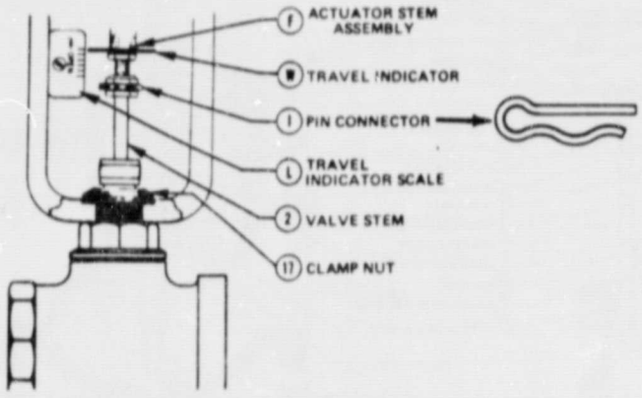


Figure 7A – VALVE STEM ATTACHMENT
(Sizes Through 2" with 30 Sq. In.)

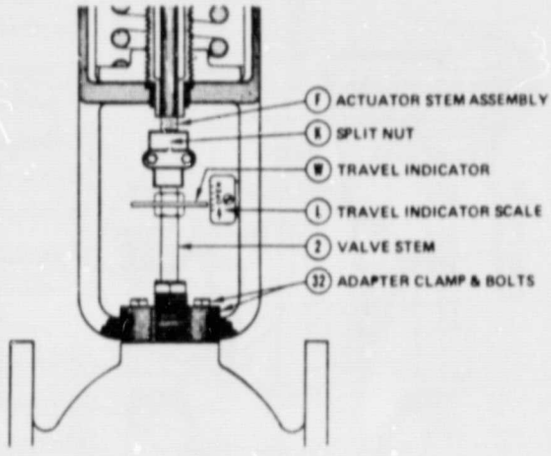


Figure 7B – VALVE STEM ATTACHMENT
(2-1/2" Through 4" with 30 Sq. In. or 80 Sq. In.)

REPLACEMENT PARTS

Actuator Assemblies (See Figures 8 through 10):

Should it become necessary to replace any part of the actuator, release the actuator spring load by turning the Spring Adjustor (J) counterclockwise (looking at the top of the actuator) for direct acting actuators and clockwise for reverse acting actuators. All parts may now be removed.

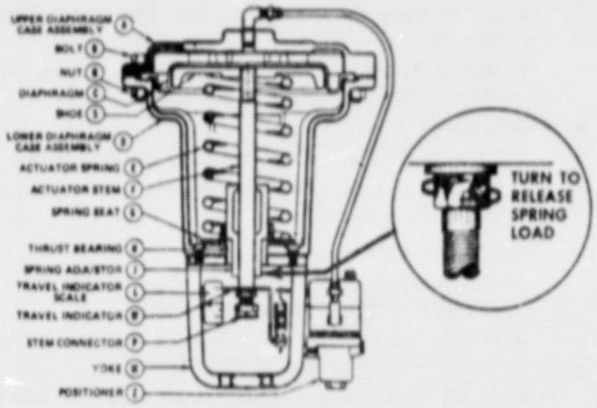


Figure 8 – 30 SQ. INCH DA ACTUATOR. ACTUATOR FOR VALVE SIZES 1-1/2" THRU 2" SHOWN. FOR SIZES 2-1/2" THRU 4" THIS ACTUATOR HAS SPLIT NUT CONNECTOR.

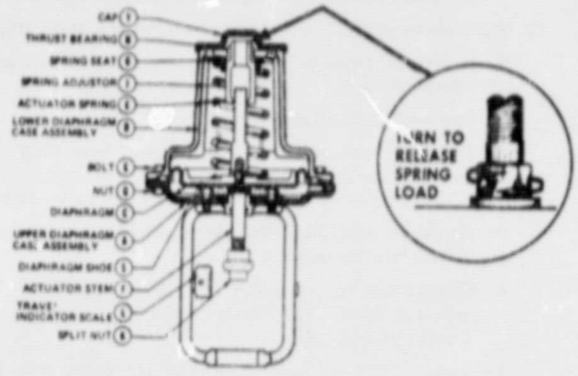
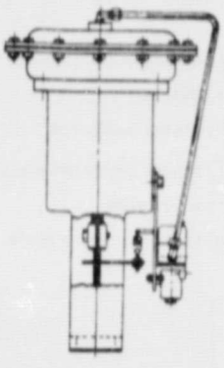


Figure 9 – 30 SQ. INCH RA ACTUATOR. ACTUATOR FOR VALVE SIZES 2-1/2" THRU 4" SHOWN. FOR SIZES 1-1/2" THRU 2" THIS ACTUATOR HAS PIN CONNECTOR.



80 SQ. IN. W/POSITIONER

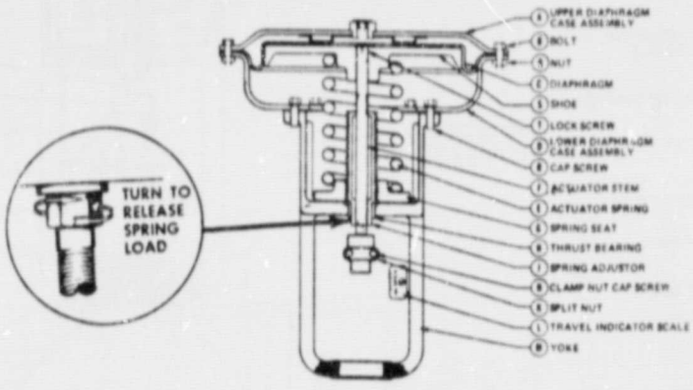
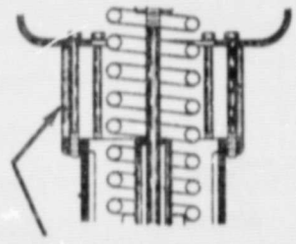


Figure 10 – 80 SQ. INCH ACTUATOR



SPACER IS REQUIRED FOR 80" W/8-12 PSI ACTUATOR

VALVE BODY ASSEMBLIES (1-1/2" Through 2" Size)

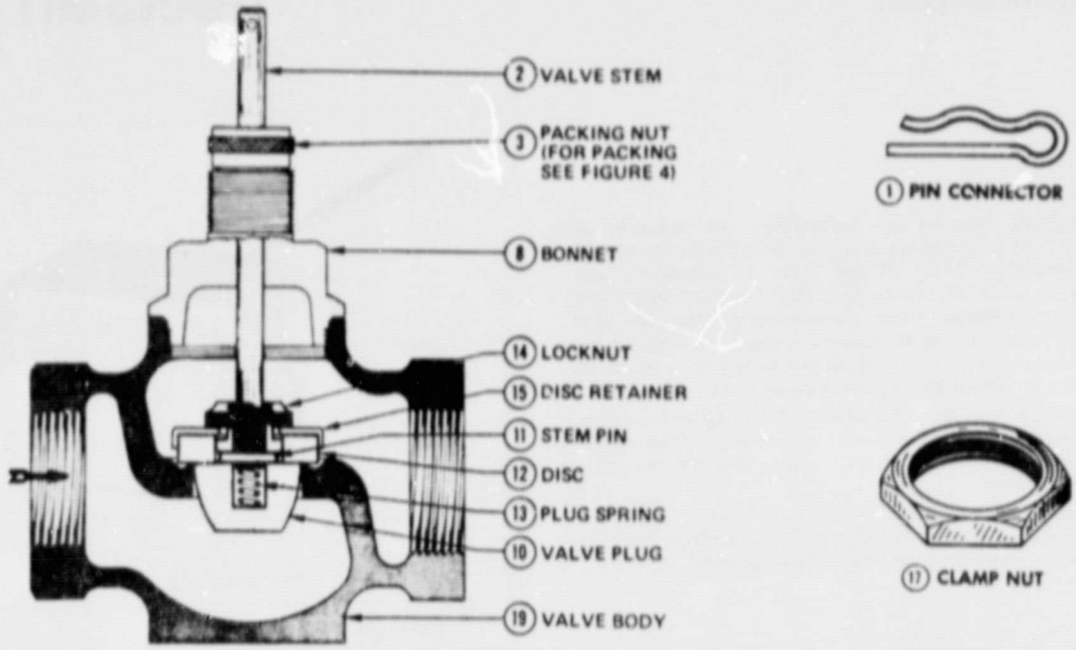


Figure 11 – MODEL VP2510 DIRECT ACTING

VALVE BODY ASSEMBLIES (2-1/2" Through 4" Size)

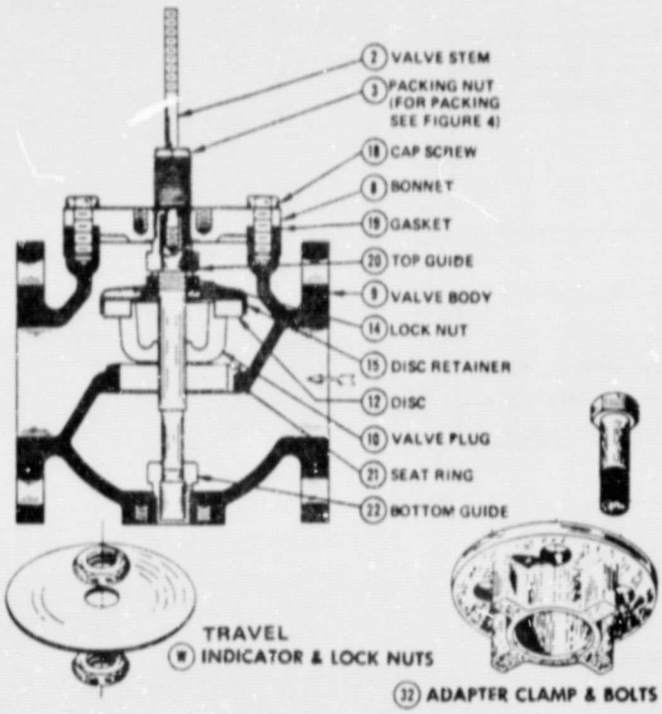


Figure 12 – MODEL VP2510, DIRECT ACTING

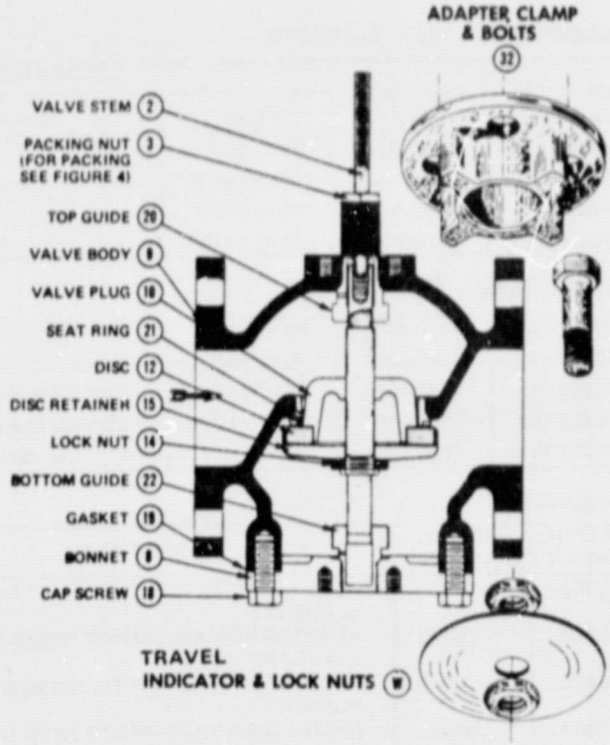


Figure 13 – MODEL VP2511 REVERSE ACTING
(For 80 Sq. In. Actuator Only)

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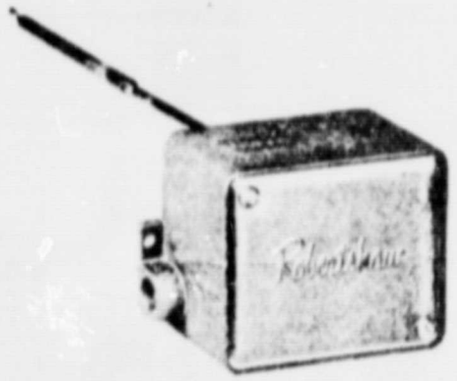
DATA SHEET

TP2252
PNEUMATIC TEMPERATURE TRANSMITTERS



TP2252 pneumatic temperature transmitters are designed to measure air or fluid temperatures in pneumatic control systems and transmit a fixed-span, 3 to 15 psig signal to controlling and indicating devices, such as receiver controllers, receiver gauges and sensitive pressure switches. These transmitters are available with several types of sensing elements (rigid stem, averaging, remote bulb or a rigid coil for fast response) and various temperature ranges to meet most control system application requirements.

TP2252 transmitters are "one-pipe" devices requiring an externally restricted source of constant pressure control air. Their design features pneumatic feedback to assure accuracy and stability over a wide temperature span.

External mounting ears are provided for strain-free mounting on ducts or other flat surfaces. Separable wells are available for rigid stem elements for immersion sensing in fluid systems.

ORDERING INFORMATION

Specify:
1. Model number.
2. Accessories (as required)

SPECIFICATIONS

Action	direct – proportional
Adjustments	none
Supply pressure	20 psig ±0.5 psi
Output pressure	3 to 15 psi
Maximum safe pressure	30 psi
Air connection	1/8" – 27 female NPT
Maximum ambient temperature	140° F
Material	copper element, cast aluminum base, cadmium plated steel cover
Weight	15 oz.
Air use	0.017 CFM

TRANSMITTERS – RIGID ELEMENTS

UNI-LINE NUMBER	FACTORY MODEL	DESCRIPTION	
		RANGE	THERMAL ELEMENT
TP2252-510	T150-1011	40 to 140° F	1/4" DIA. x 9-1/4"
TP2252-250	T150-1021	0 to 100° F	1/4" DIA. x 9-1/4"
TP2252-610	T150-1031	40 to 240° F	1/4" DIA. x 7-1/4"
TP2252-110	T150-1041	-40 to 160° F	1/4" DIA. x 7-1/4"

TRANSMITTERS – FLEXIBLE ELEMENTS

TP2252-501	T150-1012	40 to 140° F	20' AVERAGING
TP2252-251	T150-1022	0 to 100° F	20' AVERAGING
TP2252-502	T150-1013	40 to 140° F	COILED ELEMENT, APPROX. 12" L
TP2252-252	T150-1023	0 to 100° F	COILED ELEMENT, APPROX. 12" L
TP2252-151	T150-1054	-25 to 125° F	4" x 1/4" BULB W/3' CAPILLARY

ACCESSORIES

UNI-LINE NUMBER	FACTORY MODEL	DESCRIPTION
P20-782	100-25	WELL (COPPER) FOR TP2252 WITH RIGID ELEMENT
P20-803	100-47	ADAPTER FOR MOUNTING TP2252 IN STANDARD WELL
P20-805	100-49	WELL (ST. STEEL) FOR TP2252 WITH RIGID ELEMENT
P20-938	N4-31	RESTRICTOR TEE FOR USE WITH 1/4" O.D. POLY. TUBING ONLY
P20-944	N4-32	RESTRICTOR TEE – COMPRESSION FOR USE WITH 1/4" O.D. COPPER OR POLY. TUBING

DIMENSIONS

RIGID STEM LENGTHS

TEMPERATURE RANGE	DIM. "A"
0 to 100°, 40 to 140° F	9-3/8"
-40 to 160°, 40 to 240° F	7-1/16"

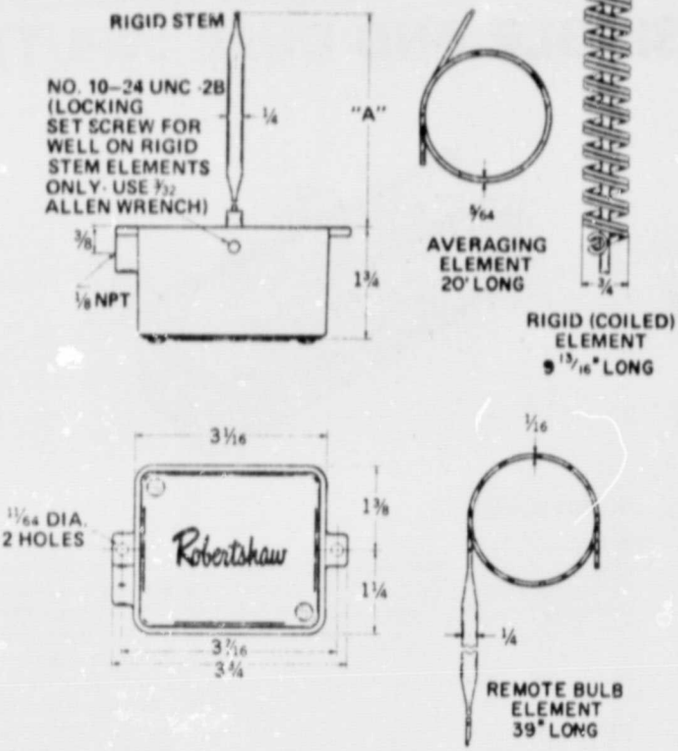


Figure 1 – TP2252 DIMENSIONS

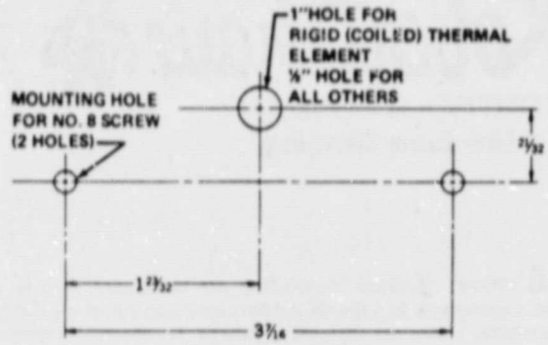
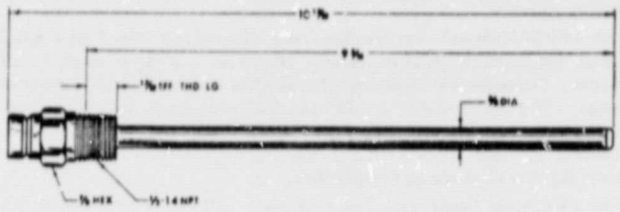
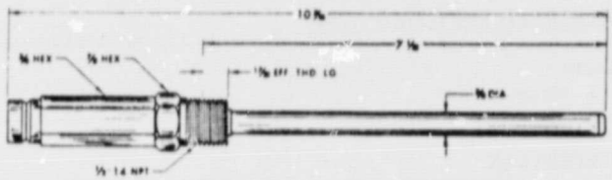


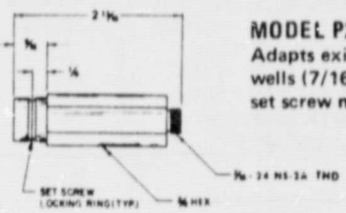
Figure 2 – SURFACE MOUNTING HOLE DIMENSIONS



MODEL P20-782 COPPER WELL (STD.)



MODEL P20-805 STAINLESS STEEL WELL



MODEL P20-803 ADAPTER
Adapts existing female threaded wells (7/16"-24) for TP2252 set screw mounting.

Figure 3 – TP2252 IMMERSION WELLS FOR RIGID STEM ELEMENTS

MAINTENANCE AND REPAIR

TP2252 transmitters feature design simplicity which insures continued efficient operation without special maintenance requirements. In the event of a malfunction that is determined not to be caused by a clogged filter or restrictor in the air supply line, replace the defective unit with a new device.

TYPICAL APPLICATION

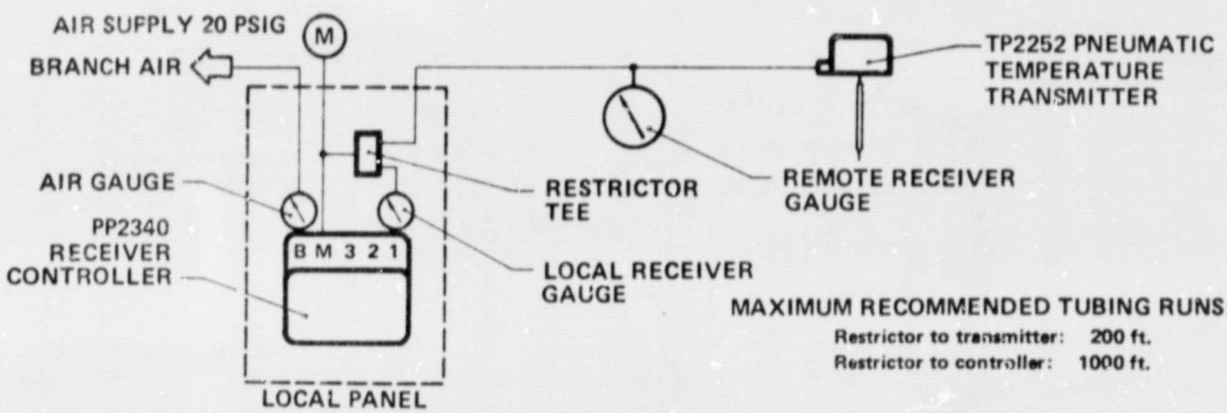


Figure 4 – TP2252 TYPICAL APPLICATION

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DATA SHEET

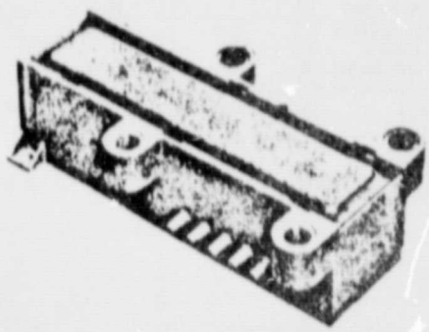
PP2341

PNEUMATIC RECEIVER CONTROLLER (SINGLE AND DUAL INPUT)

Model PP2341 Receiver Controllers are used with remote pneumatic transmitters to provide proportional control of air conditioning systems. They are designed primarily for use with Robertshaw pneumatic temperature transmitters; however, they can be used with any pneumatic device having a calibrated output of 3 to 15 psig, such as relative humidity or pressure transmitters, thermostats or humidistats.

The PP2341 design incorporates the pilot-bleed relay and pneumatic feedback principles usually found in industrial type instruments. These assure accuracy and stability over the entire operating range. The instrument can be used for both single and dual input requirements. When used as a single input instrument, simply connect air line from primary transmitter to port #1 and leave ports #2 and #3 open to atmosphere.

The throttling range and the submaster effect of the secondary input (dual input applications) are fully adjustable.



ORDERING INFORMATION

Specify:

1. Model number
2. Accessories if required

CONTROLLER

UNI-LINE NUMBER	FACTORY MODEL	INPUT	COMMENTS
PP2341-001	P341	DUAL W/REMOTE SETPOINT ADJUSTMENT CAN BE USED AS SINGLE INPUT OR DUAL INPUT W/REMOTE SETPOINT ADJUSTMENT	COVER INCLUDED

ACCESSORIES

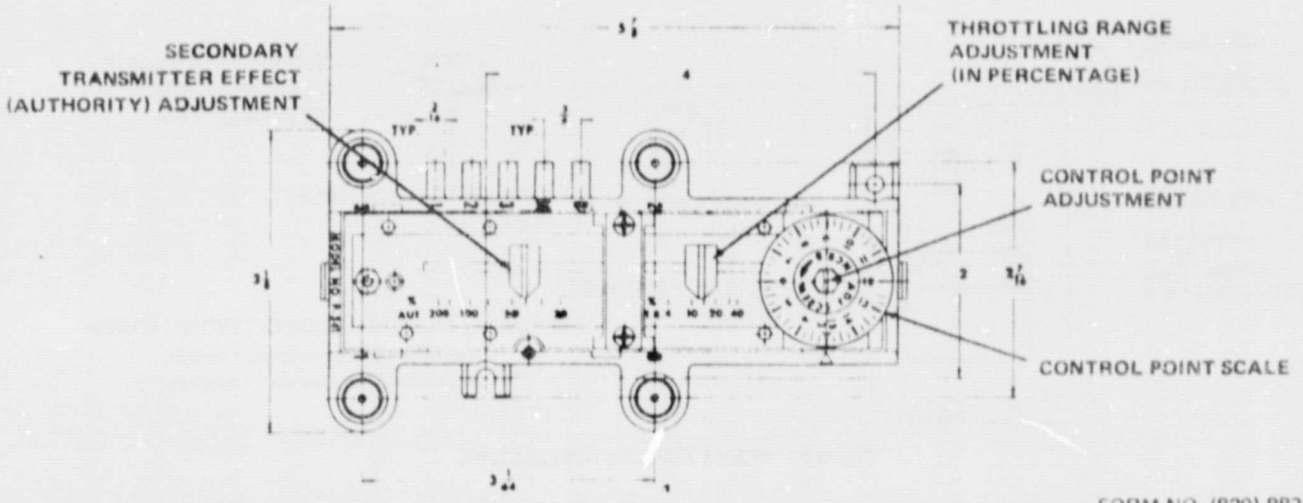
UNI-LINE NUMBER	FACTORY MODEL	DESCRIPTION
P20-983	N4-517	HEX HEAD 1/8" MPT FOR PLUGGING UNUSED GAUGE PORTS

SPECIFICATIONS

Action	direct or reverse*
Setpoint	adjustable; graduated dial with 0.25 psi divisions
Throttling range	adjustable 4 to 40% (.5 to 5.0 psi)
Authority	adjustable 20 to 200% of primary transmitter effect (submaster effect of secondary transmitter on setpoint)
Remote adjustment effect on setpoint	±15% of primary transmitter span. Direct acting
Input signals	port #1 – 3-15 psi port #2 – 3-15 psi port #3 – 3-15 psig
Supply air pressure	20 psig
Maximum air pressure	30 psig
Air connections	3/16" dia. nipples for 1/4" OD polyethylene tubing. P20-884 spring clips (included) must be used
Air use	36 scim
Ambient temperature limits	40 to 140° F
Dimensions	see figure 1
Finish	base – natural, cover – gray Lexan®
Mounting	#8 screws

*For reverse action use RP2360-151 reversing relay in branch line.

DIMENSIONS



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DATA SHEET

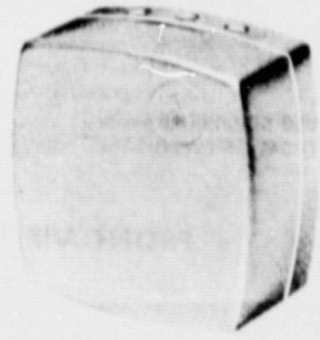
PP2310
DIFFERENTIAL PRESSURE CONTROLLER

The Model PP2310 Differential Pressure Controller is a pneumatic instrument designed for applications where a constant pressure difference is to be maintained between two points. This unit incorporates the pilot-bleed relay and pneumatic feedback principles, usually found in industrial type instruments, to assure accuracy and stability over the entire operating range.

This device is normally used on forced circulation water systems having two-way valve control at the terminal units, to maintain a constant pressure difference across the supply and return mains. Final control is a throttling valve, located either in a pump bypass or directly in the pump discharge line.

The differential element is a diaphragm assembly with opposing movements. When two pressures are applied, the resultant force is transmitted to the instrument as positive linear movements, thus allowing the dial graduations to be uniform over the operating range.

This unit can be field adjusted to perform either proportional or two-position control, with either direct or reverse action. Throttling range or differential is also field adjustable. All adjustments are set on large, easy-to-read, calibrated dials that are concealed when the over is attached. The cover and baseplate are die-castings, component parts are aluminum and stainless steel and the diaphragms are Buna N on nylon to insure long operating life. The alternate piping connections permit the unit to be panel mounted with all pipe fittings concealed, thus providing a neat front-of-board appearance.



The versatility designed into the PP2310 makes it adaptable for use as a:

- Controller with proportional output signal.
- Controller with two-position output signal.
- Differential Pressure transmitter in pneumatic transmission systems.

ORDERING INFORMATION

Specify:
1. Model number
2. Accessories if required (see below)

CONTROLLER

UNI-LINE NUMBER	FACTORY MODEL	RANGE	MAXIMUM PRESSURE	FINISH
PP2310-301	P310-03	0.5 - 50 psi	85 psi	SATIN CHROME ENAMEL

ACCESSORIES

UNI-LINE NUMBER	FACTORY MODEL	DESCRIPTION
P20-781	100-21	SET POINT STOP KIT
P20-969	N4-4	HAND VALVE – 1/4" NPT
P20-973	N4-5	HAND VALVE – 1/2" NPT

SPECIFICATIONS

Temperature limit of element	20 to 220° F
Action	proportional – direct or reverse two-position – direct or reverse
Throttling range	adjustable 1 to 50 psi
Differential	adjustable 1 to 8 psi
Adjustment means	graduated dials changeover lever for adjusting direct or reverse action
Operating pressures	main air – 15 to 20 psi standard branch pressure – 3 to 15 psi maximum – 25 psi
Connections	1/8" NPTF
Air use	0.020 CFM
Weight	2.1 lbs.

GENERAL INSTRUCTIONS

1. Do not exceed pressure and temperature limitations.
2. Controller should be mounted on a surface that is free from excessive vibration.
3. This device is to be used ONLY ON WATER AND AIR SYSTEMS. DO NOT USE ON ANY OTHER MEDIA.

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FORM NO. (820) PP2310D
1-512

INSTALLATION

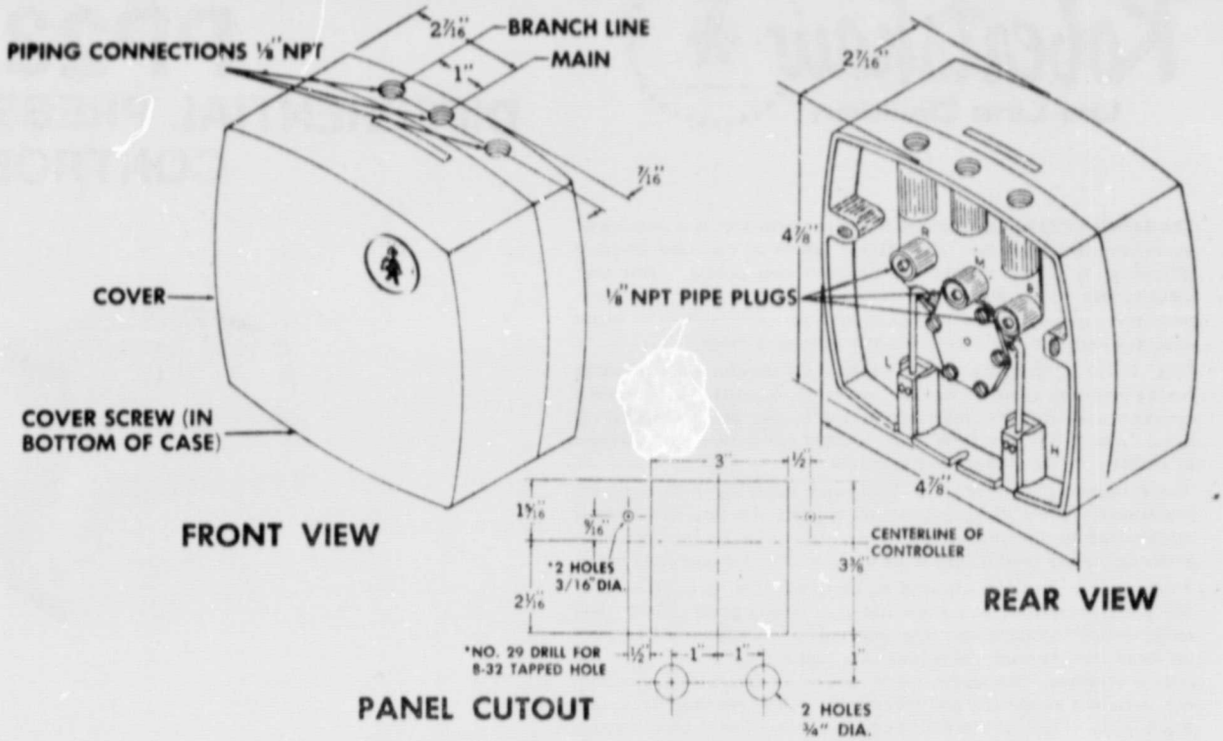


Figure 1 -- INSTALLATION DIMENSIONS

MOUNTING

The PP2310 should be located near the point of differential pressure measurement to keep the sensing lines as short as possible. IF LOCAL CODES APPLY, THEY MUST BE OBSERVED.

Central control panel mounting IS NOT RECOMMENDED if the sensing lines must exceed 50 feet. Pneumatic transmission is recommended for this type of application. Panel mounting is described below for the installations meeting the above requirements.

Always mount Controller in the vertical position with the pressure connections (H) and (L) on the bottom.

PANEL MOUNTING – Controller should be located BELOW other devices as a precaution against damage due to possible sensing line leaks. Provide a panel cutout, two mounting holes and two pressure connection access holes as shown in Fig. 1.

Remove the pipe plugs from the connections in the back of the base plate, using a 3/16" Allen wrench. Install these plugs in the connections on the top of the base plate. Install the protective plastic plugs in the open connections.

Remove the Cover by loosening the Cover Screw and lifting the cover out and up.

Remove the plastic plugs from connections (H) and (L). Install 1/8" street elbows in these connections and face them through the two access holes.

Attach the Controller securely to the panel with two #8 round-head machine screws.

Replace the Cover.

WALL MOUNTING – Select a location that is free from excessive vibration and where the Controller will be accessible for calibration, inspection and servicing.

Remove the Cover. Hold the Controller in place and mark the mounting hole locations. Drill mounting holes as required by the type of surface. Attach the Controller securely to the mounting surface using #8 round-head machine screws, wood screws, or toggle bolts (as required by the application) in the slotted holes in the baseplate. Replace the Cover.

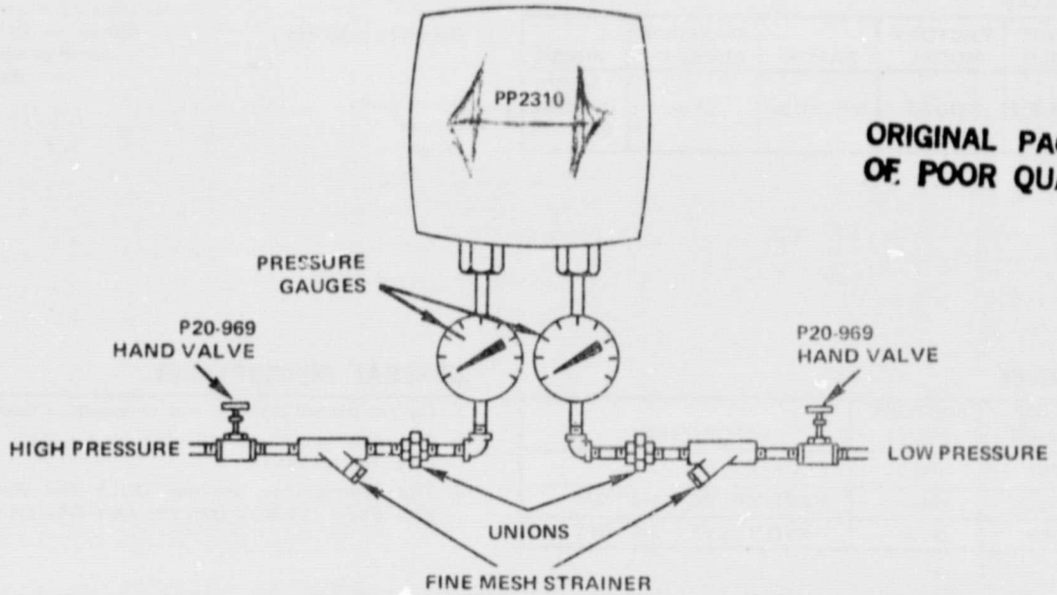


Figure 2 – TYPICAL INSTALLATION ON A WATER SYSTEM

CONTROLLED PRESSURE PIPING

Piping to the PP2310 should not be smaller than 1/4" I.D. Always provide gauges, or gauge tees, and shut-off valves to facilitate calibration and servicing. Fine mesh strainers should be installed to protect the instrument (Fig. 2).

PNEUMATIC PIPING

Remove the plastic plugs from the piping connections. Inspect each connection to be sure Filters are in place. Replace any that are missing.

Connect main air (15 psi) to the center port (M). Connect branch line serving the controlled device to the left-hand port (B). The right-hand port (R) is not used on the PP2310; however, it NEED NOT BE PLUGGED.

When the Controller is wall mounted, a gauge tee and gauge should be installed in the branch line. If a main air gauge is required, install a 1/8" x 1" brass pipe nipple and coupling between the "M" port and gauge tee, as shown in Fig. 3, to provide the proper gauge clearance. Gauge tees MUST BE INSTALLED PRIOR to mounting the controller since clearance is not sufficient to permit installation AFTER mounting.

A panel mounted Controller will be back connected and indicating gauges will be flush mounted on the panel.

Ream control air piping or tubing and keep it free of dirt, chips and excess pipe compound. When installing fittings, apply pipe compound sparingly to the male threads only, leaving the first two threads clean.

ADJUSTMENTS

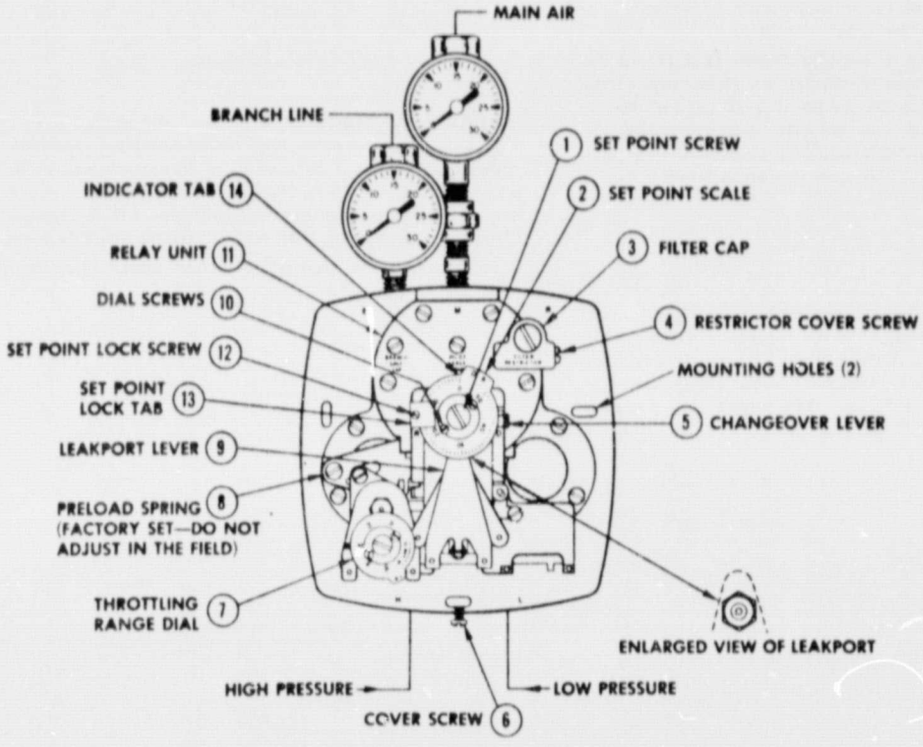


Figure 3 – PP2310 WITH COVER REMOVED

ADJUSTMENTS (Continued)

The PP2310 may be adjusted to perform the control functions outlined under "General Description". After the device has been mounted and piped, apply 15-20 psi main air in port "M", remove the Cover and adjust as follows:

STEP 1: Set the action, Direct or Reverse.

STEP 2: Set the Throttling Range or Differential.

STEP 3: Calibrate and set the Control Range. Tighten Set Point Lock Screw (12).

The following outlines the above steps in detail:

ACTION – Determine the action (DA or RA) required by the application. The unit is shipped from the factory set for Direct Acting; the Changeover Lever (5) is on the right hand side of the Set Point Scale (2) in CONTACT WITH THE STOP MARKED "D". The Set Point Scale (2) is marked "DA".

The controller may be changed to Reverse Action by moving the Changeover Lever (5) from the right hand side to the left hand side of the Set Point Scale (2) and in CONTACT WITH THE STOP MARKED "R". Loosen Set Point Lock Screw (12) and remove Set Point Lock Tab (13). Remove the two Dial Screws (10) and turn the Set Point Scale over to the side marked "RA". Replace the Dial Screws (10) and Set Point Lock Tab (13).

THROTTLING RANGE – The correct TR setting will be determined by the requirements of each individual installation. If the setting is too wide, there may be wide deviations from control point. If the setting is too narrow, there will be a tendency to "hunt" or cycle. In general the TR setting should be as narrow as possible without producing a "hunting" condition.

Using a screw driver, turn the Throttling Range Dial (7) to the required setting. The TR is equally divided on either side of the Set Point. For example, assume the set point is 20 psi and the TR setting is 10 psi. The branch line pressure will then gradually increase from 3 to 15 psi as the differential pressure changes from 15 psi to 25 psi if the PP2310 is DA, and vice versa for RA.

DIFFERENTIAL – Turn the Throttling Range Dial (7) counter-clockwise past zero to the portion of the scale marked "DIFF," and make the required setting. The Differential is equally divided on either side of the Set Point. For example, assume the set point is 20 psi and Differential setting is 10 psi. The branch line pressure will be 0 psi at 15 psi (D/P) and 15 psi at 25 psi (D/P) if the PP2310 is DA, and vice versa for RA.

CALIBRATION AND CONTROL POINT – Check the existing differential pressure on the D/P element. This MUST BE WITHIN THE RANGE of the controller and remain stationary. If this cannot be accomplished, "bench calibration" using air pressure will be necessary. Loosen Dial Screws (10) and Set Point Lock Screw (12) so the Set Point Scale (2) will rotate freely. Turn the Set Point Adjustment Screw (1) until the branch line gauge indicates 9 psi (Midpoint of the 3-15 psi range). This is the normal calibration point; however, if the controlled device operates on some other range, the calibration point should be the MIDPOINT of that range. Turn the Set Point Scale (2) until the dial marking corresponding to the measured differential pressure value is lined up with the Indicator Tab (14). Tighten the Dial Screws (10).

Using a screw driver in the Set Point Adjusting Screw (1), turn the Set Point Scale (2) to the desired control point setting. Insert the Set Point Lock Tab (13) into the slot provided on the Indicator Tab (14) and tighten the Set Point Lock Screw (12) to secure. Two slots are provided on Indicator Tab (14) in the event the tab on the Set Point Scale (2) falls at the point where Set Point Lock Tab (13) is shown in Fig. 3.

ADJUSTMENT WHEN USED AS A DIFFERENTIAL PRESSURE TRANSMITTER – The Throttling Range setting must be IDENTICAL to the scale range of the pneumatic receiver gauge. The range of the gauge and/or the Receiver Controller must be 3-15 psi. The PP2310 Set Point must be identical to the mid-point of the gauge scale range. Calibration is the same as described above.

OPERATION CHECK-OUT – When the control system is placed in operation and the controlled media has been balanced, the PP2310 should be checked to insure its correct operation in the system. Re-adjust as necessary (See Adjustments). Control Point settings may be changed without re-calibration but changes in Action, Throttling Range or Differential require re-calibration.

Covers should be securely attached after adjustments have been completed.

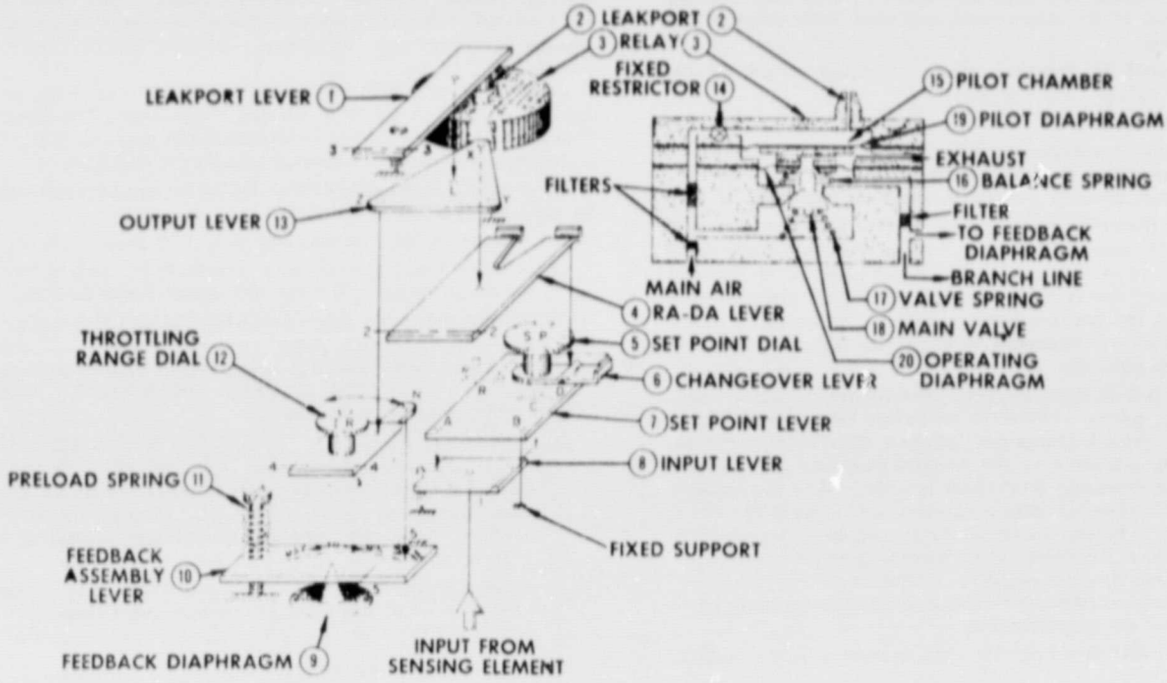


Figure 4 – SCHEMATIC DIAGRAM

DIRECT ACTING – Changeover Lever (6) in the "D" position. On an increase in differential pressure the sensing element imparts an upward force on the Input Lever (8), causing it to pivot on axis 1–1. This movement is received by the Set Point Lever (7) at point "A" and it pivots on axis B–C. Point "D" moves down and the RA–DA Lever (4) moves down, pivoting on axis 2–2. This movement is received by the Output Lever (13) at point "X". Point "X" moves down (point "Y" is fixed), thus permitting the Leakport Lever (1) to move down (pivoting on axis 3–3) and close the Leakport (2). The branch line pressure increases.

Branch line pressure is connected to the Feedback Diaphragm (9). Pre-load Spring (11) is factory set so the feedback is not effective until the branch line pressure is 3 psi. The feedback mechanism provides a true proportional relationship between the sensing element movement and the branch pressure. In addition it provides TR and DIFF. adjustment. Throttling Range Dial (12) is used to adjust the position of Point "N" on the Feedback Assembly Lever (10).

Moving the position of Point "N" to the left of axis 5-5 varies the effect of the feedback from minimum to maximum, giving an adjustable throttling range.

With the Point "N" to the left of axis 5-5, as the branch line pressure increases, Point "N" is moved up, pivoting on axis 4-4. This movement is received by the Output Lever (13) at Point "Z", moving the Output Lever (13) up, thus raising the Leakport Lever (1) to open the Leakport (2) and balance the Relay (3) at the correct branch line pressure.

Moving the position of Point "N" to the right of axis 5-5 results in negative feedback, which, in turn, changes the action to two-position control with an adjustable differential.

With Point "N" to the right of axis 5-5, as the branch line pressure increases, Point "N" is moved down. This movement is received by Output Lever (13) at Point "Z", moving Output Lever (13) down, thus lowering the Leakport Lever (1), closing the Leakport (2), and the Relay (3) cannot balance at an intermediate branch line pressure.

Decreasing differential pressure at the sensing element causes reverse lever movements from those above described.

REVERSE ACTING – Changeover Lever (6) in the "R" position. On an increase in differential pressure the sensing element imparts an upward force on the Input Lever (8), causing it to pivot on axis 1-1. This movement is received by the Set Point Lever (7) at point "A" and it pivots on axis B-C. Point "R" moves up and the RA-DA Lever (4) moves up, pivoting on axis 2-2. This movement is received by the Output Lever (13) at point "X". Point "X" moves up (point "Y" is fixed), thus lifting the Leakport Lever (1) and opening the Leakport (2). The branch line pressure decreases.

The feedback mechanism operates as described under Direct Acting.

RELAY UNIT – The relay unit is a 2:1 ratio, pilot-bleed type. The effective area of the Pilot Diaphragm (19) is twice that of the Operating Diaphragm (20). With the Leakport (2) open, the Pilot Chamber (15) pressure cannot open the Main Valve (18) due to the Balance Spring (16). As the Leakport (2) is gradually closed by the Leakport Lever (1), the pressure in the Pilot Chamber (15) increases. The downward force on the Pilot Diaphragm (19) overcomes the Balance Spring (16), closes the exhaust port and opens the Main Valve (18). Main air enters the branch chamber, branch line and Feedback Diaphragm (9) until the upward force on the Operating Diaphragm (20) plus the Balance Spring (16) exceeds the downward force on the Pilot Diaphragm (19). When this occurs, the Main Valve (18) is closed by the Valve Spring (17) and the relay is in balance.

When the Leakport Lever (1) moves away from the Leakport (2) the Pilot Chamber (15) pressure is reduced. The excess upward force on the Operating Diaphragm (20) opens the exhaust port to atmosphere. The branch line is exhausted until the forces are again in balance, at which time the exhaust port closes.

The Main Valve (18) is non-bleed and only uses air when increasing the branch line pressure. Leakport Lever (1) movements are very small and it is never necessary that the Leakport (2) be completely closed.

The PP2310 requires very little maintenance due to the simplified design, material of the components and small movements of the operating parts.

The unit should be inspected yearly to insure correct system operation, as follows (See Fig. 3):

1. Remove Cover.
2. Dirt or dust accumulations should be removed with a soft brush or a low pressure air stream.
3. Make sure pressure sensing lines are not restricted.
4. Check Throttling Range by turning the Set Point Adjusting Screw (1) until the branch line gauge reading is 3 psi. Note the Set Point and turn Set Point Adjusting Screw (1) until the branch line is 15 psi. Note the Set Point. The difference between the two Set Point readings is the actual TR of the Controller. If necessary, re-adjust the TR and recalibrate (see Adjustments).
5. Check calibration by measuring the differential pressure with accurate gauges. Divide 12 psi by the TR setting to obtain branch pressure change per 1 psi differential pressure change. Multiply this value by the difference between the set point and the measured differential pressure. Add this value to 9 psi if measured differential pressure is above Set Point, subtract if below Set Point. Totals will be within the 0-15 psi range if the measured differential pressure is within the TR setting. This is reversed for a "Reverse Acting" controller. If the original calibration point was not 9 psi, compute values based on the original point.

If the above indicates a need for re-calibration, refer to "Adjustments".

Field Repairs should be limited to:

1. Replacement of the Filter, Leakport, and Restrictor.

If more extensive repairs are necessary, replace the PP2310 with a new or factory reconditioned unit and return the defective unit to the factory.

CORRECT OPERATION OF THE RELAY UNIT may be determined as follows (see Fig. 3):

Loosen Set Point Lock Screw (12) and turn Set Point Adjusting Screw (1) until the Leakport is closed. Branch line pressure should increase quickly to 15 psi. Then lift Leakport Lever (9) to open the Leakport. Branch line pressure should decrease quickly to 0 psi. Release Leakport Lever (9) gradually SO IT DOES NOT HIT the Leakport.

If the branch line pressure WILL NOT INCREASE to 15 psi, or the increase is slow, a partially clogged Filter and/or Restrictor is indicated. If the branch line pressure will not decrease to 0 psi, or if the decrease is slow, a restricted Leakport is indicated.

If the above test indicates the Filter, Restrictor and Leakport should be replaced, proceed as follows:

1. Disconnect main air line and plug it to prevent loss of air.
2. Remove Filter Cap (3) and remove Filter with a pair of tweezers. Install new Filter and replace Filter Cap (3).
3. Remove Restrictor Cover Screw (4). Remove Fixed Restrictor, using a 1/16" Allen wrench. Install replacement Restrictor, making sure it is screwed in until it bottoms in the opening. THIS IS VERY IMPORTANT. Replace Restrictor Cover Screw (4).
4. Remove Set Point Lock Tab (13), Dial Screws (10) and Set Point Scale (2). Remove Set Point Adjusting Screw (1), turning counter-clockwise. Lift Leakport Lever (9) off its pivot points and turn it to the right until the Leakport is exposed. Remove Leakport, using a 1/4" socket or box wrench.
5. Install replacement Leakport securely. Reposition Leakport Lever (9) on its pivot points and over the Leakport.
6. Reconnect main air to the Controller.
7. Measure differential pressure with accurate gauges.
8. Replace Set Point Adjusting Screw (1) and turn it clockwise until the branch line gauge reads 9 psi. Replace Set Point Scale (2) and Dial Screws (10). Turn Set Point Scale (2) until the dial marking corresponding to the differential pressure gauge reading (Step 7) is lined up with the pointer. Tighten Dial Screws (10). Replace Set Point Lock Tab (13) and secure in place. The PP2310 is now in calibration.
9. Replace Cover and tighten Cover Screw.

Robertshaw

CONTROLS COMPANY

Uni-Line Division

GP2422

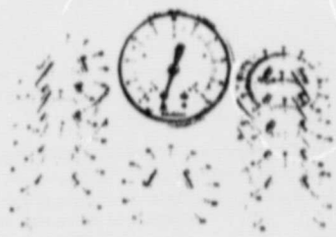
RECEIVER GAUGES

UNI-KITS®

The GP2422 RECEIVER GAUGE UNI-KITS now include eleven range scale overlays, see list below for ranges. No more ordering the scales and gauges separately — they are packaged together.

Uni-Kit Receiver Gauges are available in 2", 2-1/2" and 3-1/2" sizes. The GP2422-003 (2") Receiver Gauges are stem mounting, back connected type gauges and are used on those applications not requiring flush mounting on a panel. The case is a gray Lexan® and these gauges also use a bourdon tube to actuate a brass gear movement.

The GP2422-001 (2-1/2") and GP2422-002 (3-1/2") gauges are a flush mounting type. These gauges have zinc plated steel cases with chrome plated snap out rings. They are activated by a bourdon tube through sturdy brass gears. A U-clamp mounting arrangement is standard for use in mounting these gauges on a panel. An adjustable pointer allows accurate zero adjustment on both models.



Range scale overlays included:

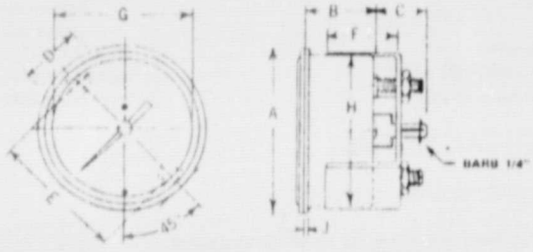
-40 to 160°F.
-25 to 125°F.
0 to 100°F.
40 to 100°F.
40 to 140°F.
40 to 240°F.
50 to 90°F.
62.5 to 92.5°F.
0 to 2.0" W.C.
0 to 7.0" W.C.
30 to 80% RH
Blank

UNI-KIT MODEL NUMBER	FACTORY NUMBER	GAUGE SIZE	SIGNAL (PSI)	MOUNTING
GP2422-001	A251	2-1/2" DIA.	3 TO 15	PANEL TYPE WITH 1/4" BARB CONNECTION
GP2422-002	A252	3-1/2" DIA.		
GP2422-003	A253-11	2" DIA.		STEM TYPE 1/8" PIPE.

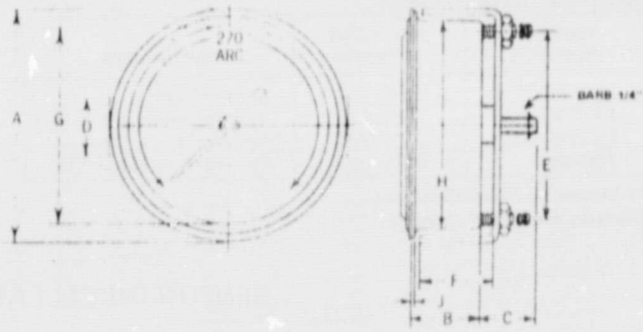
MOUNTING DIMENSIONS

DIMENSIONS IN INCHES

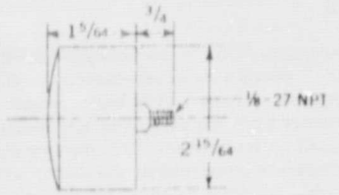
MODEL	A	B	C	D	E	F	G	H	J
GP2422-001	2-29/32	1-3/16	3/4	1	1-7/8	1-3/8	2-9/32	2-19/32	1/16
GP2422-002	4	1-3/16	3/4	1	2-15/16	1-11/32	3-15/64	3-23/32	1/16



MODEL GP2422-001



MODEL GP2422-002



MODEL GP2422 2" FIXED SCALE MODELS

ROBERTSHAW CONTROLS CO. · UNI-LINE DIVISION · P.O. BOX 2000, 4100 TEMESCAL ST., CORONA, CA 91720

PRINTED IN U.S.A. 11/73

FORM NO. (820) GP2422
REV. 6/76 1-502

Robertshaw CONTROLS COMPANY

Uni-Line Division
P.O. BOX 2000, 4190 TEMESCAL ST.
CORONA, CA 91720

ST3990 SERIES
SOLAR COMMANDER

The ST3990 Solar Commander provides sensitive temperature response and solid state switching to effectively operate a circulating pump in a liquid filled solar heat storage system.

The ST3990 Solar Commander provides pump circulation cut-in when the collector panel temperature is higher than the storage tank. The Solar Commander cut-in temperature differential is adjustable from 8 to 20°F. Temperature differentials of 5° or less between these points will signal the Solar Commander to turn the circulating pump off. The pump switch action is accomplished with solid state components, capable of handling loads up to 3.8 amp inductive, eliminating the need for any moving parts in the controller circuit.

The Solar Commander circuit incorporates electrical isolation protection for both input and output signal. The entire electrical circuit is protected by space age encapsulation.

The Solar Commander comes equipped with an easy access terminal strip for the low voltage sensor circuit and line leads hook-up. The case-frame is equipped with line lead conduit adapter access.

Solid State Thermistor Sensors, of special design, are utilized to accurately signal temperature differential to the control circuit from the solar collector and the storage tank with maximum accuracy from extended distances if necessary.

The Solar Commander sensors are conveniently encapsulated in 5/16" x 1-1/4" copper tubing and come with 6" lead lengths.

SPECIFICATIONS

Cut-in differential	adjustable 8 to 20°F
Cut-out differential	fixed 5° ± 3°F
Sensor	300°F rated thermister (interchangeable)
Sensor size	5/16" dia x 1-1/4" long with 6" leads
Recycling upper limit	190°F
Three position switch	on-off-auto
Pilot lights	power on pump on
Freeze protection	cut-in 37°F.
(Model ST3990-103 only)	cut-out 41°F.
Ambient temperature	32° to 150°F

ELECTRICAL RATING

80 to 130 VAC, 50 or 60 Hz (cycles)

3.8 amps full load inductive, 29 amps locked rotor

ORDERING INFORMATION

All models have the features listed under specifications except as noted under comments below.

ORDER NUMBER	FACTORY NUMBER	COMMENTS
ST3990-101*	SD10-2601	Standard device
ST3990-103*	SD10-3201	Includes freeze protection
ST3990-104*	SD10-3601	Without hi-limit feature
P30-098	S310-1001	Replacement sensor (1)†

*Includes (2) P30-098 sensors
†Sensors are interchangeable

SENSOR INSTALLATION INSTRUCTIONS

Good thermal transfer from the controlled medium is important. A heat sensitive compound such as GE Insulgrease #640 or Dow Corning #340 Heat Sink Compound may be used between the sensors and the surfaces to which they are being applied.

The Solar Commander Sensors are designed for surface mounting. To facilitate this, two mounting clips are included with each Solar Commander. Usually the collector sensor should be mounted on a part of the collector panel which will be directly exposed to solar input. It should also be near the collector outlet so the sensor is also reading outlet water temperature.

Sensors are rated at 300°F. maximum. Excessive time exposed to temperatures over 300°F. will degrade the sensor affecting its calibration. (For conditions above 300°F, an optional 400°F, rated sensor is available.) Figure 1 shows a set of representative resistance values to use in checking the sensors. If a faulty sensor is suspected, disconnect the sensors from the controller and measure the resistance of the sensor with an ohmmeter. This resistance should be compared to the temperature measured at the sensor using the chart in Figure 1 as a guide. An open or short circuit would indicate that the sensor should be replaced using a P30-098. These values may be used as a guide to the operation of the control but should not be used as a calibration check.

To wire the sensors, #18 wire may be used. If the sensor leads parallel the line voltage wiring for any distance, shielded cable or twisted wire must be used to minimize interference.

FIGURE 1: SENSOR CHARACTERISTICS CHART

°F	RESISTANCE	°F	RESISTANCE
40°	83,164	140°	6,777
50°	62,354	150°	5,485
60°	47,211	160°	4,465
70°	36,057	170°	3,656
80°	27,776	180°	3.010
90°	21,558	190°	2,490
100°	16,860	200°	2,070
110°	13,291	210°	1,731
120°	10,545	220°	1,453
130°	8,430	230°	1,225

CONTROLLER INSTALLATION INSTRUCTIONS

NOTE: All wiring must conform to all local electrical codes or ordinances.

1. Remove the cover and mount control. A wiring diagram is located inside the cover, and is also shown in Figure 2.
2. Mounting of the ST3990 Series controls is made through the holes in the back of the case. The control is not position sensitive and may be mounted in any plane. Each case has an outlet for high voltage leads accepting 1/2" conduit fittings and a separate opening for Class 2 sensor wiring.
3. All power to the control should be disconnected prior to wiring. Power supply terminal is marked "LINE."

NOTE: Before wiring the Solar Commander to the circulating pump, be sure to check the pump circuit for dead short circuit or ground faults. Do not test pump motor by jumping common and load terminals. Permanent damage to the Triac will result and void warranty.

4. Connect motor leads to terminals "LOAD" and "COMMON." The full load ampere rating of the motor must not exceed 3.5 amps at 120 VAC 50/60 HZ (1.7 amps at 240 VAC). The control should not be used where ambient temperature exceeds 150°F.
5. The selector switch should be in the "OFF" position prior to applying power to the control. With the power applied, the pump motor will not run. The red light will be on indicating power to the control. Moving the selector switch to "Manual" will permit the pump motor to run. The motor will run continuously regardless of sensor condition, and the amber light will be on. Moving the selector switch to "OFF" will turn off the pump motor and amber light.
6. The following procedure should be used to check out the automatic operation of the control module prior to connecting the sensors.
   A. By jumping the sensor terminals "COLLECTOR" to sensor "COMMON" will permit the motor to operate once the selector switch is moved from the "OFF" to "AUTO" position, checking the cut-in circuit of the module. Remove jumper.
   B. With the "TANK" to "COMMON" jumped and "COLLECTOR" to sensor "COMMON" opened, when moving the selector switch from "OFF" to "AUTO," the motor will not run. This checks the differential cut out portion of the module.

DIFFERENTIAL (CUT-IN) ADJUSTMENT

The ST3990 Series Controls come factory set at 20°F. cut-in differential. If adjustment is necessary, it is made on the cut-in adjustment pot located in approximately the center of the control. Rotating the adjustment counter-clockwise decreases the cut-in differential.

CAUTION

THIS DEVICE SHOULD BE INSTALLED BY A QUALIFIED PERSON WITH DUE REGARD FOR SAFETY AS IMPROPER INSTALLATION COULD RESULT IN A HAZARDOUS CONDITION.

FIGURE 2: WIRING SCHEMATIC

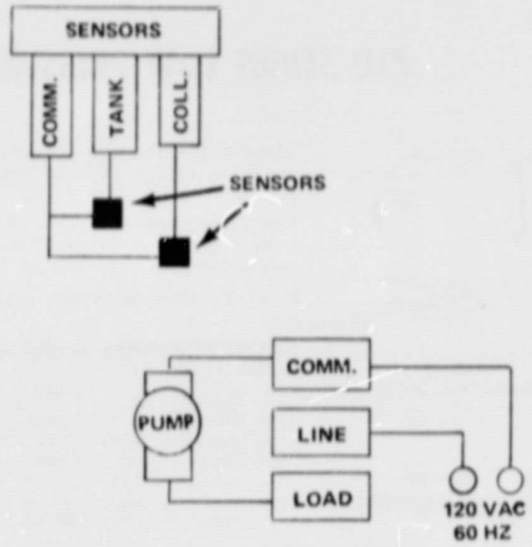
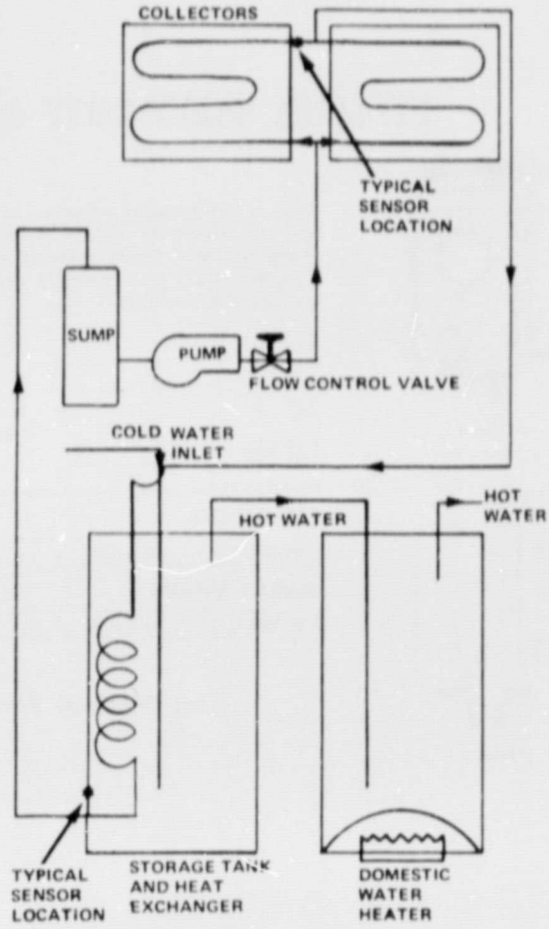


FIGURE 3: HOT WATER APPLICATION, INDIRECT SYSTEM

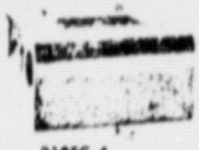
Shown is the diagram of a typical hot water system installation. Shown are the typical locations for the differential controller sensors. The controller may be located in any convenient location to facilitate ease in wiring.



P10 SERIES LOW PRESSURE CONTROL

SINGLE OR TWO-STAGE

P10BC-7
With Bracket No. BKT16A-600



P10FC-4

These SPDT pressure controls open or close an electrical circuit from a change in operating pressure.

Typical applications include: Pneumatic systems, control of pumps or small air compressors and pressure-electric interlock of fluid flow systems.

R to Y terminals make (cut-in) on pressure rise.

ELECTRICAL RATINGS — (For each Pennswitch)

P10BC, P10FC

Motor Rating	120 V.	208 V.	240 V.	277 V.
A.C. Full Load Amps.	16.0	9.2	8.0	7.0
A.C. Locked Rotor Amps.	96.0	55.2	48.0	42.0
Non-Inductive Amps.	16.0	9.2	8.0	7.2

Pilot Duty — 125 VA. at 24 to 277 V. A.C.

NOTE: On 2-stage models, the maximum connected load shall not exceed 2000 VA.

Controls have a visible calibrated scale and adjustable range. A universal mounting bracket No. BKT16A-600 is supplied as standard. Model P10FC-1 has a jumper installed on the common terminals. Model P10BJ-1 is rated for 24 amps. non-inductive. (See electrical ratings).

Maximum Allowable Pressure: 150 psig.

TO ORDER: Specify Catalog Number only.

P10BJ

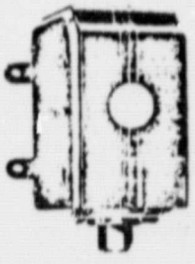
Motor Rating		120 V.	208 V.	240 V.	277 V.	600 V.
A.C. Full Load Amps.		16.0	9.2	8.0	—	—
A.C. Locked Rotor Amps.		96.0	55.2	48.0	—	—
Non-Inductive Amps.	Double Throw	16.0	16.0	16.0	16.0	16.0
	Single Throw	24.0	24.0	24.0	24.0	24.0

Pilot Duty — 125 VA. at 24 to 600 V. A.C.

Catalog Number	Number of Stages	Contact Action	Range (psig)	Factory Setting (psig)		Switch Diff. (psi)		Pressure Connector FNPTF	Shipping Wt. Lbs.
P10BC-7	1	SPDT	3 to 20	12 R to Y Cut-in)		2		⅛"	1.0
P10BJ-1	1	SPDT	3 to 20	12 R to Y Cut-in)		2		⅛"	1.0
P10FC-4	2	SPDT	3 to 20	(R to Y Cut-in) High Stage	(R-Y Cutout) Low Stage	High Stage	Low Stage	⅛"	1.5
				12	8	2	2		

P11 SERIES HEAVY DUTY AIR COMPRESSOR SWITCHES

PRESSURE RANGES TO 250 PSIG



P11BA-1

Heavy duty pressure switches for air compressor service. Contacts OPEN on rising pressure. Available with 2-way pressure release valve for compressor systems equipped with auxiliary tank or bleeding chamber.

TO ORDER: Specify Catalog Number only.

ELECTRICAL RATINGS

Volts	Single Phase A.C.	Polyphase A.C.	D.C. (120 240 V.)
120	2 H.P.	—	1 H.P.
240-550	3 H.P.	5 H.P.	1 H.P.

A.C. NON INDUCTIVE — 25 Amps. 120 V., 1Ph.

P11BB-1

Catalog Number	Range Min. Cut-in to Max. Cutout (psig)	Differential Adj. (psi) Min.	Max.	Factory Setting Open	Close	No. of Poles	Pressure Connector FNPTF	Shipping Wt. Lbs.
NO VALVE								
P11BA-1	10 to 250	26	56	150	120	2	¼"	4.6
2-WAY VALVE								
P11BB-1	10 to 250	26	56	150	120	2	¼"	4.8

For Optional Ranges and Connectors, write 'Customer Service.

ABSORPTION CHILLER

Refer to manuals provided by the chiller manufacturer, Arkla Industries, for its model WFB-300 chiller.

COOLING TOWER

INSTALLATION & MAINTENANCE INSTRUCTIONS

Goodfellow

COOLING TOWERS

JOMAC
OF ORLANDO, INC.
ROSEMONT BLDG. SUITE 117
5104 N. ORANGE BLOSSOM TRAIL
PH (305) 293-8405
ORLANDO, FL 32804

E. D. Goodfellow Co., Inc.

SUBSIDIARY OF [illegible]echnology, inc.

415 BROOKS ROAD / P.O. BOX 2119 / MEMPHIS, TENNESSEE 38101 / (901) 398-9257

GOODFELLOW Induced Draft Cooling Towers have been designed to give the utmost in performance, long life and trouble free service. The successful operation of this type cooling tower depends mainly upon its installation. It is desired that the installer follow the instructions contained herein as closely as conditions will permit.

SETTING TOWER

The tower should be set on as firm a foundation as possible and preferably anchored. This is a MUST where high winds are expected. The tower should be set level in all directions, otherwise there will be an improper distribution of water over the wetted deck surfaces. Should the tower be tilted, the water will run to the low side, thus bypassing a portion of the surfaces. This will greatly impair the tower efficiency. After the tower has been placed in operation, recheck and make certain that the water is falling evenly through the entire wetted deck area. Towers equipped with spray nozzles do not require the leveling as do those which depend upon gravity fall for water distribution.

INDOOR INSTALLATION

Make certain that there is more than ample fresh air available near the air inlet of the tower. Restricted amounts of fresh air will cause unnecessary overloading of the fan and make for poor performance. It will be necessary to attach a discharge duct to the fan discharge to convey the hot humid air to the outside. This duct should be kept as short and straight as possible. DO NOT decrease duct size smaller than the fan opening. For very quiet operation connect the duct to the tower with a canvas or other flexible material. Cover the outlet with a very coarse screen or small size chicken wire to prevent foreign objects from entering. Do not restrict the air flow any more than is necessary. Should prevailing winds blow into the discharge, it is suggested that a suitable windbreak be installed several feet away. If this is not possible, an elbow directed downward should be installed. In all cases where the tower is equipped with a fan guard, this should be removed.

OUTDOOR INSTALLATION

Place tower so that prevailing winds blow into the inlet end and not the discharge. If this is not possible protect the discharge as outlined above. Install weatherproof housing over motor. All towers have their supports drilled for anchoring bolts.

PIPING CONNECTIONS

If at all possible, new galvanized pipe should be used. Run all lines as short and straight as possible. (It is well to remember that one ell will cause as much friction loss as several feet of straight pipe.) In order to minimize friction loss, use as large a size pipe as possible. The gpm requirements of the system will dictate the smallest pipe size that can be used. Consult a pipe capacity-friction chart, if in doubt.

In cases where the tower is installed lower than the condensers, siphoning will take place. This may be prevented by several methods; however, one of the best and easiest is to install a good quality swing-type check valve in the pump discharge line.

It will be desirable to install a gate valve in the pump discharge line. Should the pumping head of the installation be less than that calculated, or should the pump have more capacity than required it will be necessary to control the amount of water over the tower. This is desirable for two important reasons: the more water that is pumped, the more the horsepower requirement; consequently, unnecessary current would be used. Also, in many cases too much water over the tower will not give proper operating temperatures. With all GOODFELLOW cooling towers with open distribution pans the water level should be at least 1-½ inches from the top of the distribution pan.

Towers equipped with spray nozzles should have a water pressure of 5 pounds at the tower header. This pressure indicates 3 gpm per ton is flowing through the system.

MAKE-UP

Check the float ball and valve for freedom of movement. When properly adjusted the float valve should close off when the basin is approximately half full of water. In some instances some siphoning action may take place in the line, causing the tower to overflow on the off cycle, and it may be necessary to reset the float ball. At no time should the float ball be so set as to permit cavitation to take place at the suction. A separate shutoff valve should be installed in the make-up line.

ELECTRICAL

Check motor nameplate and make certain that the power source is suitable as to voltage, phase and

frequency. Furnish and connect pump starter and controls. Towers equipped with belt driven fans should have the motor checked for proper rotation with the belt, or belts, removed. The fans on all propeller type towers should pull the air through the tower and discharge from the front.

TOWER OPERATION

After checking all electrical connections, tower basin should be filled with water. Before doing this, remove any debris that may have accumulated in the tower basin. Check suction screen, making certain it is securely in place. Purge all air from the pump volute. Start the pump and adjust the make-up valve, remembering that the water level rises when the pump shuts off due to the amount of water in the distribution pan and deck falling into the basin. After making certain that all pipe connections are good, the system should be put in operation and the float valve rechecked.

SHUTTING DOWN. If the tower is to be shut down, during the winter, or for any lengthy period of time, the cold water basin should be completely drained. At this time it is desirable to flush the tower with clear water. Should the tower be shut down for a considerable period of time, fan belts should be removed and stored in a dry place. Grooves in the sheaves should be cleaned and painted to prevent rust.

REMOTE OPERATION. In many cases where a tower is to be operated during the winter months in cold climates, it will be necessary to install a water collecting basin within the building. This collecting basin should consist of a make-up and float ball valve, screened suction, overflow and drain connections. With this type of installation, no float or overflow should be in the tower basin. These fittings should be plugged. It will be desirable to leave the suction screen in the tower basin and install an additional suction screen in the inside catch basin. The catch basin should be of sufficient capacity to contain all the water used in the system. If this is done, the tendency to overflow will be minimized.

MAINTENANCE

Totally enclosed motors with direct driven fans are permanently lubricated for their total life. Motors equipped with ball bearings are factory lubricated for at least two years of normal operation. Motors with sleeve bearings are generally shipped without oil. It is recommended that the proper grade of oil should be S.A.E. 10 that has no additives. In any case, check the lubrication instructions supplied by the Manufacturer which are attached to each motor.

Fan shafts with ball bearings should have grease added once a month during normal operation. A high grade waterproof ball-bearing grease should be used. This grease should have Lithium or Strontium base of NLGI No. 2 consistency. DO NOT overgrease. Bronze or graphited bronze bearings should be lubricated as follows; temperature range of 70°-120°, SAE No. 50. Range of 40°-70°, SAE No. 30. High grade nondetergent oil should be used. Oil cups should be filled at least every two months of operation and at start up or after a prolonged shut down.

Gear reducers should be serviced and lubricated in strict accordance with manufacturer's recommendations, which are attached to each unit.

Belt tension should be checked after the first week of operation and twice a month thereafter. Should any apparent stretch be noticed the motor base should be adjusted for proper belt tension. On towers that have two or more belts, never replace a single belt. Replace with a MATCHED set of belts of the same size and type.

BLOW DOWN

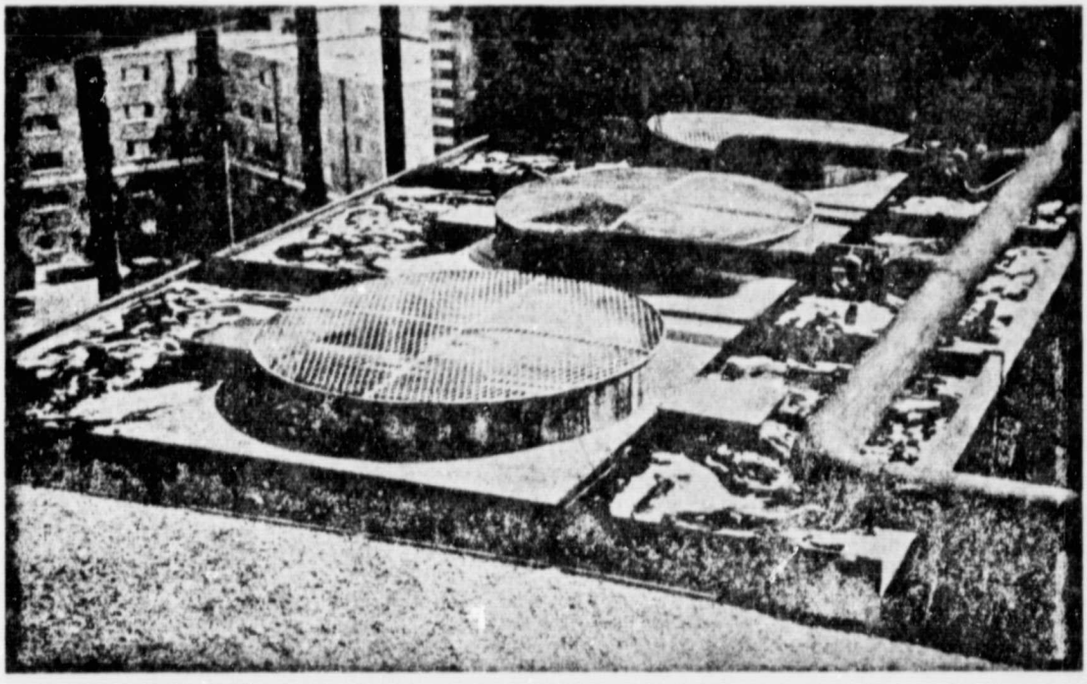
The operation of a cooling tower causes a certain amount of evaporation of the water circulated. This evaporation does not remove any of the dissolved solids that are present in the water. Continual buildup of these solids will eventually cause a buildup of scale within the piping and condenser unit. In order to minimize this effect it is often desirable to waste a small amount of the water circulated. In most cases, a waste of .25% to .5% of the water circulated will materially alleviate this situation. The blow down, or bleed line, may be connected in any part of the system. However, it has been found most desirable that this be done by making the connection in the hot water line at the tower or from a connection from the distribution pan. In this manner, minimum waste would be obtained. It is recommended that a wrench operated valve be installed in the blow down line for proper control. It is also desirable that all water be drained from the system at periodic intervals and replaced with fresh water.

ALGAE. Under certain operating conditions a green moss, or algae, may make its appearance in the tower. Chemicals such as potassium permanganate, copper sulphate, or chlorine, may be added in small quantities. Should copper sulphate be used, do not add more than *one* ounce for each 800 gallons of water in the system as this chemical, while effective, is very corrosive. Other factors also cause algae, and, should treatment with the above chemicals not suffice, a competent Water Treatment Engineer should be consulted. The use of tower cleaning chemicals and scale removers is not recommended unless the composition of the scale is known and the proper chemicals used. The services of a competent Water Treatment Engineer should be obtained and his advice followed. Certain chemicals have strong acid content that is injurious to both wood and metal. In this regard any treatment that adds sodium carbonate such as the Zeolite process, should be avoided. Great care should be taken in the selection of cleaning compounds. Avoid those that have an acid content that will attack zinc. This is most important as most cooling towers manufactured today have hot dipped galvanized casings, basins and other components.

CLEANING AND PAINTING

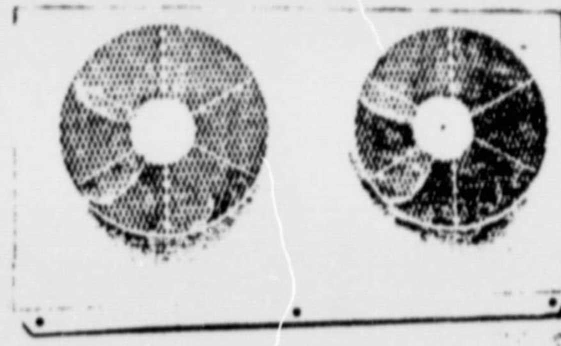
After the tower has been shut down all dirt and trash which may have collected in the water basin should be removed. The entire tower should be flushed with clean water. If any abrasions are noticed on the tower exterior, they should be sanded and primed with a coat of Zinc Chromate. After allowing sufficient time for drying, finish color should then be applied. Should it be necessary to remove the deck filling for any reason whatsoever, it should be replaced in the opposite manner from which it was removed. When replacing the deck filling make certain that all parts fit properly so that the deck filling will assemble in an even and level manner.

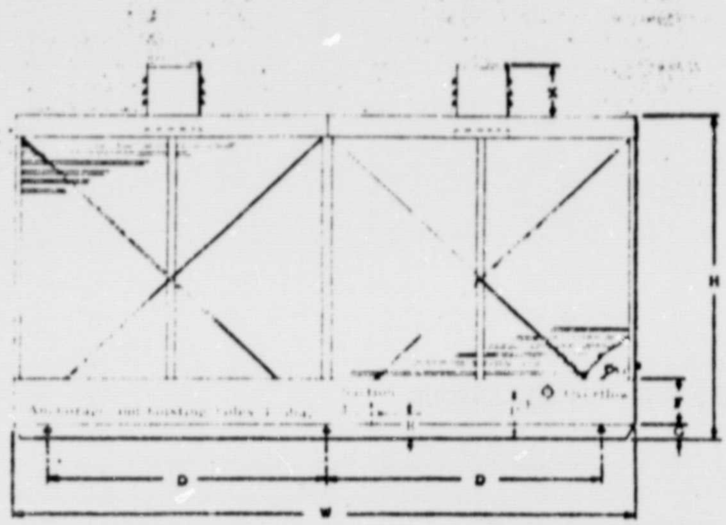
Should any problem arise not covered in these instructions, please communicate with our nearest representative or the factory direct.

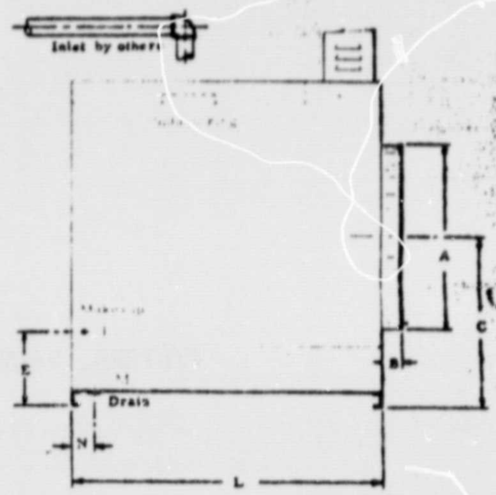


For larger capacities, these two-fan units provide the advantage of doubling single fan performance in a single tower. Flexibility of operation is apparent as close control of water temperature is possible by fan(s) control. When so ordered, a partition would be installed in the tower center, thus making the tower a two cell unit. All models are normally shipped completely assembled, to permit fast, economical installations.

FREIGHT CLASSIFICATION: All cooling towers of steel 20 gauge and thicker, or steel and wood combined, are now classified as Class 100.







Model	DIMENSIONS (in inches)	FAN	WEIGHT
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

PERFORMANCE [illegible]

Refrigeration capacity table, based on [illegible]

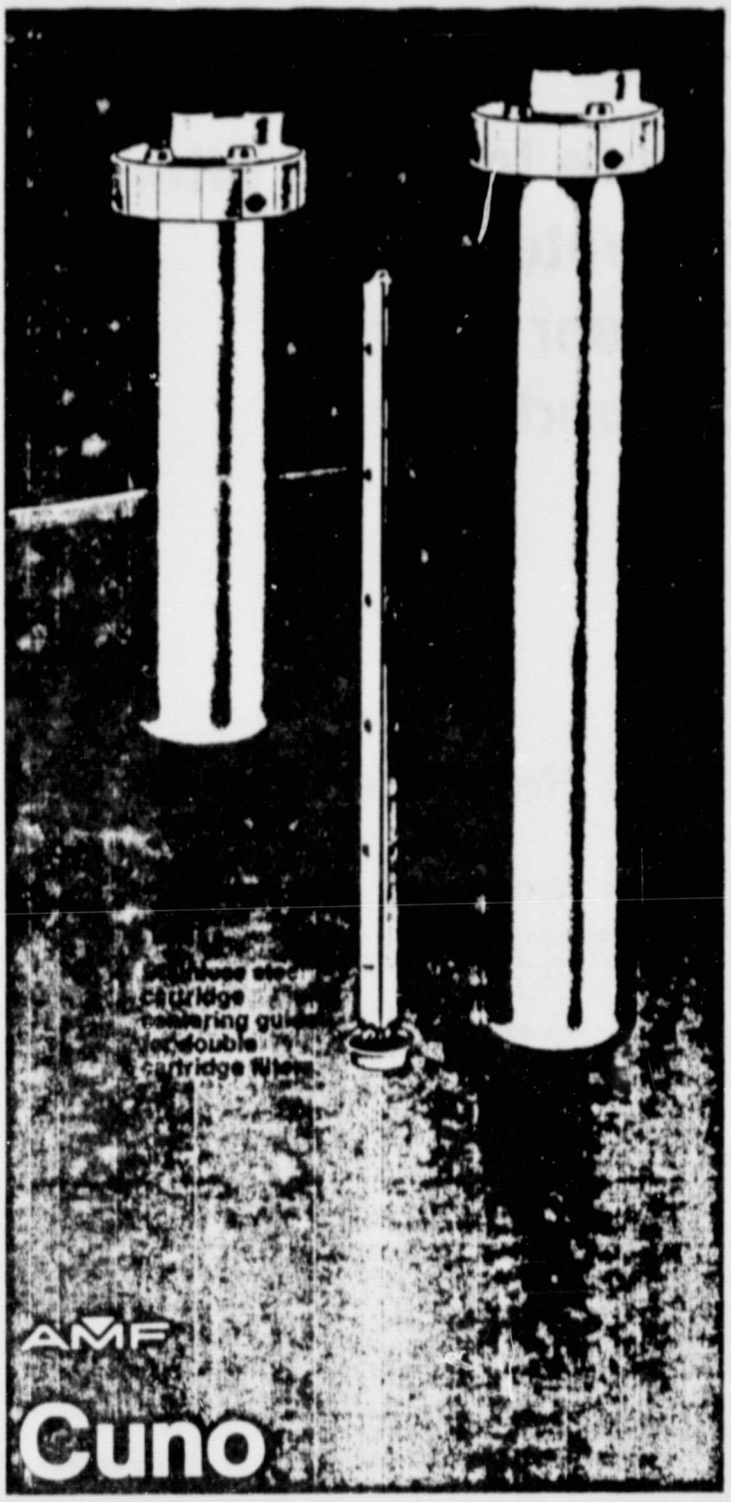
TONS OF REFRIGERATION WHEN CIRCULATING 3 GPM PER TON

Hot Water	90	87	95	92	95	96	95	97	95	96	96	96	98
Cold Water	80	77	85	82	85	86	85	87	85	86	86	86	88
Wet Bulb	65	70	70	72	72	73	75	75	78	78	79	80	82
P3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.1	[illegible]	2.6
P5	6.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P11	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P15	22.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P20	30.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20.9	[illegible]	[illegible]
P25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	25.7	[illegible]	[illegible]
P30	44.7	25.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P40	59.4	33.7	66.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P50	74.1	42.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P60	**89.4**	**50.8**	**99.6**	**71.1**	**90.2**	**93.8**	**76.2**	**88.6**	**60.6**	**67.4**	**61.4**	**56.2**	**51.5**
P75	111.2	63.2	142.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P100	146.2	84.2	165.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	102.6	[illegible]	[illegible]
P125	182.0	105.0	205.0	146.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
P150	222.3	126.3	284.4	177.9	225.9	229.2	[illegible]	221.1	[illegible]	[illegible]	153.9	139.5	128.2

For [illegible] range, 95° inlet water, add 10% [illegible] capacities shown.

ORIGINAL PAGE IS
OF POOR QUALITY

FILTERS, VALVES, AND MISCELLANEOUS



Aqua-Pure® Commercial Duty Water Filters

Models SS-1 and SS-2 Heavy Duty Filters for point-of-use and small systems

Almost everyone reacts negatively to water that tastes and smells bad . . . or looks cloudy from "unidentified" particles. It creates a poor impression, destroys good will, hurts business. The world leader in solving bad water problems is AMF Cuno. This bulletin describes heavy duty filtration units which can be installed at the point of use or manifolded in groups as small systems. Filters can be installed to clean up all the water in an establishment, or just the water in certain areas. Kitchens, dining rooms, guest rooms, special facilities in hospitals, dishwashers, ice makers, laundries, the list includes every facility and every use where clean, clear, good tasting water is a must.

AMF Cuno Aqua-Pure Taste/Odor and Dirt/Rust filters are the low-cost, high-efficiency answer to removing dirt, algae, sediment, rust, silt, bad taste and odors from water — either from well or municipal supply. You get rid of deposits that clog pipes, filters, shower heads, toilets, dishwashers and other types of water-fed equipment. The Model SS-1 and SS-2 can be used singly or in systems for removing either dirt and rust or bad tastes and odors, depending on the filter cartridges used.

Good filtration saves money, and Aqua-Pure Filters offer the best protection available. With Aqua-Pure, there's no fuss or messy collapsed filters or loose carbon to contend with. Rugged, self-contained cartridges are changed in minutes. Disposal is quick and easy. Your water system is back in service immediately. And an Aqua-Pure Heavy Duty Filter System can provide high flow rates. For instance, with a multiple filter installation involving four SS-2 filters and an AMF Cuno Model M1-4 Manifold, you can get up to 24 GPM. Other arrangements can deliver even more.

NSF

National Sanitation Foundation Testing Laboratory Seal. Aqua-Pure® products with this seal are listed with official health departments throughout the United States.

There's an Aqua-Pure long-life filter cartridge to make water sweet, clean and clear under almost any set of conditions.

For Dirt/Rust Removal

A selection of Aqua-Pure Dirt/Rust Filters is available to remove dirt and rust you cannot see from water; particles as fine as a single grain of talcum powder. They trap sand, silt, dust, algae, worms and other particles, assuring clear, clean, safe, sparkling fresh filtered water. Results: clear, pure, drinking water, brighter laundry, clean and unclogged water appliances, stain-free sink and toilet bowl water. Aqua-Pure Dirt/Rust Filters are available in models for both cold and hot water service. Their use before water softeners removes dirt and rust and extends the life of the salts.

HOW AQUA-PURE LONG-LIFE FILTERS SCRUB DIRT/RUST OUT OF WATER.

Aqua-Pure Dirt/Rust filter cartridges are made by an exclusive, scientific process in which pure white cellulose fibers are locked permanently in the form of a porous, rigid cylinder with spaces between fibers gradually growing smaller toward the center hole. As water passes through the body of the cylinder, solid matter is removed, water then flows up through center hole and into faucets and appliances. The annular grooved cylinder provides 60% more surface area than ordinary filters. Section views show how water flows through cellulose filter and is scrubbed clean.

COLD WATER SERVICE

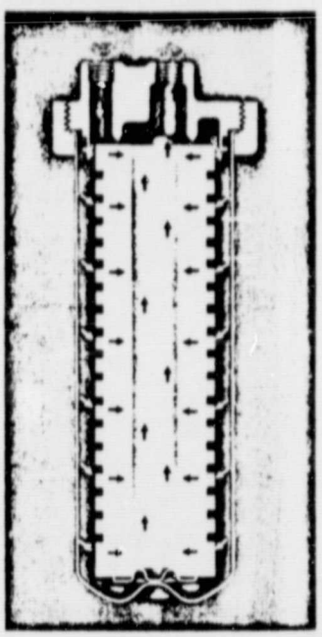
Rated for 100° F maximum water temperature. Aqua-Pure AP110 Standard Duty Cold Water Dirt/Rust Filter Cartridge has filtration capability of 5 microns and larger. For heavy dirt loads, use Aqua-Pure AP124 Heavy Duty Dirt/Rust Filter Cartridges with filtration capability of 50 microns and larger.

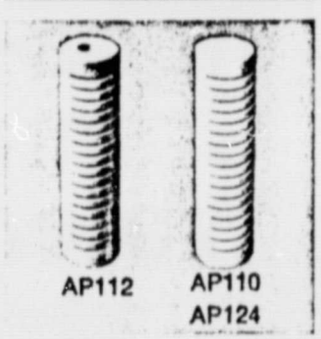
HOT WATER SERVICE

Rated for 210° F maximum water temperature. Aqua-Pure AP112 Standard Duty Hot Water Dirt/Rust Filter Cartridge has filtration capability of 5 microns and larger.

FILTER CARTRIDGE SPECIFICATIONS.

All AP110, AP124 and AP112 Dirt/Rust Filter Cartridges are 9¾" high x 2⅝" diameter x 1" center hole. Dirt/Rust Filter cartridges have a maximum flow rate of 6 GPM. Filter cartridges are packed two cartridges in a box, twelve boxes in a master carton. Shipping weight approximately 12 lbs. Also bulk packed 36 cartridges to a carton. Shipping weight 20 lbs.





AP112 AP110 AP124

SPECIFICATIONS — Aqua-Pure Models SS-1 and SS-2 Housings

Model SS-1.

This is a single filter cartridge housing with brushed stainless steel sump and nickel-plated cast brass head and threaded ring unit. Because of their rugged construction, they are recommended for commercial application or large residences. They are designed for high water pressure applications.

Model SS-2.

This housing is identical to the SS-1 but contains two filter cartridges to provide higher flow rates and greater dirt storage capacity. Model SS-2 is equipped with a stainless steel centering guide that automatically aligns filter cartridges end-to-end for single unit removal and replacement.

Model No.	Pipe Size	Dimensions Height	Dimensions Diameter	Flow GPM DIRT/RUST	Flow GPM TASTE/ODOR	Max. Pressure
SS-1	3/8"	12"	4 3/8"	6	3	300 PSI
SS-2	3/8"	22"	4 3/8"	*6	6	300 PSI

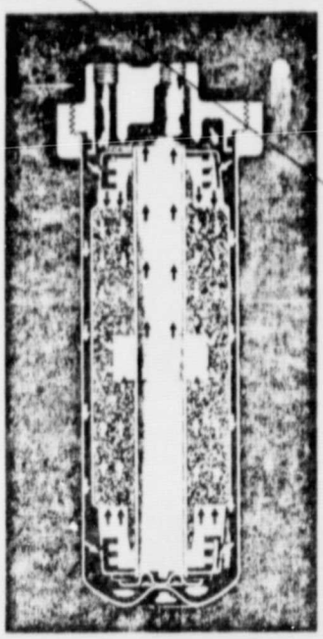
*Flow rate is limited by a maximum velocity of 8 ft./Sec. as required by National Standard Plumbing Code for water piping systems. At a velocity of 10 ft./Sec. these valves can be increased by 25%. Filter life increases by the addition of cartridges: for example an SS-2 has twice the life of the SS-1.

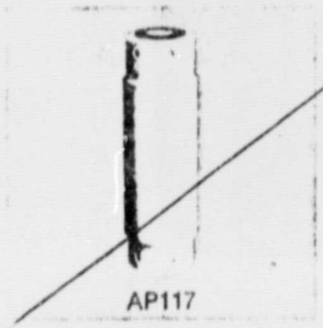
PACKAGING AND SHIPPING

SS-1 Housings are individually boxed, includes mounting bracket and installation instructions. Packed four filters to a master carton. Shipping weight approximately 20 lbs. Housings are packed without filter cartridges.

SS-2 Housings are individually boxed, includes mounting bracket, centering guide and installation instructions. Packed one filter to a master carton. Shipping weight approximately 5¾ lbs. Housings are packed without filter cartridges.

For Taste/Odor Removal





AP117

The new long-life AP117 Taste/Odor Filter Cartridge eliminates the taste and odor of chlorine, sulphur, musty, stale and metallic tastes and odors from drinking and cooking water. This unique cartridge contains hundreds of thousands of activated charcoal granules that soak up taste-spoiling contaminants and delivers fresh-tasting, sparkling clear water. As a result, the flavor of everything prepared with water is delightfully improved.

HOW AQUA-PURE TASTE/ODOR FILTERS RESTORE SPRING-FRESH TASTE TO DRINKING AND COOKING WATER.

Water enters the new filter cartridge through holes near both ends where dirt and rust particles and other sediments are trapped. The clean water then passes through a deep bed of premium activated charcoal where tastes, odors, and color are removed, and then out the middle of the cartridge through a pure white post-filter disk before flowing up and out of the filter. Section view shows how water flows through the filter.

COLD WATER SERVICE ONLY.

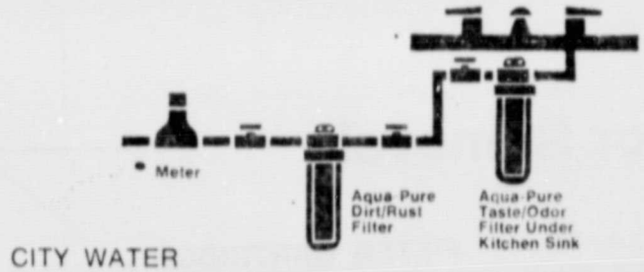
Aqua-Pure AP117 Taste/Odor Filter Cartridge rated for 100°F maximum water temperature.

FILTER CARTRIDGE SPECIFICATIONS.

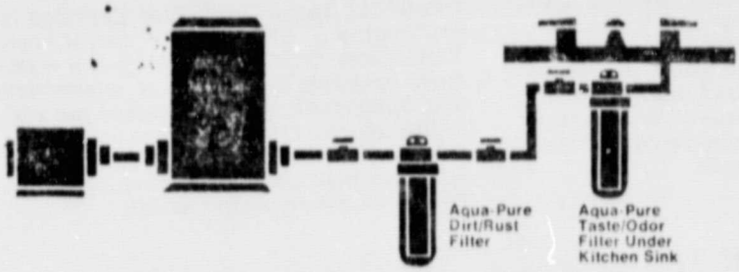
The AP117 Taste/Odor Filter Cartridge is 9¾" high x 3" diameter x 1" center hole. Taste/Odor filter cartridges have a maximum flow rate of 3 GPM of intermittent use. Filter cartridges are packed two cartridges in a box, twelve boxes in a master carton. Shipping weight approximately 30 lbs. Also bulk packed, 36 cartridges to a carton. Shipping weight 46 lbs.

Pat. No. 69379-31

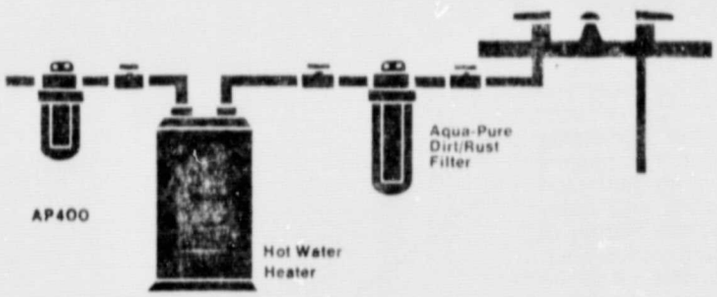
INSTALLATION AND OPERATING INSTRUCTIONS AQUA-PURE® STAINLESS STEEL FILTERS



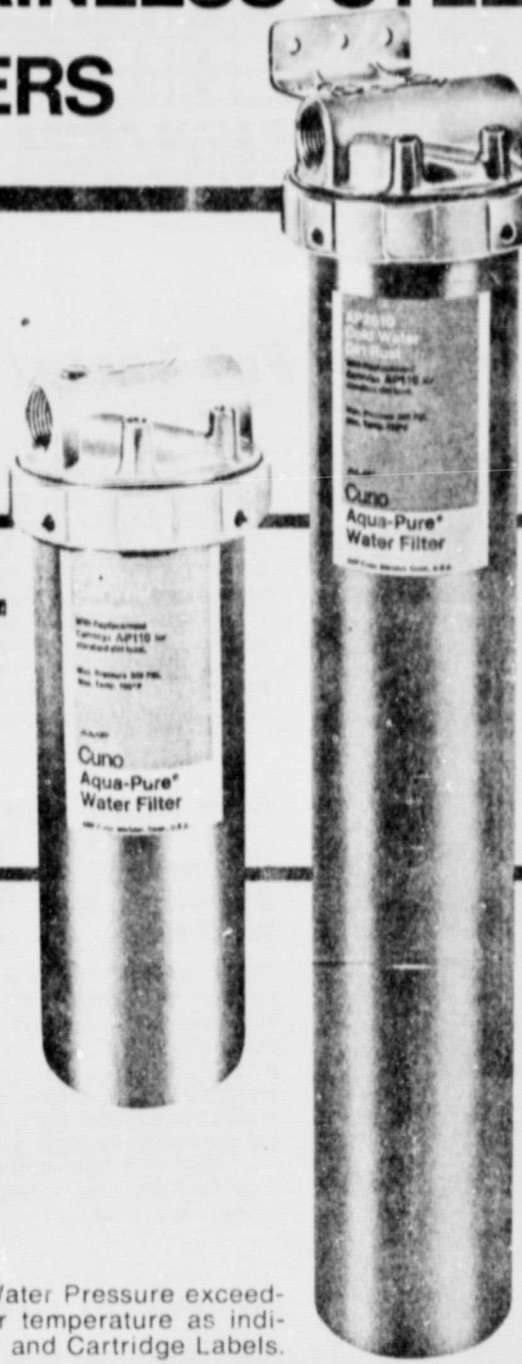
CITY WATER



WELL WATER



HOT WATER



CAUTION NOTE:

Do *NOT* use Water Pressure exceeding 300 lbs. or temperature as indicated on Filter and Cartridge Labels.

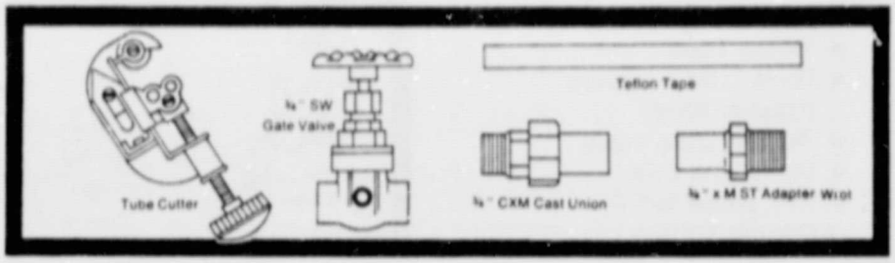
Allow Minimum of 2" clear space under Filter to facilitate cartridge change.

PROCEDURE FOR INSTALLING DIRT/RUST FILTER

ON HOT OR COLD WATER LINE (DEPENDING ON FILTER CARTRIDGE USED)

Required Materials:

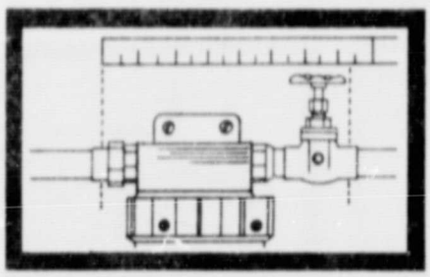
- Tube Cutter
- Teflon Tape
- ¾" SW Gate Valve
- ¾" x M ST Adapter Wrot
- ¾" CXM Cast Union
  (Valve at Main Water Meter or Hot Water Heater May Be Used As Second Valve)



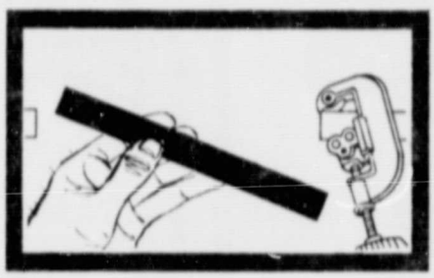
Note: Filter can be adapted to various pipe sizes by using reducing adapters on either end. Installation fittings can be sweated or threaded. Use galvanized fittings for installation on galvanized pipe. Be sure to leave suitable space under Filter to allow cartridge change. Filter can be installed on Hot or Cold Water line depending upon Filter cartridge used.

Installation Procedure: See diagrams for corresponding steps. First read "Caution Note" on page one.

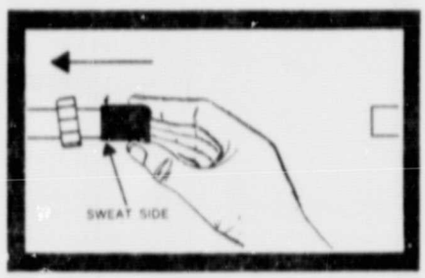
BEFORE STARTING, SHUT OFF MAIN WATER SUPPLY AND DRAIN PIPES



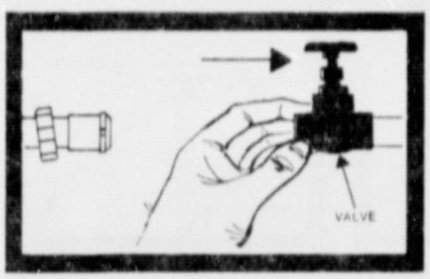
Step 1: Snug fit all component parts and calculate length of tubing to be removed.



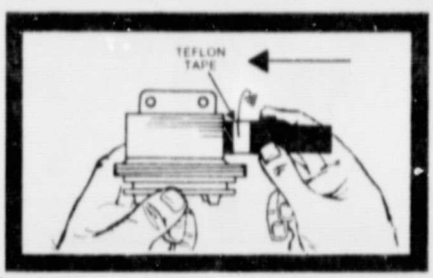
Step 2: Cut tubing.



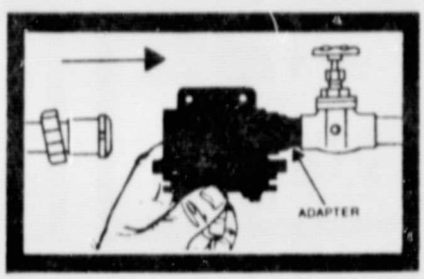
Step 3: Install sweat side of CXM Cast Union onto tube.



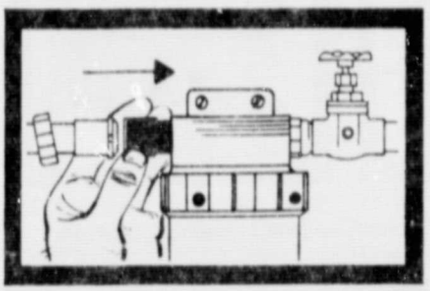
Step 4: Sweat SW Gate Valve onto line backward so drain can later be used to release pressure when changing Filter cartridge.



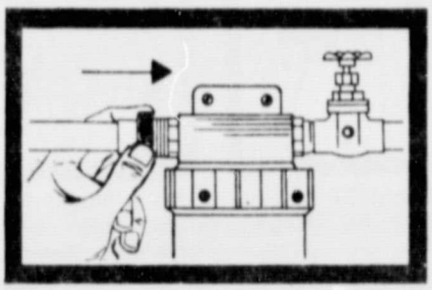
Step 5: Cover threads of M ST Adapter with Teflon Tape and screw firmly into Filter head making tight connection.



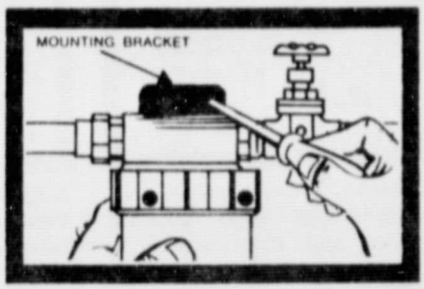
Step 6: Sweat M ST Adaptor with filter head attached to Valve making sure that filter head is vertical. (It may be necessary to temporarily support weight of filter until Filter Bracket is permanently installed. See Step 9.)



Step 7: Screw CM part of Union into Filter. It may be necessary to slightly spring tubing temporarily out of alignment in order for tubing to enter Union.



Step 8: Connect two halves of Union and tighten, making sure Filter is in straight vertical position.



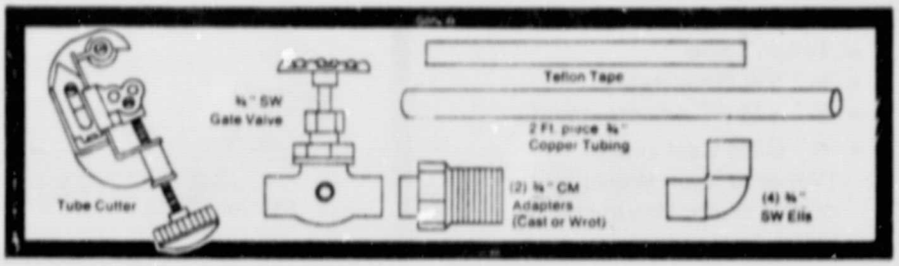
Step 9: Mount Filter Bracket to wall or suitable support.

PROCEDURE FOR INSTALLING TASTE/ODOR FILTER

UNDER KITCHEN SINK ON COLD WATER LINE

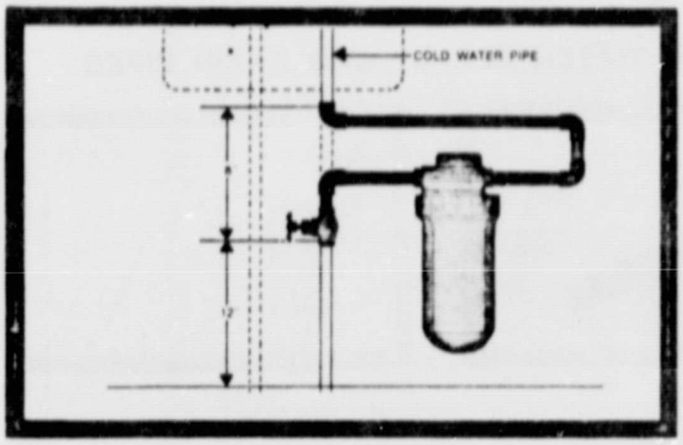
Required Materials:

- Tube Cutter
- Teflon Tape
- (2) ¾" CM Adapters (Cast or Wrot)
- ¾" SW Gate Valve
- (4) ¾" SW Ells
- 2 Ft. piece ¾" Copper Tubing

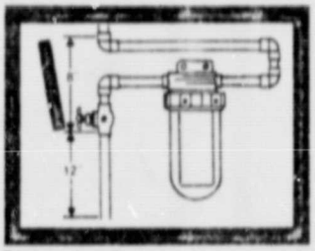


Note: Filter can be adapted to various pipe sizes by using reducing adapters, on either end. Installation fittings can be sweated or threaded. Use galvanized fittings for installation on galvanized pipe.

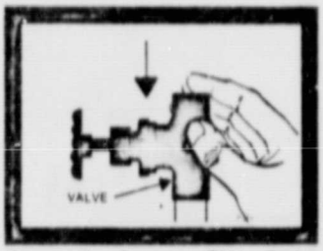
Installation Procedure: Filter can be installed on Cold Water Line. If space under sink does not permit installation there, then Filter should be installed back on cold water line just as close to sink as possible. Gate Valve should be installed backwards so drain can later be used to release pressure when changing Filter cartridge.



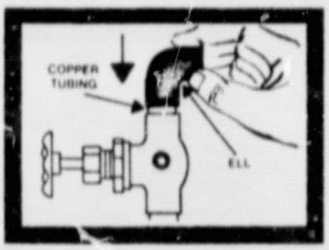
BEFORE STARTING, SHUT OFF MAIN WATER SUPPLY AND DRAIN PIPES



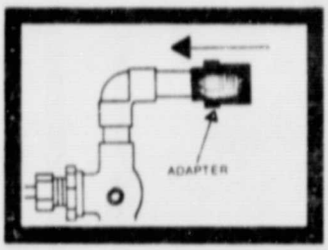
Step 1: Cut out approximately 8" section of pipe starting 12" off the floor.



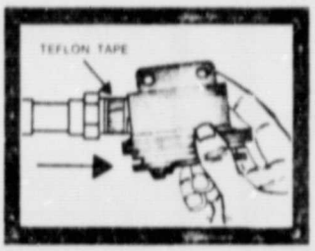
Step 2: Sweat SW Gate Valve onto water line.



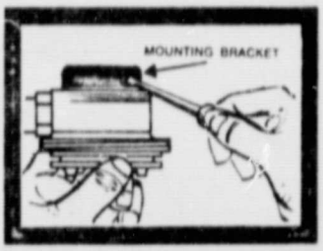
Step 3: Sweat SW Ell onto piece of copper tubing and sweat tubing to Valve.



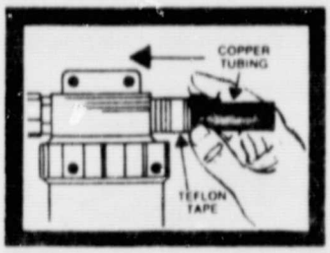
Step 4: Sweat SW Ell (Step 3) to one Adapter using piece of copper tubing.



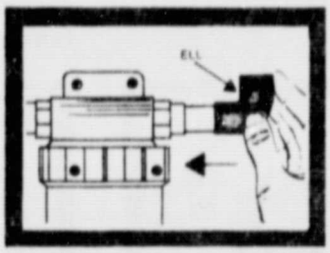
Step 5: Cover threads of both adapters with Teflon tape and screw one adapter into "IN" side of Filter.



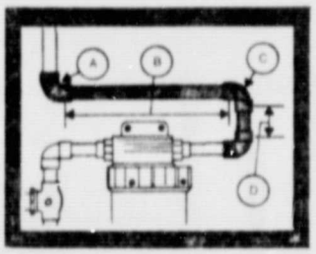
Step 6: Mount Filter bracket to wall or suitable support.



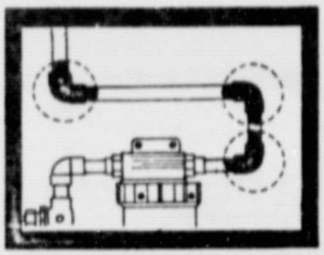
Step 7: Screw remaining adapter into "OUT" side of Filter and then sweat a piece of tubing to the adapter.



Step 8: Sweat Ell to tube connected to (Right) Adapter.



Step 9: Loose fit (A) Ell to water line coming down from sink. Measure (B) and cut tubing to go across Filter. Loose fit (C) Ell at end of tubing. Measure (D) and cut tubing to fit to Ell Sweated to (Right) adapter on Filter.



Step 10: Now proceed to sweat remaining fittings.

OPERATING INSTRUCTIONS:

Cartridge Replacement: Original cartridge may have shorter than normal life due to disturbing pipes on installation.

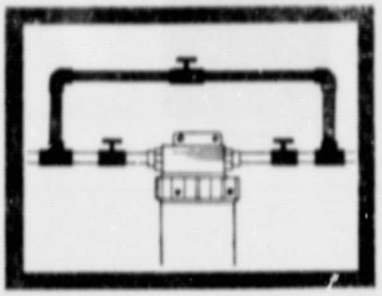
Replace cartridge when there is a decided drop in water flow at faucet or tap.

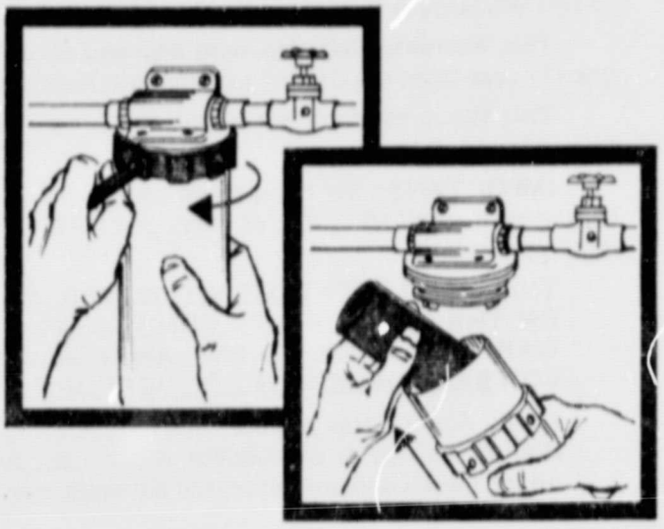
To Replace Cartridge:

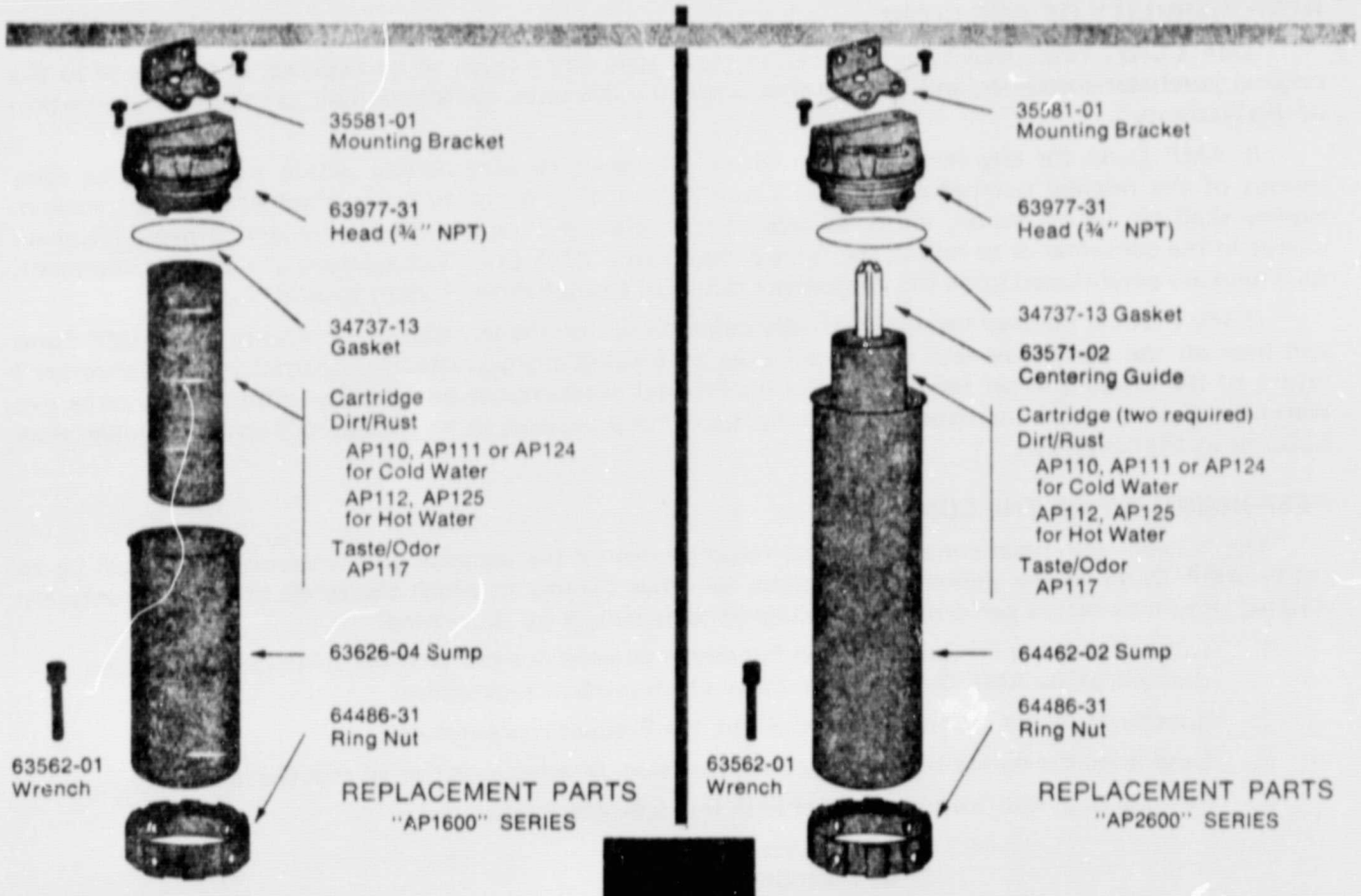
1. Shut off inlet and outlet valves. Open drain on Gate Valve, installed backwards at Filter, to relieve pressure in Filter.
2. Insert wrench (see drawings below) into hole provided in ring nut and unscrew to remove nut.
3. Remove sump and empty water.
4. Lubricate gasket with Vaseline.
5. Place new Aqua-Pure cartridge* on seal plate in sump. Bring ring nut over sump and hand tighten to head.
6. Turn on inlet valve and bleed air through Gate Valve drain until water appears. Then close drain, and open outlet valve.
7. If Filter should leak, tighten ring nut with wrench until leak stops. Do not overtighten.

* Double cartridge filters have cartridges slipped over centering guide provided.

BY-PASS SECTION can be installed around unit if desired using either threaded or sweated fittings.







AMF
Cuno
400 Research Parkway
Meriden, Conn. 06450

Printed in U.S.A.

Part No. 69632-31
Effective Jan. 1, 1977

AMF CUNO DIVISION • AMF INCORPORATED
400 Research Parkway, Meriden, Conn. 06450, U.S.A.

LIMITED ONE-YEAR WARRANTY

AMF CUNO DIVISION warrants to the original purchaser-consumer of its Product that it is free of defects in materials and workmanship. Any defect, malfunction, or other failure of the product to conform to this Warranty will be remedied by AMF Cuno in the manner provided below.

This Warranty, together with any and all warranties implied by law, shall be limited to a duration of one (1) year from the date of original purchase by the consumer.

This Warranty does not apply to defects that result from abuse, misuse, alteration or damage not caused by AMF Cuno.

IMPORTANT: To file a claim under this Warranty, you must complete and mail the Warranty registration card supplied with this Product to AMF Cuno at the address below within ten (10) days of original retail purchase.

THIS WARRANTY DOES NOT COVER, AND IS INTENDED TO EXCLUDE, ANY LIABILITY ON THE PART OF AMF CUNO, WHETHER UNDER THIS WARRANTY OR UNDER ANY WARRANTY IMPLIED BY LAW, FOR ANY INDIRECT OR CONSEQUENTIAL DAMAGES FOR BREACH HEREOF OR THEREOF.

Note: Some states prohibit limitations on the duration of implied warranties and on the exclusion of indirect or consequential damages; and so the above limitation on implied warranties and on incidental and consequential damages may not be applicable to you.

RESPONSIBILITY OF AMF CUNO

AMF Cuno's responsibility under this warranty shall be to repair at its expense, at no charge to the original purchaser-consumer, any Product that is actually defective, malfunctioning, or otherwise in violation of this Warranty.

If AMF Cuno for any reason cannot repair a Product covered hereby within two (2) weeks after receipt of the original purchaser-consumer's notification of a Warranty claim, then AMF Cuno's responsibility shall be, at its option, either to replace the defective Product with a comparable new unit at no charge to the consumer or to refund the full purchase price. AMF Cuno's obligations of repair, replacement, or refund are conditioned upon the consumer's return of the defective Product to AMF Cuno.

If any Product covered hereby is actually defective within the terms of this Warranty, then AMF Cuno will bear all the reasonable and proper shipping or mailing charges actually incurred in the consumer's return of the Product as set forth herein. If the Product proves not to be defective within the terms of this Warranty, then all costs and expenses in connection with processing of the consumer's claim hereunder shall be borne by the consumer.

RESPONSIBILITY OF THE CONSUMER

The original purchaser-consumer's sole responsibility in the instance of a warranty claim shall be to notify AMF Cuno of the defect, malfunction, or other manner in which the terms of this Warranty are violated. You may secure performance of obligations hereunder by (in writing):

1. Indentifying the Product involved (by model or serial number or other sufficient description that will allow AMF Cuno to determine which product is defective).
2. Specifying where, when, and from whom the Product was purchased.
3. Describing the nature of the defect, malfunction, or other violation of this Warranty.
4. Sending such notification together with the defective Product to:

AMF Cuno Division
47 Main Street
Talcottville, Connecticut 06066

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS, WHICH VARY FROM STATE TO STATE.

BRANCHEMCO INC. Water Treatment Division
8286 Western Way Circle
Jacksonville, Florida 32216
(904) 737-9984

CORROSION INHIBITORS FOR CLOSED WATER SYSTEMS

General

To provide a corrosion inhibitor for total corrosion protection in a hot or chilled water closed system, the selection depends on water quality, type of seals, and component metals in the system. The product recommended for your system is circled.

Branchemco 266: A liquid buffered chromate. Use at 150 ppm where mechanical seals are present.

Branchemco 241: A non-chromate liquid type inhibitor for closed hot and chilled water systems. This is primarily a blend of sodium nitrite, sodium borate, 2-MBT, and solublizing materials. Use at 6 pints per 100 gallons, or/and 8 gallons per M gallons.

Chemical Balances:

800 - 1000 ppm: NO_2
80 - 100 ppm: 2-MBT

Branchemco 243: Powdered phosphate based corrosion inhibitor for closed systems. Control at 4000/6000 ppm T-PO_4. Prefer to use soft water for make-up, but if not available then system will require periodic manual blow-down for removal of sludge. This product is manufactured from only food codex grade materials, and should be used in all closed water systems where there is potential for a leak into food.

This treatment is compatible with glycol systems. In all food related systems propylene glycol is used.

The ingredient in No. 243 is approved for use in food plant cooling systems by FDA.

Start at 5 pounds per 100 gallons water capacity.

A powder version of 241 is available as Branchemco 240. This material should be dissolved in water or glycol mixture before application to the system.

Revised 3/17/78.

Laboratory Procedure

NITRITE (NO_2)

Control Range: 800 - 1000

1. Measure a 50ml sample with a clean 50ml graduated cylinder.
2. Pour into a clean casserole.
3. Add one drop Nitrite indicator, swirl to mix.
4. Add Cerric Sulfate from the buret until the color changes from orangish red to light blue or clear, and remains light blue or clear for 15 seconds.
5. Read the buret.
6. The nitrite (NO_2) in the sample in ppm (mg/L) is equal to the buret reading times 50.

EXAMPLE:
For a 50ml sample: The buret reading is 10.6ml then the nitrite (NO_2) is:
10.6ml x 50 = 530 ppm

ACTION:

A. If Nitrite value is less than 800 ppm (mg/L) then add Branchemco No. _____ to the systems.

B. If Nitrite value is greater than 1000 ppm (mg/L) then do not add any Branchemco No. _____ to the system.

REAGENTS & APPARATUS:

10037	Nitrite Reagent
10036	Cerric Sulfate Titrating Solution
P-130	Graduated Cylinder, 50ml
10131	Casserole
P-516	Stirring Rod
10075	Buret Automatic 25ml

OPTIONS:

10086	Stirring Plate
P-517-0006	Stirring Bar

BRANCHEMCO, INC.
8286 Western Way Circle D-9
Jacksonville, Florida 32216

WATTS

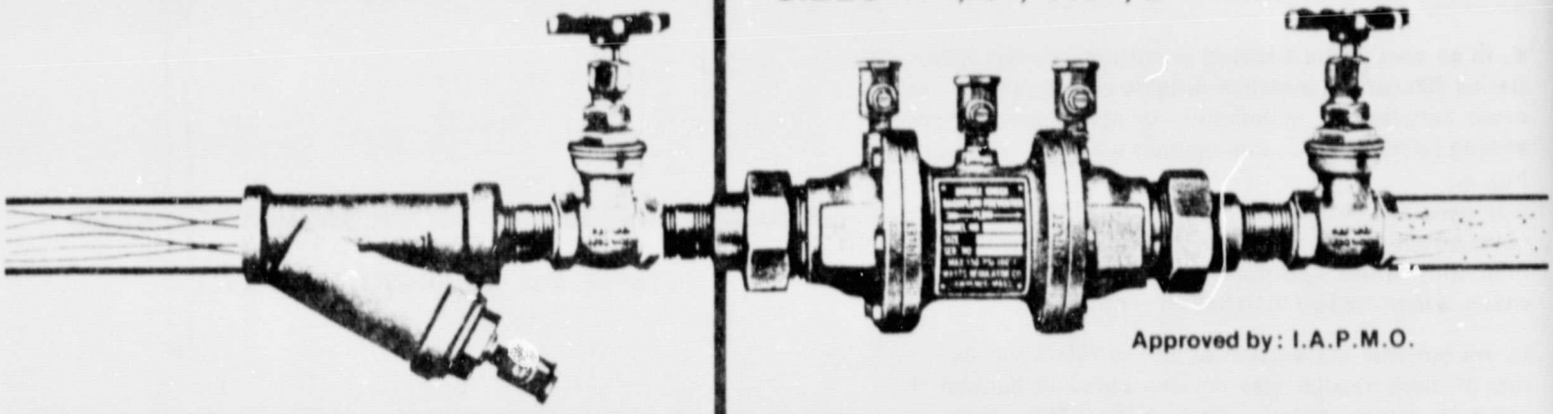
The name that protects your name

103 Years Of Leadership 1874 – 1977

Series 700

DOUBLE CHECK VALVE ASSEMBLY

SIZES ¾", 1", 1½", 2"



Approved by: I.A.P.M.O.

CROSS CONNECTION CONTROL

- ***INSTALLATION***
- ***FIELD TESTING***
- ***MAINTENANCE***

WATTS REGULATOR COMPANY • LAWRENCE, MASS., U.S.A.
TORONTO, CANADA GLOUCESTERSHIRE, ENGLAND

Manufacturers of the largest and most complete line of plumbing and heating safety valves and controls.

Basic Installation Instructions

A. WATTS Series 700 Double Check Valve may be installed in either a vertical or horizontal position. If installed vertically, the direction of flow must be vertically "down".

B. They should always be installed in an accessible location to facilitate testing and servicing.

C. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. A strainer should be installed as shown, ahead of backflow preventers to protect discs from unnecessary fouling.

CAUTION: Do not install with strainer when backflow preventer is used on seldom-used water lines which are called upon only during emergencies, such as fire sprinkler lines, etc.

D. It is important that Series 700 be tested periodically in compliance with local codes, but at least once a year or more often depending upon system conditions.

E. For indoor installations, it is important that the device be easily accessible to facilitate testing and servicing. Fig. 1.

F. In an area where freezing conditions do **not** occur, Series 700 can be installed outside of a building. The most satisfactory installation is above ground and should be installed in this manner whenever possible. Fig. 2.

It is generally recommended that backflow preventers never be placed in pits unless absolutely necessary and then only when approved by local codes. In such cases, a modified pit installation is preferred.

G. An optional installation of Series 700 is the use of two or more smaller size devices piped in parallel to serve a larger supply pipe main. This type of installation is employed whenever it is vital to maintain a continuous supply of water and where interruptions for testing and servicing would be unacceptable. It also has the advantage of providing increased capacity where needed beyond that provided by a single valve and permits testing or servicing of an individual valve without shutting down the complete line.

For a two-valve installation as shown, the total capacity of the devices should equal or exceed that required by the system. See table 1.

Figure 1

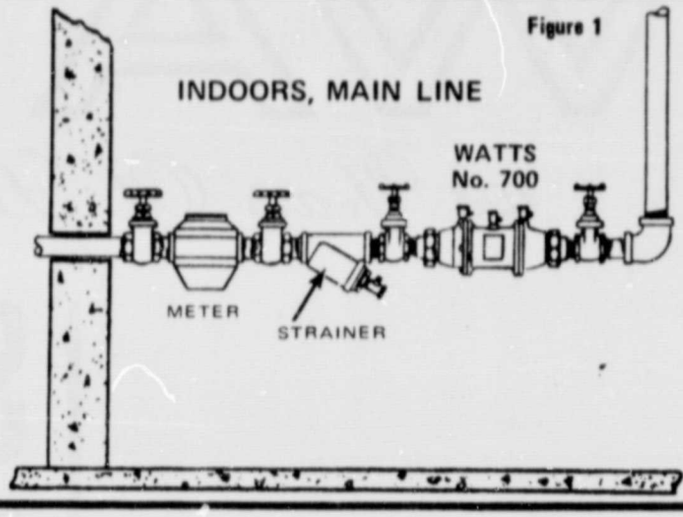


Figure 2

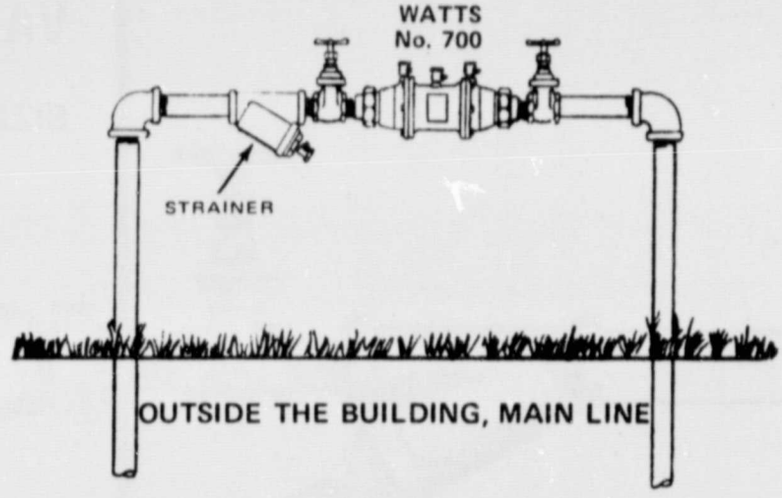


Figure 3

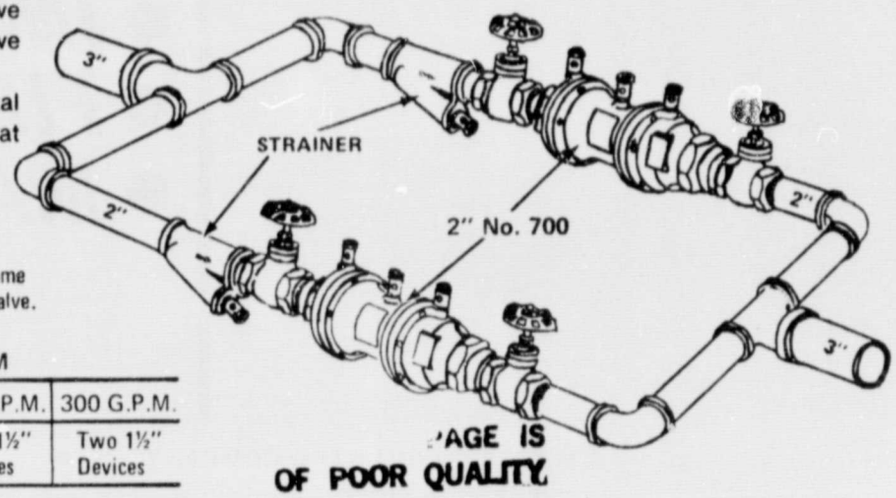


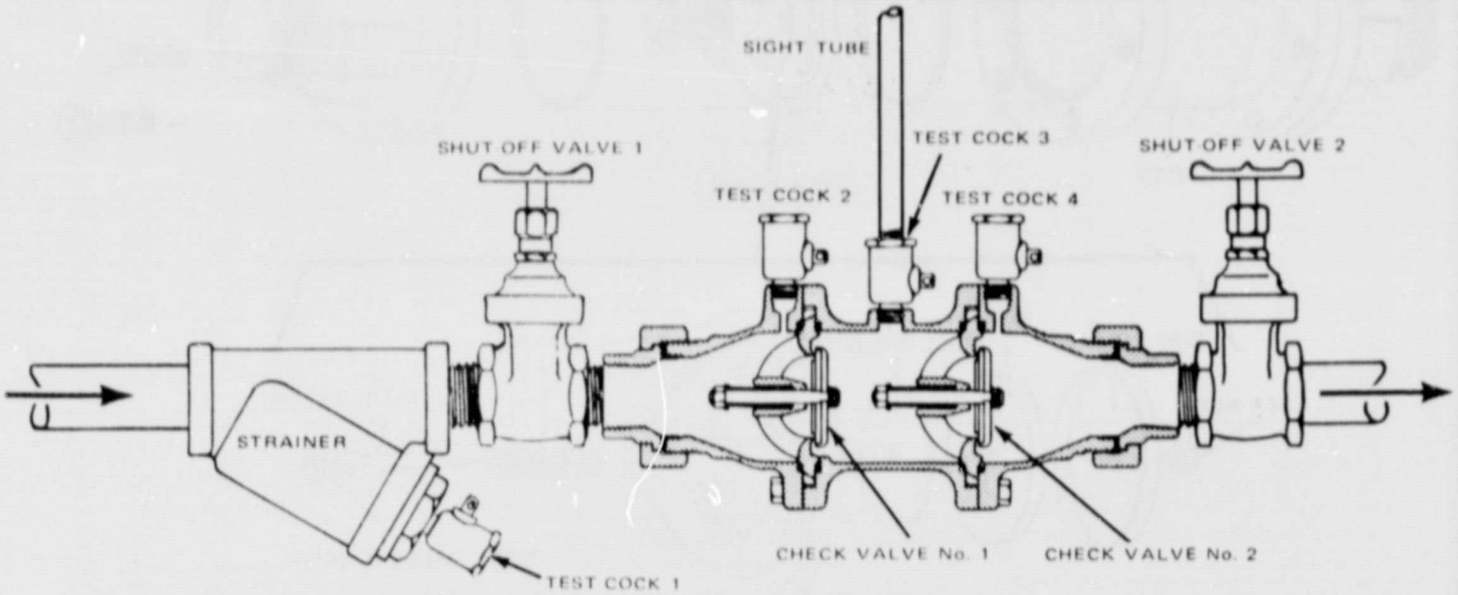
TABLE 1

Table shows number of smaller size devices of same size required to meet capacity of a single large valve.

CAPACITY REQUIRED FOR SYSTEM

50 G.P.M.	100 G.P.M.	150 G.P.M.	200 G.P.M.	250 G.P.M.	300 G.P.M.
Two ¾" Devices	Two 1" Devices	Two 1½" Devices	Two 1½" Devices	Two 1½" Devices	Two 1½" Devices

Field Testing Procedure



Series 700 DOUBLE CHECK VALVE ASSEMBLY

NOTE: Leaky shut-off valves will give erroneous test results and should be verified before testing the check valves.

A. Test of Check Valve No. 1

PURPOSE:

To test check valve No. 1 for tightness against reverse flow.

REQUIREMENT:

Valve must be tight against reverse flow under all pressure differentials.

STEPS:

1. Install sight tube in Test Cock 3. Open Test Cock 3 and allow water to fill the tube to the top. Use a tube length of at least 42 inches. This will provide a head of 1½ PSI. Close Test Cock 3.
2. Close Shut-off Valve No. 2.
3. Close Shut-off Valve No. 1.
4. Open Test Cock 3.
5. Open Test Cock 2. The water should maintain its position in the sight tube. If it slowly drops and runs out through Test Cock 2, the check valve No. 1 is leaking and must be serviced.

B. Test of Check Valve No. 2

PURPOSE:

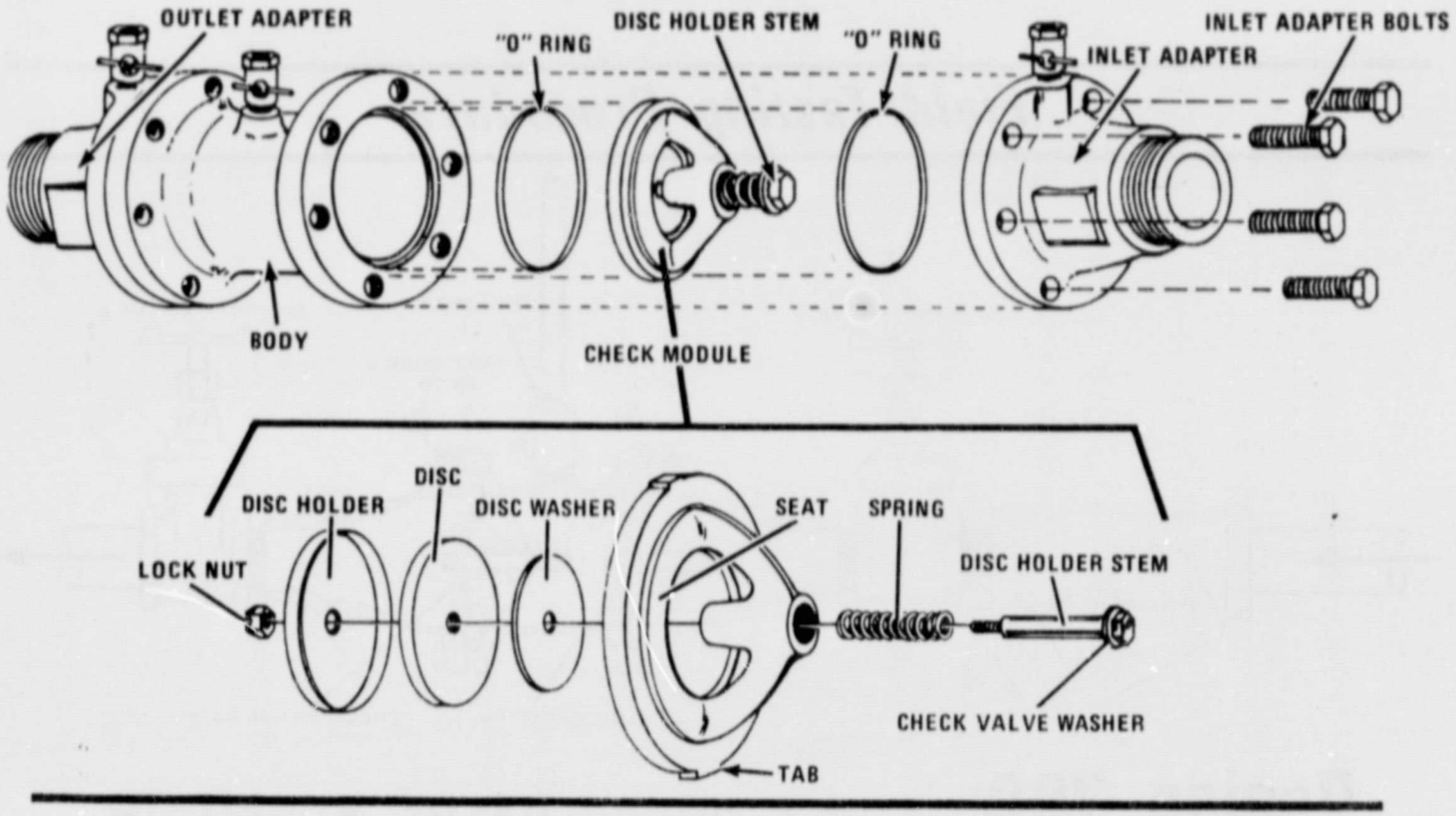
To test check valve No. 2 for tightness against reverse flow.

REQUIREMENT:

Valve must be tight against reverse flow under all pressure differentials.

STEPS:

1. Install sight tube in Test Cock 4 and fill with water as before.
2. Open Test Cock 4.
3. Open Test Cock 3. The water should maintain its position in the sight tube. If it slowly drops and runs out through Test Cock 3, check valve No. 2 is leaking and must be serviced.



Service, Replacement Parts and Maintenance

DISASSEMBLY OF No. 700:

1. Remove the No. 700 head from the line (union nuts and adapters remain in the line).
2. Remove inlet adapter bolts.
3. Remove the adapter and "O" ring. Lift out the first check module and "O" ring.
4. Disc can be exposed for cleaning by maintaining pressure on disc holder stem to overcome spring preload.
5. To remove the outlet adapter and second check assembly, repeat steps 2 and 3.
6. The check module can be disassembled by removing lock nut while maintaining pressure on the disc holder stem. Disc can now be cleaned, or replaced.

NOTE: First check module and second check module are identical and can be interchanged. Inlet and outlet adapters and "O" rings are also identical and can be interchanged.

REASSEMBLY OF No. 700:

7. Place the check valve washer and spring over the stem, and place the seat casting over the stem. Push down to compress the spring until stem projects beyond the seat ring.
8. With stem projecting out, place the disc washer on the stem. Place the disc holder with the rubber disc on the stem. Thread on the lock nut, tighten the lock nut securely while holding the head of the stem.
9. Repeat steps 7 - 8 for assembling the other check module. To assemble the inlet side of the valve, place the "O" ring in the body, take either check module and align the tabs of the check module with the slots in the body. **(Note:** Tabs on check module prevent misassembly of the check module with relation to the direction of flow). The spring end of the module will be out of the body on the inlet end.
10. In assembling the outlet side of the valve, repeat above procedure. However the spring end of the module will be in the body.
11. Place "O" ring on check module. Place the adapter on the check valve module, insert bolts and tighten.

IS-700-1 7710

PRINTED IN U.S.A.

INSTRUCTIONS

PUSH BUTTON & SELECTOR SWITCH KITS

File No	50-HD54688
Cat. No. or Class Series	14 & 40 OPEN & NEMA 1
Size	00-0-1-1P-1¼
Date	DECEMBER 1972

WIRING DIAGRAM

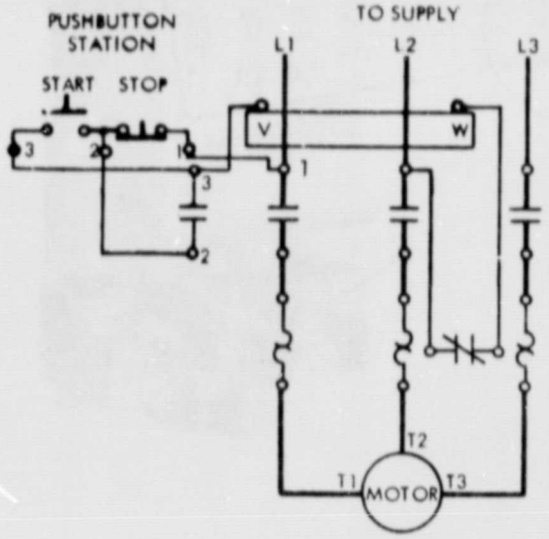


Fig. 2

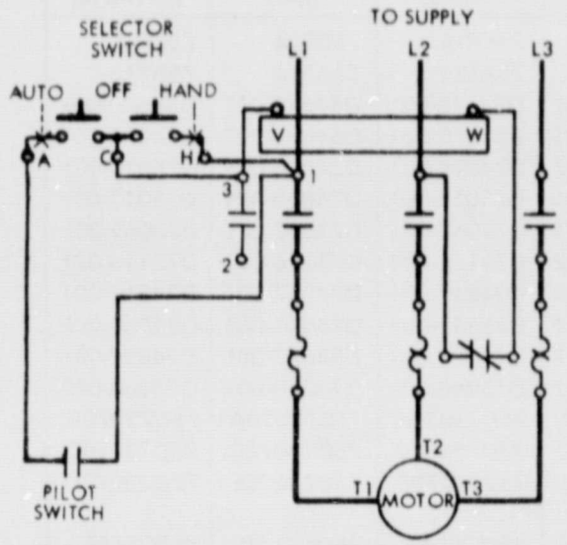
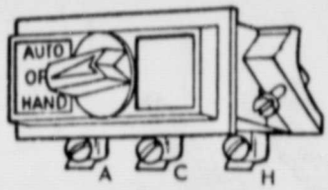
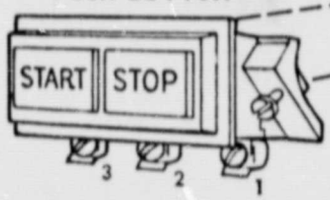


Fig. 3

SELECTOR SWITCH



PUSH BUTTON



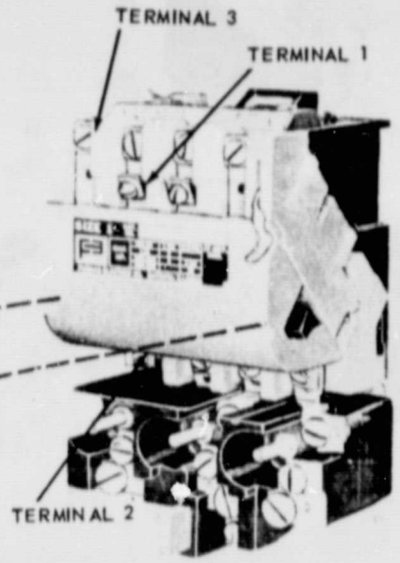


Fig. 1

CAUTION – Be sure power is disconnected before removing the enclosure cover.

A. Mount pilot controls on starter as shown in Fig. 1, using the two captive self-tapping screws.

B. Use red wire in kit and make connections as shown in wiring diagram.

PUSH BUTTON **KIT 50D54688** START-STOP (Fig. 2).

a. Connect push button terminal **1** to starter terminal **1** with long jumper.

b. Connect push button terminal **2** to starter terminal **2** with short jumper.

c. Connect push button terminal **3** to starter terminal **3** with long jumper.

SELECTOR SWITCH **KIT 50D25168** 2 position.

a. Connect selector switch to starter terminal **1** and **3** as required for application.

SELECTOR SWITCH **KIT 50D54773** 3 position. (Fig. 3).

a. Connect selector switch terminal **H** to starter terminal **1.**

b. Connect selector switch terminal **C** to starter terminal **3.**

c. Connect one terminal of the pilot control switch (pressure switch, thermostat, etc.) to terminal **1.**

d. Connect the other side of the pilot control switch to selector switch terminal **A.**

NOTE: When using a NEMA 1 enclosure, remove the knock-out in the cover.

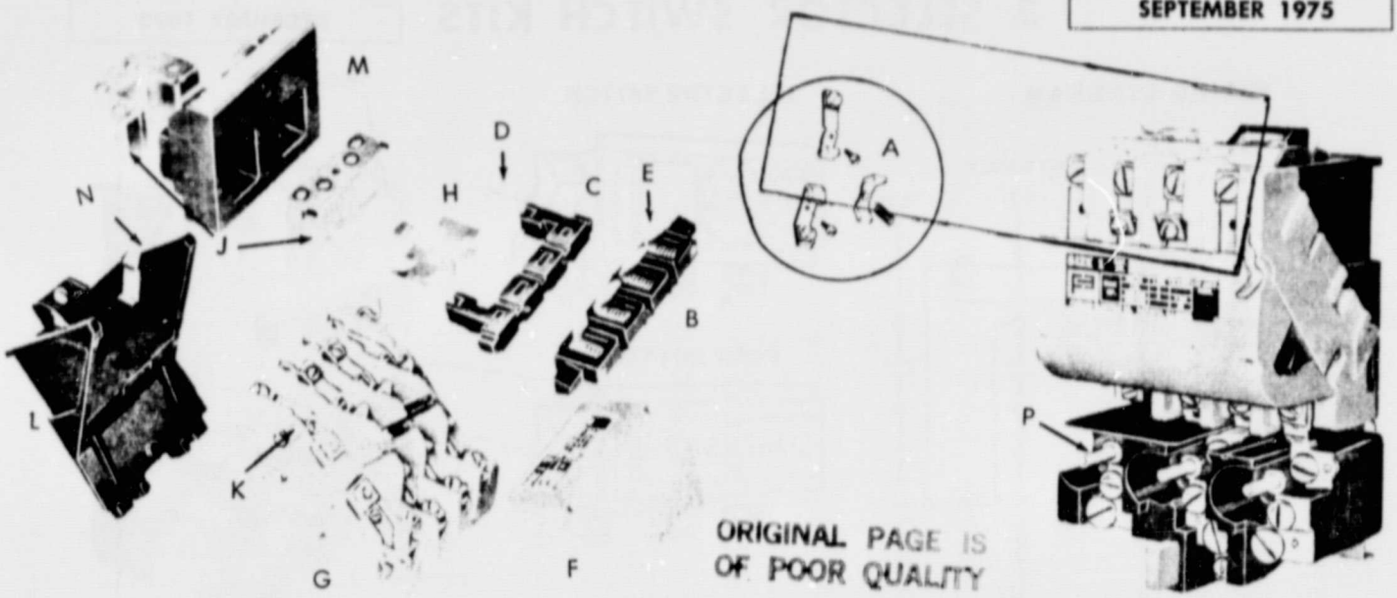
Innova/45

Supersedes Issue of January, 1975

REPLACEMENT PARTS

MAGNETIC CONTROLS

File No. 14-GCF
Cat. No. or Class Series 14BF, 14CF, 14DF, 14EF 40BF, 40CF, 40DF, 40EF
Size 00, 0, 1, 1P, & 1¾
SEPTEMBER 1975



ITEM	PART NAME		PART NUMBER			
			14BF Size 00	14CF Size 0	14DF Size 1	14EF Size 1P & 1¾
A	Contacts & Spring, One complete pole —	Power Pole	75BF14	75CF14	75DF14	75EF14
		Interlock Pole	75AF14	75AF14	75AF14	75AF14
B	Cross Arm (less contacts)		D54670-001	D54670-001	D54670-001	D54670-001
C	Cross Arm Base		D54873-001	D54873-001	D54873-001	D54873-001
D	Cross Arm Springs		D24826-001	D24826-001	D24826-001	D24826-001
E	Cross Arm Screw		D25013-001	D25013-001	D25013-001	D25013-001
F	Contact Board Cover		D73062-001	D73062-001	D73062-001	D73062-001
G	Contact Board (less contacts)		D73116-022	D73116-021	D73116-021	D73116-021
H	Armature Spring Clip		D24817-001	D24817-001	D24817-001	D24817-001
J	Magnet and Armature		D25551-001	D25551-001	D25551-001	D25551-001
K	Contact Board Screw		D24827-001	D24827-001	D24827-001	D24827-001
L	Base		D73060-001	D73060-001	D73060-001	D73060-001
M	Coil 60 Hz. 110-120/208-240 Volts	50 Hz. 110 Volts	75D73070A	75D73070A	75D73070A	75D73070A
	208-240/440-480 Volts	220 Volts	75D73070C	75D73070C	75D73070C	75D73070C
	550-600 Volts	550 Volts	75D73070E	75D73070E	75D73070E	75D73070E
N	Coil Spring Clip					
P	Overload Relays — Melting alloy (std.)	1 Pole	48DC11A2	48DC11A2	48DC11A2	48EC11A2
		3 Pole	48DC31A2	48DC31A2	48DC31A2	48EC31A2
	Standard Bimetal	1 Pole	48DC17AA2	48DC17AA2	48DC17AA2	48EC17AA2
		3 Pole	48DC37A2	48DC37A2	48DC37A2	48EC37A2
	Amb. Compensated Bimetal	1 Pole	48DC18AA2	48DC18AA2	48DC18AA2	48EC18AA2
		3 Pole	48DC38A2	48DC38A2	48DC38A2	48EC38A2

NOTE: When ordering replacement parts, give catalog number of control and part name and number.

OPERATING INSTRUCTIONS & PARTS LIST

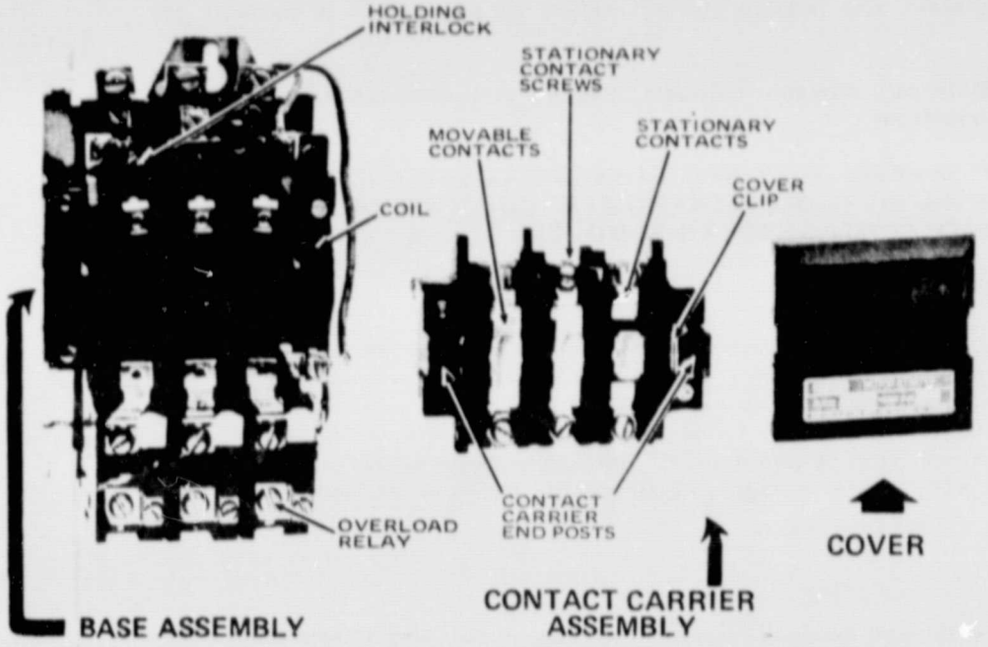
AC MAGNETIC MOTOR STARTERS SIZES 00-2

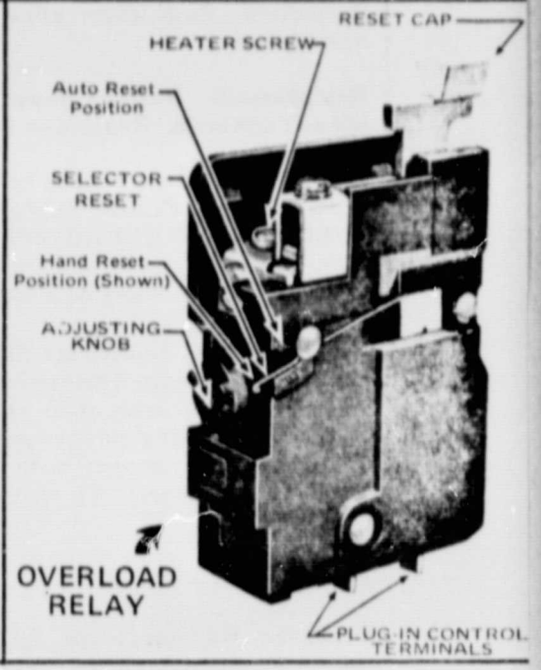
MODELS 5X150-5X151-5X152-5X153A 5X154A-5X155A-5X156A-5X245A

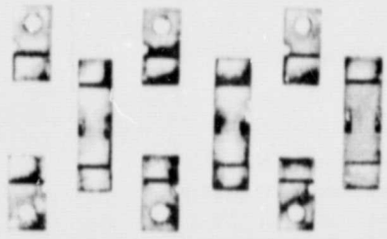
FORM 551627

DAYTON ELECTRIC MANUFACTURING CO. CHICAGO 60648

SEPT., 1975

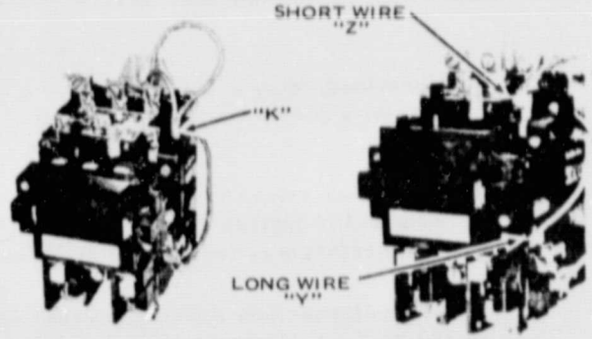






REPLACEMENT CONTACT KIT

MAGNET COIL



HIGH VOLTAGE CONNECTION

LOW VOLTAGE CONNECTION

RENEWAL PARTS AND ACCESSORY KITS

MAGNET COIL - 60 Hz	NEMA SIZE00 5X153A	NEMA SIZE 0 5X150 5X154A	NEMA SIZE 1 5X151 5X155A	NEMA SIZE 1½ 5X152	NEMA SIZE 1¾ 5X245A	NEMA SIZE 2 5X156A
115/208 - 230 VOLTS			5X171			—
208 - 230/440 - 460 VOLTS			5X172			5X173
24 VOLTS			5X175			5X176
120 VOLTS			5X178			5X179
600 VOLTS			6X224			6X225
CONTACT KIT (3 POLE SET)	5X161	5X162	5X163			5X164
OVERLOAD RELAY (HAND-AUTOMATIC RESET TYPE)	5X167			5X168	5X167	5X169

NOTE: FOR OTHER ACCESSORY KITS, SUCH AS COVER MOUNTED PUSHBUTTONS, SELECTOR SWITCHES OR REMOTE START-STOP STATIONS, CONTACT YOUR DAYTON DEALER.

MAINTENANCE INSTRUCTIONS

Before connecting to power supply, manually operate movable contact carrier assembly (by pushing on the contact carrier end posts) to assure free movement.

MAIN CONTACTS

Disconnect all power before removing cover and working on starter.
Inspection: Push cover clips outward and remove contact cover. All portions of all contacts are now visible.

Replacement: Remove cover. Slide out movable contacts. Loosen stationary contact screws and lift out contacts. Replace in reverse order.

ALL STATIONARY CONTACT SCREWS MUST BE TIGHTENED, COVER AND COVER CLIPS MUST BE IN PLACE BEFORE MAGNET COIL IS ENERGIZED. COIL FAILURE MAY OCCUR IF STARTER IS ENERGIZED WITH CONTACT COVER REMOVED.

MAGNET COIL REPLACEMENT

Remove cover. Loosen six (6) stationary contact screws. Pull out carrier assembly (all contacts and screws will remain captive in assembly). Disconnect coil jumper wires from terminals and pull out coil. To replace with dual voltage coil, feed jumper wires through hole in base assembly and plug in coil, connect long jumper wire to terminal "Y" and short jumper wire to terminal "Z" for low voltage control, or connect both jumper wires to terminal "K" for high voltage control (see pictures on front of this sheet). To replace with single voltage coil, simply plug coil in, no jumper wires are necessary.

OVERLOAD RELAY

Removal: Remove single screw attaching overload relay to the power circuit and merely unplug the relay. To replace the relay, reverse the procedure.

The overload relay is supplied with control terminals which are plugged into a pre-wired base. No control wire connections are required.

The overload relays are normally shipped without heaters. Remove heater screws, insert heaters in pockets and re-tighten heater screws. If a center heater is being added to an existing installation, original heaters may require replacement - refer to heater chart.

Reset positions: The normal position of the reset slide is "hand reset". Overload relays can be converted to "automatic reset" in the following manner. Lift the reset selector and place it in the "auto" slot.

Trip current adjustment: The normal position of the adjustment knob is 100%. The trip current can be lowered by turning the adjustment toward the 85% setting and raised by turning the adjustment knob toward the 115% setting.

GENERAL MAINTENANCE

Dayton starters are thoroughly tested and carefully inspected prior to shipment from the factory. The dual voltage coils are factory connected for operation on 208 - 230 volts. Changing this coil connection, if necessary, is the only adjustment that might be required before placing the starter in service. Under normal operating conditions the only maintenance precaution recommended is to keep parts free from excessive amounts of dirt, oil or grease, paying particular attention to contacts and magnet faces for safe, quiet operation. Terminals should be checked for tight connection. When contacts become worn or pitted more than half-way through, they should be replaced. Silver cadmium oxide contacts should not be filed. A silver contact, even though badly oxidized, will still be a good conductor.

NON-JOB — ORDER INFORMATION SHEET

ARCH.

ENGR.

JOB NAME Solar Energy Center

JOB LOCATION FTU

JOB COORDINATOR–SALES OFFICE–SALESMAN NAME, CODE

TRANE AIR CONDITIONING

JOB NO. H3 NO JOB

SHADED AREAS FACTORY USE ONLY

CUSTOMER P.O. NUMBER	CUSTOMER ACCOUNT NO.	TERMS NET 30	DATE SHIPPED	BILL OF LADING NO.	INVOICE DATE	ORDER/INVOICE NO.
7813-002	H3-15-6710-6	Net				KH3-E122

BILLING METHOD	INVOICE TYPE	INVOICE DAY	SHIP WITH	F.O.B.	ORDER DATE
[X] LUMP SUM [ ] NET EACH [ ] LIST DISC	[X] REG. [ ] PROGRESS			Lexington, F/A	11/30/78

JOB/ORDER CLASS	PROPOSAL NO.	PROPOSAL ISSUE DATE	INVOICE COPIES	SHIP VIA	PREPAID	COLLECT
A4G1E			2	Truck	[X]	[ ]

SOLD TO
S. I. Goldman Company
P. O. Box 1156
Maitland, Fl 32751

SHIP TO
S. I. Goldman
132 Candace Drive
Maitland, Fl 32751

SPECIAL INSTRUCTIONS

MARK PACKAGES
Solar Energy Center

MARK B/L: – CALL NO.: 305-830-5000 ATTN: Dave Altman 24 HRS. BEFORE DELIVERY

ITEM	QTY	DESCRIPTION	PRODUCT CODE:
A	1	Cooling Coil	

SHOP DRAWING REVIEW

If checked below, fabrication MAY be undertaken. Approval does not authorize changes to Contract Sum unless stated in separate letter or Change Order.

[X] Approved/No Exceptions Taken

[ ] Approved As Noted/Corrected

If checked below, fabrication MAY NOT be undertaken. Submit new or corrected drawings for review and approval. Correction shall be limited to items marked.

[ ] Revise & Resubmit/Note Markings

[ ] Rejected/Comments Attached

Review is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Markings or comments shall not relieve the Contractor from compliance with the requirements of the Drawings or Specifications thereof. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating the work with that of all other trades and performing his work in a safe and satisfactory manner.

STOTTLER STANGO & ASSOCIATES, ARCHITECTS, ENGINEERS, PLANNERS, INC.

By: [signature]

12/22/78

ORIGINAL PAGE IS
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C' LS

THE TRANE COMPANY - LA CROSSE, WIS.

SUBMITTAL DATA

SHOP DRAWING REVIEW APPROVAL STAMP

If checked below, fabrication MAY be undertaken. If ... below, fabrication MAY be undertaken. Submit new ... for review and approval before ... shall be limited to ...

Approved

Resubmit/Note Markings

Comments Attached

ARCHITECT

ENGINEER

PROJECT

ORDER DATE	CUSTOMER ORDER NUMBER	CUSTOMER ACCOUNT NO.

SOLD TO

Issued at ... fabrication, procedures of construction, performance of all work ...

... ENGINEERS, PLANNERS, INC.

☒ COOLING COILS ☐ HEATING COILS ☐ PROCESS COILS

SPECIFICATIONS

ITEM	QUANTITY	ORDERING NO. Submittal Dwg.	TAGGING INSTRUCTIONS	COIL TYPE (1)	FINNED PACE WIDE	FINNED PACE LONG	FINNED PACE SERIES	TUBES MATL (2)	TUBES NO. ROWS	TUBES MATL (3)	AIR FLOW CONN. (4)	FINS CIRC (5)	CHANNEL GASKET HOLES
A	1			W	33	60	18	A	4	A	HR	T	YES ☒ NO ☐
													YES ☐ NO ☐
													YES ☐ NO ☐
													YES ☐ NO ☐
													YES ☐ NO ☐

SPECIAL FEATURES

ORIGINAL PAGE IS OF POOR QUALITY

PERFORMANCE

ITEM	TAGGING INSTRUCTIONS	CAPACITY SCFM	CAPACITY AIR VELOCITY FPM	CAPACITY MBH	AIR TEMP. °F ENTERING DB/WB	AIR TEMP. °F LEAVING DB/WB	FLUID (6) GPM OR PSIG	FLUID (6) ENT TEMP OR SUCT	PRESSURE DROP AIR INCHES OF H2O	PRESSURE DROP WATER FEET H2O
A		6800		229.5	78.2/65.6	54.8/54.5	28.1	45	.28	2.9

ENTERED

MECHANICAL SPECIFICATIONS – STANDARD HEATING & COOLING COILS

TUBES: 5/8" OD Seamless for all types except H and HS; 1" OD Seamless for H and HS.
FINS: Draw Collared Plate - Fin.
CASING: 16 Gage, Zinc Grip Galvanized Steel
HEADERS:
STANDARD HEATING & COOLING COILS
Close - grained, Gray Cast Iron, all types except Type T & ST (3/4" MPT) and Type P1 and P2 (Distributor and seamless Copper Tube Suction Header)
PROCESS COILS
All coils except Type E, Schedule 80 Carbon Steel pipe with male pipe threads. Type S (Close - grained, Gray Cast Iron.
GASKETS: Rubber, Type K Coils only.
AIR BYPASS AND WATER CARRY OVER ARRESTER:
Polyurethane Synthetic foam sealing strip between top and bottom cooling channel and fins.
TEST PRESSURES
STANDARD HEATING & COOLING COILS
Cast Iron Headers, 400 PSI Hydraulic, 200 PSI Air under water. All coils except P1 & P2 coils, 300 PSI Air under water, P1 & P2 coils, 200 PSI Air Under Water, P1 & P2 Coils, 300 PSI Air Under Water
PROCESS COILS
All coils except Type E, 300 PSI Air Under Water. Type E coils, 200 PSI Air Under Water.

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STANDARD COILS

1 Cooling

SERPENTINE WATER COILS
S – Std., Single Row Serp.
D – Drainable, Single Row Serp.
DD – Drainable, Double Row Serp.
C – Cleanable, Single Row Serp.
P – 2 – 2 Tube Serpentine
P – 4 – 4 Tube Serpentine
P – 8 – 8 Tube Serpentine

1 REFRIGERANT COILS
P2 – (R – 22) – Direct Expansion
P1 – (R – 12) – Direct Expansion

Heating

STEAM COILS
1 A – Single Pass, Opp. End Conn.
N – Non Freeze, Opp. End Conn.
NS – Non Freeze, Same End Conn.
T & ST – Single Tube Serp. Same End Conn. 1 and 2 row.

WATER COILS
1 AW – Single Pass, Opp. End Conn.
WC – Two Pass, Same End Conn.
T & ST – Single Tube Serp. Same End Conn. 1 and 2 row.
TT – 2 Tube Serp., Same End Conn. 1 and 2 row.
W – 2 row – Single Row Serp., Same End Conn.

2 FIN MATERIAL
A – Aluminum
C – Copper

3 TUBE MATERIAL
A – Standard Copper
B – Std. Red Brass
C – .035 Wall R.B.
D – .049 Wall R.B.
E – .049 CU NI
(Process Coils Only)

4 AIR FLOW AND CONNECTION SIDE

ORDERING SYMBOL	AIR FLOW DIRECTION	SUPPLY CONN.
HR	-Horizontal-	Right
HL	-Horizontal-	Left
VUR	-Vertical Up-	Right
VUL	-Vertical Up-	Left
VDR	-Vertical Down-	Right
VDL	-Vertical Down-	Left

SUPPLY: Pipe Conn. facing air discharge side of Coil.

5 TURBULATORS OR CIRCUITS
WATER COILS
T - With Turbulators
O - Without Turbulators
Refrigerant or HTHW Coils Number - Number of Circuits Required (Tubes Ped)

6 FLUID TYPE
12 - Refrigerant 12
22 - Refrigerant 22
S - Steam
W - Water
G___ - % Glycol

SALES ORDER NUMBER

KH3-E122

SHEET 2 OF 2

SUBMITTAL DATA

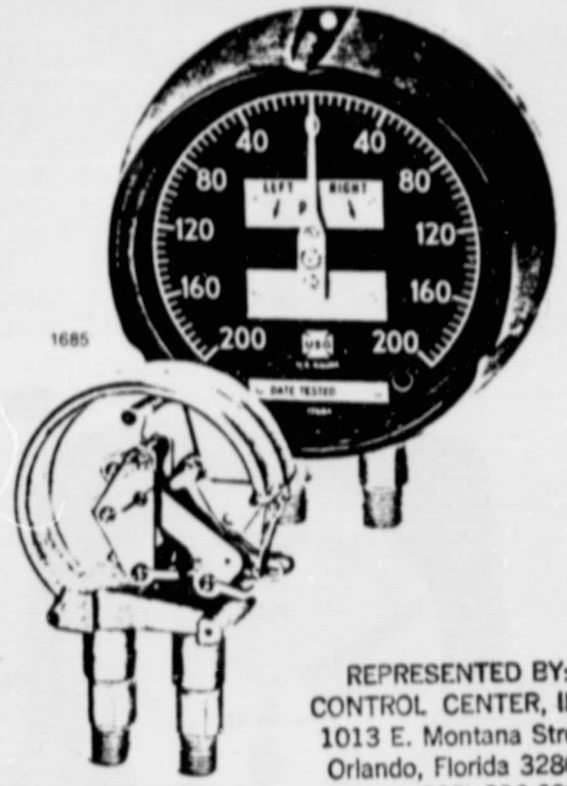
1 - 30 280 (67S)

DIFFERENTIAL GAUGES

4½" 1685

These gauges are used extensively in industrial, transportation and marine applications where a direct indication of the pressure differential between two pressures is desired.

Such differential indications are exemplified by: inlet and outlet pressure in a filter system; pressure at different points in a brake system; oil pressure at the intake and discharge ports of a pump; boiler and back pressure on marine or locomotive boilers.



REPRESENTED BY:
CONTROL CENTER, INC.
1013 E. Montana Street
Orlando, Florida 32803
Phone: (305) 896-6831

SPECIFICATIONS

DIAL SIZE: 4½"

CASE: Phenolic, black

RING: Brass, snap, black finish

WINDOW: Acrylic

POINTER: Micrometer adjustable, with positive lock and white finish

DIAL: Steel, black background with white markings

MOVEMENT: Made of dissimilar materials to reduce friction and wear. Overpressure stops

BOURDON TUBES: Phosphor bronze. 7½-0-7½ psi or 0-15 psi; 15-0-15 or 0-30 psi; 30-0-30 or 0-60 psi; soft soldered. Higher pressure ranges utilize silver brazing. Bourdons linked in opposition to each other through movement mechanism to provide differential reading between two variables

CONNECTION: ¼" ANPT, brass, side by side

ACCURACY: ±2% of span

FIGURE 1685

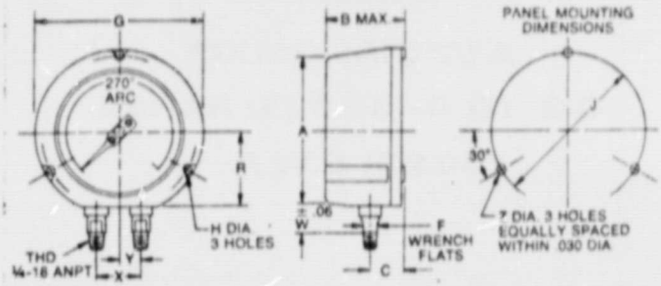
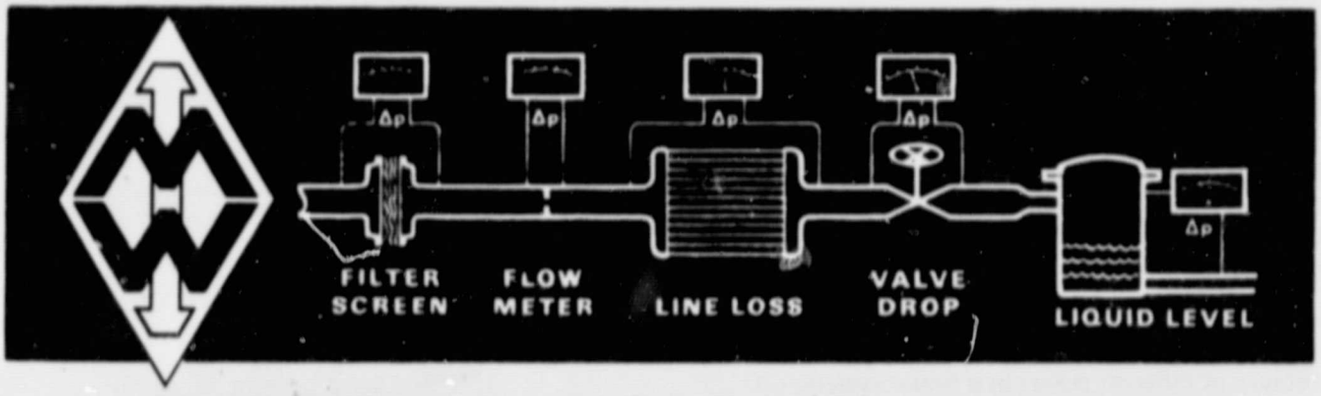


FIGURE 1685

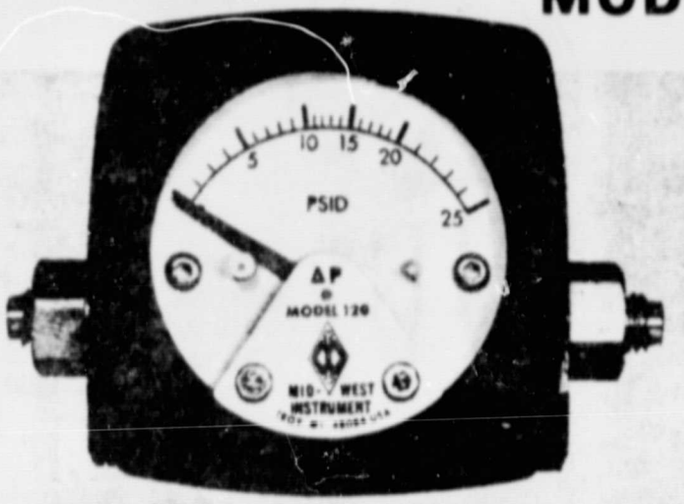
DIAL SIZE	A	B	C	F	G	H	J	R	W	X	Y	Z
4½"	5.06	2.58	1.00	.56	5.81	.219	5.375	2.62	.78	1.25	.63	.25

MAXIMUM DIAL INDICATION		DIAL GRADUATIONS		Max. Press. Limits* PSI
Split Scale PSI	Straight Scale PSI	Fig. Intervals PSI	Minor Intervals PSI	
7½-0-7½	0-15	1	¼	30
15-0-15	0-30	5	½	60
30-0-30	0-60	5	1	120
50-0-50	0-100	10	1	175
100-0-100	0-200	20	2	225
200-0-200	0-400	40	5	400

*This is maximum pressure that can be applied to either bourdon tube regardless of pressure in other bourdon tube



MODEL 820 FLOW TEST KIT



COMPACT, LOW COST DIFFERENTIAL PRESSURE FLOW TEST KIT

2 1/2 DIAL GAUGE

0-2 TO 0-100 PSID RANGE,

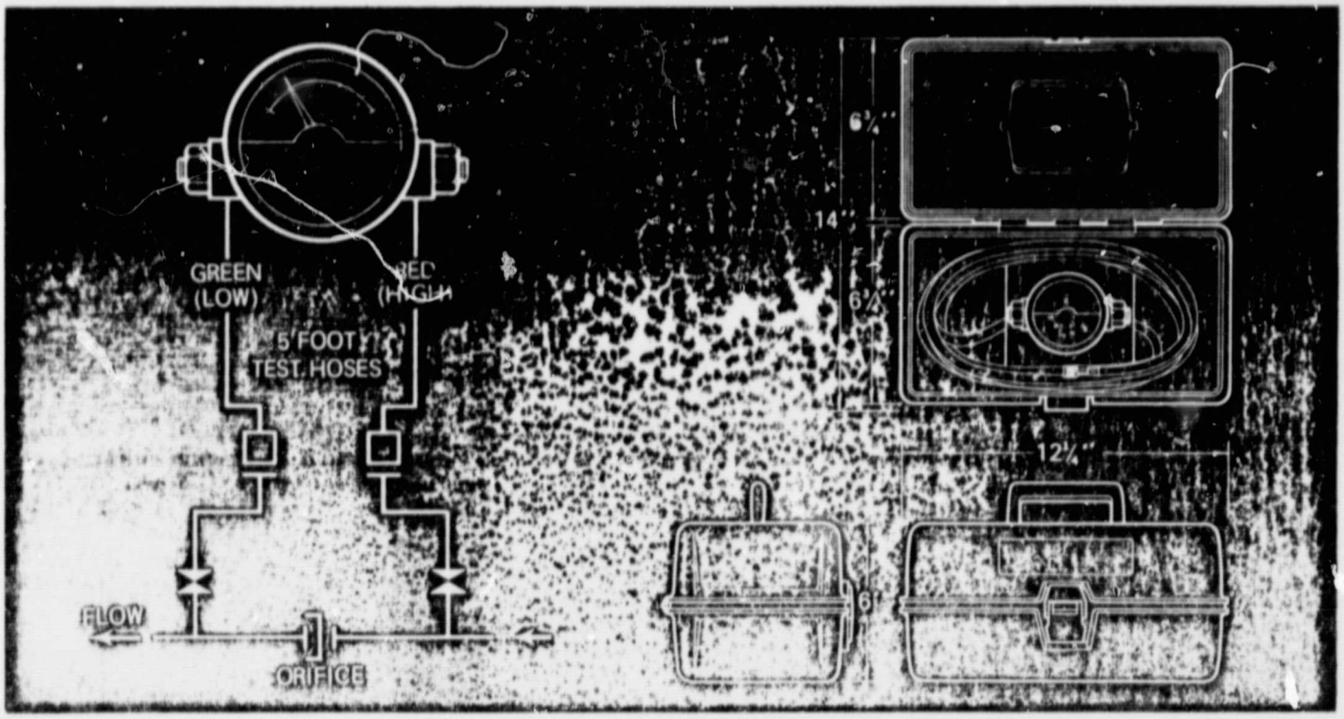
600 PSI S.W.P.

The Model 820 is a compact, low cost flow test kit for monitoring and setting flow rates thru orifices, venturis, adjustable restrictions, pitot tubes or other flow devices--or anywhere differential pressure measurements may be required in the field. The pressure gauge is a Mid-West Model 120, with a 2-1/2 inch dial. Pressure Ranges are available from 0-2 to 0-100 psid [0-0.14 to 0-7.0 Kg/cm^{-2}].

The gauge is installed in a compact, rugged carrying case of tough plastic material and is supplied complete with five foot long flexible hoses for connecting to the flow device. The Model 120 gauge is a free floating piston gauge and has a very small but continuous purge flow across the piston, and separate bleed-drain valves normal for flow test kits are not required.

Mid-West
Instrument *(The Innovators)*
P.O. Drawer 939 • Troy, Michigan 48099 • Ph. (313) 585-0900
286 Executive Dr. • Troy, Michigan 48084 • Telex No. 23-5798

MODEL 820 FLOW TEST KIT



SPECIFICATIONS:

- Pressure Range - See Table
- Working Pressure - 500 psi maximum
- Working Temperature - 200 F maximum
- Hose Connections - Very Flexible, Buna N Liner, Neoprene Jacket, with Knurled Swivel End (Quick Connect) Fittings for 1/4 Male Flare Tube Connections--5 foot length.
- Fluid Media - Gases or Liquids Compatible with: Nylon; Buna N Rubber; Brass; Aluminum; Stainless Steel.

STANDARD DIAL RANGE

RANGE	ACCURACY
0 - 2 PSID	± 0.1
0 - 5 PSID	± 0.2
0 - 10 PSID	± 0.3
0 - 15 PSID	± 0.4
0 - 20 PSID	± 0.5
0 - 25 PSID	± 0.7
0 - 30 PSID	± 1.0
0 - 50 PSID	± 1.5
0 - 75 PSID	± 2.0
0 - 100 PSID	± 2.5
0 - 60 H_2O	± 3.0
0 - 135 H_2O	± 6.0

Square Root and Metric Scales available

Note - Most Ranges available in dual scale (English & Metric Equivalent) at no additional charge.

REPRESENTED BY

Mid-West Instrument *(The Innovators)*
P.O. Drawer 939 • Troy, Michigan 48099 • Ph. (313) 585-0900
286 Executive Dr. • Troy, Michigan 48084 • Telex No. 23-5798

DRAWINGS

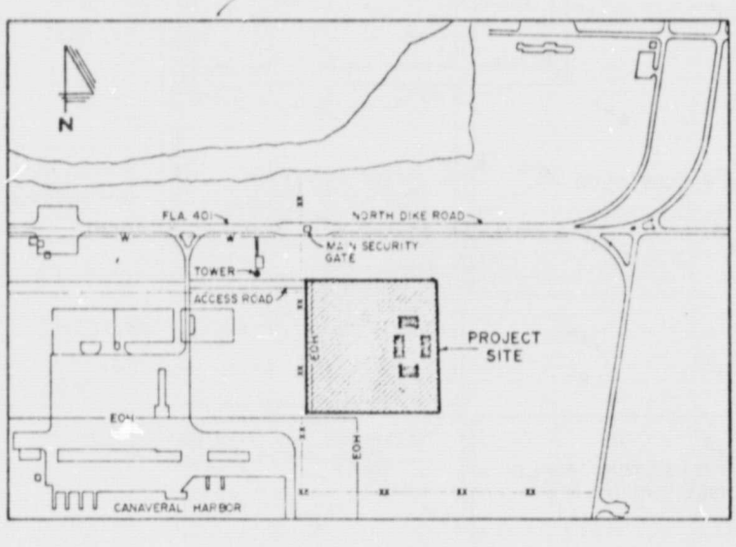
U.S. GOVERNMENT PRINTING OFFICE: 1980—640-247/455 REGION NO. 4

SOLAR HEATING
DEMONSTRATIO

FLORIDA SOLAR EN
FLORIDA TECHNOLOGI

CAPE CANAVERA
PROJECT NO.

BEING CONSTRUCTED
DEPARTMENT OF GENERAL S
THOMAS R. BROWN - EXECUTIVE



LOCATION MAP
SCALE: 1" = 400'

sht.no.	
1 of 6	TITL
2 of 6	SITE
3 of 6	PIPI
4 of 6	SOLA
5 of 6	FLOW
6 of 6	ELEC

FOLDOUT FRAME

stottler stagg & associates
architects engineers planners, inc.
brevard engineering company

ATING & COOLING
RATION PROJECT

LAR ENERGY CENTER
NOLOGICAL UNIVERSITY

IAVERAL, FLORIDA
CT NO. BR-421

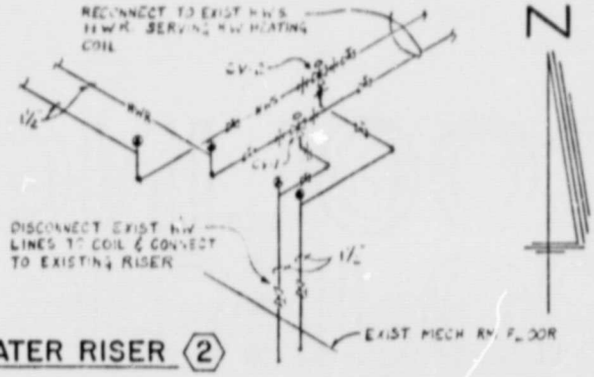
CONSTRUCTED BY :
MENT OF GENERAL SERVICES
R. BROWN - EXECUTIVE DIRECTOR.

SHEET INDEX

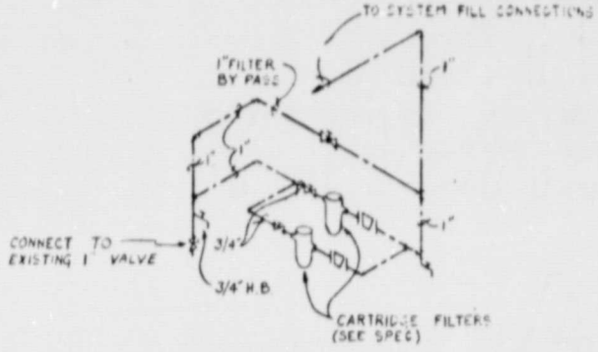
sht.no.	title	drwg.no.
1 of 6	TITLE SHEET, INDEX & LOCATION MAP	SI-1
2 of 6	SITE PLAN, LEGEND & DETAILS	SI-2
3 of 6	PIPING & EQUIPMENT PLAN	M-1
4 of 6	SOLAR COLLECTOR FIELD PLAN & DETAILS	M-2
5 of 6	FLOW SCHEMATIC, & CONTROL PANEL	M-3
6 of 6	ELECTRICAL	E-1

FOLDOUT FRAME 2

		REVISIONS	ISSUE DATE 7/24/78	SCALE AS SHOWN	TITLE SHEET, INDEX & LOCATION MAP	DWG. NO. SI-1
			PRINT DATE 7/24/78	DRAWN BY F. SOUZA	SOLAR HEATING & COOLING DEMONSTRATION PROJECT	SHT. 1 OF 6
			APPROVED BY J. HEARCE	CHECKED BY C. HEALY JR.	FLORIDA SOLAR ENERGY CENTER	JOB NO. 77/37-1
			APPROVAL DATE 7/24/78	DATE 7/24/78	FLORIDA TECHNOLOGICAL UNIVERSITY CAPE CANAVERAL, FLORIDA - PROJECT NO. BR-421	FILE NO.



HOT WATER RISER (2)



DOMESTIC WATER RISER (1)

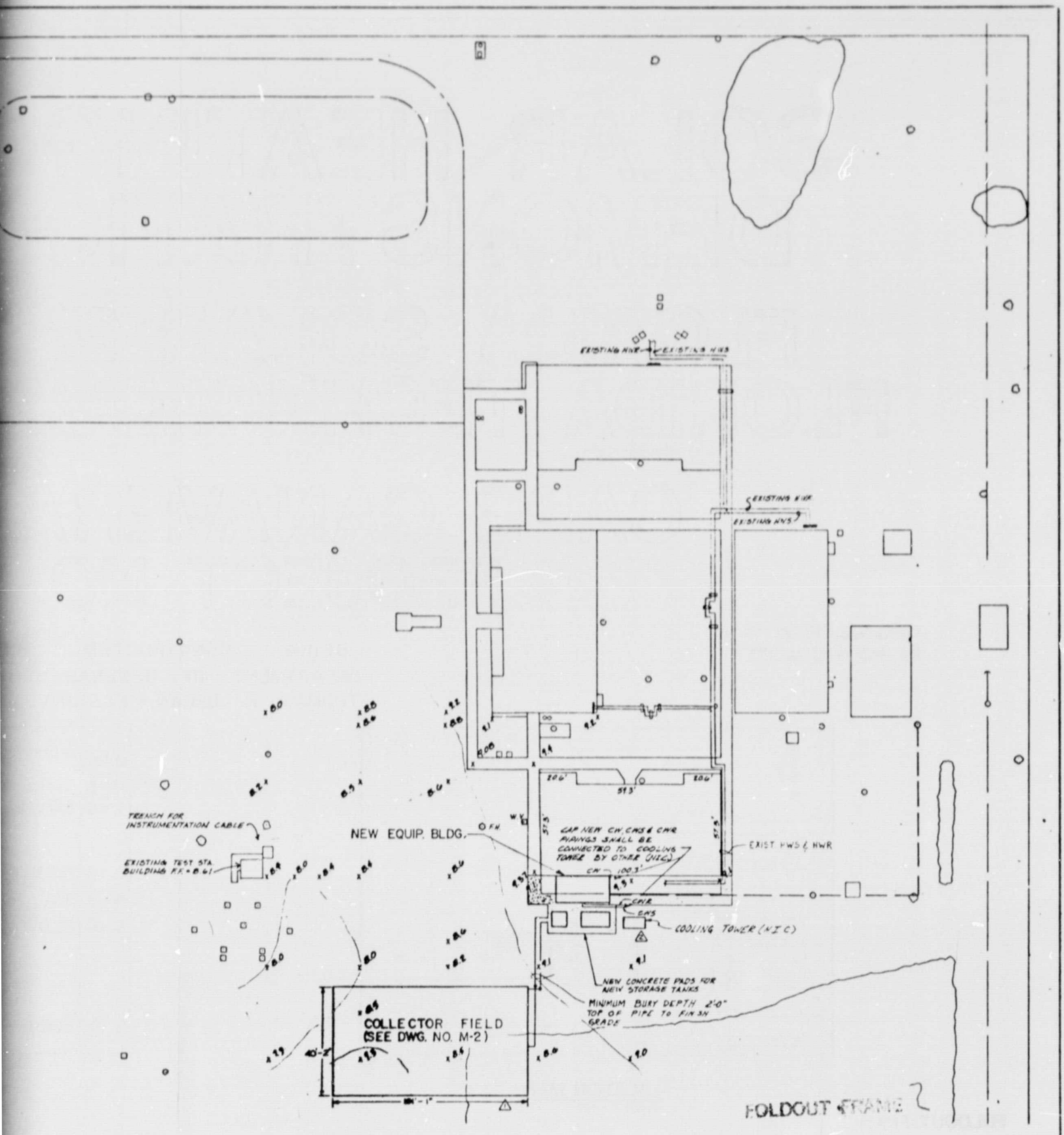
FOLDOUT FRAME 1

LEGEND	
DOMESTIC COLD WATER	
CHILLED WATER SUPPLY	CHS
CHILLED WATER RETURN	CHR
CONDENSER WATER SUPPLY	CWS
CONDENSER WATER RETURN	CWR
SOLAR HOT WATER SUPPLY	SHWS
SOLAR HOT WATER RETURN	SHWR
HOT WATER SUPPLY	HWS
HOT WATER RETURN	HWR
GATE VALVE	
CHECK VALVE	
BALANCING VALVE	B.V.
UNION	
ELBOW (UP, DOWN, PLAN)	
TEE (UP, DOWN, PLAN)	
AUTOMATIC AIR VENT	A.A.V.
RELIEF VALVE	
THERMOMETER	T-1
THERMOMETER WELL	
CONTROL VALVE (1 WAY)	
CONTROL VALVE (3 WAY)	
MANUAL AIR VENT	M.A.V.
TANK GAUGE GLASS ASSEMBLY	
PRESSURE REDUCING VALVE	
FLOW SWITCH	
RISER NUMBER	(1)

TRENCH FOR INSTRUMENTATION

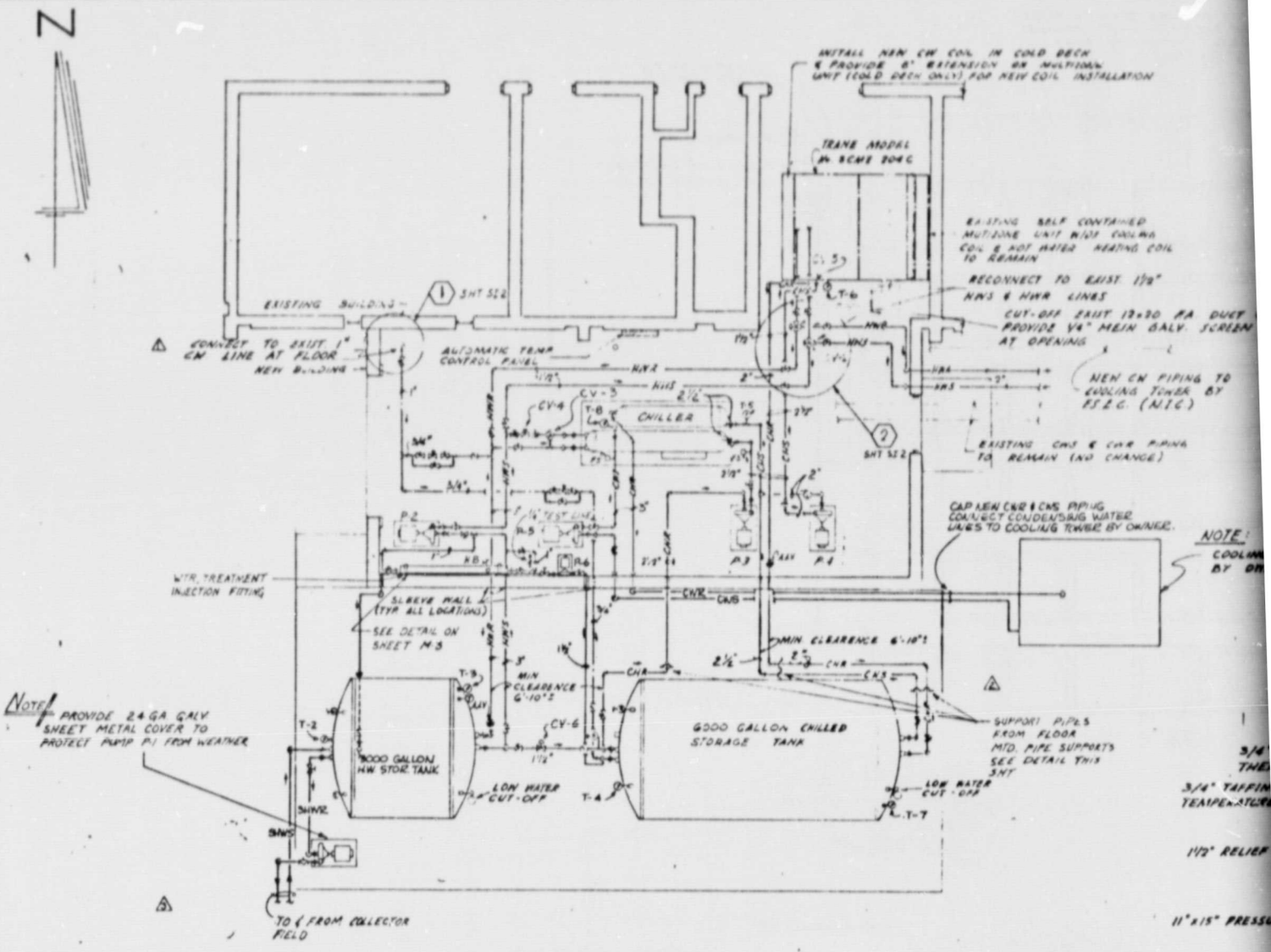
EXISTING TEST STA
BUILDING FX-B-61

stottler stagg & associates
architects engineers planners, inc.
brevard engineering company



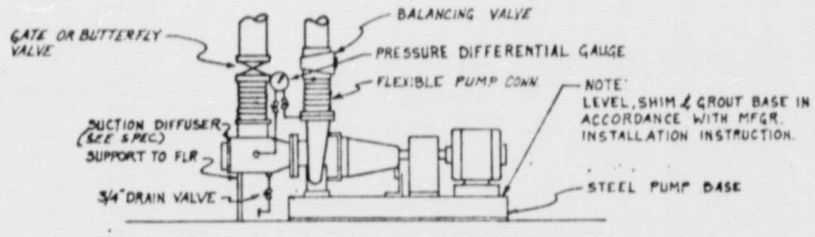
SITE PLAN

REVISIONS	ISSUE DATE	SCALE	SITE PLAN, LEGEND & DETAILS	DWG. NO.
1 MOVED COLLECTOR FIELD 8/15/78 2 MOVED COOLING TOWER 8/15/78	7/24/78	1" = 30'-0"		SI-2
	PRINT DATE 7/24/78	DRAWN BY K. SHAIL	SOLAR HEATING & COOLING DEMONSTRATION PROJECT FLORIDA SOLAR ENERGY CENTER FLORIDA TECHNOLOGICAL UNIVERSITY CAPE CANAVERAL, FLORIDA - PROJECT NO. BR-421	SHT. 2 OF 6
	APPROVED BY J. HACKER	CHECKED BY J. HACKER		JOB NO. 77/37-1
	APPROVAL DATE 7/24/78	DATE 7/24/78		FILE NO.



PIPING & EQUIPMENT PLAN

SCALE: 1/4"=1'-0"



TYPICAL PUMP MOUNTING DETAIL

SCALE: NONE

LOCATE CUT-OFF LEVEL 8" MIN. ABOVE TOP OF FLOW TOPPING

CONC.

LOW WATE

SCALE: NONE

FOLDOUT FRAME 1

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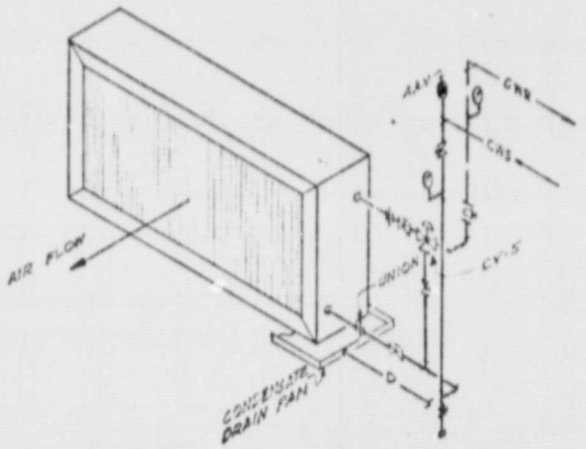
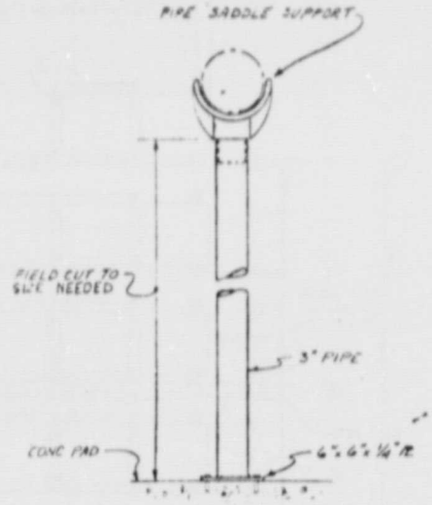
architects engineers planners, inc.
brevard engineering company

FOLDOUT FRAME 2



COOLING COIL PIPING DETAIL

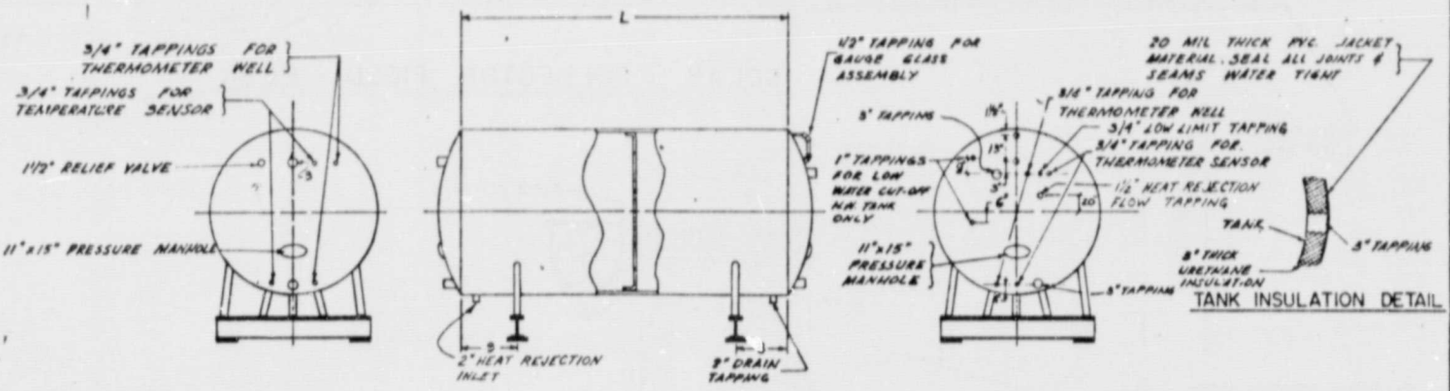
SCALE: NONE



PIPE SUPPORT

SCALE: NONE

NOTE:
COOLING TOWER BY OWNER (N.I.C.)



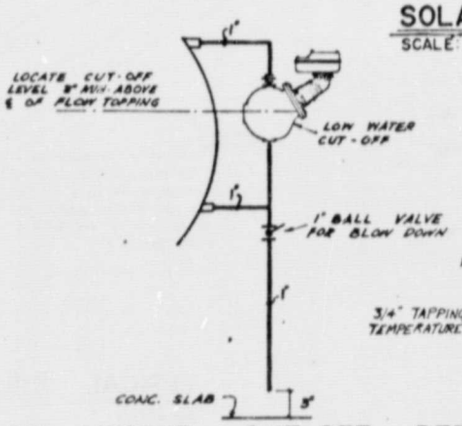
TANK INSULATION DETAIL

SOLAR & CHILLED WATER TANK DETAIL

SCALE: NONE

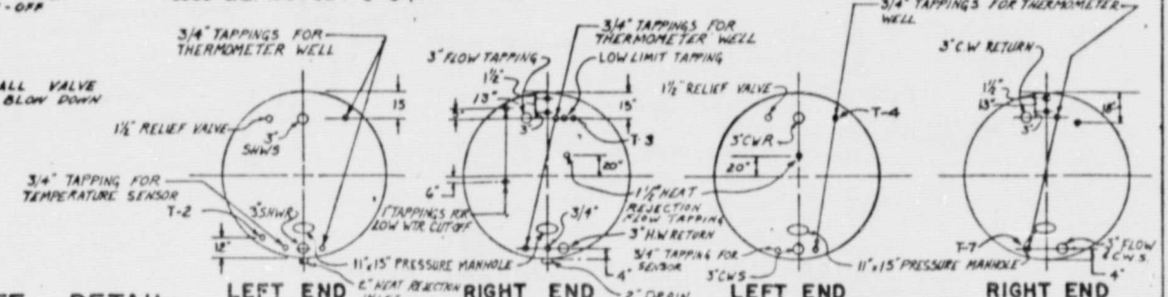
	L	S	DIA
3000 GAL.	8'-0"	24"	8'-0"
6000 GAL.	16'0"	32"	8'-0"

NOTES:
1. EXTEND ALL TAPPINGS & BOSSES 3½" MIN. PAST TANK SURFACE SEE INSULATION DETAILS
2. TANKS TO BE CONSTRUCTED & TESTED FOR MAX. WORKING PRESSURE OF 75 PSIG
3. SEE SPECIFICATION FOR INSULATION

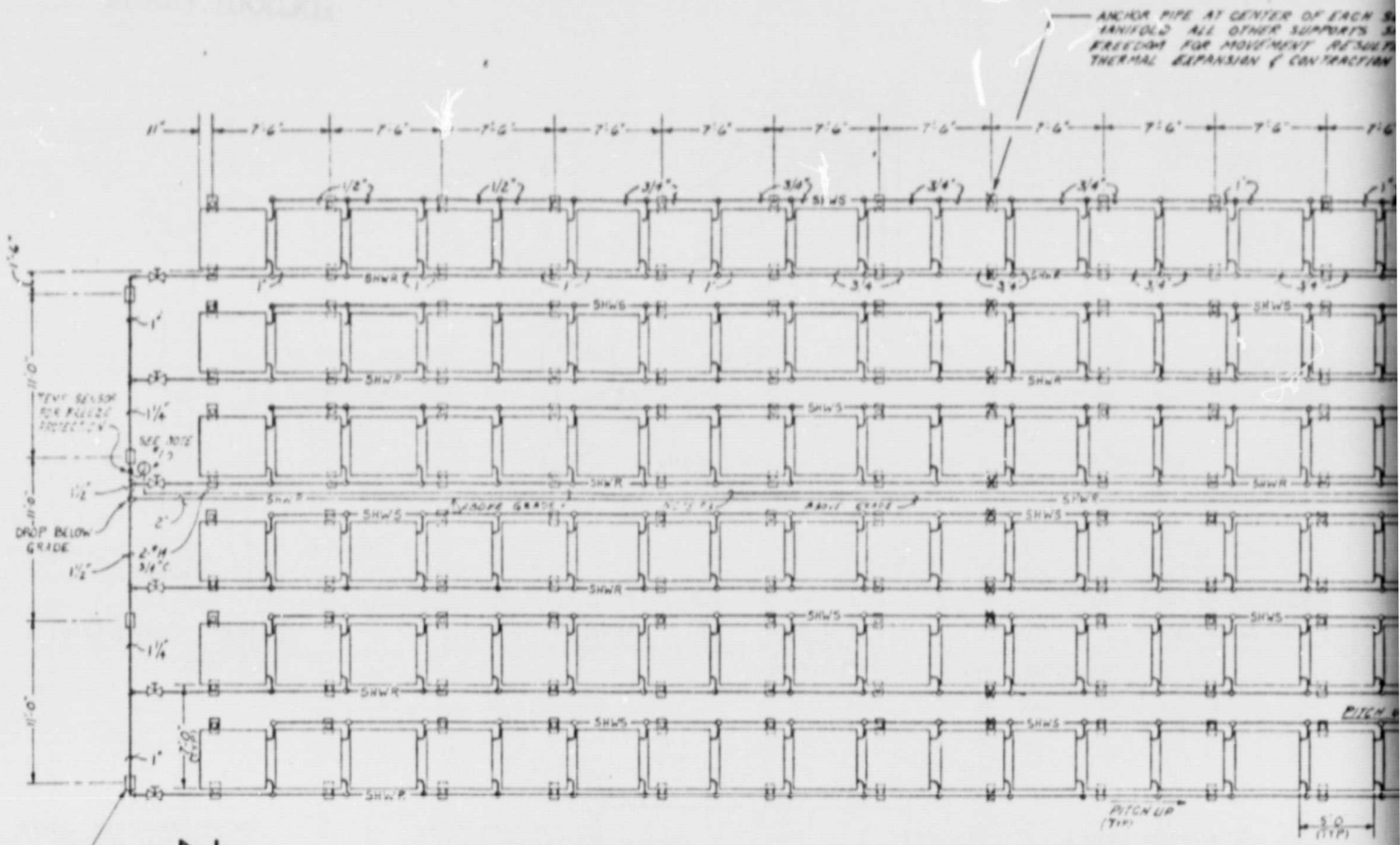


LOW WATER CUT-OFF DETAIL

SCALE: NONE

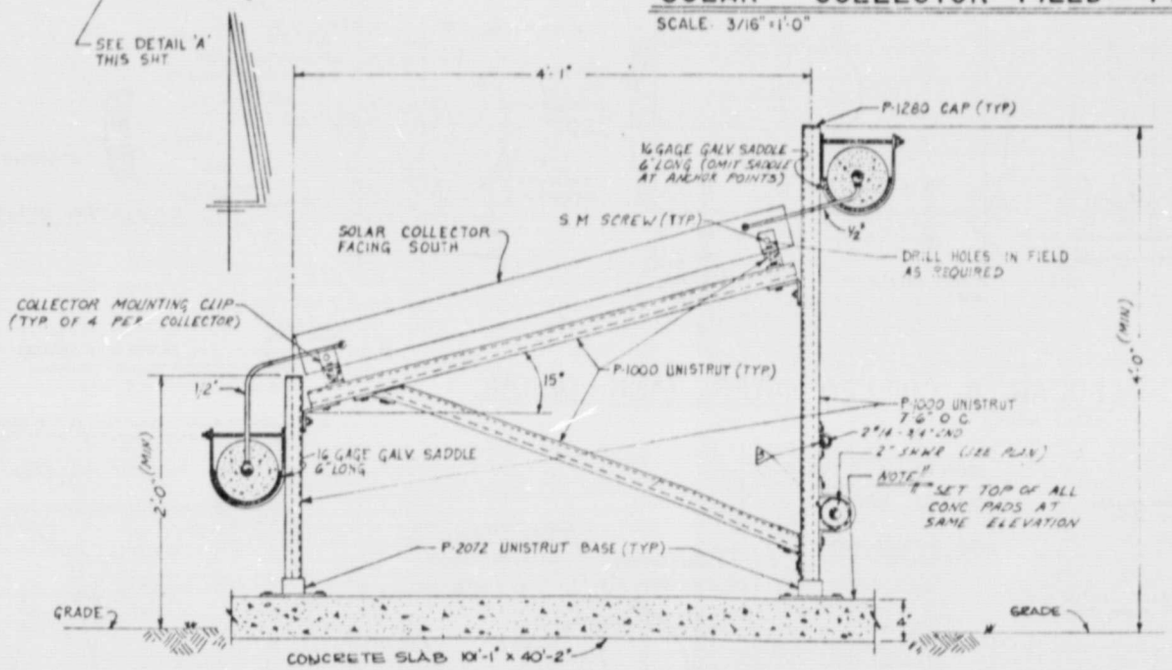


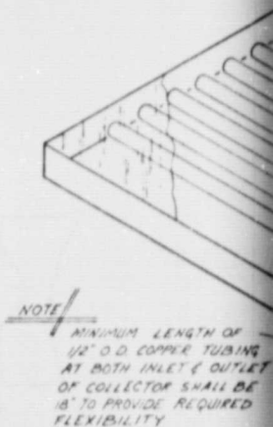
REVISIONS			ISSUE DATE 7/24/78	SCALE 1/4"=1'-0"	PIPING & EQUIPMENT PLAN	DWG NO M-1
1 CHANGED C.W. PIPING TO 1"	8/15/78		PRINT DATE 7/24/78	DRAWN BY J. Hahn	SOLAR HEATING & COOLING DEMONSTRATION PROJECT	SHT 3 OF 6
2 MOVED Cooling Tower	8/15/78		APPROVED BY J.R.B.H.	CHECKED BY J. Hahn	FLORIDA SOLAR ENERGY CENTER	JOB NO 77137-1
3 MOVED Swgr. Eq. + Ref. Piping	8/15/78		APPROVAL DATE 7/24/78	DATE 7/24/78	FLORIDA TECHNOLOGICAL UNIVERSITY CAPE CANAVERAL, FLORIDA - PROJECT NO. BR-421	FILE NO



SOLAR COLLECTOR FIELD - PLAN

SCALE: 3/16" = 1'-0"





NOTE

MINIMUM LENGTH OF 1/2" O.D. COPPER TUBING AT BOTH INLET & OUTLET OF COLLECTOR SHALL BE 18" TO PROVIDE REQUIRED FLEXIBILITY

FOLDOUT FRAME

SOLAR COLLECTOR SUPPORT DETAIL

SCALE: 1-1/2" = 1'-0"

TYPICAL SOL

NO SCALE

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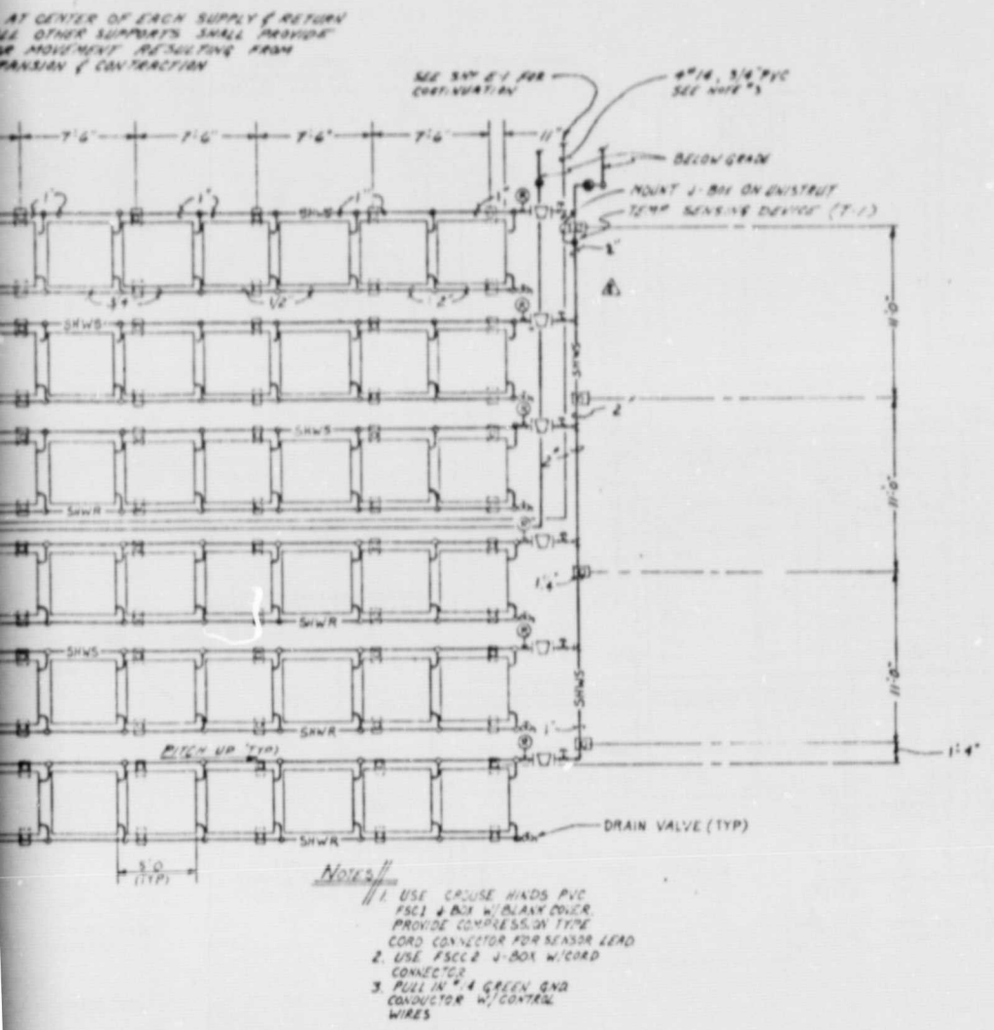
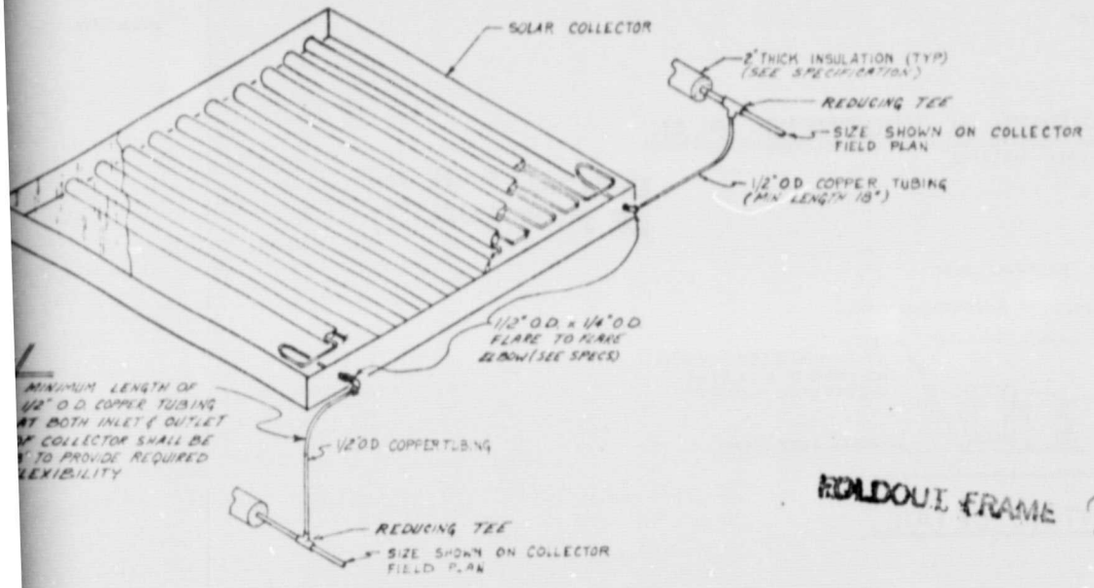


NOTES:

1. USE CROUSE HINDS PVC FSC1 J-BOX W/BLANK COVER. PROVIDE COMPRESSION TYPE CORD CONNECTOR FOR SENSOR LEAD
2. USE FSCC2 J-BOX W/CORD CONNECTOR
3. PULL IN #14 GREEN GND CONDUCTOR W/CONTROL WIRES



FOLDOUT FRAME 2

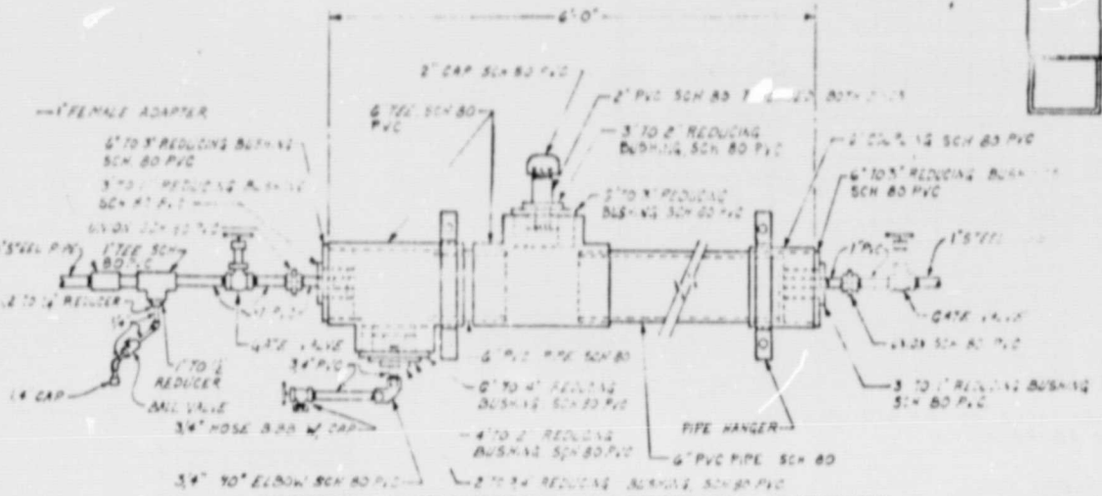
TYPICAL SOLAR COLLECTOR PIPING DETAIL

NO SCALE

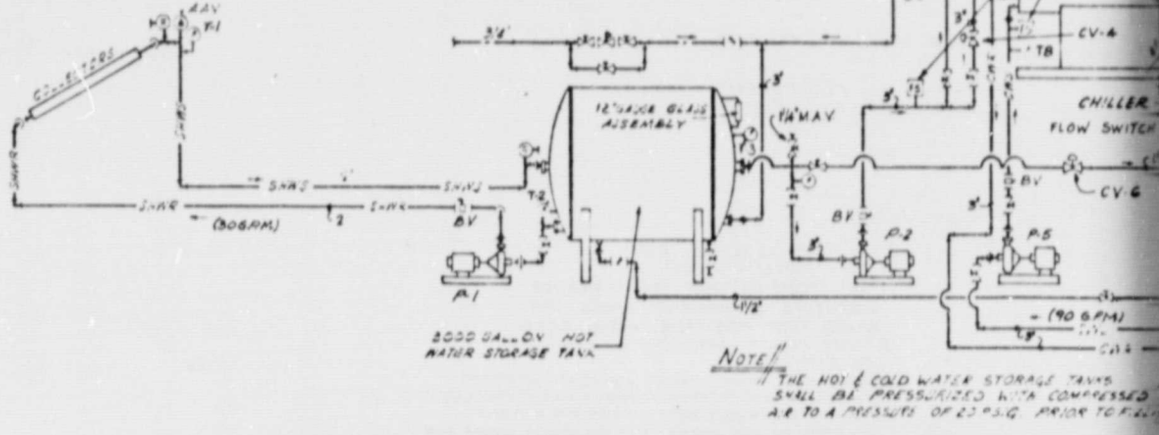
REVISIONS	ISSUE DATE 7/24/78	SCALE AS SHOWN	SOLAR COLLECTOR FIELD - PLAN & DETAILS	DWG NO. M-2 SHT. 4 OF 6
1 CHANGE LOCATION OF PIPE 8/16/78	PRINT DATE 7/24/78	DRAWN BY J. WISE	SOLAR HEATING & COOLING DEMONSTRATION PROJECT	
2 CHANGE P-1 SIZE & ROUTING 8/16/78	APPROVED BY J. WALKER	CHECKED BY J. WALKER	FLORIDA SOLAR ENERGY CENTER	JOB NO. 77137-1
3 CHANGE CIRCUIT DETAIL 8/16/78	APPROVAL DATE 7/24/78	DATE 7/24/78	FLORIDA TECHNOLOGICAL UNIVERSITY CAPE CANAVERAL, FLORIDA - PROJECT NO. BR-421	FILE NO.

PUMP SCHEDULE

MARK	SERVICE	MANUFACT.	MODEL & SIZE	FLOW (G.P.M.)	T.D.H. (FT. H2O)	MOTOR			
						R.P.M.	H.P.	VOLT	PHASE
P-1	SOLAR HW	BELL & GOSSETT	1510 - 1½" A.B.	30	65	1750	2	460	3
P-2	HW HEATING	" "	1510 - 1½" A.B.	90	45	1750	2	460	3
P-3	PRIMARY CHILLED WTR	" "	1510 - 1½" A.B.	90	35	1750	1	460	3
P-4	CHILLED WATER	" "	1510 - 1½" A.B.	38	34	1750	1	460	3
P-5	CONDENSING WATER	" "	1510 - 1½" A.B.	90	65	1750	3	460	3
P-6	HEAT RECIRCULATION PUMP	" "	1" BELL & GOSSETT BRONZE BOOSTER	20	8	1750	1/6	115	1



WATER TREATMENT INJECTION FITTING



Note: THE HOT & COLD WATER STORAGE TANKS SHALL BE PRESSURIZED WITH COMPRESSED AIR TO A PRESSURE OF 20 P.S.I. PRIOR TO FILL...

FLOW SCHEMAT...

FOLDOUT FRAME

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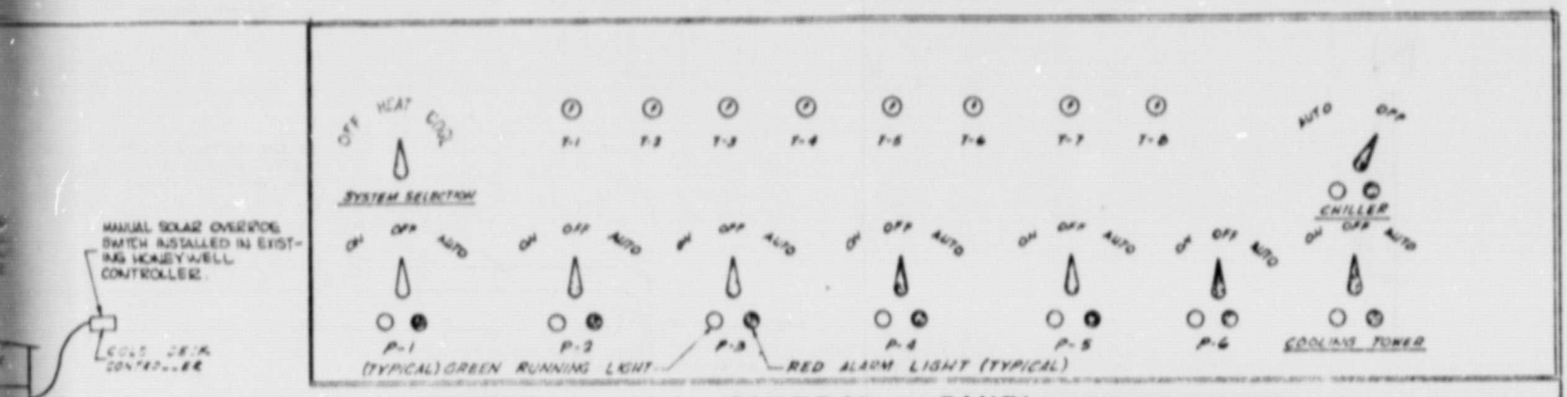
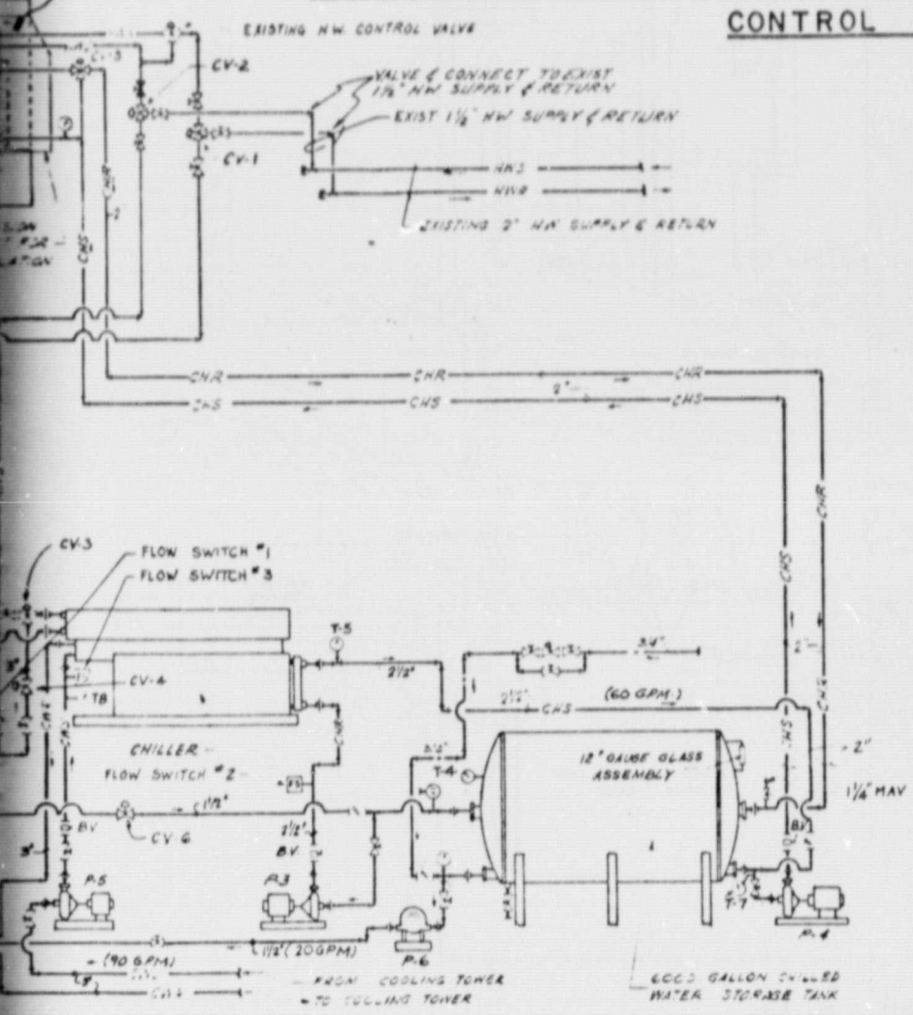
brevard engineering company



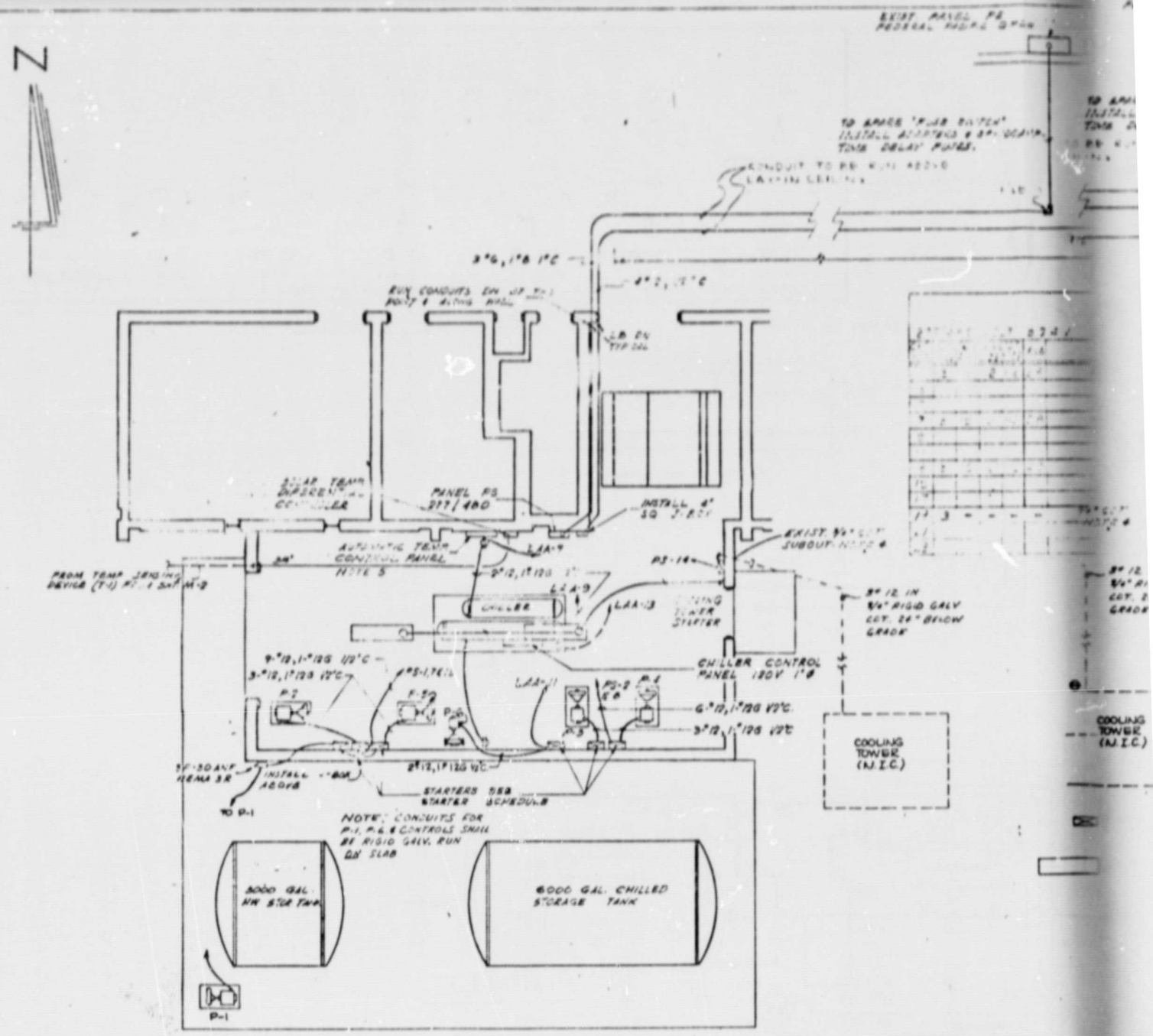
CONTROL PANEL



SCHEMATIC

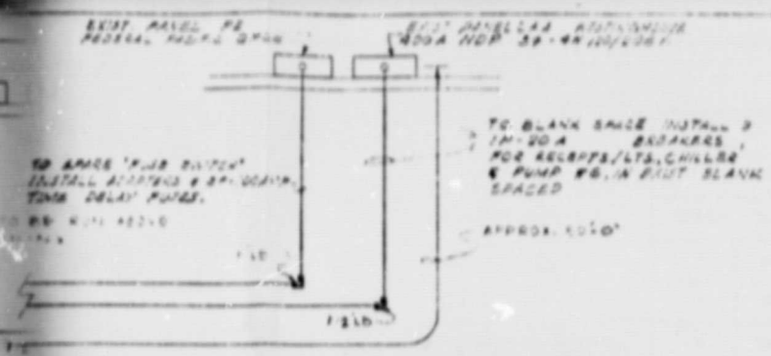
HOLDOUT FRAME 2

	REVISIONS	ISSUE DATE 7-24-78	SCALE NONE	FLOW SCHEMATIC, CONTROL PANEL & SEQUENCE OF OPERATION	DWG NO. M-3 SHT. 5 OF 6	
		PRINT DATE 7-24-78	DRAWN BY Javier Matos	SOLAR HEATING & COOLING DEMONSTRATION PROJECT FLORIDA SOLAR ENERGY CENTER FLORIDA TECHNOLOGICAL UNIVERSITY CAPE CANAVERAL, FLORIDA - PROJECT NO. BR-421	JOB NO. 77137-1	
		APPROVED BY J. HACKER	CHECKED BY J. HACKER			
		APPROVAL DATE 7-24-78	DATE 7-24-78		FILE NO.	



ELECTRICAL FLOOR PLAN

SCALE · 1/4" = 1'-0"



PANEL F

				120 AND M.L.O.					
		REMARKS							REMARKS
		FUSE #1		1	3	15	16	15	FUSE #1
				2					
		FUSE #2		3	3	15	2	12	15 FUSE #2
				4					
		(CW)		5		18	12	44	22 TOWER FAN
				6					
17	3	-	-	-	-	SPACE	20	3	- - - - SPACE
				22					
				24					

3/4" 12 IN
3/4" RIGID GALV
CDT. 24" BELOW
GRADE

COOLING
TOWER
(N.I.C.)

LEGEND

- ● DUPLEX RECEPTACLE 20 AMP. SPECIFICATION GRADE, MTD 1' ABOVE FLOOR
- --- GALV. RIGID CONDUIT RUN 24" MIN. BELOW GRADE
- —— EMT CONDUIT
- MOTOR STARTER - SEE SCHEDULE
- ▭ 1'X4' FLUORESCENT FIXTURE 2 LAMP - 277 VOLT

STARTER		
3 PHASE 480 V. WITH [illegible] - SEE [illegible]		
PUMP	H.P.	I.P.
P-1	2	[illegible]
P-2	1	[illegible]
P-3	1	[illegible]
P-4	1/2	[illegible]
P-5	2	[illegible]
P-6	1/2	00
TOWER	2	00

FURN. BY MECH. CONTR.

FURN BY OWNER

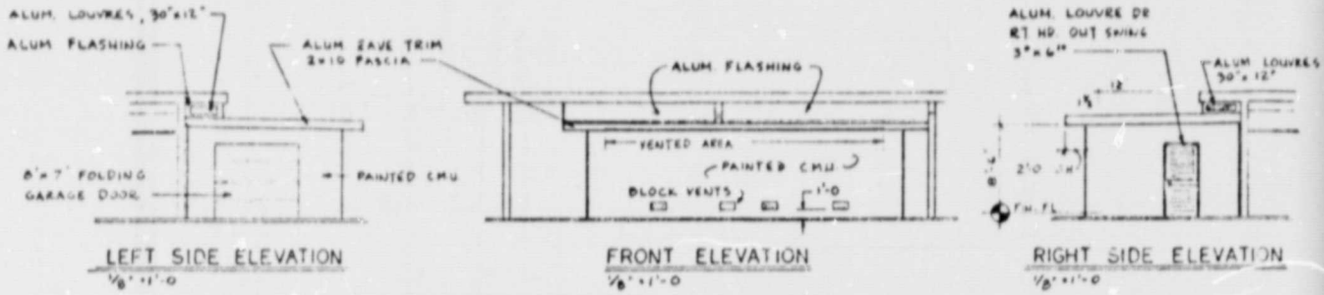
16 120 V. W/NO A. SW.

NOTE:

1) ALL WIRING SHALL BE TYPE THHN COPPER
2) ALL TERMINATIONS TO MOTORS OR VIBRATING EQUIPMENT SHALL BE MADE WITH FLEXIBLE METAL COND.
3) ELEC. CONTR. SHALL INSTALL & CONNECT ALL STARTERS
4) COOLING TOWER WILL BE INSTALLED BY OTHERS. INSTALLATION OF FAN MOTOR STARTER; CONDUIT & WIRE FROM PNL'PS TO STARTER & FROM STARTER TO FAN MOTOR; AND ALL CONECTIONS ARE THE RESPONSIBILITY OF THE ELECTRICAL CONTRACTOR.
5) AUTO. TEMP & SOLAR CONTROLLER PANEL LOCATIONS SHALL BE ADJUSTED TO AVOID EXIST. COLUMN

EDLDOLH Fig. 2

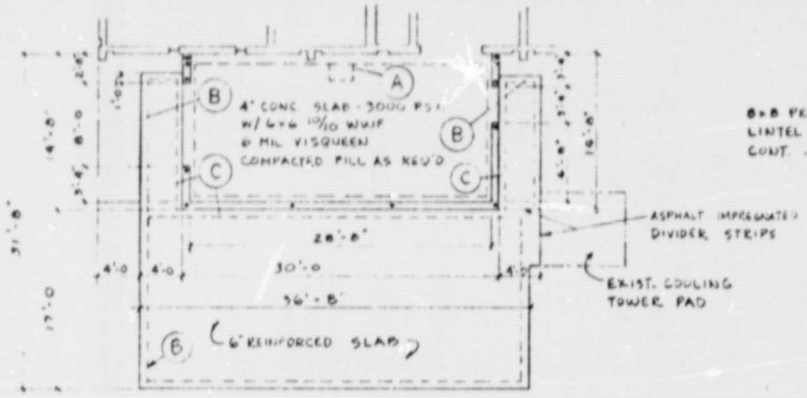
REVISIONS	ISSUE DATE	SCALE	ELECTRICAL	DRG NO
1. CHANGED PANEL SCHEDULE, ADDED NOTES 3,4, & 5. ADDED CDT. & WIRE TO COOLING TOWER	7/24/78	1/4" = 1'-0"		E-1
	PRINT DATE 1/78	DRAWN BY J. Mills	SOLAR HEATING & COOLING DEMONSTRATION PROJECT	SHT 5 OF 5
	APPROVED BY E. J. SMITH	CHECKED BY E. J. SMITH	FLORIDA SOLAR ENERGY CENTER	JOB NO 77137-1
	APPROVAL DATE 7/24/78	DATE 7/24/78	FLORIDA TECHNOLOGICAL UNIVERSITY	FILE NO
			CAPE CANAVERAL, FLOR. DA-PROJECT NO. ER-421	



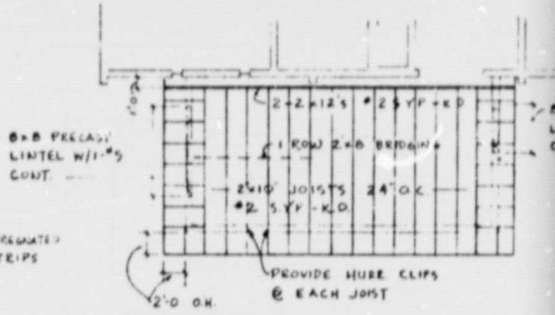
LEFT SIDE ELEVATION
1/8" = 1'-0

FRONT ELEVATION
1/8" = 1'-0

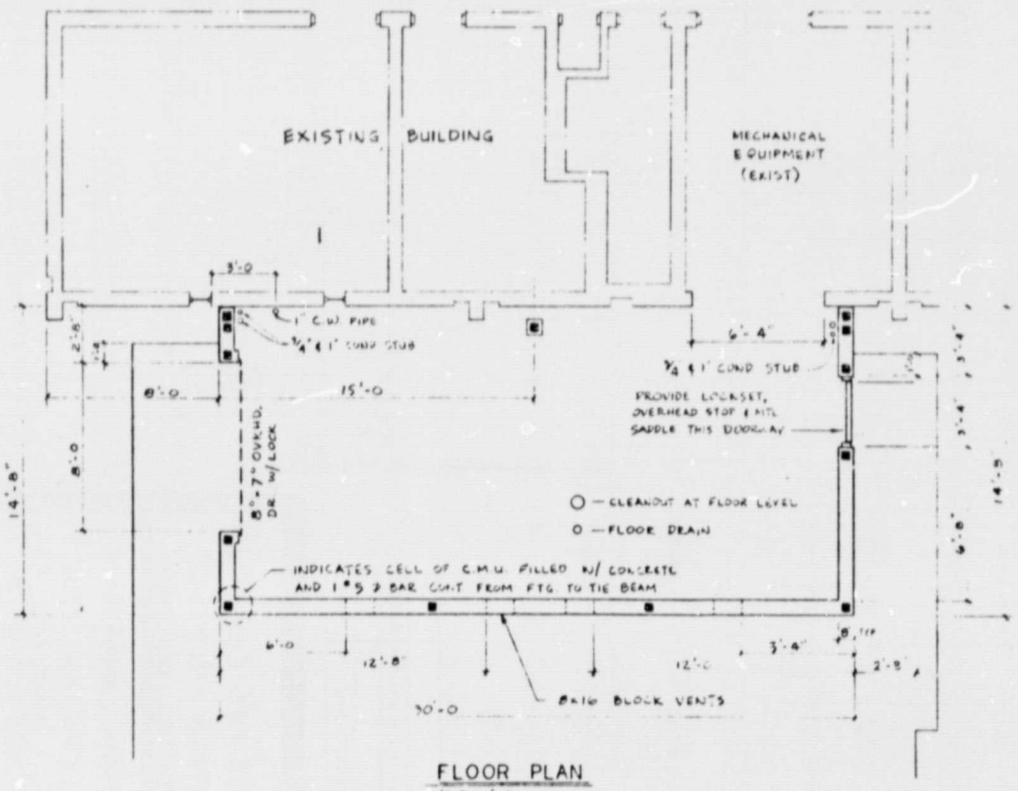
RIGHT SIDE ELEVATION
1/8" = 1'-0



FOUNDATION PLAN
1/8" = 1'-0

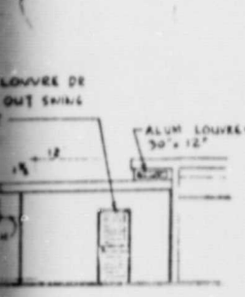


FRAMING PLAN
1/8" = 1'-0

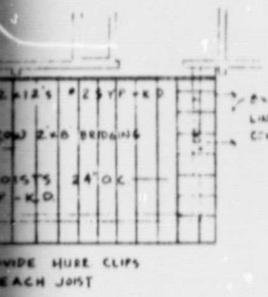


FLOOR PLAN
1/4" = 1'-0

FOLDOUT FRAME

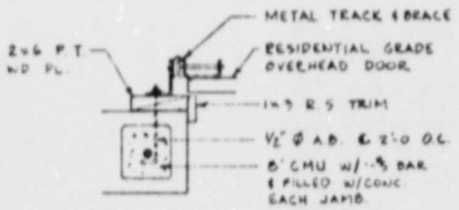


HT SIDE ELEVATION

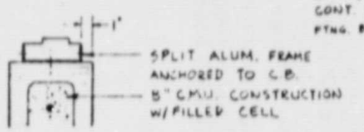


VIDE HURR CLIPS
EACH JOIST

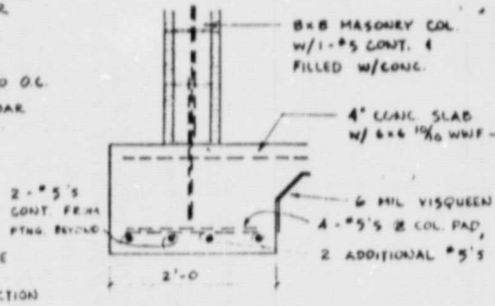
PLAN



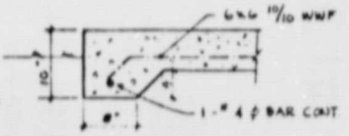
JAMB AT OVERHEAD DOOR
1½" = 1'-0



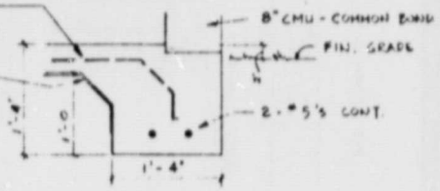
JAMB AT ENTRANCE
1½" = 1'-0



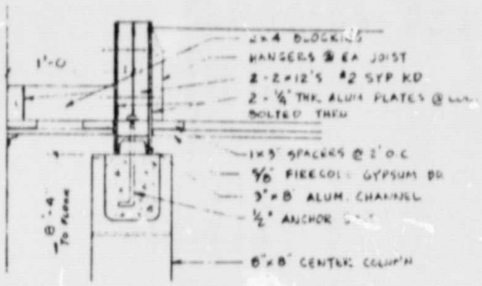
A FOOTING AT MASONRY COLUMN
1" = 1'-0



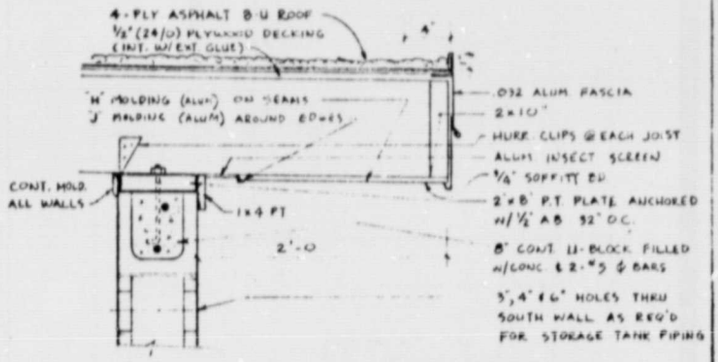
B FOOTING AROUND PAD
1" = 1'-0



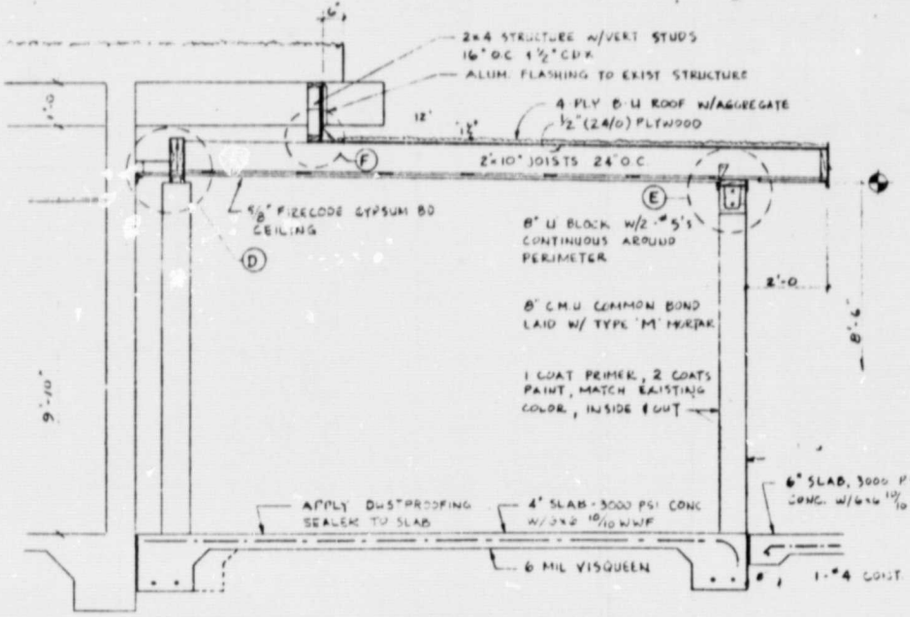
C FOOTING AT C.M.U WALL
1" = 1'-0



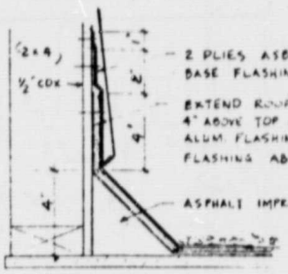
D ROOF SECTION AT CENTER COLUMN
1½" = 1'-0



E SECTION AT ROOF OVERHANG
1½" = 1'-0



CROSS SECTION
½" = 1'-0



F FLASHING DETAIL
3" = 1'-0

NOTES

1- PRESSURE TREATED WOOD USED WHERE CONCRETE OR MASONRY IS CONTACTED.
2. FOOTINGS & SLAB TERMITE TREATED.
3. SOIL UNDER FOOTING & SLAB COMPACTED AS REQ'D TO PROVIDE 2000 PSF BEARING CAPACITY.

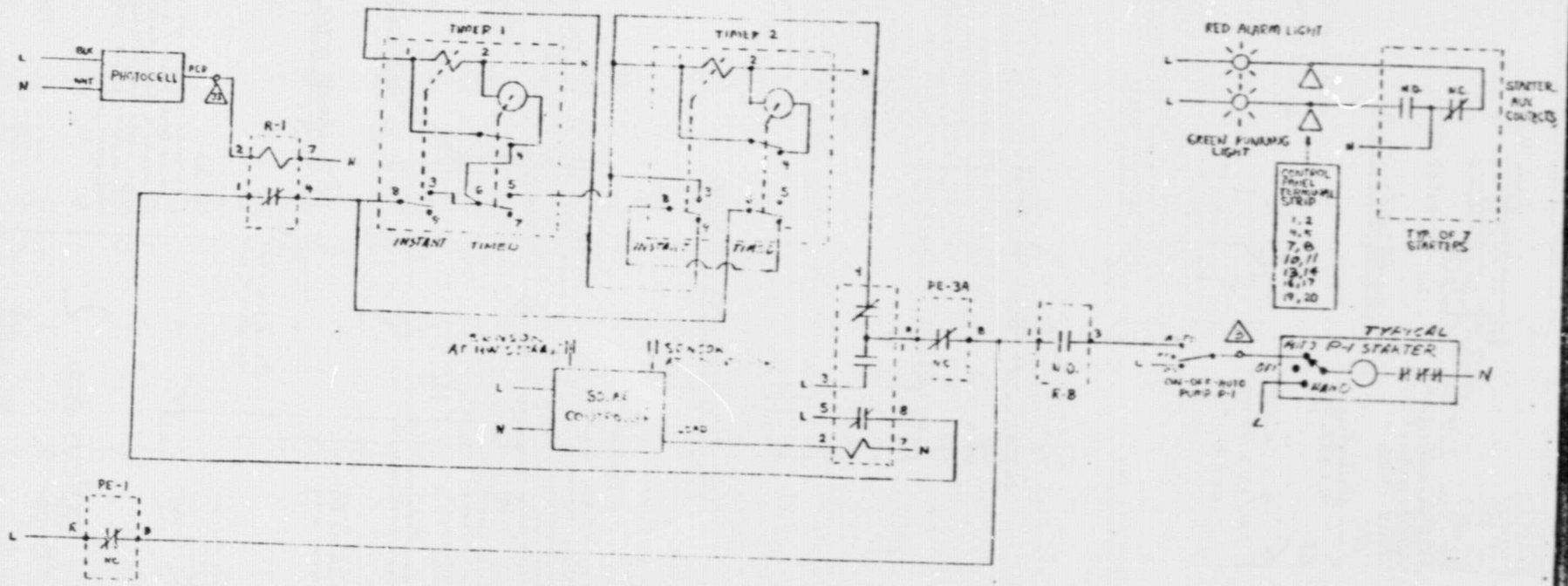
HOLDOUT FRAME 2

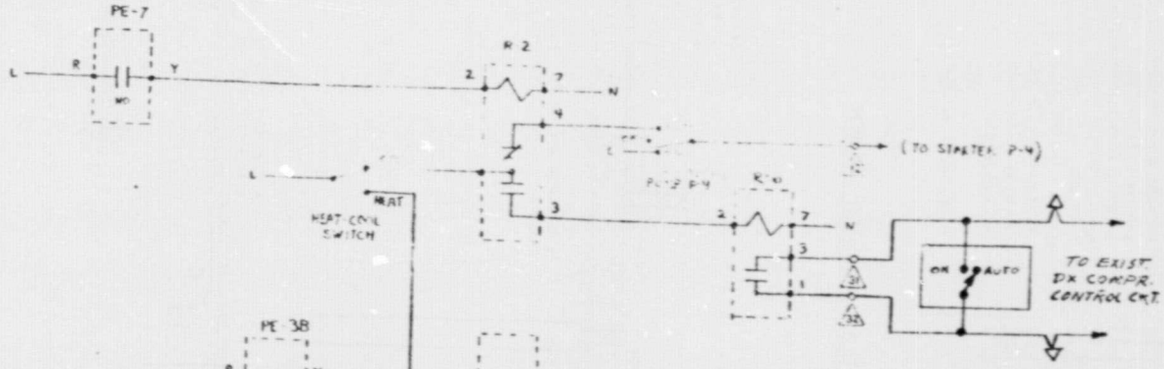
AS BUILT

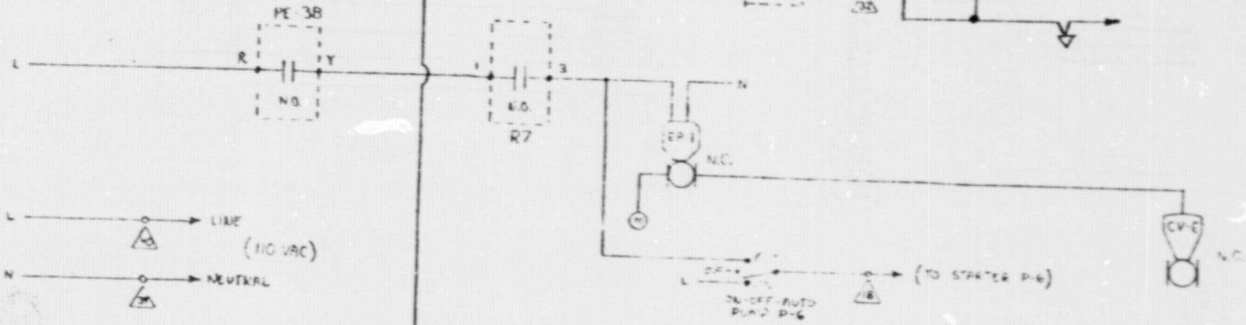
ORIGINAL PAGE IS OF POOR QUALITY

STOTTLER STAGG & ASSOCIATES
BREVARD ENGINEERING COMPANY
PROJECT NO. BR-421

ARCHITECTURAL PLANS & DETAILS	DWG NO. A1A
SOLAR HEATING & COOLING DEMONSTRATION PROJECT FLORIDA SOLAR ENERGY CENTER UNIVERSITY OF CENTRAL FLORIDA CAPE CANAVERAL, FLA.	SHT - 1 OF 1 DATE - 8/20/79 DRN BY - D SINGFIELD APP'D [signature] 8/20/79

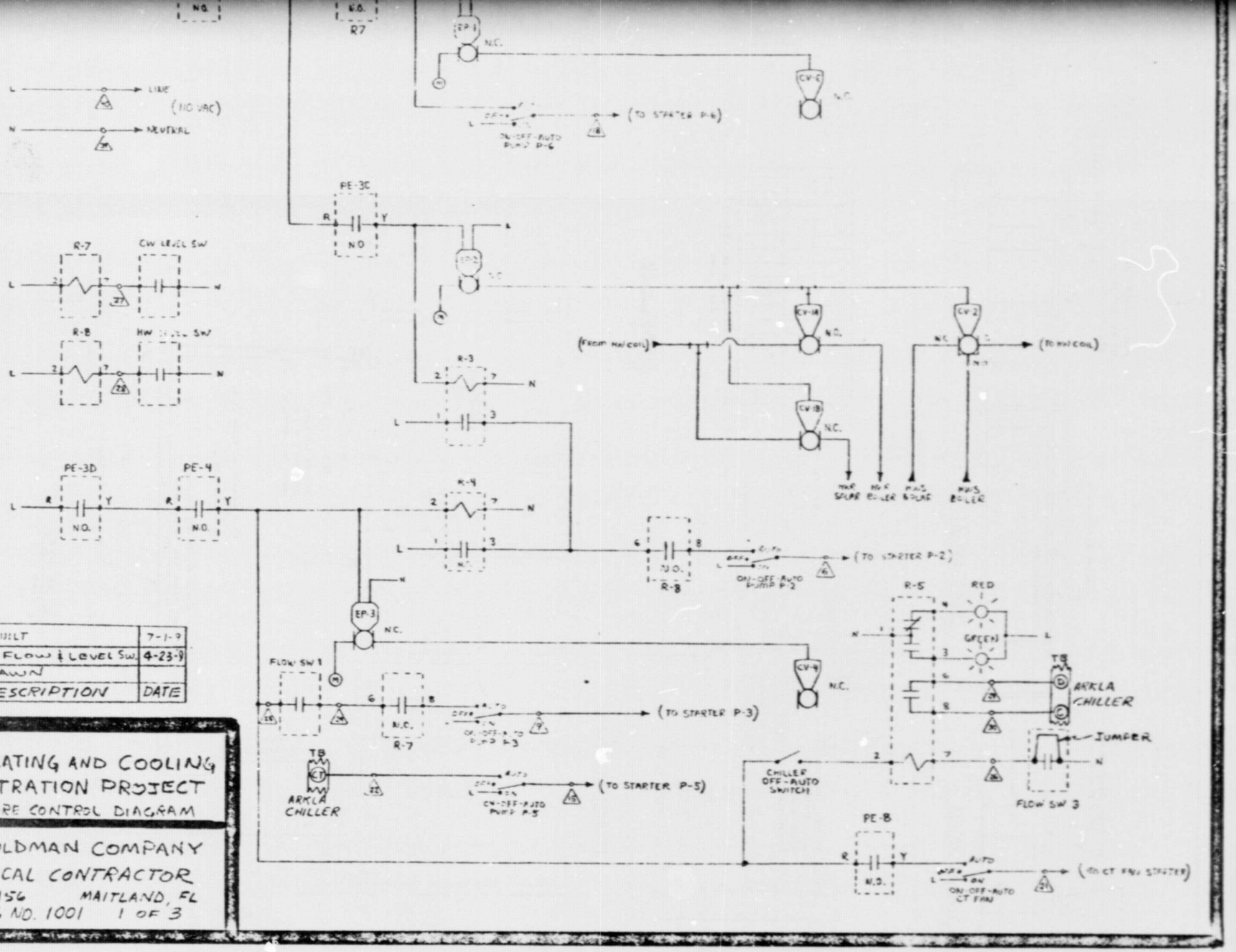






BILL OF MATERIALS

FLOW SWITCHES - MCDONNEL FS4-3
LEVEL SWITCHES - MCDONNEL 150
RELAYS - POTTER & BRUMFIELD
KRP11AG SERIES 10 A CONTACTS
PHOTOCELL - TORK MODEL 2100
CV-1A - 1½" 2-WAY N.O. VP 2567-031
CV-1B - 1½" 2-WAY N.C. VP 2568-033
CV-2 - 1½" 3-WAY VP 2566-027
CV-4 - 3" 2-WAY N.C. VP 2510-071
CV-6 - 1¼" 2-WAY N.C. VP 2568-028
TIMER-1 - EAGLE SIGNAL BR110AG (60 MIN)
TIMER-2 - EAGLE SIGNAL BR19AG (20 MIN)



REV	DESCRIPTION	DATE
3	AS BUILT	7-1-9
2	ADD FLOW & LEVEL SW.	4-23-9
1	REDRAWN	

SOLAR HEATING AND COOLING DEMONSTRATION PROJECT

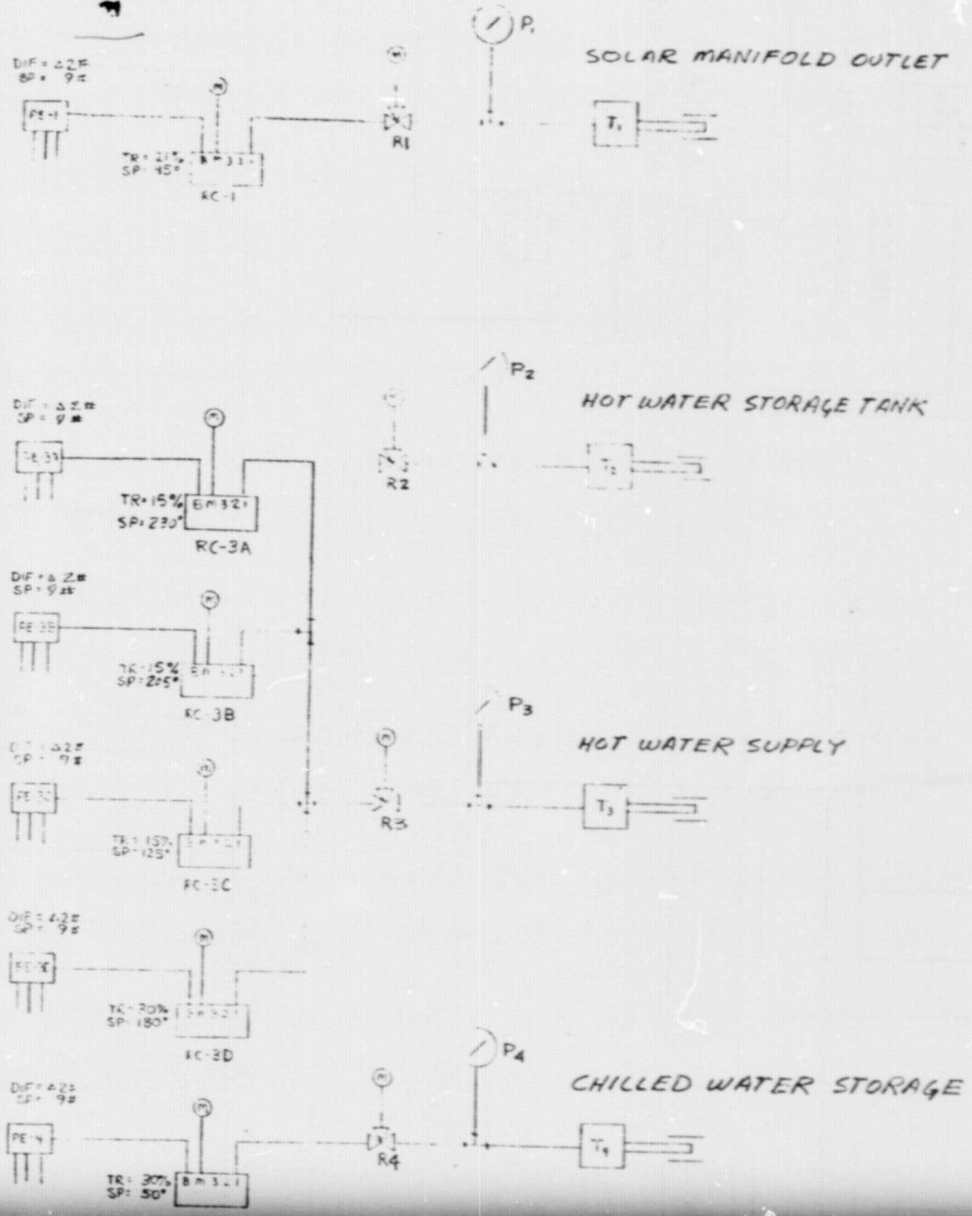
TEMPERATURE CONTROL DIAGRAM

S. I. GOLDMAN COMPANY
MECHANICAL CONTRACTOR
P.O. BOX 1156 MAITLAND, FL
DRAWING NO. 1001 1 OF 3

FOLDOUT FRAME

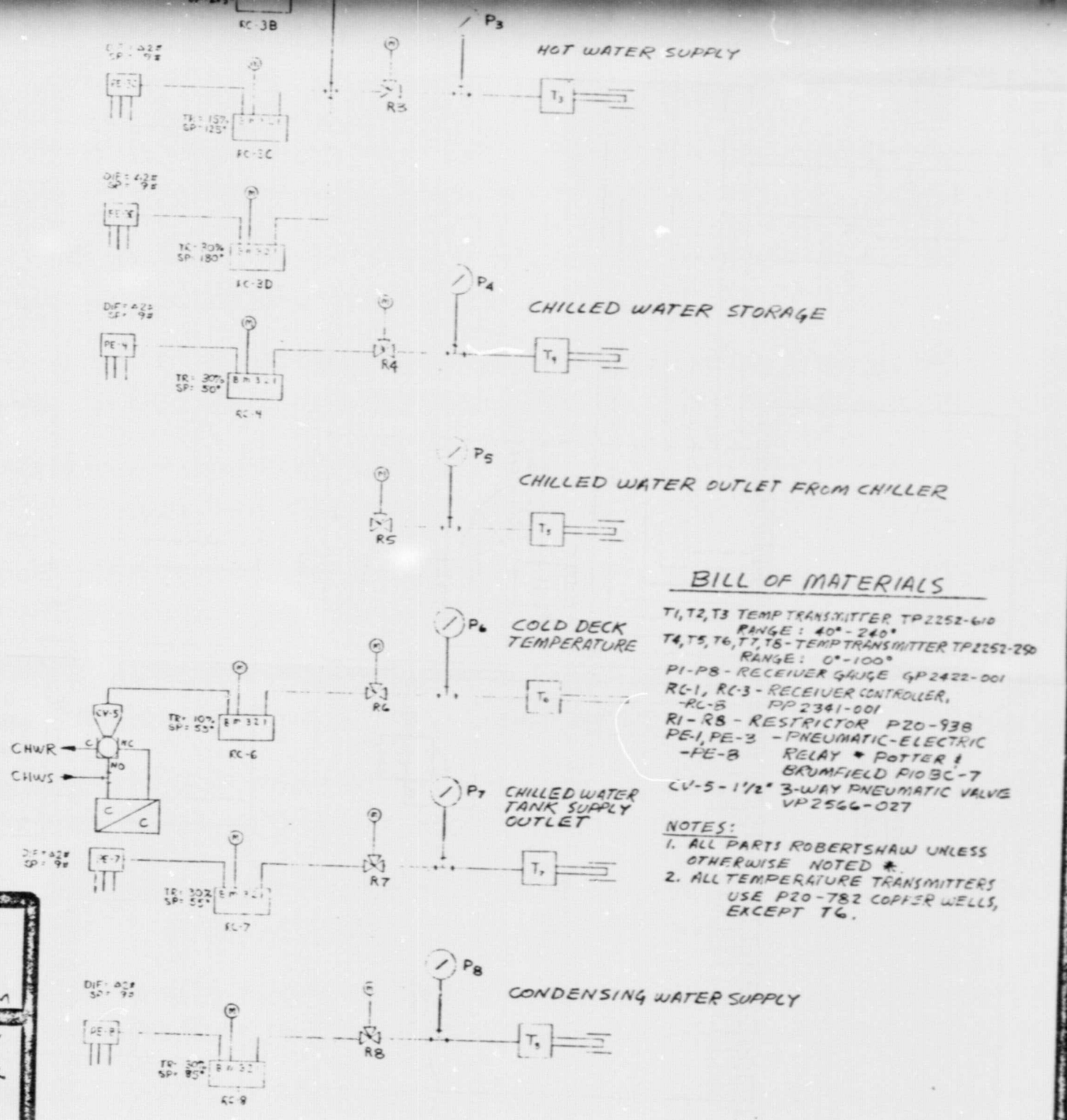
	N.O. CONTACTS		N.C. CONTACTS	
	CLOSE	OPEN	OPEN	CLOSE
PE-1			45°	38°
PE-3A			230°	225°
PE-3B	205°	200°		
PE-3C	125°	120°		
PE-3D	180°	170°		
PE-4	50°	45°		
PE-7	55°	50°		
PE-8	85°	80°		

NOTES:
1. ALL TEMPERATURES GIVEN IN DEGREES °F.
2. ALL PE RELAYS ARE SPDT



ORIGINAL PAGE IS OF POOR QUALITY

FOLDOUT FRAME 2



BILL OF MATERIALS

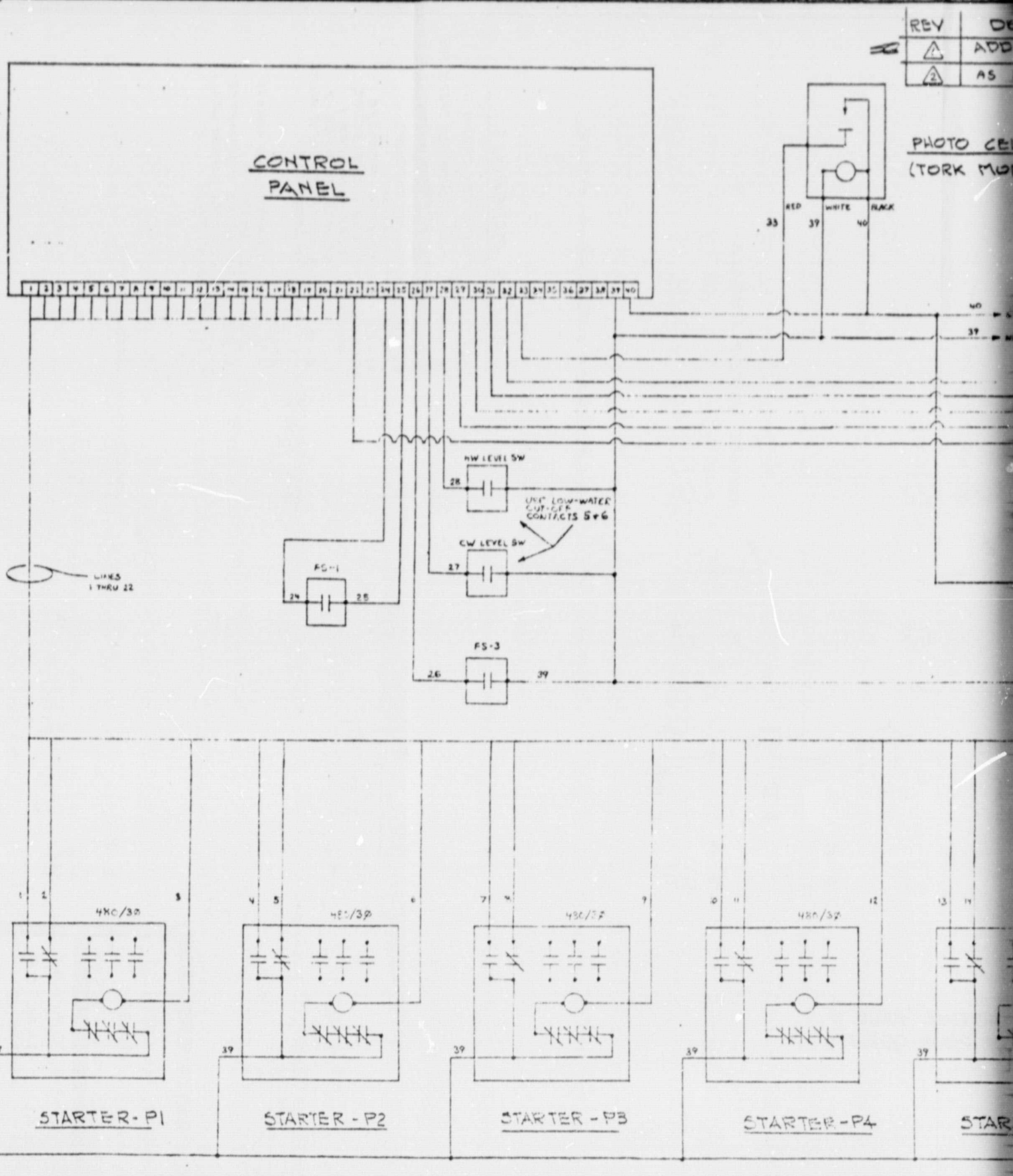
T1, T2, T3 TEMP TRANSMITTER TP2252-610
RANGE: 40°-240°
T4, T5, T6, T7, T8 - TEMP TRANSMITTER TP2252-250
RANGE: 0°-100°
P1-P8 - RECEIVER GAUGE GP2422-001
RC-1, RC-3 - RECEIVER CONTROLLER,
-RC-8 PP2341-001
R1-R8 - RESTRICTOR P20-938
PE-1, PE-3 - PNEUMATIC-ELECTRIC
-PE-8 RELAY * POTTER & BRUMFIELD R10BC-7
CV-5 - 1 1/2" 3-WAY PNEUMATIC VALVE
VP2566-027

NOTES:
1. ALL PARTS ROBERTSHAW UNLESS OTHERWISE NOTED *.
2. ALL TEMPERATURE TRANSMITTERS USE P20-782 COPPER WELLS, EXCEPT T6.

REV	DESCRIPTION	DATE
3	AS BUILT	7-1-9
2	CHANGED CV-3 TO PNEU.	4-23-9
1	ADDED SCHEDULE	

SOLAR HEATING AND COOLING
DEMONSTRATION PROJECT
TEMPERATURE CONTROL DIAGRAM

S. I. GOLDMAN COMPANY
MECHANICAL CONTRACTOR
P.O. BOX 1156 MAITLAND, FL
DRAWING NO. 1001 2 OF 3



FOLDOUT FRAME (

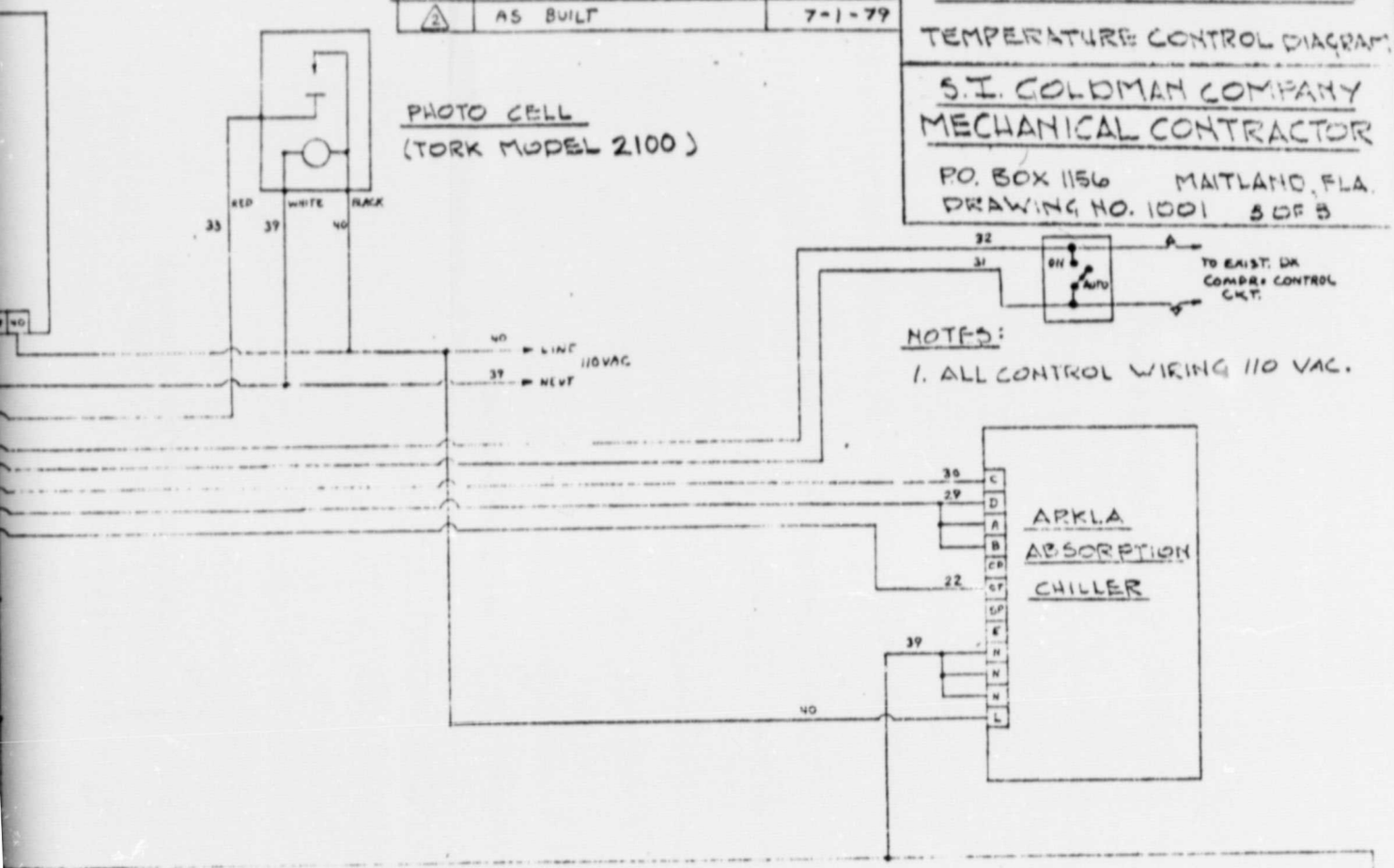
REV	DESCRIPTION	DATE
1	ADD FLOW & LEVEL SW	4-20-79
2	AS BUILT	7-1-79

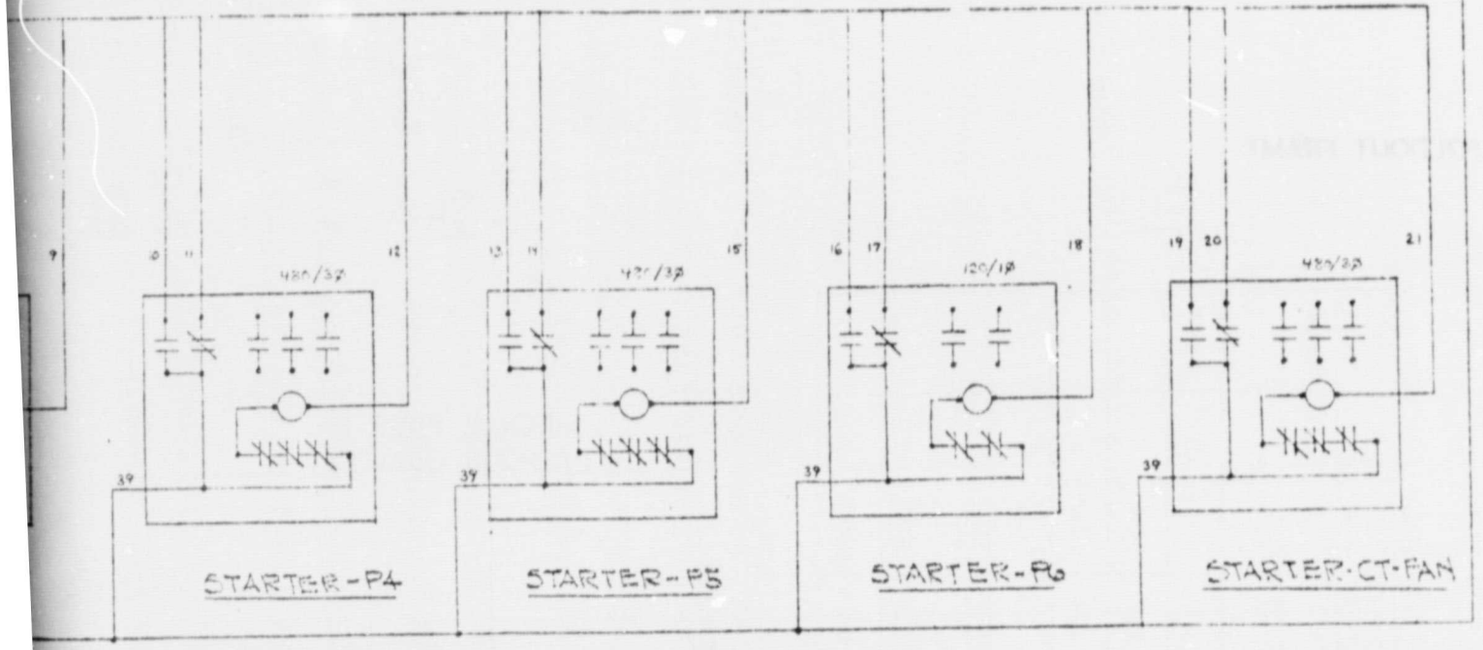
SOLAR HEATING AND COOLING DEMONSTRATION PROJECT

TEMPERATURE CONTROL DIAGRAM

S.I. GOLDMAN COMPANY
MECHANICAL CONTRACTOR

P.O. BOX 1156 MAITLAND, FLA.
DRAWING NO. 1001 8 OF 8





FOLDOUT FRAME 2